



Powering Business Worldwide

EGR-5000 - GENERATOR RELAY

Installation, Operation and Maintenance



Software-Version: 3.0.c

IM02602011E

Revision: E

English

EGR-5000 Functional Overview

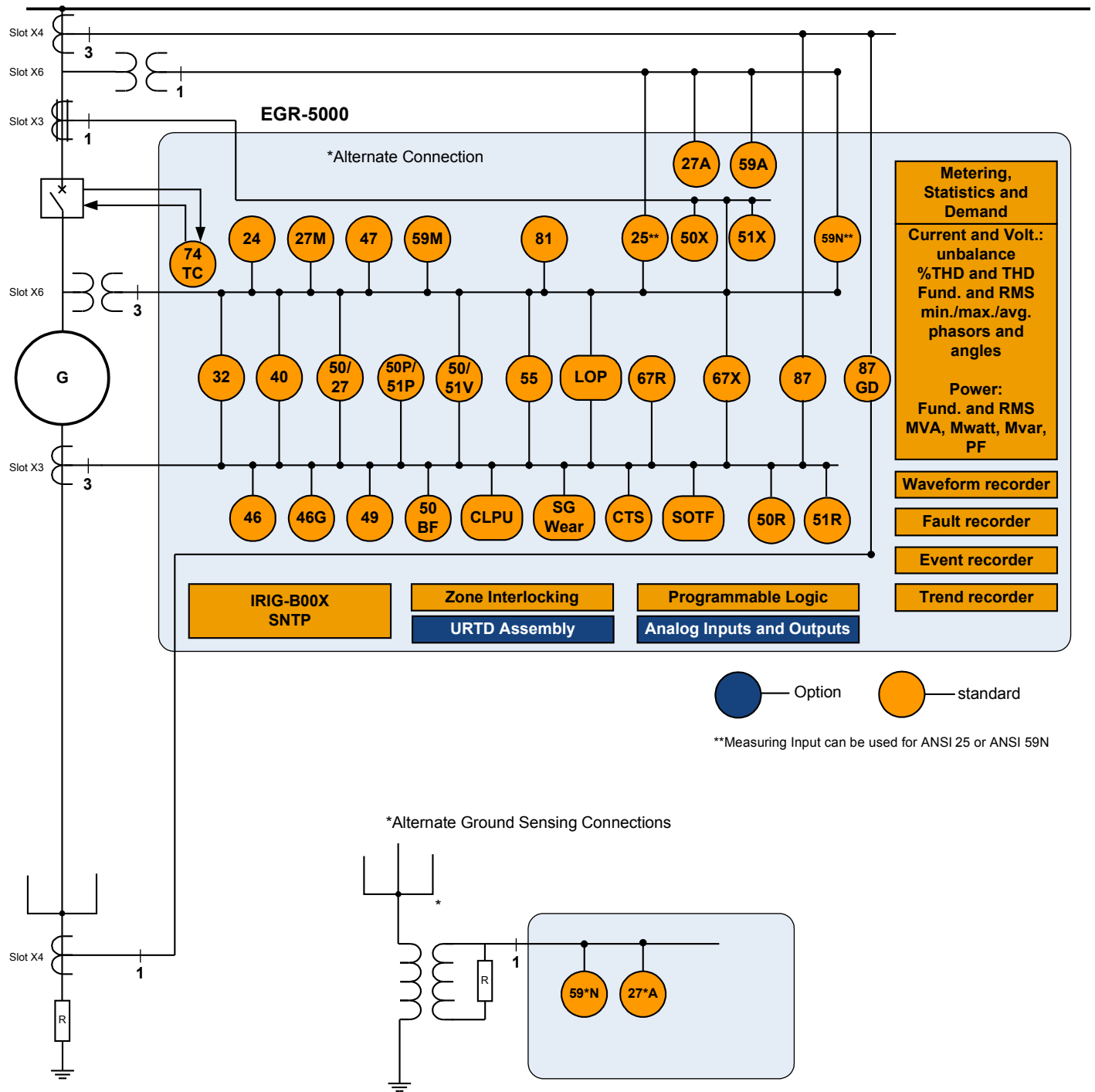


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This manual applies to devices (version):

Version 3.0.c

Build: 28471

Comments on the Manual

This manual gives a general explanation of the tasks of device planning, parameter setting, installation, commissioning, operation, and maintenance of the Eaton devices.

The manual serves as reference document for:

- Engineers in the protection field;
- Commissioning engineers;
- Personnel dealing with the setting, testing, and maintenance of protection and control devices; and
- Well trained personnel involved in electrical installations and power stations.

All functions concerning the type code will be defined. Should there be a description of any functions, parameters, or inputs/outputs that do not apply to the device in use, please ignore that information.

All details and references are explained to the best of our knowledge and are based on our experience and observations.

This manual describes the full featured versions of the devices, including all options.

All technical information and data included in this manual reflect their state at the time this document was issued. Eaton Corporation reserves the right to carry out technical modifications in line with further development without changing this manual and without previous notice. Therefore no claim can be brought based on the information and descriptions included in this manual.

Text, graphics, and formulas do not always apply to the actual delivery scope. The drawings and graphics are not true to scale. Eaton Corporation does not accept any liability for damage and operational failures caused by operating errors or disregarding the directions of this manual.

No part of this manual is allowed to be reproduced or passed on to others in any form, unless Eaton Corporation has issued advanced approval in writing.

This user manual is part of the delivery scope when purchasing the device. In case the device is passed on (sold) to a third party, the manual has to be passed on as well.

Any repair work carried out on the device requires skilled and competent personnel with verifiable knowledge and experienced with local safety regulations and have the necessary experience with working on electronic protection devices and power installations.

IMPORTANT DEFINITIONS

The symbol/word combinations detailed below are designed to call the User's attention to issues that could affect User safety and well being as well as the operating life of the device.



DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.



WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

CAUTION

CAUTION, without the safety alert symbol, is used to address practices not related to personal injury.

NOTICE

NOTICE is used to address information and practices not related to personal injury.



FOLLOW INSTRUCTIONS

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow the instructions can cause personal injury and/or property damage.



PROPER USE

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (1) constitute "misuse" and/or "negligence" within the meaning of the product warranty, thereby excluding warranty coverage for any resulting damage; and (2) invalidate product certifications or listings.

The programmable devices subject to this manual are designed for protection and also control of power installations and operational devices that are fed by voltage sources with a fixed frequency, i.e. fixed at 50 or 60 Hertz. They are not intended for use with Variable Frequency Drives. The devices are further designed for installation in low voltage (LV) compartments of medium voltage (MV) switchgear panels or in decentralized protection panels. The programming and settings have to meet all requirements of the protection concept (of the equipment that is to be protected). The User must ensure that the device will properly recognize and manage (e.g.: switch off the circuit breaker) on the basis of User selected programming and settings all operational conditions (failures). Before starting any operation and after any modification of the programming/settings, make a documented proof that the programming and settings meet the requirements of the protection concept.

The self-supervision contact has to be wired with the master communication system (SCADA) in order to supervise and monitor the state of health of the programmable protective device.

Typical applications for this product family/device line are for example:

- Feeder protection;
- Mains protection;
- Transformer protection and
- Machine protection.

This device is not designed for any usage beyond these applications. This applies also to the use as a partly completed machinery. The manufacturer cannot be held liable for any resulting damage. The User alone bears the risk if this device is used for any application for which it was not designed. As to the appropriate use of the device: the technical data specified by Eaton Corporation has to be met.



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The latest versions of most publications are available at this site.

If the User's publication is not found on the web site, please contact Eaton Customer Support to get the latest copy.

CAUTION**ELECTROSTATIC DISCHARGE AWARENESS**

All electronic equipment is sensitive to electrostatic discharge, some components more than others. To protect these components from electrostatic damage, the User must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the device.

1. Before performing maintenance on the electronic device, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).
2. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cup holders, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, and plastic ash trays) away from the device, the modules, and the work area as much as possible.
4. Do not remove any printed circuit board (PCB) from the device cabinet unless absolutely necessary. If you must remove the PCB from the device cabinet, follow these precautions:
 - Do not touch any part of the PCB except the edges.
 - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
 - When replacing a PCB, keep the new PCB in the plastic, anti-static protective bag it comes in until you are ready to install the PCB. Immediately after removing the old PCB from the device cabinet, place it in the anti-static protective bag.

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What Is Included with the Device

The device package includes all connection terminals, except communication connectors, but does not include the fastening material. Please check the package for completeness upon delivery.

Device Package Contents:

- 1 – Protective Relay;
- 1 – Mount (Standard or Projection);
- 1 – Quick Start Guide; and
- 2 – CDs
 - Disk 1 - Contains the User's Manual, Modbus Register Maps, Profibus Register Maps and GSD file, IEC 61850 Communication Documentation, Wiring Diagrams, and Device Model (Template) for Off-line Parameter Setting;
 - Disk 2 - Contains PowerPort-E and Quality Manager software applications.

NOTICE

Disk1 contains the device templates. The device templates MUST BE installed to allow PowerPort-E to configure a device off-line.

Please make sure the product label, wiring diagram, type code, and materials and description pertain to this device. If you have any doubts, please contact Eaton Corporation's Customer Service Department.

Storage

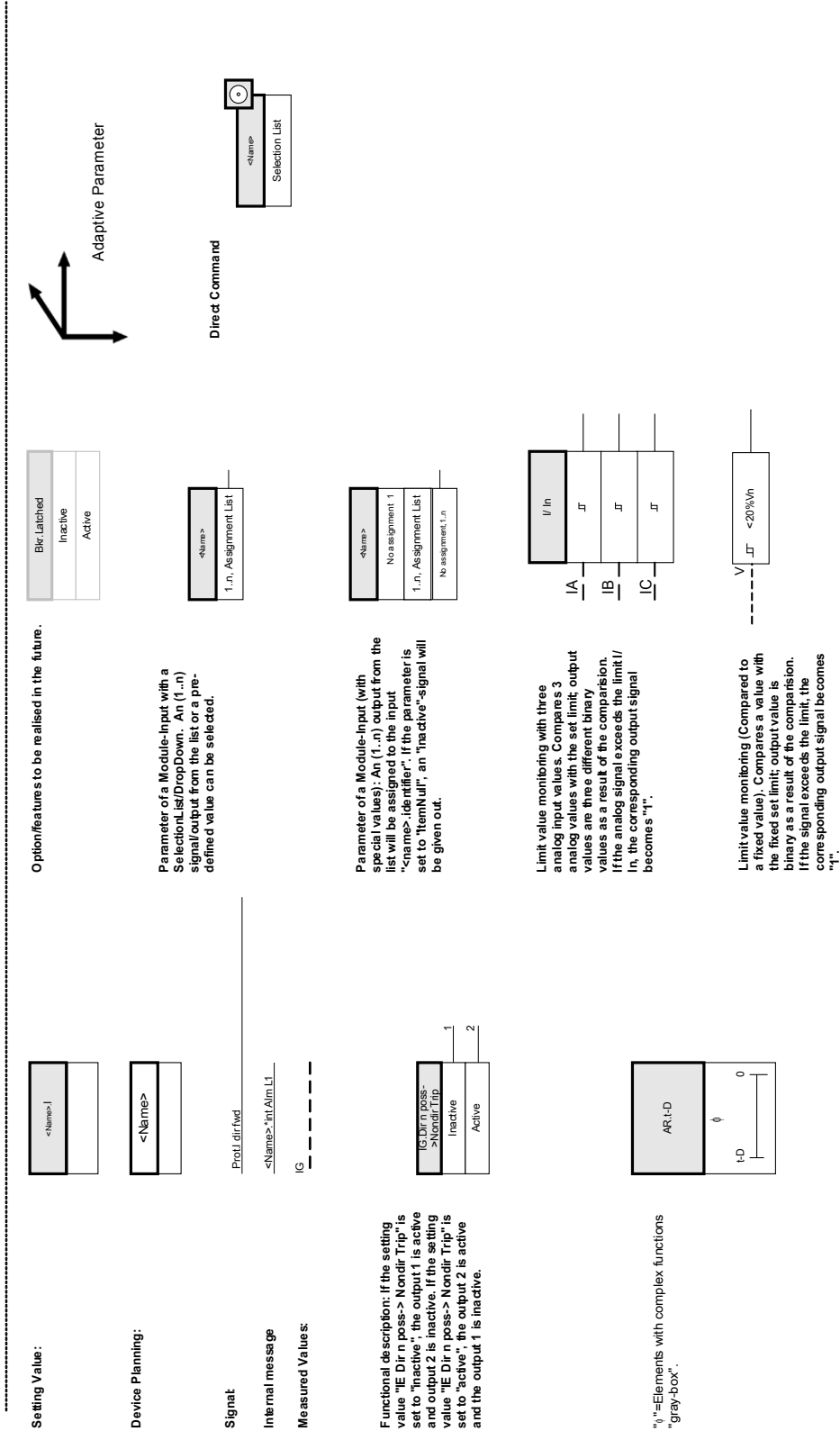
The devices must not be stored outdoors. If stored, it must be stored in an area with temperature and humidity control (see the Technical Data section contained in this manual).

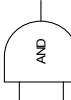
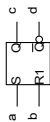
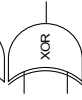
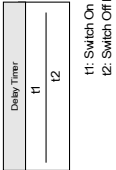
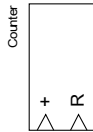
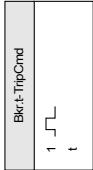
Important Information

⚠ WARNING

In line with the customer's requirement, the devices are combined in a modular way (in compliance with the order code). The terminal assignment of the device can be found on the top of the device (wiring diagram). In addition, it can be found within the Appendix of this manual (see Wiring Diagrams).

Symbols



And		RS flip-flop a b c d 0 0 Unchanged 0 1 0 1 1 0 1 0 1 1 0 1		
Or		Exclusive-XR		
Inverting	 	Time stage: A "1" at the input starts the element. If the time <name>.t is expired, the output becomes "1" too. The time stage will be reset by "0" at the input. Thus the output will be set to "0" at the same time.		
Negated Input				
Negated Output				
Band-pass (filter) IH1				
Band-pass (filter) IH2				
Quotient of Analog Values				
Analog Values				
Analog Value Comparator				
		Edge triggered counter + Increment R Reset		

General Conventions

»Parameters are indicated by right and left double arrow heads and written in *italic* .«

»SIGNALS are indicated by right and left double arrow heads and small caps .« .

[Paths are indicated by brackets.]

Software and Device names are written in italic.

Module and Instance (Element) names are displayed italic and underlined.

»Pushbuttons, Modes, and Menu entries are indicated by right and left double arrow heads .«



Image References (Squares)

2 — Input Signal -----	Output Signal — 2

Prot Available — 1	Please Refer to Diagram: Prot — 15a
Name.Active — 1	Name.Trip Phase A — 16
Name.Blo TripCmd — 3	Name.Trip Phase B — 16a
Name.Active — 4	Name.Trip Phase B — 16b
IH2.Blo Phase A — 5	Name.Trip Phase B — 17
IH2.Blo Phase B — 6	Name.Trip Phase C — 17a
IH2.Blo Phase C — 7	Name.Trip Phase C — 17b
IH2.Blo IG — 8	Name.Trip Phase C — 18
Name.Fault in Projected Direction — 9	Name.TripCmd — 18a
Name.Fault in Projected Direction — 10	Name.TripCmd — 18b
Prot - 50R - Direction Detection — 10a	Name.TripCmd — 19
Prot - 50X - Direction Detection Fault — 10b	Name.TripCmd — 19a
VTS.Pickup — 11	Name.TripCmd — 19b
VTS.Pickup — 12a	Name.TripCmd — 19c
VTS.VTS.LOP Blo — 12b	Name.TripCmd — 19d
VTS.VTS.LOP Blo — 12c	

Each pickup of a module (except from supervision modules but including BF) will lead to a general pickup (collective pickup).	14
Name.Pickup —	
Each trip of an active, trip authorized protection module will lead to a general trip.	15
Name.Trip —	
Name.TripCmd —	15a
Each trip of an active, trip authorized protection module will lead to a general trip.	16
Name.Trip Phase A —	
Each trip of an active, trip authorized protection module will lead to a general trip.	16a
Name.Trip Phase B —	
Each trip of an active, trip authorized protection module will lead to a general trip.	16b
Name.Trip Phase B —	
Each trip of an active, trip authorized protection module will lead to a general trip.	17
Name.Trip Phase B —	
Each trip of an active, trip authorized protection module will lead to a general trip.	17a
Name.Trip Phase C —	
Each trip of an active, trip authorized protection module will lead to a general trip.	17b
Name.Trip Phase C —	
Each trip of an active, trip authorized protection module will lead to a general trip.	18
Name.Trip Phase C —	
Each trip of an active, trip authorized protection module will lead to a general trip.	18a
Name.TripCmd —	
Each trip of an active, trip authorized protection module will lead to a general trip.	18b
Name.TripCmd —	
Each trip of an active, trip authorized protection module will lead to a general trip.	19
Name.TripCmd —	
Each trip of an active, trip authorized protection module will lead to a general trip.	19a
Name.TripCmd —	
Each trip of an active, trip authorized protection module will lead to a general trip.	19b
Name.TripCmd —	
Each trip of an active, trip authorized protection module will lead to a general trip.	19c
Name.TripCmd —	
Each trip of an active, trip authorized protection module will lead to a general trip.	19d

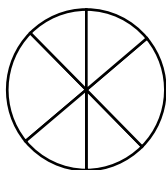
Each trip of an active, trip authorized protection module will lead to a general trip.	20	Name.Trip Phase A	Name.Pickup	Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	27a
Each trip of an active, trip authorized protection module will lead to a general trip.	21	Name.Trip Phase B	Name.Pickup	Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	27b
Each trip of an active, trip authorized protection module will lead to a general trip.	22	Name.Trip Phase C	Name.Pickup	Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	27c
Each trip of an active, trip authorized protection module will lead to a general trip.	23	Name.Trip	Name.Pickup	Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	27d
Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	24	Name.Pickup IA	Name.Pickup Phase A	Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	28
Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	24a	Name.Pickup IA	Name.Pickup Phase B	Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	29
Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	24b	Name.Pickup IA	Name.Pickup Phase C	Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	30
Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	25	Name.Pickup IB	Name.Pickup	Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	31
Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	25a	Name.Pickup IB	Prot.Blo TripCmd		32
Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	25b	Name.Pickup IB	Bkr.Stab	Please Refer to Diagram: Bkr:Bkr Manager	33
Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	26	Name.Pickup IC	Bkr.Pos CLOSE	Please Refer to Diagram: Bkr:Bkr Manager	34
Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	26a	Name.Pickup IC	Bkr.Pos OPEN	Please Refer to Diagram: Bkr:Bkr Manager	35
Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	26b	Name.Pickup IC	Bkr.Pos Indeterm	Please Refer to Diagram: Bkr:Bkr Manager	36
Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).	27	Name.Pickup	Bkr.Pos Disturb	Please Refer to Diagram: Bkr:Bkr Manager	37
			LOP.LOP Blo	Please Refer to Diagram: LOP:LOP Blo	38a
			LOP.Ex FF VT	Please Refer to Diagram: LOP.Ex FF VT	38b
			LOP.Ex FF GVT	Please Refer to Diagram: LOP.Ex FF GVT	38c

Q->&V<.Decoupling Distributed Generator	39
Please Refer to Diagram: Q->&V<.Decoupling Distributed Generator	
CTS.Pickup	40
Please Refer to Diagram: CTS.Pickup	
Bkr.Prot CLOSE	41
Bkr.Prot CLOSE	
Bkr.CLOSE Cmd	42
Bkr.CLOSE Cmd	
AnIn[1].Value	43
Please Refer to Diagram: Analog Values	
AnIn[2].Value	44
Please Refer to Diagram: Analog Values	
AnIn[n].Value	45
Please Refer to Diagram: Analog Values	
Trip Incomplete (Motor) Start Sequence	46

Access Level

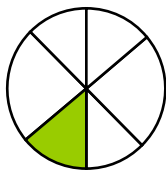
(Please refer to chapter [Parameter\Access Level])

Read Only-Lv0



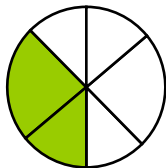
Parameters can only be read within this level.

Prot-Lv1



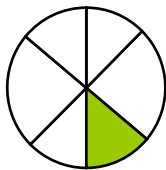
This level enables execution of Resets and Acknowledgements

Prot-Lv2



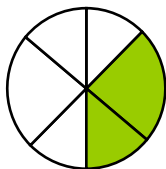
This level enables modification of protection settings

Control-Lv1



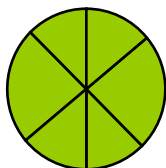
This level enables control functions

Control-Lv2



This level enables modification of switchgear settings

Supervisor-Lv3



This level provides full access (not limited) to all settings

Load Reference Arrow System

Within the E-Series the “Load Reference Arrow System” is used in principal. Generator protection relays are working based on the “Generator Reference System”.

Device

EGR-5000

Device Planning

Planning of a device means to reduce the functional range to a degree that suits the protection task to be fulfilled (i.e.: the device shows only those functions needed or desired). If the User, for example, deactivates the voltage protection function, all parameter branches related to this function will not appear in the parameter. All corresponding events, signals, etc., will also be deactivated. Due to this change, the parameter trees become very transparent.

Planning also involves adjustment of all basic system data (frequency etc.).

WARNING

It MUST be taken into account that by deactivating, for instance, protective functions, the User also changes the functionality of the device. If the User cancels the directional feature of the over-current protections, then the device no longer trips in a directional way but merely in a non-directional way.

The manufacturer does not accept liability for any personal or material damage as a result of incorrect planning.

Contact your Eaton Customer Service representative for more information.

WARNING

Beware of the inadvertent deactivating of protective functions/modules.

If the User is deactivating modules within the device planning, all parameters of those modules will be set on default.

If the User is activating one of these modules, again, all parameters of those reactivated modules will be set on default.

NOTICE

If the protective device is equipped with Zone Interlocking, overcurrent and earth current elements are needed to trigger the Zone Interlocking function. Therefore, some overcurrent and earth current elements cannot be deactivated if the device is equipped with Zone Interlocking.

Device Configuration Parameters of the Device

Parameter	Description	Options	Default	Menu path
Hardware Variant 1 	Optional Hardware Extension	»A« 16 DI, 9 RO, ZI, IRIG, URTD, »B« 8 DI, 9 RO, ZI, 2 AnOut, 2 AnIn, IRIG, URTD	16 DI, 9 RO, ZI, IRIG, URTD	[EGR-5000]
Hardware Variant 2 	Optional Hardware Extension	»0« Phase Current 5A/1A, Ground Current 5A/1A, »1« Phase Current 5A/1A, Sensitive Ground Current 5A/1A	Phase Current 5A/1A, Ground Current 5A/1A	[EGR-5000]
Communication 	Communication	»A« Without, »B« RS 485: Modbus RTU DNP RTU, »C« Ethernet: Modbus TCP DNP UDP, TCP, »D« Fiber Optics: Profibus-DP, »E« D-SUB: Profibus-DP, »F« Fiber Optics: Modbus RTU DNP RTU, »G« RS 485/D-SUB: Modbus RTU DNP RTU, »H« Ethernet: IEC61850 Modbus TCP DNP UDP, TCP, »I« RS 485 and Ethernet: Modbus TCP, RTU DNP UDP, TCP, RTU, »K« Ethernet/Fiber Optics: IEC61850 Modbus TCP DNP UDP, TCP, »L« Ethernet/Fiber Optics: Modbus TCP DNP UDP, TCP, »T« RS 485 and Ethernet: Communication Test	»A« Without	[EGR-5000]

Parameter	Description	Options	Default	Menu path
Printed Circuit Board 	Printed Circuit Board	»A« Standard, »B« Conformal Coating	»A« Standard	[EGR-5000]

There are two mounts available for the EGR-5000-2: a Standard Mount and a Projection Mount. To order the EGR-5000-2 with a Standard Mount, append the device code with a zero (0). To order the EGR-5000-2 with a Projection Mount, append the device code with a one (1). Refer to the table below for details of the available device options.

EGR-5000-2 Eaton Generator Relay Removable Terminals					
EGR-5000-2	A	0	B	A	1
Choose from the following options.					
Hardware Option 1					
16 DI, 9 Outputs, Removable Terminals, Zone Interlocking, URTD interface IRIG-B.	A				
8 DI, 9 Outputs, 2 AI + 2AO, Removable Terminals, Zone Interlocking, URTD interface IRIG-B.	B				
Hardware Option 2					
Phase Current 5A/1A, Ground Current 5A/1A, Power Supply Range: 19-300 Vdc, 40-250 Vac.		0 (Zero)			
Phase Current 5A/1A, Sensitive Ground Current 5A/1A, Power Supply Range: 19-300 Vdc, 40-250 Vac.		1			
Communication Options					
Modbus-RTU (RS-485) + DNP3.0 (interface with terminals)			B		
Modbus TCP + DNP3.0 (Ethernet 100MB / RJ45)			C		
Modbus RTU + DNP3.0 (Fibre optic interface, ST connector)			F		
DNP3.0 + Modbus RTU (RS485 / D-SUB interface)			G		
IEC-61850 (Ethernet 100MB, RJ45)			H		
Modbus-RTU (interface with terminals) + Modbus-TCP (Ethernet 100MB, RJ45)			I		
IEC61850 / Ethernet 100MB (Single LC connector)			K		
Conformal Coating Options					
None				A	
Conformal Coated Circuit Boards				B	
Mounting Options					
Standard Mount					0 (Zero)
Projection Panel Mount					1

* Consult the factory for the availability of IEC-61850 communications option.

Standard Accessories EGR-5000-2

Catalog Number	Description
URTDII-01	UNVL RTD Mod. with Modbus RTU 48-240 Vac/48-250 Vdc
URTDII-02	UNVL RTD Mod. With Modbus RTU 24-48 Vdc

Ordering Information

The catalog number identification table defines the electrical characteristics and operation features included in the EGR-5000-2. For example, if the catalog number were EGR-5000A0BA1, the device would have the following:

EGR-5000-2

- (A) - 16 DI, 9 Outputs, Removable Terminals, Zone Interlocking, URTD interface IRIG-B.
- (0) - Phase Current 5A/1A, Ground Current 5A/1A, Power Supply Range: 19-300 Vdc, 40-250 Vac.
- (B) - Modbus-RTU (RS-485)
- (A) - Without Conformal Coating
- (1) - Projection Panel Mount

Installation and Wiring

Three-Side-View

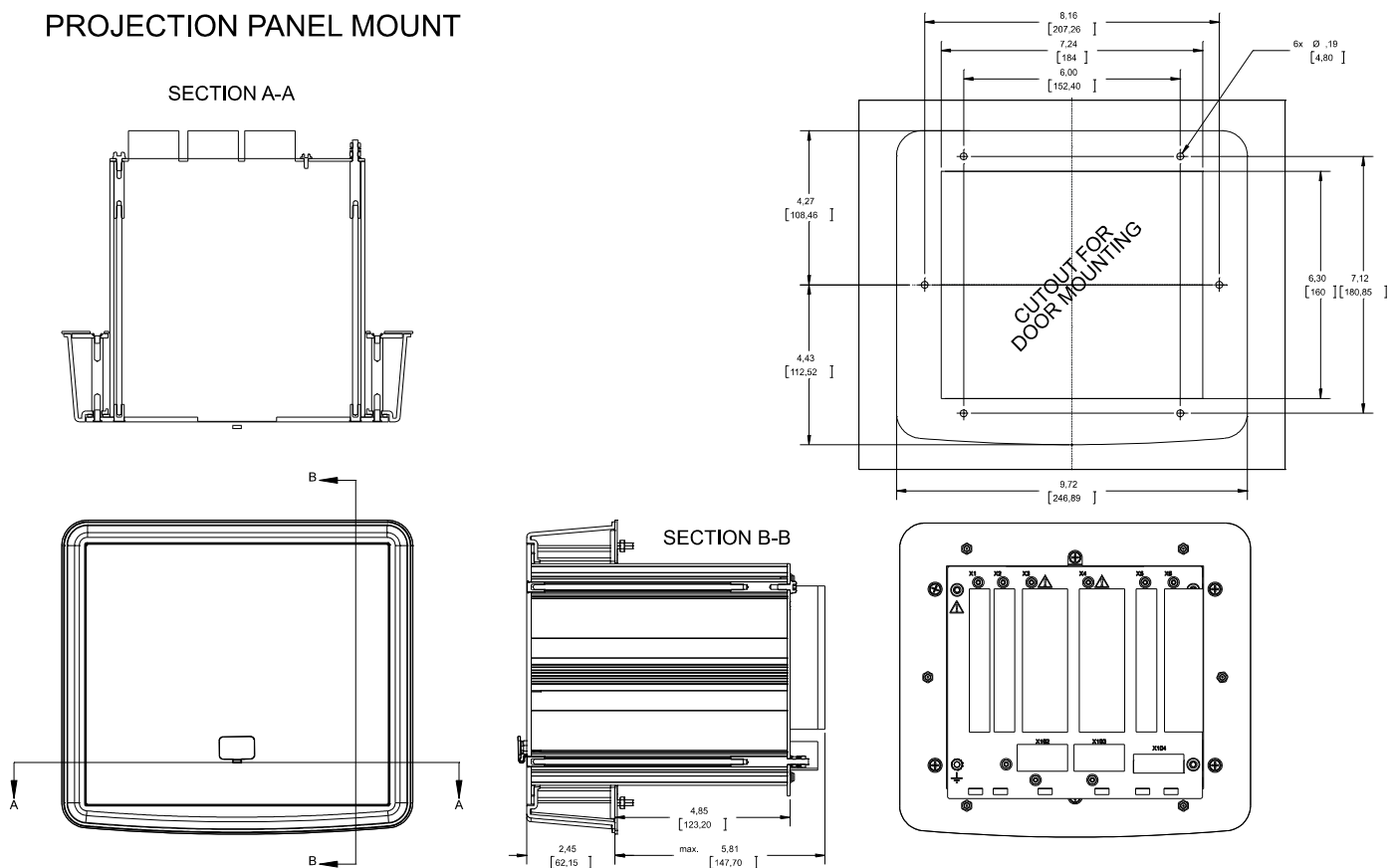
NOTICE

Depending on the connection method of the communication system used, the needed space (depth) differs. If, for instance, a D-Sub-Plug is used, it has to be added to the depth dimension.

WARNING

Even when the auxiliary voltage is switched-off, unsafe voltages remain at the device connections.

PROJECTION PANEL MOUNT



Outline Projection Mount - Door Cut-out

WARNING

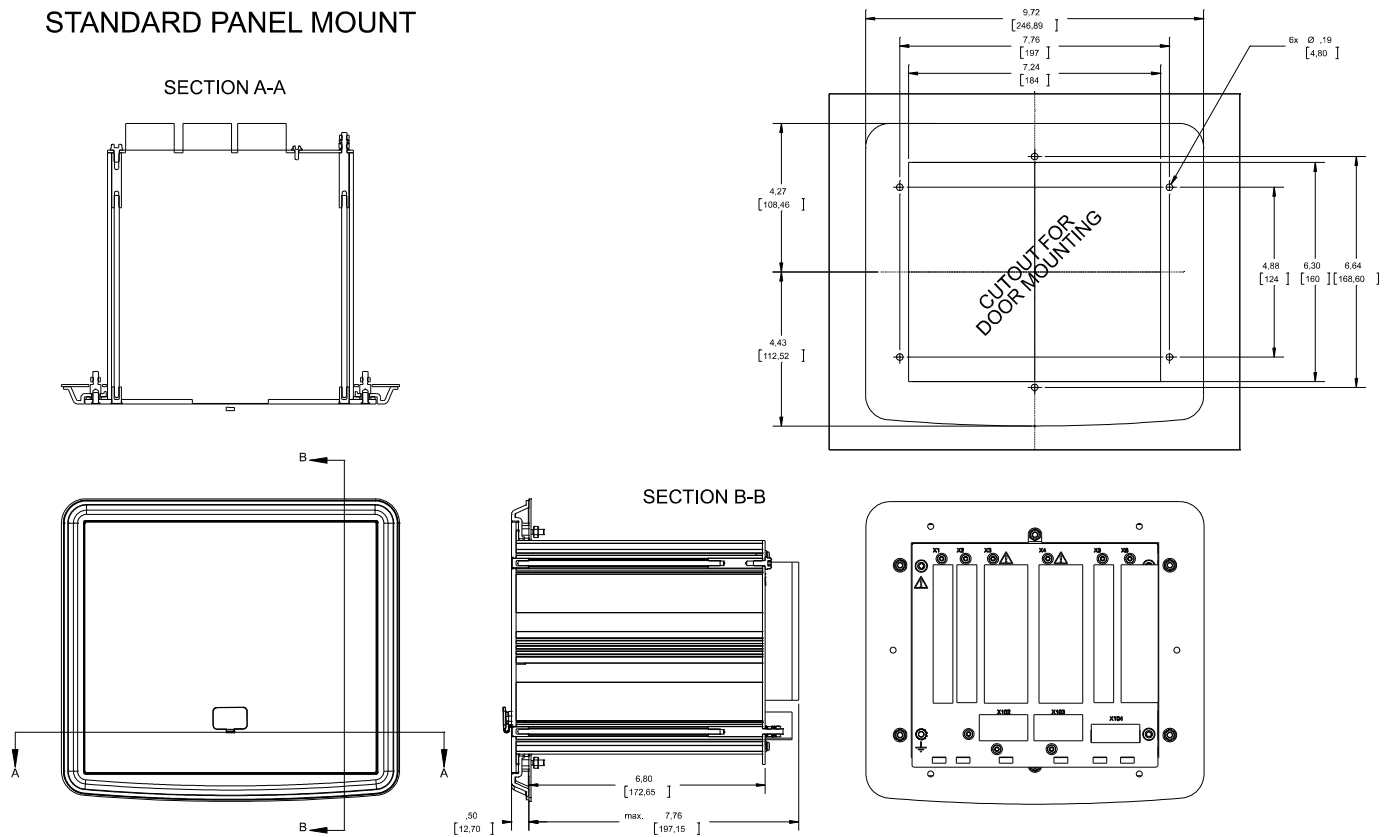
The housing must be carefully grounded. Connect a ground cable (AWG 12-10 [4 to 6 mm²] / 15 In-lb [1.7 Nm]) to the housing, using the screw that is marked with the ground symbol (at the rear side of the device).

The power supply card needs a separate ground connection (AWG 14 [2.5 mm²] / 5-7 In-lb [0.56-0.79 Nm]) at terminal X1.

CAUTION

DO NOT over-tighten the mounting nuts of the relay (0.164 X32). Check the torque by means of a torque wrench (1.7 Nm [15 In-lb]). Over-tightening the mounting nuts could cause personal injury or damage the relay.

STANDARD PANEL MOUNT



Outline Standard Mount - Door Cut-out

WARNING

The housing must be carefully grounded. Connect a ground cable (AWG 12-10 [4 to 6 mm²] / 15 In-lb [1.7 Nm]) to the housing, using the screw that is marked with the ground symbol (at the rear side of the device).

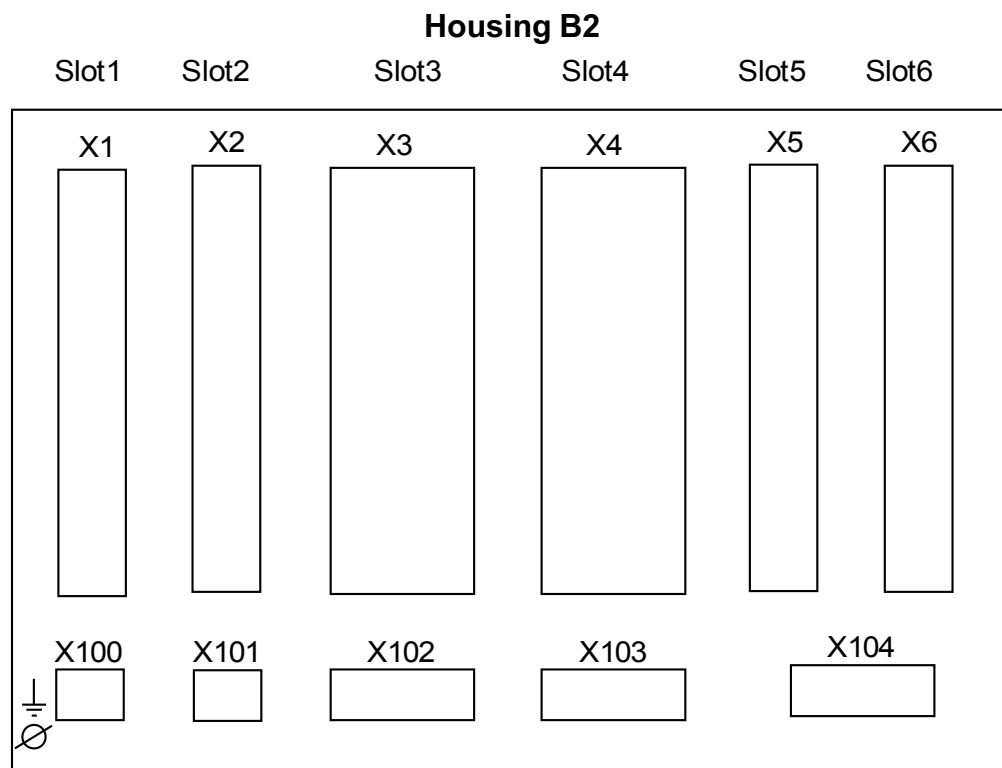
The power supply card needs a separate ground connection (AWG 14 [2.5 mm²] / 5-7 In-lb [0.56-0.79 Nm]) at terminal X1.

Overview of Slots - Assembly Groups

⚠ WARNING

In line with the customers' requirement, the devices are combined in a modular way (in compliance with the order code). In each of the slots, an assembly/group may be integrated. In the following diagram, the terminal assignment of the individual assembly/groups are shown. The exact installation/placement of the individual modules can be determined from the connection diagram attached to the top of your device.

Overview of Slots



Schematic Diagram

⚠ WARNING

The housing must be carefully grounded. Connect a ground cable (AWG 12-10 [4 to 6 mm²] / 15 In-lb [1.7 Nm]) to the housing, using the screw that is marked with the ground symbol (at the rear side of the device).

The power supply card needs a separate ground connection (AWG 14 [2.5 mm²] / 5-7 In-lb [0.56-0.79 Nm]) at terminal X1.

Grounding

WARNING

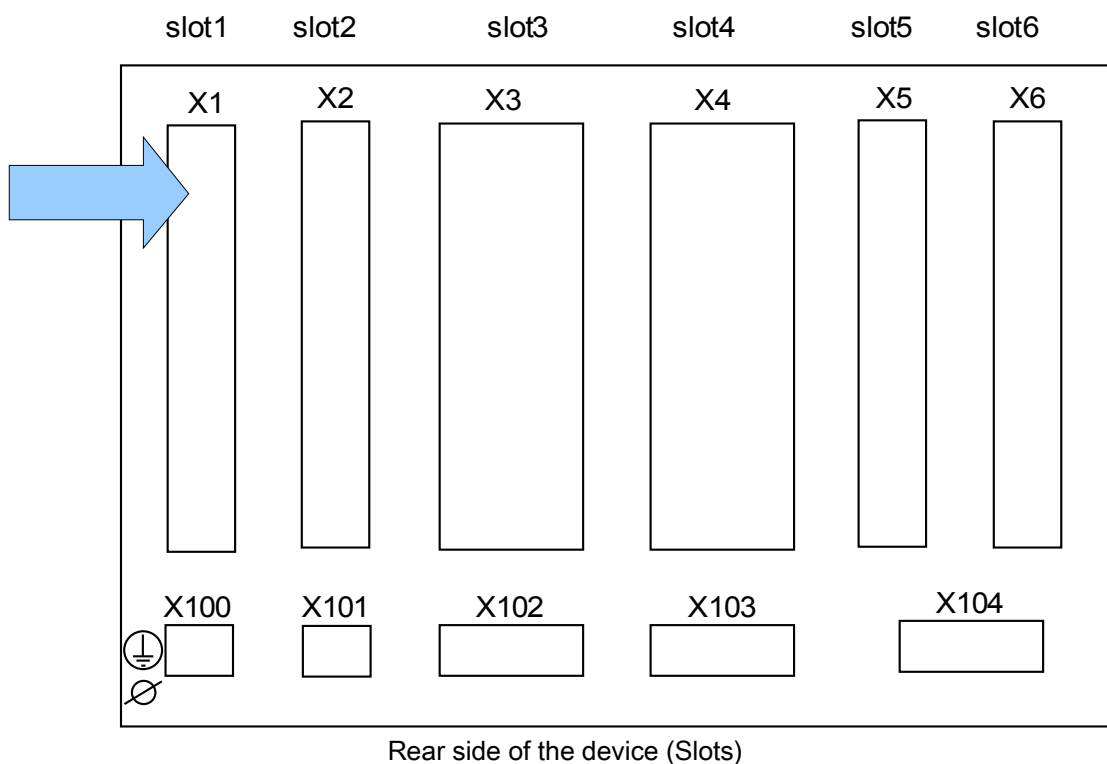
The housing must be carefully grounded. Connect a ground cable (AWG 12-10 [4 to 6 mm²] / 15 In-lb [1.7 Nm]) to the housing, using the screw that is marked with the ground symbol (at the rear side of the device).

The power supply card needs a separate ground connection (AWG 14 [2.5 mm²] / 5-7 In-lb [0.56-0.79 Nm]) at terminal X1.

CAUTION

The devices are very sensitive to electrostatic discharges.

Slot X1: Power Supply Card with Digital Inputs



The type of power supply card and the number of digital inputs on it used in this slot is dependent on the ordered device type. The different variants have a different scope of functions.

Available assembly groups in this slot:

- **(DI8-X1):** This assembly group comprises a wide-range power supply unit; and two non-grouped digital inputs and six (6) digital inputs (grouped).

NOTICE

The available combinations can be gathered from the ordering code.

DI-8 X - Power Supply and Digital Inputs



WARNING Make sure that the tightening torque is 5-7 In-lb [0.56-0.79 Nm].

This assembly group comprises:

- A wide-range power supply unit;
- Two non-grouped digital inputs; and
- Six (6) digital inputs, grouped.

Auxiliary Voltage Supply

- The auxiliary voltage inputs (wide-range power supply unit) are non-polarized. The device can be powered with an AC or DC control voltage.

Digital Inputs

CAUTION

For each digital input group, the related voltage input range has to be configured. Wrong switching thresholds can result in malfunctions/wrong signal transfer times.

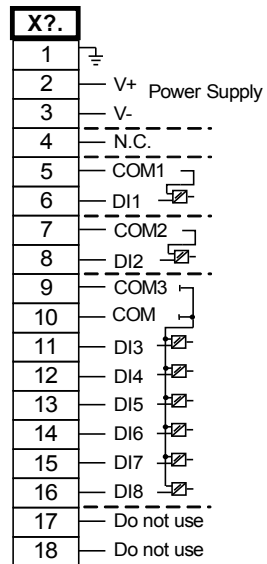
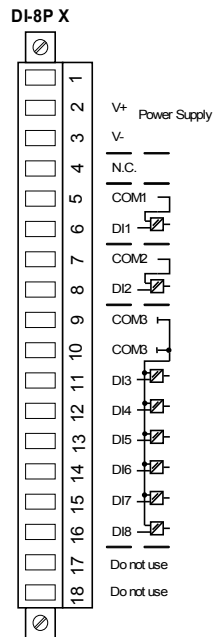
The digital inputs are provided with different switching thresholds (that are configurable) (two AC and five DC input ranges). The following switching levels can be defined:

- 24 Vdc;
- 48 Vdc
- 60 Vdc;
- 110/120 Vac/dc; and
- 230/240 Vac/dc.

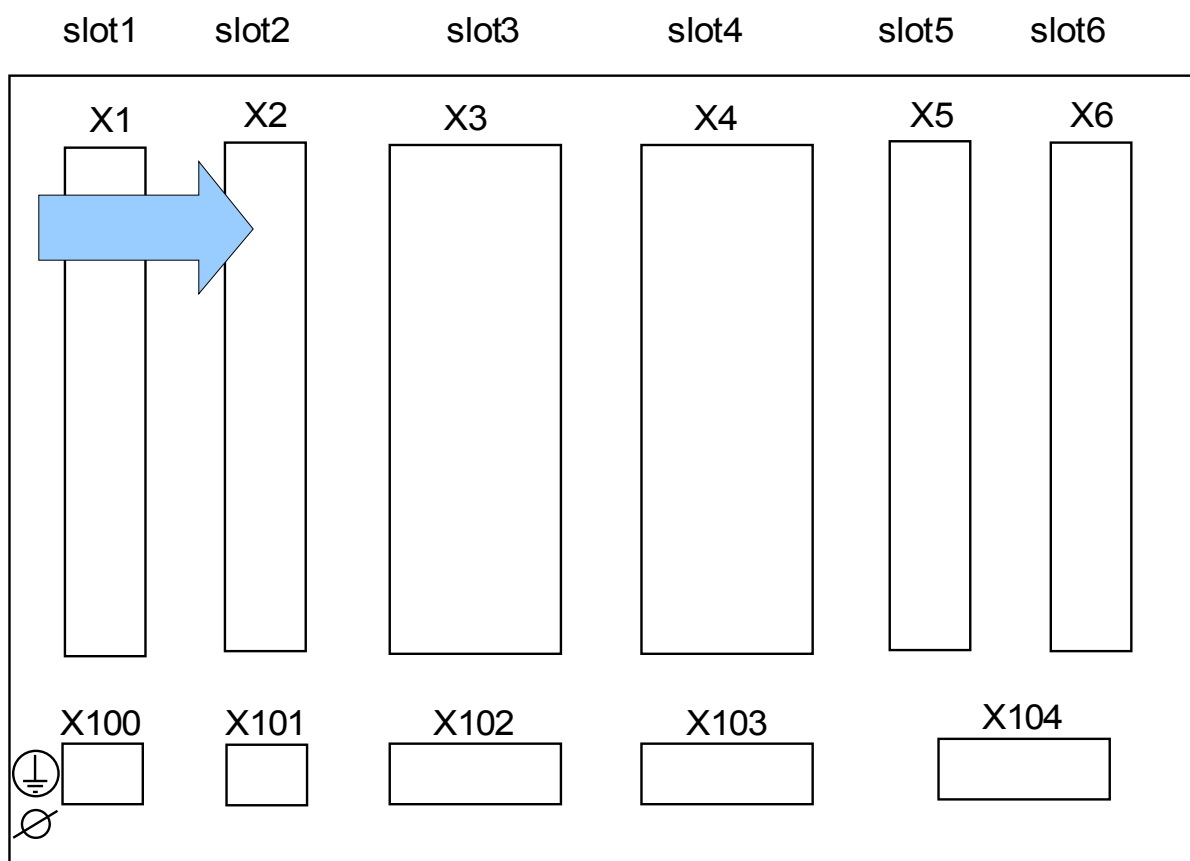
If a voltage >80% of the set switching threshold is applied at the digital input, the state change is recognized (logically “1”). If the voltage is below 40% of the set switching threshold, the device detects logically “0”.

CAUTION

When using DC supply, the negative potential has to be connected to the common terminal (COM1, COM2, COM3 - please see the terminal marking).

Terminal Marking**Pin Assignment**

Slot X2: Relay Output Card - Zone Interlock



Rear side of the device (Slots)

The type of card in this slot is dependent on the ordered device type. The different variants have a different scope of functions.

Available assembly groups in this slot:

- **(RO-4Z X2):** Assembly Group with four Relay Outputs (two Form A and two Form C) and Zone Interlocking.

NOTICE

The available combinations can be gathered from the ordering code.

RO-ZI X - Relay Outputs and Zone Interlock

The Relay Outputs are potential-free contacts. In the Assignment/Relay Outputs section, the assignment of the Relay Outputs is specified. The changeable signals are listed in the Assignment List section.

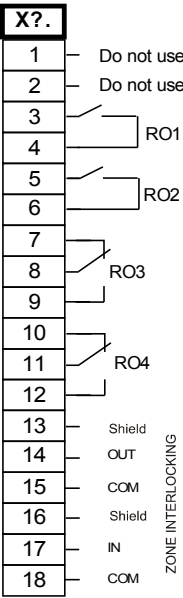


Make sure that the tightening torque is 5-7 In-lb [0.56-0.79 Nm].

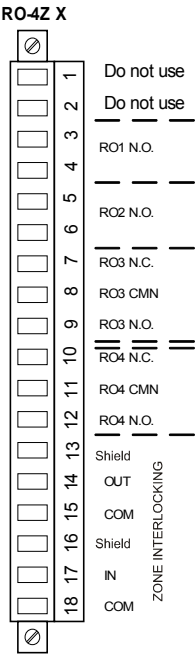
CAUTION

Please carefully consider the current carrying capacity of the Relay Outputs. Please refer to the Technical Data.

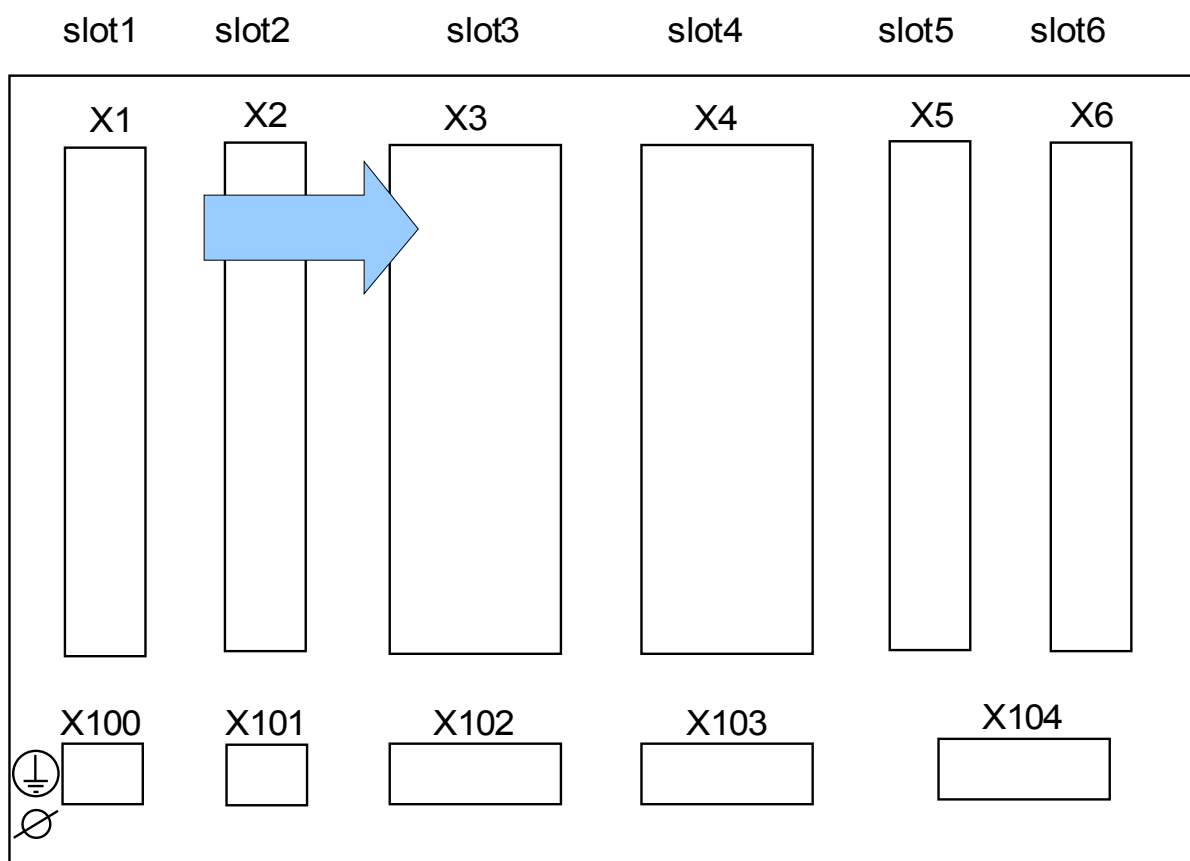
Terminal Marking



Pin Assignment



Slot X3: CT Ntrl - Current Transformer Measuring Inputs



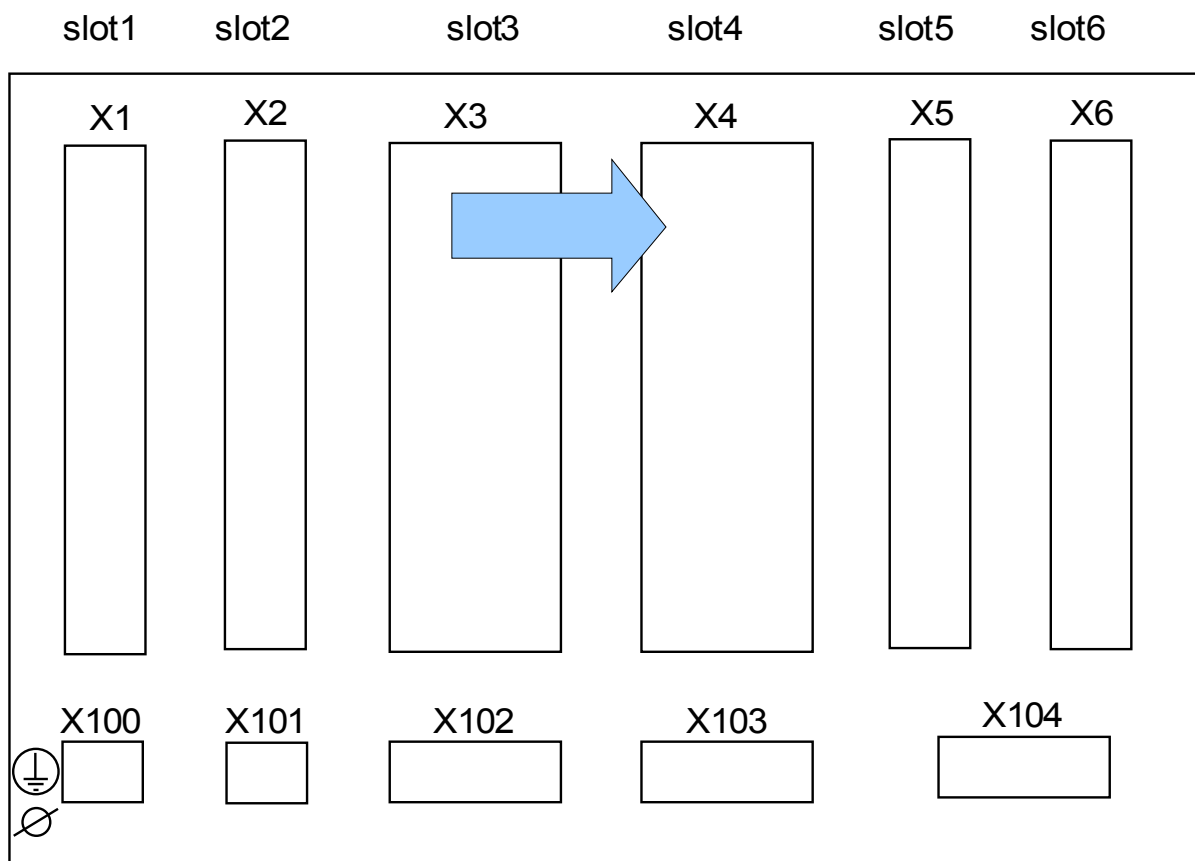
Rear side of the device (Slots)

This slot contains the current transformer measuring inputs for the neutral side of the differential protection. Depending on the order code, this might be a standard current measuring card or a sensitive ground current measuring card.

Available assembly groups in this slot:

- **(TI-4 X3):** Standard ground current measuring card.
- **(TIS-4 X3):** Sensitive Ground current measuring card. The Technical data of the sensitive ground measuring input deviate are different to the Technical Data of the phase current measuring inputs. Please refer to the Technical Data.

Slot X4: CT Mains - Current Transformer Measuring Inputs



Rear side of the device (Slots)

This slot contains the current transformer measuring inputs for the line side of the differential protection.

Available assembly groups in this slot:

- **(TI-4 X4):** Standard ground current measuring card.

TI X- Standard Phase and Ground Current Measuring Input Card

A current measuring card is provided with four (4) current measuring inputs: three for measuring the phase currents and one for measuring of the ground current.

Each of the current measuring inputs has a measuring input for 1 A and 5 A.

The input for ground current measuring either can be connected to a zero sequence current transformer or, alternatively, it is possible to connect the summation current path of the phase current transformer to this input (residual connection).



Current transformers have to be earth grounded on their secondary side.



Interrupting the secondary circuits of current transformers causes hazardous voltages.

The secondary side of the current transformers have to be short circuited before the current circuit to the device is opened.



The current measuring inputs may exclusively be connected to current measuring transformers (with galvanic separation).



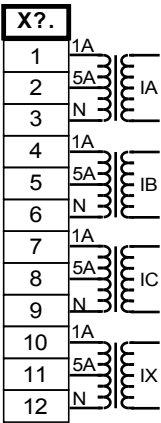
- **Do not mix the inputs (1 A/5 A).**
- **Make sure the transformer ratios and the power of the CTs are correctly rated. If the rating of the CTs is not correct (overrated), then the normal operational conditions may not be recognized. The pickup value of the measuring unit amounts to approximately 3% of the rated current of the device. Also, the CTs need a current greater than approximately 3% of the rated current to ensure sufficient accuracy.**

Example: For a 600 A CT (primary current), any currents below 18 A cannot be detected.
- **Overloading can result in destruction of the measuring inputs or faulty signals. Overloading means that, in case of a short circuit, the current carrying capacity of the measuring inputs could be exceeded.**

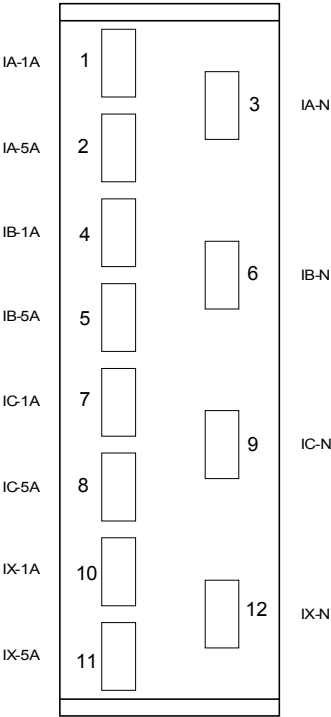


Make sure that the tightening torque is 17.7 In-lb [2 Nm].

Terminal Markings



Pin Assignment



TIS X – Phase and Sensitive Ground Current Measuring Card

The sensitive ground current measuring card is provided with four (4) current measuring inputs: three for measuring the phase currents and one for measuring of the sensitive ground current (The sensitive Ground current Input has different technical data. Please refer to chapter Technical Data.).

The input for ground current measuring either can be connected to a zero sequence current transformer or, alternatively, it is possible to connect the summation current path of the phase current transformer to this input (residual connection).



Current transformers have to be earth grounded on their secondary side.



Interrupting the secondary circuits of current transformers causes hazardous voltages.

The secondary side of the current transformers have to be short circuited before the current circuit to the device is opened.



The current measuring inputs may exclusively be connected to current measuring transformers (with galvanic separation).

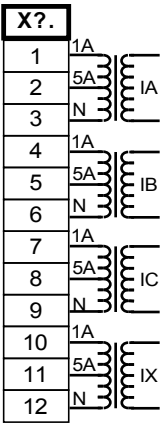


Make sure that the tightening torque is 17.7 In-lb [2 Nm].

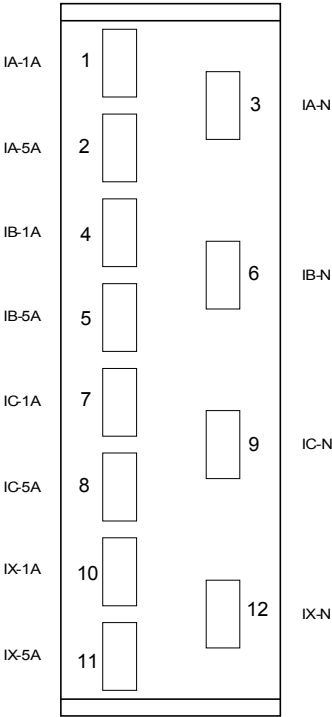


- **Do not interchange the inputs (1 A/5 A)**
- **Make sure the transformation ratios and the power of the CTs are correctly rated. If the rating of the CTs is not right (overrated), then the normal operational conditions may not be recognized. The pickup value of the measuring unit amounts approx. 3% of the rated current of the device. Also the CTs need a current greater than approx 3% of the rated current to ensure sufficient accuracy. Example: For a 600 A CT (primary current) any currents below 18 A cannot be detected any more.**
- **Overloading can result in destruction of the measuring inputs or faulty signals. Overloading means that in case of a short-circuit the current-carrying capacity of the measuring inputs could be exceeded.**

Terminal Markings



Pin Assignment



Common CT Wiring Configurations

Check the installation direction.



It is imperative that the secondary sides of measuring transformers be grounded.



The current measuring inputs may exclusively be connected to current measuring transformers (with galvanic separation).



CT secondary circuits must always to be low-burdened or short-circuited during operation.

NOTICE

For current and voltage sensing function external wired and appropriate current and voltage transformer shall be used, based on the required input measurement ratings. Those devices provide the necessary insulation functionality.

All current measuring inputs can be provided with 1 A or 5 A nominal. Make sure that the wiring is correct.

Sensitive Ground Current Measurement

The proper use of sensitive current measuring inputs is the measurement of small currents like they could occur in isolated and high resistance grounded networks.

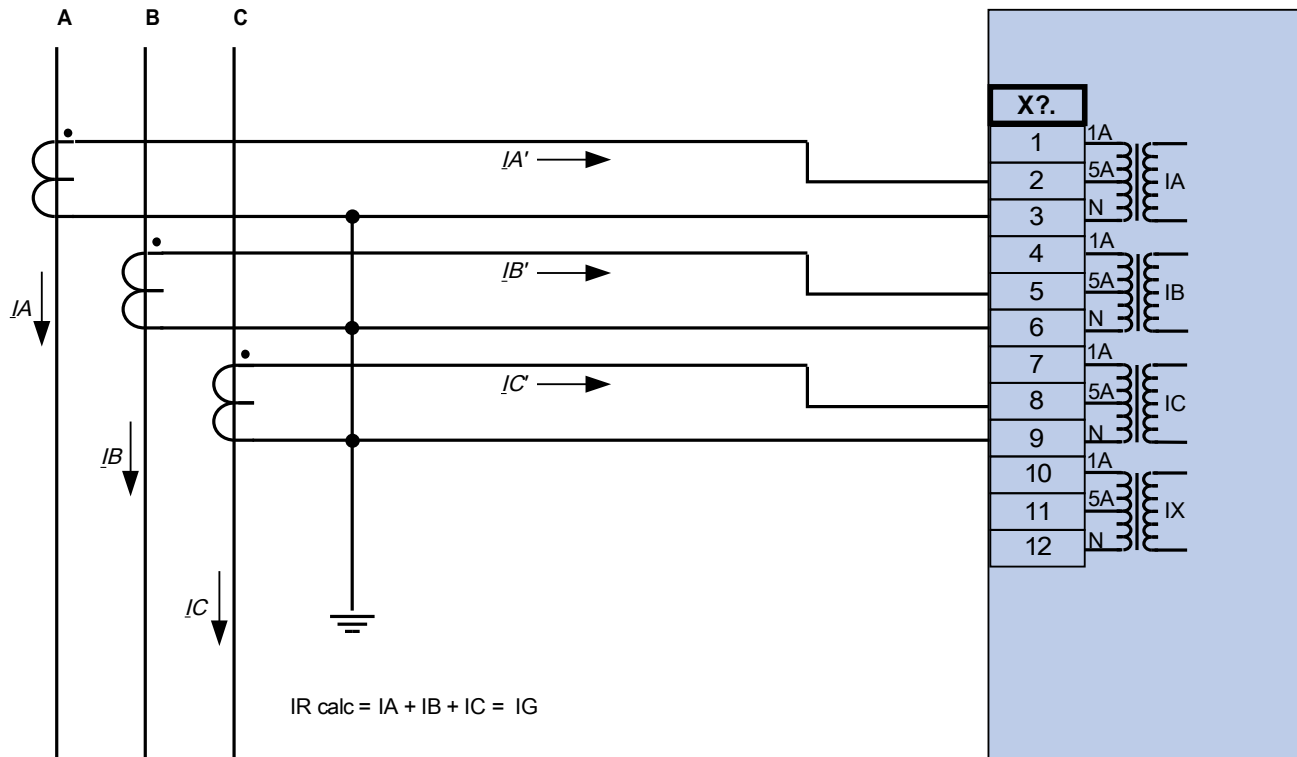
Due to the sensitiveness of these measuring inputs don't use them for the measurement of ground short circuit currents like they occur in solidly earthed networks.

If a sensitive measuring input should be used for the measurement of ground short circuit currents, it has to be ensured, that the measuring currents are transformed by a matching transformer according to the technical data of the protective device.

CT Connection Options

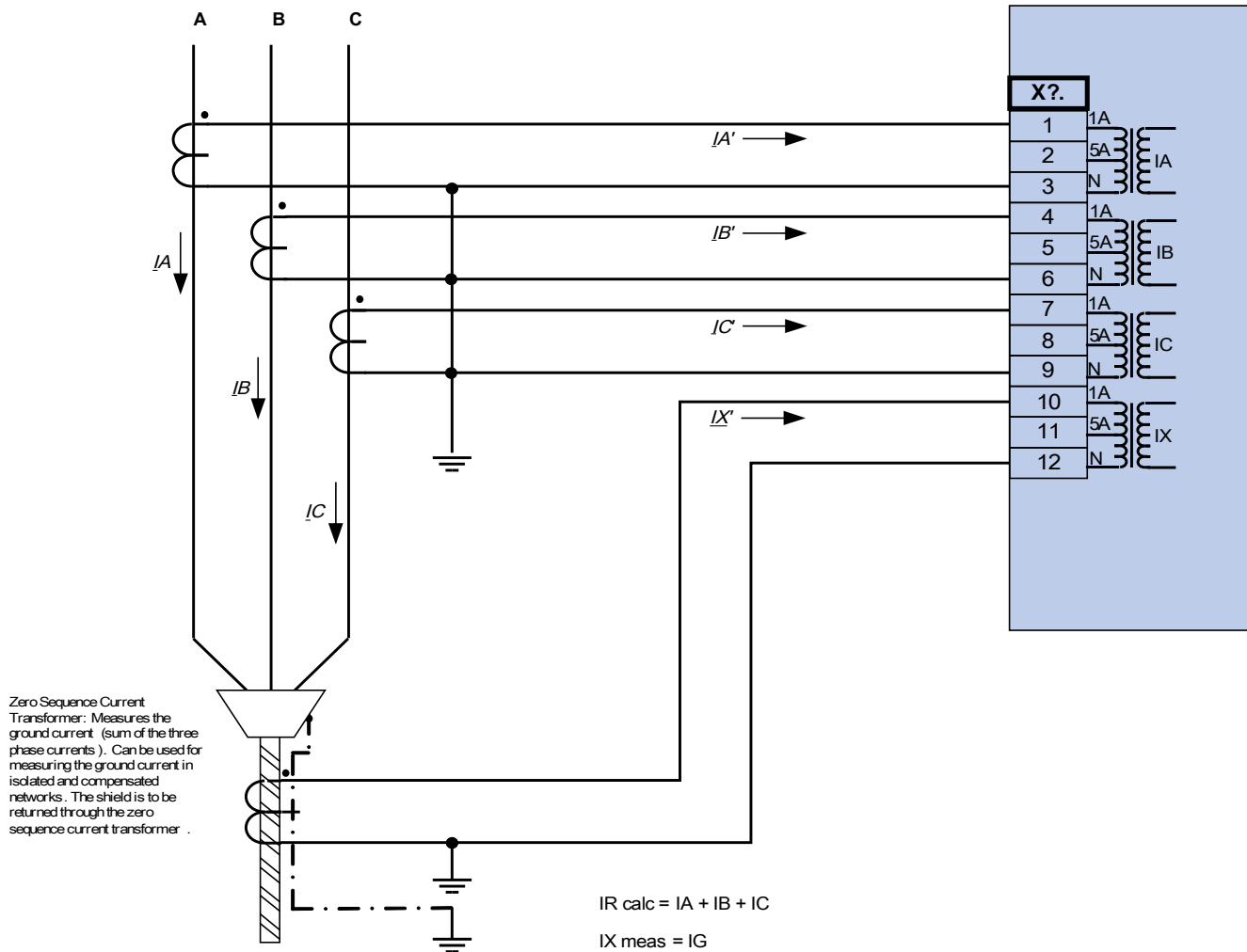
The current transformers may be connected in several ways, and the specified configuration affects the way system measurements are made and results computed. The computation of the residual current I_R , is dependent on the system configuration setting for the CT connection. The configurations resulting from the setting options are shown as well as the calculated I_R residual current.

3-phase, 3-wire IG Calculated



Three-phase Current Measurement; Inom Secondary = 5 A.

3-phase, 3-wire IG Measured



Three-phase Current Measurement ; I_{nom} Secondary = 1 A.

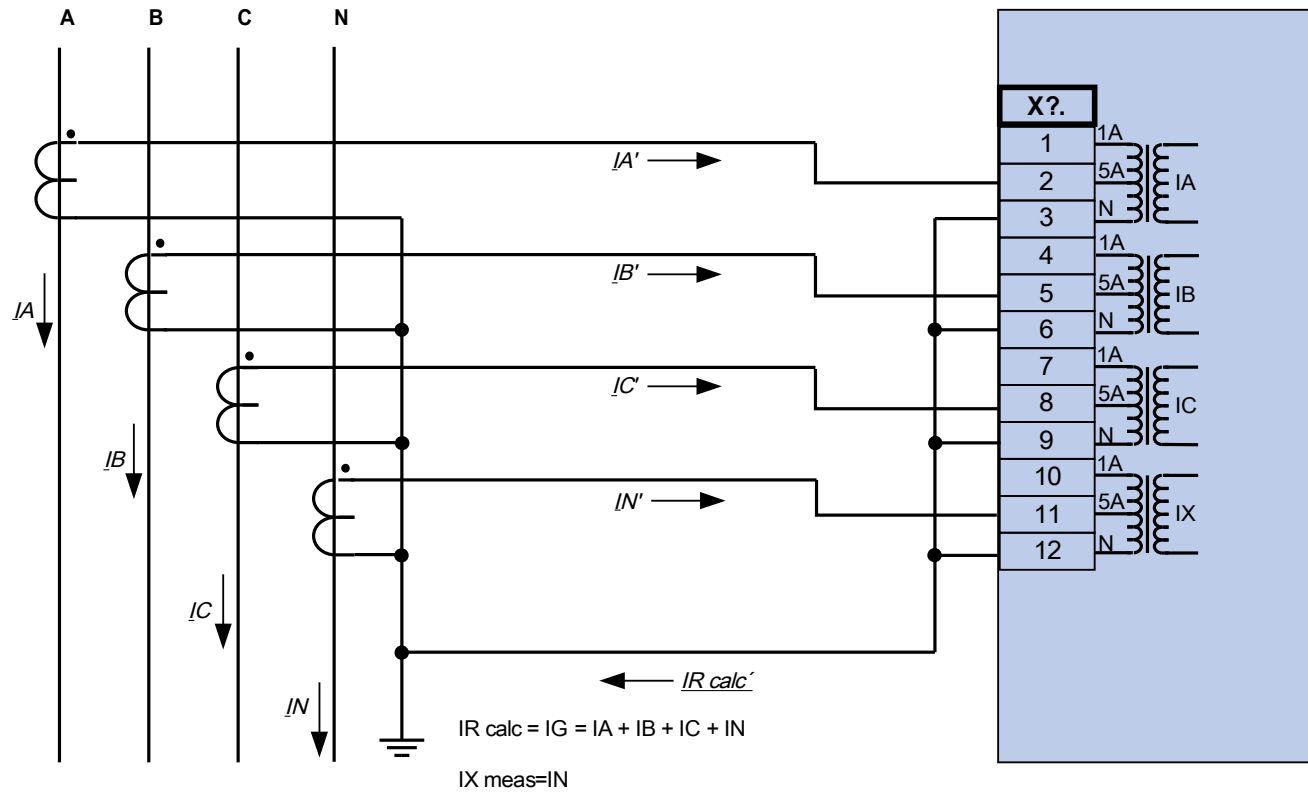
Ground Current Measuring via Zero Sequence CT ; I_{Gnom} Secondary = 1 A.



Warning!

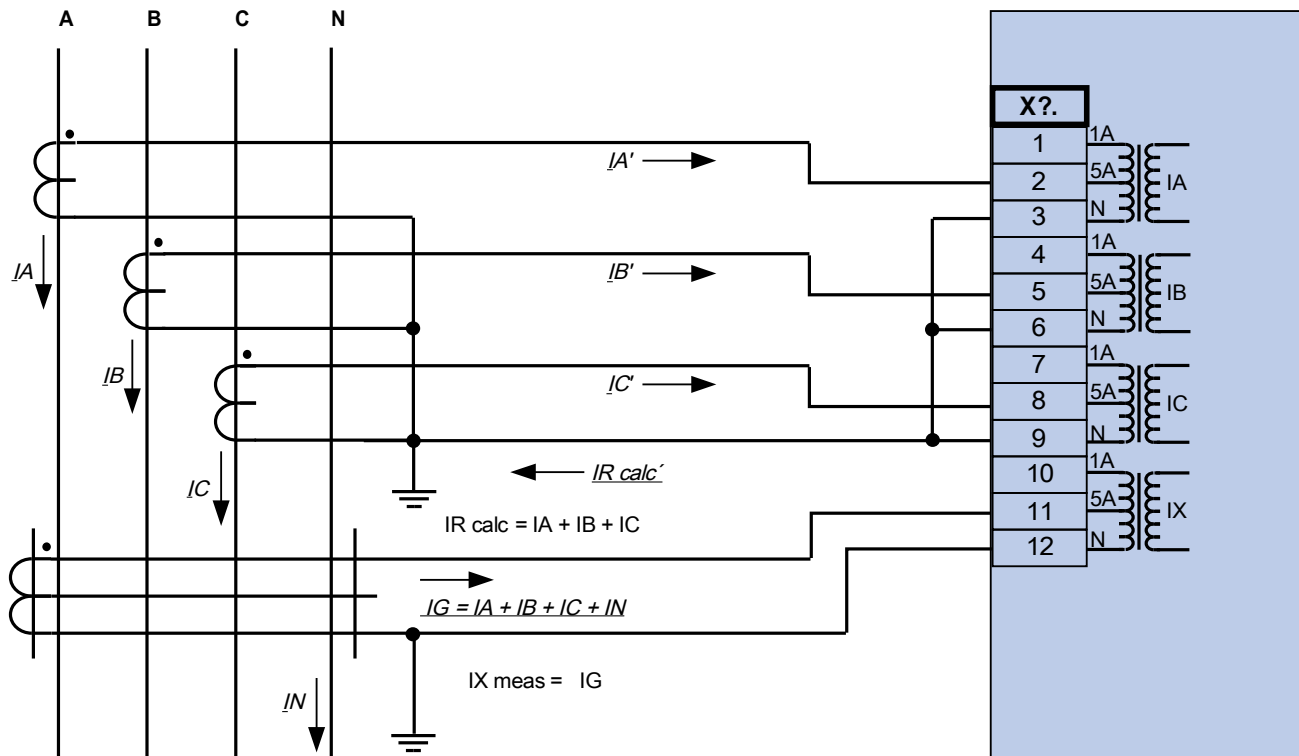
The shielding at the dismantled end of the line has to be put through the zero sequence current transformer and has to be grounded at the cable side .

4-wire system, 4th CT on Neutral



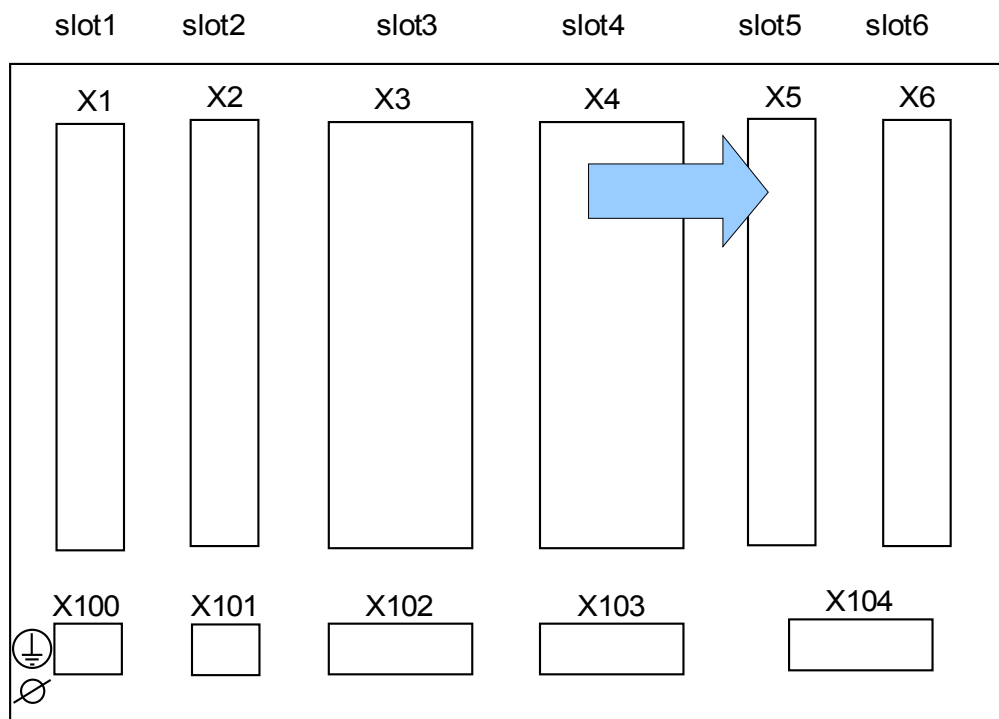
4-wire system, 4th CT on Neutral; I_N secondary = 5 A

4-wire System Ground Current CT Involving Neutral



4-wire system with ground current CT (Toroidal) involving Neutral; In secondary = 5 A.

Slot X5: Multi Input – Output Card



Rear side of the device (Slots)

The type of card in this slot is dependent on the ordered device type. The different variants have a different scope of functions.

Available assembly groups in this slot:

- **(DI8 X5 and RO4 X5):** Assembly Group with eight digital inputs and four relay outputs.
- **(AN IO2 RO4 X5):** Assembly Group with two analog inputs and two analog outputs and four relay outputs.

NOTICE

The available combinations can be gathered from the ordering code.

DI8 X- Digital Inputs

This module is provided with 8 grouped digital inputs.

In chapter [Device parameter/Digital Inputs] the assignment of the digital inputs is specified.



Make sure that the tightening torque is 0.56-0.79 Nm [5-7 In-lb].

CAUTION

When using DC supply, the negative potential has to be connected to the common terminal (COM1, COM2, COM3 - please see the terminal marking).

CAUTION

For each digital input group the related voltage input range has to be parameterized. Wrong switching thresholds can result in malfunctions/wrong signal transfer times.

NOTICE

Via the »assignment list« the states of the digital inputs are assigned to the module inputs (e.g. I[1]).

The digital inputs are provided with different switching thresholds (can be parameterized) (two AC and five DC input ranges). For each group the following switching thresholds can be defined:

- 24V DC
- 48V DC / 60V DC
- 110 V AC/DC
- 230 V AC/DC

If a voltage >80% of the set switching threshold is applied at the digital input, the state change is recognized (physically "1"). If the voltage is below 40% of the set switching threshold, the device detects physically "0".

RO-4X - Relay Outputs

The Relay Outputs are potential-free contacts. In the Assignment/Relay Outputs section, the assignment of the Relay Outputs is specified. The changeable signals are listed in the Assignment List section.

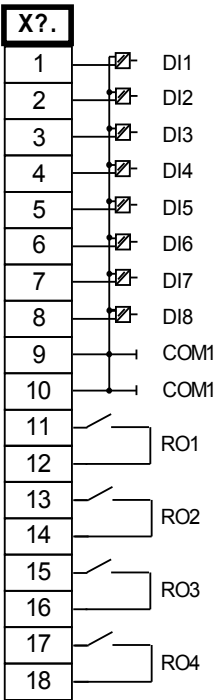


Make sure that the tightening torque is 5-7 In-lb [0.56-0.79 Nm].

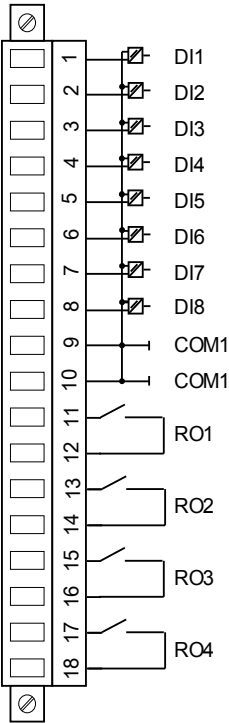
CAUTION

Please carefully consider the current carrying capacity of the Relay Outputs. Please refer to the Technical Data.

Terminal Marking



Pin Assignment



AN I02 X - Analog Inputs and Outputs

There are 2 Analog Input and 2 Analog Output channels that are configurable to either 0-20 mA, 4-20 mA, or 0-10 V. Each of the channels can be independently programmed to either of these three input/output modes.

For details on the Analog Inputs/Outputs, please refer to the Technical Data.

Analog inputs:

- 2 analog inputs with one common potential. Each input has its own common terminal.
- The mode of each input can be individually selected between current or voltage input
- In current mode the measuring range is 0-20 mA
- In current mode the input resistor is 500 Ohm
- In voltage mode the measuring range is 0-10 V
- In voltage mode the input resistor is 100 kOhm
- The accuracy is 0.5 % of the nominal value 20 mA/10 V
- The test voltage of the inputs (one group) against other electrical groups and earth is 2.5 kV

Analog outputs:

- 2 analog outputs with one common potential. Each output has its own common terminal.
- The mode of each output can be individually selected between current or voltage output
- In current mode the output range is 0-20 mA
- In current mode the maximum load resistance is 1 kOhm
- In voltage mode the output range is 0-10 V
- In voltage mode the outputs are short circuit proof
- The accuracy is 0.5 % of the nominal value 20 mA/10 V
- The test voltage of the outputs (one group) against other electrical groups and earth is 2.5 kV

Wiring

- Shielded cable is recommended
- The test voltage against earth is 1.0 kV and against other electrical groups 2.5 kV

HF-Shield

- The terminals of the HF shield should be used, when connecting the shield to earth on both sides of the cable is not possible. On one side of the cable the shield has to be directly connected to earth.

Make sure that the tightening torque is 0.56-0.79 Nm [5-7 In-lb].

For details on the Analog Inputs or Outputs please refer to the Technical Data.

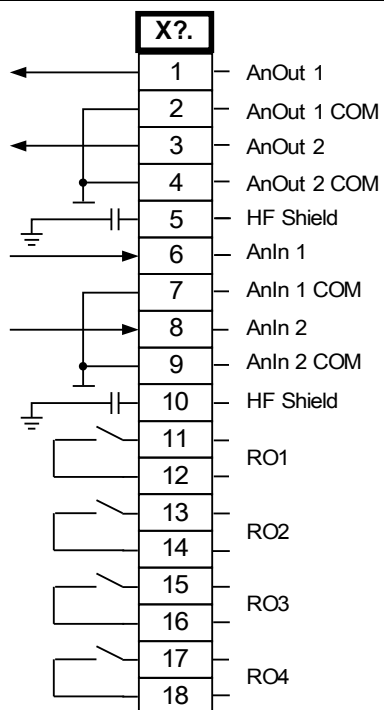
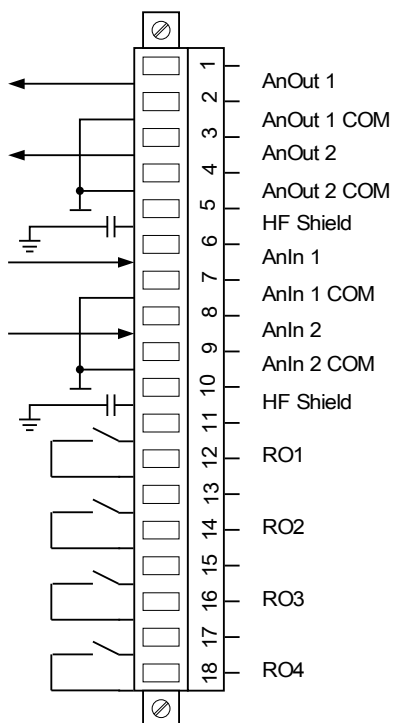
RO-4X - Relay Outputs

The Relay Outputs are potential-free contacts. In the Assignment/Relay Outputs section, the assignment of the Relay Outputs is specified. The changeable signals are listed in the Assignment List section.

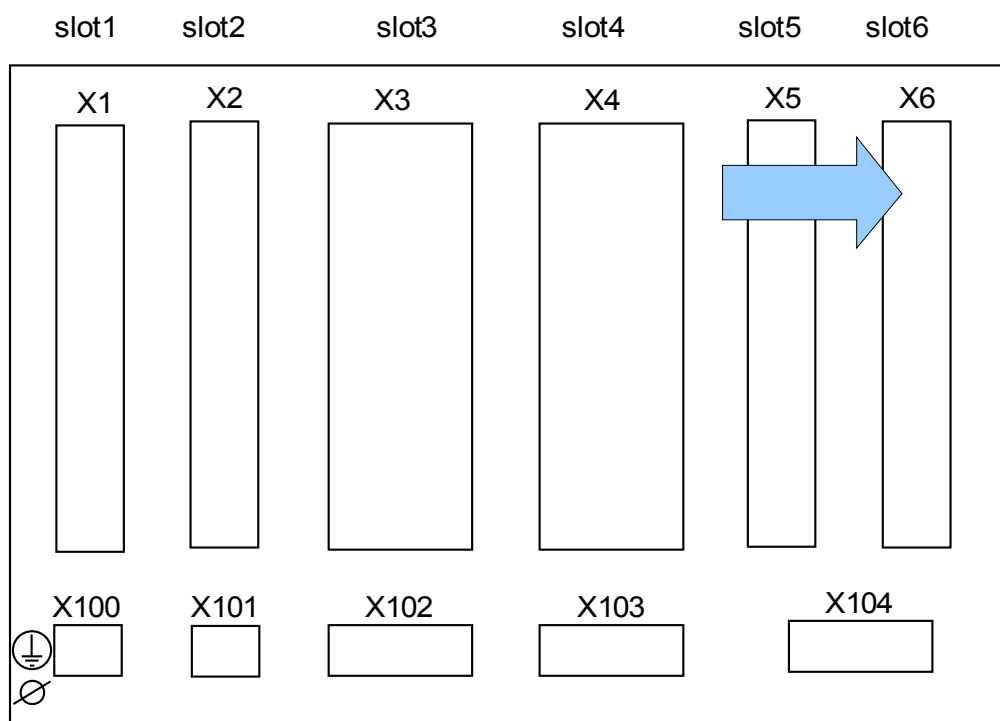
Make sure that the tightening torque is 5-7 In-lb [0.56-0.79 Nm].

CAUTION

Please carefully consider the current carrying capacity of the Relay Outputs. Please refer to the Technical Data.

Terminals**Electro-mechanical assignment**

Slot X6: Voltage Measuring Card



Rear side of the device (Slots)

The type of card in this slot is dependent on the ordered device type. The different variants have a different scope of functions.

Available assembly groups in this slot:

- **(UB2+ X6):** Voltage measuring assembly group

NOTICE

The available combinations can be gathered from the ordering code.

Voltage Measuring Inputs

The device is provided with 4 voltage measuring inputs. Three for measuring the mains voltages («VAB», «VBC», «VCA» - *in case of Open Delta*) or phase-to-neutral voltages («VA», «VB», «VC» *in case of Wye*). The fourth measuring input is to be used for «VX».



Make sure that the tightening torque is 1.2-1.6 Nm [11-15 In-lb].

CAUTION

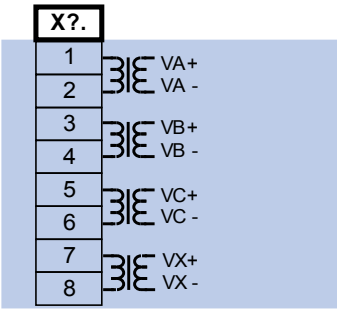
The rotating field of your power supply system has to be taken in to account. Make sure that the voltage transformers are wired correctly.

For the Open Delta connection the system parameter »Main VT con« has to be set to »Open Delta«.

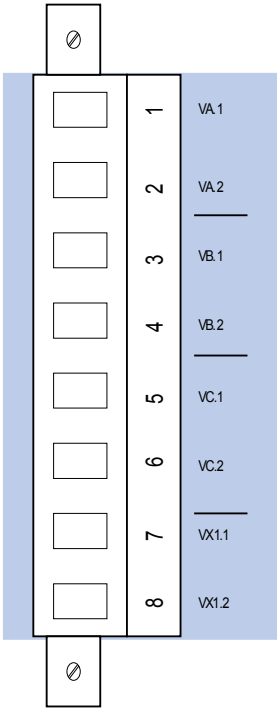
For the Wye connection the system parameter »Main VT con« has to be set to »Wye«.

Please refer to the Technical Data.

Terminal Marking



Pin assignment



Common VT Wirings

Check the installation direction of the VTs.



It is imperative that the secondary sides of measuring transformers be grounded.

NOTICE

For current and voltage sensing function, externally wired and appropriate current and voltage transformer must be used, based on the required input measurement ratings. Those devices provide the necessary insulation functionality.

VT Check Measuring Values

Connect a three-phase measuring voltage equal to the rated voltage to the relay.

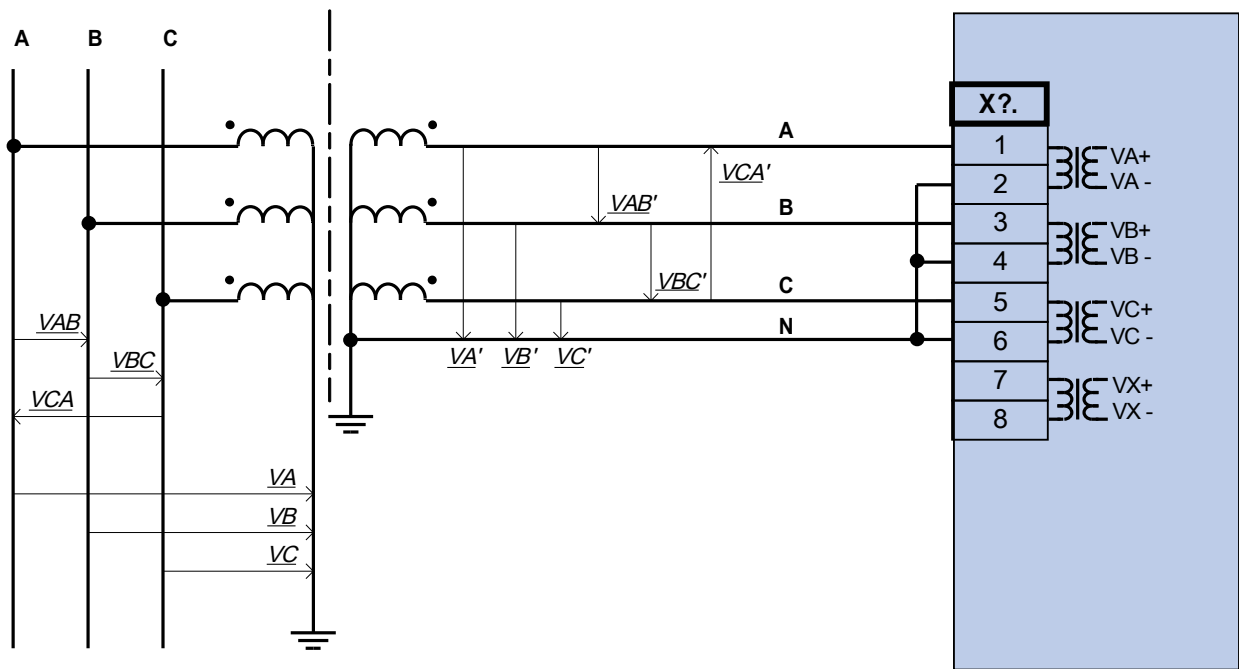
NOTICE

Take the connection of the measuring transformers (open delta/Wye connection) into account.

Now adjust the voltage values in the nominal voltage range with the corresponding nominal frequencies that are not likely to cause over-voltage or under-voltage trips.

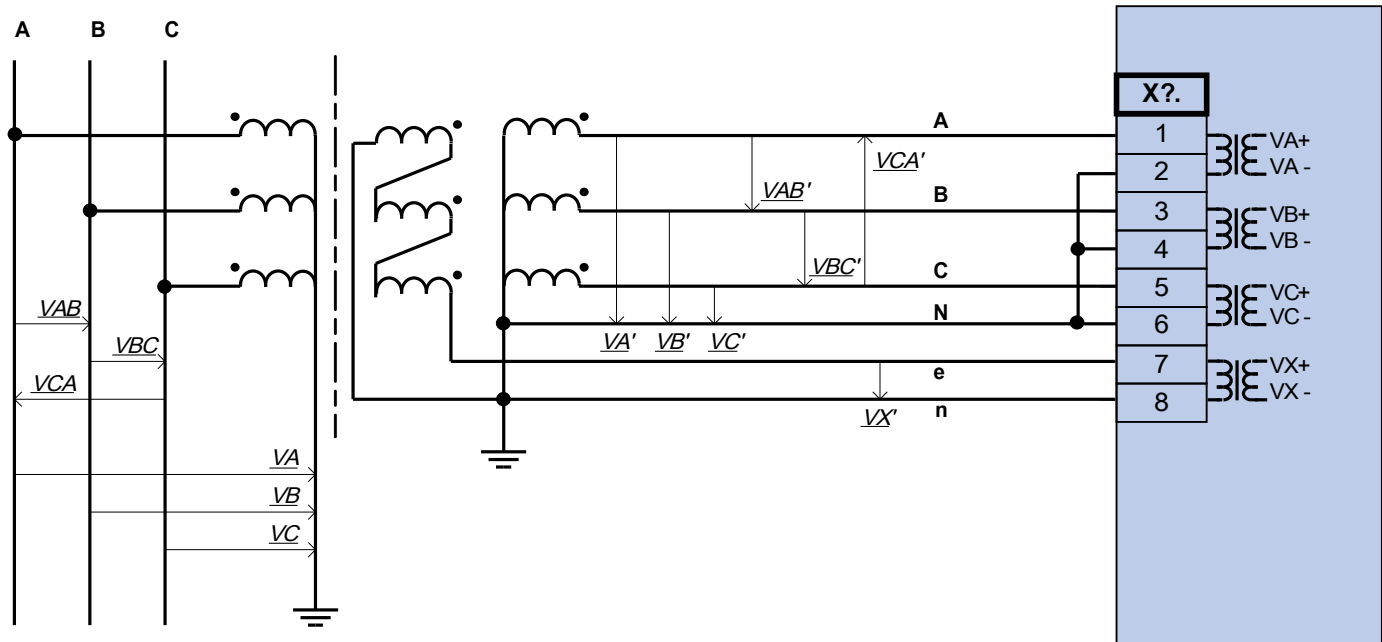
Compare the values shown in the device display with the readings of the measuring instruments. The deviation must be according to the specifications in the Technical Data section.

VT Wye



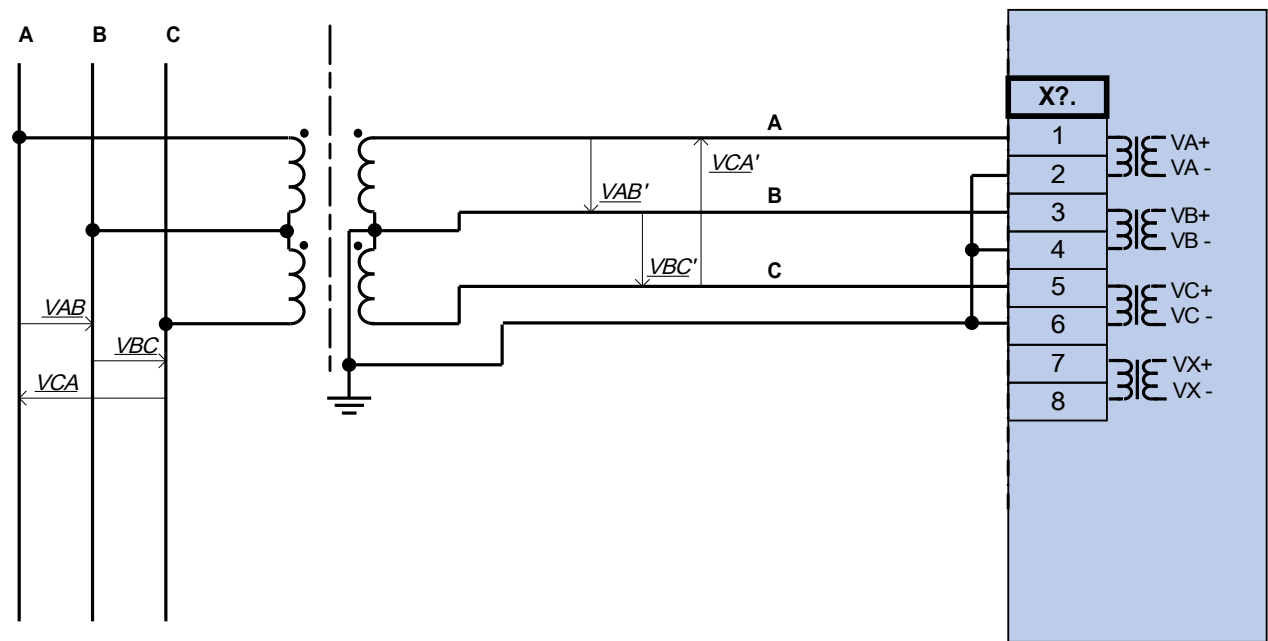
Three-phase voltage measurement - wiring of the measurement inputs : "star-connection"

VT Wye with Broken Delta Connection



Three-phase voltage measurement - wiring of the measurement inputs : "star-connection"
 Measurement of the residual voltage V_G via auxilliary windings (e-n) "broken delta"

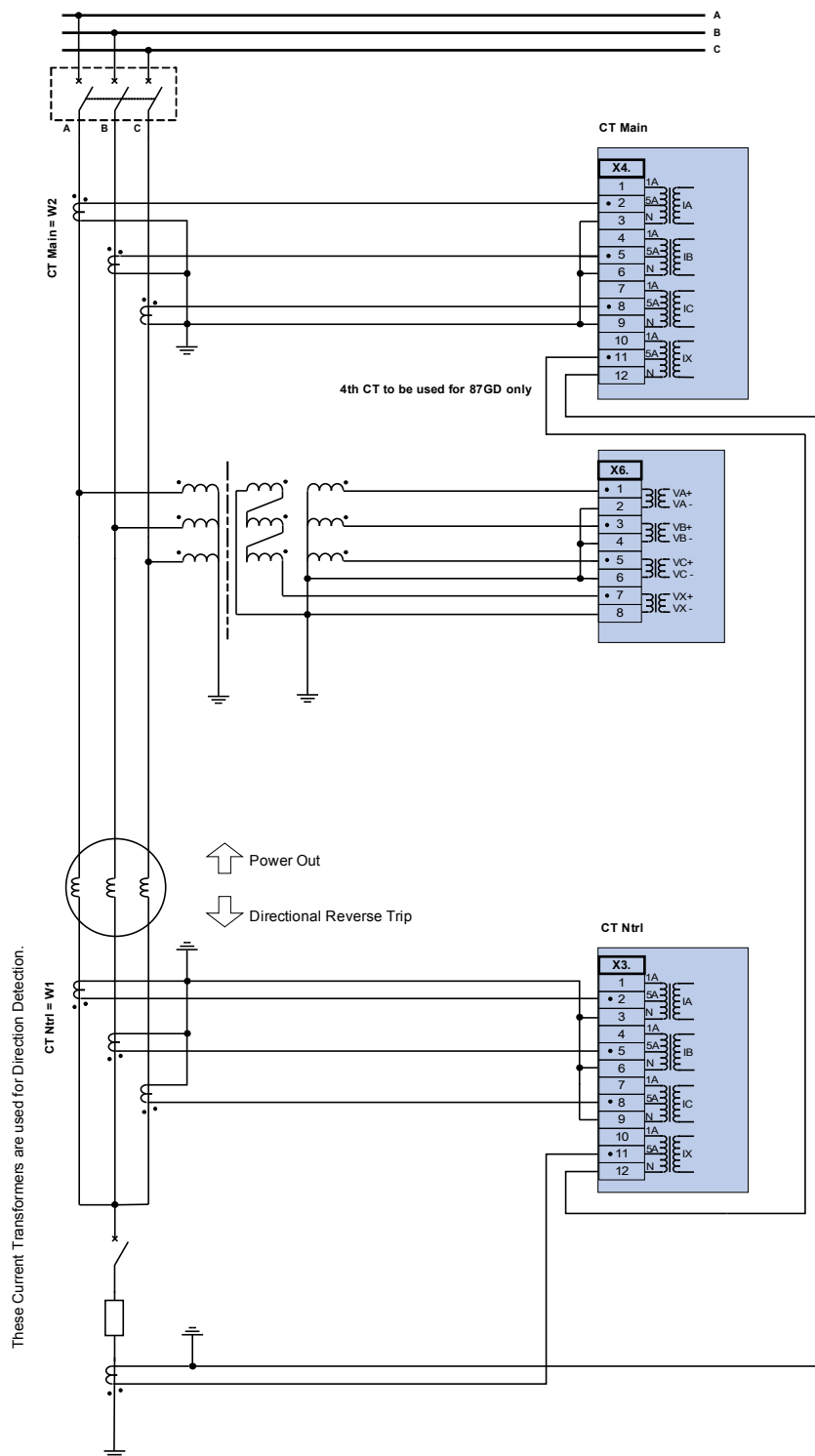
VT Open Delta



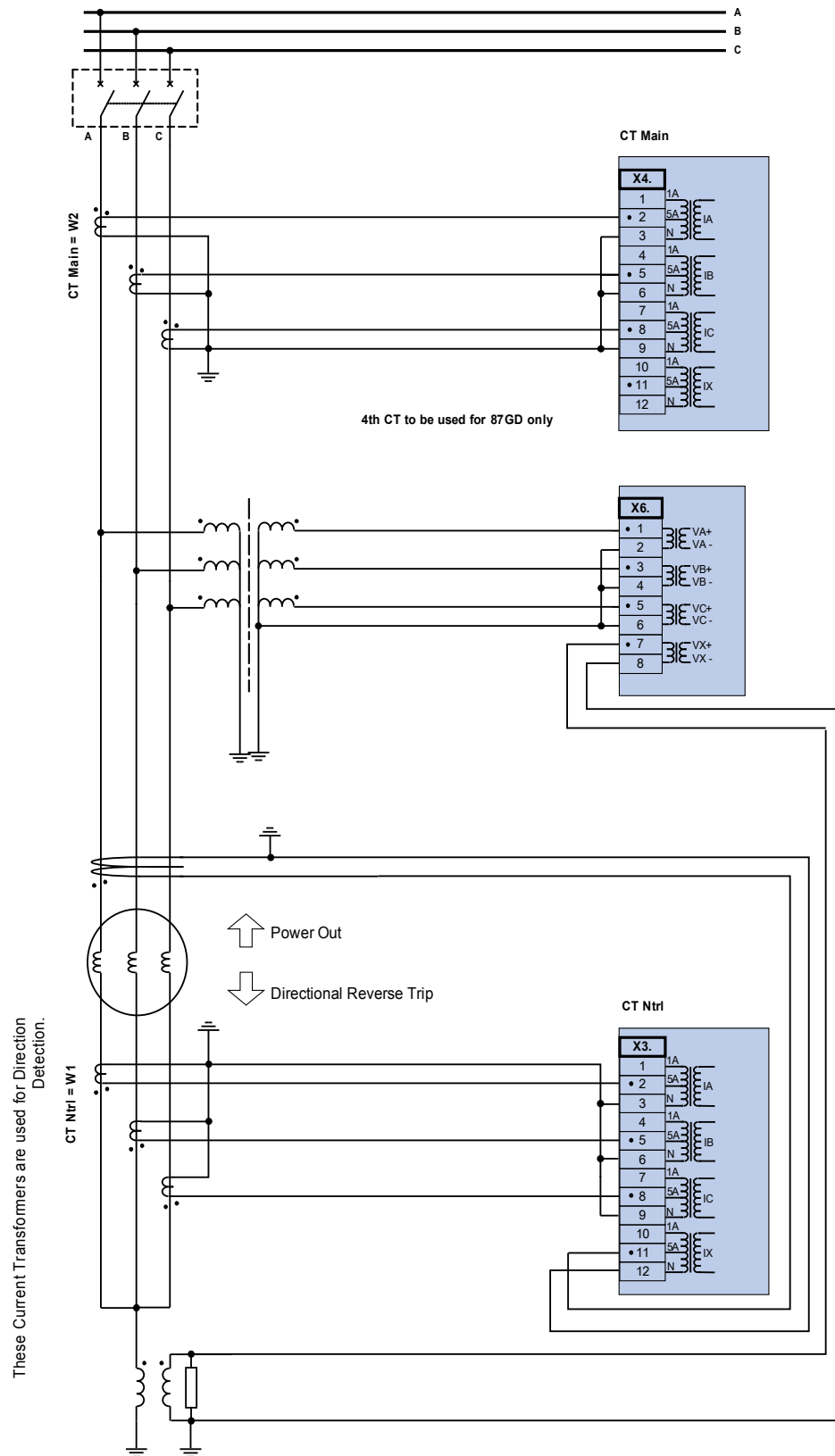
Two-phase voltage measurement - wiring of the measuring inputs: "Open Delta"

Typical External Sensing Connections

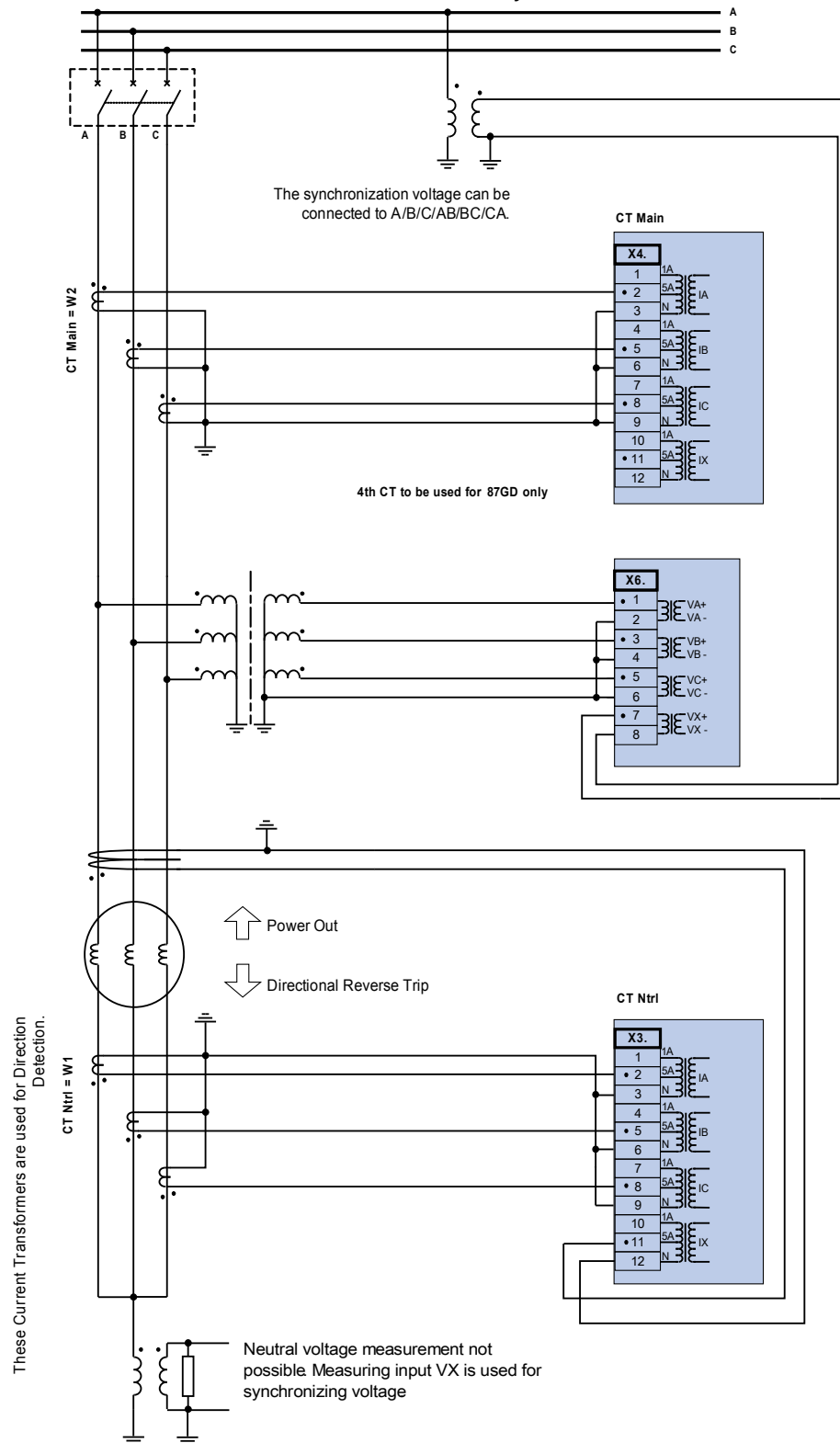
Low Resistance Grounded Generator with Phase and Ground Differential Protection



High Impedance Grounded Generator with Phase Differential and 100% Stator Ground Protection

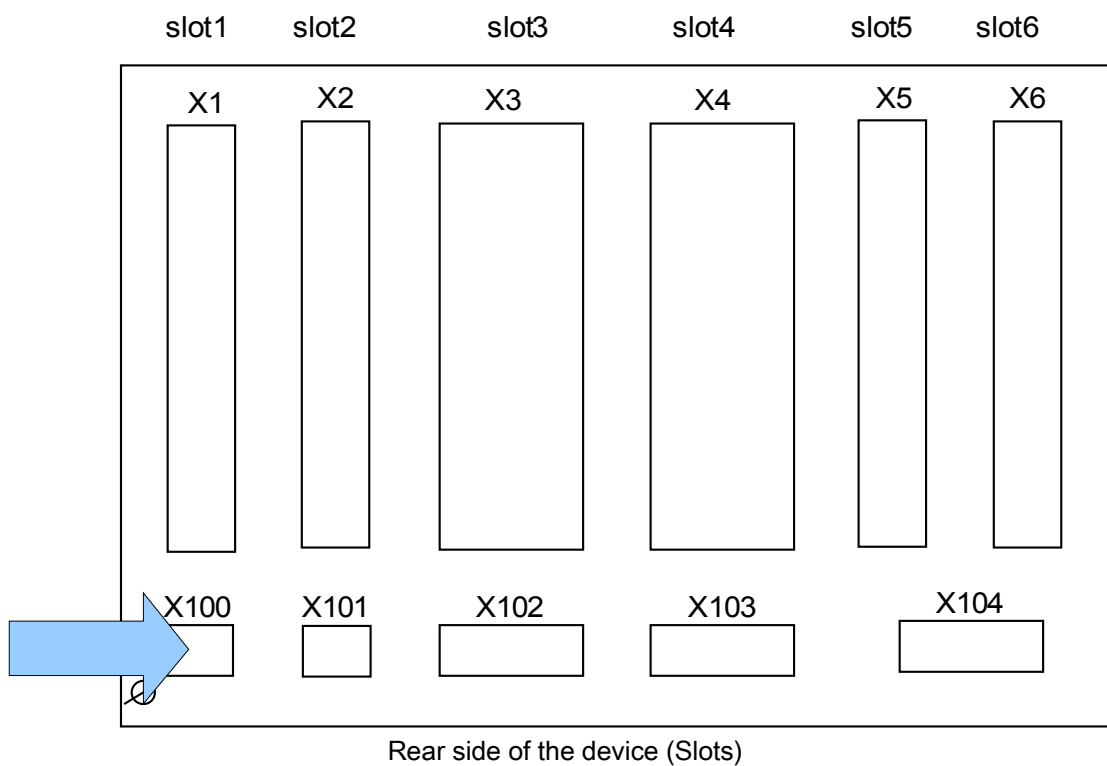


High Impedance Grounded Generator with Phase Differential and Synchronism Check



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Slot X100: Ethernet Interface



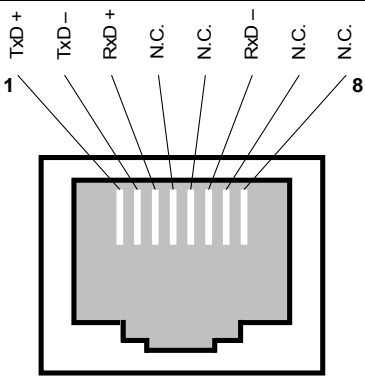
An Ethernet interface may be available depending on the device type ordered.

NOTICE

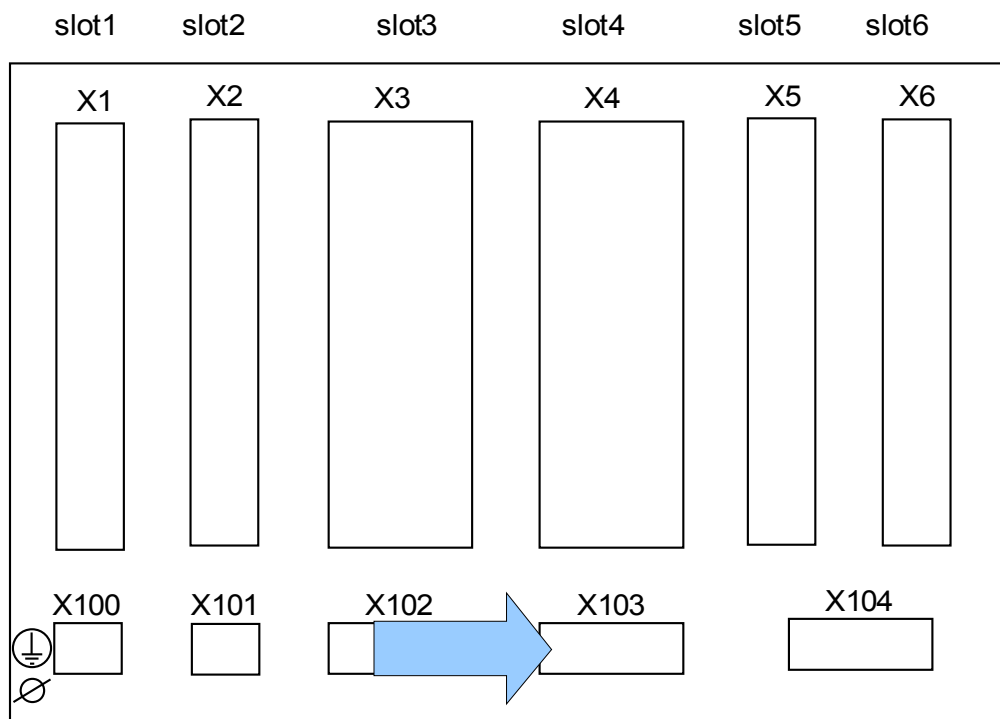
The available combinations can be gathered from the ordering code.

Ethernet - RJ45

Terminal Marking



Slot X103: Data Communication



Rear side of the device (Slots)

The data communication interface in the **X103** slot is dependent on the ordered device type. The scope of functions is dependent on the type of data communication interface.

Available assembly groups in this slot:

- RS485 Terminals for Modbus and DNP
- Ethernet Interface for Modbus and DNP
- Fiber Optics for Modbus and DNP
- D-Sub for Modbus and DNP
- Ethernet for IEC61850
- Fiber Optics Interface for Ethernet*

*=ask for availability

NOTICE

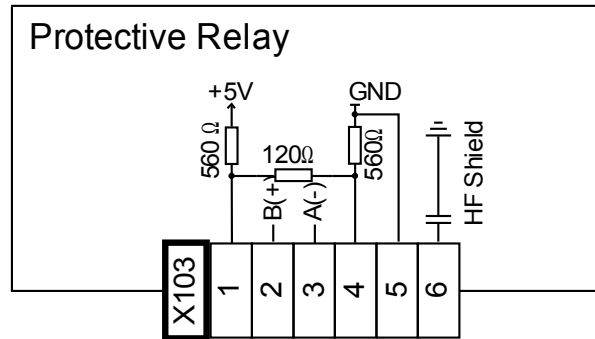
The available combinations can be gathered from the ordering code.

RS485 - Modbus® RTU

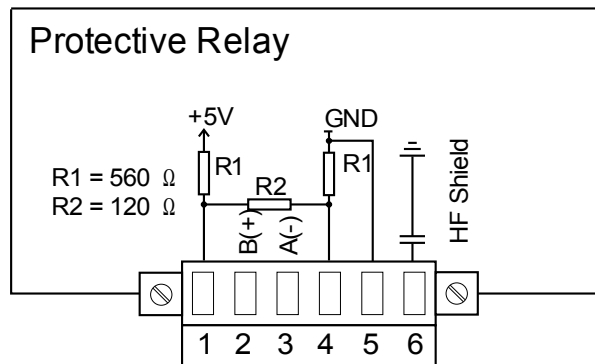


WARNING Make sure that the tightening torque is 2-4 In-lb [0.22-0.45 Nm].

Terminal Marking



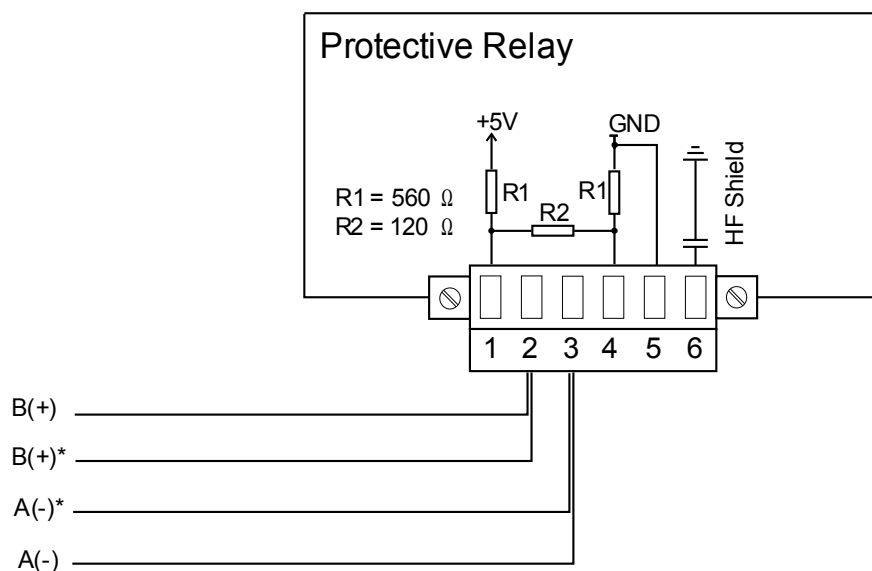
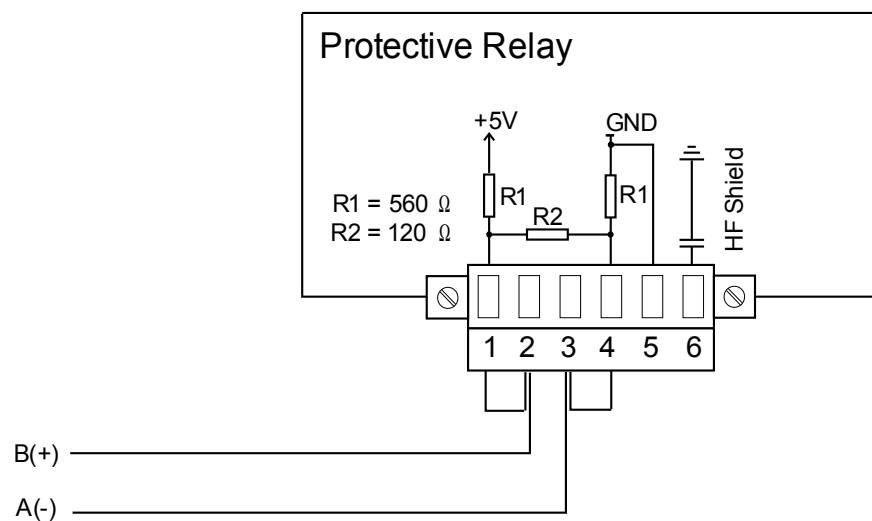
Pin Assignment



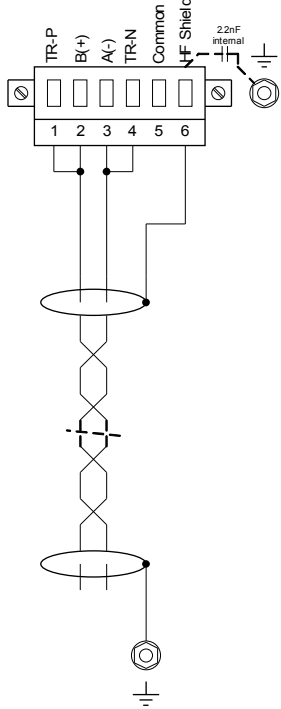
NOTICE

The Modbus® connection cable must be shielded. The shielding has to be fixed at the screw that is marked with the ground symbol at the rear side of the device.

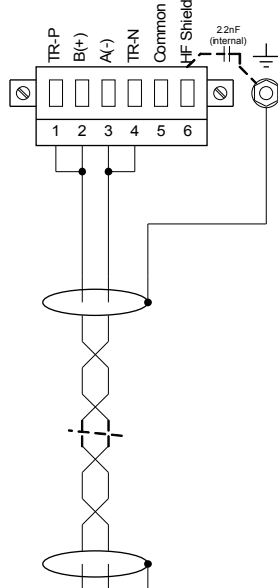
The communication is Half Duplex.

Wiring Example: Device in the Middle of the Bus*Wiring Example: Device at the End of the BUS (Using the Integrated Terminal Resistor)*

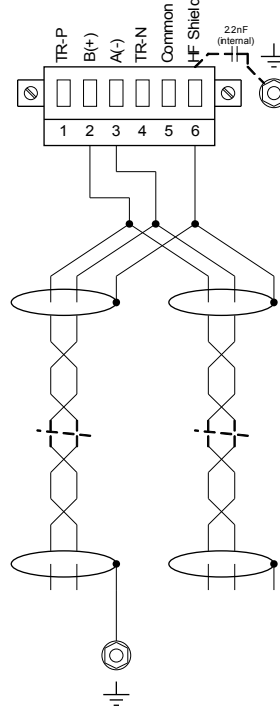
Shielding Options (2-wire + Shield)



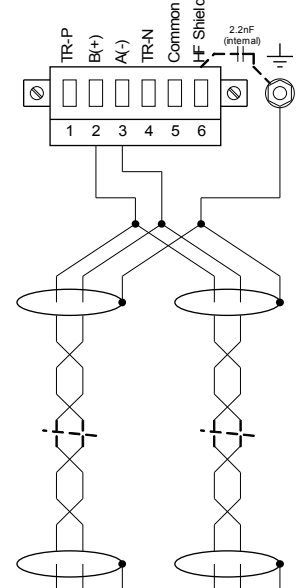
Shield at bus master side
connected to earth termination
resistors used



Shield at bus device side
connected to earth termination
resistors used

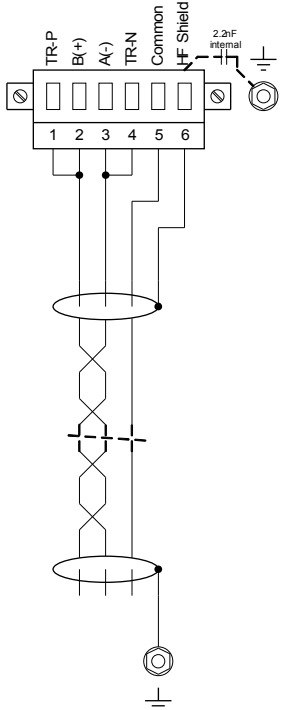


Shield at bus master side
connected to earth termination
resistors not used

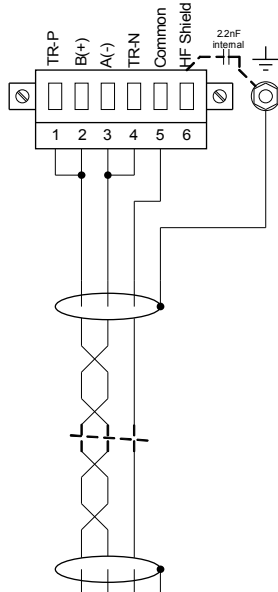


Shield at bus device side
connected to earth termination
resistors not used

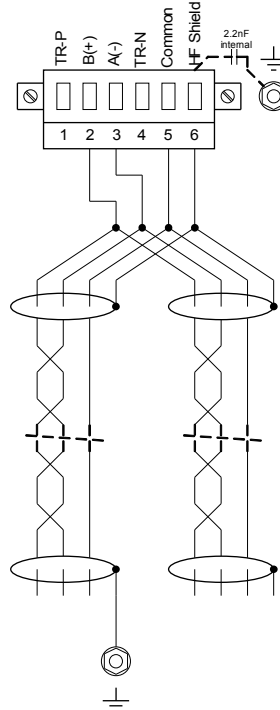
Shielding Options (3-wire + Shield)



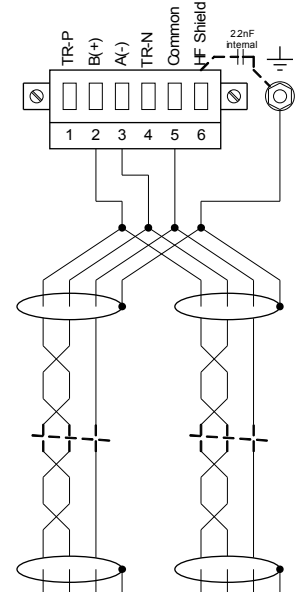
Shield at bus master side
connected to earth termination
resistors used



Shield at bus device side
connected to earth termination
resistors used

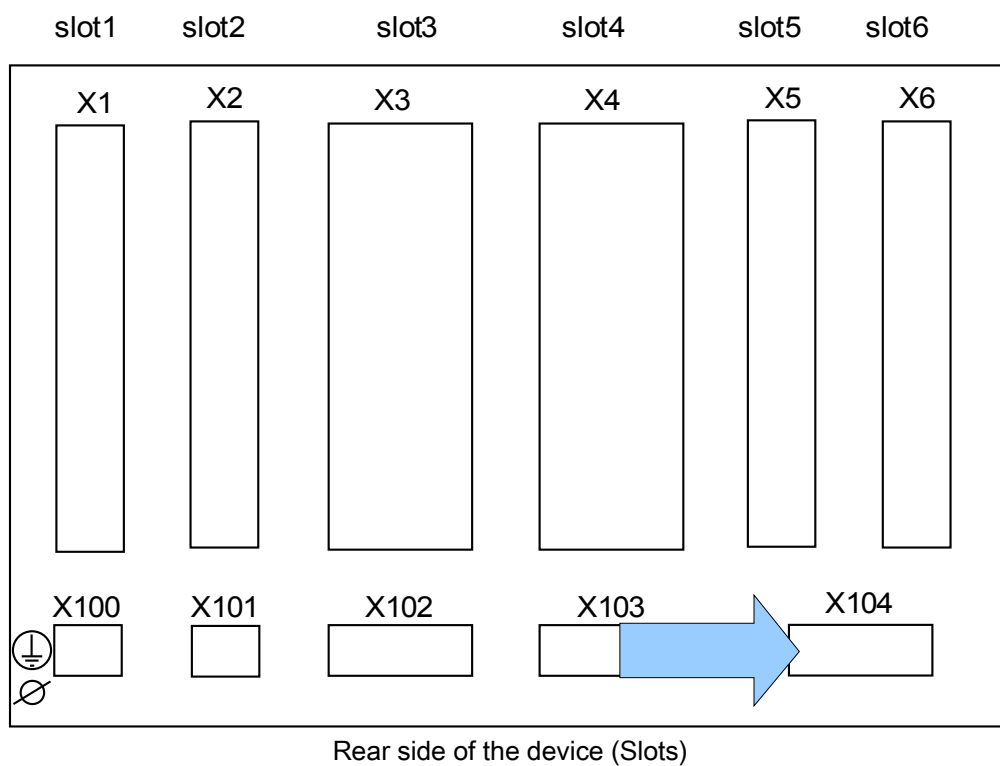


Shield at bus master side
connected to earth termination
resistors not used



Shield at bus device side
connected to earth termination
resistors not used

Slot X104: IRIG-B00X and Supervision Contact

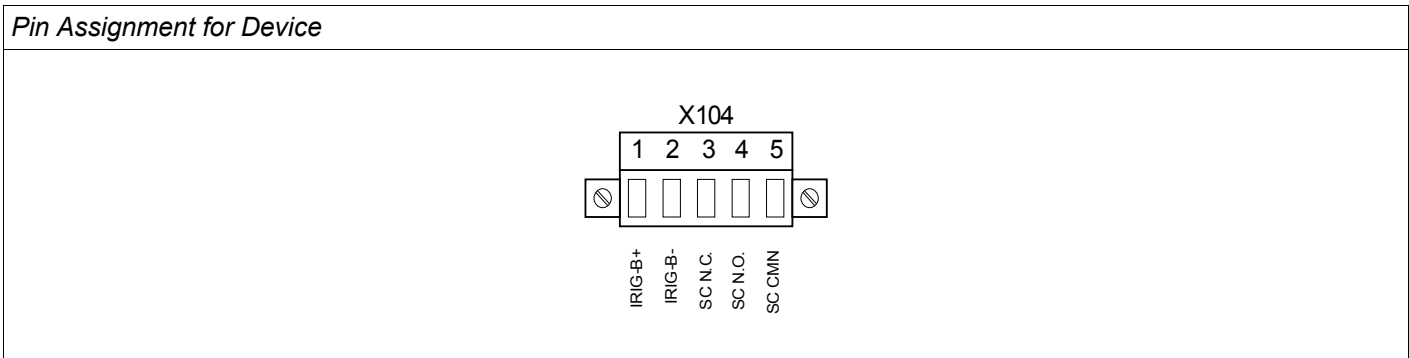
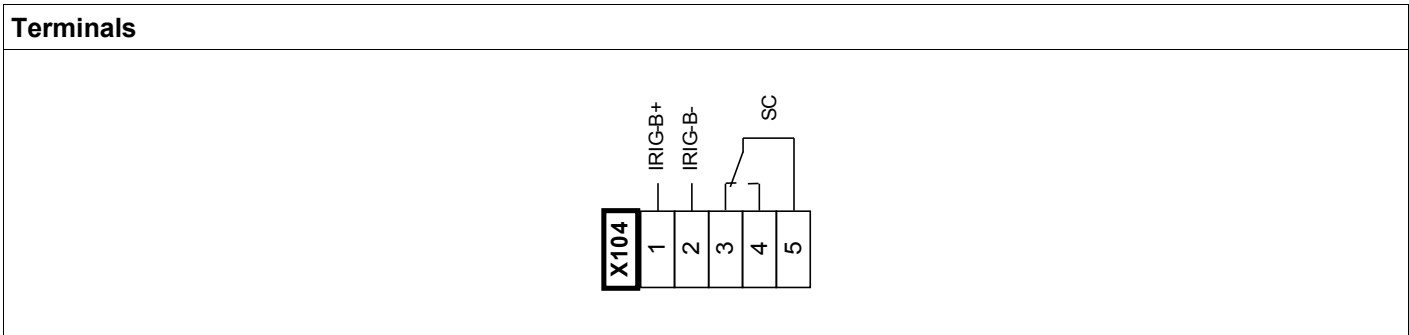


This comprises the IRIG-B00X and the System contact (Supervision Contact).

System Contact and IRIG-B00X

 **WARNING**

Make sure that the tightening torque is 5-7 In-lb [0.56-0.79 Nm].

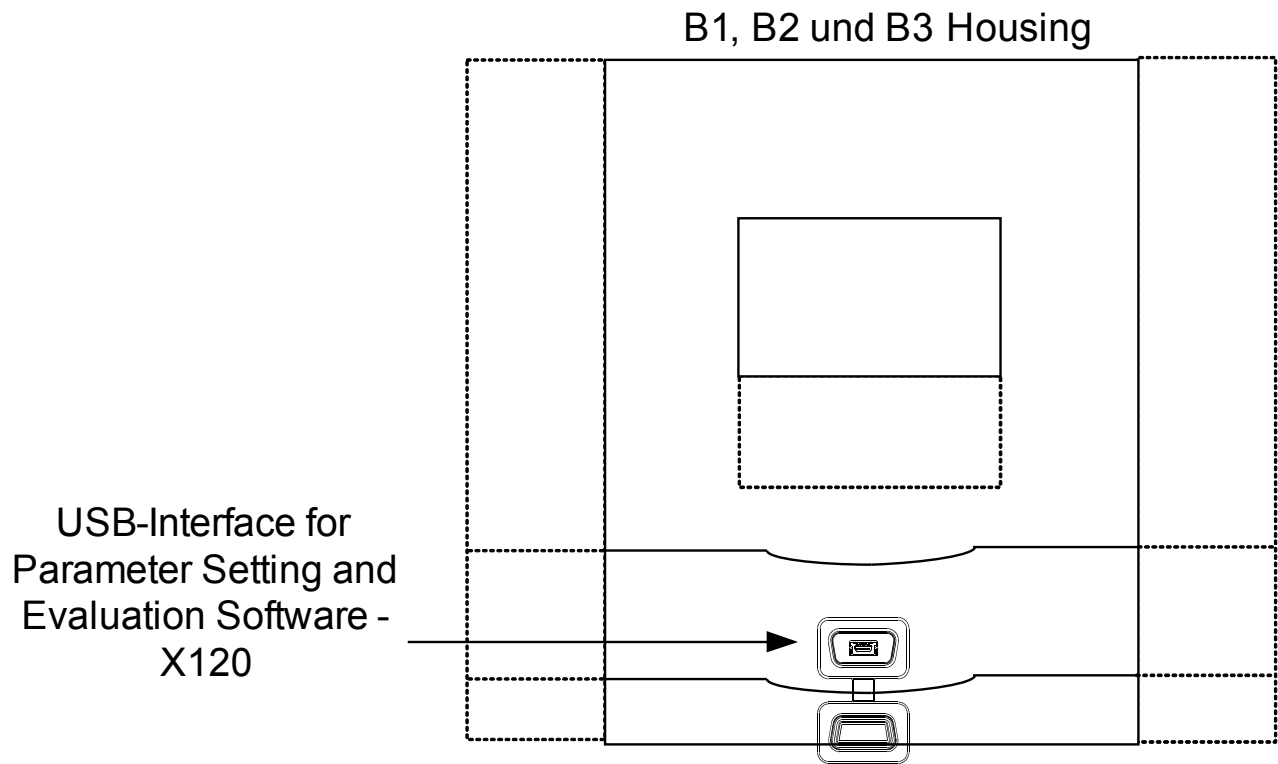


The Supervision Contact (SC) closes after the boot phase of the device if the protection is working. This Supervision Contact (SC) will open if an internal device error has occurred (please refer to the Self Supervision section).

The *System-OK contact (SC relay)* cannot be configured. The system contact is a Form “C” contact that picks up when the device is free from internal faults. While the device is booting up, the *System OK relay (SC)* remains dropped-off (unenergized). As soon as the system is properly started, the System Contact picks up and the assigned LED “Operational” is activated accordingly (please refer to the Self Supervision section).

Slot X120 - PC Interface

- USB (Mini-B)



*
TCM= Trip Coil Monitor

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Input, Output and LED Settings

Digital Input Configuration

The State of the Digital Inputs can be checked within menu:

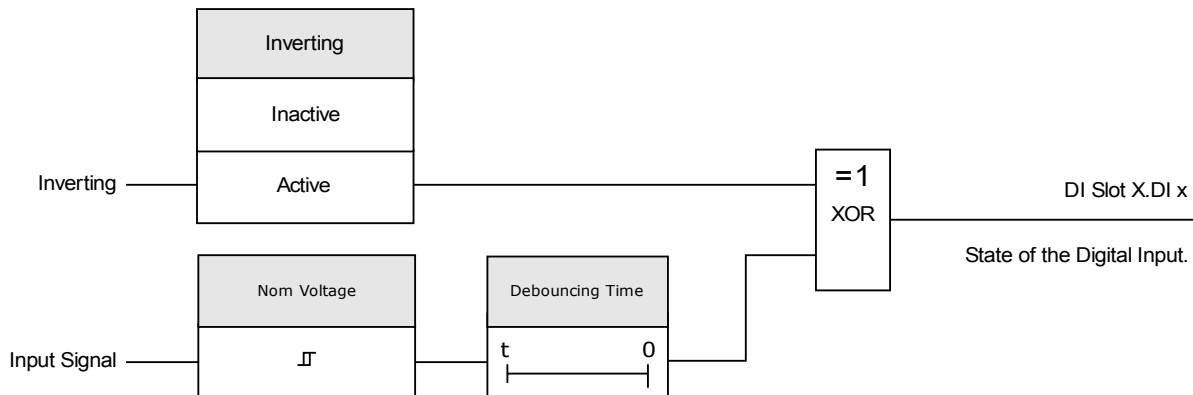
[Operations/Status Display/Name of the assembly group (e.g. DI-8X)]

The Digital Inputs can be configured within menu:

[Device Para/Digital Inputs/Name of the assembly group (e.g. DI-8X)/Group X]

Set the following parameters for each of the digital inputs:

- »*Nominal voltage*«;
- »*Debouncing time*«: A state change will only be adopted by the digital input after the debouncing time has expired;
and
- »*Inverting*« (where necessary).



CAUTION

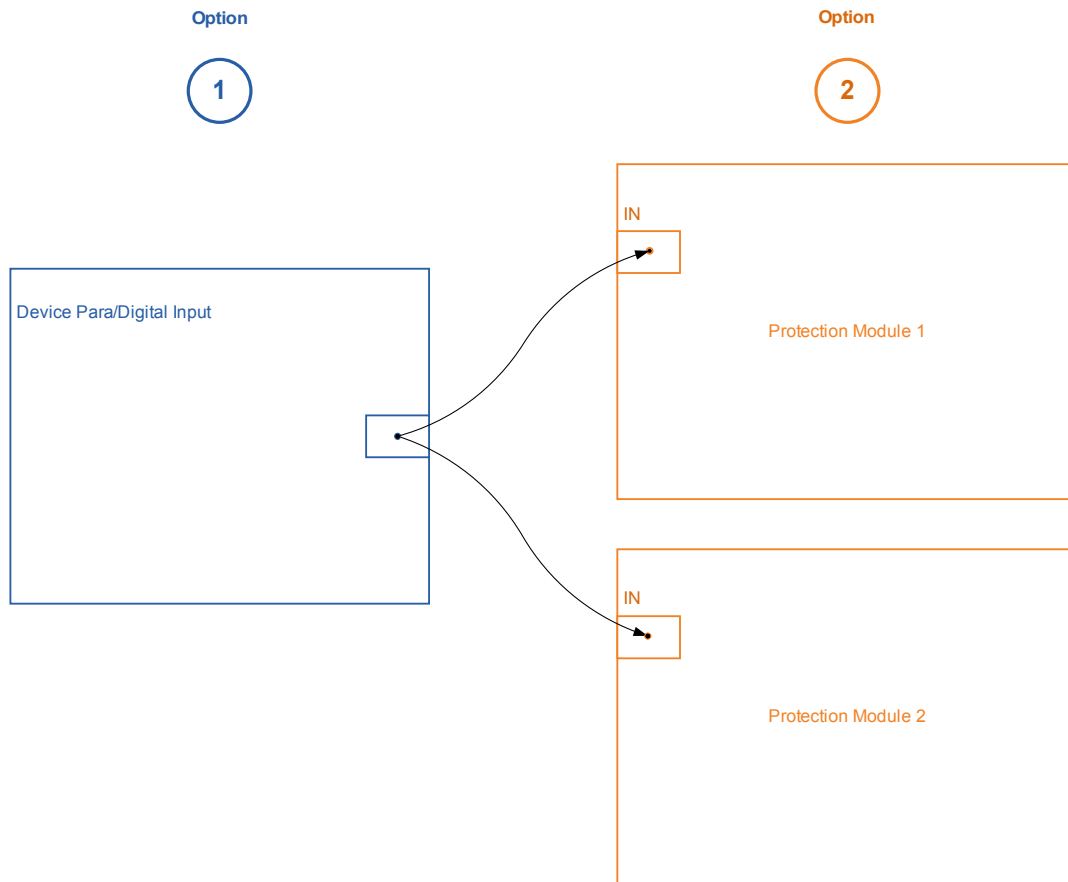
The debouncing time will be started each time the state of the input signal alternates.

CAUTION

In addition to the debouncing time that can be set via software, there is always a hardware debouncing time (approx 12 ms) that cannot be turned off.

Assignment of Digital Inputs

There are two options available in order to determine where a Digital Input should be assigned to.



Option 1 - Assigning a Digital Input onto one or multiple modules.

Adding an assignment:

Within menu [Device Parameter\Digital Inputs] Digital Inputs can be assigned onto one or multiple targets. Call up the Digital Input (Arrow right on the DI). Click on the Softkey »Parameter Setting/Wrench«. Click on »Add« and assign a target. Assign where required additional targets.

Deleting an assignment:

Select as described above a Digital Input that should be edited at the HMI.

Call up the assignments of the Digital Input (Arrow-right on the DI) and select the assignment that should be removed/deleted (Please note, this has to be marked with the cursor). The assignment can now be deleted at the HMI by means of the Softkey »Parameter setting« and selection of »remove«. Confirm the parameter setting update.

Option 2 – Connecting a Module Input with a Digital Input

Call a module. Within this module assign a Digital Input onto a module input. Example: A protection module should be blocked depending on the state of a Digital Input.. For this assign onto the blocking input within the Global Parameters the Digital Input (e.g. Ex Blo 1).

Checking the Assignments of a Digital Input

In order to check the targets that a Digital Input is assigned to please proceed as follows:

Call up menu [Device Parameter\Digital Inputs].

Navigate to the Digital Input that should be checked.

At the HMI:

A multiple assignment, that means if a Digital Input is used more than once (if it is assigned to multiple targets), this will be indicated by an "..." behind a Digital Input. Call up this Digital Input by Softkey »Arrow right« in order to see the list of targets of this Digital Input.

DI-8P X

Name of the Assembly group:

DI-8P X1

Device Parameters of the Digital Inputs on DI-8P X

Parameter	Description	Setting range	Default	Menu path
 Nom Voltage	Nominal voltage of the digital inputs	24 V dc, 48 V dc, 60 V dc, 110/120 V dc, 230/240 V dc, 110/120 V ac, 230/240 V ac	110/120 V dc	[Device Para /Digital Inputs /DI-8P X1 /Group 1]
 Inverting 1	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8P X1 /Group 1]
 Debouncing Time 1	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8P X1 /Group 1]
 Nom Voltage	Nominal voltage of the digital inputs	24 V dc, 48 V dc, 60 V dc, 110/120 V dc, 230/240 V dc, 110/120 V ac, 230/240 V ac	110/120 V dc	[Device Para /Digital Inputs /DI-8P X1 /Group 2]
 Inverting 2	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8P X1 /Group 2]

Parameter	Description	Setting range	Default	Menu path
 Debouncing Time 2	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8P X1 /Group 2]
 Nom Voltage	Nominal voltage of the digital inputs	24 V dc, 48 V dc, 60 V dc, 110/120 V dc, 230/240 V dc, 110/120 V ac, 230/240 V ac	110/120 V dc	[Device Para /Digital Inputs /DI-8P X1 /Group 3]
 Inverting 3	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8P X1 /Group 3]
 Debouncing Time 3	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8P X1 /Group 3]
 Inverting 4	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8P X1 /Group 3]
 Debouncing Time 4	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8P X1 /Group 3]
 Inverting 5	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8P X1 /Group 3]

Parameter	Description	Setting range	Default	Menu path
Debouncing Time 5 	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8P X1 /Group 3]
Inverting 6 	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8P X1 /Group 3]
Debouncing Time 6 	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8P X1 /Group 3]
Inverting 7 	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8P X1 /Group 3]
Debouncing Time 7 	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8P X1 /Group 3]
Inverting 8 	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8P X1 /Group 3]
Debouncing Time 8 	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted. 8	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8P X1 /Group 3]

Digital Inputs Output Signals on DI-8P X

Signal	Description
DI 1	Signal: Digital Input
DI 2	Signal: Digital Input
DI 3	Signal: Digital Input
DI 4	Signal: Digital Input
DI 5	Signal: Digital Input
DI 6	Signal: Digital Input
DI 7	Signal: Digital Input
DI 8	Signal: Digital Input

DI-8 X Settings

Name of the Assembly group:

DI-8 X5

Device Parameters of the Digital Inputs on DI-8 X

Parameter	Description	Setting range	Default	Menu path
Nom Voltage 	Nominal voltage of the digital inputs	24 V dc, 48 V dc, 60 V dc, 110/120 V dc, 230/240 V dc, 110/120 V ac, 230/240 V ac	110/120 V dc	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Inverting 1 	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Debouncing Time 1 	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8 X5 /Group 1]

Parameter	Description	Setting range	Default	Menu path
Inverting 2 	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Debouncing Time 2 	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Inverting 3 	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Debouncing Time 3 	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Inverting 4 	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Debouncing Time 4 	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Inverting 5 	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Debouncing Time 5 	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8 X5 /Group 1]

Parameter	Description	Setting range	Default	Menu path
Inverting 6 	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Debouncing Time 6 	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Inverting 7 	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Debouncing Time 7 	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted.	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Inverting 8 	Inverting the input signals.	Inactive, Active	Inactive	[Device Para /Digital Inputs /DI-8 X5 /Group 1]
Debouncing Time 8 	A change of the state of a digital input will only be recognized after the debouncing time has expired (become effective). Thus, transient signals will not be misinterpreted. 8	No Debouncing Time, 20 ms, 50 ms, 100 ms	20 ms	[Device Para /Digital Inputs /DI-8 X5 /Group 1]

Digital Inputs Output Signals on DI-8 X

<i>Signal</i>	<i>Description</i>
DI 1	Signal: Digital Input
DI 2	Signal: Digital Input
DI 3	Signal: Digital Input
DI 4	Signal: Digital Input
DI 5	Signal: Digital Input
DI 6	Signal: Digital Input
DI 7	Signal: Digital Input
DI 8	Signal: Digital Input

Wired Inputs (Aliases)

Available Elements:

Wired Inputs

The module WiredInputs allows to alias Digital Inputs. By means of the menu [Device Para/WiredInputs] the user can assign specific functions on digital inputs.

Alias Example: The 52a contact will be assigned/connected to Digital input1 (DI1). Once the 52a is aliased (linked) on the DI1, the signal »WiredInput.52A« can be used instead of the DI1 signal for further processing within the protective relay. That means, from now on any state changes of the Digital Input1 will be represented by the »WiredInput.52A« signal.

Global Protection Parameter of the Wired Inputs Wired

Parameter	Description	Setting range	Default	Menu path
Bkr Trouble 	Breaker Trouble	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
52a M1 	Main 1 Breaker Closed	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
52b M1 	Main 1 Breaker Open	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
TOCa M1 	Main 1 Breaker Connected	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
43/10 M1 	Main 1 Breaker Selected To Trip	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
52a M2 	Main 2 Breaker Closed	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
52b M2 	Main 2 Breaker Open	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
TOCa M2 	Main 2 Breaker Connected	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
43/10 M2 	Main 2 Breaker Selected To Trip	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
52a T 	Tie Breaker Closed	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]

<i>Parameter</i>	<i>Description</i>	<i>Setting range</i>	<i>Default</i>	<i>Menu path</i>
52b T 	Tie Breaker Open	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
TOCa T 	Tie Breaker Connected	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
43/10 T 	Tie Breaker Selected To Trip	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
43 M 	System In Manual	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
43 A 	System in Auto	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
43 P1 	Preferred Source 1	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]
43 P2 	Preferred Source 2	1..n, Dig Inputs	.-	[Device Para /Wired Inputs]

States of the Inputs of the Wired Inputs Module

Name	Description	Assignment via
Bkr Trouble-I	Breaker Trouble	[Device Para /Wired Inputs]
52a M1-I	State of the module input: Main 1 Breaker Closed	[Device Para /Wired Inputs]
52b M1-I	State of the module input: Main 1 Breaker Open	[Device Para /Wired Inputs]
TOCa M1-I	State of the module input: Main 1 Breaker Connected	[Device Para /Wired Inputs]
43/10 M1-I	State of the module input: Main 1 Breaker Selected To Trip	[Device Para /Wired Inputs]
52a M2-I	State of the module input: Main 2 Breaker Closed	[Device Para /Wired Inputs]
52b M2-I	State of the module input: Main 2 Breaker Open	[Device Para /Wired Inputs]
TOCa M2-I	State of the module input: Main 2 Breaker Connected	[Device Para /Wired Inputs]
43/10 M2-I	State of the module input: Main 2 Breaker Selected To Trip	[Device Para /Wired Inputs]
52a T-I	State of the module input: Tie Breaker Closed	[Device Para /Wired Inputs]
52b T-I	State of the module input: Tie Breaker Open	[Device Para /Wired Inputs]
TOCa T-I	State of the module input: Tie Breaker Connected	[Device Para /Wired Inputs]
43/10 T-I	State of the module input: Tie Breaker Selected To Trip	[Device Para /Wired Inputs]
43 M-I	State of the module input: System In Manual	[Device Para /Wired Inputs]
43 A-I	State of the module input: System in Auto	[Device Para /Wired Inputs]
43 P1-I	State of the module input: Preferred Source 1	[Device Para /Wired Inputs]
43 P2-I	State of the module input: Preferred Source 2	[Device Para /Wired Inputs]

Relay Output Configuration

The State of the Relay Outputs can be checked within menu:

[Operations/Status Display/Name of the assembly group (e.g. RO-XX)]

The Relay Outputs can be configured within menu:

[Device Para/Relay Outputs/Name of the assembly group (e.g. RO-XX)]

Set the following parameters for each of the relay output contacts.

- Up to seven (7) signals from the »assignment list« (OR-connected).

The states of the module outputs and the signals (e.g. states of protective functions) can be assigned to the relay output contacts. The relay output contacts are “dry-type” contacts.

- Each of the assigned signals can be inverted.

- By the Operating Mode it can be determined whether the relay output works in *Normally »De-Energized«* or *»Normally Energized«* principle.

- Each relay output contact can be set as *»Latched«* (Latched = active or inactive). A latched relay output contact will return to it's latched position after a loss of power to the protective device. A latched relay output contact will keep it's position as long as it has not been reset and as long as the power supply feeds the protective relay. In the case of a loss of power to the protective device, the relays will return to the latched position once the power is restored to the protective device (latched = relay output contacts have a memory). A latched state of a relay output contact always needs to be reset after a power loss even if the assignments are taken away (if the assignments are reprogrammed).

- Latched = inactive«*:

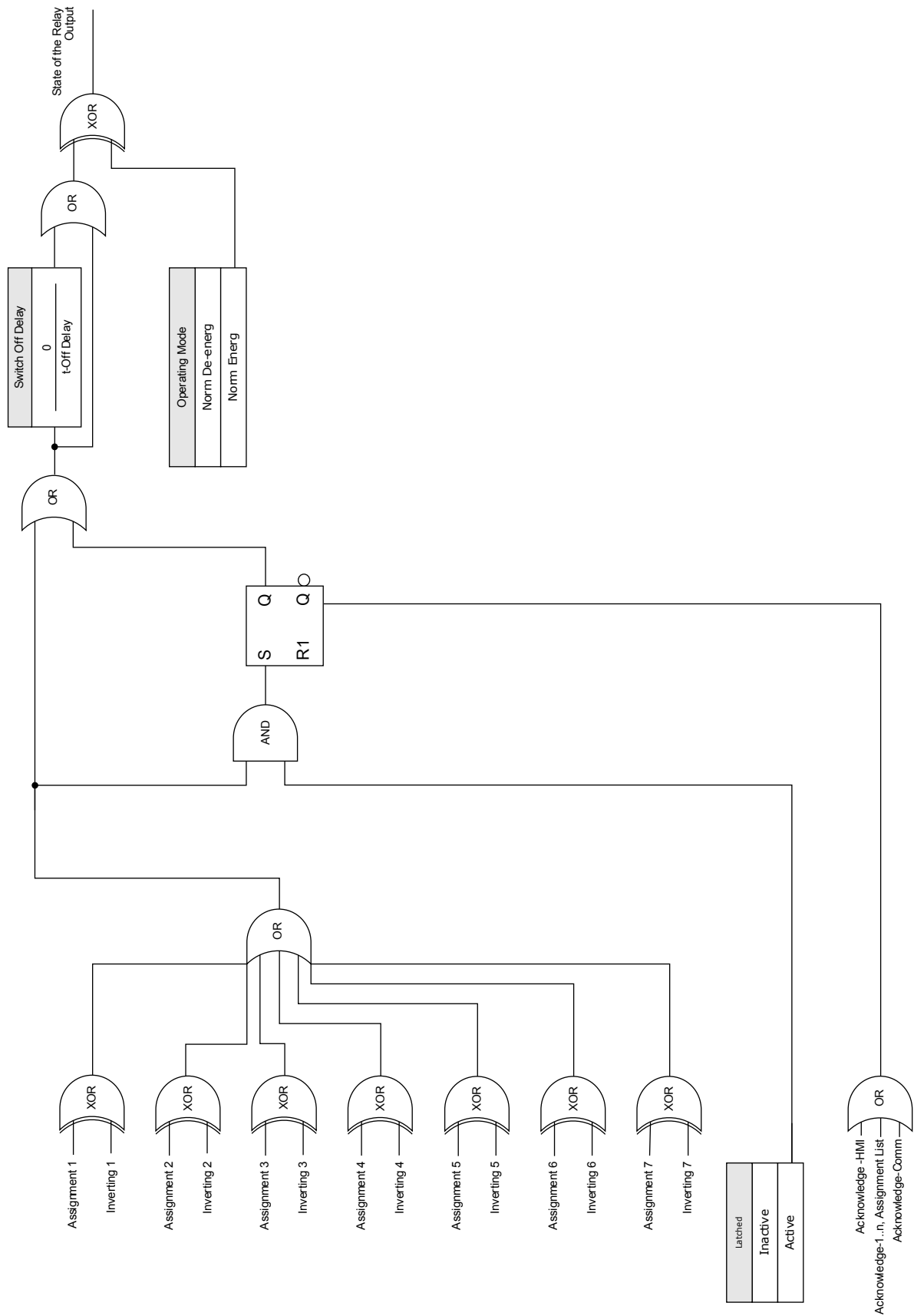
If the latching function is *»inactive«*, the relay output and, respectively, the relay output contact will adopt the state of those pickups that were assigned.

- »Latched = active«*:

If the latching function is *»active«*, the state of the relay output and, respectively, the relay output contact that was set by the pickups will be stored (they have a memory that needs to be reset).

The relay output contact can only be acknowledged after reset of those signals that had initiated the setting of the relay and after expiration of the *»t-OFF delay«*.

- At signal changes, the minimal latching time (*»t-OFF delay«*) ensures that the relay will be maintained as picked-up or released for at least this period.



CAUTION

If the relay output contacts are configured as »Latched=*active*«, they will keep their position even if there is a power outage within the power supply of the protective device.

If the relay output contacts are configured as »Latched=*active*«, they will also retain their position even if they are reprogrammed in another way. This also applies if the relay output contacts are set to »Latched is set to *inactive*«. Resetting a relay output contact that has latched a signal will always require an acknowledgement.

NOTICE

The »*System OK Relay*« (watchdog) cannot be configured.

Acknowledgment Options

Relay output contacts can be acknowledged:

- Via the push-button »Ack/Rst« at the operating panel;
- If »*Latched is active*«, each relay output contact can be acknowledged by a signal (for example: It could be reset by the state of a digital input);
- Via the module »Ex Acknowledge« where all relay output contacts can be acknowledged at once if the signal for external acknowledgment that was selected from the »Assignment list« becomes true (e.g.: the state of a digital input); and
- Via Communication (Comm), all relay output contacts can be acknowledged at once.

⚠ WARNING

Relay output contacts can be set by force or disarmed (for commissioning support, please refer to the "Service/Disarming the Relay Output Contacts" and "Service/Forcing the Relay Output Contacts" sections).

RO-4ZI X Settings

RO-4Z X2

Direct Commands of RO-4ZI X

Parameter	Description	Setting range	Default	Menu path
 DISARMED	This is the second step, after the "DISARMED Ctrl" has been activated, that is required to DISARM the relay outputs. This will DISARM those relay outputs that are currently not latched and that are not timing out. CAUTION! RELAYS DISARMED in order to safely perform maintenance while eliminating the risk of taking an entire process off-line. (Note: Zone Interlocking and Supervision Contact cannot be disarmed). YOU MUST ENSURE that the relays are ARMED AGAIN after maintenance. Only available if: DISARMED Ctrl = Active	Inactive, Active	Inactive	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /DISARMED /RO-4Z X2]
 Force all Outs	By means of this function the normal Relay Output State can be overwritten (forced). The relay can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state. Forcing all relay outputs of an entire assembly group has precedence to forcing a single relay output.	Normal, De-Energized, Energized	Normal	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4Z X2]
 Force ZI RO	Signal: Forced Zone Interlocking OUT	Normal, De-Energized, Energized	Normal	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4Z X2]
 Force RO1	By means of this function the normal Relay Output State can be overwritten (forced). The relay can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state.	Normal, De-Energized, Energized	Normal	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4Z X2]

Parameter	Description	Setting range	Default	Menu path
Force RO2 	By means of this function the normal Relay Output State can be overwritten (forced). The relay can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state.	Normal, De-Energized, Energized	Normal	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4Z X2]
Force RO3 	By means of this function the normal Relay Output State can be overwritten (forced). The relay can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state.	Normal, De-Energized, Energized	Normal	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4Z X2]
Force RO4 	By means of this function the normal Relay Output State can be overwritten (forced). The relay can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state.	Normal, De-Energized, Energized	Normal	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4Z X2]

Global Protection Parameters of RO-4ZI X

Parameter	Description	Setting range	Default	Menu path
 Operating Mode	Operating Mode	Norm De-energ, Norm Energy	Norm De-energ	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
 t-Off Delay	Switch Off Delay	0.00 - 300.00s	0.2s	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
 Latched	Defines whether the Relay Output will be latched when it picks up.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
 Acknowledgment	Acknowledgment Signal - An acknowledgment signal (that acknowledges the corresponding Relay Output) can be assigned to each Relay Output. The acknowledgement-signal is only effective if the parameter "Latched" is set to active. Only available if: Latched = Active	1..n, Assignment List	-.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
 Assignment 1	Assignment	1..n, Assignment List	Bkr.TripCmd	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
 Inverting 1	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
 Assignment 2	Assignment	1..n, Assignment List	-.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
 Inverting 2	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]

Parameter	Description	Setting range	Default	Menu path
Assignment 3 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
Assignment 4 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
Assignment 5 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
Assignment 6 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
Inverting 6 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
Assignment 7 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]

Parameter	Description	Setting range	Default	Menu path
Inverting 7 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
Operating Mode 	Operating Mode	Norm De-energ, Norm Energ	Norm De-energ	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
t-Off Delay 	Switch Off Delay	0.00 - 300.00s	0.2s	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Latched 	Defines whether the Relay Output will be latched when it picks up.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Acknowledgment 	Acknowledgment Signal - An acknowledgment signal (that acknowledges the corresponding Relay Output) can be assigned to each Relay Output. The acknowledgement-signal is only effective if the parameter "Latched" is set to active. Only available if: Latched = Active	1..n, Assignment List	-.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Assignment 1 	Assignment	1..n, Assignment List	Prot.Pickup	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Assignment 2 	Assignment	1..n, Assignment List	-.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]

Parameter	Description	Setting range	Default	Menu path
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Assignment 3 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Assignment 4 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Assignment 5 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Assignment 6 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Inverting 6 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]

Parameter	Description	Setting range	Default	Menu path
Assignment 7 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Inverting 7 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Operating Mode 	Operating Mode	Norm De-energ, Norm Energ	Norm De-energ	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
t-Off Delay 	Switch Off Delay	0.00 - 300.00s	0.2s	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Latched 	Defines whether the Relay Output will be latched when it picks up.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Acknowledgment 	Acknowledgment Signal - An acknowledgment signal (that acknowledges the corresponding Relay Output) can be assigned to each Relay Output. The acknowledgement-signal is only effective if the parameter "Latched" is set to active. Only available if: Latched = Active	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Assignment 1 	Assignment	1..n, Assignment List	BF.Trip	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]

Parameter	Description	Setting range	Default	Menu path
Assignment 2 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Assignment 3 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Assignment 4 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Assignment 5 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Assignment 6 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]

Parameter	Description	Setting range	Default	Menu path
Inverting 6 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Assignment 7 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Inverting 7 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Operating Mode 	Operating Mode	Norm De-energ, Norm Energ	Norm De-energ	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
t-Off Delay 	Switch Off Delay	0.00 - 300.00s	0.2s	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Latched 	Defines whether the Relay Output will be latched when it picks up.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Acknowledgment 	Acknowledgment Signal - An acknowledgment signal (that acknowledges the corresponding Relay Output) can be assigned to each Relay Output. The acknowledgement-signal is only effective if the parameter "Latched" is set to active. Only available if: Latched = Active	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Assignment 1 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]

Parameter	Description	Setting range	Default	Menu path
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Assignment 2 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Assignment 3 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Assignment 4 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Assignment 5 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]

Parameter	Description	Setting range	Default	Menu path
Assignment 6 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Inverting 6 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Assignment 7 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Inverting 7 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
DISARMED Ctrl 	Enables and disables the disarming of the relay outputs. This is the first step of a two step process, to inhibit the operation or the relay outputs. Please refer to "DISARMED" for the second step.	Inactive, Active	Inactive	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /DISARMED /RO-4Z X2]
Disarm Mode 	CAUTION! RELAYS DISARMED in order to safely perform maintenance while eliminating the risk of taking an entire process off-line. (Note: Zone Interlocking and Supervision Contact cannot be disarmed). YOU MUST ENSURE that the relays are ARMED AGAIN after maintenance.	Permanent, Timeout	Permanent	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /DISARMED /RO-4Z X2]
t-Timeout DISARM 	The relays will be armed again after expiring of this time. Only available if: Mode = Timeout DISARM	0.00 - 300.00s	0.03s	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /DISARMED /RO-4Z X2]

Parameter	Description	Setting range	Default	Menu path
Force Mode 	By means of this function the normal Relay Output States can be overwritten (forced) in case that the Relay Output is not in a disarmed state. The relays can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state.	Permanent, Timeout	Permanent	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4Z X2]
t-Timeout Force 	The Output State will be set by force for the duration of this time. That means, for the duration of this time, the Relay Output does not show the state of the signals that are assigned on it. Only available if: Mode = Timeout DISARM	0.00 - 300.00s	0.03s	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4Z X2]

Input States of RO-4ZI X

Name	Description	Assignment via
RO1.1	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
RO1.2	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
RO1.3	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
RO1.4	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
RO1.5	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
RO1.6	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
RO1.7	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]
Ack signal RO 1	Module Input State: Acknowledgment signal for the Relay Output. If latching is set to active, the Relay Output can only be acknowledged if those signals that initiated the setting are fallen back and the hold time is expired.	[Device Para /Relay Outputs /RO-4Z X2 /RO 1]

Name	Description	Assignment via
RO2.1	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
RO2.2	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
RO2.3	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
RO2.4	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
RO2.5	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
RO2.6	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
RO2.7	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
Ack signal RO 2	Module Input State: Acknowledgment signal for the Relay Output. If latching is set to active, the Relay Output can only be acknowledged if those signals that initiated the setting are fallen back and the hold time is expired.	[Device Para /Relay Outputs /RO-4Z X2 /RO 2]
RO3.1	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]

Name	Description	Assignment via
RO3.2	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
RO3.3	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
RO3.4	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
RO3.5	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
RO3.6	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
RO3.7	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
Ack signal RO 3	Module Input State: Acknowledgment signal for the Relay Output. If latching is set to active, the Relay Output can only be acknowledged if those signals that initiated the setting are fallen back and the hold time is expired.	[Device Para /Relay Outputs /RO-4Z X2 /RO 3]
RO4.1	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
RO4.2	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]

Name	Description	Assignment via
RO4.3	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
RO4.4	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
RO4.5	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
RO4.6	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
RO4.7	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]
Ack signal RO 4	Module Input State: Acknowledgment signal for the Relay Output. If latching is set to active, the Relay Output can only be acknowledged if those signals that initiated the setting are fallen back and the hold time is expired.	[Device Para /Relay Outputs /RO-4Z X2 /RO 4]

Signals of RO-4ZI X

<i>Signal</i>	<i>Description</i>
ZI OUT	Signal: Zone Interlocking OUT
RO 1	Signal: Relay Output
RO 2	Signal: Relay Output
RO 3	Signal: Relay Output
RO 4	Signal: Relay Output
DISARMED!	Signal: CAUTION! RELAYS DISARMED in order to safely perform maintenance while eliminating the risk of taking an entire process off-line. (Note: Zone Interlocking and Supervision Contact cannot be disarmed). YOU MUST ENSURE that the relays are ARMED AGAIN after maintenance
Outs forced	Signal: The State of at least one Relay Output has been set by force. That means that the state of at least one Relay is forced and hence does not show the state of the assigned signals.

RO-4 X Settings

RO-4 X5

Direct Commands of RO-4 X

Parameter	Description	Setting range	Default	Menu path
 DISARMED	This is the second step, after the "DISARMED Ctrl" has been activated, that is required to DISARM the relay outputs. This will DISARM those relay outputs that are currently not latched and that are not timing out. CAUTION! RELAYS DISARMED in order to safely perform maintenance while eliminating the risk of taking an entire process off-line. (Note: Zone Interlocking and Supervision Contact cannot be disarmed). YOU MUST ENSURE that the relays are ARMED AGAIN after maintenance. Only available if: DISARMED Ctrl = Active	Inactive, Active	Inactive	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /DISARMED /RO-4 X5]
 Force all Outs	By means of this function the normal Relay Output State can be overwritten (forced). The relay can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state. Forcing all relay outputs of an entire assembly group has precedence to forcing a single relay output.	Normal, De-Energized, Energized	Normal	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4 X5]
 Force RO1	By means of this function the normal Relay Output State can be overwritten (forced). The relay can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state.	Normal, De-Energized, Energized	Normal	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4 X5]
 Force RO2	By means of this function the normal Relay Output State can be overwritten (forced). The relay can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state.	Normal, De-Energized, Energized	Normal	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4 X5]
 Force RO3	By means of this function the normal Relay Output State can be overwritten (forced). The relay can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state.	Normal, De-Energized, Energized	Normal	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4 X5]

Parameter	Description	Setting range	Default	Menu path
Force RO4 	By means of this function the normal Relay Output State can be overwritten (forced). The relay can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state.	Normal, De-Energized, Energized	Normal	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4 X5]

Device Parameters of RO-4 X

Parameter	Description	Setting range	Default	Menu path
 Operating Mode	Operating Mode	Norm De-energ, Norm Energ	Norm De-energ	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
 t-Off Delay	Switch Off Delay	0.00 - 300.00s	0.2s	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
 Latched	Defines whether the Relay Output will be latched when it picks up.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
 Acknowledgment	Acknowledgment Signal - An acknowledgment signal (that acknowledges the corresponding Relay Output) can be assigned to each Relay Output. The acknowledgement-signal is only effective if the parameter "Latched" is set to active. Only available if: Latched = Active	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
 Assignment 1	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
 Inverting 1	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
 Assignment 2	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
 Inverting 2	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 1]

Parameter	Description	Setting range	Default	Menu path
Assignment 3 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
Assignment 4 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
Assignment 5 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
Assignment 6 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
Inverting 6 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
Assignment 7 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 1]

Parameter	Description	Setting range	Default	Menu path
Inverting 7 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
Operating Mode 	Operating Mode	Norm De-energy, Norm Energy	Norm De-energy	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
t-Off Delay 	Switch Off Delay	0.00 - 300.00s	0.2s	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Latched 	Defines whether the Relay Output will be latched when it picks up.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Acknowledgment 	Acknowledgment Signal - An acknowledgment signal (that acknowledges the corresponding Relay Output) can be assigned to each Relay Output. The acknowledgement-signal is only effective if the parameter "Latched" is set to active. Only available if: Latched = Active	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Assignment 1 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Assignment 2 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 2]

Parameter	Description	Setting range	Default	Menu path
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Assignment 3 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Assignment 4 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Assignment 5 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Assignment 6 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Inverting 6 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 2]

Parameter	Description	Setting range	Default	Menu path
Assignment 7 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Inverting 7 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Operating Mode 	Operating Mode	Norm De-energ, Norm Energ	Norm De-energ	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
t-Off Delay 	Switch Off Delay	0.00 - 300.00s	0.2s	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Latched 	Defines whether the Relay Output will be latched when it picks up.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Acknowledgment 	Acknowledgment Signal - An acknowledgment signal (that acknowledges the corresponding Relay Output) can be assigned to each Relay Output. The acknowledgement-signal is only effective if the parameter "Latched" is set to active. Only available if: Latched = Active	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Assignment 1 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 3]

Parameter	Description	Setting range	Default	Menu path
Assignment 2 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Assignment 3 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Assignment 4 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Assignment 5 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Assignment 6 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 3]

Parameter	Description	Setting range	Default	Menu path
Inverting 6 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Assignment 7 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Inverting 7 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Operating Mode 	Operating Mode	Norm De-energ, Norm Energ	Norm De-energ	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
t-Off Delay 	Switch Off Delay	0.00 - 300.00s	0.2s	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Latched 	Defines whether the Relay Output will be latched when it picks up.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Acknowledgment 	Acknowledgment Signal - An acknowledgment signal (that acknowledges the corresponding Relay Output) can be assigned to each Relay Output. The acknowledgement-signal is only effective if the parameter "Latched" is set to active. Only available if: Latched = Active	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Assignment 1 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 4]

Parameter	Description	Setting range	Default	Menu path
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Assignment 2 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Assignment 3 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Assignment 4 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Assignment 5 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 4]

Parameter	Description	Setting range	Default	Menu path
Assignment 6 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Inverting 6 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Assignment 7 	Assignment	1..n, Assignment List	.-	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Inverting 7 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
DISARMED Ctrl 	Enables and disables the disarming of the relay outputs. This is the first step of a two step process, to inhibit the operation or the relay outputs. Please refer to "DISARMED" for the second step.	Inactive, Active	Inactive	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /DISARMED /RO-4 X5]
Disarm Mode 	CAUTION! RELAYS DISARMED in order to safely perform maintenance while eliminating the risk of taking an entire process off-line. (Note: Zone Interlocking and Supervision Contact cannot be disarmed). YOU MUST ENSURE that the relays are ARMED AGAIN after maintenance.	Permanent, Timeout	Permanent	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /DISARMED /RO-4 X5]
t-Timeout DISARM 	The relays will be armed again after expiring of this time. Only available if: Mode = Timeout DISARM	0.00 - 300.00s	0.03s	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /DISARMED /RO-4 X5]

Parameter	Description	Setting range	Default	Menu path
Force Mode 	By means of this function the normal Relay Output States can be overwritten (forced) in case that the Relay Output is not in a disarmed state. The relays can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state.	Permanent, Timeout	Permanent	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4 X5]
t-Timeout Force 	The Output State will be set by force for the duration of this time. That means, for the duration of this time, the Relay Output does not show the state of the signals that are assigned on it. Only available if: Mode = Timeout DISARM	0.00 - 300.00s	0.03s	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Force RO /RO-4 X5]

Input States of RO-4 X

Name	Description	Assignment via
RO1.1	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
RO1.2	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
RO1.3	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
RO1.4	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
RO1.5	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
RO1.6	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
RO1.7	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 1]
Ack signal RO 1	Module Input State: Acknowledgment signal for the Relay Output. If latching is set to active, the Relay Output can only be acknowledged if those signals that initiated the setting are fallen back and the hold time is expired.	[Device Para /Relay Outputs /RO-4 X5 /RO 1]

Name	Description	Assignment via
RO2.1	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
RO2.2	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
RO2.3	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
RO2.4	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
RO2.5	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
RO2.6	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
RO2.7	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
Ack signal RO 2	Module Input State: Acknowledgment signal for the Relay Output. If latching is set to active, the Relay Output can only be acknowledged if those signals that initiated the setting are fallen back and the hold time is expired.	[Device Para /Relay Outputs /RO-4 X5 /RO 2]
RO3.1	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 3]

Name	Description	Assignment via
RO3.2	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
RO3.3	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
RO3.4	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
RO3.5	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
RO3.6	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
RO3.7	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
Ack signal RO 3	Module Input State: Acknowledgment signal for the Relay Output. If latching is set to active, the Relay Output can only be acknowledged if those signals that initiated the setting are fallen back and the hold time is expired.	[Device Para /Relay Outputs /RO-4 X5 /RO 3]
RO4.1	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
RO4.2	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 4]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
RO4.3	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
RO4.4	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
RO4.5	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
RO4.6	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
RO4.7	Module Input State: Assignment	[Device Para /Relay Outputs /RO-4 X5 /RO 4]
Ack signal RO 4	Module Input State: Acknowledgment signal for the Relay Output. If latching is set to active, the Relay Output can only be acknowledged if those signals that initiated the setting are fallen back and the hold time is expired.	[Device Para /Relay Outputs /RO-4 X5 /RO 4]

Signals of RO-4 X

<i>Signal</i>	<i>Description</i>
RO 1	Signal: Relay Output
RO 2	Signal: Relay Output
RO 3	Signal: Relay Output
RO 4	Signal: Relay Output
DISARMED!	Signal: CAUTION! RELAYS DISARMED in order to safely perform maintenance while eliminating the risk of taking an entire process off-line. (Note: Zone Interlocking and Supervision Contact cannot be disarmed). YOU MUST ENSURE that the relays are ARMED AGAIN after maintenance
Outs forced	Signal: The State of at least one Relay Output has been set by force. That means that the state of at least one Relay is forced and hence does not show the state of the assigned signals.

Analog Outputs

Available Elements:

AnOut[1] ,AnOut[2]

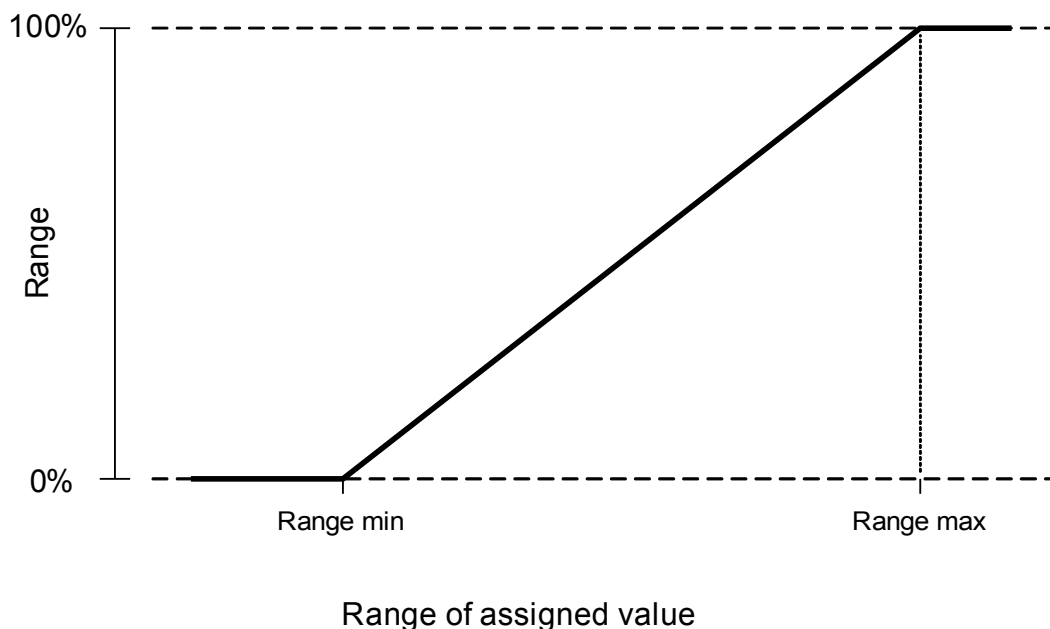
The E-Series relays can be programmed to output for three different ranges of either 0- 20mA, 4- 20 mA, or 0-10 Volts.

These outputs can be configured by the User to represent the status of User programmed parameters that are available from the relay. The User will find the configuration menu for this feature under the [Device Para/ Analog Outputs] menu option. Here the User can define to which parameter the output will correlate. As with any parameter, a password is required to configure this feature.

To program this feature, the User will select the Analog Outputs option under the main menu item “Device PARA”. Then select the wrench icon which will allow the assignment of the output to a parameter monitored by the relay.

■ The available signals, that can be assigned onto the analog outputs are shown in the “List of Analog Outputs”.

Once the assignment has been made, the User can select the expected range of the parameter that will correlate to the analog output. The User will be required to enter a “Range min”, and “Range max”. The “Range min” will determine the value at which e.g. 4 mA will be transmitted by the relay. Likewise, the “Range max” value will determine the value that will result in the transmission of a 20 mA output. The same applies when the output is configured to 0- 10 Volts.



Setting Example: Analog Output with Active Power P*

*=only available in Devices that offer Power Protection

All settings/thresholds within the power module are to be set as per unit thresholds. Per definition S_n is to be used as scale basis.

$$S_n = \sqrt{3} * \text{VoltageTransformer}_{\text{Line-to-Line\_Rated\_Voltage}} * \text{CurrentTransformer}_{\text{Rated\_Current}}$$

If thresholds should base on primary side values:

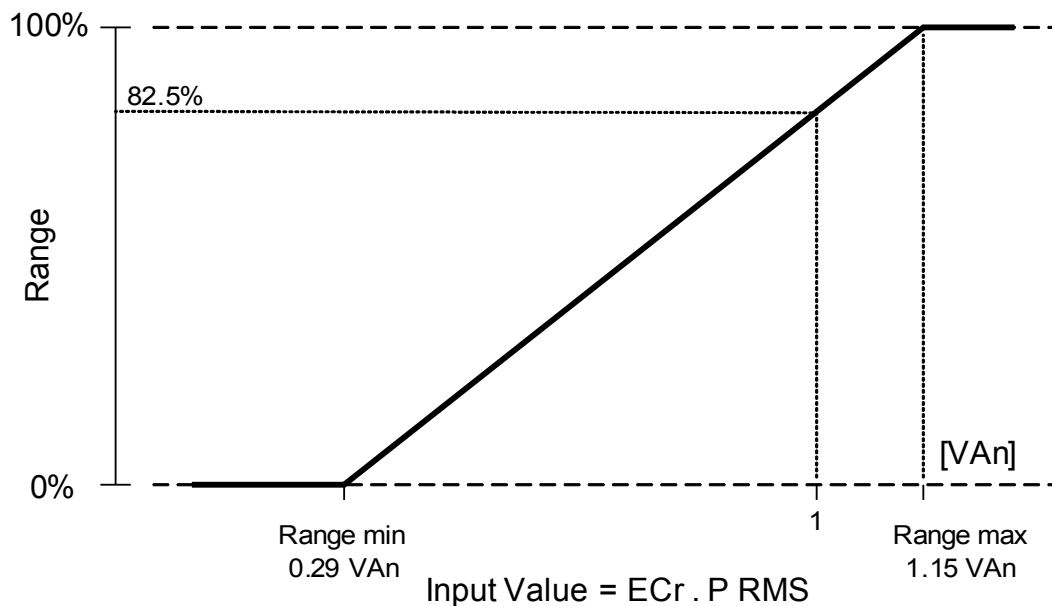
$$S_n = \sqrt{3} * \text{VoltageTransformer}_{\text{Pri\_Line-to-Line\_Rated\_Voltage}} * \text{CurrentTransformer}_{\text{Pri\_Rated\_Current}}$$

If thresholds should base on secondary side values

$$S_n = \sqrt{3} * \text{VoltageTransformer}_{\text{Sec\_Line-to-Line\_Rated\_Voltage}} * \text{CurrentTransformer}_{\text{Sec\_Rated\_Current}}$$

Example – Field Data

- CurrentTransformer CT pri =200 A; CT sec = 5 A
- VoltageTransformer VT pri = 10 kV; VT sec =100 V
- Active power range 1 MW to 4 MW is mapped to an Analog Outputs 0% to 100%.



Calculating setting for Range min and Range max based on primary side values

Active power range is 1 MW to 4 MW.

First S_n is to be calculated:

$$S_n = \sqrt{3} * \text{VoltageTransformer}_{\text{Pri\_Line-to-Line\_Rated\_Voltage}} * \text{CurrentTransformer}_{\text{Pri\_Rated\_Current}}$$

$$S_n = 1.73 * 10000 \text{ V} * 200 \text{ A} = 3.464 \text{ MVA}$$

Calculating the range settings based to S_n :

$$\text{Range min (0\%)} = 1 \text{ MW} / 3.464 \text{ MVA} = 0.29 S_n$$

$$\text{Range max (100\%)} = 4 \text{ MW} / 3.464 \text{ MVA} = 1.15 S_n$$

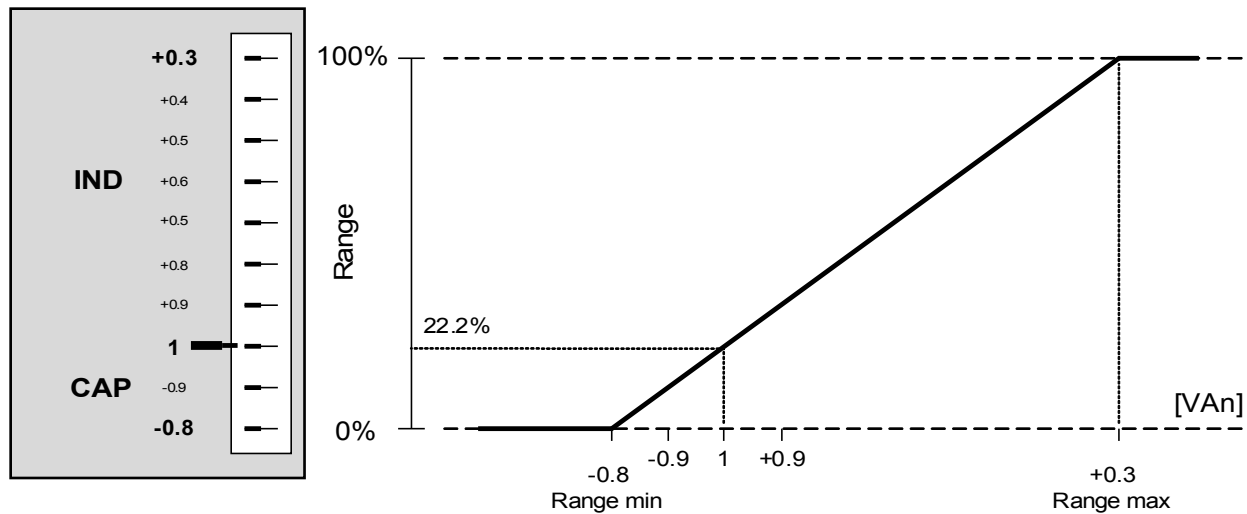
Calculate the Analog Output percentage for specific value:

$$\text{AnalogOutput (InputValue)} = 100\% / (\text{Range max} - \text{Range min}) * (\text{InputValue} - \text{Range min})$$

For e.g. Input value $1 S_n$:

$$\text{AnalogOutput}(1 S_n) = 100\% / 0.86 S_n * (1 S_n - 0.29 S_n) = 82.5\%$$

The Output current for e.g. 4...20mA type is then 17.7 mA = 4mA + 82.5% * (20mA – 4mA)



$$\text{Input Value} = E_{Cr} \cdot \cos \phi (\pm)$$

Setting Example: Analog Output with Power Factor PF*

*=only available in Devices that offer Power Protection

Since the sign of Power Factor PF follows the sign of Active Power P, there is no distinguish between capacitive and inductive Reactive Power. Hence, for Analog Output assignment the setting for PF output range uses a Power Factor with a "Sign Convention":

- a positive sign (+) PF, if Active and Reactive Power has same sign
- a negative sign (-) PF, if Active and Reactive Power has different sign

For e.g. if Active Power is flowing into the load and Current lags the voltage for a inductive load, PF with sign convention uses a positive sign. This is important to set the right range settings for Analog Output.

Use case for analog instrument with 4...20mA with linear scale, where scale is in range from 0.8 capacitive to 0.3 inductive, following setting should be uses:

$$\begin{aligned}\text{Range min (0\%)} &= \underline{-0.8} \\ \text{Range max (100\%)} &= \underline{+0.3}\end{aligned}$$

Calculate the Analog Output percentage for specific value for e.g. unity: $|PF|=1$ at $\phi = 0^\circ$:

First the signed PF needs to be converted into a linear range:

$$\begin{aligned}\text{Range min' (0\%)} &= -1 - (-0.8) = \underline{-0.2} \\ \text{Range max' (100\%)} &= +1 - (+0.3) = \underline{+0.7} \\ \text{InputValue'} &= +1 - (+1) = \underline{0.0}\end{aligned}$$

$$\text{AnalogOutput (InputValue')} = 100\% / (\text{Range max'} - \text{Range min'}) * (\text{InputValue'} - \text{Range min'})$$

$$\text{AnalogOutput(0)} = 100\% / 0.9 * 0.2 = \underline{22.2\%}$$

The Output current for e.g. 4...20mA type is then $\underline{7.5 \text{ mA}} = 4\text{mA} + 22.2\% * (20\text{mA} - 4\text{mA})$

Global Protection Parameters of the Analog Outputs

Parameter	Description	Setting range	Default	Menu path
Assignment 	Assignment	1...n, AnalogOutputList	-.-	[Device Para /Analog Outputs /AnOut[1]]
Range 	Adjustable range	0...20mA, 4...20mA, 0...10V	0...20mA	[Device Para /Analog Outputs /AnOut[1]]
Range max 	Adjustable range maximum.	-999999.00 - 999999.00°C	1.00°C	[Device Para /Analog Outputs /AnOut[1]]
Range min 	Adjustable range minimum.	-999999.00 - 999999.00°C	0.00°C	[Device Para /Analog Outputs /AnOut[1]]
Force Mode 	For commissioning purposes or for maintenance, Analog Outputs can be set by force. By means of this function the normal Analog Outputs can be overwritten (forced).	Permanent, Timeout	Permanent	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Analog Outputs /AnOut[1]]
t-Timeout Force 	The Analog Output Value will be set by force for the duration of this time. That means for the duration of this time the Analog Output does not show the value of the signals that are assigned on it. Only available if: Force Mode = Active	0.00 - 300.00s	0.03s	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Analog Outputs /AnOut[1]]

Direct Commands of the Analog Outputs

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Analog Outputs /AnOut[1]]
Force Value 	By means of this function the Analog Output Value can be overwritten (forced).	0.00 - 100.00%	0%	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Analog Outputs /AnOut[1]]

Signals of the Analog Outputs

Signal	Description
Force Mode	For commissioning purposes or for maintenance, Analog Outputs can be set by force. By means of this function the normal Analog Outputs can be overwritten (forced).

List of the Analog Outputs

Name	Description
-.-	No assignment
VT.f	Measured Value: Frequency
VT.VAB RMS	Measured value: Phase-to-phase voltage (RMS)
VT.VBC RMS	Measured value: Phase-to-phase voltage (RMS)
VT.VCA RMS	Measured value: Phase-to-phase voltage (RMS)
VT.VA RMS	Measured value: Phase-to-neutral voltage (RMS)
VT.VB RMS	Measured value: Phase-to-neutral voltage (RMS)
VT.VC RMS	Measured value: Phase-to-neutral voltage (RMS)
VT.VX meas RMS	Measured value (measured): VX measured (RMS)
VT.VR calc RMS	Measured value (calculated): VR (RMS)
VT.VAB THD	Measured value (calculated): VAB Total Harmonic Distortion
VT.VBC THD	Measured value (calculated): VBC Total Harmonic Distortion
VT.VCA THD	Measured value (calculated): VCA Total Harmonic Distortion
VT.VA THD	Measured value (calculated): VA Total Harmonic Distortion
VT.VB THD	Measured value (calculated): VB Total Harmonic Distortion
VT.VC THD	Measured value (calculated): VC Total Harmonic Distortion
CT Ntrl.IA RMS	Measured value: Phase current (RMS)
CT Ntrl.IB RMS	Measured value: Phase current (RMS)
CT Ntrl.IC RMS	Measured value: Phase current (RMS)
CT Ntrl.IX meas RMS	Measured value (measured): IX (RMS)
CT Ntrl.IR calc RMS	Measured value (calculated): IR (RMS)
CT Ntrl.IA THD	Measured Value (Calculated): IA Total Harmonic Current
CT Ntrl.IB THD	Measured Value (Calculated): IB Total Harmonic Current
CT Ntrl.IC THD	Measured Value (Calculated): IC Total Harmonic Current
49.Thermal Cap Used	Measured value: Thermal Capacity Used
Sync-check.Slip Freq	Slip frequency
Sync-check.Volt Diff	Voltage difference
Sync-check.Angle Diff	Angle difference
Sync-check.f Bus	Bus frequency
Sync-check.f Line	Line frequency
Sync-check.V Bus	Bus Voltage
Sync-check.V Line	Line Voltage
Sync-check.Angle Bus	Bus Angle (Reference)
Sync-check.Angle Line	Line Angle
URTD.WD1	Winding 1
URTD.WD2	Winding 2

Name	Description
URTD.WD3	Winding 3
URTD.WD4	Winding 4
URTD.WD5	Winding 5
URTD.WD6	Winding 6
URTD.MB1	Motor Bearing 1
URTD.MB2	Motor Bearing 2
URTD.LB1	Load Bearing 1
URTD.LB2	Load Bearing 2
URTD.Aux1	Auxiliary1
URTD.Aux2	Auxiliary2
URTD.RTD Max	Maximum temperature of all channels.
RTD.Hottest WD	Hottest motor winding temperature in degrees C.
RTD.Hottest MB	Hottest motor bearing temperature in degrees C. Resettable with "Sys Res OperationsCr" or "All".
ECr.Syst VA RMS	Measured VAs (RMS)
ECr.Syst W RMS	Measured Watts. Active power (P- = Fed Active Power, P+ = Consumpted Active Power) (RMS)
ECr.Syst VAr Fund.	Measured VARs. Reactive power (Q- = Fed Reactive Power, Q+ = Consumpted Reactive Power) (Fundamental)
ECr.Disp PF ($\pm$)	Measured Value (Calculated): 55D - Displacement Power Factor: Sign Convention: (+)PF:I lags V (-)PF:I leads V
ECr.Apt PF ($\pm$)	Measured Value (Calculated): 55A - Apparent Power Factor: Sign Convention: (+)PF:I lags V (-)PF:I leads V
ECr.VAh Net	Net VA Hours
ECr.Wh Net	Net Watt Hours
ECr.Wh Fwd	Positive Active Power is consumed active energy
ECr.Wh Rev	Negative Active Power (Fed Energy)
ECr.VArh Net	Net VAr Hours
ECr.VArh Lag	Positive Reactive Power is consumed Reactive Energy
ECr.VArh Lead	Negative Reactive Power (Fed Energy)

Analog Inputs

These inputs can be configured by the User to represent the status of external analog values that are fed to the relay.

Using Analog Inputs is a two step procedure. The user has to configure the Measuring Elements and the Analog Protection Elements. Each Analog Input (hardware) is represented by one Measuring Element (named AnIn[x]). That means the number of Measuring Elements is equal to the number of analog inputs. The user can set for each Measuring Element the type of input (e.g. 4...20 mA). The Measuring Element will provide, based on this setting, analog values. The values that are provided by the Measuring Elements have to be assigned onto the Analog Protection Elements in order to feed them. Hence one Measuring Element can be assigned on multiple Analog Protection Elements. The number and names of the Analog Protection Elements are depending on the ordered device.

Examples for Analog Input Elements.

- Generator Protection Device (Example): FldC[n] - DC Field Current.
- Motor Protection Device (Example): Spd[n] – Speed.
- Transformer Protection Device (Example) TapV[n] - Tap Voltage.

Each Analog Input Element is available as an Alarm and as a Trip Element.

The Configuration comprises:

Step 1 (please see section “Setting the Measuring Elements”): The first step is to set within the [Device Parameters] the type of input for each available Analog Input (Measuring Element). That means determining, what kind of measuring values will be provided by each analog input (e.g. 4...20 mA).

Step 2 (please see section “Configuring the Analog Protection Elements”): Configuring an Analog Protection Element means: Activating the "Trip and/or Alarm-Element" within the [Device Planning]. After that, the Element has to be configured within the [Protection Parameters].

Step 1 - Setting the Measuring Elements

The User can set the type of input within the [Device Para/ Analog Inputs] menu option.

- 0...20 mA
- 4...20 mA
- 0...10 V

Analog Measuring Elements[1]...[n]

Name = Analog Inputs[1]...[n]

*The number of Analog Inputs that are available, depends on the ordered device (order code).

***The 4...20 mA setting provides a Broken Wire detection.

Name.Broken wire

43 44 45

Analog Input[1]*.Value

Analog Input[1]*.Value

43

Analog Input[2]*.Value

Analog Input[2]*.Value

44

...

Analog Input[n]*.Value

Analog Input[n]*Value

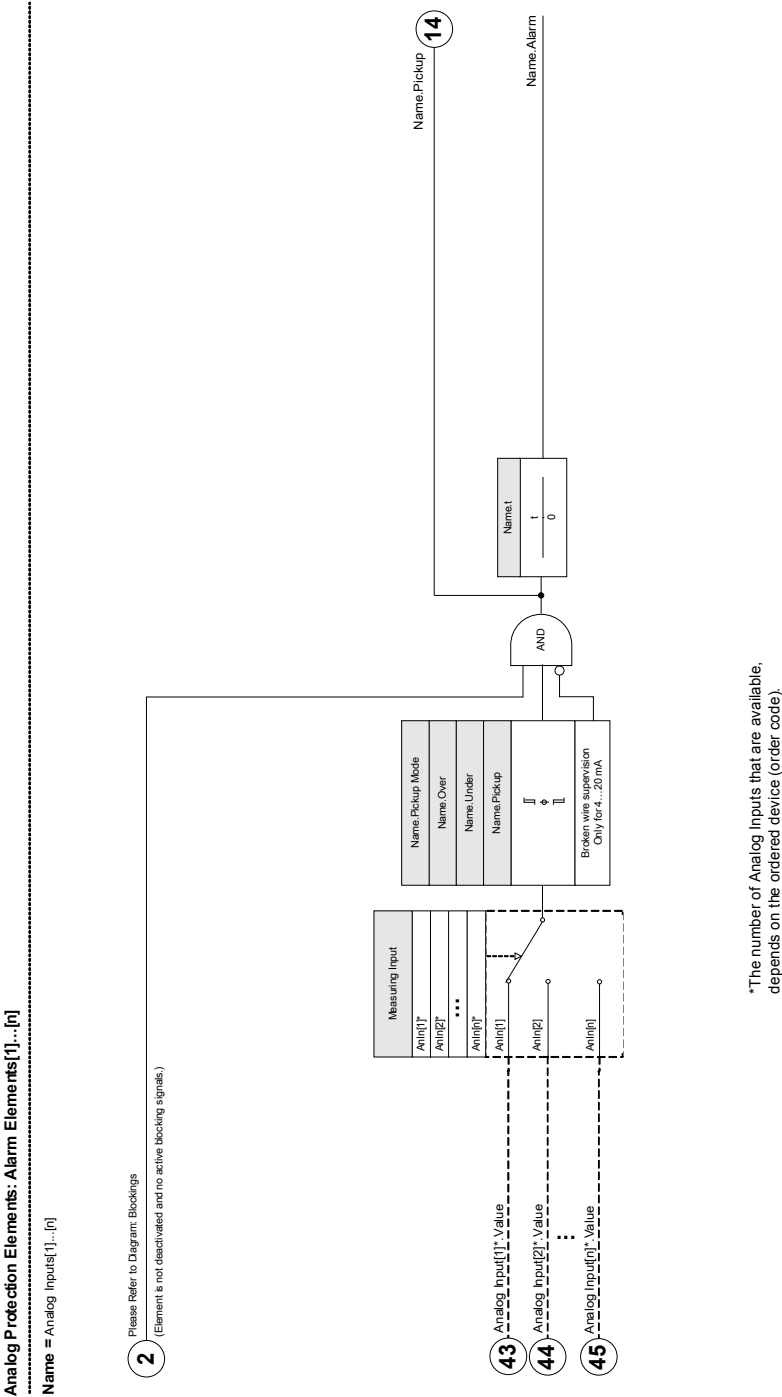
45

Step 2 - Configuring the Analog Protection Elements

Within the Protection Parameters [Protection Para/Global Para/Analog Inputs], the User has to select the Measuring element/Analog Input, that feeds the Analog Protection Element. The user also has to set a threshold and a tripping delay time for the Analog Protection Element. The number and Names of the Analog Input Functions that are available depend on the ordered device.

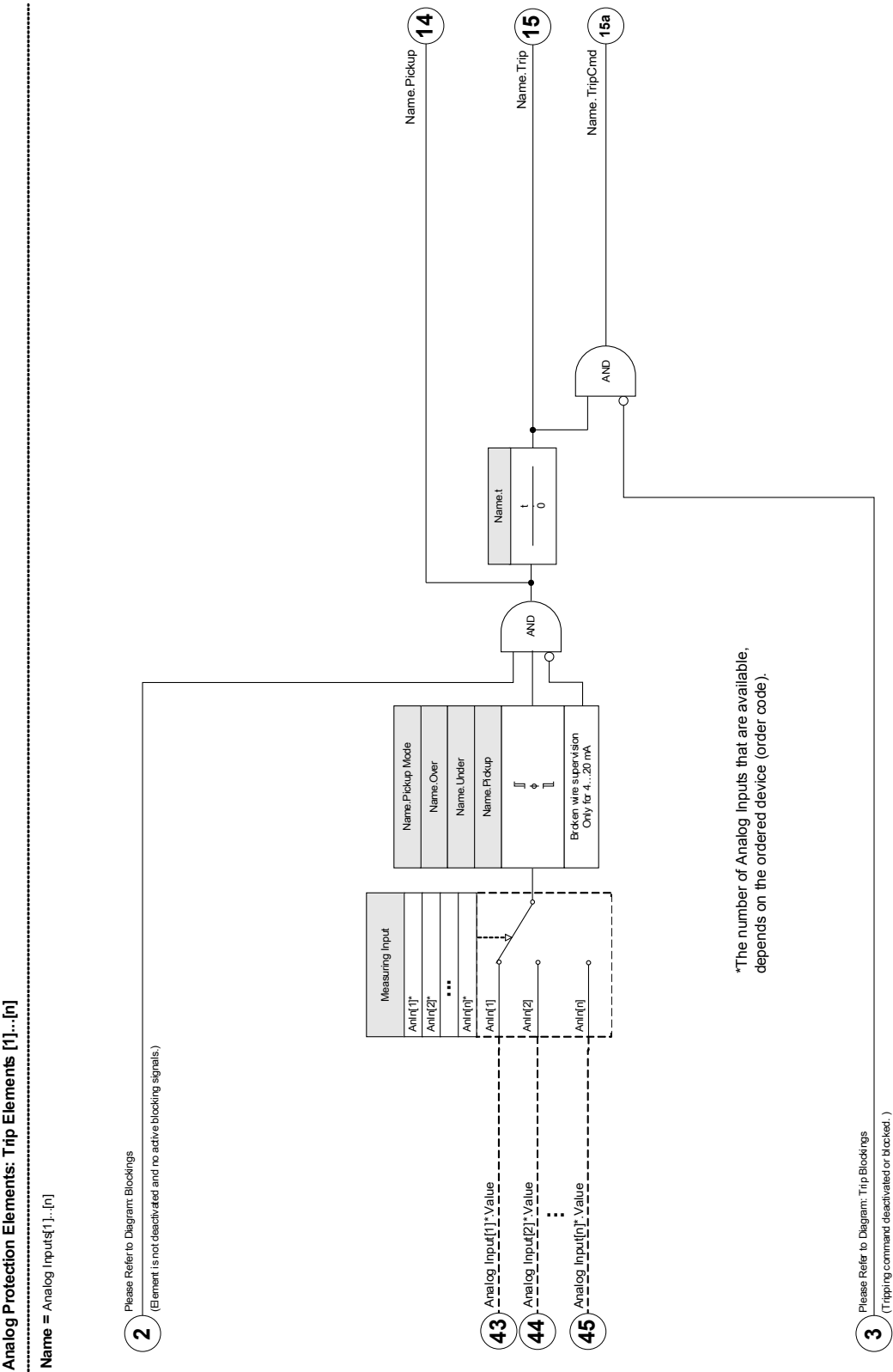
Also the Pickup Mode can be selected between »over« and »under«. The setting »over« means the relay picks up, when the analog measuring value exceeds the set threshold. The setting »under« means the relay picks up, when the analog measuring value falls below the set threshold. When the Input Type 4...20 mA is selected, the relay provides a Broken Wire Supervision. When a wire is broken, a broken wire alarm will be issued and alarm and trip commands of the Analog Protection Elements will be inhibited.

Analog Protection Alarm Elements



*The number of Analog Inputs that are available, depends on the ordered device (order code).

Analog Protection Trip Elements



Measuring Elements

AnIn[1] ,AnIn[2]

Signals (Output States) of the Analog Measuring Elements

Signal	Description
Broken wire	Signal: Broken wire. This signal is only valid, if the analog input is used in the 4..20 mA mode.
Input forced	The value of analog Input has been set by force. That means that the value of the analog Input is forced and does not represent the real measured value.

Direct Commands of the Analog Measuring Elements

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Analog Inputs /AnIn[1]]
Force Value 	By means of this function the Analog Input Value can be overwritten (forced).	0.0 - 100.0%	0%	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Analog Inputs /AnIn[1]]

Global Protection Parameters of the Analog Measuring Elements

Parameter	Description	Setting range	Default	Menu path
Updateinterv 	Adjustable time between value updates	0.00 - 5s	0.04s	[Device Para /Analog Inputs /AnIn[1]]
Mode 	The threshold depends to the mode/ mA or V	0...20 mA, 4...20 mA, 0...10V	0...20 mA	[Device Para /Analog Inputs /AnIn[1]]
Conversion Time 	Conversion time needed by the ADC to sample input values.	0.00 - 0.5s	0.01s	[Device Para /Analog Inputs /AnIn[1]]
Force Mode 	For commissioning purposes or for maintenance. Analog Inputs can be set by force. By means of this function the normal Analog Inputs can be overwritten (forced).	Permanent, Timeout	Permanent	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Analog Inputs /AnIn[1]]
t-Timeout Force 	The Analog Input Value will be set by force for the duration of this time. That means for the duration of this time the Analog Input does not show the value of the signals that are assigned on it. Only available if: Force Mode = Active	0.00 - 300.00s	0.03s	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Analog Inputs /AnIn[1]]

Values of the Analog Measuring Elements

Value	Description	Menu path
Value	Measured value of the Input in percent	[Operation /Measured Values /Analog Inputs]

List of the available Measuring Inputs

Name	Description
-.-	No assignment
AnIn[1].Value	Measured value of the Input in percent
AnIn[2].Value	Measured value of the Input in percent

Analog Alarm Protection Elements

FldC[2] ,Pres[2] ,Tmp[2] ,Vibr[2] ,Fuel[2] ,Spd[2] ,VBat[2] ,Ems[2] ,AnaP[2]

Inputs of the Analog Alarm Elements

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Analog Inputs /FldC[2]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Analog Inputs /FldC[2]]

Signals (Output States) of the Analog Alarm Elements

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Pickup	Signal: Pickup
Alarm	Alarm

Setting Group Parameters of the Analog Alarm Elements

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Analog Inputs /FldC[2]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Analog Inputs /FldC[2]]
Pickup 	Threshold	0.1 - 100.0%	20%	[Protection Para /<1..4> /Analog Inputs /FldC[2]]
t 	Tripping delay	0.00 - 10.00s	1s	[Protection Para /<1..4> /Analog Inputs /FldC[2]]

Device Planning Parameters of the Analog Alarm Elements

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	FldC[2]: Do not use Pres[2]: Do not use Tmp[2]: Do not use Vibr[2]: Do not use Fuel[2]: Do not use Spd[2]: Do not use VBat[2]: Do not use Ems[2]: Do not use AnaP[2]: Use	[Device Planning]

Global Protection Parameters of the Analog Alarm Elements

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	-.-	[Protection Para /Global Prot Para /Analog Inputs /FldC[2]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	-.-	[Protection Para /Global Prot Para /Analog Inputs /FldC[2]]
Measuring Input 	Measuring Input	1..n, AnalogOutputList	-.-	[Protection Para /Global Prot Para /Analog Inputs /FldC[2]]
Pickup Mode 	Pickup Mode	Over, Under	Over	[Protection Para /Global Prot Para /Analog Inputs /FldC[2]]

Analog Trip Protection Elements

FldC[1] .Pres[1] .Tmp[1] .Vibr[1] .Fuel[1] .Spd[1] .VBat[1] .Ems[1] .AnaP[1]

Inputs of the Analog Trip Elements

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Analog Inputs /FldC[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Analog Inputs /FldC[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Analog Inputs /FldC[1]]

Signals (Output States) of the Analog Trip Elements

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup
Trip	Signal: Trip
TripCmd	Signal: Trip Command

Setting Group Parameters of the Analog Trip Elements

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Analog Inputs /FldC[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Analog Inputs /FldC[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Analog Inputs /FldC[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Analog Inputs /FldC[1]]
Pickup 	Threshold	0.1 - 100.0%	20%	[Protection Para /<1..4> /Analog Inputs /FldC[1]]
t 	Tripping delay	0.00 - 10.00s	1s	[Protection Para /<1..4> /Analog Inputs /FldC[1]]

Device Planning Parameters of the Analog Trip Elements

<i>Parameter</i>	<i>Description</i>	<i>Options</i>	<i>Default</i>	<i>Menu path</i>
Mode 	Mode	Do not use, Use	FldC[1]: Do not use Pres[1]: Do not use Tmp[1]: Do not use Vibr[1]: Do not use Fuel[1]: Do not use Spd[1]: Do not use VBat[1]: Do not use Ems[1]: Do not use AnaP[1]: Use	[Device Planning]

Global Protection Parameters of the Analog Trip Elements

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Analog Inputs /FldC[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Analog Inputs /FldC[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Analog Inputs /FldC[1]]
Measuring Input 	Measuring Input	1..n, AnalogOutputList	.-	[Protection Para /Global Prot Para /Analog Inputs /FldC[1]]
Pickup Mode 	Pickup Mode	Over, Under	Over	[Protection Para /Global Prot Para /Analog Inputs /FldC[1]]

LED Configuration

The LEDs can be configured within menu:

[Device Para/LEDs/Group X]

CAUTION

Attention must be paid to ensure that there are no overlapping functions due to double or multiple LED assignment of colors and flashing codes.

CAUTION

If LEDs are configured as »Latched=*active*«, they will keep (return to) their blink code and color even if there is a power outage within the power supply of the protective device.

If the LEDs are configured as »Latched=*active*«, they will also retain their blink code and color even if the LEDs are reprogrammed in another way. This also applies if the LEDs are set to »Latched = *inactive*«. Resetting a LED that has latched a signal will always require an acknowledgement.

NOTICE

This chapter contains information on the LEDs that are placed on the left hand side of the display (Group A).

If your device is also equipped with LEDs on the right hand side of the display (Group B), the analog information in this chapter is valid. The only difference between “Group A” and “Group B” is within the menu paths.

Via the »INFO« push-button, it is always possible to display the current pickups and alarm texts that are assigned to an LED. Please refer to the *Navigation* section for a description of the »INFO« push-button functionality.

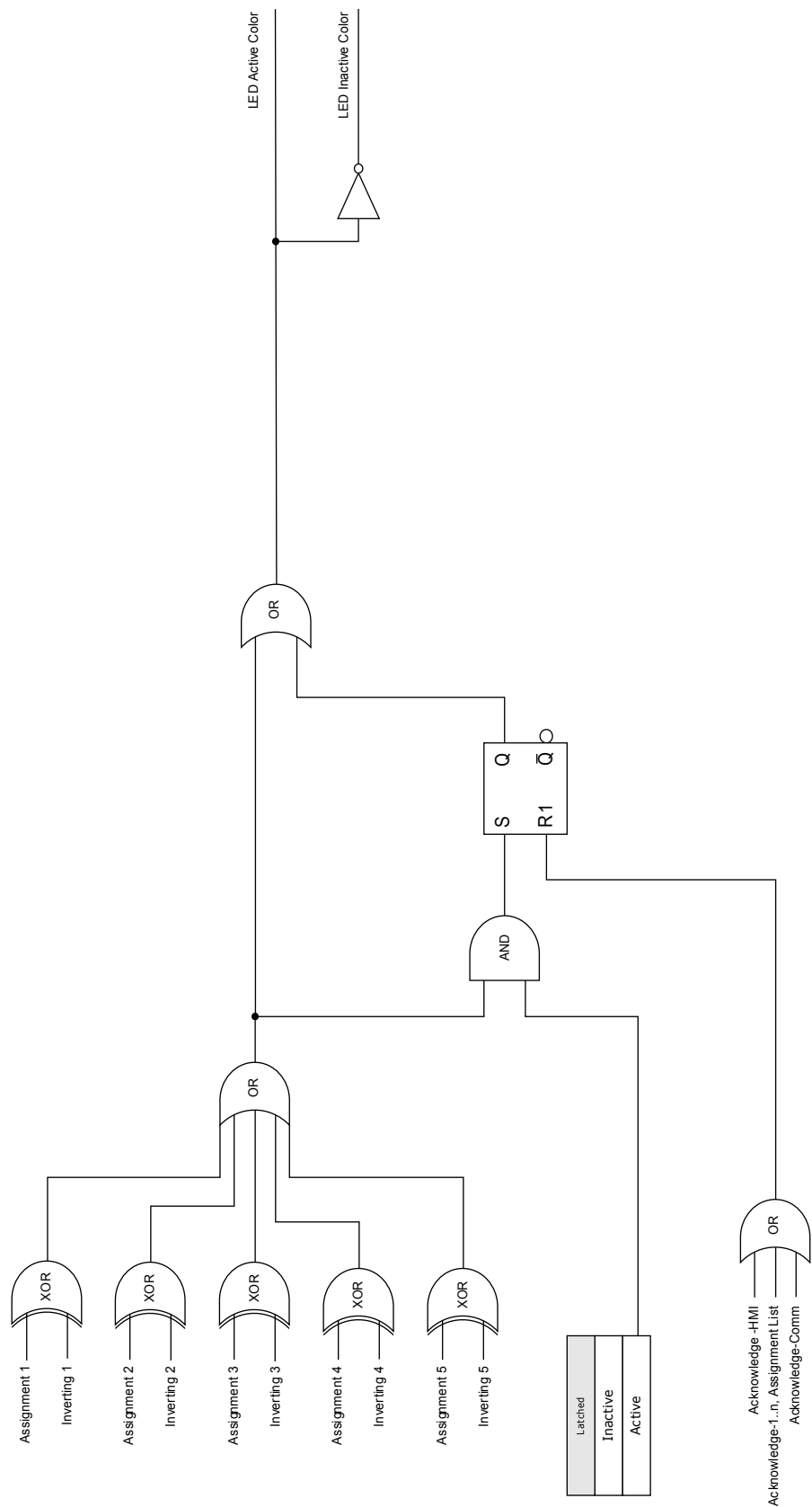
Set the following parameters for each LED.

- »*Latching (self holding function)*«: If »Latching« is set to »Active«, the state that is set by the pickups will be stored until it is reset. If »Latching« is set to »Inactive«, the LED always adopts the state of those pickups that were assigned.
- »*Acknowledgement*«: Signal that will reset the LED.
- »*LED active color*«: LED lights up in this color when at least one of the allocated functions is valid (red, red-flashing, green, green flashing, off).
- »*LED inactive color*«: LED lights up in this color when none of the allocated functions is valid (red, red-flashing, green, green flashing, off).
- »*Assignment 1...n*«: Apart from the *LED for System OK (Operational)*, each LED can be assigned up to five functions (e.g. pickups) out of the »Assignment list«.
- »*Inverting an Assignment 1...n*«: This will invert the input signal.

Acknowledgment Options

LEDs can be acknowledged by:

- The push-button »Ack/Rst« at the operating panel;
- A signal from the »LED Reset list« (e.g. digital inputs or communication signals) (If »*Latched = active*«);
- The »Ex Acknowledge« module - all LEDs can be acknowledged at once, if the signal for external acknowledgment becomes true (e.g.: the state of a digital input); and
- Communication (Comm) - all LEDs can be acknowledged at once.



The »System OK (Operational) « LED

This LED flashes green while the device is booting. After booting is complete, the LED for *System OK (Operational)* lights up in green signaling that the protection (function) is »*activated*«. Please refer to chapter "Self-Supervision" and to the external document "*Trouble Shooting Guide*" to find out further information on blink codes of the *System OK LED*

The Operational LED (System OK) cannot be configured.

LED Settings

LEDs group A ,LEDs group B

Device Parameters of the LEDs

Parameter	Description	Setting range	Default	Menu path
Latched 	Defines whether the LED will be latched when it picks up.	Inactive, Active	LEDs group A: Active LEDs group B: Inactive	[Device Para /LEDs /LEDs group A /LED 1]
Ack signal 	Acknowledgment signal for the LED. If latching is set to active the LED can only be acknowledged if all signals that initiated the setting of the LED are no longer present. Dependency Only available if: Latched = Active	1..n, Assignment List	-.-	[Device Para /LEDs /LEDs group A /LED 1]
LED Active Color 	The LED lights up in this color if the state of the OR-assignment of the signals is true.	Green, Red, Red flash, Green flash, -	LEDs group A: Red LEDs group B: Green	[Device Para /LEDs /LEDs group A /LED 1]
LED Inactive Color 	The LED lights up in this color if the state of the OR-assignment of the signals is false.	Green, Red, Red flash, Green flash, -	-	[Device Para /LEDs /LEDs group A /LED 1]
Assignment 1 	Assignment	1..n, Assignment List	LEDs group A: 50P[1].Trip LEDs group B: Bkr.Pos OPEN	[Device Para /LEDs /LEDs group A /LED 1]
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 1]
Assignment 2 	Assignment	1..n, Assignment List	LEDs group A: 51P[1].Trip LEDs group B: -.-	[Device Para /LEDs /LEDs group A /LED 1]

Parameter	Description	Setting range	Default	Menu path
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 1]
Assignment 3 	Assignment	1..n, Assignment List	.-	[Device Para /LEDs /LEDs group A /LED 1]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 1]
Assignment 4 	Assignment	1..n, Assignment List	.-	[Device Para /LEDs /LEDs group A /LED 1]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 1]
Assignment 5 	Assignment	1..n, Assignment List	.-	[Device Para /LEDs /LEDs group A /LED 1]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 1]
Latched 	Defines whether the LED will be latched when it picks up.	Inactive, Active	LEDs group A: Active LEDs group B: Inactive	[Device Para /LEDs /LEDs group A /LED 2]
Ack signal 	Acknowledgment signal for the LED. If latching is set to active the LED can only be acknowledged if all signals that initiated the setting of the LED are no longer present. Only available if: Latched = Active	1..n, Assignment List	.-	[Device Para /LEDs /LEDs group A /LED 2]

Parameter	Description	Setting range	Default	Menu path
LED Active Color 	The LED lights up in this color if the state of the OR-assignment of the signals is true.	Green, Red, Red flash, Green flash, -	Red	[Device Para /LEDs /LEDs group A /LED 2]
LED Inactive Color 	The LED lights up in this color if the state of the OR-assignment of the signals is false.	Green, Red, Red flash, Green flash, -	-	[Device Para /LEDs /LEDs group A /LED 2]
Assignment 1 	Assignment	1..n, Assignment List	LEDs group A: 50X[1].Trip LEDs group B: Bkr.Pos CLOSE	[Device Para /LEDs /LEDs group A /LED 2]
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 2]
Assignment 2 	Assignment	1..n, Assignment List	LEDs group A: 50R[1].Trip LEDs group B: -.-	[Device Para /LEDs /LEDs group A /LED 2]
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 2]
Assignment 3 	Assignment	1..n, Assignment List	LEDs group A: 51X[1].Trip LEDs group B: -.-	[Device Para /LEDs /LEDs group A /LED 2]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 2]

Parameter	Description	Setting range	Default	Menu path
Assignment 4 	Assignment	1..n, Assignment List	LEDs group A: 51R[1].Trip LEDs group B: -.-	[Device Para /LEDs /LEDs group A /LED 2]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 2]
Assignment 5 	Assignment	1..n, Assignment List	-.-	[Device Para /LEDs /LEDs group A /LED 2]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 2]
Latched 	Defines whether the LED will be latched when it picks up.	Inactive, Active	Active	[Device Para /LEDs /LEDs group A /LED 3]
Ack signal 	Acknowledgment signal for the LED. If latching is set to active the LED can only be acknowledged if all signals that initiated the setting of the LED are no longer present. Only available if: Latched = Active	1..n, Assignment List	-.-	[Device Para /LEDs /LEDs group A /LED 3]
LED Active Color 	The LED lights up in this color if the state of the OR-assignment of the signals is true.	Green, Red, Red flash, Green flash, -	Red	[Device Para /LEDs /LEDs group A /LED 3]
LED Inactive Color 	The LED lights up in this color if the state of the OR-assignment of the signals is false.	Green, Red, Red flash, Green flash, -	-	[Device Para /LEDs /LEDs group A /LED 3]

Parameter	Description	Setting range	Default	Menu path
Assignment 1 	Assignment	1..n, Assignment List	LEDs group A: 46G[1].Trip LEDs group B: 81[1].TripCmd	[Device Para /LEDs /LEDs group A /LED 3]
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 3]
Assignment 2 	Assignment	1..n, Assignment List	LEDs group A: -. LEDs group B: 81[3].TripCmd	[Device Para /LEDs /LEDs group A /LED 3]
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 3]
Assignment 3 	Assignment	1..n, Assignment List	LEDs group A: -. LEDs group B: 81[5].TripCmd	[Device Para /LEDs /LEDs group A /LED 3]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 3]
Assignment 4 	Assignment	1..n, Assignment List	-.	[Device Para /LEDs /LEDs group A /LED 3]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 3]
Assignment 5 	Assignment	1..n, Assignment List	-.	[Device Para /LEDs /LEDs group A /LED 3]

Parameter	Description	Setting range	Default	Menu path
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 3]
Latched 	Defines whether the LED will be latched when it picks up.	Inactive, Active	LEDs group A: Inactive LEDs group B: Active	[Device Para /LEDs /LEDs group A /LED 4]
Ack signal 	Acknowledgment signal for the LED. If latching is set to active the LED can only be acknowledged if all signals that initiated the setting of the LED are no longer present. Only available if: Latched = Active	1..n, Assignment List	.-	[Device Para /LEDs /LEDs group A /LED 4]
LED Active Color 	The LED lights up in this color if the state of the OR-assignment of the signals is true.	Green, Red, Red flash, Green flash, -	LEDs group A: Red flash LEDs group B: Red	[Device Para /LEDs /LEDs group A /LED 4]
LED Inactive Color 	The LED lights up in this color if the state of the OR-assignment of the signals is false.	Green, Red, Red flash, Green flash, -	-	[Device Para /LEDs /LEDs group A /LED 4]
Assignment 1 	Assignment	1..n, Assignment List	LEDs group A: Prot.Pickup LEDs group B: 24[1].Trip	[Device Para /LEDs /LEDs group A /LED 4]
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 4]
Assignment 2 	Assignment	1..n, Assignment List	.-	[Device Para /LEDs /LEDs group A /LED 4]

Parameter	Description	Setting range	Default	Menu path
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 4]
Assignment 3 	Assignment	1..n, Assignment List	.-	[Device Para /LEDs /LEDs group A /LED 4]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 4]
Assignment 4 	Assignment	1..n, Assignment List	.-	[Device Para /LEDs /LEDs group A /LED 4]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 4]
Assignment 5 	Assignment	1..n, Assignment List	.-	[Device Para /LEDs /LEDs group A /LED 4]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 4]
Latched 	Defines whether the LED will be latched when it picks up.	Inactive, Active	Active	[Device Para /LEDs /LEDs group A /LED 5]
Ack signal 	Acknowledgment signal for the LED. If latching is set to active the LED can only be acknowledged if all signals that initiated the setting of the LED are no longer present. Only available if: Latched = Active	1..n, Assignment List	.-	[Device Para /LEDs /LEDs group A /LED 5]

Parameter	Description	Setting range	Default	Menu path
LED Active Color 	The LED lights up in this color if the state of the OR-assignment of the signals is true.	Green, Red, Red flash, Green flash, -	Red	[Device Para /LEDs /LEDs group A /LED 5]
LED Inactive Color 	The LED lights up in this color if the state of the OR-assignment of the signals is false.	Green, Red, Red flash, Green flash, -	-	[Device Para /LEDs /LEDs group A /LED 5]
Assignment 1 	Assignment	1..n, Assignment List	LEDs group A: BF.Trip LEDs group B: 40-Z1[1].Trip	[Device Para /LEDs /LEDs group A /LED 5]
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 5]
Assignment 2 	Assignment	1..n, Assignment List	LEDs group A: -.- LEDs group B: 40-Z2[1].Trip	[Device Para /LEDs /LEDs group A /LED 5]
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 5]
Assignment 3 	Assignment	1..n, Assignment List	-.-	[Device Para /LEDs /LEDs group A /LED 5]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 5]

Parameter	Description	Setting range	Default	Menu path
Assignment 4 	Assignment	1..n, Assignment List	-.-	[Device Para /LEDs /LEDs group A /LED 5]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 5]
Assignment 5 	Assignment	1..n, Assignment List	-.-	[Device Para /LEDs /LEDs group A /LED 5]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 5]
Latched 	Defines whether the LED will be latched when it picks up.	Inactive, Active	Active	[Device Para /LEDs /LEDs group A /LED 6]
Ack signal 	Acknowledgment signal for the LED. If latching is set to active the LED can only be acknowledged if all signals that initiated the setting of the LED are no longer present. Only available if: Latched = Active	1..n, Assignment List	-.-	[Device Para /LEDs /LEDs group A /LED 6]
LED Active Color 	The LED lights up in this color if the state of the OR-assignment of the signals is true.	Green, Red, Red flash, Green flash, -	Red	[Device Para /LEDs /LEDs group A /LED 6]
LED Inactive Color 	The LED lights up in this color if the state of the OR-assignment of the signals is false.	Green, Red, Red flash, Green flash, -	-	[Device Para /LEDs /LEDs group A /LED 6]

Parameter	Description	Setting range	Default	Menu path
Assignment 1 	Assignment	1..n, Assignment List	LEDs group A: Prot.Trip LEDs group B: 32[1].Trip	[Device Para /LEDs /LEDs group A /LED 6]
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 6]
Assignment 2 	Assignment	1..n, Assignment List	LEDs group A: -.- LEDs group B: 32[2].Trip	[Device Para /LEDs /LEDs group A /LED 6]
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 6]
Assignment 3 	Assignment	1..n, Assignment List	LEDs group A: -.- LEDs group B: 32[3].Trip	[Device Para /LEDs /LEDs group A /LED 6]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 6]
Assignment 4 	Assignment	1..n, Assignment List	-.-	[Device Para /LEDs /LEDs group A /LED 6]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 6]
Assignment 5 	Assignment	1..n, Assignment List	-.-	[Device Para /LEDs /LEDs group A /LED 6]

Parameter	Description	Setting range	Default	Menu path
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 6]
Latched 	Defines whether the LED will be latched when it picks up.	Inactive, Active	LEDs group A: Inactive LEDs group B: Active	[Device Para /LEDs /LEDs group A /LED 7]
Ack signal 	Acknowledgment signal for the LED. If latching is set to active the LED can only be acknowledged if all signals that initiated the setting of the LED are no longer present. Only available if: Latched = Active	1..n, Assignment List	.-	[Device Para /LEDs /LEDs group A /LED 7]
LED Active Color 	The LED lights up in this color if the state of the OR-assignment of the signals is true.	Green, Red, Red flash, Green flash, -	LEDs group A: Green flash LEDs group B: Red	[Device Para /LEDs /LEDs group A /LED 7]
LED Inactive Color 	The LED lights up in this color if the state of the OR-assignment of the signals is false.	Green, Red, Red flash, Green flash, -	-	[Device Para /LEDs /LEDs group A /LED 7]
Assignment 1 	Assignment	1..n, Assignment List	LEDs group A: Sys.Maint Mode Active LEDs group B: 87H.Trip	[Device Para /LEDs /LEDs group A /LED 7]
Inverting 1 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 7]
Assignment 2 	Assignment	1..n, Assignment List	LEDs group A: -. LEDs group B: 87.Trip	[Device Para /LEDs /LEDs group A /LED 7]

Parameter	Description	Setting range	Default	Menu path
Inverting 2 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 7]
Assignment 3 	Assignment	1..n, Assignment List	LEDs group A: -.- LEDs group B: 87GD.Trip	[Device Para /LEDs /LEDs group A /LED 7]
Inverting 3 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 7]
Assignment 4 	Assignment	1..n, Assignment List	LEDs group A: -.- LEDs group B: 87GDH.Trip	[Device Para /LEDs /LEDs group A /LED 7]
Inverting 4 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 7]
Assignment 5 	Assignment	1..n, Assignment List	-.-	[Device Para /LEDs /LEDs group A /LED 7]
Inverting 5 	Inverting of the state of the assigned signal.	Inactive, Active	Inactive	[Device Para /LEDs /LEDs group A /LED 7]

LED Input States

Name	Description	Assignment via
LED1.1	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 1]
LED1.2	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 1]
LED1.3	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 1]
LED1.4	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 1]
LED1.5	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 1]
Acknow Sig 1	Module Input State: Acknowledgment Signal (only for automatic acknowledgment).	[Device Para /LEDs /LEDs group A /LED 1]
LED2.1	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 2]
LED2.2	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 2]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
LED2.3	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 2]
LED2.4	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 2]
LED2.5	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 2]
Acknow Sig 2	Module Input State: Acknowledgment Signal (only for automatic acknowledgment).	[Device Para /LEDs /LEDs group A /LED 2]
LED3.1	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 3]
LED3.2	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 3]
LED3.3	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 3]
LED3.4	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 3]
LED3.5	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 3]

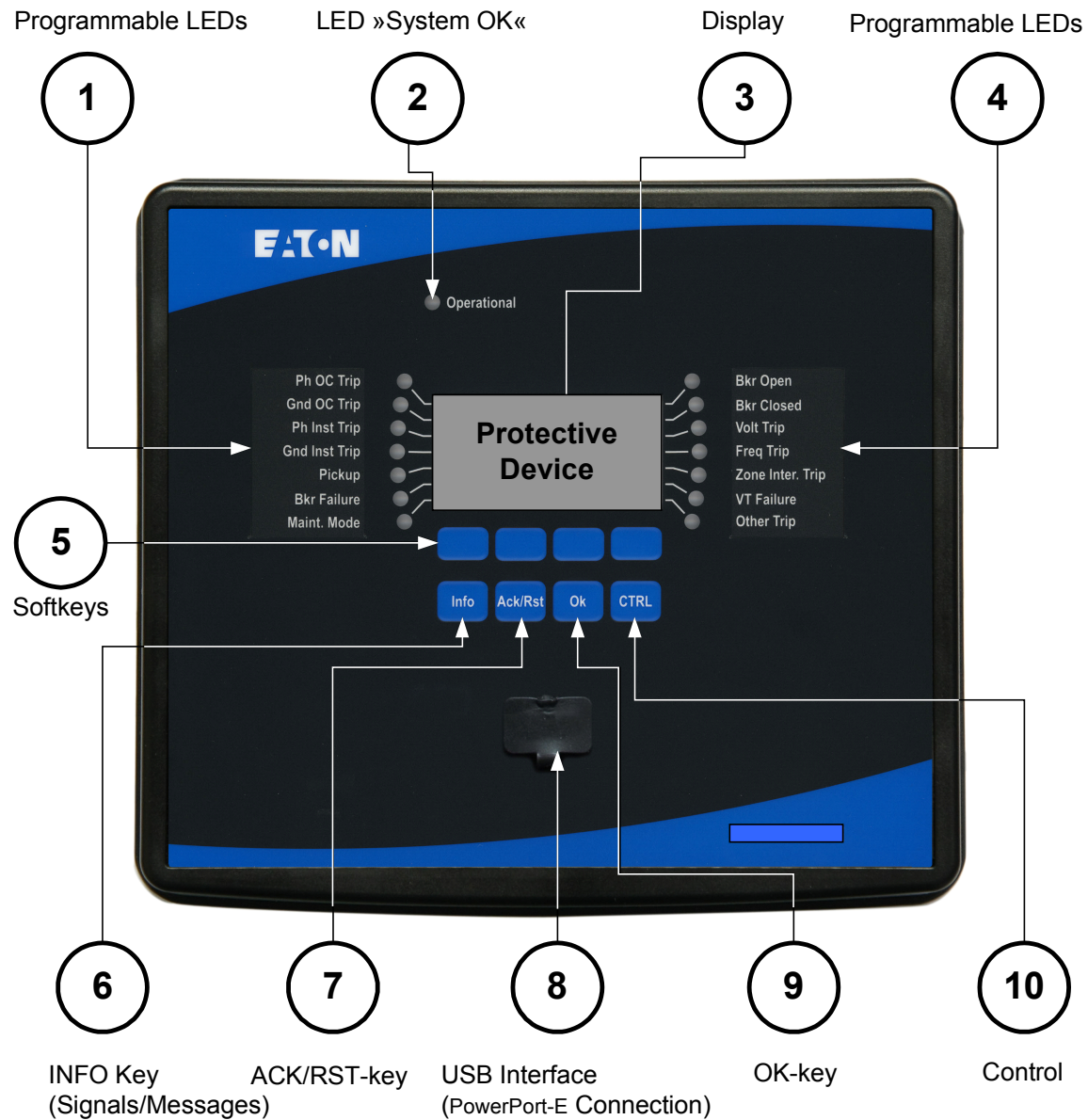
Name	Description	Assignment via
Acknow Sig 3	Module Input State: Acknowledgment Signal (only for automatic acknowledgment).	[Device Para /LEDs /LEDs group A /LED 3]
LED4.1	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 4]
LED4.2	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 4]
LED4.3	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 4]
LED4.4	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 4]
LED4.5	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 4]
Acknow Sig 4	Module Input State: Acknowledgment Signal (only for automatic acknowledgment).	[Device Para /LEDs /LEDs group A /LED 4]
LED5.1	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 5]
LED5.2	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 5]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
LED5.3	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 5]
LED5.4	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 5]
LED5.5	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 5]
Acknow Sig 5	Module Input State: Acknowledgment Signal (only for automatic acknowledgment).	[Device Para /LEDs /LEDs group A /LED 5]
LED6.1	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 6]
LED6.2	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 6]
LED6.3	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 6]
LED6.4	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 6]
LED6.5	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 6]

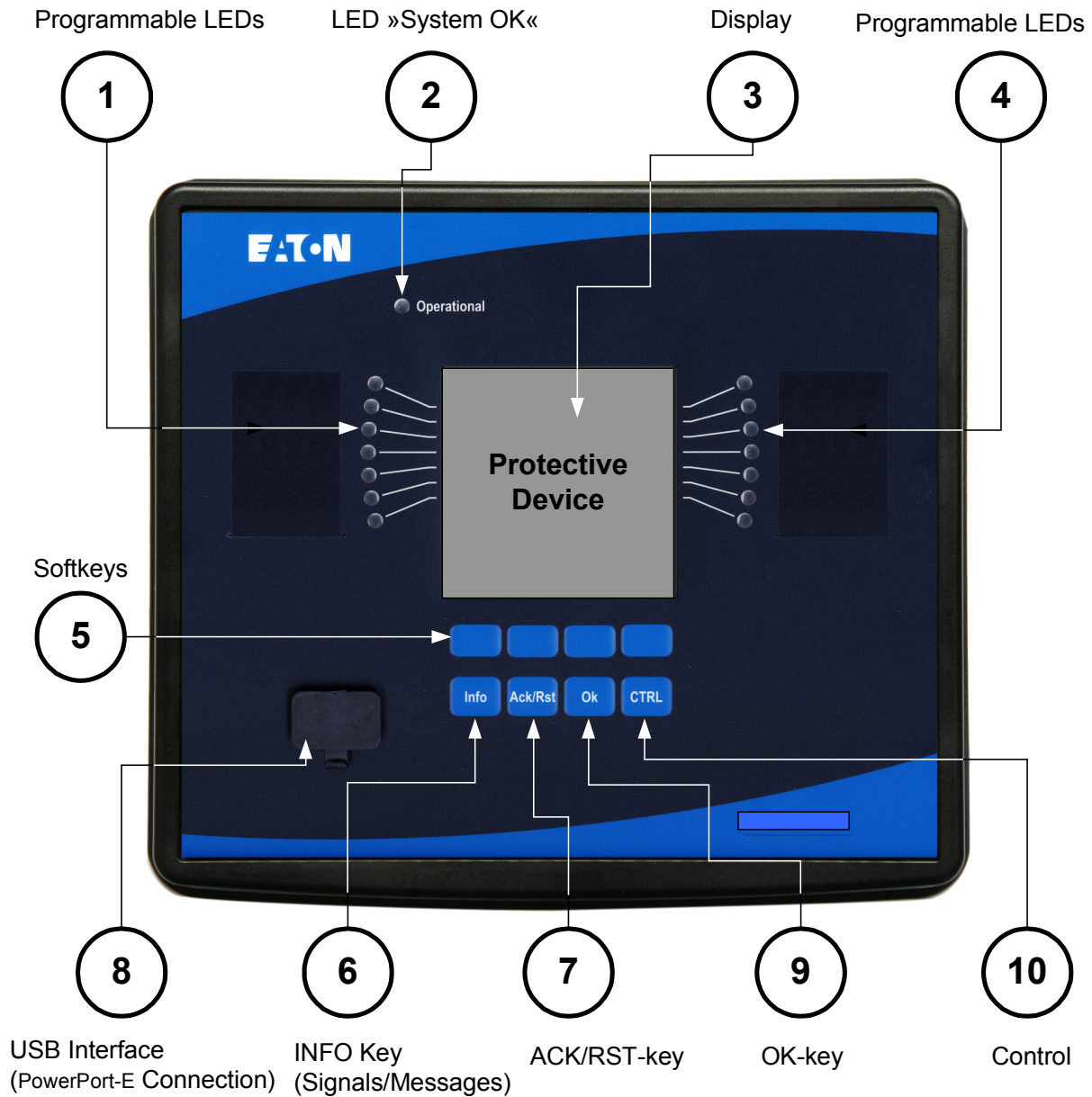
Name	Description	Assignment via
Acknow Sig 6	Module Input State: Acknowledgment Signal (only for automatic acknowledgment).	[Device Para /LEDs /LEDs group A /LED 6]
LED7.1	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 7]
LED7.2	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 7]
LED7.3	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 7]
LED7.4	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 7]
LED7.5	Module Input State: LED	[Device Para /LEDs /LEDs group A /LED 7]
Acknow Sig 7	Module Input State: Acknowledgment Signal (only for automatic acknowledgment).	[Device Para /LEDs /LEDs group A /LED 7]

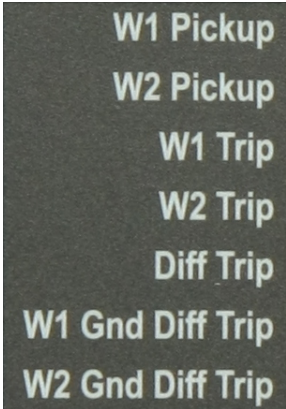
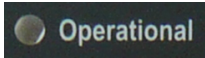
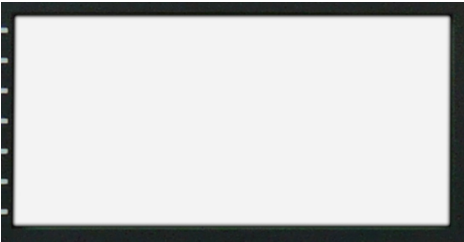
Front Panel

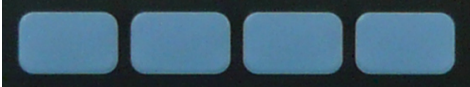
The following illustration applies to protective devices with a small display:

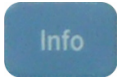


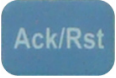
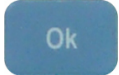
The following illustration applies to protective devices with a large display:



Item	Graphic	Name	Description
1	 (Example for an insert)	Group A: Programmable LEDs	Basically, there are 14 programmable LEDs (7 on the left, 7 on the right side) provided for User to configure. The choice for each programmable LED can be any signal from the global assignment list, which includes all internal operation states of each function activated. Based on the application need, up to 14 (but not necessarily all) programmable LEDs can be activated. By properly configuring some or all 14 LEDs, the User will be able to view the relay's overall operation and some critical information immediately and intuitively without having to access any menu.
2		LED »System OK«	Should the LED »System OK« flash red during operation, contact Customer Support immediately.
3		Display	Via the display, the User can view operational data and edit the parameters.

Item	Graphic	Name	Description
4	 (Example for an insert)	Group B: Programmable LEDs	Basically, there are 14 programmable LEDs (7 on the left, 7 on the right side) provided for User to configure. The choice for each programmable LED can be any signal from the global assignment list, which includes all internal operation states of each function activated. Based on the application need, up to 14 (but not necessarily all) programmable LEDs can be activated. By properly configuring some or all 14 LEDs, the User will be able to view the relay's overall operation and some critical information immediately and intuitively without having to access any menu.
5		Softkeys	The function of the »SOFTKEYS« changes. Their active functions appear on the bottom line of the display. Possible functions are: ■ Navigation; ■ Parameter decrement/increment; ■ Scrolling up/down a menu page; ■ Moving to a digit; and ■ Change into the parameter setting mode »Wrench Symbol«.

Item	Graphic	Name	Description
6		INFO Key (Signals/Messages)	Looking through the present LED assignment. The Direct Select key can be activated at any time. If the INFO key is actuated again, the User will leave the LED menu. Here only the first assignments of the LEDs will be shown. Every three seconds the »SOFTKEYS« will be shown (flashing). <i>Displaying the Multiple Assignments</i> If the INFO key is pressed, only the first assignments of any LED is shown. Every three seconds the »SOFTKEYS« will be shown (flashing). If there is more than one signal assigned to an LED (indicated by three dots), the User can check the state of the multiple assignments by proceeding as follows. In order to show all (multiple) assignments, select an LED by means of the »SOFTKEYS« »up« and »down«. Via the »Softkey« »right«, call up a sub-menu of this LED that gives the User detailed information on the state of all signals assigned to this LED. An arrow symbol points to the LED whose assignments are currently displayed. Via the »SOFTKEYS« »up« and »down«, the User can call up the next / previous LED. In order to leave the LED menu, press the »SOFTKEY« »left« multiple times.

Item	Graphic	Name	Description
7		»ACK/RST- Key«	Used to abort changes and to acknowledge messages as well as resetting counters. In order to reset, press the Soft-key »Wrench« and enter the password. The User can exit the reset menu by pressing the Softkey »Arrow-left«
8		USB Interface (PowerPort-E Connection)	Connection to the computer/software PowerPort-E is done via the USB interface.
9		»OK Key«	When using the »OK« key, parameter changes are temporarily stored. If the »OK« key is pressed again, those changes are stored indefinitely.
10		»CTRL Key«	Access to the Control menu (not available in all devices)

Basic Menu Control

The graphic user interface is equivalent to a hierarchical structured menu tree. For access to the individual sub-menus, the »SOFTKEYS«/Navigation Keys are used. The function of the »SOFTKEYS« can be found near the bottom of the display.

Softkey	Description
	■ Via »SOFTKEY« »Up«, the User will be taken to the prior menu point/one parameter up by scrolling upwards.
	■ Via »SOFTKEY« »Left«, the User will be taken one step back.
	■ Via »SOFTKEY« »Down«, the User will be taken to the next menu point/one parameter down by scrolling downwards.
	■ Via »SOFTKEY« »Right«, the User will be taken to a sub-menu.
	■ Via »SOFTKEY« »Top of List«, the User will be taken directly to the top of a list.
	■ Via »SOFTKEY« »Bottom of List«, the User will be taken directly to the end of a list.
	■ Via »SOFTKEY« »+«, the related digit will be incremented. (Continuous pressure -> fast).
	■ Via »SOFTKEY« »-«, the related digit will be decremented. (Continuous pressure -> fast)
	■ Via »SOFTKEY« »Left«, the User will be taken one digit to the left.
	■ Via »SOFTKEY« »Right«, the User will be taken one digit to the right.
	■ Via »SOFTKEY« »Parameter Setting«, the User will call up the parameter setting mode.
	■ Via »SOFTKEY« »Delete«, data will be deleted.
	■ Fast forward scrolling is possible via »SOFTKEY« »Fast forward«
	■ Fast backward scrolling is possible via »SOFTKEY« »Fast backward«

In order to return to the main menu, just keep pressing the Softkey »Arrow-Left« until you arrive at the »Main Menu«.

PowerPort-E

PowerPort-E is a parameter setting and evaluation software. Please see separate manual (MN026001EN).

- Menu-controlled parameter setting incl. validity checks
- Offline configuration of all relay types
- Reading and evaluating of statistical data and measuring values
- Setting into operation assistance
- Display of the device status
- Fault analysis via event- and fault and waveform recorder

Quality Manager

Quality Manager is an E-Series waveform and event viewing software. It is installed automatically with *PowerPort-E*. It can also be used as a standard COMTRADE file viewer.

- Open and review downloaded waveforms
- Customize waveform channel layout and views including channel overlapping and zooming
- Analyze sample by sample data points and line up the displayed analog waveform channels along with the recorded internal relay logic
- Save window setups (snapshots) and print for reporting
- Open industry standard COMTRADE files from other intelligent electronic devices
- Convert downloaded waveform files to COMTRADE file format using "Export" feature

Wide Frequency Range

⚠ WARNING

WARNING if the frequency deviates more than +/-5 Hz from the rated frequency, than protective elements that work based on DFT (fundamental) values will be blocked.

Protective elements that work based on RMS values work over the entire wide frequency range (5-70 Hz).

NOTICE

DFT is used if the protective element criterion is set to Fundamental.

NOTICE

The wide frequency range applies to current and voltage protective elements as well as elements that are working based on quantities that are calculated based on a combination of current and voltage (e.g. power).

The frequency will be calculated based on the three-phase voltages as well as the fourth voltage measuring input.

Some protective elements are using Discrete Fourier Transformation (DFT) in order to extract the fundamentals and phase angles from the measured values. Other protective elements are using True RMS values. For some protective elements, the User can specify if they should work based on DFT or True RMS values.

The calculation of measuring quantities via DFT is very fast. The values are calculated several times per cycle. For some technical reasons, the calculation of DFT values is only possible if the frequency is close to the nominal frequency (+/- 5 Hz). If the frequency is out of the nominal frequency range, the DFT values are no longer precise. That is why protective elements (and directional features), that work based on DFT values, will be blocked either because they are set fixed to DFT or they are set by the User to DFT, as soon as the frequency leaves the nominal range (+/- 5 Hz).

Protective elements, that are working based on True RMS values, are able to work in a wide frequency range (5-70 Hz). For technical reasons, the True RMS based calculation of measured values will be done once per cycle. The lower the frequency, the longer the cycle, and the slower the calculation will become. That means that the True RMS based calculations will have longer settling times (<2 cycles). This especially applies the lower the frequency is.

The duration of a cycle will be calculated based on the voltage measuring channels. The duration of a cycle for True RMS is possible if the voltage magnitudes exceeds 10 V. In case the cycle duration cannot be determined, the rated frequency will be assumed for DFT and True RMS calculations. As soon as a sufficient magnitude is fed to the relay, the wide frequency range will be activated a few cycles later (after the settling time) if the frequency is out of the nominal range.

$ (f - f_N) < 5 \text{ Hz}$	$ (f - f_N) > 5 \text{ Hz}$
DFT available: The measured values are calculated several times per cycle.	DFT imprecise: Protective elements will be blocked.
True RMS available: The measured values are calculated several times per cycle.	True RMS available 5-70 Hz: Measured values are updated after each cycle.

The dropout ratio is 1 Hz below 5 Hz.

Measuring Values

Read Out Measured Values

In the »Operation/Measured Values« menu, both measured and calculated values can be viewed. The measured values are ordered by »Standard values« and »Special values« (depending on the type of device).

Measurement Display

Menu [Operation\General Settings] offers options to change the display of measured values within the HMI and PowerPort-E.

Scaling of Measured values

By means of the parameter »Scaling« the user can determine how measured values are to be displayed within the HMI and *PowerPort-E*:

- Per Unit quantities
- Primary quantities
- Secondary quantities

Power Units (applies only for devices with power measurement)

By means of the parameter »Power Units« the User can determine how measured values are to be displayed within the HMI and *PowerPort-E*:

- Power Auto Scaling
- kW, kVAr or kVA
- MW, MVar or MVA
- GW, GVar or GVA

Energy Units (applies only for devices with energy measurement)

By means of the parameter »*Energy Units*« the User can determine how measured values are to be displayed within the HMI and *PowerPort-E*:

- Energy Auto Scaling
- kWh, kVAh or kVAh
- MWh, MVAh or MVAh
- GWh, GVAh or GVAh

In case of an overflow of the counter, the counter will start counting again at zero. A corresponding signal will indicate the counter overflow.

Counter overflow at:

■ Energy Auto Scaling	Depends on the settings for the current and voltage transformers
■ kWh, kVAh or kVAh	999,999.99
■ MWh, MVAh or MVAh	999,999.99
■ GWh, GVAh or GVAh	999,999.99

Temperature Unit (applies only for devices with temperature measurement)

By means of the parameter »*Temperature Unit*« the User can determine how measured values are to be displayed within the HMI and *PowerPort-E*:

- ° Celsius
- ° Fahrenheit

Phase Differential Current - Measured Values

87

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
IrA	Measured Value (Calculated): Restraint Current Phase A	[Operation /Measured Values /87]
IrB	Measured Value (Calculated): Restraint Current Phase B	[Operation /Measured Values /87]
IrC	Measured Value (Calculated): Restraint Current Phase C	[Operation /Measured Values /87]
IdA	Measured Value (Calculated): Differential Current Phase A	[Operation /Measured Values /87]
IdB	Measured Value (Calculated): Differential Current Phase B	[Operation /Measured Values /87]
IdC	Measured Value (Calculated): Differential Current Phase C	[Operation /Measured Values /87]

Ground Differential Current - Measured Values

87GD

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
IrG W2	Measured Value (Calculated): Ground Restraint Current Winding 2	[Operation /Measured Values /87GD]
IdG W2	Measured Value (Calculated): Ground Differential Current Winding 2	[Operation /Measured Values /87GD]

Differential Current - Measured Values

Differential Protection

CT Line

If the device is not equipped with an voltage measuring card the first measuring input on the first current measuring card (slot with the lowest number) will be used as the reference angle (« I_A »).

Differential Current - Measured Values

Value	Description	Menu path
IA Fund.	Measured value: Phase current (Fundamental)	[Operation /Measured Values /CT Line /Current Fund.]
IB Fund.	Measured value: Phase current (Fundamental)	[Operation /Measured Values /CT Line /Current Fund.]
IC Fund.	Measured value: Phase current (Fundamental)	[Operation /Measured Values /CT Line /Current Fund.]
IX meas Fund.	Measured value (measured): IX (Fundamental)	[Operation /Measured Values /CT Line /Current Fund.]
IR calc Fund.	Measured value (calculated): IR (Fundamental)	[Operation /Measured Values /CT Line /Current Fund.]
Angle IA	Measured Value (Calculated): Angle of Phasor IA	[Operation /Measured Values /CT Line /Current Fund.]
Angle IB	Measured Value (Calculated): Angle of Phasor IB	[Operation /Measured Values /CT Line /Current Fund.]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Angle IC	Measured Value (Calculated): Angle of Phasor IC	[Operation /Measured Values /CT Line /Current Fund.]
Angle IX meas	Measured Value (Calculated): Angle of Phasor IX meas	[Operation /Measured Values /CT Line /Current Fund.]
Angle IR calc	Measured Value (Calculated): Angle of Phasor IR calc	[Operation /Measured Values /CT Line /Current Fund.]
IA RMS	Measured value: Phase current (RMS)	[Operation /Measured Values /CT Line /Current RMS]
IB RMS	Measured value: Phase current (RMS)	[Operation /Measured Values /CT Line /Current RMS]
IC RMS	Measured value: Phase current (RMS)	[Operation /Measured Values /CT Line /Current RMS]
IX meas RMS	Measured value (measured): IX (RMS)	[Operation /Measured Values /CT Line /Current RMS]
IR calc RMS	Measured value (calculated): IR (RMS)	[Operation /Measured Values /CT Line /Current RMS]

Current - Measured Values

CT Ntrl

If the device is not equipped with an voltage measuring card the first measuring input on the first current measuring card (slot with the lowest number) will be used as the reference angle ($\gg I_A \ll$).

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
IA Fund.	Measured value: Phase current (Fundamental)	[Operation /Measured Values /CT Ntrl /Current Fund.]
IB Fund.	Measured value: Phase current (Fundamental)	[Operation /Measured Values /CT Ntrl /Current Fund.]
IC Fund.	Measured value: Phase current (Fundamental)	[Operation /Measured Values /CT Ntrl /Current Fund.]
IX meas Fund.	Measured value (measured): IX (Fundamental)	[Operation /Measured Values /CT Ntrl /Current Fund.]
IR calc Fund.	Measured value (calculated): IR (Fundamental)	[Operation /Measured Values /CT Ntrl /Current Fund.]
I0 Fund.	Measured value (calculated): Zero current (Fundamental)	[Operation /Measured Values /CT Ntrl /Current Fund.]
I1 Fund.	Measured value (calculated): Positive phase sequence current (Fundamental)	[Operation /Measured Values /CT Ntrl /Current Fund.]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
I2 Fund.	Measured value (calculated): Unbalanced load current (Fundamental)	[Operation /Measured Values /CT Ntrl /Current Fund.]
Angle IA	Measured Value (Calculated): Angle of Phasor IA	[Operation /Measured Values /CT Ntrl /Current Fund.]
Angle IB	Measured Value (Calculated): Angle of Phasor IB	[Operation /Measured Values /CT Ntrl /Current Fund.]
Angle IC	Measured Value (Calculated): Angle of Phasor IC	[Operation /Measured Values /CT Ntrl /Current Fund.]
Angle IX meas	Measured Value (Calculated): Angle of Phasor IX meas	[Operation /Measured Values /CT Ntrl /Current Fund.]
Angle IR calc	Measured Value (Calculated): Angle of Phasor IR calc	[Operation /Measured Values /CT Ntrl /Current Fund.]
Angle I0	Measured Value (calculated): Angle of Zero Sequence System	[Operation /Measured Values /CT Ntrl /Current Fund.]
Angle I1	Measured Value (calculated): Angle of Positive Sequence System	[Operation /Measured Values /CT Ntrl /Current Fund.]
Angle I2	Measured value (calculated): Angle of Negative Sequence System	[Operation /Measured Values /CT Ntrl /Current Fund.]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
IA RMS	Measured value: Phase current (RMS)	[Operation /Measured Values /CT Ntrl /Current RMS]
IB RMS	Measured value: Phase current (RMS)	[Operation /Measured Values /CT Ntrl /Current RMS]
IC RMS	Measured value: Phase current (RMS)	[Operation /Measured Values /CT Ntrl /Current RMS]
IX meas RMS	Measured value (measured): IX (RMS)	[Operation /Measured Values /CT Ntrl /Current RMS]
IR calc RMS	Measured value (calculated): IR (RMS)	[Operation /Measured Values /CT Ntrl /Current RMS]
%IA THD	Measured Value (Calculated): IA Total Harmonic Distortion	[Operation /Measured Values /CT Ntrl /Current RMS]
%IB THD	Measured Value (Calculated): IB Total Harmonic Distortion	[Operation /Measured Values /CT Ntrl /Current RMS]
%IC THD	Measured Value (Calculated): IC Total Harmonic Distortion	[Operation /Measured Values /CT Ntrl /Current RMS]
IA THD	Measured Value (Calculated): IA Total Harmonic Current	[Operation /Measured Values /CT Ntrl /Current RMS]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
IB THD	Measured Value (Calculated): IB Total Harmonic Current	[Operation /Measured Values /CT Ntrl /Current RMS]
IC THD	Measured Value (Calculated): IC Total Harmonic Current	[Operation /Measured Values /CT Ntrl /Current RMS]
%(I2/I1)	Measured value (calculated): I2/I1, phase sequence will be taken into account automatically.	[Operation /Measured Values /CT Ntrl /Current Fund.]

Voltage - Measured Values

VT

The first measuring input on the first measuring card (slot with the lowest number) is used as the reference angle.
E.g. »VA« respectively »VAB«.

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
f	Measured Value: Frequency	[Operation /Measured Values /Voltage RMS]
VAB Fund.	Measured value: Phase-to-phase voltage (Fundamental)	[Operation /Measured Values /Voltage Fund.]
VBC Fund.	Measured value: Phase-to-phase voltage (Fundamental)	[Operation /Measured Values /Voltage Fund.]
VCA Fund.	Measured value: Phase-to-phase voltage (Fundamental)	[Operation /Measured Values /Voltage Fund.]
VA Fund.	Measured value: Phase-to-neutral voltage (Fundamental)	[Operation /Measured Values /Voltage Fund.]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
VB Fund.	Measured value: Phase-to-neutral voltage (Fundamental)	[Operation /Measured Values /Voltage Fund.]
VC Fund.	Measured value: Phase-to-neutral voltage (Fundamental)	[Operation /Measured Values /Voltage Fund.]
VX meas Fund.	Measured value (measured): VX measured (Fundamental)	[Operation /Measured Values /Voltage Fund.]
VR calc Fund.	Measured value (calculated): VR (Fundamental)	[Operation /Measured Values /Voltage Fund.]
V0 Fund.	Measured value (calculated): Symmetrical components Zero voltage(Fundamental)	[Operation /Measured Values /Voltage Fund.]
V1 Fund.	Measured value (calculated): Symmetrical components positive phase sequence voltage(Fundamental)	[Operation /Measured Values /Voltage Fund.]
V2 Fund.	Measured value (calculated): Symmetrical components negative phase sequence voltage(Fundamental)	[Operation /Measured Values /Voltage Fund.]
VAB RMS	Measured value: Phase-to-phase voltage (RMS)	[Operation /Measured Values /Voltage RMS]
VBC RMS	Measured value: Phase-to-phase voltage (RMS)	[Operation /Measured Values /Voltage RMS]
VCA RMS	Measured value: Phase-to-phase voltage (RMS)	[Operation /Measured Values /Voltage RMS]
VA RMS	Measured value: Phase-to-neutral voltage (RMS)	[Operation /Measured Values /Voltage RMS]
VB RMS	Measured value: Phase-to-neutral voltage (RMS)	[Operation /Measured Values /Voltage RMS]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
VC RMS	Measured value: Phase-to-neutral voltage (RMS)	[Operation /Measured Values /Voltage RMS]
VX meas RMS	Measured value (measured): VX measured (RMS)	[Operation /Measured Values /Voltage RMS]
VR calc RMS	Measured value (calculated): VR (RMS)	[Operation /Measured Values /Voltage RMS]
Angle VAB	Measured Value (Calculated): Angle of Phasor VAB	[Operation /Measured Values /Voltage Fund.]
Angle VBC	Measured Value (Calculated): Angle of Phasor VBC	[Operation /Measured Values /Voltage Fund.]
Angle VCA	Measured Value (Calculated): Angle of Phasor VCA	[Operation /Measured Values /Voltage Fund.]
Angle VA	Measured Value (Calculated): Angle of Phasor VA	[Operation /Measured Values /Voltage Fund.]
Angle VB	Measured Value (Calculated): Angle of Phasor VB	[Operation /Measured Values /Voltage Fund.]
Angle VC	Measured Value (Calculated): Angle of Phasor VC	[Operation /Measured Values /Voltage Fund.]
Angle VX meas	Measured Value: Angle of Phasor VX meas	[Operation /Measured Values /Voltage Fund.]
Angle VR calc	Measured Value (Calculated): Angle of Phasor VR calc	[Operation /Measured Values /Voltage Fund.]
Angle V0	Measured Value (calculated): Angle of Zero Sequence System	[Operation /Measured Values /Voltage Fund.]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Angle V1	Measured Value (calculated): Angle of Positive Sequence System	[Operation /Measured Values /Voltage Fund.]
Angle V2	Measured value (calculated): Angle of Negative Sequence System	[Operation /Measured Values /Voltage Fund.]
%(V2/V1)	Measured value (calculated): V2/V1, phase sequence will be taken into account automatically.	[Operation /Measured Values /Voltage Fund.]
%VAB THD	Measured value (calculated): VAB Total Harmonic Distortion / fundamental	[Operation /Measured Values /Voltage RMS]
%VBC THD	Measured value (calculated): VBC Total Harmonic Distortion / fundamental	[Operation /Measured Values /Voltage RMS]
%VCA THD	Measured value (calculated): VCA Total Harmonic Distortion / fundamental	[Operation /Measured Values /Voltage RMS]
%VA THD	Measured value (calculated): VA Total Harmonic Distortion / fundamental	[Operation /Measured Values /Voltage RMS]
%VB THD	Measured value (calculated): VB Total Harmonic Distortion / fundamental	[Operation /Measured Values /Voltage RMS]
%VC THD	Measured value (calculated): VC Total Harmonic Distortion / fundamental	[Operation /Measured Values /Voltage RMS]
VAB THD	Measured value (calculated): VAB Total Harmonic Distortion	[Operation /Measured Values /Voltage RMS]
VBC THD	Measured value (calculated): VBC Total Harmonic Distortion	[Operation /Measured Values /Voltage RMS]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
VCA THD	Measured value (calculated): VCA Total Harmonic Distortion	[Operation /Measured Values /Voltage RMS]
VA THD	Measured value (calculated): VA Total Harmonic Distortion	[Operation /Measured Values /Voltage RMS]
VB THD	Measured value (calculated): VB Total Harmonic Distortion	[Operation /Measured Values /Voltage RMS]
VC THD	Measured value (calculated): VC Total Harmonic Distortion	[Operation /Measured Values /Voltage RMS]
VX meas H3	Third harmonic of measured neutral voltage used to detect generator stator ground faults.	[Operation /Measured Values /Voltage Fund.]
Volts/Hertz	Ratio Volts/Hertz in relation to nominal values.	[Operation /Measured Values /Voltage RMS]

Power - Measured Values

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Syst VA Fund.	Measured VAs (Fundamental)	[Operation /Measured Values /Power]
Syst W Fund.	Measured Watts. Active power (P- = Fed Active Power, P+ = Consumpted Active Power) (Fundamental)	[Operation /Measured Values /Power]
Syst VAr Fund.	Measured VARs. Reactive power (Q- = Fed Reactive Power, Q+ = Consumpted Reactive Power) (Fundamental)	[Operation /Measured Values /Power]
Disp PF	Measured Value (Calculated): 55D - Displacement Power Factor: Sign Convention: sign(PF) = sign(Syst W)	[Operation /Measured Values /Power]
Wh Fwd	Positive Active Power is consumed active energy	[Operation /Measured Values /Energy]
Wh Rev	Negative Active Power (Fed Energy)	[Operation /Measured Values /Energy]
VArh Lag	Positive Reactive Power is consumed Reactive Energy	[Operation /Measured Values /Energy]
VArh Lead	Negative Reactive Power (Fed Energy)	[Operation /Measured Values /Energy]
VAh Net	Net VA Hours	[Operation /Measured Values /Energy]
Wh Net	Net Watt Hours	[Operation /Measured Values /Energy]
VArh Net	Net VAr Hours	[Operation /Measured Values /Energy]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Start Date/Time	Energy counters run since... (Date and time of last reset)	[Operation /Measured Values /Energy]
Syst VA RMS	Measured VAs (RMS)	[Operation /Measured Values /Power]
Syst W RMS	Measured Watts. Active power (P- = Fed Active Power, P+ = Consumpted Active Power) (RMS)	[Operation /Measured Values /Power]
Apt PF	Measured Value (Calculated): 55A - Apparent Power Factor: Sign Convention: sign(PF) = sign(Syst W)	[Operation /Measured Values /Power]
Syst W 1	Measured Watts. Active power in positive sequence system (P- = Fed Active Power, P+ = Consumpted Active Power)	[Operation /Measured Values /Power]
Syst VAR 1	Measured VARs. Reactive power in positive sequence system (Q- = Fed Reactive Power, Q+ = Consumpted Reactive Power)	[Operation /Measured Values /Power]

Energy Counter

EGr

Global Parameters of the Energy Counter Module

Parameter	Description	Setting range	Default	Menu path
Power Units 	Power Units	Power Auto Scaling, kW/kVAr/kVA, MW/MVAr/MVA, GW/GVAr/GVA	Power Auto Scaling	[Operation /General Settings]
Energy Units 	Energy Units	Energy Auto Scaling, kWh/kVArh/kVAh, MWh/MVArh/MVAh, GWh/GVArh/GVAh	MWh/MVArh/MVAh	[Operation /General Settings]

Direct Commands of the Energy Counter Module

Parameter	Description	Setting range	Default	Menu path
Res all Energy Cr 	Reset of all Energy Counters	Inactive, Active	Inactive	[Operation /Reset]

Signals of the Energy Counter Module (States of the Outputs)

<i>Signal</i>	<i>Description</i>
Cr Oflw VAh Net	Signal: Counter Overflow VAh Net
Cr Oflw Wh Net	Signal: Counter Overflow Wh Net
Cr Oflw Wh Fwd	Signal: Counter Overflow Wh Fwd
Cr Oflw Wh Rev	Signal: Counter Overflow Wh Rev
Cr Oflw VARh Net	Signal: Counter Overflow VARh Net
Cr Oflw VARh Lag	Signal: Counter Overflow VARh Lag
Cr Oflw VARh Lead	Signal: Counter Overflow VARh Lead
VAh Net Res Cr	Signal: VAh Net Reset Counter
Wh Net Res Cr	Signal: Wh Net Reset Counter
Wh Fwd Res Cr	Signal: Wh Fwd Reset Counter
Wh Rev Res Cr	Signal: Wh Rev Reset Counter
VARh Net Res Cr	Signal: VARh Net Reset Counter
VARh Lag Res Cr	Signal: VARh Lag Reset Counter
VARh Lead Res Cr	Signal: VARh Lead Reset Counter
Res all Energy Cr	Signal: Reset of all Energy Counters
Cr OflwW VAh Net	Signal: Counter VAh Net will overflow soon
Cr OflwW Wh Net	Signal: Counter Wh Net will overflow soon
Cr OflwW Wh Fwd	Signal: Counter Wh Fwd will overflow soon
Cr OflwW Wh Rev	Signal: Counter Wh Rev will overflow soon
Cr OflwW VARh Net	Signal: Counter VARh Net will overflow soon
Cr OflwW VARh Lag	Signal: Counter VARh Lag will overflow soon
Cr OflwW VARh Lead	Signal: Counter VARh Lead will overflow soon

Statistics

Statistics

In menu »*Operation/Statistics*« the min., max. and mean values of the measured and calculated measured quantities can be found.

Configuration of the Minimum and Maximum Values

The calculation of the minimum and maximum values will be started:

- When a Reset signal becomes active (Min/Max)
- When the device is restarted
- After configuration

<i>Minimum and Maximum Values (Peak Values/Pointers)</i>		
	Time interval for the calculation of the minimum and maximum values	Reset
Configuration Options Where to configure? Within menu [Device Para\ Statistics\ Min/Max]	The minimum and maximum values will be reset with the rising edge of the corresponding reset signal.	Res Min Res Max (e.g. via digital Inputs). These signals will reset the minimum and maximum pointers.
<i>Display of Minimum Values</i>	Where? Within menu [Operation\Statistics\Min]	
<i>Display of Maximum Values</i>	Where? Within menu [Operation\Statistics\Max]	

Configuration of the Average Value Calculation

Configuration of the Current Based Average Value Calculation*

*=Availability depends on the ordered device code.

<i>Current based Average Values and Peak Values</i>			
	Time period for the calculation of the average and peak values	Start options	Reset of the average and peak values
Configuration Options Where to configure? In [Device Para\ Statistics\ Demand\ Current Demand]	sliding: (sliding: average calculation based on sliding period) fixed: (fixed: Average calculation is reset by the end of the period, that means with the next starting period)	duration: (fixed or sliding period) Start Fct: (The average values are calculated based on the time period between two rising edges of this signal)	Res Fc (e.g. via Digital Input in order to reset the average values in advance (before the next rising edge of the start signal). This applies to option »Start FC« only.
<i>Trip (command) option to limit the average current demand:</i> Yes	Please refer to chapter »System Alarms«		
<i>View average values and peak values</i>	Where? Within menu [Operation\Statistics\Demand]		

Configuration of the Voltage Based Average Value Calculation*

*=Availability depends on the ordered device code.

	Voltage based Average Values		
	Time period for the calculation of the average values	Start options	Reset of the average and peak values
Configuration Options Where to configure? In [Device Para\ Statistics\ Umit]	sliding: (sliding: average calculation based on sliding period) fixed: (fixed: Average calculation is reset by the end of the period, that means with the next starting period)	duration: (fixed or sliding period) Start Fct: (The average values are calculated based on the time period between two rising edges of this signal)	Res Fc (e.g. via Digital Input in order to reset the average values in advance (before the next rising edge of the start signal). This applies to option »Start FC« only.
View average values	Where? Within menu [Operation\Statistics\Vavg]		

Configuration of the Power Based Average Value Calculation*

*=Availability depends on the ordered device code.

	Power based Average Values (Demand) and Peak Values		
	Time period for the calculation of the average and peak values	Start options	Reset of the average and peak values
Configuration Options Where to configure? In [Device Para\ Statistics\ Bezugsmanagm\ Power Demand]	sliding: (sliding: average calculation based on sliding period) fixed: (fixed: Average calculation is reset by the end of the period, that means with the next starting period)	duration: (fixed or sliding period) Start Fct: (The average values are calculated based on the time period between two rising edges of this signal)	Res Fc (e.g. via Digital Input in order to reset the average values in advance (before the next rising edge of the start signal). This applies to option »Start FC« only.
Trip (command) option to limit the average power demand: Yes	Please refer to chapter »System Alarms«		
View average values and peak values	Where? Within menu [Operation\Statistics\Demand]		

Direct Commands

Parameter	Description	Setting range	Default	Menu path
ResFc all 	Resetting of all Statistic values (Current Demand, Power Demand, Min, Max)	Inactive, Active	Inactive	[Operation /Reset]
ResFc I Demand 	Resetting of Statistics - Current Demand (avg, peak avg)	Inactive, Active	Inactive	[Operation /Reset]
ResFc P Demand 	Resetting of Statistics - Power Demand (avg, peak avg)	Inactive, Active	Inactive	[Operation /Reset]
ResFc Min 	Resetting of all Minimum values	Inactive, Active	Inactive	[Operation /Reset]
ResFc Max 	Resetting of all Maximum values	Inactive, Active	Inactive	[Operation /Reset]

Global Protection Parameters of the Statistics Module

Parameter	Description	Setting range	Default	Menu path
ResFc Max 	Resetting of all Maximum values	1..n, Assignment List	.-	[Device Para /Statistics /Min / Max]
ResFc Min 	Resetting of all Minimum values	1..n, Assignment List	.-	[Device Para /Statistics /Min / Max]
Start I Demand via: 	Start Current demand by:	Duration, StartFct	Duration	[Device Para /Statistics /Demand /Current Demand]

Parameter	Description	Setting range	Default	Menu path
Start I Demand Fc 	Start of the calculation, if the assigned signal becomes true. Only available if: Start I Demand via: = StartFct	1..n, Assignment List	-.-	[Device Para /Statistics /Demand /Current Demand]
ResFc I Demand 	Resetting of Statistics - Current Demand (avg, peak avg)	1..n, Assignment List	-.-	[Device Para /Statistics /Demand /Current Demand]
Duration I Demand 	Recording time Only available if: Start I Demand via: = Duration	2 s, 5 s, 10 s, 15 s, 30 s, 1 min, 5 min, 10 min, 15 min, 30 min, 1 h, 2 h, 6 h, 12 h, 1 d, 2 d, 5 d, 7 d, 10 d, 30 d	15 s	[Device Para /Statistics /Demand /Current Demand]
Window I Demand 	Window configuration	Sliding, Fixed	Fixed	[Device Para /Statistics /Demand /Current Demand]
Start P Demand via: 	Start Active Power demand by:	Duration, StartFct	Duration	[Device Para /Statistics /Demand /Power Demand]

Parameter	Description	Setting range	Default	Menu path
Start P Demand Fc 	Start of the calculation, if the assigned signal becomes true. Only available if: Start P Demand via: = StartFct	1..n, Assignment List	-.-	[Device Para /Statistics /Demand /Power Demand]
ResFc P Demand 	Resetting of Statistics - Power Demand (avg, peak avg)	1..n, Assignment List	-.-	[Device Para /Statistics /Demand /Power Demand]
Duration P Demand 	Recording time Only available if: Start P Demand via: = Duration	2 s, 5 s, 10 s, 15 s, 30 s, 1 min, 5 min, 10 min, 15 min, 30 min, 1 h, 2 h, 6 h, 12 h, 1 d, 2 d, 5 d, 7 d, 10 d, 30 d	15 s	[Device Para /Statistics /Demand /Power Demand]
Window P Demand 	Window configuration	Sliding, Fixed	Sliding	[Device Para /Statistics /Demand /Power Demand]

States of the Inputs of the Statistics Module

Name	Description	Assignment via
StartFc I Demand-I	State of the module input: Start of Statistics of the Current Demand (Update the displayed Demand)	[Device Para /Statistics /Demand /Current Demand]
StartFc P Demand-I	State of the module input: Start of Statistics of the Active Power Demand	[Device Para /Statistics /Demand /Power Demand]
ResFc I Demand-I	State of the module input: Resetting of Statistics - Current Demand (avg, peak avg)	[Device Para /Statistics /Demand /Current Demand]
ResFc P Demand-I	State of the module input: Resetting of Statistics - Power Demand (avg, peak avg)	[Device Para /Statistics /Demand /Power Demand]
ResFc Max-I	State of the module input: Resetting of all Maximum values	[Device Para /Statistics /Min / Max]
ResFc Min-I	State of the module input: Resetting of all Minimum values	[Device Para /Statistics /Min / Max]

Signals of the Statistics Module

<i>Signal</i>	<i>Description</i>
ResFc all	Signal: Resetting of all Statistic values (Current Demand, Power Demand, Min, Max)
ResFc I Demand	Signal: Resetting of Statistics - Current Demand (avg, peak avg)
ResFc P Demand	Signal: Resetting of Statistics - Power Demand (avg, peak avg)
ResFc Max	Signal: Resetting of all Maximum values
ResFc Min	Signal: Resetting of all Minimum values

Counters of the Module Statistics

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Res Cr I Demand	Number of resets since last booting. The timestamp shows date and time of the last reset.	[Operation /Statistics /Demand /Current Demand]
Res Cr P Demand	Number of resets since last booting. The timestamp shows date and time of the last reset.	[Operation /Statistics /Demand /Power Demand]
Res Cr Min values	Number of resets since last booting. The timestamp shows date and time of the last reset.	[Operation /Statistics /Min /Power]
Res Cr Max values	Number of resets since last booting. The timestamp shows date and time of the last reset.	[Operation /Statistics /Max /49]

Phase Differential Current - Statistic Values

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
IrA max	Measured Value (Calculated): Restraint Current Phase A Maximum Value	[Operation /Statistics /Max /87]
IrB max	Measured Value (Calculated): Restraint Current Phase B Maximum Value	[Operation /Statistics /Max /87]
IrC max	Measured Value (Calculated): Restraint Current Phase C Maximum Value	[Operation /Statistics /Max /87]
IdA max	Measured Value (Calculated): Differential Current Phase A Maximum Value	[Operation /Statistics /Max /87]
IdB max	Measured Value (Calculated): Differential Current Phase B Maximum Value	[Operation /Statistics /Max /87]
IdC max	Measured Value (Calculated): Differential Current Phase C Maximum Value	[Operation /Statistics /Max /87]

Earth Differential Current - Statistic Values

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
IrG W2 max	Measured Value (Calculated): Ground Restraint Current Winding 2 Maximum Value	[Operation /Statistics /Max /87GD]
IdG W2 max	Measured Value (Calculated): Ground Differential Current Winding 2 Maximum Value	[Operation /Statistics /Max /87GD]

Current - Statistic Values

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
I1 max Fund.	Maximum value positive phase sequence current (Fundamental)	[Operation /Statistics /Max /CT Ntrl]
I1 min Fund.	Minimum value positive phase sequence current (Fundamental)	[Operation /Statistics /Min /CT Ntrl]
I2 max Fund.	Maximum value unbalanced load current (Fundamental)	[Operation /Statistics /Max /CT Ntrl]
I2 min Fund.	Minimum value unbalanced load current (Fundamental)	[Operation /Statistics /Min /CT Ntrl]
IA max RMS	IA maximum value (RMS)	[Operation /Statistics /Max /CT Ntrl]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
IA avg RMS	IA average value (RMS)	[Operation /Statistics /Demand /Current Demand]
IA min RMS	IA minimum value (RMS)	[Operation /Statistics /Min /CT Ntrl]
IB max RMS	IB maximum value (RMS)	[Operation /Statistics /Max /CT Ntrl]
IB avg RMS	IB average value (RMS)	[Operation /Statistics /Demand /Current Demand]
IB min RMS	IB minimum value (RMS)	[Operation /Statistics /Min /CT Ntrl]
IC max RMS	IC maximum value (RMS)	[Operation /Statistics /Max /CT Ntrl]
IC avg RMS	IC average value (RMS)	[Operation /Statistics /Demand /Current Demand]
IC min RMS	IC minimum value (RMS)	[Operation /Statistics /Min /CT Ntrl]
IX meas max RMS	Measured value: IX maximum value (RMS)	[Operation /Statistics /Max /CT Ntrl]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
IX meas min RMS	Measured value: IX minimum value (RMS)	[Operation /Statistics /Min /CT Ntrl]
IR calc max RMS	Measured value (calculated): IR maximum value (RMS)	[Operation /Statistics /Max /CT Ntrl]
IR calc min RMS	Measured value (calculated): IR minimum value (RMS)	[Operation /Statistics /Min /CT Ntrl]
%(I2/I1) max	Measured value (calculated): I2/I1 maximum value, phase sequence will be taken into account automatically	[Operation /Statistics /Max /CT Ntrl]
%(I2/I1) min	Measured value (calculated): I2/I1 minimum value, phase sequence will be taken into account automatically	[Operation /Statistics /Min /CT Ntrl]
IA Peak demand	IA Peak value, RMS value	[Operation /Statistics /Demand /Current Demand]
IB Peak demand	IB Peak value, RMS value	[Operation /Statistics /Demand /Current Demand]
IC Peak demand	IC Peak value, RMS value	[Operation /Statistics /Demand /Current Demand]

Voltage - Statistic Values

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
f max	Max. frequency value	[Operation /Statistics /Max /Voltage]
f min	Min. frequency value	[Operation /Statistics /Min /Voltage]
V1 max Fund.	Maximum value: Symmetrical components positive phase sequence voltage(Fundamental)	[Operation /Statistics /Max /Voltage]
V1 min Fund.	Minimum value: Symmetrical components positive phase sequence voltage(Fundamental)	[Operation /Statistics /Min /Voltage]
V2 max Fund.	Maximum value: Symmetrical components negative phase sequence voltage(Fundamental)	[Operation /Statistics /Max /Voltage]
V2 min Fund.	Minimum value: Symmetrical components negative phase sequence voltage(Fundamental)	[Operation /Statistics /Min /Voltage]
VAB max RMS	VAB maximum value (RMS)	[Operation /Statistics /Max /Voltage]
VAB min RMS	VAB minimum value (RMS)	[Operation /Statistics /Min /Voltage]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
VBC max RMS	VBC maximum value (RMS)	[Operation /Statistics /Max /Voltage]
VBC min RMS	VBC minimum value (RMS)	[Operation /Statistics /Min /Voltage]
VCA max RMS	VCA maximum value (RMS)	[Operation /Statistics /Max /Voltage]
VCA min RMS	VCA minimum value (RMS)	[Operation /Statistics /Min /Voltage]
VA max RMS	VA maximum value (RMS)	[Operation /Statistics /Max /Voltage]
VA min RMS	VA minimum value (RMS)	[Operation /Statistics /Min /Voltage]
VB max RMS	VB maximum value (RMS)	[Operation /Statistics /Max /Voltage]
VB min RMS	VB minimum value (RMS)	[Operation /Statistics /Min /Voltage]
VC max RMS	VC maximum value (RMS)	[Operation /Statistics /Max /Voltage]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
VC min RMS	VC minimum value (RMS)	[Operation /Statistics /Min /Voltage]
VX meas max RMS	Measured value: VX maximum value (RMS)	[Operation /Statistics /Max /Voltage]
VX meas min RMS	Measured value: VX minimum value (RMS)	[Operation /Statistics /Min /Voltage]
VR calc max RMS	Measured value (calculated): VR maximum value (RMS)	[Operation /Statistics /Max /Voltage]
VR calc min RMS	Measured value (calculated): VR minimum value (RMS)	[Operation /Statistics /Min /Voltage]
%(V2/V1) max	Measured value (calculated): V2/V1 maximum value, phase sequence will be taken into account automatically	[Operation /Statistics /Max /Voltage]
%(V2/V1) min	Measured value (calculated): V2/V1 minimum value , phase sequence will be taken into account automatically	[Operation /Statistics /Min /Voltage]
VX meas H3 max	Maximum value: Third harmonic of measured neutral voltage used to detect generator stator ground faults.	[Operation /Statistics /Max /Voltage]
VX meas H3 min	Minimum value: Third harmonic of measured neutral voltage used to detect generator stator ground faults.	[Operation /Statistics /Min /Voltage]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Volts/Hertz max	Maximum value: Ratio Volts/Hertz in relation to nominal values.	[Operation /Statistics /Max /Voltage]
Volts/Hertz min	Minimum value: Ratio Volts/Hertz in relation to nominal values.	[Operation /Statistics /Min /Voltage]

Power - Statistic Values

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Disp PF max	Maximum value of the 55D - Displacement Power Factor: Sign Convention: sign(PF) = sign(Syst W)	[Operation /Statistics /Max /Power]
Disp PF min	Minimum value of the 55D - Displacement Power Factor: Sign Convention: sign(PF) = sign(Syst W)	[Operation /Statistics /Min /Power]
Syst VA max	Maximum value of the apparent power	[Operation /Statistics /Max /Power]
Syst VA avg	Average of the apparent power	[Operation /Statistics /Demand /Power Demand]
Syst VA min	Minimum value of the apparent power	[Operation /Statistics /Min /Power]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Syst W max	Maximum value of the active power	[Operation /Statistics /Max /Power]
Syst W avg	Average of the active power	[Operation /Statistics /Demand /Power Demand]
Syst W min	Minimum value of the active power	[Operation /Statistics /Min /Power]
Syst VAr max	Maximum value of the reactive power	[Operation /Statistics /Max /Power]
Syst VAr avg	Average of the reactive power	[Operation /Statistics /Demand /Power Demand]
Syst VAr min	Minimum value of the reactive power	[Operation /Statistics /Min /Power]
Apt PF max	Maximum value of the 55A - Apparent Power Factor: Sign Convention: $\text{sign(PF)} = \text{sign(Syst W)}$	[Operation /Statistics /Max /Power]
Apt PF min	Minimum value of the 55A - Apparent Power Factor: Sign Convention: $\text{sign(PF)} = \text{sign(Syst W)}$	[Operation /Statistics /Min /Power]
VA Peak demand	VA Peak value, RMS value	[Operation /Statistics /Demand /Power Demand]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Watt Peak demand	WATTS Peak value, RMS value	[Operation /Statistics /Demand /Power Demand]
VAR Peak demand	VARs Peak value, RMS value	[Operation /Statistics /Demand /Power Demand]

System Alarms

Available Elements:

SysA

Within the System Alarms menu [SysA] the User can configure:

- General Settings (activate/inactivate the Demand Management, optional assign a signal, that will block the Demand Management);
- Power Protection (please refer to section 32, 32V, 32VA);
- Demand Management (Power and Current); and
- THD Protection.

Please note, that all thresholds are to be set as primary values.

Demand Management

Demand is the average of system current or power over a time interval (window). Demand management supports the User to keep energy demand below target values bound by contract (with the energy supplier). If the contractual target values are exceeded, extra charges are to be paid to the energy supplier.

Therefore, demand management helps the User detect and avoid averaged peak loads that are taken into account for the billing. In order to reduce the demand charge respective to demand rate, peak loads, if possible, should be diversified. That means, if possible, avoiding large loads at the same time. In order to assist the User in analyzing the demand, demand management might inform the User by an alarm. The User might also use demand alarms and assign them on relays in order to perform load shedding (where applicable).

Demand management comprises:

- Watt Demand (Active Power);
- VAr Demand (Reactive Power);
- VA Demand (Apparent Power); and
- Current Demand.

Configuring the Demand

Configuring the demand is a two step procedure. Proceed as follows.

Step1. Configure the general settings within the [Device Para/Statistics/Demand] menu:

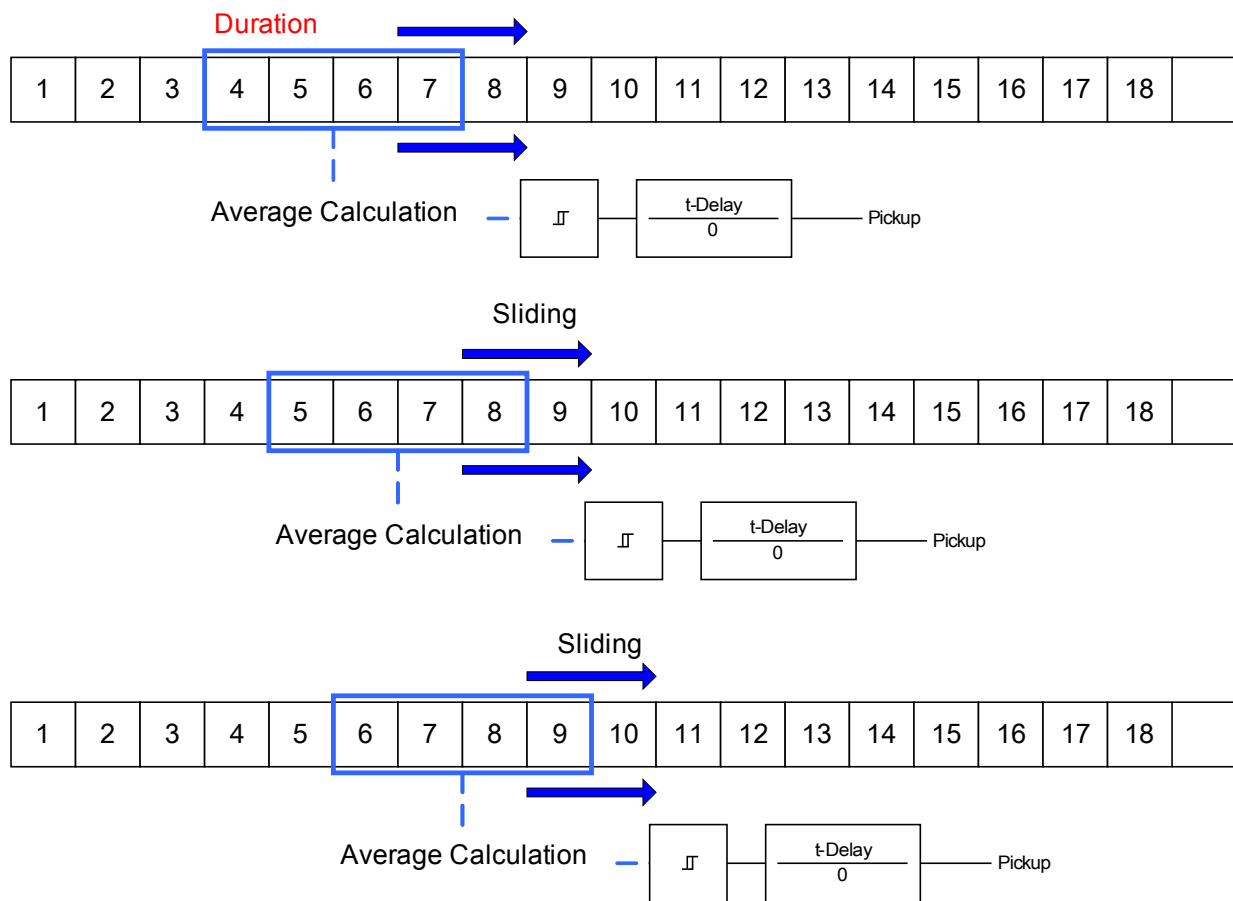
- Set the trigger source to »*Duration*«.
- Select a time base for the »*window*«.
- Determine if the window is »*fixed*« or »*sliding*«.

The interval time (window) can be set to fixed or sliding.

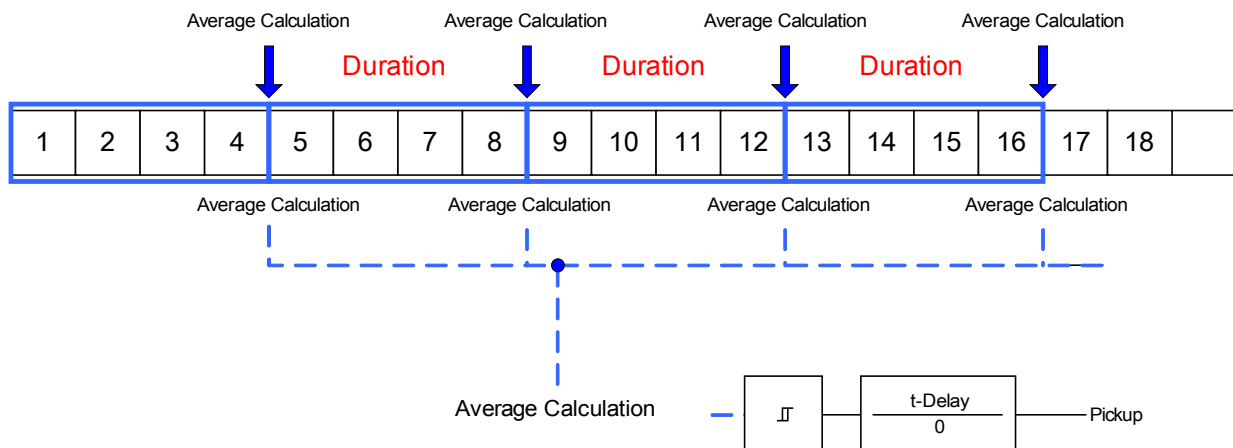
Example for a fixed window: If the range is set for 15 minutes, the protective device calculates the average current or power over the past 15 minutes and updates the value every 15 minutes.

Example for a sliding window: If the sliding window is selected and the interval is set to 15 minutes, the protective device calculates and updates the average current or power continuously, for the past 15 minutes (the newest measuring value replaces the oldest measuring value continuously).

Window configuration = Sliding



Window configuration = Fixed



Step 2. In addition, the Demand specific settings have to be configured in the [SysA] menu:

- Determine if the demand should generate an alarm or if it should run in the silent mode (Alarm active/inactive);
- Set the threshold; and
- Where applicable, set a delay time for the alarm.

Peak Demand

The protective device also saves the peak demand values for current and power. The quantities represent the largest demand value since the demand values were last reset. Peak demands for current and system power are date and time stamped.

Within the [Operation/Statistics/Demand] menu, the current Demand and Peak demand values can be seen.

Min. and Max. Values.

Within the Operation menu the minimum (min.) and maximum (max.) values can be seen.

Minimum values since last reset: The minimum values are continuously compared to the last minimum value for that measuring value. If the new value is less than the last minimum, the value is updated. Within the [Device Para/Statistics] menu, a reset signal can be assigned.

Maximum values since last reset: The maximum values are continuously compared to the last maximum value for that measuring value. If the new value is greater than the last maximum, the value is updated. Within the [Device Para/Statistics] menu, a reset signal can be assigned.

THD Protection

In order to supervise power quality, the protective device can monitor the voltage (phase-to-phase) and current THDs.

Within the [SysA/THD] menu:

- Determine if an alarm is to be issued or not (Alarm active/inactive);
- Set the threshold; and
- Where applicable, set a delay time for the alarm.

Device Planning Parameters of the Demand Management

Parameter	Description	Options	Default	Menu path
Mode	Mode	Do not use, Use	Use	[Device Planning]
				

Signals of the Demand Management (States of the Outputs)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Alarm Watt Power	Signal: Alarm WATTS peak
Alarm VAr Power	Signal: Alarm VArS peak
Alarm VA Power	Signal: Alarm VAS peak
Alarm Watt Demand	Signal: Alarm WATTS demand value
Alarm VAr Demand	Signal: Alarm VARs demand value
Alarm VA Demand	Signal: Alarm VAs demand value
Alm Current Demd	Signal: Alarm Current demand value
Alarm I THD	Signal: Alarm Total Harmonic Distortion Current
Alarm V THD	Signal: Alarm Total Harmonic Distortion Voltage
Trip Watt Power	Signal: Trip WATTS peak
Trip VAr Power	Signal: Trip VArS peak
Trip VA Power	Signal: Trip VAS peak
Trip Watt Demand	Signal: Trip WATTS demand value
Trip VAr Demand	Signal: Trip VARs demand value
Trip VA Demand	Signal: Trip VAs demand value
Trip Current Demand	Signal: Trip Current demand value
Trip I THD	Signal: Trip Total Harmonic Distortion Current
Trip V THD	Signal: Trip Total Harmonic Distortion Voltage

Global Protection Parameter of the Demand Management

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[SysA /General Settings]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	1..n, Assignment List	-.-	[SysA /General Settings]
CT Winding Side 	Measuring values will be used from this winding side	CT Ntrl, CT Line	CT Ntrl	[SysA /General Settings]
Alarm 	Alarm	Inactive, Active	Inactive	[SysA /Power /Watt]
Threshold 	Threshold (to be entered as primary value)	1 - 40000000kW	10000kW	[SysA /Power /Watt]
t-Delay 	Tripping Delay	0 - 60min	0min	[SysA /Power /Watt]
Alarm 	Alarm	Inactive, Active	Inactive	[SysA /Power /VAr]
Threshold 	Threshold (to be entered as primary value)	1 - 40000000kVAr	10000kVAr	[SysA /Power /VAr]
t-Delay 	Tripping Delay	0 - 60min	0min	[SysA /Power /VAr]

Parameter	Description	Setting range	Default	Menu path
Alarm 	Alarm	Inactive, Active	Inactive	[SysA /Power /VA]
Threshold 	Threshold (to be entered as primary value)	1 - 40000000kVA	10000kVA	[SysA /Power /VA]
t-Delay 	Tripping Delay	0 - 60min	0min	[SysA /Power /VA]
Alarm 	Alarm	Inactive, Active	Inactive	[SysA /Demand /Power Demand /Watt Demand]
Threshold 	Threshold (to be entered as primary value)	1 - 40000000kW	10000kW	[SysA /Demand /Power Demand /Watt Demand]
t-Delay 	Tripping Delay	0 - 60min	0min	[SysA /Demand /Power Demand /Watt Demand]
Alarm 	Alarm	Inactive, Active	Inactive	[SysA /Demand /Power Demand /VAr Demand]
Threshold 	Threshold (to be entered as primary value)	1 - 40000000kVAr	20000kVAr	[SysA /Demand /Power Demand /VAr Demand]
t-Delay 	Tripping Delay	0 - 60min	0min	[SysA /Demand /Power Demand /VAr Demand]

Parameter	Description	Setting range	Default	Menu path
Alarm 	Alarm	Inactive, Active	Inactive	[SysA /Demand /Power Demand /VA Demand]
Threshold 	Threshold (to be entered as primary value)	1 - 40000000kVA	20000kVA	[SysA /Demand /Power Demand /VA Demand]
t-Delay 	Tripping Delay	0 - 60min	0min	[SysA /Demand /Power Demand /VA Demand]
Alarm 	Alarm	Inactive, Active	Inactive	[SysA /Demand /Current Demand]
Threshold 	Threshold (to be entered as primary value)	10 - 500000A	500A	[SysA /Demand /Current Demand]
t-Delay 	Tripping Delay	0 - 60min	0min	[SysA /Demand /Current Demand]
Alarm 	Alarm	Inactive, Active	Inactive	[SysA /THD /I THD]
Threshold 	Threshold (to be entered as primary value)	1 - 500000A	500A	[SysA /THD /I THD]
t-Delay 	Tripping Delay	0 - 3600s	0s	[SysA /THD /I THD]
Alarm 	Alarm	Inactive, Active	Inactive	[SysA /THD /V THD]

Parameter	Description	Setting range	Default	Menu path
Threshold 	Threshold (to be entered as primary value)	1 - 500000V	10000V	[SysA /THD /V THD]
t-Delay 	Tripping Delay	0 - 3600s	0s	[SysA /THD /V THD]

States of the Inputs of the Demand Management

Name	Description	Assignment via
ExBlo-I	Module Input State: External Blocking	[SysA /General Settings]

Resets

Collective Acknowledgments for Latched Signals:

Collective Acknowledgments					
	<i>LEDs</i>	<i>Relay Outputs</i>	<i>SCADA</i>	<i>Pending Trip Command</i>	<i>LEDs+ Relay Outputs+ SCADA+ Pending Trip Command</i>
Via PowerPort-E or at the panel all... can be acknowledged. At the panel, the [Operation\ Acknowledge] menu can directly be accessed via the »Ack/Rst« key.	All LEDs at once: Where? [Operation\ Acknowledge]	All Relay Outputs at once: Where? [Operation\ Acknowledge]	All SCADA signals at once: Where? [Operation\ Acknowledge]	All pending trip commands at once: Where? [Operation\ Acknowledge]	All at once: Where? [Operation\ Acknowledge]
External Acknowledgment*: Via a signal from the assignment list (e.g.: a digital Input) all... can be acknowledged.	All LEDs at once: Where? Within the <u>Ex Acknowledge menu.</u>	All Relay Outputs at once: <u>Where?</u> Within the <u>Ex Acknowledge menu.</u>	All SCADA signals at once: <u>Where?</u> Within the <u>Ex Acknowledge menu.</u>	All Pending Trip commands at once: <u>Where?</u> Within the <u>Ex Acknowledge menu.</u>	All at once: <u>Where?</u> Within the <u>Ex Acknowledge menu.</u>

*The External Acknowledgement might be disabled if parameter »Ex Acknowledgement« is set to »inactive« within menu [Device Para/Ex Acknowledge]. This blocks also the acknowledgement via Communication (e.g. Modbus).

Options for Individual Acknowledgments for Latched Signals:

Individual Acknowledgment			
	<i>LEDs</i>	<i>Relay Output</i>	<i>Pending Trip Command</i>
Via a signal from the assignment list (e.g.: a digital Input), a single ... can be acknowledged.	Single LED: Where? Within the Configuration menu of this single LED.	Relay Output: Where? Within the Configuration menu of this single Relay Output.	Pending Trip Command. Where? Within the module <u>BkrManager</u>

NOTICE

If the User is within the parameter setting mode, the User cannot acknowledge.

NOTICE

In case of a fault during parameter setting via the operating panel, the User must first leave the parameter mode by pressing either the push-buttons »Ack/Rst« or »OK« before accessing the »Acknowledgements« menu via the push-button.

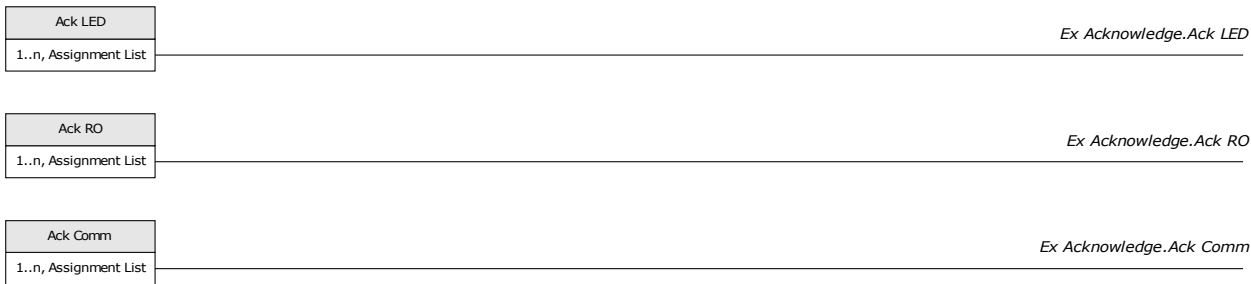
Manual Acknowledgment

- Press the »Ack/Rst« button on the panel.
- Select the item to be acknowledged via the softkeys:
 - Relay Outputs;
 - LEDs;
 - SCADA;
 - A trip command; or
 - All the above mentioned items at once.
- Press the Softkey with the »Wrench-Symbol«.
- Enter the password.

External Acknowledgments

Within the [Device Para\Ex Acknowledge] menu, the User can assign a signal (e.g.: the state of a digital input) from the assignment list that:

- Acknowledges all (acknowledgeable) LEDs at once;
- Acknowledges all (acknowledgeable) Output Relays at once; or
- Acknowledges all (acknowledgeable) Communication (Scada) signals at once.



Manual Resets

In the »Operation/Reset« menu, the User can:

- Reset counters;
- Delete records (e.g.: waveform records); and
- Reset special things (like statistics, thermal replica, etc.).

NOTICE

The description of the reset commands can be found within the corresponding modules.

Reset to Factory Defaults

⚠ WARNING

This Function will reset the device to the factory defaults.
All records will be deleted and the measured values and counters will be reset. The operation hours counter will be kept.

This Function is available at the HMI only.

- Press the »Ack/Rst-key« during a cold start, in order to access the »Reset« menu.
- Select »Reset to factory default«.
- Confirm »Reset device to factory defaults and reboot« with »Yes« in order to execute the reset to factory defaults.«

Status Display

In the status display within the »Operation« menu, the present state of all signals can be viewed. This means the User is able to see if the individual signals are active or inactive at that moment. The User can see all signals sorted by protective elements/modules.

<i>State of the Module Input / Signal Is...</i>	<i>Is Shown at the Panel as...</i>
false / »0«	
true / »1«	

Operating Panel (HMI)

HMI

Special Parameters of the Panel

The »Device Parameter/HMI« menu is used to define the contrast of the display, the maximum admissible edit time, and the menu language (after expiration, all unsaved parameter changes will be rejected).

Direct Commands of the Panel

Parameter	Description	Setting range	Default	Menu path
Contrast 	Contrast	0 - 100%	50%	[Device Para /HMI]

Global Protection Parameters of the Panel

Parameter	Description	Setting range	Default	Menu path
t-max Edit/Access 	If no other key(s) is pressed at the panel, after expiration of this time, all cached (changed) parameters are cancelled. The device access will be locked by falling back into Read-only level Lv0.	20 - 3600s	180s	[Device Para /HMI]
Display Off 	The display back light will be turned off when this timer has expired.	20 - 3600s	180s	[Device Para /HMI]

Recorders

Waveform Recorder

Waveform rec

- Disturbance records can be downloaded (read out) by means of the parameter setting and evaluation software PowerPort-E.
- The disturbance records can be viewed and analyzed within *Quality manager* (will be installed with PowerPort-E).
- Waveform records can be converted into the comtrade file format by means of *Quality manager*.

The waveform recorder works with 32 samples per cycle. It can be started by one of eight start events (selection from the »Assignment list«/OR-Logic).

The waveform record contains the measuring values including the pre-trigger time. By means of PowerPort-E/*Quality Manager* (option), the oscillographic curves of the analog (current, voltage) and digital channels/traces can be shown and evaluated in a graphical form.

The waveform recorder has a storage capacity of 120 s (duration). The amount of records depends on the file size of each record.

The waveform recorder can be configured in the »*Device Parameter/Recorder/Waveform rec*« menu.

Determine the maximum recording time to register a waveform event. The maximum total length of a recording is 10 s (including pre-trigger and post-trigger time).

To trigger the waveform recorder, up to eight signals can be selected from the »Assignment list«. The trigger events are OR-linked. If a waveform record is written, a new waveform record cannot be triggered until all trigger signals, which have triggered the previous waveform record, are gone.

Recording is only done for the time the assigned event exists (event controlled), plus the time for the pre- and post-trigger, but not longer than 10 s. The time for the pre- and post-trigger is to be entered as percent of the maximum file size.

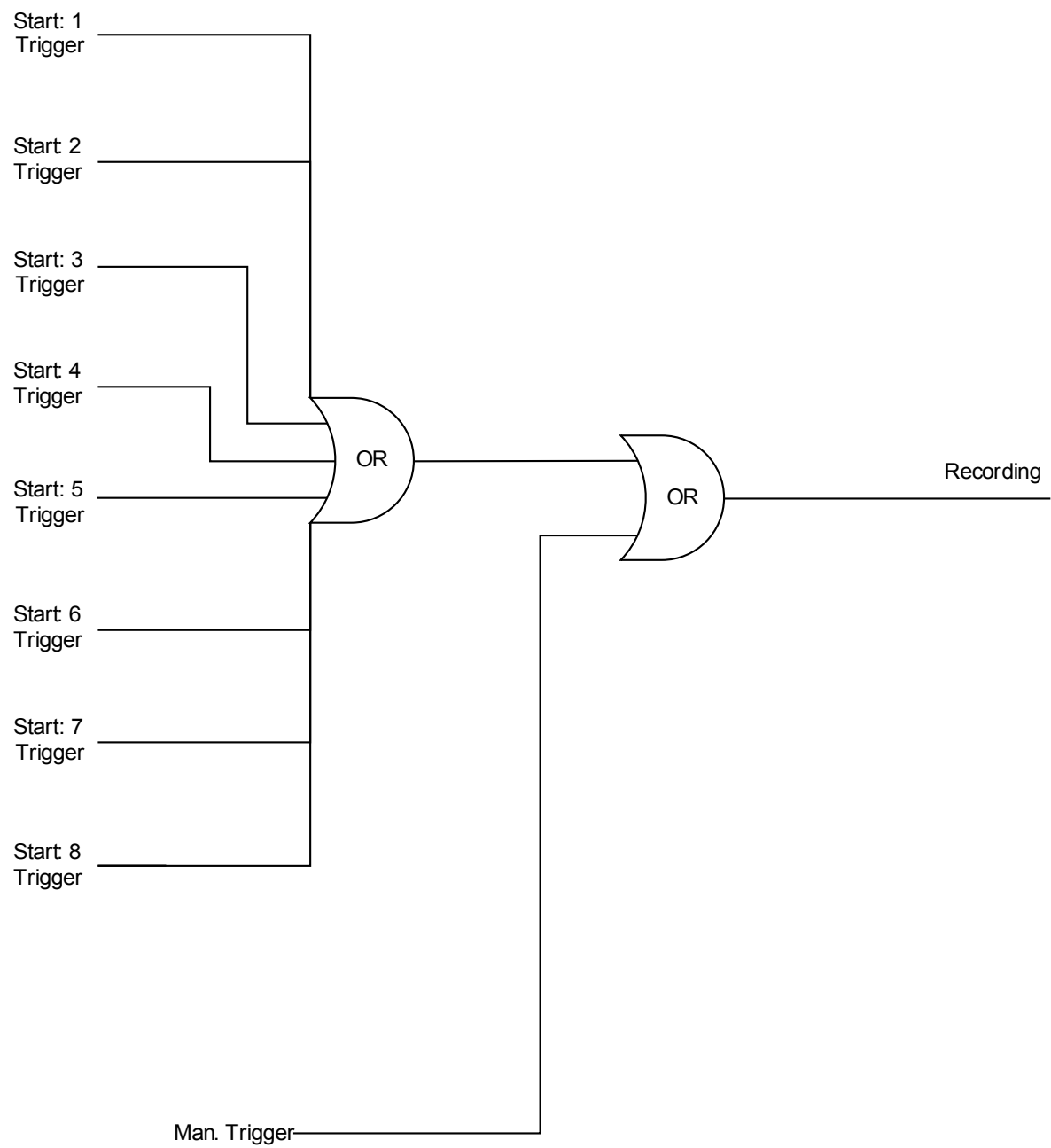
NOTICE

The post-trigger time will be up to the "Post-trigger time" depending on the duration of the trigger signal. The post-trigger will be the remaining time of the "Max file size" but, at maximum, the "Post-trigger time".

Example

The waveform recorder is started by the general activation facility. After the fault has been cleared (plus follow-up time), the recording process is stopped (but after 10 s at the latest).

The parameter »*Auto Delete*« defines how the device will react if a location to which to save the waveform record is not available. In case »*Auto Delete*« is »*Active*«, the first recorded waveform will be overwritten according to the FIFO principle. If the parameter is set to »*Inactive*«, recording of the waveform events will be stopped until the storage location is manually released.



Start 1 = Prot.Pickup

Start 2 = -.-

Start 3 = -.-

Start 4 = -.-

Start 5 = -.-

Start 6 = -.-

Start 7 = -.-

Start 8 = -.-

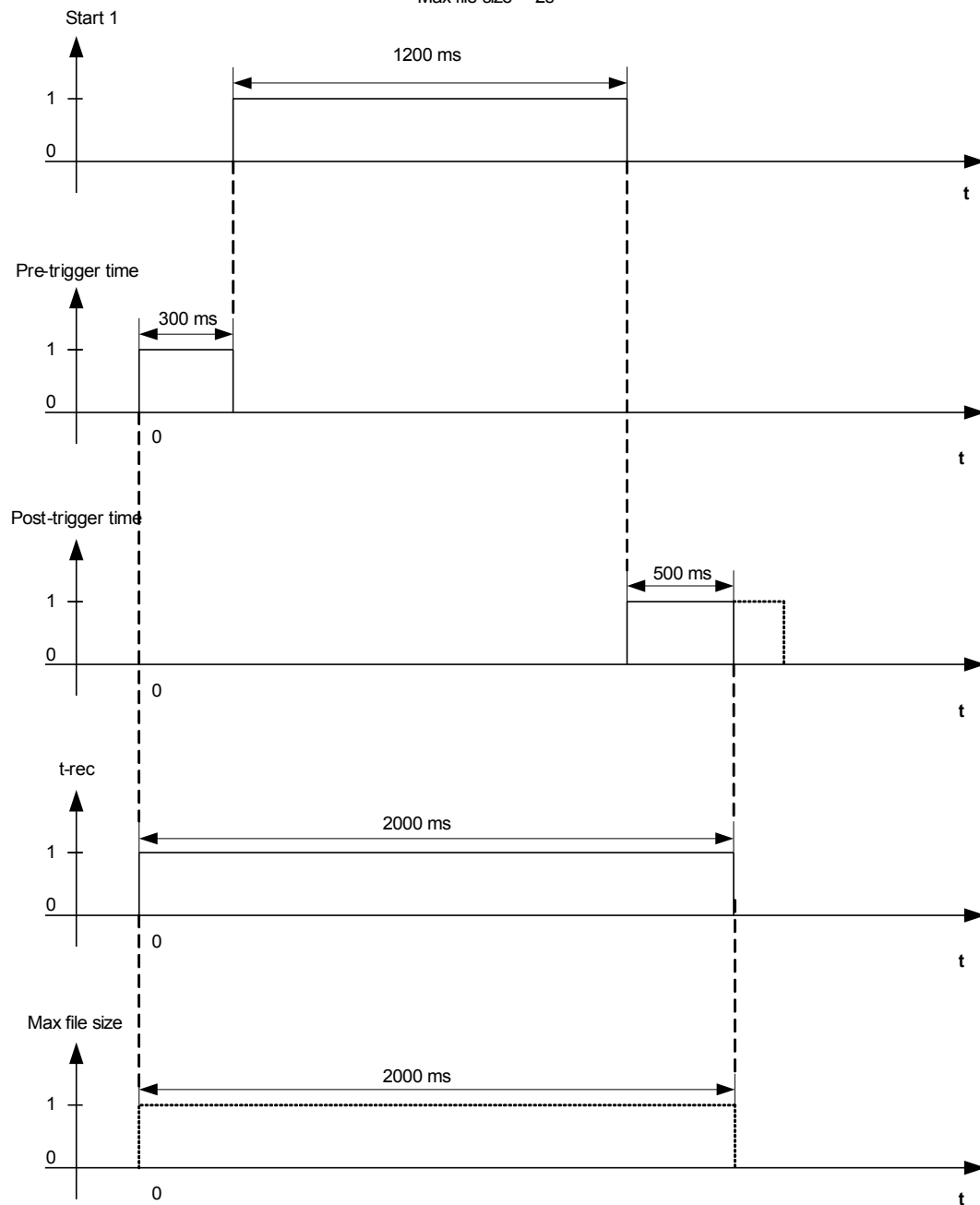
Auto overwriting = Active

Post-trigger time = 25%

Pre-trigger time = 15%

Max file size = 2s

t-rec = Max file size



Start 1 = Prot.Trip

Start 2 = -.-

Start 3 = -.-

Start 4 = -.-

Start 5 = -.-

Start 6 = -.-

Start 7 = -.-

Start 8 = -.-

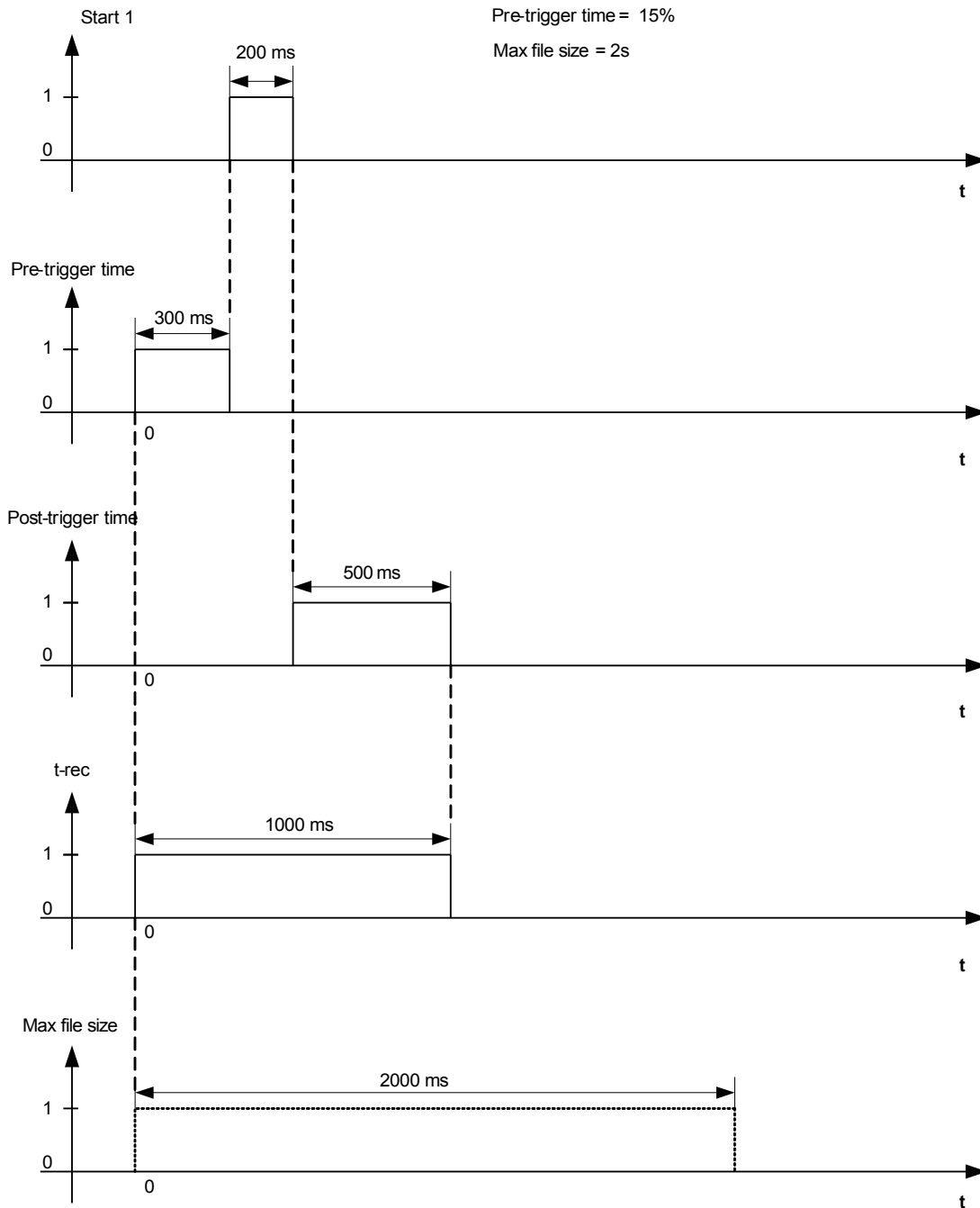
Auto overwriting = Active

Post-trigger time = 25%

Pre-trigger time = 15%

Max file size = 2s

t-rec < Max file size



Read Out of Waveform Records

Within the »Operation/Waveform rec« menu, the User can:

- Detect the accumulated waveform records.

NOTICE

Within the »Operation/Recorders/Man Trigger« menu, the User can trigger the waveform recorder manually.

Deleting Waveform Records

Within the »Operation/Waveform rec« menu, the User can:

- Delete waveform records;
- Choose the waveform record that is to be deleted via »SOFTKEY« »up« and »SOFTKEY« »down«;
- Call up the detailed view of the waveform record via »SOFTKEY« »right«;
- Confirm by pressing »SOFTKEY« »delete«;
- Enter the User password followed by pressing the »OK« key;
- Choose whether only the current or all waveform records should be deleted; and
- Confirm by pressing »SOFTKEY« »OK«.

Direct Commands of the Waveform Recorder Module

Parameter	Description	Setting range	Default	Menu path
Man. Trigger 	Manual Trigger	False, True	False	[Operation /Recorders /Man. Trigger]
Res all rec 	Reset all records	Inactive, Active	Inactive	[Operation /Reset]

Global Protection Parameters of the Waveform Recorder Module

Parameter	Description	Setting range	Default	Menu path
Start: 1 	Start recording if the assigned signal is true.	1..n, Assignment List	Prot.Pickup	[Device Para /Recorders /Waveform rec]
Start: 2 	Start recording if the assigned signal is true.	1..n, Assignment List	Prot.Trip	[Device Para /Recorders /Waveform rec]
Start: 3 	Start recording if the assigned signal is true.	1..n, Assignment List	-.-	[Device Para /Recorders /Waveform rec]
Start: 4 	Start recording if the assigned signal is true.	1..n, Assignment List	-.-	[Device Para /Recorders /Waveform rec]
Start: 5 	Start recording if the assigned signal is true.	1..n, Assignment List	-.-	[Device Para /Recorders /Waveform rec]
Start: 6 	Start recording if the assigned signal is true.	1..n, Assignment List	-.-	[Device Para /Recorders /Waveform rec]

Parameter	Description	Setting range	Default	Menu path
Start: 7 	Start recording if the assigned signal is true.	1..n, Assignment List	.-	[Device Para /Recorders /Waveform rec]
Start: 8 	Start recording if the assigned signal is true.	1..n, Assignment List	.-	[Device Para /Recorders /Waveform rec]
Auto overwriting 	If there is no more free memory capacity left, the oldest file will be overwritten.	Inactive, Active	Active	[Device Para /Recorders /Waveform rec]
Post-trigger time 	The post trigger time is settable up to a maximum of 50% of the Maximum file size setting. The post-trigger will be the remaining time of the "Max file size" but at maximum "Post-trigger time"	0 - 50%	20%	[Device Para /Recorders /Waveform rec]
Pre-trigger time 	The pre trigger time is settable up to a maximum of 50% of the Maximum file size setting.	0 - 50%	20%	[Device Para /Recorders /Waveform rec]
Max file size 	The maximum storage capacity per record is 10 seconds, including pre-trigger and post-trigger time. The waveform recorder has a total storage capacity of 120 seconds.	0.1 - 10.0s	2s	[Device Para /Recorders /Waveform rec]

Waveform Recorder Module Input States

Name	Description	Assignment via
Start1-I	State of the module input:: Trigger event / start recording if:	[Device Para /Recorders /Waveform rec]
Start2-I	State of the module input:: Trigger event / start recording if:	[Device Para /Recorders /Waveform rec]
Start3-I	State of the module input:: Trigger event / start recording if:	[Device Para /Recorders /Waveform rec]
Start4-I	State of the module input:: Trigger event / start recording if:	[Device Para /Recorders /Waveform rec]
Start5-I	State of the module input:: Trigger event / start recording if:	[Device Para /Recorders /Waveform rec]
Start6-I	State of the module input:: Trigger event / start recording if:	[Device Para /Recorders /Waveform rec]
Start7-I	State of the module input:: Trigger event / start recording if:	[Device Para /Recorders /Waveform rec]
Start8-I	State of the module input:: Trigger event / start recording if:	[Device Para /Recorders /Waveform rec]

Waveform Recorder Module Signals

Signal	Description
Recording	Signal: Recording
Memory full	Signal: Memory Full
Clear fail	Signal: Clear Failure in Memory
Res all rec	Signal: All records deleted
Res record	Signal: Delete Record
Man. Trigger	Signal: Manual Trigger

Special Parameters of the Waveform Recorder

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
Rec state	Recording state	Ready	Ready, Recording, Writing file, Trigger Blo	[Operation /Status Display /Recorders /Waveform rec]
Error code	Error code	OK	OK, Write err, Clear fail, Calculation err, File not found, Auto overwriting off	[Operation /Status Display /Recorders /Waveform rec]

Fault Recorder

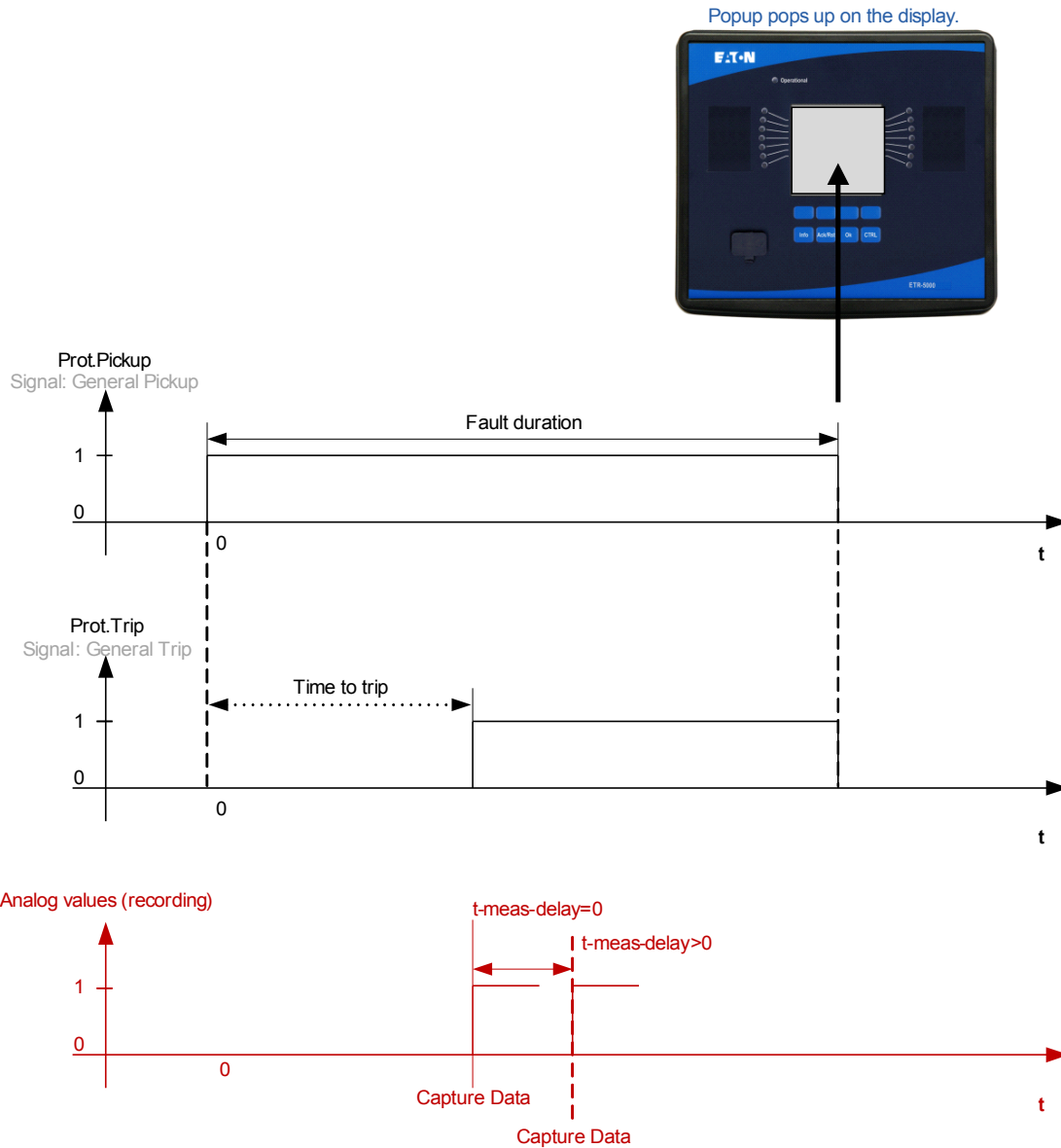
Fault rec

Purpose of the Fault recorder

The *Fault Recorder* provides compressed information about faults (e.g. Trip Causes). The compressed information can be read out also at the HMI. This might be helpful for fast fault analysis already at the HMI. After a fault, a popup window will be sent onto the display in order to draw the users attention to the fault. The *Fault Recorder* will provide information on the causes of the fault. A detailed fault analysis (in oscillographic form) can be done means of the Waveform Recorder. The reference between the Fault Records and the corresponding Waveform (Disturbance) Records are the »*Fault Number*« and the »*Grid Fault Number*«.

Definitions

- Time to Trip:** Time between *First Alarm* (Prot.Pickup) and *First Trip* (Prot.Trip) decision
- Fault Duration:** Time period from the rising edge of the General Pickup (»PROT.PICKUP«) signal up to the falling edge of the General Pickup Signal. Please note that General Pickup is an or-connection (disjunction) of all Pickup signals. General Trip is an OR-connection of all Trips.



Behavior of the Fault Recorder

Who triggers the Fault Recorder?

The Fault Recorder will be triggered by the rising edge of the »PROT.PICKUP« (General Pickup) signal. Please note that »PROT.PICKUP« (General Pickup) is an or-connection of all Pickup signals. The first Pickup will trigger the Fault recorder.

At which point of time will the fault measurements be captured?

The fault measurements will be captured (written) when the trip decision is taken. The point in time, when the measurements are captured (after a trip) can be delayed optionally by the parameter »*t-meas-delay*«. This might be reasonable in order to achieve more reliable measuring values (e.g. in order to avoid measuring disturbances caused by significant DC-components).

Modes

In case of a fault record should be written even if an general alarm has not lead to a trip, the parameter »*Record-Mode*« is to be set to »*Alarms and Pickups*« .

Set parameter »*Record-Mode*« to »*Trips only*«, if an Alarm that is not followed by a trip decision should not lead to a trip.

When does the overlay (popup) appears on the display of the HMI?

A popup will appear on the HMI display, when the General Pickup (Prot.Pickup) disappears.

NOTICE

No time to trip will be shown if the pickup signal that triggers the fault recorder is issued by another protection module than the trip signal. This might happen if more than one protection module is involved into a fault.

NOTICE

Please note: The parameter settings (thresholds etc.) that are shown in a fault record are not part of the fault record itself. They are always read out from the current device setting. If parameters settings that are shown in a fault record could have been updated, they will be indicated with an asterisk symbol within the fault record.

To prevent this please proceed as follows:

Save any fault record that should be archived to your local network/hard disk before doing any parameter change. Delete all the fault records in your fault recorder afterwards.

Memory

The last stored fault record is saved (fail-safe) within the Fault Recorder (the others are saved within a memory that depends on the auxiliary power of the protective relay). If there is no more memory free, the oldest record will be overwritten (FIFO). Up to 20 records can be stored.

How to close the overlay/popup?

By using Softkey »OK«.

How to find out fast, if a fault has lead to a trip or not?

Faults that lead to a trip will be indicated by a flash icon  (right side) within the overview menu of the fault recorder.

Which fault record pops up?

The newest fault.

Content of a Fault Record

A fault record comprises information about:

Date/Time	Date and Time of the Fault			
FaultNr	The number of the fault will be incremented with each fault (General Alarm or »PROT.PICKUP«)			
Grid Fault No.	This counter will be incremented by each General Pickup (Exception AR: this applies only to devices that offer auto reclosing).			
Active Set	The active parameter set			
Time to trip	The time between pickup and trip. Please note: No time to trip will be shown if the first pickup and the first trip are issued by different protection modules.			
Pickup	Name of the module that picked up first.			
Trip	Name of the module that tripped first. The information that will be displayed depends on which protection module has tripped. That means e.g. that the thresholds are shown. In case that the trip was initiated by the MotorStart (applies to motor protection relays) protection module, additional information will be displayed.			
Adaptive Set	In case that adaptive sets are used, the number of the active set will be displayed.			
Fault type	In case of overcurrent trips, the fault type will be evaluated based on the energized phases.			
	Pickup Phase A	Pickup Phase B	Pickup Phase C	Fault Type
	x			AG
		x		BG
			x	CG
	x	x		AB
		x	x	BC
	x		x	AC
	x	x	x	ABC
Direction	In case that a direction has been detected, the evaluated direction will be displayed (this applies to directional phase and ground overcurrent relays only).			
Measured Values	Various measuring values at the time of tripping (or delayed depending on parameter setting) will be displayed.			

How to set up the Fault Recorder

The »*Record-Mode*« will determine if trips only cause a fault record or if also Alarms without a consecutively trip should cause a fault record. This parameter is to be set within menu [Device Para\Recorders\Fault rec]

How to navigate within the Fault Recorder

<i>Navigation within the Fault recorder</i>	Softkey
Back to overview.	
Next (upper) item within this fault record.	
Previous fault record.	
Next (lower) item within this fault record.	

How to read Out the Fault Recorder

In order to read out a fault record there are two options available:

- Option 1: A Fault has popped up on the HMI (because an trip or pickup has occurred).
- Option 2: Call up manually the Fault recorder menu.

Option 1 (in case a fault record pops up on the display (overlay):

- Analyze the fault record by using Softkeys Arrow Up and Arrow Down.
- Or close the Popup by using Softkey OK

Option 2 :

- Call up the main menu;
- Call up the sub-menu »Operation/Recorders/Fault rec.«;
- Select a fault record; and
- Analyze the fault record by using Softkeys Arrow Up and Arrow Down.

How to Test the Fault Recorder

After generating an General Alarm Signal a fault record should be written.

Direct Commands of the Fault Recorder Module

Parameter	Description	Setting range	Default	Menu path
Res all rec 	Reset all records	Inactive, Active	Inactive	[Operation /Reset]

Global Protection Parameters of the Fault Recorder Module

Parameter	Description	Setting range	Default	Menu path
Record-Mode 	Recorder Mode (Set the behaviour of the recorder)	Pickups and Trips, Trips only	Trips only	[Device Para /Recorders /Fault rec]
t-meas-delay 	After the Trip, the measurement will be delayed for this time.	0 - 60ms	0ms	[Device Para /Recorders /Fault rec]

Fault Recorder Module Signals

Signal	Description
Res record	Signal: Delete Record

Event Recorder

Event rec

The event recorder can register up to 300 events and the last 50 (minimum) saved events are stored in non-volatile memory, and therefore retained when power is lost to the unit. The following information is provided for any of the events.

Events are logged as follows:

<i>Record No.</i>	<i>Fault No.</i>	<i>No of grid faults</i>	<i>Date of Record</i>	<i>Module Name</i>	<i>State</i>
Sequential Number	Number of the ongoing fault. This counter will be incremented by each General Pickup (Prot.Pickup).	A grid fault No. can have several Fault Nos. This counter will be incremented by each General Pickup. (Exception AR: this applies only to devices that offer auto reclosing).	Time stamp	What has changed?	Changed Value

There are three different classes of events.

•Alternation of binary states are shown as:

- 0->1 if the signal changes physically from »0« to »1«.
- 1->0 if the signal changes physically from »1« to »0«.

•Counters increment is shown as:

- Old Counter state -> New Counter state (e.g.: 3->4)

•Alternation of multiple states are shown as:

- Old state -> New state (e.g.: 0->2)

Read Out the Event Recorder

- Call up the »*main menu*«.
- Call up the sub-menu »*Operation/Recorders/Event rec*«.
- Select an event.

Direct Commands of the Event Recorder Module

Parameter	Description	Setting range	Default	Menu path
Res all rec 	Reset all records	Inactive, Active	Inactive	[Operation /Reset]

Event Recorder Module Signals

Signal	Description
Res all rec	Signal: All records deleted

Trend Recorder

Available Elements:

Trend rec

Configuring the Trend Recorder

The Trend Recorder is to be configured within [Device Para/Recorders/Trend Recorder] menu.

The User has to set the time interval. This defines the distance between two measuring points.

The User can select up to ten values that will be recorded.

Global Protection Parameters of the Trend Recorder

Parameter	Description	Setting range	Default	Menu path
Resolution 	Resolution (recording frequency)	60 min, 30 min, 15 min, 10 min, 5 min	15 min	[Device Para /Recorders /Trend rec]
Observed Value1 	Observed Value1	1..n, TrendRecList	CT Ntrl.IA RMS	[Device Para /Recorders /Trend rec]
Observed Value2 	Observed Value2	1..n, TrendRecList	CT Ntrl.IB RMS	[Device Para /Recorders /Trend rec]
Observed Value3 	Observed Value3	1..n, TrendRecList	CT Ntrl.IC RMS	[Device Para /Recorders /Trend rec]
Observed Value4 	Observed Value4	1..n, TrendRecList	CT Ntrl.IX meas RMS	[Device Para /Recorders /Trend rec]
Observed Value5 	Observed Value5	1..n, TrendRecList	VT.VA RMS	[Device Para /Recorders /Trend rec]
Observed Value6 	Observed Value6	1..n, TrendRecList	VT.VB RMS	[Device Para /Recorders /Trend rec]
Observed Value7 	Observed Value7	1..n, TrendRecList	VT.VC RMS	[Device Para /Recorders /Trend rec]
Observed Value8 	Observed Value8	1..n, TrendRecList	VT.VX meas RMS	[Device Para /Recorders /Trend rec]
Observed Value9 	Observed Value9	1..n, TrendRecList	-.-	[Device Para /Recorders /Trend rec]

Parameter	Description	Setting range	Default	Menu path
Observed Value10 	Observed Value10	1..n, TrendRecList	.-	[Device Para /Recorders /Trend rec]

Trend Recorder Module Signals (Output States)

Signal	Description
Hand Reset	Hand Reset

Direct Commands of the Trend Recorder

Parameter	Description	Setting range	Default	Menu path
Reset 	Delete all entries	Inactive, Active	Inactive	[Operation /Reset]

Counter Values of the Trend Recorder

Value	Description	Default	Size	Menu path
Max avail Entries	Maximum available entries in the current configuration	0	0 - 999999999	[Operation /Count and RevData /Trend rec]

Global Values of the Trend Recorder

Name	Description
--	No assignment
VT.VA Fund.	Measured value: Phase-to-neutral voltage (Fundamental)
VT.VB Fund.	Measured value: Phase-to-neutral voltage (Fundamental)
VT.VC Fund.	Measured value: Phase-to-neutral voltage (Fundamental)
VT.VX meas Fund.	Measured value (measured): VX measured (Fundamental)
VT.VR calc Fund.	Measured value (calculated): VR (Fundamental)
VT.VAB Fund.	Measured value: Phase-to-phase voltage (Fundamental)
VT.VBC Fund.	Measured value: Phase-to-phase voltage (Fundamental)
VT.VCA Fund.	Measured value: Phase-to-phase voltage (Fundamental)
VT.VA RMS	Measured value: Phase-to-neutral voltage (RMS)
VT.VB RMS	Measured value: Phase-to-neutral voltage (RMS)
VT.VC RMS	Measured value: Phase-to-neutral voltage (RMS)
VT.VX meas RMS	Measured value (measured): VX measured (RMS)
VT.VR calc RMS	Measured value (calculated): VR (RMS)
VT.VAB RMS	Measured value: Phase-to-phase voltage (RMS)
VT.VBC RMS	Measured value: Phase-to-phase voltage (RMS)
VT.VCA RMS	Measured value: Phase-to-phase voltage (RMS)
VT.Volts/Hertz	Ratio Volts/Hertz in relation to nominal values.
VT.V0 Fund.	Measured value (calculated): Symmetrical components Zero voltage(Fundamental)
VT.V1 Fund.	Measured value (calculated): Symmetrical components positive phase sequence voltage(Fundamental)
VT.V2 Fund.	Measured value (calculated): Symmetrical components negative phase sequence voltage(Fundamental)
VT.%(V2/V1)	Measured value (calculated): V2/V1, phase sequence will be taken into account automatically.
VT.VX meas H3	Third harmonic of measured neutral voltage used to detect generator stator ground faults.
VT.f	Measured Value: Frequency
VT.VA THD	Measured value (calculated): VA Total Harmonic Distortion
VT.VB THD	Measured value (calculated): VB Total Harmonic Distortion
VT.VC THD	Measured value (calculated): VC Total Harmonic Distortion
VT.VAB THD	Measured value (calculated): VAB Total Harmonic Distortion
VT.VBC THD	Measured value (calculated): VBC Total Harmonic Distortion
VT.VCA THD	Measured value (calculated): VCA Total Harmonic Distortion
CT Ntrl.IA Fund.	Measured value: Phase current (Fundamental)
CT Ntrl.IB Fund.	Measured value: Phase current (Fundamental)
CT Ntrl.IC Fund.	Measured value: Phase current (Fundamental)
CT Ntrl.IX meas Fund.	Measured value (measured): IX (Fundamental)
CT Ntrl.IR calc Fund.	Measured value (calculated): IR (Fundamental)

Name	Description
CT Ntrl.IA RMS	Measured value: Phase current (RMS)
CT Ntrl.IB RMS	Measured value: Phase current (RMS)
CT Ntrl.IC RMS	Measured value: Phase current (RMS)
CT Ntrl.IX meas RMS	Measured value (measured): IX (RMS)
CT Ntrl.IR calc RMS	Measured value (calculated): IR (RMS)
CT Ntrl.I0 Fund.	Measured value (calculated): Zero current (Fundamental)
CT Ntrl.I1 Fund.	Measured value (calculated): Positive phase sequence current (Fundamental)
CT Ntrl.I2 Fund.	Measured value (calculated): Unbalanced load current (Fundamental)
CT Ntrl.%(I2/I1)	Measured value (calculated): I2/I1, phase sequence will be taken into account automatically.
CT Ntrl.IA avg RMS	IA average value (RMS)
CT Ntrl.IB avg RMS	IB average value (RMS)
CT Ntrl.IC avg RMS	IC average value (RMS)
CT Ntrl.IA THD	Measured Value (Calculated): IA Total Harmonic Current
CT Ntrl.IB THD	Measured Value (Calculated): IB Total Harmonic Current
CT Ntrl.IC THD	Measured Value (Calculated): IC Total Harmonic Current
49.Thermal Cap Used	Measured value: Thermal Capacity Used
URTD.WD1	Winding 1
URTD.WD1 max	Winding1 Maximum Value
URTD.WD2	Winding 2
URTD.WD2 max	Winding2 Maximum Value
URTD.WD3	Winding 3
URTD.WD3 max	Winding3 Maximum Value
URTD.WD4	Winding 4
URTD.WD4 max	Winding4 Maximum Value
URTD.WD5	Winding 5
URTD.WD5 max	Winding5 Maximum Value
URTD.WD6	Winding 6
URTD.WD6 max	Winding6 Maximum Value
URTD.MB1	Motor Bearing 1
URTD.MB1 max	Motor Bearing1 Maximum Value
URTD.MB2	Motor Bearing 2
URTD.MB2 max	Motor Bearing2 Maximum Value
URTD.LB1	Load Bearing 1
URTD.LB1 max	Load Bearing1 Maximum Value
URTD.LB2	Load Bearing 2
URTD.LB2 max	Load Bearing2 Maximum Value
URTD.Aux1	Auxiliary1

Name	Description
URTD.Aux1 max	Auxiliary1 Maximum Value
URTD.Aux2	Auxiliary2
URTD.Aux2 max	Auxiliary2 Maximum Value
URTD.RTD Max	Maximum temperature of all channels.
RTD.Hottest WD	Hottest motor winding temperature in degrees C.
RTD.Hottest MB	Hottest motor bearing temperature in degrees C. Resettable with "Sys Res OperationsCr" or "All".
RTD.Hottest LB	Hottest load bearing temperature in degrees C. Resettable with "Sys Res OperationsCr" or "All".
RTD.Hottest Aux	Hottest Auxiliary temperature in degrees C. Resettable with "Sys Res OperationsCr" or "All".
ECr.Syst VA Fund.	Measured VAs (Fundamental)
ECr.Syst W Fund.	Measured Watts. Active power (P- = Fed Active Power, P+ = Consumpted Active Power) (Fundamental)
ECr.Syst VAr Fund.	Measured VARs. Reactive power (Q- = Fed Reactive Power, Q+ = Consumpted Reactive Power) (Fundamental)
ECr.Syst W 1	Measured Watts. Active power in positive sequence system (P- = Fed Active Power, P+ = Consumpted Active Power)
ECr.Syst VAr 1	Measured VARs. Reactive power in positive sequence system (Q- = Fed Reactive Power, Q+ = Consumpted Reactive Power)
ECr.Syst VA RMS	Measured VAs (RMS)
ECr.Syst W RMS	Measured Watts. Active power (P- = Fed Active Power, P+ = Consumpted Active Power) (RMS)
ECr.Disp PF	Measured Value (Calculated): 55D - Displacement Power Factor: Sign Convention: sign(PF) = sign(Syst W)
ECr.Apt PF	Measured Value (Calculated): 55A - Apparent Power Factor: Sign Convention: sign(PF) = sign(Syst W)
ECr.VAh Net	Net VA Hours
ECr.Wh Net	Net Watt Hours
ECr.VArh Net	Net VAr Hours
ECr.Wh Fwd	Positive Active Power is consumed active energy
ECr.Wh Rev	Negative Active Power (Fed Energy)
ECr.VArh Lag	Positive Reactive Power is consumed Reactive Energy
ECr.VArh Lead	Negative Reactive Power (Fed Energy)
AnIn[1].Value	Measured value of the Input in percent
AnIn[2].Value	Measured value of the Input in percent

Time Synchronization

TimeZones

The device gives the User the ability to synchronize the device with a central time generator. This provides the following advantages:

- The time does not drift from the reference time. A continuously accumulating deviation of the reference time thereby will be balanced. Also refer to the Specifications (Tolerances Real Time Clock) section.
- All time synchronized devices operate with the same time. Therefore, logged events of the individual devices can be compared exactly and be evaluated (single events of the event recorder, waveform records).

The device's time can be synchronized via the following protocols:

- IRIG-B;
- SNTP;
- Communications-Protocol Modbus (RTU or TCP); and/or

These protocols use different hardware interfaces and are different in accuracy. Further information can be found in the Specifications section.

<i>Used Protocol</i>	<i>Hardware-Interface</i>	<i>Recommended Application</i>
Without time synchronization	---	Not recommended.
IRIG-B	IRIG-B Terminal	Recommend, if interface available.
SNTP	RJ45 (Ethernet)	Recommend alternative to IRIG-B, especially when using IEC 61850 or Modbus TCP.
Modbus RTU	RS485, D-SUB or Fiber Optic	Recommend when using Modbus RTU communication protocol and when no IRIG-B real time clock is available.
Modbus TCP	RJ45 (Ethernet)	Limited recommendation when Modbus TCP communication protocol is used and when no IRIG-B real time clock or SNTP-Server is available.

Accuracy of Time Synchronization

The accuracy of the device's synchronized system time depends on different factors:

- Accuracy of the connected time generator;
- Synchronization protocol that is used; and
- At Modbus TCP and SNTP: Network load and data package transmission times

NOTICE

Please consider the accuracy of the time generator used. Deviations of the time generator's time causes the same deviations on the device's system time.

Selection of Timezone and Synchronization Protocol

The protection relay masters both UTC and local time. This means that the device can be synchronized with UTC time while using local time for user display.

Time Synchronization with UTC time (recommended):

Time synchronization is usually done using UTC time. This means for example that an IRIG-B time generator is sending UTC time information to the protection relay. This is the recommended use case, since here a continuous time synchronization can be ensured. There are no “leaps in time” through change of Daylight Savings Time.

To achieve that the device shows the current local time, the timezone and the change to Daylight Savings Time can be configured.

Please carry out the following parameterization steps under [Device Para/ Time]:

1. Select your local timezone in the timezone menu.
2. There also configure the switching of daylight savings time.
3. Select the used time synchronization protocol in the TimeSync menu (e.g. “IRIG-B”).
4. Set the parameters of the synchronization protocol (refer to the according chapter).

Time Synchronization with local time:

Should the time synchronization however be done using local time, then please leave the timezone to »UTC+0 London« and do not use switching of daylight saving time.

NOTICE

The synchronization of the relay's system time is exclusively done by the synchronization protocol selected in the menu [Device Para/ Time/ TimeSync/ Used Protocol].

Without Time Synchronization:

To achieve that the device shows the current local time, the timezone and the change to Daylight Savings Time can be configured.

Please carry out the following parameterization steps under [Device Para/ Time]:

5. Select your local timezone in the timezone menu.
6. There also configure the switching of daylight savings time.
7. Select »manual« as your used protocol in the TimeSync menu.
8. Set date and time.

Global Protection Parameters of the Time Synchronization

Parameter	Description	Setting range	Default	Menu path
DST offset 	Difference to wintertime	-180 - 180min	60min	[Device Para /Time /Timezone]
DST manual 	Manual setting of the Daylight Saving Time	Inactive, Active	Active	[Device Para /Time /Timezone]
Summertime 	Daylight Saving Time Only available if: DST manual = Active	Inactive, Active	Inactive	[Device Para /Time /Timezone]
Summertime m 	Month of clock change summertime Only available if: DST manual = Inactive	January, February, March, April, May, June, July, August, September, October, November, December	March	[Device Para /Time /Timezone]
Summertime d 	Day of clock change summertime Only available if: DST manual = Inactive	Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, General day	Sunday	[Device Para /Time /Timezone]

Parameter	Description	Setting range	Default	Menu path
Summertime w 	Place of selected day in month (for clock change summertime) Only available if: DST manual = Inactive	First, Second, Third, Fourth, Last	Last	[Device Para /Time /Timezone]
Summertime h 	Hour of clock change summertime Only available if: DST manual = Inactive	0 - 23h	2h	[Device Para /Time /Timezone]
Summertime min 	Minute of clock change summertime Only available if: DST manual = Inactive	0 - 59min	0min	[Device Para /Time /Timezone]
Wintertime m 	Month of clock change wintertime Only available if: DST manual = Inactive	January, February, March, April, May, June, July, August, September, October, November, December	October	[Device Para /Time /Timezone]
Wintertime d 	Day of clock change wintertime Only available if: DST manual = Inactive	Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, General day	Sunday	[Device Para /Time /Timezone]
Wintertime w 	Place of selected day in month (for clock change wintertime) Only available if: DST manual = Inactive	First, Second, Third, Fourth, Last	Last	[Device Para /Time /Timezone]

Parameter	Description	Setting range	Default	Menu path
Wintertime h 	Hour of clock change wintertime Only available if: DST manual = Inactive	0 - 23h	3h	[Device Para /Time /Timezone]
Wintertime min 	Minute of clock change wintertime Only available if: DST manual = Inactive	0 - 59min	0min	[Device Para /Time /Timezone]

Parameter	Description	Setting range	Default	Menu path
Time Zones 	Time Zones	UTC+14 Kiritimati, UTC+13 Rawaki, UTC+12.75 Chat- ham Island, UTC+12 Wellington, UTC+11.5 Kingston, UTC+11 Port Vila, UTC+10.5 Lord Howe Island, UTC+10 Sydney, UTC+9.5 Adelaide, UTC+9 Tokyo, UTC+8 Hong Kong, UTC+7 Bangkok, UTC+6.5 Rangoon, UTC+6 Colombo, UTC+5.75 Kath- mandu, UTC+5.5 New Delhi, UTC+5 Islamabad, UTC+4.5 Kabul, UTC+4 Abu Dhabi, UTC+3.5 Tehran, UTC+3 Moscow, UTC+2 Athens, UTC+1 Berlin, UTC+0 London, UTC-1 Azores, UTC-2 Fern. d. No- ronha, UTC-3 Buenos Ai- res, UTC-3.5 St. John's, UTC-4 Santiago, UTC-5 New York, UTC-6 Chicago, UTC-7 Salt Lake City, UTC-8 Los Angeles,	UTC+0 London	[Device Para /Time /Timezone]

Parameter	Description	Setting range	Default	Menu path
TimeSync 	Time synchronization	-, IRIG-B, SNTP, Modbus, DNP	-	[Device Para /Time /TimeSync /TimeSync]

SNTP

SNTP

NOTICE

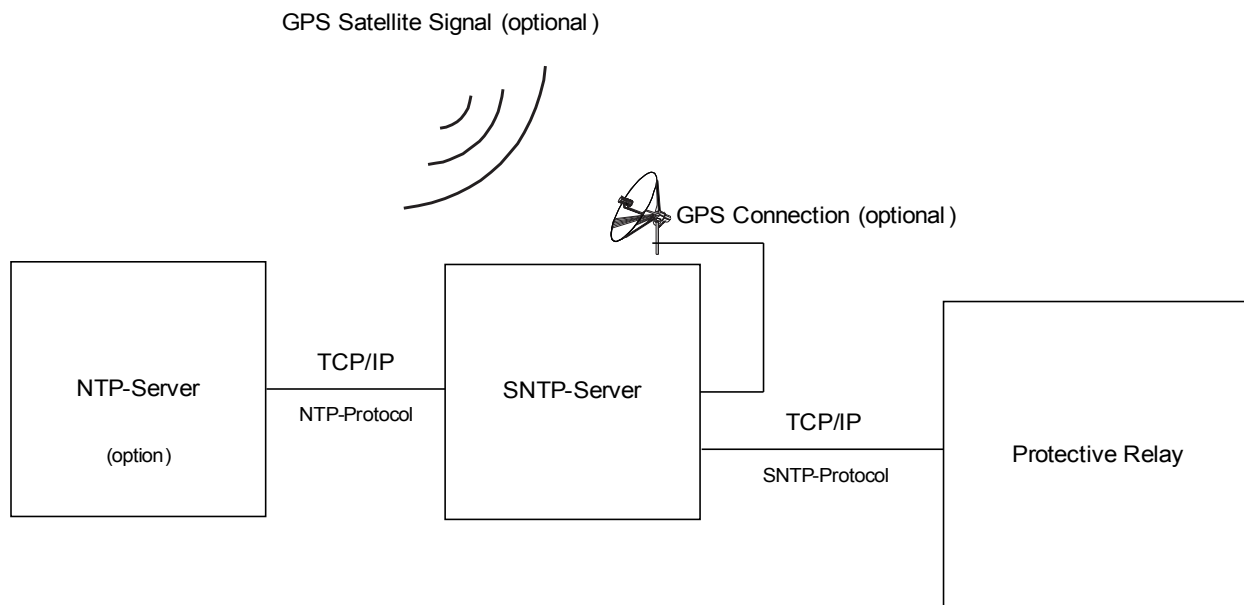
Important pre-condition: The device needs to have access to an SNTP server via the connected network. This server preferably should be installed locally.

Principle – General Use

SNTP is a standard protocol for time synchronization via a network. At minimum, one SNTP server has to be integrated into the network. The device can be configured for one or two connected SNTP servers.

The device's system time will be synchronized by the connected SNTP server 1 to 4 times per minute. In turn, the SNTP server synchronizes its time via NTP with other NTP servers. This is the normal case. Alternatively it can receive its time via GPS, radio controlled clock, or the like.

If the server's "Stratum" has been set manually, it is not an indication of its quality or reliability.



Accuracy

The accuracy of the SNTP server used and the accuracy of its reference clock influences the accuracy of the protection relay's clock.

With each transmitted time information, the SNTP server sends information about its accuracy:

- **Stratum:** The stratum gives information on how close the SNTP server within the cluster is to other NTP servers that are connected to an atomic clock.
- **Precision:** This is the accuracy, the SNTP server provides the system time.

Also the performance (traffic and data package transmission time) of the connected network has an influence on the accuracy of the time synchronization. A locally installed SNTP server with an accuracy of $\leq 200 \mu\text{sec}$ is recommended. If this cannot be provided, the connected server's accuracy can be checked in the [Operation/Status Display/Time Sync.] menu:

- The server quality gives information about the accuracy of the used server. The quality should be GOOD or SUFFICIENT. A server with BAD quality should not be used because this could cause fluctuations of the time synchronization.
- The network quality gives information about the network's load and data package transmission time. The quality should be GOOD or SUFFICIENT. A network with BAD quality should not be used because this could cause fluctuations during time synchronization.

Using two SNTP Servers

When configuring two SNTP servers, the device selects the server with the lower stratum value because this provides a more precise time synchronization. If the servers have the same stratum value, the device selects the server with the better accuracy (precision). It does not matter which of the servers is configured as Server 1 or Server 2. When the last used server fails, the device automatically switches to the other server. When the server recovers, the device switches back to the previous one with the better quality.

SNTP Commissioning

Activate the SNTP time synchronization by means of the [Device Para/ Time/ TimeSync] menu:

- Select »SNTP« in the time synchronization menu.
- Set the IP address of the first server in the SNTP menu.
- Set the IP address of the second server, if available.
- Set all configured servers to "active".

Fault Analysis

If there is no SNTP signal for more than 120 seconds., the SNTP status changes from “active” to “inactive” and an entry in the Event Recorder will be set.

The SNTP functionality can be checked in the [Operation/Status Display/Time Sync./Sntp] menu.

If the SNTP status is not “active”, please proceed as follows:

- Check if the wiring is correct (Ethernet-cable connected).
- Check if a valid IP address is set in the device (Device Para/TCP/IP).
- Check if the Ethernet connection is active (Device Para/TCP/IP/Link = Up?).
- Check if the SNTP server as well as the protection device answers to a Ping.
- Check if the SNTP server is up and working.

Device Planning Parameters of the SNTP

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Do not use	[Device Planning]

Direct Commands of the SNTP

Parameter	Description	Setting range	Default	Menu path
Res Counter 	Reset all Counters.	Inactive, Active	Inactive	[Operation /Reset]

Global Protection Parameters of the SNTP

Parameter	Description	Setting range	Default	Menu path
Server1 	Server 1	Inactive, Active	Inactive	[Device Para /Time /TimeSync /SNTP]
IP Byte1 	IP1.IP2.IP3.IP4	0 - 255	0	[Device Para /Time /TimeSync /SNTP]
IP Byte2 	IP1.IP2.IP3.IP4	0 - 255	0	[Device Para /Time /TimeSync /SNTP]
IP Byte3 	IP1.IP2.IP3.IP4	0 - 255	0	[Device Para /Time /TimeSync /SNTP]
IP Byte4 	IP1.IP2.IP3.IP4	0 - 255	0	[Device Para /Time /TimeSync /SNTP]
Server2 	Server 2	Inactive, Active	Inactive	[Device Para /Time /TimeSync /SNTP]
IP Byte1 	IP1.IP2.IP3.IP4	0 - 255	0	[Device Para /Time /TimeSync /SNTP]
IP Byte2 	IP1.IP2.IP3.IP4	0 - 255	0	[Device Para /Time /TimeSync /SNTP]

Parameter	Description	Setting range	Default	Menu path
IP Byte3 	IP1.IP2.IP3.IP4	0 - 255	0	[Device Para /Time /TimeSync /SNTP]
IP Byte4 	IP1.IP2.IP3.IP4	0 - 255	0	[Device Para /Time /TimeSync /SNTP]

Signals of the SNTP

Signal	Description
SNTP active	Signal: If there is no valid SNTP signal for 120 sec, SNTP is regarded as inactive.

SNTP Counters

Value	Description	Default	Size	Menu path
NoOfSyncs	Total Number of Synchronizations.	0	0 - 999999999	[Operation /Count and RevData /TimeSync /SNTP]
NoOfConnectLost	Total Number of lost SNTP Connections (no sync for 120 sec).	0	0 - 999999999	[Operation /Count and RevData /TimeSync /SNTP]
NoOfSmallSyncs	Service counter: Total Number of very small Time Corrections.	0	0 - 999999999	[Operation /Count and RevData /TimeSync /SNTP]
NoOfNormSyncs	Service counter: Total Number of normal Time Corrections.	0	0 - 999999999	[Operation /Count and RevData /TimeSync /SNTP]

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
NoOfBigSyncs	Service counter: Total Number of big Time Corrections.	0	0 - 999999999	[Operation /Count and RevData /TimeSync /SNTP]
NoOfFiltSyncs	Service counter: Total Number of filtered Time Corrections.	0	0 - 999999999	[Operation /Count and RevData /TimeSync /SNTP]
NoOfSlowTrans	Service counter: Total Number of slow Transfers.	0	0 - 999999999	[Operation /Count and RevData /TimeSync /SNTP]
NoOfHighOffs	Service counter: Total Number of high Offsets.	0	0 - 999999999	[Operation /Count and RevData /TimeSync /SNTP]
NoOfIntTimeouts	Service counter: Total Number of internal timeouts.	0	0 - 999999999	[Operation /Count and RevData /TimeSync /SNTP]
StratumServer1	Stratum of Server 1	0	0 - 999999999	[Operation /Status Display /TimeSync /SNTP]
StratumServer2	Stratum of Server 2	0	0 - 999999999	[Operation /Status Display /TimeSync /SNTP]

SNTP Values

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
Used Server	Which Server is used for SNTP synchronization.	None	Server1, Server2 , None	[Operation /Status Display /TimeSync /SNTP]
PrecServer1	Precision of Server 1	0ms	0 - 1000.00000ms	[Operation /Status Display /TimeSync /SNTP]
PrecServer2	Precision of Server 2	0ms	0 - 1000.00000ms	[Operation /Status Display /TimeSync /SNTP]
ServerQty	Quality of Server used for Synchronization (GOOD, SUFFICIENT, BAD)	-	GOOD, SUFFICIENT, BAD, -	[Operation /Status Display /TimeSync /SNTP]
NetConn	Quality of Network Connection (GOOD, SUFFICIENT, BAD).	-	GOOD, SUFFICIENT, BAD, -	[Operation /Status Display /TimeSync /SNTP]

IRIG-B00X

IRIG-B

NOTICE

Requirement: An IRIG-B00X time code generator is needed. IRIG-B004 and higher will support/transmit the “year information”.

If you are using an IRIG time code that does not support the “year information” (IRIG-B000, IRIG-B001, IRIG-B002, IRIG-B003), you have to set the “year” manually within the device. In these cases the correct year information is a precondition for a properly working IRIG-B.

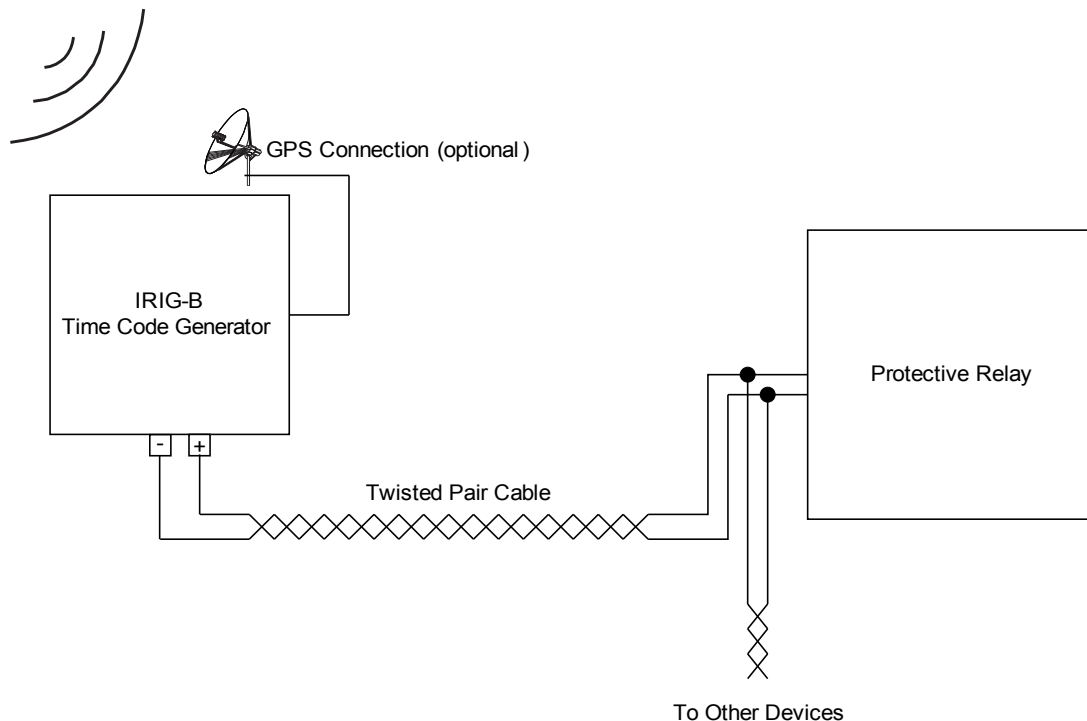
Principle - General Use

The IRIG-B standard is the most used standard to synchronize the time of protection devices in medium voltage applications. The protection device supports IRIG-B according to the IRIG STANDARD 200-04.

This means that all time synchronization formats IRIG-B00X (IRIG-B000 / B001 / B002 / B003 / B004 / B005 / B006 / B007) are supported. It is recommended to use IRIG-B004 and higher which also transmits the “year information”.

The system time of the protection device is being synchronized with the connected IRIG-B code generator once a second. The accuracy of the used IRIG-B code generator can be increased by connecting a GPS-receiver to it.

GPS Satellite Signal (optional)



The location of the IRIG-B interface depends to the device type. Please refer to the wiring diagram supplied with the protective device.

IRIG-B Commissioning

Activate the IRIG-B synchronization within menu [Device Para/ Time/ TimeSync]:

- Select »IRIG-B« in the time synchronization menu.
- Set the time synchronization in the IRIG-B menu to »Active«.
- Select the IRIG-B type (choose B000 through B007).

Fault Analysis

If the device does not receive any IRIG-B time code for more than 60 s, the IRIG-B status switches from »active« to »inactive« and there is created an entry within the Event Recorder.

Check the IRIG-B functionality through the menu [Operation/ Status display/ TimeSync/ IRIG-B]:
Should the IRIG-B status not be reported as being »active«, please proceed as follows:

- To begin with check the IRIG-B wiring.
- Check, if the correct IRIG-B00X type is configured.

IRIG-B Control Commands

In addition to the date and time information, the IRIG-B code offers the option to transmit up to 18 control commands that can be processed by the protective device. They have to be set and issued by the IRIG-B code generator.

The protective device offers up to 18 IRIG-B assignment options for those control commands in order to carry out the assigned action. If there is a control command assigned to an action, this action is being triggered as soon as the control command is transmitted as being true. As an example there can be triggered the start of statistics or the street lighting can be switched on through a relay.

Device Planning Parameters of the IRIG-B00X

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Do not use	[Device Planning]

Direct Commands of the IRIG-B00X

Parameter	Description	Setting range	Default	Menu path
Res IRIG-B Cr 	Resetting of the Diagnosis Counters: IRIG-B	Inactive, Active	Inactive	[Operation /Reset]

Global Protection Parameters of the IRIG-B00X

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Device Para /Time /TimeSync /IRIG-B]
IRIG-B00X 	Determination of the Type: IRIG-B00X. IRIG-B types differ in types of included "Coded Expressions" (year, control-functions, straight-binary-seconds).	IRIGB-000, IRIGB-001, IRIGB-002, IRIGB-003, IRIGB-004, IRIGB-005, IRIGB-006, IRIGB-007	IRIGB-000	[Device Para /Time /TimeSync /IRIG-B]

Signals of the IRIG-B00X (Output States)

<i>Signal</i>	<i>Description</i>
IRIG-B active	Signal: If there is no valid IRIG-B signal for 60 sec, IRIG-B is regarded as inactive.
High-Low Invert	Signal: The High and Low signals of the IRIG-B are inverted. This does NOT mean that the wiring is faulty. If the wiring is faulty no IRIG-B signal will be detected.
Control Signal1	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal2	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal3	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal4	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal5	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal6	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal7	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal8	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal9	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal10	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal11	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal12	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal13	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal14	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal15	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal16	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal17	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
Control Signal18	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).

IRIG-B00X Values

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
NoOfFramesOK	Total number valid Frames.	0	0 - 65535	[Operation /Count and RevData /TimeSync /IRIG-B]
NoOfFrameErrors	Total Number of Frame Errors. Physically corrupted Frame.	0	0 - 65535	[Operation /Count and RevData /TimeSync /IRIG-B]
Edges	Edges: Total number of rising and falling edges. This signal indicates if a signal is available at the IRIG-B input.	0	0 - 65535	[Operation /Count and RevData /TimeSync /IRIG-B]

Device Parameters

Sys

Date and Time

In the »*Device parameters/Date/Time*« menu, the User can set the date and time.

NOTICE

The User cannot set time and date manually (manual changes will be ignored), if the clock of the protective device is synchronized automatically (e.g. via IRIG-B or SNTP).

Version

Within the »*Device parameters/Version*« menu, the User can obtain information on the software and hardware versions.

TCP/IP Settings



WARNING Warning: Mixing up IP Addresses

(In case there is more than one protective device within the TCP/IP network or establishing an unintentional wrong connection to a protective device based on a wrong entered IP address.

Transferring parameters into the wrong protective device might lead to death, personal injury, or damage of electrical equipment.

In order to prevent faulty connections, the User **MUST** document and maintain a list with the IP addresses of any switchboard/protective devices.

The User **MUST** double check the IP addresses of the connection that is to be established. That means, the User **MUST** first read out the IP address at the HMI of the device (within menu [Device para/TCP IP]) then compare the IP address with the list. If the addresses are identical, establish the connection. If they are not, **DO NOT** establish the connection.

Within »Device Para / TCP/IP/TCP/IP Config« menu, the TCP/IP settings have to be set.

The first-time setting of the TCP/IP Parameters can be done at the panel (HMI) only.

NOTICE

Establishing a connection via TCP/IP to the device is only possible if the device is equipped with an Ethernet interface (RJ45).

Contact your IT administrator in order to establish the network connection.

Set the TCP/IP Parameters:

Call up »Device parameter/TCP/IP/TCP/IP Config« at the HMI (panel) and set the following parameters:

- TCP/IP address;
- Subnetmask; and
- Gateway.

Direct Commands of the System Module

Parameter	Description	Setting range	Default	Menu path
Ack RO LED Comm TCmd 	Reset the Relay Outputs, LEDs, Communication, and the Trip Command.	Inactive, Active	Inactive	[Operation /Reset]
Ack LED 	All acknowledgeable LEDs will be acknowledged.	Inactive, Active	Inactive	[Operation /Reset]
Ack RO 	All acknowledgeable Relay Outputs will be acknowledged.	Inactive, Active	Inactive	[Operation /Reset]
Ack Comm 	Communication will be acknowledged.	Inactive, Active	Inactive	[Operation /Reset]
Reboot 	Rebooting the device.	No, Yes	No	[Service /General]
MaintMode Manually 	Arc Flash Reduction Maintenance Switch Mode: Manual Activation of the Arc Flash Reduction Mode Only available if: Maint Mode = Activation Manually	Maint Mode inactive, Activation via Comm, Activation via DI, Inactive, Active	Inactive	[Service /MaintMode Manually]
Program Mode Bypass 	Short-period bypass of the Program Mode.	Inactive, Active	Inactive	[System Para /General Settings]

CAUTION

CAUTION: Manually rebooting the device will release the Supervision Contact.

Global Protection Parameters of the System

Parameter	Description	Setting range	Default	Menu path
PSet-Switch 	Switching Parameter Set	PS1, PS2, PS3, PS4, PSS via Inp fct, PSS via Comm	PSS via Inp fct	[Protection Para /PSet-Switch]
PS1: Activated by 	This Setting Group will be the active one if: The Parameter Setting Group Switch is set to "Switch via Input" and the other three input functions are inactive at the same time. In case there is more than one input function active, no Parameter Setting Group Switch will be executed. In case all input functions are inactive, the device will keep working with the Setting Group that was activated lastly. Only available if: PSet-Switch = PSS via Inp fct	1..n, PSS	Sys.Maint Mode Inactive	[Protection Para /PSet-Switch]
PS2: Activated by 	This Setting Group will be the active one if: The Parameter Setting Group Switch is set to "Switch via Input" and the other three input functions are inactive at the same time. In case there is more than one input function active, no Parameter Setting Group Switch will be executed. In case all input functions are inactive, the device will keep working with the Setting Group that was activated lastly. Only available if: PSet-Switch = PSS via Inp fct	1..n, PSS	Sys.Maint Mode Active	[Protection Para /PSet-Switch]
PS3: Activated by 	This Setting Group will be the active one if: The Parameter Setting Group Switch is set to "Switch via Input" and the other three input functions are inactive at the same time. In case there is more than one input function active, no Parameter Setting Group Switch will be executed. In case all input functions are inactive, the device will keep working with the Setting Group that was activated lastly. Only available if: PSet-Switch = PSS via Inp fct	1..n, PSS	-.-	[Protection Para /PSet-Switch]
PS4: Activated by 	This Setting Group will be the active one if: The Parameter Setting Group Switch is set to "Switch via Input" and the other three input functions are inactive at the same time. In case there is more than one input function active, no Parameter Setting Group Switch will be executed. In case all input functions are inactive, the device will keep working with the Setting Group that was activated lastly. Only available if: PSet-Switch = PSS via Inp fct	1..n, PSS	-.-	[Protection Para /PSet-Switch]

Parameter	Description	Setting range	Default	Menu path
Remote Reset 	Enables or disables the option to acknowledge from external/remote via signals (assignments) and Communication.	Inactive, Active	Active	[Device Para /Ex Acknowledge]
Ack LED 	All acknowledgeable LEDs will be acknowledged if the state of the assigned signal becomes true. Only available if: Remote Reset = Active	1..n, Assignment List	.-	[Device Para /Ex Acknowledge]
Ack RO 	All acknowledgeable Relay Outputs will be acknowledged if the state of the assigned signal becomes true. Only available if: Remote Reset = Active	1..n, Assignment List	.-	[Device Para /Ex Acknowledge]
Ack Comm 	Communication will be acknowledged if the state of the assigned signal becomes true. Only available if: Remote Reset = Active	1..n, Assignment List	.-	[Device Para /Ex Acknowledge]
Scaling 	Display of the measured values as primary, secondary, or per unit values	Per unit values, Primary values, Secondary values	Primary values	[Operation /General Settings]
Maint Mode 	Activation Mode of the Arc Flash Reduction. Switching into another mode is only possible when no Activation Signal is active (pending).	Inactive, Activation Manually, Activation via Comm, Activation via DI	Inactive	[Service /Maint Mode]
Maint Mode Activated by 	Activation Signal for the Arc Flash Reduction Maintenance Switch Only available if: Maint Mode Activated by = Activation via DI	1..n, Dig Inputs	DI-8P X1.DI 7	[Service /Maint Mode]
Program Mode 	Program Mode	Either Bkr Open or Close, Bkr Open	Either Bkr Open or Close	[System Para /General Settings]

System Module Input States

Name	Description	Assignment via
Ack LED-I	Module Input State: LEDs Acknowledgment by Digital Input.	[Device Para /Ex Acknowledge]
Ack RO-I	Module Input State: Acknowledgment of the Relay Outputs.	[Device Para /Ex Acknowledge]
Ack Comm-I	Module Input State: Acknowledge Communication via Digital Input. The replica that Communication has received from the device is to be reset.	[Device Para /Ex Acknowledge]
PS1-I	State of the module input, respectively of the signal, that should activate this Parameter Setting Group.	[Protection Para /PSet-Switch]
PS2-I	State of the module input, respectively of the signal, that should activate this Parameter Setting Group.	[Protection Para /PSet-Switch]
PS3-I	State of the module input, respectively of the signal, that should activate this Parameter Setting Group.	[Protection Para /PSet-Switch]
PS4-I	State of the module input, respectively of the signal, that should activate this Parameter Setting Group.	[Protection Para /PSet-Switch]
Maint Mode-I	Module Input State: Arc Flash Reduction Maintenance Switch	[Service /Maint Mode]

System Module Signals

Signal	Description
Reboot	Signal: Rebooting the device: 1=Restart initiated by power supply; 2=Restart initiated by the User; 3=Set on defaults (Super Reset); 4=Restart by the debugger; 5=Restart because of configuration change; 6=General failure; 7=Restart initiated by System Abort (host side); 8=Restart initiated by watchdog timeout (host side); 9=Restart initiated by System Abort (dsp side); 10=Restart initiated by watchdog timeout (dsp side); 11=Power supply failure (short term interruption) or power supply voltage too low; 12=illegal memory access.
Act Set	Signal: Active Parameter Set
PS 1	Signal: Parameter Set 1
PS 2	Signal: Parameter Set 2
PS 3	Signal: Parameter Set 3
PS 4	Signal: Parameter Set 4
PSS manual	Signal: Manual switch over of a Parameter Set
PSS via Comm	Signal: Parameter Set Switch via Scada. Write into this output byte the integer of the parameter set that should become active (e.g. 4 => Switch onto parameter set 4).
PSS via Inp fct	Signal: Parameter Set Switch via Input Function
Min. 1 param changed	Signal: At least one parameter has been changed

<i>Signal</i>	<i>Description</i>
Program Mode Bypass	Signal: Short-period bypass of the Program Mode.
Maint Mode Active	Signal: Arc Flash Reduction Maintenance Active
Maint Mode Inactive	Signal: Arc Flash Reduction Maintenance Inactive
MaintMode Manually	Signal: Arc Flash Reduction Maintenance Manual Mode
Maint Mode Comm	Signal: Arc Flash Reduction Maintenance Comm Mode
Maint Mode DI	Signal: Arc Flash Reduction Maintenance Digital Input Mode
Param to be saved	Number of parameters to be saved. 0 means that all parameter changes are overtaken.
Ack LED	Signal: LEDs Acknowledgment
Ack RO	Signal: Acknowledgment of the Relay Outputs
Ack Counter	Signal: Reset of all Counters
Ack Comm	Signal: Acknowledge Communication
Ack TripCmd	Signal: Reset Trip Command
Ack LED-HMI	Signal: LEDs Acknowledgment :HMI
Ack RO-HMI	Signal: Acknowledgment of the Relay Outputs :HMI
Ack Counter-HMI	Signal: Reset of all Counters :HMI
Ack Comm-HMI	Signal: Acknowledge Communication :HMI
Ack TripCmd-HMI	Signal: Reset Trip Command :HMI
Ack LED-Comm	Signal: LEDs Acknowledgment :Communication
Ack RO-Comm	Signal: Acknowledgment of the Relay Outputs :Communication
Ack Counter-Comm	Signal: Reset of all Counters :Communication
Ack Comm-Comm	Signal: Acknowledge Communication :Communication
Ack TripCmd-Comm	Signal: Reset Trip Command :Communication

Special Values of the System Module

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Build	Build	[Device Para /Version]
Version	Version	[Device Para /Version]
Operating hours Cr	Operating hours counter of the protective device	[Operation /Count and RevData /Sys]

Communication Protocols

Module: SCADA

Comm

Device Planning Parameters of the Serial SCADA Interface

<i>Parameter</i>	<i>Description</i>	<i>Options</i>	<i>Default</i>	<i>Menu path</i>
Protocol 	CAUTION! Changing the protocol will cause a restart of the device	Do not use, Modbus RTU, Modbus TCP, DNP RTU, DNP TCP, DNP UDP, IEC61850, Profibus	Do not use	[Device Planning]

Signals (Output States) of the SCADA Interface

<i>Signal</i>	<i>Description</i>
Comm connected	At least one Communication system is connected to the device.
Comm not connected	No Communication system is connected to the device.

TCP/IP Parameter

Tcplp

Global TCP/IP Parameters

Parameter	Description	Setting range	Default	Menu path
 Keep Alive Time	Keep Alive Time is the duration between two keep alive transmissions in idle condition	1 - 7200s	720s	[Device Para /TCP/IP /Advanced Settings]
 Keep Alive Interval	Keep Alive Interval is the duration between two successive keep alive retransmissions, if the acknowledgement to the previous keepalive transmission was not received.	1 - 60s	15s	[Device Para /TCP/IP /Advanced Settings]
 Keep Alive Retry	Keep alive retry is the number of retransmissions to be carried out before declaring that the remote end is not available.	3 - 3	3	[Device Para /TCP/IP /Advanced Settings]

Modbus®

Modbus

Modbus® Protocol Configuration

The time-controlled Modbus® protocol is based on the master-slave working principle. This means that the substation control and protection system sends an inquiry or instruction to a certain device (slave address) that will then be answered or carried out accordingly. If the inquiry/instruction cannot be answered/carried out (e.g.: because of an invalid slave address), a failure message is returned to the master.

The master (substation control and protection system) can query information from the device, such as:

- Type of unit version;
- Measuring values/statistical measured values;
- Switch operating position (in preparation);
- State of device;
- Time and date;
- State of the device's digital inputs; and
- Protection-/state pickups.

The master (control system) can give commands/instructions to the device, such as:

- Control of switchgear (where applicable, i.e.: each according to the applied device version);
- Change-over of parameter set;
- Reset and acknowledgment of pickups/signals;
- Adjustment of the date and time; and
- Control of pickup relays.

For detailed information on data point lists and error handling, please refer to the Modbus® documentation.

To allow configuration of the devices for Modbus® connection, some default values of the control system must be available.

Modbus RTU

Part 1: Configuration of the Devices

Call up »*Device parameter/Modbus*« and set the following communication parameters:

- Slave address, to allow clear identification of the device; and
- Baud rate.

Also, select the RS485 interface-related parameters such as:

- Number of data bits;
- One of the following supported communication variants:
 - Number of data bits,
 - Even,
 - Odd,
 - Parity or no parity, or
 - Number of stop bits;
- »*t-timeout*«: communication errors are only identified after expiration of a supervision time »*t-timeout*«; and
- Response time (defining the period within which an inquiry from the master has to be answered).

Part 2: Hardware Connection

- For hardware connection to the control system, there is an RS485 interface at the rear side of the device (RS485, fiber optic or terminals).
- Connect the bus and the device (wiring).
- Up to 32 devices can be connected to the bus (point to point connection/spurs).
- Connect a terminating resistor to the bus.

Error Handling - Hardware Errors

Information on physical communication errors, such as:

- Baud rate error and
- Parity error;

can be obtained from the event recorder.

Error Handling – Errors on Protocol Level

If, for example, an invalid memory address is inquired, error codes will be returned by the device that need to be interpreted.

Modbus TCP

NOTICE

Establishing a connection via TCP/IP to the device is only possible if the device is equipped with an Ethernet Interface (RJ45).

Contact your IT administrator in order to establish the network connection.

Part 1: Setting the TCP/IP Parameters

Call up »Device parameter/TCP/IP« at the HMI (panel) and set the following parameters:

- TCP/IP address;
- Subnetmask; and
- Gateway.

Part 2: Configuration of the Devices

Call up »Device parameter/Modbus« and set the following communication parameters.

- Setting a unit identifier is only necessary if a TCP network should be coupled to a RTU network.
- If a different port than the default port 502 should be used, please proceed as follows:
 - Choose "Private" within the TCP-Port-Configuration.
 - Set the port number.
- Set the maximum acceptable time out for "no communication". If this time has expired without any communication, the device concludes a failure has occurred within the master system.
- Allow or disallow the blocking of SCADA commands.

Part 3: Hardware Connection

- There is a RJ45 interface at the rear side of the device for the hardware connection to the control system.
- Establish the connection to the device by means of a proper Ethernet cable.

Direct Commands of the Modbus®

Parameter	Description	Setting range	Default	Menu path
Res Diagn Cr 	All Modbus Diagnosis Counters will be reset.	Inactive, Active	Inactive	[Operation /Reset]

Global Protection Parameters of the Modbus®

Parameter	Description	Setting range	Default	Menu path
Slave ID 	Device address (Slave ID) within the bus system. Each device address has to be unique within a bus system.	1 - 247	1	[Device Para /Modbus /Communication]
Unit ID 	The Unit Identifier is used for routing. This parameter is to be set, if a Modbus RTU and a Modbus TCP network should be coupled.	1 - 255	255	[Device Para /Modbus /Communication]
TCP Port Config 	TCP Port Configuration. This parameter is to be set only if the default Modbus TCP Port should not be used.	Default, Private	Default	[Device Para /Modbus /Communication]
Port 	Port number And Only available if: TCP Port Config = Private	502 - 65535	502	[Device Para /Modbus /Communication]
t-timeout 	Within this time the answer has to be received by the Communication system, otherwise the request will be disregarded. In that case, the Communication system detects a communication failure and the Communication System has to send a new request.	0.01 - 10.00s	1s	[Device Para /Modbus /Communication]
Baud rate 	Baud rate	1200, 2400, 4800, 9600, 19200, 38400	19200	[Device Para /Modbus /Communication]

Parameter	Description	Setting range	Default	Menu path
Physical Settings 	Digit 1: Number of bits. Digit 2: E=even parity, O=odd parity, N=no parity. Digit 3: Number of stop bits. More information on the parity: It is possible that the last data bit is followed by a parity bit which is used for recognition of communication errors. The parity bit ensures that with even parity ("EVEN") always an even number of bits with valence "1" or with odd parity ("ODD") an odd number of "1" valence bits are transmitted. But it is also possible to transmit no parity bits (here the setting is "Parity = None"). More information on the stop-bits: The end of a data byte is terminated by the stop-bits.	8E1, 8O1, 8N1, 8N2	8E1	[Device Para /Modbus /Communication]
t-call 	If there is no request message sent from Communication to the device after expiry of this time, the device concludes a communication failure within the Communication system.	1 - 3600s	10s	[Device Para /Modbus /Communication]
Comm CmdBlo 	Activating (allowing)/ Deactivating (disallowing) the blocking of the Communication Commands	Inactive, Active	Inactive	[Device Para /Modbus /Communication]
Disable Latching 	Disable Latching: If this parameter is active (true), none of the Modbus states will be latched. That means that trip signals wont be latched by Modbus.	Inactive, Active	Inactive	[Device Para /Modbus /Communication]
AllowGap 	If this parameter is active (True), the User can request a set of modbus register without getting an exception, because of invalid address in the requested array. The invalid addresses have a special value 0xFAFA, but the User is responsible for ignoring invalid addresses. Attention: This special value can be valid, if address is valid.	Inactive, Active	Active	[Device Para /Modbus /Communication]
Optical rest position 	Optical rest position	Light off, Light on	Light on	[Device Para /Modbus /Communication]
Config Bin Inp1 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	SSV.System Error	[Device Para /Modbus /Configb Registers /States]

Parameter	Description	Setting range	Default	Menu path
Latched Config Bin Inp1 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp2 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	Prot.Pickup	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp2 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp3 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	Prot.Trip	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp3 	Latched Configurable Binary Input	Inactive, Active	Active	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp4 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	-.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp4 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp5 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	-.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp5 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]

Parameter	Description	Setting range	Default	Menu path
 Config Bin Inp6	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
 Latched Config Bin Inp6	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
 Config Bin Inp7	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
 Latched Config Bin Inp7	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
 Config Bin Inp8	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
 Latched Config Bin Inp8	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
 Config Bin Inp9	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	Bkr.Pos OPEN	[Device Para /Modbus /Configb Registers /States]
 Latched Config Bin Inp9	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
 Config Bin Inp10	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	Bkr.Pos CLOSE	[Device Para /Modbus /Configb Registers /States]

Parameter	Description	Setting range	Default	Menu path
Latched Config Bin Inp10 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp11 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	BF.Pickup	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp11 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp12 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	BF.Trip	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp12 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp13 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	BF.Lockout	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp13 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp14 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	-.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp14 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]

Parameter	Description	Setting range	Default	Menu path
 Config Bin Inp15	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
 Latched Config Bin Inp15	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
 Config Bin Inp16	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
 Latched Config Bin Inp16	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
 Config Bin Inp17	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	Sgen.Running	[Device Para /Modbus /Configb Registers /States]
 Latched Config Bin Inp17	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
 Config Bin Inp18	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	Sys.Maint Mode Active	[Device Para /Modbus /Configb Registers /States]
 Latched Config Bin Inp18	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
 Config Bin Inp19	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]

<i>Parameter</i>	<i>Description</i>	<i>Setting range</i>	<i>Default</i>	<i>Menu path</i>
Latched Config Bin Inp19 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp20 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp20 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp21 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp21 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp22 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp22 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp23 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp23 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]

Parameter	Description	Setting range	Default	Menu path
Config Bin Inp24 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp24 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp25 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp25 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp26 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp26 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp27 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp27 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp28 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]

Parameter	Description	Setting range	Default	Menu path
Latched Config Bin Inp28 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp29 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp29 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp30 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp30 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp31 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp31 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp32 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Modbus /Configb Registers /States]
Latched Config Bin Inp32 	Latched Configurable Binary Input	Inactive, Active	Inactive	[Device Para /Modbus /Configb Registers /States]

Parameter	Description	Setting range	Default	Menu path
Mapped Meas 1 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 2 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 3 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 4 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 5 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 6 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 7 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 8 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 9 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]

Parameter	Description	Setting range	Default	Menu path
Mapped Meas 10 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 11 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 12 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 13 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 14 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 15 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]
Mapped Meas 16 	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	1..n, TrendRecList	.-	[Device Para /Modbus /Configb Registers /Measured Values]

States of the Module Inputs of the MODBUS® Protocol

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
Config Bin Inp1-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp2-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp3-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp4-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp5-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp6-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp7-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp8-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
Config Bin Inp9-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp10-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp11-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp12-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp13-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp14-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp15-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp16-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp17-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
Config Bin Inp18-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp19-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp20-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp21-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp22-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp23-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp24-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp25-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp26-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
Config Bin Inp27-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp28-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp29-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp30-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp31-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]
Config Bin Inp32-I	State of the module input: Config Bin Inp	[Device Para /Modbus /Configb Registers /States]

Values of the MODBUS® Protocol

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Mapped Meas 1	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 2	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 3	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 4	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 5	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 6	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 7	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 8	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 9	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 10	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Mapped Meas 11	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 12	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 13	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 14	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 15	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]
Mapped Meas 16	Mapped Measured Values. They can be used to provide measured values to the Modbus Master.	[Operation /Count and RevData /Modbus]

Counters of the MODBUS® Protocol

<i>Parameter</i>	<i>Description</i>
Device Type	Device Type: Eaton: EDR-3000 - 2 EDR-5000 - 3 EMR-3000 - 4 EMR-4000 - 5 EMR-5000 - 6 ETR-4000 - 8 ETR-5000 - 9 EGR-5000 - 12
Comm Version	Modbus Communication version. This version number changes if something becomes incompatible between different Modbus releases.

Modbus® Module Signals (Output States)

NOTICE

Some signals (that are active for a short time only) have to be acknowledged separately (e.g.: trip signals) by the communication system.

<i>Signal</i>	<i>Description</i>
Transmission	Signal: Communication Active
Comm Cmd 1	Communication Command
Comm Cmd 2	Communication Command
Comm Cmd 3	Communication Command
Comm Cmd 4	Communication Command
Comm Cmd 5	Communication Command
Comm Cmd 6	Communication Command
Comm Cmd 7	Communication Command
Comm Cmd 8	Communication Command
Comm Cmd 9	Communication Command
Comm Cmd 10	Communication Command
Comm Cmd 11	Communication Command
Comm Cmd 12	Communication Command
Comm Cmd 13	Communication Command
Comm Cmd 14	Communication Command
Comm Cmd 15	Communication Command
Comm Cmd 16	Communication Command

Modbus® Module Values

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
NoOfRequestsTotal	Total number of requests. Includes requests for other slaves.	0	0 - 999999999	[Operation /Count and RevData /Modbus]
NoOfRequestsForMe	Total Number of requests for this slave.	0	0 - 999999999	[Operation /Count and RevData /Modbus]
NoOfResponse	Total number of requests having been responded.	0	0 - 999999999	[Operation /Count and RevData /Modbus]
NoOfResponTimeO verruns	Total number of requests with exceeded response time. Physically corrupted Frame.	0	0 - 999999999	[Operation /Count and RevData /Modbus]
NoOfOverrunErros	Total Number of Overrun Failures. Physically corrupted Frame.	0	0 - 999999999	[Operation /Count and RevData /Modbus]
NoOfParityErrors	Total number of parity errors. Physically corrupted Frame.	0	0 - 999999999	[Operation /Count and RevData /Modbus]
NoOfFrameErrors	Total Number of Frame Errors. Physically corrupted Frame.	0	0 - 999999999	[Operation /Count and RevData /Modbus]
NoOfBreaks	Number of detected communication aborts	0	0 - 999999999	[Operation /Count and RevData /Modbus]
NoOfQueryInvalid	Total Number of Request errors. Request could not be interpreted	0	0 - 999999999	[Operation /Count and RevData /Modbus]
NoOfInternalError	Total Number of Internal errors while interpreting the request.	0	0 - 999999999	[Operation /Count and RevData /Modbus]

Profibus

Profibus

Part 1: Configuration of the Devices

Call up »*Device parameter/Profibus*« and set the following communication parameter:

- Slave-address, to allow clear identification of the device.

In addition to that the Master has to be provided with the GSD-file. The GSD-file can be taken from the Product-CD.

Part 2: Hardware Connection

- For hardware connection to the control system, there is optional an D-SUB interface at the rear side of the device.
- Connect bus and device (wiring).
- Up to 123 slaves can be connected.
- Terminate the Bus by means of an Terminate Resistor.

Error Handling

Information on physical communication errors, such as:

- Baudrate Error

can be obtained from the event recorder or the status display.

Error Handling – Status LED at the rear side

The Profibus D-SUB interface at the rear side of the device is equipped with an status LED.

- Baud Search -> red flashing
- Baud Found -> green flashing
- Data Exchange -> green
- No Profibus/Unplugged, not connected -> red

Direct Commands of the Profibus

Parameter	Description	Setting range	Default	Menu path
Reset Comds 	All Profibus Commands will be reset.	Inactive, Active	Inactive	[Operation /Reset]

Global Protection Parameters of the Profibus

Parameter	Description	Setting range	Default	Menu path
Config Bin Inp 1 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 1 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 2 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 2 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 3 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 3 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 4 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]

Parameter	Description	Setting range	Default	Menu path
Latched 4 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 5 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 5 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 6 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 6 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 7 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 7 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 8 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 8 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 9 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]

Parameter	Description	Setting range	Default	Menu path
Latched 9 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 10 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 10 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 11 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 11 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 12 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 12 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 13 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 13 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 14 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]

Parameter	Description	Setting range	Default	Menu path
Latched 14 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 15 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 15 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 16 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 1-16]
Latched 16 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 1-16]
Config Bin Inp 17 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 17 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 18 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 18 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 19 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]

Parameter	Description	Setting range	Default	Menu path
Latched 19 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 20 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 20 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 21 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 21 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 22 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 22 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 23 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 23 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 24 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]

Parameter	Description	Setting range	Default	Menu path
Latched 24 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 25 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 25 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 26 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 26 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 27 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 27 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 28 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 28 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 29 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]

Parameter	Description	Setting range	Default	Menu path
Latched 29 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 30 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 30 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 31 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 31 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Config Bin Inp 32 	Virtual Digital Input. This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /Profibus /Config Bin Inp 17-32]
Latched 32 	Defines whether the Input is latched. Only available if: Latched = Active	Inactive, Active	Inactive	[Device Para /Profibus /Config Bin Inp 17-32]
Slave ID 	Device address (Slave ID) within the bus system. Each device address has to be unique within a bus system.	2 - 125	2	[Device Para /Profibus /Bus parameters]

Inputs of the Profibus

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
Assignment 1-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 2-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 3-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 4-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 5-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 6-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 7-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 8-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 9-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 10-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 11-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
Assignment 12-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 13-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 14-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 15-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 16-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 1-16]
Assignment 17-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 18-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 19-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 20-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 21-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 22-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 23-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
Assignment 24-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 25-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 26-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 27-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 28-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 29-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 30-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 31-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]
Assignment 32-I	Module input state: Comm Assignment	[Device Para /Profibus /Config Bin Inp 17-32]

Profibus Signals (Output States)

<i>Signal</i>	<i>Description</i>
Data OK	Data within the input field are OK (Yes=1)
SubModul Err	Assignable Signal, Failure in Sub-Module, Communication Failure.
Connection active	Connection active
Comm Cmd 1	Communication Command
Comm Cmd 2	Communication Command
Comm Cmd 3	Communication Command
Comm Cmd 4	Communication Command
Comm Cmd 5	Communication Command
Comm Cmd 6	Communication Command
Comm Cmd 7	Communication Command
Comm Cmd 8	Communication Command
Comm Cmd 9	Communication Command
Comm Cmd 10	Communication Command
Comm Cmd 11	Communication Command
Comm Cmd 12	Communication Command
Comm Cmd 13	Communication Command
Comm Cmd 14	Communication Command
Comm Cmd 15	Communication Command
Comm Cmd 16	Communication Command

Profibus Values

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
Fr Sync Err	Frames, that were sent from the master to the slave are faulty.	1	1 - 99999999	[Operation /Count and RevData /Profibus]
crcErrors	Number of CRC errors that the ss manager has recognized in received response frames from ss (each error caused a subsystem reset)	1	1 - 99999999	[Operation /Count and RevData /Profibus]
frLossErrors	Number of frame loss errors that the ss manager recognized in received response frames from ss (each error caused a subsystem reset)	1	1 - 99999999	[Operation /Count and RevData /Profibus]
ssCrcErrors	Number of CRC errors that the subsystem has recognized in received trigger frames from host	1	1 - 99999999	[Operation /Count and RevData /Profibus]
ssResets	Number of subsystem resets/restarts from ss manager	1	1 - 99999999	[Operation /Count and RevData /Profibus]
Master ID	Device address (Master ID) within the bus system. Each device address has to be unique within a bus system.	1	1 - 125	[Operation /Status Display /Profibus /State]
HO Id PSub	Handoff Id of PbSub	0	0 - 9999999999	[Operation /Status Display /Profibus /State]
t-WatchDog	The Profibus Chip detects a communication issue if this timer is expired without any communication (Parametrizing telegram).	0	0 - 9999999999	[Operation /Status Display /Profibus /State]

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
Slave State	Communication State between slave and master.	Baud Search	Baud Search, Baud Found, PRM OK, PRM REQ, PRM Fault, CFG Fault, Clear Data, Data exchange	[Operation /Status Display /Profibus /State]
Baud rate	The baud rate that has been detected lastly, will still be shown after a connection issue.	-.-	12 Mb/s, 6 Mb/s, 3 Mb/s, 1.5 Mb/s, 0.5 Mb/s, 187500 baud, 93750 baud, 45450 baud, 19200 baud, 9600 baud, -.-	[Operation /Status Display /Profibus /State]
PNO Id	PNO Identification Number. GSD Identification Number.	0C50h	0C50h	[Operation /Status Display /Profibus /State]

IEC 61850

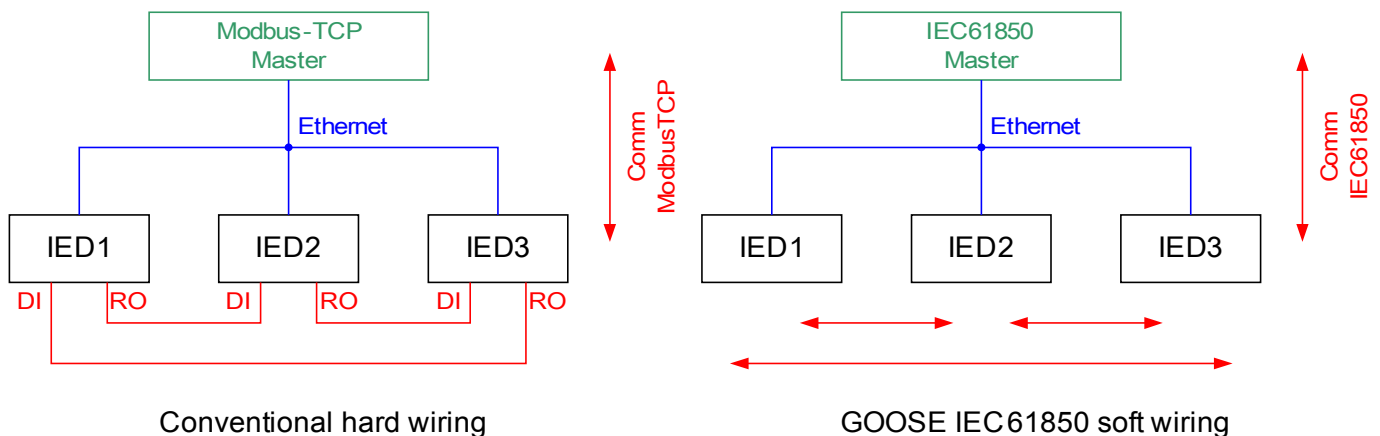
IEC61850

Introduction

To understand the functioning and mode of operation of a substation in an IEC 61850 automation environment, it is useful to compare the commissioning steps with those of a conventional substation in a Modbus TCP environment. In a conventional substation, the individual Intelligent Electronic Devices (IEDs) communicate in a vertical direction with the higher level control center via Communication. The horizontal communication is exclusively realized by wiring relay outputs (RO) and digital inputs (DI) together.

In an IEC 61850 environment, communication between the IEDs takes place digitally (via Ethernet) by a service called Generic Object Oriented Substation Event (GOOSE). By means of this service, information about events is submitted between each IED. Therefore each IED has to know about the functional capability of all other connected IEDs.

Each IEC 61850 capable device includes a description of its own functionality and communications skills (IED Capability Description, *.ICD). By means of a Substation Configuration Tool to describe the structure of the substation, assignment of the devices to the primary technique, etc., virtual wiring of the IEDs between each other and with other switch gear of the substation can be achieved. A description of the substation configuration will be generated in the form of a *.SCD file. Finally, this file has to be submitted to each device. Now the IEDs are able to communicate with each other, react to interlockings, and operate switch gear.



Commissioning steps for a conventional substation with modbus TCP environment:

- Parameter setting of the IEDs;
- Ethernet installation;
- TCP/IP settings for the IEDs; and
- Wiring according to wiring scheme.

Commissioning steps for a substation with IEC 61850 environment:

1. Parameter setting of the IEDs
Ethernet installation
TCP/IP settings for the IEDs
2. IEC 61850 configuration (software wiring)
 - a) Exporting an ICD file from each device
 - b) Configuration of the substation
(generating a SCD file)
 - c) Transmit SCD file to each device.

Generation/Export of a Device Specific ICD File

Each Eaton IEC 61850 capable device includes a description of its own functionality and communications skills in the form of an IED Capability Description (*.ICD) file. This file can be exported as follows and be used for the configuration of the substation.

NOTICE

- **A change of the devices parameters has an influence on the content of the ICD file.**

1. Connect the device with your PC/Notebook.
2. Start PowerPort E.
3. Click on »*Receive data from Device*« in the »*Device*« menu.
4. Click on »*IEC 61850*« in the »*Device Para*« menu.
5. Click on the ICD icon in the IEC 61850 window.
6. Select a drive and file name for the ICD file and click "save".
7. Repeat the steps 1 to 6 for all connected devices in this IEC 61850 environment.

Generation/Export of a SCD file

Each device can create an export it's own functionality and communications skills in form of a *.SCD file.

1. Connect the device with your PC/Notebook.
2. Start Power-Port-E.
3. Click on »*Receive data from Device*« in the menu »*Device*«.
4. Click on »*IEC61850*« in the menu »*Device Para*«.
5. Click on the SCD icon in the IEC61850 window.
6. Select a drive and file name for the SCD file and click "save".
7. Repeat the steps 1 to 6 for all connected devices in this IEC61850 environment.

Generation of a Substation Configuration Description (SCD) File

The substation configuration (i. e. connection of all logical nodes of protection and control devices) as well as switch gear usually is done with a "Substation Configuration Tool". Therefore the ICD files of all connected IEDs in the IEC 61850 environment have to be available. The result of the station wide "software wiring" can be exported in the form of a Station Configuration Description (SCD) file.

Suitable Substation Configuration Tools (SCT) are available by the following Companies:

H&S, Hard- & Software Technologie GmbH & Co. KG, Dortmund (Germany) (www.hstech.de).

Applied Systems Engineering Inc. (www.ase-systems.com)

Kalki Communication Technologies Limited (www.kalkitech.com)

Import of the *.SCD File into the Device

When the substation configuration is completed, the *.SCD file has to be transmitted to all connected devices. This has to be done as follows:

1. Connect the device with your PC/notebook.
2. Start PowerPort E.
3. Click on »*Receive data from Device*« in the »*Device*« menu.
4. Click on »*IEC 61850*« in the »*Device Para*« menu.
5. Switch the parameter »*IEC 61850 Communication*« to »*OFF*« and submit the changed parameter set into the device.
6. Click on the IEC icon in the IEC 61850 window.
7. Select the folder where the *.SCD file is stored. Select the *.SCD file and click "Open".
8. A password is requested. Enter the same password, which you use for parameter setting of the device.
9. Following Step 5, again switch on the IEC Communication and submit the changed parameter set into the device.
10. Repeat Steps 1 through 9 for all devices connected to this IEC 61850 environment.
11. If no error message occurs, the configuration has been completed successfully.



- **When changing the substation configuration, usually a new *.SCD file has to be generated. This *.SCD file must be transmitted to all devices by means of PowerPort E. If the file is not transmitted to all devices, IEC 61850 malfunctions will be the result.**
- **If the parameters of the devices are changed after the completion of the substation configuration, changes in the corresponding *.ICD file may result. This, in turn, may make an update of the *.SCD file necessary.**

IEC 61850 Virtual Outputs

In addition to the standardized logical node status information, up to 32 free configurable status information items can be assigned to the 32 Virtual Outputs. This can be done in the [Device Para/IEC61850] menu.

Direct Commands of the IEC 61850

Parameter	Description	Setting range	Default	Menu path
ResetStatistic 	Reset of all IEC61850 diagnostic counters	Inactive, Active	Inactive	[Operation /Reset]

Global Protection Parameters of the IEC 61850

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Device Para /IEC61850]
Deadb integr time 	Deadband integration time.	0 - 300	0	[Device Para /IEC61850]

Global Parameters of the IEC 61850

Parameter	Description	Setting range	Default	Menu path
VirtualOutput1 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput2 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput3 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput4 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]

Parameter	Description	Setting range	Default	Menu path
VirtualOutput5 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput6 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput7 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput8 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput9 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput10 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput11 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput12 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput13 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput14 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]

Parameter	Description	Setting range	Default	Menu path
VirtualOutput15 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput16 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput17 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput18 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput19 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput20 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput21 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput22 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput23 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput24 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]

Parameter	Description	Setting range	Default	Menu path
VirtualOutput25 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput26 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput27 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput28 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput29 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput30 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput31 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]
VirtualOutput32 	Virtual Output. This signal can be assigned or visualized via the SCD file to other devices within the IEC61850 substation.	1..n, Assignment List	.-	[Device Para /IEC61850]

States of the Inputs of the IEC 61850

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
VirtOut1-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut2-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut3-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut4-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut5-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut6-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut7-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut8-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut9-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut10-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut11-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut12-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut13-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut14-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut15-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut16-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut17-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
VirtOut18-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut19-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut20-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut21-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut22-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut23-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut24-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut25-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut26-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut27-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut28-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut29-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut30-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut31-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]
VirtOut32-I	Module input state: Binary state of the Virtual Output (GGIO)	[Device Para /IEC61850]

IEC 61850 Module Signals (Output States)

<i>Signal</i>	<i>Description</i>
MMS Client connected	At least one MMS client is connected to the device
All Goose Subscriber active	All Goose subscriber in the device are working
VirtInp1	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp2	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp3	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp4	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp5	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp6	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp7	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp8	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp9	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp10	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp11	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp12	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp13	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp14	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp15	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp16	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp17	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp18	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp19	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp20	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp21	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp22	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp23	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp24	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp25	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp26	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp27	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp28	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp29	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp30	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp31	Signal: Virtual Input (IEC61850 GGIO Ind)
VirtInp32	Signal: Virtual Input (IEC61850 GGIO Ind)
Quality of GGIO In1	Self-Supervision of the GGIO Input

<i>Signal</i>	<i>Description</i>
Quality of GGIO In2	Self-Supervision of the GGIO Input
Quality of GGIO In3	Self-Supervision of the GGIO Input
Quality of GGIO In4	Self-Supervision of the GGIO Input
Quality of GGIO In5	Self-Supervision of the GGIO Input
Quality of GGIO In6	Self-Supervision of the GGIO Input
Quality of GGIO In7	Self-Supervision of the GGIO Input
Quality of GGIO In8	Self-Supervision of the GGIO Input
Quality of GGIO In9	Self-Supervision of the GGIO Input
Quality of GGIO In10	Self-Supervision of the GGIO Input
Quality of GGIO In11	Self-Supervision of the GGIO Input
Quality of GGIO In12	Self-Supervision of the GGIO Input
Quality of GGIO In13	Self-Supervision of the GGIO Input
Quality of GGIO In14	Self-Supervision of the GGIO Input
Quality of GGIO In15	Self-Supervision of the GGIO Input
Quality of GGIO In16	Self-Supervision of the GGIO Input
Quality of GGIO In17	Self-Supervision of the GGIO Input
Quality of GGIO In18	Self-Supervision of the GGIO Input
Quality of GGIO In19	Self-Supervision of the GGIO Input
Quality of GGIO In20	Self-Supervision of the GGIO Input
Quality of GGIO In21	Self-Supervision of the GGIO Input
Quality of GGIO In22	Self-Supervision of the GGIO Input
Quality of GGIO In23	Self-Supervision of the GGIO Input
Quality of GGIO In24	Self-Supervision of the GGIO Input
Quality of GGIO In25	Self-Supervision of the GGIO Input
Quality of GGIO In26	Self-Supervision of the GGIO Input
Quality of GGIO In27	Self-Supervision of the GGIO Input
Quality of GGIO In28	Self-Supervision of the GGIO Input
Quality of GGIO In29	Self-Supervision of the GGIO Input
Quality of GGIO In30	Self-Supervision of the GGIO Input
Quality of GGIO In31	Self-Supervision of the GGIO Input
Quality of GGIO In32	Self-Supervision of the GGIO Input
SPCSO1	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO2	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO3	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).

<i>Signal</i>	<i>Description</i>
SPCSO4	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO5	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO6	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO7	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO8	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO9	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO10	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO11	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO12	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO13	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO14	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO15	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO16	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO17	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO18	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO19	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO20	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO21	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO22	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO23	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO24	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO25	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).

<i>Signal</i>	<i>Description</i>
SPCSO26	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO27	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO28	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO29	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO30	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO31	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
SPCSO32	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).

IEC 61850 Module Values

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
NoOfGooseRxAll	Total number of received GOOSE messages including messages for other devices (subscribed and not subscribed messages).	0	0 - 999999999	[Operation /Count and RevData /IEC61850]
NoOfGooseRxSubscribed	Total Number of subscribed GOOSE messages including messages with incorrect content.	0	0 - 999999999	[Operation /Count and RevData /IEC61850]
NoOfGooseRxCorrect	Total Number of subscribed and correctly received GOOSE messages.	0	0 - 999999999	[Operation /Count and RevData /IEC61850]
NoOfGooseRxNew	Number of subscribed and correctly received GOOSE messages with new content.	0	0 - 999999999	[Operation /Count and RevData /IEC61850]
NoOfGooseTxAll	Total Number of GOOSE messages that have been published by this device.	0	0 - 999999999	[Operation /Count and RevData /IEC61850]

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
NoOfGooseTxNew	Total Number of new GOOSE messages (modified content) that have been published by this device.	0	0 - 999999999	[Operation /Count and RevData /IEC61850]
NoOfServerRequests All	Total number of MMS Server requests including incorrect requests.	0	0 - 999999999	[Operation /Count and RevData /IEC61850]
NoOfDataReadAll	Total Number of values read from this device including incorrect requests.	0	0 - 999999999	[Operation /Count and RevData /IEC61850]
NoOfDataReadCorre ct	Total Number of correctly read values from this device.	0	0 - 999999999	[Operation /Count and RevData /IEC61850]
NoOfDataWrittenAll	Total Number of values written by this device including incorrect ones.	0	0 - 999999999	[Operation /Count and RevData /IEC61850]
NoOfDataWrittenCorr ect	Total Number of correctly written values by this device.	0	0 - 999999999	[Operation /Count and RevData /IEC61850]
NoOfDataChangeNot ification	Number of detected changes within the datasets that are published with GOOSE messages.	0	0 - 999999999	[Operation /Count and RevData /IEC61850]
No of Client Connections	Number of active MMS client connections	0	0 - 999999999	[Operation /Count and RevData /IEC61850]

Values of the IEC 61850

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
GoosePublisherState	State of the GOOSE Publisher (on or off)	Off	Off, On, Error	[Operation /Status Display /IEC61850 /State]
GooseSubscriberState	State of the GOOSE Subscriber (on or off)	Off	Off, On, Error	[Operation /Status Display /IEC61850 /State]
MmsServerState	State of MMS Server (on or off)	Off	Off, On, Error	[Operation /Status Display /IEC61850 /State]

DNP3

DNP

DNP (Distributed Network Protocol) is for data and information exchange between SCADA (Master) and IEDs (Intelligent Electronic Devices). The DNP protocol has been developed in first releases for serial communication. Due to further development of the DNP protocol, it offers now also TCP and UDP communication options via Ethernet.

DNP Device Planning

Depending on the hardware of the protective device up to three DNP communication options are available within the Device Planning.

Call up the device planning menu.

Select (depending on device code) the appropriate SCADA Protocol.

- DNP3 RTU (via serial Port)
- DNP3 TCP (via Ethernet)
- DNP3 UDP (via Ethernet)

DNP Protocol General Settings

NOTICE

Please note that unsolicited reporting is not available for serial communication, if more than one slave is connected to the serial communication (collisions). Do not use in these cases unsolicited reporting for DNP RTU.

Unsolicited reporting is available also for serial communication, if each slave is connected via a separated connection to the Master-System. That means, the master is equipped with a separate serial interface for each slave (multi serial cards).

Call up menu [Device Para/DNP3/Communication].

The Communication (General Settings) Settings have to be set according to the needs of the Communication Master – System.

Self Addressing is available for DNP-TCP. That means that the Master and Slave id are auto-detected.

Point Mapping

NOTICE

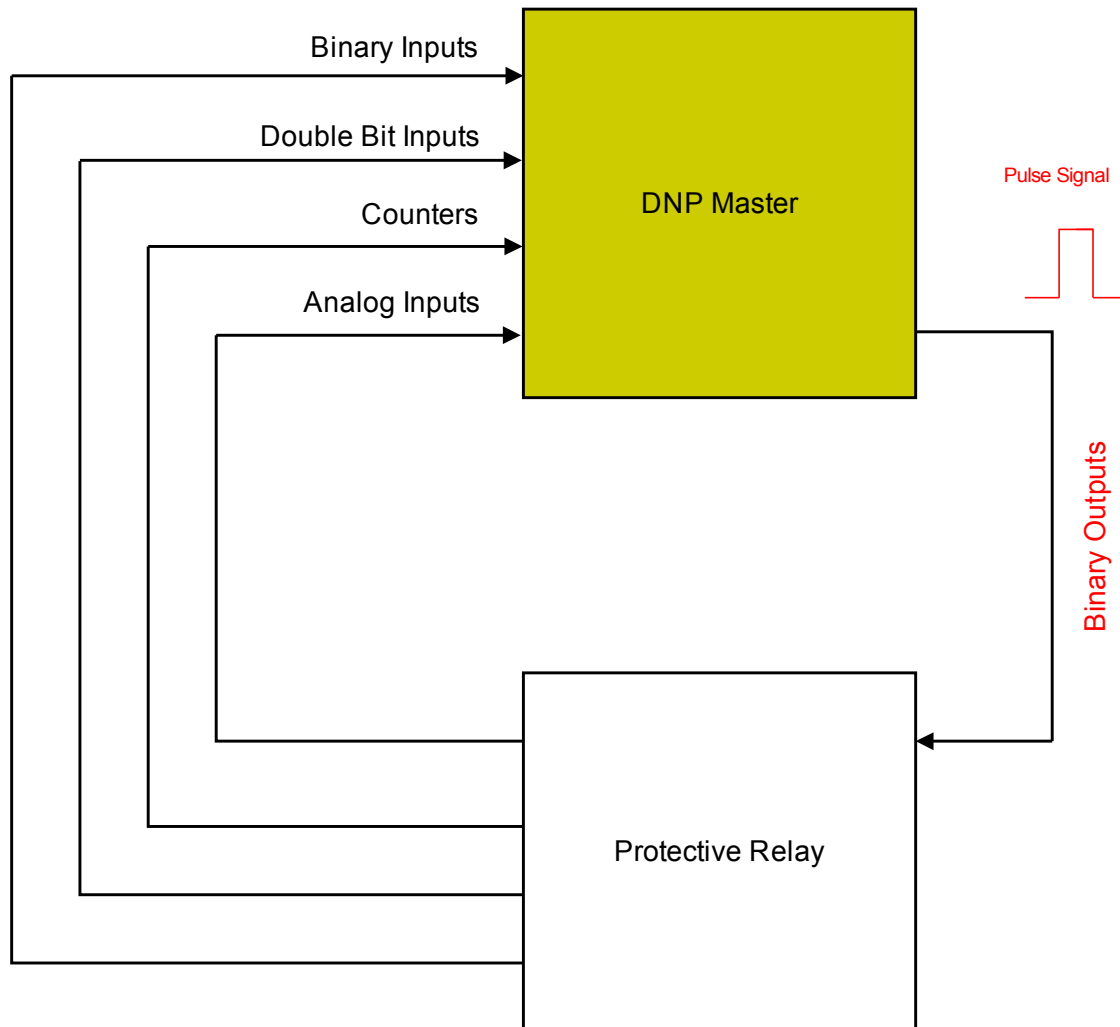
Please take into account that the designations of inputs and outputs are set from the Masters perspective. This way of choosing the designations is due to a definition in the DNP standard. That means for example that Binary Inputs that can be set within the Device Parameters of the DNP protocol are the “Binary Inputs” of the Master.

Call up menu [Device Para/DNP3/Point Map]. Once the general settings of the DNP protocol are done, the point mapping is to be done as a next step.

- Binary Inputs (States to be send to the master)
- Double Bit Inputs (Breaker states to be send to the master)
- Counters (Counters to be send to the master)
- Analog Inputs (e.g. measured values to be send to the master). Please take into account that floating values have to be transmitted as integers. That means they have to be scaled (multiplied) with a scaling factor in order to bring them into the integer format.

Use Binary outputs in order to control e.g. LEDs or Relays within the protective device (via Logic).

Point Mapping



Please try to avoid gaps that will slow down the performance of the DNP communication. That means do not leave unused inputs / outputs in between used inputs / outputs (e.g. Do not use Binary Output 1 and 3 when 2 is unused).

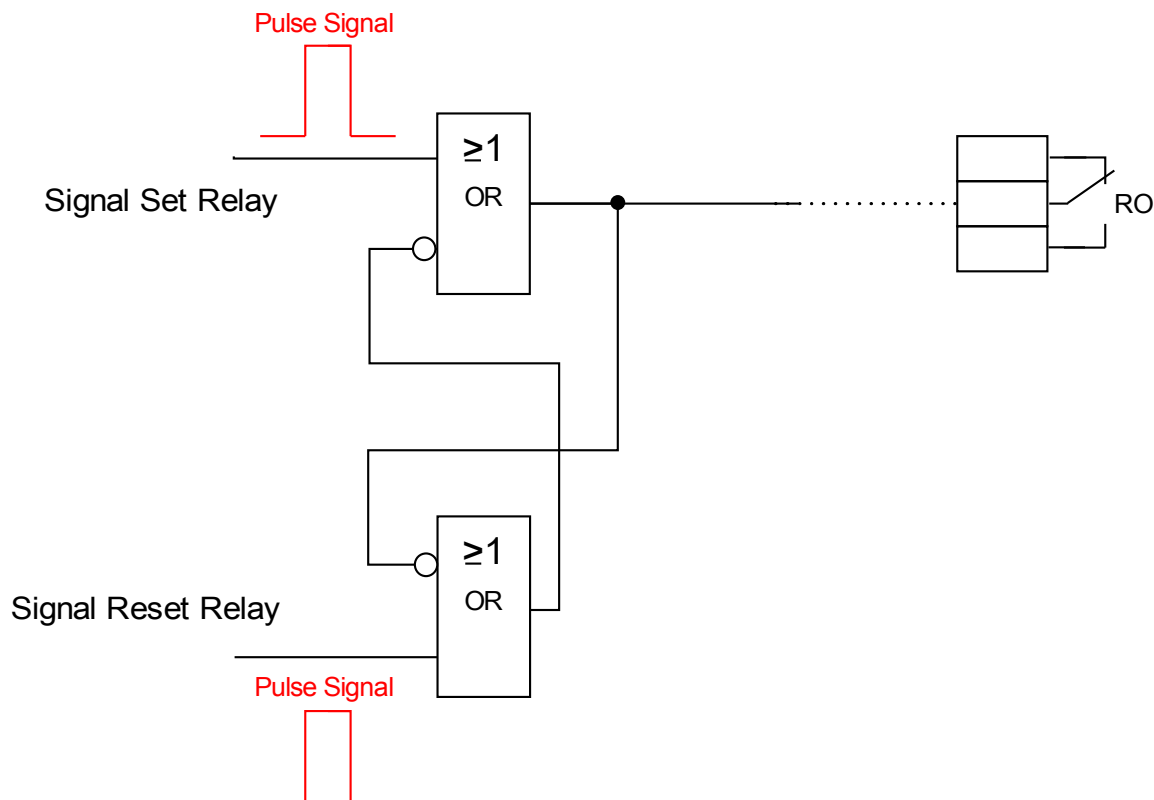
Application Example Setting a Relay:

Binary Output signals of the DNP cannot directly be used in order to switch relays because the DNP Binary Outputs are pulse signals (by DNP definition, not steady state). Steady states can be created by means of Logic functions. The Logic Functions can be assigned onto the Relay Inputs.

Please note: You can use a Set/Reset element (Flip Flop) from Logics.

Logic

Assign Logic Functions onto Relay Inputs



Direct Commands of the DNP

Parameter	Description	Setting range	Default	Menu path
Res all Diag Cr 	Reset all diagnosis counters	Inactive, Active	Inactive	[Operation /Reset]
Slave Id 	SlaveId defines the DNP3 address of this device (Outstation)	0 - 65519	1	[Device Para /DNP /Communication]
Master Id 	MasterId defines the DNP3 address of master (SCADA)	0 - 65519	65500	[Device Para /DNP /Communication]

Global Protection Parameters of the DNP

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Device Para /DNP /Communication]
IP Port Number 	Port Number of the IP address	0 - 65535	20000	[Device Para /DNP /Communication]
Baud rate 	Baud rate for communication	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200	19200	[Device Para /DNP /Communication]
Frame Layout 	Frame Layout	8E1, 8O1, 8N1, 8N2	8E1	[Device Para /DNP /Communication]

Parameter	Description	Setting range	Default	Menu path
Optical rest position 	Optical rest position	Light off, Light on	Light on	[Device Para /DNP /Communication]
SelfAddress 	Support of self (automatic) addresses	Inactive, Active	Inactive	[Device Para /DNP /Communication]
DataLink confirm 	Enables or disables the data layer confirmation (ack).	Never, Always, On_Large	Never	[Device Para /DNP /Communication]
t-DataLink confirm 	Data layer confirmation timeout	0.1 - 10.0s	1s	[Device Para /DNP /Communication]
DataLink num retries 	Number of repetition of data link packet sending after failing	0 - 255	3	[Device Para /DNP /Communication]
Direction Bit 	Enables Direction Bit functionality. The Direction Bit is 0 for SlaveStation and 1 for MasterStation	Inactive, Active	Inactive	[Device Para /DNP /Communication]
Max Frame Size 	This value is used to limit the net Frame Size	64 - 255	255	[Device Para /DNP /Communication]
Test Link Period 	This value specifies the time period when to send a Test Link-Frame	0.0 - 120.0s	0s	[Device Para /DNP /Communication]
AppLink confirm 	Determines if the device will request that the Application Layer response be confirmed or not	Never, Always, Event	Always	[Device Para /DNP /Communication]
t-AppLink confirm 	Application layer response timeout	0.1 - 10.0s	5s	[Device Para /DNP /Communication]

Parameter	Description	Setting range	Default	Menu path
AppLink num retries 	The number of times the device will retransmit an Application Layer fragment	0 - 255	0	[Device Para /DNP /Communication]
Unsol Reporting 	Enables supports unsolicited reporting. This is only for Network connections available. For serial connection this setting is fix set to inactive	Inactive, Active	Inactive	[Device Para /DNP /Communication]
Unsol Reporting Timeout 	Set the amount of time that the outstation will wait for an Application Layer confirmation back from the master indicating that the master received the unsolicited response message.	1.0 - 60.0s	10s	[Device Para /DNP /Communication]
Unsol Reporting Retry 	Set the number of retries that an outstation transmits in each unsolicited response series if it does not receive confirmation back from the master.	0 - 255	2	[Device Para /DNP /Communication]
TestSeqNo 	Test if sequence number of request is incremented. If it is not correctly incremented the request will be ignored. It is recommended to have it inactive but some older DNP implementations need it activated.	Inactive, Active	Inactive	[Device Para /DNP /Communication]
TestSBO 	It enables a stricter comparing of SBO and operate command. For older DNP versions it is recommended to deactivated it.	Inactive, Active	Active	[Device Para /DNP /Communication]
Timeout SBO 	DNP Outputs can be controlled in a two stage procedure (SBO: Select Before Operate). These outputs are to be selected first by a select command. After this the bit is reserved for this operate request. When this timer is expired, the bit will be released.	1.0 - 60.0s	30s	[Device Para /DNP /Communication]
ColdRestart 	Enables support for Cold Restart function.	Inactive, Active	Inactive	[Device Para /DNP /Communication]
Deadb integr time 	Deadband integration time.	0 - 300	1	[Device Para /DNP /Communication]

Parameter	Description	Setting range	Default	Menu path
BinaryInput 0 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 1 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 2 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 3 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 4 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 5 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 6 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 7 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 8 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]

Parameter	Description	Setting range	Default	Menu path
BinaryInput 9 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 10 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 11 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 12 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 13 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 14 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 15 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 16 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 17 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]

Parameter	Description	Setting range	Default	Menu path
BinaryInput 18 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 19 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 20 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 21 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 22 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 23 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 24 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 25 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 26 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]

Parameter	Description	Setting range	Default	Menu path
BinaryInput 27 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 28 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 29 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 30 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 31 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 32 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 33 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 34 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 35 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]

Parameter	Description	Setting range	Default	Menu path
BinaryInput 36 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 37 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 38 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 39 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 40 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 41 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 42 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 43 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 44 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]

Parameter	Description	Setting range	Default	Menu path
BinaryInput 45 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 46 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 47 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 48 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 49 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 50 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 51 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 52 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 53 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]

Parameter	Description	Setting range	Default	Menu path
BinaryInput 54 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 55 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 56 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 57 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 58 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 59 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 60 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 61 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput 62 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]

Parameter	Description	Setting range	Default	Menu path
BinaryInput 63 	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Binary Inputs]
DoubleBitInput 0 	Double Bit Digital Input (DNP). This corresponds to a double bit binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Double Bit Inputs]
DoubleBitInput 1 	Double Bit Digital Input (DNP). This corresponds to a double bit binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Double Bit Inputs]
DoubleBitInput 2 	Double Bit Digital Input (DNP). This corresponds to a double bit binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Double Bit Inputs]
DoubleBitInput 3 	Double Bit Digital Input (DNP). This corresponds to a double bit binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Double Bit Inputs]
DoubleBitInput 4 	Double Bit Digital Input (DNP). This corresponds to a double bit binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Double Bit Inputs]
DoubleBitInput 5 	Double Bit Digital Input (DNP). This corresponds to a double bit binary output of the protective device.	1..n, Assignment List	.-	[Device Para /DNP /Point map /Double Bit Inputs]
BinaryCounter 0 	Counter can be used to report counter values to the DNP master.	1..n, Assignment List	.-	[Device Para /DNP /Point map /BinaryCounter]
BinaryCounter 1 	Counter can be used to report counter values to the DNP master.	1..n, Assignment List	.-	[Device Para /DNP /Point map /BinaryCounter]

Parameter	Description	Setting range	Default	Menu path
BinaryCounter 2 	Counter can be used to report counter values to the DNP master.	1..n, Assignment List	.-	[Device Para /DNP /Point map /BinaryCounter]
BinaryCounter 3 	Counter can be used to report counter values to the DNP master.	1..n, Assignment List	.-	[Device Para /DNP /Point map /BinaryCounter]
BinaryCounter 4 	Counter can be used to report counter values to the DNP master.	1..n, Assignment List	.-	[Device Para /DNP /Point map /BinaryCounter]
BinaryCounter 5 	Counter can be used to report counter values to the DNP master.	1..n, Assignment List	.-	[Device Para /DNP /Point map /BinaryCounter]
BinaryCounter 6 	Counter can be used to report counter values to the DNP master.	1..n, Assignment List	.-	[Device Para /DNP /Point map /BinaryCounter]
BinaryCounter 7 	Counter can be used to report counter values to the DNP master.	1..n, Assignment List	.-	[Device Para /DNP /Point map /BinaryCounter]
Analog value 0 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 0 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 0 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 1 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 1 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 1 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 2 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
 Scale Factor 2	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
 Dead Band 2	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
 Analog value 3	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
 Scale Factor 3	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
 Dead Band 3	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
 Analog value 4	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 4 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 4 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 5 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 5 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 5 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 6 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 6 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 6 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 7 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 7 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 7 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 8 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
 Scale Factor 8	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
 Dead Band 8	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
 Analog value 9	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
 Scale Factor 9	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
 Dead Band 9	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
 Analog value 10	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 10 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 10 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 11 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 11 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 11 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 12 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 12 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 12 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 13 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 13 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 13 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 14 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 14 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 14 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 15 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 15 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 15 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 16 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 16 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 16 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 17 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 17 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 17 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 18 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 18 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 18 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 19 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 19 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 19 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 20 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 20 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 20 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 21 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 21 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 21 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 22 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 22 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 22 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 23 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 23 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 23 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 24 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 24 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 24 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 25 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 25 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 25 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 26 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 26 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 26 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 27 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 27 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 27 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 28 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 28 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 28 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 29 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 29 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 29 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 30 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]

Parameter	Description	Setting range	Default	Menu path
Scale Factor 30 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 30 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]
Analog value 31 	Analog value can be used to report values to the master (DNP)	1..n, TrendRecList	.-	[Device Para /DNP /Point map /Analog Input]
Scale Factor 31 	The scale factor is used to convert the measured value in an integer format	0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000, 1000000	1	[Device Para /DNP /Point map /Analog Input]
Dead Band 31 	If a change of measured value is greater than the deadband value it will be reported to the master.	0.01 - 100.00%	1%	[Device Para /DNP /Point map /Analog Input]

Inputs of the DNP

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
BinaryInput0-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput1-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput2-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput3-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput4-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput5-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput6-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput7-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
BinaryInput8-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput9-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput10-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput11-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput12-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput13-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput14-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput15-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput16-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
BinaryInput17-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput18-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput19-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput20-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput21-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput22-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput23-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput24-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput25-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
BinaryInput26-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput27-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput28-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput29-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput30-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput31-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput32-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput33-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput34-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
BinaryInput35-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput36-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput37-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput38-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput39-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput40-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput41-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput42-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput43-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
BinaryInput44-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput45-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput46-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput47-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput48-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput49-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput50-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput51-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput52-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
BinaryInput53-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput54-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput55-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput56-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput57-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput58-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput59-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput60-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput61-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
BinaryInput62-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
BinaryInput63-I	Virtual Digital Input (DNP). This corresponds to a virtual binary output of the protective device.	[Device Para /DNP /Point map /Binary Inputs]
DoubleBitInput0-I	Double Bit Digital Input (DNP). This corresponds to a double bit binary output of the protective device.	[Device Para /DNP /Point map /Double Bit Inputs]
DoubleBitInput1-I	Double Bit Digital Input (DNP). This corresponds to a double bit binary output of the protective device.	[Device Para /DNP /Point map /Double Bit Inputs]
DoubleBitInput2-I	Double Bit Digital Input (DNP). This corresponds to a double bit binary output of the protective device.	[Device Para /DNP /Point map /Double Bit Inputs]
DoubleBitInput3-I	Double Bit Digital Input (DNP). This corresponds to a double bit binary output of the protective device.	[Device Para /DNP /Point map /Double Bit Inputs]
DoubleBitInput4-I	Double Bit Digital Input (DNP). This corresponds to a double bit binary output of the protective device.	[Device Para /DNP /Point map /Double Bit Inputs]
DoubleBitInput5-I	Double Bit Digital Input (DNP). This corresponds to a double bit binary output of the protective device.	[Device Para /DNP /Point map /Double Bit Inputs]

Options of the DNP

Name	Description
-.-	No assignment
Prot.FaultNo	Waveform No.
Prot.No of GridFaults	Number of grid faults: A grid fault, e.g. a short circuit, might cause several faults with trip and autoreclosing, each fault being identified by an increased fault number. In this case, the grid fault number remains the same.
Generator.Gen Op hours	Generator running hours
Bkr.TripCmd Cr	Counter: Total number of trips of the switchgear (breaker, load break switch...). Resettable with Total or All.
LVRT [1].NumOf Vdips in t-LVRT	Number of Voltage dips during t-LVRT
LVRT [1].Cr Tot Numb of Vdips	Counter Total number of voltage dips.
LVRT [1].Cr Tot Numb of Vdips to Trip	Counter Total number of voltage dips that caused a Trip.
LVRT [2].NumOf Vdips in t-LVRT	Number of Voltage dips during t-LVRT
LVRT [2].Cr Tot Numb of Vdips	Counter Total number of voltage dips.
LVRT [2].Cr Tot Numb of Vdips to Trip	Counter Total number of voltage dips that caused a Trip.
ECr.Wh Fwd	Positive Active Power is consumed active energy
ECr.Wh Rev	Negative Active Power (Fed Energy)
ECr.VArh Lag	Positive Reactive Power is consumed Reactive Energy
ECr.VArh Lead	Negative Reactive Power (Fed Energy)
Sys.Operating hours Cr	Operating hours counter of the protective device

Selectable Switchgears of the DNP

Name	Description
-.-	No assignment
Bkr.State	Signal: Breaker Position (0 = Indeterminate, 1 = OPEN, 2 = CLOSE, 3 = Disturbed)

DNP Signals (Output States)

NOTICE

Some signals (that are for a short time active only) have to be acknowledged separately (e.g. Trip signals) by the Communication System.

Signal	Description
busy	This message is set if the protocol is started. It will be reset if the protocol is shut down.
ready	The message will be set if the protocol is successfully started and ready for data exchange.
active	The communication with the Master (Scada) is active.
BinaryOutput0	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput1	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput2	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput3	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput4	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput5	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput6	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput7	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput8	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput9	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput10	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput11	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput12	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput13	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput14	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput15	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput16	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput17	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput18	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput19	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput20	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput21	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput22	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput23	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput24	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput25	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput26	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput27	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput28	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.

<i>Signal</i>	<i>Description</i>
BinaryOutput29	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput30	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
BinaryOutput31	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.

DNP Values

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
NReceived	Diagnostic counter: Number of received characters	0	0 - 999999999	[Operation /Count and RevData /DNP]
NSent	Diagnostic counter: Number of sent characters	0	0 - 999999999	[Operation /Count and RevData /DNP]
NBadFramings	Diagnostic counter: Number of bad framings. A large number indicates a disturbed serial connection.	0	0 - 999999999	[Operation /Count and RevData /DNP]
NBadParities	Diagnostic counter: Number of parity errors. A large number indicates a disturbed serial connection.	0	0 - 999999999	[Operation /Count and RevData /DNP]
NBreakSignals	Diagnostic counter: Number of break signals. A large number indicates a disturbed serial connection.	0	0 - 999999999	[Operation /Count and RevData /DNP]
NBadChecksum	Diagnostic counter: Number of frames received with bad checksum.	0	0 - 999999999	[Operation /Count and RevData /DNP]

Parameters

Parameter setting and planning can be done:

- Directly at the device; or
- By way of the *PowerPort-E* software application.

Parameter Definitions

Device Parameters

By modifying the Device Parameters, the User may (depending on the type of device):

- Configure digital inputs, Assign LEDs;
- Configure Relay Outputs;
- Assign acknowledgment signals;
- Configure statistics;
- Configure general Protocol Settings;
- Adapt HMI settings;
- Configure recorders (reports);
- Set date and time;
- Change passwords; and/or
- Check the version (build) of the device.

System Parameters

System Parameters comprise the essential, basic settings of your switchboard such as rated frequency and transformer ratios.

Protection Parameters



Please note that by deactivating, for example protective functions, the User also changes the functionality of the device.

The manufacturer does not accept liability for any personal or material damage as a result of incorrect planning.

Contact your Eaton Customer Service representative for more information.

The protection parameters include the following protection parameter trees.

- Global Protection Parameters »*Global Prot Para*«: Here the User can find all protection parameters that are universally valid. That means they are valid independent of the protection parameter sets.
- Setting Group Parameters »*Set1..4*«: The protection parameters that the User set within a parameter set are only valid if the parameter set selected is switched to active.

Device Planning Parameters

- **Improving the Usability (Clarity):** All protection modules that are currently unused can be hidden (switched to invisible) through Device Planning. In the Device Planning menu, the User can adapt the scope of functionality of the protective device exactly as needed. The User can improve the usability by hiding all modules that are not currently needed.
- **Adapting the device to the application:** For those modules that are needed, determine how they should be set up (e.g.: directional, non-directional, <, >...).

Direct Commands

Direct Commands are part of the “Device Parameter tree” but **NOT** part of the parameter file. They will be executed directly (e.g.: Resetting of a Counter).

State of the Module Inputs

Module Inputs are part of the “Device Parameter tree”. The State of the Module Input is context-dependent.

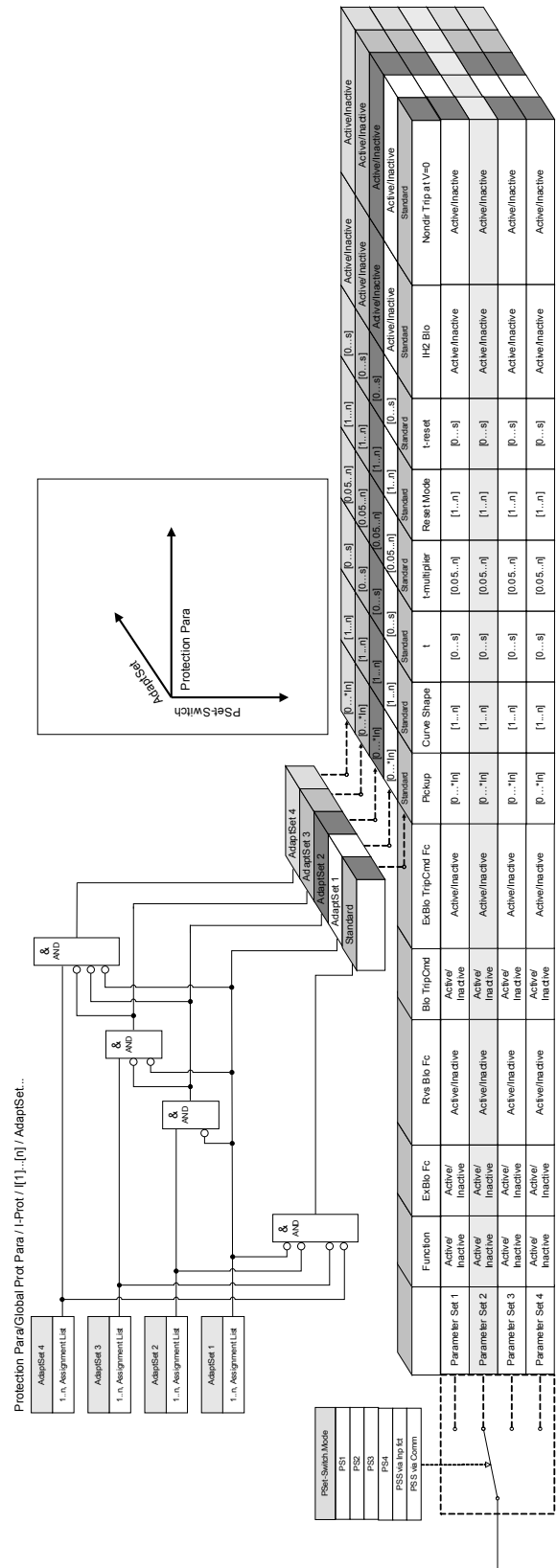
By means of the Module Inputs, information can be passed to and acted upon by the modules. The User can assign signals to **Module Inputs**. The state of the signals that are assigned to an input can be viewed from the Status Display. Module Inputs can be identified by an **“-I”** at the end of the name.

Signals

Signals are part of the “Device Parameter tree”. The state of the signal is context-dependent.

- **Signals** represent the state of the installation/equipment (e.g.: position indicators of the breaker).
- **Signals** are assessments of the state of the grid and the equipment (System OK, Transformer failure detected, ...).
- **Signals** represent decisions that are taken by the device (e.g.: Trip Command) based on the User parameter settings.

Adaptive Parameter Sets



Adaptive Parameter Sets are part of the “Device Parameter tree”.

By means of **Adaptive Parameter Sets**, the User can temporarily modify single parameters within the Parameter Setting groups.

NOTICE

Adaptive Parameters drop-out automatically if the acknowledged signal that has activated them has dropped-out. Please take into account that Adaptive Set 1 is dominant to Adaptive Set 2. Adaptive Set 2 is dominant to Adaptive Set 3. Adaptive Set 3 is dominant to Adaptive Set 4.

NOTICE

In order to increase the usability (clarity), Adaptive Parameter Sets become visible if a corresponding activation signal has been assigned (PowerPort-E V. 1.2 and higher).

Example: In order to use Adaptive Parameters within Protective Element I [1], please proceed as follows.

- Assign within the Global Parameter tree, within Protective Element I[1], an activation signal for Adaptive Parameter Set 1.
- Adaptive Parameter Set 1 becomes now visible within the Protection Parameter Sets for element I[1].

By means of additional activation signals, further Adaptive Parameter Sets can be used.

The functionality of the IED (relay) can be enhanced / adapted, by means of **Adaptive Parameters** in order to meet the requirements of modified states of the grid or the power supply system respectively, to manage unpredictable events.

Moreover, the adaptive parameter can also be used to realize various special protective functions or to expand the existing function modules in a simple way, without costly redesign the existing hardware or software platform.

The **Adaptive Parameter** feature allows, besides a standard parameter set, one of the four parameter sets labeled from 1 to 4, to be used, for example, in a time overcurrent element under the control of the configurable Set Control Logic. The dynamic switch-over of the adaptive parameter set is only active for a particular element when its adaptive set control logic is configured and only as long as the activation signal is true.

For some protection elements, such as time overcurrent and instantaneous overcurrent (50P, 51P, 50G, 51G, ...), besides the “default” setting there exists another four “alternative” settings for pickup value, curve type, time dial, and reset mode set values that can dynamically be switched-over by means of the configurable adaptive setting control logic in the single set parameter.

If the **Adaptive Parameter** feature is not used, the adaptive set control logic will not be selected (assigned). The protective elements work, in this case, just like a normal protection using the “Default” settings. If one of the **Adaptive Set** Control logic is assigned to a logic function, the protective element will be “switched-over” to the corresponding adaptive settings if the assigned logic function is asserted and will drop-out to the “Default” setting if the assigned signal that has activated the **Adaptive Set** has dropped-out.

Adaptive Parameter Set Activation Signals

Name	Description
--	No assignment
27M[1].Pickup	Signal: Pickup Voltage Element
27M[2].Pickup	Signal: Pickup Voltage Element
59M[1].Pickup	Signal: Pickup Voltage Element
59M[2].Pickup	Signal: Pickup Voltage Element
LVRT [1].Pickup	Signal: Pickup Voltage Element
LVRT [1].t-LVRT is running	Signal: t-LVRT is running
LVRT [2].Pickup	Signal: Pickup Voltage Element
LVRT [2].t-LVRT is running	Signal: t-LVRT is running
47[1].Pickup	Signal: Pickup Voltage Asymmetry
47[2].Pickup	Signal: Pickup Voltage Asymmetry
SOTF.enabled	Signal: Switch Onto Fault enabled. This Signal can be used to modify Overcurrent Protection Settings.
CLPU.enabled	Signal: Cold Load enabled
ExP[1].Alarm	Signal: Alarm
ExP[2].Alarm	Signal: Alarm
ExP[3].Alarm	Signal: Alarm
ExP[4].Alarm	Signal: Alarm
CTS.Pickup	Signal: Pickup Current Transformer Measuring Circuit Supervision
LOP.Pickup	Signal: Pickup Loss of Potential
DI-8P X1.DI 1	Signal: Digital Input
DI-8P X1.DI 2	Signal: Digital Input
DI-8P X1.DI 3	Signal: Digital Input
DI-8P X1.DI 4	Signal: Digital Input
DI-8P X1.DI 5	Signal: Digital Input
DI-8P X1.DI 6	Signal: Digital Input
DI-8P X1.DI 7	Signal: Digital Input
DI-8P X1.DI 8	Signal: Digital Input
DI-8 X5.DI 1	Signal: Digital Input
DI-8 X5.DI 2	Signal: Digital Input
DI-8 X5.DI 3	Signal: Digital Input
DI-8 X5.DI 4	Signal: Digital Input
DI-8 X5.DI 5	Signal: Digital Input
DI-8 X5.DI 6	Signal: Digital Input
DI-8 X5.DI 7	Signal: Digital Input
DI-8 X5.DI 8	Signal: Digital Input

<i>Name</i>	<i>Description</i>
Modbus.Comm Cmd 1	Communication Command
Modbus.Comm Cmd 2	Communication Command
Modbus.Comm Cmd 3	Communication Command
Modbus.Comm Cmd 4	Communication Command
Modbus.Comm Cmd 5	Communication Command
Modbus.Comm Cmd 6	Communication Command
Modbus.Comm Cmd 7	Communication Command
Modbus.Comm Cmd 8	Communication Command
Modbus.Comm Cmd 9	Communication Command
Modbus.Comm Cmd 10	Communication Command
Modbus.Comm Cmd 11	Communication Command
Modbus.Comm Cmd 12	Communication Command
Modbus.Comm Cmd 13	Communication Command
Modbus.Comm Cmd 14	Communication Command
Modbus.Comm Cmd 15	Communication Command
Modbus.Comm Cmd 16	Communication Command
IEC61850.VirtInp1	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp2	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp3	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp4	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp5	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp6	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp7	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp8	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp9	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp10	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp11	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp12	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp13	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp14	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp15	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp16	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp17	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp18	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp19	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp20	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp21	Signal: Virtual Input (IEC61850 GGIO Ind)

<i>Name</i>	<i>Description</i>
IEC61850.VirtInp22	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp23	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp24	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp25	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp26	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp27	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp28	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp29	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp30	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp31	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp32	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.SPCSO1	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO2	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO3	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO4	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO5	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO6	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO7	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO8	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO9	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO10	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO11	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO12	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO13	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO14	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO15	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).

<i>Name</i>	<i>Description</i>
IEC61850.SPCSO16	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
Profibus.Comm Cmd 1	Communication Command
Profibus.Comm Cmd 2	Communication Command
Profibus.Comm Cmd 3	Communication Command
Profibus.Comm Cmd 4	Communication Command
Profibus.Comm Cmd 5	Communication Command
Profibus.Comm Cmd 6	Communication Command
Profibus.Comm Cmd 7	Communication Command
Profibus.Comm Cmd 8	Communication Command
Profibus.Comm Cmd 9	Communication Command
Profibus.Comm Cmd 10	Communication Command
Profibus.Comm Cmd 11	Communication Command
Profibus.Comm Cmd 12	Communication Command
Profibus.Comm Cmd 13	Communication Command
Profibus.Comm Cmd 14	Communication Command
Profibus.Comm Cmd 15	Communication Command
Profibus.Comm Cmd 16	Communication Command
Logic.LE1.Gate Out	Signal: Output of the logic gate
Logic.LE1.Timer Out	Signal: Timer Output
Logic.LE1.Out	Signal: Latched Output (Q)
Logic.LE1.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE2.Gate Out	Signal: Output of the logic gate
Logic.LE2.Timer Out	Signal: Timer Output
Logic.LE2.Out	Signal: Latched Output (Q)
Logic.LE2.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE3.Gate Out	Signal: Output of the logic gate
Logic.LE3.Timer Out	Signal: Timer Output
Logic.LE3.Out	Signal: Latched Output (Q)
Logic.LE3.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE4.Gate Out	Signal: Output of the logic gate
Logic.LE4.Timer Out	Signal: Timer Output
Logic.LE4.Out	Signal: Latched Output (Q)
Logic.LE4.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE5.Gate Out	Signal: Output of the logic gate
Logic.LE5.Timer Out	Signal: Timer Output
Logic.LE5.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE5.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE6.Gate Out	Signal: Output of the logic gate
Logic.LE6.Timer Out	Signal: Timer Output
Logic.LE6.Out	Signal: Latched Output (Q)
Logic.LE6.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE7.Gate Out	Signal: Output of the logic gate
Logic.LE7.Timer Out	Signal: Timer Output
Logic.LE7.Out	Signal: Latched Output (Q)
Logic.LE7.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE8.Gate Out	Signal: Output of the logic gate
Logic.LE8.Timer Out	Signal: Timer Output
Logic.LE8.Out	Signal: Latched Output (Q)
Logic.LE8.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE9.Gate Out	Signal: Output of the logic gate
Logic.LE9.Timer Out	Signal: Timer Output
Logic.LE9.Out	Signal: Latched Output (Q)
Logic.LE9.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE10.Gate Out	Signal: Output of the logic gate
Logic.LE10.Timer Out	Signal: Timer Output
Logic.LE10.Out	Signal: Latched Output (Q)
Logic.LE10.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE11.Gate Out	Signal: Output of the logic gate
Logic.LE11.Timer Out	Signal: Timer Output
Logic.LE11.Out	Signal: Latched Output (Q)
Logic.LE11.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE12.Gate Out	Signal: Output of the logic gate
Logic.LE12.Timer Out	Signal: Timer Output
Logic.LE12.Out	Signal: Latched Output (Q)
Logic.LE12.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE13.Gate Out	Signal: Output of the logic gate
Logic.LE13.Timer Out	Signal: Timer Output
Logic.LE13.Out	Signal: Latched Output (Q)
Logic.LE13.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE14.Gate Out	Signal: Output of the logic gate
Logic.LE14.Timer Out	Signal: Timer Output
Logic.LE14.Out	Signal: Latched Output (Q)
Logic.LE14.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE15.Gate Out	Signal: Output of the logic gate
Logic.LE15.Timer Out	Signal: Timer Output
Logic.LE15.Out	Signal: Latched Output (Q)
Logic.LE15.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE16.Gate Out	Signal: Output of the logic gate
Logic.LE16.Timer Out	Signal: Timer Output
Logic.LE16.Out	Signal: Latched Output (Q)
Logic.LE16.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE17.Gate Out	Signal: Output of the logic gate
Logic.LE17.Timer Out	Signal: Timer Output
Logic.LE17.Out	Signal: Latched Output (Q)
Logic.LE17.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE18.Gate Out	Signal: Output of the logic gate
Logic.LE18.Timer Out	Signal: Timer Output
Logic.LE18.Out	Signal: Latched Output (Q)
Logic.LE18.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE19.Gate Out	Signal: Output of the logic gate
Logic.LE19.Timer Out	Signal: Timer Output
Logic.LE19.Out	Signal: Latched Output (Q)
Logic.LE19.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE20.Gate Out	Signal: Output of the logic gate
Logic.LE20.Timer Out	Signal: Timer Output
Logic.LE20.Out	Signal: Latched Output (Q)
Logic.LE20.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE21.Gate Out	Signal: Output of the logic gate
Logic.LE21.Timer Out	Signal: Timer Output
Logic.LE21.Out	Signal: Latched Output (Q)
Logic.LE21.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE22.Gate Out	Signal: Output of the logic gate
Logic.LE22.Timer Out	Signal: Timer Output
Logic.LE22.Out	Signal: Latched Output (Q)
Logic.LE22.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE23.Gate Out	Signal: Output of the logic gate
Logic.LE23.Timer Out	Signal: Timer Output
Logic.LE23.Out	Signal: Latched Output (Q)
Logic.LE23.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE24.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE24.Timer Out	Signal: Timer Output
Logic.LE24.Out	Signal: Latched Output (Q)
Logic.LE24.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE25.Gate Out	Signal: Output of the logic gate
Logic.LE25.Timer Out	Signal: Timer Output
Logic.LE25.Out	Signal: Latched Output (Q)
Logic.LE25.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE26.Gate Out	Signal: Output of the logic gate
Logic.LE26.Timer Out	Signal: Timer Output
Logic.LE26.Out	Signal: Latched Output (Q)
Logic.LE26.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE27.Gate Out	Signal: Output of the logic gate
Logic.LE27.Timer Out	Signal: Timer Output
Logic.LE27.Out	Signal: Latched Output (Q)
Logic.LE27.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE28.Gate Out	Signal: Output of the logic gate
Logic.LE28.Timer Out	Signal: Timer Output
Logic.LE28.Out	Signal: Latched Output (Q)
Logic.LE28.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE29.Gate Out	Signal: Output of the logic gate
Logic.LE29.Timer Out	Signal: Timer Output
Logic.LE29.Out	Signal: Latched Output (Q)
Logic.LE29.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE30.Gate Out	Signal: Output of the logic gate
Logic.LE30.Timer Out	Signal: Timer Output
Logic.LE30.Out	Signal: Latched Output (Q)
Logic.LE30.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE31.Gate Out	Signal: Output of the logic gate
Logic.LE31.Timer Out	Signal: Timer Output
Logic.LE31.Out	Signal: Latched Output (Q)
Logic.LE31.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE32.Gate Out	Signal: Output of the logic gate
Logic.LE32.Timer Out	Signal: Timer Output
Logic.LE32.Out	Signal: Latched Output (Q)
Logic.LE32.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE33.Gate Out	Signal: Output of the logic gate
Logic.LE33.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE33.Out	Signal: Latched Output (Q)
Logic.LE33.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE34.Gate Out	Signal: Output of the logic gate
Logic.LE34.Timer Out	Signal: Timer Output
Logic.LE34.Out	Signal: Latched Output (Q)
Logic.LE34.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE35.Gate Out	Signal: Output of the logic gate
Logic.LE35.Timer Out	Signal: Timer Output
Logic.LE35.Out	Signal: Latched Output (Q)
Logic.LE35.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE36.Gate Out	Signal: Output of the logic gate
Logic.LE36.Timer Out	Signal: Timer Output
Logic.LE36.Out	Signal: Latched Output (Q)
Logic.LE36.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE37.Gate Out	Signal: Output of the logic gate
Logic.LE37.Timer Out	Signal: Timer Output
Logic.LE37.Out	Signal: Latched Output (Q)
Logic.LE37.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE38.Gate Out	Signal: Output of the logic gate
Logic.LE38.Timer Out	Signal: Timer Output
Logic.LE38.Out	Signal: Latched Output (Q)
Logic.LE38.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE39.Gate Out	Signal: Output of the logic gate
Logic.LE39.Timer Out	Signal: Timer Output
Logic.LE39.Out	Signal: Latched Output (Q)
Logic.LE39.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE40.Gate Out	Signal: Output of the logic gate
Logic.LE40.Timer Out	Signal: Timer Output
Logic.LE40.Out	Signal: Latched Output (Q)
Logic.LE40.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE41.Gate Out	Signal: Output of the logic gate
Logic.LE41.Timer Out	Signal: Timer Output
Logic.LE41.Out	Signal: Latched Output (Q)
Logic.LE41.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE42.Gate Out	Signal: Output of the logic gate
Logic.LE42.Timer Out	Signal: Timer Output
Logic.LE42.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE42.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE43.Gate Out	Signal: Output of the logic gate
Logic.LE43.Timer Out	Signal: Timer Output
Logic.LE43.Out	Signal: Latched Output (Q)
Logic.LE43.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE44.Gate Out	Signal: Output of the logic gate
Logic.LE44.Timer Out	Signal: Timer Output
Logic.LE44.Out	Signal: Latched Output (Q)
Logic.LE44.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE45.Gate Out	Signal: Output of the logic gate
Logic.LE45.Timer Out	Signal: Timer Output
Logic.LE45.Out	Signal: Latched Output (Q)
Logic.LE45.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE46.Gate Out	Signal: Output of the logic gate
Logic.LE46.Timer Out	Signal: Timer Output
Logic.LE46.Out	Signal: Latched Output (Q)
Logic.LE46.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE47.Gate Out	Signal: Output of the logic gate
Logic.LE47.Timer Out	Signal: Timer Output
Logic.LE47.Out	Signal: Latched Output (Q)
Logic.LE47.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE48.Gate Out	Signal: Output of the logic gate
Logic.LE48.Timer Out	Signal: Timer Output
Logic.LE48.Out	Signal: Latched Output (Q)
Logic.LE48.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE49.Gate Out	Signal: Output of the logic gate
Logic.LE49.Timer Out	Signal: Timer Output
Logic.LE49.Out	Signal: Latched Output (Q)
Logic.LE49.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE50.Gate Out	Signal: Output of the logic gate
Logic.LE50.Timer Out	Signal: Timer Output
Logic.LE50.Out	Signal: Latched Output (Q)
Logic.LE50.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE51.Gate Out	Signal: Output of the logic gate
Logic.LE51.Timer Out	Signal: Timer Output
Logic.LE51.Out	Signal: Latched Output (Q)
Logic.LE51.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE52.Gate Out	Signal: Output of the logic gate
Logic.LE52.Timer Out	Signal: Timer Output
Logic.LE52.Out	Signal: Latched Output (Q)
Logic.LE52.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE53.Gate Out	Signal: Output of the logic gate
Logic.LE53.Timer Out	Signal: Timer Output
Logic.LE53.Out	Signal: Latched Output (Q)
Logic.LE53.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE54.Gate Out	Signal: Output of the logic gate
Logic.LE54.Timer Out	Signal: Timer Output
Logic.LE54.Out	Signal: Latched Output (Q)
Logic.LE54.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE55.Gate Out	Signal: Output of the logic gate
Logic.LE55.Timer Out	Signal: Timer Output
Logic.LE55.Out	Signal: Latched Output (Q)
Logic.LE55.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE56.Gate Out	Signal: Output of the logic gate
Logic.LE56.Timer Out	Signal: Timer Output
Logic.LE56.Out	Signal: Latched Output (Q)
Logic.LE56.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE57.Gate Out	Signal: Output of the logic gate
Logic.LE57.Timer Out	Signal: Timer Output
Logic.LE57.Out	Signal: Latched Output (Q)
Logic.LE57.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE58.Gate Out	Signal: Output of the logic gate
Logic.LE58.Timer Out	Signal: Timer Output
Logic.LE58.Out	Signal: Latched Output (Q)
Logic.LE58.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE59.Gate Out	Signal: Output of the logic gate
Logic.LE59.Timer Out	Signal: Timer Output
Logic.LE59.Out	Signal: Latched Output (Q)
Logic.LE59.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE60.Gate Out	Signal: Output of the logic gate
Logic.LE60.Timer Out	Signal: Timer Output
Logic.LE60.Out	Signal: Latched Output (Q)
Logic.LE60.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE61.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE61.Timer Out	Signal: Timer Output
Logic.LE61.Out	Signal: Latched Output (Q)
Logic.LE61.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE62.Gate Out	Signal: Output of the logic gate
Logic.LE62.Timer Out	Signal: Timer Output
Logic.LE62.Out	Signal: Latched Output (Q)
Logic.LE62.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE63.Gate Out	Signal: Output of the logic gate
Logic.LE63.Timer Out	Signal: Timer Output
Logic.LE63.Out	Signal: Latched Output (Q)
Logic.LE63.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE64.Gate Out	Signal: Output of the logic gate
Logic.LE64.Timer Out	Signal: Timer Output
Logic.LE64.Out	Signal: Latched Output (Q)
Logic.LE64.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE65.Gate Out	Signal: Output of the logic gate
Logic.LE65.Timer Out	Signal: Timer Output
Logic.LE65.Out	Signal: Latched Output (Q)
Logic.LE65.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE66.Gate Out	Signal: Output of the logic gate
Logic.LE66.Timer Out	Signal: Timer Output
Logic.LE66.Out	Signal: Latched Output (Q)
Logic.LE66.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE67.Gate Out	Signal: Output of the logic gate
Logic.LE67.Timer Out	Signal: Timer Output
Logic.LE67.Out	Signal: Latched Output (Q)
Logic.LE67.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE68.Gate Out	Signal: Output of the logic gate
Logic.LE68.Timer Out	Signal: Timer Output
Logic.LE68.Out	Signal: Latched Output (Q)
Logic.LE68.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE69.Gate Out	Signal: Output of the logic gate
Logic.LE69.Timer Out	Signal: Timer Output
Logic.LE69.Out	Signal: Latched Output (Q)
Logic.LE69.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE70.Gate Out	Signal: Output of the logic gate
Logic.LE70.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE70.Out	Signal: Latched Output (Q)
Logic.LE70.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE71.Gate Out	Signal: Output of the logic gate
Logic.LE71.Timer Out	Signal: Timer Output
Logic.LE71.Out	Signal: Latched Output (Q)
Logic.LE71.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE72.Gate Out	Signal: Output of the logic gate
Logic.LE72.Timer Out	Signal: Timer Output
Logic.LE72.Out	Signal: Latched Output (Q)
Logic.LE72.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE73.Gate Out	Signal: Output of the logic gate
Logic.LE73.Timer Out	Signal: Timer Output
Logic.LE73.Out	Signal: Latched Output (Q)
Logic.LE73.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE74.Gate Out	Signal: Output of the logic gate
Logic.LE74.Timer Out	Signal: Timer Output
Logic.LE74.Out	Signal: Latched Output (Q)
Logic.LE74.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE75.Gate Out	Signal: Output of the logic gate
Logic.LE75.Timer Out	Signal: Timer Output
Logic.LE75.Out	Signal: Latched Output (Q)
Logic.LE75.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE76.Gate Out	Signal: Output of the logic gate
Logic.LE76.Timer Out	Signal: Timer Output
Logic.LE76.Out	Signal: Latched Output (Q)
Logic.LE76.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE77.Gate Out	Signal: Output of the logic gate
Logic.LE77.Timer Out	Signal: Timer Output
Logic.LE77.Out	Signal: Latched Output (Q)
Logic.LE77.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE78.Gate Out	Signal: Output of the logic gate
Logic.LE78.Timer Out	Signal: Timer Output
Logic.LE78.Out	Signal: Latched Output (Q)
Logic.LE78.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE79.Gate Out	Signal: Output of the logic gate
Logic.LE79.Timer Out	Signal: Timer Output
Logic.LE79.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE79.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE80.Gate Out	Signal: Output of the logic gate
Logic.LE80.Timer Out	Signal: Timer Output
Logic.LE80.Out	Signal: Latched Output (Q)
Logic.LE80.Out inverted	Signal: Negated Latched Output (Q NOT)
Sys.Maint Mode Active	Signal: Arc Flash Reduction Maintenance Active
Sys.Maint Mode Inactive	Signal: Arc Flash Reduction Maintenance Inactive

Adaptive Parameters via HMI

NOTICE

The use of Adaptive Parameters via the HMI (panel) differs a bit to the use via PowerPort-E.

Adaptive Parameters can be also used via the HMI (instead of using the recommended *PowerPort-E*). The principle method of using them via the HMI is as follows.

1. Assign an activation signal for an Adaptive Parameter Set within the Global Parameters »*Global Para*« for a protective element (available for current functions only).
2. Call up this protective element within a Setting Group.
3. Go to the parameter that should be modified adaptively and call it up for editing (arrow-right-key).
4. Choose the corresponding Adaptive Set.
5. Set the modified parameter for the selected Adaptive Set.

Application Example

The tripping time »*t*« for the 50[1] element of »*Parameter Set 1*« should be desensitized (reduced) in case Digital Input 2 becomes active.

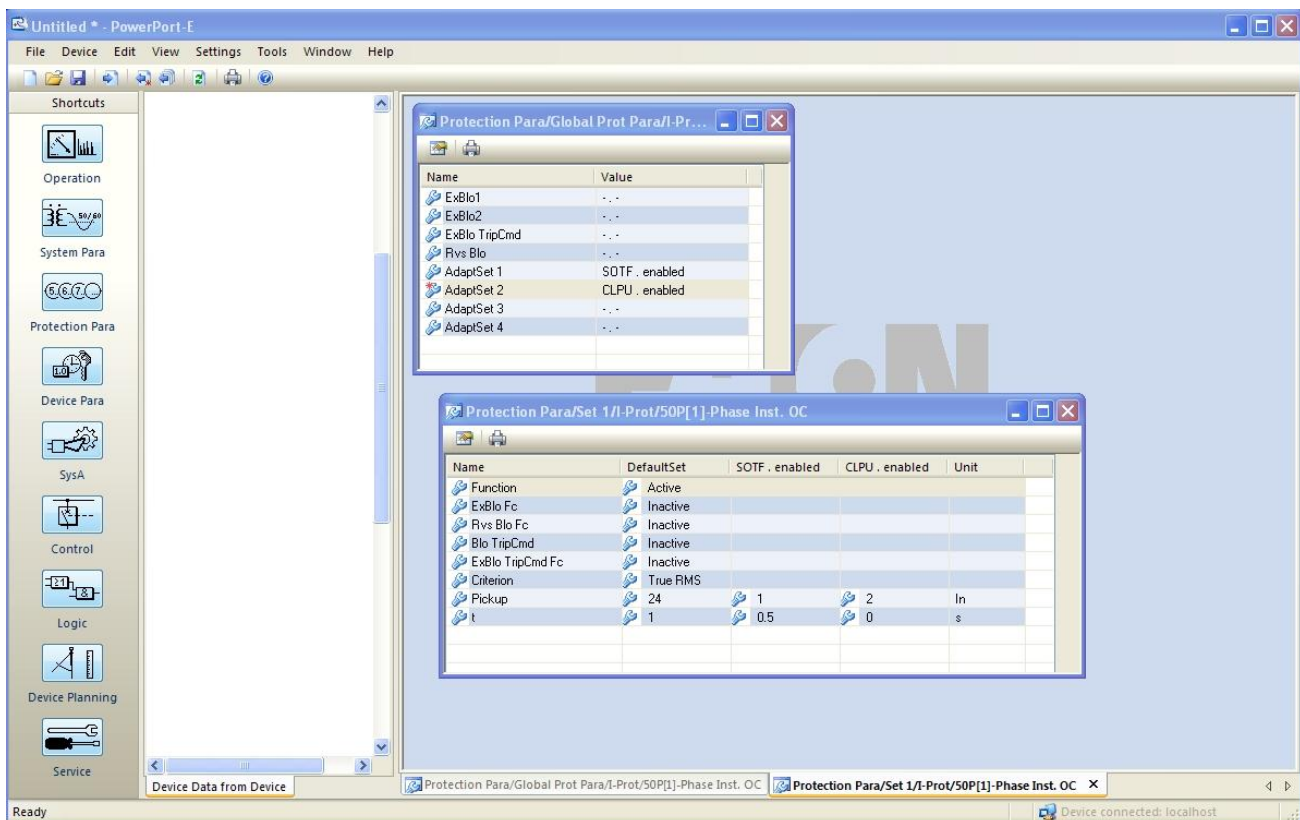
1. Call up the menu [Protection Para/Global Protection Para/I-Prot/50[1]/AdaptSet1] and assign Digital Input 2 as activation signal.
2. Call up the 50[1] element within the menu [Protection Para/Set[1]/I-Port/50[1].
3. Go to the tripping time parameter »*t*« by means of the softkey (arrow-down) and call up the submenu by means of the softkey (arrow-right).
4. Call up the corresponding parameter set (Adaptive Set 1 in this example).
5. Set the reduced tripping time for »*AdaptSet 1*«.

Check and confirm that the functionality is in compliance with your protection plan via a commissioning test.

Application Example

During a “Switch-OnTo-Fault” condition, the User is usually requested to make the embedded protective function tripping of the faulted line faster, instantaneous, or sometimes non-directional.

Such a “Switch-OnTo-Fault” application can easily be realized using the **Adaptive Parameter** features mentioned previously. The standard time overcurrent protection element (e.g.: 51P) should trip instantaneously in case of SOTF condition,. If the SOTF logic function »SOTF_{ENABLED}« is detecting a manual breaker close condition, the relay switches to **Adaptive Set 1** if the signal »SOTF_{ENABLED}« is assigned to **Adaptive Set 1**. The corresponding **Adaptive Set 1** will become active and than » $t = 0$ « sec.



The screen shot above shows the adaptive setting configurations following applications based on only one simple overcurrent protection element:

1. Standard Set: Default settings;
2. Adaptive Set 1: SOTF application (Switch-OnTo-Fault);
3. Adaptive Set 2: CLPU application (Cold Load Pickup);

Application Examples

- The output signal of the Switch OnTo Fault module can be used to activate an **Adaptive Parameter Set** that sensitizes the overcurrent protection.
- The output signal of the Cold Load Pickup module can be used to activate an **Adaptive Parameter Set** that desensitizes the overcurrent protection.
- By means of **Adaptive Parameter Sets**, an Adaptive Auto Reclosure can be realized. After a reclosure attempt, the tripping thresholds or tripping curves of the overcurrent protection can be adapted.
- Depending on undervoltage, the overcurrent protection can be modified (voltage controlled). This applies to devices that offer voltage protection only.
- The ground overcurrent protection can be modified by the residual voltage. This applies to devices that offer voltage protection only.
- Dynamic and automatic adaption of the ground current settings in order to adapt the settings to different loads (single-phase load diversity).

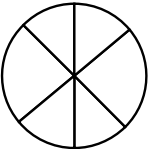
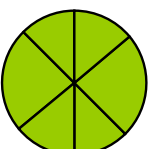
NOTICE

Adaptive Parameter Sets are only available for devices with current protection modules.

Access Authorizations (access areas)

Passwords – Areas

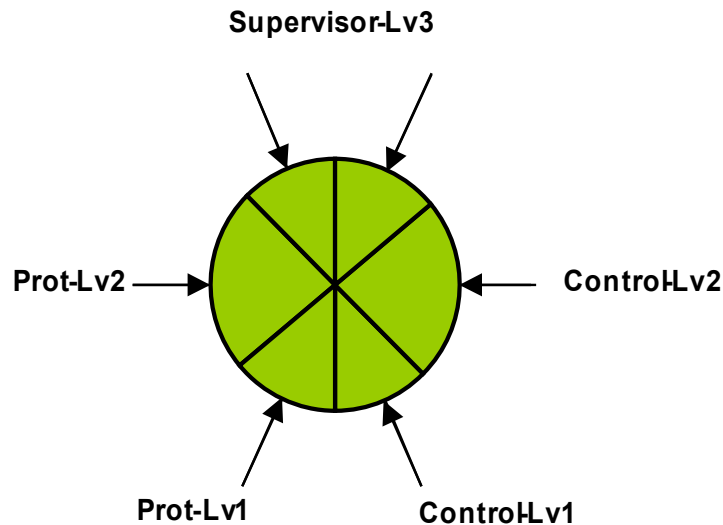
The following table shows the access areas and the authorization passwords that they require in order to access them.

<i>Area Symbol</i>	<i>Authorization Password</i>	<i>Access to:</i>
	 Read Only-Lv0	Level 0 provides Read Only access to all settings and parameters of the device. The device will fall back into this level automatically after a longer period or inactivity
	 Prot-Lv1	This password provides access to the reset- and acknowledge options. In addition to that, it permits the execution of manual trigger signals.
	 Prot-Lv2	This password provides access to the reset and acknowledge options. In addition to that it permits changing of protection settings and the configuration of the trip manager.
	 Control-Lv1	This password grants permission for switching operations (switching switchgears)
	 Control-Lv2	This password grants permission for switching operations (switching switchgears). In addition to that it gives access to the switchgear settings (switching authority, interlockings, general settings of switchgears, Breaker wear...).
	 Supervisor-Lv3	This password grants non-restricted access to all parameters and settings of the device (device configuration). This includes also the devices planning, device parameters (e.g. Date and Time), Field Parameters, Service Parameters and Logic Parameters.

NOTICE

If the device was not active within the parameter setting mode for a longer time (can be set between 20 – 3600 seconds) it changes into »Read Only-Lv0« mode automatically. This parameter (t-max-Edit) can be modified within menu [Device Para\HMI].

Access Areas (Password Level):

**NOTICE**

You have to ensure, that the access authorizations are protected by secure passwords. These passwords have to be kept as a secret and to be known only by the authorized persons.

NOTICE

A lock symbol indicates in the upper right corner of the display if there are any access authorizations active at the moment. That means, within the mode "Read Only Lv0" a closed (locked) lock symbol will be shown in the upper right corner of the display. As soon as there are any access authorizations active (above the "Read Only-Lv0" level), the upper right corner of the display will show an unlocked (open) lock symbol.

NOTICE

During setting parameters the Ack/Rst-Button will be used for the cancelling of parameter changes. Because of that it is not possible, to acknowledge (LEDs, Output Relays...) as long as there are non saved (cached only) parameters.

The acknowledgement menu cannot be accessed as long as the parameter modifications are not overtaken by the device (indicated by a star symbol in the upper left corner).

**NOTICE**

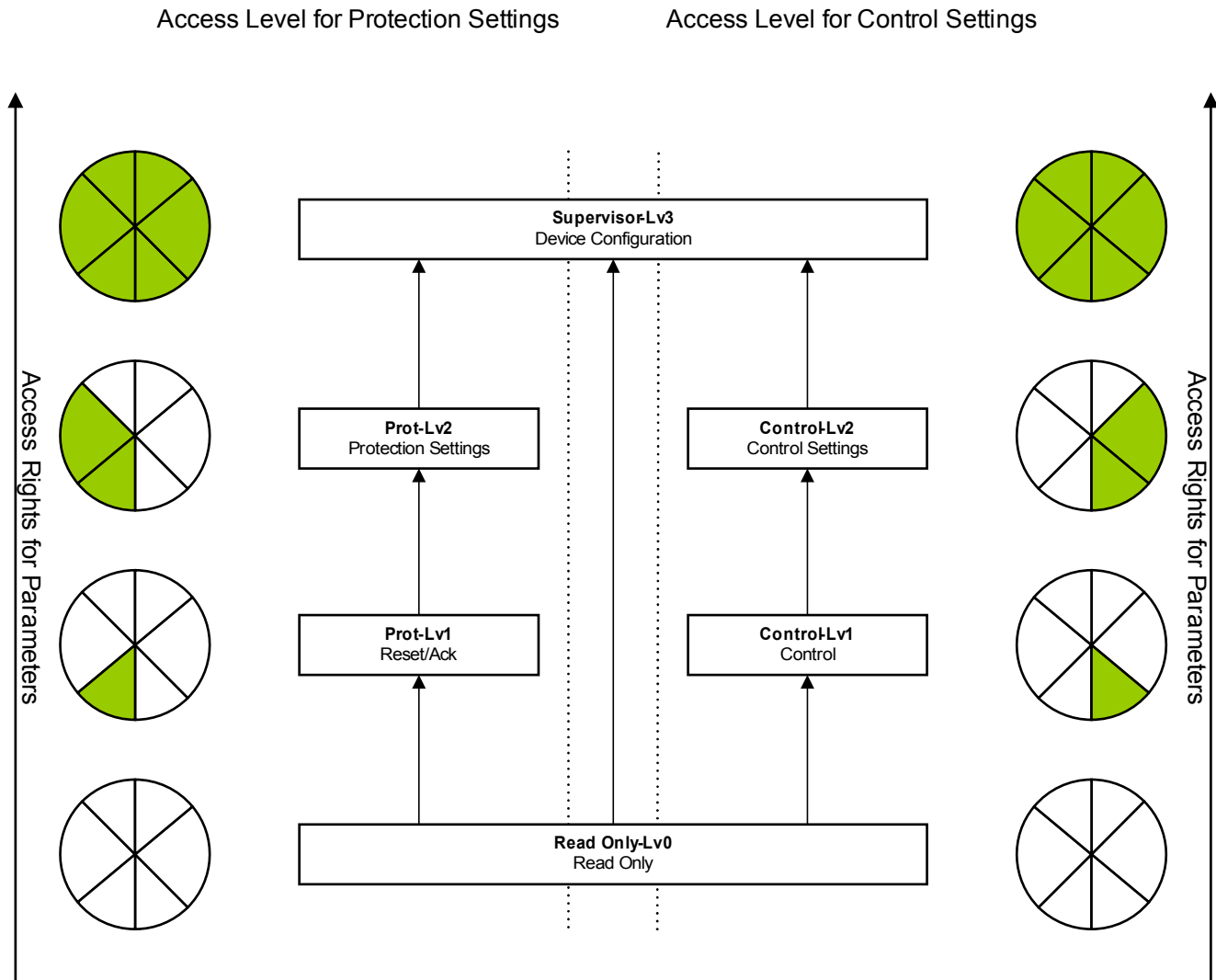
The passwords are part of the device (fixed assignments). That means, passwords will not be overwritten, if a parameter file is transmitted into a device.

Existing passwords are persistent (assigned to a device). If an offline created parameter file is transmitted into a device, or if a parameter file is transmitted from one device to another, this will have no impact on existing passwords within the device.

Available Levels/Access Authorizations

The access authorizations are designed in form of two hierarchic strings.

The supervisor (administrator) password provides access to all parameters and settings.



Legend: Lv = Level

◁ Parameters are read only

◀ Parameters can be modified

How to find out what access areas/levels are unlocked?

The menu [Device para\Access levels] provides the information, which access areas (authorizations) are currently unlocked.

As soon as there is an unlocked access area (authorization) above »Read Only-Lv0«, this will be indicated by an unlocked lock symbol within the upper right corner of the device display.

Unlocking Access Areas

Within the menu [Device Para\Access level] access areas can be unlocked or locked (at the HMI).

Changing Passwords

Passwords can be changed at the device in menu [Device Para/Passwords] or by means of the *Power-Port-E* software.

NOTICE

A password must be a user-defined combination of the numerics 1, 2, 3 and 4.

All other characters and keys won't be accepted.

When you want to change a password, the existing one has to be entered firstly. The new password (up to 8 digits) is then to be confirmed twice. Please proceed as follows:

- In order to change the password please enter your old password by means of the Softkeys followed by pressing the »OK«-key.
- Enter the new password by means of the Softkeys and press the »OK«-key.
- Afterwards enter the new password once again by means of the Softkeys and press the »OK«-key.

Deactivating Passwords during Commissioning

It is possible optionally to deactivate passwords during commissioning. It is not allowed to use this feature for other purposes than commissioning. In order to deactivate the password protection replace the existing password with an empty one for the corresponding access areas. All access authorizations (access areas) that are protected by an empty password are unlocked permanent. That means, that all parameters and settings within those areas can be modified without any further access authorization. It is no longer possible to change into the »*Read Only-Lv0*« level (the protective device will also not fall back into this mode if the maximum edit time is expired (t-max-Edit)).

⚠ WARNING

You have to ensure that all passwords are activated again after the commissioning. That means, that all access areas have to be protected by a password that consists of 4 digits as minimum.

The manufacturer will not overtake any liability for any personal injuries or damages that are caused by deactivated password protection.

Password Entry at the Panel

Passwords can be entered by way of the Softkeys.



Example: For password (3244) press successively:

- Softkey 3
- Softkey 2
- Softkey 4
- Softkey 4

Password Forgotten

By pressing the »Ack/Rst« key during cold booting a reset menu will be called up. By selecting »Reset All Passwords?« and confirming with »Yes« all passwords will be reset to the defaults »1234«.

Parameter Setting at the HMI

Every parameter belongs to an access area. Editing and changing of a parameter requires a sufficient access authorization.

The User can obtain the required access authorizations by unlocking access areas in advance of parameter changes or context-dependent. In the following sections both options will be explained.

Option 1: Direct Authorization for an Access Area

Call up menu [Device Para\Access level].

Select the required access level respectively navigate to the required access authorization (level). Enter the required password. If the correct password has been entered, the required access authorization will be obtained. In order to do the parameter changes please proceed as follows:

- Move to the parameter you want to change by using the Softkeys. If the parameter is selected, the lower right corner of the display should show a »Wrench« symbol.



This symbol indicates, that the parameter is unlocked and can be edited, because the required access authorization is available. Confirm the Softkey »Wrench«, in order to edit the parameter. Change the parameter.

Now you can:

- save the change you made and have them adopted by the system or:
- change additional parameters and save finally all the altered parameters and have them adopted by the system.

To save parameter changes immediately,

- press the »OK« key for saving changed parameters directly and to have them adopted by the device. Confirm the parameter changes by pressing the »Yes« Softkey or dismiss by pressing »No«.

To change additional parameters and save afterwards,

- move to other parameters and change them

NOTICE

A star symbol in front of the changed parameters indicates that the modifications have only been saved temporarily, they are not yet finally stored and adopted by the device.

In order to make things easier to follow, especially where complex parameter changes are involved, on every superior/higher-ranking menu level the intended change of the parameter is indicated by the star symbol (star trace). This makes it possible to control or follow up from the main menu level at any time where parameter changes have been made and have not been saved finally.

In addition to the star trace to the temporary saved parameter changes, a general parameter changing symbol is faded-in at the left corner of the display, and so it is possible from each point of the menu tree to see that there are parameter changes still not adopted by the device.

Press the »OK« key to initiate the final storage of all parameter changes. Confirm the parameter changes by pressing the »Yes« softkey or dismiss by pressing Softkey »No«.

NOTICE

If the display shows a Key Symbol instead of a Wrench-Symbol, this will indicate, that the required access authorization is not available.



In order to edit this parameter, a password is required, that provides the required authorization.

NOTICE

Plausibility check: In order to prevent obvious wrong settings the device monitors constantly all temporary saved parameter changes. If the device detects an implausibility, this is indicated by a question mark in front of the respective parameter.

In order to make things easier to follow up, especially where complex parameter changes are involved, on every superior/higher-ranking menu level, above the temporarily saved parameters an invalidity is indicated by the question mark (plausibility trace). This makes it possible to control or follow from the main menu level at any time where implausibilities are intended to be saved.

In addition to the question mark trace to the temporary saved implausible parameter changes a general implausibility symbol/question mark is faded-in at the left corner of the display, and so it is possible to see from each point of the menu tree that implausibilities have been detected by the device.

A star/parameter change indication is always overwritten by the question mark/implausibility symbol.

If a device detects an implausibility, it rejects saving and adopting of the parameters.

Option 2: Context-dependent Access Authorization

Navigate to the parameter, that is to be changed. If the parameter is selected, the lower right corner of the display shows a »Key«-Symbol.



This symbol indicates, that the device is still within the »Read Only Lv0«-Level, or that the current level does not provide sufficient access rights to allow editing of this parameter.

Press this Softkey and enter the password¹⁾ that provides access to this parameter.

Please change the parameter settings.

¹⁾ This page provides also information, which password/access authorization is required to do changes on this parameter.

Now you can:

- save the change you made and have them adopted by the system or:
- change additional parameters and save finally all the altered parameters and have them adopted by the system.

To save parameter changes immediately,

- press the »OK« key for saving changed parameters directly and to have them adopted by the device. Confirm the parameter changes by pressing the »Yes« Softkey or dismiss by pressing »No«.

To change additional parameters and save afterwards,

- move to other parameters and change them

NOTICE

A star symbol in front of the changed parameters indicates that the modifications have only been saved temporary, they are not yet finally stored and adopted by the device.

In order to make things easier to follow up, especially where complex parameter changes are involved, on every superior/higher-ranking menu level the intended change of the parameter is indicated by the star symbol (star trace). This makes it possible to control or follow from the main menu level at any time where parameter changes have been made and have not been saved finally.

In addition to the star trace to the temporary saved parameter changes, a general parameter changing symbol is faded-in at the left corner of the display, and so it is possible from each point of the menu tree to see that there are parameter changes still not adopted by the device.

Press the »OK« key to initiate the final storage of all parameter changes. Confirm the parameter changes by pressing the »Yes« Softkey or dismiss by pressing Softkey »No«.

NOTICE

Plausibility check: In order to prevent obvious wrong settings the device monitors constantly all temporary saved parameter changes. If the device detects an implausibility, this is indicated by a question mark in front of the respective parameter.

In order to make things easier to follow up, especially where complex parameter changes are involved, on every superior/higher-ranking menu level, above the temporary saved parameters an invalidity is indicated by the question mark (plausibility trace). This makes it possible to control or follow from the main menu level at any time where implausibilities are intended to be saved.

In addition to the question mark trace to the temporary saved implausible parameter changes a general implausibility symbol/question mark is faded-in at the left corner of the display, and so it is possible to see from each point of the menu tree that implausibilities have been detected by the device.

A star/parameter change indication is always overwritten by the question mark/implausibility symbol.

If a device detects an implausibility, it rejects saving and adopting of the parameters.

Setting Groups

Setting Group Switch

Within the »Protection Para/P-Set Switch« menu, the User has the following possibilities:

- To manually set one of the four setting groups active;
- To assign a signal to each setting group that sets this group to active; and
- Scada switches the setting groups.

Option	Setting Group Switch
<i>Manual Selection</i>	Switch over, if another setting group is chosen manually within the menu »Protection Para/P-Set Switch«
<i>Via Input Function (e.g. Digital Input)</i>	Switch over not until the request is clear. That means, if there is more or less than one request signal active, no switch over will be executed. Example:: DI3 is assigned onto Parameter set 1. DI3 is active "1". DI4 is assigned onto Parameter set 2. DI4 is inactive "0". Now the device should switch from parameter set 1 to parameter set 2. Therefore at first DI3 has to become inactive "0". Than DI4 has to be active "1". If DI4 becomes again inactive "0", parameter set 2 will remain active "1" as long as there is no clear request (e.g. DI3 becomes active "1", all the other assignments are inactive "0")
<i>Via Scada</i>	Switch over if there is a clear SCADA request. Otherwise no switch over will be executed.

NOTICE

The description of the parameters can be found within the "System Parameters" section.

Signals that can be used for PSS

Name	Description
--	No assignment
Prot.DFT Invalid	DFT values of fundamental and harmonics (except VX) are not valid. They depend on period time of frequency and measured channels 1-3 (VA/VAB,VB/VBC,VC/VCA).
Prot.DFT Valid	DFT values of fundamental and harmonics (except VX) are valid. They depend on period time of frequency and measured channels 1-3 (VA/VAB,VB/VBC,VC/VCA).
Prot.DFT Invalid (VX)	DFT values of fundamental and harmonics of VX (only) are not valid.
Prot.DFT Valid (VX)	DFT values of fundamental and harmonics of VX (only) are valid.
CTS.Pickup	Signal: Pickup Current Transformer Measuring Circuit Supervision
LOP.Pickup	Signal: Pickup Loss of Potential
DI-8P X1.DI 1	Signal: Digital Input
DI-8P X1.DI 2	Signal: Digital Input
DI-8P X1.DI 3	Signal: Digital Input
DI-8P X1.DI 4	Signal: Digital Input
DI-8P X1.DI 5	Signal: Digital Input
DI-8P X1.DI 6	Signal: Digital Input
DI-8P X1.DI 7	Signal: Digital Input
DI-8P X1.DI 8	Signal: Digital Input
DI-8 X5.DI 1	Signal: Digital Input
DI-8 X5.DI 2	Signal: Digital Input
DI-8 X5.DI 3	Signal: Digital Input
DI-8 X5.DI 4	Signal: Digital Input
DI-8 X5.DI 5	Signal: Digital Input
DI-8 X5.DI 6	Signal: Digital Input
DI-8 X5.DI 7	Signal: Digital Input
DI-8 X5.DI 8	Signal: Digital Input
Logic.LE1.Gate Out	Signal: Output of the logic gate
Logic.LE1.Timer Out	Signal: Timer Output
Logic.LE1.Out	Signal: Latched Output (Q)
Logic.LE1.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE2.Gate Out	Signal: Output of the logic gate
Logic.LE2.Timer Out	Signal: Timer Output
Logic.LE2.Out	Signal: Latched Output (Q)
Logic.LE2.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE3.Gate Out	Signal: Output of the logic gate
Logic.LE3.Timer Out	Signal: Timer Output
Logic.LE3.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE3.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE4.Gate Out	Signal: Output of the logic gate
Logic.LE4.Timer Out	Signal: Timer Output
Logic.LE4.Out	Signal: Latched Output (Q)
Logic.LE4.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE5.Gate Out	Signal: Output of the logic gate
Logic.LE5.Timer Out	Signal: Timer Output
Logic.LE5.Out	Signal: Latched Output (Q)
Logic.LE5.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE6.Gate Out	Signal: Output of the logic gate
Logic.LE6.Timer Out	Signal: Timer Output
Logic.LE6.Out	Signal: Latched Output (Q)
Logic.LE6.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE7.Gate Out	Signal: Output of the logic gate
Logic.LE7.Timer Out	Signal: Timer Output
Logic.LE7.Out	Signal: Latched Output (Q)
Logic.LE7.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE8.Gate Out	Signal: Output of the logic gate
Logic.LE8.Timer Out	Signal: Timer Output
Logic.LE8.Out	Signal: Latched Output (Q)
Logic.LE8.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE9.Gate Out	Signal: Output of the logic gate
Logic.LE9.Timer Out	Signal: Timer Output
Logic.LE9.Out	Signal: Latched Output (Q)
Logic.LE9.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE10.Gate Out	Signal: Output of the logic gate
Logic.LE10.Timer Out	Signal: Timer Output
Logic.LE10.Out	Signal: Latched Output (Q)
Logic.LE10.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE11.Gate Out	Signal: Output of the logic gate
Logic.LE11.Timer Out	Signal: Timer Output
Logic.LE11.Out	Signal: Latched Output (Q)
Logic.LE11.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE12.Gate Out	Signal: Output of the logic gate
Logic.LE12.Timer Out	Signal: Timer Output
Logic.LE12.Out	Signal: Latched Output (Q)
Logic.LE12.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE13.Gate Out	Signal: Output of the logic gate
Logic.LE13.Timer Out	Signal: Timer Output
Logic.LE13.Out	Signal: Latched Output (Q)
Logic.LE13.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE14.Gate Out	Signal: Output of the logic gate
Logic.LE14.Timer Out	Signal: Timer Output
Logic.LE14.Out	Signal: Latched Output (Q)
Logic.LE14.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE15.Gate Out	Signal: Output of the logic gate
Logic.LE15.Timer Out	Signal: Timer Output
Logic.LE15.Out	Signal: Latched Output (Q)
Logic.LE15.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE16.Gate Out	Signal: Output of the logic gate
Logic.LE16.Timer Out	Signal: Timer Output
Logic.LE16.Out	Signal: Latched Output (Q)
Logic.LE16.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE17.Gate Out	Signal: Output of the logic gate
Logic.LE17.Timer Out	Signal: Timer Output
Logic.LE17.Out	Signal: Latched Output (Q)
Logic.LE17.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE18.Gate Out	Signal: Output of the logic gate
Logic.LE18.Timer Out	Signal: Timer Output
Logic.LE18.Out	Signal: Latched Output (Q)
Logic.LE18.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE19.Gate Out	Signal: Output of the logic gate
Logic.LE19.Timer Out	Signal: Timer Output
Logic.LE19.Out	Signal: Latched Output (Q)
Logic.LE19.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE20.Gate Out	Signal: Output of the logic gate
Logic.LE20.Timer Out	Signal: Timer Output
Logic.LE20.Out	Signal: Latched Output (Q)
Logic.LE20.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE21.Gate Out	Signal: Output of the logic gate
Logic.LE21.Timer Out	Signal: Timer Output
Logic.LE21.Out	Signal: Latched Output (Q)
Logic.LE21.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE22.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE22.Timer Out	Signal: Timer Output
Logic.LE22.Out	Signal: Latched Output (Q)
Logic.LE22.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE23.Gate Out	Signal: Output of the logic gate
Logic.LE23.Timer Out	Signal: Timer Output
Logic.LE23.Out	Signal: Latched Output (Q)
Logic.LE23.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE24.Gate Out	Signal: Output of the logic gate
Logic.LE24.Timer Out	Signal: Timer Output
Logic.LE24.Out	Signal: Latched Output (Q)
Logic.LE24.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE25.Gate Out	Signal: Output of the logic gate
Logic.LE25.Timer Out	Signal: Timer Output
Logic.LE25.Out	Signal: Latched Output (Q)
Logic.LE25.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE26.Gate Out	Signal: Output of the logic gate
Logic.LE26.Timer Out	Signal: Timer Output
Logic.LE26.Out	Signal: Latched Output (Q)
Logic.LE26.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE27.Gate Out	Signal: Output of the logic gate
Logic.LE27.Timer Out	Signal: Timer Output
Logic.LE27.Out	Signal: Latched Output (Q)
Logic.LE27.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE28.Gate Out	Signal: Output of the logic gate
Logic.LE28.Timer Out	Signal: Timer Output
Logic.LE28.Out	Signal: Latched Output (Q)
Logic.LE28.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE29.Gate Out	Signal: Output of the logic gate
Logic.LE29.Timer Out	Signal: Timer Output
Logic.LE29.Out	Signal: Latched Output (Q)
Logic.LE29.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE30.Gate Out	Signal: Output of the logic gate
Logic.LE30.Timer Out	Signal: Timer Output
Logic.LE30.Out	Signal: Latched Output (Q)
Logic.LE30.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE31.Gate Out	Signal: Output of the logic gate
Logic.LE31.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE31.Out	Signal: Latched Output (Q)
Logic.LE31.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE32.Gate Out	Signal: Output of the logic gate
Logic.LE32.Timer Out	Signal: Timer Output
Logic.LE32.Out	Signal: Latched Output (Q)
Logic.LE32.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE33.Gate Out	Signal: Output of the logic gate
Logic.LE33.Timer Out	Signal: Timer Output
Logic.LE33.Out	Signal: Latched Output (Q)
Logic.LE33.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE34.Gate Out	Signal: Output of the logic gate
Logic.LE34.Timer Out	Signal: Timer Output
Logic.LE34.Out	Signal: Latched Output (Q)
Logic.LE34.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE35.Gate Out	Signal: Output of the logic gate
Logic.LE35.Timer Out	Signal: Timer Output
Logic.LE35.Out	Signal: Latched Output (Q)
Logic.LE35.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE36.Gate Out	Signal: Output of the logic gate
Logic.LE36.Timer Out	Signal: Timer Output
Logic.LE36.Out	Signal: Latched Output (Q)
Logic.LE36.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE37.Gate Out	Signal: Output of the logic gate
Logic.LE37.Timer Out	Signal: Timer Output
Logic.LE37.Out	Signal: Latched Output (Q)
Logic.LE37.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE38.Gate Out	Signal: Output of the logic gate
Logic.LE38.Timer Out	Signal: Timer Output
Logic.LE38.Out	Signal: Latched Output (Q)
Logic.LE38.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE39.Gate Out	Signal: Output of the logic gate
Logic.LE39.Timer Out	Signal: Timer Output
Logic.LE39.Out	Signal: Latched Output (Q)
Logic.LE39.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE40.Gate Out	Signal: Output of the logic gate
Logic.LE40.Timer Out	Signal: Timer Output
Logic.LE40.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE40.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE41.Gate Out	Signal: Output of the logic gate
Logic.LE41.Timer Out	Signal: Timer Output
Logic.LE41.Out	Signal: Latched Output (Q)
Logic.LE41.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE42.Gate Out	Signal: Output of the logic gate
Logic.LE42.Timer Out	Signal: Timer Output
Logic.LE42.Out	Signal: Latched Output (Q)
Logic.LE42.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE43.Gate Out	Signal: Output of the logic gate
Logic.LE43.Timer Out	Signal: Timer Output
Logic.LE43.Out	Signal: Latched Output (Q)
Logic.LE43.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE44.Gate Out	Signal: Output of the logic gate
Logic.LE44.Timer Out	Signal: Timer Output
Logic.LE44.Out	Signal: Latched Output (Q)
Logic.LE44.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE45.Gate Out	Signal: Output of the logic gate
Logic.LE45.Timer Out	Signal: Timer Output
Logic.LE45.Out	Signal: Latched Output (Q)
Logic.LE45.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE46.Gate Out	Signal: Output of the logic gate
Logic.LE46.Timer Out	Signal: Timer Output
Logic.LE46.Out	Signal: Latched Output (Q)
Logic.LE46.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE47.Gate Out	Signal: Output of the logic gate
Logic.LE47.Timer Out	Signal: Timer Output
Logic.LE47.Out	Signal: Latched Output (Q)
Logic.LE47.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE48.Gate Out	Signal: Output of the logic gate
Logic.LE48.Timer Out	Signal: Timer Output
Logic.LE48.Out	Signal: Latched Output (Q)
Logic.LE48.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE49.Gate Out	Signal: Output of the logic gate
Logic.LE49.Timer Out	Signal: Timer Output
Logic.LE49.Out	Signal: Latched Output (Q)
Logic.LE49.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE50.Gate Out	Signal: Output of the logic gate
Logic.LE50.Timer Out	Signal: Timer Output
Logic.LE50.Out	Signal: Latched Output (Q)
Logic.LE50.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE51.Gate Out	Signal: Output of the logic gate
Logic.LE51.Timer Out	Signal: Timer Output
Logic.LE51.Out	Signal: Latched Output (Q)
Logic.LE51.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE52.Gate Out	Signal: Output of the logic gate
Logic.LE52.Timer Out	Signal: Timer Output
Logic.LE52.Out	Signal: Latched Output (Q)
Logic.LE52.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE53.Gate Out	Signal: Output of the logic gate
Logic.LE53.Timer Out	Signal: Timer Output
Logic.LE53.Out	Signal: Latched Output (Q)
Logic.LE53.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE54.Gate Out	Signal: Output of the logic gate
Logic.LE54.Timer Out	Signal: Timer Output
Logic.LE54.Out	Signal: Latched Output (Q)
Logic.LE54.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE55.Gate Out	Signal: Output of the logic gate
Logic.LE55.Timer Out	Signal: Timer Output
Logic.LE55.Out	Signal: Latched Output (Q)
Logic.LE55.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE56.Gate Out	Signal: Output of the logic gate
Logic.LE56.Timer Out	Signal: Timer Output
Logic.LE56.Out	Signal: Latched Output (Q)
Logic.LE56.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE57.Gate Out	Signal: Output of the logic gate
Logic.LE57.Timer Out	Signal: Timer Output
Logic.LE57.Out	Signal: Latched Output (Q)
Logic.LE57.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE58.Gate Out	Signal: Output of the logic gate
Logic.LE58.Timer Out	Signal: Timer Output
Logic.LE58.Out	Signal: Latched Output (Q)
Logic.LE58.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE59.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE59.Timer Out	Signal: Timer Output
Logic.LE59.Out	Signal: Latched Output (Q)
Logic.LE59.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE60.Gate Out	Signal: Output of the logic gate
Logic.LE60.Timer Out	Signal: Timer Output
Logic.LE60.Out	Signal: Latched Output (Q)
Logic.LE60.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE61.Gate Out	Signal: Output of the logic gate
Logic.LE61.Timer Out	Signal: Timer Output
Logic.LE61.Out	Signal: Latched Output (Q)
Logic.LE61.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE62.Gate Out	Signal: Output of the logic gate
Logic.LE62.Timer Out	Signal: Timer Output
Logic.LE62.Out	Signal: Latched Output (Q)
Logic.LE62.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE63.Gate Out	Signal: Output of the logic gate
Logic.LE63.Timer Out	Signal: Timer Output
Logic.LE63.Out	Signal: Latched Output (Q)
Logic.LE63.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE64.Gate Out	Signal: Output of the logic gate
Logic.LE64.Timer Out	Signal: Timer Output
Logic.LE64.Out	Signal: Latched Output (Q)
Logic.LE64.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE65.Gate Out	Signal: Output of the logic gate
Logic.LE65.Timer Out	Signal: Timer Output
Logic.LE65.Out	Signal: Latched Output (Q)
Logic.LE65.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE66.Gate Out	Signal: Output of the logic gate
Logic.LE66.Timer Out	Signal: Timer Output
Logic.LE66.Out	Signal: Latched Output (Q)
Logic.LE66.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE67.Gate Out	Signal: Output of the logic gate
Logic.LE67.Timer Out	Signal: Timer Output
Logic.LE67.Out	Signal: Latched Output (Q)
Logic.LE67.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE68.Gate Out	Signal: Output of the logic gate
Logic.LE68.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE68.Out	Signal: Latched Output (Q)
Logic.LE68.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE69.Gate Out	Signal: Output of the logic gate
Logic.LE69.Timer Out	Signal: Timer Output
Logic.LE69.Out	Signal: Latched Output (Q)
Logic.LE69.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE70.Gate Out	Signal: Output of the logic gate
Logic.LE70.Timer Out	Signal: Timer Output
Logic.LE70.Out	Signal: Latched Output (Q)
Logic.LE70.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE71.Gate Out	Signal: Output of the logic gate
Logic.LE71.Timer Out	Signal: Timer Output
Logic.LE71.Out	Signal: Latched Output (Q)
Logic.LE71.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE72.Gate Out	Signal: Output of the logic gate
Logic.LE72.Timer Out	Signal: Timer Output
Logic.LE72.Out	Signal: Latched Output (Q)
Logic.LE72.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE73.Gate Out	Signal: Output of the logic gate
Logic.LE73.Timer Out	Signal: Timer Output
Logic.LE73.Out	Signal: Latched Output (Q)
Logic.LE73.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE74.Gate Out	Signal: Output of the logic gate
Logic.LE74.Timer Out	Signal: Timer Output
Logic.LE74.Out	Signal: Latched Output (Q)
Logic.LE74.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE75.Gate Out	Signal: Output of the logic gate
Logic.LE75.Timer Out	Signal: Timer Output
Logic.LE75.Out	Signal: Latched Output (Q)
Logic.LE75.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE76.Gate Out	Signal: Output of the logic gate
Logic.LE76.Timer Out	Signal: Timer Output
Logic.LE76.Out	Signal: Latched Output (Q)
Logic.LE76.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE77.Gate Out	Signal: Output of the logic gate
Logic.LE77.Timer Out	Signal: Timer Output
Logic.LE77.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE77.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE78.Gate Out	Signal: Output of the logic gate
Logic.LE78.Timer Out	Signal: Timer Output
Logic.LE78.Out	Signal: Latched Output (Q)
Logic.LE78.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE79.Gate Out	Signal: Output of the logic gate
Logic.LE79.Timer Out	Signal: Timer Output
Logic.LE79.Out	Signal: Latched Output (Q)
Logic.LE79.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE80.Gate Out	Signal: Output of the logic gate
Logic.LE80.Timer Out	Signal: Timer Output
Logic.LE80.Out	Signal: Latched Output (Q)
Logic.LE80.Out inverted	Signal: Negated Latched Output (Q NOT)
Sys.Maint Mode Active	Signal: Arc Flash Reduction Maintenance Active
Sys.Maint Mode Inactive	Signal: Arc Flash Reduction Maintenance Inactive

Program Mode

By means of the Program Mode, parameter settings can be locked against any changes as long as one or all of the breaker(s) are in the »CLOSED« position. The Program Mode can be activated within the [System Para/General Settings/Program Mode Bypass] menu.

- »Both Bkr Open« - Parameter changes require all breakers to be in the »OPEN« state.
- »Either Bkr Open or Close« - Parameter changes do not require the breaker to be in the »OPEN« state.

Unlike, if the Program Mode is used for Motor Protection devices, the user has the following options:

- »Motor Stop« - Lock parameter changes, if the motor is not in the »STOP« state.
This ensures, that parameter changes can only be done while the motor stands still (zero speed).
- »Either Motor Stopped or Running« - Parameter changes do not require the motor to be in the »Motor stop« state.

Bypass of the Program Mode

The program mode can be bypassed by means of the Direct Control Parameter »Program Mode Bypass«. The protective device will fall back into the program mode either:

- Directly after a parameter change has been saved, else
- 10 minutes after the bypass has been activated.

System Parameters

System Para

Within the system parameters, the User can set all parameters that are relevant for the primary side and the mains operational method like frequency, primary and secondary values, and the star point treatment.

General System Parameters

<i>Parameter</i>	<i>Description</i>	<i>Setting range</i>	<i>Default</i>	<i>Menu path</i>
Phase Sequence 	Phase Sequence direction	ABC, ACB	ABC	[System Para /General Settings]
f 	Nominal frequency	50Hz, 60Hz	60Hz	[System Para /General Settings]

System Parameters – Current Related

Parameter	Description	Setting range	Default	Menu path
CT con 	Current transformer connection	3-wire, 4th CT IN, 4th CT IG	3-wire	[System Para /General Settings]
CT pri 	Nominal current of the primary side of the current transformers.	1 - 50000A	4000A	[System Para /General Settings]
CT sec 	Nominal current of the secondary side of the current transformers.	1A, 5A	5A	[System Para /General Settings]
CT dir 	Protection functions with directional feature can only work properly if the connection of the current transformers is free of wiring errors. If all current transformers are connected to the device with an incorrect polarity, the wiring error can be compensated by this parameter. This parameter turns the current vectors by 180 degrees.	0°, 180°	0°	[System Para /General Settings]
XCT pri 	This parameter defines the primary nominal current of the connected ground current transformer. If the ground current is measured via the Residual connection, the primary value of the phase current transformer must be entered here.	1 - 50000A	50A	[System Para /General Settings]
XCT sec 	This parameter defines the secondary nominal current of the connected ground current transformer. If the ground current is done via the Residual connection, the primary value of the phase current transformer must be entered here.	1A, 5A	5A	[System Para /General Settings]
XCT dir 	Ground fault protection with directional feature depends also on the correct wiring of the ground current transformer. An incorrect polarity/wiring can be corrected by means of the settings "0°" or "180°". The operator has the possibility of turning the current vector by "180°" (change of sign) without modification of the wiring. This means, that – in terms of figures - the determined current indicator was turned by "180°" by the device.	0°, 180°	0°	[System Para /General Settings]

System Parameters – Voltage Related

Parameter	Description	Setting range	Default	Menu path
 Main VT pri	Enter the primary phase to phase voltage of the VTs	60 - 500000V	4200V	[System Para /General Settings]
 Main VT sec	Enter the secondary phase to phase voltage of the VTs	60.00 - 600.00V	120V	[System Para /General Settings]
 Main VT con	Main VTs connection	Wye, Phase-to-Phase, Open-Delta	Wye	[System Para /General Settings]
 Aux VT pri	Primary voltage of Aux VTs	60 - 500000V	4200V	[System Para /General Settings]
 Aux VT sec	Secondary voltage of Aux VTs	35.00 - 600.00V	120V	[System Para /General Settings]
 V Sync	The fourth measuring input of the voltage measuring card measures the voltage that is to be synchronized.	A, B, C, AB, BC, CA	A	[System Para /General Settings]
 delta phi - Mode	The delta phi element (vector surge) trips, if the permissible voltage angle shift (delta phi) of the three measured voltages (phase-ground or phase-phase) in: one phase, two phases or within all phases is exceeded.	one phase, two phases, three phases	two phases	[System Para /General Settings]
 Phase MTA	Maximum Torque Angle: Angle between phase current and reference voltage in case of a short circuit. This angle is needed to determine the fault direction in case of short circuits.	0 - 360°	30°	[System Para /Direction]
 IR Dir Cntrl	Options for direction detection. IR is used as operating quantity.	IR 3V0, IR IPol, IR Dual, IR Neg	IR 3V0	[System Para /Direction]

Parameter	Description	Setting range	Default	Menu path
IX Dir Cntrl 	Options for direction detection. IX is used as operating quantity.	IX 3V0, IX Neg, IX Dual	IX 3V0	[System Para /Direction]
3V0 Source 	Earth overcurrent protection elements take into account this parameter for direction decisions. You have to ensure, that this parameter is set to "Measured" only if the fourth measuring input (VX) of the voltage measuring card is connected to a wye-grounded, broken-delta 3V0 connection.	Measured, Calculated	Calculated	[System Para /Direction]
Ground MTA 	Ground Maximum Torque Angle: Angle between chosen operating quantity and chosen reference quantity in case of a ground fault. This angle is needed to determine the ground fault direction in case of a short circuit. Depending on the selected ground direction option, different MTA values are used: IR 3V0, IX 3V0 : Ground MTA; IR Neg, IX Neg : $90^\circ + \text{Phase MTA}$; IR IPol : 0° ; IR Dual : 0° (if I2 and V2 available) or Ground MTA; IX Dual : $90^\circ + \text{Phase MTA}$ (if I2 and V2 available) or Ground MTA.	0 - 360°	110°	[System Para /Direction]

System Parameters of the Generator

Generator

Signals (Output States) of the Generator

Signal	Description
Running Hours Alarm	Running Hours Alarm
Res Running hours	Reset Running hours

Direct Commands of the Generator

Parameter	Description	Setting range	Default	Menu path
t - Res Gen Op hours 	Resettable Generator running hours	Inactive, Active	Inactive	[Operation /Reset]

Global Protection Parameters of the Generator

Parameter	Description	Setting range	Default	Menu path
SN 	Generator MVA rating	0.001 - 2000.000MVA	20MVA	[System Para /Generator]
Rated Voltage 	Rated Voltage of the Generator (Phase-Phase)	60 - 60000V	10000V	[System Para /Generator]
Power Factor 	Power Factor	0.05 - 0.99	0.80	[System Para /Generator]
Running hours Limit 	Running hours Limit	1.00 - 1000000.00h	1000.00h	[System Para /Generator]
Running hours Initial 	Running hours Initial	0.00 - 999999.00h	0.00h	[System Para /Generator]

Values of the Generator

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Gen Op hours	Generator running hours	[Operation /Measured Values /Generator]

System Parameters of the Ground Differential

Parameter	Description	Setting range	Default	Menu path
CT pri 	Nominal current of the primary side of the current transformers.	1 - 50000A	4000A	[System Para /CT Line]
CT sec 	Nominal current of the secondary side of the current transformers.	1A, 5A	5A	[System Para /CT Line]
CT dir 	Protection functions with directional feature can only work properly if the connection of the current transformers is free of wiring errors. If all current transformers are connected to the device with an incorrect polarity, the wiring error can be compensated by this parameter. This parameter turns the current vectors by 180 degrees.	0°, 180°	0°	[System Para /CT Line]
XCT pri 	This parameter defines the primary nominal current of the connected ground current transformer. If the ground current is measured via the Residual connection, the primary value of the phase current transformer must be entered here.	1 - 50000A	50A	[System Para /CT Line]
XCT sec 	This parameter defines the secondary nominal current of the connected ground current transformer. If the ground current is done via the Residual connection, the primary value of the phase current transformer must be entered here.	1A, 5A	5A	[System Para /CT Line]
XCT dir 	Ground fault protection with directional feature depends also on the correct wiring of the ground current transformer. An incorrect polarity/wiring can be corrected by means of the settings "0°" or "180°". The operator has the possibility of turning the current vector by "180°" (change of sign) without modification of the wiring. This means, that – in terms of figures - the determined current indicator was turned by "180°" by the device.	0°, 180°	0°	[System Para /CT Line]

Blocking

The device provides a function for temporary blocking of the complete protection functionality or of single protections.



Make absolutely sure that no illogical or even life-threatening blockings are allocated.

Make sure not to carelessly deactivate protection functions that have to be available according to the protection concept.

Permanent Blocking

Switching "On" or "Off" the Complete Protection Functionality

In the *»Protection«* module, the complete protection of the device can be switched "On" or "Off". Set the Function parameter to *»Active«* or *»Inactive«* in the *»Prot«* module.



Protection is activated only if in the *»Prot«* module the parameter *Function* is = *»Active«* (i.e.: with *»Function«* = *»Inactive«*, no protection function are operating). If *»Function«* = *»Inactive«*, then the device cannot protect any components.

Switching Modules "On" or "Off"

Each of the modules can be switched "On" or "Off" (permanently). This is achieved when the *»Function«* parameter is set to *»Active«* or *»Inactive«* in the respective module.

Activating or Deactivating the Tripping Command of a Protection Permanently

In each of the protections, the tripping command to the breaker can be permanently blocked. For this purpose, the *»TripCmd Blo«* parameter has to be set to *»Active«*.

Temporary Blocking

To Block the Complete Protection of the Device Temporarily by a Signal

In the *»Prot«* module, the complete protection of the device can be blocked temporarily by a signal. On the condition that a module-external blocking is permitted (*»ExBlo Fc=active«*). In addition to this, a related blocking signal from the *»Assignment list«* must have been assigned. For the time the allocated blocking signal is active, the module is blocked.



If the *»Prot«* module is blocked, the complete protection function does not work. As long as the blocking signal is active, the device cannot protect any components.

To Block a Complete Protection Module Temporarily by an Active Assignment

- In order to establish a temporary blockage of a protection module, the parameter *»ExBlo Fc«* of the module has to be set to *»Active«*. This gives the permission: *»This module can be blocked«*.
- Within the general protection parameters, a signal has to be additionally chosen from the *»Assignment list«*. The blocking only becomes active when the assigned signal is active.

To Block the Tripping Command of a Protection Element Temporarily by an Active Assignment

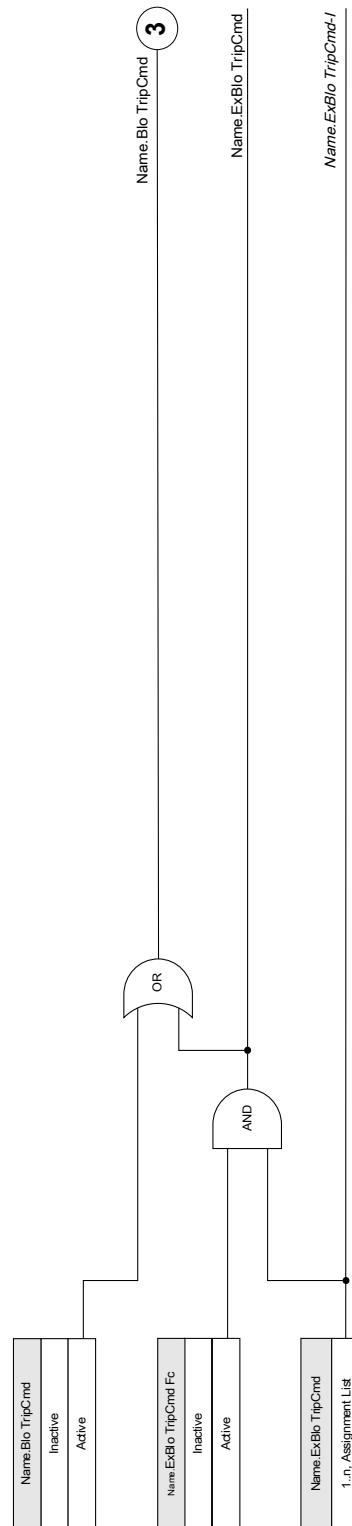
The tripping command of any of the protection modules can be blocked from an external signal. In this case, external does not only mean from outside the device, but also from outside the module. Not only real external signals are permitted to be used as blocking signals (for example: the state of a digital input), but the User can also choose any other signal from the *»Assignment list«*.

- In order to establish a temporary blockage of a protection element, the parameter *»ExBlo TripCmd Fc«* of the module has to be set to *»Active«*. This gives the permission: *»The tripping command of this element can be blocked«*.
- Within the general protection parameters, an additional signal has to be chosen and assigned to the *»ExBlo«* parameter from the *»Assignment list«*. If the selected signal is activated, the temporary blockage becomes effective.

To Activate or Deactivate the Tripping Command of a Protection Module

Trip Blockings

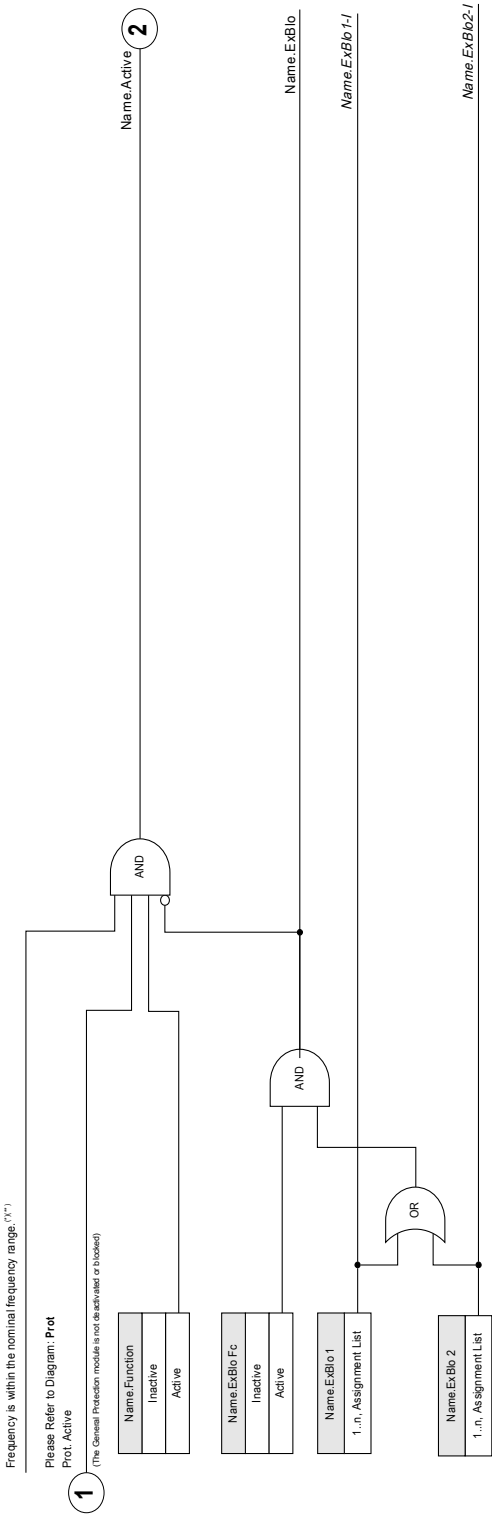
Name = All Modules That Are Blockable



Activate, Deactivate Respectively to Block Temporary Protection Functions

Blockings

Name =All Modules That Are Blockable

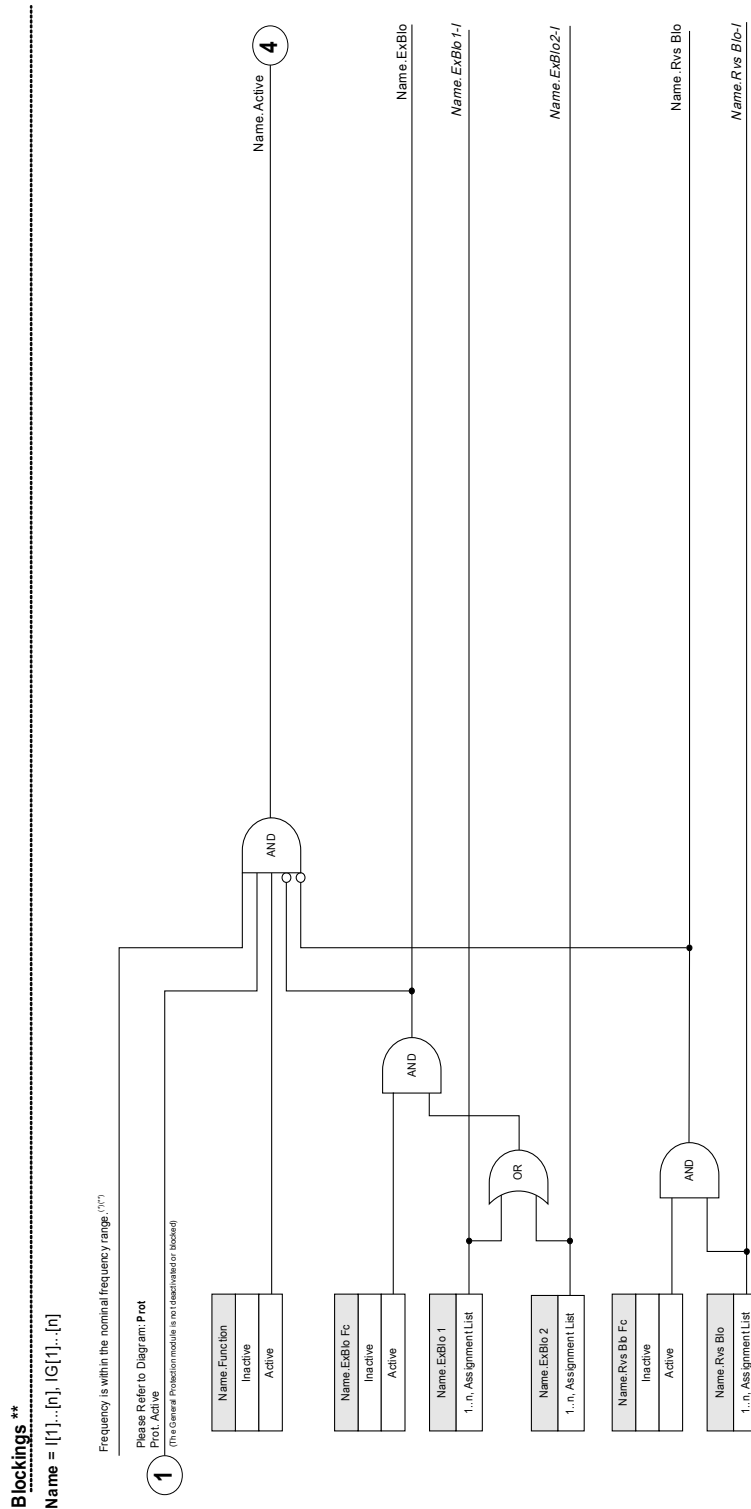


*All protective elements will be blocked that are using fundamentals or harmonic measured values, if the frequency leaves the nominal frequency range. Protective elements that are using RMS values will remain active. See chapter "Wide frequency range".

**This applies to devices that offer wide frequency range measurement only.

Current protective functions cannot only be blocked permanently («*Function = Inactive*») or temporarily by any blocking signal from the »Assignment list«, but also by »*Reverse Interlocking*«.

All other protection functions can be activated, deactivated, or blocked in the same manner.



*All protective elements will be blocked that are using fundamentals or harmonic measured values, if the frequency leaves the nominal frequency range. Protective elements that are using RMS values will remain active. See chapter "Wide frequency range".

**This applies to devices that offer wide frequency range measurement only.

Protection (Prot) Module

Prot

The »Protection« module serves as the outer frame for all other protection modules (i.e.: they are all enclosed by the »Protection« Module).



In the case where the »Protection« module is blocked, the complete protective function of the device is disabled.

Module Prot Blocked - Protection Inactive:

If the master »Protection« module is allowed to be temporarily blocked and the allocated blocking signals are active, then all protection functions will be disabled. In such a case, the protective function is »Inactive«.

Protection Active:

If the master »Protection« module was activated and a blockade for this module was not activated respectively, the assigned blocking signals are inactive at that moment, then the »Protection« is »Active«.

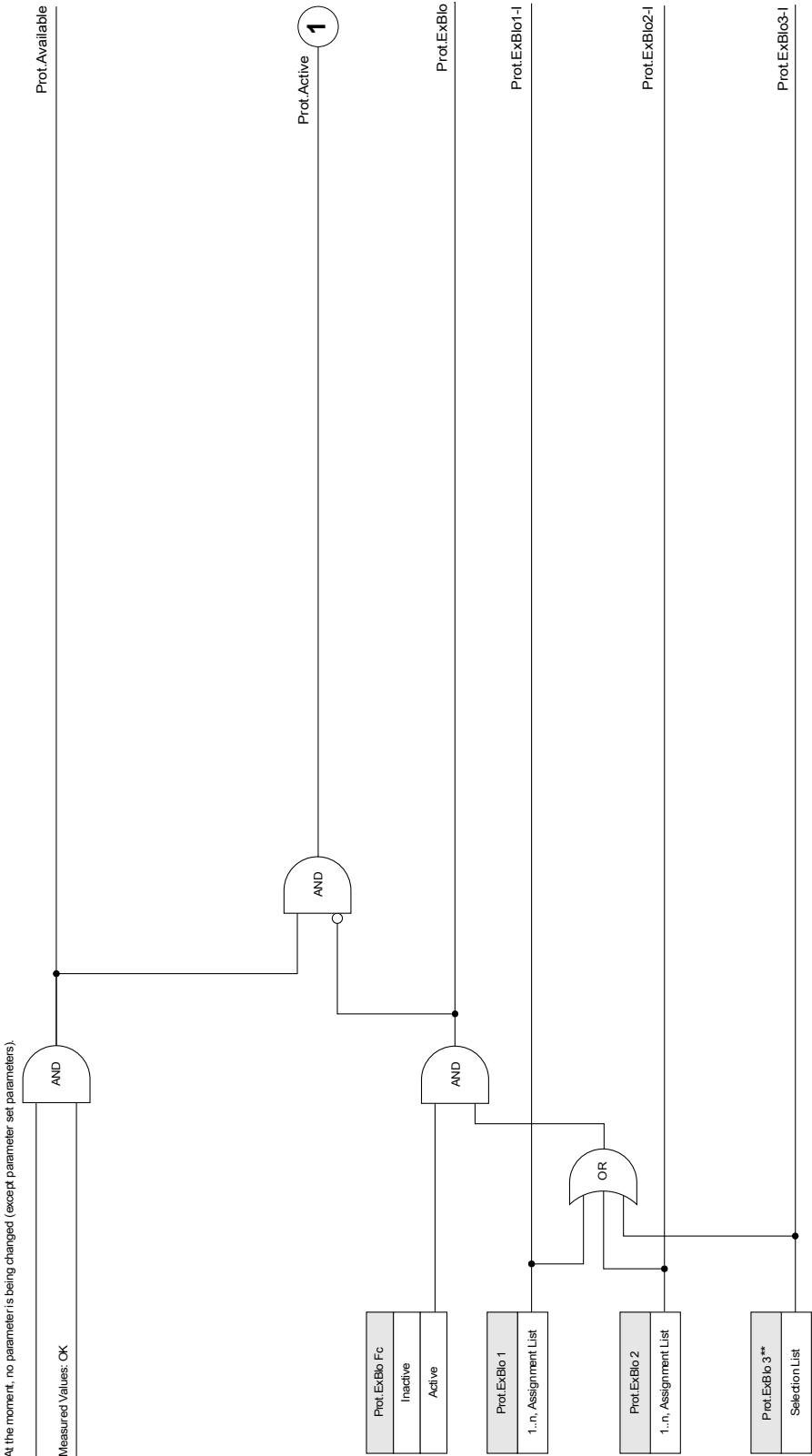
How to Block All Protective and Supervisory Functions

In order to block all protective and supervisory functions, call up the menu [Protection/Para/Global Prot Para/Prot]:

- Set the parameter »ExBlo Fc = active«;
- Choose an assignment for »ExBlo1«; and
- Optionally choose an assignment for »ExBlo2«.

If the signal becomes true, then all protective and supervisory functions will be blocked as long as one of these signals are true.

Prot - Active



**=Availability of third blocking input depends on device and module

Each protection element generates its own pickup and trip signals, which are automatically passed onto the »Prot« module where the phase based and general (collective) pickup and trip signals are generated. The »Prot« module serves as a top level and a common place to group all pickups and trips from each individual protection element.

For instance, »PROT.PICKUP PHASE A« is the phase A pickup signal OR-ed from all protection elements; »PROT.TRIP PHASE A« is the phase A trip signal OR-ed from all protection elements; »PROT.PICKUP« is the collective pickup signal OR-ed from all protection elements; Prot.Trip is the collective Trip signal OR-ed from all protection elements, and etc. The Tripping commands of the protection elements have to be fed to the »Bkr Manager« module for further trip request processing.



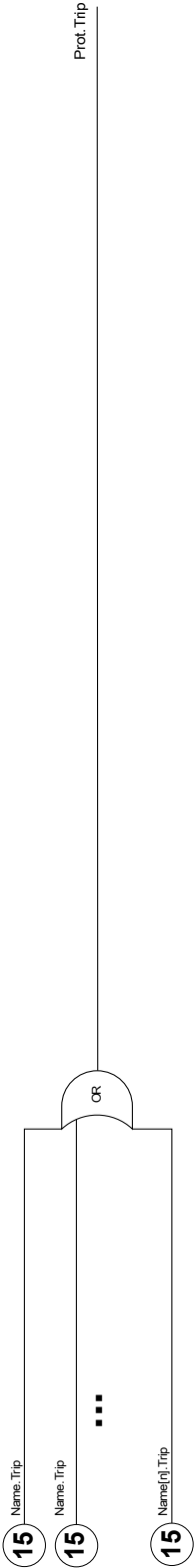
The tripping commands are executed by the »Bkr Manager« module.

Tripping commands have to be assigned to a breaker. The Breaker Manager will issue the trip command to the breaker.

If a protection element is activated and respectively decides to trip, two pickup signals will be created.

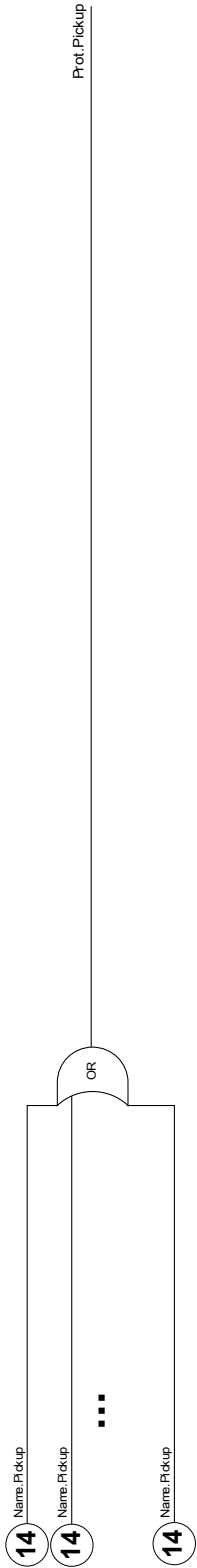
1. The module or the protection element issues an pickup/alarm (e.g.: »50P[1].PICKUP« or »50P[1].TRIP«).
2. The master »Prot« module collects/summarizes the signals and issues a pickup/alarm or a trip signal »PROT.PICKUP« »PROT.TRIP«.

Prot.Trip
Name = Each trip of an active, trip authorized protection module will lead to a general trip.



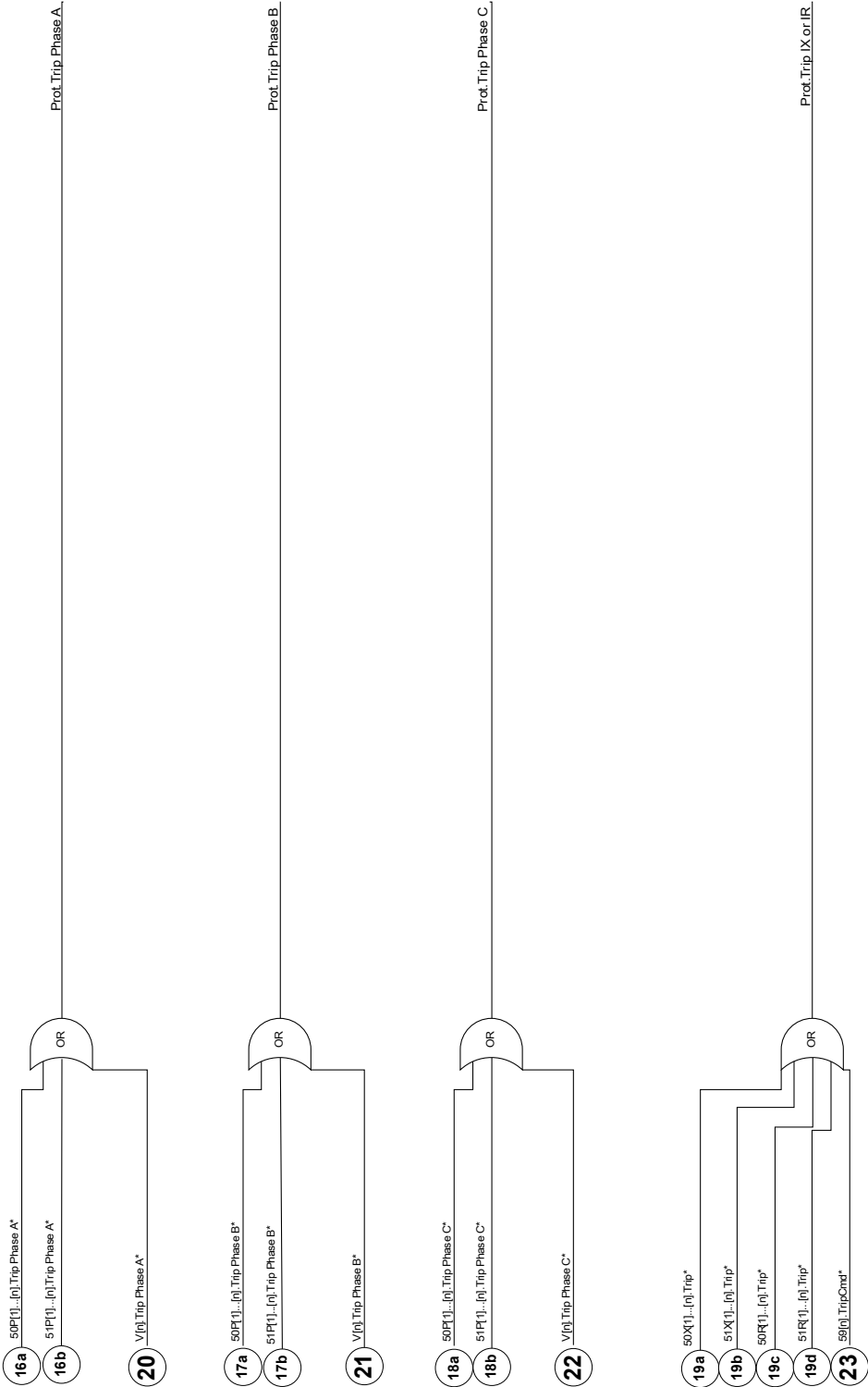
Prot.Pickup

Name = Each pickup of a module (except from supervision modules but including BF) will lead to a general pickup (collective pickup).



Prot.Trip

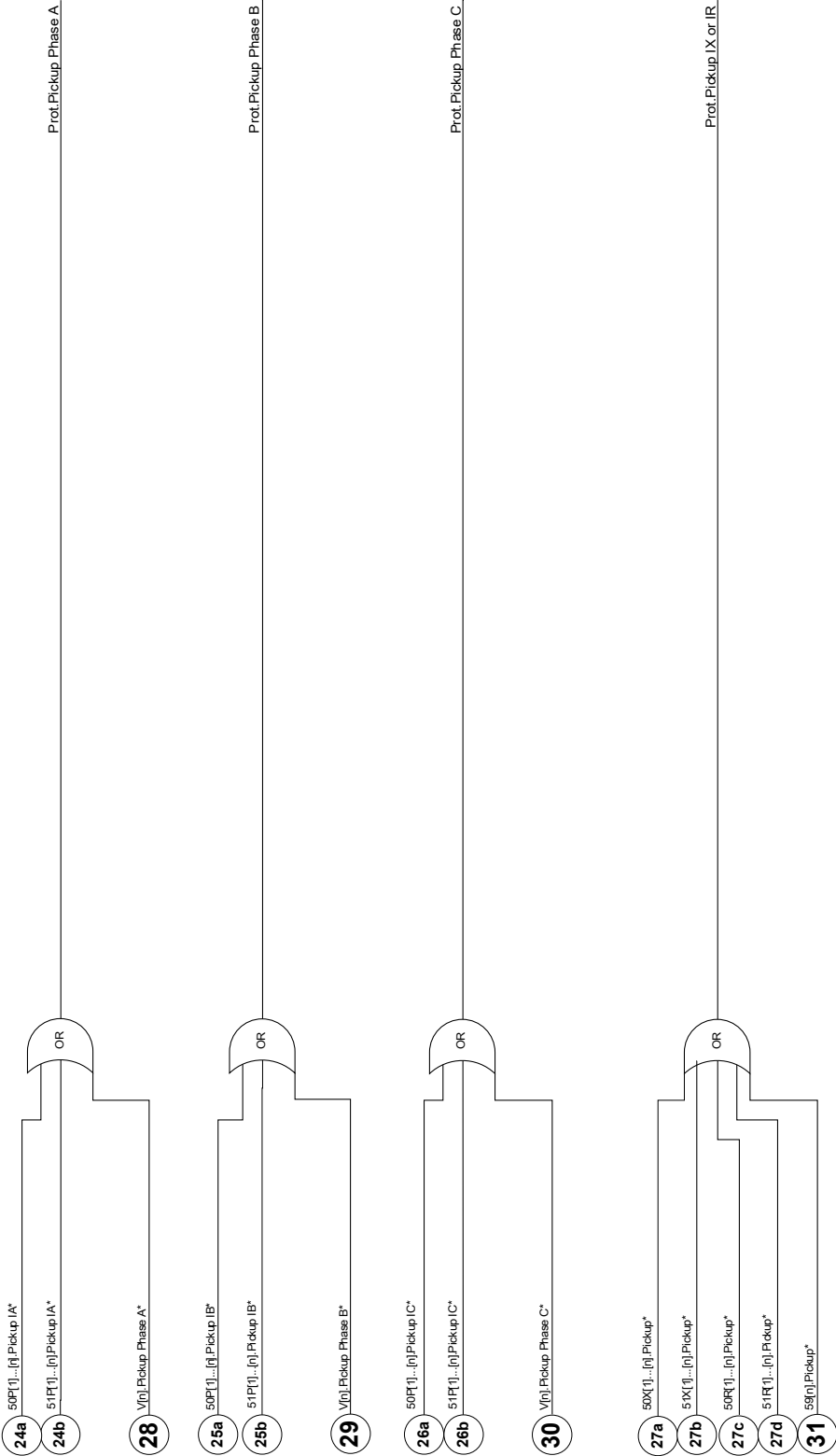
Each phase selective trip of a trip authorized module (I, IG, V, VX depending on the device type) will lead to a phase selective general trip.



*=Depending on the type of device

Prot.Pickup

Each phase selective pickup of a module (I, IG, V, VX depending on the device type) will lead to a phase selective general pickup (collective pickup).



*=Depending on the type of device

Direct Commands of the Protection Module

Parameter	Description	Setting range	Default	Menu path
Res FaultNo a GridFaultNo 	Resetting of fault number and grid fault number.	Inactive, Active	Inactive	[Operation /Reset]

Global Protection Parameters of the Protection Module

Parameter	Description	Setting range	Default	Menu path
ExBlo Fc 	Activate (allow) the external blocking of the global protection functionality of the device.	Inactive, Active	Inactive	[Protection Para /Global Prot Para /Prot]
ExBlo1 	If external blocking of this module is activated (allowed), the global protection functionality of the device will be blocked if the state of the assigned signal becomes true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Prot]
ExBlo2 	If external blocking of this module is activated (allowed), the global protection functionality of the device will be blocked if the state of the assigned signal becomes true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Prot]

Protection Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Prot]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Prot]

Protection Module Signals (Output States)

Signal	Description
Available	Signal: Protection is available.
Active	Signal: Active
ExBlo	Signal: External Blocking
Pickup Phase A	Signal: General Pickup Phase A
Pickup Phase B	Signal: General Pickup Phase B
Pickup Phase C	Signal: General Pickup Phase C
Pickup IX or IR	Signal: General Pickup - Ground Fault
Pickup	Signal: General Pickup
Trip Phase A	Signal: General Trip Phase A
Trip Phase B	Signal: General Trip Phase B
Trip Phase C	Signal: General Trip Phase C
Trip IX or IR	Signal: General Trip Ground Fault
Trip	Signal: General Trip
Res FaultNo a GridFaultNo	Signal: Resetting of fault number and grid fault number.
I dir fwd	Signal: Phase current failure forward direction
I dir rev	Signal: Phase current failure reverse direction
I dir n poss	Signal: Phase fault - missing reference voltage
IR dir fwd	Signal: IR Ground fault (calculated) forward
IR dir rev	Signal: IR Ground fault (calculated) reverse direction
IR dir n poss	Signal: IR Ground fault (calculated) direction detection not possible
IX dir fwd	Signal: IX Ground fault (measured) forward
IX dir rev	Signal: IX Ground fault (measured) reverse direction
IX dir n poss	Signal: IX Ground fault (measured) direction detection not possible
f(VABC)<10Hz	Frequency of the measuring channels 1-3 (VA,VB,VC) is lower than 10Hz.
f(VABC)>10Hz	Frequency of the measuring channels 1-3 (VA,VB,VC) is greater than 10Hz.

<i>Signal</i>	<i>Description</i>
f(VABC)<70Hz	Frequency of the measuring channels 1-3 (VA,VB,VC) is lower than 70Hz.
f(VABC)>70Hz	Frequency of the measuring channels 1-3 (VA,VB,VC) is greater than 70Hz.
DFT Invalid	DFT values of fundamental and harmonics (except VX) are not valid. They depend on period time of frequency and measured channels 1-3 (VA/VAB,VB/VBC,VC/VCA).
DFT Valid	DFT values of fundamental and harmonics (except VX) are valid. They depend on period time of frequency and measured channels 1-3 (VA/VAB,VB/VBC,VC/VCA).
f(VX)<10Hz	Frequency of the measuring channel 4 (VX) is lower than 10Hz.
f(VX)>10Hz	Frequency of the measuring channel 4 (VX) is greater than 10Hz.
f(VX)<70Hz	Frequency of the measuring channel 4 (VX) is lower than 70Hz.
f(VX)>70Hz	Frequency of the measuring channel 4 (VX) is greater than 70Hz.
DFT Invalid (VX)	DFT values of fundamental and harmonics of VX (only) are not valid.
DFT Valid (VX)	DFT values of fundamental and harmonics of VX (only) are valid.

Values of the Protection Module

<i>Parameter</i>	<i>Description</i>
FaultNo	Waveform No.
No of GridFaults	Number of grid faults: A grid fault, e.g. a short circuit, might cause several faults with trip and autoreclosing, each fault being identified by an increased fault number. In this case, the grid fault number remains the same.
Trip	First trip cause which is the same as listed in fault record: See SCADA doc for code (section Cause of Trip). See manual (section Fault Recorder) for more information.

Switchgear/Breaker – Manager

Bkr



WARNING Misconfiguration of switchgear could result in death or serious injury. This e. g. is the case when opening a disconnecter under load or when switching a ground connector to live parts of a system.

Beside protection functions, protective relays more and more will take care about controlling switchgear, like breakers, load break switches, disconnectors and ground connectors.

A correct configuration of all switchgear is an indispensable precondition for the proper functioning of the protective device. This also is the case, when the switchgear are not controlled, but supervised only.

Single Line Diagram

For construction of a single line diagram, please address to our technical support.

The single line diagram includes the graphically description of the switchgear and their designations (names) as well as their features (short circuit proof or not ...). For displaying in the devices software, the switchgear designations (e. g. QA1, QA2, instead of SG[x]) will be taken from the single line diagram.

Beside switching properties a configuration file also includes a single line diagram. Switching properties and single line diagram are coupled via the the configuration file. Since the single line diagram is independent of the device type, a new/other single line diagram can be imported into the configuration file.

NOTICE

Whenever a configuration file is loaded into a protection device, a single line diagram will be always loaded at the same time.

This means, whenever a configuration file is transfered from one to another device, a suitable single line digram has to be loaded by means of the Device Planning menu.

After the single line diagram has been loaded, each individual switchgear has to be configured. The following table shows the required configurations dependent on the type of switchgear.

To be configured at:	Type of switchgear							
[Control\SG\Designation of switchgear]	Breaker (controlled)	Breaker (supervised)	Switch Disconnector (controlled)	Switch Disconnector (supervised)	Ground Connector (controlled)	Ground Connector (supervised)	Disconnector (controlled)	Disconnector (supervised)
Assignment of position indications (Digital inputs)	x	x	x	x	x	x	x	x
Assignment of commands (Output relays)	x	-	x	-	x	-	x	-
Setting of supervision timers	x	x	x	x	x	x	x	x
Interlockings	x	-	x	-	x	-	x	-
Trip Manager (Assignment of trip commands)	x	x	-	-	-	-	-	-
Optional: Synchronous switching	x	-	-	-	-	-	-	-
Optional: Ex OPEN/CLOSE Cmd	x	-	x	-	x	-	x	-
Optional: SGW	x	x	x	x	x	x	x	x

Switchgear Configuration

Wiring

At first the switchgear positioning indicators have to be connected to the digital inputs of the protection device. One of the position indicators (either the »Aux CLOSE« or the »Aux OPEN«) contact has to be connected necessarily. It is recommended also to connect the »Aux OPEN« contact.

Thereafter the command outputs (relay outputs) have to be connected with the switchgear.

NOTICE

Please observe the following option: In the general settings of a breaker, the CLOSE/OPEN commands of a protection element can be issued to the same output relays, where the other control commands are issued. If the commands are issued to different relays output relays the amount of wiring increases.

Assignment of Position Indications

The position indication is needed by the device to get (evaluate) the information about the current status /position of the breaker. The switchgear position indications are shown in the devices display. Each position change of a switchgear results in a change of the corresponding switchgear symbol.

NOTICE

For the detection of a switchgear's position always two separate Aux contacts are recommended! If only one Aux contact is used, no intermediate or disturbed positions can be detected. A (reduced) transition supervision (time between issue of the command and position feedback indication of the switchgear) is also possible by one Aux contact.

In the menu [Control/Bkr/Bkr [x]] the assignments for the position indications have to be set.

*Detection of switchgear position with two Aux contacts – **Aux CLOSE and Aux OPEN (recommended!)***

For detection of their positions switchgear are provided with Aux contacts (Aux CLOSE and Aux OPEN). It is recommended to use both contacts to detect intermediate and disturbed positions too.

The protection device continuously supervises the status of the inputs »Aux CLOSE-I« and »Aux OPEN-I«. These signals are validated based on the supervision timers »t-Move CLOSE« and »t-Move OPEN« validation functions. As a result, the switchgear position will be detected by the following signals:

- Pos CLOSE
- Pos OPEN
- Pos Indeterm
- Pos Disturb.
- Pos (State=0,1,.2 or 3)

Supervision of the CLOSE command

When an CLOSE command is initiated, the »*t-Move CLOSE*« timer will be started. While the timer is running, the »POS INDETERM« State will become true. If the command is executed and properly fed back from the switchgear before the timer has run down, »POS CLOSE« will become true. Otherwise, if the timer has expired »POS DISTURB« will become true.

Supervision of the OPEN command

When an OPEN command is initiated, the »*t-Move OPEN*« timer will be started. While the timer is running, the »POS INDETERM« State will become true. If the command is executed and properly fed back before the timer has run down, »POS OPEN« will become true. Otherwise, if the timer has expired »POS DISTURB« will become true.

The following table shows how switchgear positions are validated:

States of the Digital Inputs		Validated Breaker Positions				
Aux CLOSE-I	Aux OPEN-I	POS CLOSE	POS OPEN	POS Indeterm	POS Disturb	POS State
0	0	0	0	1 (while a Moving timer is running)	0 (while a Moving timer is running)	0 Intermediate
1	1	0	0	1 (while a Moving timer is running)	0 (while a Moving timer is running)	0 Intermediate
0	1	0	1	0	0	1 OPEN
1	0	1	0	0	0	2 CLOSE
0	0	0	0	0 (Moving timer elapsed)	1 (Moving timer elapsed)	3 Disturbed
1	1	0	0	0 (Moving timer elapsed)	1 (Moving timer elapsed)	3 Disturbed

Single Position Indication **Aux CLOSE or Aux OPEN**

If the single pole indication is used, the »SI SINGLECONTACTIND« will become true.

The moving time supervision works only in one direction. If the Aux OPEN signal is connected to the device, only the “OPEN command” can be supervised and if the Aux CLOSE signal is connected to the device, only the “CLOSE command” can be supervised.

Single Position Indication – **Aux CLOSE**

If only the Aux CLOSE signal is used for the Status Indication of an “CLOSE command”, the switch command will also start the moving time, the position indication indicates an INTERMEDIATE position during this time interval. When the switchgear reaches the end position indicated by the signals Pos CLOSE and CES succesf before the moving time has elapsed the signal Pos Indeterm disappears.

If the moving time elapsed before the switchgear has reached the end position, the switching operation was not successful and the Position Indication will change to POS Disturb and the signal Pos Indeterm disappears. After the moving time has elapsed, the Dwell time will be started (if set). During this time interval the Position Indication will also indicate an INTERMEDIATE state. When the Dwell time elapses the Position Indication will change to Pos CLOSE.

The following table shows how breaker positions are validated based on **Aux CLOSE**:

States of the Digital Input		Validated Breaker Positions				
<i>Aux CLOSE-I</i>	<i>Aux OPEN-I</i>	<i>POS CLOSE</i>	<i>POS OPEN</i>	<i>POS Indeterm</i>	<i>POS Disturb</i>	<i>POS State</i>
0	Not wired	0	0	1 (while t-Move CLOSE is running)	0 (while t-Move CLOSE is running)	0 Intermediate
0	Not wired	0	1	0	0	1 OPEN
1	Not wired	1	0	0	0	2 CLOSE

If there is no digital input assigned to the »Aux CLOSE« contact, the position indication will have the value 3 (disturbed).

Single Position Indication – **Aux OPEN**

If only the Aux OPEN signal is used for the monitoring of the “OPEN command”, the switch command will start the moving timer. The Position Indication will indicate an INTERMEDIATE position. When the switchgear reaches its end position before the moving timer elapses, »CES succesf« will be indicated. At the same time the signal »Pos Indeterm« disappears.

If the moving time elapsed before the switchgear has reached the OPEN position, the switching operation was not successful and the Position Indication will change to »Pos Disturb« and the signal »Pos Indeterm« disappears. When the moving timer has elapsed, the dwell timer will be started (if configured). During this timer elapses »Pos Disturb« will be indicated. When the dwell time has elapsed, the OPEN position of the switchgear will be indicated by the »Pos OPEN« signal.

The following table shows how breaker positions are validated based on **Aux OPEN**:

States of the Digital Input		Validated Breaker Positions				
<i>Aux CLOSE-I</i>	<i>Aux OPEN-I</i>	<i>POS CLOSE</i>	<i>POS OPEN</i>	<i>POS Indeterm</i>	<i>POS Disturb</i>	<i>POS State</i>
Not wired	0	0	0	1 (while t-Move OPEN is running)	0 (while t-Move OPEN is running)	0 Intermediate
Not wired	1	0	1	0	0	1 OPEN
Not wired	0	1	0	0	0	2 CLOSE

If there is no digital input assigned to the »Aux OPEN« contact, the position indication will have the value 3 (disturbed).

Setting of Supervision Times

In the menu [Control/SG/SG[x]/General Settings] the supervision times of the individual switchgear have to be set. Dependent on the type of switchgear it can be necessary to set further parameters, like dwell time.

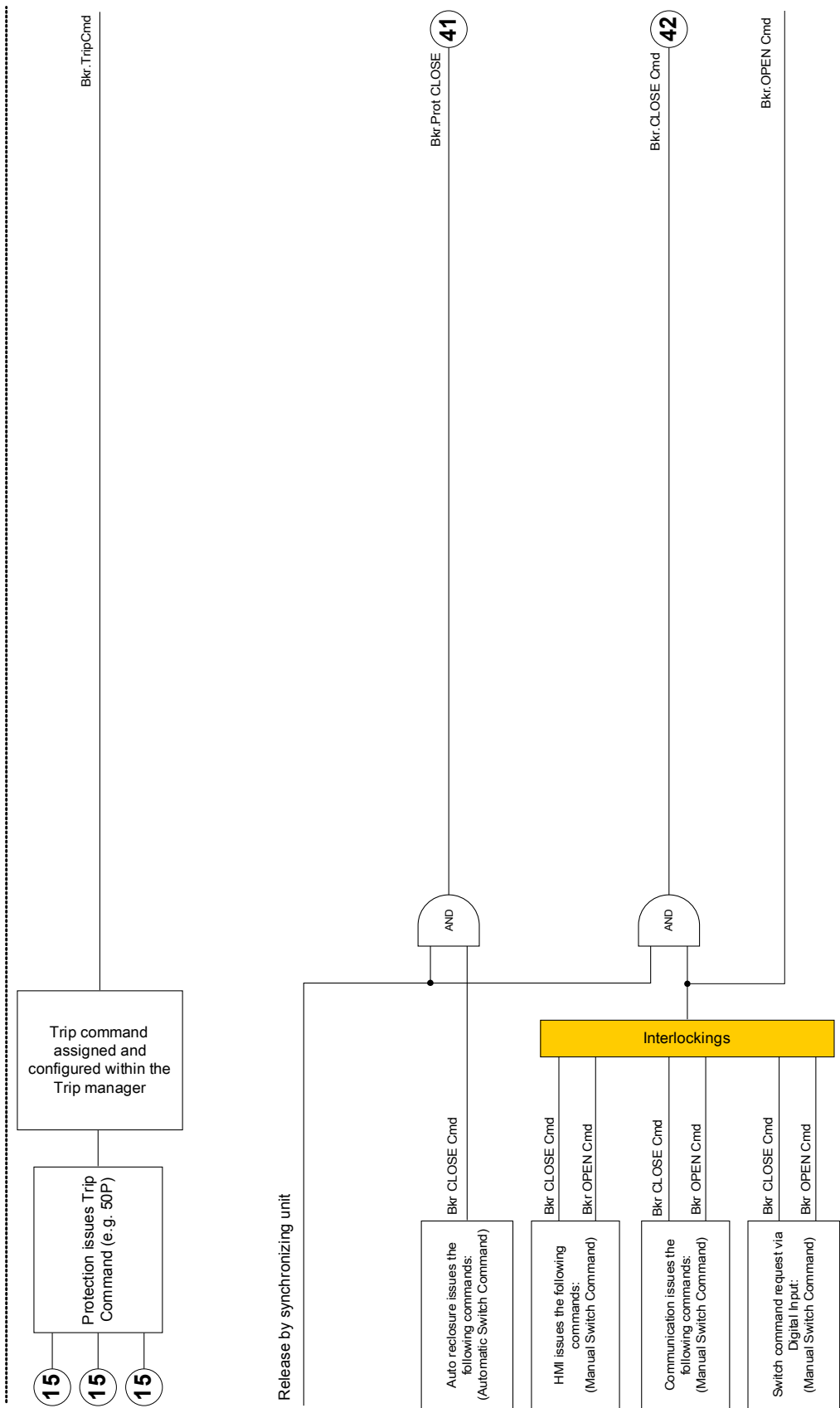
Interlockings

To avoid faulty operations, interlockings have to be provided. This can be realized mechanically or electrically.

For a controllable switchgear up to three interlockings can be assigned in both switching directions (CLOSE/OPEN). These interlockings prevent switching in the corresponding direction.

The protection OPEN command and the reclosing command of the AR module are always executed without interlockings. For the case, that a protection OPEN command must not be issued, this must be blocked separately.

Further interlockings can be realized by means of the Logic module.



Trip Manager – Assignment of commands

The trip commands of the protection elements have to be assigned to those switchgear, that are make/break capable (Breaker). For every make/break capable switchgear a Trip Manager is provided.

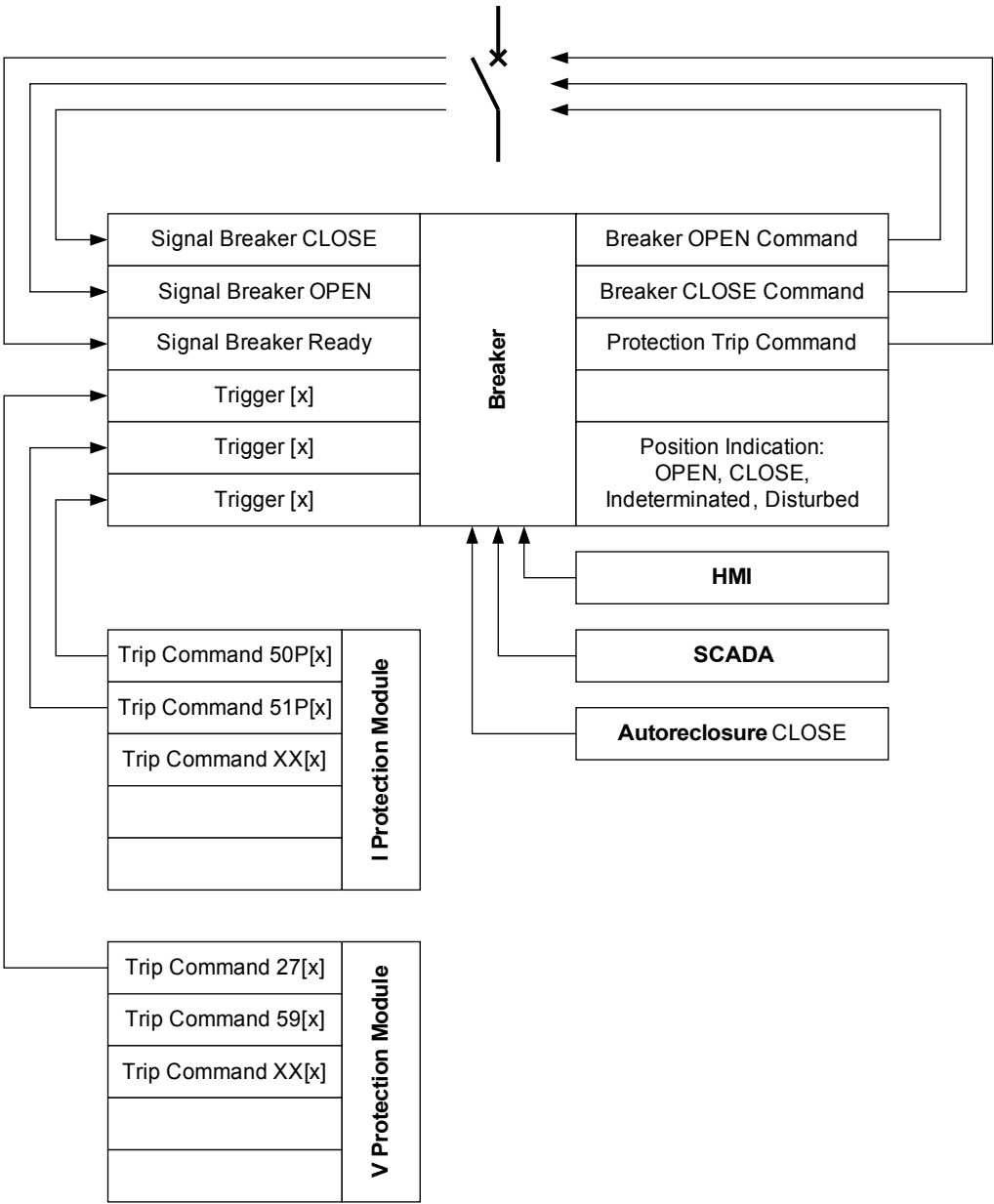
In the Trip Manager all tripping commands are combined by an “OR” logic. The actual tripping command to the switchgear is exclusively given by the Trip Manager. This means, that only tripping commands which are assigned in the Trip Manager lead to an operation of the switchgear. In addition to that, the User can set the minimum hold time of the tripping command within this module and define whether the tripping command is latched or not.

Tripable Elements:

Name	Description
-.-	No assignment
50P[1].TripCmd	Signal: Trip Command
50P[2].TripCmd	Signal: Trip Command
50P[3].TripCmd	Signal: Trip Command
51P[1].TripCmd	Signal: Trip Command
51P[2].TripCmd	Signal: Trip Command
51P[3].TripCmd	Signal: Trip Command
50X[1].TripCmd	Signal: Trip Command
50X[2].TripCmd	Signal: Trip Command
51X[1].TripCmd	Signal: Trip Command
51X[2].TripCmd	Signal: Trip Command
50R[1].TripCmd	Signal: Trip Command
50R[2].TripCmd	Signal: Trip Command
51R[1].TripCmd	Signal: Trip Command
51R[2].TripCmd	Signal: Trip Command
87.TripCmd	Signal: Trip Command
87H.TripCmd	Signal: Trip Command
87GD.TripCmd	Signal: Trip Command
87GDH.TripCmd	Signal: Trip Command
49.TripCmd	Signal: Trip Command
27M[1].TripCmd	Signal: Trip Command
27M[2].TripCmd	Signal: Trip Command
59M[1].TripCmd	Signal: Trip Command
59M[2].TripCmd	Signal: Trip Command
27A[1].TripCmd	Signal: Trip Command
27A[2].TripCmd	Signal: Trip Command
59A[1].TripCmd	Signal: Trip Command

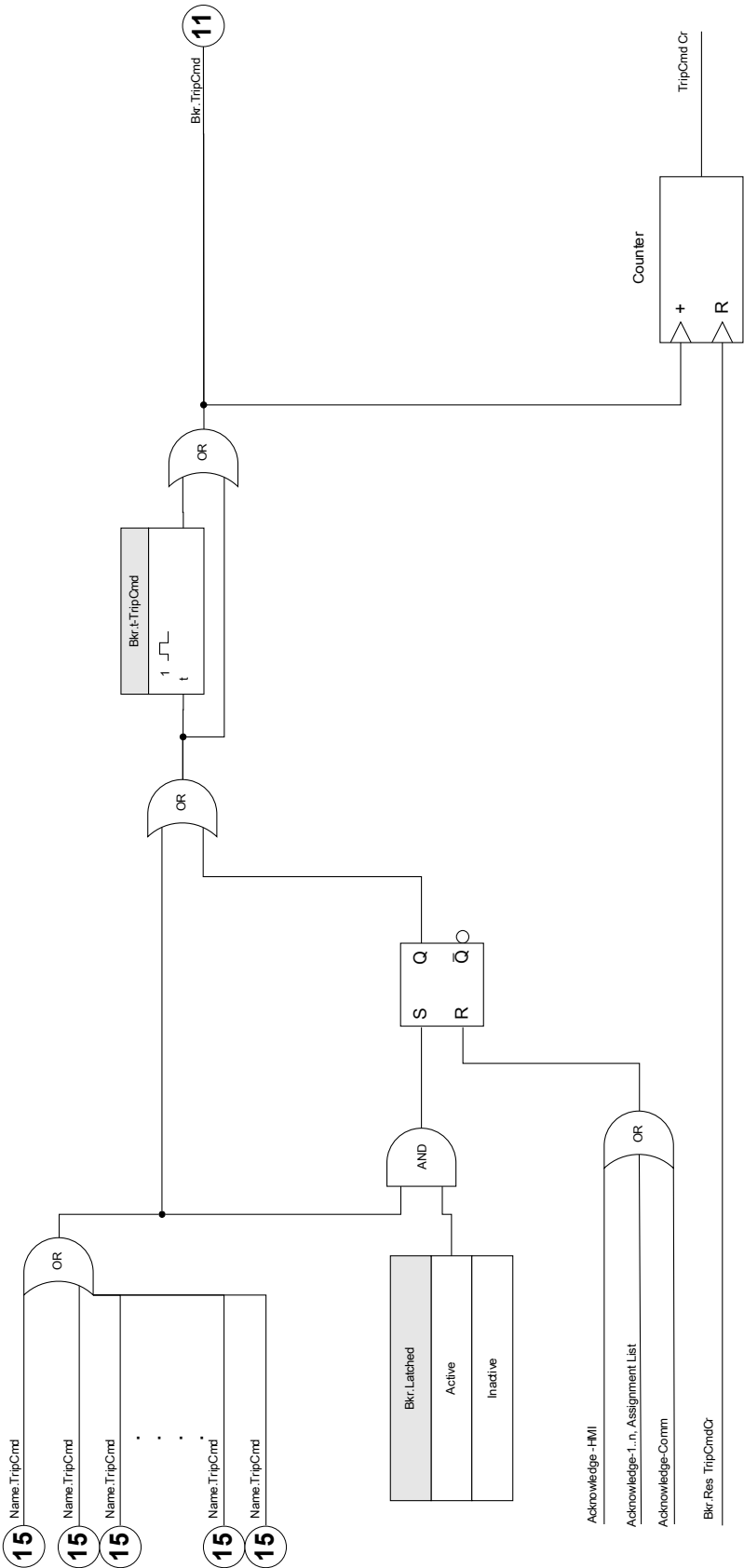
<i>Name</i>	<i>Description</i>
59A[2].TripCmd	Signal: Trip Command
59N[1].TripCmd	Signal: Trip Command
59N[2].TripCmd	Signal: Trip Command
LVRT [1].TripCmd	Signal: Trip Command
LVRT [2].TripCmd	Signal: Trip Command
46[1].TripCmd	Signal: Trip Command
46[2].TripCmd	Signal: Trip Command
46G[1].TripCmd	Signal: Trip Command
46G[2].TripCmd	Signal: Trip Command
47[1].TripCmd	Signal: Trip Command
47[2].TripCmd	Signal: Trip Command
81[1].TripCmd	Signal: Trip Command
81[2].TripCmd	Signal: Trip Command
81[3].TripCmd	Signal: Trip Command
81[4].TripCmd	Signal: Trip Command
81[5].TripCmd	Signal: Trip Command
81[6].TripCmd	Signal: Trip Command
32[1].TripCmd	Signal: Trip Command
32[2].TripCmd	Signal: Trip Command
32[3].TripCmd	Signal: Trip Command
32V[1].TripCmd	Signal: Trip Command
32V[2].TripCmd	Signal: Trip Command
32V[3].TripCmd	Signal: Trip Command
PF-55D[1].TripCmd	Signal: Trip Command
PF-55D[2].TripCmd	Signal: Trip Command
PF-55A[1].TripCmd	Signal: Trip Command
PF-55A[2].TripCmd	Signal: Trip Command
ZI.TripCmd	Signal: Zone Interlocking Trip Command
40-Z1[1].TripCmd	Signal: Trip Command
40-Z2[1].TripCmd	Signal: Trip Command
40-Z1[2].TripCmd	Signal: Trip Command
40-Z2[2].TripCmd	Signal: Trip Command
24[1].TripCmd	Signal: Trip Command
24[2].TripCmd	Signal: Trip Command
50/27.TripCmd	Signal: Trip Command
ExP[1].TripCmd	Signal: Trip Command
ExP[2].TripCmd	Signal: Trip Command

<i>Name</i>	<i>Description</i>
Exp[3].TripCmd	Signal: Trip Command
Exp[4].TripCmd	Signal: Trip Command
RTD.TripCmd	Signal: Trip Command
FldC[1].TripCmd	Signal: Trip Command
Pres[1].TripCmd	Signal: Trip Command
Tmp[1].TripCmd	Signal: Trip Command
Vibr[1].TripCmd	Signal: Trip Command
Fuel[1].TripCmd	Signal: Trip Command
Spd[1].TripCmd	Signal: Trip Command
VBat[1].TripCmd	Signal: Trip Command
Ems[1].TripCmd	Signal: Trip Command
AnaP[1].TripCmd	Signal: Trip Command



Bkr.Trip Bkr

Name =Each trip of an active, trip authorized protection module will lead to a general trip.



Ex CLOSE/OPEN

If the switchgear should be opened or closed by an external signal, the User can assign one signal that will trigger the CLOSE and one signal that will trigger the OPEN command (e.g. digital inputs or output signals of the Logics). An OPEN command has priority. CLOSE commands are slope oriented, OPEN commands are level oriented.

Synchronized Switching*

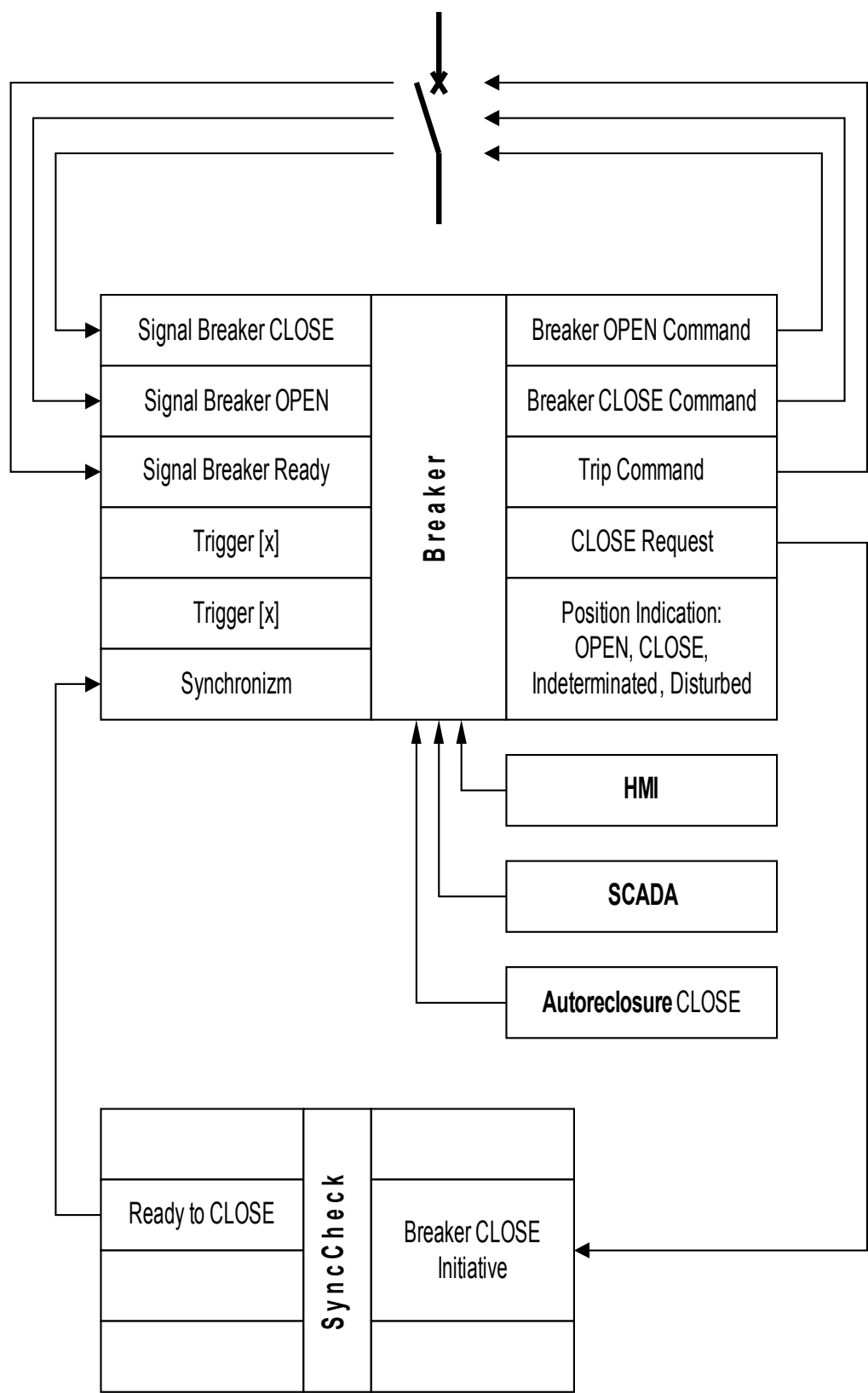
*=availability depends on ordered device type

Before a switchgear may connect two mains sections, synchronism of these sections must be assured. In the menu [Synchronous Switching] the parameter »Synchronism« defines which signal indicates synchronism.

If the synchronism condition shall be evaluated by the internal Synch-Check module the signal »*Sync. Ready to Close*« (release by synch-check module) has to be assigned. Alternatively a digital input or a logic output can be assigned.

In the synchronization mode "Generator-to-System" additionally the synchronism request has to be assigned in the menu [Protection Para\Global Prot Para\Sync].

If a synchronism signal is assigned, the switching command will only be executed, when the synchronism signal will become true within the maximum supervision time »*t-MaxSyncSuperv*«. This supervision time will be started with the issued CLOSE command. If no synchronism signal has been assigned, the synchronism release is permanently.



Switching Authority

For the Switching Authority [Control\General Settings], the following general settings are possible:

NONE: No control function;
 LOCAL: Control only via push buttons at the panel;
 REMOTE: Control only via SCADA, digital inputs, or internal signals; and
 LOCAL&REMOTE: Control via push buttons, SCADA, digital inputs, or internal signals.

The following Signals can trigger the Sync-check:

The following Signals can be used to indicate synchronizm

Name	Description
--	No assignment
Sync-check.In-Sync Allowed	Signal: In-Sync Allowed
DI-8P X1.DI 1	Signal: Digital Input
DI-8P X1.DI 2	Signal: Digital Input
DI-8P X1.DI 3	Signal: Digital Input
DI-8P X1.DI 4	Signal: Digital Input
DI-8P X1.DI 5	Signal: Digital Input
DI-8P X1.DI 6	Signal: Digital Input
DI-8P X1.DI 7	Signal: Digital Input
DI-8P X1.DI 8	Signal: Digital Input
DI-8 X5.DI 1	Signal: Digital Input
DI-8 X5.DI 2	Signal: Digital Input
DI-8 X5.DI 3	Signal: Digital Input
DI-8 X5.DI 4	Signal: Digital Input
DI-8 X5.DI 5	Signal: Digital Input
DI-8 X5.DI 6	Signal: Digital Input
DI-8 X5.DI 7	Signal: Digital Input
DI-8 X5.DI 8	Signal: Digital Input
Logic.LE1.Gate Out	Signal: Output of the logic gate
Logic.LE1.Timer Out	Signal: Timer Output
Logic.LE1.Out	Signal: Latched Output (Q)
Logic.LE1.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE2.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE2.Timer Out	Signal: Timer Output
Logic.LE2.Out	Signal: Latched Output (Q)
Logic.LE2.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE3.Gate Out	Signal: Output of the logic gate
Logic.LE3.Timer Out	Signal: Timer Output
Logic.LE3.Out	Signal: Latched Output (Q)
Logic.LE3.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE4.Gate Out	Signal: Output of the logic gate
Logic.LE4.Timer Out	Signal: Timer Output
Logic.LE4.Out	Signal: Latched Output (Q)
Logic.LE4.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE5.Gate Out	Signal: Output of the logic gate
Logic.LE5.Timer Out	Signal: Timer Output
Logic.LE5.Out	Signal: Latched Output (Q)
Logic.LE5.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE6.Gate Out	Signal: Output of the logic gate
Logic.LE6.Timer Out	Signal: Timer Output
Logic.LE6.Out	Signal: Latched Output (Q)
Logic.LE6.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE7.Gate Out	Signal: Output of the logic gate
Logic.LE7.Timer Out	Signal: Timer Output
Logic.LE7.Out	Signal: Latched Output (Q)
Logic.LE7.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE8.Gate Out	Signal: Output of the logic gate
Logic.LE8.Timer Out	Signal: Timer Output
Logic.LE8.Out	Signal: Latched Output (Q)
Logic.LE8.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE9.Gate Out	Signal: Output of the logic gate
Logic.LE9.Timer Out	Signal: Timer Output
Logic.LE9.Out	Signal: Latched Output (Q)
Logic.LE9.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE10.Gate Out	Signal: Output of the logic gate
Logic.LE10.Timer Out	Signal: Timer Output
Logic.LE10.Out	Signal: Latched Output (Q)
Logic.LE10.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE11.Gate Out	Signal: Output of the logic gate
Logic.LE11.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE11.Out	Signal: Latched Output (Q)
Logic.LE11.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE12.Gate Out	Signal: Output of the logic gate
Logic.LE12.Timer Out	Signal: Timer Output
Logic.LE12.Out	Signal: Latched Output (Q)
Logic.LE12.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE13.Gate Out	Signal: Output of the logic gate
Logic.LE13.Timer Out	Signal: Timer Output
Logic.LE13.Out	Signal: Latched Output (Q)
Logic.LE13.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE14.Gate Out	Signal: Output of the logic gate
Logic.LE14.Timer Out	Signal: Timer Output
Logic.LE14.Out	Signal: Latched Output (Q)
Logic.LE14.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE15.Gate Out	Signal: Output of the logic gate
Logic.LE15.Timer Out	Signal: Timer Output
Logic.LE15.Out	Signal: Latched Output (Q)
Logic.LE15.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE16.Gate Out	Signal: Output of the logic gate
Logic.LE16.Timer Out	Signal: Timer Output
Logic.LE16.Out	Signal: Latched Output (Q)
Logic.LE16.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE17.Gate Out	Signal: Output of the logic gate
Logic.LE17.Timer Out	Signal: Timer Output
Logic.LE17.Out	Signal: Latched Output (Q)
Logic.LE17.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE18.Gate Out	Signal: Output of the logic gate
Logic.LE18.Timer Out	Signal: Timer Output
Logic.LE18.Out	Signal: Latched Output (Q)
Logic.LE18.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE19.Gate Out	Signal: Output of the logic gate
Logic.LE19.Timer Out	Signal: Timer Output
Logic.LE19.Out	Signal: Latched Output (Q)
Logic.LE19.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE20.Gate Out	Signal: Output of the logic gate
Logic.LE20.Timer Out	Signal: Timer Output
Logic.LE20.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE20.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE21.Gate Out	Signal: Output of the logic gate
Logic.LE21.Timer Out	Signal: Timer Output
Logic.LE21.Out	Signal: Latched Output (Q)
Logic.LE21.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE22.Gate Out	Signal: Output of the logic gate
Logic.LE22.Timer Out	Signal: Timer Output
Logic.LE22.Out	Signal: Latched Output (Q)
Logic.LE22.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE23.Gate Out	Signal: Output of the logic gate
Logic.LE23.Timer Out	Signal: Timer Output
Logic.LE23.Out	Signal: Latched Output (Q)
Logic.LE23.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE24.Gate Out	Signal: Output of the logic gate
Logic.LE24.Timer Out	Signal: Timer Output
Logic.LE24.Out	Signal: Latched Output (Q)
Logic.LE24.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE25.Gate Out	Signal: Output of the logic gate
Logic.LE25.Timer Out	Signal: Timer Output
Logic.LE25.Out	Signal: Latched Output (Q)
Logic.LE25.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE26.Gate Out	Signal: Output of the logic gate
Logic.LE26.Timer Out	Signal: Timer Output
Logic.LE26.Out	Signal: Latched Output (Q)
Logic.LE26.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE27.Gate Out	Signal: Output of the logic gate
Logic.LE27.Timer Out	Signal: Timer Output
Logic.LE27.Out	Signal: Latched Output (Q)
Logic.LE27.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE28.Gate Out	Signal: Output of the logic gate
Logic.LE28.Timer Out	Signal: Timer Output
Logic.LE28.Out	Signal: Latched Output (Q)
Logic.LE28.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE29.Gate Out	Signal: Output of the logic gate
Logic.LE29.Timer Out	Signal: Timer Output
Logic.LE29.Out	Signal: Latched Output (Q)
Logic.LE29.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE30.Gate Out	Signal: Output of the logic gate
Logic.LE30.Timer Out	Signal: Timer Output
Logic.LE30.Out	Signal: Latched Output (Q)
Logic.LE30.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE31.Gate Out	Signal: Output of the logic gate
Logic.LE31.Timer Out	Signal: Timer Output
Logic.LE31.Out	Signal: Latched Output (Q)
Logic.LE31.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE32.Gate Out	Signal: Output of the logic gate
Logic.LE32.Timer Out	Signal: Timer Output
Logic.LE32.Out	Signal: Latched Output (Q)
Logic.LE32.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE33.Gate Out	Signal: Output of the logic gate
Logic.LE33.Timer Out	Signal: Timer Output
Logic.LE33.Out	Signal: Latched Output (Q)
Logic.LE33.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE34.Gate Out	Signal: Output of the logic gate
Logic.LE34.Timer Out	Signal: Timer Output
Logic.LE34.Out	Signal: Latched Output (Q)
Logic.LE34.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE35.Gate Out	Signal: Output of the logic gate
Logic.LE35.Timer Out	Signal: Timer Output
Logic.LE35.Out	Signal: Latched Output (Q)
Logic.LE35.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE36.Gate Out	Signal: Output of the logic gate
Logic.LE36.Timer Out	Signal: Timer Output
Logic.LE36.Out	Signal: Latched Output (Q)
Logic.LE36.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE37.Gate Out	Signal: Output of the logic gate
Logic.LE37.Timer Out	Signal: Timer Output
Logic.LE37.Out	Signal: Latched Output (Q)
Logic.LE37.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE38.Gate Out	Signal: Output of the logic gate
Logic.LE38.Timer Out	Signal: Timer Output
Logic.LE38.Out	Signal: Latched Output (Q)
Logic.LE38.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE39.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE39.Timer Out	Signal: Timer Output
Logic.LE39.Out	Signal: Latched Output (Q)
Logic.LE39.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE40.Gate Out	Signal: Output of the logic gate
Logic.LE40.Timer Out	Signal: Timer Output
Logic.LE40.Out	Signal: Latched Output (Q)
Logic.LE40.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE41.Gate Out	Signal: Output of the logic gate
Logic.LE41.Timer Out	Signal: Timer Output
Logic.LE41.Out	Signal: Latched Output (Q)
Logic.LE41.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE42.Gate Out	Signal: Output of the logic gate
Logic.LE42.Timer Out	Signal: Timer Output
Logic.LE42.Out	Signal: Latched Output (Q)
Logic.LE42.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE43.Gate Out	Signal: Output of the logic gate
Logic.LE43.Timer Out	Signal: Timer Output
Logic.LE43.Out	Signal: Latched Output (Q)
Logic.LE43.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE44.Gate Out	Signal: Output of the logic gate
Logic.LE44.Timer Out	Signal: Timer Output
Logic.LE44.Out	Signal: Latched Output (Q)
Logic.LE44.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE45.Gate Out	Signal: Output of the logic gate
Logic.LE45.Timer Out	Signal: Timer Output
Logic.LE45.Out	Signal: Latched Output (Q)
Logic.LE45.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE46.Gate Out	Signal: Output of the logic gate
Logic.LE46.Timer Out	Signal: Timer Output
Logic.LE46.Out	Signal: Latched Output (Q)
Logic.LE46.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE47.Gate Out	Signal: Output of the logic gate
Logic.LE47.Timer Out	Signal: Timer Output
Logic.LE47.Out	Signal: Latched Output (Q)
Logic.LE47.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE48.Gate Out	Signal: Output of the logic gate
Logic.LE48.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE48.Out	Signal: Latched Output (Q)
Logic.LE48.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE49.Gate Out	Signal: Output of the logic gate
Logic.LE49.Timer Out	Signal: Timer Output
Logic.LE49.Out	Signal: Latched Output (Q)
Logic.LE49.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE50.Gate Out	Signal: Output of the logic gate
Logic.LE50.Timer Out	Signal: Timer Output
Logic.LE50.Out	Signal: Latched Output (Q)
Logic.LE50.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE51.Gate Out	Signal: Output of the logic gate
Logic.LE51.Timer Out	Signal: Timer Output
Logic.LE51.Out	Signal: Latched Output (Q)
Logic.LE51.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE52.Gate Out	Signal: Output of the logic gate
Logic.LE52.Timer Out	Signal: Timer Output
Logic.LE52.Out	Signal: Latched Output (Q)
Logic.LE52.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE53.Gate Out	Signal: Output of the logic gate
Logic.LE53.Timer Out	Signal: Timer Output
Logic.LE53.Out	Signal: Latched Output (Q)
Logic.LE53.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE54.Gate Out	Signal: Output of the logic gate
Logic.LE54.Timer Out	Signal: Timer Output
Logic.LE54.Out	Signal: Latched Output (Q)
Logic.LE54.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE55.Gate Out	Signal: Output of the logic gate
Logic.LE55.Timer Out	Signal: Timer Output
Logic.LE55.Out	Signal: Latched Output (Q)
Logic.LE55.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE56.Gate Out	Signal: Output of the logic gate
Logic.LE56.Timer Out	Signal: Timer Output
Logic.LE56.Out	Signal: Latched Output (Q)
Logic.LE56.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE57.Gate Out	Signal: Output of the logic gate
Logic.LE57.Timer Out	Signal: Timer Output
Logic.LE57.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE57.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE58.Gate Out	Signal: Output of the logic gate
Logic.LE58.Timer Out	Signal: Timer Output
Logic.LE58.Out	Signal: Latched Output (Q)
Logic.LE58.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE59.Gate Out	Signal: Output of the logic gate
Logic.LE59.Timer Out	Signal: Timer Output
Logic.LE59.Out	Signal: Latched Output (Q)
Logic.LE59.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE60.Gate Out	Signal: Output of the logic gate
Logic.LE60.Timer Out	Signal: Timer Output
Logic.LE60.Out	Signal: Latched Output (Q)
Logic.LE60.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE61.Gate Out	Signal: Output of the logic gate
Logic.LE61.Timer Out	Signal: Timer Output
Logic.LE61.Out	Signal: Latched Output (Q)
Logic.LE61.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE62.Gate Out	Signal: Output of the logic gate
Logic.LE62.Timer Out	Signal: Timer Output
Logic.LE62.Out	Signal: Latched Output (Q)
Logic.LE62.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE63.Gate Out	Signal: Output of the logic gate
Logic.LE63.Timer Out	Signal: Timer Output
Logic.LE63.Out	Signal: Latched Output (Q)
Logic.LE63.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE64.Gate Out	Signal: Output of the logic gate
Logic.LE64.Timer Out	Signal: Timer Output
Logic.LE64.Out	Signal: Latched Output (Q)
Logic.LE64.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE65.Gate Out	Signal: Output of the logic gate
Logic.LE65.Timer Out	Signal: Timer Output
Logic.LE65.Out	Signal: Latched Output (Q)
Logic.LE65.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE66.Gate Out	Signal: Output of the logic gate
Logic.LE66.Timer Out	Signal: Timer Output
Logic.LE66.Out	Signal: Latched Output (Q)
Logic.LE66.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE67.Gate Out	Signal: Output of the logic gate
Logic.LE67.Timer Out	Signal: Timer Output
Logic.LE67.Out	Signal: Latched Output (Q)
Logic.LE67.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE68.Gate Out	Signal: Output of the logic gate
Logic.LE68.Timer Out	Signal: Timer Output
Logic.LE68.Out	Signal: Latched Output (Q)
Logic.LE68.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE69.Gate Out	Signal: Output of the logic gate
Logic.LE69.Timer Out	Signal: Timer Output
Logic.LE69.Out	Signal: Latched Output (Q)
Logic.LE69.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE70.Gate Out	Signal: Output of the logic gate
Logic.LE70.Timer Out	Signal: Timer Output
Logic.LE70.Out	Signal: Latched Output (Q)
Logic.LE70.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE71.Gate Out	Signal: Output of the logic gate
Logic.LE71.Timer Out	Signal: Timer Output
Logic.LE71.Out	Signal: Latched Output (Q)
Logic.LE71.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE72.Gate Out	Signal: Output of the logic gate
Logic.LE72.Timer Out	Signal: Timer Output
Logic.LE72.Out	Signal: Latched Output (Q)
Logic.LE72.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE73.Gate Out	Signal: Output of the logic gate
Logic.LE73.Timer Out	Signal: Timer Output
Logic.LE73.Out	Signal: Latched Output (Q)
Logic.LE73.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE74.Gate Out	Signal: Output of the logic gate
Logic.LE74.Timer Out	Signal: Timer Output
Logic.LE74.Out	Signal: Latched Output (Q)
Logic.LE74.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE75.Gate Out	Signal: Output of the logic gate
Logic.LE75.Timer Out	Signal: Timer Output
Logic.LE75.Out	Signal: Latched Output (Q)
Logic.LE75.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE76.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE76.Timer Out	Signal: Timer Output
Logic.LE76.Out	Signal: Latched Output (Q)
Logic.LE76.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE77.Gate Out	Signal: Output of the logic gate
Logic.LE77.Timer Out	Signal: Timer Output
Logic.LE77.Out	Signal: Latched Output (Q)
Logic.LE77.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE78.Gate Out	Signal: Output of the logic gate
Logic.LE78.Timer Out	Signal: Timer Output
Logic.LE78.Out	Signal: Latched Output (Q)
Logic.LE78.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE79.Gate Out	Signal: Output of the logic gate
Logic.LE79.Timer Out	Signal: Timer Output
Logic.LE79.Out	Signal: Latched Output (Q)
Logic.LE79.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE80.Gate Out	Signal: Output of the logic gate
Logic.LE80.Timer Out	Signal: Timer Output
Logic.LE80.Out	Signal: Latched Output (Q)
Logic.LE80.Out inverted	Signal: Negated Latched Output (Q NOT)

Non Interlocked Switching

For test purposes, during commissioning and temporarily operations, interlockings can be disabled.



WARNING: Non interlocked Switching can lead to serious injuries or death!

For non interlocked switching the menü [Control\General Settings] provides the following options:

- Non interlocked switching for one single command
- Permanent
- Non interlocked switching for a certain time
- Non interlocked switching, activated by an assigned signal

The set time for non interlocked switching applies also for the “single Operation“ mode.

Manual Manipulation of the Switchgear Position

In case of faulty position indication contacts (Aux contacts) or broken wires, the position indication resulted from the assigned signals can be manipulated (overwritten) manually, to keep the ability to switch the affected switchgear. A manipulated switchgear position will be indicated on the display by an exclamation mark “!” beside the switchgear symbol.



WARNING: Manipulation of the Switchgear Position can lead to serious injuries or death!

Double Operation Locking

All control commands to any switchgear in a bay have to be processed sequentially. During a running control command no other command will be handled.

Switch Direction Control

Switching commands are validated before execution. When the switchgear is already in the desired position, the switch command will not be issued again. An opened breaker cannot be opened again. This also applies for switching command at the HMI or via SCADA.

Anti Pumping

By pressing the CLOSE command softkey only a single switching CLOSE impulse will be issued independent, how long the softkey is actuated. The switchgear will close only once per close command.

Direct Commands of the Control

<i>Parameter</i>	<i>Description</i>	<i>Setting range</i>	<i>Default</i>	<i>Menu path</i>
Res Bwear SI Breaker 	Resetting the slow breaker alarm	Inactive, Active	Inactive	[Operation /Reset]
Ack TripCmd 	Acknowledge Trip Command	Inactive, Active	Inactive	[Operation /Reset]

Global Protection Parameters of the Control

Parameter	Description	Setting range	Default	Menu path
CinBkr-52a 	The breaker is in CLOSE-position if the state of the assigned signal is true (52a).	1..n, Dig Inputs	DI-8P X1.DI 5	[Control /Bkr /Pos Indicatr Wirng]
CinBkr-52b 	The breaker is in OPEN-position if the state of the assigned signal is true (52b).	1..n, Dig Inputs	DI-8P X1.DI 6	[Control /Bkr /Pos Indicatr Wirng]
Ready 	Breaker is ready for operation if the state of the assigned signal is true. This digital input can be used by some protective elements (if they are available within the device) like Auto Reclosure (AR), e.g. as a trigger signal.	1..n, Dig Inputs	.-	[Control /Bkr /Pos Indicatr Wirng]
Interl CLOSE1 	Interlocking of the CLOSE command	1..n, Assignment List	Wired Inputs.Bkr Trouble-I	[Control /Bkr /Interlockings]
Interl CLOSE2 	Interlocking of the CLOSE command	1..n, Assignment List	.-	[Control /Bkr /Interlockings]
Interl CLOSE3 	Interlocking of the CLOSE command	1..n, Assignment List	.-	[Control /Bkr /Interlockings]
Interl OPEN1 	Interlocking of the OPEN command	1..n, Assignment List	.-	[Control /Bkr /Interlockings]
Interl OPEN2 	Interlocking of the OPEN command	1..n, Assignment List	.-	[Control /Bkr /Interlockings]
Interl OPEN3 	Interlocking of the OPEN command	1..n, Assignment List	.-	[Control /Bkr /Interlockings]

Parameter	Description	Setting range	Default	Menu path
SC CLOSE 	Switching CLOSE Command, e.g. the state of the Logics or the state of the digital input	1..n, DI-LogicList	.-	[Control /Bkr /Ex OPEN/CLOSE Cmd]
SC OPEN 	Switching OPEN Command, e.g. the state of the Logics or the state of the digital input	1..n, DI-LogicList	.-	[Control /Bkr /Ex OPEN/CLOSE Cmd]
t-TripCmd 	Minimum hold time of the OPEN-command (Breaker, load break switch)	0 - 300.00s	0.2s	[Control /Bkr /Trip Manager]
Latched 	Defines whether the Relay Output will be Latched when it picks up.	Inactive, Active	Inactive	[Control /Bkr /Trip Manager]
Ack TripCmd 	Ack TripCmd	1..n, Assignment List	.-	[Control /Bkr /Trip Manager]
Trigger1 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	50P[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger2 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	50P[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger3 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	50P[3].TripCmd	[Control /Bkr /Trip Manager]
Trigger4 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	51P[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger5 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	51P[2].TripCmd	[Control /Bkr /Trip Manager]

Parameter	Description	Setting range	Default	Menu path
Trigger6 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	51P[3].TripCmd	[Control /Bkr /Trip Manager]
Trigger7 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	50X[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger8 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	50X[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger9 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	51X[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger10 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	51X[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger11 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	50R[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger12 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	50R[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger13 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	51R[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger14 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	51R[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger15 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	27M[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger16 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	27M[2].TripCmd	[Control /Bkr /Trip Manager]

Parameter	Description	Setting range	Default	Menu path
Trigger17 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	59M[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger18 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	59M[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger19 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	27A[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger20 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	27A[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger21 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	59A[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger22 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	59A[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger23 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	59N[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger24 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	59N[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger25 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	46[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger26 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	46[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger27 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	47[1].TripCmd	[Control /Bkr /Trip Manager]

Parameter	Description	Setting range	Default	Menu path
Trigger28 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	47[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger29 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	32[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger30 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	32[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger31 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	32[3].TripCmd	[Control /Bkr /Trip Manager]
Trigger32 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	32V[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger33 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	32V[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger34 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	32V[3].TripCmd	[Control /Bkr /Trip Manager]
Trigger35 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	PF-55D[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger36 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	PF-55D[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger37 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	PF-55A[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger38 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	PF-55A[2].TripCmd	[Control /Bkr /Trip Manager]

Parameter	Description	Setting range	Default	Menu path
Trigger39 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	81[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger40 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	81[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger41 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	81[3].TripCmd	[Control /Bkr /Trip Manager]
Trigger42 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	81[4].TripCmd	[Control /Bkr /Trip Manager]
Trigger43 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	81[5].TripCmd	[Control /Bkr /Trip Manager]
Trigger44 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	81[6].TripCmd	[Control /Bkr /Trip Manager]
Trigger45 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	49.TripCmd	[Control /Bkr /Trip Manager]
Trigger46 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	46G[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger47 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	46G[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger48 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	ZI.TripCmd	[Control /Bkr /Trip Manager]
Trigger49 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	40-Z1[1].TripCmd	[Control /Bkr /Trip Manager]

Parameter	Description	Setting range	Default	Menu path
Trigger50 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	40-Z2[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger51 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	40-Z1[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger52 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	40-Z2[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger53 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	24[1].TripCmd	[Control /Bkr /Trip Manager]
Trigger54 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	24[2].TripCmd	[Control /Bkr /Trip Manager]
Trigger55 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	50/27.TripCmd	[Control /Bkr /Trip Manager]
Trigger56 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	87.TripCmd	[Control /Bkr /Trip Manager]
Trigger57 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	87H.TripCmd	[Control /Bkr /Trip Manager]
Trigger58 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	87GD.TripCmd	[Control /Bkr /Trip Manager]
Trigger59 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	87GDH.TripCmd	[Control /Bkr /Trip Manager]
Trigger60 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	-.-	[Control /Bkr /Trip Manager]

Parameter	Description	Setting range	Default	Menu path
Trigger61 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	.-	[Control /Bkr /Trip Manager]
Trigger62 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	.-	[Control /Bkr /Trip Manager]
Trigger63 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	.-	[Control /Bkr /Trip Manager]
Trigger64 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	.-	[Control /Bkr /Trip Manager]
Trigger65 	Open Command to the Breaker if the state of the assigned signal becomes true.	1..n, Trip Cmds	.-	[Control /Bkr /Trip Manager]
Synchronizm 	Synchronizm	1..n, In-SyncList	.-	[Control /Bkr /Synchron Switchg]
t-MaxSyncSuperv 	Synchron-Run timer: Max. time allowed for synchronizing process after a close initiate. Only used for GENERATOR2SYSTEM working mode.	0 - 3000.00s	0.2s	[Control /Bkr /Synchron Switchg]
t-Move CLOSE 	Time to move to the CLOSE Position	0.01 - 100.00s	0.1s	[Control /Bkr /General Settings]
t-Move OPEN 	Time to move to the OPEN Position	0.01 - 100.00s	0.1s	[Control /Bkr /General Settings]

Switchgear/Breaker Input States

Name	Description	Assignment via
CinBkr-52a-I	Module Input State: Feed-back signal of the Bkr (52a)	[Control /Bkr /Pos Indicatr Wirng]
CinBkr-52b-I	Module Input State: Feed-back signal of the Bkr. (52b)	[Control /Bkr /Pos Indicatr Wirng]
Ready-I	Module Input State: Breaker Ready	[Control /Bkr /Pos Indicatr Wirng]
Sys-in-Sync-I	State of the module input: This signals has to become true within the synchronization time. If not, switching is unsuccessful.	[Control /Bkr /Synchron Switchg]
Ack TripCmd-I	State of the module input: Acknowledgment Signal (only for automatic acknowledgment). Module input signal	[Control /Bkr /Trip Manager]
Interl CLOSE1-I	State of the module input: Interlocking of the CLOSE command	[Control /Bkr /Interlockings]
Interl CLOSE2-I	State of the module input: Interlocking of the CLOSE command	[Control /Bkr /Interlockings]
Interl CLOSE3-I	State of the module input: Interlocking of the CLOSE command	[Control /Bkr /Interlockings]
Interl OPEN1-I	State of the module input: Interlocking of the OPEN command	[Control /Bkr /Interlockings]
Interl OPEN2-I	State of the module input: Interlocking of the OPEN command	[Control /Bkr /Interlockings]
Interl OPEN3-I	State of the module input: Interlocking of the OPEN command	[Control /Bkr /Interlockings]

Name	Description	Assignment via
SC CLOSE-I	State of the module input: Switching CLOSE Command, e.g. the state of the Logics or the state of the digital input	[Control /Bkr /Ex OPEN/CLOSE Cmd]
SC OPEN-I	State of the module input: Switching OPEN Command, e.g. the state of the Logics or the state of the digital input	[Control /Bkr /Ex OPEN/CLOSE Cmd]

Switchgear/Breaker Signals (Outputs States)

Signal	Description
SI SingleContactInd	Signal: The Position of the Switchgear is detected by one auxiliary contact (pole) only. Thus indeterminate and disturbed Positions cannot be detected.
Pos not CLOSE	Signal: Pos not CLOSE
Pos CLOSE	Signal: Breaker is in CLOSE-Position
Pos OPEN	Signal: Breaker is in OPEN-Position
Pos Inderm	Signal: Breaker is in Indeterminate Position
Pos Disturb	Signal: Breaker Disturbed - Undefined Breaker Position. The feed-back signals (Position Indicators) contradict themselves. After expiring of a supervision timer this signal becomes true.
State	Signal: Breaker Position (0 = Indeterminate, 1 = OPEN, 2 = CLOSE, 3 = Disturbed)
Ready	Signal: Breaker is ready for operation.
Interl CLOSE	Signal: One or more IL_Close inputs are active.
Interl OPEN	Signal: One or more IL_Open inputs are active.
CES succesf	Signal: Command Execution Supervision: Switching command executed successfully.
CES Disturbed	Signal: Command Execution Supervision: Switching Command unsuccessful. Switchgear in disturbed position.
CES Fail TripCmd	Signal: Command Execution Supervision: Command execution failed because trip command is pending.
CES SwitchgDir	Signal: Command Execution Supervision respectively Switching Direction Control: This signal becomes true, if a switch command is issued even though the switchgear is already in the requested position. Example: A switchgear that is already OPEN should be switched OPEN again (doubly). The same applies to CLOSE commands.
CES CLOSE d OPEN	Signal: Command Execution Supervision: CLOSE Command during a pending OPEN Command.
CES SG not ready	Signal: Command Execution Supervision: Switchgear not ready
CES Field Interl	Signal: Command Execution Supervision: Switching Command not executed because of field interlocking.
CES SyncTimeout	Signal: Command Execution Supervision: Switching Command not executed. No Synchronization signal while t-sync was running.
CES SG removed	Signal: Command Execution Supervision: Switching Command unsuccessful, Switchgear removed.
TripCmd	Signal: Trip Command

<i>Signal</i>	<i>Description</i>
Ack TripCmd	Signal: Acknowledge Trip Command
Bwear Slow Breaker	Signal: Slow Breaker Alarm
Res Bwear SI Breaker	Signal: Resetting the slow breaker alarm
CLOSE Cmd	Signal: CLOSE command issued to the switchgear. Depending on the setting the signal may include the CLOSE command of the Prot module.
OPEN Cmd	Signal: OPEN command issued to the switchgear. Depending on the setting the signal may include the OPEN command of the Prot module.
CLOSE Cmd manual	Signal: CLOSE Cmd manual
OPEN Cmd manual	Signal: OPEN Cmd manual
Sync CLOSE request	Signal: Synchronous CLOSE request

Direct commands of the Switching Authority

<i>Parameter</i>	<i>Description</i>	<i>Setting range</i>	<i>Default</i>	<i>Menu path</i>
Switching Authority 	Switching Authority	None, Local, Remote, Local and Remote	Local	[Control /General Settings]

Signals of the Switching Authority

<i>Signal</i>	<i>Description</i>
Local	Switching Authority: Local
Remote	Switching Authority: Remote
SG Indeterm	Minimum one Switchgear is moving (Position cannot be determined).
SG Disturb	Minimum one Switchgear is disturbed.

Counters of the Switching Authority

<i>Parameter</i>	<i>Description</i>
CES SAuthority	Command Execution Supervision: Switching Command not executed. No switching authority.
CES DoubleOperating	Command Execution Supervision: A second switch command is in conflict with a pending one.
No. of rej. Com	No. of rej. Com because Locked by ParaSystem

Switchgear Wear

Switchgear Wear Features

The sum of the accumulated interrupted currents.

A »SGwear Slow Switchgear« might indicate malfunction at an early stage.

The protective relay will calculate the »SG OPEN Capacity« continuously. 100% means, that switchgear maintenance is mandatory now.

The protective relay will make a alarm decision based on the curve that the user provides.

The relay will monitor the frequency of CLOSE/OPEN cycles. The User can set thresholds for the maximum allowed sum of interrupt currents and the maximum allowed sum of interrupt currents per hour. By means of this alarm, excessive switchgear operations can be detected at an early stage.

Slow Switchgear Alarm

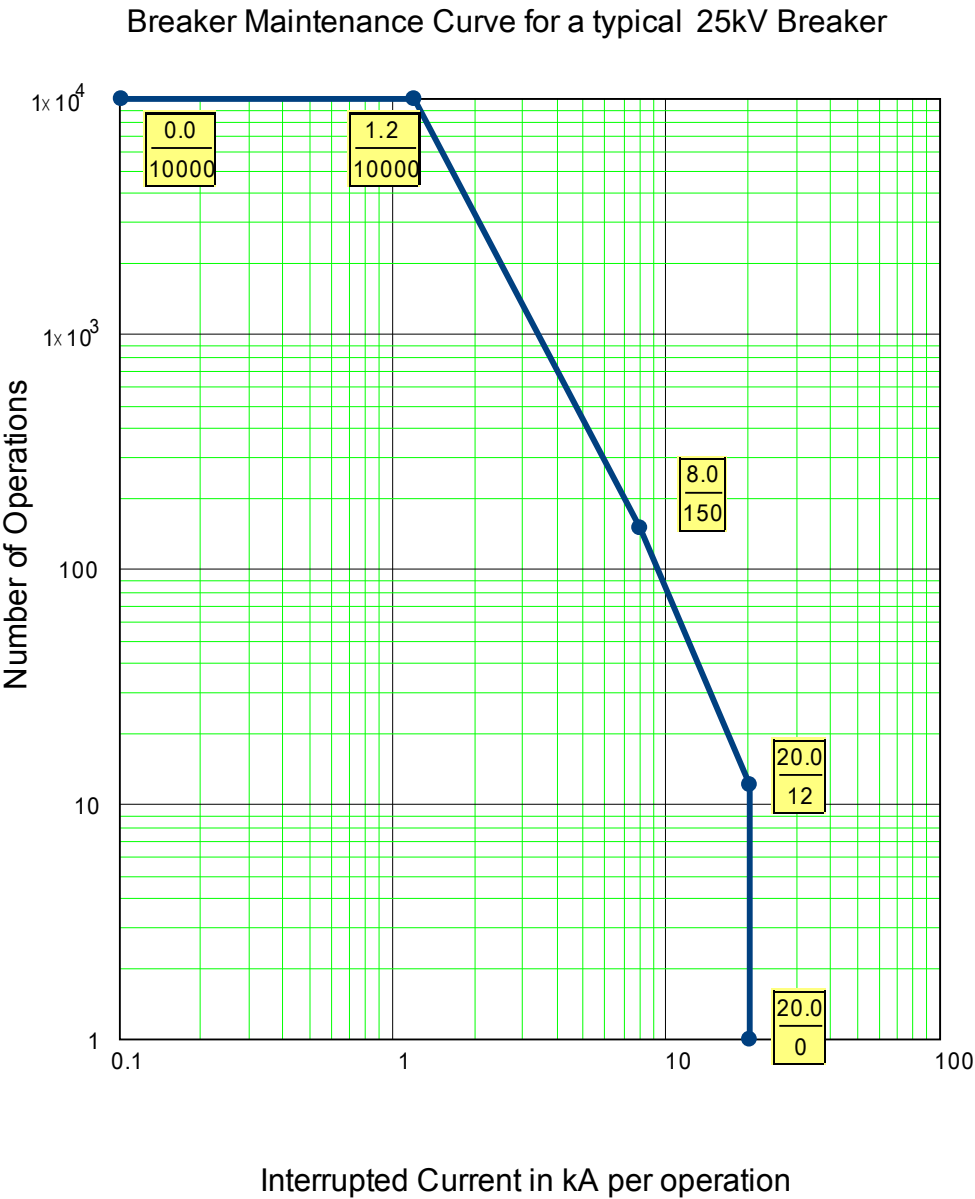
An increase of the close or opening time of the switchgear is an indication for the maintenance need. If the measured time exceeds the time »*t-Move OPEN*« or »*t-Move CLOSE*«, the signal »SGwear Slow Switchgear« will be activated.

Switchgear Wear Curve

In order to keep the switchgear in good working condition, the switchgear needs to be monitored. The switchgear health (operation life) depends above all on:

- The number of CLOSE/OPEN cycles.
- The amplitudes of the interrupting currents.
- The frequency that the switchgear operates (Operations per hour).

The User has to maintain the switchgear accordingly to the maintenance schedule that is to be provided by the manufacturer (switchgear operation statistics). By means of up to ten points that the user can replicate the switchgear wear curve within menu [Control/SG/SG[x]/SGW] . Each point has two settings: the interrupt current in kilo amperes and the allowed operation counts. No matter how many points are used, the operation counts the last point as zero. The protective relay will interpolate the allowed operations based on the switchgear wear curve. When the interrupted current is greater than the interrupt current at the last point, the protective relay will assume zero operation counts.



Global Protection Parameters of the Breaker Wear Module

Parameter	Description	Setting range	Default	Menu path
 Operations Alarm	Service Alarm, too many Operations	1 - 100000	9999	[Control /Bkr /Bwear]
 Isum Intr Alarm	Alarm, the Sum (Limit) of interrupting currents has been exceeded.	0.00 - 2000.00kA	100.00kA	[Control /Bkr /Bwear]
 Isum Intr ph Alm	Alarm, the per hour Sum (Limit) of interrupting currents has been exceeded.	0.00 - 2000.00kA	100.00kA	[Control /Bkr /Bwear]
 Bwear Curve Fc	The Breaker Wear Curve defines the maximum allowed CLOSE/OPEN cycles depending on the brake currents. If the breaker maintenance curve is exceeded, an alarm will be issued. The breaker maintenance curve is to be taken from the technical data sheet of the breaker manufacturer. By means of the available points this curve is to be replicated.	Inactive, Active	Inactive	[Control /Bkr /Bwear]
 WearLevel Alarm	Breaker Wear curve Alarm Only available if: Bwear Curve Fc = Active	0.00 - 100.00%	80.00%	[Control /Bkr /Bwear]
 WearLevel Lockout	Breaker Wear Curve Lockout Level Only available if: Bwear Curve Fc = Active	0.00 - 100.00%	95.00%	[Control /Bkr /Bwear]
 Current1	Interrupted Current Level #1 Only available if: Bwear Curve Fc = Active	0.00 - 2000.00kA	0.1kA	[Control /Bkr /Bwear]
 Count1	Open Counts Allowed #1 Only available if: Bwear Curve Fc = Active	1 - 32000	10000	[Control /Bkr /Bwear]
 Current2	Interrupted Current Level #2 Only available if: Bwear Curve Fc = Active	0.00 - 2000.00kA	1.00kA	[Control /Bkr /Bwear]

Parameter	Description	Setting range	Default	Menu path
Count2 	Open Counts Allowed #2 Only available if:Bwear Curve Fc = Active	1 - 32000	10000	[Control /Bkr /Bwear]
Current3 	Interrupted Current Level #3 Only available if:Bwear Curve Fc = Active	0.00 - 2000.00kA	1.15kA	[Control /Bkr /Bwear]
Count3 	Open Counts Allowed #3 Only available if:Bwear Curve Fc = Active	1 - 32000	10000	[Control /Bkr /Bwear]
Current4 	Interrupted Current Level #4 Only available if:Bwear Curve Fc = Active	0.00 - 2000.00kA	3.00kA	[Control /Bkr /Bwear]
Count4 	Open Counts Allowed #4 Only available if:Bwear Curve Fc = Active	1 - 32000	1900	[Control /Bkr /Bwear]
Current5 	Interrupted Current Level #5 Only available if:Bwear Curve Fc = Active	0.00 - 2000.00kA	5.00kA	[Control /Bkr /Bwear]
Count5 	Open Counts Allowed #5 Only available if:Bwear Curve Fc = Active	1 - 32000	850	[Control /Bkr /Bwear]
Current6 	Interrupted Current Level #6 Only available if:Bwear Curve Fc = Active	0.00 - 2000.00kA	6.00kA	[Control /Bkr /Bwear]
Count6 	Open Counts Allowed #6 Only available if:Bwear Curve Fc = Active	1 - 32000	500	[Control /Bkr /Bwear]
Current7 	Interrupted Current Level #7 Only available if:Bwear Curve Fc = Active	0.00 - 2000.00kA	13.00kA	[Control /Bkr /Bwear]
Count7 	Open Counts Allowed #7 Only available if:Bwear Curve Fc = Active	1 - 32000	110	[Control /Bkr /Bwear]

Parameter	Description	Setting range	Default	Menu path
Current8 	Interrupted Current Level #8 Only available if:Bwear Curve Fc = Active	0.00 - 2000.00kA	16.00kA	[Control /Bkr /Bwear]
Count8 	Open Counts Allowed #8 Only available if:Bwear Curve Fc = Active	1 - 32000	75	[Control /Bkr /Bwear]
Current9 	Interrupted Current Level #9 Only available if:Bwear Curve Fc = Active	0.00 - 2000.00kA	20.00kA	[Control /Bkr /Bwear]
Count9 	Open Counts Allowed #9 Only available if:Bwear Curve Fc = Active	1 - 32000	45	[Control /Bkr /Bwear]
Current10 	Interrupted Current Level #10 Only available if:Bwear Curve Fc = Active	0.00 - 2000.00kA	25.00kA	[Control /Bkr /Bwear]
Count10 	Open Counts Allowed #10 Only available if:Bwear Curve Fc = Active	1 - 32000	30	[Control /Bkr /Bwear]

Breaker Wear Signals (Output States)

<i>Signal</i>	<i>Description</i>
Operations Alarm	Signal: Service Alarm, too many Operations
Isum Intr trip: IA	Signal: Maximum permissible Summation of the interrupting (tripping) currents exceeded: IA
Isum Intr trip: IB	Signal: Maximum permissible Summation of the interrupting (tripping) currents exceeded: IB
Isum Intr trip: IC	Signal: Maximum permissible Summation of the interrupting (tripping) currents exceeded: IC
Isum Intr trip	Signal: Maximum permissible Summation of the interrupting (tripping) currents exceeded in at least one phase.
Res TripCmdCr	Signal: Resetting of the Counter: total number of trip commands
Res Isum trip	Signal: Reset summation of the tripping currents
WearLevel Alarm	Signal: Breaker Wear curve Alarm
WearLevel Lockout	Signal: Breaker Wear Curve Lockout Level
Res Bwear Curve	Signal: Reset of the Breaker Wear maintenance curve.
Isum Intr ph Alm	Signal: Alarm, the per hour Sum (Limit) of interrupting currents has been exceeded.
Res Isum Intr ph Alm	Signal: Reset of the Alarm, "the per hour Sum (Limit) of interrupting currents has been exceeded".

Breaker Wear Counter Values

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
TripCmd Cr	Counter: Total number of trips of the switchgear (breaker, load break switch...). Resettable with Total or All.	0	0 - 200000	[Operation /Count and RevData /Control /Bkr]

Breaker Wear Values

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
Isum trip IA	Summation of the tripping currents phase	0.00A	0.00 - 1000.00A	[Operation /Count and RevData /Control /Bkr]
Isum trip IB	Summation of the tripping currents phase	0.00A	0.00 - 1000.00A	[Operation /Count and RevData /Control /Bkr]
Isum trip IC	Summation of the tripping currents phase	0.00A	0.00 - 1000.00A	[Operation /Count and RevData /Control /Bkr]
Isum Intr per hour	Sum per hour of interrupting currents.	0.00kA	0.00 - 1000.00kA	[Operation /Count and RevData /Control /Bkr]
Bkr OPEN capacity	CB OPEN capacity. 100% means, that the breaker is to be maintained.	0.0%	0.0 - 100.0%	[Operation /Count and RevData /Control /Bkr]

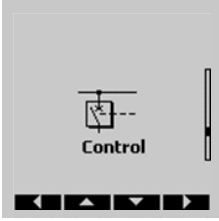
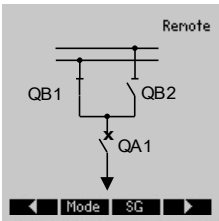
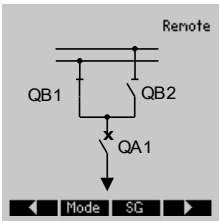
Direct Commands of the Breaker Wear Module

<i>Parameter</i>	<i>Description</i>	<i>Setting range</i>	<i>Default</i>	<i>Menu path</i>
Res TripCmdCr 	Resetting of the Counter: total number of trip commands	Inactive, Active	Inactive	[Operation /Reset]
Res lsum trip 	Reset summation of the tripping currents	Inactive, Active	Inactive	[Operation /Reset]
Res lsum Intr per hour 	Sum per hour of interrupting currents.	Inactive, Active	Inactive	[Operation /Reset]
Res Bkr OPEN capacity 	Resetting of the CB OPEN capacity. 100% means, that the breaker is to be maintained.	Inactive, Active	Inactive	[Operation /Reset]

Control - Example: Switching of a Breaker

Ctrl

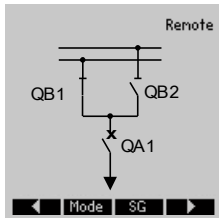
The following example shows how to switch a breaker via the HMI at the device.

	Change into the menu »Control« by pushing the »right arrow« softkey..
	Change to the control page by pushing the »right arrow« softkey.
	Information only: On the control page a single line diagram with the current switchgear positions is displayed. By means of the softkey »Mode« it can be switched to the menu »General Settings«. In this menu switching authority and interlockings can be set. By means of the softkey »SG« it can be switched to the menu »SG«. In this menu specific settings for the switch gear can be done. Please note: This control key can be directly called up via the key "CTRL" at the front panel.
	To execute a switching operation, change into the switching menu by pushing the right arrow softkey button.

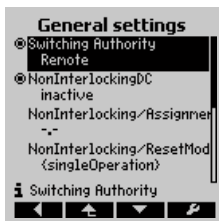


Executing a switching command via the devices HMI is only possible when the switching authority is set to »Local«. If no switching authority is given, this has to be set first to »Local« or »Local and Remote«.

With the softkey »OK« it can be switched back to the single line diagram page.



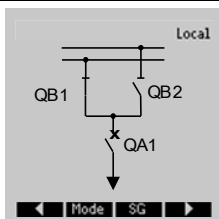
Pushing the softkey »Mode« leads to the menu »General Settings«.



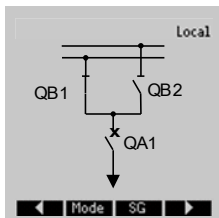
In this menu the switching authority can be changed.



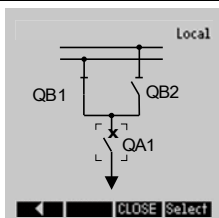
Select between »Local« or »Local and Remote«.



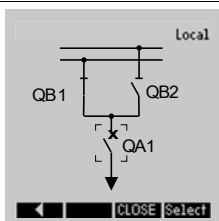
Now it is possible to execute switching commands at the HMI.



Push the »right arrow« softkey to get to the control page.



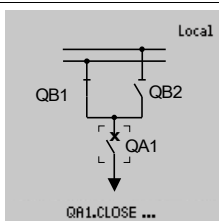
To select a switchgear press the softkey »Select« as long as the desired switchgear is selected. The current selection is displayed by the edges of a rectangle. In this example the breaker is selected. Switchgears that are supervised only, cannot be selected.



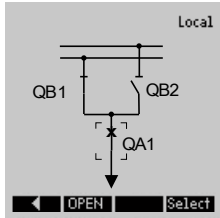
The breaker is opened, therefore it can be closed only. After pushing the softkey »ON« a confirmation window appears.



When you are sure to proceed with the switching operation, press the softkey »YES«.



The switching command will be given to the breaker. The display shows the intermediate position of the switchgear.



It will be shown on the display when the switchgear reaches the new end position. Further possible switching operations (OPEN) will be displayed by softkeys.



Notice: For the case, the switchgear does not reach the new end position within the set supervision time the following Warning appears on the display.

Protective Elements

87 - Phase Current Differential Protection

Available elements:

87

Description

The protective device provides restrained phase differential protection function with User-configurable multiple slope percentage restrained characteristic that allows to compensate both the static error and the dynamic error. The static error may be caused by magnetizing currents or by matching errors within the current measuring circuit. The dynamic error may be caused by CT secondary currents falsely representing their primary currents due to the increased magnetizing current caused by fault current.

In addition, the static tripping characteristic can be modified temporarily at the User's choice to prevent some nuisance tripping from the CT saturation. The transients are monitored by the CT saturation detector.

Phase Differential Protection Applications

The phase differential protection can be used for:

Generator Phase Differential Protection - 87

For this application, the phase differential protection will detect phase faults in the generator stator windings. The differential zone is between the current transformers (CT) installed at the generator neutral and line side.

For detailed application configuration, please see also the application table on the next page.

It is to note that the phase differential protection base current I_b , to which both the differential and restraining currents are scaled, will be calculated from the set generator ratings as follows:

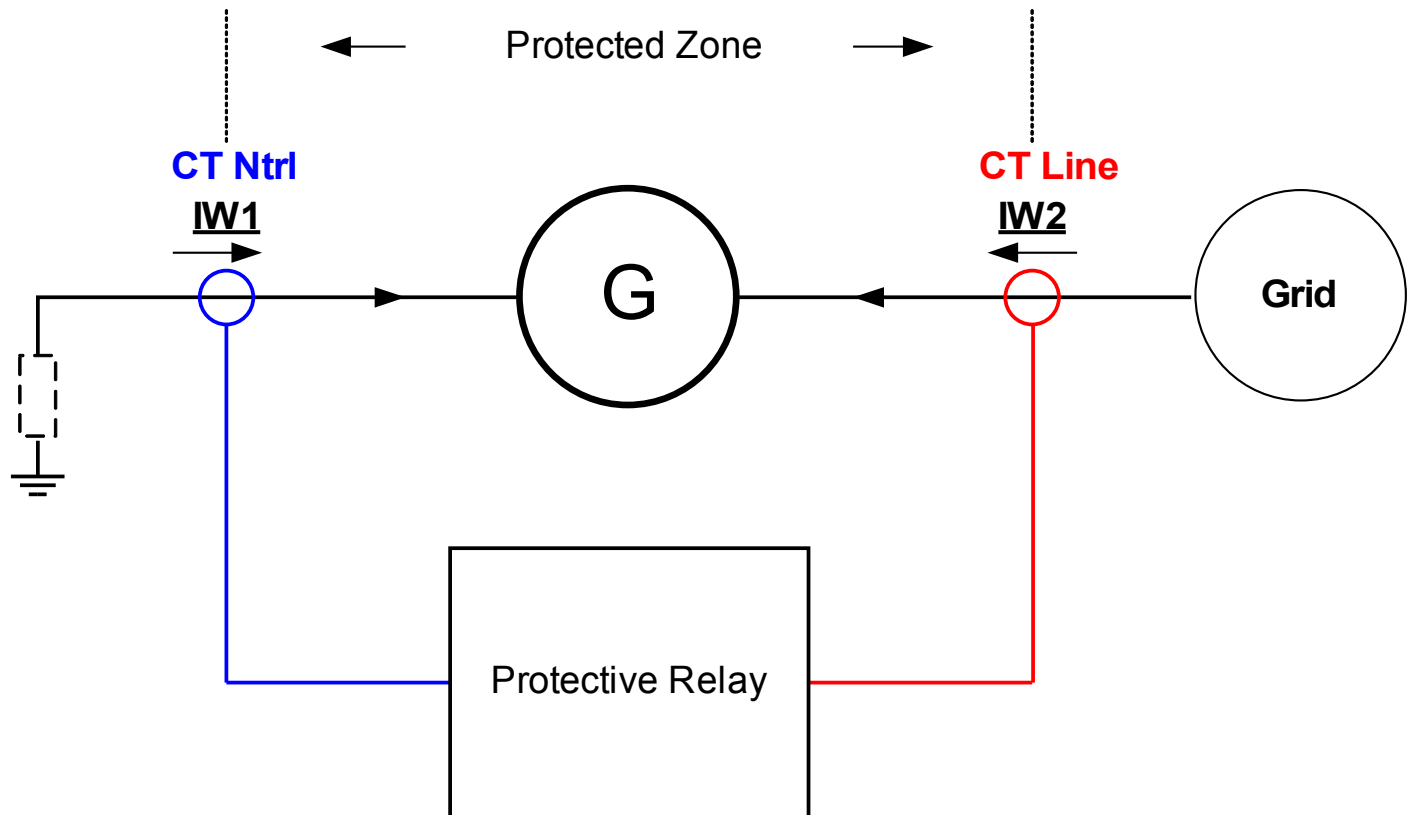
$$I_b = \frac{S_N}{\sqrt{3} * V_{LL}} = \frac{\text{Rated Power}_{Generator}}{\sqrt{3} * \text{Rated Voltage}_{Generator}}$$

Application Options	Required Settings
ANSI 87 – Generator Differential Protection (Bus connection) The diagram shows a generator (G) connected to a bus on the left and a grid on the right. The bus has a CT Ntrl (blue circle) and a CT Line (red circle). The grid has a CT Line (red circle). A protective relay is connected to the CT Ntrl and CT Line. A 'Protected Zone' is indicated between the bus and the grid.	<i>Note 1:</i> "CT Neutral" at generator neutral must be connected to the device current input X3 (W1) and "CT Line" at generator terminal must be connected to device current terminal X4 (W2). Set the Field Parameters of the Generator. Where? Within [Field Para\Generator] Set the Differential Protection Parameters. Where? Within [Protection Para\Set [x]\Diff-Prot]

Direction Definitions

The direction convention adopted here is as shown in the following drawing.

Protection Principle of the Current Differential Protection



Please see also Legend on next page.

Legend

Symbol	Explanation
S_N	Rated Power from Protected Object (e.g. Generator or Stepup Transformer)
V_{LL}	Rated Voltage from Protected Object (e.g. Generator)
$CT_{pri,W1}$	Primary Rated current of the Current Transformers on the Generator Neutral side (W1)
$CT_{sec,W1}$	Secondary Rated current of the Current Transformers on the Generator Neutral side (W1)
$CT_{pri,W2}$	Primary Rated current of the Current Transformers on the Generator Line side (W2)
$CT_{sec,W2}$	Secondary Rated current of the Current Transformers on the Generator Line side (W2)
I_b	Base current (is depending on the applied context, in general, it is the Rated Current of Protected Object, e.g. Generator or Transformer)
$I_{pri,W1} \quad I_{pri,W2}$	Uncompensated primary current phasors on corresponding winding side
$\vec{I}_{W1} \quad \vec{I}_{W2}$	Uncompensated secondary current phasors on corresponding winding side

Tripping curve

The restrained percentage phase differential protection tripping characteristic can be expressed mathematically as:

$$|\vec{I}_d| \geq |\vec{I}_{dmin}| + \underbrace{K_1 * |\vec{I}_s|}_{I_s > I_{s(ldmin)} \text{ and } I_d < 2 * I_b} + \underbrace{K_2 * |\vec{I}_s|}_{I_s \geq 2 * I_b} + d(H, m)$$

Where

$$|\vec{I}_d| = |\vec{I}_{W1}'' + \vec{I}_{W2}''| \quad \text{is defined as fundamental differential current.}$$

$|\vec{I}_r| = 0.5 * |\vec{I}_{W1}'' - \vec{I}_{W2}''|$ is defined as fundamental restraining current, and it is also called the through current for normal load and external faults.

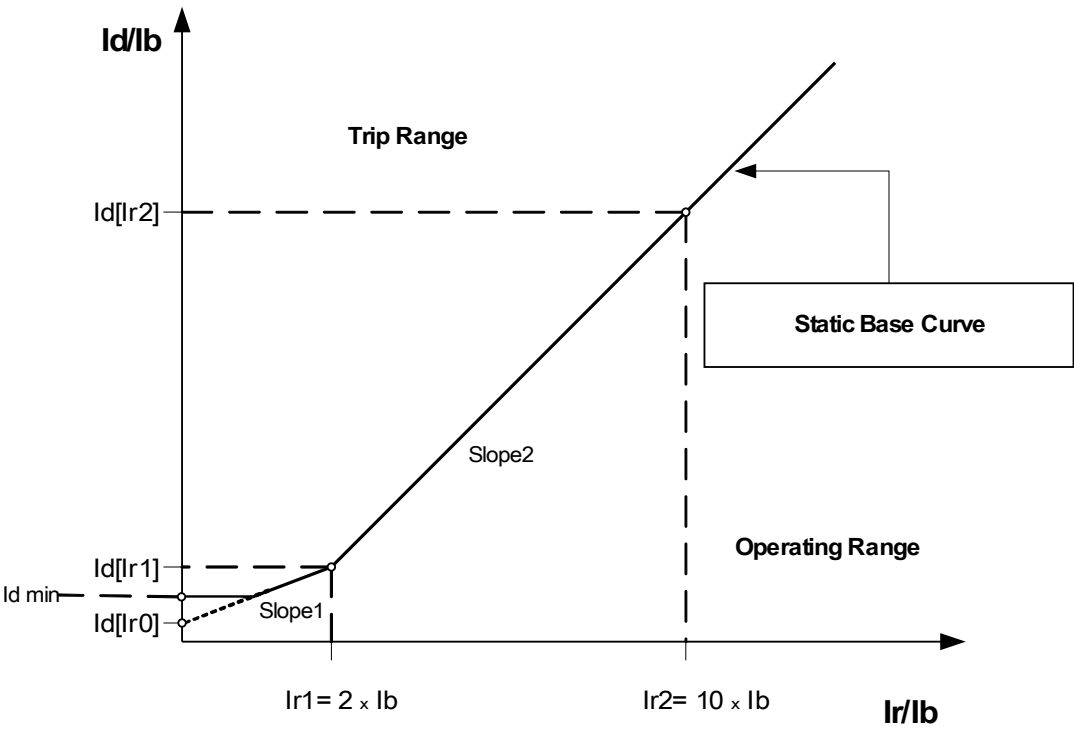
$|\vec{I}_{dmin}|$ is the minimum differential current scaled to the base current.

K_1 and K_2 are slope factors for two slope sections on the operating curve respectively.

$d(H, m)$ is the temporary restraining current, which is a configurable multiple of the base current I_b .

$\vec{I}_{W1}''$ and $\vec{I}_{W2}''$ are the corresponding compensated secondary current phasors, which are scaled from the uncompensated primary phase current phasors $\vec{I}_{pri,W1}$ and $\vec{I}_{pri,W2}$ flowing into the protected object.

Under normal conditions, the differential current should be below $|\vec{I}_{dmin}|$. When an internal fault occurs, the differential current will raise above the restraining current to trip. To establish a correct trip criterion, two currents flowing into the protected object must be matched by compensating their magnitudes and phases.



Setting the Tripping Curve

$|\vec{I}_{dmin}|$ is the minimum differential current multiple scaled to the base current to get the restrained phase differential protection to trip, which should be set based on the static error (no load error, transformer magnetizing current, and measurement circuit noise). K_1 and K_2 are the restraining slopes that will be determined with the settings $I_d(|\vec{I}_{s0}|)$, $I_d(|\vec{I}_{s1}|)$, and $I_d(|\vec{I}_{s2}|)$ as follows:

$$K_1 = |I_d(|\vec{I}_{r1}|) - I_d(|\vec{I}_{r0}|)| / 2$$

$$K_2 = |I_d(|\vec{I}_{r2}|) - I_d(|\vec{I}_{r1}|)| / 8$$

All current settings are expressed as multiples of the base current (I_b). The base current will be calculated internally from the power rating and voltage ratings of the protected object under the field parameter menu.

For generator differential protection the base current is defined as:

$$I_b = \frac{S_N}{\sqrt{3} * V_{LL}} = \frac{\text{Rated Power}_{Generator}}{\sqrt{3} * \text{Rated Voltage}_{Generator}}$$

NOTICE

For the 87 Generator Phase Differential the base current $I_b = I_{b, WI}$ from the Generator is to be used.

The procedures to configure: $I_d(|\vec{I}_{r0}|)$, $I_d(|\vec{I}_{r1}|)$, and $I_d(|\vec{I}_{r2}|)$:

1. Use $I_d(|\vec{I}_{r0}|)$ as a minimum differential current to trip when the restraining current is zero;
2. Select the slope K_1 (usually around 15%-40% [typically 25%]);
3. Calculate set value $I_d(|\vec{I}_{r1}|)$ using $I_d(|\vec{I}_{r0}|)$ and K_1 : $I_d(|\vec{I}_{r1}|) = I_d(|\vec{I}_{r0}|) + 2 * K_1$;
4. Select the slope K_2 (usually around 40%-90% [typically 60%]);
5. Calculate set value $I_d(|\vec{I}_{r2}|)$ using $I_d(|\vec{I}_{r1}|)$ and K_2 : $I_d(|\vec{I}_{r2}|) = I_d(|\vec{I}_{r1}|) + 8 * K_2$;

CT Mismatch

Please note: This section applies only if a step up transformer is part of the protected differential zone.

NOTICE

None of the Amplitudes Matching factors must exceed a value of 10.

$$k_{CT1} = \frac{CT_{pri,W1}}{I_{bW1}} \leq 10 \quad \text{and} \quad k_{CT2} = \frac{CT_{pri,W2}}{I_{bW2}} \leq 10$$

The ratio between the maximum and second largest amplitudes matching factors must not exceed a value of 3.

Transient Restraining

The transient behavior can be evoked by:

- Saturation of the CT.

Temporarily restraining can be triggered by:

- CT saturation trigger is enabled and saturation is detected.

NOTICE

By means of the »Block mode« (Cross Block), the User can specify if a harmonic signal or CT saturation within one phase temporarily causes restraining within this phase only or a cross block (3 phases).

Temporarily Restraining (by monitoring of the harmonics)

The protective device also offers the temporary restraining feature for further securing phase percentage restrained differential protection against CT saturation. Separating the temporary restraining from the fundamental restraining can make the differential protection more sensitive to internal faults. The temporary restraining, whenever effective, will essential add a constant $d(H, m)$ to the fundamental restraining. Graphically, the static tripping curve is temporarily raised by $d(H, m)$. The amount of the temporary restraining is configured as multiple of the base current I_b .

Temporarily Restraining (by CT saturation monitoring)

Beside the harmonic temporary restraining triggers, the protective device offers another trigger function - the Transients Monitor (Gradient Monitor). This monitor supervises the current transformer saturation. This monitor will be triggered by the behavior of the phase currents (their slopes, normalized derivative).

The normalized derivative is defined as:

$$m = \frac{1}{\omega * I_{peak}} * \frac{di}{dt} ,$$

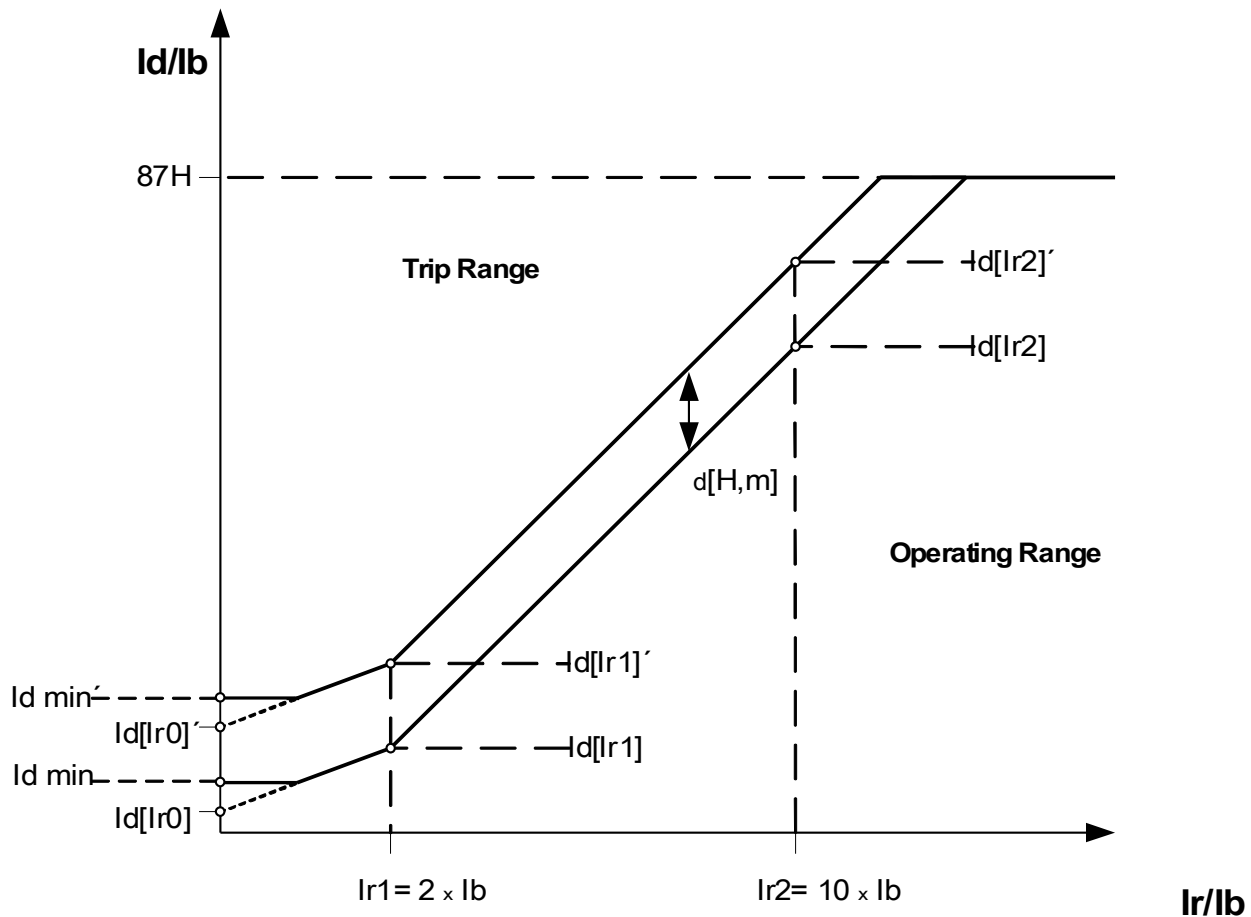
where I_{peak} is the peak value within a half cycle and ω is the system frequency.

For a pure sinusoidal waveform, the normalized derivative should be equal to 1. Under CT saturation, m will be greater than 1. The setting CT Satur Sensitivn should be set properly to identify effectively CT saturation but not to generate a nuisance trigger.

When the CT saturation monitor is active, it will trigger the temporary restraining if m exceeds an internal threshold. The temporary restraining, whenever effective, will essentially add a constant $d(H, m)$ to the fundamental restraining. Graphically, the static tripping curve is temporarily raised by $d(H, m)$ which the sensitivity of the differential protection function is reduced temporarily.

The internal threshold can be modified by means of the CT Saturation Sensitivn. The CT saturation monitor will behave more sensitively the lower the setting value is set.

Temporary Dynamic Rise of the Static Tripping Characteristic.



NOTICE

The following signals cannot become true if $I_d < I_{dmin}$:

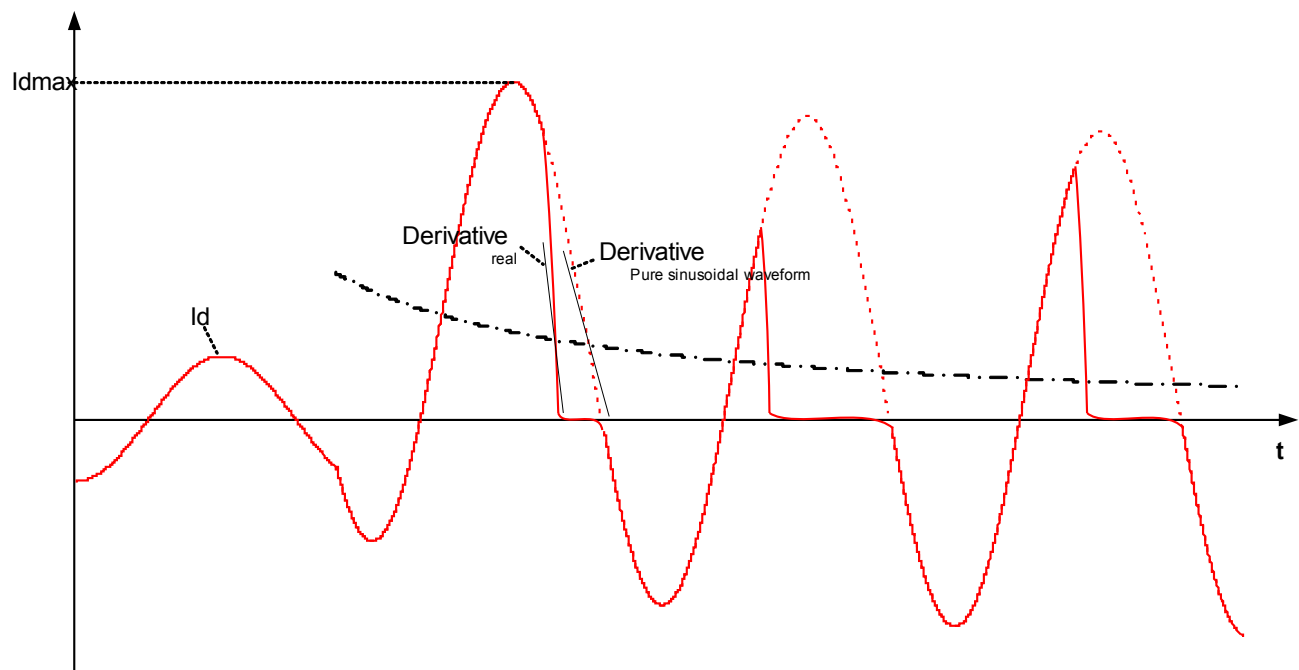
- 87. Slope Blo
- 87. Restraining

The signal restraining will become true if "87. Slope Blo" is true.

The Transient Monitor analyzes continuously the differential current signal. If it detects saturation $|m| > 1$, it will decide whether the saturation is caused by internal or external faults.

- External Faults: the sign of differential current and of slope are equal (both “-“ or both”+”).
- Internal Faults: the sign of differential current and slope are different (one “-“ and the other “+” or the other way round).

If the saturation is caused by an internal fault, there will be no raising/stabilizing of the tripping curve. If the saturation is caused by an external fault, the tripping curve will be raised by $d(H,m)$.



CT Satur Monit	
Default (example)	
active	

The recommended value of the CT saturation monitor is 120%.

CT Satur Sensitvn	
Default (example)	
100%	

Device Planning Parameters of the Phase Current Differential Protection

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Phase Current Differential Protection

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /87]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /87]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /87]

Setting Group Parameters of the Phase Current Differential Protection

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Active	[Protection Para /<1..4> /I-Prot /87]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87]
Id min 	Constant minimum pickup current (differential current).	0.1 - 1.00lb	0.1lb	[Protection Para /<1..4> /I-Prot /87]
Id(Ir0) 	Starting point of the static tripping characteristic when Ir = 0	0.0 - 1.00lb	0.0lb	[Protection Para /<1..4> /I-Prot /87]
Id(Ir1) 	Breaking point of the static tripping characteristic when Ir = 2 x lb	0.2 - 2.00lb	0.2lb	[Protection Para /<1..4> /I-Prot /87]

Parameter	Description	Setting range	Default	Menu path
Id(Ir2) 	Value of the static tripping characteristic when $I_r = 10 \times I_b$	1.0 - 8.0Ib	2.0Ib	[Protection Para /<1..4> /I-Prot /87]
d(H,m) 	Restraining factor for rising the static tripping characteristic in case of stationary or transient harmonic components, which are ascertained by Fourier analysis (H) or transients monitor (m).	0.0 - 30.0Ib	4.0Ib	[Protection Para /<1..4> /I-Prot /87]
Block mode 	Phase overlapping restraining of the differential protection function.	Inactive, Active	Active	[Protection Para /<1..4> /I-Prot /87]
CT Satur Monit 	Current Transformer Saturation Supervision	Inactive, Active	Active	[Protection Para /<1..4> /I-Prot /87]
CT Satur Level 	Sensitiveness of the Current Transformer Saturation Supervision. The higher the value, the lower the sensitiveness. Only available if: VRestraining = Active	100 - 500%	100%	[Protection Para /<1..4> /I-Prot /87]

Phase Current Differential Protection Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /I-Prot /87]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /I-Prot /87]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /I-Prot /87]

Phase Current Differential Protection Module Signals (Output States)

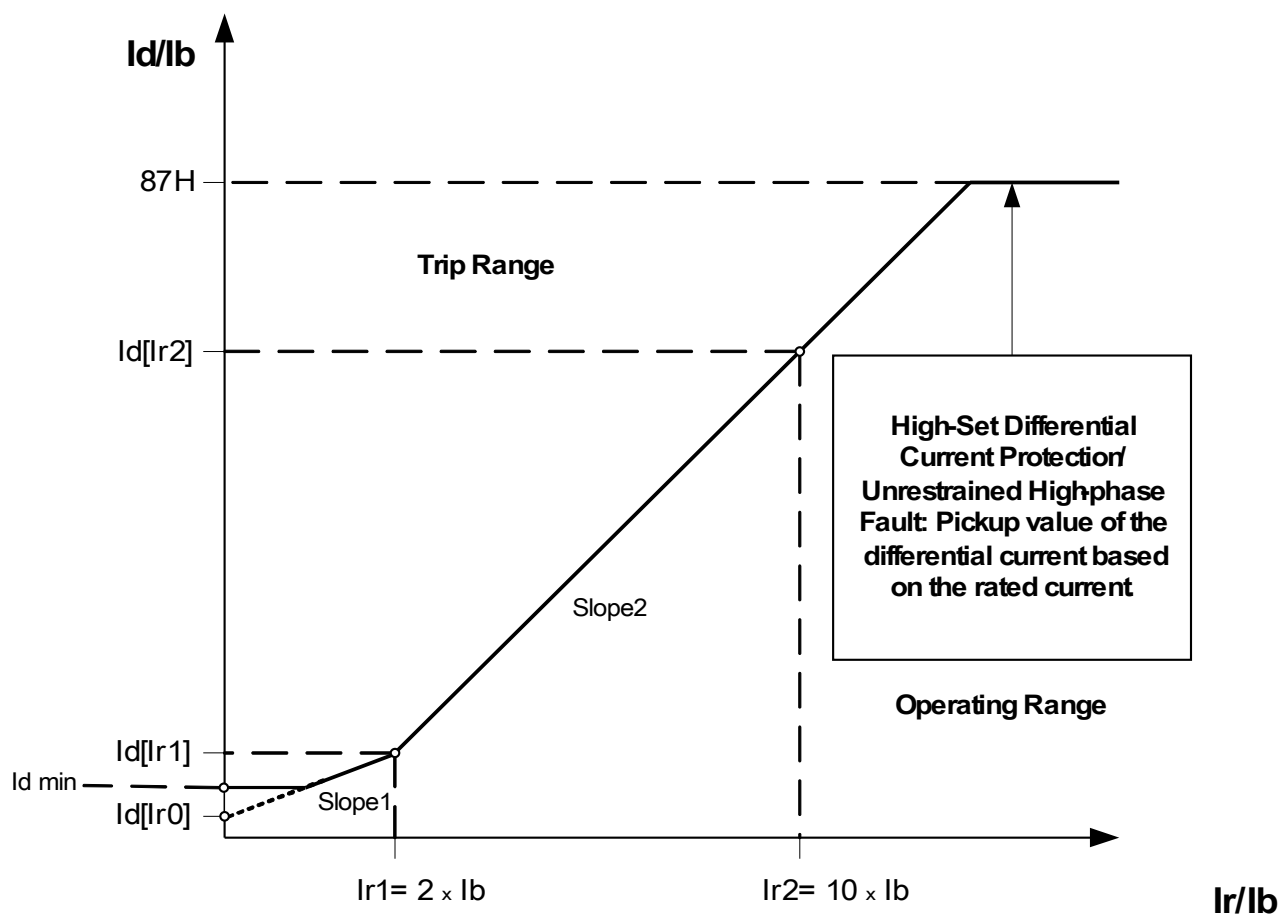
<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Alarm A	Signal: Pickup System Phase A
Alarm B	Signal: Pickup System Phase B
Alarm C	Signal: Pickup System C
Pickup	Signal: Pickup
Trip A	Signal: Trip System Phase A
Trip B	Signal: Trip System Phase B
Trip C	Signal: Trip System Phase C
Trip	Signal: Trip
TripCmd	Signal: Trip Command
Slope Blo	Signal: Differential protection was blocked by current transformer saturation. The tripping characteristic was lifted because of current transformer saturation.
Restraining	Signal: Restraining of the differential protection by means of rising the tripping curve.
Slope Blo: A	Slope Blo: A
Slope Blo: B	Slope Blo: B
Slope Blo: C	Slope Blo: C
Restraining: A	Restraining: A
Restraining: B	Restraining: B
Restraining: C	Restraining: C

Unrestrained High-set Differential Current Protection IdH

Elements:
87H

Irrespective of the set static tripping characteristic and restraining factors $d[H,m]$, a pickup value for a max. differential current I_{dH} can be adjusted and results in undelayed tripping when exceeded. This protection step is referred to as high-set differential step I_{dH} and only trips on faults within the protection zone.

Unrestrained High-set Differential Protection Step I_{dH}



Device Planning Parameters of the Unrestrained High-set Differential Current Protection Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Unrestrained High-set Differential Current Protection Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /87H]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /87H]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /87H]

Setting Group Parameters of the Unrestrained High-set Differential Current Protection Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Active	[Protection Para /<1..4> /I-Prot /87H]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87H]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87H]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87H]
Id>> 	High-Set Differential Current Protection/Unrestrained High-phase Fault: Pickup value of the differential current based on the rated current.	2.0 - 30.0lb	10.0lb	[Protection Para /<1..4> /I-Prot /87H]

Unrestrained High-set Differential Current Protection Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /I-Prot /87H]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /I-Prot /87H]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /I-Prot /87H]

Signals of the Unrestrained High-set Differential Current Protection Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Alarm A	Signal: Pickup System Phase A
Alarm B	Signal: Pickup System Phase B
Alarm C	Signal: Pickup System C
Pickup	Signal: Pickup
Trip A	Signal: Trip System Phase A
Trip B	Signal: Trip System Phase B
Trip C	Signal: Trip System Phase C
Trip	Signal: Trip
TripCmd	Signal: Trip Command

87GD - Ground Current Differential Protection

Available elements:

87GD

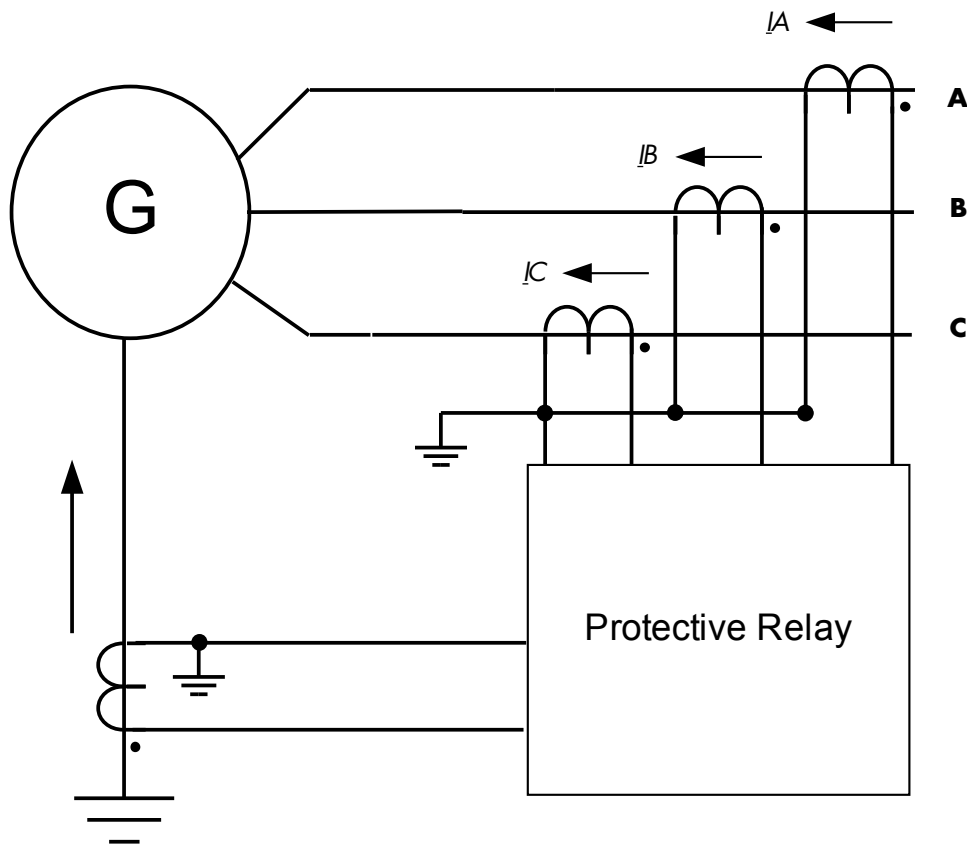
The ground differential protective element can be used to provide:

- Sensitive ground fault detection for solidly or low -impedance grounded generators.

Description

This protection principle is based on a restricted ground fault scheme that only can be used in systems with an earthed neutral. The ground differential current is the vector sum of the measured earth current and the calculated zero sequence current from three measured phase currents. Similarly to the phase restrained differential protection, the ground restraining current is the vector difference of the measured earth current and the calculated zero sequence current from three measured phase currents. The trip characteristic is very much similar to the phase restrained differential protection and it does not have the temporary restraining.

Protection Principle of Ground Current Differential Protection



WARNING The trip commands generated by the ground differential protection 87GD have to be assigned within the Breaker Manager.

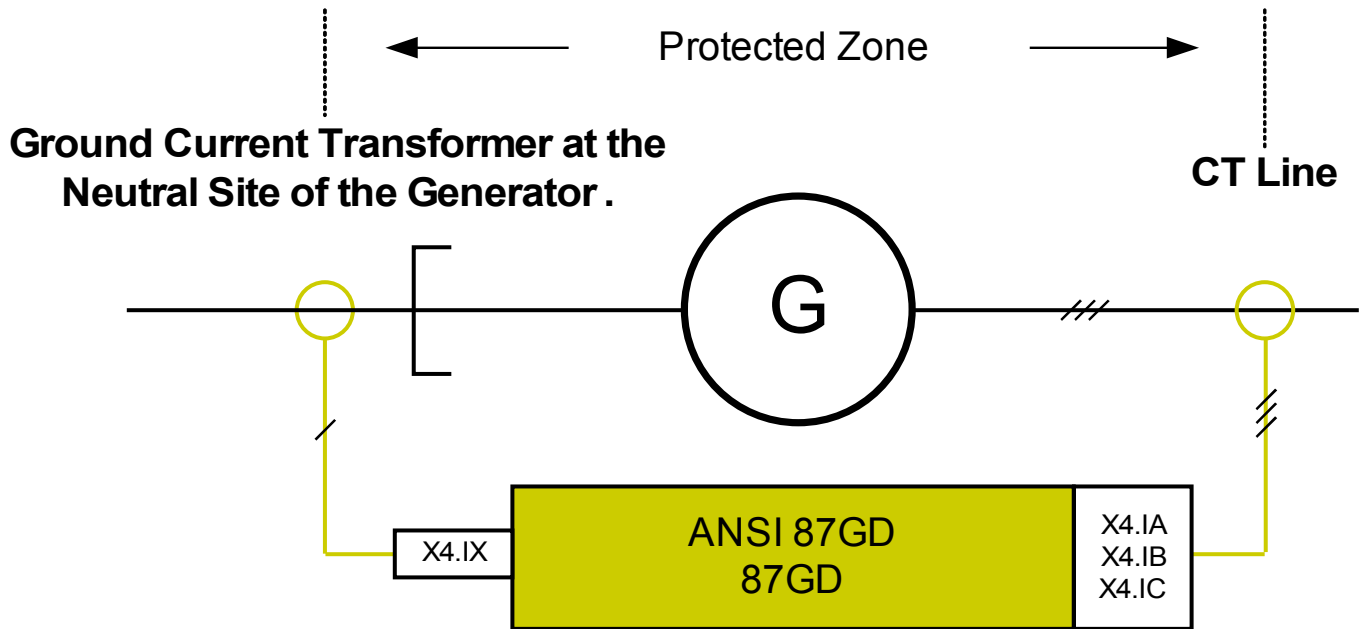
NOTICE

Please be aware that the ground differential protection 87GD solely can be applied to the winding end which builds an earthed neutral point.

Ground Differential Protection Options

The following applications describe the corresponding system connections, relay current input connection, relay parameter settings and some tips for special applications accordingly.

Application ANSI 87GD



Proper Use

To be used if the generator is connected directly to a busbar and should be protected against ground faults between the phase and the neutral current transformer (within the generator).

Required type of current transformers and current transformer locations

- Phase current transformers at the line site of the generator.
- Ring core type current transformer or ground current transformer at the neutral site of the generator.

Name of the Element that is to be used

87GD

Wiring of the current transformers

- Phase current transformers to be connected to X4.IA, X4.IB, X4.IC
- Ring core or ground current transformer to be connected to X4.IX

Calculated Reference Current

$$I_b = \frac{S_N}{\sqrt{3} * V_{LL}} = \frac{\text{Rated Power}_{\text{Generator}}}{\sqrt{3} * \text{Rated Voltage}_{\text{Generator}} (Ph-Ph)}$$

Required Settings

Activate the Protective Element within the Device Planning.

Where? Within [Device Planning]

Set „87GD.Mode=use“

Set the Field Parameters of the Generator.

Where? Within [System Para\Generator]

Set the Differential Protection Parameters.

Where? Within [Protection Para\Set [x]\I-Prot\87GD]

Device Planning Parameters of the Ground Differential Protection

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Ground Differential Protection

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /87GD]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /87GD]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /87GD]

Setting Group Parameters of the Ground Differential Protection

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87GD]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87GD]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87GD]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87GD]
IdG min 	Constant minimum pickup current (differential current).	0.05 - 1.00Ib	0.05Ib	[Protection Para /<1..4> /I-Prot /87GD]
IdG(Ir0) 	Starting point of the static tripping characteristic when Ir = 0	0.00 - 1.00Ib	0.1Ib	[Protection Para /<1..4> /I-Prot /87GD]
IdG(Ir1) 	Breaking point of the static tripping characteristic when Ir = 2 x Ib	0.2 - 2.0Ib	0.2Ib	[Protection Para /<1..4> /I-Prot /87GD]

Parameter	Description	Setting range	Default	Menu path
IdG(Ir2)	Value of the static tripping characteristic when $I_r = 10 \times I_b$	1.0 - 8.0Ib	2.0Ib	[Protection Para /<1..4> /I-Prot /87GD]



Ground Differential Protection Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /I-Prot /87GD]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /I-Prot /87GD]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /I-Prot /87GD]

Ground Differential Protection Module Signals (Output States)

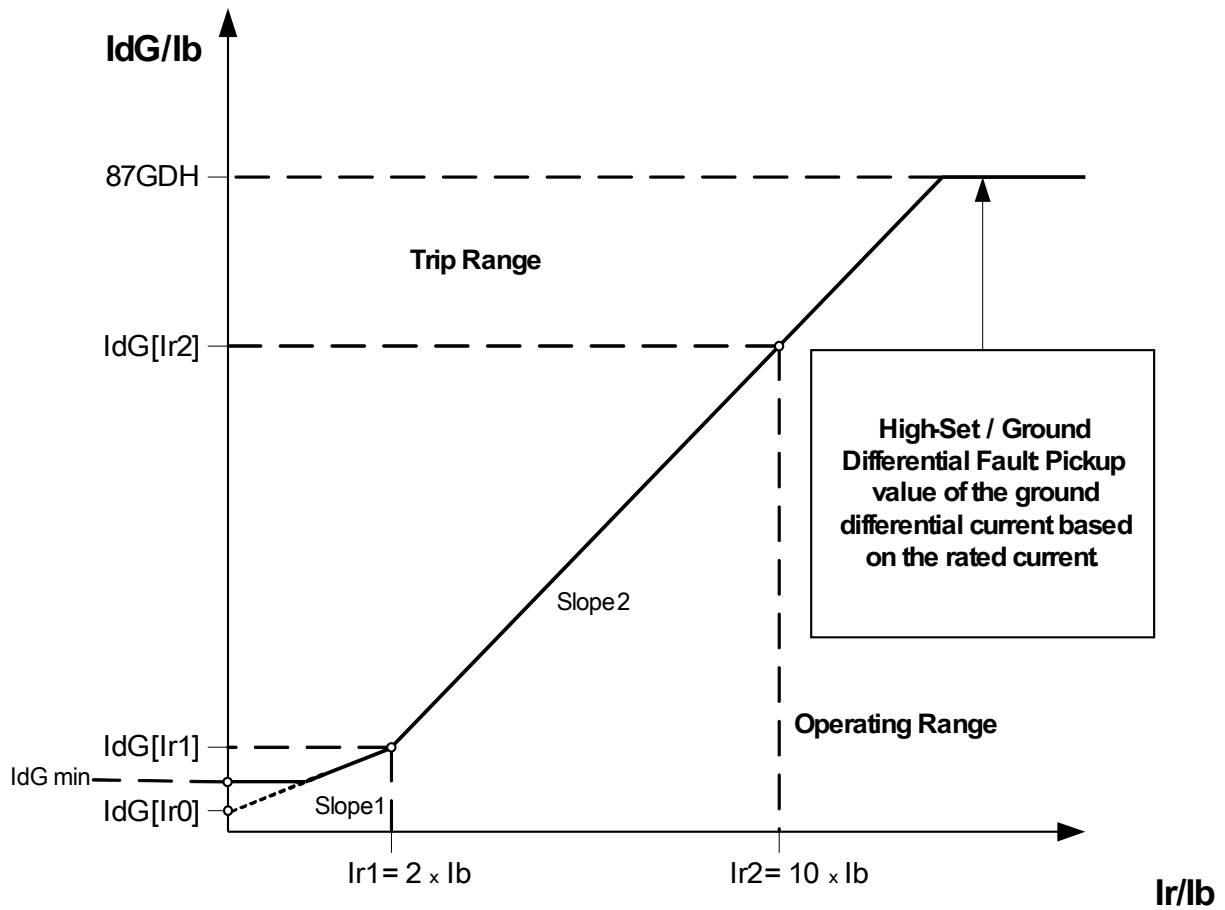
Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup
Trip	Signal: Trip
TripCmd	Signal: Trip Command

87GDH - High Set Ground Differential Protection IdGH

Elements

87GDH

Similar to the unrestrained phase differential protection, unrestrained ground differential protection functions are provided for a high ground differential current.



Unstabilized High Set Ground Differential Protection Element IdGH

Device Planning Parameters of the High Set Ground Differential Protection Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the High Set Ground Differential Protection Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /87GDH]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /87GDH]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /87GDH]

Setting Group Parameters of the High Set Ground Differential Protection Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87GDH]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87GDH]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87GDH]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /87GDH]
IdG>> 	High-Set / Ground Differential Fault: Pickup value of the ground differential current based on the rated current.	2.00 - 20.00lb	2.00lb	[Protection Para /<1..4> /I-Prot /87GDH]

High Set Ground Differential Protection Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /I-Prot /87GDH]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /I-Prot /87GDH]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /I-Prot /87GDH]

High Set Ground Differential Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup
Trip	Signal: Trip
TripCmd	Signal: Trip Command

Directional Feature – Phase Current

All elements can be selected as »*Non-directional/Forward/Reverse*« operated. This has to be done in the »*Device Planning*« menu.

NOTICE

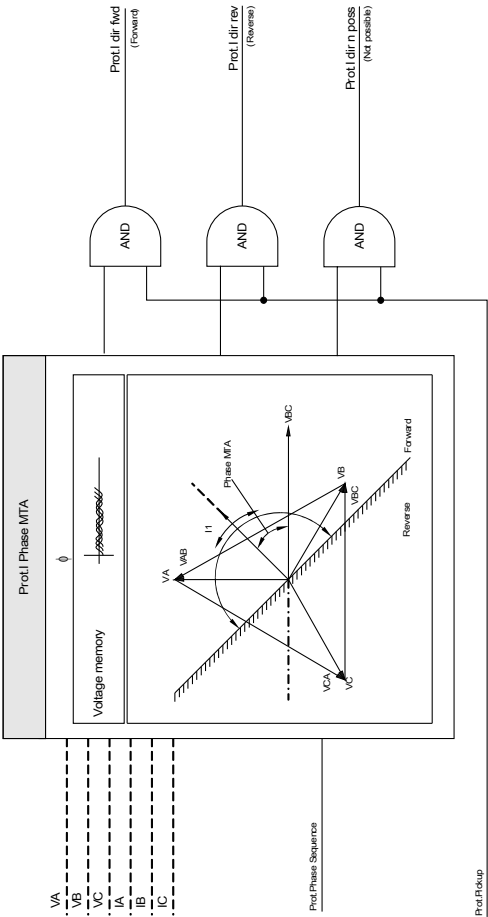
For the direction detection it is mandatory, that the required voltages exceed 0.35 V and the required currents exceed 10 mA.

For the case, that the voltage drops below 0.35 V, the last angle between the operating and polarizing quantity will be used for the directional detection.

Overcurrent protection elements, time inverse or instantaneous or time delay, etc, can trip in a specified fault current direction. When the trip direction is set to »*Non-directional*«, the direction detection takes no effect. When it is set to »*Forward*«, a trip is only permitted in the forward direction where fault current lies within $\pm 90^\circ$ around the maximum torque angle »*Phase MTA*«. When it is set to »*Reverse*«, a trip is only permitted in reverse direction where fault current lies within $\pm 90^\circ$ around the opposite of the maximum torque angle.

In the case of a 3-phase nearly zero voltage fault, the memorized voltage, or prefault voltages, is used to establish the correct fault direction.

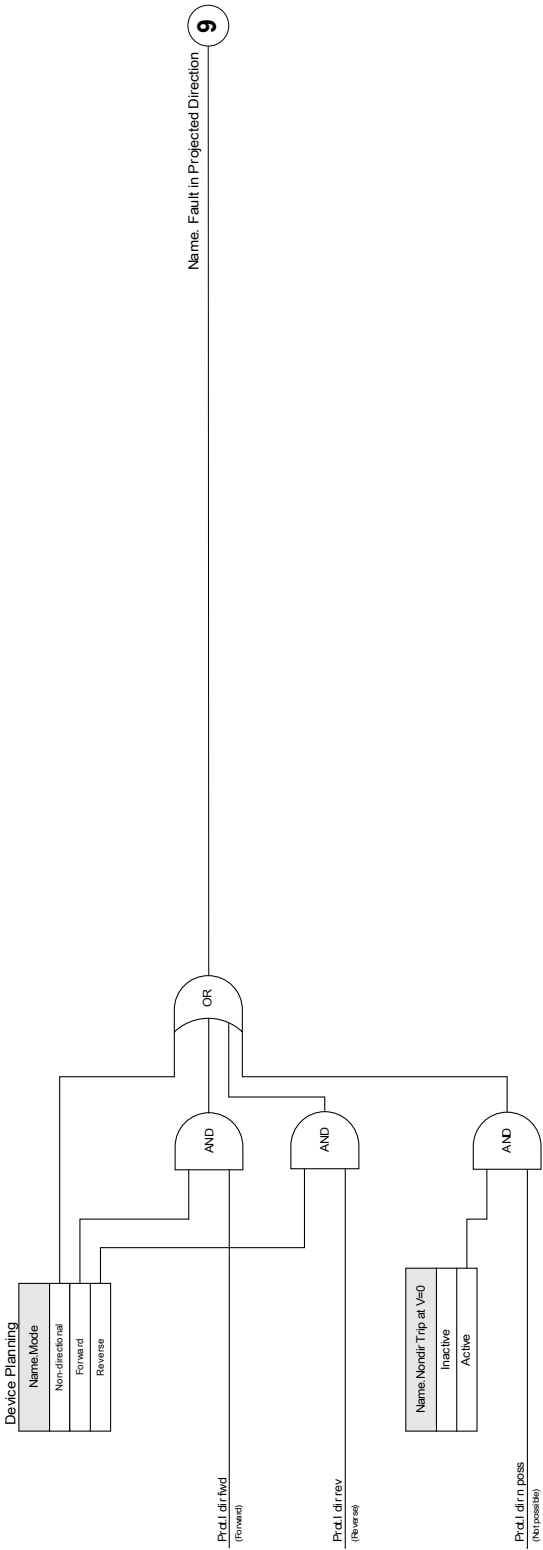
Prot - Phase failure Direction Detection



Phase Directional Supervision Logic

Direction Decision Phase overcurrent

Name = [1]...[n]



50P/67P - DEFT Overcurrent Protection

Available Elements

50P[1] , 50P[2] , 50P[3]



WARNING

If using inrush blockings, the tripping delay of the current protection functions must be at least 30 ms or more in order to prevent faulty trippings (applies only to devices which are equipped with Inrush protection)..

NOTICE

All overcurrent protective elements are identically structured.

NOTICE

All ANSI 67 elements (directional overcurrent protection), will be displayed as ANSI 50 elements. That means, that the name of an ANSI 50 element wont change, if it is set within the device planning from “non-directional” to “directional”.

For each element the following characteristic is available:

- DEFT (definite time).

Explanation

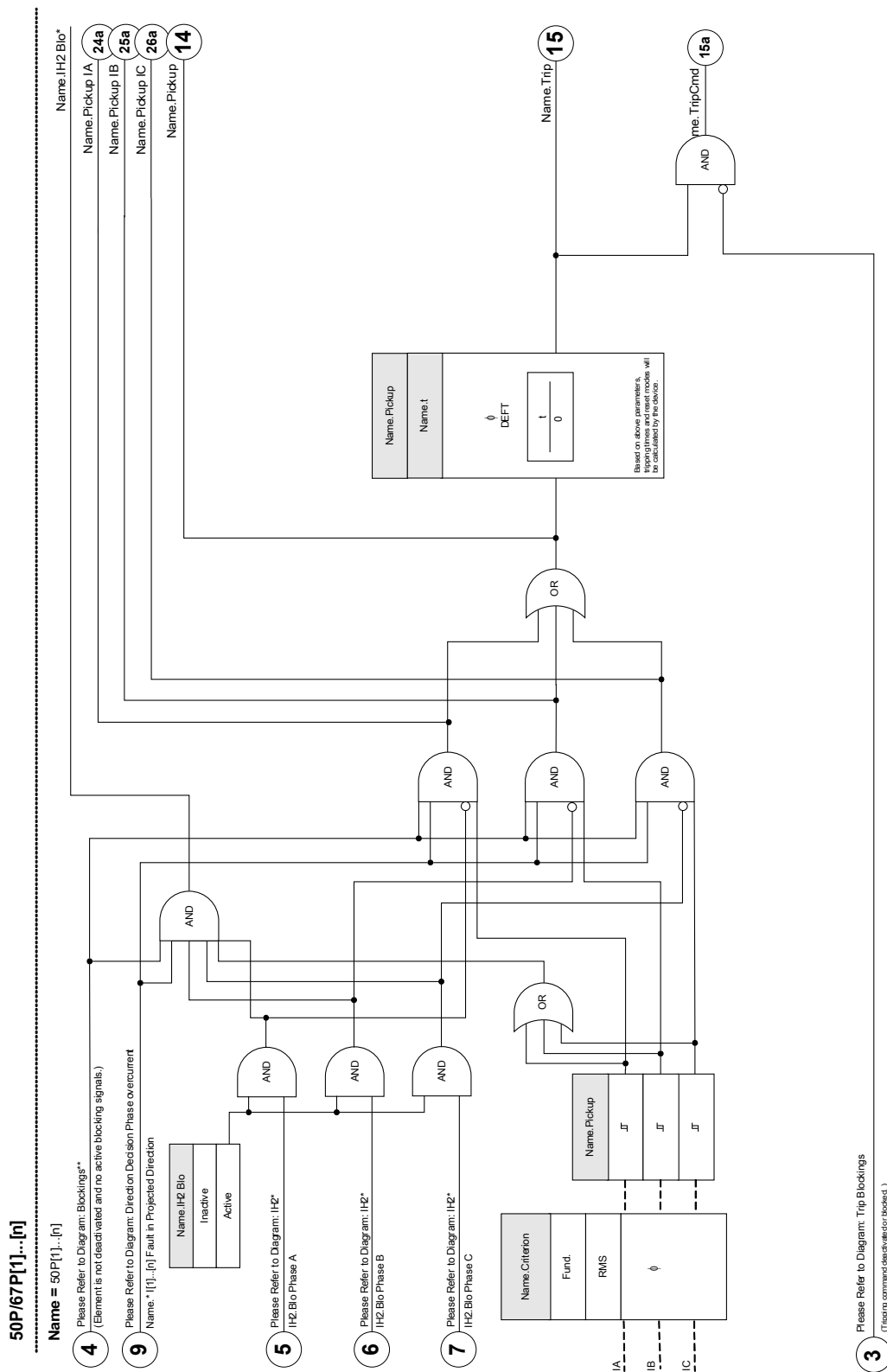
t = Tripping delay

I = Fault current

Pickup = If the pickup value is exceeded, the module/element starts to time out to trip .

This element offers a criterion setting. The criterion setting tells if the threshold is based on the fundamental (Phasor) or RMS.

For Tripping curves, please refer to “Instantaneous Current Curves (Phase)” located in the Appendix.



*=Applies only to devices that offer Inrush Protection

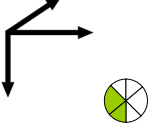
Device Planning Parameters of the 50P/67P Module

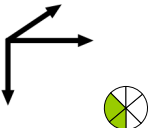
<i>Parameter</i>	<i>Description</i>	<i>Options</i>	<i>Default</i>	<i>Menu path</i>
Mode 	Mode	50P[1]: Non-directional, Forward, Reverse 50P[2]: Non-directional, Forward, Reverse 50P[3]: Do not use, Non-directional, Forward, Reverse	Non-directional	[Device Planning]

Global Protection Parameters of the 50P/67P Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /50P[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /50P[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /50P[1]]
Rvs Blo 	Reverse Blocking, if Reverse Blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /50P[1]]
AdaptSet 1 	Assignment Adaptive Parameter 1	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /50P[1]]
AdaptSet 2 	Assignment Adaptive Parameter 2	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /50P[1]]
AdaptSet 3 	Assignment Adaptive Parameter 3	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /50P[1]]
AdaptSet 4 	Assignment Adaptive Parameter 4	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /50P[1]]

Setting Group Parameters of the 50P/67P Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	50P[1]: Active 50P[2]: Active 50P[3]: Inactive	[Protection Para /<1..4> /I-Prot /50P[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /50P[1]]
Rvs Blo Fc 	Activate (allow) or inactivate (disallow) reverse blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/element are blocked that are parameterized "Rvs Blo Fc = active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /50P[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /50P[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /50P[1]]
Criterion 	Measuring method: fundamental or rms or 3rd harmonic (only generator protection relays)	Fundamental, True RMS	True RMS	[Protection Para /<1..4> /I-Prot /50P[1]]
Pickup 	If the pickup value is exceeded, the module/element starts to time out to trip. Only available if: Characteristic = DEFT Or Characteristic = INV Minimum of the setting range If: VRestrict = Active Minimum of the setting range If: VRestrict = Inactive	0.02 - 40.00In	50P[1]: 2In 50P[2]: 2.5In 50P[3]: 3.0In	[Protection Para /<1..4> /I-Prot /50P[1]]

Parameter	Description	Setting range	Default	Menu path
t 	Tripping delay Only available if: Characteristic = DEFT	0.00 - 300.00s	50P[1]: 0s 50P[2]: 0.25s 50P[3]: 0.25s	[Protection Para /<1..4> /I-Prot /50P[1]]

50P/67P Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /I-Prot /50P[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /I-Prot /50P[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /I-Prot /50P[1]]
Rvs Blo-I	Module Input State: Reverse Blocking	[Protection Para /Global Prot Para /I-Prot /50P[1]]
AdaptSet1-I	Module Input State: Adaptive Parameter1	[Protection Para /Global Prot Para /I-Prot /50P[1]]
AdaptSet2-I	Module Input State: Adaptive Parameter2	[Protection Para /Global Prot Para /I-Prot /50P[1]]
AdaptSet3-I	Module Input State: Adaptive Parameter3	[Protection Para /Global Prot Para /I-Prot /50P[1]]
AdaptSet4-I	Module Input State: Adaptive Parameter4	[Protection Para /Global Prot Para /I-Prot /50P[1]]

50P/67P Module Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Rvs Blo	Signal: Reverse Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup IA	Signal: Pickup IA
Pickup IB	Signal: Pickup IB
Pickup IC	Signal: Pickup IC
Pickup	Signal: Pickup
Trip	Signal: Trip
TripCmd	Signal: Trip Command
Active AdaptSet	Active Adaptive Parameter
DefaultSet	Signal: Default Parameter Set
AdaptSet 1	Signal: Adaptive Parameter 1
AdaptSet 2	Signal: Adaptive Parameter 2
AdaptSet 3	Signal: Adaptive Parameter 3
AdaptSet 4	Signal: Adaptive Parameter 4

Commissioning: Overcurrent Protection, directional [ANSI 50P/67P]

Object to be tested:

•For each directional overcurrent element is to be measured: the total tripping time (recommendation) or alternatively tripping delays and the dropout ratios; each time 3 x single-phase and 1 x three-phase.

NOTICE

Especially in Holmgreen connections, wiring errors can happen easily and these are then detected safely. By measuring the total tripping time, it can be ensured that the secondary wiring is OK (from the terminal on, up to the trip coil of the Breaker).

NOTICE

Eaton recommends measuring the total tripping time instead of the tripping delay. The tripping delay should be specified by the User. The total tripping time is measured at the position signaling contact of the breaker (not at the relay output contacts!).

Total tripping time = tripping delay (please refer to the tolerances of the protection elements)
 + breaker operating time (about 50 ms)

Please take the breaker operating times from the technical data specified in the relevant documentation provided by the breaker manufacturer.

Necessary means

- Synchronizable current and voltage sources
- Optional: ampere meters
- Timer

Procedure

Synchronize the 3-phase current and voltage sources with each other. Then simulate the tripping directions to be tested by the angle between current and voltage.

Testing the threshold values (3 x single-phase and 1 x three-phase)

Each time feed a current which is about 3-5% above the threshold value for activation/tripping. Check then the threshold values.

Testing the total tripping delay (recommendation)

Measure the total tripping times at the auxiliary contacts of the Brk (Brk tripping).

Testing the trip delay (measured at the relay output)

Measure the tripping times at the relay output.

Testing the dropout ratio

Reduce the current to 97% below the trip value and check the dropout ratio.

Successful test result

The measured total tripping delays or individual tripping delays, threshold values and dropout ratios correspond with those values, specified in the adjustment list. Permissible deviations/tolerances can be found under Technical Data.

51P - Overcurrent Protection [51, 51C, 51V, 67]

Available stages:

51P[1] , 51P[2] , 51P[3]

⚠ WARNING

If you are using inrush blockings the tripping delay of the current protection functions must be at least 30ms or more in order to prevent faulty trippings.

CAUTION

In order to ensure correct functioning of the directional detection after single-phase short-circuits, the following reference voltage is used: For phase current *IA* it is the line-to-line voltage *VBC*, for phase current *IB* the line-to-line voltage *VCA* and for phase current *IC* the line-to-line voltage *VAB*.

In case the fault happens to be near the measuring location and there is no reference voltage for directional recognition available any more (neither measured or from history (voltage memory)), then the module will - depending on the parameter setting - either trip non-directional or it will be blocked.

NOTICE

All overcurrent protective elements are identically structured.

NOTICE

This module offers Adaptive Parameter Sets.
Parameters can be modified within parameter sets dynamically by means of Adaptive Parameter Sets.
Please refer to chapter Parameter / Adaptive Parameter Sets.

The following table shows the application options of the Overcurrent Protection element

Applications of the 51P-Protection Module	Setting in	Option
ANSI 51 – Short circuit protection, non-directional	Device Planning menu	Criterion: Fundamental/TrueRMS
ANSI 67 – Overcurrent/ Short circuit protection, directional	Device Planning menu	Criterion: Fundamental/TrueRMS
ANSI 51V – Voltage restraint overcurrent protection	Parameter Set: VRestraint = active	Criterion: Fundamental/TrueRMS
51C Voltage controlled overcurrent protection (Please refer to the chapter Parameter/Adaptive Parameter)	Adaptive Parameters	Criterion: Fundamental/TrueRMS

Criterion - Measuring Mode

For all protection elements it can be determined, whether the measurement is done on basis of the »*Fundamental*« or if »*TrueRMS*« measurement is used.

Voltage restraint overcurrent protection 51V

When the Parameter »*VRestraint*« is set to active the overcurrent protection element works voltage restraint. That means, the overcurrent pickup threshold will be lowered during voltage drops. This results in a more sensitive overcurrent protection. For the voltage threshold »*VRestraint max*« additionally the »*Measuring Channel*« can be determined.

All 51P overcurrent protective elements can be planned as non-directional or optionally as directional elements. This means, all 6 elements can be planned user defined in forward/reverse or non directional.

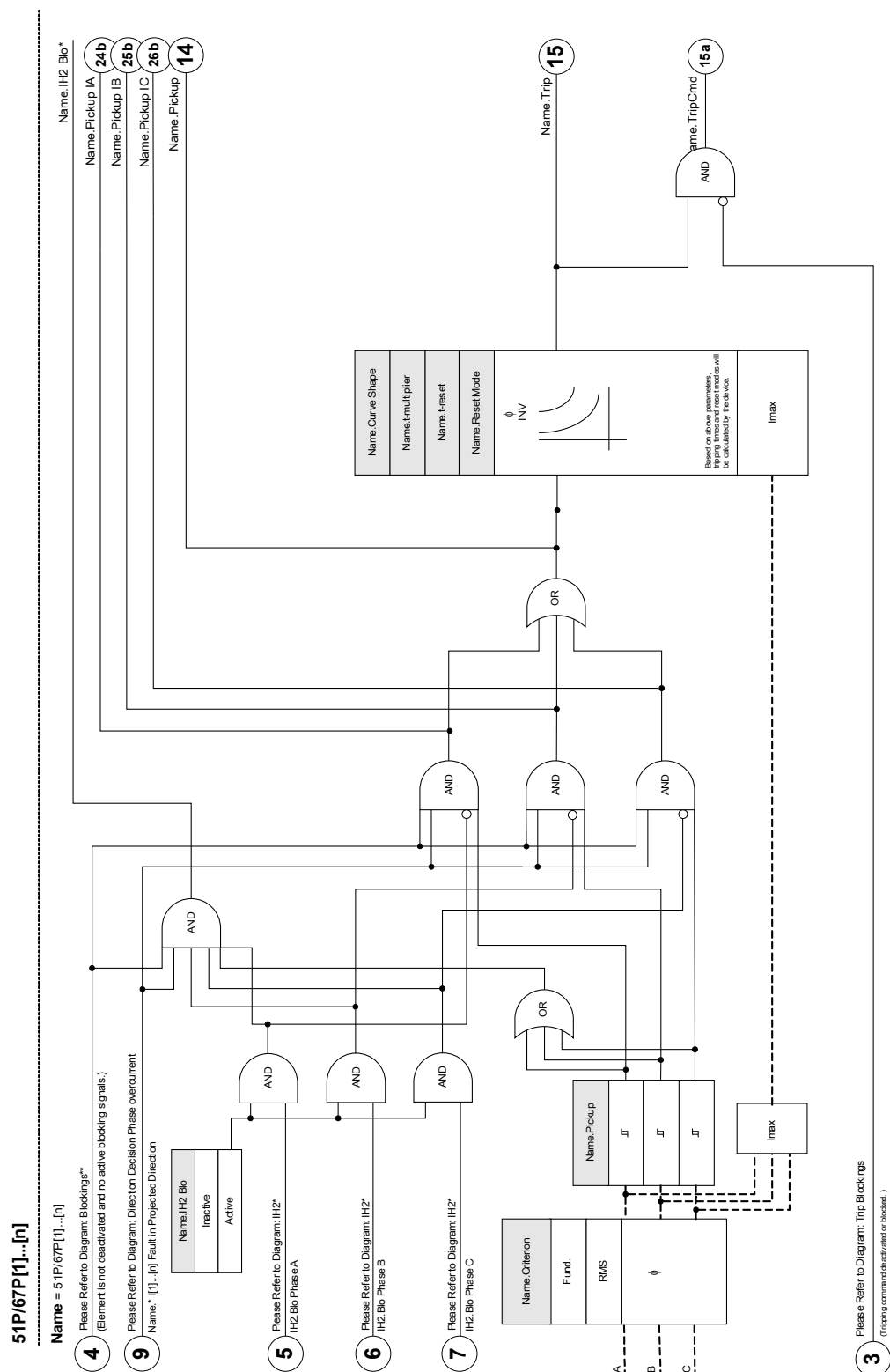
For each element the following characteristics are available:

- NINV (IEC/AMZ)
- VINV (IEC/AMZ)
- LINV (IEC/AMZ)
- EINV (IEC/AMZ)
- MINV (ANSI/AMZ)
- VINV (ANSI/AMZ)
- EINV (ANSI/AMZ)
- Thermal Flat
- IT
- I2T
- I4T

For tripping curves please refer to "Time Current Curves (PHASE)" located in the Appendix.

By using the projecting parameters each of the overcurrent protective elements can be defined as »*forward*«, »*reverse*« or »*non-directional*«. The forward or reverse direction is based on the characteristic angle for the phase direction specified by the field parameter »*I MTA*«. No directional information will be taken into account if the current protective element is planned as »*non-directional*«

51P, 67 P – Phase Overcurrent

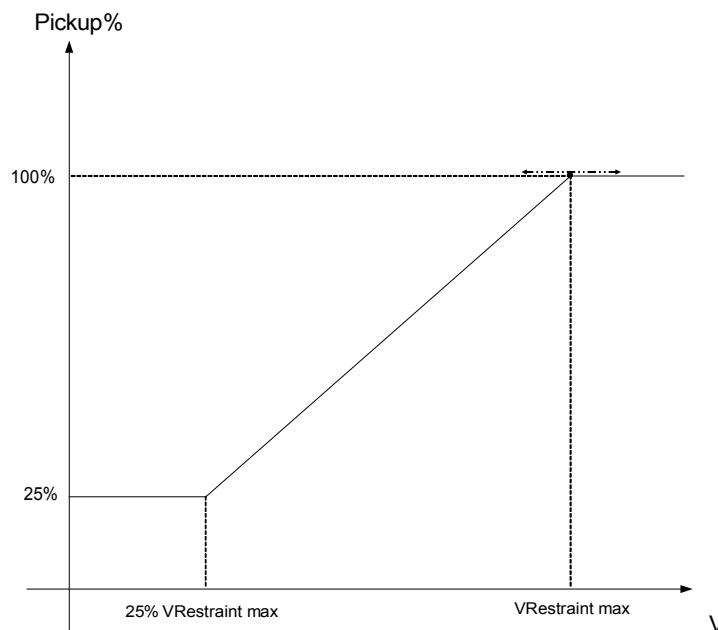


*=Applies only to devices that offer Inrush Protection

For activating this function, the parameter »*VRestraint*« has to be set to *active* in the parameter set of the corresponding overcurrent element I[x].

The *51V* protection function restrains operation which reduces pickup levels. This allows the User to lower the pickup value of the *51V* protection function with the corresponding phase input voltage (phase-to-phase or phase-to-ground, depending on the setting of »*Measuring Channel*« within the current protection module). When the minimum fault phase current is close to the load current, it may make the phase time overcurrent protection coordination difficult. In this case, an undervoltage function may be used to alleviate this situation. When the voltage is low, the phase time overcurrent pickup threshold may be set low accordingly, so that the phase time overcurrent protection may achieve adequate sensitivity and better coordination. The device uses a simple linear model to determine the effective pickup by characterizing the relationship between the voltage and the phase time overcurrent pickup threshold.

Once the voltage restraint protection function is activated, the effective phase time overcurrent pickup threshold will be the calculated Pickup% times the phase time overcurrent pickup setting. The effective pickup threshold must be within the setting range allowed and, if it is less, the minimum pickup value will be used.



That means:

$$V_{min} = 0.25 \cdot V_{max};$$

- $Pickup\%_{min} = 25\%$;

- $Pickup\% = 25\%$, if $V \leq V_{min}$;

- $Pickup\% = 1/V_{max} \cdot (V - V_{min}) + 25\%$, if $V_{min} < V < V_{max}$;

- $Pickup\% = 100\%$, if $V \geq V_{max}$;

The tripping curves (characteristic) will not be influenced by the voltage restraint function.

If the voltage transformer supervision is activated, the voltage restraint overcurrent protection element is blocked in case of m.c.b. trip to avoid false trippings.

NOTICE**Definition of V_n :**

V_n is dependent on the »*Measuring Channel*« setting in the current protection modules.

In case that this parameter is set to "Phase to Phase":

$$V_n = \text{Main } VT \text{ sec}$$

In case that this parameter is set to "Phase to Neutral":

$$V_n = \frac{\text{Main } VT \text{ sec}}{\sqrt{3}}$$

If the parameter »*VT con*« within the field parameters is set to »*Phase to Phase*« the setting »*Phase to Neutral*« in the current modules is effectless.

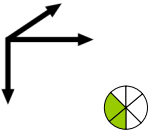
Device Planning Parameters of the 51P Module

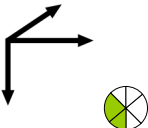
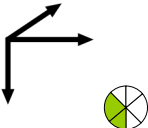
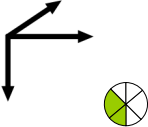
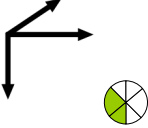
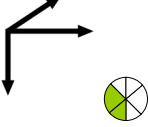
Parameter	Description	Options	Default	Menu path
Mode 	Mode	51P[1]: Non-directional, Forward, Reverse 51P[2]: Do not use, Non-directional, Forward, Reverse 51P[3]: Do not use, Non-directional, Forward, Reverse	Non-directional	[Device Planning]

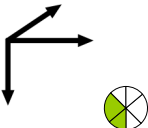
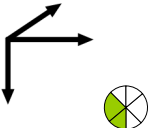
Global Protection Parameters of the 51P Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /51P[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /51P[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /51P[1]]
Rvs Blo 	Reverse Blocking, if Reverse Blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /51P[1]]
AdaptSet 1 	Assignment Adaptive Parameter 1	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /51P[1]]
AdaptSet 2 	Assignment Adaptive Parameter 2	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /51P[1]]
AdaptSet 3 	Assignment Adaptive Parameter 3	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /51P[1]]
AdaptSet 4 	Assignment Adaptive Parameter 4	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /51P[1]]

Setting Group Parameters of the 51P Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	51P[1]: Active 51P[2]: Active 51P[3]: Inactive	[Protection Para /<1..4> /I-Prot /51P[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51P[1]]
Rvs Blo Fc 	Activate (allow) or inactivate (disallow) reverse blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/element are blocked that are parameterized "Rvs Blo Fc = active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51P[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51P[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51P[1]]
Criterion 	Measuring method: fundamental or rms or 3rd harmonic (only generator protection relays)	Fundamental, True RMS	True RMS	[Protection Para /<1..4> /I-Prot /51P[1]]
Pickup 	If the pickup value is exceeded, the module/element starts to time out to trip. Minimum of the setting range If: VRestrict = Active Minimum of the setting range If: VRestrict = Inactive	0.02 - 40.00In	1.00In	[Protection Para /<1..4> /I-Prot /51P[1]]

Parameter	Description	Setting range	Default	Menu path
Curve Shape 	Characteristic	IEC NINV, IEC VINV, IEC EINV, IEC LINV, ANSI MINV, ANSI VINV, ANSI EINV, Therm Flat, IT, I2T, I4T	ANSI MINV	[Protection Para /<1..4> /I-Prot /51P[1]]
t-multiplier 	Time multiplier/tripping characteristic factor. The setting range depends on the selected tripping curve.	0.02 - 20.00	51P[1]: 1 51P[2]: 2 51P[3]: 3	[Protection Para /<1..4> /I-Prot /51P[1]]
Reset Mode 	Reset Mode	Instantaneous, t-delay, Calculated	Calculated	[Protection Para /<1..4> /I-Prot /51P[1]]
t-reset 	Reset time for intermittent phase failures (INV characteristics only) Available if: Reset Mode = t-delay	0.00 - 60.00s	0s	[Protection Para /<1..4> /I-Prot /51P[1]]
VRestrict 	Voltage Restraint Protection	Inactive, Active	51P[1]: Inactive 51P[2]: Active 51P[3]: Active	[Protection Para /<1..4> /I-Prot /51P[1]]

Parameter	Description	Setting range	Default	Menu path
VRestrict max 	Maximum voltage restraint level. Definition of Vn: Vn is dependent on the System Parameter setting of "Main VT con". When the System Parameters "Main VT con" is set to "Open-Delta", "Vn = Main VT sec ". When the System Parameters "Main VT con" is set to "Wye", "Vn = Main VT sec/SQRT(3)". Only available if: VRestrict = Active	0.04 - 1.30Vn	1.00Vn	[Protection Para /<1..4> /I-Prot /51P[1]]
LOP Blo 	Activates the use of the measuring circuit supervision. In this case the module will be blocked if a measuring circuit supervision module (e.g. LOP, VTS) signals a disturbed measuring circuit (e.g. caused by a fuse failure). Only available if: VRestrict = Active	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51P[1]]

51P Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /I-Prot /51P[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /I-Prot /51P[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /I-Prot /51P[1]]
Rvs Blo-I	Module Input State: Reverse Blocking	[Protection Para /Global Prot Para /I-Prot /51P[1]]
AdaptSet1-I	Module Input State: Adaptive Parameter1	[Protection Para /Global Prot Para /I-Prot /51P[1]]
AdaptSet2-I	Module Input State: Adaptive Parameter2	[Protection Para /Global Prot Para /I-Prot /51P[1]]
AdaptSet3-I	Module Input State: Adaptive Parameter3	[Protection Para /Global Prot Para /I-Prot /51P[1]]
AdaptSet4-I	Module Input State: Adaptive Parameter4	[Protection Para /Global Prot Para /I-Prot /51P[1]]

51P Module Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Rvs Blo	Signal: Reverse Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup IA	Signal: Pickup IA
Pickup IB	Signal: Pickup IB
Pickup IC	Signal: Pickup IC
Pickup	Signal: Pickup
Trip	Signal: Trip
TripCmd	Signal: Trip Command
Active AdaptSet	Active Adaptive Parameter
DefaultSet	Signal: Default Parameter Set
AdaptSet 1	Signal: Adaptive Parameter 1
AdaptSet 2	Signal: Adaptive Parameter 2
AdaptSet 3	Signal: Adaptive Parameter 3
AdaptSet 4	Signal: Adaptive Parameter 4

Commissioning: Overcurrent Protection, non-directional [50, 51]

Object to be tested

- Signals to be measured for each current protection element, the threshold values, total tripping time (recommended), or alternatively tripping delays and the dropout ratios; each time 3 x single-phase and 1 x three-phase.

NOTICE

Especially in Holmgreen connections, wiring errors can easily happen, and these are then detected safely. Measuring the total tripping time can ensure that the secondary wiring is o.k. (from the terminal on, up to the trip coil of the breaker).

NOTICE

It is recommended to measure the total tripping time instead of the tripping delay. The tripping delay should be specified by the customer. The total tripping time is measured at the position signalling contact of the breaker (not at the relay output!).

Total tripping time = tripping delay (please refer to the tolerances of the protection stages) + breaker operating time (about 50 ms)

Please take the breaker operating times from the technical data specified in the relevant documentation provided by the breaker manufacturer.

Necessary means

- Current source
- May be: ampere meters
- Timer

Procedure

Testing the threshold values (3 x single-phase and 1 x three-phase)

Each time feed a current which is about 3-5% above the threshold value for activation/tripping. Then check the threshold values.

Testing the total tripping delay (recommendation)

Measure the total tripping times at the auxiliary contacts of the breaker (breaker tripping).

Testing the tripping delay (measuring at the relay output)

Measure the tripping times at the relay output.

Testing the dropout ratio

Reduce the current to 97% below the trip value and check the dropout ratio.

Successful test result

The measured total tripping delays or individual tripping delays, threshold values and dropout ratios correspond with those values, specified in the adjustment list. Permissible deviations/tolerances can be found under Technical Data.

Commissioning: Overcurrent Protection, directional [67]

Object to be tested

For each directional overcurrent element is to be measured: the total tripping time (recommendation) or alternatively tripping delays and the dropout ratios; each time 3 x single-phase and 1 x three-phase.

NOTICE

Especially in Holmgreen connections, wiring errors can happen easily and these are then detected safely. By measuring the total tripping time, it can be ensured that the secondary wiring is o.k. (from the terminal on, up to the trip coil of the breaker).

NOTICE

It is recommended to measure the total tripping time instead of the tripping time. The tripping delay should be specified by the customer. The total tripping time is measured at the position signaling contacts of the breakers (not at the relay output!).

Total tripping time: = tripping delay (please refer to the tolerances of the protection stages) + breaker operating time (about 50 ms)

Please take the breaker switching times from the technical data, specified in the relevant documentation, provided by the breaker manufacturer.

Necessary means

- Synchronizable current and voltage sources
- May be: ampere meters
- Timer

Procedure

Synchronize the 3-phase current and voltage sources with each other. Then simulate the tripping directions to be tested by the angle between current and voltage.

Testing the threshold values (3 x single-phase and 1 x three-phase)

Each time feed a current which is about 3-5% above the threshold value for activation/tripping. Check then the threshold values.

Testing the total tripping delay (recommendation)

Measure the total tripping times at the auxiliary contacts of the breaker (breaker tripping).

Testing the trip delay (measured at the relay output)

Measure the tripping times at the relay output.

Testing the dropout ratio

Reduce the current to 97% below the trip value and check the dropout ratio.

Successful test result

The measured total tripping delays or individual tripping delays, threshold values and dropout ratios correspond with those values, specified in the adjustment list. Permissible deviations/tolerances can be found under Technical Data.

Commissioning: Overcurrent Protection, Non-directional [ANSI 51V]

Object to be tested:

Signals to be measured for Voltage Restraint protection function: the threshold values, total tripping time (recommended), or alternatively tripping delays and the dropout ratios; each time 3 x single-phase and 1 x three-phase.

NOTICE

It is recommended to measure the total tripping time instead of the tripping time. The tripping delay should be specified by the customer. The total tripping time is measured at the position signaling contacts of the breakers (not at the relay output!).

Total tripping time: = tripping delay (please refer to the tolerances of the protection stages) + breaker operating time (about 50 ms)

Please take the breaker switching times from the technical data, specified in the relevant documentation, provided by the breaker manufacturer.

Necessary means:

- Current source;
- Voltage Source;
- Current and Voltage meters; and
- Timer.

Procedure:

Testing the threshold values (3 x single-phase and 1 x three-phase)

Feed %Pickup voltage. For each test performed, feed a current that is about 3-5% above the threshold value for activation/tripping. Then check if the pickup values are %Pickup of the value according to the standard overcurrent protection.

Testing the total tripping delay (recommendation)

Measure the total tripping times at the auxiliary contacts of the breakers (breaker tripping).

Testing the tripping delay (measuring at the relay output contact)

Measure the tripping times at the relay output contact.

Testing the dropout ratio

Reduce the current to 97% below the trip value and check the dropout ratio.

Successful test result

The measured total tripping delays or individual tripping delays, threshold values, and dropout ratios correspond with those values specified in the adjustment list. Permissible deviations/tolerances can be found under Technical Data.

Voltage Controlled Overcurrent Protection [51C]

When a sort circuit is near the generator, the voltage might drop down. By means of **Adaptive Parameters** (Please refer to chapter Parameter) the tripping times or tripping characteristics can be modified by the output signal of a voltage element (depending on a threshold). The device might change a load curve to a fault curve (taking influence on tripping time, trip curves and reset modes).

Please proceed as follows:

- Read and understand the section “Adaptive Parameters” within the chapter Parameter.
- Do the device planning and set all required parameters for the Undervoltage element.
- Do the device planning and set all required parameters for the Overcurrent element.
- Set the **Adaptive Parameters** within the Overcurrent element in the relevant parameter sets (e.g. Curve multiplier, curve type...).
- Assign the Undervoltage alarm (pickup) within the **Global Parameters** as an activation signal for the corresponding **Adaptive Parameter set** of the overcurrent element that should be modified.
- Check the functionality by a commissioning test.

Directional Features for Measured (IX) Ground Fault Elements 50X/51X

All ground fault elements can be selected as »*Non-directional/Forward/Reverse*« operated. This has to be done in the »*Device Planning*« menu.

NOTICE

For the direction detection, it is mandatory that the required voltages exceed 0.35 V and the required currents exceed 10 mA. An exception is the measured sensitive ground current which has to exceed 1 mA.

Important Definitions

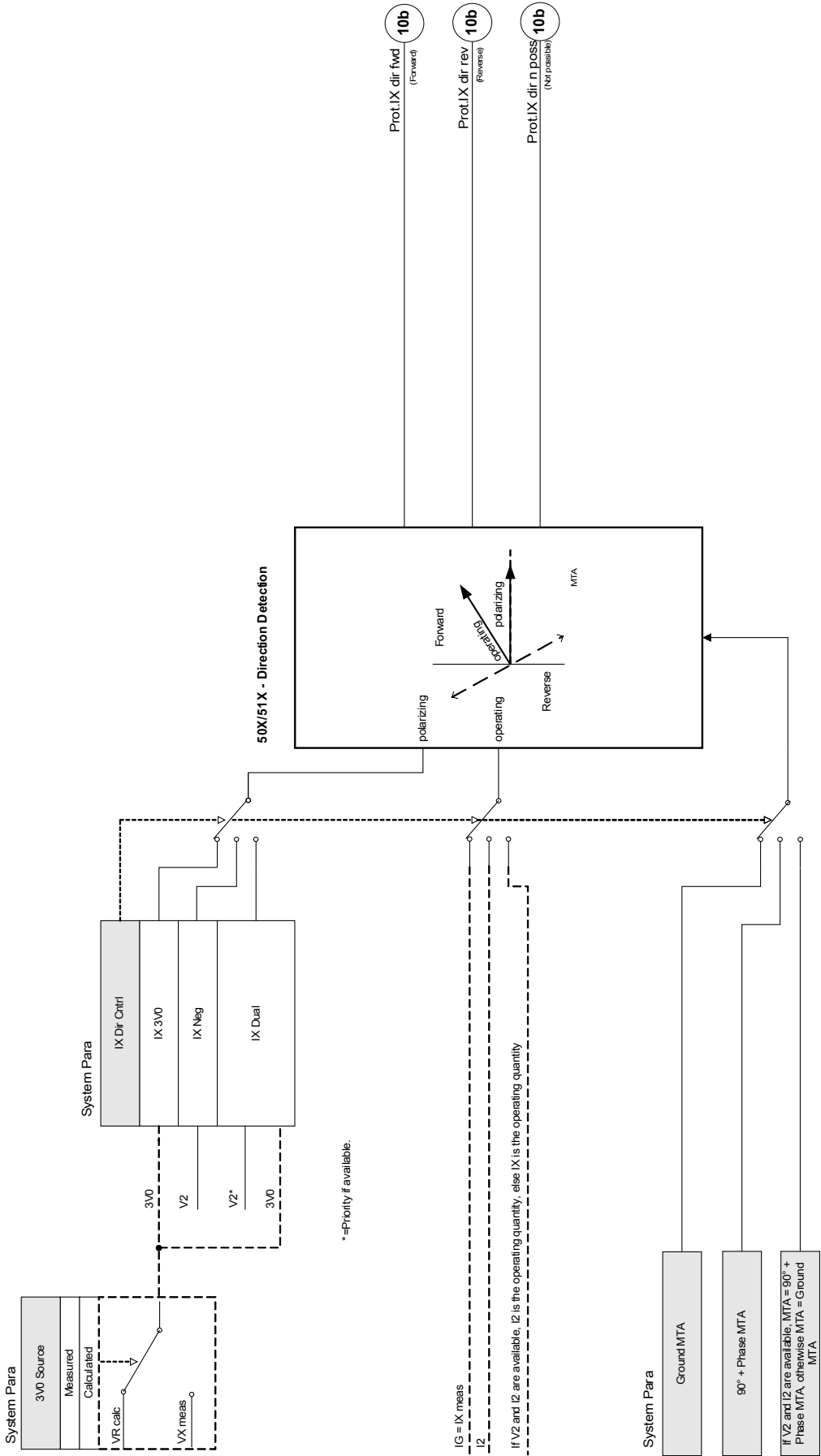
Polarizing Quantity: This is the quantity that is used as a reference value. The *polarizing quantity* can be selected by the parameter »*IX Direction Control*« in the [System Para/Direction] menu as follows:

- »*IX 3V0*«: The neutral voltage selected by the parameter »*3V0 Source*« will be used as the polarizing quantity. The traditional way to polarize a ground fault element is to use neutral voltage (3V0). The neutral voltage can, however, be either »*measured*« or »*calculated*«. This can be selected by the parameter »*3V0 Source*« in the [System Para/Direction] menu.
- »*IX Neg*«: With this selection, the negative phase sequence voltage and current (Polarizing: V2/Operating: I2) will be used to detect direction. The monitored current is still the measured residual current IX.
- »*IX Dual*«: For this method, the negative phase sequence voltage »*V2*« will be used as polarizing quantity if »*V2*« and »*I2*« are available, otherwise 3V0 will be used. The operating quantity is either I2 if »*V2*« and »*I2*« are available, else IX.

The following table gives the User a quick overview of the all possible directional settings.

50X/51X Direction Decision by Angle Between:	[System Para/ Direction] The Following Angle Has to Be Set:	[System Para/Direction]: IX Dir Cntrl =	[System Para/Direction]: 3V0 Source =
Measured ground current and neutral voltage: IX, 3V0 (measured)	Ground MTA	IX 3V0	Measured
Measured ground current and neutral voltage: IX, 3V0 (calculated)	Ground MTA	IX 3V0	Calculated
Negative sequence voltage and current I2, V2	90° + Phase MTA	IX Neg	N.A.
Negative phase sequence current and voltage (preferred), measured ground current and neutral voltage (alternatively): I2, V2 (if available) or else: IX, 3V0 (measured)	If V2 and I2 are available: 90° + Phase MTA else: Ground MTA	IX Dual	Measured
Negative phase sequence current and voltage (preferred), measured ground current and neutral voltage (alternatively): I2, V2 (if available) or else: IX, 3V0 (calculated)	If V2 and I2 are available: 90° + Phase MTA else: Ground MTA	IX Dual	Calculated

Prot - 50X/51X - Direction Detection



50X/67X DEFT Measured Ground Fault Protection

Elements
50X[1], 50X[2]



WARNING If using inrush blockings, the tripping delay of the ground current protection functions must be at least 30 ms or more in order to prevent faulty trippings.

NOTICE

All ground current elements are identically structured.

The following table shows the application options of the earth overcurrent protection element

Applications of the IG-Protection Module	Setting in	Option
ANSI 50X – Ground overcurrent protection, non-directional	Device Planning menu Setting: Non-directional	Measuring Mode: Fundamental/TrueRMS
ANSI 67X – Ground overcurrent protection, directional	Device Planning menu Setting: Forward/Reverse	Measuring Mode: Fundamental/TrueRMS VX Selection: measured ^{*1} /calculated

^{*1}=for wiring see chapter "Connection Examples / VT Wye with Broken Delta"

Criterion

For all protection elements it can be determined, whether the measurement is done on basis of the »*Fundamental*« or if »*TrueRMS*« measurement is used.

VX Selection

Within the parameter menu, this parameter determines, whether the earth current and the residual voltage is »*measured*« or »*calculated*«.

NOTICE

Calculation is only possible, when phase to neutral voltage is applied to the voltage inputs.

At setting »*measured*« the quantities to be measured, i. e. Residual voltage and the measured ground current have to be applied to the corresponding 4th measuring input.

All ground current protective elements can be planned user defined as non-directional or as directional stages. This means, for instance, all elements can be projected in forward/reverse direction.

For each element the following characteristics are available:

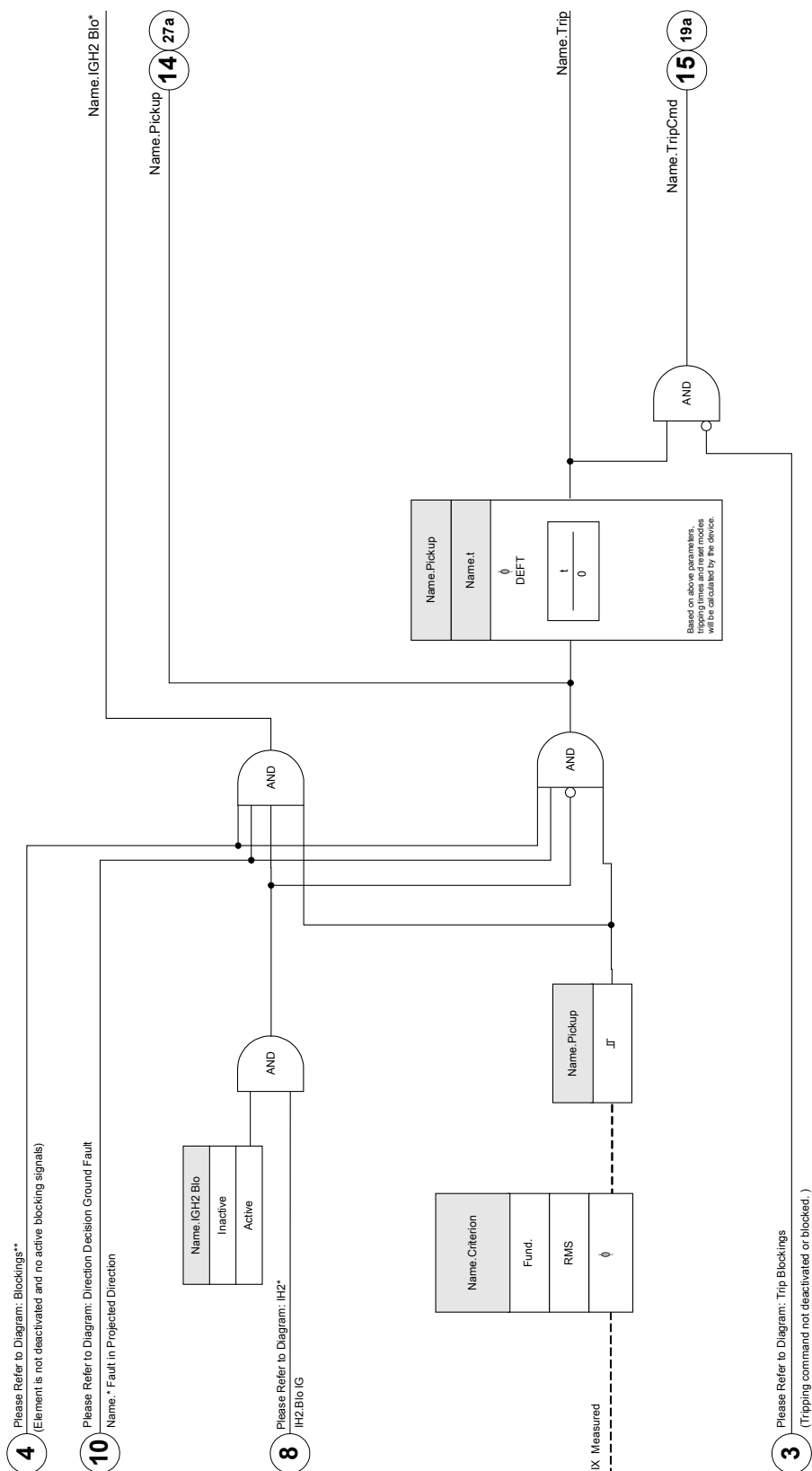
- DEFT (definite time).

For tripping curves please refer to “Instantaneous Current Curves (Ground Current Measured)” located in the Appendix.

The ground current can be measured either directly via a zero sequence transformer or detected by a residual connection. The ground current can alternatively be calculated from the phase currents. However, this is only possible if the current transformers are Wye-connected.

50X[1]...[n]

Name = 50X[1]...[n]



*=Applies only to devices that offer Inrush Protection

Device Planning Parameters of the 50X/67X Ground Fault Protection

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Non-directional, Forward, Reverse	Non-directional	[Device Planning]

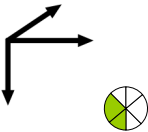
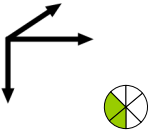
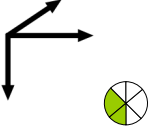
Global Protection Parameters of the 50X/67X Ground Fault Protection

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /50X[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /50X[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /50X[1]]
Rvs Blo 	Reverse Blocking, if Reverse Blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /50X[1]]
AdaptSet 1 	Assignment Adaptive Parameter 1	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /50X[1]]
AdaptSet 2 	Assignment Adaptive Parameter 2	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /50X[1]]

Parameter	Description	Setting range	Default	Menu path
AdaptSet 3 	Assignment Adaptive Parameter 3	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /50X[1]]
AdaptSet 4 	Assignment Adaptive Parameter 4	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /50X[1]]

Setting Group Parameters of the 50X/67X Ground Fault Protection

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Active	[Protection Para /<1..4> /I-Prot /50X[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /50X[1]]
Rvs Blo Fc 	Activate (allow) or inactivate (disallow) reverse blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/element are blocked that are parameterized "Rvs Blo Fc = active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /50X[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /50X[1]]

Parameter	Description	Setting range	Default	Menu path
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /50X[1]]
Criterion 	Measuring method: fundamental or rms or 3rd harmonic (only generator protection relays)	Fundamental, True RMS	True RMS	[Protection Para /<1..4> /I-Prot /50X[1]]
Pickup 	If the pickup value is exceeded, the module/element will be started.	0.02 - 20.00In	50X[1]: 1In 50X[2]: 2In	[Protection Para /<1..4> /I-Prot /50X[1]]
Pickup (sensitive) 	If the pickup value is exceeded, the module/element will be started.	0.002 - 2.000In	0.02In	[Protection Para /<1..4> /I-Prot /50X[1]]
t 	Tripping delay Only available if: Characteristic = DEFT	0.00 - 300.00s	0.5s	[Protection Para /<1..4> /I-Prot /50X[1]]

50X/67X Ground Fault Protection Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /I-Prot /50X[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /I-Prot /50X[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /I-Prot /50X[1]]
Rvs Blo-I	Module Input State: Reverse Blocking	[Protection Para /Global Prot Para /I-Prot /50X[1]]
AdaptSet1-I	Module Input State: Adaptive Parameter1	[Protection Para /Global Prot Para /I-Prot /50X[1]]
AdaptSet2-I	Module Input State: Adaptive Parameter2	[Protection Para /Global Prot Para /I-Prot /50X[1]]
AdaptSet3-I	Module Input State: Adaptive Parameter3	[Protection Para /Global Prot Para /I-Prot /50X[1]]
AdaptSet4-I	Module Input State: Adaptive Parameter4	[Protection Para /Global Prot Para /I-Prot /50X[1]]

50X/67X Ground Fault Protection Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Rvs Blo	Signal: Reverse Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup IX or IR
Trip	Signal: Trip
TripCmd	Signal: Trip Command
Active AdaptSet	Active Adaptive Parameter
DefaultSet	Signal: Default Parameter Set
AdaptSet 1	Signal: Adaptive Parameter 1
AdaptSet 2	Signal: Adaptive Parameter 2
AdaptSet 3	Signal: Adaptive Parameter 3
AdaptSet 4	Signal: Adaptive Parameter 4

Commissioning: Ground Fault Protection – Non-directional [ANSI 50X/67X]

Please test the non-directional ground overcurrent analog to the non-directional phase overcurrent protection.

51X/67X INV Measured Ground Fault Protection

Elements

51X[1], 51X[2]

NOTICE

All ground current elements are identically structured.

The following table shows the application options of the earth overcurrent protection element

Applications of the IG-Protection Module	Setting in	Option
ANSI 51X – Ground overcurrent protection, non-directional	Device Planning menu Setting: Non-directional	Measuring Mode: Fundamental/TrueRMS
ANSI 67X – Ground overcurrent protection, directional	Device Planning menu Setting: Forward/Reverse	Measuring Mode: Fundamental/TrueRMS VX Selection: measured ^{*1} /calculated

^{*1}=for wiring see chapter "Connection Examples / VT Wye with Broken Delta"

Criterion

For all protection elements it can be determined, whether the measurement is done on basis of the »*Fundamental*« or if »*TrueRMS*« measurement is used.

VX Selection

Within the parameter menu, this parameter determines, whether the earth current and the residual voltage is »*measured*« or »*calculated*«.

NOTICE

Calculation is only possible, when phase to neutral voltage is applied to the voltage inputs.

At setting »*measured*« the quantities to be measured, i. e. Residual voltage and the measured ground current have to be applied to the corresponding 4th measuring input.

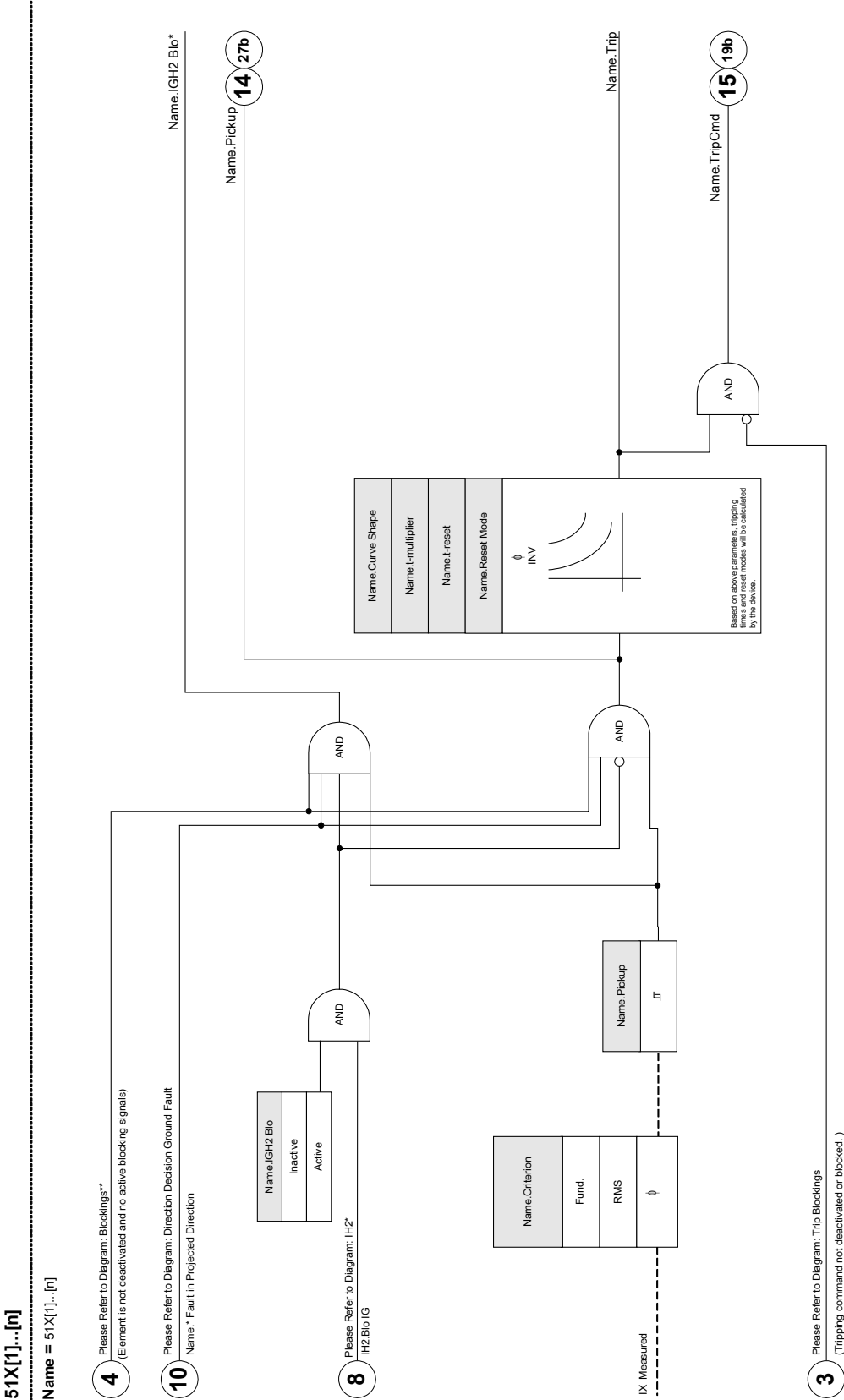
All ground current protective elements can be planned user defined as non-directional or as directional stages. This means, for instance, all elements can be projected in forward/reverse direction.

For each element the following characteristics are available:

- NINV (IEC/XInv);
- VINV (IEC/XInv);
- LINV (IEC/XInv);
- EINV (IEC/XInv);
- MINV (ANSI/XInv);
- VINV (ANSI/XInv);
- EINV (ANSI/XInv);
- Thermal Flat;
- IT;
- I2T; and
- I4T.

For tripping curves please refer to “Time Current Curves (Ground Current)” located in the Appendix.

The ground current can be measured either directly via a zero sequence transformer or detected by a residual connection. The ground current can alternatively be calculated from the phase currents. However, this is only possible if the current transformers are Wye-connected.



*=Applies only to devices that offer Inrush Protection

Device Planning Parameters of the 51X/67X Ground Fault Protection

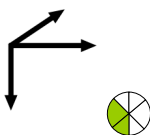
Parameter	Description	Options	Default	Menu path
Mode 	Mode	51X[1]: Non-directional, Forward, Reverse 51X[2]: Do not use, Non-directional, Forward, Reverse	Non-directional	[Device Planning]

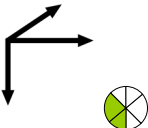
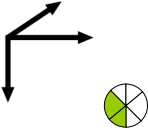
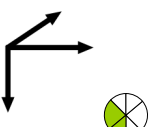
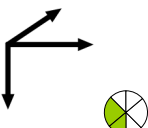
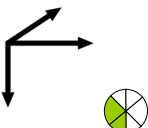
Global Protection Parameters of the 51X/67X Ground Fault Protection

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /51X[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /51X[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /51X[1]]
Rvs Blo 	Reverse Blocking, if Reverse Blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /51X[1]]
AdaptSet 1 	Assignment Adaptive Parameter 1	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /51X[1]]

Parameter	Description	Setting range	Default	Menu path
AdaptSet 2 	Assignment Adaptive Parameter 2	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /51X[1]]
AdaptSet 3 	Assignment Adaptive Parameter 3	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /51X[1]]
AdaptSet 4 	Assignment Adaptive Parameter 4	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /51X[1]]

Setting Group Parameters of the 51X/67X Ground Fault Protection

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Active	[Protection Para /<1..4> /I-Prot /51X[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51X[1]]
Rvs Blo Fc 	Activate (allow) or inactivate (disallow) reverse blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/element are blocked that are parameterized "Rvs Blo Fc = active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51X[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51X[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51X[1]]
Criterion 	Measuring method: fundamental or rms or 3rd harmonic (only generator protection relays)	Fundamental, True RMS	True RMS	[Protection Para /<1..4> /I-Prot /51X[1]]
Pickup 	If the pickup value is exceeded, the module/element will be started.	0.02 - 20.00In	0.5In	[Protection Para /<1..4> /I-Prot /51X[1]]

Parameter	Description	Setting range	Default	Menu path
Pickup (sensitive) 	If the pickup value is exceeded, the module/element will be started.	0.002 - 2.000In	0.02In	[Protection Para /<1..4> /I-Prot /51X[1]]
Curve Shape 	Characteristic	IEC NINV, IEC VINV, IEC EINV, IEC LINV, ANSI MINV, ANSI VINV, ANSI EINV, Therm Flat, IT, I2T, I4T	ANSI MINV	[Protection Para /<1..4> /I-Prot /51X[1]]
t-multiplier 	Time multiplier/tripping characteristic factor. The setting range depends on the selected tripping curve.	0.02 - 20.00	51X[1]: 1 51X[2]: 2	[Protection Para /<1..4> /I-Prot /51X[1]]
Reset Mode 	Reset Mode	Instantaneous, t-delay, Calculated	Calculated	[Protection Para /<1..4> /I-Prot /51X[1]]
t-reset 	Reset time for intermittent phase failures (INV characteristics only) Only available if: Reset Mode = t-delay	0.00 - 60.00s	0.00s	[Protection Para /<1..4> /I-Prot /51X[1]]

51X/67X Ground Fault Protection Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /I-Prot /51X[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /I-Prot /51X[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /I-Prot /51X[1]]
Rvs Blo-I	Module Input State: Reverse Blocking	[Protection Para /Global Prot Para /I-Prot /51X[1]]
AdaptSet1-I	Module Input State: Adaptive Parameter1	[Protection Para /Global Prot Para /I-Prot /51X[1]]
AdaptSet2-I	Module Input State: Adaptive Parameter2	[Protection Para /Global Prot Para /I-Prot /51X[1]]
AdaptSet3-I	Module Input State: Adaptive Parameter3	[Protection Para /Global Prot Para /I-Prot /51X[1]]
AdaptSet4-I	Module Input State: Adaptive Parameter4	[Protection Para /Global Prot Para /I-Prot /51X[1]]

51X/67X Ground Fault Protection Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Rvs Blo	Signal: Reverse Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup IX or IR
Trip	Signal: Trip
TripCmd	Signal: Trip Command
Active AdaptSet	Active Adaptive Parameter
DefaultSet	Signal: Default Parameter Set
AdaptSet 1	Signal: Adaptive Parameter 1
AdaptSet 2	Signal: Adaptive Parameter 2
AdaptSet 3	Signal: Adaptive Parameter 3
AdaptSet 4	Signal: Adaptive Parameter 4

Commissioning: Ground Fault Protection – Non-directional [ANSI 51X/67X]

Please test the non-directional ground overcurrent analog to the non-directional phase overcurrent protection.

Directional Features for Calculated (IR) Ground Fault Elements 50R/51R

All ground fault elements can be selected as »*Non-directional/Forward/Reverse*« operated. This has to be done in the »*Device Planning*« menu.

NOTICE

For the direction detection, it is mandatory that the required voltages exceed 0.35 V and the required currents exceed 10 mA. An exception is the measured sensitive ground current which has to exceed 1 mA.

Important Definitions

Polarizing Quantity: This is the quantity that is used as a reference value. The *polarizing quantity* can be selected by the parameter »*IR Direction Control*« in the [System Para/Direction] menu as follows:

- »*IR 3V0*«: The neutral voltage selected by the parameter »*3V0 Source*« will be used as the polarizing quantity. The traditional way to polarize a ground fault element is to use neutral voltage (3V0). The neutral voltage can, however, be either »*measured*« or »*calculated*«. This can be selected by the parameter »*3V0 Source*« in the [System Para/Direction] menu.
- »*IR IPol*«: The measured neutral current (usually = IX) will be used as polarizing quantity.
- »*IR Dual*«: For this method, the measured neutral current IPol=IX will be used as polarizing quantity, if available, otherwise 3V0 will be used.
- »*IR Neg*«: With this selection, the negative phase sequence voltage and current will be used to detect the direction. The monitored current is still the calculated residual current IR.

Operating Quantity: For the directional IR elements, the *operating quantity* is in general the *calculated neutral current IR* (except from »*IR Neg*« mode, where »*I2*« is the operating quantity).

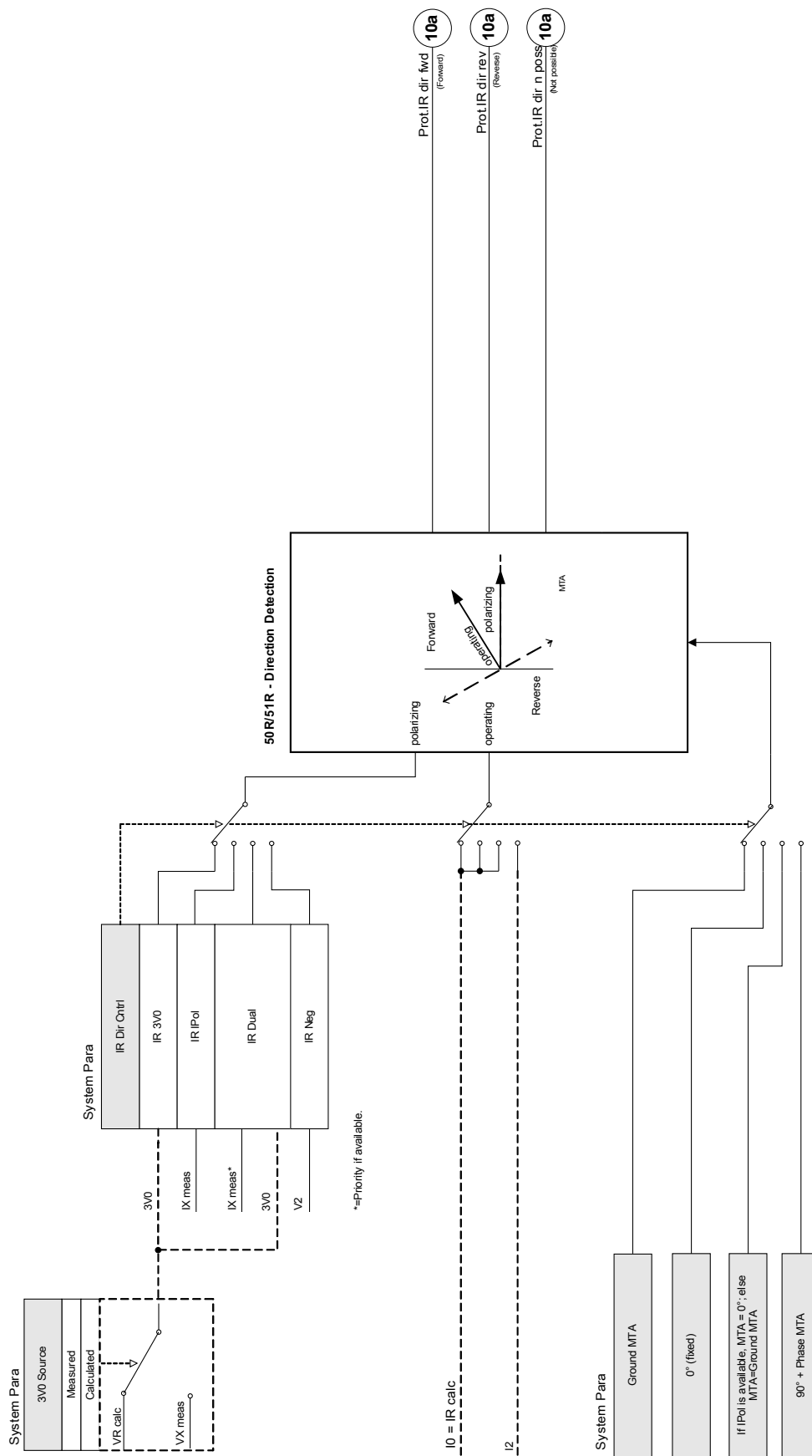
The ground maximum torque angles (MTA) can be adjusted from 0° to 360°, except, if »*IR IPol*« is selected. In this case it is set to 0° (fixed).

The following table gives the User a quick overview of the all possible directional settings.

50R/51R Direction Decision by Angle Between:	[System Para/ Direction] The Following Angle Has to Be Set:	[System Para/Direction]: IR Dir Cntrl =	[System Para/Direction]: 3V0 Source =
Residual current and neutral voltage: IR, 3V0 (measured)	Ground MTA	IR 3V0	Measured ^{*1}
Residual current and neutral voltage: IR, 3V0 (calculated)	Ground MTA	IR 3V0	Calculated
Residual current and neutral/ground current IR, IX	0° (fixed)	IR IPol	N.A.
Residual current and neutral/ground current (preferred), residual current and neutral voltage (alternatively): IR, IX (if available) or else: IR, 3V0 (measured)	If Ipol (=IX) is available, MTA = 0° (fixed); else MTA=Ground MTA	IR Dual	Measured ^{*1}
Residual current and neutral/ground current (preferred), residual current and neutral voltage (alternatively): IR, IX (if available) or else: IR, 3V0 (calculated)	If Ipol (=IX) is available, MTA = 0° (fixed); else MTA=Ground MTA	IR Dual	Calculated
Negative sequence voltage and current I2, V2	90° + Phase MTA	IR Neg	N.A.

^{*1}=for wiring see chapter "Connection Examples / VT Wye with Broken Delta"

Prot - 50R/51R - Direction Detection



50R/67R DEFT Calculated Ground Fault Protection

Elements
50R[1], 50R[2]



WARNING If using inrush blockings, the tripping delay of the ground current protection functions must be at least 30 ms or more in order to prevent faulty trippings.

NOTICE

All ground current elements are identically structured.

The following table shows the application options of the earth overcurrent protection element

Applications of the IG-Protection Module	Setting in	Option
ANSI 50R – Ground overcurrent protection, non-directional	Device Planning menu Setting: Non-directional	Measuring Mode: Fundamental/TrueRMS
ANSI 67R – Ground overcurrent protection, directional	Device Planning menu Setting: Forward/Reverse	Measuring Mode: Fundamental/TrueRMS VX Selection: measured ^{*1} /calculated

^{*1}=for wiring see chapter "Connection Examples / VT Wye with Broken Delta"

Criterion

For all protection elements it can be determined, whether the measurement is done on basis of the »*Fundamental*« or if »*TrueRMS*« measurement is used.

VX Selection

Within the parameter menu, this parameter determines, whether the earth current and the residual voltage is »*measured*« or »*calculated*«.

NOTICE

Calculation is only possible, when phase to neutral voltage is applied to the voltage inputs.

At setting »*measured*« the quantities to be measured, i. e. Residual voltage and the measured ground current have to be applied to the corresponding 4th measuring input.

All ground current protective elements can be planned user defined as non-directional or as directional stages. This means, for instance, all elements can be projected in forward/reverse direction.

For each element the following characteristics are available:

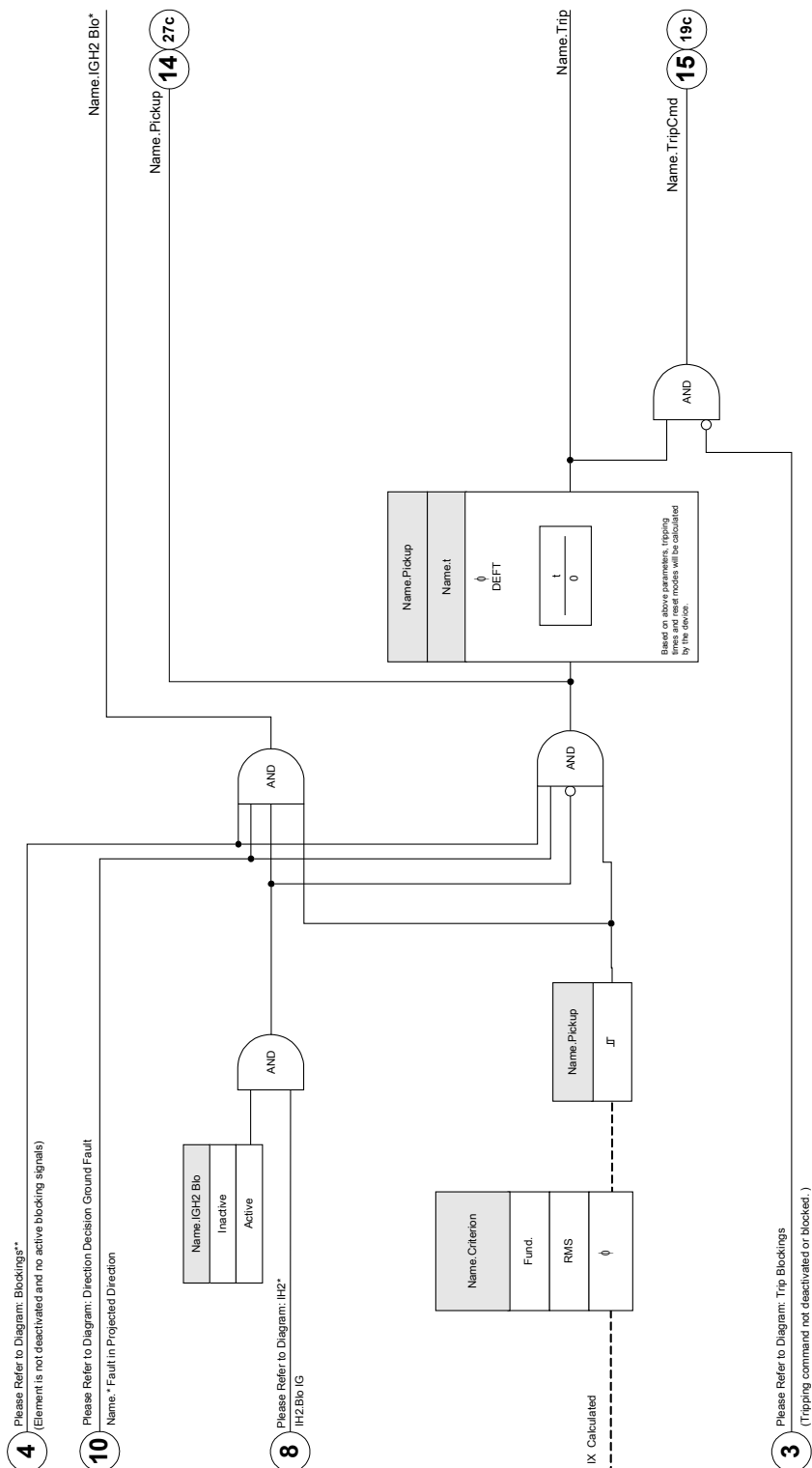
- DEFT (definite time).

For tripping curves please refer to “Instantaneous Current Curves (Ground Current Calculated)” located in the Appendix.

The ground current can be measured either directly via a zero sequence transformer or detected by a residual connection. The ground current can alternatively be calculated from the phase currents. However, this is only possible if the current transformers are Wye-connected.

50R[1]...[n]

Name = 50R[1]...[n]



*=Applies only to devices that offer Inrush Protection

Device Planning Parameters of the 50R/67R Ground Fault Protection

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Non-directional, Forward, Reverse	Non-directional	[Device Planning]

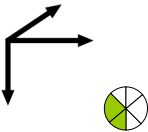
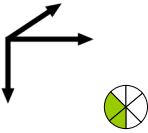
Global Protection Parameters of the 50R/67R Ground Fault Protection

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /50R[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /50R[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /50R[1]]
Rvs Blo 	Reverse Blocking, if Reverse Blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /50R[1]]
AdaptSet 1 	Assignment Adaptive Parameter 1	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /50R[1]]
AdaptSet 2 	Assignment Adaptive Parameter 2	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /50R[1]]

Parameter	Description	Setting range	Default	Menu path
AdaptSet 3 	Assignment Adaptive Parameter 3	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /50R[1]]
AdaptSet 4 	Assignment Adaptive Parameter 4	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /50R[1]]

Setting Group Parameters of the 50R/67R Ground Fault Protection

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Active	[Protection Para /<1..4> /I-Prot /50R[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /50R[1]]
Rvs Blo Fc 	Activate (allow) or inactivate (disallow) reverse blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/element are blocked that are parameterized "Rvs Blo Fc = active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /50R[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /50R[1]]

Parameter	Description	Setting range	Default	Menu path
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /50R[1]]
Criterion 	Measuring method: fundamental or rms or 3rd harmonic (only generator protection relays)	Fundamental, True RMS	True RMS	[Protection Para /<1..4> /I-Prot /50R[1]]
Pickup 	If the pickup value is exceeded, the module/element will be started.	0.02 - 20.00In	50R[1]: 1In 50R[2]: 2In	[Protection Para /<1..4> /I-Prot /50R[1]]
t 	Tripping delay Only available if: Characteristic = DEFT	0.00 - 300.00s	0.5s	[Protection Para /<1..4> /I-Prot /50R[1]]

50R/67R Ground Fault Protection Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /I-Prot /50R[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /I-Prot /50R[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /I-Prot /50R[1]]
Rvs Blo-I	Module Input State: Reverse Blocking	[Protection Para /Global Prot Para /I-Prot /50R[1]]
AdaptSet1-I	Module Input State: Adaptive Parameter1	[Protection Para /Global Prot Para /I-Prot /50R[1]]
AdaptSet2-I	Module Input State: Adaptive Parameter2	[Protection Para /Global Prot Para /I-Prot /50R[1]]
AdaptSet3-I	Module Input State: Adaptive Parameter3	[Protection Para /Global Prot Para /I-Prot /50R[1]]
AdaptSet4-I	Module Input State: Adaptive Parameter4	[Protection Para /Global Prot Para /I-Prot /50R[1]]

50R/67R Ground Fault Protection Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Rvs Blo	Signal: Reverse Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup IX or IR
Trip	Signal: Trip
TripCmd	Signal: Trip Command
Active AdaptSet	Active Adaptive Parameter
DefaultSet	Signal: Default Parameter Set
AdaptSet 1	Signal: Adaptive Parameter 1
AdaptSet 2	Signal: Adaptive Parameter 2
AdaptSet 3	Signal: Adaptive Parameter 3
AdaptSet 4	Signal: Adaptive Parameter 4

Commissioning: Ground Fault Protection – Non-directional [ANSI 50R/67R]

Please test the non-directional ground overcurrent using the procedure for non-directional phase overcurrent protection.

51R/67R INV Calculated Ground Fault Protection

Elements

51R[1], 51R[2]

NOTICE

All ground current elements are identically structured.

The following table shows the application options of the earth overcurrent protection element

Applications of the IG-Protection Module	Setting in	Option
ANSI 51R – Ground overcurrent protection, non-directional	Device Planning menu Setting: Non-directional	Measuring Mode: Fundamental/TrueRMS
ANSI 67R – Ground overcurrent protection, directional	Device Planning menu Setting: Forward/Reverse	Measuring Mode: Fundamental/TrueRMS VX Selection: measured ^{*1} /calculated

^{*1}=for wiring see chapter "Connection Examples / VT Wye with Broken Delta"

Criterion

For all protection elements it can be determined, whether the measurement is done on basis of the »*Fundamental*« or if »*TrueRMS*« measurement is used.

VX Selection

Within the parameter menu, this parameter determines, whether the earth current and the residual voltage is »*measured*« or »*calculated*«.

NOTICE

Calculation is only possible, when phase to neutral voltage is applied to the voltage inputs.

At setting »*measured*« the quantities to be measured, i. e. Residual voltage and the measured ground current have to be applied to the corresponding 4th measuring input.

All ground current protective elements can be planned user defined as non-directional or as directional stages. This means, for instance, all elements can be projected in forward/reverse direction.

For each element the following characteristics are available:

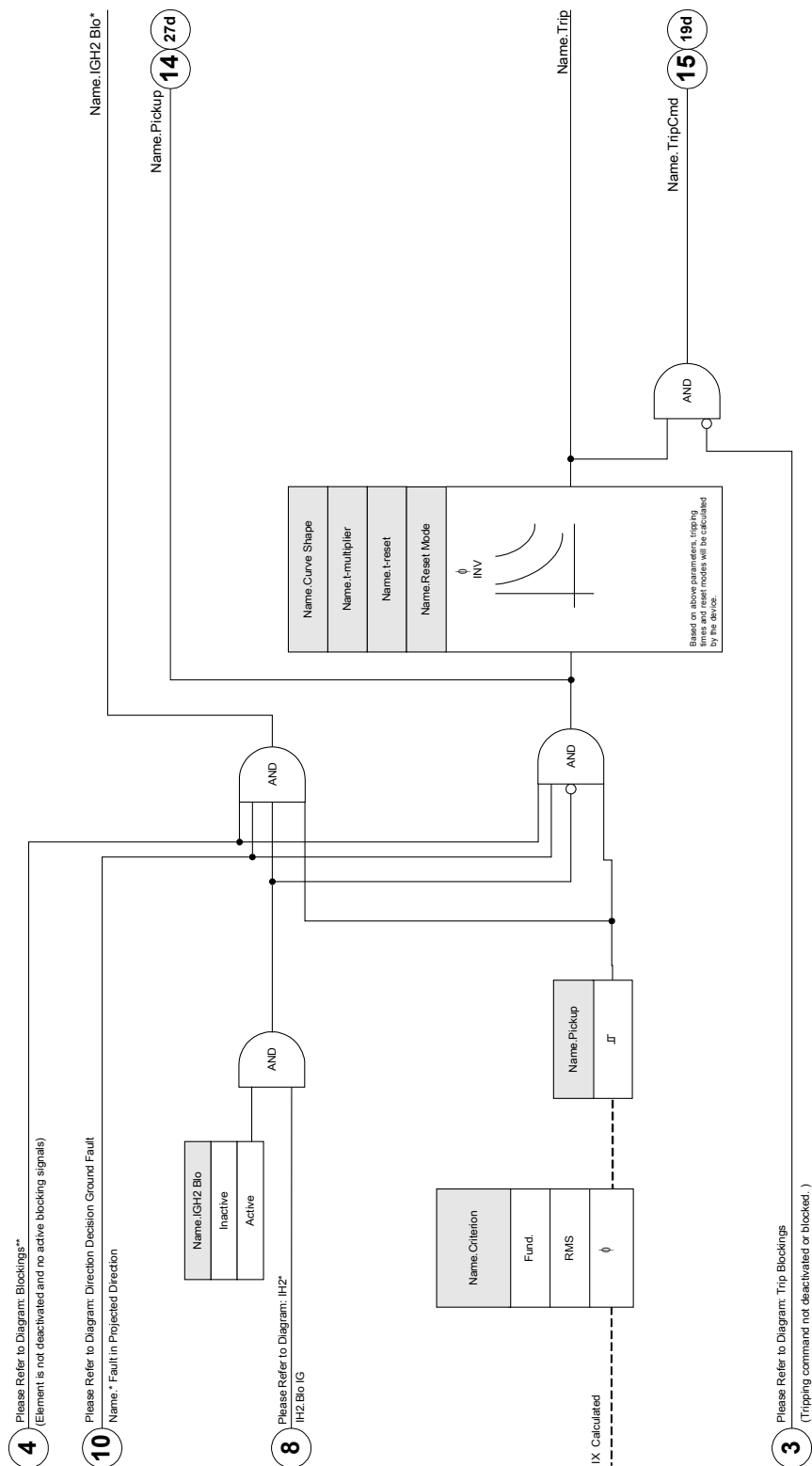
- NINV (IEC/XInv);
- VINV (IEC/XInv);
- LINV (IEC/XInv);
- EINV (IEC/XInv);
- MINV (ANSI/XInv);
- VINV (ANSI/XInv);
- EINV (ANSI/XInv);
- Thermal Flat;
- IT;
- I2T; and
- I4T.

For tripping curves please refer to “Time Current Curves (Ground Current)” located in the Appendix.

The ground current can be measured either directly via a zero sequence transformer or detected by a residual connection. The ground current can alternatively be calculated from the phase currents. However, this is only possible if the current transformers are Wye-connected.

51R[1]...[n]

Name = 51R[1]...[n]



*=Applies only to devices that offer Inrush Protection

Device Planning Parameters of the 51R/67R Ground Fault Protection

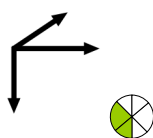
Parameter	Description	Options	Default	Menu path
Mode 	Mode	51R[1]: Non-directional, Forward, Reverse 51R[2]: Do not use, Non-directional, Forward, Reverse	Non-directional	[Device Planning]

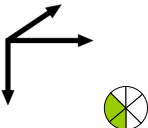
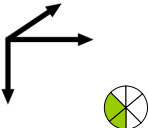
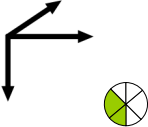
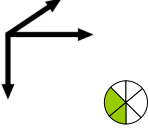
Global Protection Parameters of the 51R/67R Ground Fault Protection

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /51R[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /51R[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /51R[1]]
Rvs Blo 	Reverse Blocking, if Reverse Blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /51R[1]]
AdaptSet 1 	Assignment Adaptive Parameter 1	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /51R[1]]

Parameter	Description	Setting range	Default	Menu path
AdaptSet 2 	Assignment Adaptive Parameter 2	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /51R[1]]
AdaptSet 3 	Assignment Adaptive Parameter 3	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /51R[1]]
AdaptSet 4 	Assignment Adaptive Parameter 4	AdaptSet	.-	[Protection Para /Global Prot Para /I-Prot /51R[1]]

Setting Group Parameters of the 51R/67R Ground Fault Protection

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Active	[Protection Para /<1..4> /I-Prot /51R[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51R[1]]
Rvs Blo Fc 	Activate (allow) or inactivate (disallow) reverse blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/element are blocked that are parameterized "Rvs Blo Fc = active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51R[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51R[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /51R[1]]
Criterion 	Measuring method: fundamental or rms or 3rd harmonic (only generator protection relays)	Fundamental, True RMS	True RMS	[Protection Para /<1..4> /I-Prot /51R[1]]
Pickup 	If the pickup value is exceeded, the module/element will be started.	0.02 - 20.00In	51R[1]: 0.1In 51R[2]: 0.5In	[Protection Para /<1..4> /I-Prot /51R[1]]

Parameter	Description	Setting range	Default	Menu path
Curve Shape 	Characteristic	IEC NINV, IEC VINV, IEC EINV, IEC LINV, ANSI MINV, ANSI VINV, ANSI EINV, Therm Flat, IT, I2T, I4T	ANSI MINV	[Protection Para /<1..4> /I-Prot /51R[1]]
t-multiplier 	Time multiplier/tripping characteristic factor. The setting range depends on the selected tripping curve.	0.02 - 20.00	51R[1]: 1 51R[2]: 2	[Protection Para /<1..4> /I-Prot /51R[1]]
Reset Mode 	Reset Mode	Instantaneous, t-delay, Calculated	Calculated	[Protection Para /<1..4> /I-Prot /51R[1]]
t-reset 	Reset time for intermittent phase failures (INV characteristics only) Only available if: Reset Mode = t-delay	0.00 - 60.00s	0.00s	[Protection Para /<1..4> /I-Prot /51R[1]]

51R/67R Ground Fault Protection Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /I-Prot /51R[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /I-Prot /51R[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /I-Prot /51R[1]]
Rvs Blo-I	Module Input State: Reverse Blocking	[Protection Para /Global Prot Para /I-Prot /51R[1]]
AdaptSet1-I	Module Input State: Adaptive Parameter1	[Protection Para /Global Prot Para /I-Prot /51R[1]]
AdaptSet2-I	Module Input State: Adaptive Parameter2	[Protection Para /Global Prot Para /I-Prot /51R[1]]
AdaptSet3-I	Module Input State: Adaptive Parameter3	[Protection Para /Global Prot Para /I-Prot /51R[1]]
AdaptSet4-I	Module Input State: Adaptive Parameter4	[Protection Para /Global Prot Para /I-Prot /51R[1]]

51R/67R Ground Fault Protection Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Rvs Blo	Signal: Reverse Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup IX or IR
Trip	Signal: Trip
TripCmd	Signal: Trip Command
Active AdaptSet	Active Adaptive Parameter
DefaultSet	Signal: Default Parameter Set
AdaptSet 1	Signal: Adaptive Parameter 1
AdaptSet 2	Signal: Adaptive Parameter 2
AdaptSet 3	Signal: Adaptive Parameter 3
AdaptSet 4	Signal: Adaptive Parameter 4

Commissioning: Ground Fault Protection – Non-directional [ANSI 51R/67R]

Please test the non-directional ground overcurrent analog to the non-directional phase overcurrent protection.

ZI - Zone Interlocking

Elements

ZI

Principle – General Use

The purpose of zone interlocking is to speed up tripping for some faults without sacrificing the coordination of the system and interjecting nuisance trips into the system. Zone interlocking devices can communicate across distribution zones to determine whether or not a device sees a fault condition.

Zone interlocking is a communication scheme used with breakers and protective relays to improve the level of protection in a power distribution system. This is achieved through communication between the downstream and upstream devices in a power system. The zones are classified by their location downstream of the main circuit protective device which is generally defined as Zone 1.

By definition, a selectively coordinated system is one where by adjusting the trip unit pickup and time delay settings, the breaker closest to the fault trips first. The upstream breaker serves two functions: (1) back-up protection to the downstream breaker and (2) protection of the conductors between the upstream and downstream breakers.

For faults which occur on the conductors between the upstream and downstream breakers, it is ideal for the upstream breaker to trip with no time delay. This is the feature provided by Zone Selective Interlocking.

The zone interlocking information can be transferred to or received from other compatible zone interlocking devices by means of suitable communication cables. The single zone interlock terminal block, with its 3-wire scheme, can be used for either phase zone interlocking, ground zone interlocking, or a combination of the two. If phase and ground zone interlocking are combined, the potential consequences must be understood before implementation.



WARNING

Systems containing multiple sources, or where the direction of power flow varies, require special considerations, or may not be suitable for this feature.

NOTICE

The breaker failure pickup signal »BF.PICKUP« is implicitly connected to zone interlocking, so that NO zone interlock output signal can be sent to the upstream device if a breaker failure on a downstream device is detected.

Description of the Functions and Features

- Configurable protection functions to initiate the zone interlocking OUTPUT signal (start functions).
- Remove zone interlocking OUTPUT signal immediately after detection of a breaker failure.
- Reset time (about ten cycles - settable) to interrupt OUTPUT signal for durable trip signal.
- Small trip delay (about three cycles – settable) to wait for downstream devices interlocking signals.
- Zone interlocking trip signal only possible by absence of zone interlocking INPUT signals.
- Configurable zone interlocking trip functions (protective functions serve as zone interlocking trip functions).
- Zone interlocking trip function pickup and tripping characteristic adaption using adaptive settings controlled by the zone interlocking input signals.

Device Planning Parameters of the Zone Interlocking

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Use	Use	[Device Planning]

Global Protection Parameters of the Zone Interlocking

In the global parameter menu for zone interlocking, two external blocking inputs (» *Ex Block1/Ex Block2*«), as with other protection modules, can be assigned to the input of the zone interlocking function so that the zone interlock function can be blocked by an assigned function.

Via an external input signal, the zone interlocking can also be blocked if the parameter » *ExtBlockTripCMD*« is assigned.

NOTICE

Breaker Failure Pickup flag BF.Pickup is implicitly connected to zone interlocking, so that NO zone interlock output signal can be sent to the upstream device if a breaker failure on downstream device is detected.

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /ZI]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /ZI]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /ZI]

Setting Group Parameters of the Zone Interlocking

The zone interlocking Setting Group Parameters consists of three groups of setting to configure the zone interlocking module to adapt to various application philosophies accordingly:

- General: This group comprises the settings used to control the general usage of the zone interlocking module.
- OUTPUT: What should be assigned to the Zone Out?
 - Phase,
 - Ground, or
- - Both.

The OUTPUT group comprises the settings to configure the zone interlocking output logic. If the zone interlocking application is used to a downstream device, the settings in OUTPUT group should be programmed accordingly. If the zone interlocking application is only used for an upstream device (main breaker or Zone 1), the setting ZoneInterlockOut within the OUTPUT group should be disabled.

- TRIP: Activate the Zone Trip.

The TRIP group comprises the settings used to configure the zone interlocking TRIP logic. If the zone interlocking application is applied to an upstream device, (main breaker or Zone 1), the settings in the TRIP group should be programmed accordingly. If the zone interlocking application is only used for a downstream device (feeder breaker or Zone 2), the setting ZoneInterlockTrip in TRIP group should be disabled.

Setting the above mentioned setting groups accordingly the zone interlocking module can be configured as:

- Downstream device application (using only OUTPUT logic);,
- Upstream device application (using only TRIP logic); or
- Midstream device application (using both OUTPUT and TRIP logics together).

The following menu and tables show the detailed information about the settings.

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/stage. The elements, that are associated with Zone Interlocking depend on the protective device. Transformer relays: ZI[1]: 50P[1], 50P[2], 51P[1], 50X[1], 51X[1], 50R[1], 51R[1] ZI[2]: 50P[3], 50P[4], 51P[3], 50X[2], 51X[2], 50R[2], 51R[2] All other Protective Devices: ZI: 50P[1], 50P[2], 51P[1], 50X[1], 50X[2], 51X[1], 50R[1], 50R[2], 51R[1]	Inactive, Active	Inactive	[Protection Para /<1..4> /ZI /General Settings]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /ZI /General Settings]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /ZI /General Settings]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /ZI /General Settings]
ZI OUT Fc 	Zone Interlocking Out activate (allow) / inactivate (disallow)	Inactive, Active	Active	[Protection Para /<1..4> /ZI /Zone Out]
Fault Type 	Fault Type	Phase, Ground, Both	Both	[Protection Para /<1..4> /ZI /Zone Out]

Parameter	Description	Setting range	Default	Menu path
Trip 	Signal: Zone Interlocking Trip	Inactive, Active	Active	[Protection Para /<1..4> /ZI /Zone Trip]
Fault Type 	Fault Type	Phase, Ground, Both	Both	[Protection Para /<1..4> /ZI /Zone Trip]

Zone Interlocking Output Logic [X2]

The following current protective function elements serve as the Phase Zone Interlock OUTPUT start functions:

- 51P[1];
- 50P[1]; and
- 50P[2].

The following current protective function serves as the Ground Zone Interlock OUTPUT start functions:

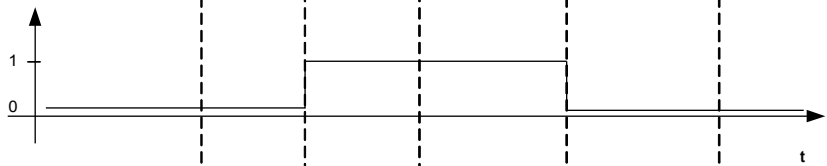
- 51X[1];
- 50X[1];
- 50X[2];
- 51R[1];
- 50R[1] and
- 50R[2].

Zone Interlocking OUTPUT Logic Timing

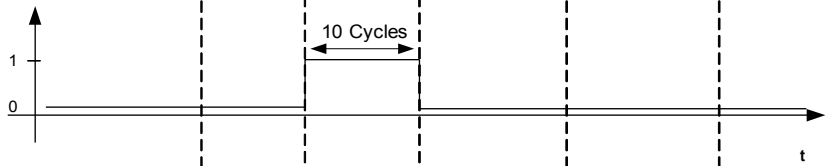
51P[1].Pickup



51P[1].Trip



Reset Timer



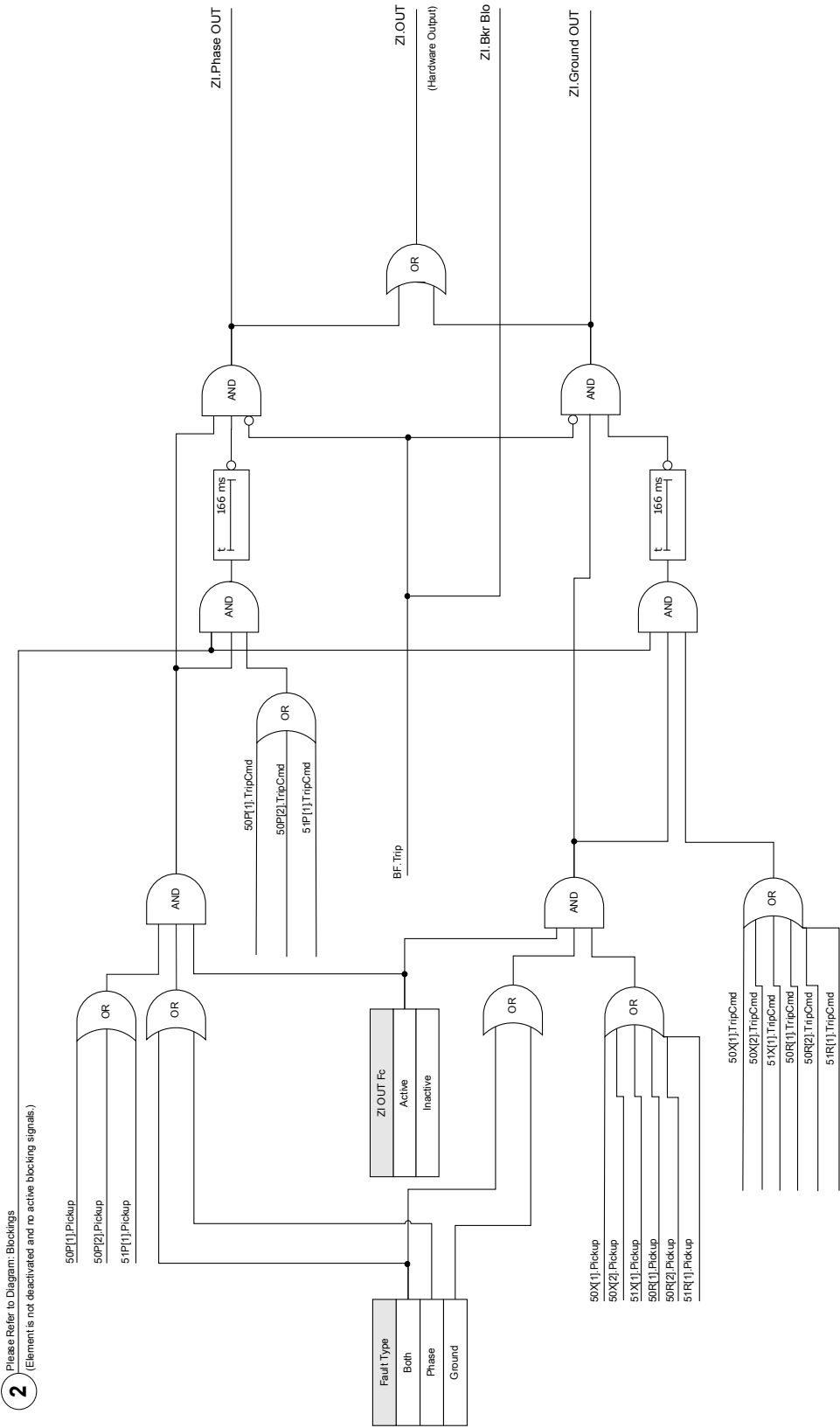
ZI.Bkr Blo



ZI.OUT



ZI Zone Out



Zone Interlocking Trip Logic [X2]

The following overcurrent protection elements trigger Phase Zone-Interlock trip functions:

- $1.5 * 51P[1]$;
- $50P[1]$; and
- $50P[2]$.

The following overcurrent protection elements trigger Ground Zone Interlock trip functions:

- $51X[1]$;
- $50X[1]$;
- $50X[2]$;
- $51R[1]$;
- $50R[1]$, and
- $50R[2]$.

Zone Interlocking TRIP Logic Timing

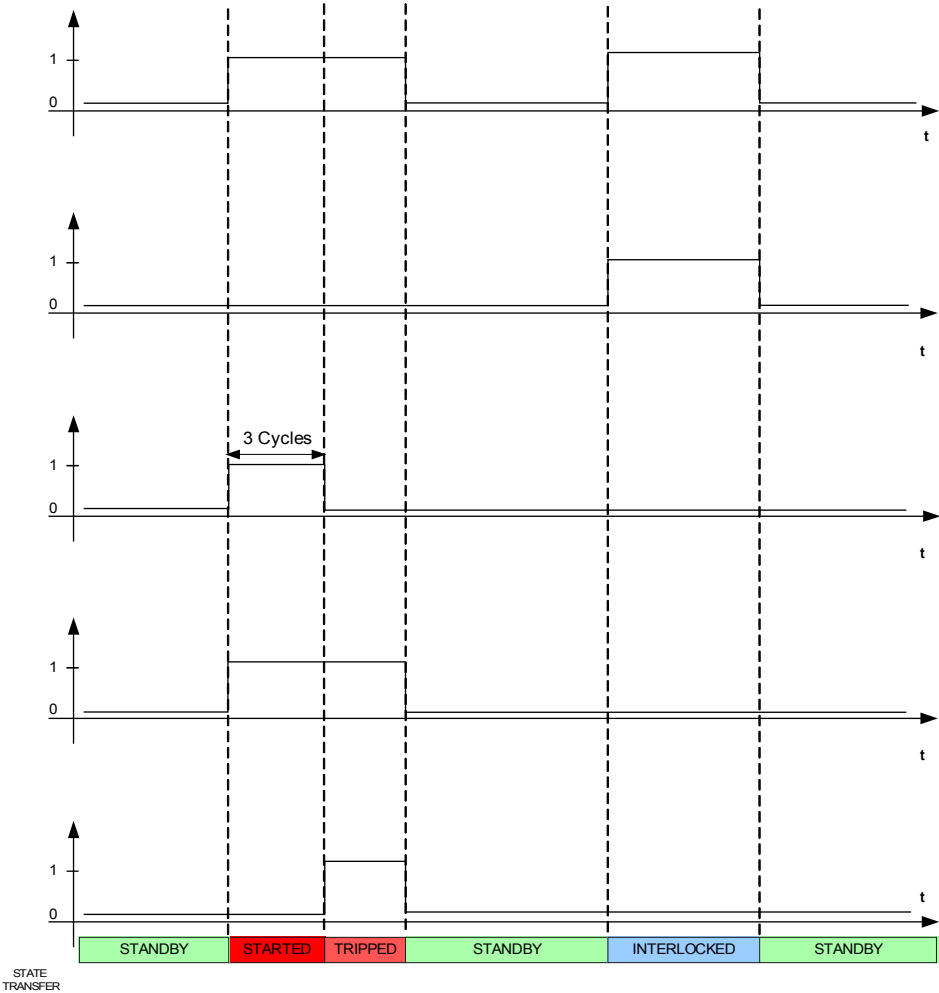
51P[1].Pickup

ZI.IN

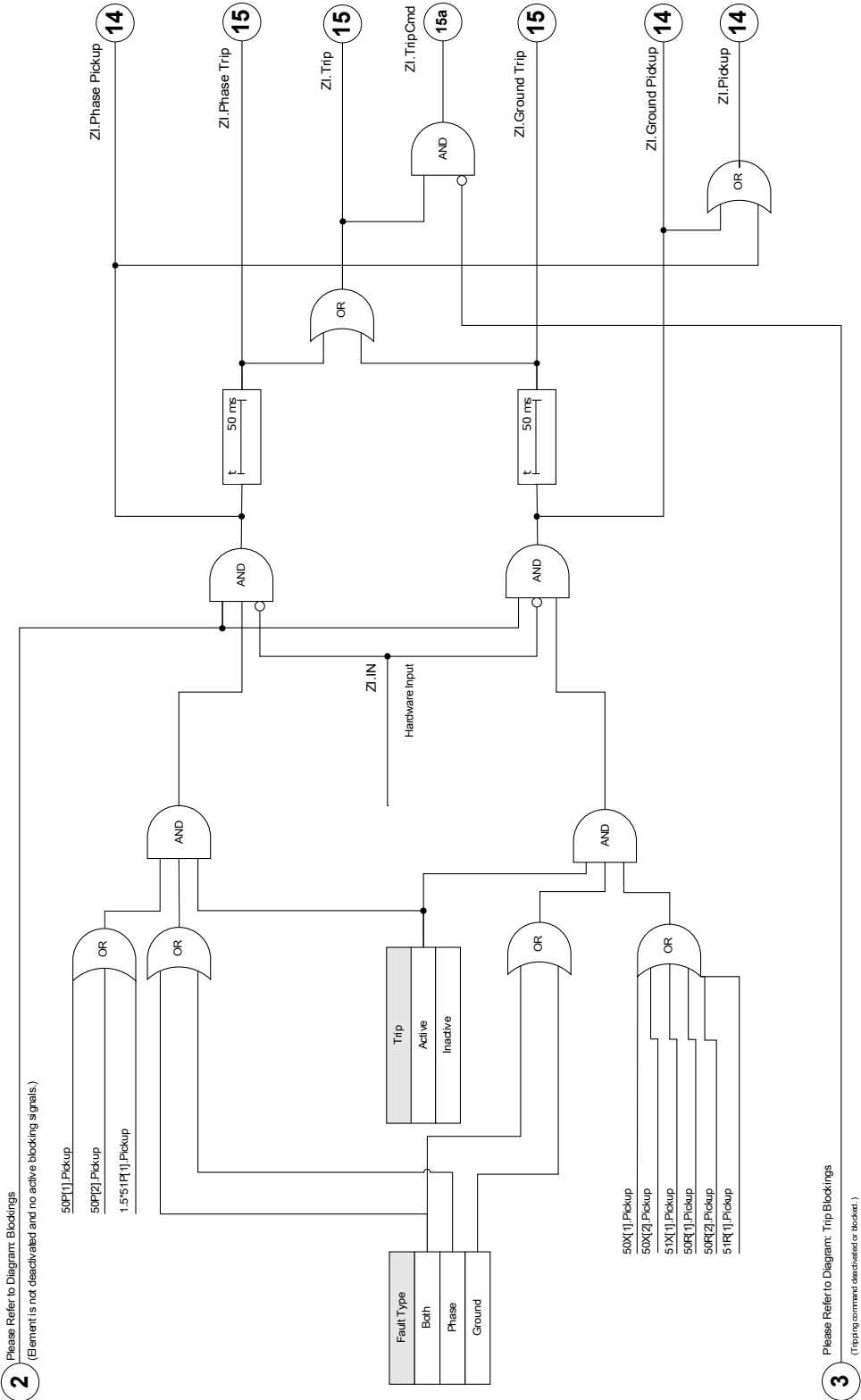
Trip Delay Timer

ZI.Pickup

ZI.Trip



ZI:Zone Trip



Zone Interlocking Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /ZI]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /ZI]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /ZI]

Zone Interlocking Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Bkr Blo	Signal: Blocked by Breaker Failure
Phase Pickup	Signal: Zone Interlocking Phase Pickup
Phase Trip	Signal: Zone Interlocking Phase Trip
Ground Pickup	Signal: Zone Interlocking Ground Pickup
Ground Trip	Signal: Zone Interlocking Ground Trip
Pickup	Signal: Pickup Zone Interlocking
Trip	Signal: Zone Interlocking Trip
TripCmd	Signal: Zone Interlocking Trip Command
Phase OUT	Signal: Zone Interlocking Phase OUT
Ground OUT	Signal: Zone Interlocking Ground OUT
OUT	Signal: Zone Interlocking OUT
IN	Signal: Zone Interlocking IN

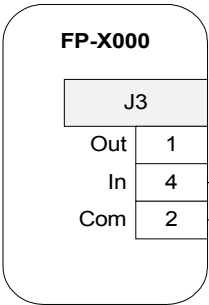
Zone Interlocking Wiring

NOTICE

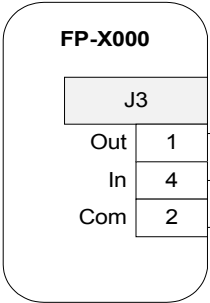
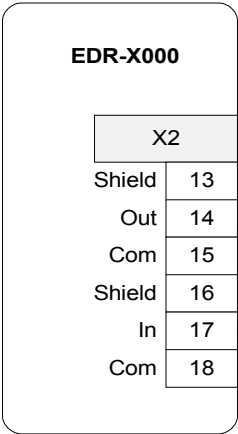
The ZI Outputs are for use with connection to electronic inputs only.

The zone interlocking connection between relays is done by means of a twisted shielded cable. Downstream zone interlock outputs may be paralleled from up to ten devices (FP-5000 or DT-3000 or a combination of both) for connection to upstream zone interlocked relays.

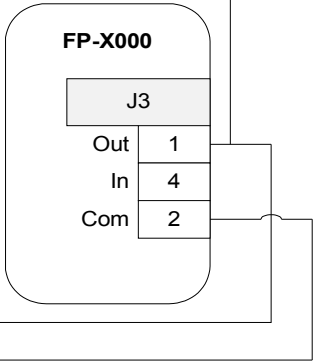
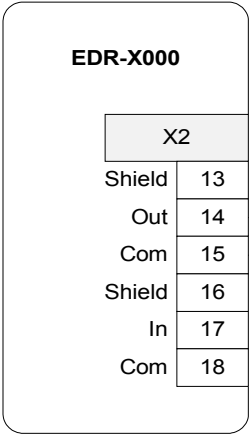
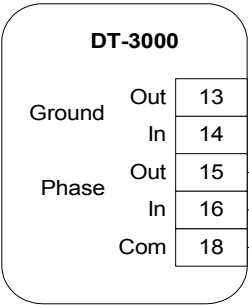
Zone 1



Zone 2



Zone 3

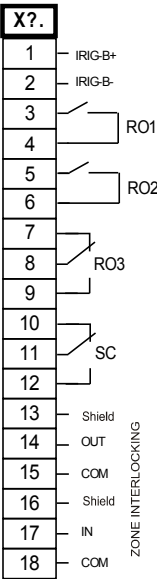


Hardware Terminals for Zone Interlocking

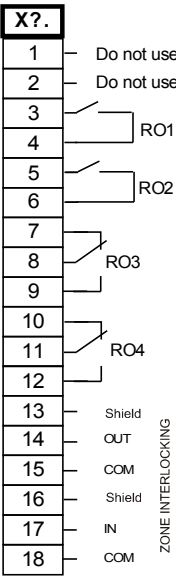
By means of the zone interlocking terminals, the device can be connected to other Eaton protective devices such as an FP5000, DT3000, etc.

As an upstream device, the terminals - Phase/Ground IN should be connected to the OUT terminals of up to ten downstream device(s) by means of a dedicated cable wired in parallel. As a downstream device, the terminals - Phase/Ground OUT should be connected to the IN terminals of an upstream device by means of a dedicated cable.

Terminal Marking X2 for Device: EDR-3000



Terminal Marking X2 for Device: EDR-4000, EDR-5000, EMR-4000, EMR-5000, EGR-4000 and EGR-5000



46 - Current Unbalance Protection

Elements:

46[1] , 46[2]

This is the 46 device Current Unbalance setting, which works similar to the 47 device Voltage Unbalance setting. The positive and negative sequence currents are calculated from the 3-phase currents. The Threshold setting defines a minimum operating current magnitude of either I1 or I2 for the 46 function to operate, which ensures that the relay has a solid basis for initiating a current unbalance trip. The » $\%(I2/I1)$ « setting is the unbalance trip pickup setting. It is defined by the ratio of negative sequence current to positive sequence current » $\%(I2/I1)$ « for ABC rotation and » $\%(I1/I2)$ « for ACB rotation. The device will automatically select the correct ratio based on the Phase Sequence setting in the System Configuration group described above.

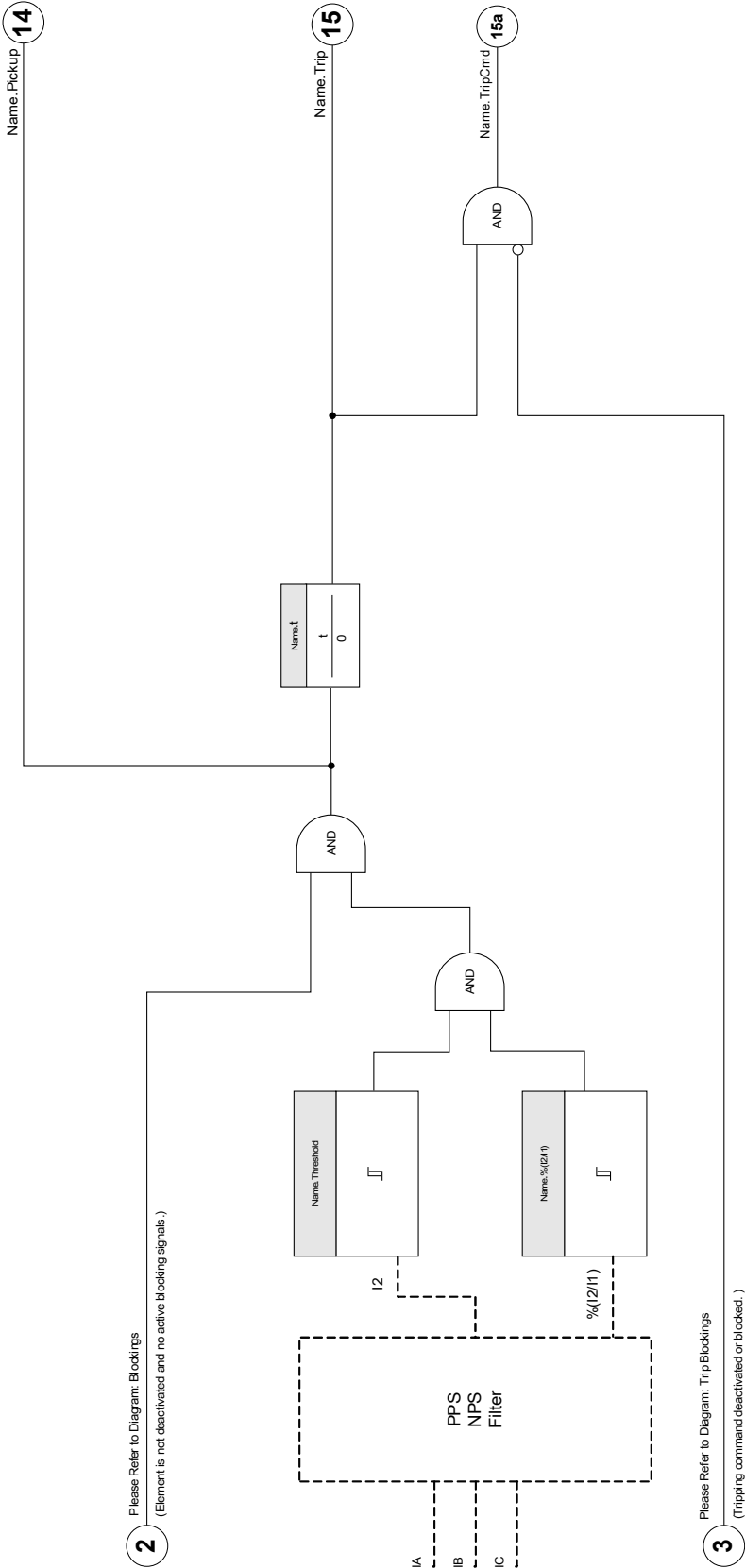
This function requires positive or negative sequence current magnitude above the threshold setting and the percentage current unbalance above the » $\%(I2/I1)$ « setting before allowing a current unbalance trip. Therefore, both the threshold and percent settings must be met for the specified Delay time setting before the relay initiates a trip for current unbalance.

NOTICE

All elements are identically structured.

46[1]...[n]

Name = 46[1]...[n]



Device Planning Parameters of the Current Unbalance Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Current Unbalance Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Unbalance-Prot /46[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Unbalance-Prot /46[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Unbalance-Prot /46[1]]

Setting Group Parameters of the Current Unbalance Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /46[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /46[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /46[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /46[1]]
Threshold 	The Threshold setting defines a minimum operating current magnitude of I ₂ for the 46 function to operate, which ensures that the relay has a solid basis for initiating a current unbalance trip. This is a supervisory function and not a trip level. Only available if: Device Planning: 51Q.Mode = 46	0.01 - 4.00In	0.1In	[Protection Para /<1..4> /Unbalance-Prot /46[1]]
%(I ₂ /I ₁) 	The %(I ₂ /I ₁) setting is the unbalance trip pickup setting. It is defined by the ratio of negative sequence current to positive sequence current (% Unbalance=I ₂ /I ₁). Phase sequence will be taken into account automatically. Only available if: %(I ₂ /I ₁) = Use	2 - 40%	46[1]: 40% 46[2]: 20%	[Protection Para /<1..4> /Unbalance-Prot /46[1]]
t 	Tripping delay Only available if: Characteristic = DEFT	0.00 - 300.00s	46[1]: 10s 46[2]: 20s	[Protection Para /<1..4> /Unbalance-Prot /46[1]]

Current Unbalance Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Unbalance-Prot /46[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Unbalance-Prot /46[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Unbalance-Prot /46[1]]

Current Unbalance Module Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup Negative Sequence
Trip	Signal: Trip
TripCmd	Signal: Trip Command

Commissioning: Current Unbalance Module

Object to be tested:

Test of the unbalanced load protection function.

Necessary means:

- Three-phase current source with adjustable current unbalance; and
- Timer.

Procedure:

Check the phase sequence:

- Ensure that the phase sequence is the same as that set in the field parameters.
- Feed-in a three-phase nominal current.
- Change to the »Measuring Values« menu.
- Check the measuring value for the unbalanced current »I2 Fund.«. The measuring value displayed for »I2 Fund.« should be zero (within the physical measuring accuracy).

NOTICE

If the displayed magnitude for I2 Fund. is the same as that for the balanced nominal currents fed to the relay, it implies that the phase sequence of the currents seen by the relay is reversed.

- Now turn-off phase A.
- Again check the measuring value of the unbalanced current »I2 Fund.« in the »Measuring Values« menu. The measuring value of the unbalanced current »I2 Fund.« should now be 33%.
- Turn-on phase A, but turn-off phase B.
- Once again check the measuring value of the unbalanced current I2 Fund. in the »Measuring Values« menu. The measuring value of the asymmetrical current »I2 Fund.« should be again 33%.
- Turn-on phase B, but turn-off phase C.
- Again check the measuring value of unbalanced current »I2 Fund.« in the »Measuring Values« menu. The measuring value of the unbalanced current »I2 Fund.« should still be 33%.

Testing the trip delay:

- Apply a balanced three-phase current system (nominal currents).
- Switch off IA (the threshold value » *Threshold*« for » *I2 Fund.*« must be below 33%).
- Measure the tripping time.

The present current unbalance » *I2 Fund.*« corresponds with 1/3 of the existing phase current displayed.

Testing the threshold values

- Configure minimum » $\%(I2/I1)$ « setting (2%) and an arbitrary threshold value » *Threshold*« (I2 Fund.).
- For testing the threshold value, a current has to be fed to phase A which is lower than three times the adjusted threshold value » *Threshold*« (I2 Fund.).
- Feeding only phase A results in » $\%(I2/I1) = 100\%$ «, so the first condition » $\%(I2/I1) \geq 2\%$ « is always fulfilled.
- Now increase the phase A current until the relay is activated.

Testing the dropout ratio of the threshold values

Having tripped the relay in the previous test, now decrease the phase A current. The dropout ratio must not be higher than 0.97 times the threshold value.

Testing » $\%(I2/I1)$ «

- Configure minimum threshold value » *Threshold*« (I2 Fund.) ($0.01 \times I_n$) and set » $\%(I2/I1)$ « greater or equal to 10%.
- Apply a balanced three-phase current system (nominal currents). The measuring value of » $\%(I2/I1)$ « should be 0%.
- Now increase the phase A current. With this configuration, the threshold value » *Threshold*« (I2 Fund.) should be reached before the value » $\%(I2/I1)$ « reaches the set » $\%(I2/I1)$ « ratio threshold.
- Continue increasing the phase 1 current until the relay is activated.

Testing the dropout ratio of $\%(I2/I1)$

Having tripped the relay in the previous test, now decrease the phase A current. The dropout of » $\%(I2/I1)$ « has to be 1% below the » $\%(I2/I1)$ « setting.

Successful test result:

The measured trip delays, threshold values, and dropout ratios are within the permitted deviations/tolerances, specified under Technical Data.

46G - Generator Unbalance Protection

The 46G[1] function has a definite time element. The 46G[2] function has an inverse time element. The definite time element 46G[1] is usually assigned to an alarm function. The inverse time element 46G[2] is normally assigned to a trip function.

NOTICE

The relation of CTprim/FLA must be less than 2.

46G[1] – Definite Time Generator Unbalance Protection Element

This is the 46G device Generator Unbalance setting, which works similar to the 47 device Voltage Unbalance setting. The negative sequence currents are calculated from the 3-phase currents. The »Pickup« setting is the generator unbalance trip pickup setting. It is defined by the ratio of negative sequence current I2 to FLA.

This function requires a generator unbalance above the »Pickup« setting before allowing a generator unbalance trip. Therefore, the pickup setting must be met for the specified delay time setting before the relay initiates a trip for current unbalance.

This protection must not operate for system faults that will be cleared by system relaying. This requires consideration of line protection, bus differential and breaker failure backup protection.

Elements:

46G[1]

Device Planning Parameters of the 46G[1] - Definite Time Element

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the 46G[1] - Definite Time Element

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Unbalance-Prot /46G[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Unbalance-Prot /46G[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Unbalance-Prot /46G[1]]

Setting Group Parameters of the 46G[1] - Definite Time Element

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /46G[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /46G[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /46G[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /46G[1]]
Pickup 	Negative current as a percentage of the nominal (FLA) current calculated under generator/motor parameters where this element picks up. It is typically set at the maximum continuous negative sequence current rating of the machine. Only available if: Device Planning: 51Q.Mode = 46G	0.000 - 1.000FLA	0.03FLA	[Protection Para /<1..4> /Unbalance-Prot /46G[1]]
t 	Tripping delay Only available if: Characteristic = DEFT	0.00 - 300.00s	5.0s	[Protection Para /<1..4> /Unbalance-Prot /46G[1]]

46G[1] - Definite Time Element Element Input States

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Unbalance-Prot /46G[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Unbalance-Prot /46G[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Unbalance-Prot /46G[1]]

46G[1] - Definite Time Element Element Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup Negative Sequence
Trip	Signal: Trip
TripCmd	Signal: Trip Command

46G[2] – Inverse Time Generator Unbalance Protection Element

The tripping characteristic of the inverse time element is described by the following formula:

$$t = \frac{K - value}{\left(\frac{I_2}{FLA}\right)^2}$$

Where:

t = trip delay

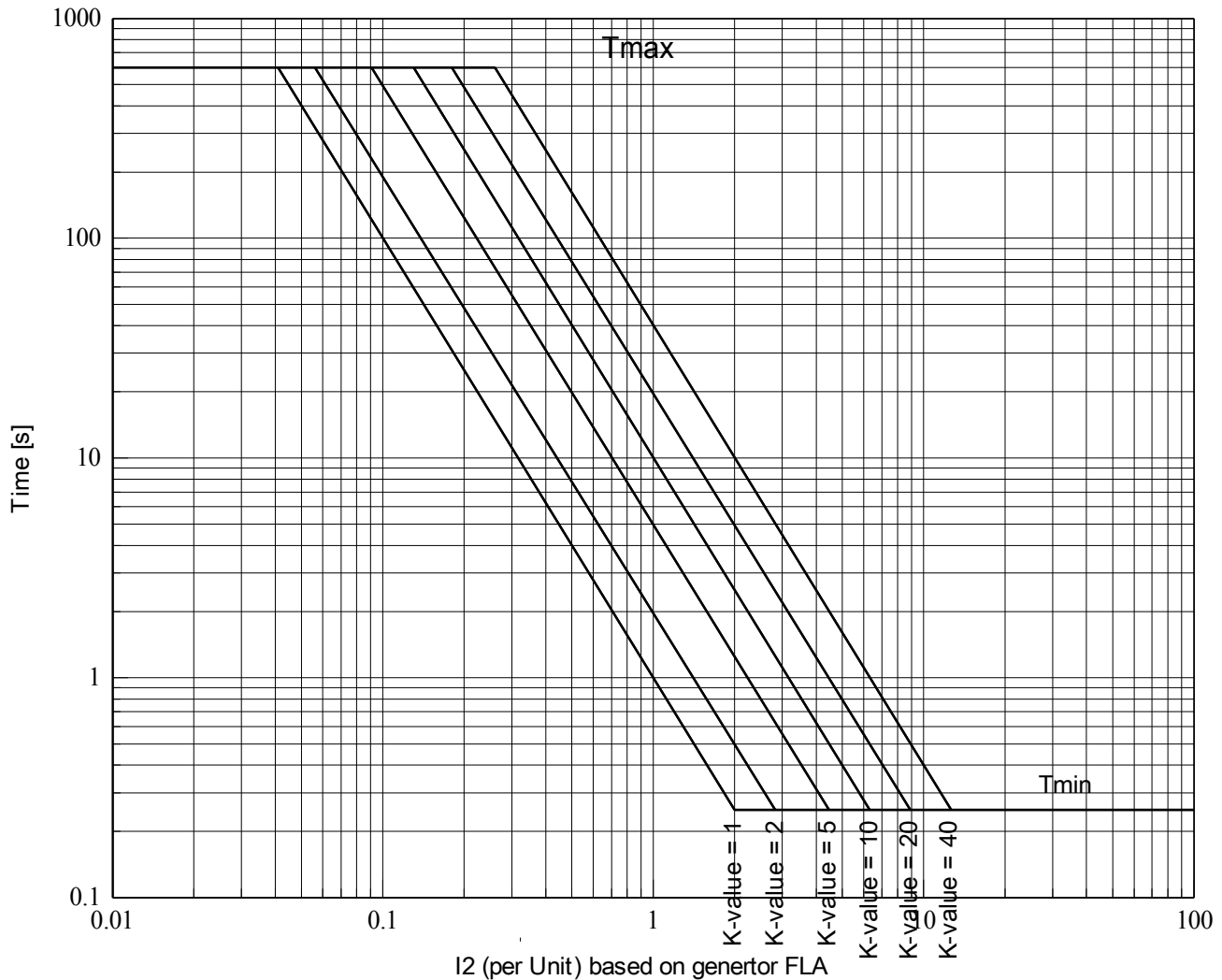
I₂ = negative phase sequence current

FLA = Full load amperage

K-value = negative sequence capability (please refer to data sheet of your machine)

The negative sequence capability K-value = (I₂/FLA)²*t stands for the generator unbalance limits of the individual machine and can normally be obtained from the data sheet.

Generator unbalance tripping curves



The before described parameters can be set in the menu [Protection Para/Set(x)/Unbalance-Prot/46G[2]-I.Unbalance].

Also the following parameters can be set.

»*Tmin*«: This is the minimum operate time of this element. The element will not operate before this time expires. This is set to prevent false trips for faults that would be cleared normally by system protections.

»*Tmax*«: This is the maximum operate time of this element. This setting can be applied to limit the maximum tripping time for low level unbalances.

The setting of »*K-reset*« defines the reset rate of this element. It is the maximum reset time from the threshold of tripping. It emulates generator cool down time.

Setting example for generator unbalance 46G[2]

Given generator data as follows:

Generator MVA rating (from Generator name plate or data sheet):	$S_{Gn} = 30 \text{ MVA}$
Generator rated voltage (from Generator name plate or data sheet):	$U_{Gn} = 4160 \text{ V}$
Generator rated current (FLA, to be calculated):	$I_{Gn} = S_{Gn} / (\sqrt{3} \cdot U_{Gn}) = \underline{\underline{4163.6 \text{ A}}}$
Generator continuous current unbalance capability: (from Generator name plate or data sheet)	8% = Pickup = <u>0.08</u>
Generator unbalance fault capability: (from Generator name plate or data sheet)	10 s (permissible $I_2^{2 \cdot t}$) = K-value = <u>10</u>
Unbalance reset (cooling) time constant: (from Generator name plate or data sheet)	$\tau_{\text{cool}} = 240 \text{ s} = \text{K-reset} = \underline{\underline{240}}$
Maximum allowed tripping time at unbalance pickup: (please see unbalance tripping curves)	$T_{\text{max}} = \underline{\underline{600 \text{ s}}}$
Minimum allowed tripping time at unbalance pickup: (please see unbalance tripping curves)	$T_{\text{min}} = \underline{\underline{0.25 \text{ s}}}$

NOTICE

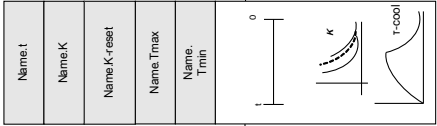
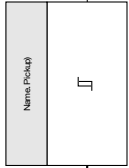
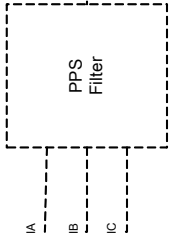
All double underlined values have to be set in the menu [Protection Para/Set(x)/Unbalance-Prot/46G[2]-I.Unbalance]

46G[1]...[n]

Name = 46G[1]...[n]

2

Please Refer to Diagram: Blockings
(Element is not deactivated and no active blocking signals.)



Name.Pickup 14

Name.Trip 15

Name.TripCmd 15a



3

Please Refer to Diagram: Trip Blockings
(Tripping command deactivated or blocked.)

Elements:
46G[2]

Device Planning Parameters of the 46G[2] - Definite Time Element

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the 46G[2] - Definite Time Element

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Unbalance-Prot /46G[2]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Unbalance-Prot /46G[2]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Unbalance-Prot /46G[2]]

Setting Group Parameters of the 46G[2] - Definite Time Element

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /46G[2]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /46G[2]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /46G[2]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /46G[2]]
Pickup 	Negative current as a percentage of the nominal (FLA) current calculated under generator/motor parameters where this element picks up. It is typically set at the maximum continuous negative sequence current rating of the machine. Only available if: Device Planning: 51Q.Mode = 46G	0.000 - 1.000FLA	0.08FLA	[Protection Para /<1..4> /Unbalance-Prot /46G[2]]
K-value 	This setting is the negative sequence capability constant. This value is normally provided by the generator manufacturer (refer to ANSI C50.13 for details). Only available if: Characteristic = INV	1.00 - 200.00s	10.0s	[Protection Para /<1..4> /Unbalance-Prot /46G[2]]
K-reset 	This setting defines the linear reset rate of this element. It is the maximum reset time from the threshold of tripping. Emulates generator cool down time. Only available if: Characteristic = INV	0.0 - 60000.0s	240.0s	[Protection Para /<1..4> /Unbalance-Prot /46G[2]]

Parameter	Description	Setting range	Default	Menu path
Tmax 	This is the maximum operate time of this element. This setting can be applied to limit the maximum tripping time for low level unbalances. Only available if: Characteristic = INV	0.00 - 1000.00s	600.00s	[Protection Para /<1..4> /Unbalance-Prot /46G[2]]
Tmin 	This is the minimum operate time of this element. The element will not operate before this time expires. This is set to prevent false trips for faults that would be cleared normally by system protections. Only available if: Characteristic = INV	0.00 - 50.00s	0.25s	[Protection Para /<1..4> /Unbalance-Prot /46G[2]]

46G[2] - Definite Time Element Element Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Unbalance-Prot /46G[2]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Unbalance-Prot /46G[2]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Unbalance-Prot /46G[2]]

46G[2] - Definite Time Element Element Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup Negative Sequence
Trip	Signal: Trip
TripCmd	Signal: Trip Command

Commissioning: Generator Unbalance Module

Object to be tested:

Test of the generator unbalance protection function.

Necessary means:

- Three-phase current source with adjustable current unbalance; and
- Timer.

Procedure:

Check the phase sequence:

- Ensure that the phase sequence is the same as that set in the field parameters.
- Feed-in a three-phase nominal current.
- Change to the »Measuring Values« menu.
- Check the measuring value for the unbalanced current »*I2 Fund.*«. The measuring value displayed for »*I2 Fund.*« should be approximately zero (within the physical measuring accuracy).

NOTICE

If the displayed magnitude for *I2 Fund.* is the same as that for the balanced nominal currents fed to the relay, it implies that the phase sequence of the currents seen by the relay is reversed.

- Now turn-off phase A.
- Again check the measuring value of the unbalanced current »*I2 Fund.*« in the »Measuring Values« menu. The measuring value of the unbalanced current »*I2 Fund.*« should now be 33%.
- Turn-on phase A, but turn-off phase B.
- Once again check the measuring value of the unbalanced current *I2 Fund.* in the »Measuring Values« menu. The measuring value of the asymmetrical current »*I2 Fund.*« should be again 33%.
- Turn-on phase B, but turn-off phase C.
- Again check the measuring value of unbalanced current »*I2 Fund.*« in the »Measuring Values« menu. The measuring value of the unbalanced current »*I2 Fund.*« should still be 33%.

Testing the trip delay definite time element 46G[1]:

- Apply a balanced three-phase current system (nominal currents).
- Switch off IA (the pickup value must be below 33% of FLA).
- Measure if the tripping time corresponds to the set tripping delay.

Testing the trip delay inverse time element 46G[2]:

- Set a K-value, e. g. K-value = 5
- Calculate the resulting tripping time acc. to the *Generator unbalance tripping curves* or to the following formula

$$t = \frac{K - value}{\left(\frac{I2}{FLA}\right)^2} \quad \text{in this example} \quad t = \frac{5s}{(0.33)^2} = 46s$$

- Apply a balanced three-phase current system (nominal currents).
- Switch off IA (the threshold value » *Threshold*« for » *I2 Fund.*« must be below 33%).
-
- The present current unbalance » *I2 Fund.*« corresponds with 1/3 of the existing phase current displayed.

Measure if the tripping time corresponds to the calculated tripping delay.

Successful test result:

The measured trip delays are within the permitted deviations/tolerances, specified under Technical Data.

CLPU - Supervision Module Cold Load Pickup

Available Elements:

CLPU

When manually or automatically closing a breaker after it has been open for a prolonged time, a greater than normal load current may be experienced due to the load inrush. This high starting current causes some overcurrent elements to unnecessarily trip the breaker. The cold load pickup (CLPU) function prevents this from happening.

The cold load pickup function detects a warm-to-cold load transition according to the four selectable cold load detection modes:

- Breaker state;
- Undercurrent ($I <$);
- Breaker state AND undercurrent; and
- Breaker state OR undercurrent.

After a warm-to-cold load transition has been detected, a specified load-off timer will be started. This User-settable load-off timer is used in some cases to make sure that the load is really “cold” enough. After the load-off timer times out, the CLPU function issues an “enable” signal »CLPU.ENABLED« that can be used to block User-selected, sensitive protection elements such as instantaneous overcurrent elements, current unbalance, or power protection elements. Using this enable signal, some User-selected time inverse overcurrent elements may also be desensitized by means of activating adaptive settings of the corresponding overcurrent elements.

When a cold load condition is finished (a cold-to-warm load condition is detected) due to, for example, breaker closing or load current injection, a load inrush detector will be initiated that supervises the coming and going of the load inrush current process. A load inrush is detected if the coming load current exceeds a User-specified inrush current threshold. This load inrush is considered as finished if the load current is decreased to 90% of the inrush current threshold.

After the inrush current is diminished, a settle timer starts. The cold load pickup enable signal can only be reset after the settle timer times out. Another max-Block timer, which is started parallel with the load inrush detector after a cold load condition is finished, may also terminate the CLPU enable signal if a load inrush condition is prolonged abnormally.

The cold load pickup function can be blocked manually by external or internal signal at the User’s choice. For the devices with the Auto-Reclosing function, the CLPU function will be blocked automatically if auto-reclosure is initiated (AR is running).



This module issues a signal only (it is not armed).

In order to influence the tripping settings of the overcurrent protection, the User has to assign the signal “CLPU.ENABLED” to an adaptive parameter set. Please refer to the Parameter / Adaptive Parameter Sets section. Within the adaptive parameter set, the User has to modify the tripping characteristic of the overcurrent protection according to the needs.

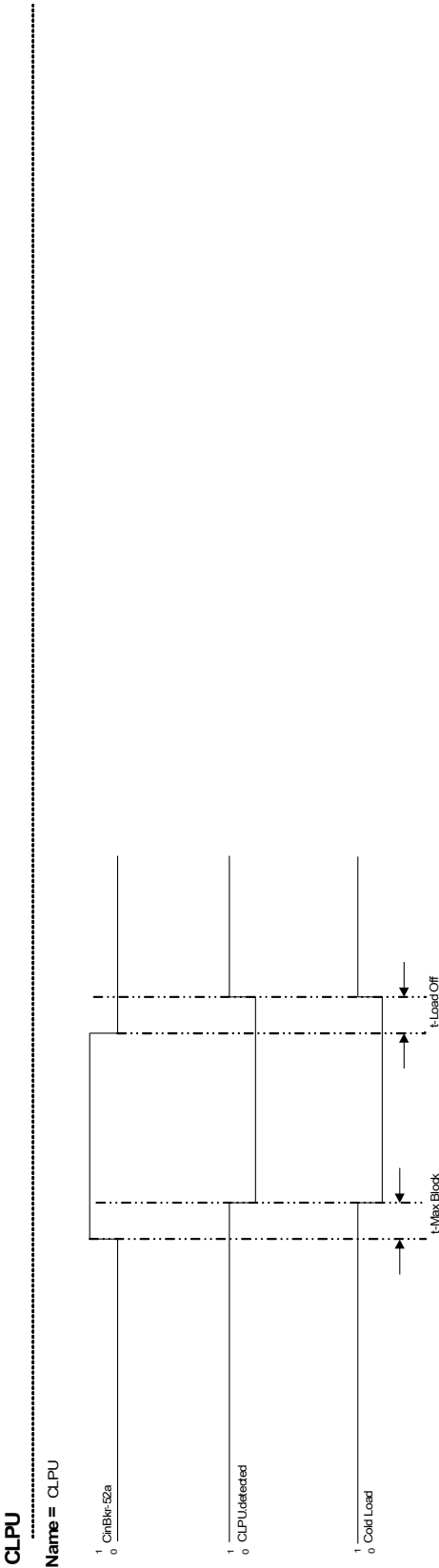
NOTICE

Please be aware of the meaning of the two delay timers.

t load Off (Pickup Delay): After this time expires, the load is no longer diversified.

t Max Block (Release Delay): After the starting condition is fulfilled (e.g.: breaker switched on manually), the “CLPU.enabled” signal will be issued for this time. That means for the duration of this time, the tripping thresholds of the overcurrent protection can be desensitized by means of adaptive parameters (please refer to the Parameters section). This timer will be stopped if the current falls below 0.9 times of the threshold of the load inrush detector and remains below 0.9 times of the threshold for the duration of the settle time.

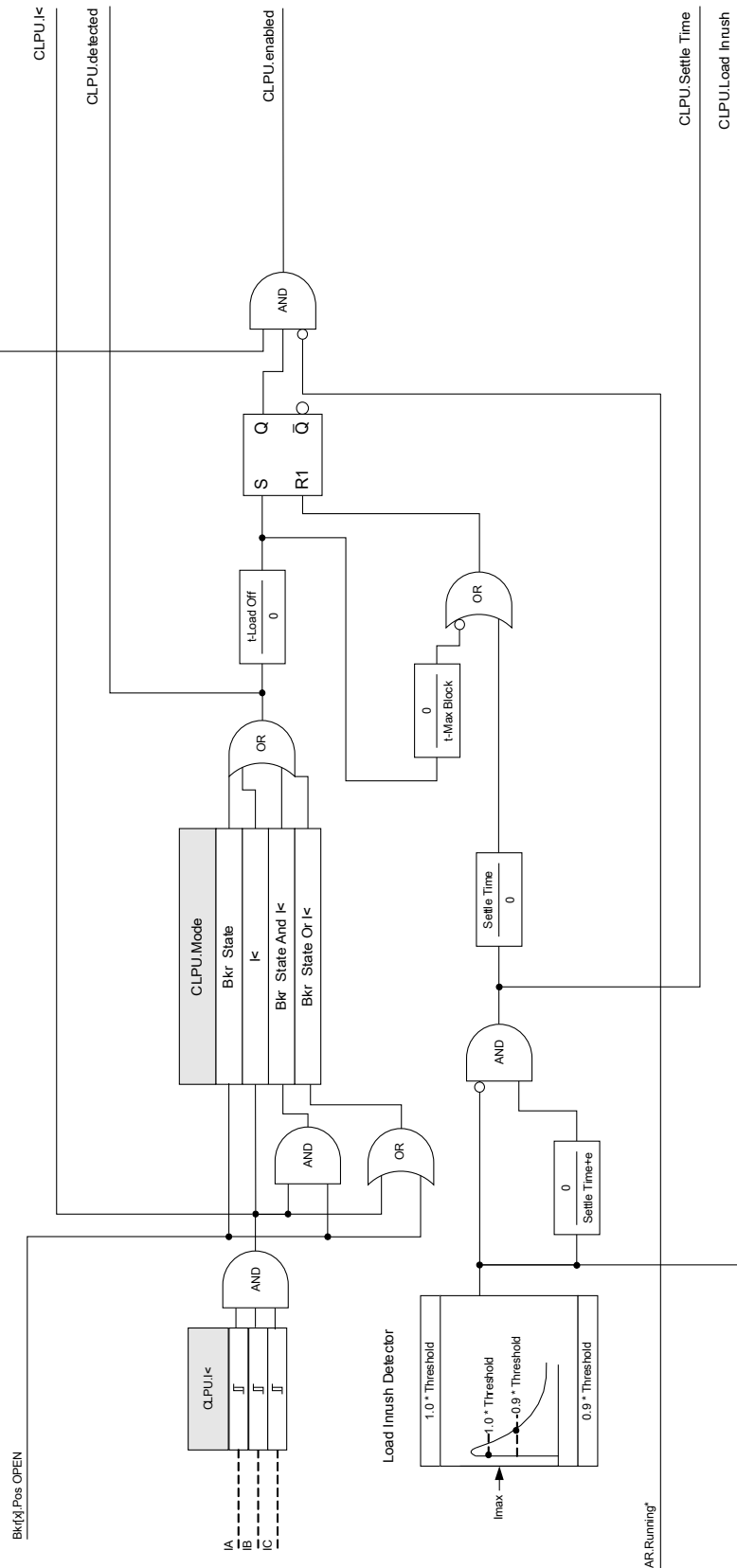
Example Mode: Breaker Position



CLPU

Name = CLPU

2 Please Refer to Diagram: Blockings
(Element is not deactuated and no active blocking signals.)



*Applies only for devices with Auto Reclosure

Device Planning Parameters of the Cold Load Pickup Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Do not use	[Device Planning]

Global Protection Parameter of the Cold Load Pickup Module

Parameter	Description	Setting range	Default	Menu path
Mode 	Mode	Bkr State, I<, Bkr State Or I<, Bkr State And I<	Bkr State	[Protection Para /Global Prot Para /CLPU]
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /CLPU]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /CLPU]
Rvs Blo 	Reverse Blocking, if Reverse Blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /CLPU]

Set Parameters of the Cold Load Pickup Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /CLPU]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /CLPU]
Rvs Blo Fc 	Activate (allow) or inactivate (disallow) reverse blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/element are blocked that are parameterized "Rvs Blo Fc = active".	Inactive, Active	Inactive	[Protection Para /<1..4> /CLPU]
t-Load Off 	Select the outage time required for a load to be considered cold. If the Pickup Timer (Delay) has run out, a Cold Load Signal will be issued.	0.00 - 7200.00s	10s	[Protection Para /<1..4> /CLPU]
t-Max Block 	Select the maximum amount of time allowed for cold load pickup to be active; if the time has elapsed a warm load signal will be issued.	0.00 - 300.00s	10s	[Protection Para /<1..4> /CLPU]
I< 	The breaker is in the OPEN Position, if the measured current is less than this parameter.	0.01 - 1.00In	0.01In	[Protection Para /<1..4> /CLPU]
Threshold 	Set the load current inrush threshold.	0.10 - 4.00In	1.2In	[Protection Para /<1..4> /CLPU]
Settle Time 	Select the time for the cold load inrush.	0.00 - 300.00s	1.00s	[Protection Para /<1..4> /CLPU]

States of the Inputs of the Cold Load Pickup Module

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking	[Protection Para /Global Prot Para /CLPU]
ExBlo2-I	Module Input State: External Blocking	[Protection Para /Global Prot Para /CLPU]
Rvs Blo-I	Module Input State: Reverse Blocking	[Protection Para /Global Prot Para /CLPU]

Signals of the Cold Load Pickup Module (States of the Outputs)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Rvs Blo	Signal: Reverse Blocking
enabled	Signal: Cold Load enabled
detected	Signal: Cold Load detected
I<	Signal: No Load Current.
Load Inrush	Signal: Load Inrush
Settle Time	Signal: Settle Time

Commissioning of the Cold Load Pickup Module

Object to be tested:

Testing the Cold Load Pickup module according to the configured operating mode:

- I< (No current);
- Bkr state (Breaker position);
- I< (No Current) and Bkr state (Breaker position); and
- I< (No Current) or Bkr state (Breaker position).

Necessary means:

- Three-phase current source (if the Enable Mode depends on current);
- Ampere meters (may be needed if the Enable Mode depends on current); and
- Timer.

Test Example for Mode Bkr State (Breaker Position)

NOTICE

Mode I<: In order to test the tripping delay, start the timer then feed with an abruptly changing current that is distinctly less than the I<-threshold. Measure the tripping delay. In order to measure the drop-out ratio, feed an abruptly changing current that is distinctly above the I<-threshold.

Mode I< and Bkr state: Combine the abruptly changing current (switching the current ON and OFF) with the manual switching ON and OFF of the breaker.

Mode I< or Bkr state: Initially carry out the test with an abruptly changing current that is switched ON and OFF (above and below the I<-threshold). Measure the tripping times. Finally, carry out the test by manually switching the breaker ON and OFF.

- The breaker has to be in the OFF position. There must not be any load current.
- The Status Display of the device shows the signal "CLPU.ENABLED"=1.
- The Status Display of the device shows the signal "CLPU.I<="=1.

Testing the tripping delay and the resetting ratio:

- Manually switch the breaker ON and simultaneously start the timer.
- After the the »t Max Block (Release Delay)« timer has expired, the signal "CPLU.Enabled"=0 has to be false.
- Write down the measured time.
- Manually switch the breaker OFF and simultaneously start the timer.
- After the »t load Off« timer has expired, the signal "CPLU.ENABLED"=1 has to become true.
- Write down the measured time.

Successful test result:

The measured total tripping delays or individual tripping delays, threshold values, and drop-out ratios correspond with those values specified in the adjustment list. Permissible deviations/tolerances can be found in the Technical Data section.

SOTF - Switch Onto Fault Protection

SOTF

In case a faulty line is energized (e.g.: when an grounding switch is in the CLOSE position), an instantaneous trip is required. The SOTF module is provided to generate a permissive signal for other protection functions such as overcurrents to accelerate their trips. The SOTF condition is recognized according to the User's operation mode that can be based on:

- The breaker state;
- No current flowing;
- Breaker state and no current flowing;
- Breaker switched on manually; and/or
- An external trigger.

This protection module can initiate a high speed trip of the overcurrent protection modules. The module can be started via a digital input that indicates that the breaker is manually closed.



This module issues a signal only (the module is not armed and does not issue a trip command).

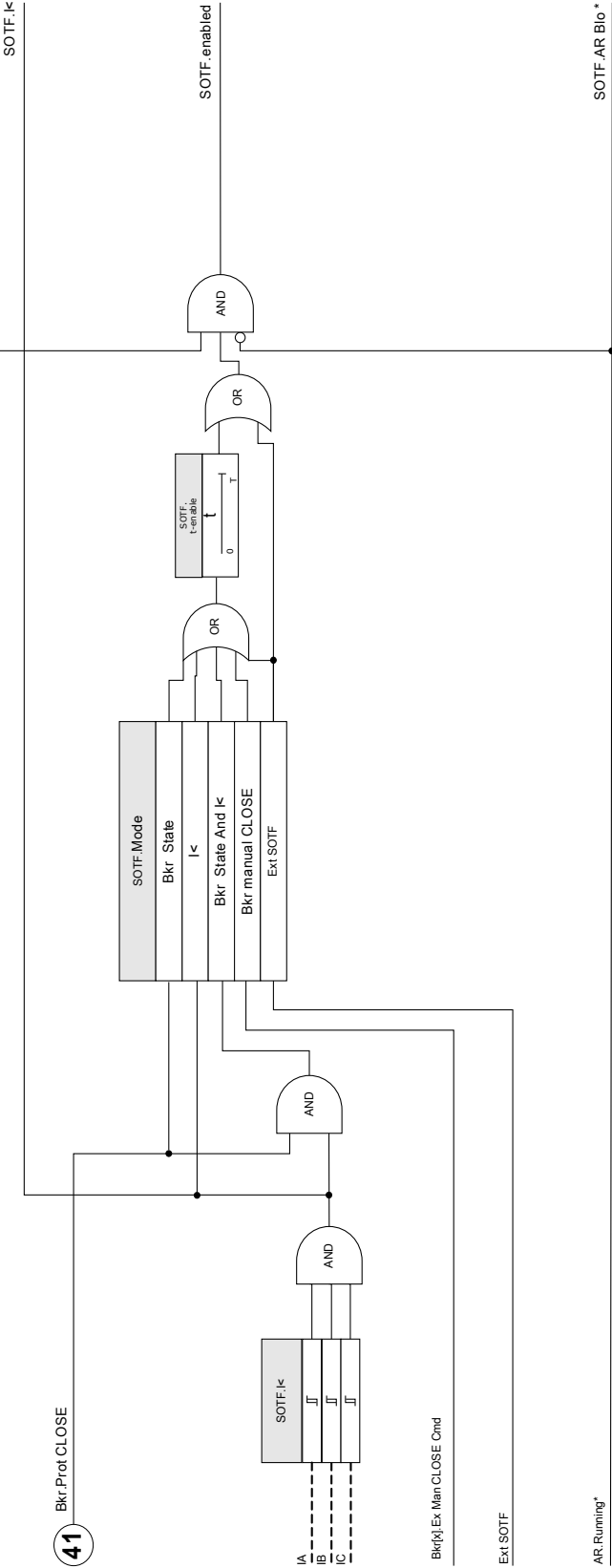
In order to influence the trip settings of the overcurrent protection in case of switching onto a fault, the User has to assign the signal "SOTF.ENABLED" to an Adaptive Parameter Set. Please refer to Parameter / Adaptive Parameter Sets sections. Within the Adaptive Parameter Set, the User has to modify the trip characteristic of the overcurrent protection according to the User's needs.

SOTF

Name = SOTF

2

Please Refer to Diagram: Blockings
(Element is not deactivated and no active blocking signals.)



*Applies only for devices with Auto Reclosure

Device Planning Parameters of the Switch Onto Fault Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Do not use	[Device Planning]

Global Protection Parameters of the Switch Onto Fault Module

Parameter	Description	Setting range	Default	Menu path
Mode 	Mode	Bkr State, I<, Bkr State And I<, Bkr manual CLOSE, Ext SOTF	Bkr manual CLOSE	[Protection Para /Global Prot Para /SOTF]
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /SOTF]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /SOTF]
Rvs Blo 	Reverse Blocking, if Reverse Blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /SOTF]
Ext SOTF 	External Switch Onto Fault Only available if: Mode = Ext SOTF	1..n, DI-LogicList	.-	[Protection Para /Global Prot Para /SOTF]

Setting Group Parameters of the Switch Onto Fault Module

Parameter	Description	Setting range	Default	Menu path
 Function	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /SOTF]
 ExBlo Fc	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /SOTF]
 Rvs Blo Fc	Activate (allow) or inactivate (disallow) reverse blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/element are blocked that are parameterized "Rvs Blo Fc = active".	Inactive, Active	Inactive	[Protection Para /<1..4> /SOTF]
 I<	The breaker is in the OPEN Position, if the measured current is less than this parameter.	0.01 - 1.00In	0.01In	[Protection Para /<1..4> /SOTF]
 t-enable	While this timer is running, and while the module is not blocked, the Switch Onto Fault Module is effective (SOTF is armed).	0.10 - 10.00s	2s	[Protection Para /<1..4> /SOTF]

Switch Onto Fault Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking	[Protection Para /Global Prot Para /SOTF]
ExBlo2-I	Module Input State: External Blocking	[Protection Para /Global Prot Para /SOTF]
Rvs Blo-I	Module Input State: Reverse Blocking	[Protection Para /Global Prot Para /SOTF]
Ext SOTF-I	Module Input State: External Switch Onto Fault Alarm	[Protection Para /Global Prot Para /SOTF]

Signals of the Switch Onto Fault Module (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Rvs Blo	Signal: Reverse Blocking
enabled	Signal: Switch Onto Fault enabled. This Signal can be used to modify Overcurrent Protection Settings.
I<	Signal: No Load Current.

Commissioning: Switch Onto Fault [ANSI 50HS]

Object to be tested:

Testing the module Switch Onto Fault according to the configured operating mode:

- I< (No current);
- Bkr state (Breaker position);
- I< (No current) and Bkr state (Breaker position); and
- Bkr manual CLOSE.

Necessary means:

- Three-phase current source (if the Enable Mode depends on current);
- Ampere meters (may be needed if the Enable Mode depends on current); and
- Timer.

Test Example for Mode Bkr Manual CLOSE

NOTICE

Mode I< (In order to test the effectiveness): Initially, do not feed any current. Start the timer and feed with an abruptly changing current that is distinctly greater than the I<-threshold to the measuring inputs of the relay.

Mode I< and Bkr state: Simultaneously, manually switch on the breaker and feed with an abrupt change current that is distinctly greater than the I<-threshold.

Mode Bkr state: The breaker has to be in the OFF position. The signal „SOTF.ENABLED“=0 is false. If the breaker is switched on, the signal „SOTF.ENABLED“=1 becomes true as long as the timer t-effective is running.

- The breaker has to be in the OPEN position. There must be no load current.
- The status display of the device shows the signal "SOTF.ENABLED"=1.

Testing:

- Manually switch the breaker to the CLOSE position and start the timer at the same time.
- After the hold time t-enable is expired, the state of the signal has to change to "SOTF.enabled"=0.
- Write down the measured time.

Successful test result:

The measured total tripping delays or individual tripping delays, threshold values, and drop-out ratios correspond with those values, specified in the adjustment list. Permissible deviations/tolerances can be found in the Technical Data section.

40 - Loss of Excitation

NOTICE

If the loss of excitation is to be used in work two zones, the User has to use a 40-Z1 and a 40-Z2 element.

This flexible protective function detects the partial or complete loss of excitation using a pair (Z1 and Z2) of offset mho circles. Because of balanced feature under loss-of-excitation conditions the »*positive phase sequence impedances*« are measured and used to set the offset mho zones.

There are four protective elements available: two Z1 elements (40-Z1[1/2]) and two Z2 elements (40-Z2[1/2]), so that two independent, complete loss of excitation functions can be realized if needed.

Each of the four 40-elements offers an adjustable offset mho characteristic with its tripping time delay »*t-Mho*« and a *voltage-controlled tripping acceleration* »*V< Acc Trip*« function. The »*Mho diameter*« and »*Mho offset*« determines the operating zone of an offset mho characteristic. The offset of a mho characteristic can be set from -250 Ohm to +250 Ohm (for 1 A CTs) which determines the location of the mho circle on the reactance axis. A negative offset setting makes the mho characteristic on the III and IV quarters with a minus offset to the original (ref. to Z1/Z2 mho circle in option 1), whereas a positive offset setting makes the mho circle stretched into the I and II quarters with a plus offset to original (ref. to Z2 mho circle in option 2). A trip for the corresponding zone occurs if the measured positive sequence impedance is inside the mho zone longer than the set time delay »*t-Mho*«. The voltage controlled feature "accelerates", if enabled, the tripping with the set time »*t-V<*« (that is usually set less than »*t-Mho*«) if the positive sequence voltage is below the voltage control setting »*V<*«. The purpose of the voltage control is to have a faster tripping in case the reactive power consumption of the generator causes significant low voltage.

The two 40-Z2 elements additionally offer a directional feature that can be enabled or disabled. This "directional blinder" »*Z directional*« is provided to block the relay operation in case of slightly under-excitations by using a positive offset mho zone (ref. to Z2 in option 2). In case of a negative offset, the direction is implied and a directional element is, therefore, not required. The angle »*Dir Angle*« for determining the direction can be set in a range from -20° to 0.

The time delay for Z2 offset mho elements has to be set long enough to prevent a malfunction (faulty tripping) e.g.: during stable power swing.

NOTICE

Please note, that the allowed setting ranges for the use of 1 A and 5 A CTs are different!

For 1 A CTs:

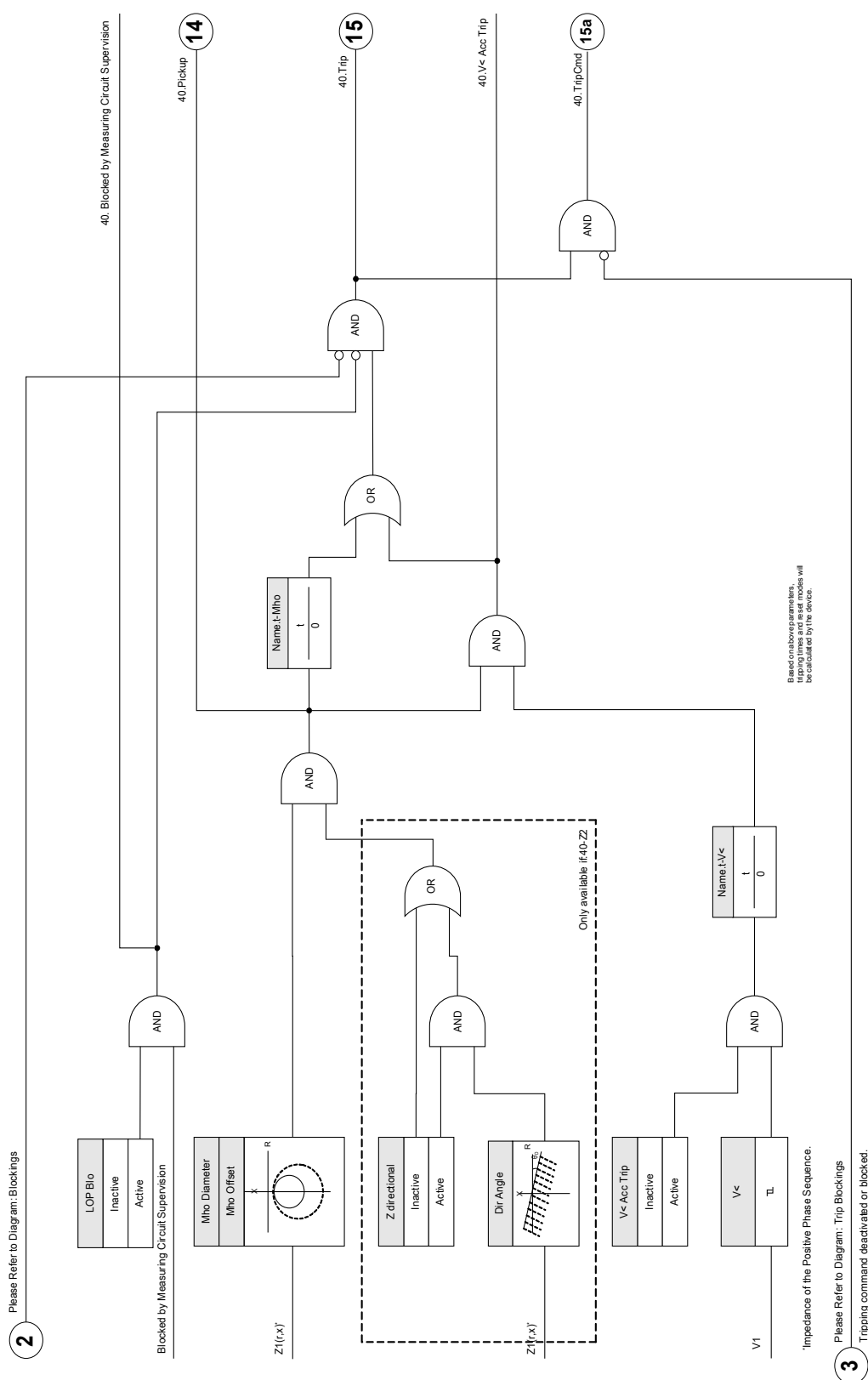
Setting Range Diameter: 5 ... 500 Ohm

Setting Range Offset: -250 ... +250 Ohm

For 5 A CTs:

Setting Range Diameter: 1 ... 100 Ohm

Setting Range Offset: -50 ... +50 Ohm



Application Notes

1. The 40 protective function provides loss-of-excitation protection in two options:
 - For generator-bus connection (option 1) and
 - For generator and unit transformer connection (option 2).
2. To set the loss of excitation function properly, the following generator and system data should be available:
 - Generator transient reactance x'_d ;
 - Generator synchronous reactance x_d ;
 - Generator rated voltage (phase-to-phase);
 - Generator rated current (FLA);
 - Current transformer (CT ratio);
 - Voltage transformer (VT ratio); and
 - Step-up transformer reactance X_T (In case of option 2).
3. All impedance settings are secondary relay quantities and can be derived from the following formula:
$$Z_{SEC} = Z_{PRI} \times (RC \div RV)$$

Where:

 - Z_{SEC} = Set impedance in secondary ohms;
 - Z_{PRI} = Set impedance in primary ohms;
 - RC = Current transformer ratio; and
 - RV = Voltage transformer ratio.
4. By setting an mho circle, the diameter should be set greater than the offset of the circle. This is usually also the case in the real applications.

Setting Example for Loss of Excitation Function

Generator Technical Data:

MVA:	200 MVA
Voltage (Ph-Ph):	15.75 kV
Generator rated current (FLA):	$200 \text{ MVA} / (\sqrt{3} * 15.75 \text{ kV}) = 7331 \text{ A}$
X'd:	0.2428 pu
Xd:	1.908 pu
CT ratio:	8000 A/1 A = 8000
PT ratio:	15800 V/100 V = 158

Setting Calculation:

Primary Base Impedance:	$Z_{b,Prim} = \text{Base kV}^2 / \text{Base MVA} = (15.75 \text{ kV})^2 / 200 \text{ MVA} = 1.24 \Omega$
Secondary Base Impedance:	$Z_{b,Sec} = Z_{b,Prim} * \text{CT/PT} = 1.24 \Omega * 8000 / 158 = 62.78 \Omega$
Transient Reactance in secondary:	$X'_{d,Sec} = X'_d * Z_{b,Sec} = 0.2408 \text{ pu} * 62.78 \Omega = 15.12 \Omega$
Synchronous Reactance in secondary:	$X_{d,Sec} = X_d * Z_{b,Sec} = 1.908 \text{ pu} * 62.78 \Omega = 119.78 \Omega$

Setting Recommendation:

Zone 1 Settings (40-Z1[1]):

Mho Offset:	$-X'_{d,Sec}/2 = -7.6 \Omega$
Mho Diameter:	$1.0 \text{ pu} = Z_{b,Sec} = 62.8 \Omega$
t-mho:	0.25 s

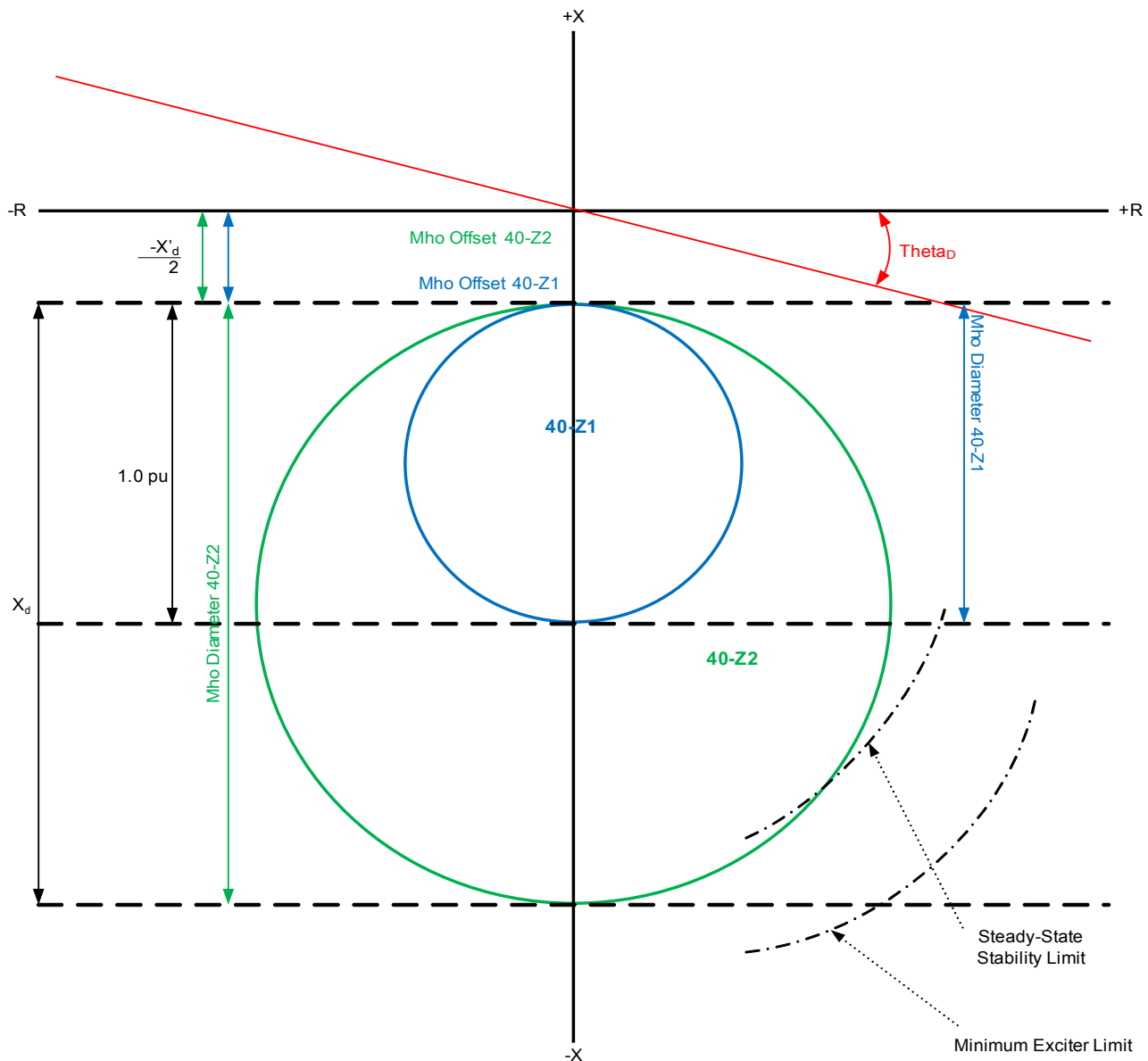
Zone 2 Settings (40-Z2[1]):

Mho Offset:	$-X'_{d,Sec}/2 = -7.6 \Omega$
Mho Diameter:	$X_{d,Sec} = 119.8 \Omega$
t-mho:	1.0 s

Option 1 (generator)

The offset for both mho-elements is $-X'_d \div 2$. X'_d is the (saturated) direct axis transient reactance of the generator.

The diameter of the smaller circle (40-Z1) is set at 1.0 pu impedance on the generator base. The purpose of this element is to detect the loss of excitation in a range from full load to approx. 30%. The protection will be very fast if the delay time is set very short. The diameter of the second (larger) circle (40-Z2) is set to X_d . X_d is the (unsaturated) direct axis synchronous reactance of the generator. The purpose of the second mho element is to detect the loss of excitation in a range from full load to nearly 0% load. A time delay of approximately 30 to 60 cycles (40-Z2) prevents malfunction on stable swings. The time delay with voltage control is to be set shorter than the other time delay.



Option 2 (generator and unit transformer)

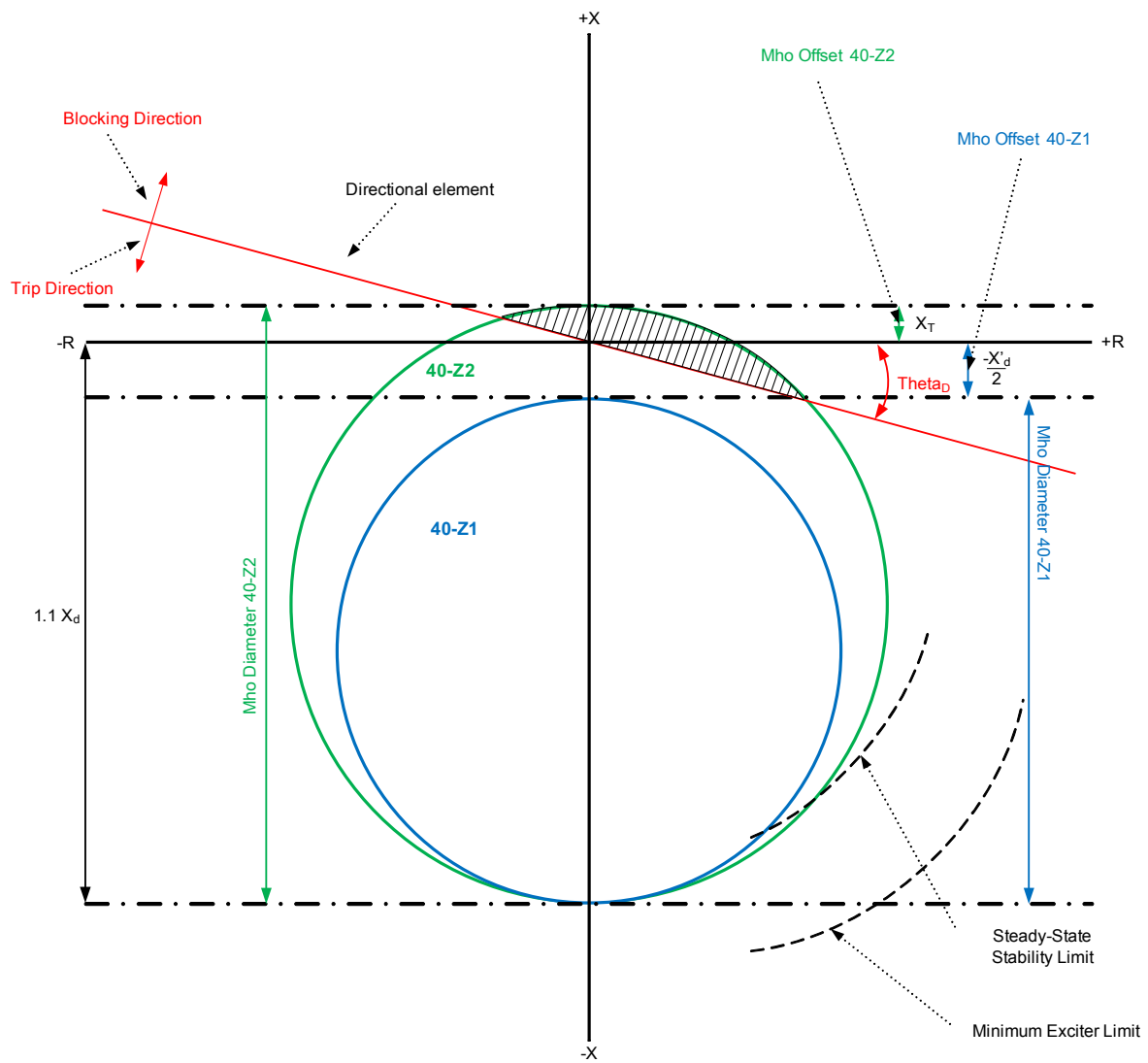
In this approach, one of the mho elements is set with an offset of $-X'_d \div 2$, a diameter of $1.1 X_d - (X'_d \div 2)$, and a time delay of 10 to 30 cycles. The second circle (40-Z2) coordinates the minimum excitation limit of the generator with the steady state limit of the generator. The diameter of this element is nearly equal to $(1.1 X_d + X_T)$. The proper coordination requires to set the offset of this element positive. The positive offset is typically set equal to the reactance (XT) of the transformer unit.

A time delay of approximately 30 to 60 cycles prevents malfunction on stable swings.

If the voltage control is used, the following time settings are additionally suggested to the standard delay times.

	<u>40-Z1</u>	<u>40-Z2</u>
Voltage Control	--	80-90% of the nominal voltage
»t-mho«	250 ms	60 s
»t-V« (with accelerated trip/voltage control)	Disable	1 s

Typical setting is 13° (0.974 power factor). This setting is common to both element 40-Z1 and 40-Z2. Option1 can also be used for 40-Z1, and option2 for 40-Z1. Thus a better coordination with the limits of AVR, generator capabilities, and steady state stability limits can be achieved.



Available 40Z1 Elements
 40-Z1[1], 40-Z1[2]

Device Planning Parameters of the 40Z1 Element

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the 40Z1 Element

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /LossOfExcitation /40-Z1[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /LossOfExcitation /40-Z1[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /LossOfExcitation /40-Z1[1]]

Setting Group Parameters of the 40Z1 Element

Parameter	Description	Setting range	Default	Menu path
 Function	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /LossOfExcitation /40-Z1[1]]
 ExBlo Fc	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /LossOfExcitation /40-Z1[1]]
 Blo TripCmd	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /LossOfExcitation /40-Z1[1]]
 ExBlo TripCmd Fc	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /LossOfExcitation /40-Z1[1]]
 LOP Blo	Activates the use of the measuring circuit supervision. In this case the module will be blocked if a measuring circuit supervision module (e.g. LOP, VTS) signals a disturbed measuring circuit (e.g. caused by a fuse failure).	Inactive, Active	Inactive	[Protection Para /<1..4> /LossOfExcitation /40-Z1[1]]
 Mho Diameter	Mho Zone diameter in ohm (secondary value).	0.2 - 750.0Ohm	13.4Ohm	[Protection Para /<1..4> /LossOfExcitation /40-Z1[1]]
 Mho Offset	Mho Zone offset reactance in ohm (secondary value).	-250.0 - +250.0Ohm	-2.5Ohm	[Protection Para /<1..4> /LossOfExcitation /40-Z1[1]]

Parameter	Description	Setting range	Default	Menu path
t-Mho 	Mho Zone pickup time delay.	0.00 - 400.00s	0.25s	[Protection Para /<1..4> /LossOfExcitation /40-Z1[1]]
V< Acc Trip 	Mho Zone Accelerated trip for loss of voltage active or inactive.	Inactive, Active	Inactive	[Protection Para /<1..4> /LossOfExcitation /40-Z1[1]]
V< 	Mho Zone Voltage pickup level Only available if: V< Acc Trip = Active	0.01 - 1.30Vn	0.80Vn	[Protection Para /<1..4> /LossOfExcitation /40-Z1[1]]
t-V< 	Trip Delay for the Undervoltage Only available if: V< Acc Trip = Active	0.00 - 300.00s	0.00s	[Protection Para /<1..4> /LossOfExcitation /40-Z1[1]]

40Z1 Element Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /LossOfExcitation /40-Z1[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /LossOfExcitation /40-Z1[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /LossOfExcitation /40-Z1[1]]

40Z1 Element Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup Loss of Excitation
Trip	Signal: Trip
TripCmd	Signal: Trip Command
V< Acc Trip	Signal: V< Acc Trip
MeasCircuitSupv Blo	Blocked by Measuring Circuit Supervision

Available 40Z2 Elements

40-Z2[1], 40-Z2[2]

Device Planning Parameters of the 40Z2 Elements

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the 40Z2 Elements

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /LossOfExcitation /40-Z2[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /LossOfExcitation /40-Z2[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /LossOfExcitation /40-Z2[1]]

Setting Group Parameters of the 40Z2 Elements

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]
LOP Blo 	Activates the use of the measuring circuit supervision. In this case the module will be blocked if a measuring circuit supervision module (e.g. LOP, VTS) signals a disturbed measuring circuit (e.g. caused by a fuse failure).	Inactive, Active	Inactive	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]
Mho Diameter 	Mho Zone diameter in ohm (secondary value).	0.2 - 750.0Ohm	25.0Ohm	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]
Mho Offset 	Mho Zone offset reactance in ohm (secondary value).	-250.0 - +250.0Ohm	-2.5Ohm	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]

Parameter	Description	Setting range	Default	Menu path
t-Mho 	Mho Zone pickup time delay.	0.00 - 400.00s	60.0s	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]
Z directional 	Mho Zone Directional Supervision active or inactive .	Inactive, Active	Inactive	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]
Dir Angle 	Mho Zone Directional Supervision Angle. Only available if: Dir Angle = Active	-20 - 0°	-10°	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]
V< Acc Trip 	Mho Zone Accelerated trip for loss of voltage active or inactive.	Inactive, Active	Active	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]
V< 	Mho Zone Voltage pickup level Only available if: V< Acc Trip = Active	0.01 - 1.30Vn	0.80Vn	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]
t-V< 	Trip Delay for the Undervoltage Only available if: V< Acc Trip = Active	0.00 - 300.00s	1.0s	[Protection Para /<1..4> /LossOfExcitation /40-Z2[1]]

40Z2 Element Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /LossOfExcitation /40-Z2[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /LossOfExcitation /40-Z2[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /LossOfExcitation /40-Z2[1]]

40Z2 Element Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup Loss of Excitation
Trip	Signal: Trip
TripCmd	Signal: Trip Command
V< Acc Trip	Signal: V< Acc Trip
MeasCircuitSupv Blo	Blocked by Measuring Circuit Supervision

49 - Thermal Overload Protection

49

One thermal overload protection function is provided for tripping and alarming based on the thermal model using the maximum phase current (transformer only - from either winding 1 or winding 2) based on the User's choice.

NOTICE

This thermal overload protection function applies to transformers ONLY.

The thermal model, with preload current taken into account, is in compliance with IEC255-8 (VDE 435 T301). The thermal tripping limit is determined by the so called overload factor K multiplying the maximum permissible continuous phase current I_b . I_b is also referred to as the base current or rated current, which can be found from the transformer (or other equipment to be protected) name plate. The overload factor K must be determined based on the transformer type and its cooling method (or other equipment to be protected). The transformer with natural cooling may have less tolerance on overload while other types of transformer with forced cooling (oil or air) may be allowed to run under substantial overload for a relatively long time.

The warming and cooling process of the thermal overload model is dictated by the warming, cooling constants τ (« t_{warm} », « t_{cool} »). « t_{warm} » is the time in which the temperature of the operating equipment to be protected has reached 63% of the stationary operating temperature under rated load current after switching on. « t_{cool} » is the time in which the temperature of the operating equipment to be protected has dropped 63% of the stationary operating temperature when switching off from the rated load condition. These time constants may be found in the data sheet of the transformer or may be derived from test reports.

The tripping time is determined by the tripping time characteristic according to the thermal model. The alarm threshold is defined as a percentage of the thermal tripping limit.

$$t = \tau_{warm} \ln \left(\frac{I^2 - I_p^2}{I^2 - (K \cdot I_b)^2} \right)$$

Legend:

t = Tripping delay

τ_{warm} = Warming-up time constant

τ_{cool} = Cooling time constant

I_b = Base Current: Maximum permissible thermal continuous current.

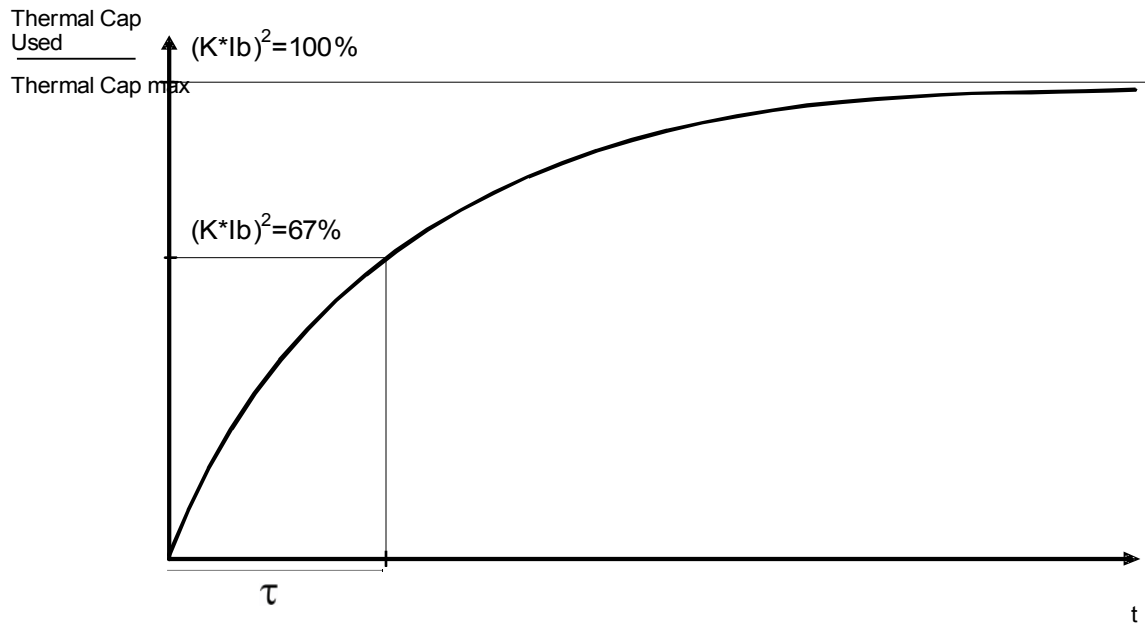
K = Overload Factor: The maximum thermal limit is defined as $k \cdot I_b$, the product of the overload factor and the base current.

I = Measured current (x In)

I_p = Preload Current

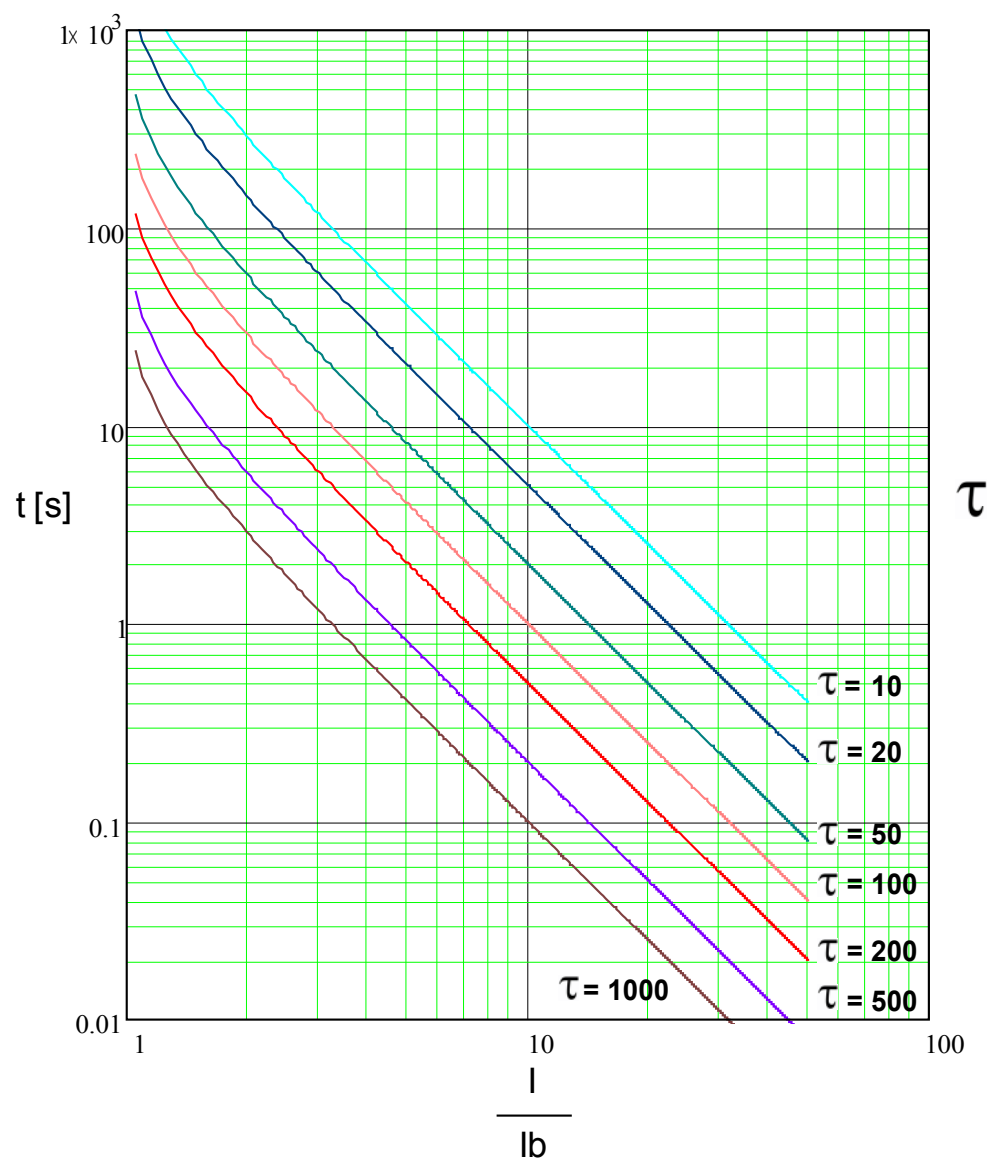
Tripping characteristic with initial load:

Characteristic with complete memory function - the heating caused by the current before the overload happens is taken into account for the thermal model of the electrical equipment to be protected.

**NOTICE**

The curves below are valid for $I_p=0$ and $K=1$.

Thermal Overload Characteristic Example – IEC Trip Characteristic for Overload Protection

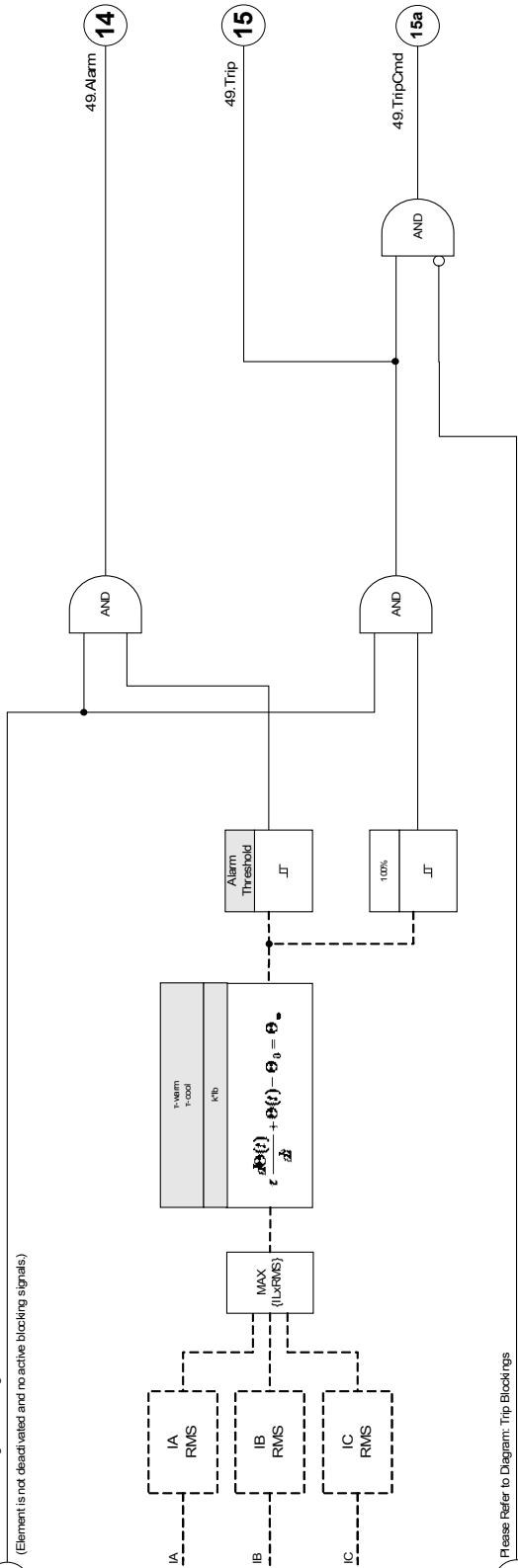


49

Name = 49

2

Please Refer to Diagram: Blockings
(Element is not deactivated and no active blocking signals.)



3

Please Refer to Diagram: Trip Blockings
(Tripping command deactivated or blocked.)

Direct Commands of the Thermal Overload Module

Parameter	Description	Setting range	Default	Menu path
Reset 	Reset the Thermal Replica	Inactive, Active	Inactive	[Operation /Reset]

Device Planning Parameters of the Thermal Overload Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Thermal Overload Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /49]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /49]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /I-Prot /49]

Setting Group Parameters of the Thermal Overload Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /49]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /49]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /49]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /I-Prot /49]
Ib 	Base Current: Maximum permissible thermal continuous current.	0.01 - 4.00In	1.00In	[Protection Para /<1..4> /I-Prot /49]
K 	Overload Factor: The maximum thermal limit is defined as $k \cdot I_B$, the product of the overload factor and the base current.	0.80 - 1.20	1.00	[Protection Para /<1..4> /I-Prot /49]
Alarm Threshold 	Alarm Threshold	50 - 100%	80%	[Protection Para /<1..4> /I-Prot /49]

Parameter	Description	Setting range	Default	Menu path
t-warm 	Warming-up time constant	1 - 60000s	10s	[Protection Para /<1..4> /I-Prot /49]
t-cool 	Cooling time constant	1 - 60000s	10s	[Protection Para /<1..4> /I-Prot /49]

Thermal Overload Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /I-Prot /49]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /I-Prot /49]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /I-Prot /49]

Signals of the Thermal Overload Module (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Alarm	Signal: Alarm Thermal Overload
Trip	Signal: Trip
TripCmd	Signal: Trip Command
Res Thermal Cap	Signal: Resetting Thermal Replica

Thermal Overload Module Values

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Thermal Cap Used	Measured value: Thermal Capacity Used	[Operation /Measured Values /49]
Time To Trip	Measured value (calculated/measured): Remaining time until the thermal overload module will trip	[Operation /Measured Values /49]

Thermal Overload Module Statistics

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Thermal Cap max	Thermal Capacity maximum value	[Operation /Statistics /Max /49]

Commissioning: Thermal Overload Model [49]

Object to be tested:

Protective function *ThR*

Necessary means:

- Three-phase current source
- Timer

Procedure:

Calculate the tripping time based on the formula provided.

NOTICE

The warming-up time constant has to be known to guarantee optimal protection.

$$t = \tau\text{-warm} \ln\left(\frac{I^2 - I_p^2}{I^2 - (K \cdot I_b)^2}\right)$$

Legend:

t = Tripping delay

$\tau\text{-warm}$ = Warming-up time constant

$\tau\text{-cool}$ = Cooling time constant

I_b = Base Current: Maximum permissible thermal continuous current.

K = Overload Factor: The maximum thermal limit is defined as $k \cdot I_b$, the product of the overload factor and the base current.

I = Measured current (x In)

I_p = Preload Current

Testing the threshold values:

Apply the current on which the mathematical calculation was based.

Testing the trip delay:

NOTICE

The thermal capacity should be zero before the test is started (see »Measuring Values«).

For testing the trip delay, a timer is to be connected to the contact of the associated trip relay. Apply the current on which the mathematical calculation was based. The timer is started as soon as the current is applied and it is stopped when the relay trips.

Successful test result:

The calculated tripping time and the drop-out ratio comply with the measured values. For permissible deviations/tolerances, please see the Technical Data section.

24 - Volts/Hertz

Available Elements

24[1] 24[2]

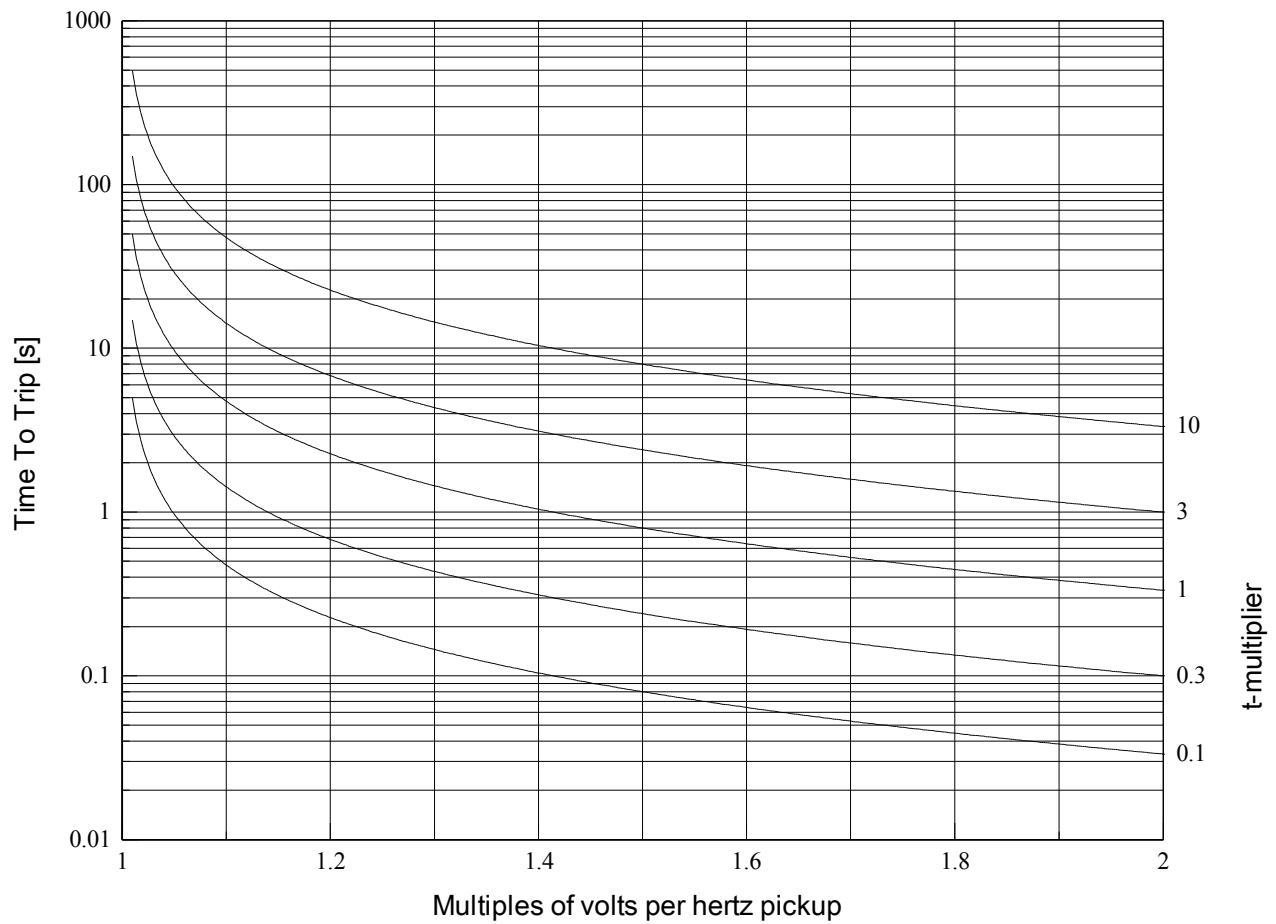
This protective element of the device provides over-excitation protection for the generator and unit connected transformers. It incorporates two elements that can be programmed to specific times and used to create traditional, two-step over-excitation protection.

In addition, the protective elements can be programmed as inverse time elements to provide advanced protection by closely approximating the combined generator/unit transformer over-excitation curve. Standard inverse time curves can be selected along with a linear reset rate that may be programmed to match the specific machine cooling characteristics.

The percent pickup is based on the Nominal Voltage and Nominal Frequency settings. The V/Hz function provides reliable measurements of V/Hz up to 200% for a frequency range of 2 - 80 Hz (normal 8-80Hz).

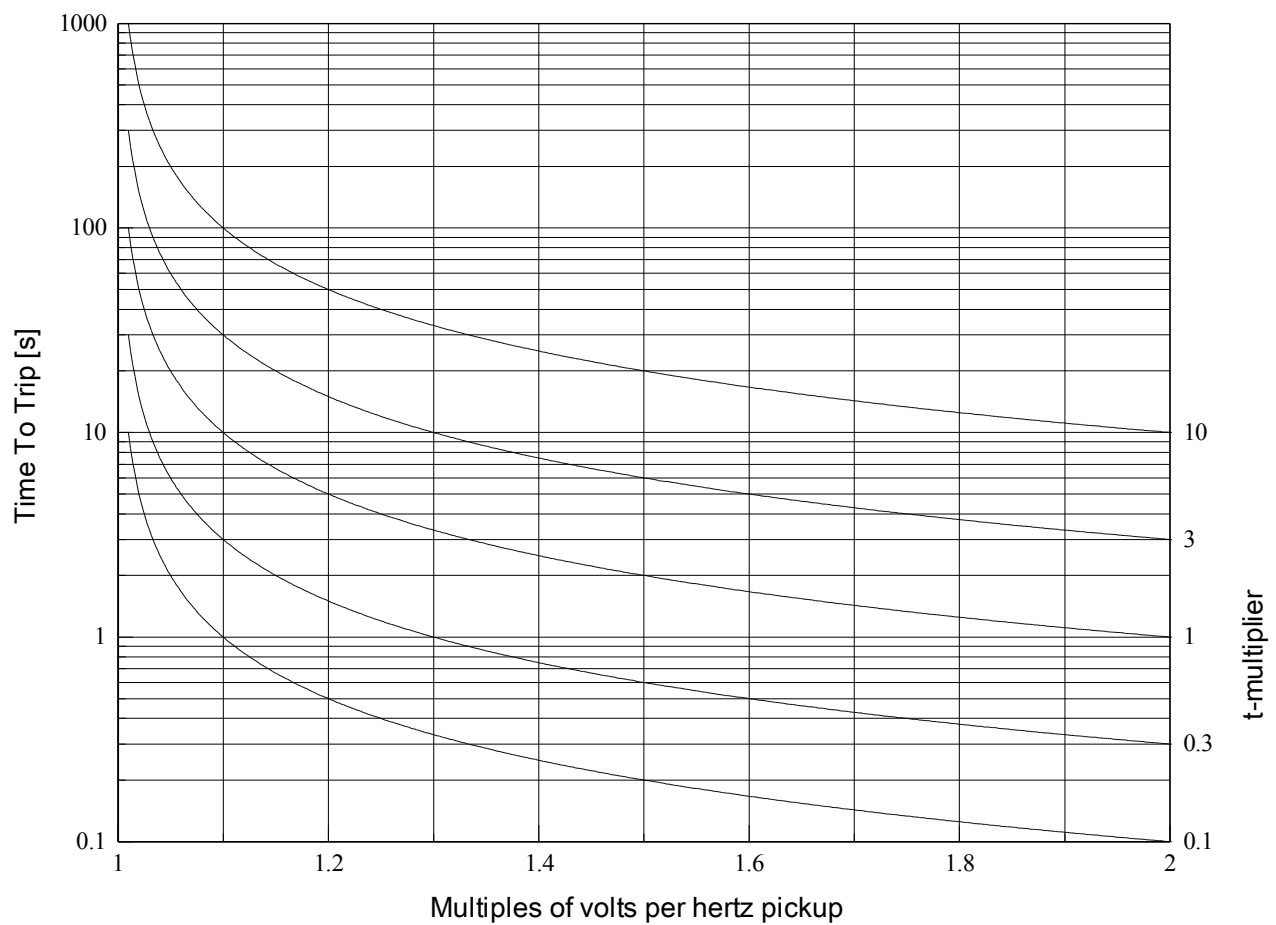
$$t = \frac{\text{t-multiplier}}{\left(\frac{\frac{V / V_n}{f / f_N}}{\text{Pickup}} \right)^2}^{-1}$$

Tripping characteristic Inverse A



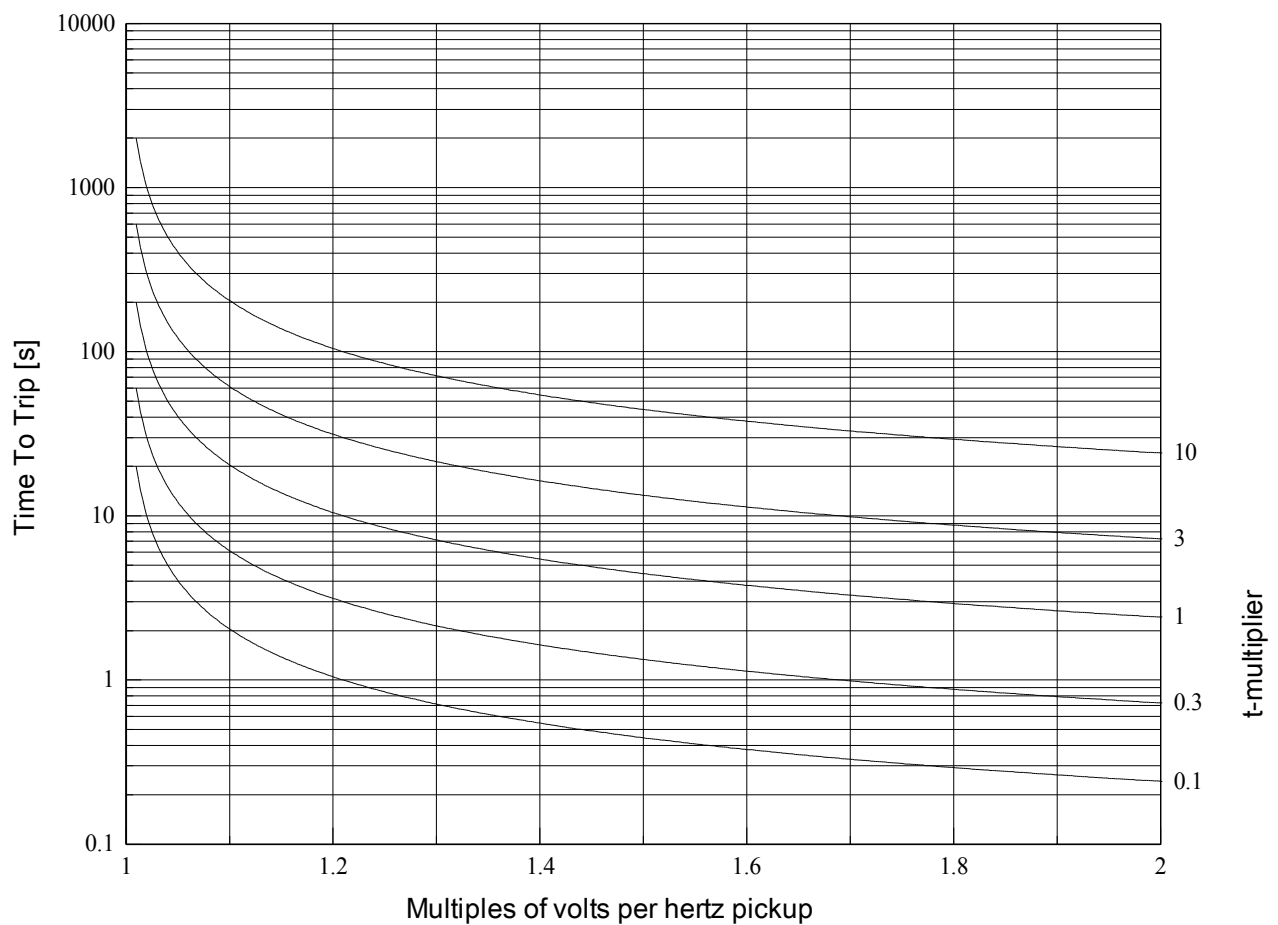
$$t = \frac{t\text{-multiplier}}{\left(\frac{\frac{V / V_n}{f / f_N}}{\text{Pickup}} \right)^{-1}}$$

Tripping characteristic Inverse B

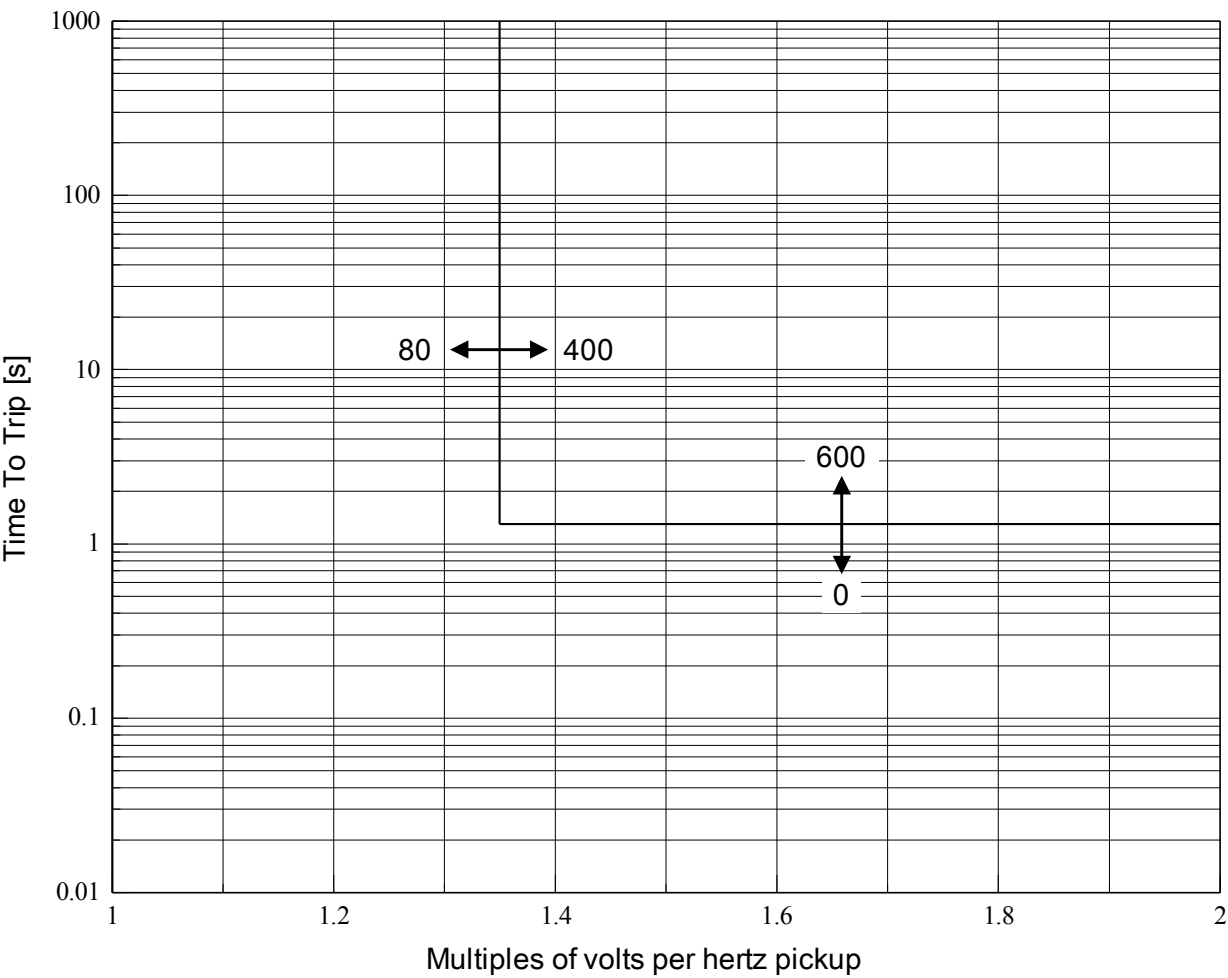


$$t = \frac{t\text{-multiplier}}{\left(\frac{\frac{V / V_n}{f / f_N}}{\text{Pickup}} \right)^{-1}}^{0.5}$$

Tripping characteristic Inverse C



Tripping characteristic DEFT (definite time)



Device Planning Parameters of the Volts/Hertz Element

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Volts/Hertz Element

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Volts/Hertz /24[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Volts/Hertz /24[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Volts/Hertz /24[1]]

Setting Group Parameters of the Volts/Hertz Element

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Volts/Hertz /24[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Volts/Hertz /24[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Volts/Hertz /24[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Volts/Hertz /24[1]]
Pickup 	If the pickup value is exceeded, the element will be started.	80.0 - 400.0%	100.0%	[Protection Para /<1..4> /Volts/Hertz /24[1]]
Curve Shape 	Tripping characteristics of V/f Over-Excitation protection.	DEFT, INV A, INV B, INV C	DEFT	[Protection Para /<1..4> /Volts/Hertz /24[1]]
t 	Tripping delay Only available if: Characteristic = DEFT	0.00 - 600.00s	1.00s	[Protection Para /<1..4> /Volts/Hertz /24[1]]

Parameter	Description	Setting range	Default	Menu path
t-multiplier 	Time Multiplier for inverse characteristics. Only available if: Characteristic = INV	0.05 - 600.00	1.00	[Protection Para /<1..4> /Volts/Hertz /24[1]]
t-reset 	Reset time for inverse characteristics. Only available if: Characteristic = INV	0.0 - 1000.0s	1.0s	[Protection Para /<1..4> /Volts/Hertz /24[1]]

Input States of the Volts/Hertz Element

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Volts/Hertz /24[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Volts/Hertz /24[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Volts/Hertz /24[1]]

Signals of the Volts/Hertz (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup
Trip	Signal: Trip
TripCmd	Signal: Trip Command

50/27 - Inadvertent Energization 50/27

Available Elements

50/27

What does inadvertent energization mean?

Inadvertent energization of a synchronous generator means that the stator winding of the generator is connected to the power system because of accident or unintended reason.

Inadvertent energization may be caused by the following events:

- Malfunctions within the control circuits;
- Flash-overs within the breaker [especially large generators (high voltages)];
- Gen-set control malfunctions; and/or
- Operator mistake(s).

What are the serious consequences of inadvertent energization?

If a synchronous generator that stands still or is close to standstill is energized inadvertently, then the generator will be accelerated like an induction unit. If a synchronous generator is energized while it stands still or is close to standstill, high currents will flow (similar to starting currents of a starting induction unit). As a consequence, the armature/rotor winding or even the entire gen-set might be damaged within seconds.

How to prevent inadvertent energization?

Inadvertent energization can be prevented by means of a special logic that evaluates overcurrent, undervoltage, and/or the state of the breaker. See block diagram on the following page.

The inadvertent energization is an overcurrent element that is released or blocked by a logic. The logic comprises a pickup and a dropout timer. The logic can be applied in two different variants to detect, that the generator is taken out of service:

- Undervoltage and Breaker status Open or
- Undervoltage or Breaker Status.

The User can choose between the two above mentioned options by means of the »Arming Signal« function.

The OR-Logic might be used if the voltage transformers are mounted on the line side.

Device Planning Parameters of the Inadvertent Energization

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Inadvertent Energization

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Inadv. Energ. 50/27]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Inadv. Energ. 50/27]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Inadv. Energ. 50/27]

Setting Group Parameters of the Inadvertent Energization

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Inadv. Energ. 50/27]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Inadv. Energ. 50/27]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Inadv. Energ. 50/27]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Inadv. Energ. 50/27]
Arming Signal 	Select if the protection is going to be enabled by "U/V and offline" or "U/V or offline".	U/V and Offline, U/V or Offline	U/V and Offline	[Protection Para /<1..4> /Inadv. Energ. 50/27]
O/C Pickup 	Typical pickup setting is 0.5 amps. No coordination is required with other protection since this function is only operational when the generator is off-line.	0.05 - 3.00In	0.05In	[Protection Para /<1..4> /Inadv. Energ. 50/27]
U/V Pickup 	The purpose of the undervoltage detector is to determine whether the unit is connected to the system. The voltage level during this accidental energization depends on the system strength. Typical setting is 50%–70% of rated voltage (in some cases, it may be set as low as 20%.)	0.20 - 0.99Vn	0.5Vn	[Protection Para /<1..4> /Inadv. Energ. 50/27]
Pickup Delay 	The pickup time delay is the time for the undervoltage unit to operate to arm the protection.	0.00 - 300.00s	5.00s	[Protection Para /<1..4> /Inadv. Energ. 50/27]

Parameter	Description	Setting range	Default	Menu path
Dropout Delay 	The dropout time delay is the time for the unit to operate to disarm the protection when the voltage is increased above the pickup value or the generator is brought on-line.	0.00 - 300.00s	0.25s	[Protection Para /<1..4> /Inadv. Energ. 50/27]
LOP Blo 	Activates the use of the measuring circuit supervision. In this case the module will be blocked if a measuring circuit supervision module (e.g. LOP, VTS) signals a disturbed measuring circuit (e.g. caused by a fuse failure).	Inactive, Active	Active	[Protection Para /<1..4> /Inadv. Energ. 50/27]

Signals (Output States) of the Inadvertent Energization

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Inadvertent Energization
Trip	Signal: Trip
TripCmd	Signal: Trip Command
MeasCircuitSupv Blo	Blocked by Measuring Circuit Supervision

Inputs of the Inadvertent Energization

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Inadv. Energ. 50/27]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Inadv. Energ. 50/27]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Inadv. Energ. 50/27]

27M - Undervoltage Protection

Available elements:

27M[1], 27M[2]

NOTICE

M is for “Main” referring to protection metered by the Main Voltage transformer in the System Configuration.

All undervoltage elements are identically structured.

NOTICE

Definition of V_n : V_n is dependent on the System Parameter setting of “Main VT con”.

In case that within the System Parameters “Main VT con” is set to “Open-Delta”:

$$V_n = \text{Main VT sec} \quad .$$

In case that “Main VT con” is set to “Wye”:

$$V_n = \frac{\text{Main VT sec}}{\sqrt{3}}$$

This is the 27 device undervoltage setting for the main three phase VT. This function consists of a Phase, a Pickup, a Delay setting. The Phase setting allows the User to select at which phase (any one, any two, or all) the undervoltage function operates. The Pickup setting is the magnitude at which the undervoltage element operates. The Delay setting is the time period an undervoltage must occur before the device initiates a trip. Depending on the settings within the System Parameters, the element works based on phase-to-phase («Open-Delta») or phase-to-ground («wye») voltages. This element will operate depending on the phase setting: if any one, any two, or all of the voltage(s) that is/are selected by the Phase setting drop(s) below the set point. This element works based on True RMS values.

An undervoltage pickup occurs when the measured voltage drops below the UV Threshold setting. The undervoltage trip is set when the voltage stays below the threshold setting for the delay time specified (within the number of phases specified by the phase setting). The undervoltage pickup and trip is reset when the voltage rises above the dropout ratio specified in Specifications section for the undervoltage protection.

If the element should be blocked in the event of a “Loss of Potential”, the »LOP BLO« parameter must be set to »active«.

CAUTION

If the VT measurement location is not at the bus bar side but at the output side, the following has to be taken into account.

When disconnecting the line, it has to be ensured by an »*External Blocking*« that undervoltage tripping cannot happen. In order to block the 27M element in case that the breaker is open:

- Assign the »*Bkr.POS OPEN*« signal to a blocking input (»ExBlo1« or »ExBlo2« within the Global Parameters) of the 27M element,
and
- »ExBlo Fc« has to be set to “active” within the parameter sets of the the 27M element.

When the auxiliary voltage is switched on and the measuring voltage has not yet been applied, undervoltage tripping has to be prevented by an »*External Blocking*«. Otherwise a continuous tripping would occur, disabling the ability to energize again.

NOTICE

If phase voltages are applied to the measuring inputs of the device and field parameter »Main VT Con« is set to »Wye«, the messages issued by the voltage protection module in case of actuation or trip should be interpreted as follows:

»27M[1].PICKUP A« or »27M[1].TRIP A« => pickup or trip caused by phase voltage »VA«.

»27M[1].PICKUP B« or »27M[1].TRIP B« => pickup or trip caused by phase voltage »VB«.

»27M[1].PICKUP C« or »27M[1].TRIP C« => pickup or trip caused by phase voltage »VC«.

However, if line-to-line voltages are applied to the measuring inputs and field parameter »Main VT Con« is set to »Phase to Phase«, then the messages should be interpreted as follows:

»27M[1].PICKUP A« or »27M[1].TRIP A« => pickup or trip caused by phase-to-phase voltage »VAB«.

»27M[1].PICKUP B« or »27M[1].TRIP B« => pickup or trip caused by phase-to-phase voltage »VBC«.

»27M[1].PICKUP C« or »27M[1].TRIP C« => pickup or trip caused by phase-to-phase voltage »VCA«.

Criterion - Measuring Method

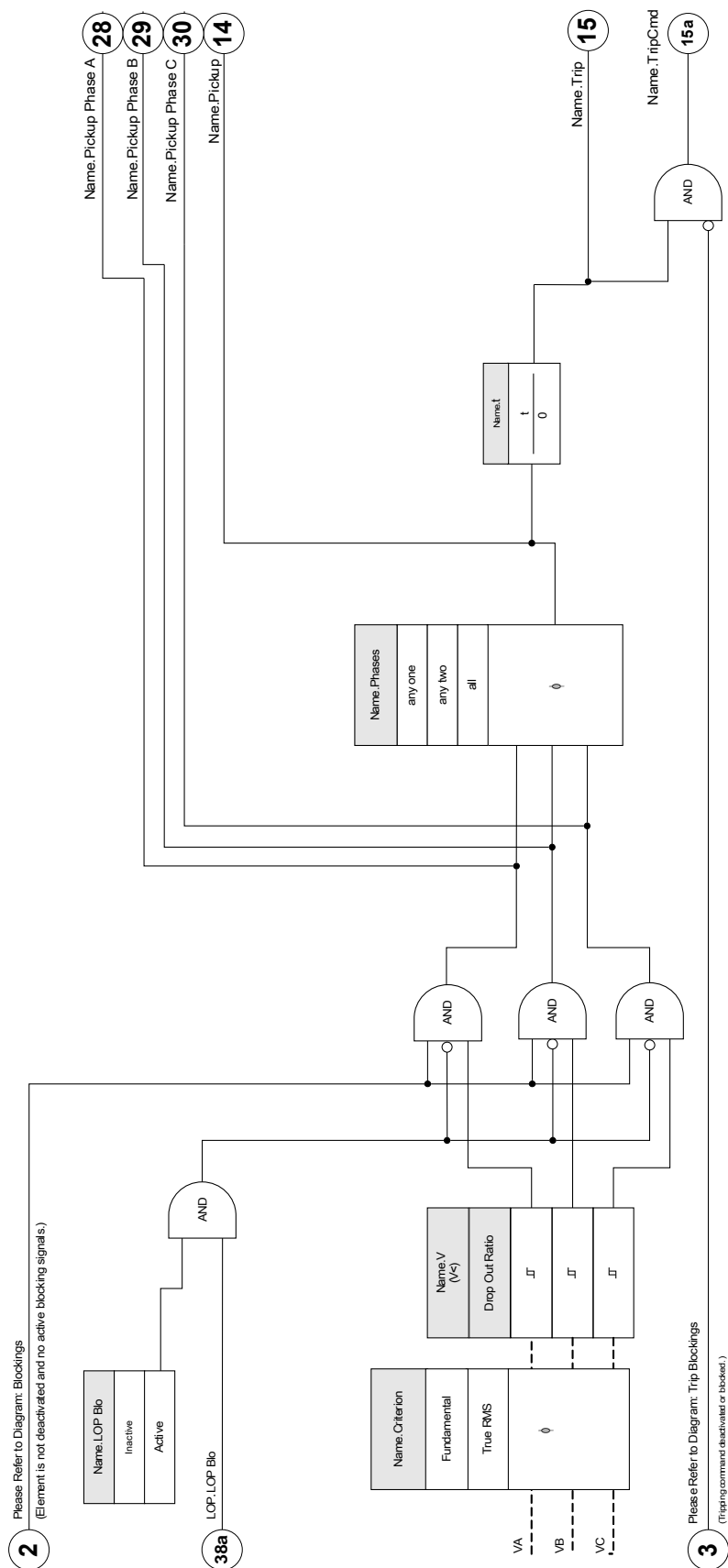
For all protection elements it can be determined, whether the measurement is done on basis of the »Fundamental« or if »True RMS« measurement is used.

Dropout Ratio

The dropout ratio is settable.

27M[1]...[n]

.....
Name = 27M[1]...[n]



Device Planning Parameters of the Undervoltage Protection Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Undervoltage Protection Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Main-V-Prot /27M[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Main-V-Prot /27M[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Main-V-Prot /27M[1]]

Setting Group Parameters of the Undervoltage Protection Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Main-V-Prot /27M[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Main-V-Prot /27M[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Main-V-Prot /27M[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Main-V-Prot /27M[1]]
Criterion 	Measuring method: fundamental or rms	Fundamental, True RMS	True RMS	[Protection Para /<1..4> /Main-V-Prot /27M[1]]
Phases 	Indicates if one, two of three or all phases are required for operation	any one, any two, all	any one	[Protection Para /<1..4> /Main-V-Prot /27M[1]]
Pickup 	If the pickup value is exceeded, the module/element will be started. Definition of Vn: Vn is dependent on the System Parameter setting of "Main VT con". In case that within the System Parameters "Main VT con" is set to "Open-Delta", "Vn = Main VT sec ". In case that "Main VT con" is set to "Wye", "Vn = Main VT sec/SQRT(3)". Only available if: Device Planning: V.Mode = V<	0.01 - 1.300Vn	27M[1]: 0.80Vn 27M[2]: 0.90Vn	[Protection Para /<1..4> /Main-V-Prot /27M[1]]

Parameter	Description	Setting range	Default	Menu path
V< Drop Out 	Drop Out (is in percent of setting) Only available if: Device Planning: V.Mode = V<	101 - 110%	103%	[Protection Para /<1..4> /Main-V-Prot /27M[1]]
t 	Tripping delay	0.00 - 3000.00s	0.00s	[Protection Para /<1..4> /Main-V-Prot /27M[1]]
LOP Blo 	Activates the use of the measuring circuit supervision. In this case the module will be blocked if a measuring circuit supervision module (e.g. LOP, VTS) signals a disturbed measuring circuit (e.g. caused by a fuse failure).	Inactive, Active	Active	[Protection Para /<1..4> /Main-V-Prot /27M[1]]

Undervoltage Protection Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Main-V-Prot /27M[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Main-V-Prot /27M[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Main-V-Prot /27M[1]]

Undervoltage Protection Module Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup Phase A	Signal: Pickup Phase A
Pickup Phase B	Signal: Pickup Phase B
Pickup Phase C	Signal: Pickup Phase C
Pickup	Signal: Pickup Voltage Element
Trip	Signal: Trip
TripCmd	Signal: Trip Command

Commissioning: Undervoltage Protection [27M]

This test can be carried out similar to the test for overvoltage protection 59M (by using the related undervoltage values).

Please consider the following deviations:

- For testing the threshold values, the test voltage has to be decreased until the relay is activated.
- For detection of the dropout ratio, the measuring quantity has to be increased to achieve more than the set dropout ratio of the trip value. Above the set dropout ratio of the trip value, the relay is to dropout at the earliest moment.

59M - Overvoltage Protection

Available elements:

59M[1], 59M[2]

NOTICE

M is for “Main” referring to protection metered by the Main Voltage transformer in the System Configuration.

All elements are identically structured.

NOTICE

Definition of V_n : V_n is dependent on the System Parameter setting of “Main VT con”.

In case that within the System Parameters “Main VT con” is set to “Open-Delta”:

$$V_n = \text{Main VT sec} \quad .$$

In case that “Main VT con” is set to “Wye”:

$$V_n = \frac{\text{Main VT sec}}{\sqrt{3}}$$

This is the 59 device Overvoltage setting for the Main VT. This element consists of a Phase, a Pickup, and a Delay setting. The Phase setting allows the User to select which phase (any one, any two, or all) the Overvoltage function operates. Depending on the settings within the System Parameters, the element works based on phase-to-phase («Open-Delta») or phase-to-ground («wye») voltages. This element will operate depending on the phase setting: if any one, any two, or all of the voltage(s) that is/are selected by the Phase setting rise(s) above the set point. This element works based on True RMS values.

An overvoltage pickup occurs when the measured voltage rises above the overvoltage Threshold setting. The overvoltage trip is set when the voltage stays above the threshold setting for the delay time specified (within the number of phases specified by the phase setting).. The overvoltage pickup and trip is reset when the voltage falls below the dropout ratio specified in Specifications section for the overvoltage protection.

NOTICE

If phase voltages are applied to the measuring inputs of the device and field parameter »Main VT con« is set to »Wye«, the messages issued by the voltage protection module in case of actuation or trip should be interpreted as follows:

»59M[1].PICKUP A« or »59M[1].TRIP A« => pickup or trip caused by phase voltage »VA«.
»59M[1].PICKUP B« or »59M[1].TRIP B« => pickup or trip caused by phase voltage »VB«.
»59M[1].PICKUP C« or »59M[1].TRIP C« => pickup or trip caused by phase voltage »VC«.

However, if line-to-line voltages are applied to the measuring inputs and field parameter »Main VT con« is set to »Wye«, then the messages should be interpreted as follows:

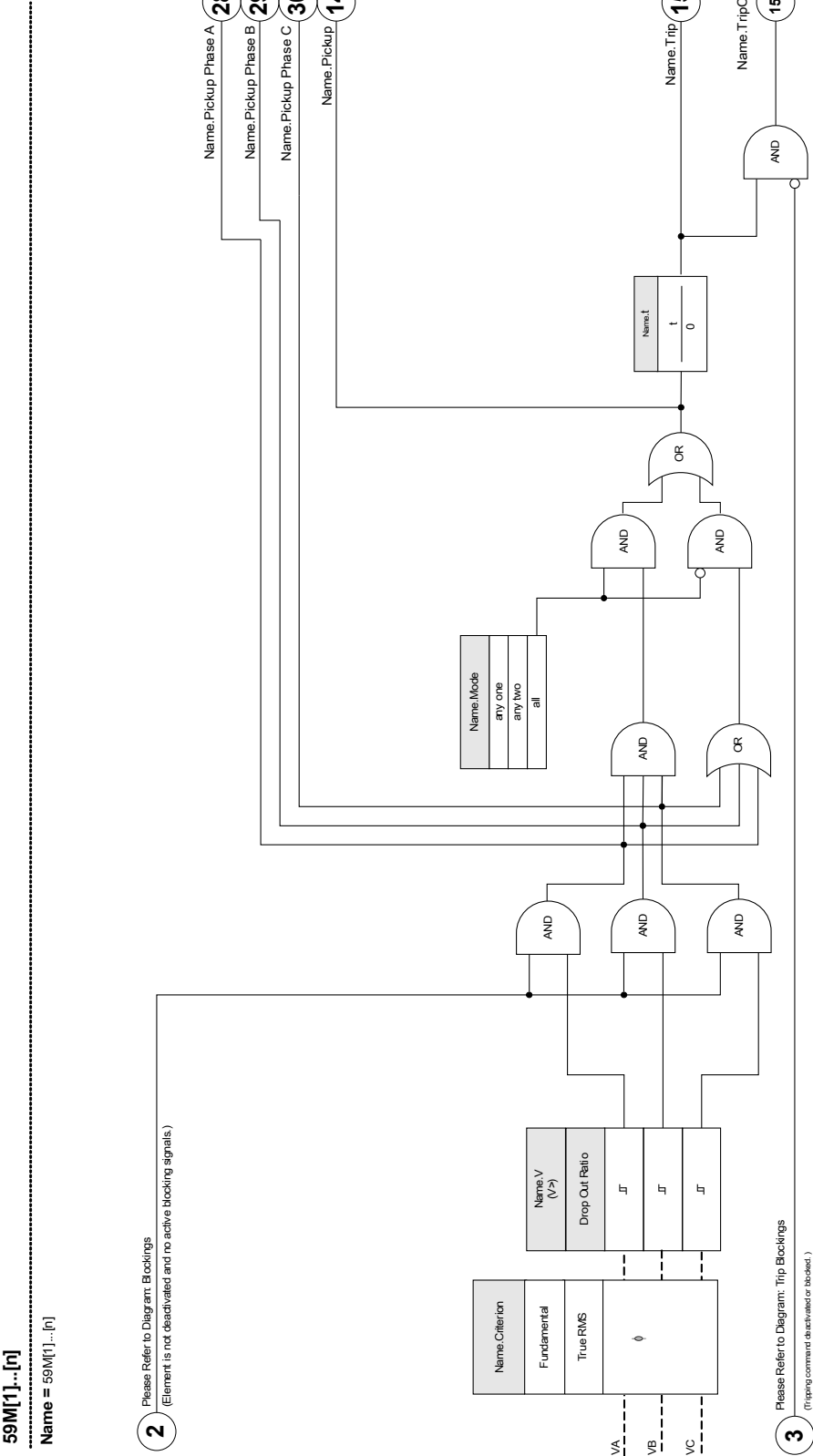
»59M[1].PICKUP A« or »59M[1].TRIP A« => pickup or trip caused by line-to-line voltage »VAB«.
»59M[1].PICKUP B« or »59M[1].TRIP B« => pickup or trip caused by line-to-line voltage »VBC«.
»59M[1].PICKUP C« or »59M[1].TRIP C« => pickup or trip caused by line-to-line voltage »VCA«.

Criterion - Measuring Method

For all protection elements it can be determined, whether the measurement is done on basis of the »Fundamental« or if »True RMS« measurement is used.

Dropout Ratio

The dropout ratio is settable.



Device Planning Parameters of the Overvoltage Protection Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Overvoltage Protection Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Main-V-Prot /59M[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Main-V-Prot /59M[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Main-V-Prot /59M[1]]

Setting Group Parameters of the Overvoltage Protection Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Main-V-Prot /59M[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Main-V-Prot /59M[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Main-V-Prot /59M[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Main-V-Prot /59M[1]]
Criterion 	Measuring method: fundamental or rms	Fundamental, True RMS	True RMS	[Protection Para /<1..4> /Main-V-Prot /59M[1]]
Phases 	Indicates if one, two of three or all phases are required for operation	any one, any two, all	any one	[Protection Para /<1..4> /Main-V-Prot /59M[1]]
Pickup 	If the pickup value is exceeded, the module/element will be started. Definition of Vn: Vn is dependent on the System Parameter setting of "Main VT con". In case that within the System Parameters "Main VT con" is set to "Open-Delta", "Vn = Main VT sec ". In case that "Main VT con" is set to "Wye", "Vn = Main VT sec/SQRT(3)".	0.01 - 1.300Vn	59M[1]: 1.2Vn 59M[2]: 1.1Vn	[Protection Para /<1..4> /Main-V-Prot /59M[1]]

Parameter	Description	Setting range	Default	Menu path
V> Drop Out 	Drop Out (is in percent of setting)	80 - 99%	97%	[Protection Para /<1..4> /Main-V-Prot /59M[1]]
t 	Tripping delay	0.00 - 3000.00s	0.00s	[Protection Para /<1..4> /Main-V-Prot /59M[1]]

Overvoltage Protection Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Main-V-Prot /59M[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Main-V-Prot /59M[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Main-V-Prot /59M[1]]

Overvoltage Protection Module Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup Phase A	Signal: Pickup Phase A
Pickup Phase B	Signal: Pickup Phase B
Pickup Phase C	Signal: Pickup Phase C
Pickup	Signal: Pickup Voltage Element
Trip	Signal: Trip
TripCmd	Signal: Trip Command

Commissioning: Overvoltage Protection [59M]

Object to be tested:

Test of the overvoltage protection elements, 3 x single-phase and 1 x three-phase (for each element).

Necessary means:

- Three phase AC voltage source;
- Timer for measuring of the tripping time; and
- Voltmeter.

Procedure (3 x single-phase, 1 x three-phase, for each element)

Testing the threshold values:

For testing the threshold values and dropout values, the test voltage has to be increased until the relay is activated. When comparing the displayed values with those of the voltmeter, the deviation must be within the permissible tolerances.

Testing the trip delay:

For testing the trip delay, a timer is to be connected to the contact of the associated trip relay. The timer is started when the limiting value of the tripping voltage is exceeded and it is stopped when the relay trips.

Testing the dropout ratio:

Reduce the measuring quantity to less than the set drop out value of the trip value. The relay must only dropout before the set drop out value of the trip value.

Successful test result:

The measured threshold values, trip delays, and dropout ratios comply with those specified in the adjustment list. Permissible deviations/tolerances can be taken from the Technical Data.

27A - Auxiliary Undervoltage Protection

Available elements:

27A[1], 27A[2]

NOTICE

All elements are identically structured.

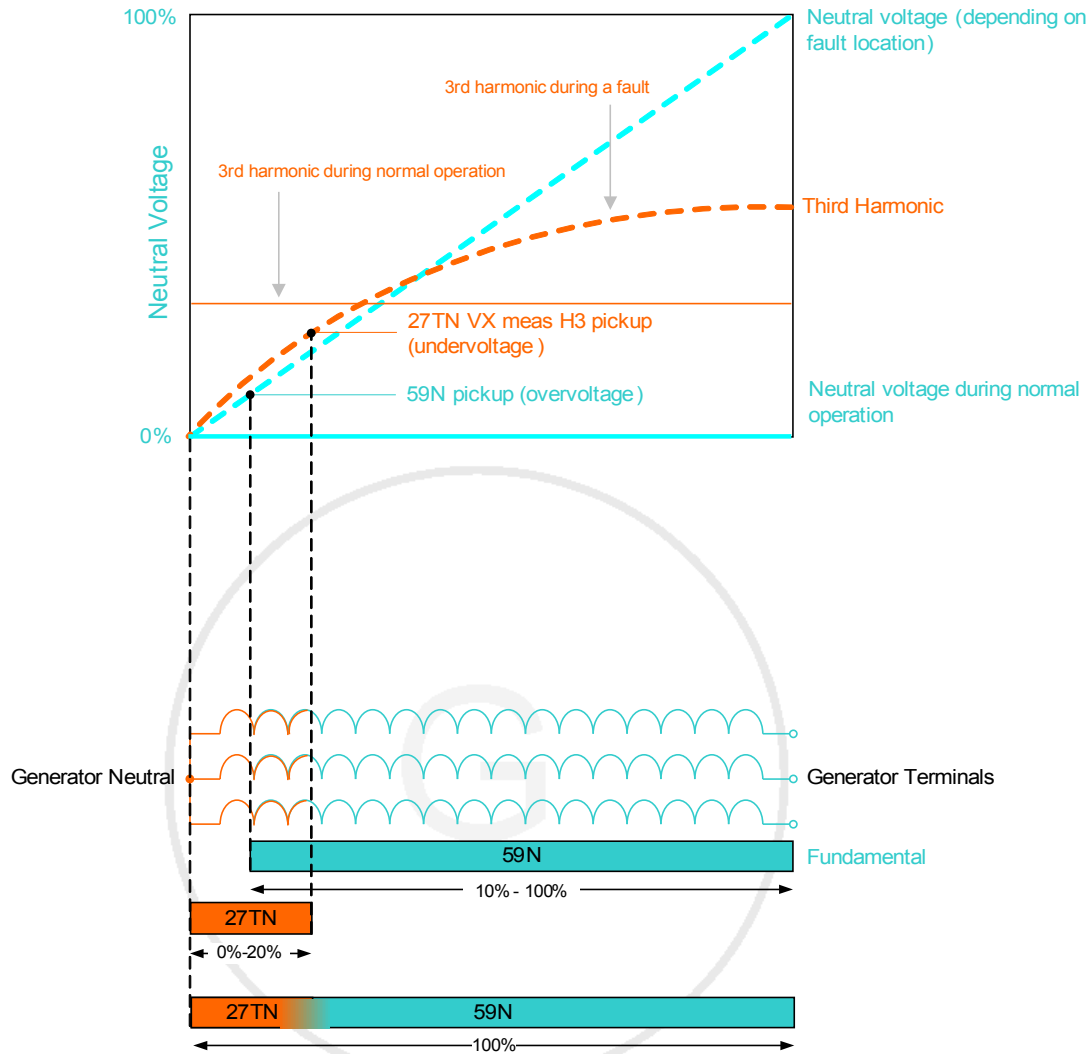
This device setting works similar to the 27M element, except it is a single-phase element only operating from the Auxiliary VT input. It has an adjustable pickup threshold and an adjustable trip delay. Furthermore the user can select between three measuring criteria.

Criterion	Description
Fundamental	The <u>27A</u> element measures the aux. voltage on basis of its fundamental wave.
True RMS	The <u>27A</u> element measures the True Root Mean Square values of the aux. voltage.
VX meas H3	The <u>27A</u> element measures the 3 rd harmonic of the aux. voltage.

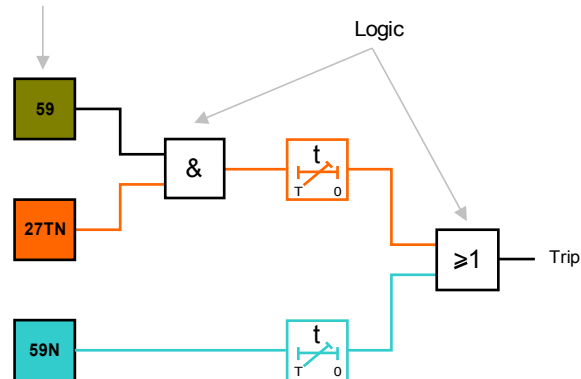
27A – measuring criterion »VX meas H3«

With this setting the relay can detect stator ground faults at high impedance grounded generators near the machines stator neutral. With this criterion the 27A element measures the 3rd harmonic of the connected voltage. It is able to detect ground faults, which occur between the stator neutral and up to approx. 20% of the winding towards the stator terminals. In combination with the 59N element, which detects ground faults which occur from the stator terminals down to approx. 10% of the stator winding towards the neutral, a 100% stator ground fault protection can be realized.

The following figure shows the neutral voltages of 27A with measuring criterion »VX meas H3« (third harmonic) and of 59N.

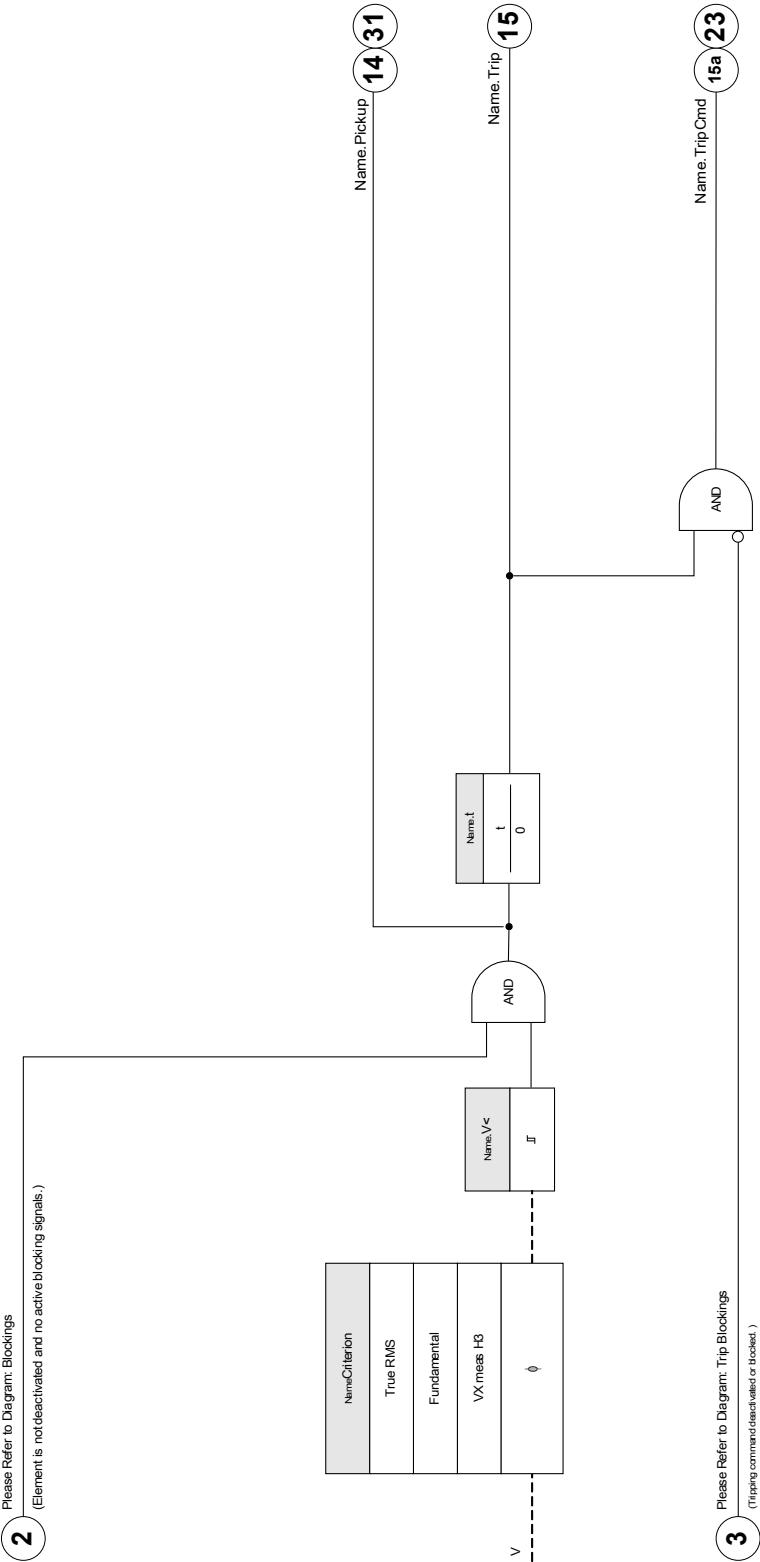


prevents faulty tripping during dead system / generator standstill



27A[1]...[n]

Name = 27A[1]...[n]



Device Planning Parameters of the Aux. Undervoltage Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Aux. Undervoltage Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Aux-V-Prot /27A[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Aux-V-Prot /27A[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Aux-V-Prot /27A[1]]

Setting Group Parameters of the Aux. Undervoltage Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Aux-V-Prot /27A[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Aux-V-Prot /27A[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Aux-V-Prot /27A[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Aux-V-Prot /27A[1]]
Criterion 	Measuring method: fundamental or rms or 3rd harmonic (only generator protection relays)	Fundamental, True RMS, VX meas H3	True RMS	[Protection Para /<1..4> /Aux-V-Prot /27A[1]]
Pickup 	Vn refers to either the primary or secondary voltage of the aux VT. Only available if: Device Planning: 59.Mode = V<	0.01 - 1.30Vn	27A[1]: 0.8Vn 27A[2]: 0.9Vn	[Protection Para /<1..4> /Aux-V-Prot /27A[1]]
t 	Tripping delay	0.00 - 300.00s	0.00s	[Protection Para /<1..4> /Aux-V-Prot /27A[1]]

Aux. Undervoltage Module Input States

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Aux-V-Prot /27A[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Aux-V-Prot /27A[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Aux-V-Prot /27A[1]]

Aux. Undervoltage Module Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup Residual Voltage Supervision-Element
Trip	Signal: Trip
TripCmd	Signal: Trip Command

Commissioning: Aux. Undervoltage

Object to be tested:

Aux. undervoltage protection elements.

Necessary components:

- Single-phase AC voltage source with adjustable frequency.
- Timer for measuring of the tripping time; and
- Voltmeter.

Procedure:

Testing the threshold value

For measuring criterion »*Fundamental*« or »*True RMS*« set the frequency to 50/60 Hz according to the set rated frequency.

For measuring criterion VX meas H3 set the frequency to 150/180 Hz according to the set rated frequency ($3 \times f_n$).

To test the threshold and dropout value, the test voltage at the measuring input for the residual voltage has to be decreased until the relay is activated. When comparing the displayed value with this of the voltmeter, the deviation must be within the permissible tolerances.

Testing the trip delay

For testing the trip delay, a timer is to be connected to the contact of the associated trip relay. The timer is started when the limiting value of the tripping voltage is reached and it is stopped when the relay trips.

Testing the dropout ratio

Increase the measuring quantity to more than 103% of the trip value. The relay must only dropout at a maximum of 103% of the trip value.

Successful test result

The measured threshold value, trip delay, and dropout ratio comply with those specified in the adjustment list.

Permissible deviations/tolerances can be taken from the Technical Data.

59A - Auxiliary Overvoltage Protection

Available elements:

59A[1], 59A[2]

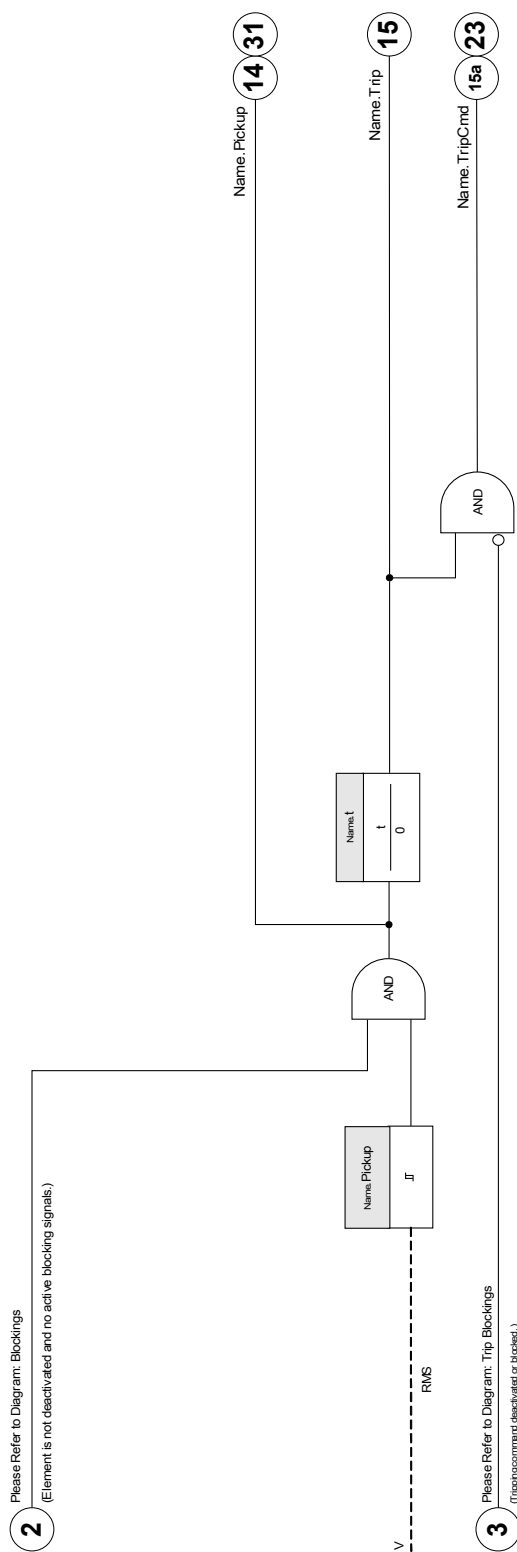
NOTICE

All elements are identically structured.

This is the 59 device Overvoltage setting for the Auxiliary VT. This device setting works exactly the same as the 59M, except it is a single-phase element only operating from the Auxiliary VT input (this element works based on True RMS).

59A[1]...[n]

Name = 59A[1]...[n]



Device Planning Parameters of the Aux. Overvoltage Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Aux. Overvoltage Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Aux-V-Prot /59A[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Aux-V-Prot /59A[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Aux-V-Prot /59A[1]]

Setting Group Parameters of the Aux. Overvoltage Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Aux-V-Prot /59A[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Aux-V-Prot /59A[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Aux-V-Prot /59A[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Aux-V-Prot /59A[1]]
Pickup 	Vn refers to the rated secondary voltage of the aux VT. Only available if: Device Planning: 59.Mode = V>	0.01 - 1.30Vn	59A[1]: 1.1Vn 59A[2]: 1.2Vn	[Protection Para /<1..4> /Aux-V-Prot /59A[1]]
t 	Tripping delay	0.00 - 300.00s	0.00s	[Protection Para /<1..4> /Aux-V-Prot /59A[1]]

Aux. Overvoltage Module Input States

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Aux-V-Prot /59A[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Aux-V-Prot /59A[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Aux-V-Prot /59A[1]]

Aux. Overvoltage Module Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup Residual Voltage Supervision-Element
Trip	Signal: Trip
TripCmd	Signal: Trip Command

Commissioning: Aux. Overvoltage

Object to be tested:

Aux. Overvoltage protection elements.

Necessary components:

- One-phase AC voltage source;
- Timer for measuring of the tripping time; and
- Voltmeter.

Procedure (for each element):

Testing the threshold values

For testing the threshold and dropout values, the test voltage at the measuring input for the voltage has to be increased until the relay is activated. When comparing the displayed values with those of the voltmeter, the deviation must be within the permissible tolerances.

Testing the trip delay

For testing the trip delay a timer is to be connected to the contact of the associated trip relay. The timer is started when the limiting value of the tripping voltage is exceeded and it is stopped when the relay trips.

Testing the dropout ratio

Reduce the measuring quantity to less than 97% of the trip value. The relay must only dropout at a minimum of 97% of the trip value.

Successful test result

The measured threshold values, trip delays, and dropout ratios comply with those specified in the adjustment list. Permissible deviations/tolerances can be taken from the Technical Data.

59N - Neutral Overvoltage

Available elements:

59N[1], 59N[2]

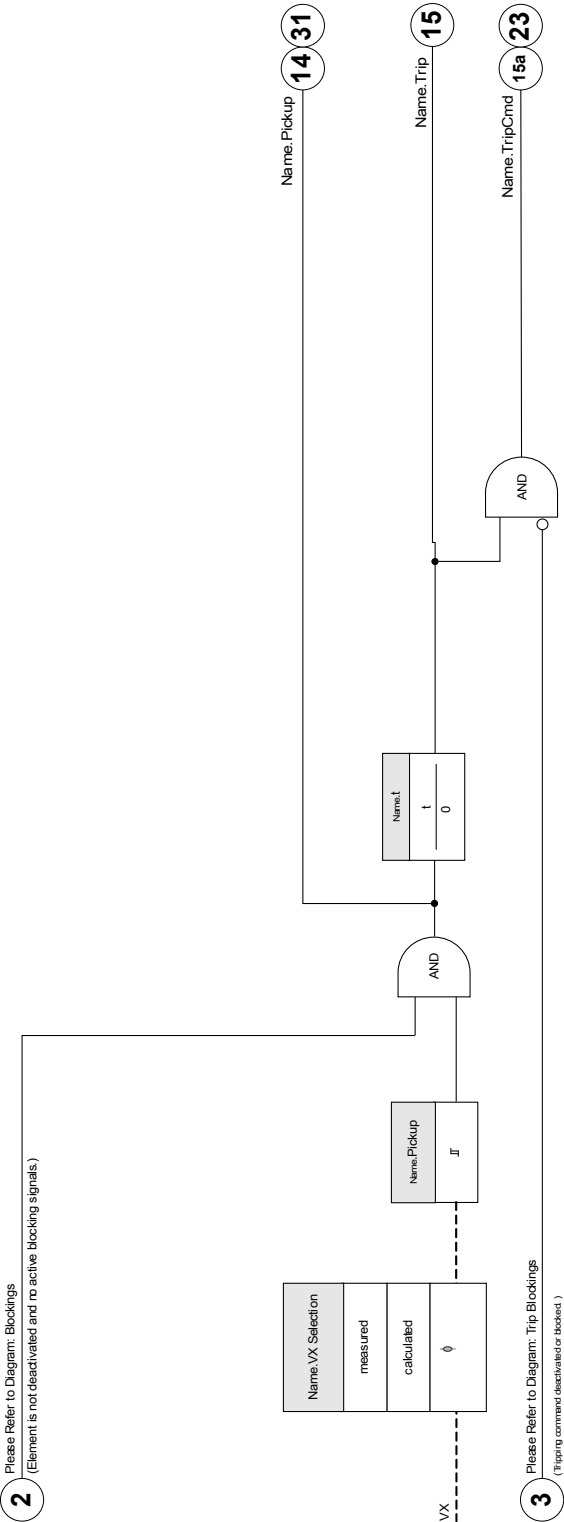
NOTICE

All elements are identically structured.

This is the 59 device for the Neutral Overvoltage settings (this element works based on fundamental).

59N[1]..[n]

Name = 59N[1]..[n]



Device Planning Parameters of the Neutral Overvoltage Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Neutral Overvoltage Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Neutral-V-Prot /59N[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Neutral-V-Prot /59N[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Neutral-V-Prot /59N[1]]

Setting Group Parameters of the Neutral Overvoltage Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Neutral-V-Prot /59N[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Neutral-V-Prot /59N[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Neutral-V-Prot /59N[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Neutral-V-Prot /59N[1]]
VX Selection 	Selection if VX is measured or calculated (neutral voltage or residual voltage)	measured, calculated	measured	[Protection Para /<1..4> /Neutral-V-Prot /59N[1]]
Pickup 	Vn refers to the rated secondary voltage of the aux VT. Only available if: Device Planning: 59.Mode = V>	0.01 - 1.30Vn	59N[1]: 0.8Vn 59N[2]: 0.9Vn	[Protection Para /<1..4> /Neutral-V-Prot /59N[1]]
t 	Tripping delay	0.00 - 300.00s	0.00s	[Protection Para /<1..4> /Neutral-V-Prot /59N[1]]

Neutral Overvoltage Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Neutral-V-Prot /59N[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Neutral-V-Prot /59N[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Neutral-V-Prot /59N[1]]

Neutral Overvoltage Module Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup Residual Voltage Supervision-Element
Trip	Signal: Trip
TripCmd	Signal: Trip Command

Commissioning: Neutral Overvoltage Protection

Object to be tested:

Neutral overvoltage protection elements.

Necessary components:

- One-phase AC voltage source;
- Timer for measuring of the tripping time; and
- Voltmeter.

Procedure (for each element):

Testing the threshold values

For testing the threshold and dropout values, the test voltage at the measuring input for the voltage has to be increased until the relay is activated. When comparing the displayed values with those of the voltmeter, the deviation must be within the permissible tolerances.

Testing the trip delay

For testing the trip delay, a timer is to be connected to the contact of the associated trip relay. The timer is started when the limiting value of the tripping voltage is exceeded and it is stopped when the relay trips.

Testing the dropout ratio

Reduce the measuring quantity to less than 97% of the trip value. The relay must only dropout at a minimum of 97% of the trip value.

Successful test result

The measured threshold values, trip delays, and dropout ratios comply with those specified in the adjustment list. Permissible deviations/tolerances can be taken from the Technical Data.

25 - Sync-check

Available Elements:

Sync-check



The sync-check function can be bypassed by external sources. In this case, synchronization has to be secured by other synchronizing systems before breaker closing!

NOTICE

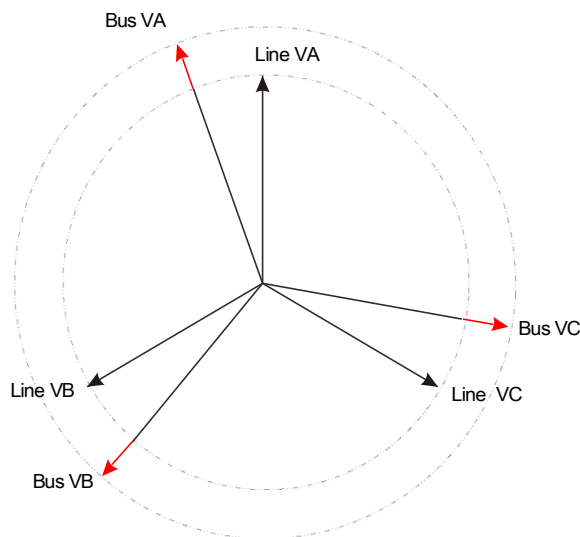
The Bus voltages are to be measured by the first three measuring inputs of the voltage measuring card (VA/VAB, VB/VBC, VC/VCA). The line voltage is to be measured by the fourth measuring input of the voltage measuring card (VX). In the menu [System Para/General Settings/V Sync] the User has to define to which phase the fourth measuring input is compared.

Sync-check

The sync-check function is provided for the applications where a line has two-ended power sources. The sync-check function has the abilities to check voltage magnitude, angle differences, and frequency difference (slip frequency) between the bus and the line. If enabled, the sync-check may supervise the closing operation manually, automatically, or both.. This function can be overridden by certain bus-line operation conditions and can be bypassed with an external source.

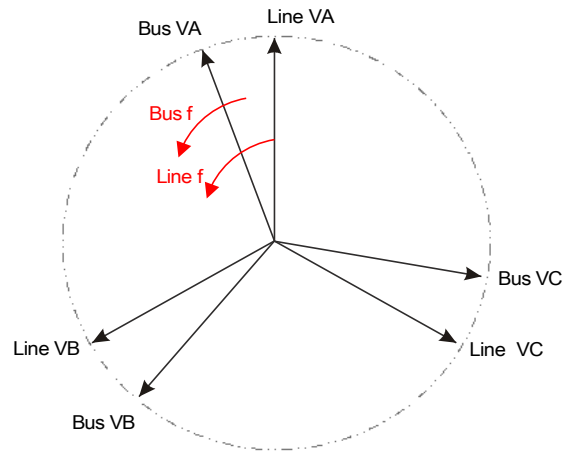
Voltage Difference ΔV

The first condition for paralleling two electrical systems is that their voltage phasors have the same magnitude. This can be controlled by the generator's AVR.

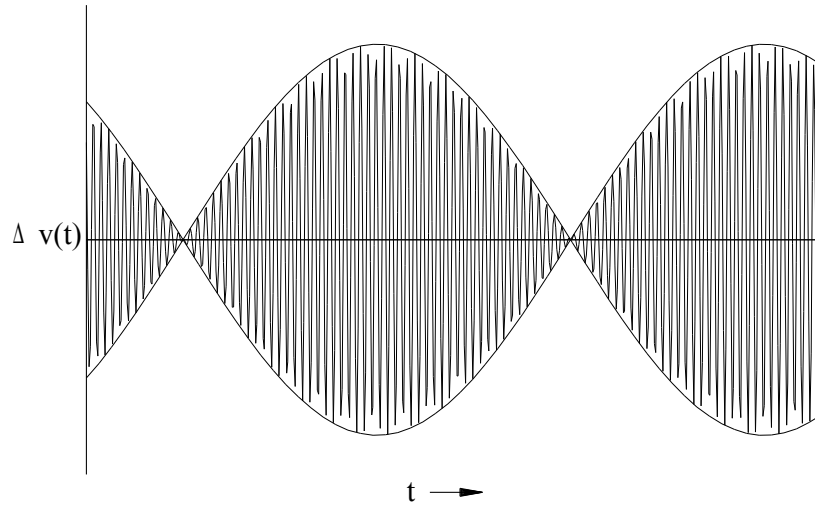


Frequency Difference (Slip Frequency) ΔF

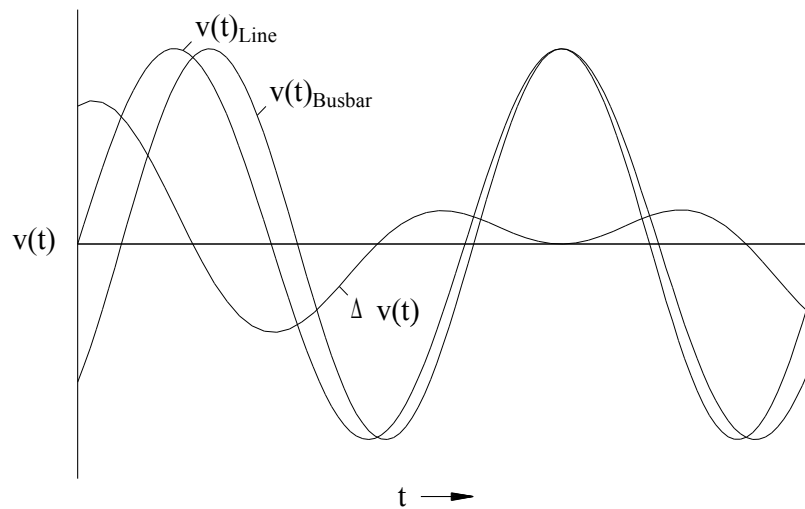
The second condition for paralleling two electrical systems is that their frequencies are nearly equal. This can be controlled by the generator's speed governor.



If the generator frequency f_{Bus} is not equal to the mains frequency f_{Line} , it results in a slip frequency $\Delta F = |f_{\text{Bus}} - f_{\text{Line}}|$ between the two system frequencies.

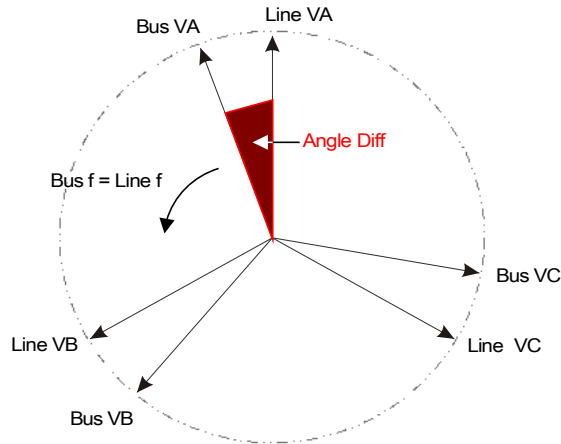


Voltage Curve with Enlarged Resolution.



Angular or Phase Difference.

Even if the frequency of both systems is exactly identical, usually an angular difference of the voltage phasors is the case.



At the instant of synchronization, the angular difference of the two systems should be nearly zero because, otherwise, unwanted load inrushes occur. Theoretically, the angular difference can be regulated to zero by giving short pulses to the speed governors. When paralleling generators with the grid, in practice, synchronization is requested as quick as possible and so usually a slight frequency difference is accepted. In such cases, the angular difference is not constant but changes with the slip frequency ΔF .

By taking the breaker closing time into consideration, a lead of the closing release impulse can be calculated in a way that breaker closing takes place at exactly the time when both systems are in angular conformity.

Basically the following applies:

Where large rotating masses are concerned, the frequency difference (slip frequency) of the two systems should possibly be nearly zero, because of the very high load inrushes at the instant of breaker closing. For smaller rotating masses, the frequency difference of the systems can be higher.

Synchronization Modes

The sync-check module is able to check the synchronization of two electrical systems (system-to-system) or between a generator and an electrical system (generator-to-system). For paralleling two electrical systems, the station frequency, voltage, and phase angle should be exactly the same as the utility grid. Whereas the synchronization of a generator to a system can be done with a certain slip-frequency, depending on the size of the generator used. Therefore the maximum breaker closing time has to be taken into consideration. With the set breaker closing time, the sync-check module is able to calculate the moment of synchronization and gives the paralleling release.



When paralleling two systems, it has to be verified that the system-to-system mode is selected. Paralleling two systems in generator-to-system mode can cause severe damage!

Working Principle Sync-check (Generator-to-System)

(Please refer to the block diagram on next page.)

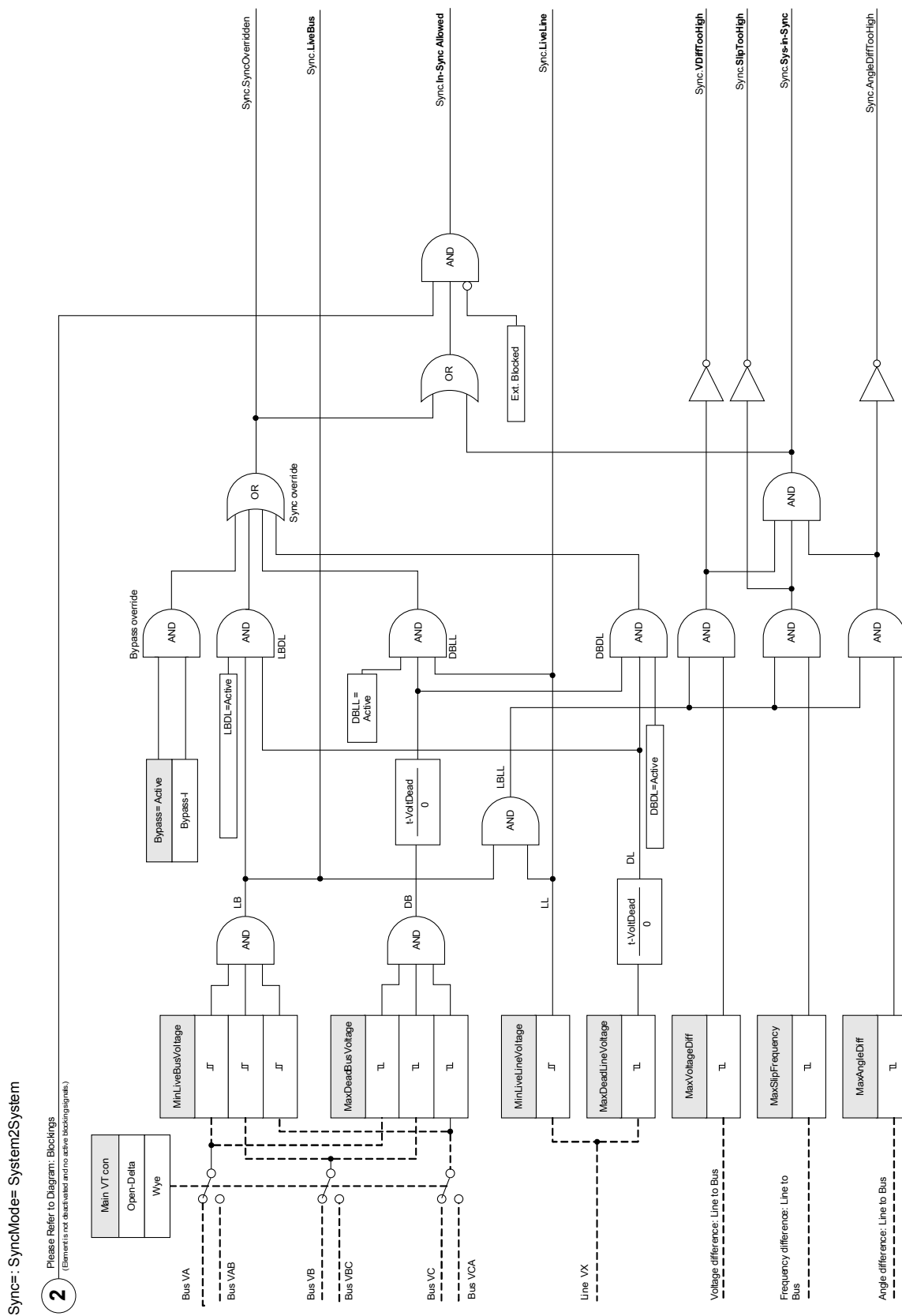
The sync-check element measures the three phase-to-neutral voltages » V_A «, » V_B «, and » V_C « or the three phase-to-phase voltages » V_{AB} «, » V_{BC} «, and » V_{CA} « of the generator busbar. The line voltage V_x is measured by the fourth voltage input. If all synchronous conditions are fulfilled (i. e.: ΔV [VoltageDiff], ΔF [SlipFrequency], and $\Delta \phi$ [AngleDiff]) are within the limits, a signal will be issued that both systems are synchronous. An advanced Close Angle Evaluator function takes the breaker closing time into consideration.



Working Principle Sync-check (System-to-System)

(Please refer to the block diagram on next page.)

The sync-check function for two systems is very similar to the sync-check function for generator-to-system except there is no need to take the breaker closing time into account. The sync-check element measures the three phase-to-neutral voltages »VA«, »VB«, and »VC« or the three phase-to-phase voltages »VAB«, »VBC«, and »VCA« of the station voltage bus bar. The line voltage V_x is measured by the fourth voltage input. If all synchronous conditions are fulfilled (i. e.: ΔV [VoltageDiff], ΔF [SlipFrequency], and $\Delta \phi$ [AngleDiff]) are within the limits, a signal will be issued that both systems are synchronous.



Sync-check Override Conditions

If enabled the following conditions can override the sync-check function:

- LBDL = Live Bus – Dead Line
- DBLL = Dead Bus – Live Line
- DBDL = Dead Bus – Dead Line

Also the sync-check function can be bypassed by an external source.



When the sync-check function is overridden or bypassed, synchronization has to be secured by other synchronizing systems before breaker closing!

Device Planning Parameters of the Sync-check Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameter of the Sync-check Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Sync-check]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Sync-check]
Bypass 	The Sync-check will be bypassed if the state of the assigned signal (logic input) becomes true.	1..n, DI-LogicList	.-	[Protection Para /Global Prot Para /Sync-check]
BkrCloseInitiate 	Breaker Close Initiate with synchronism check from any control sources (e.g. HMI / SCADA). If the state of the assigned signal becomes true, a Breaker Close will be initiated (Trigger Source).	1..n, SyncRequestList	.-	[Protection Para /Global Prot Para /Sync-check]

Set Parameters of the Sync-check Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Sync-check /General Settings]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Sync-check /General Settings]
Bypass Fc 	Allowing to bypass the Sync-check, if the state signal that is assigned to the parameter with the same name within the Global Parameters (logic input) becomes true.	Inactive, Active	Inactive	[Protection Para /<1..4> /Sync-check /General Settings]
SyncMode 	Sync-check mode: GENERATOR2SYSTEM = Synchronizing generator to system (breaker close initiate needed). SYSTEM2SYSTEM = SynchronCheck between two systems (Stand-Alone, no breaker info needed)	System2System, Generator2System	System2System	[Protection Para /<1..4> /Sync-check /Mode / Times]
t-MaxBkrCloseDelay 	Maximum breaker close time delay (Only used for GENERATOR-SYSTEM working mode and is critical for a correct synchronized switching) Only available if: SyncMode = System2System	0.00 - 300.00s	0.05s	[Protection Para /<1..4> /Sync-check /Mode / Times]
t-MaxSyncSuperv 	Synchron-Run timer: Max. time allowed for synchronizing process after a close initiate. Only used for GENERATOR2SYSTEM working mode. Only available if: SyncMode = System2System	0.00 - 3000.00s	30.00s	[Protection Para /<1..4> /Sync-check /Mode / Times]
MinLiveBusVoltage 	Minimum Live Bus voltage (Live bus detected, when all three phase bus voltages are above this limit.)	0.10 - 1.30Vn	0.65Vn	[Protection Para /<1..4> /Sync-check /DeadLiveVLevels]
MaxDeadBusVoltage 	Maximum Dead Bus voltage (Dead bus detected, when all three phase bus voltages are below this limit.)	0.01 - 1.00Vn	0.03Vn	[Protection Para /<1..4> /Sync-check /DeadLiveVLevels]

Parameter	Description	Setting range	Default	Menu path
MinLiveLineVoltage 	Minimum Live Line voltage (Live line detected, when line voltage above this limit.)	0.10 - 1.30Vn	0.65Vn	[Protection Para /<1..4> /Sync-check /DeadLiveVLevels]
MaxDeadLineVoltage 	Maximum Dead Line voltage (Dead Line detected, when line voltage below this limit.)	0.01 - 1.00Vn	0.03Vn	[Protection Para /<1..4> /Sync-check /DeadLiveVLevels]
t-VoltDead 	Voltage dead time (A Dead Bus/Line condition will be accepted only if the voltage falls below the set dead voltage levels longer than this time setting)	0.000 - 300.000s	0.167s	[Protection Para /<1..4> /Sync-check /DeadLiveVLevels]
MaxVoltageDiff 	Maximum voltage difference between bus and line voltage phasors (Delta V) for synchronism (Related to bus voltage secondary rating)	0.01 - 1.00Vn	0.24Vn	[Protection Para /<1..4> /Sync-check /Conditions]
MaxSlipFrequency 	Maximum frequency difference (Slip: Delta f) between bus and line voltage allowed for synchronism	0.01 - 2.00Hz	0.20Hz	[Protection Para /<1..4> /Sync-check /Conditions]
MaxAngleDiff 	Maximum phase angle difference (Delta-Phi in degree) between bus and line voltages allowed for synchronism	1 - 60°	20°	[Protection Para /<1..4> /Sync-check /Conditions]
DBDL 	Enable/disable Dead-Bus AND Dead-Line synchronism overriding	Inactive, Active	Inactive	[Protection Para /<1..4> /Sync-check /Override]
DBLL 	Enable/disable Dead-Bus AND Live-Line synchronism overriding	Inactive, Active	Inactive	[Protection Para /<1..4> /Sync-check /Override]
LBDL 	Enable/disable Live-Bus AND Dead-Line synchronism overriding	Inactive, Active	Inactive	[Protection Para /<1..4> /Sync-check /Override]

States of the Inputs of the Sync-check Module

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Sync-check]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Sync-check]
Bypass-I	State of the module input: Bypass	[Protection Para /Global Prot Para /Sync-check]
BkrCloseInitiate-I	State of the module input: Breaker Close Initiate with synchronism check from any control sources (e.g. HMI / SCADA). If the state of the assigned signal becomes true, a Breaker Close will be initiated (Trigger Source).	[Protection Para /Global Prot Para /Sync-check]

Signals of the Sync-check Module (States of the Outputs)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
LiveBus	Signal: Live-Bus flag: 1=Live-Bus, 0=Voltage is below the LiveBus threshold
LiveLine	Signal: Live Line flag: 1=Live-Line, 0=Voltage is below the LiveLine threshold
SynchronRunTiming	Signal: SynchronRunTiming
SynchronFailed	Signal: This signal indicates a failed synchronization. It is set for 5s when the breaker is still open after the Synchron-Run-timer has timed out.
SyncOverridden	Signal: Synchronism Check is overridden because one of the Synchronism overriding conditions (DB/DL or ExtBypass) is met.
VDiffTooHigh	Signal: Voltage difference between bus and line too high.
SlipTooHigh	Signal: Frequency difference (slip frequency) between bus and line voltages too high.
AngleDiffTooHigh	Signal: Phase Angle difference between bus and line voltages too high.
Sys-in-Sync	Signal: Bus and line voltages are in synchronism according to the system synchronism criteria.
In-Sync Allowed	Signal: In-Sync Allowed

Sync-check Statistic Values

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Slip Freq	Slip frequency	[Operation /Measured Values /Sync-check]
Volt Diff	Voltage difference	[Operation /Measured Values /Sync-check]
Angle Diff	Angle difference	[Operation /Measured Values /Sync-check]
f Bus	Bus frequency	[Operation /Measured Values /Sync-check]
f Line	Line frequency	[Operation /Measured Values /Sync-check]
V Bus	Bus Voltage	[Operation /Measured Values /Sync-check]
V Line	Line Voltage	[Operation /Measured Values /Sync-check]
Angle Bus	Bus Angle (Reference)	[Operation /Measured Values /Sync-check]
Angle Line	Line Angle	[Operation /Measured Values /Sync-check]

Sync-check Breaker Close Initiate Signals

These Signals can be used for a Breaker Close Initiate with synchronism check from any control sources (e.g. HMI / SCADA). If the state of the assigned signal becomes true, a Breaker Close will be initiated (Trigger Source).

Name	Description
-.-	No assignment
Bkr.Sync CLOSE request	Signal: Synchronous CLOSE request
DI-8P X1.DI 1	Signal: Digital Input
DI-8P X1.DI 2	Signal: Digital Input
DI-8P X1.DI 3	Signal: Digital Input
DI-8P X1.DI 4	Signal: Digital Input
DI-8P X1.DI 5	Signal: Digital Input
DI-8P X1.DI 6	Signal: Digital Input
DI-8P X1.DI 7	Signal: Digital Input
DI-8P X1.DI 8	Signal: Digital Input
DI-8 X5.DI 1	Signal: Digital Input
DI-8 X5.DI 2	Signal: Digital Input
DI-8 X5.DI 3	Signal: Digital Input
DI-8 X5.DI 4	Signal: Digital Input
DI-8 X5.DI 5	Signal: Digital Input
DI-8 X5.DI 6	Signal: Digital Input
DI-8 X5.DI 7	Signal: Digital Input
DI-8 X5.DI 8	Signal: Digital Input
Logic.LE1.Gate Out	Signal: Output of the logic gate
Logic.LE1.Timer Out	Signal: Timer Output
Logic.LE1.Out	Signal: Latched Output (Q)
Logic.LE1.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE2.Gate Out	Signal: Output of the logic gate
Logic.LE2.Timer Out	Signal: Timer Output
Logic.LE2.Out	Signal: Latched Output (Q)
Logic.LE2.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE3.Gate Out	Signal: Output of the logic gate
Logic.LE3.Timer Out	Signal: Timer Output
Logic.LE3.Out	Signal: Latched Output (Q)
Logic.LE3.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE4.Gate Out	Signal: Output of the logic gate
Logic.LE4.Timer Out	Signal: Timer Output
Logic.LE4.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE4.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE5.Gate Out	Signal: Output of the logic gate
Logic.LE5.Timer Out	Signal: Timer Output
Logic.LE5.Out	Signal: Latched Output (Q)
Logic.LE5.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE6.Gate Out	Signal: Output of the logic gate
Logic.LE6.Timer Out	Signal: Timer Output
Logic.LE6.Out	Signal: Latched Output (Q)
Logic.LE6.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE7.Gate Out	Signal: Output of the logic gate
Logic.LE7.Timer Out	Signal: Timer Output
Logic.LE7.Out	Signal: Latched Output (Q)
Logic.LE7.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE8.Gate Out	Signal: Output of the logic gate
Logic.LE8.Timer Out	Signal: Timer Output
Logic.LE8.Out	Signal: Latched Output (Q)
Logic.LE8.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE9.Gate Out	Signal: Output of the logic gate
Logic.LE9.Timer Out	Signal: Timer Output
Logic.LE9.Out	Signal: Latched Output (Q)
Logic.LE9.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE10.Gate Out	Signal: Output of the logic gate
Logic.LE10.Timer Out	Signal: Timer Output
Logic.LE10.Out	Signal: Latched Output (Q)
Logic.LE10.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE11.Gate Out	Signal: Output of the logic gate
Logic.LE11.Timer Out	Signal: Timer Output
Logic.LE11.Out	Signal: Latched Output (Q)
Logic.LE11.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE12.Gate Out	Signal: Output of the logic gate
Logic.LE12.Timer Out	Signal: Timer Output
Logic.LE12.Out	Signal: Latched Output (Q)
Logic.LE12.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE13.Gate Out	Signal: Output of the logic gate
Logic.LE13.Timer Out	Signal: Timer Output
Logic.LE13.Out	Signal: Latched Output (Q)
Logic.LE13.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE14.Gate Out	Signal: Output of the logic gate
Logic.LE14.Timer Out	Signal: Timer Output
Logic.LE14.Out	Signal: Latched Output (Q)
Logic.LE14.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE15.Gate Out	Signal: Output of the logic gate
Logic.LE15.Timer Out	Signal: Timer Output
Logic.LE15.Out	Signal: Latched Output (Q)
Logic.LE15.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE16.Gate Out	Signal: Output of the logic gate
Logic.LE16.Timer Out	Signal: Timer Output
Logic.LE16.Out	Signal: Latched Output (Q)
Logic.LE16.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE17.Gate Out	Signal: Output of the logic gate
Logic.LE17.Timer Out	Signal: Timer Output
Logic.LE17.Out	Signal: Latched Output (Q)
Logic.LE17.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE18.Gate Out	Signal: Output of the logic gate
Logic.LE18.Timer Out	Signal: Timer Output
Logic.LE18.Out	Signal: Latched Output (Q)
Logic.LE18.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE19.Gate Out	Signal: Output of the logic gate
Logic.LE19.Timer Out	Signal: Timer Output
Logic.LE19.Out	Signal: Latched Output (Q)
Logic.LE19.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE20.Gate Out	Signal: Output of the logic gate
Logic.LE20.Timer Out	Signal: Timer Output
Logic.LE20.Out	Signal: Latched Output (Q)
Logic.LE20.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE21.Gate Out	Signal: Output of the logic gate
Logic.LE21.Timer Out	Signal: Timer Output
Logic.LE21.Out	Signal: Latched Output (Q)
Logic.LE21.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE22.Gate Out	Signal: Output of the logic gate
Logic.LE22.Timer Out	Signal: Timer Output
Logic.LE22.Out	Signal: Latched Output (Q)
Logic.LE22.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE23.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE23.Timer Out	Signal: Timer Output
Logic.LE23.Out	Signal: Latched Output (Q)
Logic.LE23.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE24.Gate Out	Signal: Output of the logic gate
Logic.LE24.Timer Out	Signal: Timer Output
Logic.LE24.Out	Signal: Latched Output (Q)
Logic.LE24.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE25.Gate Out	Signal: Output of the logic gate
Logic.LE25.Timer Out	Signal: Timer Output
Logic.LE25.Out	Signal: Latched Output (Q)
Logic.LE25.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE26.Gate Out	Signal: Output of the logic gate
Logic.LE26.Timer Out	Signal: Timer Output
Logic.LE26.Out	Signal: Latched Output (Q)
Logic.LE26.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE27.Gate Out	Signal: Output of the logic gate
Logic.LE27.Timer Out	Signal: Timer Output
Logic.LE27.Out	Signal: Latched Output (Q)
Logic.LE27.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE28.Gate Out	Signal: Output of the logic gate
Logic.LE28.Timer Out	Signal: Timer Output
Logic.LE28.Out	Signal: Latched Output (Q)
Logic.LE28.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE29.Gate Out	Signal: Output of the logic gate
Logic.LE29.Timer Out	Signal: Timer Output
Logic.LE29.Out	Signal: Latched Output (Q)
Logic.LE29.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE30.Gate Out	Signal: Output of the logic gate
Logic.LE30.Timer Out	Signal: Timer Output
Logic.LE30.Out	Signal: Latched Output (Q)
Logic.LE30.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE31.Gate Out	Signal: Output of the logic gate
Logic.LE31.Timer Out	Signal: Timer Output
Logic.LE31.Out	Signal: Latched Output (Q)
Logic.LE31.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE32.Gate Out	Signal: Output of the logic gate
Logic.LE32.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE32.Out	Signal: Latched Output (Q)
Logic.LE32.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE33.Gate Out	Signal: Output of the logic gate
Logic.LE33.Timer Out	Signal: Timer Output
Logic.LE33.Out	Signal: Latched Output (Q)
Logic.LE33.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE34.Gate Out	Signal: Output of the logic gate
Logic.LE34.Timer Out	Signal: Timer Output
Logic.LE34.Out	Signal: Latched Output (Q)
Logic.LE34.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE35.Gate Out	Signal: Output of the logic gate
Logic.LE35.Timer Out	Signal: Timer Output
Logic.LE35.Out	Signal: Latched Output (Q)
Logic.LE35.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE36.Gate Out	Signal: Output of the logic gate
Logic.LE36.Timer Out	Signal: Timer Output
Logic.LE36.Out	Signal: Latched Output (Q)
Logic.LE36.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE37.Gate Out	Signal: Output of the logic gate
Logic.LE37.Timer Out	Signal: Timer Output
Logic.LE37.Out	Signal: Latched Output (Q)
Logic.LE37.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE38.Gate Out	Signal: Output of the logic gate
Logic.LE38.Timer Out	Signal: Timer Output
Logic.LE38.Out	Signal: Latched Output (Q)
Logic.LE38.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE39.Gate Out	Signal: Output of the logic gate
Logic.LE39.Timer Out	Signal: Timer Output
Logic.LE39.Out	Signal: Latched Output (Q)
Logic.LE39.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE40.Gate Out	Signal: Output of the logic gate
Logic.LE40.Timer Out	Signal: Timer Output
Logic.LE40.Out	Signal: Latched Output (Q)
Logic.LE40.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE41.Gate Out	Signal: Output of the logic gate
Logic.LE41.Timer Out	Signal: Timer Output
Logic.LE41.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE41.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE42.Gate Out	Signal: Output of the logic gate
Logic.LE42.Timer Out	Signal: Timer Output
Logic.LE42.Out	Signal: Latched Output (Q)
Logic.LE42.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE43.Gate Out	Signal: Output of the logic gate
Logic.LE43.Timer Out	Signal: Timer Output
Logic.LE43.Out	Signal: Latched Output (Q)
Logic.LE43.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE44.Gate Out	Signal: Output of the logic gate
Logic.LE44.Timer Out	Signal: Timer Output
Logic.LE44.Out	Signal: Latched Output (Q)
Logic.LE44.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE45.Gate Out	Signal: Output of the logic gate
Logic.LE45.Timer Out	Signal: Timer Output
Logic.LE45.Out	Signal: Latched Output (Q)
Logic.LE45.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE46.Gate Out	Signal: Output of the logic gate
Logic.LE46.Timer Out	Signal: Timer Output
Logic.LE46.Out	Signal: Latched Output (Q)
Logic.LE46.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE47.Gate Out	Signal: Output of the logic gate
Logic.LE47.Timer Out	Signal: Timer Output
Logic.LE47.Out	Signal: Latched Output (Q)
Logic.LE47.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE48.Gate Out	Signal: Output of the logic gate
Logic.LE48.Timer Out	Signal: Timer Output
Logic.LE48.Out	Signal: Latched Output (Q)
Logic.LE48.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE49.Gate Out	Signal: Output of the logic gate
Logic.LE49.Timer Out	Signal: Timer Output
Logic.LE49.Out	Signal: Latched Output (Q)
Logic.LE49.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE50.Gate Out	Signal: Output of the logic gate
Logic.LE50.Timer Out	Signal: Timer Output
Logic.LE50.Out	Signal: Latched Output (Q)
Logic.LE50.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE51.Gate Out	Signal: Output of the logic gate
Logic.LE51.Timer Out	Signal: Timer Output
Logic.LE51.Out	Signal: Latched Output (Q)
Logic.LE51.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE52.Gate Out	Signal: Output of the logic gate
Logic.LE52.Timer Out	Signal: Timer Output
Logic.LE52.Out	Signal: Latched Output (Q)
Logic.LE52.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE53.Gate Out	Signal: Output of the logic gate
Logic.LE53.Timer Out	Signal: Timer Output
Logic.LE53.Out	Signal: Latched Output (Q)
Logic.LE53.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE54.Gate Out	Signal: Output of the logic gate
Logic.LE54.Timer Out	Signal: Timer Output
Logic.LE54.Out	Signal: Latched Output (Q)
Logic.LE54.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE55.Gate Out	Signal: Output of the logic gate
Logic.LE55.Timer Out	Signal: Timer Output
Logic.LE55.Out	Signal: Latched Output (Q)
Logic.LE55.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE56.Gate Out	Signal: Output of the logic gate
Logic.LE56.Timer Out	Signal: Timer Output
Logic.LE56.Out	Signal: Latched Output (Q)
Logic.LE56.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE57.Gate Out	Signal: Output of the logic gate
Logic.LE57.Timer Out	Signal: Timer Output
Logic.LE57.Out	Signal: Latched Output (Q)
Logic.LE57.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE58.Gate Out	Signal: Output of the logic gate
Logic.LE58.Timer Out	Signal: Timer Output
Logic.LE58.Out	Signal: Latched Output (Q)
Logic.LE58.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE59.Gate Out	Signal: Output of the logic gate
Logic.LE59.Timer Out	Signal: Timer Output
Logic.LE59.Out	Signal: Latched Output (Q)
Logic.LE59.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE60.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE60.Timer Out	Signal: Timer Output
Logic.LE60.Out	Signal: Latched Output (Q)
Logic.LE60.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE61.Gate Out	Signal: Output of the logic gate
Logic.LE61.Timer Out	Signal: Timer Output
Logic.LE61.Out	Signal: Latched Output (Q)
Logic.LE61.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE62.Gate Out	Signal: Output of the logic gate
Logic.LE62.Timer Out	Signal: Timer Output
Logic.LE62.Out	Signal: Latched Output (Q)
Logic.LE62.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE63.Gate Out	Signal: Output of the logic gate
Logic.LE63.Timer Out	Signal: Timer Output
Logic.LE63.Out	Signal: Latched Output (Q)
Logic.LE63.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE64.Gate Out	Signal: Output of the logic gate
Logic.LE64.Timer Out	Signal: Timer Output
Logic.LE64.Out	Signal: Latched Output (Q)
Logic.LE64.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE65.Gate Out	Signal: Output of the logic gate
Logic.LE65.Timer Out	Signal: Timer Output
Logic.LE65.Out	Signal: Latched Output (Q)
Logic.LE65.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE66.Gate Out	Signal: Output of the logic gate
Logic.LE66.Timer Out	Signal: Timer Output
Logic.LE66.Out	Signal: Latched Output (Q)
Logic.LE66.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE67.Gate Out	Signal: Output of the logic gate
Logic.LE67.Timer Out	Signal: Timer Output
Logic.LE67.Out	Signal: Latched Output (Q)
Logic.LE67.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE68.Gate Out	Signal: Output of the logic gate
Logic.LE68.Timer Out	Signal: Timer Output
Logic.LE68.Out	Signal: Latched Output (Q)
Logic.LE68.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE69.Gate Out	Signal: Output of the logic gate
Logic.LE69.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE69.Out	Signal: Latched Output (Q)
Logic.LE69.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE70.Gate Out	Signal: Output of the logic gate
Logic.LE70.Timer Out	Signal: Timer Output
Logic.LE70.Out	Signal: Latched Output (Q)
Logic.LE70.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE71.Gate Out	Signal: Output of the logic gate
Logic.LE71.Timer Out	Signal: Timer Output
Logic.LE71.Out	Signal: Latched Output (Q)
Logic.LE71.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE72.Gate Out	Signal: Output of the logic gate
Logic.LE72.Timer Out	Signal: Timer Output
Logic.LE72.Out	Signal: Latched Output (Q)
Logic.LE72.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE73.Gate Out	Signal: Output of the logic gate
Logic.LE73.Timer Out	Signal: Timer Output
Logic.LE73.Out	Signal: Latched Output (Q)
Logic.LE73.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE74.Gate Out	Signal: Output of the logic gate
Logic.LE74.Timer Out	Signal: Timer Output
Logic.LE74.Out	Signal: Latched Output (Q)
Logic.LE74.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE75.Gate Out	Signal: Output of the logic gate
Logic.LE75.Timer Out	Signal: Timer Output
Logic.LE75.Out	Signal: Latched Output (Q)
Logic.LE75.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE76.Gate Out	Signal: Output of the logic gate
Logic.LE76.Timer Out	Signal: Timer Output
Logic.LE76.Out	Signal: Latched Output (Q)
Logic.LE76.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE77.Gate Out	Signal: Output of the logic gate
Logic.LE77.Timer Out	Signal: Timer Output
Logic.LE77.Out	Signal: Latched Output (Q)
Logic.LE77.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE78.Gate Out	Signal: Output of the logic gate
Logic.LE78.Timer Out	Signal: Timer Output
Logic.LE78.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE78.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE79.Gate Out	Signal: Output of the logic gate
Logic.LE79.Timer Out	Signal: Timer Output
Logic.LE79.Out	Signal: Latched Output (Q)
Logic.LE79.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE80.Gate Out	Signal: Output of the logic gate
Logic.LE80.Timer Out	Signal: Timer Output
Logic.LE80.Out	Signal: Latched Output (Q)
Logic.LE80.Out inverted	Signal: Negated Latched Output (Q NOT)

47 - Voltage Unbalance Protection

Available elements:

47[1], 47[2]

This is the 47 device Voltage Unbalance setting, which consists of the Threshold, $\%(V2/V1)$, and Delay settings. The voltage unbalance function is based on the Main VT system 3-phase voltages.

The positive and negative sequence voltages are calculated from the 3-phase voltages. The Threshold setting defines a minimum operating voltage magnitude of either V1 or V2 for the 47 function to operate, which ensures that the relay has a solid basis for initiating a voltage unbalance trip. This is a supervisory function and not a trip level.

The $\%(V2/V1)$ setting is the unbalance trip pickup setting. It is defined by the ratio of negative sequence voltage to positive sequence voltage ($\% \text{ Unbalance} = V2/V1$), or $\%(V2/V1)$ for ABC rotation and $\%(V1/V2)$ for ACB rotation. The device will automatically select the correct ratio based on the Phase Sequence setting in the System Configuration group described above.

This function requires positive or negative sequence voltage magnitude above the threshold setting and the percentage voltage unbalance above the $\%(V2/V1)$ setting before allowing a voltage unbalance trip. Therefore, both the threshold and percent settings must be met for the specified Delay time setting before the relay initiates a trip for voltage unbalance.

The voltage unbalance pickup and trip functions are reset when the positive and negative sequence voltages V1 and V2 drop below the Threshold setting or $(V2/V1)$ drops below the $\%(V2/V1)$ setting minus 1%.

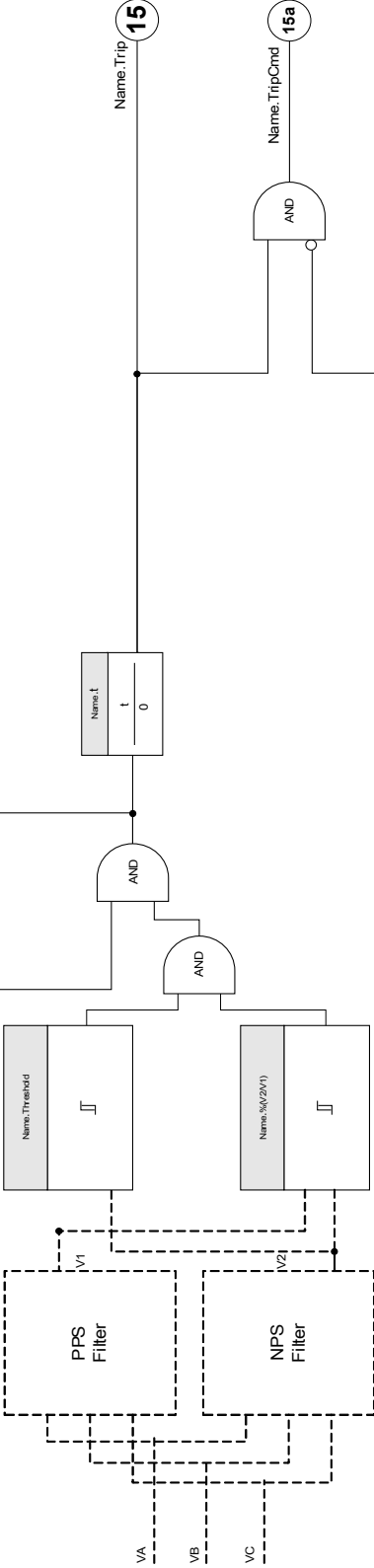
47[1]..[n]

Name = 47[1]..[n]

Name.Pickup

2

Please Refer to Diagram: Blockings
(Element is not deactivated and no active blocking signals.)



3

Please Refer to Diagram: Trip Blockings
(Tripping command is deactivated or blocked.)

Device Planning Parameters of the Voltage Unbalance Module

Parameter	Description	Options	Default	Menu path
Mode 	Unbalance Protection: Supervision of the Voltage System	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Voltage Unbalance Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.1	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Unbalance-Prot /47[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.2	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Unbalance-Prot /47[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Unbalance-Prot /47[1]]

Parameter Set Parameters of the Voltage Unbalance Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /47[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /47[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /47[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /47[1]]
Threshold 	The Threshold defines a minimum operating voltage magnitude of either V1 or V2 for the 47 function to operate, which ensures that the relay has a solid basis for initiating a voltage unbalance trip. This is a supervisory function and not a trip level. The meaning of Vn: Phase to Phase: Vn = Main VT sec. Phase to Ground: Vn = Main VT / SQRT(3). Only available if: Device Planning: 47.Mode = Threshold	0.01 - 1.30Vn	0.2Vn	[Protection Para /<1..4> /Unbalance-Prot /47[1]]
%(V2/V1) 	The %(V2/V1) setting is the unbalance trip pickup setting. It is defined by the ratio of negative sequence voltage to positive sequence voltage (% Unbalance=V2/V1). Phase sequence will be taken into account automatically. Only available if: %(V2/V1) = Use	2 - 40%	47[1]: 40% 47[2]: 20%	[Protection Para /<1..4> /Unbalance-Prot /47[1]]
t 	Tripping delay	0.00 - 300.00s	47[1]: 10.0s 47[2]: 20s	[Protection Para /<1..4> /Unbalance-Prot /47[1]]

Parameter	Description	Setting range	Default	Menu path
LOP Blo 	Activates the use of the measuring circuit supervision. In this case the module will be blocked if a measuring circuit supervision module (e.g. LOP, VTS) signals a disturbed measuring circuit (e.g. caused by a fuse failure).	Inactive, Active	Inactive	[Protection Para /<1..4> /Unbalance-Prot /47[1]]

States of the Inputs of the Voltage Unbalance Module

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Unbalance-Prot /47[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Unbalance-Prot /47[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Unbalance-Prot /47[1]]

Signals of the Voltage Unbalance Module (States of the Outputs)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup Voltage Asymmetry
Trip	Signal: Trip
TripCmd	Signal: Trip Command

Commissioning: Voltage Unbalance Module

Object to be tested:

Test of the unbalanced load protection function.

Necessary means:

- Three-phase AC voltage source with adjustable voltage unbalance; and
- Timer.

Procedure:

Check the phase sequence:

- Ensure that the phase sequence is the same as that set in the field parameters.
- Feed-in a three-phase nominal voltage.
- Change to the [Measured Values/Voltage] menu.
- Check the measuring value for the unbalanced voltage »V2 Fund.«. The measuring value displayed for »V2 Fund.« should be zero (within the physical measuring accuracy).

NOTICE

If the displayed magnitude for V2 Fund. is the same as that for the balanced nominal voltages fed to the relay, it implies that the phase sequence of the voltages seen by the relay is reversed.

- Now turn-off phase A.
- Again check the measuring value of the unbalanced voltage »V2 Fund.« in the [Measured Values/Voltage] menu. The measuring value of the unbalanced voltage »V2 Fund.« should now be 33% of the nominal voltage.
- Turn-on phase A, but turn-off phase B.
- Once again check the measuring value of the unbalanced voltage »V2 Fund.« in the [Measured Values/Voltage] menu. The measuring value of the unbalanced voltage »V2 Fund.« should be again 33%.
- Turn-on phase B, but turn-off phase C.
- Again check the measuring value of unbalanced voltage »V2 Fund.« in the [Measured Values/Voltage] menu. The measuring value of the unbalanced voltage »V2 Fund.« should still be 33%.

Testing the trip delay:

- Apply a balanced three-phase voltage system (nominal voltages).
- Switch off VA (the threshold value » *Threshold*« for » *V2 Fund.*« must be below 33% of the nominal voltage Vn).
- Measure the tripping time.

The present voltage unbalance » *V2 Fund.*« corresponds with 1/3 of the existing phase voltage displayed.

Testing the threshold values

- Configure minimum » $\%(V2/V1)$ « setting (2%) and an arbitrary threshold value » *Threshold*« (V2 Fund.).
- For testing the threshold value, a voltage has to be fed to phase A which is lower than three times the adjusted threshold value » *Threshold*« (V2 Fund.).
- Feeding only phase A results in » $\%(V2/V1) = 100\%$ «, so the first condition » $\%(V2/V1) \geq 2\%$ « is always fulfilled.
- Now increase the phase A voltage until the relay is activated.

Testing the dropout ratio of the threshold values

Having tripped the relay in the previous test, now decrease the phase A voltage. The dropout ratio must not be higher than 0.97 times the threshold value.

Testing $\%(V2/V1)$

- Configure minimum threshold value » *Threshold*« (V2 Fund.) ($0.01 \times V_n$) and set » $\%(V2/V1)$ « greater or equal to 10%.
- Apply a balanced three-phase voltage system (nominal voltages). The measuring value of » $\%(V2/V1)$ « should be approximately 0%.
- Now increase the phase A voltage. With this configuration, the threshold value » *Threshold*« (V2 Fund.) should be reached before the value » $\%(V2/V1)$ « reaches the set » $\%(V2/V1)$ « ratio threshold.
- Continue increasing the phase 1 voltage until the relay is activated.

Testing the dropout ratio of $\%(V2/V1)$

Having tripped the relay in the previous test, now decrease the phase A voltage. The dropout of » $\%(V2/V1)$ « has to be 1% below the » $\%(V2/V1)$ « setting.

Successful test result:

The measured trip delays, threshold values, and dropout ratios are within the permitted deviations/tolerances, specified under Technical Data.

81O/U, 81R, 78V - Frequency Protection

Available elements:

81[1] 81[2] 81[3] 81[4] 81[5] 81[6]

NOTICE

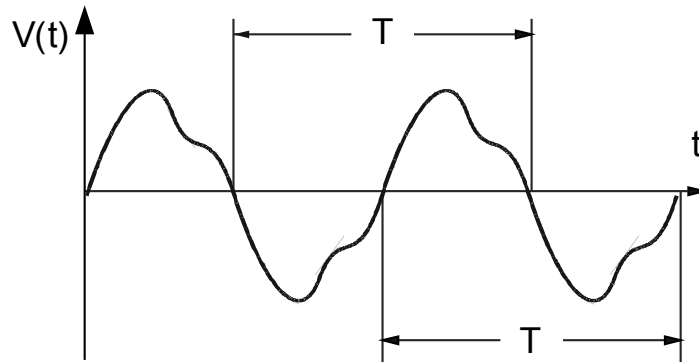
All frequency protective elements are identically structured.

Frequency - Measuring Principle

NOTICE

The frequency is calculated as the average of the measured values of the three phase frequencies. Only valid measured frequency values are taken into account. If a phase voltage is no longer measurable, this phase will be excluded from the calculation of the average value.

The measuring principle of the frequency supervision is based in general on the time measurement of complete cycles, whereby a new measurement is started at each zero passage. The influence of harmonics on the measuring result is thus minimized.



Frequency tripping is sometimes not desired by low measured voltages which, for instance, occur during alternator acceleration. All frequency supervision functions are blocked if the voltage is lower 0.15 times V_n .

Frequency Functions

Due to its various frequency functions, the device is very flexible. That makes it suitable for a wide range of applications where frequency supervision is an important criterion.

In the *Device Planning* menu, the User can decide how to use each of the six frequency elements.

f[1] to *f[6]* can be assigned as:

- 81U – Underfrequency;
- 81O – Overfrequency;
- 81R – Rate of Change of Frequency (df/dt);
- 81UR – Underfrequency and Rate of Change of Frequency (df/dt);
- 81OR – Overfrequency and Rate of Change of Frequency (df/dt);
- 81UΔR – Underfrequency and DF/DT (absolute frequency change per definite time interval);
- 81OΔR – Overfrequency and DF/DT (absolute frequency change per definite time interval); and
- 78V – Vector Surge.

81U – Underfrequency

This protection element provides a pickup threshold and a tripping delay. If the frequency falls below the set pickup threshold, an alarm will be issued instantaneously. If the frequency remains under the set pickup threshold until the tripping delay has elapsed, a tripping command will be issued.

With this setting, the frequency element protects electrical generators, loads, or electrical operating equipment in general against underfrequency.

81O – Overfrequency

This protection element provides a pickup threshold and a tripping delay. If the frequency exceeds the set pickup threshold, an alarm will be issued instantaneously. If the frequency remains above the set pickup threshold until the tripping delay has elapsed, a tripping command will be issued.

With this setting, the frequency element protects electrical generators, loads, or electrical operating equipment in general against overfrequency.

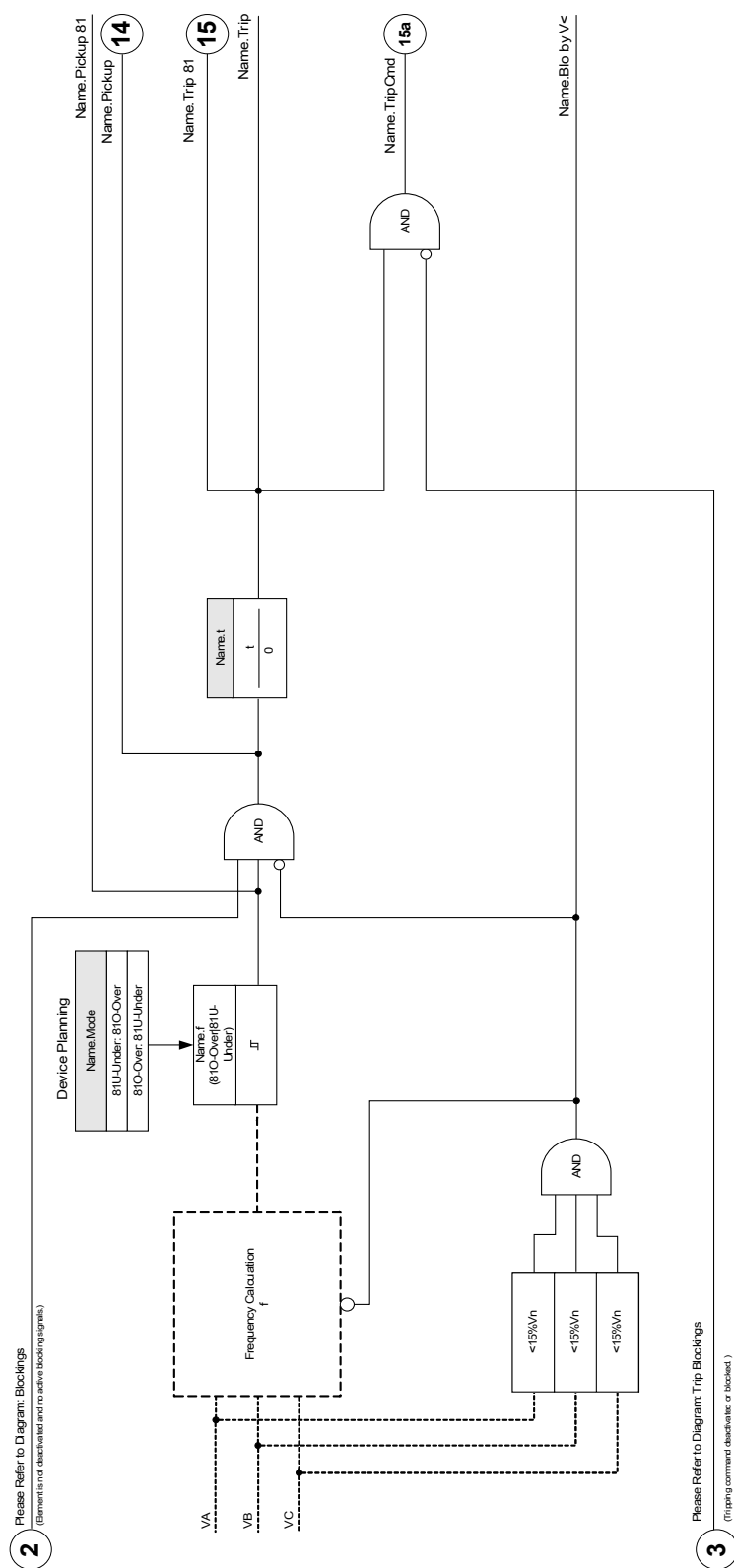
Working Principle

(Please refer to the block diagram on next page.)

The frequency element supervises the three phase voltages » V_A «, » V_B « and » V_C «. If all of the three phase voltages are below 15% V_n , the frequency calculation is blocked. According to the frequency supervision mode set in the Device Planning (81U or 81O), the evaluated phase voltages are compared to the set pickup threshold for over- or under-frequency. If in any of the phases, the frequency exceeds or falls below the set pickup threshold and if there are no blocking commands for the frequency element, an alarm is issued instantaneously and the tripping delay timer is started. When the frequency still exceeds or is below the set pickup threshold after the tripping delay timer has elapsed, a tripping command will be issued.

81[1]...[n]:81U-Under Or 81O-Over

.....
Name = 81[1]...[n]



81R Rate of Change of Frequency (df/dt)

Electrical generators running in parallel with the mains (e. g.: industrial internal power supply plants) should be separated from the mains when failure in the intra-system occurs for the following reasons:

- Damage to electrical generators must be prevented when mains voltage is recovering asynchronously (e. g.: after a short interruption).
- The industrial internal power supply must be maintained.

A reliable criterion of detecting mains failure is the measurement of the rate of change of frequency 81R (df/dt). The precondition for this is a load flow via the mains coupling point. At mains failure, the load flow change spontaneously leads to an increasing or decreasing frequency. At active power deficit of the internal power station, a linear drop of the frequency occurs and a linear increase occurs at power excess. Typical frequency gradients during application of "mains decoupling" are in the range of 0.5 Hz/s up to over 2 Hz/s.

The protective device detects the instantaneous frequency gradient 81R (df/dt) of each mains voltage period. Through multiple evaluations of the frequency gradient in sequence, the continuity of the directional change (sign of the frequency gradient) is determined. Because of this special measuring procedure, a high safety in tripping and thus a high stability against transient processes (e. g.: switching procedure) are achieved.

The frequency gradient (rate of change of frequency [df/dt]) may have a negative or positive sign, depending on frequency increase (positive sign) or decrease (negative sign).

In the frequency parameter sets, the User can define the kind of df/dt mode:

- Positive df/dt = the frequency element detects an increase in frequency;
- Negative df/dt = the frequency element detects a decrease in frequency; and
- Absolute df/dt (positive and negative) = the frequency element detects both, increase and decrease in frequency.

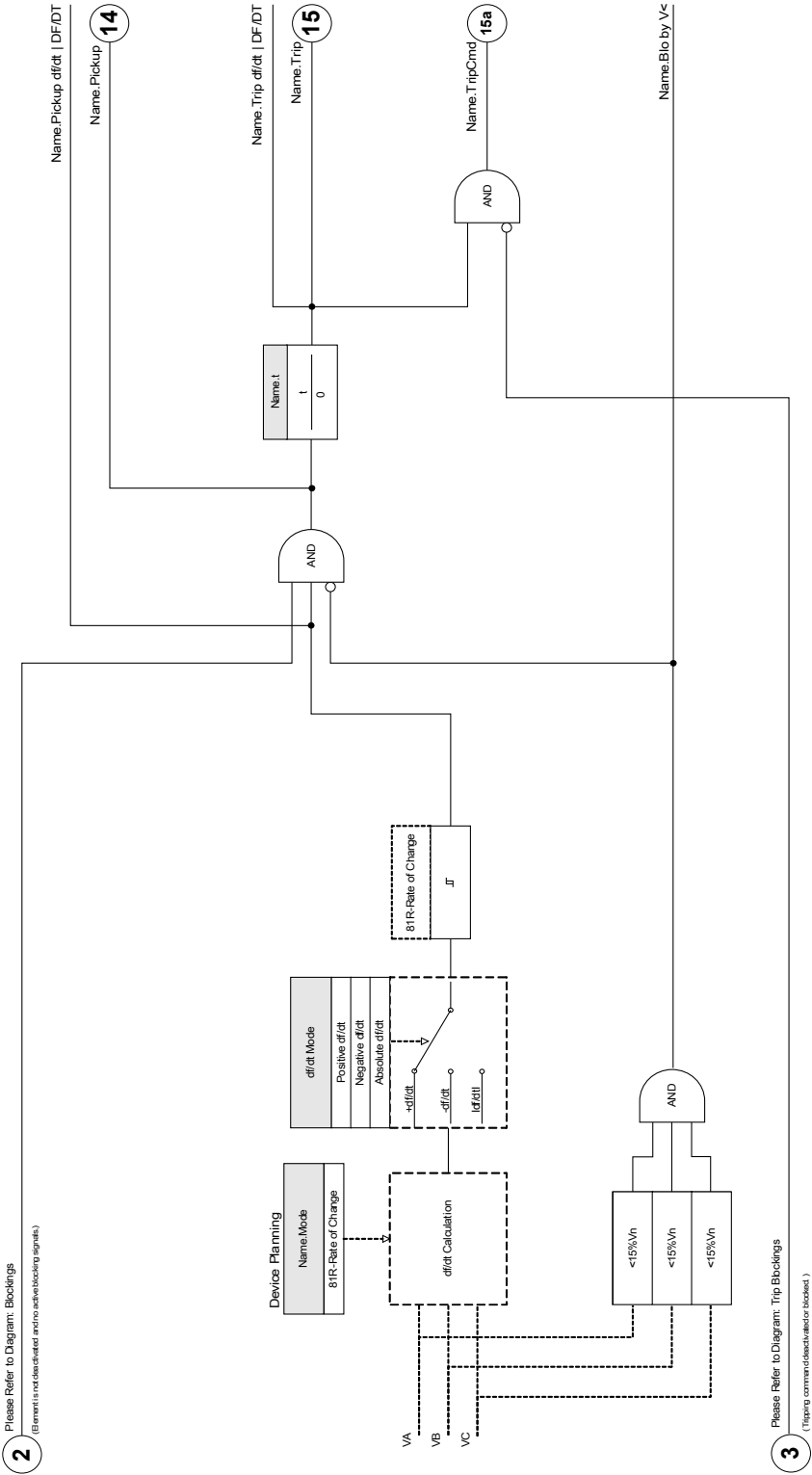
This protection element provides a tripping threshold and a tripping delay. If the frequency gradient df/dt exceeds or falls below the set tripping threshold, an alarm will be issued instantaneously. If the frequency gradient remains still above/below the set tripping threshold until the tripping delay has elapsed, a tripping command will be issued.

Working Principle

(Please refer to block diagram on next page.)

The frequency element supervises the three phase voltages »VA«, »VB« and »VC«. If any of the evaluated three phase voltages is below 15% Vn, the frequency calculation is blocked. According to the frequency supervision mode set in the Device Planning (81R), the phase voltages are compared to the set frequency gradient (df/dt) threshold. If in any of the phases, the frequency gradient exceeds or falls below the set pickup threshold (acc. to the set df/dt mode) and if there are no blocking commands for the frequency element, an alarm is issued instantaneously and the tripping delay timer is started. When the frequency gradient still exceeds or is below the set pickup threshold after the tripping delay timer has elapsed, a tripping command will be issued.

81[t]...[n]: 81R-Rate of Change
Name = 81[t]...[n]



81UR – Underfrequency and Rate of Change of Frequency (df/dt)

With this setting, the frequency element supervises if the frequency falls below a set pickup threshold and if the frequency gradient exceeds a set threshold at the same time.

In the selected frequency parameter set 81[X], an underfrequency pickup threshold $f<$, a frequency gradient df/dt , and a tripping delay can be set.

Whereby:

- Positive df/dt = the frequency element detects an increase in frequency;
- Negative df/dt = the frequency element detects a decrease in frequency; and
- Absolute df/dt (positive and negative) = the frequency element detects both, increase and decrease in frequency.

81OR – Overfrequency and Rate of Change of Frequency (df/dt)

With this setting, the frequency element supervises if the frequency exceeds a set pickup threshold and if the frequency gradient exceeds a set threshold at the same time.

In the selected frequency parameter set 81[X], an overfrequency pickup threshold $f>$, a frequency gradient df/dt , and a tripping delay can be set.

Whereby:

- Positive df/dt = the frequency element detects an increase in frequency;
- Negative df/dt = the frequency element detects a decrease in frequency; and
- Absolute df/dt (positive and negative) = the frequency element detects both, increase and decrease in frequency.

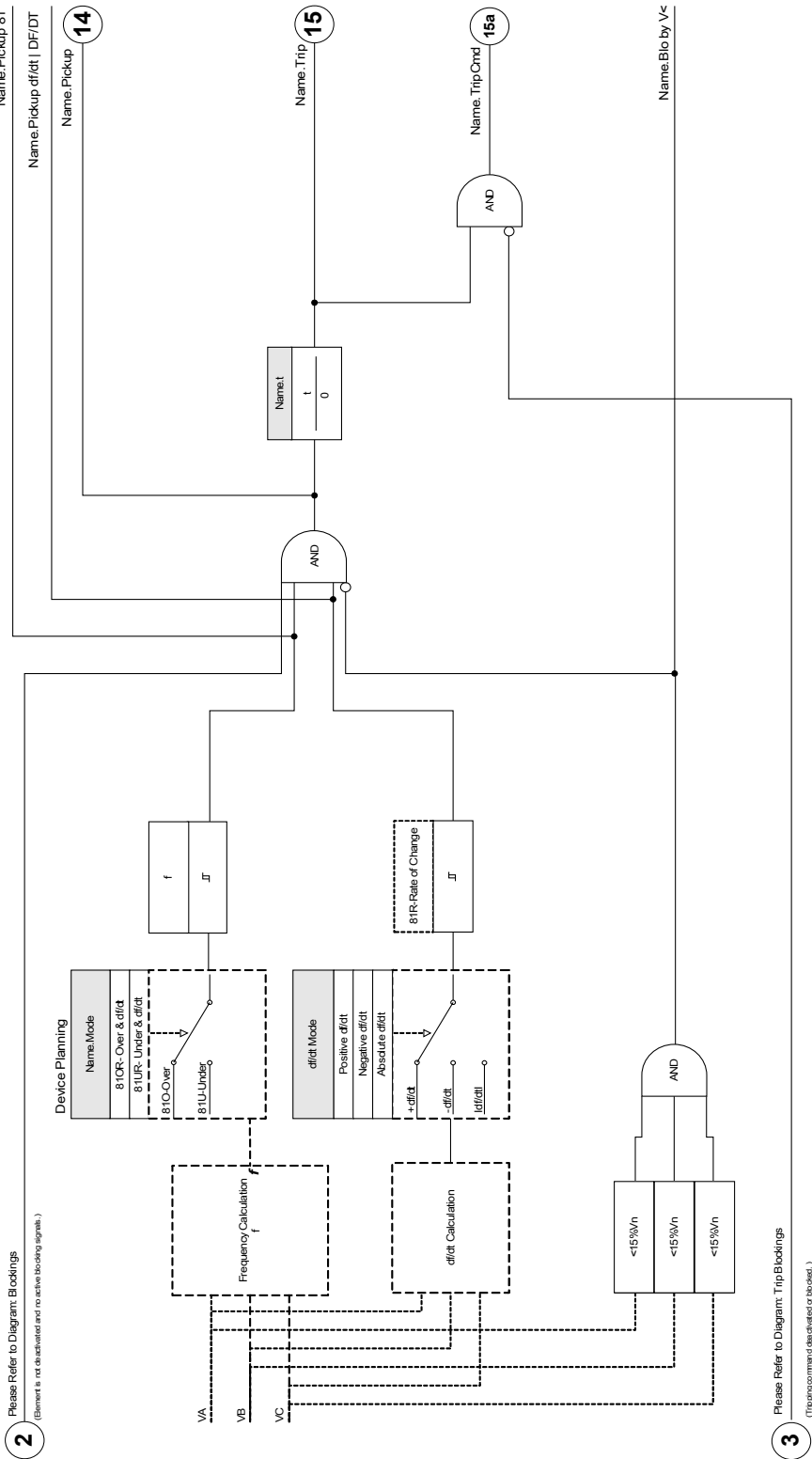
Working Principle

(Please refer to block diagram on next page.)

The frequency element supervises the three phase voltages »VA«, »VB« and »VC«. If any of the three phase voltages is below 15% V_n , the frequency calculation is blocked. According to the frequency supervision mode set in the Device Planning (81UR & df/dt or 81OR & df/dt), the evaluated phase voltages are compared to the set frequency pickup threshold and the set frequency gradient (df/dt) threshold. If in any of the phases, both the frequency and the frequency gradient exceed or falls below the set thresholds and if there are no blocking commands for the frequency element, an alarm is issued instantaneously and the tripping delay timer is started. When the frequency and the frequency gradient still exceed or are below the set threshold after the tripping delay timer has elapsed, a tripping command will be issued.

81[1]...[n]: 81UR- Under & df/dt Or 81OR- Over & df/dt

Name = 81[1]...[n]



81UΔR – Underfrequency and DF/DT

With this setting, the frequency element supervises the frequency and the absolute frequency difference during a definite time interval.

In the selected frequency parameter set 81[X], an underfrequency pickup threshold $f_{<}$, a threshold for the absolute frequency difference (frequency decrease) DF and supervision interval DT can be set.

81OΔR – Overfrequency and DF/DT

With this setting, the frequency element supervises the frequency and the absolute frequency difference during a definite time interval.

In the selected frequency parameter set 81[X], an overfrequency pickup threshold $f_{>}$, a threshold for the absolute frequency difference (frequency increase) DF and supervision interval DT can be set.

Working Principle

(Please refer to block diagram on next page.)

The frequency element supervises the three phase voltages »VA«, »VB« and »VC«. If any of the three phase voltages is below 15% V_n , the frequency calculation is blocked. According to the frequency supervision mode set in the Device Planning (81UR & DF/DT or 81OR & DF/DT), the evaluated phase voltages are compared to the set frequency pickup threshold and the set frequency decrease or increase threshold DF.

If in any of the phases, the frequency exceeds or falls below the set pickup threshold and if there are no blocking commands for the frequency element, an alarm is issued instantaneously. At the same time the timer for the supervision interval DT is started. When, during the supervision interval DT, the frequency still exceeds or is below the set pickup threshold and the frequency decrease/increase reaches the set threshold DF, a tripping command will be issued.

Working Principle of DF/DT Function

(Please refer to f(t) diagram after the block diagram.)

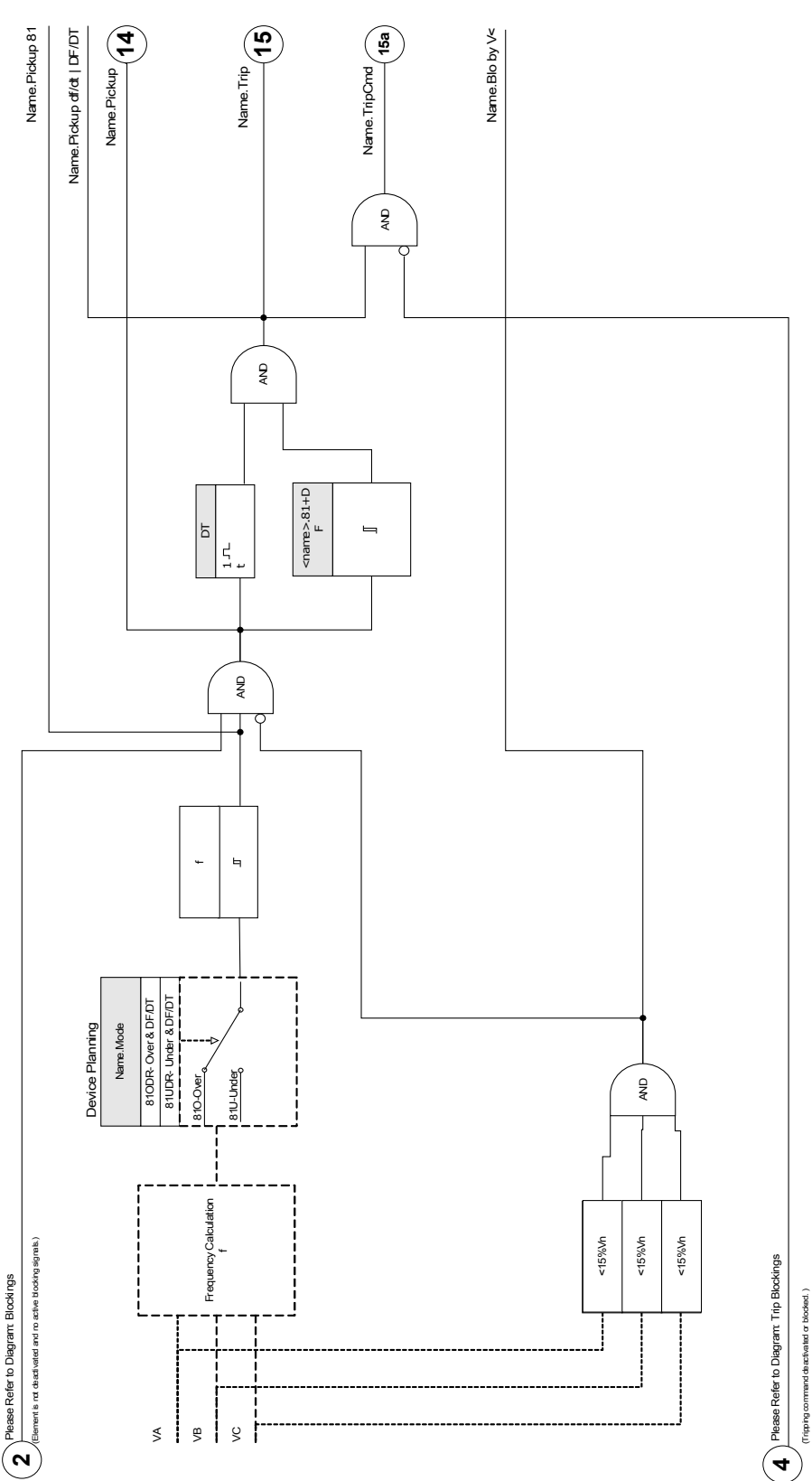
Case 1:

When the frequency falls below a set $f_{<}$ threshold (81U) at t_1 , the DF/DT element energizes. If the frequency difference (decrease) does not reach the set value DF before the time interval DT has expired, no trip will occur. The frequency element remains blocked until the frequency falls below the underfrequency threshold $f_{<}$ (81U) again.

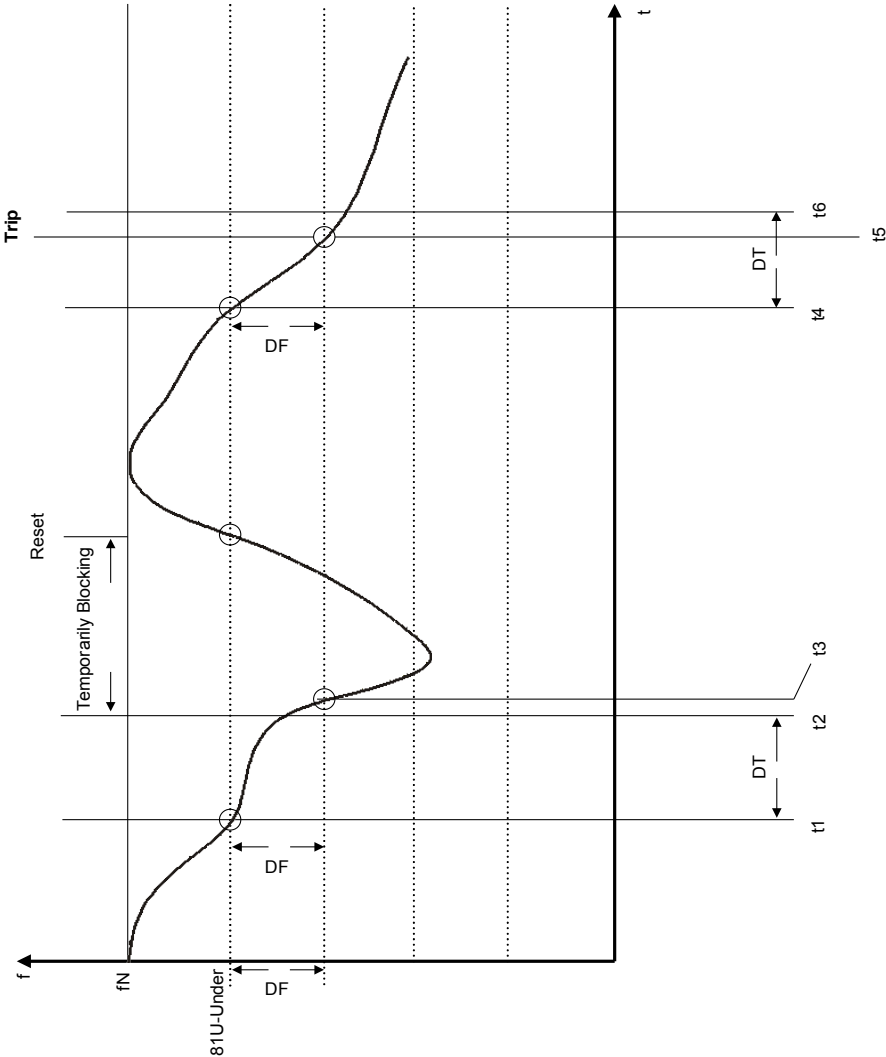
Case 2:

When the frequency falls below a set $f_{<}$ threshold (81U) at t_4 , the DF/DT element energizes. If the frequency difference (decrease) reaches the set value DF before the time interval DT has expired (t_5), a trip command is issued.

8[1]...[n]: 81UDR - Under & DF/DT Or 81ODR - Over & DF/DT
Name = 8[1]...[n]



81[1]...[n]: 81UDR- Under & DF/DT
Name = 81[1]...[n]



78V Vector Surge

The vector surge supervision protects synchronous generators in mains parallel operation due to very fast decoupling in case of mains failure. Very dangerous are mains auto reclosings for synchronous generators. The mains voltage returning typically after 300 ms can hit the generator in asynchronous position. A very fast decoupling is also necessary in case of long time mains failures.

Generally there are two different applications.

- Only mains parallel operation - no single operation:

In this application, the vector surge supervision protects the generator by tripping the generator circuit breaker in case of mains failure.

- Mains parallel operation and single operation:

For this application, the vector surge supervision trips the mains circuit breaker. Here it is insured that the gen.-set is not blocked when it is required as an emergency set.

A very fast decoupling in case of mains failures for synchronous generators is very difficult. Voltage supervision units cannot be used because the synchronous alternator, as well as the load impedance, support the decreasing voltage.

In this situation, the mains voltage drops only after some 100 ms below the pickup threshold of the voltage supervision and, therefore, a safe detection of mains auto reclosings is not possible with voltage supervision only.

Frequency supervision is partially unsuitable because only a highly loaded generator decreases its speed within 100 ms. Current relays detect a fault only when short-circuit type currents exist, but cannot avoid their development. Power relays are able to pickup within 200 ms, but they also cannot prevent the power from rising to short-circuit values. Since power changes are also caused by sudden loaded alternators, the use of power relays can be problematic.

Whereas the vector surge supervision of the device detects mains failures within 60 ms without the restrictions described above because it is specially designed for applications where very fast decoupling from the mains is required. Adding the typical operating time of a circuit breaker or contactor, the total disconnection time remains below 150 ms.

Basic requirement for tripping of the generator/mains monitor is a change in load of more than 15 - 20% of the rated load. Slow changes of the system frequency, for instance at regulating processes (adjustment of speed regulator), do not cause the relay to trip.

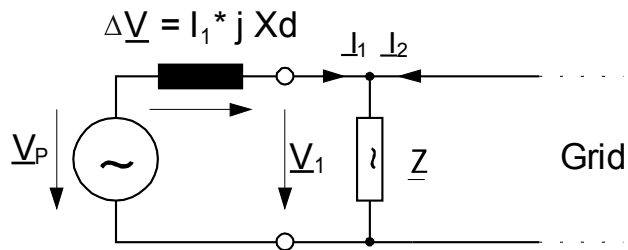
Trippings can also be caused by short-circuits within the grid, because a voltage vector surge higher than the preset value can occur. The magnitude of the voltage vector surge depends on the distance between the short-circuit and the generator. This function is also of advantage to the Power Utility Company because the mains short-circuit capacity and, consequently, the energy feeding the short-circuit is limited.

To prevent a possible false tripping, the vector surge measuring is blocked at a low input voltage $<15\% V_n$. The undervoltage lockout acts faster than the vector surge measurement.

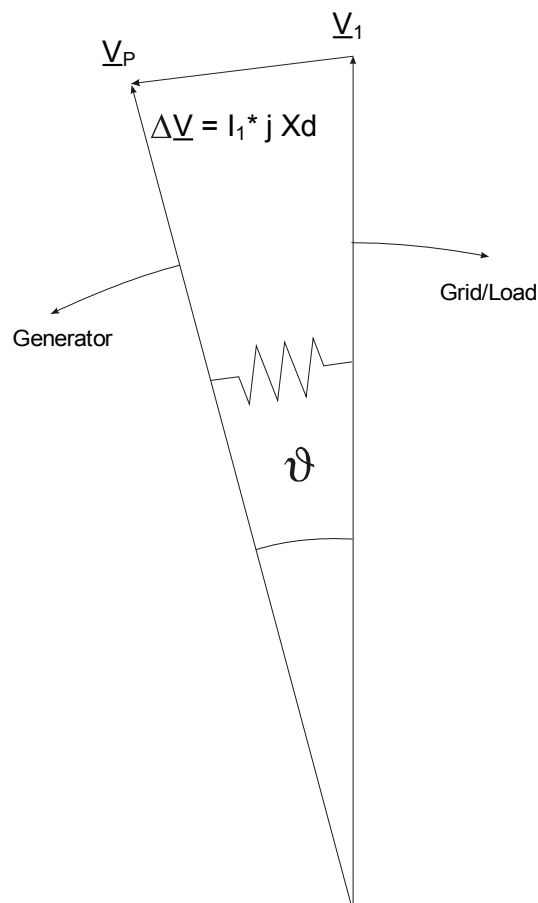
Vector surge tripping is blocked by a phase loss so that a VT fault (e. g.: faulty VTs fuse) does not cause false tripping.

Measuring Principle of Vector Surge Supervision

Equivalent circuit at synchronous generator in parallel with the mains.

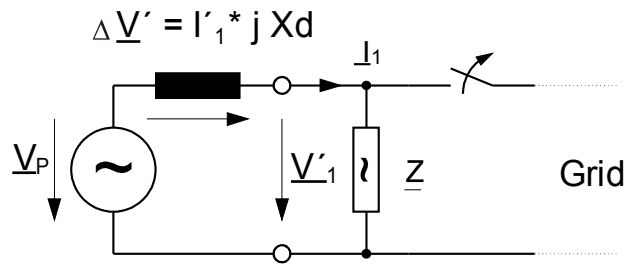


Voltage vectors at mains parallel operation.



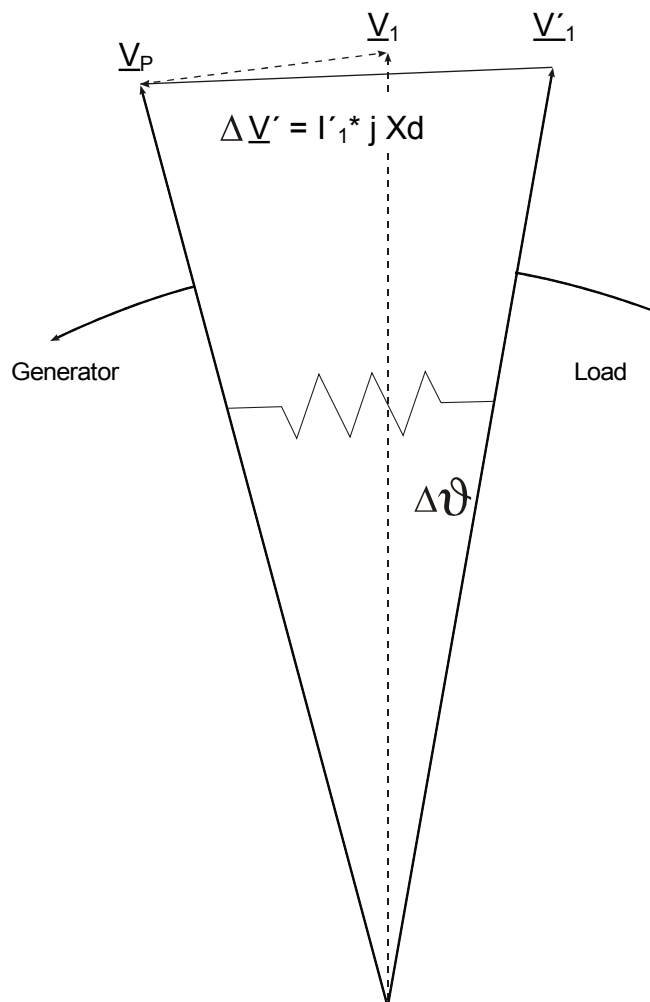
The rotor displacement angle between stator and rotor is dependent on the mechanical moving torque of the generator shaft. The mechanical shaft power is balanced with the electrical fed mains power and, therefore, the synchronous speed keeps constant.

Equivalent circuit at mains failure.

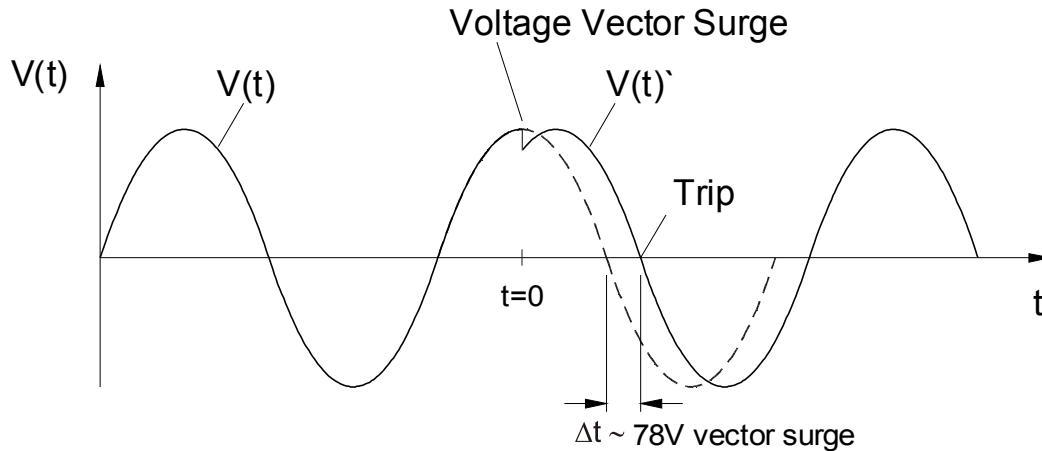


In case of mains failure or auto-reclosing, the generator suddenly feeds a very high load. The rotor displacement angle is decreased repeatedly and the voltage vector V_1 changes its direction (V_1').

Voltage vectors at mains failure.



Voltage vector surge.



As shown in the voltage/time diagram, the instantaneous value of the voltage jumps to another value and the phase position changes. This is called phase or vector surge.

The relay measures the cycle duration. A new measuring is started at each zero passage. The measured cycle duration is internally compared with a reference time and from this the deviation of the cycle duration of the voltage signal is ascertained. In case of a vector surge as shown in the above graphic, the zero passage occurs either earlier or later. The established deviation of the cycle duration is in compliance with the vector surge angle. If, depending on the parameter setting, in all three, in two or in one of the phases, the vector surge exceeds the set threshold and if there are no blocking commands for the frequency element, an alarm and a trip command is issued instantaneously.

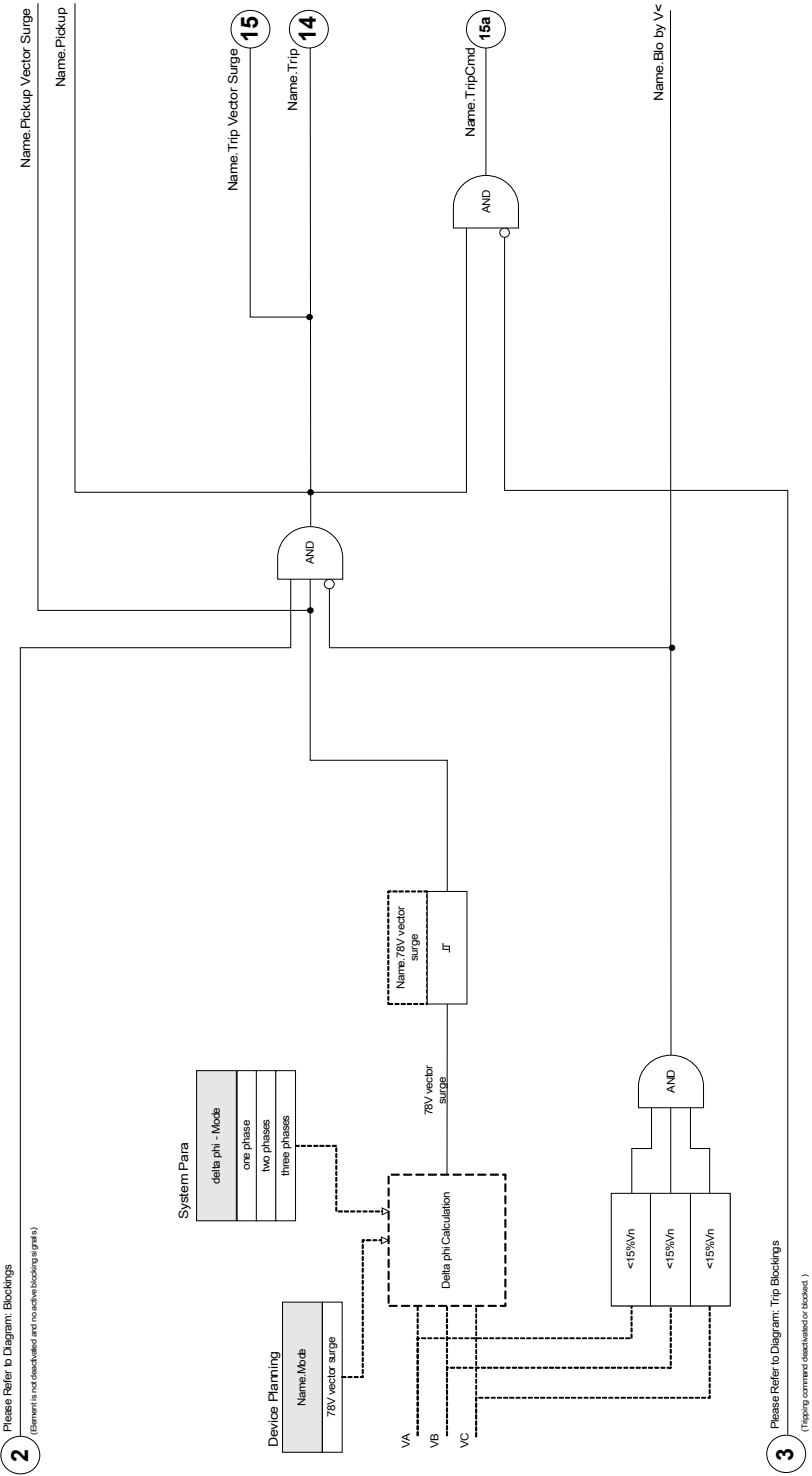
Tripping of the vector surge is blocked in case of loss of one or more phases of the measuring voltage.

Working Principle

(Please refer to block diagram on next page.)

The vector surge element supervises the three phase voltages »VA«, »VB« and »VC«. If any of the three phase voltages is below 15% V_n , the vector surge calculation is blocked. According to the frequency supervision mode set in the Device Planning (78V), the phase voltages are compared to the set vector surge threshold. If in any of the phases, the vector surge exceeds the set threshold and if there are no blocking commands for the frequency element, an alarm and a trip command is issued instantaneously.

8[1]...[n]. 78V vector surge
Name = 8[1]...[n]



Device Planning Parameters of the Frequency Protection Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, 81U-Under, 81O-Over, 81UR- Under & df/dt, 81OR- Over & df/dt, 81UDR- Under & DF/DT, 81ODR- Over & DF/DT, 81R-Rate of Change, 78V vector surge	81[1]: 81O-Over 81[2]: 81O-Over 81[3]: 81U-Under 81[4]: 81U-Under 81[5]: 81U-Under 81[6]: 81U-Under	[Device Planning]

Global Protection Parameters of the Frequency Protection Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Freq-Prot /81[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Freq-Prot /81[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Freq-Prot /81[1]]

Setting Group Parameters of the Frequency Protection Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Freq-Prot /81[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Freq-Prot /81[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Freq-Prot /81[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Freq-Prot /81[1]]
81O-Over 	Pickup value for overfrequency. Only available if: Device Planning: 81.Mode = 81O-Over Or 81OR- Over & df/dt Or 81ODR- Over & DF/DT	40.00 - 69.95Hz	61.0Hz	[Protection Para /<1..4> /Freq-Prot /81[1]]
81U-Under 	Pickup value for underfrequency. Only available if: Device Planning: 81.Mode = 81U-Under Or 81UR- Under & df/dt Or 81UDR- Under & DF/DT	40.00 - 69.95Hz	59.0Hz	[Protection Para /<1..4> /Freq-Prot /81[1]]
t 	Tripping delay Only available if: Device Planning: 81.Mode = 81U-Under Or 81O-OverOr 81OR- Over & df/dt Or 81UR- Under & df/dt	0.00 - 3600.00s	1.00s	[Protection Para /<1..4> /Freq-Prot /81[1]]

Parameter	Description	Setting range	Default	Menu path
81R-Rate of Change 	Measured value (calculated): Rate-of-frequency-change. Only available if: Device Planning: 81.Mode = 81R-Rate of Change Or 81UR- Under & df/dt Or 81OR- Over & df/dt	0.100 - 10.000Hz/s	1.000Hz/s	[Protection Para /<1..4> /Freq-Prot /81[1]]
t-df/dt 	Trip delay df/dt	0.00 - 300.00s	1.00s	[Protection Para /<1..4> /Freq-Prot /81[1]]
DF 	Frequency difference for the maximum admissible variation of the mean of the rate of frequency-change. This function is inactive if DF=0. Only available if: Device Planning: 81.Mode = 81UDR- Under & DF/DT Or 81ODR- Over & DF/DT	0.0 - 10.0Hz	1.00Hz	[Protection Para /<1..4> /Freq-Prot /81[1]]
DT 	Time interval of the maximum admissible rate-of-frequency-change. Only available if: Device Planning: 81.Mode = 81UDR- Under & DF/DT Or 81ODR- Over & DF/DT	0.1 - 10.0s	1.00s	[Protection Para /<1..4> /Freq-Prot /81[1]]
df/dt Mode 	df/dt Mode Only available if: Device Planning: 81.Mode = 81R-Rate of Change Or 81UR- Under & df/dt Or 81OR- Over & df/dt Only available if: Device Planning: 81.Mode = 81R-Rate of Change Or 81UR- Under & df/dt Or 81OR- Over & df/dt Only available if: Device Planning: 81.Mode = 81R-Rate of Change	Absolute df/dt, Positive df/dt, Negative df/dt	Absolute df/dt	[Protection Para /<1..4> /Freq-Prot /81[1]]
78V vector surge 	Measured Value (Calculated): Vector Surge Only available if: Device Planning: 81.Mode = 78V vector surge	1 - 30°	10°	[Protection Para /<1..4> /Freq-Prot /81[1]]

Frequency Protection Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Freq-Prot /81[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Freq-Prot /81[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Freq-Prot /81[1]]

Frequency Protection Module Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo by V<	Signal: Module is blocked by undervoltage.
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup 81	Signal: Pickup Frequency Protection
Pickup df/dt DF/DT	Pickup instantaneous or average value of the rate-of-frequency-change
Pickup Vector Surge	Signal: Pickup Vector Surge
Pickup	Signal: Pickup Frequency Protection (collective signal)
Trip 81	Signal: Frequency has exceeded the limit.
Trip df/dt DF/DT	Signal: Trip df/dt or DF/DT
Trip Vector Surge	Signal: Trip delta phi
Trip	Signal: Trip Frequency Protection (collective signal)
TripCmd	Signal: Trip Command

Commissioning: Overfrequency [ANSI 81O]

Object to be tested:

All configured overfrequency protection stages.

Necessary means:

- Three-phase voltage source with variable frequency; and
- Timer

Procedure:

Testing the threshold values

- Keep on increasing the frequency until the respective frequency element is activated;
- Note the frequency value; and
- Disconnect the test voltage.

Testing the trip delay

- Set the test voltage to nominal frequency and
- Now connect a frequency jump (activation value) and then start a timer. Measure the tripping time at the relay output.

Testing the fallback ratio:

Reduce the measuring quantity to less than 99.95% of the trip value (or 0.05% fn). The relay must only fall back at 99.95% of the trip value at the earliest (or 0.05% fn).

Successful test result:

Permissible deviations/tolerances can be taken from the Technical Data.

Commissioning: Underfrequency [ANSI 81U]

For all configured underfrequency elements, this test can be carried out similar to the test for overfrequency protection (by using the related underfrequency values).

Please consider the following deviations:

- For testing the threshold values, the frequency has to be decreased until the protection element is activated.
- For detection of the fallback ratio, the measuring quantity has to be increased to more than 100.05% of the trip value (or 0.05% fn). At 100.05% of the trip value the relay is to fall back at the earliest (or 0.05% fn).

Commissioning: 81R Rate of Change (df/dt)

Object to be tested:

All frequency protection stages that are projected as df/dt.

Necessary means:

- Three-phase voltage source and
- Frequency generator that can generate and measure a linear, defined rate of change of frequency.

Procedure:

Testing the threshold values

- Keep on increasing the rate of change of frequency until the respective element is activated and
- Note the value.

Testing the trip delay

- Set the test voltage to nominal frequency:
- Now apply a step change (sudden change) that is 1.5 times the setting value (example: apply 3 Hz per second if the setting value is 2 Hz per second); and
- Measure the tripping time at the relay output. Compare the measured tripping time to the configured tripping time.

Successful test result:

Permissible deviations/tolerances and dropout ratios can be taken from the Technical Data.

Commissioning: 81U and Rate of Change ($f<$ and $-df/dt$)

Object to be tested:

All frequency protection stages that are projected as $f<$ and $-df/dt$.

Necessary means:

- Three-phase voltage source and
- Frequency generator that can generate and measure a linear, defined rate of change of frequency.

Procedure:

Testing the threshold values

- Feed nominal voltage and nominal frequency to the device:
- Decrease the frequency below the $f<$ threshold: and
- Apply a rate of change of frequency (step change) that is below the setting value (example: apply -1 Hz per second if the setting value is -0.8 Hz per second). After the tripping delay is expired the relay has to trip.

Successful test result:

Permissible deviations/tolerances and dropout ratios can be taken from the Technical Data.

Commissioning: 81O and Rate of Change ($f>$ and df/dt)

Object to be tested:

All frequency protection stages that are projected as $f>$ and df/dt .

Necessary means:

- Three-phase voltage source and
- Frequency generator that can generate and measure a linear, defined rate of change of frequency.

Procedure:

Testing the threshold values

- Feed nominal voltage and nominal frequency to the device;
- Increase the frequency above the $f>$ threshold; and
- Apply a rate of change of frequency (step change) that is above the setting value (example: apply 1 Hz per second if the setting value is 0.8 Hz per second). After the tripping delay is expired the relay has to trip.

Successful test result:

Permissible deviations/tolerances and dropout ratios can be taken from the Technical Data.

Commissioning: 81UAR – Underfrequency and DF/DT

Object to be tested:

All frequency protection stages that are projected as $f <$ and Df/Dt .

Necessary means:

- Three-phase voltage source and
- Frequency generator that can generate and measure a defined frequency change.

Procedure:

Testing the threshold values

- Feed nominal voltage and nominal frequency to the device;
- Decrease the frequency below the $f <$ threshold; and
- Apply a defined frequency change (step change) that is above the setting value (example: apply a frequency change of 1 Hz during the set time interval DT if the setting value DF is 0.8 Hz). The relay has to trip immediately.

Successful test result:

Permissible deviations/tolerances and dropout ratios can be taken from the Technical Data.

Commissioning: 81OAR – Overfrequency and DF/DT

Object to be tested:

All frequency protection stages that are projected as $f >$ and Df/Dt .

Necessary means:

- Three-phase voltage source and
- Frequency generator that can generate and measure a defined frequency change.

Procedure:

Testing the threshold values

- Feed nominal voltage and nominal frequency to the device;
- Increase the frequency above the $f >$ threshold; and
- Apply a defined frequency change (step change) that is above the setting value (example: apply a frequency change of 1 Hz during the set time interval DT if the setting value DF is 0.8 Hz). The relay has to trip immediately.

Successful test result:

Permissible deviations/tolerances and dropout ratios can be taken from the Technical Data.

Commissioning: Vector Surge 78V

Object to be tested:

All frequency protection stages that are projected as vector surge (78V).

Necessary means:

- Three-phase voltage source that can generate a definite step (sudden change) of the voltage pointers (phase shift).

Procedure:

Testing the threshold values

- Apply a vector surge (sudden change) that is 1.5 times the setting value (example: if the setting value is 10° apply 15°).

Successful test result:

Permissible deviations/tolerances and dropout ratio can be taken from the Technical Data.

32 - Power Protection

Available Elements:

32[1] .32[2] .32[3]

This is the 32 device Power Protection setting. Each element can be set to one of five settings:

- Do Not Use;
- Over Forward Power (P>);
- Under Forward Power (P<);
- Over Reverse Power (Pr>); and
- Under Reverse Power (Pr<).

Each element consists of a Pickup and a Delay setting. These elements are based on rated apparent power VAn.

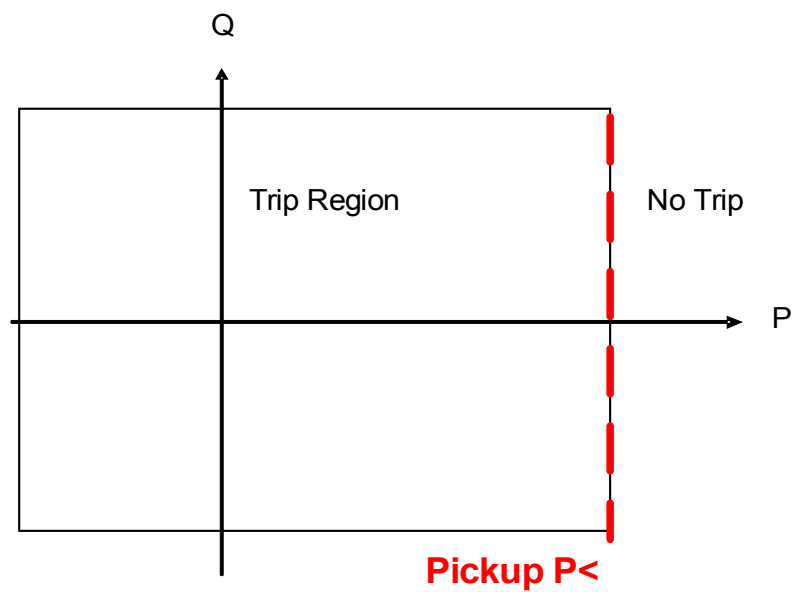
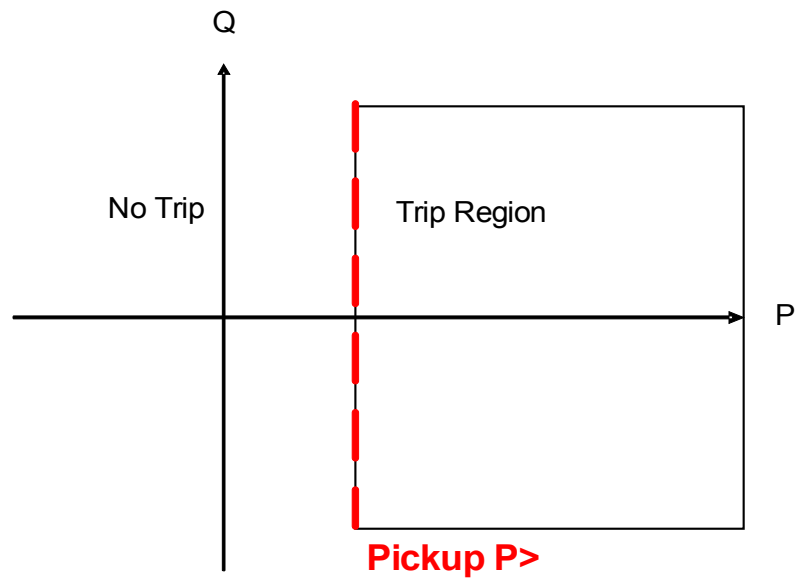
Definition for VAn is as follows:

$V_{An} = \text{SQRT}(3) * VT \text{ secondary rating} * CT \text{ secondary rating (I=1/5A) for wye}$

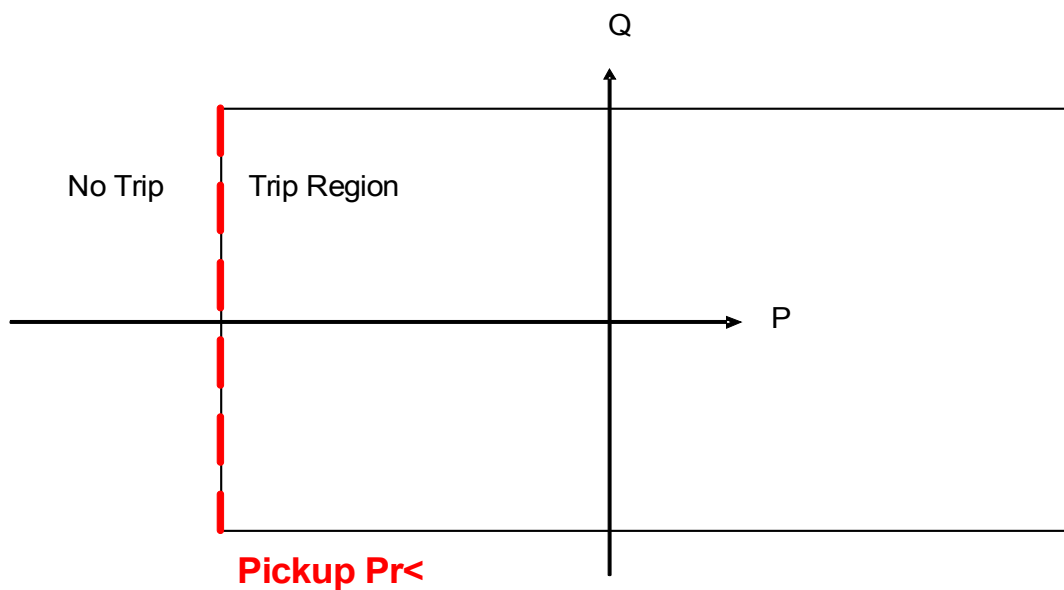
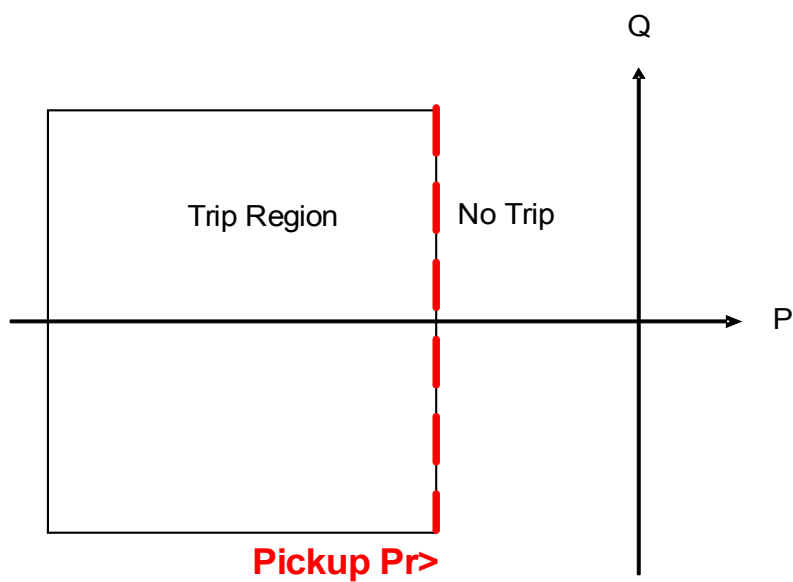
or $V_{An} = 3 * VT \text{ secondary rating} / \text{SQRT}(3) * CT \text{ secondary rating (I=1/5A) for delta connections.}$

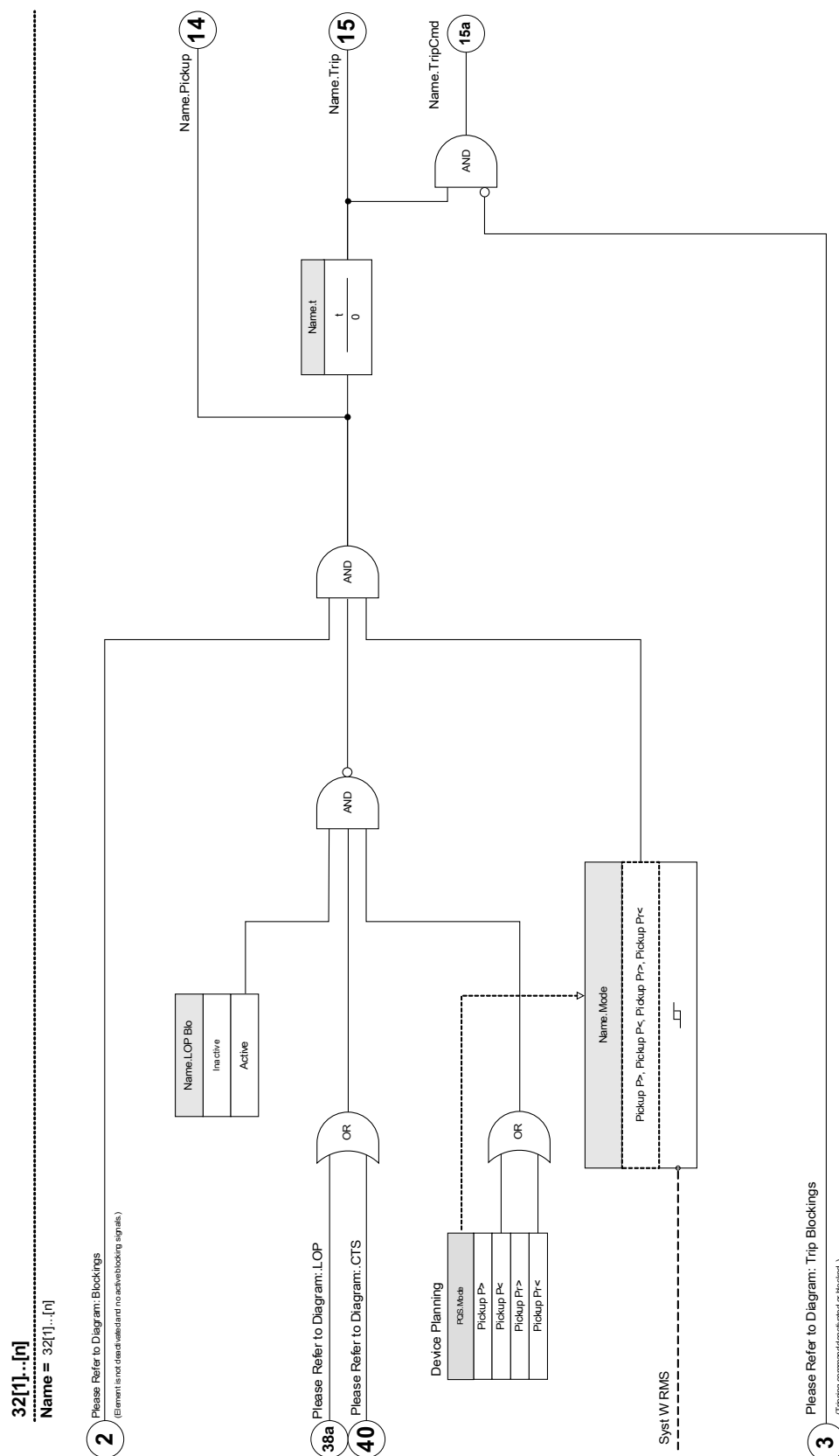
The following graphics show the areas that are protected by the corresponding modes.

32 - Forward Power - Over and Under



32 - Reverse Power - Over and Under





Device Planning Parameters of the Power Protection Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Over forward, Over reverse, Under forward, Under reverse	32[1]: Over reverse 32[2]: Under forward 32[3]: Over forward	[Device Planning]

Global Protection Parameters of the Power Protection Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Power-Prot /32[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Power-Prot /32[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Power-Prot /32[1]]

Parameter Set Parameters of the Power Protection Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Power-Prot /32[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Power-Prot /32[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Power-Prot /32[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Power-Prot /32[1]]
LOP Blo 	Measuring Circuit Supervision Voltage	Inactive, Active	Inactive	[Protection Para /<1..4> /Power-Prot /32[1]]
CTS Blo 	Measuring Circuit Supervision Current	Inactive, Active	Inactive	[Protection Para /<1..4> /Power-Prot /32[1]]
Pickup P> 	Over(load) Active Power Pickup Value. Can be used for monitoring the maximum allowed forward power limits of transformers or overhead lines. Definition for Sn is as follows: $S_n = 1.7321 \cdot V_T \text{ rating} \cdot C_T \text{ rating}$. The voltage is the line-to-line voltage. Only available if: Device Planning: PQS.Mode = Pickup P>	0.003 - 10.000VAn	1.20VAn	[Protection Para /<1..4> /Power-Prot /32[1]]

Parameter	Description	Setting range	Default	Menu path
Pickup P< 	Under(load) Active Power Pickup Value (e.g.: caused by idling motors). Definition for Sn is as follows: $S_n = 1.7321 \cdot VT \text{ rating} \cdot CT \text{ rating}$. The voltage is the line-to-line voltage. Only available if: Device Planning: PQS.Mode = Pickup P<	0.003 - 10.000VAn	0.80VAn	[Protection Para /<1..4> /Power-Prot /32[1]]
Pickup Pr> 	Overload Reverse Active Power Pickup Value. Protection against reverse feeding into the power supply network. Definition for Sn is as follows: $S_n = 1.7321 \cdot VT \text{ rating} \cdot CT \text{ rating}$. The voltage is the line-to-line voltage. Only available if: Device Planning: PQS.Mode = Pickup Pr>	0.003 - 10.000VAn	0.020VAn	[Protection Para /<1..4> /Power-Prot /32[1]]
Pickup Pr< 	Under Reverse Definition for Sn is as follows: $S_n = 1.7321 \cdot VT \text{ rating} \cdot CT \text{ rating}$. The voltage is the line-to-line voltage. Only available if: Device Planning: PQS.Mode = Pickup Pr<	0.003 - 10.000VAn	0.80VAn	[Protection Para /<1..4> /Power-Prot /32[1]]
t 	Tripping delay	0.00 - 1100.00s	0.01s	[Protection Para /<1..4> /Power-Prot /32[1]]

States of the Inputs of the Power Protection Module

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking	[Protection Para /Global Prot Para /Power-Prot /32[1]]
ExBlo2-I	Module Input State: External Blocking	[Protection Para /Global Prot Para /Power-Prot /32[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Power-Prot /32[1]]

Signals of the Power Protection module (states of the outputs)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup Power Protection
Trip	Signal: Trip Power Protection
TripCmd	Signal: Trip Command

Commissioning Examples for the Power Protection Module

Object to be tested:

Testing the projected Power Protection Modules:

- $P>$;
- $P<$;
- $Pr>$; and
- $Pr<$.

Necessary means:

- 3-phase AC voltage source;
- 3-phase AC current source; and
- Timer.

Procedure – Testing the wiring:

- Feed rated voltage and rated current to the measuring inputs of the relay.
- Adjust the current pointers 30 degrees lagging to the voltage pointers.
- The following measuring values have to be shown:
 $P=0.86 P_n$;
 $Q=0.5 Q_n$; and
 $S=1 S_n$.

NOTICE

If the measured values are shown with a negative (algebraic) sign, check the wiring.

NOTICE

The examples shown within this chapter have to be carried out with the tripping values and tripping delays that apply to the User's switchboard.

If the User is testing "greater than thresholds" (e.g.: $P>$), start at 80% of the tripping value and increase the object to be tested until the relay picks up.

In case the User is testing "less than thresholds" (e.g.: $P<$), start at 120% of the tripping value and reduce the object to be tested until the relay picks up.

If the User is testing tripping delays of "greater than" modules (e.g.: $P>$), start a timer simultaneously with an abrupt change of the object to be tested from 80% of the tripping value to 120% of the tripping value.

If the User is testing tripping delays of "less than" modules (e.g.: $P<$), start a timer simultaneously with an abrupt change of the object to be tested from 120% of the tripping value to 80% of the tripping value.

P>

Testing the threshold values (Example, Threshold 1.1 Pn)

- Feed rated voltage and 0.9 times rated current in phase to the measuring inputs of the relay (PF=1).
- The measured values for the active power "P" must show a positive algebraic sign.
- Set the pickup threshold (e.g.: 1.1 Pn).
- In order to test the pickup thresholds, feed 0.9 times rated current to the measuring inputs of the relay. Increase the current slowly until the relay picks up. Ensure that the angle between current and voltage remains constant. Compare the measured pickup value to the configured value.

Testing the tripping delay (Example, Threshold 1.1 Pn)

- Feed rated voltage and 0.9 times rated current in phase to the measuring inputs of the relay (PF=1).
- The measured values for the active power "P" must show a positive algebraic sign.
- Set the pickup threshold (e.g.: 1.1 Pn).
- In order to test the tripping delay, feed 0.9 times rated current to the measuring inputs of the relay. Increase the current with an abrupt change to 1.2 In. Ensure that the angle between current and voltage remains constant. Measure the tripping delay at the output of the relay.

Successful test result:

The measured total tripping delays or individual tripping delays, threshold values, and dropout ratios correspond with those values specified in the adjustment list. Permissible deviations/tolerances can be found in the Technical Data section.

P<

Testing the threshold values (Example, Threshold 0.3 P_n)

- Feed rated voltage and 0.5 times rated current in phase to the measuring inputs of the relay (PF=1).
- The measured values for the active power "P" must show a positive algebraic sign.
- Set the pickup threshold (e.g.: 0.3 P_n).
- In order to test the pickup thresholds, feed 0.5 times rated current to the measuring inputs of the relay. Decrease the current slowly until the relay picks up. Ensure that the angle between current and voltage remains constant. Compare the measured pickup value to the configured.

Testing the tripping delay (Example, Threshold 0.3 P_n)

- Feed rated voltage and 0.5 times rated current in phase to the measuring inputs of the relay (PF=1).
- The measured values for the active power "P" must show a positive algebraic sign.
- Set the pickup threshold (e.g.: 0.3 P_n).
- In order to test the tripping delay feed, 0.5 times rated current to the measuring inputs of the relay. Decrease the current with an abrupt change to 0.2 I_n. Ensure that the angle between current and voltage remains constant. Measure the tripping delay at the output of the relay.

Successful test result:

The measured total tripping delays or individual tripping delays, threshold values, and dropout ratios correspond with those values specified in the adjustment list. Permissible deviations/tolerances can be found in the Technical Data section.

Pr>

Testing the threshold values (Example, Threshold 1.1 P_n)

- Feed rated voltage and 0.9 times rated current with 180 degree phase angle between voltage and current pointers to the measuring inputs of the relay.
- The measured values for the active power "P" must show a negative algebraic sign.
- Set the pickup threshold (e. g.: 1.1 P_n).
- In order to test the pickup thresholds, feed 0.9 times rated current to the measuring inputs of the relay. Increase the current slowly until the relay picks up. Ensure that the angle between current and voltage remains constant. Compare the measured pickup value to the configured value.

Testing the tripping delay (Example, Threshold 1.1 P_n)

- Feed rated voltage and 0.9 times rated current with 180 degree phase shift between voltage and current pointers to the measuring inputs of the relay.
- The measured values for the active power "P" must show a negative algebraic sign.
- Set the pickup threshold (e.g.: 1.1 P_n).
- In order to test the tripping delay, feed 0.9 times rated current to the measuring inputs of the relay. Increase the current with an abrupt change to 1.2 I_n. Ensure that the angle between current and voltage remains constant. Measure the tripping delay at the output of the relay.

Successful test result:

The measured total tripping delays or individual tripping delays, threshold values, and dropout ratios correspond with those values specified in the adjustment list. Permissible deviations/tolerances can be found in the Technical Data section.

Pr<

Testing the threshold values (Example, Threshold 0.3 Pn)

- Feed rated voltage and 0.5 times rated current with 180 degree phase shift between voltage and current pointers to the measuring inputs of the relay.
- The measured values for the active power "P" must show a negative algebraic sign.
- Set the pickup threshold (e. g.: 0.3 Pn).
- In order to test the pickup thresholds, feed 0.5 times rated current to the measuring inputs of the relay. Decrease the current slowly until the relay picks up. Ensure that the angle between current and voltage remains constant. Compare the measured pickup value to the configured value.

Testing the tripping delay (Example, Threshold 0.3 Pn)

- Feed rated voltage and 0.5 times rated current with 180 degree phase shift between voltage and current pointers to the measuring inputs of the relay.
- The measured values for the active power "P" must show a negative algebraic sign.
- Set the pickup threshold (e.g.: 0.3 Pn).
- In order to test the tripping delay, feed 0.5 times rated current to the measuring inputs of the relay. Decrease the current with an abrupt change to 0.2 In. Ensure that the angle between current and voltage remains constant. Measure the tripping delay at the output of the relay.

Successful test result:

The measured total tripping delays or individual tripping delays, threshold values, and dropout ratios correspond with those values specified in the adjustment list. Permissible deviations/tolerances can be found in the Technical Data section.

32V - Reactive Power Protection

Available Elements:

32V[1] .32V[2] .32V[3]

This is the 32V device Reactive Power Protection setting. Each element can be set to one of five settings:

- Do Not Use;
- Over Forward Reactive Power (Q>);
- Under Forward Reactive Power (Q<);
- Over Reverse Reactive Power (Qr>); and
- Under Reverse Reactive Power (Qr<).

Each element consists of a Pickup and a Delay setting. These elements are based on rated apparent power V_{An} .

Definition for V_{An} is as follows:

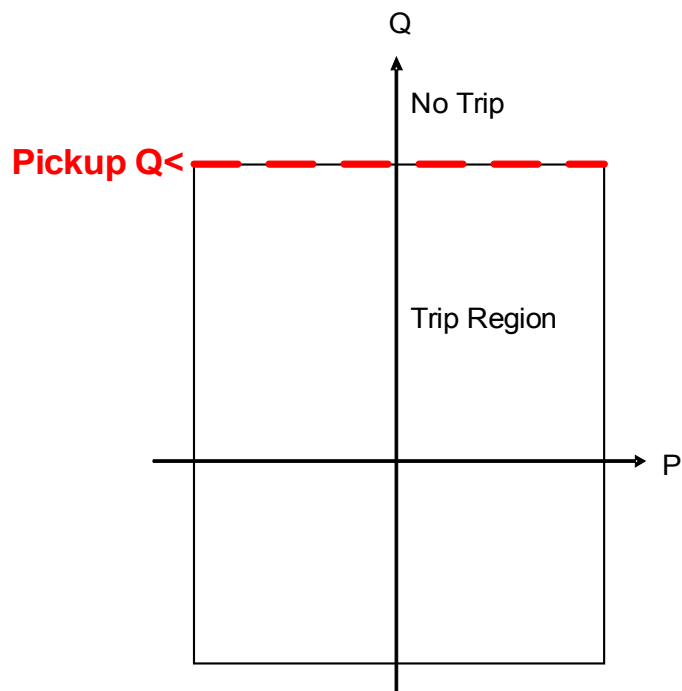
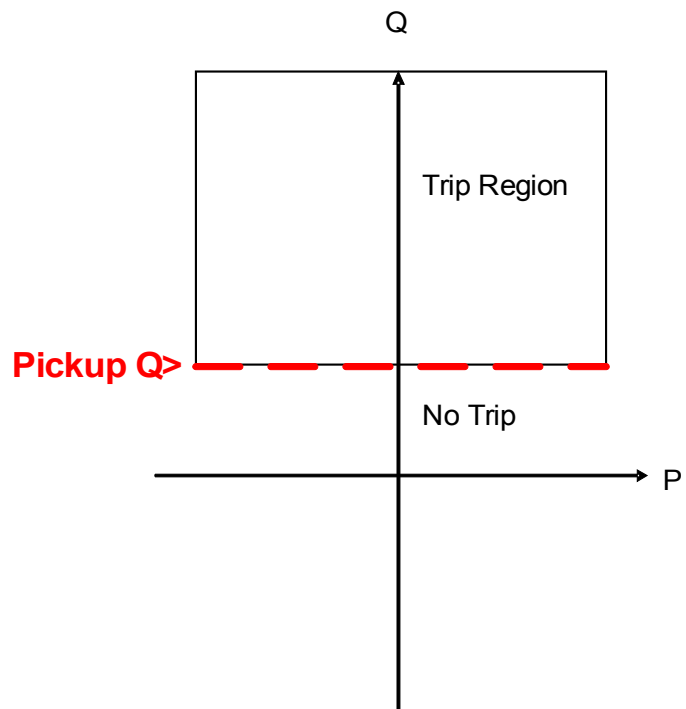
$V_{An} = \text{SQRT}(3) * VT \text{ secondary rating} * CT \text{ secondary rating (I=1/5A) for wye}$

or $V_{An} = 3 * VT \text{ secondary rating/SQRT}(3) * CT \text{ secondary rating (I=1/5A) for delta connections.}$

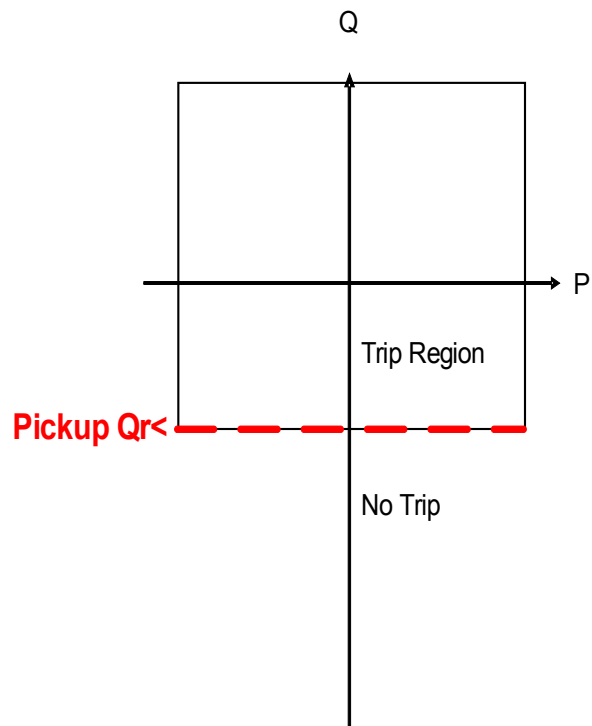
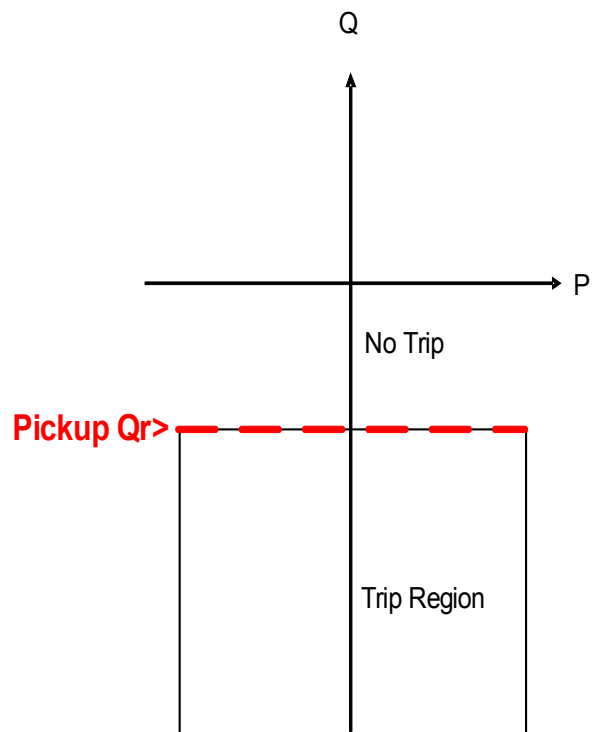
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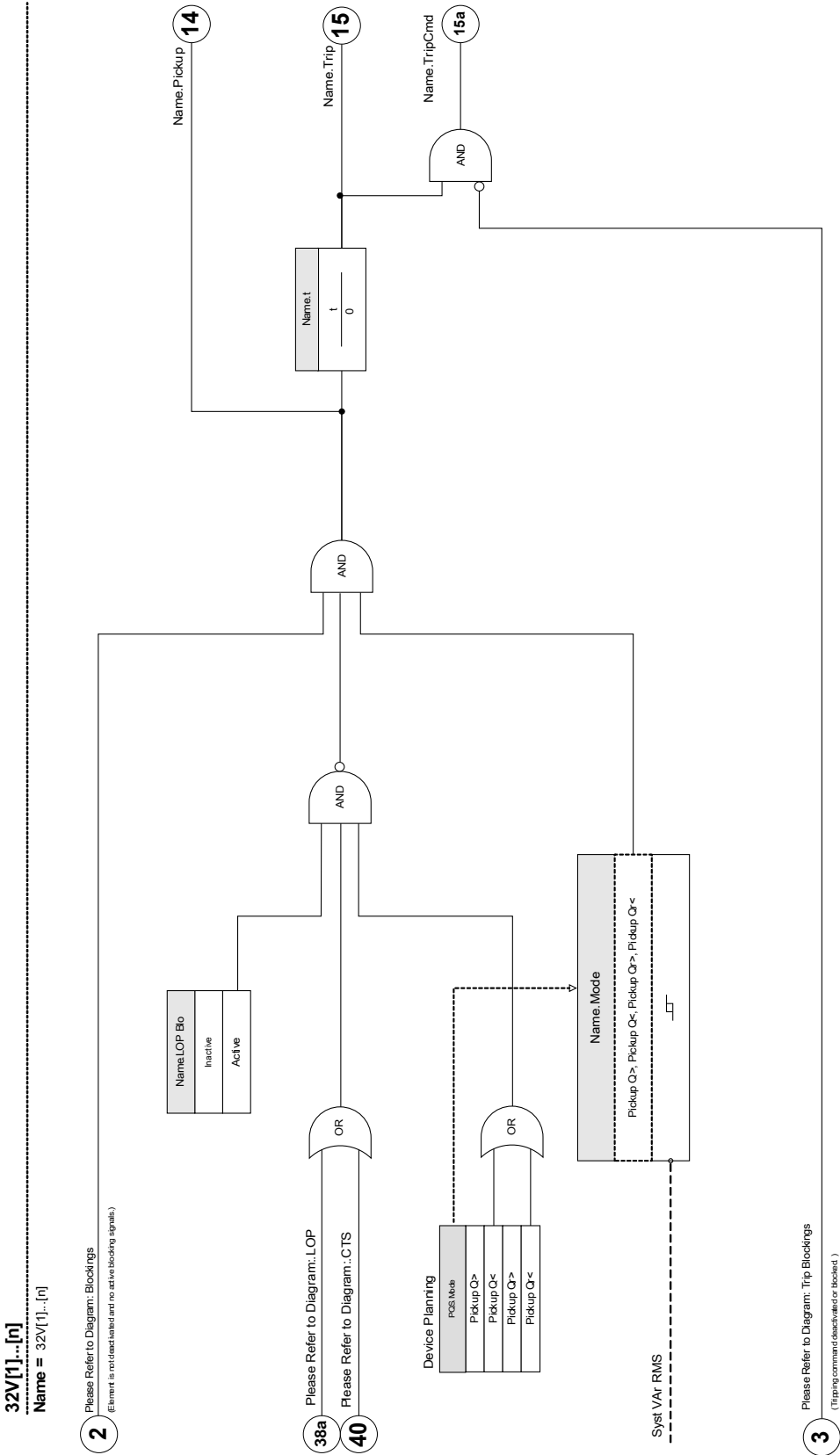
The following graphics show the areas that are protected by the corresponding modes.

32V Forward Reactive Power - Over and Under



32V Reverse Reactive Power - Over and Under





Device Planning Parameters of the Reactive Power Protection Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Over forward, Over reverse, Under forward, Under reverse	32V[1]: Over reverse 32V[2]: Under forward 32V[3]: Over forward	[Device Planning]

Global Protection Parameters of the Reactive Power Protection Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	-.-	[Protection Para /Global Prot Para /Power-Prot /32V[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	-.-	[Protection Para /Global Prot Para /Power-Prot /32V[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	-.-	[Protection Para /Global Prot Para /Power-Prot /32V[1]]

Parameter Set Parameters of the Reactive Power Protection Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Power-Prot /32V[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Power-Prot /32V[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Power-Prot /32V[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Power-Prot /32V[1]]
LOP Blo 	Measuring Circuit Supervision Voltage	Inactive, Active	Inactive	[Protection Para /<1..4> /Power-Prot /32V[1]]
CTS Blo 	Measuring Circuit Supervision Current	Inactive, Active	Inactive	[Protection Para /<1..4> /Power-Prot /32V[1]]
Pickup Q> 	Over(load) Reactive Power Pickup Value. Monitoring the maximum allowed reactive power of the electrical equipment like transformers or overhead lines). If the maximum value is exceeded, a condensator bank could be switched off. Definition for S_n is as follows: $S_n = 1.7321 \cdot V_T \text{ rating} \cdot C_T \text{ rating}$. The voltage is the line-to-line voltage. Only available if: Device Planning: PQS.Mode = Pickup Q>	0.003 - 10.000VAn	1.20VAn	[Protection Para /<1..4> /Power-Prot /32V[1]]

Parameter	Description	Setting range	Default	Menu path
Pickup Q< 	Under(load) Reactive Power Pickup Value. Monitoring the minimum value of the reactive power. If it falls below the set value, a condensator bank could be switched on. Definition for Sn is as follows: $S_n = 1.7321 \cdot VT \text{ rating} \cdot CT \text{ rating}$. The voltage is the line-to-line voltage. Only available if: Device Planning: PQS.Mode = Pickup Q<	0.003 - 10.000VAn	0.80VAn	[Protection Para /<1..4> /Power-Prot /32V[1]]
Pickup Qr> 	Overload Reverse Reactive Power Pickup Value Definition for Sn is as follows: $S_n = 1.7321 \cdot VT \text{ rating} \cdot CT \text{ rating}$. The voltage is the line-to-line voltage. Only available if: Device Planning: PQS.Mode = Pickup Qr>	0.003 - 10.000VAn	0.020VAn	[Protection Para /<1..4> /Power-Prot /32V[1]]
Pickup Qr< 	Under Reverse Definition for Sn is as follows: $S_n = 1.7321 \cdot VT \text{ rating} \cdot CT \text{ rating}$. The voltage is the line-to-line voltage. Only available if: Device Planning: PQS.Mode = Pickup Qr<	0.003 - 10.000VAn	0.80VAn	[Protection Para /<1..4> /Power-Prot /32V[1]]
t 	Tripping delay	0.00 - 1100.00s	0.01s	[Protection Para /<1..4> /Power-Prot /32V[1]]

States of the Inputs of the Reactive Power Protection Module

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking	[Protection Para /Global Prot Para /Power-Prot /32V[1]]
ExBlo2-I	Module Input State: External Blocking	[Protection Para /Global Prot Para /Power-Prot /32V[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Power-Prot /32V[1]]

Signals of the Reactive Power Protection Module (States of the Outputs)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup Power Protection
Trip	Signal: Trip Power Protection
TripCmd	Signal: Trip Command

Commissioning Examples for the Reactive Power Protection Module

Object to be tested:

Testing the projected Power Protection Modules.

- $Q>$;
- $Q<$;
- $Qr>$; and
- $Qr<$.

Necessary means:

- 3-phase AC voltage source;
- 3-phase AC current source; and
- Timer.

Procedure – Testing the wiring:

- Feed rated voltage and rated current to the measuring inputs of the relay.
- Adjust the current pointers 30° lagging to the voltage pointers.
- The following measuring values have to be shown:
 - $P=0.86 P_n$;
 - $Q=0.5 Q_n$; and
 - $S=1 S_n$.

NOTICE

If the measured values are shown with a negative (algebraic) sign, check the wiring.

NOTICE

The examples shown within this chapter have to be carried out with the tripping values and tripping delays that apply to the User's switchboard.

If the User is testing "greater than thresholds" (e.g.: $Q>$), start at 80% of the tripping value and increase the object to be tested until the relay picks up.

In case the User is testing "less than thresholds" (e.g.: $Q<$), start at 120% of the tripping value and reduce the object to be tested until the relay picks up.

If the User is testing tripping delays of "greater than" modules (e.g.: $Q>$), start a timer simultaneously with an abrupt change of the object to be tested from 80% of the tripping value to 120% of the tripping value.

If the User is testing tripping delays of "less than" modules (e.g.: $Q<$), start a timer simultaneously with an abrupt change of the object to be tested from 120% of the tripping value to 80% of the tripping value.

Q>

Testing the threshold values (Example, Threshold 1,1 Qn)

- Feed rated voltage and 0.9 times rated current (90 degrees phase shift) to the measuring inputs of the relay (PF=0).
- The measured values for the active power "Q" must show a positive algebraic sign.
- Set the pickup threshold (e.g.: 1.1. Qn).
- In order to test the pickup thresholds, feed 0.9 times rated current to the measuring inputs of the relay. Increase the current slowly until the relay picks up. Ensure that the angle between current and voltage remains constant. Compare the measured pickup value to the configured value.

Testing the tripping delay (Example, Threshold 1.1 Qn)

- Feed rated voltage and 0.9 times rated current (90 degree phase shift) to the measuring inputs of the relay (PF=0).
- The measured values for the active power "Q" must show a positive algebraic sign.
- Set the pickup threshold (e.g. 1.1. Qn).
- In order to test the tripping delay, feed 0.9 times rated current to the measuring inputs of the relay. Increase the current with an abrupt change to 1.2 In. Ensure that the angle between current and voltage remains constant. Measure the tripping delay at the output of the relay.

Successful test result:

The measured total tripping delays or individual tripping delays, threshold values, and dropout ratios correspond with those values specified in the adjustment list. Permissible deviations/tolerances can be found in the Technical Data section.

Q<

Testing the threshold values (Example, Threshold 0.3 Qn)

- Feed rated voltage and 0.5 times rated current (90 degree phase shift) to the measuring inputs of the relay (PF=0).
- The measured values for the active power "Q" must show a positive algebraic sign.
- Set the pickup threshold (e.g.: 0.3 Qn).
- In order to test the pickup thresholds, feed 0.5 times rated current to the measuring inputs of the relay. Decrease the current slowly until the relay picks up. Ensure that the angle between current and voltage remains constant. Compare the measured pickup value to the configured value.

Testing the tripping delay (Example, Threshold 0.3 Qn)

- Feed rated voltage and 0.5 times rated current (90 degree phase shift) to the measuring inputs of the relay (PF=0).
- The measured values for the active power "Q" must show a positive algebraic sign.
- Set the pickup threshold (e.g.: 0.3 Qn).
- In order to test the tripping delay, feed 0.5 times rated current to the measuring inputs of the relay. Decrease the current with an abrupt change to 0.2 In. Ensure that the angle between current and voltage remains constant. Measure the tripping delay at the output of the relay.

Successful test result:

The measured total tripping delays or individual tripping delays, threshold values, and dropout ratios correspond with those values specified in the adjustment list. Permissible deviations/tolerances can be found in the Technical Data section.

Qr>

Testing the threshold values (Example, Threshold 1.1 Qn)

- Feed rated voltage and 0.9 times rated current with -90 degree phase shift between voltage and current pointers to the measuring inputs of the relay.
- The measured values for the active power "Q" must show a negative algebraic sign.
- Set the pickup threshold (e. g.: 1.1 Qn).
- In order to test the pickup thresholds, feed 0.9 times rated current to the measuring inputs of the relay. Increase the current slowly until the relay picks up. Ensure that the angle between current and voltage remains constant. Compare the measured pickup value to the configured value.

Testing the tripping delay (Example, Threshold 1.1 Qn)

- Feed rated voltage and 0.9 times rated current with -90 degree phase shift between voltage and current pointers to the measuring inputs of the relay.
- The measured values for the active power "Q" must show a negative algebraic sign.
- Set the pickup threshold (e. g. 1.1 Qn).
- In order to test the tripping delay, feed 0.9 times rated current to the measuring inputs of the relay. Increase the current with an abrupt change to 1.2 In. Ensure that the angle between current and voltage remains constant. Measure the tripping delay at the output of the relay.

Successful test result:

The measured total tripping delays or individual tripping delays, threshold values, and dropout ratios correspond with those values specified in the adjustment list. Permissible deviations/tolerances can be found in the Technical Data section.

Qr<

Testing the threshold values (Example, Threshold 0.3 Qn)

- Feed rated voltage and 0.5 times rated current with -90 degree phase shift between voltage and current pointers to the measuring inputs of the relay.
- The measured values for the active power "Q" must show a negative algebraic sign.
- Set the pickup threshold (e. g.: 0.3 Qn).
- In order to test the pickup thresholds, feed 0.5 times rated current to the measuring inputs of the relay. Decrease the current slowly until the relay picks up. Ensure that the angle between current and voltage remains constant. Compare the measured pickup value to the configured value.

Testing the tripping delay (Example, Threshold 0.3 Qn)

- Feed rated voltage and 0.5 times rated current with -90 degree phase shift between voltage and current pointers to the measuring inputs of the relay.
- The measured values for the active power "Q" must show a negative algebraic sign.
- Set the pickup threshold (e. g. 0.3 Qn).
- In order to test the tripping delay, feed 0.5 times rated current to the measuring inputs of the relay. Decrease the current with an abrupt change to 0.2 In. Ensure that the angle between current and voltage remains constant. Measure the tripping delay at the output of the relay.

Successful test result:

The measured total tripping delays or individual tripping delays, threshold values, and dropout ratios correspond with those values specified in the adjustment list. Permissible deviations/tolerances can be found in the Technical Data section.

55A and 55D - PF Protection*

Available elements:

PF-55D[1] ,PF-55D[2] ,PF-55A[1] ,PF-55A[2]

*=Please Note: Some devices, depending on the ordered device, offer 55-Measurement. Some devices, depending on the ordered device, offer 55-Measurement and Protection.

Definition Apparent Power Factor 55A (RMS - Includes Harmonics):

The Apparent Power Factor is computed by dividing real power (watts) by volt-amperes. The apparent power factor computation includes harmonics.

$$PF_{\text{apparent}} = \frac{Watt}{VA}$$

Definition Displacement Power Factor 55D (Fundamental):

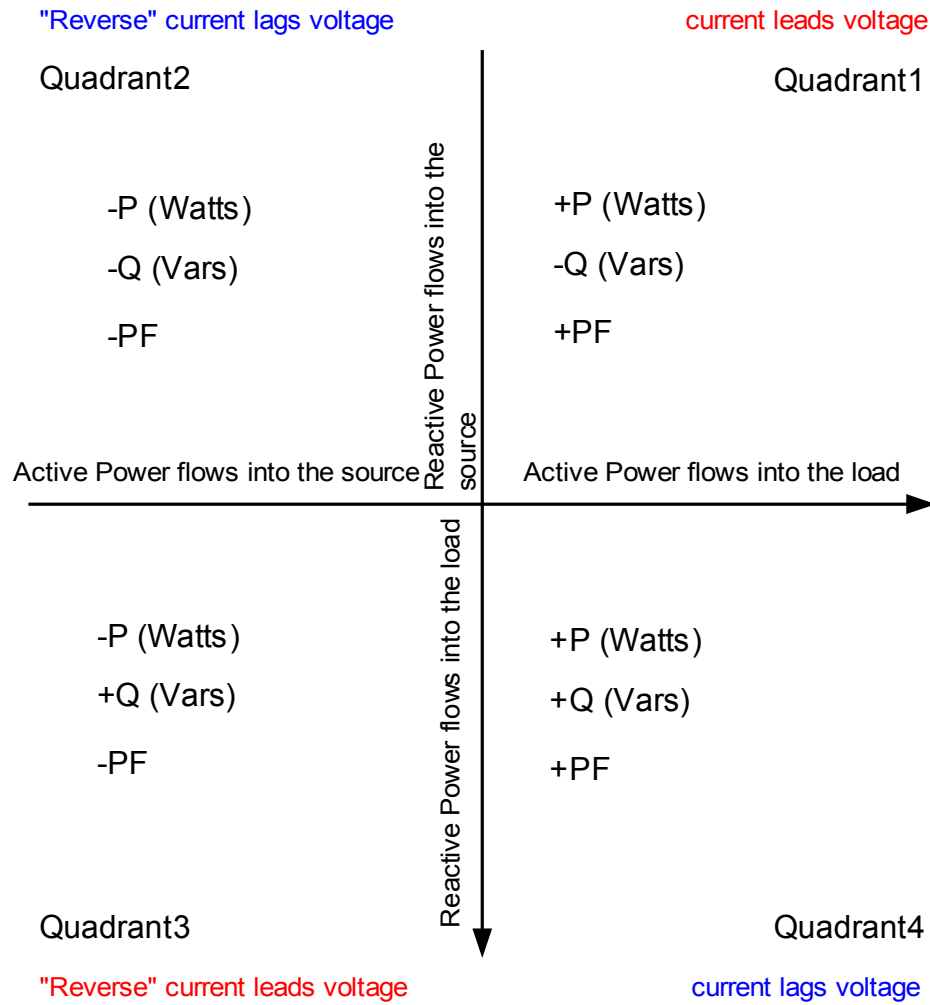
The Displacement Power Factor is computed by dividing the fundamental watts by the fundamental volt-amperes as shown below. This definition is only valid at the system fundamental operating frequency. The Displacement Power Factor isolates the fundamental portion of the Power Factor from the effects of harmonics.

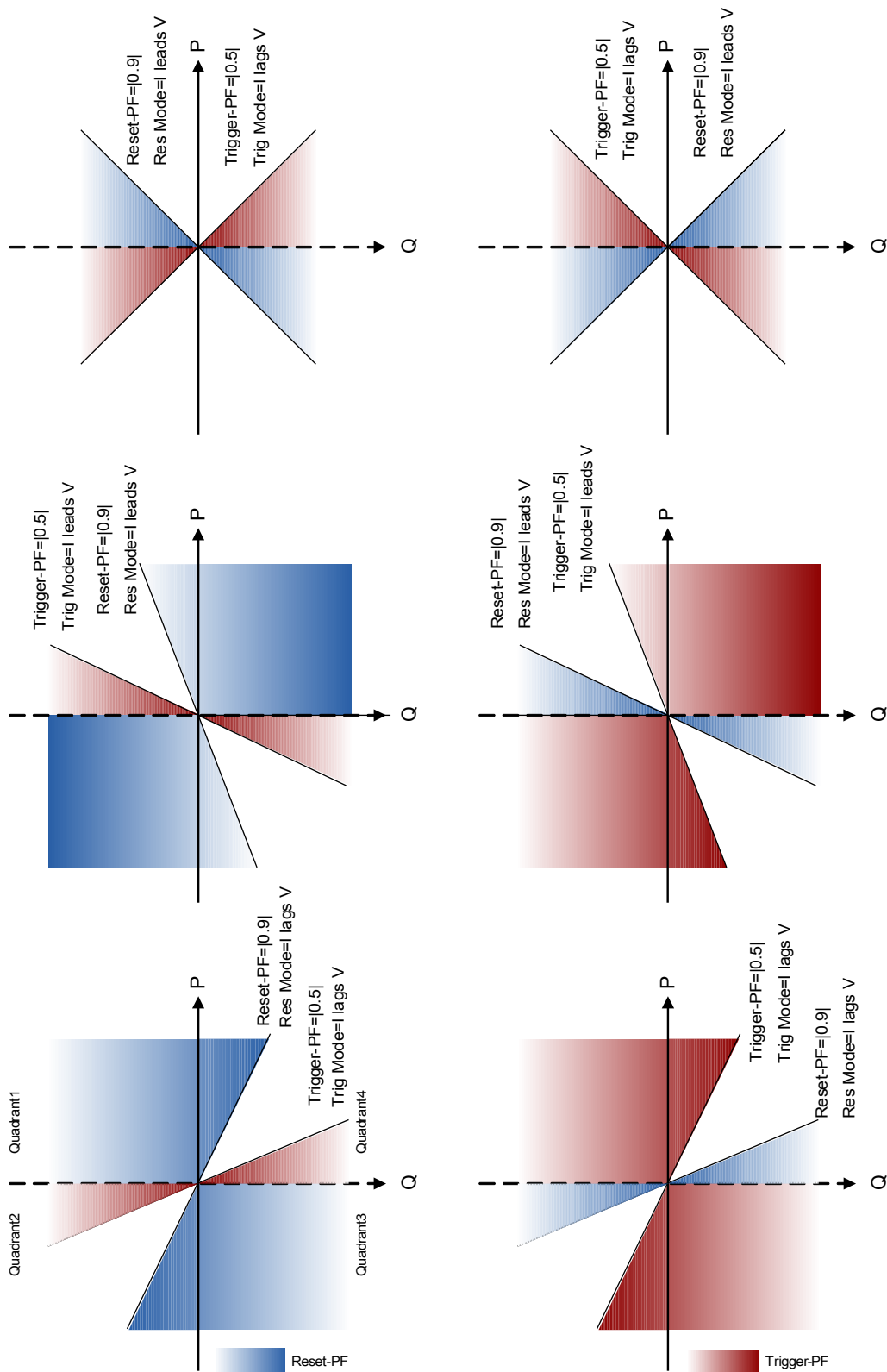
$$PF_{\text{displacement}} = \frac{Watt}{\sqrt{Watt^2 + var^2}}$$

These elements supervise the Power Factor within a defined area (limits).

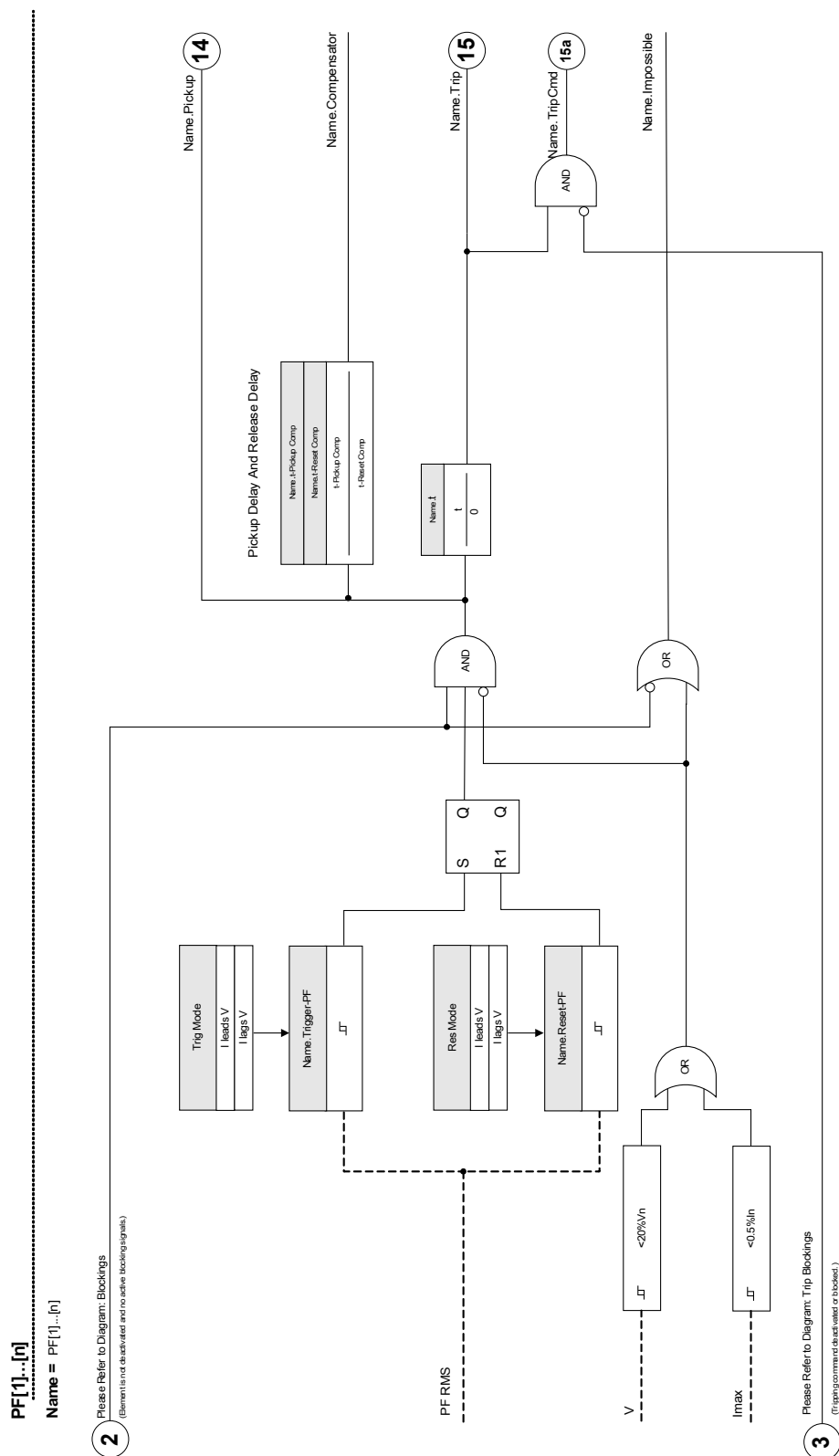
The area is defined by four parameters:

- The Trigger Quadrant (lead or lag);
- The Threshold (Power Factor value);
- The Reset Quadrant (lead or lag); and
- The Reset Value (Power Factor value).

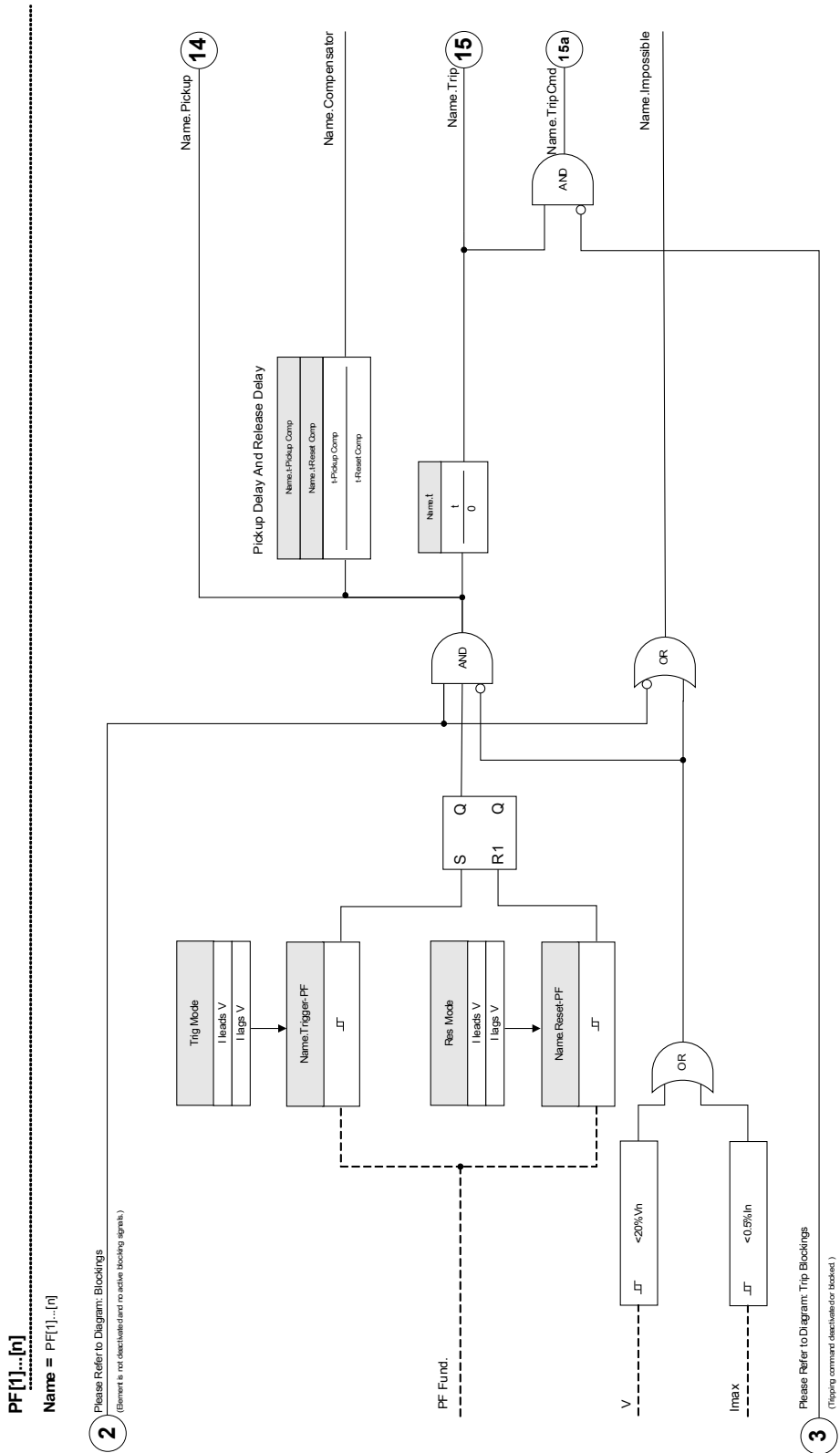




Apparent Power Factor 55A



Displacement Power Factor 55D



Device Planning Parameters of the Power Factor Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameter of the Power Factor Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Power Factor-Prot /PF-55D[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Power Factor-Prot /PF-55D[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Power Factor-Prot /PF-55D[1]]

Set Parameters of the Power Factor Module

Parameter	Description	Setting range	Default	Menu path
 Function	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Power Factor-Prot /PF-55D[1]]
 ExBlo Fc	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Power Factor-Prot /PF-55D[1]]
 Blo TripCmd	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Power Factor-Prot /PF-55D[1]]
 ExBlo TripCmd Fc	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Power Factor-Prot /PF-55D[1]]
 Trig Mode	Trigger Mode. Should the Module be triggered if the Current Phasor is leading to the Voltage Phasor = Lead? Or should the Module be triggered if the Current Phasor is lagging to the Voltage Phasor = Lag?	I leads V, I lags V	I lags V	[Protection Para /<1..4> /Power Factor-Prot /PF-55D[1]]
 Trigger-PF	This is the power factor where the relay will pick up	0.5 - 0.99	0.7	[Protection Para /<1..4> /Power Factor-Prot /PF-55D[1]]
 Res Mode	Trigger Mode. Should the Module be triggered if the Current Phasor is leading to the Voltage Phasor = Lead? Or should the Module be triggered if the Current Phasor is lagging to the Voltage Phasor = Lag?	I leads V, I lags V	I lags V	[Protection Para /<1..4> /Power Factor-Prot /PF-55D[1]]

Parameter	Description	Setting range	Default	Menu path
Reset-PF 	This setting is the power factor, at which the relay will reset the power factor trip. It is like setting a hysteresis for the Trigger setting.	0.5 - 0.99	0.9	[Protection Para /<1..4> /Power Factor-Prot /PF-55D[1]]
t-trip 	Tripping delay	0.00 - 300.00s	0.00s	[Protection Para /<1..4> /Power Factor-Prot /PF-55D[1]]
t-Pickup Comp 	Pre-trigger time for the Compensation Signal. When this timer is elapsed the compensation signal will be activated.	0.00 - 300.00s	5.00s	[Protection Para /<1..4> /Power Factor-Prot /PF-55D[1]]
t-Reset Comp 	Reset (Post-trigger) time of the Compensation Signal. When this timer is elapsed the compensation signal will be deactivated.	0.00 - 300.00s	5.00s	[Protection Para /<1..4> /Power Factor-Prot /PF-55D[1]]

States of the Inputs of the Power Factor Module

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking	[Protection Para /Global Prot Para /Power Factor-Prot /PF-55D[1]]
ExBlo2-I	Module Input State: External Blocking	[Protection Para /Global Prot Para /Power Factor-Prot /PF-55D[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Power Factor-Prot /PF-55D[1]]

Signals of the Power Factor Module (States of the Outputs)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup	Signal: Pickup Power Factor
Trip	Signal: Trip Power Factor
TripCmd	Signal: Trip Command
Compensator	Signal: Compensation Signal
Impossible	Signal: Pickup Power Factor Impossible

Commissioning: Power Factor

Object to be tested:

- Testing the projected Power Factor Modules.

Necessary means:

- Three-phase AC voltage source;
- Three-phase AC current source; and
- Timer.

Procedure – Testing the wiring:

- Feed the rated voltage and rated current to the measuring inputs of the relay.
- Adjust the current pointers 30° lagging to the voltage pointers.
- The following measuring values have to be shown:
 - $P = 0.86 P_n$
 - $Q = 0.5 Q_n$
 - $S = 1 S_n$

NOTICE

If the measured values are shown with a negative (algebraic) sign, check the wiring.

NOTICE

In this example, the PF-Trigger is set to $0.86 = 30^\circ$ (lagging) and the PF-Reset is set to $0.86 = 30^\circ$ (leading).

Carry out the test with the settings (trigger and reset) that fit the switchboard.

Testing the threshold values (Trigger) (PF Trigger: Example = 0.86 lagging):

- Feed the rated voltage and rated current in phase to the measuring inputs of the relay ($PF=1$).
- Adjust the angle between the voltage and current (current pointer lagging) until the relay picks up.
- Write down the pickup value.

Testing the Reset (PF Reset: Example = 0.86 leading):

- Reduce the angle between voltage and current beyond $PF = 1$ (current pointer leading) until the alarm drops off.
- Write down the reset value.

Testing the trip delay (PF Trigger: Example = 0.86 lagging):

- Feed the rated voltage and rated current in phase to the measuring inputs of the relay (PF=1).
- Adjust the angle between voltage and current (current pointer lagging) with an abrupt change to PF = 0.707 (45°) lagging.
- Measure the tripping delay at the output of the relay. Compare the measured tripping time to the selected trip time.

Successful test result:

The measured total tripping delays, threshold, and reset values correspond with those values specified in the adjustment list. Permissible deviations/tolerances can be found the Technical Data section.

Q->&V< Reactive-Power/Undervoltage Protection

Available Elements:

Q->&V<

The number of distributed energy resources (DER) raises continuously. At the same time the controllable power reserve through large-scale power plants decreases.

Therefore various grid codes requirements and regulations stipulate that mains parallel distributed power plants, consisting of one or more power generation units feeding power into the MV grid, have to support the mains voltage in case of failures.

In case of failure the voltage close to the short circuit location drops nearly to zero. Around the fault location a potential gradient area is built whose expansion can be restricted by feeding reactive-power into the grid. At mains failures (voltage drop) the Q->V< protection prevents the expansion of the potential gradient area for the case that any further reactive-power is taken from the mains.

The function of this protection module is not the protection of the power generation system itself, but more the decoupling of the power generation system when it takes reactive current from the mains in case the voltage drops below a certain value. This protection is an upstream system protection.

The Q->V< protection module with decoupling and auto reconnection function is implemented as an autonomous protection element according to the German regulations ¹ and ² mentioned below.

The comprehensive setting and configuration possibilities of this protection element allow the adaptation of connected energy resources to various grid conditions.

For the correct function of this protection module you have to

- Configure the »General Settings«,
- Select and set the decoupling method.
- Configure the reconnection of the power generation units (see chapter Reconnection).

General Settings

For each parameter set [Protection Para\Set [x]\Q->&V<] the general settings »General Settings« can be configured.

Here the entire function of this protection element can be activated or deactivated.

By activating the voltage transformer supervision a malfunction of this protection module can be prevented.

¹ Technische Anschlussregeln für die Hochspannung (VDE-AR-N 4120)

² Technische Richtlinie "Erzeugungsanlagen am Mittelspannungsnetz", Richtlinie für Anschluss und Parallelbetrieb von Erzeugungsanlagen am Mittelspannungsnetz, Ausgabe Juni 2008, BDEW Bundesverband der Energie- und Wasserwirtschaft e.V., siehe Kap. 3.2.3.2 – Blindleistungs-Unterspannungsschutz Q->&U<

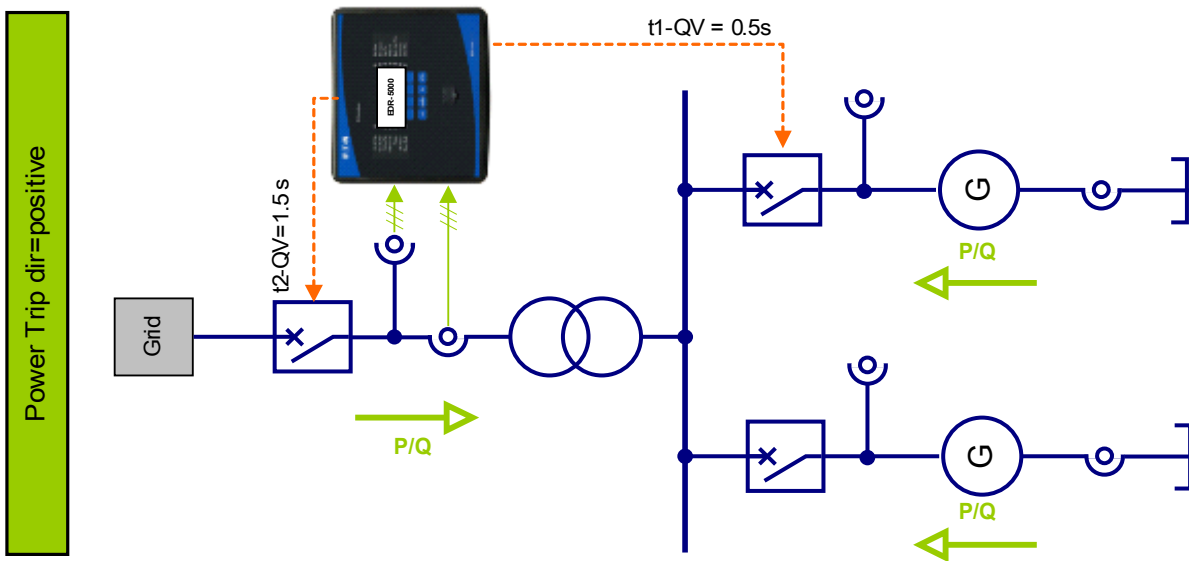
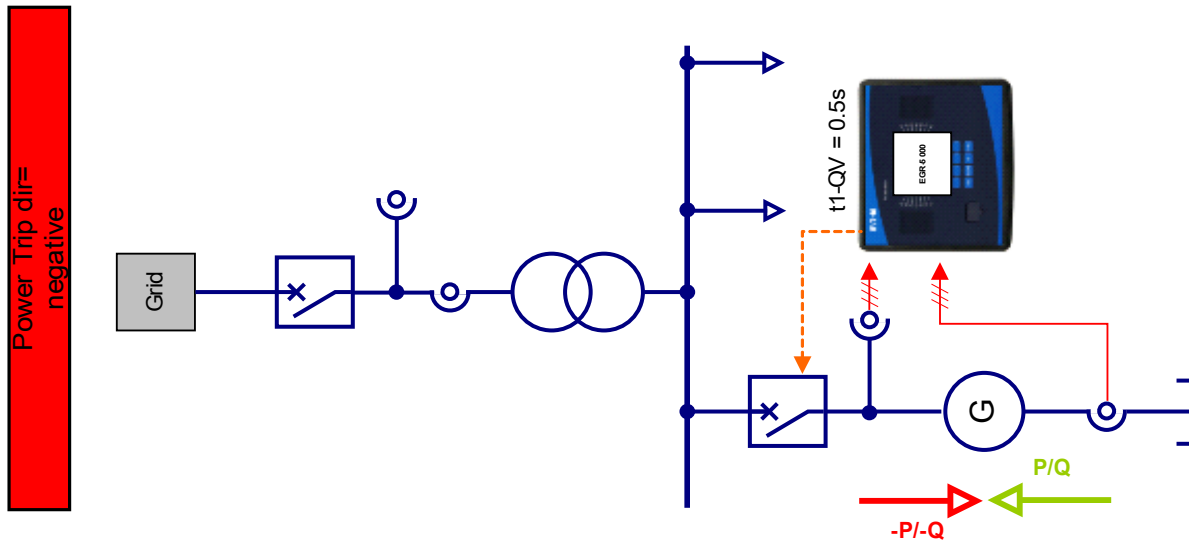
QV Protection Trip Direction

Definitons

- Load Flow Arrow System = Consumed active and reactive are counted positive (greater than zero)
- Generator Flow Arrow System = produced power is to be counted positive (greater than zero)

By means of the parameter power trip dir positive/negative a sign reversal can be applied to the reactive power within the QV-Protection module. Protective devices that use the load flow arrow (like the EDR-5000 or the ETR-5000) are to be set to »*Power Trip dir= positive*«. Protective devices that are working on the base of the generator flow arrow system (like the EGR-5000) are to be set to »*Power Trip dir= negative*«. By means of that generator protection relays like the EGR-5000 can be set to the load flow arrow system internal within the QV-Protection (only). That means that outside of the QV-Protection no other power measurement or power protection is effected.

Trip Direction of the QV-Protection



Parameter Setting of Decoupling

To support dynamical the decreasing voltage (voltage drop) during faults the grid codes of the transmission system owners (e.g. VDE AR 4120 page 57) require the following behavior during grid problems (voltage sags) by the connected energy resources:

The QV-Protection supervises the grid compliant behavior after a grid fault. Energy sources that have a negative impact on the restoration by consuming inductive reactive power have to be disconnected from the grid before timers of grid protection devices expire.

Therefore the energy source will be disconnected from the grid after 0.5 seconds by the QV-protection if all three line-to-line voltages at the point of common coupling are less than 0.85 times V_n (logical AND connected) and if the energy resource consumes at the same time inductive reactive power from the grid (VDE AR 4120 page 57).

NOTICE

The reactive-power of the positive phase sequence system (Q1) is evaluated.

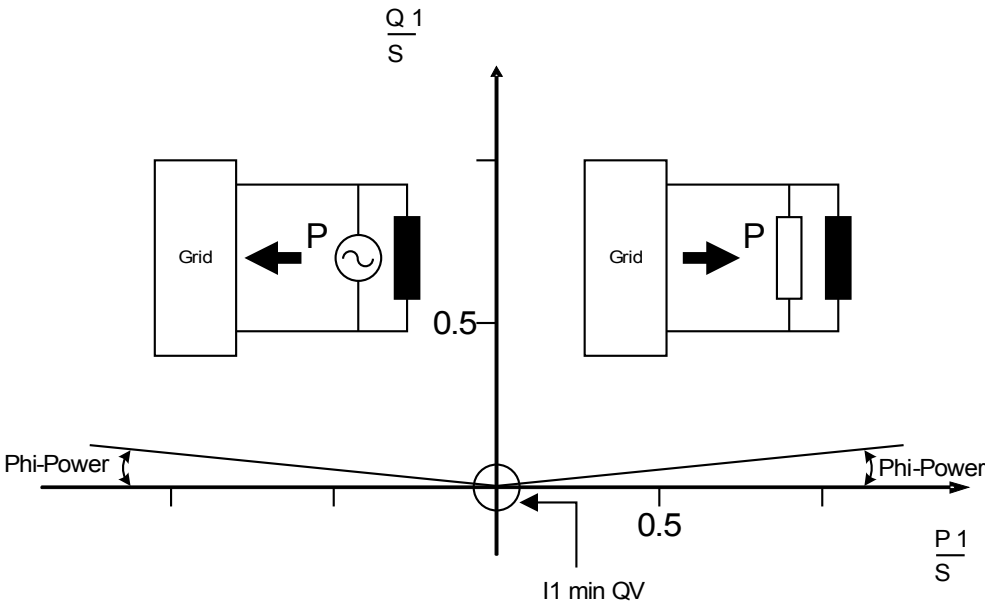
**The voltage supervision only monitors the phase to phase voltages.
This prevents any influence on the measurement through neutral point displacement in resonant earthed systems.**

In the menu [Protection Para\Set[x]\Q->&U<] the »Decoupling« parameters can be set.

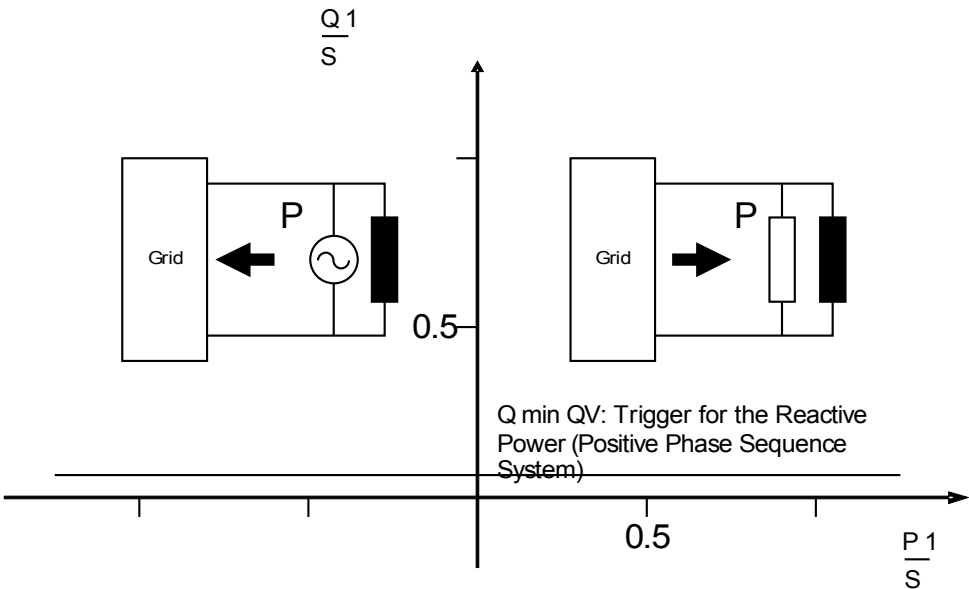
The reactive-power demand from the grid can be detected by two different methods. Therefor the decoupling method »QV-Method« has to be selected first.

- Power Angle Supervision (method 1)
- Pure Reactive Power Supervision (method 2)

Method 1: Power Angle Supervision



Method 2: Pure Reactive Power Supervision



A minimum current supervision (I1) in the positive phase sequence system prevents a hyperfunction of the reactive-power supervision at lower power levels.

For the power angle supervision, the minimum current supervision is always active. For the pure reactive-power supervision the minimum current supervision is optional.

When using the power angle supervision (method 1):

- Set the power factor »*Phi-Power*« (Default setting 3°).
- Select a suitable minimum current »*I min QV*« (Default setting 0.1 In) which prevents false tripping.

When using the pure reactive power supervision (method 2):

- Set the reactive-power threshold »*Q min QV*« (Default setting 0.05 Sn).
- Optionally select a suitable minimum current »*I min QV*« (Default setting 0.1 In) to prevent false tripping.

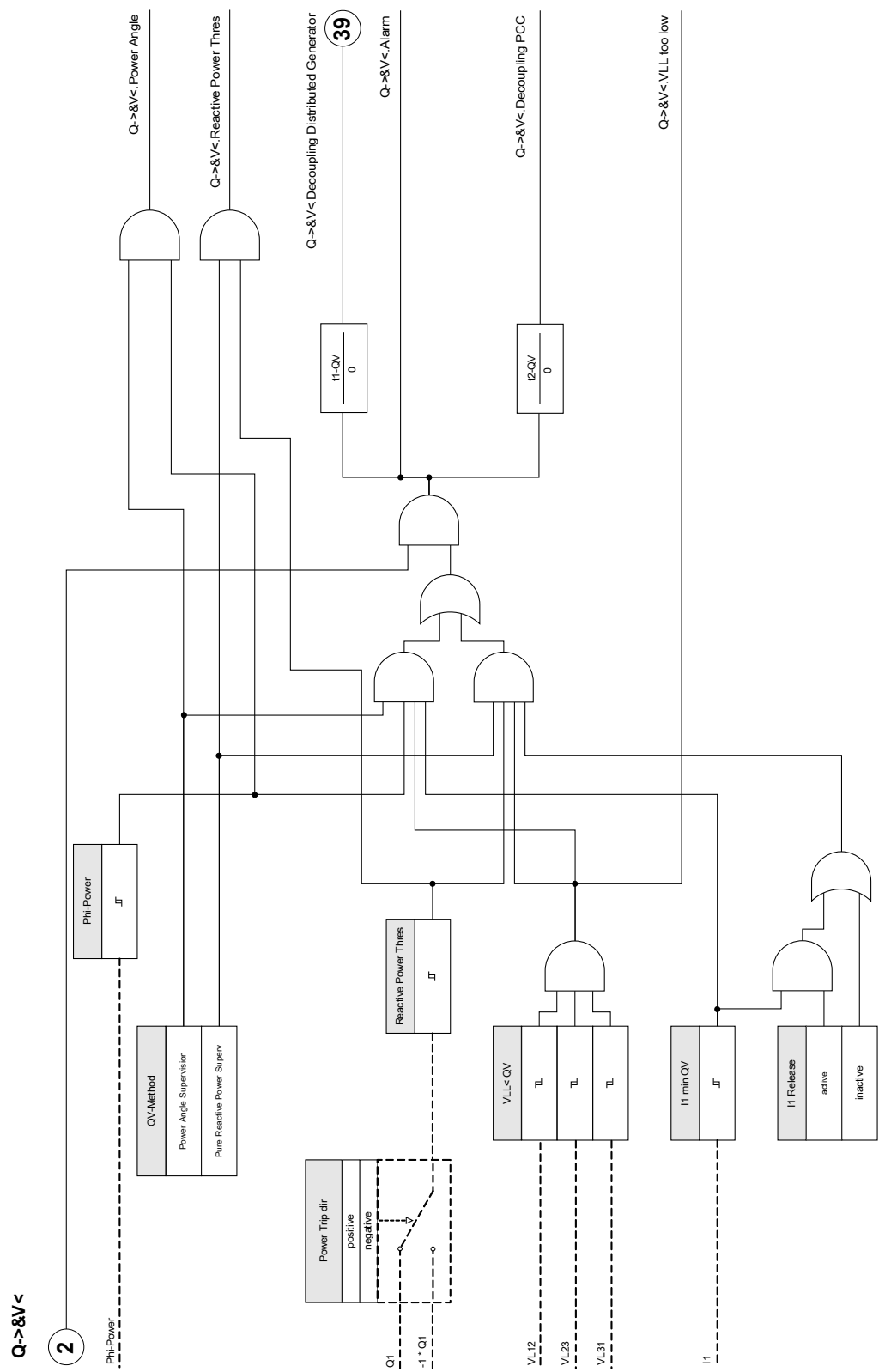
Two timer elements are available »*t1-QV*« and »*t2-QV*«. Both timer elements will be started at pick-up of the Q->V< module.

First timer element (Decoupling of the power generation unit)

When several mains parallel power generation units feed one PCC, the first timer element can give a trip command to the generator circuit breaker of the power generation unit (Default setting 0.5 s)

Second timer element (Decoupling at the PCC)

For the case, that tripping of the first timer element (decoupling of a certain power generation unit) does not have the expected effect the second timer element can give a trip command to the circuit breaker at the PCC (Default setting 1.5 s). This decouples the entire DER from the grid.



Device Planning Parameters of the Q->&V< Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Do not use	[Device Planning]

Global Protection Parameters of the Q->&V< Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Q->&V<]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Q->&V<]
Power Trip dir 	By means of this parameter the trip direction of active and reactive power can be inverted within the QV-Module (sign reversal).	positive, negative	negative	[Protection Para /Global Prot Para /Q->&V<]

Setting Group Parameters of the Q->&V< Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Q->&V< /General Settings]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Q->&V< /General Settings]
LOP Blo 	Activates the use of the measuring circuit supervision. In this case the module will be blocked if a measuring circuit supervision module (e.g. LOP, VTS) signals a disturbed measuring circuit (e.g. caused by a fuse failure).	Inactive, Active	Inactive	[Protection Para /<1..4> /Q->&V< /General Settings]
QV-Method 	Selection of the Q(V)-Method: Power Angle or Reactive Power Threshold	Power Angle Supervision, Pure Reactive Power Superv	Power Angle Supervision	[Protection Para /<1..4> /Q->&V< /Decoupling]
I1 Release 	Activation of the "I1 Minimum Current"-Criterion. Only available if: QV-Method = Power Angle Supervision	Inactive, Active	Active	[Protection Para /<1..4> /Q->&V< /Decoupling]
I1 min QV 	Activation of an I1 Minimum Current of the rated current of the (distributed) energy resource can prevent faulty tripping. Only available if: Activation of the "I1 Minimum Current"-Criterion. = Active	0.01 - 0.20I _n	0.10I _n	[Protection Para /<1..4> /Q->&V< /Decoupling]
VLL< QV 	Undervoltage threshold (line-to-line voltage!)	0.70 - 1.00V _n	0.85V _n	[Protection Para /<1..4> /Q->&V< /Decoupling]
Phi-Power 	Trigger Phi-Power (Positive Phase Sequence System) Only available if: QV-Method = Power Angle Supervision	0 - 10°	3°	[Protection Para /<1..4> /Q->&V< /Decoupling]

Parameter	Description	Setting range	Default	Menu path
Q min QV 	Trigger for the Reactive Power (Positive Phase Sequence System) Only available if: QV-Method = Pure Reactive Power Superv	0.01 - 0.20VAn	0.05VAn	[Protection Para /<1..4> /Q->&V< /Decoupling]
t1-QV 	First timer. If this timer has elapsed, a trip signal will be issued to the (local) energy resource.	0.00 - 2.00s	0.5s	[Protection Para /<1..4> /Q->&V< /Decoupling]
t2-QV 	Second timer. If this timer is elapsed, the an trip signal will be issued to the PCC (Point of Common Coupling)	0.00 - 4.00s	1.5s	[Protection Para /<1..4> /Q->&V< /Decoupling]

Input States of the Q->&V< Module

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Q->&V<]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Q->&V<]

Q->&V< Module Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Fuse Fail VT Blo	Signal: Blocked by Fuse Failure (VT)
Pickup	Signal: Pickup Reactive Power Undervoltage Protection
Decoupling Distributed Generator	Signal: Decoupling of the (local) Energy Generator/Resource
Decoupling PCC	Signal: Decoupling at the Point of Common Coupling
Power Angle	Signal: Admissable power angle exceeded
Reactive Power Thres	Signal: Admissable Reactive Power Threshold exceeded
VLL too low	Signal: Line-to-Line voltage too low

Reconnection Module

Available Elements:

ReCon

The reconnection function after a mains decoupling is based on the requirements of the VDE AR-N 4120¹ and the German directive „Erzeugungsanlagen am MS-Netz“².

To monitor the reconnection conditions after a mains decoupling, a reconnection function has been implemented in parallel to the decoupling functions.

Mains voltage (phase to phase) and frequency are the main criteria for reconnection. Always the mains side voltage (line to line) at the generator circuit breaker (mains side) has to be evaluated.

The reconnection function is only one of the system functions for mains decoupling and return synchronizing. The reconnection element is tied to decoupling functions like the Q->&U<-element and other integrated decoupling functions like under-/overvoltage, under-/overfrequency. The reconnection can be triggered by up to 6 decoupling elements or via digital input signals, logic functions or via scada (communication system).

After a trip of the circuit breaker at the PCC by the decoupling function, reconnection has to be done manually.



WARNING

Danger of asynchronously reconnection:

The reconnection function does not substitute a synchronizing device.

Before connecting different electrical networks, synchronism has to be secured.

After decoupling by the Q->&V< module or other decoupling functions, like V</V<<, V>/>>, f</> the reconnection release signal for reconnection the circuit breaker of the power generating unit will be blocked for a preset time interval (default setting 10 min.). This is to wait until all switching operations are completed. The automatic reconnection must not be executed before mains voltage and frequency are inside the acceptable bands (quasi permanent) that means within the admissible limit values for a preset, settable time.

The purpose of the reconnection function is to reconnect a decoupled energy resource safe to the mains/grid.

Release logic for the PCC circuit breaker

If the PCC circuit breaker has tripped the reconnection has to be done manually. A special blocking logic is not necessary.

NOTICE

If a power generating unit should be reconnected by the generator circuit breaker the voltage transformers have to be installed at the mains side of the circuit breaker.

1 Technische Anschlussregeln für die Hochspannung (VDE-AR-N 4120)

2 Technische Richtlinie „Erzeugungsanlagen am Mittelspannungsnetz“, Richtlinie für Anschluss und Parallelbetrieb von Erzeugungsanlagen am Mittelspannungsnetz, Ausgabe Juni 2008, BDEW Bundesverband der Energie- und Wasserwirtschaft e.V., siehe Kap. 3.2.3.2 – Blindleistungs-Unterspannungsschutz Q->&U<



Voltage release via remote control connection from the PCC

NOTICE

The voltage has to be recovered at the PCC before the reconnection is done.

If the PCC is located in the HV level the distance to the PCC is in general large.

The information that the voltage is restored is to be transmitted via a remote control signal to the distributed energy resource.

This method has to be used, if the PCC is on the HV side.

This method can be used, if the PCC is on the MV side.

If reconnection release should be done via remote control signal from the PCC:

In the menu [Protection Para\Set[x]\ReCon\General settings] the parameter »*V Ext Release PCC Fc*« has to be set to »*active*«. With this setting the voltage release signal from the PCC should be used (e. g. signal via digital input)

Additionally the parameter »*Reclosure Release Cond*« in the menu [Protection Para\Set[x]\ReCon\Release Para\Reconnect. Release Cond] has to be set to »*V Ext Release PCC*«

Also the remote control release signal has to be assigned to the parameter »*V Ext Release PCC*« in the menu [Protection Para\Global Prot Para\Intercon-Prot\ReCon\General settings]

Voltage release by (self-) measured voltage values

NOTICE

This method can be used, if the PCC is on the MV side.

If the PCC is on the MV side, the device can measure the phase to phase voltages on the mains side and decide if the mains voltage has stabilized sufficiently for reconnection.

For this method the parameter »*V Ext Release PCC Fk*« in the menu [Protection Para\Set[x]\ReCon\General settings] has to be set to »*inactive*«.

Additionally the parameter »*Reclosure. Release Cond*« in the menu [Protection Para\Set[x]\ReCon\Reclosure Release] has to be set to »*V internal release*«

PCC in HV systems

According to VDE-AR-N 4120 a reconnection of a Distributed Energy Resource to the grid is not allowed before the following conditions are fulfilled: The frequency of the mains/grid has to be between 47.5 and 51.5 Hz and the voltage between 93.5 and 127 kV (100 kV level). Voltage and frequency have to be within their limits for minimum 5 minutes.

NOTICE

It is required that the PCC and also the DER are equipped with a decoupling devices.

It is required that the decoupling device of the PCC controls the PCC's circuit breaker.

It is required that the decoupling device of the power generation unit controls the generator circuit breaker.

Reconnection Conditions:

Before reconnection a power generation unit, it has to be secured, that mains voltage has been stabilized sufficiently. For this a corresponding remote signal has to be available.

Set the parameter *»Reclosure Release Cond«* in the menu [Protection Para\Set[x]\ReCon\Release Para] to *»V Ext Release PCC«*. The required parameter settings are described in the chapter *»General Settings«*.

Set the blocking signals in the menu [Protection Para\Set[x]\ReCon] the decoupling signals which start the mains recovery time (OR logic).

Select a sufficiently long recovery time *»t1-Release Blo«* in the menu [Protection Para\Set[x]\Reconnection\Release Para]. Reconnection is only possible after this timer has been elapsed. This time will be started by the trigger that have to be set in: [Global Para\Intercon-Prot\Reconnection\Decoupling]

In the menu [Protection Para\Set[x]\Reconnection\Release Para] the frequency and voltage range to be met for reconnection can be set.

Set the parameters for the release of the voltage for the reconnection as described in section "Voltage release via remote control connection from the PCC".

PCC in MV systems

NOTICE

It is required that the PCC and also the DER are equipped with a decoupling device.

It is required that the decoupling device of the PCC controls the PCC's circuit breaker.

It is required that the decoupling device of the power generation (DER) unit controls the generator circuit breaker.

The German regulation „Erzeugungsanlagen am MS-Netz“ (BDEW, Issue June 2008 ^[2]) recommends to have a time delay (some minutes) between mains voltage recovery and reclosure after a trip of a decoupling system as a result of a mains failure. This is to wait until all switching operations are completed. Usually this is the case after 10 minutes. A reconnection of the DER is only permitted, when the mains voltage is >95% of V_n and the frequency is in the range of 47.5 Hz to 50.05 Hz.

Set the blocking signals in the menu
[Global Prot Para\Intercon-Prot\ReCon\Decoupling] which start the mains recovery time
(OR logic).

Select a sufficiently long recovery time »t1-Release Blo« in the menu
[Protection Para\Set[x]\ReCon\Release Para]. Reconnection is only possible after this timer has been elapsed
(This time stage will be triggered by the signals that are assigned in menu [Global Para\Intercon-Prot\Reconnection\Decoupling]).

In the menu [Protection Para\Set[x]\ReCon\Release Para] the frequency and voltage range to be met for reconnection can be set.

Set the parameters for the release of the voltage as described in the corresponding sections for the voltage release.

Device Planning Parameters of the Reconnection Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Do not use	[Device Planning]

Global Protection Parameters of the Reconnection Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /ReCon /General Settings]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /ReCon /General Settings]
V Ext Release PCC 	Release Signal by the Point of Common Coupling. The line-to-line voltage is greater than 95% of VN.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /ReCon /General Settings]
PCC Fuse Fail VT 	Blocking if the fuse of a voltage transformer has tripped at the PCC.	1..n, Dig Inputs	.-	[Protection Para /Global Prot Para /ReCon /General Settings]
reconnected 	This signal indicates the state "reconnected" (mains parallel).	1..n, Assignment List	.-	[Protection Para /Global Prot Para /ReCon /General Settings]
Decoupling1 	Decoupling signal that triggers the reclosure.	Decoupling Functions	.-	[Protection Para /Global Prot Para /ReCon /Decoupling]

Parameter	Description	Setting range	Default	Menu path
Decoupling2 	Decoupling signal that triggers the reclosure.	Decoupling Functions	-.-	[Protection Para /Global Prot Para /ReCon /Decoupling]
Decoupling3 	Decoupling signal that triggers the reclosure.	Decoupling Functions	-.-	[Protection Para /Global Prot Para /ReCon /Decoupling]
Decoupling4 	Decoupling signal that triggers the reclosure.	Decoupling Functions	-.-	[Protection Para /Global Prot Para /ReCon /Decoupling]
Decoupling5 	Decoupling signal that triggers the reclosure.	Decoupling Functions	-.-	[Protection Para /Global Prot Para /ReCon /Decoupling]
Decoupling6 	Decoupling signal that triggers the reclosure.	Decoupling Functions	-.-	[Protection Para /Global Prot Para /ReCon /Decoupling]

Decoupling Functions of the Reconnection Module

Name	Description
-.-	No assignment
50P[1].TripCmd	Signal: Trip Command
50P[2].TripCmd	Signal: Trip Command
50P[3].TripCmd	Signal: Trip Command
51P[1].TripCmd	Signal: Trip Command
51P[2].TripCmd	Signal: Trip Command
51P[3].TripCmd	Signal: Trip Command
50X[1].TripCmd	Signal: Trip Command
50X[2].TripCmd	Signal: Trip Command
51X[1].TripCmd	Signal: Trip Command
51X[2].TripCmd	Signal: Trip Command
50R[1].TripCmd	Signal: Trip Command

<i>Name</i>	<i>Description</i>
50R[2].TripCmd	Signal: Trip Command
51R[1].TripCmd	Signal: Trip Command
51R[2].TripCmd	Signal: Trip Command
87.TripCmd	Signal: Trip Command
87H.TripCmd	Signal: Trip Command
87GD.TripCmd	Signal: Trip Command
87GDH.TripCmd	Signal: Trip Command
49.TripCmd	Signal: Trip Command
27M[1].TripCmd	Signal: Trip Command
27M[2].TripCmd	Signal: Trip Command
59M[1].TripCmd	Signal: Trip Command
59M[2].TripCmd	Signal: Trip Command
27A[1].TripCmd	Signal: Trip Command
27A[2].TripCmd	Signal: Trip Command
59A[1].TripCmd	Signal: Trip Command
59A[2].TripCmd	Signal: Trip Command
59N[1].TripCmd	Signal: Trip Command
59N[2].TripCmd	Signal: Trip Command
LVRT [1].TripCmd	Signal: Trip Command
LVRT [2].TripCmd	Signal: Trip Command
46[1].TripCmd	Signal: Trip Command
46[2].TripCmd	Signal: Trip Command
46G[1].TripCmd	Signal: Trip Command
46G[2].TripCmd	Signal: Trip Command
47[1].TripCmd	Signal: Trip Command
47[2].TripCmd	Signal: Trip Command
81[1].TripCmd	Signal: Trip Command
81[2].TripCmd	Signal: Trip Command
81[3].TripCmd	Signal: Trip Command
81[4].TripCmd	Signal: Trip Command
81[5].TripCmd	Signal: Trip Command
81[6].TripCmd	Signal: Trip Command
32[1].TripCmd	Signal: Trip Command
32[2].TripCmd	Signal: Trip Command
32[3].TripCmd	Signal: Trip Command
32V[1].TripCmd	Signal: Trip Command
32V[2].TripCmd	Signal: Trip Command

<i>Name</i>	<i>Description</i>
32V[3].TripCmd	Signal: Trip Command
PF-55D[1].TripCmd	Signal: Trip Command
PF-55D[2].TripCmd	Signal: Trip Command
PF-55A[1].TripCmd	Signal: Trip Command
PF-55A[2].TripCmd	Signal: Trip Command
Q->&V<.Decoupling Distributed Generator	Signal: Decoupling of the (local) Energy Generator/Resource
Q->&V<.Decoupling PCC	Signal: Decoupling at the Point of Common Coupling
ZI.TripCmd	Signal: Zone Interlocking Trip Command
40-Z1[1].TripCmd	Signal: Trip Command
40-Z2[1].TripCmd	Signal: Trip Command
40-Z1[2].TripCmd	Signal: Trip Command
40-Z2[2].TripCmd	Signal: Trip Command
24[1].TripCmd	Signal: Trip Command
24[2].TripCmd	Signal: Trip Command
50/27.TripCmd	Signal: Trip Command
ExP[1].TripCmd	Signal: Trip Command
ExP[2].TripCmd	Signal: Trip Command
ExP[3].TripCmd	Signal: Trip Command
ExP[4].TripCmd	Signal: Trip Command
RTD.TripCmd	Signal: Trip Command
DI-8P X1.DI 1	Signal: Digital Input
DI-8P X1.DI 2	Signal: Digital Input
DI-8P X1.DI 3	Signal: Digital Input
DI-8P X1.DI 4	Signal: Digital Input
DI-8P X1.DI 5	Signal: Digital Input
DI-8P X1.DI 6	Signal: Digital Input
DI-8P X1.DI 7	Signal: Digital Input
DI-8P X1.DI 8	Signal: Digital Input
DI-8 X5.DI 1	Signal: Digital Input
DI-8 X5.DI 2	Signal: Digital Input
DI-8 X5.DI 3	Signal: Digital Input
DI-8 X5.DI 4	Signal: Digital Input
DI-8 X5.DI 5	Signal: Digital Input
DI-8 X5.DI 6	Signal: Digital Input
DI-8 X5.DI 7	Signal: Digital Input
DI-8 X5.DI 8	Signal: Digital Input

<i>Name</i>	<i>Description</i>
FldC[1].TripCmd	Signal: Trip Command
Pres[1].TripCmd	Signal: Trip Command
Tmp[1].TripCmd	Signal: Trip Command
Vibr[1].TripCmd	Signal: Trip Command
Fuel[1].TripCmd	Signal: Trip Command
Spd[1].TripCmd	Signal: Trip Command
VBat[1].TripCmd	Signal: Trip Command
Ems[1].TripCmd	Signal: Trip Command
AnaP[1].TripCmd	Signal: Trip Command
DNP.BinaryOutput0	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput1	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput2	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput3	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput4	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput5	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput6	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput7	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput8	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput9	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput10	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput11	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput12	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput13	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput14	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput15	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput16	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput17	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput18	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput19	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput20	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput21	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput22	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput23	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput24	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput25	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput26	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput27	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.

<i>Name</i>	<i>Description</i>
DNP.BinaryOutput28	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput29	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput30	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput31	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
Modbus.Comm Cmd 1	Communication Command
Modbus.Comm Cmd 2	Communication Command
Modbus.Comm Cmd 3	Communication Command
Modbus.Comm Cmd 4	Communication Command
Modbus.Comm Cmd 5	Communication Command
Modbus.Comm Cmd 6	Communication Command
Modbus.Comm Cmd 7	Communication Command
Modbus.Comm Cmd 8	Communication Command
Modbus.Comm Cmd 9	Communication Command
Modbus.Comm Cmd 10	Communication Command
Modbus.Comm Cmd 11	Communication Command
Modbus.Comm Cmd 12	Communication Command
Modbus.Comm Cmd 13	Communication Command
Modbus.Comm Cmd 14	Communication Command
Modbus.Comm Cmd 15	Communication Command
Modbus.Comm Cmd 16	Communication Command
IEC61850.VirtInp1	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp2	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp3	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp4	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp5	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp6	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp7	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp8	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp9	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp10	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp11	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp12	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp13	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp14	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp15	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp16	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp17	Signal: Virtual Input (IEC61850 GGIO Ind)

<i>Name</i>	<i>Description</i>
IEC61850.VirtInp18	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp19	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp20	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp21	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp22	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp23	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp24	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp25	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp26	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp27	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp28	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp29	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp30	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp31	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp32	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.SPCSO1	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO2	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO3	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO4	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO5	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO6	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO7	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO8	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO9	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO10	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO11	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO12	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO13	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).

<i>Name</i>	<i>Description</i>
IEC61850.SPCSO14	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO15	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO16	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
Profibus.Comm Cmd 1	Communication Command
Profibus.Comm Cmd 2	Communication Command
Profibus.Comm Cmd 3	Communication Command
Profibus.Comm Cmd 4	Communication Command
Profibus.Comm Cmd 5	Communication Command
Profibus.Comm Cmd 6	Communication Command
Profibus.Comm Cmd 7	Communication Command
Profibus.Comm Cmd 8	Communication Command
Profibus.Comm Cmd 9	Communication Command
Profibus.Comm Cmd 10	Communication Command
Profibus.Comm Cmd 11	Communication Command
Profibus.Comm Cmd 12	Communication Command
Profibus.Comm Cmd 13	Communication Command
Profibus.Comm Cmd 14	Communication Command
Profibus.Comm Cmd 15	Communication Command
Profibus.Comm Cmd 16	Communication Command
Logic.LE1.Gate Out	Signal: Output of the logic gate
Logic.LE1.Timer Out	Signal: Timer Output
Logic.LE1.Out	Signal: Latched Output (Q)
Logic.LE1.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE2.Gate Out	Signal: Output of the logic gate
Logic.LE2.Timer Out	Signal: Timer Output
Logic.LE2.Out	Signal: Latched Output (Q)
Logic.LE2.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE3.Gate Out	Signal: Output of the logic gate
Logic.LE3.Timer Out	Signal: Timer Output
Logic.LE3.Out	Signal: Latched Output (Q)
Logic.LE3.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE4.Gate Out	Signal: Output of the logic gate
Logic.LE4.Timer Out	Signal: Timer Output
Logic.LE4.Out	Signal: Latched Output (Q)
Logic.LE4.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE5.Gate Out	Signal: Output of the logic gate
Logic.LE5.Timer Out	Signal: Timer Output
Logic.LE5.Out	Signal: Latched Output (Q)
Logic.LE5.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE6.Gate Out	Signal: Output of the logic gate
Logic.LE6.Timer Out	Signal: Timer Output
Logic.LE6.Out	Signal: Latched Output (Q)
Logic.LE6.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE7.Gate Out	Signal: Output of the logic gate
Logic.LE7.Timer Out	Signal: Timer Output
Logic.LE7.Out	Signal: Latched Output (Q)
Logic.LE7.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE8.Gate Out	Signal: Output of the logic gate
Logic.LE8.Timer Out	Signal: Timer Output
Logic.LE8.Out	Signal: Latched Output (Q)
Logic.LE8.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE9.Gate Out	Signal: Output of the logic gate
Logic.LE9.Timer Out	Signal: Timer Output
Logic.LE9.Out	Signal: Latched Output (Q)
Logic.LE9.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE10.Gate Out	Signal: Output of the logic gate
Logic.LE10.Timer Out	Signal: Timer Output
Logic.LE10.Out	Signal: Latched Output (Q)
Logic.LE10.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE11.Gate Out	Signal: Output of the logic gate
Logic.LE11.Timer Out	Signal: Timer Output
Logic.LE11.Out	Signal: Latched Output (Q)
Logic.LE11.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE12.Gate Out	Signal: Output of the logic gate
Logic.LE12.Timer Out	Signal: Timer Output
Logic.LE12.Out	Signal: Latched Output (Q)
Logic.LE12.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE13.Gate Out	Signal: Output of the logic gate
Logic.LE13.Timer Out	Signal: Timer Output
Logic.LE13.Out	Signal: Latched Output (Q)
Logic.LE13.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE14.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE14.Timer Out	Signal: Timer Output
Logic.LE14.Out	Signal: Latched Output (Q)
Logic.LE14.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE15.Gate Out	Signal: Output of the logic gate
Logic.LE15.Timer Out	Signal: Timer Output
Logic.LE15.Out	Signal: Latched Output (Q)
Logic.LE15.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE16.Gate Out	Signal: Output of the logic gate
Logic.LE16.Timer Out	Signal: Timer Output
Logic.LE16.Out	Signal: Latched Output (Q)
Logic.LE16.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE17.Gate Out	Signal: Output of the logic gate
Logic.LE17.Timer Out	Signal: Timer Output
Logic.LE17.Out	Signal: Latched Output (Q)
Logic.LE17.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE18.Gate Out	Signal: Output of the logic gate
Logic.LE18.Timer Out	Signal: Timer Output
Logic.LE18.Out	Signal: Latched Output (Q)
Logic.LE18.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE19.Gate Out	Signal: Output of the logic gate
Logic.LE19.Timer Out	Signal: Timer Output
Logic.LE19.Out	Signal: Latched Output (Q)
Logic.LE19.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE20.Gate Out	Signal: Output of the logic gate
Logic.LE20.Timer Out	Signal: Timer Output
Logic.LE20.Out	Signal: Latched Output (Q)
Logic.LE20.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE21.Gate Out	Signal: Output of the logic gate
Logic.LE21.Timer Out	Signal: Timer Output
Logic.LE21.Out	Signal: Latched Output (Q)
Logic.LE21.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE22.Gate Out	Signal: Output of the logic gate
Logic.LE22.Timer Out	Signal: Timer Output
Logic.LE22.Out	Signal: Latched Output (Q)
Logic.LE22.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE23.Gate Out	Signal: Output of the logic gate
Logic.LE23.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE23.Out	Signal: Latched Output (Q)
Logic.LE23.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE24.Gate Out	Signal: Output of the logic gate
Logic.LE24.Timer Out	Signal: Timer Output
Logic.LE24.Out	Signal: Latched Output (Q)
Logic.LE24.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE25.Gate Out	Signal: Output of the logic gate
Logic.LE25.Timer Out	Signal: Timer Output
Logic.LE25.Out	Signal: Latched Output (Q)
Logic.LE25.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE26.Gate Out	Signal: Output of the logic gate
Logic.LE26.Timer Out	Signal: Timer Output
Logic.LE26.Out	Signal: Latched Output (Q)
Logic.LE26.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE27.Gate Out	Signal: Output of the logic gate
Logic.LE27.Timer Out	Signal: Timer Output
Logic.LE27.Out	Signal: Latched Output (Q)
Logic.LE27.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE28.Gate Out	Signal: Output of the logic gate
Logic.LE28.Timer Out	Signal: Timer Output
Logic.LE28.Out	Signal: Latched Output (Q)
Logic.LE28.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE29.Gate Out	Signal: Output of the logic gate
Logic.LE29.Timer Out	Signal: Timer Output
Logic.LE29.Out	Signal: Latched Output (Q)
Logic.LE29.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE30.Gate Out	Signal: Output of the logic gate
Logic.LE30.Timer Out	Signal: Timer Output
Logic.LE30.Out	Signal: Latched Output (Q)
Logic.LE30.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE31.Gate Out	Signal: Output of the logic gate
Logic.LE31.Timer Out	Signal: Timer Output
Logic.LE31.Out	Signal: Latched Output (Q)
Logic.LE31.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE32.Gate Out	Signal: Output of the logic gate
Logic.LE32.Timer Out	Signal: Timer Output
Logic.LE32.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE32.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE33.Gate Out	Signal: Output of the logic gate
Logic.LE33.Timer Out	Signal: Timer Output
Logic.LE33.Out	Signal: Latched Output (Q)
Logic.LE33.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE34.Gate Out	Signal: Output of the logic gate
Logic.LE34.Timer Out	Signal: Timer Output
Logic.LE34.Out	Signal: Latched Output (Q)
Logic.LE34.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE35.Gate Out	Signal: Output of the logic gate
Logic.LE35.Timer Out	Signal: Timer Output
Logic.LE35.Out	Signal: Latched Output (Q)
Logic.LE35.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE36.Gate Out	Signal: Output of the logic gate
Logic.LE36.Timer Out	Signal: Timer Output
Logic.LE36.Out	Signal: Latched Output (Q)
Logic.LE36.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE37.Gate Out	Signal: Output of the logic gate
Logic.LE37.Timer Out	Signal: Timer Output
Logic.LE37.Out	Signal: Latched Output (Q)
Logic.LE37.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE38.Gate Out	Signal: Output of the logic gate
Logic.LE38.Timer Out	Signal: Timer Output
Logic.LE38.Out	Signal: Latched Output (Q)
Logic.LE38.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE39.Gate Out	Signal: Output of the logic gate
Logic.LE39.Timer Out	Signal: Timer Output
Logic.LE39.Out	Signal: Latched Output (Q)
Logic.LE39.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE40.Gate Out	Signal: Output of the logic gate
Logic.LE40.Timer Out	Signal: Timer Output
Logic.LE40.Out	Signal: Latched Output (Q)
Logic.LE40.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE41.Gate Out	Signal: Output of the logic gate
Logic.LE41.Timer Out	Signal: Timer Output
Logic.LE41.Out	Signal: Latched Output (Q)
Logic.LE41.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE42.Gate Out	Signal: Output of the logic gate
Logic.LE42.Timer Out	Signal: Timer Output
Logic.LE42.Out	Signal: Latched Output (Q)
Logic.LE42.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE43.Gate Out	Signal: Output of the logic gate
Logic.LE43.Timer Out	Signal: Timer Output
Logic.LE43.Out	Signal: Latched Output (Q)
Logic.LE43.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE44.Gate Out	Signal: Output of the logic gate
Logic.LE44.Timer Out	Signal: Timer Output
Logic.LE44.Out	Signal: Latched Output (Q)
Logic.LE44.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE45.Gate Out	Signal: Output of the logic gate
Logic.LE45.Timer Out	Signal: Timer Output
Logic.LE45.Out	Signal: Latched Output (Q)
Logic.LE45.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE46.Gate Out	Signal: Output of the logic gate
Logic.LE46.Timer Out	Signal: Timer Output
Logic.LE46.Out	Signal: Latched Output (Q)
Logic.LE46.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE47.Gate Out	Signal: Output of the logic gate
Logic.LE47.Timer Out	Signal: Timer Output
Logic.LE47.Out	Signal: Latched Output (Q)
Logic.LE47.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE48.Gate Out	Signal: Output of the logic gate
Logic.LE48.Timer Out	Signal: Timer Output
Logic.LE48.Out	Signal: Latched Output (Q)
Logic.LE48.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE49.Gate Out	Signal: Output of the logic gate
Logic.LE49.Timer Out	Signal: Timer Output
Logic.LE49.Out	Signal: Latched Output (Q)
Logic.LE49.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE50.Gate Out	Signal: Output of the logic gate
Logic.LE50.Timer Out	Signal: Timer Output
Logic.LE50.Out	Signal: Latched Output (Q)
Logic.LE50.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE51.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE51.Timer Out	Signal: Timer Output
Logic.LE51.Out	Signal: Latched Output (Q)
Logic.LE51.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE52.Gate Out	Signal: Output of the logic gate
Logic.LE52.Timer Out	Signal: Timer Output
Logic.LE52.Out	Signal: Latched Output (Q)
Logic.LE52.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE53.Gate Out	Signal: Output of the logic gate
Logic.LE53.Timer Out	Signal: Timer Output
Logic.LE53.Out	Signal: Latched Output (Q)
Logic.LE53.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE54.Gate Out	Signal: Output of the logic gate
Logic.LE54.Timer Out	Signal: Timer Output
Logic.LE54.Out	Signal: Latched Output (Q)
Logic.LE54.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE55.Gate Out	Signal: Output of the logic gate
Logic.LE55.Timer Out	Signal: Timer Output
Logic.LE55.Out	Signal: Latched Output (Q)
Logic.LE55.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE56.Gate Out	Signal: Output of the logic gate
Logic.LE56.Timer Out	Signal: Timer Output
Logic.LE56.Out	Signal: Latched Output (Q)
Logic.LE56.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE57.Gate Out	Signal: Output of the logic gate
Logic.LE57.Timer Out	Signal: Timer Output
Logic.LE57.Out	Signal: Latched Output (Q)
Logic.LE57.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE58.Gate Out	Signal: Output of the logic gate
Logic.LE58.Timer Out	Signal: Timer Output
Logic.LE58.Out	Signal: Latched Output (Q)
Logic.LE58.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE59.Gate Out	Signal: Output of the logic gate
Logic.LE59.Timer Out	Signal: Timer Output
Logic.LE59.Out	Signal: Latched Output (Q)
Logic.LE59.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE60.Gate Out	Signal: Output of the logic gate
Logic.LE60.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE60.Out	Signal: Latched Output (Q)
Logic.LE60.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE61.Gate Out	Signal: Output of the logic gate
Logic.LE61.Timer Out	Signal: Timer Output
Logic.LE61.Out	Signal: Latched Output (Q)
Logic.LE61.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE62.Gate Out	Signal: Output of the logic gate
Logic.LE62.Timer Out	Signal: Timer Output
Logic.LE62.Out	Signal: Latched Output (Q)
Logic.LE62.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE63.Gate Out	Signal: Output of the logic gate
Logic.LE63.Timer Out	Signal: Timer Output
Logic.LE63.Out	Signal: Latched Output (Q)
Logic.LE63.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE64.Gate Out	Signal: Output of the logic gate
Logic.LE64.Timer Out	Signal: Timer Output
Logic.LE64.Out	Signal: Latched Output (Q)
Logic.LE64.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE65.Gate Out	Signal: Output of the logic gate
Logic.LE65.Timer Out	Signal: Timer Output
Logic.LE65.Out	Signal: Latched Output (Q)
Logic.LE65.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE66.Gate Out	Signal: Output of the logic gate
Logic.LE66.Timer Out	Signal: Timer Output
Logic.LE66.Out	Signal: Latched Output (Q)
Logic.LE66.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE67.Gate Out	Signal: Output of the logic gate
Logic.LE67.Timer Out	Signal: Timer Output
Logic.LE67.Out	Signal: Latched Output (Q)
Logic.LE67.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE68.Gate Out	Signal: Output of the logic gate
Logic.LE68.Timer Out	Signal: Timer Output
Logic.LE68.Out	Signal: Latched Output (Q)
Logic.LE68.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE69.Gate Out	Signal: Output of the logic gate
Logic.LE69.Timer Out	Signal: Timer Output
Logic.LE69.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE69.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE70.Gate Out	Signal: Output of the logic gate
Logic.LE70.Timer Out	Signal: Timer Output
Logic.LE70.Out	Signal: Latched Output (Q)
Logic.LE70.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE71.Gate Out	Signal: Output of the logic gate
Logic.LE71.Timer Out	Signal: Timer Output
Logic.LE71.Out	Signal: Latched Output (Q)
Logic.LE71.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE72.Gate Out	Signal: Output of the logic gate
Logic.LE72.Timer Out	Signal: Timer Output
Logic.LE72.Out	Signal: Latched Output (Q)
Logic.LE72.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE73.Gate Out	Signal: Output of the logic gate
Logic.LE73.Timer Out	Signal: Timer Output
Logic.LE73.Out	Signal: Latched Output (Q)
Logic.LE73.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE74.Gate Out	Signal: Output of the logic gate
Logic.LE74.Timer Out	Signal: Timer Output
Logic.LE74.Out	Signal: Latched Output (Q)
Logic.LE74.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE75.Gate Out	Signal: Output of the logic gate
Logic.LE75.Timer Out	Signal: Timer Output
Logic.LE75.Out	Signal: Latched Output (Q)
Logic.LE75.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE76.Gate Out	Signal: Output of the logic gate
Logic.LE76.Timer Out	Signal: Timer Output
Logic.LE76.Out	Signal: Latched Output (Q)
Logic.LE76.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE77.Gate Out	Signal: Output of the logic gate
Logic.LE77.Timer Out	Signal: Timer Output
Logic.LE77.Out	Signal: Latched Output (Q)
Logic.LE77.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE78.Gate Out	Signal: Output of the logic gate
Logic.LE78.Timer Out	Signal: Timer Output
Logic.LE78.Out	Signal: Latched Output (Q)
Logic.LE78.Out inverted	Signal: Negated Latched Output (Q NOT)

Name	Description
Logic.LE79.Gate Out	Signal: Output of the logic gate
Logic.LE79.Timer Out	Signal: Timer Output
Logic.LE79.Out	Signal: Latched Output (Q)
Logic.LE79.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE80.Gate Out	Signal: Output of the logic gate
Logic.LE80.Timer Out	Signal: Timer Output
Logic.LE80.Out	Signal: Latched Output (Q)
Logic.LE80.Out inverted	Signal: Negated Latched Output (Q NOT)

Setting Group Parameters of the Reconnection Module

Parameter	Description	Setting range	Default	Menu path
	Function	Inactive, Active	Inactive	[Protection Para /<1..4> /ReCon /General Settings]
	ExBlo Fc	Inactive, Active	Inactive	[Protection Para /<1..4> /ReCon /General Settings]
	LOP Blo	Inactive, Active	Inactive	[Protection Para /<1..4> /ReCon /General Settings]
	V Ext Release PCC Fc	Inactive, Active	Inactive	[Protection Para /<1..4> /ReCon /General Settings]
	Reclosure Release Cond	V Internal Release, V Ext Release PCC	V Internal Release	[Protection Para /<1..4> /ReCon /Release Para]

Parameter	Description	Setting range	Default	Menu path
PCC Fuse Fail VT Fk 	Blocking if the fuse of a voltage transformer has tripped at the PCC. Only available if: Reclosure Release Cond = V Ext Release PCC	Inactive, Active	Inactive	[Protection Para /<1..4> /ReCon /Release Para]
VLL> Release 	Minimum voltage (line-to-line) for reclosure (Restoration Voltage) Only available if: Reclosure Release Cond = V Internal Release	0.70 - 1.00Vn	0.95Vn	[Protection Para /<1..4> /ReCon /Release Para]
VLL< Release 	Maximum voltage (line-to-line) for reclosure (Restoration Voltage) Only available if: Reclosure Release Cond = V Internal Release	1.00 - 1.50Vn	1.10Vn	[Protection Para /<1..4> /ReCon /Release Para]
f< 	Lower frequency limit for the reclosure (Restoration Voltage)	40.00 - 69.90Hz	47.5Hz	[Protection Para /<1..4> /ReCon /Release Para]
f> 	Upper frequency limit for the reclosure	40.00 - 69.90Hz	50.05Hz	[Protection Para /<1..4> /ReCon /Release Para]
t-Release Blo 	Time stage (delay) for the reclosure of the energy resources. The Mains saddle time takes based on experience approx. 10 - 15 minutes.	0.00 - 3600.00s	600s	[Protection Para /<1..4> /ReCon /Release Para]

Input States of the Reconnection Module

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /ReCon /General Settings]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /ReCon /General Settings]
V Ext Release PCC-I	Module input state: Release signal is being generated by the PCC (External Release)	[Protection Para /Global Prot Para /ReCon /General Settings]
PCC Fuse Fail VT-I	State of the module input: Blocking if the fuse of a voltage transformer has tripped at the PCC.	[Protection Para /Global Prot Para /ReCon /General Settings]
reconnected-I	This signal indicates the state "reconnected" (mains parallel).	[Protection Para /Global Prot Para /ReCon /General Settings]
Decoupling1-I	Decoupling signal that triggers the reclosure.	[Protection Para /Global Prot Para /ReCon /Decoupling]
Decoupling2-I	Decoupling signal that triggers the reclosure.	[Protection Para /Global Prot Para /ReCon /Decoupling]
Decoupling3-I	Decoupling signal that triggers the reclosure.	[Protection Para /Global Prot Para /ReCon /Decoupling]

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
Decoupling4-I	Decoupling signal that triggers the reclosure.	[Protection Para /Global Prot Para /ReCon /Decoupling]
Decoupling5-I	Decoupling signal that triggers the reclosure.	[Protection Para /Global Prot Para /ReCon /Decoupling]
Decoupling6-I	Decoupling signal that triggers the reclosure.	[Protection Para /Global Prot Para /ReCon /Decoupling]

Reconnection Module Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo by Meas Circuit Superv	Signal: Module blocked by measuring circuit supervision
Release Energy Resource	Signal: Release Energy Resource.

27(t) - LVRT - Low Voltage Ride Through

Available Elements:

LVRT [1] LVRT [2]

Why LVRT? - Motivation for LVRT

The rapid development of distributed resources (DR) based on the renewable energy such as wind, solar and others has been changing the electric power system and concepts for its control, protection, metering and communication rapidly, too.

One of the important challenges for the interconnection between the DR and local electric power system (EPS) is the behaviour of the DR during disturbances within the electrical power system. Most of the disturbances within the EPS are characterized mainly by non-permanent system voltage collapses (voltage dip/sag) with different time durations.

According to traditional protection concepts a distributed energy resource should be tripped as fast as possible from the grid in case of a significant low voltage condition. This is no longer acceptable because of the continuous rising share of distributed energy resources within the energy market. Uncontrolled disconnecting significant parts of the power generation during disturbances within the grid endangers the system stability of the electrical power system.

It was reported³ that during system fault with low voltage drops, a complete 5000 MW wind park (without LVRT capability) was decoupled from the electrical power system. The consequence was a dangerous system voltage and frequency instability.

Based on experiences like that, lots of electric utilities and state public utilities have issued interconnection standards which require Low-Voltage-Ride-Through (LVRT) capability during EPS disturbances.

What does LVRT mean in detail?

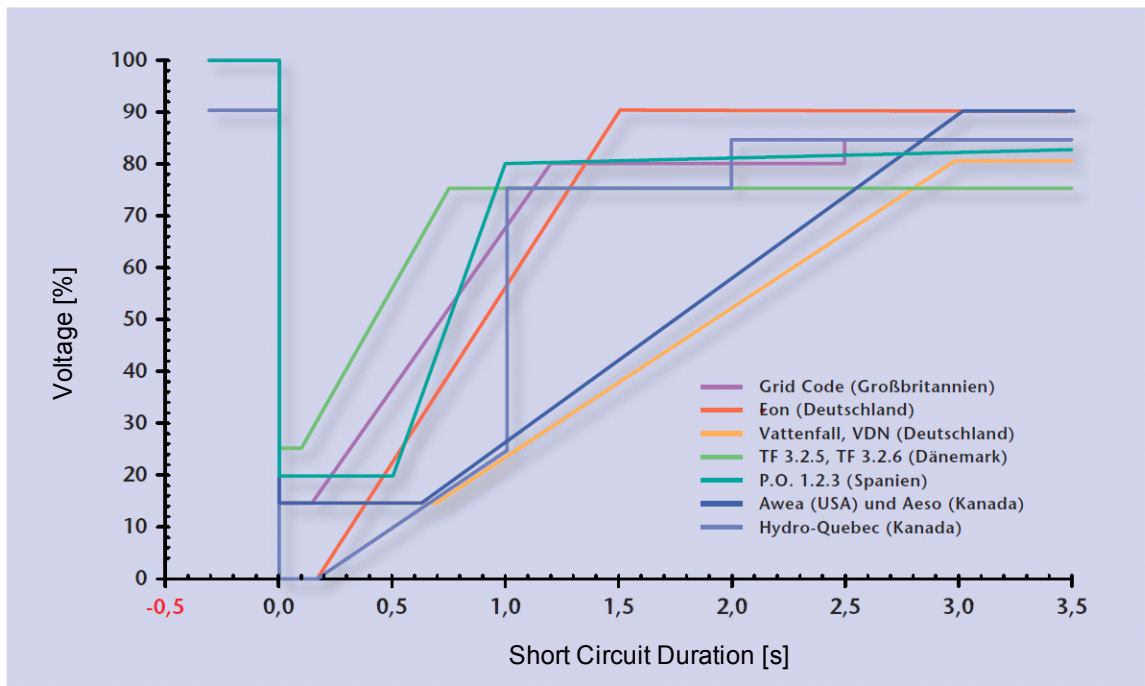
It is no longer allowed to decouple/disconnect a DR from the grid just because of a non-permanent voltage dip. Protective relays and control units have to take this into account.

Instead of that, the distributed resource has to be able to ride through such disturbances according to a LVRT profile. The shape of this LVRT profile is very similar according to the different guidelines within different countries or local utilities. But they could differ in details.

By means of LVRT the system stability is improved in situations, when the contribution of DRs is needed mostly. The importance of LVRT will rise with the growing share of DRs within the electrical power system.

Based on the technical requirements mentioned above, a LVRT protection function was developed for the E-Series which covers the LVRT profiles (capabilities) defined by all relevant national and local grid interconnection standards.

The following drawing shows details on the different LVRT standards in different countries. Please note, that the standards and hence the grid codes are in some countries still under development.



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Authors: Dipl.-Ing. Thomas Smolka, Dr.-Ing. Karl-Heinz Weck, Zertifizierungstelle der FGH e.V., Mannheim, sowie Dipl.-Ing. (FH) Matthias Bartsch, Enercon GmbH, Aurich.

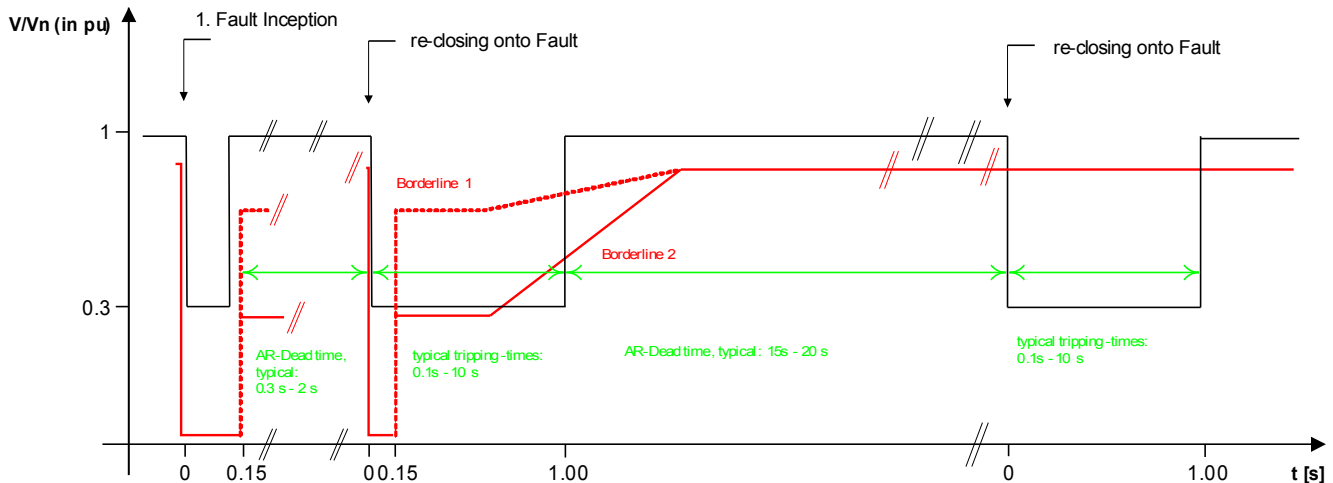
Functional Principle of the LVRT

From the grid operators point of view, a LVRT profile defines a voltage profile which a distributed energy resource, that is connected to the grid, should be able to ride through in case of a low voltage event (voltage dip). The distributed energy resource is only allowed to disconnect from the grid if the voltage at the point of common coupling drops below the LVRT borderline. In other words, a LVRT protection function is a time-dependent voltage supervision according to a predefined voltage profile. The time-dependent voltage supervision will be started, as soon as the voltage at the point of common coupling falls below the start voltage level. The LVRT will be stopped, as soon as the voltage rises above the recover voltage level.

Auto Reclosure controlled LVRT

As already mentioned, the purpose of LVRT is to keep the DR connected to the grid in case of a non-permanent voltage dip/sag. For faults within the electrical power system by which auto-reclosing function is used to coordinate with the short circuit protections like overcurrent or distance protections, it is to expect that more than one voltage dips are coming one after another in a time period which is determined by the preset auto-reclosing dead times and protection relay operating times. Voltage dips/sags caused by the dead times of auto reclosings are non-permanent. Hence the protective device has to be able to detect voltage sags/dips in accordance with an auto reclosure and issues a trip command in that case that the voltage drops below the profile or that all parameterized auto reclosure shots were unsuccessful.

The following figure¹ depicts the voltage excursion by an unsuccessful two-shot Auto-Reclosing. According to some grid codes¹ it is obligated for a distributed generation to ride through a series of temporary voltage dips, but can be disconnected from the electrical power system immediately for a permanent fault. This kind of applications can be realized easily using the feature of »AR-controlled LVRT« in LVRT protection function.



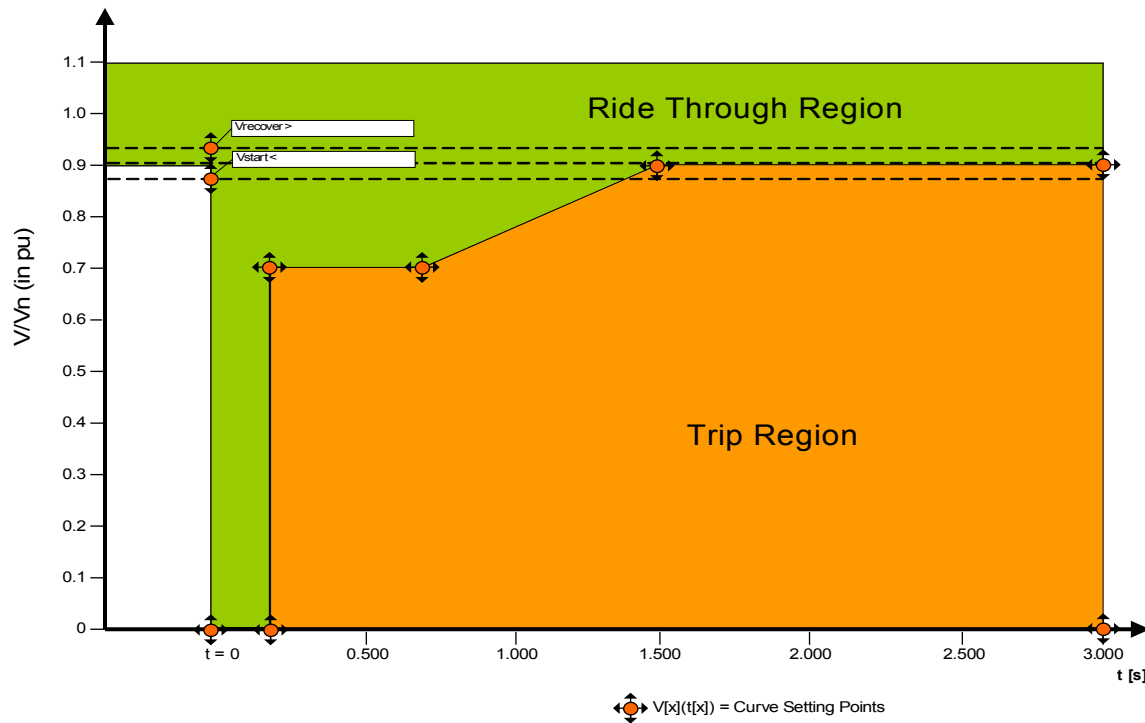
Source: Technische Richtlinie, Erzeugungsanlagen am Mittelspannungsnetz, Ausgabe Juni 2008, BDEW Bundesverband der Energie- und Wasserwirtschaft e.V. (Page 89).

Figure: Run of voltage curve during an unsuccessful two-shot auto reclosure

Functional Description of the LVRT

The LVRT element is designed for distributed generation resources that operate in parallel with the grid. It supervises system voltage disturbances by comparing them with a configurable voltage profile that is triggered once the system voltage falls below a configurable start value » V_{start} «.

Once triggered, the LVRT element supervises the system voltage consecutively and determines if the voltage excursion is above or below of the preset voltage profile. A trip signal is only issued if the voltage excursion exits the "Ride-Through" region and goes into the "Tripping" region.



The LVRT element will change into standby again as soon as the system voltage recovers: That means, the voltage has risen above the preset recover voltage »*V_{recovery}*«.

Auto Reclosure controlled LVRT

In case that the LVRT should be able to ride through auto reclosures, the parameter »*ARControlledLVRT*« has to be set to »*active*«.

In order to supervise the Low Voltage Ride Through events during reclosure, the user has to set the supervision timer »*t_{LVRT}*« *at least equal or greater than* the complete Multi-Shot AR-runtime. In addition to that the number of permitted LVRTs has to be set which is usually the number of auto reclosure attempts. The actual LVRT supervision will be controlled to ride through the preset LVRT voltage pattern. By reaching the preset number of LVRT events »*NumberOfLVRT*«, the actual LVRT supervision assumes that the detected system fault is permanent, ignores the voltage profile and issues a tripping command instantaneously in order to disconnect the distributed resource from the electrical power system.



Device Planning Parameters of the Low-Voltage-Ride-Through

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Do not use	[Device Planning]

Setting Group Parameters of the Low-Voltage-Ride-Through

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /LVRT [1] /General Settings]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /LVRT [1] /General Settings]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /LVRT [1] /General Settings]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /LVRT [1] /General Settings]
Measuring Mode 	Measuring/Supervision Mode: Determines if the phase-to-phase or phase-to-earth voltages are to be supervised	Phase to Ground, Phase to Phase	Phase to Ground	[Protection Para /<1..4> /LVRT [1] /General Settings]

Parameter	Description	Setting range	Default	Menu path
Criterion 	Measuring method: fundamental or rms or 3rd harmonic (only generator protection relays)	Fundamental, True RMS	Fundamental	[Protection Para /<1..4> /LVRT [1] /General Settings]
Phases 	Indicates if one, two of three or all phases are required for operation	any one, any two, all	any one	[Protection Para /<1..4> /LVRT [1] /General Settings]
LOP Blo 	Activates the use of the measuring circuit supervision. In this case the module will be blocked if a measuring circuit supervision module (e.g. LOP, VTS) signals a disturbed measuring circuit (e.g. caused by a fuse failure).	Inactive, Active	Inactive	[Protection Para /<1..4> /LVRT [1] /General Settings]
AR controlled LVRT 	AR controlled Low Voltage Ride Through	Inactive, Active	Inactive	[Protection Para /<1..4> /LVRT [1] /General Settings]
Number of LVRT 	Number of LVRT events, after that a disconnection of DR is allowed. Only available if:AR controlled LVRT = Active	1 - 6	1	[Protection Para /<1..4> /LVRT [1] /General Settings]
t-LVRT 	This timer defines the supervision interval (window/period) for counting the number of voltage dips to trip ("No of V dips to trip"). The first voltage ip will start the timer. The counted number of voltage dips will be reset if the timer is expired. The timer will also be reset if the maximum "No of V dips to trip" is reached. Only available if:AR controlled LVRT = Active	0.00 - 3000.00s	30.00s	[Protection Para /<1..4> /LVRT [1] /General Settings]
Vstart< 	A voltage dip is detected if the measured voltage falls below this threshold.	0.00 - 1.30Vn	0.90Vn	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
Vrecover> 	The voltage is recovered if the measured voltage raises above this threshold.	0.10 - 1.30Vn	0.93Vn	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]

Parameter	Description	Setting range	Default	Menu path
V(t1) 	Voltage value of a point V(t(n)). These points define the LVRT profile.	0.00 - 1.30Vn	0.00Vn	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
t1 	Point in time for the corresponding voltage value V(t(n)). These points define the LVRT profile.	0.00 - 20.00s	0.00s	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
V(t2) 	Voltage value of a point V(t(n)). These points define the LVRT profile.	0.00 - 1.30Vn	0.00Vn	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
t2 	Point in time for the corresponding voltage value V(t(n)). These points define the LVRT profile.	0.00 - 20.00s	0.15s	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
V(t3) 	Voltage value of a point V(t(n)). These points define the LVRT profile.	0.00 - 1.30Vn	0.70Vn	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
t3 	Point in time for the corresponding voltage value V(t(n)). These points define the LVRT profile.	0.00 - 20.00s	0.15s	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
V(t4) 	Voltage value of a point V(t(n)). These points define the LVRT profile.	0.00 - 1.30Vn	0.70Vn	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
t4 	Point in time for the corresponding voltage value V(t(n)). These points define the LVRT profile.	0.00 - 20.00s	0.70s	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
V(t5) 	Voltage value of a point V(t(n)). These points define the LVRT profile.	0.00 - 1.30Vn	0.90Vn	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]

Parameter	Description	Setting range	Default	Menu path
t5 	Point in time for the corresponding voltage value $V(t(n))$. These points define the LVRT profile.	0.00 - 20.00s	1.50s	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
V(t6) 	Voltage value of a point $V(t(n))$. These points define the LVRT profile.	0.00 - 1.30Vn	0.90Vn	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
t6 	Point in time for the corresponding voltage value $V(t(n))$. These points define the LVRT profile.	0.00 - 20.00s	3.00s	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
V(t7) 	Voltage value of a point $V(t(n))$. These points define the LVRT profile.	0.00 - 1.30Vn	0.90Vn	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
t7 	Point in time for the corresponding voltage value $V(t(n))$. These points define the LVRT profile.	0.00 - 20.00s	3.00s	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
V(t8) 	Voltage value of a point $V(t(n))$. These points define the LVRT profile.	0.00 - 1.30Vn	0.90Vn	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
t8 	Point in time for the corresponding voltage value $V(t(n))$. These points define the LVRT profile.	0.00 - 20.00s	3.00s	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
V(t9) 	Voltage value of a point $V(t(n))$. These points define the LVRT profile.	0.00 - 1.30Vn	0.90Vn	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
t9 	Point in time for the corresponding voltage value $V(t(n))$. These points define the LVRT profile.	0.00 - 20.00s	3.00s	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]

Parameter	Description	Setting range	Default	Menu path
V(t10) 	Voltage value of a point V(t(n)). These points define the LVRT profile.	0.00 - 1.30Vn	0.90Vn	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]
t10 	Point in time for the corresponding voltage value V(t(n)). These points define the LVRT profile.	0.00 - 20.00s	3.00s	[Protection Para /<1..4> /LVRT [1] /LVRT Profile]

General application notes on setting the LVRT

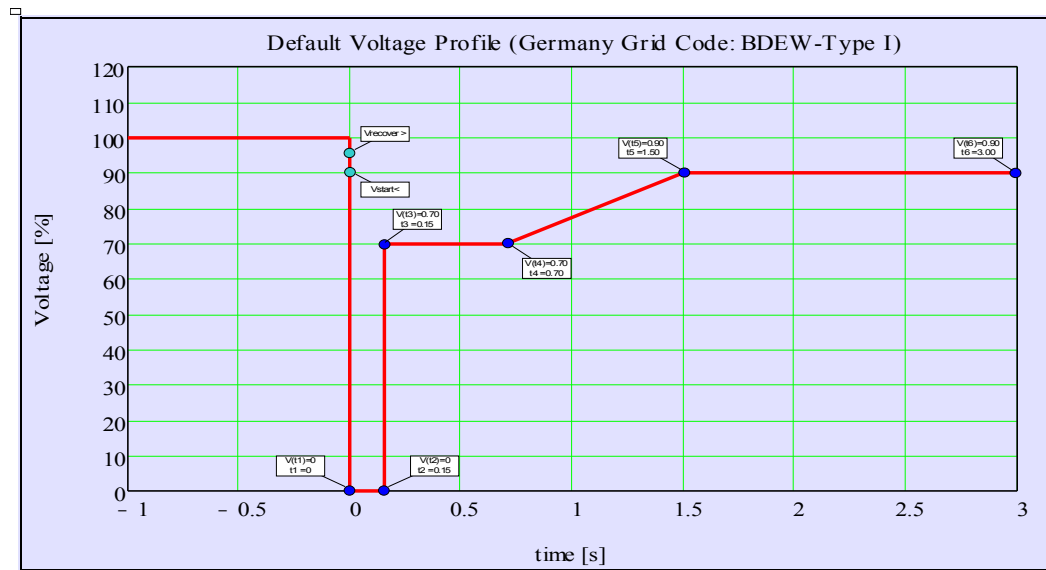
The LVRT menu comprises among other things the following parameters:

- By means of »Vstart«, the LVRT will be started (triggered).
- By means of »Vrecover« the LVRT will detect the end of the disturbance.
- Please note, that the »Vrecover« should be greater than »Vstart«. If this is not the case, the internal plausibility supervision will set »Vrecover« to 103% of »Vstart«.
- »Vk«, »tk« are the set points for setting the LVRT-profile.

Special application notes on setting the LVRT-profile

- In many cases not all available setpoints are needed in order to build up the LVRT-profile.
- In case that not all available setpoints are used, the unused setpoints can be set to the same values as the last set point.
- Set points should be selected in a manner of left-to-right with time begin at t=0 (tk+1>tk).
- The voltage setpoints must be selected in a ascending manner (Vk+1>Vk).
- The voltage value for last used set point should be set greater than the starting voltage. If this is not the case, the starting voltage will be modified internally to the value of maximum voltage set value.

In general the factory default LVRT-profile is preset based on the Type-I curve from Germany Grid Code¹⁾ (BDEW 2008) as shown in the following drawing:



LVRT-Default Profile (BDEW-Type I)

Global Protection Parameters of the Low-Voltage-Ride-Through

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /LVRT [1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /LVRT [1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /LVRT [1]]

Inputs of the Low-Voltage-Ride-Through

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /LVRT [1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /LVRT [1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /LVRT [1]]

Signals (Output States) of the Low-Voltage-Ride-Through

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pickup Phase A	Signal: Pickup Phase A
Pickup Phase B	Signal: Pickup Phase B
Pickup Phase C	Signal: Pickup Phase C
Pickup	Signal: Pickup Voltage Element
Trip	Signal: Trip
TripCmd	Signal: Trip Command
t-LVRT is running	Signal: t-LVRT is running

Counter Values of the Low-Voltage-Ride-Through

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
NumOf Vdips in t-LVRT	Number of Voltage dips during t-LVRT	[Operation /Count and RevData /LVRT [1]]
Cr Tot Numb of Vdips	Counter Total number of voltage dips.	[Operation /Count and RevData /LVRT [1]]
Cr Tot Numb of Vdips to Trip	Counter Total number of voltage dips that caused a Trip.	[Operation /Count and RevData /LVRT [1]]

Direct Commands of the Low-Voltage-Ride-Through

Parameter	Description	Setting range	Default	Menu path
Res LVRT Cr 	Reset LVRT counter.	Inactive, Active	Inactive	[Operation /Reset]

References:

¹ Technische Richtlinie „Erzeugungsanlagen am Mittelspannungsnetz – Richtlinie für Anschluss und Parallelbetrieb von Erzeugungsanlagen am Mittelspannungsnetz“, Juni 2008, BDEW, Berlin

² IEEE Std 1547™-2003, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems.

³ Title: Can China Wind Power meet the challenge of “Low-Voltage-Ride-Through” Date: 18.05.2011 Author: Shi Feng-Lei.
<http://energy.people.com.cn/GB/14667118.html>.

ExP - External Protection

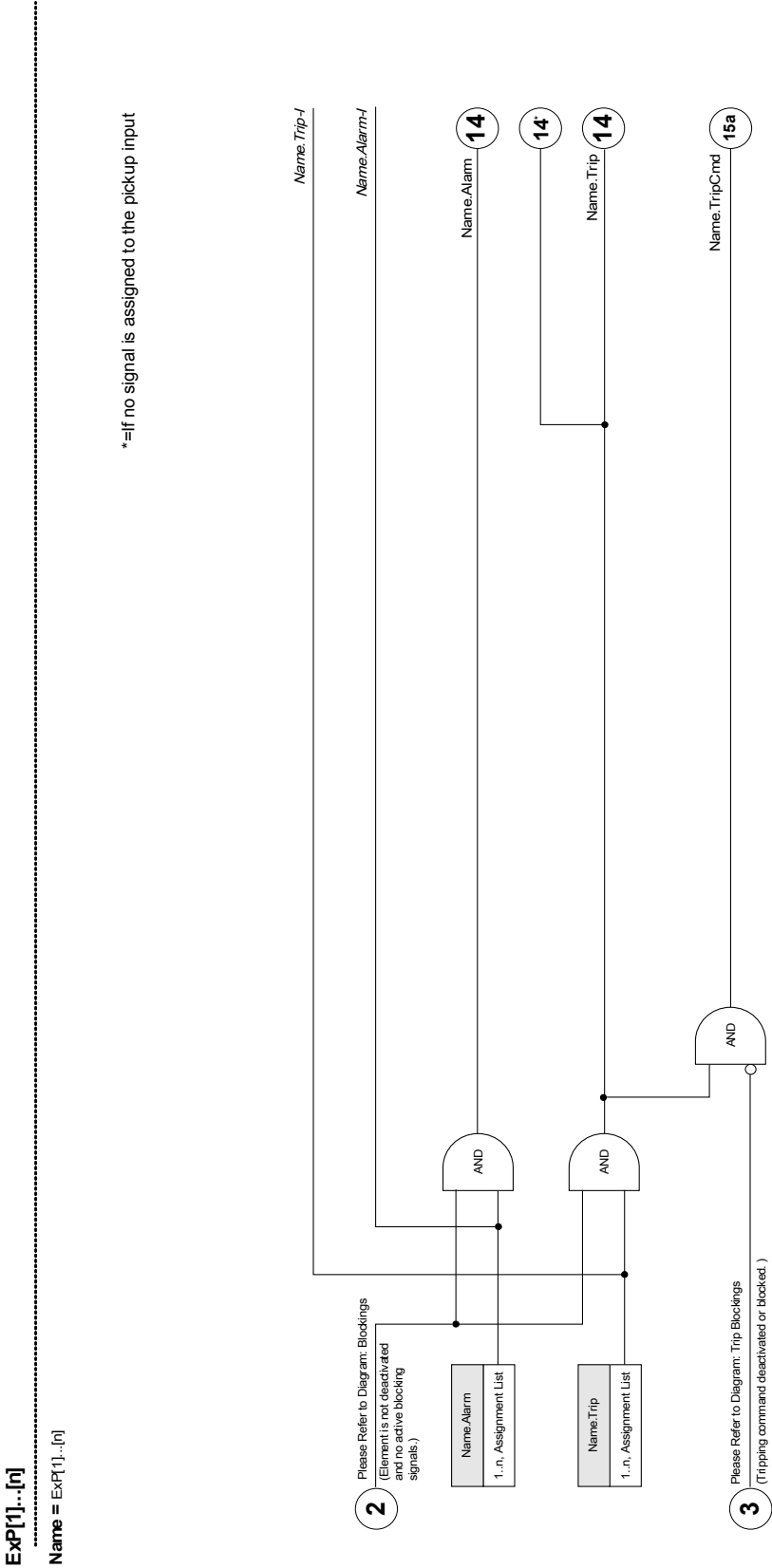
Available elements:

ExP[1] . ExP[2] . ExP[3] . ExP[4]

NOTICE

All elements of the external protection ExP[1]...[4] are identically structured.

By means of these elements, the protective device can detect and execute pickups and trips that are issued by other external devices. This can be helpful, for logging purposes, if the other device is not equipped with an event or waveform recorder. This might also be helpful if the other device has no communication (SCADA) interface.



Device Planning Parameters of the External Protection Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Do not use	[Device Planning]

Global Protection Parameters of the External Protection Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /ExP /ExP[1]]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /ExP /ExP[1]]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /ExP /ExP[1]]
Alarm 	Assignment for External Alarm	1..n, Assignment List	.-	[Protection Para /Global Prot Para /ExP /ExP[1]]
Trip 	External trip of the Bkr. if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /ExP /ExP[1]]

Setting Group Parameters of the External Protection Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /ExP /ExP[1]]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /ExP /ExP[1]]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /ExP /ExP[1]]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /ExP /ExP[1]]

External Protection Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /ExP /ExP[1]]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /ExP /ExP[1]]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /ExP /ExP[1]]
Alarm-I	Module Input State: Alarm	[Protection Para /Global Prot Para /ExP /ExP[1]]
Trip-I	Module Input State: Trip	[Protection Para /Global Prot Para /ExP /ExP[1]]

External Protection Module Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Alarm	Signal: Alarm
Trip	Signal: Trip
TripCmd	Signal: Trip Command

Commissioning: External Protection

Object to be tested:

Test of the External Protection Module.

Necessary means:

Dependent on the application.

Procedure:

Simulate the functionality of the External Protection (pickup, trip, and blockings) by (de-)energizing the digital inputs.

Successful test result:

All external pickups, external trips, and external blockings are correctly recognized and processed by the device.

RTD Protection Module

Elements:

RTD

General – Principle Use

NOTICE

The Resistance-based Temperature Detector (RTD) Protection Module uses temperature data that are provided by Eaton's Universal Resistance-based Temperature Detector (URTD) module (please refer to the URTD Module section) or Eaton's Universal Resistance-based Temperature Detector II (URTDII) module (please refer to the URTDII Module section).

NOTICE

If voting trip is required, please map the output used for tripping purposes: "RTD. Voting Trip Grp 1" or "RTD.Voting Trip Grp 2"

The protective device provides tripping and alarming functions based on the direct temperature measurements read from Eaton's (URTD) device that has 11 temperature sensor channels or Eaton's (URTDII) device that has 11 or 12 temperature sensor channels. Each channel will have one trip function without an intended delay and one alarm function with a delay.

- The "trip" function has only a threshold setting.
- Each individual »Alarm Function« will have a threshold setting range, and can be individually enabled or disabled. Since the temperature cannot change instantaneously (which is a way that temperature differs from current), the "delay" is essentially built in to the function due to the fact that the temperature will take some time to increase from room temperature to the "trip threshold" level.
- The dropout ratio for both trip and alarm is 0.99.
- The temperature rise is limited by the RTD driver.
- The entire function can be turned off or on, or individual channels can be turned off or on.

Voting

Additionally, RTD voting schemes are available and User programmable. The Voting feature must be activated and configured within the following menu, [Protection Para\Set[x]\Temp-Prot/ RTD\Vote[x]]. Here, the setting »*Function*« has to be set to »*Active*«.

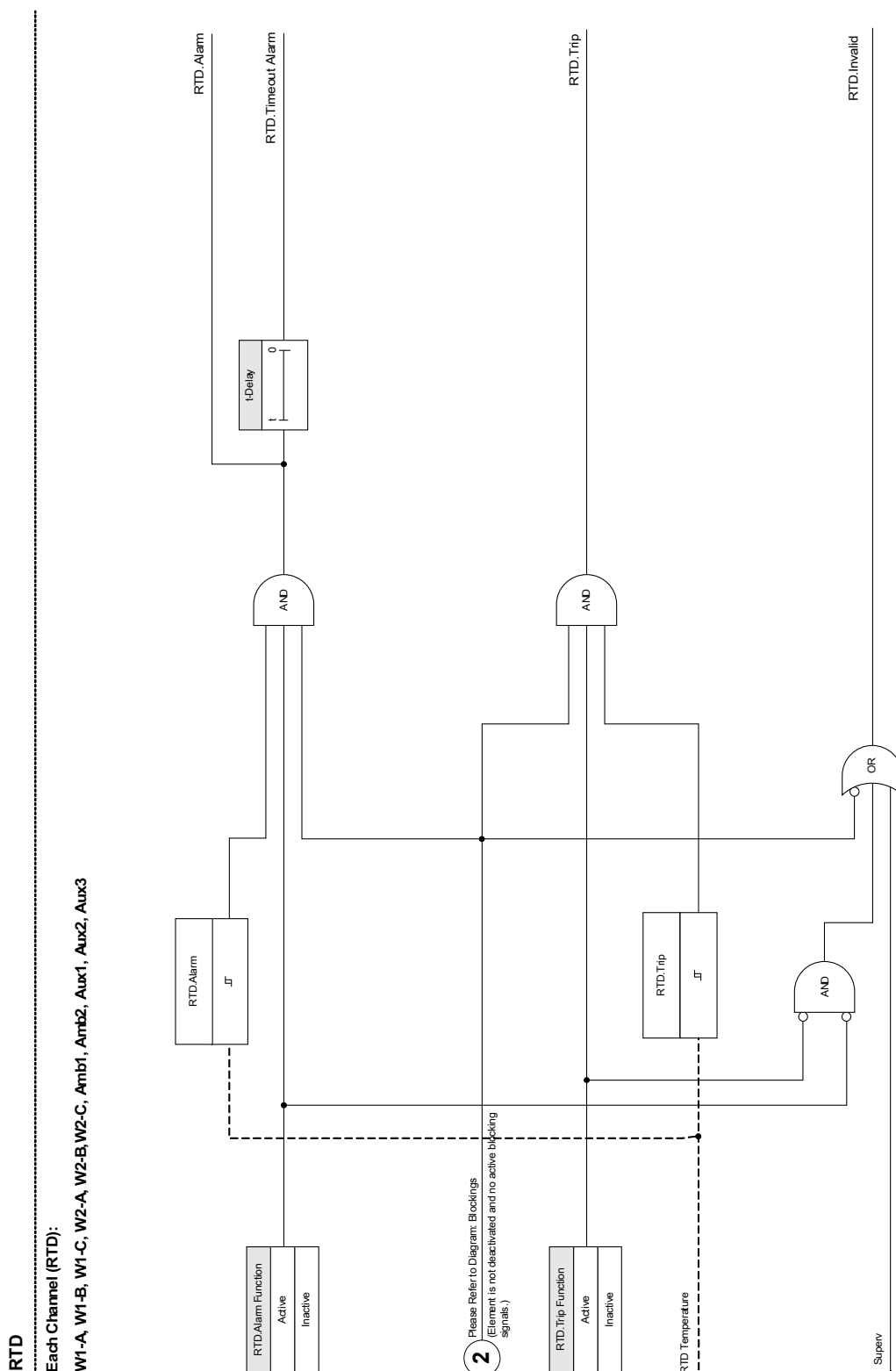
Once activated, the number of channels that will be used by the voting feature is selected. This is set by way of the parameter »*Voting[x]*«. This parameter defines how many of the selected channels must be over its threshold level in order to get a voting trip. Each individual channel must be selected or deselected by setting to either »*Yes*« or »*No*«. When selecting »*Yes*«, the channel will be used in the voting process. Note that in order to be selected, each channel must also be active and the RTD module itself has to be active.

If for example, Vote[x] is set to »3«, and all channels are set to »*Yes*«, and if any three of the selected channels exceed their individual threshold settings, a Vote trip will occur.

Please note that the voting trip will be issued as a RTD trip only, if the parameter »*TripCmd Selection*« is set to »*Voting trip*« within the Global Protection Parameters of the RTD module. The Trip has to be assigned then within the trip manager to the Breaker.

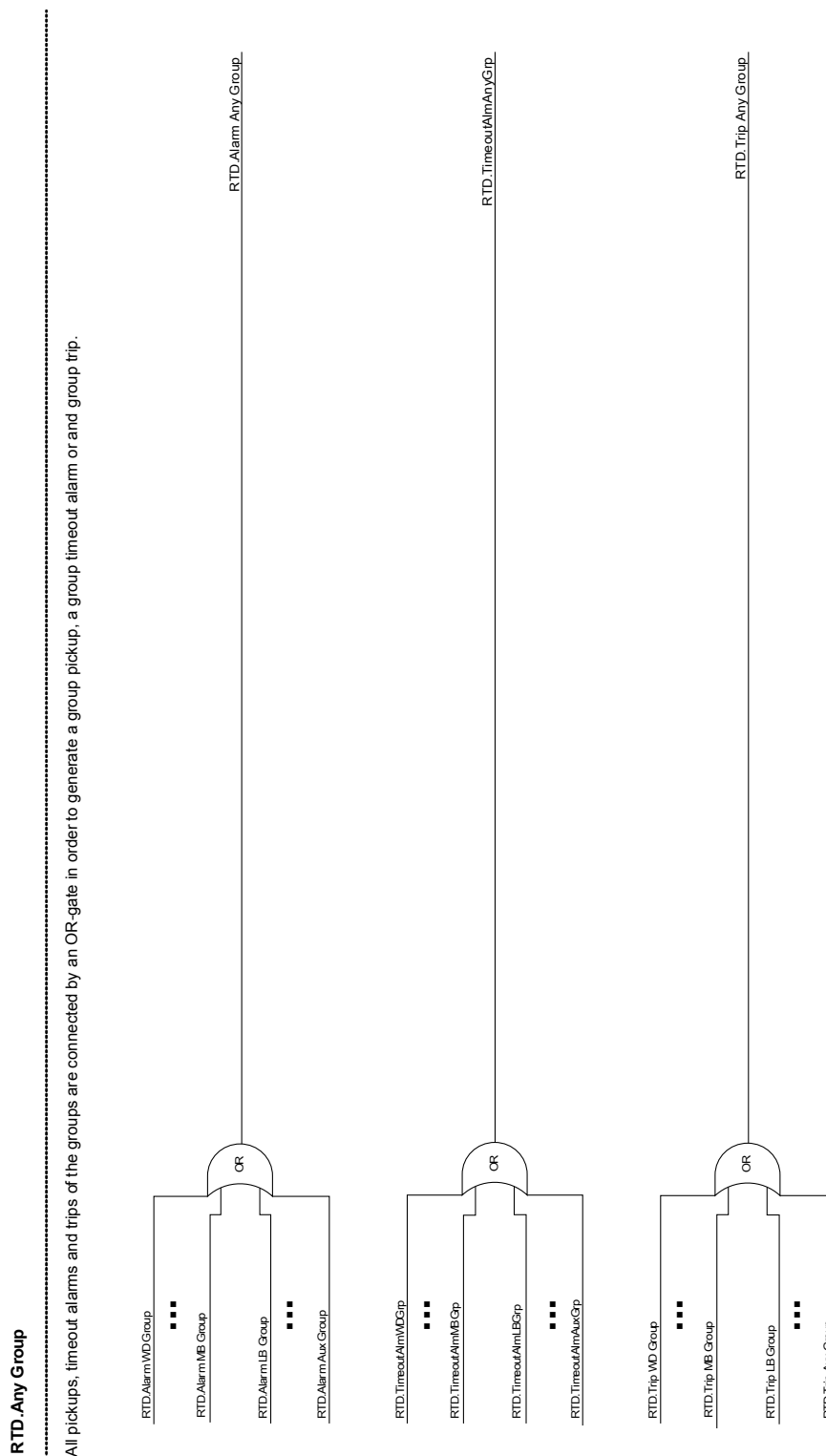
Alarm, Timeout Alarm and Trip Principle for each RTD Sensor

The following diagram shows the general working principle (delayed alarm, undelayed trip) of each of the RTD sensors.



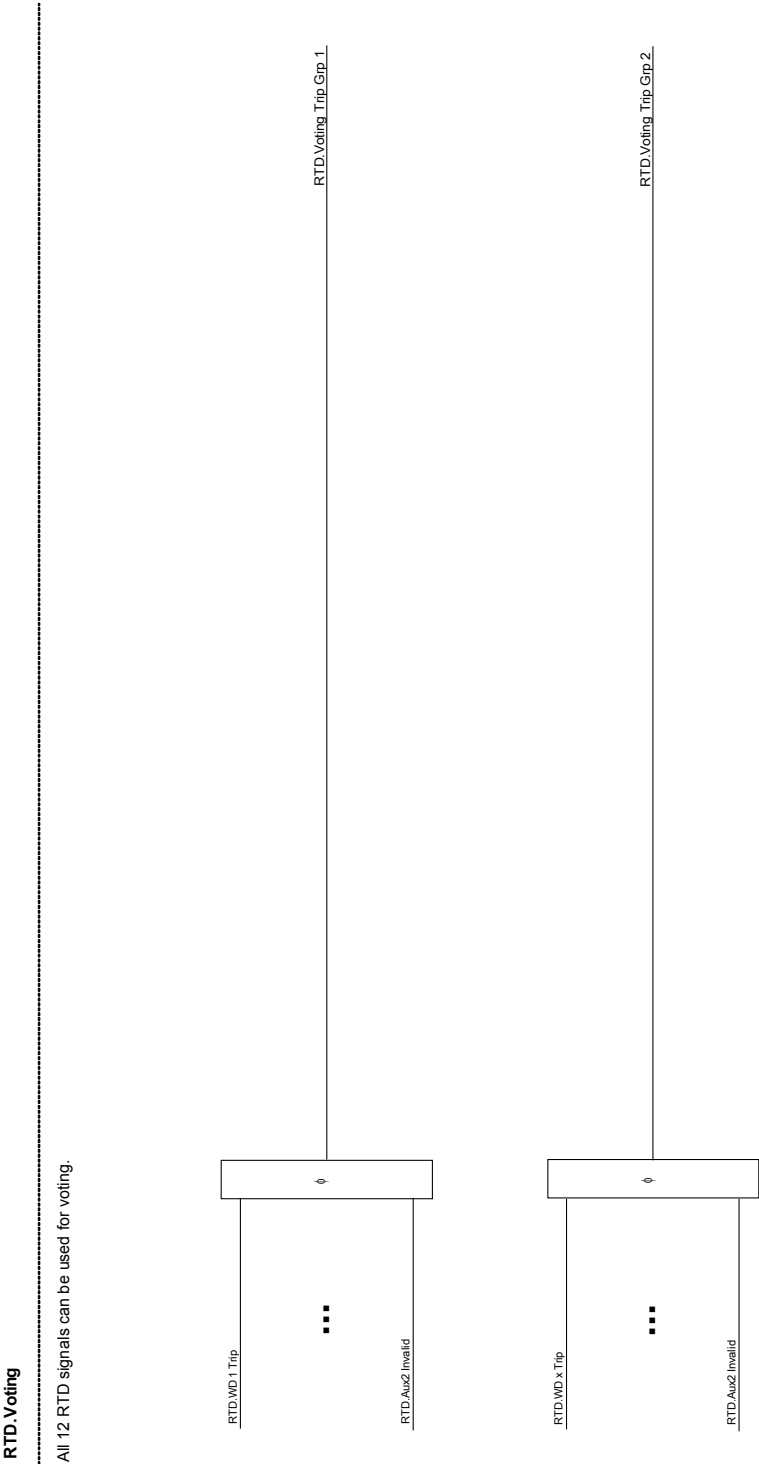
Collective Alarm, Timeout Alarm and Trip Signals

The RTD sensors are assigned to four groups (depending on the ordered device). These four groups are OR-connected to the "AnyGroup". The AnyGroup generates an alarm, an timeout alarm and a trip signal if any of the sensors mounted into this issues the corresponding signal.



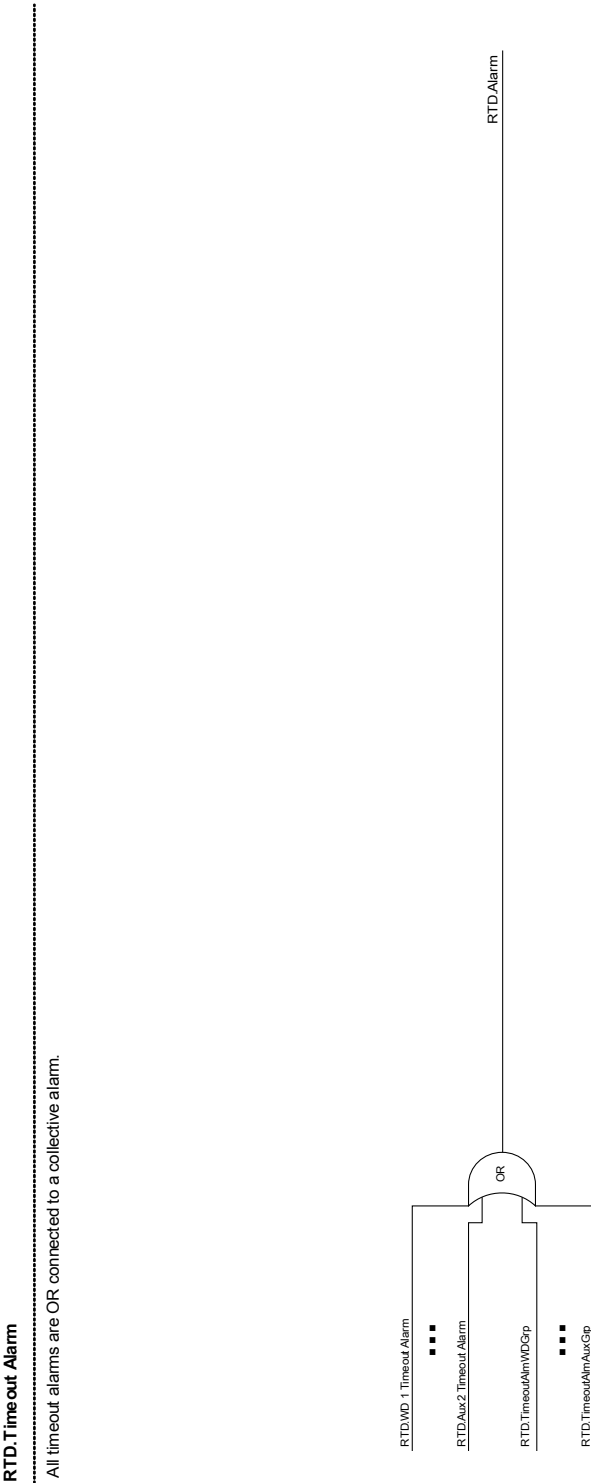
Trips of the Voting Groups

In order to use voting groups the user has to determine the sensors that should belong to a voting group and how many of them have to trip in order to generate a voting trip of the corresponding group.



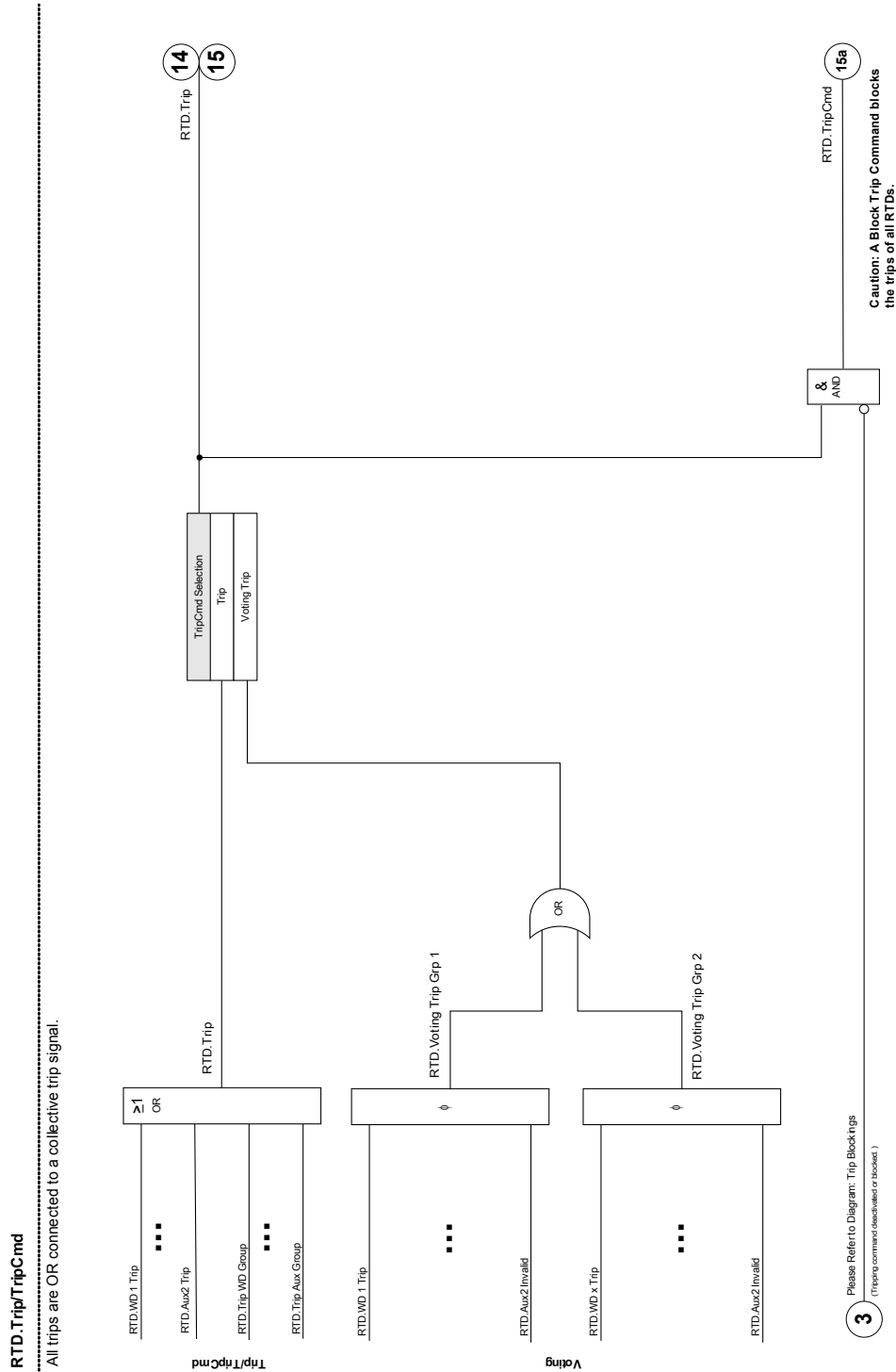
Collective Timeout Alarm Signal

All RTD sensor timeout alarms and all group timeouts are OR-connected.



Collective Trip Signal

By means of the trip command selection »*TripCmdSelection*« the user determines if the RTD element should use for the final trip signal the OR-connected default RTD trips or if the RTD element should use the OR-connected voting trips.



Device Planning Parameters of the RTD Temperature Protection Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the RTD Temperature Protection Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Temp-Prot /RTD]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Temp-Prot /RTD]
ExBlo TripCmd 	External blocking of the Trip Command of the module/the element, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Temp-Prot /RTD]
TripCmd Selection 	This parameter determines if the final trip of the RTD module is issued by the default way or by the voting groups.	Trip, Voting Trip	Trip	[Protection Para /Global Prot Para /Temp-Prot /RTD]

Setting Group Parameters of the RTD Temperature Protection Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /General Settings]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /General Settings]
Blo TripCmd 	Permanent blocking of the Trip Command of the module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /General Settings]
ExBlo TripCmd Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo TripCmd Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /General Settings]
WD 1 Alarm Function 	Winding 1 Alarm Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /WD 1]
WD 1 Trip Function 	Winding 1 Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /WD 1]

Parameter	Description	Setting range	Default	Menu path
WD 1 Alarm 	Winding 1 Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD 1]
WD 1 t-Delay 	Winding 1 If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /WD 1]
WD 1 Trip 	Winding 1 Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD 1]
WD 2 Alarm Function 	Winding 2 Alarm Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /WD 2]
WD 2 Trip Function 	Winding 2 Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /WD 2]
WD 2 Alarm 	Winding 2 Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD 2]
WD 2 t-Delay 	Winding 2 If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /WD 2]

Parameter	Description	Setting range	Default	Menu path
WD 2 Trip 	Winding 2 Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD 2]
WD 3 Alarm Function 	Winding 3 Alarm Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /WD 3]
WD 3 Trip Function 	Winding 3 Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /WD 3]
WD 3 Alarm 	Winding 3 Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD 3]
WD 3 t-Delay 	Winding 3 If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /WD 3]
WD 3 Trip 	Winding 3 Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD 3]
WD 4 Alarm Function 	Winding 4 Alarm Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /WD 4]

Parameter	Description	Setting range	Default	Menu path
WD 4 Trip Function 	Winding 4 Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /WD 4]
WD 4 Alarm 	Winding 4 Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD 4]
WD 4 t-Delay 	Winding 4 If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /WD 4]
WD 4 Trip 	Winding 4 Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD 4]
WD 5 Alarm Function 	Winding 5 Alarm Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /WD 5]
WD 5 Trip Function 	Winding 5 Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /WD 5]
WD 5 Alarm 	Winding 5 Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD 5]

Parameter	Description	Setting range	Default	Menu path
WD 5 t-Delay 	Winding 5 If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /WD 5]
WD 5 Trip 	Winding 5 Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD 5]
WD 6 Alarm Function 	Winding 6 Alarm Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /WD 6]
WD 6 Trip Function 	Winding 6 Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /WD 6]
WD 6 Alarm 	Winding 6 Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD 6]
WD 6 t-Delay 	Winding 6 If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /WD 6]
WD 6 Trip 	Winding 6 Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD 6]

Parameter	Description	Setting range	Default	Menu path
MB 1 Alarm Function 	Motor Bearing 1 Alarm Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /MB 1]
MB 1 Trip Function 	Motor Bearing 1 Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /MB 1]
MB 1 Alarm 	Motor Bearing 1 Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /MB 1]
MB 1 t-Delay 	Motor Bearing 1 If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /MB 1]
MB 1 Trip 	Motor Bearing 1 Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /MB 1]
MB 2 Alarm Function 	Motor Bearing 2 Alarm Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /MB 2]
MB 2 Trip Function 	Motor Bearing 2 Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /MB 2]

Parameter	Description	Setting range	Default	Menu path
 MB 2 Alarm	Motor Bearing 2 Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /MB 2]
 MB 2 t-Delay	Motor Bearing 2 If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /MB 2]
 MB 2 Trip	Motor Bearing 2 Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /MB 2]
 LB 1 Alarm Function	Load Bearing 1 Alarm Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /LB 1]
 LB 1 Trip Function	Load Bearing 1 Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /LB 1]
 LB 1 Alarm	Load Bearing 1 Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /LB 1]
 LB 1 t-Delay	Load Bearing 1 If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /LB 1]

Parameter	Description	Setting range	Default	Menu path
LB 1 Trip 	Load Bearing 1 Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /LB 1]
LB 2 Alarm Function 	Load Bearing 2 Alarm Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /LB 2]
LB 2 Trip Function 	Load Bearing 2 Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /LB 2]
LB 2 Alarm 	Load Bearing 2 Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /LB 2]
LB 2 t-Delay 	Load Bearing 2 If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /LB 2]
LB 2 Trip 	Load Bearing 2 Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /LB 2]
Aux1 Alarm Function 	Auxiliary 1 Alarm Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /Aux1]

Parameter	Description	Setting range	Default	Menu path
Aux1 Trip Function 	Auxiliary 1 Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /Aux1]
Aux1 Alarm 	Auxiliary 1 Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function1 = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /Aux1]
Aux1 t-Delay 	Auxiliary 1 If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function1 = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /Aux1]
Aux1 Trip 	Auxiliary 1 Threshold for Temperature Trip Only available if: Device Planning: Trip Function2 = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /Aux1]
Aux2 Alarm Function 	Auxiliary 2 Alarm Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /Aux2]
Aux2 Trip Function 	Auxiliary 2 Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /Aux2]
Aux2 Alarm 	Auxiliary 2 Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function2 = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /Aux2]

Parameter	Description	Setting range	Default	Menu path
Aux2 t-Delay 	Auxiliary 2 If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function2 = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /Aux2]
Aux2 Trip 	Auxiliary 2 Threshold for Temperature Trip Only available if: Device Planning: Trip Function2 = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /Aux2]
WD Alarm Function 	Winding Alarm Function	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /WD Group]
WD Trip Function 	Winding Trip Function	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /WD Group]
WD Alarm 	Winding Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD Group]
WD t-Delay 	Winding If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /WD Group]
WD Trip 	Winding Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /WD Group]

Parameter	Description	Setting range	Default	Menu path
MB Alarm Function 	Motor Bearing Alarm Function	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /MB Group]
MB Trip Function 	Motor Bearing Trip Function	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /MB Group]
MB Alarm 	Motor Bearing Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /MB Group]
MB t-Delay 	Motor Bearing If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /MB Group]
MB Trip 	Motor Bearing Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /MB Group]
LB Alarm Function 	Load Bearing Alarm Function	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /LB Group]
LB Trip Function 	Load Bearing Trip Function	Inactive, Active	Active	[Protection Para /<1..4> /Temp-Prot /RTD /LB Group]

Parameter	Description	Setting range	Default	Menu path
LB Alarm 	Load Bearing Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /LB Group]
LB t-Delay 	Load Bearing If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /LB Group]
LB Trip 	Load Bearing Threshold for Temperature Trip Only available if: Device Planning: Trip Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /LB Group]
Aux Alarm Function 	Auxiliary Alarm Function	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /Aux Group]
Aux Trip Function 	Auxiliary Trip Function	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /Aux Group]
Aux Alarm 	Auxiliary Threshold for Temperature Alarm Only available if: Device Planning: Alarm Function = Use	0 - 200°C	80°C	[Protection Para /<1..4> /Temp-Prot /RTD /Aux Group]
Aux t-Delay 	Auxiliary If this time is expired a Temperature Alarm will be generated. Only available if: Device Planning: Alarm Function = Use	0 - 360min	1min	[Protection Para /<1..4> /Temp-Prot /RTD /Aux Group]

Parameter	Description	Setting range	Default	Menu path
Aux Trip 	Auxiliary Threshold for Temperature Trip Only available if: Device Planning: Aux = Use	0 - 200°C	100°C	[Protection Para /<1..4> /Temp-Prot /RTD /Aux Group]
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]
Voting 1 	Voting: This parameter defines how many of the selected channels must be over its threshold level for getting a voting trip	1 - 12	1	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]
WD 1 	Winding 1	No, Yes	Yes	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]
WD 2 	Winding 2	No, Yes	Yes	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]
WD 3 	Winding 3	No, Yes	Yes	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]
WD 4 	Winding 4	No, Yes	Yes	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]

Parameter	Description	Setting range	Default	Menu path
WD 5 	Winding 5	No, Yes	Yes	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]
WD 6 	Winding 6	No, Yes	Yes	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]
MB 1 	Motor Bearing 1	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]
MB 2 	Motor Bearing 2	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]
LB 1 	Load Bearing 1	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]
LB 2 	Load Bearing 2	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]
Aux1 	Auxiliary1	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]

Parameter	Description	Setting range	Default	Menu path
Aux2 	Auxiliary2	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting1]
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]
Voting 2 	Voting: This parameter defines how many of the selected channels must be over its threshold level for getting a voting trip	1 - 12	1	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]
WD 1 	Winding 1	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]
WD 2 	Winding 2	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]
WD 3 	Winding 3	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]
WD 4 	Winding 4	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]

Parameter	Description	Setting range	Default	Menu path
WD 5 	Winding 5	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]
WD 6 	Winding 6	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]
MB 1 	Motor Bearing 1	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]
MB 2 	Motor Bearing 2	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]
LB 1 	Load Bearing 1	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]
LB 2 	Load Bearing 2	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]
Aux1 	Auxiliary1	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]

Parameter	Description	Setting range	Default	Menu path
Aux2 	Auxiliary2	No, Yes	No	[Protection Para /<1..4> /Temp-Prot /RTD /Voting2]

RTD Temperature Protection Module Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Temp-Prot /RTD]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Temp-Prot /RTD]
ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command	[Protection Para /Global Prot Para /Temp-Prot /RTD]

RTD Temperature Protection Module Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Blo TripCmd	Signal: Trip Command blocked
ExBlo TripCmd	Signal: External Blocking of the Trip Command
Alarm	Alarm RTD Temperature Protection
Trip	Signal: Trip
TripCmd	Signal: Trip Command
WD 1 Trip	Winding 1 Signal: Trip
WD 1 Alarm	Winding 1 Alarm RTD Temperature Protection
WD 1 Timeout Alarm	Winding 1 Timeout Alarm
WD 1 Invalid	Winding 1 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
WD 2 Trip	Winding 2 Signal: Trip
WD 2 Alarm	Winding 2 Alarm RTD Temperature Protection
WD 2 Timeout Alarm	Winding 2 Timeout Alarm
WD 2 Invalid	Winding 2 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
WD 3 Trip	Winding 3 Signal: Trip
WD 3 Alarm	Winding 3 Alarm RTD Temperature Protection
WD 3 Timeout Alarm	Winding 3 Timeout Alarm
WD 3 Invalid	Winding 3 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
WD 4 Trip	Winding 4 Signal: Trip
WD 4 Alarm	Winding 4 Alarm RTD Temperature Protection
WD 4 Timeout Alarm	Winding 4 Timeout Alarm
WD 4 Invalid	Winding 4 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
WD 5 Trip	Winding 5 Signal: Trip
WD 5 Alarm	Winding 5 Alarm RTD Temperature Protection
WD 5 Timeout Alarm	Winding 5 Timeout Alarm
WD 5 Invalid	Winding 5 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
WD 6 Trip	Winding 6 Signal: Trip
WD 6 Alarm	Winding 6 Alarm RTD Temperature Protection
WD 6 Timeout Alarm	Winding 6 Timeout Alarm
WD 6 Invalid	Winding 6 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)

<i>Signal</i>	<i>Description</i>
MB 1 Trip	Motor Bearing 1 Signal: Trip
MB 1 Alarm	Motor Bearing 1 Alarm RTD Temperature Protection
MB 1 Timeout Alarm	Motor Bearing 1 Timeout Alarm
MB 1 Invalid	Motor Bearing 1 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
MB 2 Trip	Motor Bearing 2 Signal: Trip
MB 2 Alarm	Motor Bearing 2 Alarm RTD Temperature Protection
MB 2 Timeout Alarm	Motor Bearing 2 Timeout Alarm
MB 2 Invalid	Motor Bearing 2 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
LB 1 Trip	Load Bearing 1 Signal: Trip
LB 1 Alarm	Load Bearing 1 Alarm RTD Temperature Protection
LB 1 Timeout Alarm	Load Bearing 1 Timeout Alarm
LB 1 Invalid	Load Bearing 1 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
LB 2 Trip	Load Bearing 2 Signal: Trip
LB 2 Alarm	Load Bearing 2 Alarm RTD Temperature Protection
LB 2 Timeout Alarm	Load Bearing 2 Timeout Alarm
LB 2 Invalid	Load Bearing 2 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
Aux1 Trip	Auxiliary 1 Signal: Trip
Aux1 Alarm	Auxiliary 1 Alarm RTD Temperature Protection
Aux1 Timeout Alarm	Auxiliary 1 Timeout Alarm
Aux1 Invalid	Auxiliary 1 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
Aux2 Trip	Auxiliary 2 Signal: Trip
Aux2 Alarm	Auxiliary 2 Alarm RTD Temperature Protection
Aux2 Timeout Alarm	Auxiliary 2 Timeout Alarm
Aux2 Invalid	Auxiliary 2 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
Trip WD Group	Trip all Windings
Alarm WD Group	Alarm all Windings
TimeoutAlmWDGrp	Timeout Alarm all Windings
WD Group Invalid	Winding Group Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
Trip MB Group	Trip all Motor Bearings
Alarm MB Group	Alarm all Motor Bearings
TimeoutAlmMBGrp	Timeout Alarm all Motor Bearings
MB Group Invalid	Motor Bearing Group Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)

<i>Signal</i>	<i>Description</i>
Trip LB Group	Trip all Load Bearings
Alarm LB Group	Alarm all Load Bearings
TimeoutAlmLBGrp	Timeout Alarm all Load Bearings
LB Group Invalid	Load Bearing Group Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
Trip Any Group	Trip Any Group
Alarm Any Group	Alarm Any Group
TimeoutAlmAnyGrp	Timeout Alarm Any Group
Voting Trip Grp 1	Voting Trip Group 1
Voting Trip Grp 2	Voting Trip Group 2
Timeout Alarm	Alarm timeout expired
Trip Aux Group	Trip Auxiliary Group
Alarm Aux Group	Alarm Auxiliary Group
TimeoutAlmAuxGrp	Timeout Alarm Auxiliary Group
AuxGrpInvalid	Invalid Auxiliary Group

RTD Temperature Protection Module Counter Values

<i>Value</i>	<i>Description</i>	<i>Default</i>	<i>Size</i>	<i>Menu path</i>
Hottest WD	Hottest motor winding temperature in degrees C.	0°C	0 - 200°C	[Operation /Measured Values /URTD]
Hottest MB	Hottest motor bearing temperature in degrees C. Resettable with "Sys Res OperationsCr" or "All".	0°C	0 - 200°C	[Operation /Measured Values /URTD]
Hottest LB	Hottest load bearing temperature in degrees C. Resettable with "Sys Res OperationsCr" or "All".	0°C	0 - 200°C	[Operation /Measured Values /URTD]
Hottest Aux	Hottest Auxiliary temperature in degrees C. Resettable with "Sys Res OperationsCr" or "All".	0°C	0 - 200°C	[Operation /Measured Values /URTD]

URTDII Module Interface

URTD

Principle – General Use

The optional Universal Resistance-based Temperature Detector II (URTDII) Module provides temperature data to the protective device up to 12 RTDs embedded in the motor, generator, transformer, or cable connector and driven equipment (see Eaton I.L. IL02602013E). The temperature data will be shown as measured values and statistics in the Operating Data menu. In addition, each channel will be monitored. The measured data provided by the URTDII Module can also be used for temperature protection (please refer to the Temperature Protection section).

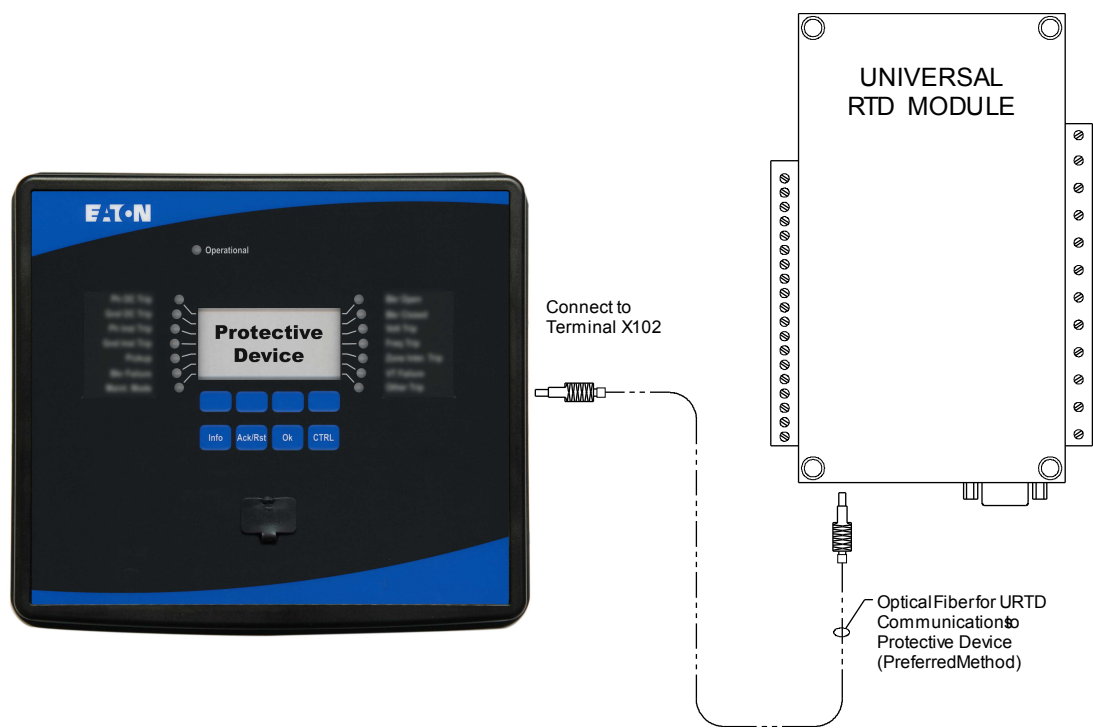
The URTDII conveys multiplexed temperature data back to the relay via a single optical fiber. The URTDII may be mounted remotely from the protective device. The fiber optic connector is located on the **X102** terminal of the protective device.

Consider the benefit of mounting the URTDII module away from the protective device and as close to the protected equipment as possible. The big bundle of RTD wires to the protected equipment becomes much shorter. The URTDII may be placed up to 400 ft (121.9 m) from the protective device with the optical fiber connection. Note that the URTDII will require a power supply connection at its remote location.

Connect a suitable source to the power terminals J10A-1 and J10A-2 on the URTDII module. Connect any of the Shield terminals to a non-current-carrying safety ground. It is recommended to have a ground connection on both sides of the unit.

<u>Style</u>	<u>Power Supply</u>
URTDII-01	48-240VAC 48-250VDC
URTDII-02	24-48VDC

URTDII Module Fiber Optic Connection to the Protective Device



The figure above shows the fiber optic connections between the URTDII Module and the protective device. The protective device supports the optical fiber connection. The following table lists the fiber optic order options.

Fiber Optic Order Options.

Cutler-Hammer Agilent Technologies

Length	Catalog Number	Number
3.3 ft (1 m)	MPFO-1	HBFR-ELS001 or HBFRRLS001
16.4 ft (5 m)	MPFO-5	HBFR-ELS005 or HBFRRLS005
32.8 ft (10 m)	MPFO-10	HBFR-ELS010 or HBFRRLS010
82.0 ft (25 m)	MPFO-25	HBFR-ELS025
164.0 ft (50 m)	MPFO-50	HBFR-ELS050
246.1 ft (75 m)	MPFO-75	HBFR-ELS075
249.3 ft (76 m)	MPFO-76	HBFR-ELS076
328.1 ft (100 m)	MPFO-100	HBFR-ELS100
393.7 ft (120 m)	MPFO-120	HBFR-ELS120
Uncut Fiber	HBFR-EUS (Length)	

The optical fiber is the only method of transmitting temperature data from the URTDII Module to the protective device.

Preassembled plastic optical fibers with connectors can be ordered from Eaton, or from any distributor of Agilent Technologies® optical fiber products. In addition, these same distributors offer long rolls of cable with connectors that can be installed in the field. Some distributors will make custom lengths to order.

NOTICE

Force is 11 pounds (50 Newtons).

Surplus length of a pre-cut fiber does not cause a problems. Simply coil and tie the excess fiber at a convenient point. Avoid high tie pressure. Bending radius of the fiber should be greater than 2 in. (50.8 mm).

The fiber termination at the URTDII simply snaps into or out of the connector. To connect the fiber termination at the protective device, push the plug of the fiber optic onto the device interface then turn it until it “snaps”.

CAUTION

The protective device as well as the URTDII have various power supply options. Make certain that the power supply is acceptable for both units before connecting the same power supply to both devices.

Wiring RTDs to the URTDII Module

RTD Control	URTDII Connection Name	Terminals	Transformer Temperature Monitoring Point
RTD1: Alarm Functional Trip Functional W1-A Alarm W1-A t-Delay W1-A Trip	MW1	J2-1, J2-2	W1-A – Transformer Winding 1, Phase A RTD Temperature.
RTD2: Alarm Functional Trip Functional W1-B Alarm W1-B t-Delay W1-B Trip	MW2	J2-5, J2-6	W1-B - Transformer Winding 1, Phase B RTD Temperature.
RTD3: Alarm Functional Trip Functional W1-C Alarm W1-C t-Delay W1-C Trip	MW3	J2-8, J2-9	W1-C - Transformer Winding 1, Phase C RTD Temperature.
RTD4: Alarm Functional Trip Functional W2-A Alarm W2-A t-Delay W2-A Trip	MW4	J2-12, J2-13	W2-A - Transformer Winding 2, Phase A RTD Temperature.
RTD5: Alarm Functional Trip Functional W2-B Alarm W2-B t-Delay W2-B Trip	MW5	J2-15, J2-16	W2-B - Transformer Winding 2, Phase B RTD Temperature.
RTD6: Alarm Functional Trip Functional W2-C Alarm W2-C t-Delay W2-C Trip	MW6	J2-19, J2-20	W2-C - Transformer Winding 2, Phase C RTD Temperature.
RTD7: Alarm Functional Trip Functional Amb1 Alarm Amb1 t-Delay Amb1 Trip	MB1	J10B-19, J10B-20	AMB1 - Transformer Ambient RTD Temperature (1).

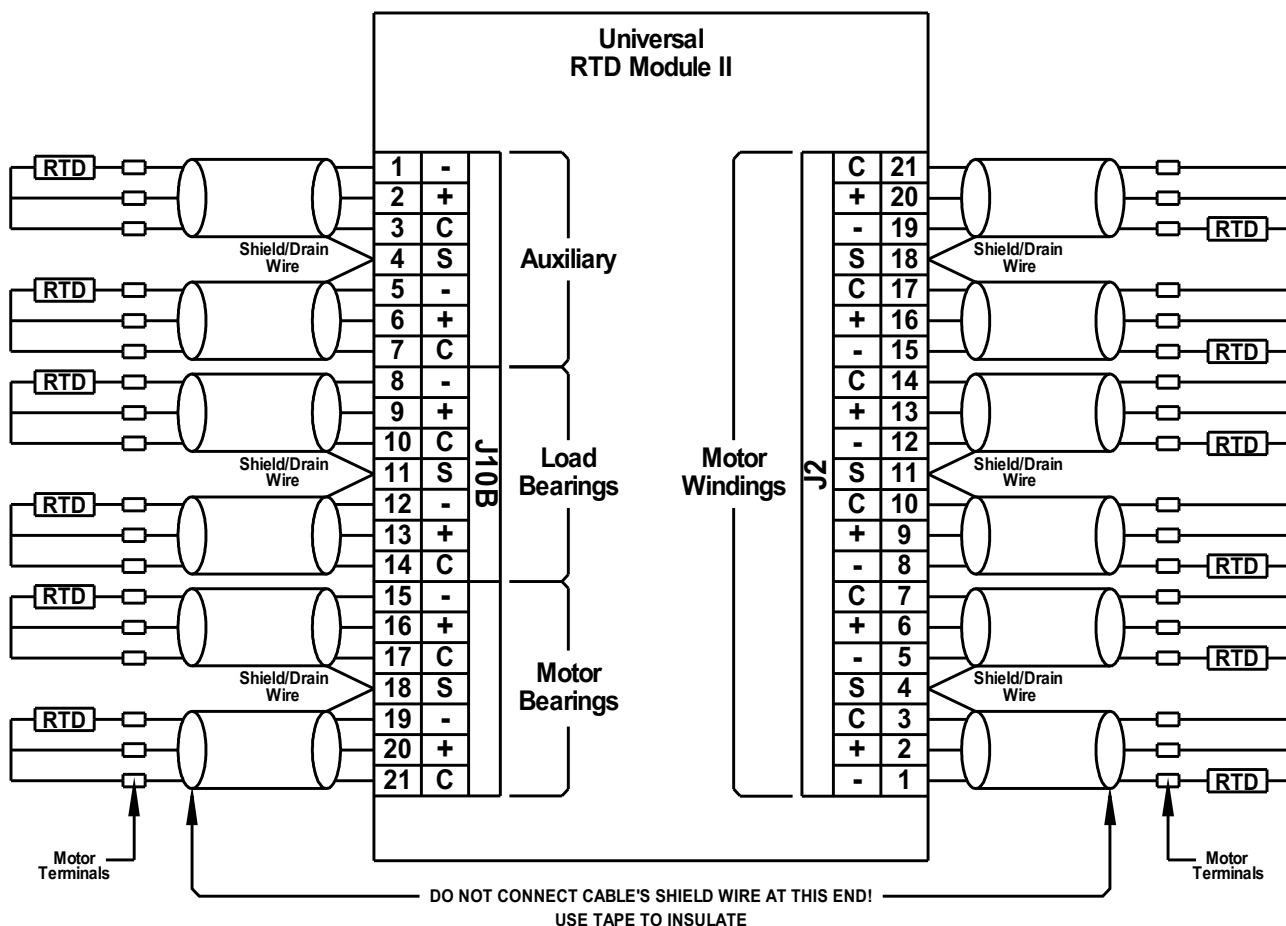
RTD Control	URTDII Connection Name	Terminals	Transformer Temperature Monitoring Point
RTD8: Alarm Functional Trip Functional Amb2 Alarm Amb2 t-Delay Amb2 Trip	MB2	J10B-15, J10B-16	AMB2 - Transformer Ambient RTD Temperature (2).
RTD9: Alarm Functional Trip Functional Aux1 Alarm Aux1 t-Delay Aux1 Trip	LB1	J10B-12, J10B-13	AUX1 – User Defined RTD Temperature.
RTD10: Alarm Functional Trip Functional Aux2 Alarm Aux2 t-Delay Aux2 Trip	LB2	J10B-8, J10B-9	AUX2 – User Defined RTD Temperature.
RTD11: Alarm Functional Trip Functional Aux3 Alarm Aux3 t-Delay Aux3 Trip	AUX1	J10B-5, J10B-6	AUX3 – User Defined RTD Temperature.
RTD12: Alarm Functional Trip Functional Aux4 Alarm Aux4 t-Delay Aux4 Trip	AUX2	J10B-1, J10B-2	AUX4 – User Defined RTD Temperature.

NOTICE

Consult the URTDII Module Instruction Leaflet (I.L. IL02602013E) for complete instructions.

Three URTD terminals are provided for each RTD input.

The three terminals for any unused RTD input channel should be wired together. For example, if MW5 and MW6 are unused, MW5 terminals J2-15, J2-16, and J2-17 should be wired together and MW6 terminals J2-19, J2-20, J2-21 should be separately wired together.



See the figure above for wiring of RTDs to the URTD inputs. Use #18 AWG, three-conductor shielded cable. Note the connection rules in the figure. When making connections to a two-lead RTD, connect two of the cable conductors to one of the RTD leads as shown. Make this connection as close to the transformer as possible. Connect the third cable conductor to the remaining RTD lead.

Connect the shield / drain wire to the Shield terminal as shown in the figure. The RTD cable shield should be connected only at the URTD end, and insulated at the RTD end. The RTD's themselves must not be grounded at the object to be protected.

Remember to set the URTDII module DIP switches according to the types of RTDs in each of the channels (see I.L. IL02602013E).

Direct Commands of the URTD Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
Force WD1 	Force Winding 1	0 - 392	0	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
Force WD2 	Force Winding 2	0 - 392	0	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
Force WD3 	Force Winding 3	0 - 392	0	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
Force WD4 	Force Winding 4	0 - 392	0	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
Force WD5 	Force Winding 5	0 - 392	0	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
Force WD6 	Force Winding 6	0 - 392	0	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]

Parameter	Description	Setting range	Default	Menu path
Force MB1 	Force Motor Bearing 1	0 - 392	0	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
Force MB2 	Force Motor Bearing 2	0 - 392	0	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
Force LB1 	Force Load Bearing 1	0 - 392	0	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
Force LB2 	Force Load Bearing 2	0 - 392	0	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
Force Aux1 	Force Auxiliary1	0 - 392	0	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
Force Aux2 	Force Auxiliary2	0 - 392	0	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]

Global Protection Parameters of the URTD Module

Parameter	Description	Setting range	Default	Menu path
 Force Mode	By means of this function the normal Relay Output States can be overwritten (forced) in case that the Relay Output is not in a disarmed state. The relays can be set from normal operation (relay works according to the assigned signals) to "force energized" or "force de-energized" state.	Permanent, Timeout	Permanent	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
 t-Timeout Force	The Output State will be set by force for the duration of this time. That means, for the duration of this time, the Relay Output does not show the state of the signals that are assigned on it. Only available if: Mode = Timeout DISARM	0.00 - 300.00s	0.03s	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /URTD]
 Temperature Unit	Temperature Unit	Celsius, Fahrenheit	Celsius	[System Para /General Settings]

URTD Signals (Output States)

Signal	Description
WD1 Superv	Signal: Supervision Channel WD1
WD2 Superv	Signal: Supervision Channel WD2
WD3 Superv	Signal: Supervision Channel WD3
WD4 Superv	Signal: Supervision Channel WD4
WD5 Superv	Signal: Supervision Channel WD5
WD6 Superv	Signal: Supervision Channel WD6
MB1 Superv	Signal: Supervision Channel MB1
MB2 Superv	Signal: Supervision Channel MB2
LB1 Superv	Signal: Supervision Channel LB1
LB2 Superv	Signal: Supervision Channel LB2
Aux1 Superv	Signal: Supervision Channel Aux1
Aux2 Superv	Signal: Supervision Channel Aux2
Superv	Signal: URTD Supervision Channel
active	Signal: URTD active
Outs forced	Signal: The State of at least one Relay Output has been set by force. That means that the state of at least one Relay is forced and hence does not show the state of the assigned signals.

URTD Module Statistics

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
WD1 max	Winding1 Maximum Value	[Operation /Statistics /Max /URTD]
WD2 max	Winding2 Maximum Value	[Operation /Statistics /Max /URTD]
WD3 max	Winding3 Maximum Value	[Operation /Statistics /Max /URTD]
WD4 max	Winding4 Maximum Value	[Operation /Statistics /Max /URTD]
WD5 max	Winding5 Maximum Value	[Operation /Statistics /Max /URTD]
WD6 max	Winding6 Maximum Value	[Operation /Statistics /Max /URTD]
MB1 max	Motor Bearing1 Maximum Value	[Operation /Statistics /Max /URTD]
MB2 max	Motor Bearing2 Maximum Value	[Operation /Statistics /Max /URTD]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
LB1 max	Load Bearing1 Maximum Value	[Operation /Statistics /Max /URTD]
LB2 max	Load Bearing2 Maximum Value	[Operation /Statistics /Max /URTD]
Aux1 max	Auxiliary1 Maximum Value	[Operation /Statistics /Max /URTD]
Aux2 max	Auxiliary2 Maximum Value	[Operation /Statistics /Max /URTD]

URTD Measured Values

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
WD1	Winding 1	[Operation /Measured Values /URTD]
WD2	Winding 2	[Operation /Measured Values /URTD]
WD3	Winding 3	[Operation /Measured Values /URTD]
WD4	Winding 4	[Operation /Measured Values /URTD]
WD5	Winding 5	[Operation /Measured Values /URTD]

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
WD6	Winding 6	[Operation /Measured Values /URTD]
MB1	Motor Bearing 1	[Operation /Measured Values /URTD]
MB2	Motor Bearing 2	[Operation /Measured Values /URTD]
LB1	Load Bearing 1	[Operation /Measured Values /URTD]
LB2	Load Bearing 2	[Operation /Measured Values /URTD]
Aux1	Auxiliary1	[Operation /Measured Values /URTD]
Aux2	Auxiliary2	[Operation /Measured Values /URTD]
RTD Max	Maximum temperature of all channels.	[Operation /Measured Values /URTD]

Supervision

BF- Breaker Failure [50BF*/62BF]

*=only available in protective relays that offer current measurement.

Available elements:

BF

Principle – General Use

The breaker failure (BF) protection is used to provide backup protection in the event that a breaker fails to operate properly during fault clearing. This signal is to be used to trip the upstream breaker (e.g. infeed of a busbar) either via an output relay or via Communication. Depending on the ordered device and type there are different/multiple schemes available to detect a breaker failure.

Start/Trigger of the BF Timer

A supervision timer »*t-BF*« will be started, once the BF module is triggered. Even if the Trigger signal drops again, this timer will continue to run. If the timer runs down/elapses (is not stopped), the module will issue a trip afterwards. This trip signal is to be used to trip the upstream breaker (backup).

Stopping the BF

The timer will be stopped if the opening of the breaker is detected. Depending on the supervision scheme the timer will be stopped if the current falls below the current threshold or if the position signals indicate the open position of the breaker or a combination of both. The BF module will remain within the state rejected until the trigger signal drops (falls back).

Detecting a Breaker Failure

Depending on the supervision scheme, the Breaker Failure signal (Trip) will be set if either:

- the current doesn't fall below the threshold or
- the position signals indicate that the breaker is in the closed position or
- both.

Reject state of the BF-module

The BF module will switch into the rejected state if the Breaker failure triggers are still active while the open position of the breaker has been detected successfully.

Readiness for Operation

The BF module will switch back into the Stand-by if the trigger signals drop (fall back).

Locking

A locking signal will be issued simultaneously with the BF-Signal (Trip). The locking signal is permanent. This signal has to be acknowledged at the HMI.

NOTICE**Note on devices that offer Wide Frequency Range measurement:**

The supervision scheme 50BF will be blocked as soon as the frequency differs more than 5% from the nominal frequency. As long as the frequency differs more than 5% from the nominal frequency the supervision scheme “50BF and CB Pos” will work according to the “CB Pos” scheme.

Supervision Schemes

Up to three supervision schemes are available depending on the ordered device type and variant in order to detect a Breaker Failure.

*50BF**

A supervision timer will be started as soon as the BF-module is triggered by a trip signal. A Breaker Failure will be detected and a signal will be issued if the measured current does not fall below a set threshold while this timer runs down.

This supervision scheme is available within protective relays that offer current measurement.

CB Pos

A supervision timer will be started as soon as the BF module is triggered by a trip signal. A Breaker Failure will be detected and a signal will be issued if the evaluation of the position indicators of the Breaker does not indicate that the breaker has been switched off successfully while this timer runs down.

This supervision scheme is available within all protective relays. This scheme is recommended if Breaker Failures have to be detected while there is no or not much load flow (small currents). This might e.g. be the case if overvoltage or overfrequency is supervised for a Gen-Set that is running in Stand-by.

*50 BF and CB Pos**

A supervision timer will be started as soon as the BF module is triggered by a trip signal. A Breaker Failure will be detected and a signal will be issued if the measured current does not fall below a set threshold and if simultaneously the evaluation of the position indicators of the Breaker does not indicate that the breaker has been switched off successfully while this timer runs down.

This scheme is recommended if Breaker Failures have to be double checked. This scheme will issue a trip command to the upstream breaker even if position indicators indicate misleadingly (faulty) that the breaker has been opened or if the current measurement indicates misleadingly (faulty) that the breaker is now in the open position.

*=only available in protective relays that offer current measurement.

Trigger Modes

There are three trigger modes for the BF module available. In addition to that, there are three assignable trigger inputs available that might trigger the BF module even if they are not assigned within the breaker manager onto the breaker that is to be monitored.

- *All Trips*: All trip signals that are assigned to this breaker (within the trip manager) will start the BF module (please refer also to section "Trigger signals of the Breaker Failure").
- *Current Trips*: All current trips that are assigned to this breaker (within the trip manager) will start the BF module (please refer also to section "Trigger signals of the Breaker Failure").
- *External Trips*: All external trips that are assigned to this breaker (within the trip manager) will start the BF module (please refer also to section "Trigger signals of the Breaker Failure").
- In addition, the User can also select *none* (e.g.: if the User intends to use one of the three additional assignable trigger inputs).

NOTICE

Those trips can exclusively start the breaker failures that are assigned within the trip manager to the breaker that is to be supervised. In contrast to that the additional three triggers 1-3 will trigger the BF module even if they are not assigned onto the breaker within the corresponding breaker manager.

NOTICE

Select the winding side (Breaker, Winding) from which the measured currents should be taken in case this protective device provides more than one current measurement card.

NOTICE

This Notice applies to protective devices that offer control functionality only! This protective element requires, that a switchgear (Breaker) is assigned to it. It is allowed only to assign switchgears (Breaker) to this protective element, whose measuring transformers provide measuring data to the protective device.

Breaker Failure Lockout

The signal of the Breaker Failure is latched. This signal can be used to block the breaker against a switching on attempt.

Tabular Summary

	Supervision Schemes		
	Where? Within [Protection Para\Global Prot Para\Supervision\BF]		
	CB Pos²⁾	50BF³⁾	CBPos und 50BF⁴⁾
<i>Which breaker is to be monitored?</i> Where to select? Within [Protection Para\Global Prot Para\Supervision\BF]	Selection of the breaker that is to be monitored. (In case that more than one breaker is available)	Selection of the breaker that is to be monitored. (In case that more than one breaker is available)	Selection of the breaker that is to be monitored. (In case that more than one breaker is available)
<i>Trigger Modi</i> (Who starts the BF-timer?) Where to set? Within [Protection Para\Global Prot Para\Supervision\BF]	All Trips ⁵⁾ or All Current Trips ⁵⁾ or External Trips ⁵⁾ ...and the breaker is in the closed position and the BF module is within the stand-by state.	All Trips ⁵⁾ or All Current Trips ⁵⁾ or External Trips ⁵⁾ ...and the BF module is within the stand-by state.	All Trips ⁵⁾ or All Current Trips ⁵⁾ or External Trips ⁵⁾ ...and the breaker is in the closed position and the BF module is within the stand-by state.
<i>Who stops the BF-Timer?</i> Once the timer has been stopped the BF module will switch into the state "Rejected". The module will switch back into the state "Stand-by" if the trigger signals are dropped.	Position indicators indicate that the switchgear (breaker) is in the open position.	Current is fallen below the $I < \text{threshold}^{1)}$.	Position indicators indicate that the switchgear (breaker) is in the open position and current is fallen below the $I < \text{threshold}^{1)}$.
<i>A Breaker Failure will be detected</i> ...and a trip signal to the upstream breaker will be issued?	When the BF-Timer has run down (elapsed).	When the BF-Timer has run down (elapsed).	When the BF-Timer has run down (elapsed).
<i>When does the trip signal to the upstream breaker drops (falls back)?</i>	If the position indicators indicate that the switchgear (breaker) is in the open position and if the trigger signals are dropped (fallen back)	If the current is fallen below the $I <$ and if the trigger signals are dropped (fallen back)	If the position indicators indicate that the switchgear (breaker) is in the open position and if the current is fallen below the $I <$ and if the trigger signals are dropped (fallen back)

¹⁾ It is recommended to set the $I <$ threshold to a value that is slightly below the fault current that is expectable. By means of that it is possible to shorten the BF supervision timer and hence reduce thermal and mechanical damage of the electrical equipment in case of a Breaker Failure. The lower the threshold, the longer the time that is needed to detect, that the breaker is in the open position, especially if there are transients/harmonics.

Note: Tripping delay of the BF module = Minimum delay time (tripping time) of the backup protection!

2), 3), 4)

Available in all devices with the
corresponding software

Available in all devices that offer
current measurement

Available in all devices that offer
current measurement

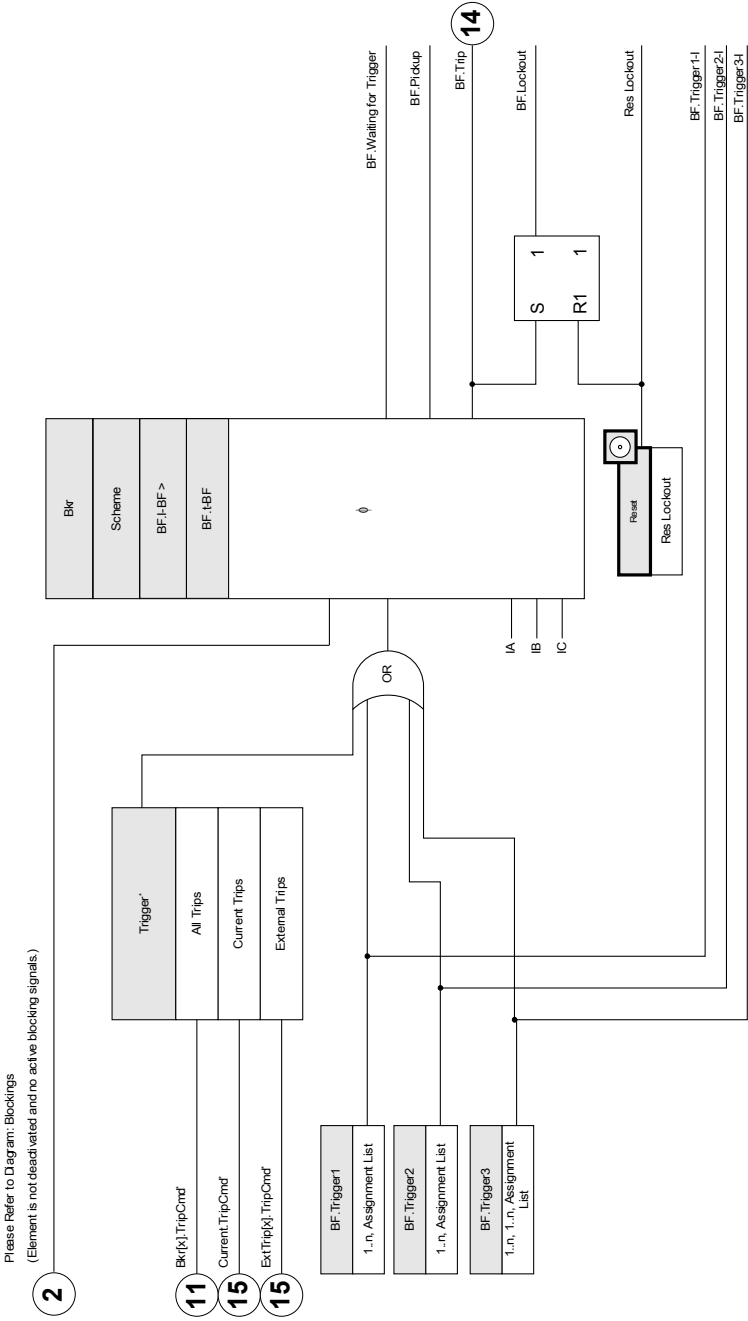
5)

Only if the signals are assigned onto the breaker within the breaker manager.

Breaker Failure Protection for devices that offer current measurement

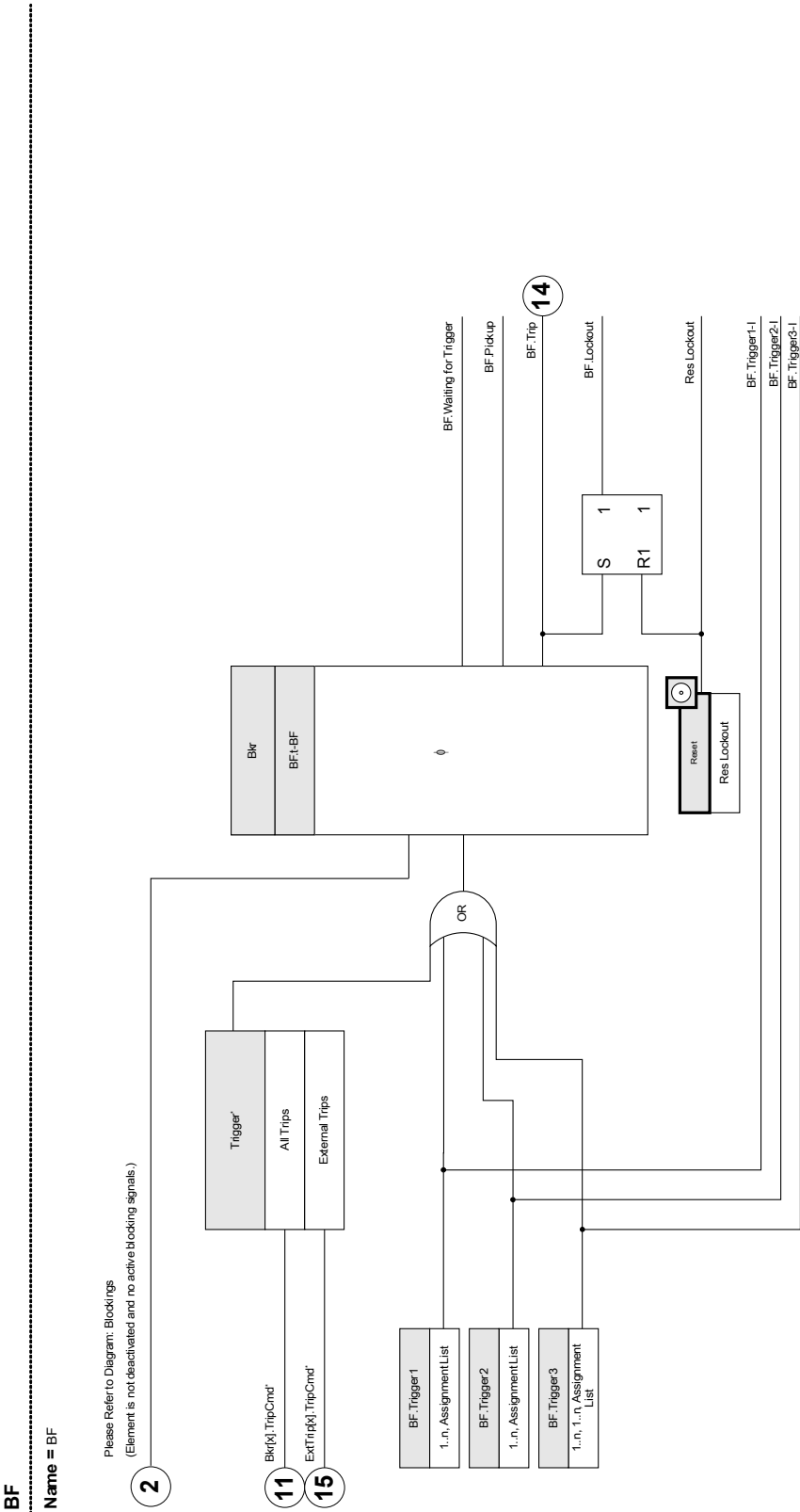
BF

Name = BF



*The Breaker Failure will be triggered only by those trip signals that are assigned onto the breaker within the Trip Manager.

Breaker Failure Protection for devices that offer voltage measurement only



*The Breaker Failure will be triggered only by those trip signals that are assigned onto the breaker within the Trip Manager.

Device Planning Parameters of the BF

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Use	Use	[Device Planning]

Global Protection Parameters of the BF

Parameter	Description	Setting range	Default	Menu path
Scheme 	Scheme	50BF, CB Pos, 50BF and CB Pos	50BF	[Protection Para /Global Prot Para /Supervision /BF]
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Supervision /BF]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Supervision /BF]
Trigger 	Determining the trigger mode for the Breaker Failure.	-. -, All Trips, ExP Fc, Current Trips	All Trips	[Protection Para /Global Prot Para /Supervision /BF]
Trigger1 	Trigger that will start the BF	Trigger	.-	[Protection Para /Global Prot Para /Supervision /BF]
Trigger2 	Trigger that will start the BF	Trigger	.-	[Protection Para /Global Prot Para /Supervision /BF]

Parameter	Description	Setting range	Default	Menu path
Trigger3 	Trigger that will start the BF	Trigger	-.-	[Protection Para /Global Prot Para /Supervision /BF]

Direct Commands of the BF

Parameter	Description	Setting range	Default	Menu path
Res Lockout 	Reset Lockout	Inactive, Active	Inactive	[Operation /Reset]

Setting Group Parameters of the BF

NOTICE

In order to prevent a faulty activation of the BF Module, the pickup (alarm) time must be greater than the sum of:

- Operating time of the protective relay
- +The close-open time of the breaker (please refer to the technical data of the manufacturer of the breaker);
- +Drop off time (current- or position indicators)
- +Security margin.

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para <1..4> /Supervision /BF]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para <1..4> /Supervision /BF]
I-BF > 	Breaker Failure Alarm will be initiated if this threshold is still exceeded after the timer has expired (50 BF). Only available if: Scheme50BF = Or Scheme = 50BF and CB Pos	0.02 - 4.00In	0.02In	[Protection Para <1..4> /Supervision /BF]
t-BF 	If the delay time is expired, an BF alarm is given out.	0.00 - 10.00s	0.20s	[Protection Para <1..4> /Supervision /BF]

BF Input States

Name	Description	Assignment via
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Supervision /BF]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Supervision /BF]
Trigger1-I	Module Input: Trigger that will start the BF	[Protection Para /Global Prot Para /Supervision /BF]
Trigger2-I	Module Input: Trigger that will start the BF	[Protection Para /Global Prot Para /Supervision /BF]
Trigger3-I	Module Input: Trigger that will start the BF	[Protection Para /Global Prot Para /Supervision /BF]

BF Signals (Output States)

Signal	Description
Active	Signal: Active
ExBlo	Signal: External Blocking
Waiting for Trigger	Waiting for Trigger
Pickup	Signal: BF-Module Started (Pickup)
Trip	Signal: Breaker Failure Trip
Lockout	Signal: Lockout
Res Lockout	Signal: Reset Lockout

Trigger signals of the Breaker Failure

*These trips will start the **BF** module if »All trips« have been selected as the trigger event.*

Name	Description
-.-	No assignment
50P[1].TripCmd	Signal: Trip Command
50P[2].TripCmd	Signal: Trip Command
50P[3].TripCmd	Signal: Trip Command
51P[1].TripCmd	Signal: Trip Command
51P[2].TripCmd	Signal: Trip Command
51P[3].TripCmd	Signal: Trip Command
50X[1].TripCmd	Signal: Trip Command
50X[2].TripCmd	Signal: Trip Command
51X[1].TripCmd	Signal: Trip Command
51X[2].TripCmd	Signal: Trip Command
50R[1].TripCmd	Signal: Trip Command
50R[2].TripCmd	Signal: Trip Command
51R[1].TripCmd	Signal: Trip Command
51R[2].TripCmd	Signal: Trip Command
87.TripCmd	Signal: Trip Command
87H.TripCmd	Signal: Trip Command
87GD.TripCmd	Signal: Trip Command
87GDH.TripCmd	Signal: Trip Command
49.TripCmd	Signal: Trip Command
27M[1].TripCmd	Signal: Trip Command
27M[2].TripCmd	Signal: Trip Command
59M[1].TripCmd	Signal: Trip Command
59M[2].TripCmd	Signal: Trip Command
27A[1].TripCmd	Signal: Trip Command
27A[2].TripCmd	Signal: Trip Command
59A[1].TripCmd	Signal: Trip Command
59A[2].TripCmd	Signal: Trip Command
59N[1].TripCmd	Signal: Trip Command
59N[2].TripCmd	Signal: Trip Command
LVRT [1].TripCmd	Signal: Trip Command
LVRT [2].TripCmd	Signal: Trip Command
46[1].TripCmd	Signal: Trip Command
46[2].TripCmd	Signal: Trip Command

<i>Name</i>	<i>Description</i>
46G[1].TripCmd	Signal: Trip Command
46G[2].TripCmd	Signal: Trip Command
47[1].TripCmd	Signal: Trip Command
47[2].TripCmd	Signal: Trip Command
81[1].TripCmd	Signal: Trip Command
81[2].TripCmd	Signal: Trip Command
81[3].TripCmd	Signal: Trip Command
81[4].TripCmd	Signal: Trip Command
81[5].TripCmd	Signal: Trip Command
81[6].TripCmd	Signal: Trip Command
32[1].TripCmd	Signal: Trip Command
32[2].TripCmd	Signal: Trip Command
32[3].TripCmd	Signal: Trip Command
32V[1].TripCmd	Signal: Trip Command
32V[2].TripCmd	Signal: Trip Command
32V[3].TripCmd	Signal: Trip Command
PF-55D[1].TripCmd	Signal: Trip Command
PF-55D[2].TripCmd	Signal: Trip Command
PF-55A[1].TripCmd	Signal: Trip Command
PF-55A[2].TripCmd	Signal: Trip Command
Q->&V<.Decoupling PCC	Signal: Decoupling at the Point of Common Coupling
Q->&V<.Decoupling Distributed Generator	Signal: Decoupling of the (local) Energy Generator/Resource
ZI.TripCmd	Signal: Zone Interlocking Trip Command
40-Z1[1].TripCmd	Signal: Trip Command
40-Z2[1].TripCmd	Signal: Trip Command
40-Z1[2].TripCmd	Signal: Trip Command
40-Z2[2].TripCmd	Signal: Trip Command
24[1].TripCmd	Signal: Trip Command
24[2].TripCmd	Signal: Trip Command
50/27.TripCmd	Signal: Trip Command
ExP[1].TripCmd	Signal: Trip Command
ExP[2].TripCmd	Signal: Trip Command
ExP[3].TripCmd	Signal: Trip Command
ExP[4].TripCmd	Signal: Trip Command
RTD.TripCmd	Signal: Trip Command
DI-8P X1.DI 1	Signal: Digital Input

<i>Name</i>	<i>Description</i>
DI-8P X1.DI 2	Signal: Digital Input
DI-8P X1.DI 3	Signal: Digital Input
DI-8P X1.DI 4	Signal: Digital Input
DI-8P X1.DI 5	Signal: Digital Input
DI-8P X1.DI 6	Signal: Digital Input
DI-8P X1.DI 7	Signal: Digital Input
DI-8P X1.DI 8	Signal: Digital Input
DI-8 X5.DI 1	Signal: Digital Input
DI-8 X5.DI 2	Signal: Digital Input
DI-8 X5.DI 3	Signal: Digital Input
DI-8 X5.DI 4	Signal: Digital Input
DI-8 X5.DI 5	Signal: Digital Input
DI-8 X5.DI 6	Signal: Digital Input
DI-8 X5.DI 7	Signal: Digital Input
DI-8 X5.DI 8	Signal: Digital Input
FldC[1].TripCmd	Signal: Trip Command
FldC[2].TripCmd	Signal: Trip Command
Pres[1].TripCmd	Signal: Trip Command
Pres[2].TripCmd	Signal: Trip Command
Tmp[1].TripCmd	Signal: Trip Command
Tmp[2].TripCmd	Signal: Trip Command
Vibr[1].TripCmd	Signal: Trip Command
Vibr[2].TripCmd	Signal: Trip Command
Fuel[1].TripCmd	Signal: Trip Command
Fuel[2].TripCmd	Signal: Trip Command
Spd[1].TripCmd	Signal: Trip Command
Spd[2].TripCmd	Signal: Trip Command
VBat[1].TripCmd	Signal: Trip Command
VBat[2].TripCmd	Signal: Trip Command
Ems[1].TripCmd	Signal: Trip Command
Ems[2].TripCmd	Signal: Trip Command
AnaP[1].TripCmd	Signal: Trip Command
AnaP[2].TripCmd	Signal: Trip Command
Logic.LE1.Gate Out	Signal: Output of the logic gate
Logic.LE1.Timer Out	Signal: Timer Output
Logic.LE1.Out	Signal: Latched Output (Q)
Logic.LE1.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE2.Gate Out	Signal: Output of the logic gate
Logic.LE2.Timer Out	Signal: Timer Output
Logic.LE2.Out	Signal: Latched Output (Q)
Logic.LE2.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE3.Gate Out	Signal: Output of the logic gate
Logic.LE3.Timer Out	Signal: Timer Output
Logic.LE3.Out	Signal: Latched Output (Q)
Logic.LE3.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE4.Gate Out	Signal: Output of the logic gate
Logic.LE4.Timer Out	Signal: Timer Output
Logic.LE4.Out	Signal: Latched Output (Q)
Logic.LE4.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE5.Gate Out	Signal: Output of the logic gate
Logic.LE5.Timer Out	Signal: Timer Output
Logic.LE5.Out	Signal: Latched Output (Q)
Logic.LE5.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE6.Gate Out	Signal: Output of the logic gate
Logic.LE6.Timer Out	Signal: Timer Output
Logic.LE6.Out	Signal: Latched Output (Q)
Logic.LE6.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE7.Gate Out	Signal: Output of the logic gate
Logic.LE7.Timer Out	Signal: Timer Output
Logic.LE7.Out	Signal: Latched Output (Q)
Logic.LE7.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE8.Gate Out	Signal: Output of the logic gate
Logic.LE8.Timer Out	Signal: Timer Output
Logic.LE8.Out	Signal: Latched Output (Q)
Logic.LE8.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE9.Gate Out	Signal: Output of the logic gate
Logic.LE9.Timer Out	Signal: Timer Output
Logic.LE9.Out	Signal: Latched Output (Q)
Logic.LE9.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE10.Gate Out	Signal: Output of the logic gate
Logic.LE10.Timer Out	Signal: Timer Output
Logic.LE10.Out	Signal: Latched Output (Q)
Logic.LE10.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE11.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE11.Timer Out	Signal: Timer Output
Logic.LE11.Out	Signal: Latched Output (Q)
Logic.LE11.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE12.Gate Out	Signal: Output of the logic gate
Logic.LE12.Timer Out	Signal: Timer Output
Logic.LE12.Out	Signal: Latched Output (Q)
Logic.LE12.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE13.Gate Out	Signal: Output of the logic gate
Logic.LE13.Timer Out	Signal: Timer Output
Logic.LE13.Out	Signal: Latched Output (Q)
Logic.LE13.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE14.Gate Out	Signal: Output of the logic gate
Logic.LE14.Timer Out	Signal: Timer Output
Logic.LE14.Out	Signal: Latched Output (Q)
Logic.LE14.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE15.Gate Out	Signal: Output of the logic gate
Logic.LE15.Timer Out	Signal: Timer Output
Logic.LE15.Out	Signal: Latched Output (Q)
Logic.LE15.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE16.Gate Out	Signal: Output of the logic gate
Logic.LE16.Timer Out	Signal: Timer Output
Logic.LE16.Out	Signal: Latched Output (Q)
Logic.LE16.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE17.Gate Out	Signal: Output of the logic gate
Logic.LE17.Timer Out	Signal: Timer Output
Logic.LE17.Out	Signal: Latched Output (Q)
Logic.LE17.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE18.Gate Out	Signal: Output of the logic gate
Logic.LE18.Timer Out	Signal: Timer Output
Logic.LE18.Out	Signal: Latched Output (Q)
Logic.LE18.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE19.Gate Out	Signal: Output of the logic gate
Logic.LE19.Timer Out	Signal: Timer Output
Logic.LE19.Out	Signal: Latched Output (Q)
Logic.LE19.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE20.Gate Out	Signal: Output of the logic gate
Logic.LE20.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE20.Out	Signal: Latched Output (Q)
Logic.LE20.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE21.Gate Out	Signal: Output of the logic gate
Logic.LE21.Timer Out	Signal: Timer Output
Logic.LE21.Out	Signal: Latched Output (Q)
Logic.LE21.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE22.Gate Out	Signal: Output of the logic gate
Logic.LE22.Timer Out	Signal: Timer Output
Logic.LE22.Out	Signal: Latched Output (Q)
Logic.LE22.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE23.Gate Out	Signal: Output of the logic gate
Logic.LE23.Timer Out	Signal: Timer Output
Logic.LE23.Out	Signal: Latched Output (Q)
Logic.LE23.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE24.Gate Out	Signal: Output of the logic gate
Logic.LE24.Timer Out	Signal: Timer Output
Logic.LE24.Out	Signal: Latched Output (Q)
Logic.LE24.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE25.Gate Out	Signal: Output of the logic gate
Logic.LE25.Timer Out	Signal: Timer Output
Logic.LE25.Out	Signal: Latched Output (Q)
Logic.LE25.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE26.Gate Out	Signal: Output of the logic gate
Logic.LE26.Timer Out	Signal: Timer Output
Logic.LE26.Out	Signal: Latched Output (Q)
Logic.LE26.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE27.Gate Out	Signal: Output of the logic gate
Logic.LE27.Timer Out	Signal: Timer Output
Logic.LE27.Out	Signal: Latched Output (Q)
Logic.LE27.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE28.Gate Out	Signal: Output of the logic gate
Logic.LE28.Timer Out	Signal: Timer Output
Logic.LE28.Out	Signal: Latched Output (Q)
Logic.LE28.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE29.Gate Out	Signal: Output of the logic gate
Logic.LE29.Timer Out	Signal: Timer Output
Logic.LE29.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE29.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE30.Gate Out	Signal: Output of the logic gate
Logic.LE30.Timer Out	Signal: Timer Output
Logic.LE30.Out	Signal: Latched Output (Q)
Logic.LE30.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE31.Gate Out	Signal: Output of the logic gate
Logic.LE31.Timer Out	Signal: Timer Output
Logic.LE31.Out	Signal: Latched Output (Q)
Logic.LE31.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE32.Gate Out	Signal: Output of the logic gate
Logic.LE32.Timer Out	Signal: Timer Output
Logic.LE32.Out	Signal: Latched Output (Q)
Logic.LE32.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE33.Gate Out	Signal: Output of the logic gate
Logic.LE33.Timer Out	Signal: Timer Output
Logic.LE33.Out	Signal: Latched Output (Q)
Logic.LE33.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE34.Gate Out	Signal: Output of the logic gate
Logic.LE34.Timer Out	Signal: Timer Output
Logic.LE34.Out	Signal: Latched Output (Q)
Logic.LE34.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE35.Gate Out	Signal: Output of the logic gate
Logic.LE35.Timer Out	Signal: Timer Output
Logic.LE35.Out	Signal: Latched Output (Q)
Logic.LE35.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE36.Gate Out	Signal: Output of the logic gate
Logic.LE36.Timer Out	Signal: Timer Output
Logic.LE36.Out	Signal: Latched Output (Q)
Logic.LE36.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE37.Gate Out	Signal: Output of the logic gate
Logic.LE37.Timer Out	Signal: Timer Output
Logic.LE37.Out	Signal: Latched Output (Q)
Logic.LE37.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE38.Gate Out	Signal: Output of the logic gate
Logic.LE38.Timer Out	Signal: Timer Output
Logic.LE38.Out	Signal: Latched Output (Q)
Logic.LE38.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE39.Gate Out	Signal: Output of the logic gate
Logic.LE39.Timer Out	Signal: Timer Output
Logic.LE39.Out	Signal: Latched Output (Q)
Logic.LE39.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE40.Gate Out	Signal: Output of the logic gate
Logic.LE40.Timer Out	Signal: Timer Output
Logic.LE40.Out	Signal: Latched Output (Q)
Logic.LE40.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE41.Gate Out	Signal: Output of the logic gate
Logic.LE41.Timer Out	Signal: Timer Output
Logic.LE41.Out	Signal: Latched Output (Q)
Logic.LE41.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE42.Gate Out	Signal: Output of the logic gate
Logic.LE42.Timer Out	Signal: Timer Output
Logic.LE42.Out	Signal: Latched Output (Q)
Logic.LE42.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE43.Gate Out	Signal: Output of the logic gate
Logic.LE43.Timer Out	Signal: Timer Output
Logic.LE43.Out	Signal: Latched Output (Q)
Logic.LE43.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE44.Gate Out	Signal: Output of the logic gate
Logic.LE44.Timer Out	Signal: Timer Output
Logic.LE44.Out	Signal: Latched Output (Q)
Logic.LE44.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE45.Gate Out	Signal: Output of the logic gate
Logic.LE45.Timer Out	Signal: Timer Output
Logic.LE45.Out	Signal: Latched Output (Q)
Logic.LE45.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE46.Gate Out	Signal: Output of the logic gate
Logic.LE46.Timer Out	Signal: Timer Output
Logic.LE46.Out	Signal: Latched Output (Q)
Logic.LE46.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE47.Gate Out	Signal: Output of the logic gate
Logic.LE47.Timer Out	Signal: Timer Output
Logic.LE47.Out	Signal: Latched Output (Q)
Logic.LE47.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE48.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE48.Timer Out	Signal: Timer Output
Logic.LE48.Out	Signal: Latched Output (Q)
Logic.LE48.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE49.Gate Out	Signal: Output of the logic gate
Logic.LE49.Timer Out	Signal: Timer Output
Logic.LE49.Out	Signal: Latched Output (Q)
Logic.LE49.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE50.Gate Out	Signal: Output of the logic gate
Logic.LE50.Timer Out	Signal: Timer Output
Logic.LE50.Out	Signal: Latched Output (Q)
Logic.LE50.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE51.Gate Out	Signal: Output of the logic gate
Logic.LE51.Timer Out	Signal: Timer Output
Logic.LE51.Out	Signal: Latched Output (Q)
Logic.LE51.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE52.Gate Out	Signal: Output of the logic gate
Logic.LE52.Timer Out	Signal: Timer Output
Logic.LE52.Out	Signal: Latched Output (Q)
Logic.LE52.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE53.Gate Out	Signal: Output of the logic gate
Logic.LE53.Timer Out	Signal: Timer Output
Logic.LE53.Out	Signal: Latched Output (Q)
Logic.LE53.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE54.Gate Out	Signal: Output of the logic gate
Logic.LE54.Timer Out	Signal: Timer Output
Logic.LE54.Out	Signal: Latched Output (Q)
Logic.LE54.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE55.Gate Out	Signal: Output of the logic gate
Logic.LE55.Timer Out	Signal: Timer Output
Logic.LE55.Out	Signal: Latched Output (Q)
Logic.LE55.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE56.Gate Out	Signal: Output of the logic gate
Logic.LE56.Timer Out	Signal: Timer Output
Logic.LE56.Out	Signal: Latched Output (Q)
Logic.LE56.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE57.Gate Out	Signal: Output of the logic gate
Logic.LE57.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE57.Out	Signal: Latched Output (Q)
Logic.LE57.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE58.Gate Out	Signal: Output of the logic gate
Logic.LE58.Timer Out	Signal: Timer Output
Logic.LE58.Out	Signal: Latched Output (Q)
Logic.LE58.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE59.Gate Out	Signal: Output of the logic gate
Logic.LE59.Timer Out	Signal: Timer Output
Logic.LE59.Out	Signal: Latched Output (Q)
Logic.LE59.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE60.Gate Out	Signal: Output of the logic gate
Logic.LE60.Timer Out	Signal: Timer Output
Logic.LE60.Out	Signal: Latched Output (Q)
Logic.LE60.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE61.Gate Out	Signal: Output of the logic gate
Logic.LE61.Timer Out	Signal: Timer Output
Logic.LE61.Out	Signal: Latched Output (Q)
Logic.LE61.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE62.Gate Out	Signal: Output of the logic gate
Logic.LE62.Timer Out	Signal: Timer Output
Logic.LE62.Out	Signal: Latched Output (Q)
Logic.LE62.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE63.Gate Out	Signal: Output of the logic gate
Logic.LE63.Timer Out	Signal: Timer Output
Logic.LE63.Out	Signal: Latched Output (Q)
Logic.LE63.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE64.Gate Out	Signal: Output of the logic gate
Logic.LE64.Timer Out	Signal: Timer Output
Logic.LE64.Out	Signal: Latched Output (Q)
Logic.LE64.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE65.Gate Out	Signal: Output of the logic gate
Logic.LE65.Timer Out	Signal: Timer Output
Logic.LE65.Out	Signal: Latched Output (Q)
Logic.LE65.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE66.Gate Out	Signal: Output of the logic gate
Logic.LE66.Timer Out	Signal: Timer Output
Logic.LE66.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE66.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE67.Gate Out	Signal: Output of the logic gate
Logic.LE67.Timer Out	Signal: Timer Output
Logic.LE67.Out	Signal: Latched Output (Q)
Logic.LE67.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE68.Gate Out	Signal: Output of the logic gate
Logic.LE68.Timer Out	Signal: Timer Output
Logic.LE68.Out	Signal: Latched Output (Q)
Logic.LE68.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE69.Gate Out	Signal: Output of the logic gate
Logic.LE69.Timer Out	Signal: Timer Output
Logic.LE69.Out	Signal: Latched Output (Q)
Logic.LE69.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE70.Gate Out	Signal: Output of the logic gate
Logic.LE70.Timer Out	Signal: Timer Output
Logic.LE70.Out	Signal: Latched Output (Q)
Logic.LE70.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE71.Gate Out	Signal: Output of the logic gate
Logic.LE71.Timer Out	Signal: Timer Output
Logic.LE71.Out	Signal: Latched Output (Q)
Logic.LE71.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE72.Gate Out	Signal: Output of the logic gate
Logic.LE72.Timer Out	Signal: Timer Output
Logic.LE72.Out	Signal: Latched Output (Q)
Logic.LE72.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE73.Gate Out	Signal: Output of the logic gate
Logic.LE73.Timer Out	Signal: Timer Output
Logic.LE73.Out	Signal: Latched Output (Q)
Logic.LE73.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE74.Gate Out	Signal: Output of the logic gate
Logic.LE74.Timer Out	Signal: Timer Output
Logic.LE74.Out	Signal: Latched Output (Q)
Logic.LE74.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE75.Gate Out	Signal: Output of the logic gate
Logic.LE75.Timer Out	Signal: Timer Output
Logic.LE75.Out	Signal: Latched Output (Q)
Logic.LE75.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE76.Gate Out	Signal: Output of the logic gate
Logic.LE76.Timer Out	Signal: Timer Output
Logic.LE76.Out	Signal: Latched Output (Q)
Logic.LE76.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE77.Gate Out	Signal: Output of the logic gate
Logic.LE77.Timer Out	Signal: Timer Output
Logic.LE77.Out	Signal: Latched Output (Q)
Logic.LE77.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE78.Gate Out	Signal: Output of the logic gate
Logic.LE78.Timer Out	Signal: Timer Output
Logic.LE78.Out	Signal: Latched Output (Q)
Logic.LE78.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE79.Gate Out	Signal: Output of the logic gate
Logic.LE79.Timer Out	Signal: Timer Output
Logic.LE79.Out	Signal: Latched Output (Q)
Logic.LE79.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE80.Gate Out	Signal: Output of the logic gate
Logic.LE80.Timer Out	Signal: Timer Output
Logic.LE80.Out	Signal: Latched Output (Q)
Logic.LE80.Out inverted	Signal: Negated Latched Output (Q NOT)

These trips will start the BF module if »All current« functions have been selected as the trigger event.

Name	Description
-.-	No assignment
50P[1].TripCmd	Signal: Trip Command
50P[2].TripCmd	Signal: Trip Command
50P[3].TripCmd	Signal: Trip Command
51P[1].TripCmd	Signal: Trip Command
51P[2].TripCmd	Signal: Trip Command
51P[3].TripCmd	Signal: Trip Command
50X[1].TripCmd	Signal: Trip Command
50X[2].TripCmd	Signal: Trip Command
51X[1].TripCmd	Signal: Trip Command
51X[2].TripCmd	Signal: Trip Command
50R[1].TripCmd	Signal: Trip Command
50R[2].TripCmd	Signal: Trip Command
51R[1].TripCmd	Signal: Trip Command
51R[2].TripCmd	Signal: Trip Command
87.TripCmd	Signal: Trip Command
87H.TripCmd	Signal: Trip Command
87GD.TripCmd	Signal: Trip Command
87GDH.TripCmd	Signal: Trip Command
49.TripCmd	Signal: Trip Command
46[1].TripCmd	Signal: Trip Command
46[2].TripCmd	Signal: Trip Command
46G[1].TripCmd	Signal: Trip Command
46G[2].TripCmd	Signal: Trip Command
ZI.TripCmd	Signal: Zone Interlocking Trip Command
50/27.TripCmd	Signal: Trip Command

These trips will start the BF module if »External trips« have been selected as the trigger event.

Name	Description
-.-	No assignment
ExP[1].TripCmd	Signal: Trip Command
ExP[2].TripCmd	Signal: Trip Command
ExP[3].TripCmd	Signal: Trip Command
ExP[4].TripCmd	Signal: Trip Command

Commissioning Example: Supervision Scheme 50BF

Object to Be Tested:

Test of the Breaker Failure protection (Supervision Scheme 50BF).

Necessary Means:

- Current source;
- Ammeter; and
- Timer.

NOTICE

When testing, the applied test current must always be higher than the tripping threshold »I-BF«. If the test current falls below the threshold while the breaker is in the “Off” position, no pickup will be generated.

Procedure (Single-Phase):

For testing the tripping time of the BF protection, a test current has to be higher than the threshold value of one of the current protection modules that are assigned to trigger the BF protection. The BF trip delay can be measured from the time when one of the triggering inputs becomes active to the time when the BF protection trip is asserted.

To avoid wiring errors, checked to make sure the breaker in the upstream system switches off.

The time, measured by the timer, should be in line with the specified tolerances.

Successful Test Result:

The actual times measured comply with the setpoint times. The breaker in the higher-level section switches off.



WARNING

Re-connect the control cable to the breaker!

CTS - Current Transformer Supervision

CTS

Most functions of metering, protection, and control in the relay rely on correct current measurements. It is important to make sure the CT connections and their operations are correct. The failures (including CT secondary wire broken, insulation broken down, broken wiring between CT and relay, and mismatched polarities) will cause the incorrect current measurements. The other CT errors (due to the magnetizing current that is proportional to the primary current, CT saturation, and measuring circuit and quantization error) can also cause inaccurate current measurements.

The CTS utilizes the Kirchhoff's current law to detect a CT failure and can differentiate the wiring errors from the measurement errors by adding biases to offset the measurement related errors. The biases include two terms, one of which is related to the static error that accounts for CT magnetizing characteristic differences and current measurement circuit calibration errors and other is the dynamic error that is proportional to the measured maximum current due to CT transformation characteristics. The CTs are assumed to be used in the wye-grounded winding sides. Under normal conditions, the mismatch between the calculated and the measured zero sequence current should be less than the bias value. However, if there is a CT wiring error, such relationship will not hold true. If the mismatch exceeds the bias for a specified time, an pickup (alarm) will be generated.

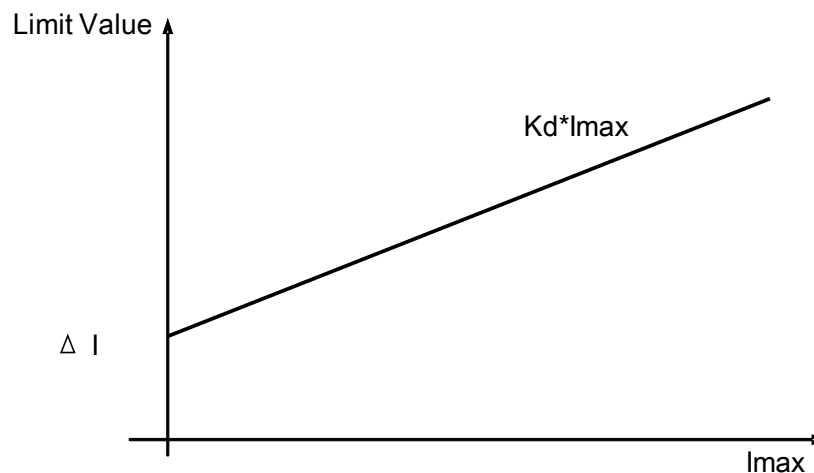
The operating principle can be expressed in terms of CT secondary currents as follow:

$$(\vec{I_L1} + \vec{I_L2} + \vec{I_L3}) + KI \cdot \vec{I_G} = 3 \cdot I_0 + KI \cdot \vec{I_G} \geq \Delta I + Kd \cdot I_{max}$$

KI is the ratio of the ground CT ratio over the phase CT ratio, and it is automatically calculated from the rated system parameters.

- ΔI = The static error, a minimum mismatch allowed between the calculated and measured zero sequence current.
- Kd = The dynamic error factor, a restrain slope that defines a percentage error generated by a high current.
- I_{max} = maximum phase current.
- Total bias value = $\Delta I + Kd \times I_{max}$.

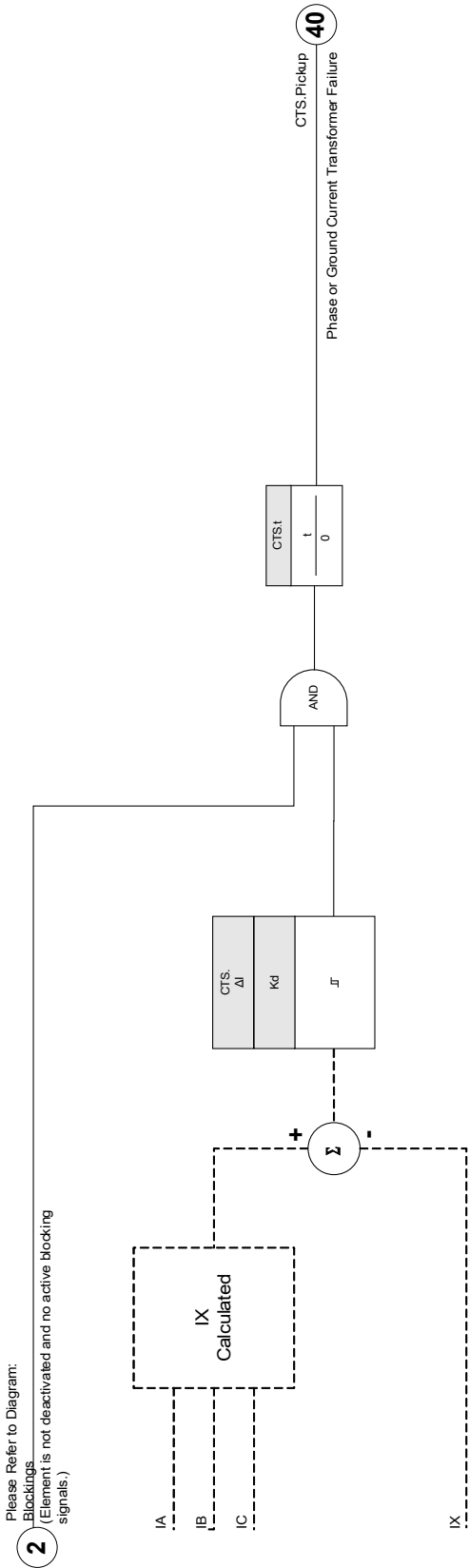
The current transformer supervision operation can be graphically represented as follows.



CAUTION

If the current is measured in two phases only (for example only IA/IB) or if there is no separate ground current measuring (e.g.: normally via a zero sequence CT), the supervision function should be deactivated.

CTS



Device Planning Parameters of the Current Transformer Supervision

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Do not use	[Device Planning]

Global Protection Parameter of the Current Transformer Supervision

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Supervision /CTS]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Supervision /CTS]

Setting Group Parameters of the Current Transformer Supervision

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Supervision /CTS]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Supervision /CTS]
ΔI 	In order to prevent faulty tripping of phase selective protection functions that use the current as tripping criterion. If the difference of the measured ground current and the calculated value I_0 is higher than the pick up value ΔI , an pickup event is generated after expiring of the excitation time. In such a case, a fuse failure, a broken wire or a faulty measuring circuit can be assumed.	0.10 - 1.00In	0.50In	[Protection Para /<1..4> /Supervision /CTS]
Pickup delay 	Pickup delay	0.1 - 9999.0s	1.0s	[Protection Para /<1..4> /Supervision /CTS]
Kd 	Dynamic correction factor for the evaluation of the difference between calculated and measured ground current. This correction factor allows transformer faults, caused by higher currents, to be compensated.	0.00 - 0.99	0.00	[Protection Para /<1..4> /Supervision /CTS]

Current Transformer Supervision Input States

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Supervision /CTS]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Supervision /CTS]

Current Transformer Supervision Signals (Outputs States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Pickup	Signal: Pickup Current Transformer Measuring Circuit Supervision

Commissioning: Current Transformer Failure Supervision

NOTICE

Preconditions:

- 1.Measurement of all three-phase currents (are applied to the measuring inputs of the device).
- 2.The ground current is detected via a zero sequence transformer (not in residual connection).

Object to Be Tested:

Check of the CT Supervision (by comparing the calculated with the measured ground current).

Necessary Means:

Three-phase current source.

Procedure, Part 1:

- Set the limiting value of the CTs to » $\Delta I = 0.1 \cdot I_n$ «.
- Feed a three-phase, symmetrical current system (approx. nominal current) to the secondary side.
- Disconnect the current of one phase from one of the measuring inputs (the symmetrical feeding at the secondary side has to be maintained).
- Make sure that the »CTS.PICKUP« signal is generated.

Successful Test Result, Part 1:

The »CTS.PICKUP« signal is generated.

Procedure, Part 2:

- Feed a three-phase, symmetrical current system (approx. nominal current) to the secondary side.
- Feed a current that is higher than the threshold value for the measuring circuit supervision to the ground current measuring input.
- Make sure that the »CTS.PICKUP« signal is generated.

Successful Test Result, Part 2:

The »CTS.PICKUP« signal is generated.

LOP - Loss of Potential

Available elements:

LOP

NOTICE

Ensure that the LOP has enough time to block faulty tripping of modules that use LOP. That means, the delay time of the LOP should be shorter than the tripping delay of modules that use LOP.

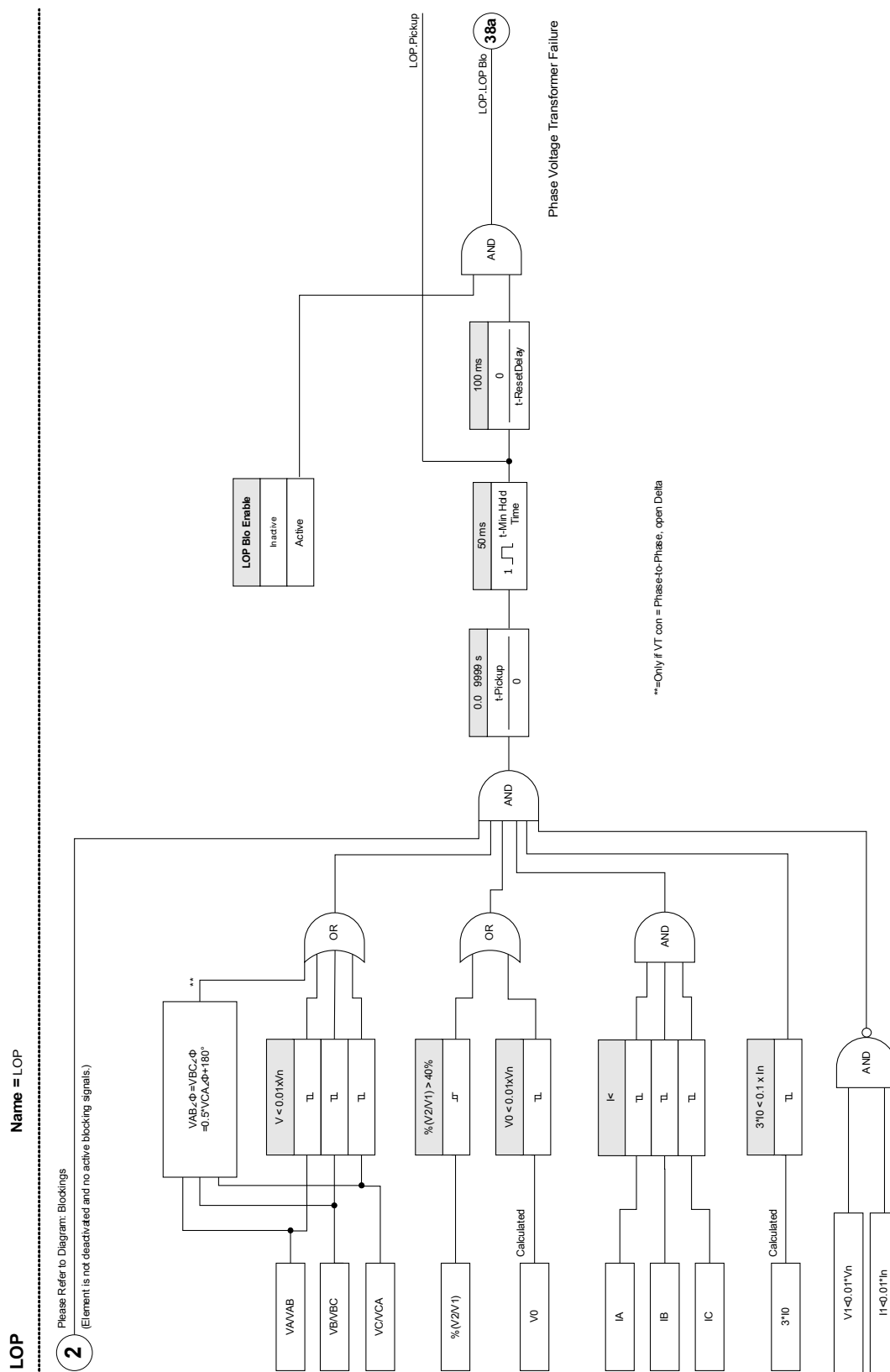
NOTICE

In case of transformer protection relays the LOP element uses current and voltage measured at the winding side determined by paramter:
[System Para / VT / VT Winding Side].

LOP function detects the loss of voltage in any of the voltage input measuring circuits and uses the following measured values and information to detect an LOP condition:

- Three-phase voltages;
- Ratio of negative-to-positive sequence voltages;
- Zero sequence voltage;
- Three-phase currents;
- Residual current (I0);

Once an LOP condition is detected and it lasts longer than an adjustable minimum pickup time, the LOP Pickup will be set. The LOP Block will only be set if the LOP-Block control setting is set to enabled (activated). The LOP Pickup and LOP Block signals can both be used as logical signal to block the protective functions which use the voltage information such as voltage restraint. The minimum pickup timer is used to prevent short time incorrect operation of the LOP function during breaker switching-on operation.



Device Planning Parameters of the LOP Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the LOP Module

Parameter	Description	Setting range	Default	Menu path
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Supervision /LOP]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Supervision /LOP]

Setting Group Parameters of the LOP Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Supervision /LOP]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Supervision /LOP]
LOP Blo Enable 	Activate (allow) or inactivate (disallow) blocking by the module LOP.	Inactive, Active	Inactive	[Protection Para /<1..4> /Supervision /LOP]
I< 	To prevent unintended operation during faults, the overcurrent threshold should be used to distinguish between load current and overcurrent. If the current detector identifies load current as overcurrent (threshold too low), a LOP situation will not be detected and if the threshold is too high, a fault situation will be identified as LOP which results in blocking of protection functions.	0.5 - 4.0In	2.0In	[Protection Para /<1..4> /Supervision /LOP]
t-Pickup 	Pickup Delay	0 - 9999.0s	0.1s	[Protection Para /<1..4> /Supervision /LOP]

LOP Module Input States

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Supervision /LOP]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Supervision /LOP]

LOP Module Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Pickup	Signal: Pickup Loss of Potential
LOP Blo	Signal: Loss of Potential blocks other elements

Commissioning: Loss of Potential

Object to be tested:

Testing the LOP.

Necessary means:

- Three-phase current source and
- Three-phase voltage source.

Procedure part 1:

Examine if the output signals »LOP B_{LO}« (200ms delay) and »LOP« only become true if:

- Any of the three-phase voltages becomes less $0.01 \cdot V_n$ Volt
- and
- The residual voltage is less than $0.01 \cdot V_n$ Volt or the $\%V_2/V_1$ ratio is greater 40%
- and
- All three-phase currents are less than the load current / overcurrent detection ($I_{<}$) setting.
- and
- The residual current is less than 0.1 I_{pu} (rated current)
- and
- The offline detection has not detected a dead busbar (No current, no voltage measured).

Successful test result part 1:

The output signals only become true if all the above mentioned conditions are fulfilled.

Procedure part 2:

Assign the »LOP« or »LOP B_{LO}« output signals to all protection element that should be blocked by LOP (e.g.: Undervoltage Protection, Voltage Restraint...).

Test if those elements are blocked if the LOP modules issue a blocking signal.

Successful test result part 2:

All elements that should be blocked in case of LOP are blocked if the conditions (Procedure part 1) are fulfilled.

74TC - Trip Circuit Monitoring

TCM

The trip circuit monitoring is used for monitoring if the trip circuit is ready for opening operations. The monitoring can be fulfilled by two ways. The first assumes only 52a is used in the trip circuit. The second assumes that, in addition to 52a, 52b is also used for the circuit monitoring. Two options either 52a only (or breaker closed) or both (52a and 52b) are provided for the User to select based on use of the breaker status in the trip circuit. With 52a only in the trip circuit, the monitoring is only effective when the breaker is closed while if both 52a and 52b are used, the trip circuit will be monitored all time as long as the control power is on.

The trip circuit continuity is monitored through the digital inputs DI1 and DI2, and the breaker status 52a or 52b or both must be monitored through the other digital inputs. Note that the digital inputs used for this purpose must be configured properly based on the trip circuit control voltage and also that the de-bouncing times must be set to minimum. If the trip circuit is detected broken, an alarm will be issued with a specified delay, which must be greater than a period from the time when a trip contact is closed to the time when the breaker status is clearly recognized by the relay.

NOTICE

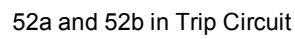
Slot 1 has two digital inputs, each of which has a separate root (contact separation) for the trip circuit supervision.

In this case, the trip circuit supply voltage serves also as supply voltage for the digital inputs and so the supply voltage failure of a trip circuit can be detected directly.

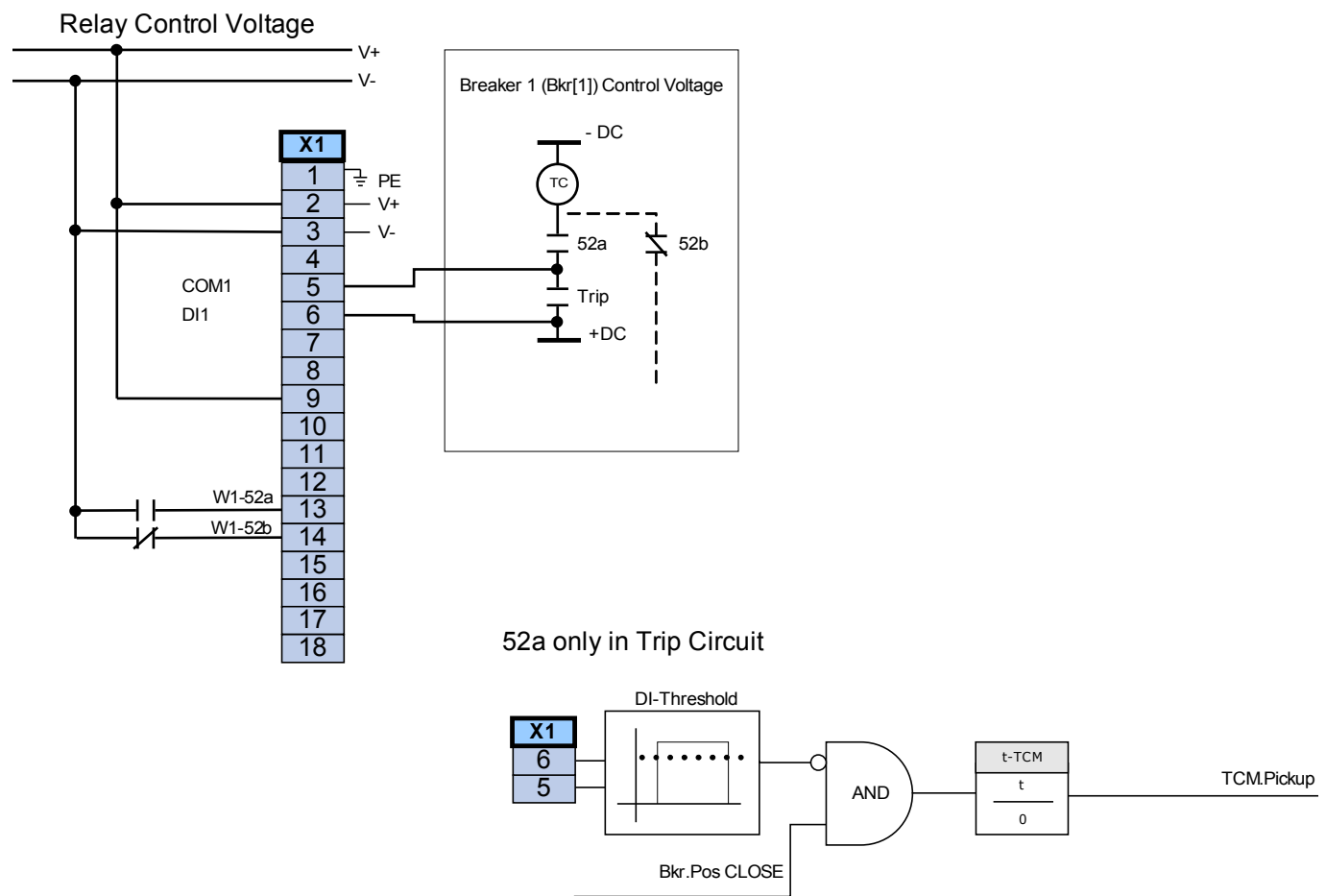
In order to identify a conductor failure in the trip circuit on the supply line or in the trip coil, the off-coil has to be looped-in to the supervision circuit.

The time delay is to be set in a way that switching actions cannot cause false trips in this module.

Trip Circuit Monitoring for one Breaker: Auxiliary Contacts (52a and 52b) in trip circuit.



Trip Circuit Monitoring for One Breaker: Auxiliary Contacts (52a Only) in Trip Circuit.



Device Planning Parameters of the Trip Circuit Monitoring Module

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameters of the Trip Circuit Monitoring Module

Parameter	Description	Setting range	Default	Menu path
Mode 	Select if trip circuit is going to be monitored when the breaker is closed or when the breaker is either open or close.	Closed, Either	Closed	[Protection Para /Global Prot Para /Supervision /TCM]
Input 1 	Select the input configured to monitor the trip coil when the breaker is closed.	1..n, Dig Inputs	DI-8P X1.DI 1	[Protection Para /Global Prot Para /Supervision /TCM]
Input 2 	Select the input configured to monitor the trip coil when the breaker is open. Only available if Mode set to "Either". Only available if: Mode = Either	1..n, Dig Inputs	.-	[Protection Para /Global Prot Para /Supervision /TCM]
ExBlo1 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Supervision /TCM]
ExBlo2 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	.-	[Protection Para /Global Prot Para /Supervision /TCM]

Setting Group Parameters of the Trip Circuit Monitoring Module

Parameter	Description	Setting range	Default	Menu path
Function 	Permanent activation or deactivation of module/element.	Inactive, Active	Inactive	[Protection Para /<1..4> /Supervision /TCM]
ExBlo Fc 	Activate (allow) or inactivate (disallow) blocking of the module/element. This parameter is only effective if a signal is assigned to the corresponding global protection parameter. If the signal becomes true, those modules/elements are blocked that are parameterized "ExBlo Fc=active".	Inactive, Active	Inactive	[Protection Para /<1..4> /Supervision /TCM]
t-TCM 	Tripping delay time of the Trip Circuit Supervision	0.10 - 10.00s	0.2s	[Protection Para /<1..4> /Supervision /TCM]

Trip Circuit Monitoring Module Input States

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
CinBkr-52a-I	Module Input State: Feed-back signal of the Bkr (52a)	[Protection Para /Global Prot Para /Supervision /TCM]
CinBkr-52b-I	Module Input State: Feed-back signal of the Bkr. (52b)	[Protection Para /Global Prot Para /Supervision /TCM]
ExBlo1-I	Module Input State: External Blocking1	[Protection Para /Global Prot Para /Supervision /TCM]
ExBlo2-I	Module Input State: External Blocking2	[Protection Para /Global Prot Para /Supervision /TCM]

Trip Circuit Monitoring Module Signals (Output States)

<i>Signal</i>	<i>Description</i>
Active	Signal: Active
ExBlo	Signal: External Blocking
Pickup	Signal: Pickup Trip Circuit Supervision
Not Possible	Not possible because no state indicator assigned to the breaker.

Commissioning: Trip Circuit Monitoring for Breakers

NOTICE

For breakers that trip by means of little energy (e.g.: via an optocoupler), it has to be ensured that the current applied by the digital inputs will not cause false tripping of the breaker.

Object to Be Tested:

Test of the trip circuit monitoring (with 52a and 52b contact).

Procedure, Part 1:

Simulate failure of the control voltage in the power circuits.

Successful Test Result, Part 1:

After expiration of »*t*-TCM« the trip circuit supervision, TCM of the device should signal a pickup.

Procedure, Part 2:

Simulate a broken cable in the breaker control circuit.

Successful Test Result, Part 2:

After expiration of »*t*-TCM«, the trip circuit supervision TCM of the device should signal a pickup.

Self Supervision

SSV

The protection devices are supervised by various check routines during normal operation and during the start-up phase on faulty operation.

The protection devices are carrying out various self supervision tests.

<i>Self Supervision within the devices</i>		
Supervision of...	Supervised by...	Action on detected issue...
Start phase	The duration (permitted time) of the boot phase is monitored.	The device will be rebooted. => The device will be taken out of service after three unsuccessful start attempts.
Supervision of the duration of a protection cycle (Software cycle)	The maximum permitted time for a protection cycle is monitored by a timing analysis.	The self-supervision contact will be deenergized if the permitted time for a protection cycle is exceeded (first threshold). The protection device will be rebooted, if the protection cycle exceeds the second threshold.
Monitoring of the communication between Main and Digital Signal Processor (DSP)	The cyclic measured value processing of the DSP is monitored by the main processor.	The device will be rebooted, if a failure is detected. The self-supervision contact will be deenergized.
Analog-Digital-Converter	The DSP does a plausibility check on the digitalized data.	Protection will be blocked, if a failure is detected, in order to prevent faulty tripping.
Supervision of data consistency after an outage of the power supply. (e.g. outage of the power supply while changing the parameter settings).	An internal logic detects fragmentary saved data after an outage of the power supply.	If the new data is incomplete or corrupt, it will be deleted during the reboot phase of the device. The device will continue to work with the last valid data set.
Data consistency in general	Generation of check-sums.	The device will be taken out of service in case that inconsistent data is detected that is not caused by an outage of the power supply. (fatal internal error).

<i>Self Supervision within the devices</i>		
Parameter Setting (Device)	Protecting the parameter setting by plausibility checks.	Implausibilities within the parameter configuration can be detected by means of plausibility checks. Detected implausibilities are highlighted by a question mark symbol. Please refer to chapter parameter setting for detailed information.
Quality of the power supply	A hardware circuit ensures that the device can only be used, if the power supply is in the range specified by the technical data.	If the supply voltage is too low, the device will not start up or it will be set out of service respectively.
Sags of the supply voltage	Short-term sags of the supply voltage are detected and can be bridged in most of the cases by means of the integrated buffer within the power supply hardware. This buffer also allows the termination of ongoing data writing procedures.	The module for the supervision of the system utilization will detect repetitive short-term sags of the supply voltage.
Internal data of the device (memory load, internal resources, ...)	An internal module monitors the system utilization.	The module for the supervision of the system utilization initiates in case of a fatal error a reboot of the device. In case of minor faults the system led will flash alternating red and green (please refer to the trouble shooting guide). The issue will be recorded within an integrated fault memory.
Status of the device communication (SCADA)	The projected and activated SCADA module supervises its connection to the master communication system.	You can check if there is active communication with the master system within menu <Operation/ Status display/ Communication>. In order to monitor this state you can assign this status onto an LED and/or an output relay. For details on the status of the GOOSE communication please refer to chapter IEC61850.

Device Start (Reboot)

The device starts up if:

- it is connected to the supply voltage,
- the User initiates (intentionally) a restart of the device,
- the device is set back to factory defaults,
- the internal self-supervision of the device detects a fatal error.

The reason for a device start/reboot is shown numerically within menu <Operation/ Status display/ Sys/ Restart> (please refer to the table below). The reason will also be logged within the event recorder (Event: Sys.Restart).

The table below explains the numbers indicating the reason of the restart.

<i>Device Start-up Codes</i>	
1.	Normal Start-up Start-up after clean disconnection of the supply voltage.
2.	Reboot by the Operator Device reboot triggered by the operator via HMI or Smart view.
3.	Reboot by means of Super Reset Automatic reboot when setting the device back to factory defaults.
4.	-- (outdated)
5.	-- (outdated)
6.	Unknown Error Source Reboot due to unknown error source.
7.	Forced Reboot (initiated by the main processor) The main processor identified invalid conditions or data.
8.	Exceeded Time Limit of the Protection Cycle Unexpected interruption of the Protection Cycle.
9.	Forced Reboot (initiated by the digital signal processor) The digital signal processor identified invalid conditions or data.
10.	Exceeded Time Limit of the Measured Value Processing Unexpected interruption of the cyclic measured value processing.
11.	Sags of the Supply Voltage Reboot after short-term sag or outage of the supply voltage.
12.	Illegal Memory Access Reboot after illegal memory access.

Device taken out of Service “Device Stopped“

The protection device will be taken out of service, if there is an undefined state that cannot be escaped after three reboots.

In this state the system LED will be illuminated red or red flashing. The display will show the message “Device Stopped“ followed by a 6-digit error code, e.g. E01487.

In addition to the recorders, messages and display information that can be accessed by the user, there may exist additional error information accessible by the Service Staff. These offer further failure analysis and diagnosis opportunities to the Service Staff.

NOTICE

In such a case please contact the Eaton Service Staff and provide them the error code.

For further information on trouble shooting please refer to the separately provided “Trouble Shooting Guide“.

Direct Commands of the Self Supervision

Parameter	Description	Setting range	Default	Menu path
Ack System LED 	Ack System LED (red/green flashing LED)	False, True	False	[Operation /Reset]

Signals (Output States) of the Self Supervision

Signal	Description
System Error	Signal: Device Failure
SelfSuperVision Contact	Signal: SelfSuperVision Contact

Values of the Self Supervision

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Last Failure	Last Failure	[Operation /Self Supervision /System Error]

Counter Values of the Self Supervision

<i>Value</i>	<i>Description</i>	<i>Menu path</i>
Resets by Device	Resets initiated by the device	[Operation /Self Supervision /System Error]
Cr No of free sockets	Counter for network diagnosis. Number of free sockets.	[Operation /Self Supervision /System State]

Programmable Logic

Available Elements (Equations):

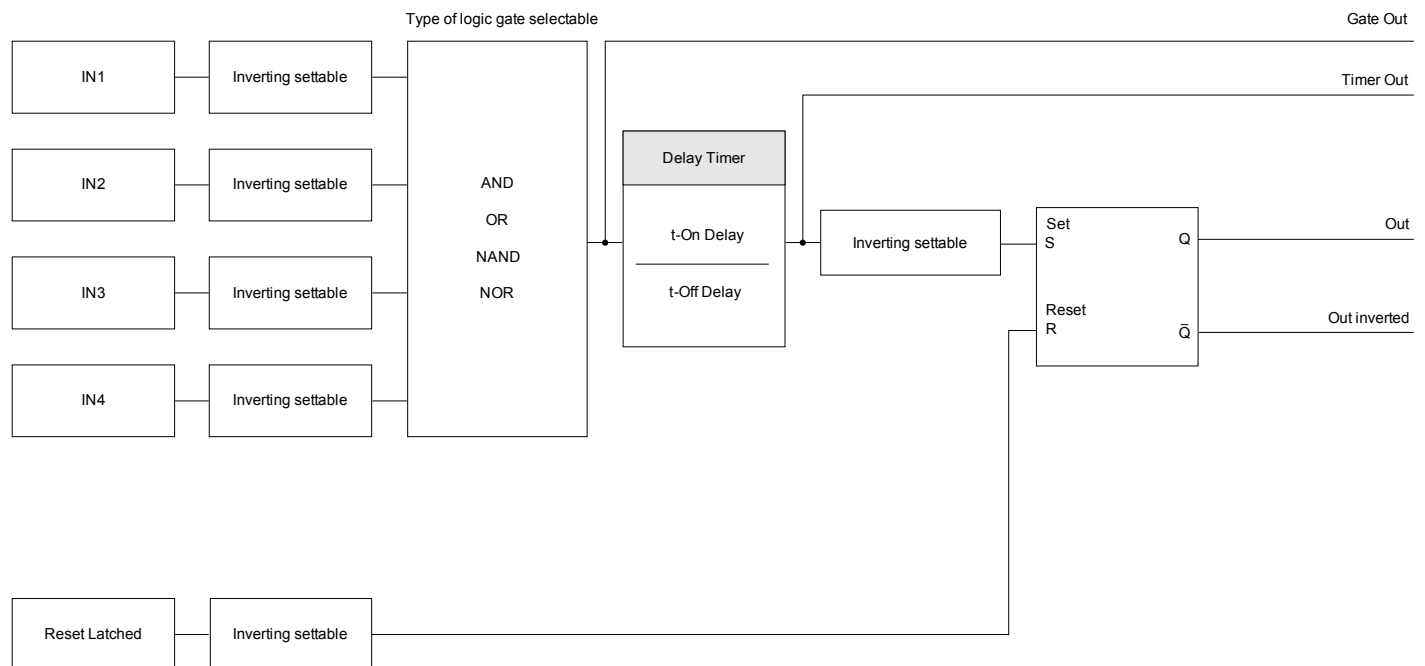
Logic

General Description

The protective device includes programmable logic equations for programming inputs, outputs, blocking of protective functions, and custom logic functions in the relay.

The logic provides control of the output relays based on the state of the inputs that can be chosen from the assignment list (protective function pickups, protective function states, breaker states, system alarms, and module inputs). The User can use the output signals of a logic equation as inputs in higher equations (e.g.: the output signal of logic equation 10 might be used as an input of logic equation 11).

Principle Overview.



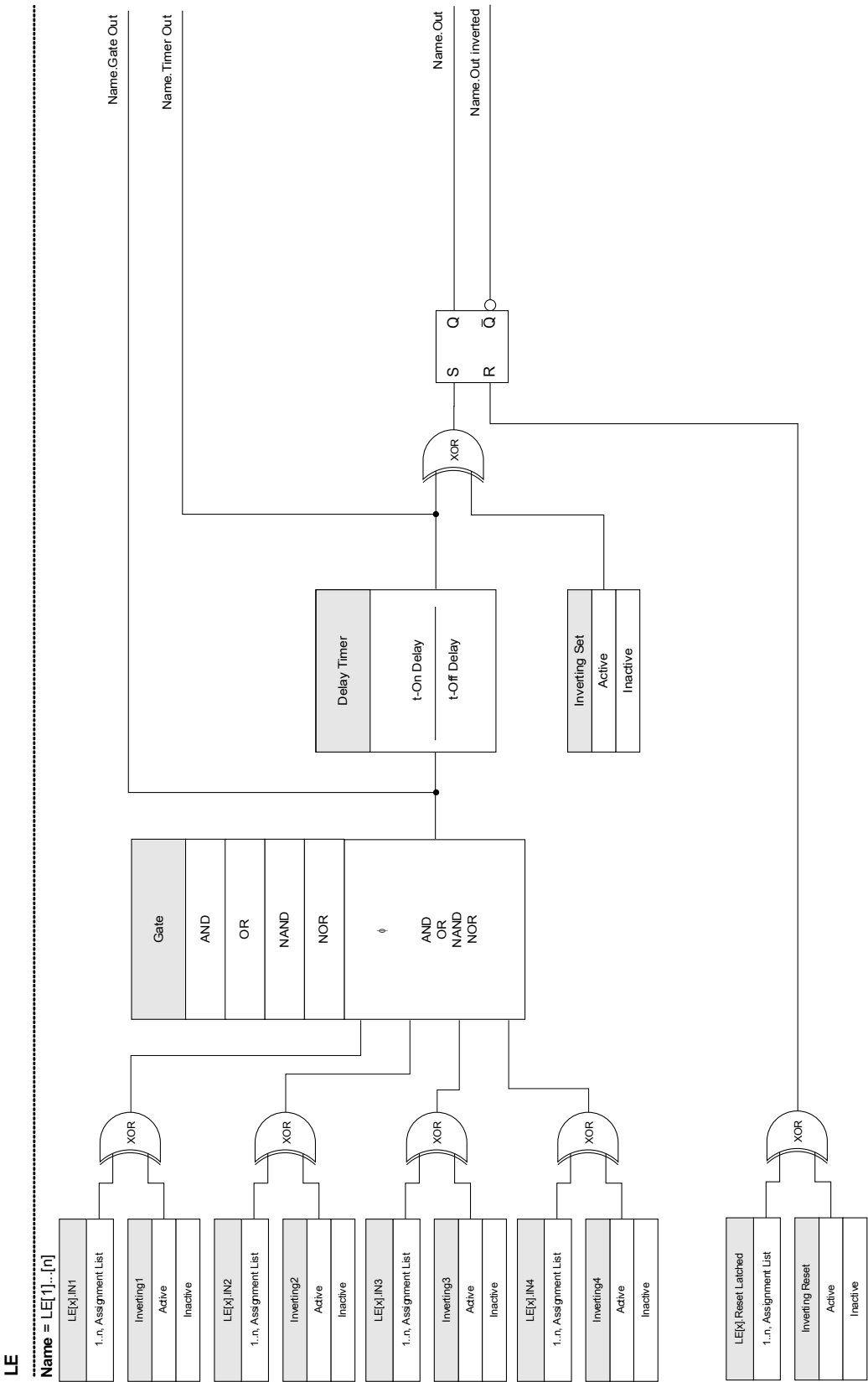
If no signal is assigned to a logic gate (All inputs are "0"), then the output of the gate will be set as follows:

- "0" for an AND gate
- "1" for a NAND gate
- "0" for an OR gate
- "1" for a NOR gate

If at least one input signal is assigned to a gate all not assigned inputs are set to:

- "1" for AND / NAND gates
- "0" for an OR / NOR gates

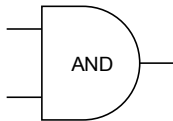
Detailed Overview – Overall Logic Diagram.



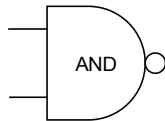
Available Gates (Operators)

Within the Logic Equation, the following Gates can be used.

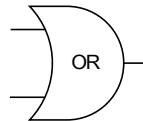
Gate



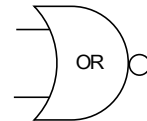
AND



NAND



OR



NOR

Input Signals

The User can assign up to four Input signals (from the assignment list) to the inputs of the gate.

As an option, each of the four input signals can be inverted (negated).

Timer Gate (On Delay and Off Delay)

The output of the gate can be delayed. The User has the option to set an On and an Off delay.

Latching

The timer issues two signals: an unlatched and a latched signal. The latched output can optionally be inverted.

In order to reset the latched signal, the User has to assign a reset signal from the assignment list. Optionally, the reset signal can also be inverted.

If no »Reset Latched« signal is assigned, then the »LATCH OUT« signal will be identical with the »TIMER OUT« signal.

Cascading Logical Outputs

The device will evaluate output states of the logic equations starting from “Logic Equation 1” up to the logic equation with the highest number. This evaluation cycle will be continuously repeated.

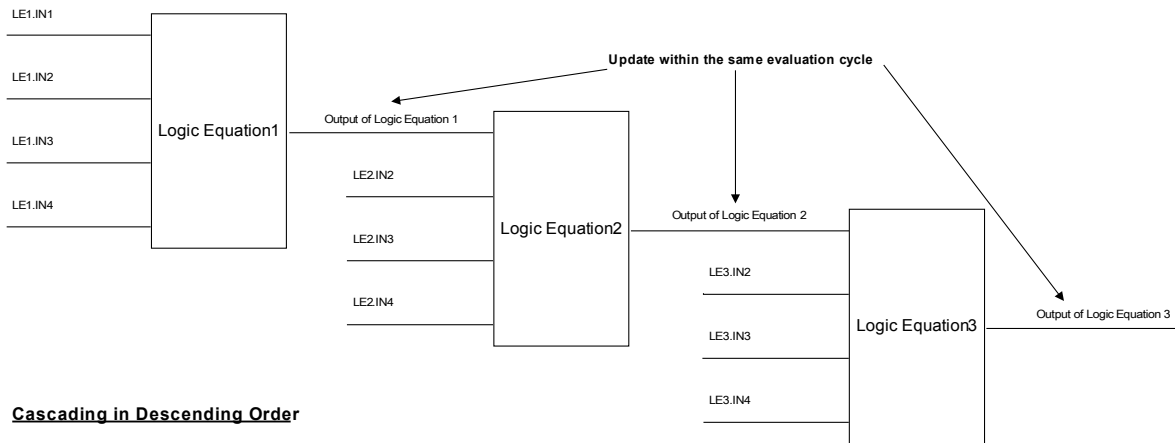
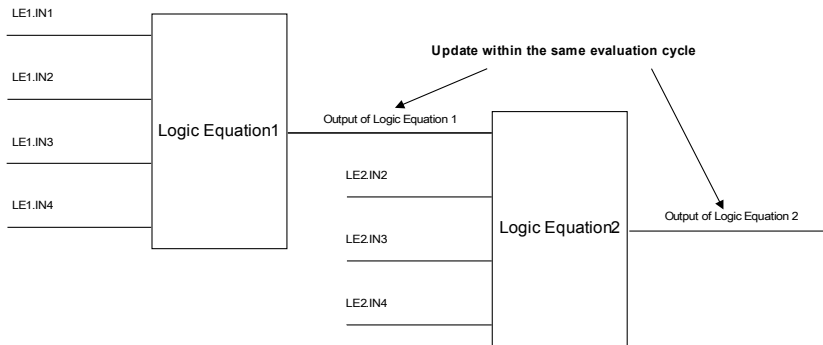
Cascading Logic Equations in an ascending sequence.

Cascading in an ascending sequence means that the User utilizes the output signal of “Logic Equation n ” as input of “Logic Equation $n+1$ ”. If the state of “Logic Equation n ” changes, the state of the output of “Logic Equation $n+1$ ” will be updated within the same cycle.

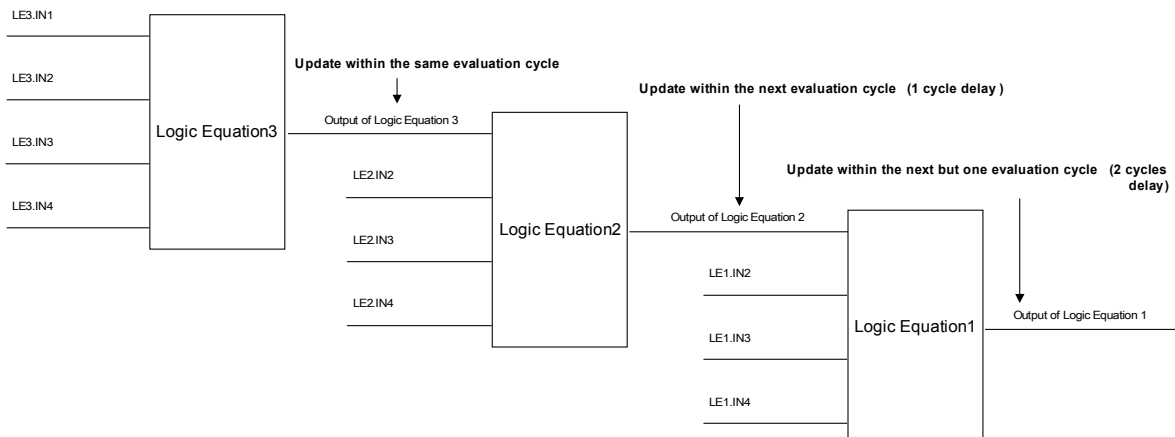
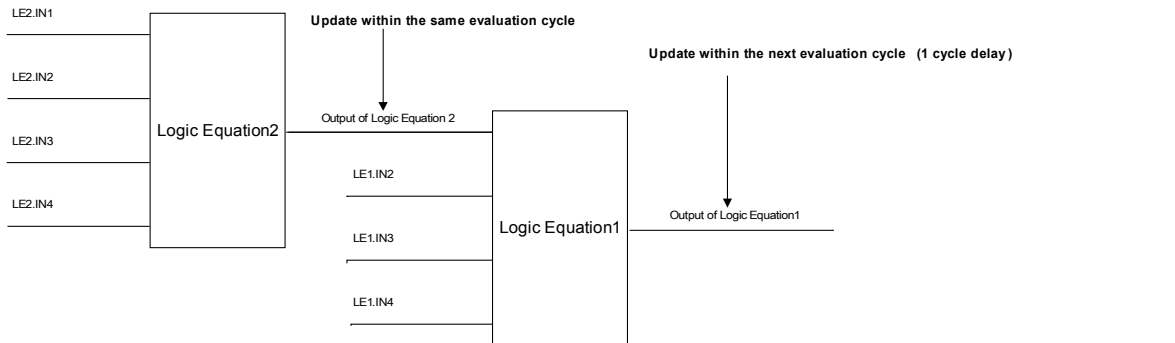
Cascading Logic Equations in a descending sequence.

Cascading in a descending sequence means that the User utilizes the output signal of “Logic Equation $n+1$ ” as input of “Logic Equation n ”. If the output of “Logic Equation $n+1$ ” changes, this change of the feed back signal at the input of “Logic Equation n ” will be delayed for one cycle.

Cascading in Ascending Order



Cascading in Descending Order



Programmable Logic at the Panel



WARNING improper use of logic equations might result in personal injury or damage the electrical equipment.

Do not use logic equations unless the User can ensure the safe functionality.

How to configure a logic equation?

- Within the Device Planning, set the number of required Logic Equations.
- Call up the [Logic] menu.
- Select a Logic Equation that is to be set.
- Set the Input Signals (where necessary, invert them).
- If required, configure the timer (»On delay« and »Off delay«).
- If the latched output signal is used, assign a reset signal to the reset input.
- Within the »status display«, the User can check the status of the logical inputs and outputs of the logic equation.

In case the logic equations should be cascaded, the User has to be aware of timing delays (cycles) in case of descending sequences (Please refer to the Cascading Logical Outputs section).

By means of the Status Display [Operation/Status Display], the logical states can be verified.

Device Planning Parameters of the Programmable Logic

Parameter	Description	Options	Default	Menu path
No of Equations: 	Number of required Logic Equations:	0, 5, 10, 20, 40, 80	20	[Device Planning]

Global Protection Parameter of the Programmable Logic

Parameter	Description	Setting range	Default	Menu path
LE1.Gate 	Logic gate	AND, OR, NAND, NOR	AND	[Logic /LE 1]
LE1.IN1 	Assignment of the Input Signal	1..n, Assignment List	-.-	[Logic /LE 1]
LE1.Inverting1 	Inverting the input signals. Only available if an input signal has been assigned.	Inactive, Active	Inactive	[Logic /LE 1]
LE1.IN2 	Assignment of the Input Signal	1..n, Assignment List	-.-	[Logic /LE 1]
LE1.Inverting2 	Inverting the input signals. Only available if an input signal has been assigned.	Inactive, Active	Inactive	[Logic /LE 1]
LE1.IN3 	Assignment of the Input Signal	1..n, Assignment List	-.-	[Logic /LE 1]

Parameter	Description	Setting range	Default	Menu path
LE1.Inverting3 	Inverting the input signals. Only available if an input signal has been assigned.	Inactive, Active	Inactive	[Logic /LE 1]
LE1.IN4 	Assignment of the Input Signal	1..n, Assignment List	.-	[Logic /LE 1]
LE1.Inverting4 	Inverting the input signals. Only available if an input signal has been assigned.	Inactive, Active	Inactive	[Logic /LE 1]
LE1.t-On Delay 	Switch On Delay	0.00 - 36000.00s	0.00s	[Logic /LE 1]
LE1.t-Off Delay 	Switch Off Delay	0.00 - 36000.00s	0.00s	[Logic /LE 1]
LE1.Reset Latched 	Reset Signal for the Latching	1..n, Assignment List	.-	[Logic /LE 1]
LE1.Inverting Reset 	Inverting Reset Signal for the Latching	Inactive, Active	Inactive	[Logic /LE 1]
LE1.Inverting Set 	Inverting the Setting Signal for the Latching	Inactive, Active	Inactive	[Logic /LE 1]

Programmable Logic Inputs

<i>Name</i>	<i>Description</i>	<i>Assignment via</i>
LE1.Gate In1-I	State of the module input: Assignment of the Input Signal	[Logic /LE 1]
LE1.Gate In2-I	State of the module input: Assignment of the Input Signal	[Logic /LE 1]
LE1.Gate In3-I	State of the module input: Assignment of the Input Signal	[Logic /LE 1]
LE1.Gate In4-I	State of the module input: Assignment of the Input Signal	[Logic /LE 1]
LE1.Reset Latch-I	State of the module input: Reset Signal for the Latching	[Logic /LE 1]

Programmable Logic Outputs

<i>Signal</i>	<i>Description</i>
LE1.Gate Out	Signal: Output of the logic gate
LE1.Timer Out	Signal: Timer Output
LE1.Out	Signal: Latched Output (Q)
LE1.Out inverted	Signal: Negated Latched Output (Q NOT)

Commissioning

Before starting work on an open switchboard, it is required that the switchboard is de-energized and the following five safety regulations have been met.

DANGER

Safety precautions:

- Disconnect the power supply;
- Secure against reconnection;
- Verify that the equipment is de-energized;
- Connect to ground and short-circuit all phases; and
- Cover or safeguard all live adjacent parts.

DANGER

The secondary circuit of a current transformer must never be opened during operation. The prevailing high voltages can cause severe injury or death.

WARNING

Even when the auxiliary voltage is switched off, it is likely that there are still hazardous voltages at the component connections.

All locally applicable national and international installation and safety regulations for working at electrical power installations **MUST** always to be followed.

WARNING

Prior to the initial voltage connection, the following must be guaranteed:

- Correct grounding of the device;
- That all signal circuits are tested;
- That all control circuits are tested;
- Transformer wiring is checked;
- Correct rating of the CTs;
- Correct burden of the CTs;
- That the operational conditions are in line with the Technical Data;
- Correct rating of the transformer protection;
- Function of the transformer fuses;
- Correct wiring of all digital inputs;
- Polarity and capacity of the supply voltage; and
- Correct wiring of the analog inputs and outputs.

NOTICE

The permissible deviations of measuring values and device adjustment are dependent on the Technical Data/Tolerances.

Commissioning/Protection Test

WARNING

Commissioning/protection test must be carried out by authorized and qualified personnel. Before the device is put into operation, the related documentation **MUST** be read and understood.

WARNING

With any test of the protection functions, the following has to be checked:

- Is activation/tripping saved in the event recorder?
- Is tripping saved in the fault recorder?
- Is tripping saved in the waveform recorder?
- Are all signals/messages correctly generated?
- Do all generally configured blocking functions work properly?
- Do all temporarily configured (via DI) blocking functions work properly?
- To enable checks on all LEDs and relay functions, these have to be provided with the relevant pickup (alarm) and tripping functions of the respective protection functions/elements. This **MUST** be tested in practical operation.

WARNING

Check of all temporary blockings (via digital inputs).

- In order to avoid malfunctions, all blockings related to tripping/non-tripping of protection function **MUST** be tested. The test can be very complex and should therefore be performed by the same personnel who set up the protection concept.

CAUTION

Check all general trip blockings. All general trip blockings **MUST** be tested.

NOTICE

Prior to the initial operation of the protection device, all tripping times and values shown in the adjustment list **MUST** be confirmed by a secondary test.

NOTICE

Any description of functions, parameters, inputs, or outputs that does not match the device in hand can be ignored.

Decommissioning – Removing the Plug from the Relay

WARNING

Dismounting the relay will lead to a loss of the protection functionality. Ensure that there is a back-up protection. If you are not aware of the consequences of decommissioning the device – STOP! DO NOT start.

WARNING

Inform SCADA before you start.

Switch-off the power supply.

Ensure that the cabinet is de-energized and that there are no voltages that could lead to injury of personnel.

Disconnect the terminals at the rear-side of the device. DO NOT pull any cable – pull on the plug! If it is stuck, use a screw driver.

Fasten the cables and terminals in the cabinet by means of cable clips to ensure that no accidental electrical connections are caused.

Hold the device at the front-side while removing the mounting nuts.

Remove the device carefully from the cabinet.

In case no other device is to be mounted or replaced, cover/close the cut-out in the front-door.

Close the cabinet.

Service and Commissioning Support

Within the service menu, various functions support maintenance and commissioning of the device.

General

Within the [Service/General] menu, the User can initiate a reboot of the device.

Maintenance Mode

Principle – General Use

NOTICE

The Maintenance Mode can be used to reduce arc flash levels. Refer to Std. NFPA70E.

! DANGER

DO NOT attempt to install or perform maintenance on equipment while it is energized. Severe personal injury or death can result from contact with energized equipment. Verify that no voltage is present before opening doors of the switchboard.

! DANGER

If maintenance will be performed on a device, special protective clothing and equipment **MUST BE USED** and all industry standard procedures **MUST BE FOLLOWED**. Failure to do so can result in severe personal injury or death.

The Maintenance Mode can improve safety by providing a simple and reliable method to reduce fault clearing time and lower incident energy levels at energized panels. The Maintenance Mode allows the User to switch to more sensitive settings via the HMI/panel, Communication, or via a Digital Input while maintenance work is being performed at an energized panel or device. The more sensitive settings provide greater security for maintenance personnel and helps reduce the possibility of injury.

The status of the Maintenance Mode (active/inactive) is stored power fail-safe.

NOTICE

Manual activation is only possible via the HMI/panel (not via PowerPort-E).

The Maintenance Mode can be activated:

- Manually (only at the HMI/panel);
- Via communication; or
- Via a digital input.

NOTICE

Changing to another mode is only possible if there is no active Activation Signal (e.g.: if the device is in the “Via Digital Input Mode” and while the assigned Digital Input is “true”, the User cannot switch to the “Manual Mode”).

Before Use



The sensitivity settings for the Maintenance Mode have to be calculated and programmed into the device (according to Std. NFPA70E). They are not part of the device by default.

When the Maintenance Mode is enabled and fault current causes its operation, the fault clearing time of the associated breaker has to be very fast. Calculate the sensitivity setting on the basis of **Std. NFPA70E**.

Program those sensitivity settings either into a setting group or into Adaptive Parameters.

How to Use the Maintenance Mode

Calculate the sensitivity setting on the basis of **Std. NFPA70E**. Program those sensitivity settings either into a setting group or into Adaptive Parameters.

The Maintenance Mode offers two output signals: "Maint Mode activated" and "Maint Mode not activated".

The »Maint Mode.ACTIVATED« signal should be used to:

- Switch to another setting group (in case the sensitivity settings are saved within this setting group);
- Activate "Adaptive Parameters" (in case the sensitivity settings are saved within these adaptive parameters); and/or
- Block or activate dedicated functions.

Please see the Adaptive Parameters section for more details.

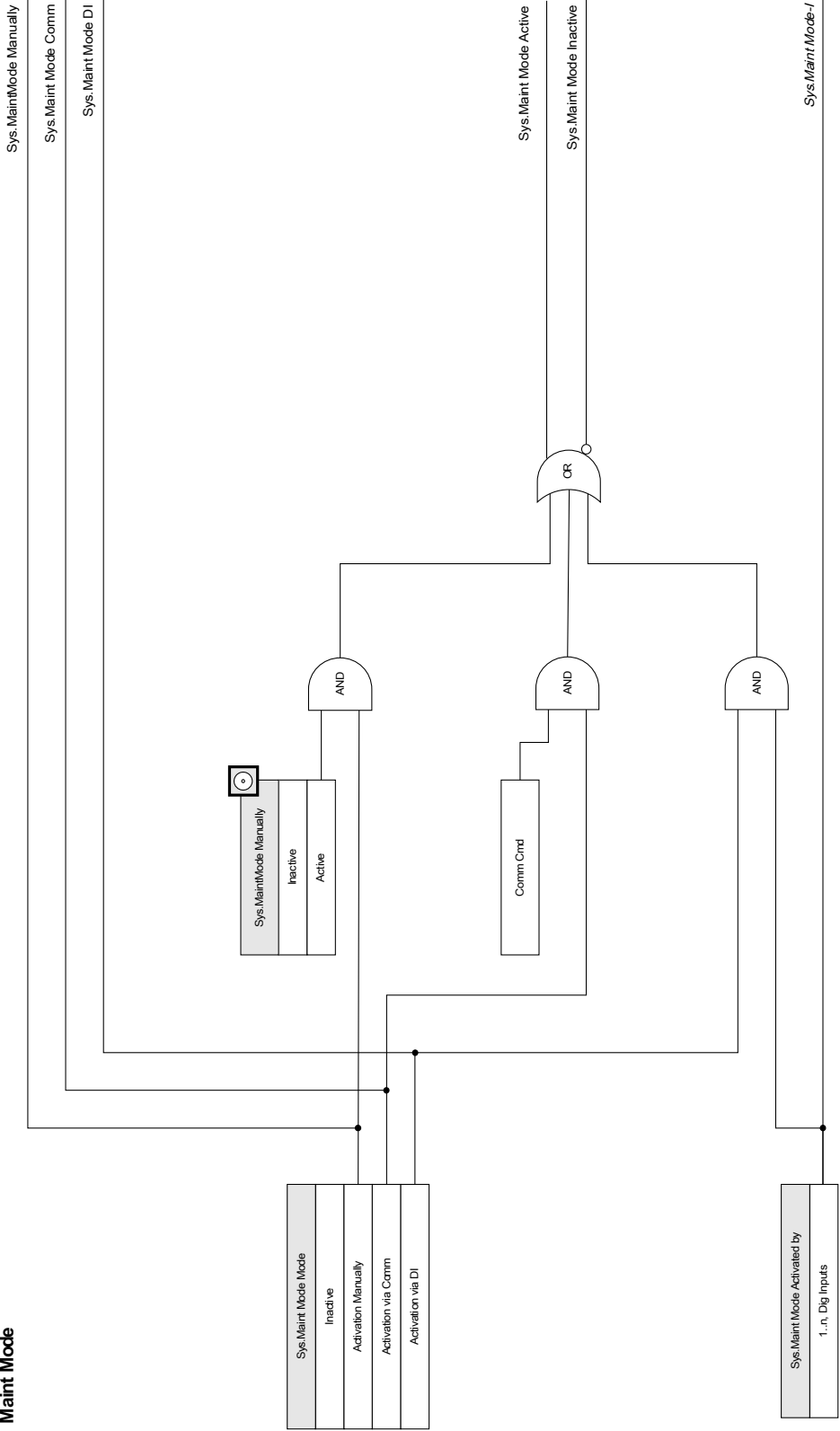
The »Maint Mode.NOT ACTIVATED« signal should be used to:

- Switch back to the standard setting group when Maintenance Mode should not be used.

For fast access, the Maintenance Mode can be accessed by means of the »Softkey« Maint on the start screen (root) of the device.

Sys

Maint Mode



Forcing the Relay Output Contacts

NOTICE

The parameters, their defaults, and setting ranges have to be taken from Relay Output Contacts section.

Principle – General Use

⚠ DANGER

The User **MUST ENSURE** that the relay output contacts operate normally after maintenance is completed. If the relay output contacts do not operate normally, the protective device **WILL NOT** provide protection.

For commissioning purposes or for maintenance, relay output contacts can be set by force.

Within this mode [Service/Test Mode (Prot inhibit)/WARNING! Cont?/Force RO], relay output contacts can be set by force:

- Permanent; or
- Via timeout.

If they are set with a timeout, they will keep their “Force Position” only as long as this timer runs. If the timer expires, the relay will operate normally. If they are set as Permanent, they will keep the “Force Position” continuously.

There are two options available:

- Forcing a single relay »*Force Rox*«; and
- Forcing an entire group of relay output contacts »*Force all Outs*«.

Forcing an entire group takes precedence over forcing a single relay output contact!

NOTICE

A relay output contact **WILL NOT follow a force command** as long as it is disarmed at the same time.

NOTICE

A relay output contact **WILL follow a force command**:

- If it is not disarmed; and
- If the Direct Command is applied to the relay(s).

Keep in mind, that forcing all relay output contacts (of the same assembly group) takes precedence over the force command of a single relay output contact.

Disarming the Relay Output Contacts

NOTICE

The parameters, their defaults, and setting ranges have to be taken from the Relay Output Contacts section.

Principle – General Use

Within this mode [Service/Test Mode (Prot inhibit)/WARNING! Cont?/DISARMED], entire groups of relay output contacts can be disabled. By means of this test mode, contact outputs switching actions of the relay output contacts are prevented. If the relay output contacts are disarmed, maintenance actions can be carried out without the risk of taking entire processes off-line.

⚠ DANGER

The User **MUST ENSURE** that the relay output contacts are **ARMED AGAIN** after maintenance is complete. If they are not armed, the protective device **WILL NOT** provide protection.

NOTICE

Zone Interlocking Output and the Supervision Contact cannot be disarmed.

Within this mode [Service/Test Mode (Prot inhibit)/WARNING! Cont?/DISARMED] entire groups of relay output contacts can be disarmed:

- Permanent; or
- Via timeout.

If they are set with a timeout, they will keep their “Disarm Position” only as long as this timer runs. If the timer expires, the relay output contacts will operate normally. If they are set Permanent, they will keep the “Disarm State” continuously.

NOTICE

A relay output contact **WILL NOT be disarmed as long as:**

- A relay output contact **WILL NOT** be disarmed if it is latched (and not yet reset).
- A relay output contact **WILL NOT** be disarmed as long as a running t-OFF-delay timer is not yet expired (hold time of a relay output contact).
- If the Disarm Control is not set to active.
- If the Direct Command is not applied.

NOTICE

A relay output contact **WILL be disarmed** if it is not latched and:

- If there is **no running t-OFF-delay timer (hold time of a relay output contact); and**
- **If the DISARM Control is set to active; and**
- **If the Direct Command Disarm is applied.**

Forcing RTDs*

* = Availability depends on ordered device.

NOTICE

The parameters, their defaults, and setting ranges have to be taken from RTD/UTRD section.

Principle – General Use**! DANGER**

The User **MUST ENSURE** that the RTDs operate normally after maintenance is completed. If the RTDs do not operate normally, the protective device **WILL NOT** provide protection.

For commissioning purposes or for maintenance, RTD temperatures can be set by force.

Within this mode [Service/Test Mode (Prot inhibit)/WARNING! Cont?/URTD], RTD temperatures can be set by force:

- Permanent; or
- Via timeout.

If they are set with a timeout, they will keep their “Forced Temperature” only as long as this timer runs. If the timer expires, the RTD will operate normally. If they are set as »*Permanent*«, they will keep the “Forced Temperature” continuously. This menu will show the measured values of the RTDs until the User activates the force mode by calling up the »*Function*«. As soon as the force mode is activated, the shown values will be frozen as long as this mode is active. Now the User can force RTD values. As soon as the force mode is deactivated, measured values will again be shown.

Forcing Analog Outputs*

* = Availability depends on ordered device.

NOTICE

The parameters, their defaults, and setting ranges have to be taken from Analog Output section.

Principle – General Use

! DANGER

The User **MUST ENSURE** that the Analog Outputs operate normally after maintenance is completed. Do not use this mode if forced Analog Outputs cause issues in external processes.

For commissioning purposes or for maintenance, Analog Outputs can be set by force.

Within this mode [Service/Test Mode (Prot inhibit)/WARNING! Cont?/Analog Outputs], Analog Outputs can be set by force:

- Permanent; or
- Via timeout.

If they are set with a timeout, they will keep their “Forced Value” only as long as this timer runs. If the timer expires, the Analog Output will operate normally. If they are set as »*Permanent*«, they will keep the “Forced Value” continuously. This menu will show the current value that is assigned to the Analog Output until the User activates the force mode by calling up the »*Function*«. As soon as the force mode is activated, the shown values will be frozen as long as this mode is active. Now the User can force Analog Output values. As soon as the force mode is deactivated, measured values will again be shown.

Forcing Analog Inputs*

* = Availability depends on ordered device.

NOTICE

The parameters, their defaults, and setting ranges have to be taken from Analog Inputs section.

Principle – General Use

⚠ DANGER

The User **MUST ENSURE** that the Analog Inputs operate normally after maintenance is completed.

For commissioning purposes or for maintenance, Analog Inputs can be set by force.

Within this mode [Service/Test Mode (Prot inhibit)/WARNING! Cont?/Analog Inputs], Analog Inputs can be set by force:

- Permanent; or
- Via timeout.

If they are set with a timeout, they will keep their “Forced Value” only as long as this timer runs. If the timer expires, the Analog Input will operate normally. If they are set as »*Permanent*«, they will keep the “Forced Value” continuously. This menu will show the current value that is fed to the Analog Input until the User activates the force mode by calling up the »*Function*«. As soon as the force mode is activated, the shown value will be frozen as long as this mode is active. Now the User can force the Analog Input value. As soon as the force mode is deactivated, measured value will be shown again.

Failure Simulator (Sequencer)*

Available Elements:

Sgen

* = Availability depends on ordered device. This applies especially to the availability of voltage and current. Voltage simulation is only available in voltage relays, current simulation is only available in current relays.

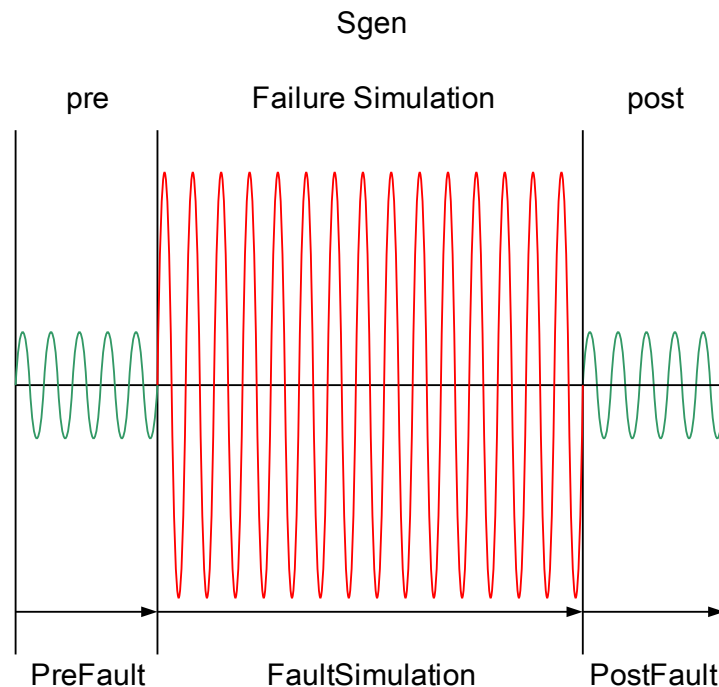
For commissioning support and in order to analyze failures, the protective device offers the option to simulate measuring quantities. The simulation menu can be found within the [Service/Test Mode (Prot inhibit)/WARNING! Cont?/Sine wave gen] menu. The simulation cycle consists of three states:

- Pre-failure;
- Failure; and
- Post-failure State (Phase).

Within the [Service/Test Mode (Prot inhibit)/WARNING! Cont?/Sine wave gen/Configuration] sub-menu, the duration of each phase can be set. In addition; the measuring quantities to be simulated can be determined (e.g.: voltages, currents, and the corresponding angles) for each phase (and ground). The simulation will be terminated, if a phase current exceeds 0.1 times I_n . A simulation can be restarted, five seconds after the current has fallen below 0.1 times I_n .



Setting the device into the simulation mode means taking the protective device out of operation for the duration of the simulation. Do not use this feature during operation of the device if the User cannot guarantee that there is a running and properly working backup protection.



The energy counters will be stopped while the failure simulator is running.

NOTICE

The simulation voltages are always phase to neutral voltages, irrespectively of the mains voltage transformers' connection method (Phase-to-phase / Wey / Open Delta).

*Application Options of the Fault Simulator**:*

Stop Options	Cold Simulation (Option 1)	Hot Simulation (Option 2)
Do not stop Run complete: Pre Failure, Failure, Post Failure. How To?: Call up [Service/Test Mode (Prot inhibit)/WARNING! Cont?/Sine wave gen/Process] Ex Force Post = no assignment and Press/Call up Start Simulation.	Simulation without tripping the breaker: The TripCmd of all protection functions will be blocked. The protection function will possibly trip but not generate a TripCmd. How To?: Call up [Service/Test Mode (Prot inhibit)/WARNING! Cont?/Sine wave gen/Process] Trip Cmd Mode = No TripCmd	Simulation is authorized to trip the breaker: How To?: Call up [Service/Test Mode (Prot inhibit)/WARNING! Cont?/Sine wave gen/Process] Trip Cmd Mode = With TripCmd
Stop by external signal Force Post: As soon as this signal becomes true, the Fault Simulation will be forced to switch into the Post Failure mode. How To?: Call up [Service/Test Mode (Prot inhibit)/WARNING! Cont?/Sine wave gen/Process] Ex Force Post = Assigned Signal		
Manual stop As soon as this signal becomes true, the Fault Simulation will be terminated and the device changes back to normal operation. How To?: Call up [Service/Test Mode (Prot inhibit)/WARNING! Cont?/Sine wave gen/Process] Press/Call up Stop Simulation.		

**Please note: Due to internal dependencies, the frequency of the simulation module is 0.16% greater than the rated one.

Device Planning Parameters of the Failure Simulator

Parameter	Description	Options	Default	Menu path
Mode 	Mode	Do not use, Use	Use	[Device Planning]

Global Protection Parameter of the Failure Simulator

Parameter	Description	Setting range	Default	Menu path
PreFault 	Pre Fault Duration	0.00 - 300.00s	0.0s	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /Times]
FaultSimulation 	Duration of Fault Simulation	0.00 - 10800.00s	0.0s	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /Times]
PostFault 	PostFault	0.00 - 300.00s	0.0s	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /Times]
TripCmd Mode 	Trip Command Mode	No TripCmd, With TripCmd	No TripCmd	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Process]

Parameter	Description	Setting range	Default	Menu path
Ex Start Simulation 	External Start of Fault Simulation (Using the test parameters)	1..n, Assignment List	.-	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Process]
ExBlo 	External blocking of the module, if blocking is activated (allowed) within a parameter set and if the state of the assigned signal is true.	1..n, Assignment List	Bkr.Pos CLOSE	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Process]
Ex ForcePost 	Force Post state. Abort simulation.	1..n, Assignment List	.-	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Process]

Voltage Parameter of the Failure Simulator

Parameter	Description	Setting range	Default	Menu path
VA Fund. 	Voltage Fundamental Magnitude in Pre State: Phase A	0.00 - 1.30Vn	0.57Vn	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /VT]
VB Fund. 	Voltage Fundamental Magnitude in Pre State: Phase B	0.00 - 1.30Vn	0.57Vn	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /VT]

Parameter	Description	Setting range	Default	Menu path
VC Fund. 	Voltage Fundamental Magnitude in Pre State: Phase C	0.00 - 1.30Vn	0.57Vn	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /VT]
VX Fund. 	Voltage Fundamental Magnitude in Pre State: VX	0.00 - 1.30Vn	0.0Vn	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /VT]
Angle VA Fund. 	Start Position respectively Start Angle of the Voltage Phasor during Pre Phase:Phase A	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /VT]
Angle VB Fund. 	Start Position respectively Start Angle of the Voltage Phasor during Pre Phase:Phase B	-360 - 360°	240°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /VT]

Parameter	Description	Setting range	Default	Menu path
Angle VC Fund. 	Start Position respectively Start Angle of the Voltage Phasor during Pre Phase:Phase C	-360 - 360°	120°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /VT]
Angle VX meas Fund. 	Start Position respectively Start Angle of the Voltage Phasor during Pre Phase: VX	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /VT]
VA Fund. 	Voltage Fundamental Magnitude in Fault State: Phase A	0.00 - 1.30Vn	0.29Vn	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /VT]
VB Fund. 	Voltage Fundamental Magnitude in Fault State: Phase B	0.00 - 1.30Vn	0.29Vn	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /VT]

Parameter	Description	Setting range	Default	Menu path
VC Fund. 	Voltage Fundamental Magnitude in Fault State: Phase C	0.00 - 1.30Vn	0.29Vn	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /VT]
VX Fund. 	Voltage Fundamental Magnitude in Fault State: Phase VX	0.00 - 1.30Vn	0.29Vn	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /VT]
Angle VA Fund. 	Start Position respectively Start Angle of the Voltage Phasor during Fault Phase:Phase A	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /VT]
Angle VB Fund. 	Start Position respectively Start Angle of the Voltage Phasor during Fault Phase:Phase B	-360 - 360°	240°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /VT]

Parameter	Description	Setting range	Default	Menu path
Angle VC Fund. 	Start Position respectively Start Angle of the Voltage Phasor during Fault Phase:Phase C	-360 - 360°	120°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /VT]
Angle VX meas Fund. 	Start Position respectively Start Angle of the Voltage Phasor during Fault Phase: VX	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /VT]
VA Fund. 	Voltage Fundamental Magnitude during Post phase: Phase A	0.00 - 1.30Vn	0.57Vn	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /VT]
VB Fund. 	Voltage Fundamental Magnitude during Post phase: Phase B	0.00 - 1.30Vn	0.57Vn	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /VT]

Parameter	Description	Setting range	Default	Menu path
VC Fund. 	Voltage Fundamental Magnitude during Post phase: Phase C	0.00 - 1.30Vn	0.57Vn	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /VT]
VX Fund. 	Voltage Fundamental Magnitude during Post phase: Phase VX	0.00 - 1.30Vn	0.0Vn	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /VT]
Angle VA Fund. 	Start Position respectively Start Angle of the Voltage Phasor during Post phase: Phase A	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /VT]
Angle VB Fund. 	Start Position respectively Start Angle of the Voltage Phasor during Post phase: Phase B	-360 - 360°	240°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /VT]

Parameter	Description	Setting range	Default	Menu path
Angle VC Fund. 	Start Position respectively Start Angle of the Voltage Phasor during Post phase: Phase C	-360 - 360°	120°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /VT]
Angle VX meas Fund. 	Start Position respectively Start Angle of the Voltage Phasor during Post phase: Phase VX	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /VT]

Parameter	Description	Setting range	Default	Menu path
CT Ntrl.IA Fund. 	Current Fundamental Magnitude in Pre State: Phase A	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Ntrl]
CT Ntrl.IB Fund. 	Current Fundamental Magnitude in Pre State: Phase B	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Ntrl]

Parameter	Description	Setting range	Default	Menu path
CT Ntrl.IC Fund. 	Current Fundamental Magnitude in Pre State: Phase C	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Ntrl]
CT Ntrl.IX meas Fund. 	Current Fundamental Magnitude in Pre State: IX	0.00 - 25.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Ntrl]
CT Ntrl.Angle IA Fund. 	Start Position respectively Start Angle of the Current Phasor during Pre Phase:Phase A	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Ntrl]
CT Ntrl.Angle IB Fund. 	Start Position respectively Start Angle of the Current Phasor during Pre Phase:Phase B	-360 - 360°	240°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Ntrl]

Parameter	Description	Setting range	Default	Menu path
CT Ntrl.Angle IC Fund. 	Start Position respectively Start Angle of the Current Phasor during Pre Phase:Phase C	-360 - 360°	120°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Ntrl]
CT Ntrl.Angle IX meas Fund. 	Start Position respectively Start Angle of the Current Phasor during Pre Phase: IX	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Ntrl]
CT Ntrl.IA Fund. 	Current Fundamental Magnitude in Fault State: Phase A	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Ntrl]
CT Ntrl.IB Fund. 	Current Fundamental Magnitude in Fault State: Phase B	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Ntrl]

Parameter	Description	Setting range	Default	Menu path
CT Ntrl.IC Fund. 	Current Fundamental Magnitude in Fault State: Phase C	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Ntrl]
CT Ntrl.IX meas Fund. 	Current Fundamental Magnitude in Fault State: IX	0.00 - 25.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Ntrl]
CT Ntrl.Angle IA Fund. 	Start Position respectively Start Angle of the Current Phasor during Fault Phase:Phase A	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Ntrl]
CT Ntrl.Angle IB Fund. 	Start Position respectively Start Angle of the Current Phasor during Fault Phase:Phase B	-360 - 360°	240°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Ntrl]

Parameter	Description	Setting range	Default	Menu path
CT Ntrl.Angle IC Fund. 	Start Position respectively Start Angle of the Current Phasor during Fault Phase:Phase C	-360 - 360°	120°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Ntrl]
CT Ntrl.Angle IX meas Fund. 	Start Position respectively Start Angle of the Current Phasor during Fault Phase: IX	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Ntrl]
CT Ntrl.IA Fund. 	Current Fundamental Magnitude during Post phase: Phase A	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Ntrl]
CT Ntrl.IB Fund. 	Current Fundamental Magnitude during Post phase: Phase B	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Ntrl]

Parameter	Description	Setting range	Default	Menu path
CT Ntrl.IC Fund. 	Current Fundamental Magnitude during Post phase: Phase C	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Ntrl]
CT Ntrl.IX meas Fund. 	Current Fundamental Magnitude during Post phase: IX	0.00 - 25.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Ntrl]
CT Ntrl.Angle IA Fund. 	Start Position respectively Start Angle of the Current Phasor during Post phase: Phase A	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Ntrl]
CT Ntrl.Angle IB Fund. 	Start Position respectively Start Angle of the Current Phasor during Post phase: Phase B	-360 - 360°	240°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Ntrl]

Parameter	Description	Setting range	Default	Menu path
CT Ntrl.Angle IC Fund. 	Start Position respectively Start Angle of the Current Phasor during Post phase: Phase C	-360 - 360°	120°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Ntrl]
CT Ntrl.Angle IX meas Fund. 	Start Position respectively Start Angle of the Current Phasor during Post phase: IX	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Ntrl]

Parameter	Description	Setting range	Default	Menu path
CT Line.IA Fund. 	Current Fundamental Magnitude in Pre State: Phase A	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Line]
CT Line.IB Fund. 	Current Fundamental Magnitude in Pre State: Phase B	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Line]

Parameter	Description	Setting range	Default	Menu path
CT Line.IC Fund. 	Current Fundamental Magnitude in Pre State: Phase C	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Line]
CT Line.IX meas Fund. 	Current Fundamental Magnitude in Pre State: IX	0.00 - 25.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Line]
CT Line.Angle IA Fund. 	Start Position respectively Start Angle of the Current Phasor during Pre Phase:Phase A	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Line]
CT Line.Angle IB Fund. 	Start Position respectively Start Angle of the Current Phasor during Pre Phase:Phase B	-360 - 360°	240°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Line]

Parameter	Description	Setting range	Default	Menu path
CT Line.Angle IC Fund. 	Start Position respectively Start Angle of the Current Phasor during Pre Phase:Phase C	-360 - 360°	120°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Line]
CT Line.Angle IX meas Fund. 	Start Position respectively Start Angle of the Current Phasor during Pre Phase: IX	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PreFault /CT Line]
CT Line.IA Fund. 	Current Fundamental Magnitude in Fault State: Phase A	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Line]
CT Line.IB Fund. 	Current Fundamental Magnitude in Fault State: Phase B	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Line]

Parameter	Description	Setting range	Default	Menu path
CT Line.IC Fund. 	Current Fundamental Magnitude in Fault State: Phase C	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Line]
CT Line.IX meas Fund. 	Current Fundamental Magnitude in Fault State: IX	0.00 - 25.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Line]
CT Line.Angle IA Fund. 	Start Position respectively Start Angle of the Current Phasor during Fault Phase:Phase A	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Line]
CT Line.Angle IB Fund. 	Start Position respectively Start Angle of the Current Phasor during Fault Phase:Phase B	-360 - 360°	240°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Line]

Parameter	Description	Setting range	Default	Menu path
CT Line.Angle IC Fund. 	Start Position respectively Start Angle of the Current Phasor during Fault Phase:Phase C	-360 - 360°	120°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Line]
CT Line.Angle IX meas Fund. 	Start Position respectively Start Angle of the Current Phasor during Fault Phase: IX	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /FaultSimulation /CT Line]
CT Line.IA Fund. 	Current Fundamental Magnitude during Post phase: Phase A	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Line]
CT Line.IB Fund. 	Current Fundamental Magnitude during Post phase: Phase B	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Line]

Parameter	Description	Setting range	Default	Menu path
CT Line.IC Fund. 	Current Fundamental Magnitude during Post phase: Phase C	0.00 - 40.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Line]
CT Line.IX meas Fund. 	Current Fundamental Magnitude during Post phase: IX	0.00 - 25.00In	0.0In	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Line]
CT Line.Angle IA Fund. 	Start Position respectively Start Angle of the Current Phasor during Post phase: Phase A	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Line]
CT Line.Angle IB Fund. 	Start Position respectively Start Angle of the Current Phasor during Post phase: Phase B	-360 - 360°	240°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Line]

Parameter	Description	Setting range	Default	Menu path
CT Line.Angle IC Fund. 	Start Position respectively Start Angle of the Current Phasor during Post phase: Phase C	-360 - 360°	120°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Line]
CT Line.Angle IX meas Fund. 	Start Position respectively Start Angle of the Current Phasor during Post phase: IX	-360 - 360°	0°	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Configuration /PostFault /CT Line]

States of the Inputs of the Failure Simulator

Name	Description	Assignment via
Ex Start Simulation-I	State of the module input: External Start of Fault Simulation (Using the test parameters)	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Process]
ExBlo	Module Input State: External Blocking	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Process]
Ex ForcePost-I	State of the module input: Force Post state. Abort simulation.	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Process]

Signals of the Failure Simulator (States of the Outputs)

Signal	Description
Running	Signal: Measuring value simulation is running
State	Signal: Wave generation states: 0=Off, 1=PreFault, 2=Fault, 3=PostFault, 4=InitReset

Direct Commands of the Failure Simulator

Parameter	Description	Setting range	Default	Menu path
 Start Simulation	Start Fault Simulation (Using the test parameters)	Inactive, Active	Inactive	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Process]
 Stop Simulation	Stop Fault Simulation (Using the test parameters)	Inactive, Active	Inactive	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /Process]

Failure Simulator Values

Value	Description	Default	Size	Menu path
State	Wave generation states: 0=Off, 1=PreFault, 2=Fault, 3=PostFault, 4=InitReset	Off	Off, PreFault, FaultSimulation, PostFault, Init Res	[Service /Test Mode (Prot inhibit) /WARNING! Cont? /Sgen /State]

Technical Data

NOTICE

Use Copper conductors only, 75°C (167°F).
Conductor size AWG 14 [2.5 mm].

Climatic Environmental Conditions

Storage Temperature:	-30°C to +70°C (-22°F to 158°F)
Operating Temperature:	-20°C to +60°C (-4°F to 140°F)
Permissible Humidity at Ann. Average:	<75% rel. (on 56d up to 95% rel.)
Permissible Installation Altitude:	<2,000 m (6,561.67 ft) above sea level If 4,000 m (13,123.35 ft) altitude applies, a changed classification of the operating and test voltages may be necessary.

Degree of Protection EN 60529

HMI Front Panel with Seal:	IP54
Rear Side Terminals:	IP20

Routine Test

Insulation Test Acc. to IEC60255-5:	All tests to be carried out against ground and other input and output circuits.
Aux. Voltage Supply, Digital Inputs, Current Measuring Inputs, Signal Relay Outputs:	2.5 kV (eff.) / 50 Hz
Voltage Measuring Inputs:	3.0 kV (eff.) / 50 Hz
All Wire-Bound Communication Interfaces:	1.5 kV DC

Housing

Housing B2: Height / Width	183 mm (7.205 in.) / 212.7 mm (8.374 in.)
Housing Depth (Incl. Terminals):	208 mm (8.189 in.)
Material, Housing:	Aluminum extruded section
Material, Front Panel:	Aluminum/Foil front
Mounting Position:	Horizontal (±45° around the X-axis must be permitted)
Weight:	Approx. 4.2 kg (9.259 lb)

Current and Ground Current Measurement

Plug-in Connector with Integrated Short-Circuiter (Conventional Current Inputs)

Phase and Ground Current Inputs:

Nominal Currents:	1 A / 5 A
Max. Measuring Range:	Up to 40 x I_n (phase currents) Up to 25 x I_n (ground current standard)
Capacity:	4 x I_n /continuously
Overcurrent Proof:	30 x I_n / 10 s 100 x I_n / 1 s 250 x I_n / 10 ms (1 half-wave)
Power Consumption:	Phase current inputs At $I_n = 1$ A $S = 25$ mVA At $I_n = 5$ A $S = 90$ mVA Ground current input At $I_n = 1$ A $S = 25$ mVA At $I_n = 5$ A $S = 90$ mVA

Sensitive Ground Current Inputs:

Nominal Currents:	1 A / 5 A with 50:0.025 core balance CT
Max. Measuring Range:	Up to 2.5 x I_n
Capacity:	2 x I_n /continuously
Overcurrent Proof:	10 x I_n / 10 s 25 x I_n / 1 s 100 x I_n / 10 ms (1 half-wave)
Power Consumption:	At 1 A $S = 550$ mVA At 0.1 A $S = 7$ mVA At 5 A $S = 870$ mVA At 0.5 A $S = 10$ mVA
Frequency Range:	50 Hz / 60 Hz $\pm 10\%$
Terminals:	Screw-type terminals with integrated short-circuiters (contacts)

**Phase and Ground
Current Inputs:**

Screws M4, captive type acc. to VDEW

Connection Cross Sections: 1 x or 2 x 2.5 mm² (2 x AWG 14) with wire end ferrule
1 x or 2 x 4.0 mm² (2 x AWG 12) with ring cable sleeve or cable sleeve
1 x or 2 x 6 mm² (2 x AWG 10) with ring cable sleeve or cable sleeve

The current measuring board's terminal blocks may be used as with 2 (double) conductors AWG 10,12,14 otherwise with single conductors only.

Voltage and Residual Voltage Measurement

Nominal Voltages:	60 - 520 V (can be configured)
Max. Measuring Range:	800 Vac
Continuous Loading Capacity:	800 Vac
Power Consumption:	at $V_n = 100\text{ V}$ $S = 22\text{ mVA}$ at $V_n = 110\text{ V}$ $S = 25\text{ mVA}$ at $V_n = 230\text{ V}$ $S = 110\text{ mVA}$ at $V_n = 400\text{ V}$ $S = 330\text{ mVA}$
Frequency Range:	50 Hz or 60 Hz $\pm 10\%$
Terminals:	Screw-type terminals

Frequency Measurement

Nominal Frequencies:	50 Hz / 60 Hz

Voltage Supply

Aux. Voltage:	24 - 270 Vdc / 48 - 230 Vac (-20/+10%) $\approx$
Buffer Time in Case of Supply Failure:	$\geq$ 50 ms at minimal aux. voltage Interrupted communication is permitted.
Max. Permissible Making Current:	18 A peak value for <0.25 ms 12 A peak value for <1 ms

The voltage supply must be protected by a fuse of:

- 2,5 A time-lag miniature fuse 5 x 20 mm (approx. 0.2 x 0.8 in.) according to IEC 60127
- 3,5 A time-lag miniature fuse 6,3 x 32 mm (approx. 0.25 x 1.25 in.) according to UL 248-14

Power Consumption

Power Supply Range:	Power consumption in Idle Mode	Max. Power Consumption
24 - 270 Vdc:	Approx. 8 W	Approx. 13 W
48 - 230 Vac (For Frequencies of 50-60 Hz):	Approx. 8 W / 16 VA	Approx. 13 W / 21 VA

Display

Display Type:	LCD with LED background illumination
Resolution - Graphics Display:	128 x 64 pixel

LED - Type:	Two colored: red / green
Number of LEDs, Housing B2:	15

Front Interface USB

Type:	Mini B

Real Time Clock

Running Reserve of the Real Time Clock:	1 year min.

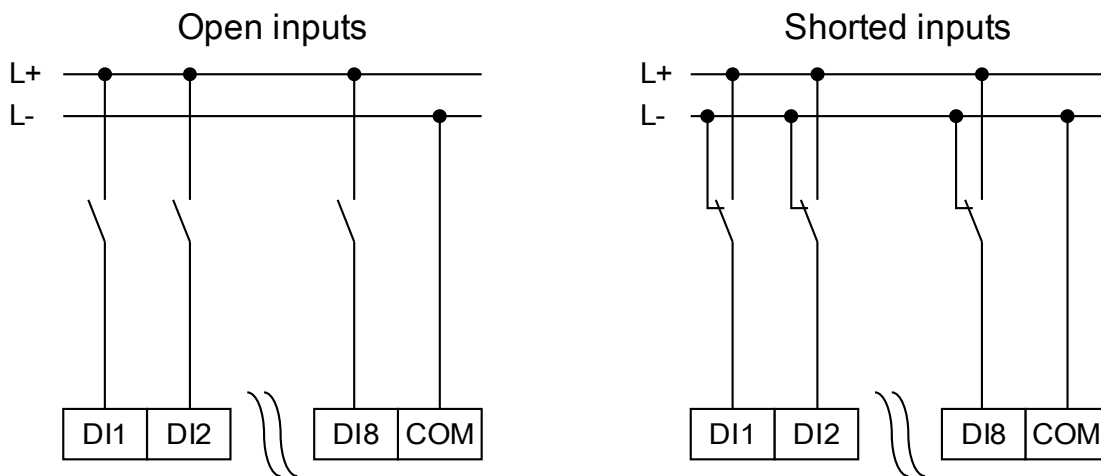
Digital Inputs

Max. Input Voltage: 300 Vdc / 259 Vac

Input Current: DC <4 mA
AC <16 mA

Reaction Time: <20 ms

Fallback Time:
Shorted inputs <30 ms
Open inputs <90 ms



(Safe State of the Digital Inputs)

Switching Thresholds: $U_n = 24 \text{ Vdc}, 48 \text{ Vdc}, 60 \text{ Vdc},$
110 Vac / dc, 230 Vac / dc

$U_n = 24 \text{ Vdc}$

Switching Threshold 1 ON: Min. 19.2 Vdc

Switching Threshold 1 OFF: Max. 9.6 Vdc

$U_n = 48 \text{ V} / 60 \text{ Vdc}$

Switching Threshold 2 ON: Min. 42.6 Vdc

Switching Threshold 2 OFF: Max. 21.3 Vdc

$U_n = 110 / 120 \text{ Vac} / \text{dc}$

Switching Threshold 3 ON: Min. 88.0 Vdc / 88.0 Vac

Switching Threshold 3 OFF: Max. 44.0 Vdc / 44.0 Vac

$U_n = 230 / 240 \text{ Vac} / \text{dc}$

Switching Threshold 4 ON: Min. 184 Vdc / 184 Vac

Switching Threshold 4 OFF: Max. 92 Vdc / 92 Vac

Terminals: Screw-type terminal

Relay Outputs

Continuous Current:	5 A ac / dc
Max. Make Current:	25 A ac / 25 A dc for 4 s 48W (VA) at L/R = 40ms 30 A / 230Vac according to ANSI IEEE Std C37.90-2005 30 A / 250Vdc according to ANSI IEEE Std C37.90-2005
Max. Breaking Current:	5 A ac up to 240 Vac 4 A ac at 230V and $\cos \phi = 0,4$ 5 A dc up to 30 V (resistive) 0.3 A dc at 250 V (resistive) 0,1 A dc at 220 V and L/R = 40ms
Max. Switching Voltage:	250 Vac / 250 Vdc
Switching Capacity:	3,000 VA
Contact Type:	Form C or normally open contact
Terminals:	Screw-type terminals

Supervision Contact (SC)

Continuous Current:	5 A ac / dc
Max. Switch-on Current:	15 A ac / 15 A dc for 4 s
Max. Breaking Current:	5 A ac up to 250 Vac 5 A dc up to 30 Vdc (resistive) 0,25 A at 250 Vdc (resistive)
Max. Switching Voltage:	250 V ac / 250 Vdc
Switching Capacity:	1,250 VA
Contact Type:	Form C
Terminals:	Screw-type terminals

Time Synchronization IRIG-B00X

Nominal input voltage:	5 V
Connection:	Screw-type terminals (twisted pair)

Zone Interlocking

Only for Zone Interlock Tripping Outputs (Zone Interlock, semiconductor output): 5 Vdc, <2mA for connection to electronic inputs only.

Zone Out:

Output voltage (High)	4.75 to 5.25 Vdc
Output voltage (Low)	0.0 to +0.5 Vdc

Zone In:

Nominal input voltage	+5 Vdc
Max. input voltage	+5.5 Vdc
Switching threshold ON	min. 4.0 Vdc
Switching threshold OFF	max. 1.5 Vdc

Galvanic isolation	2.5 kV ac (to ground and other IO)
Connection:	Screw-type terminals (twisted pair)

RS485*

Master/Slave:	Slave
Connection:	6 screw-clamping terminals RM 3.5 mm (138 MIL) (terminating resistors internal)

CAUTION

The RS485 interface is realized via terminals. The communication cable has to be shielded. The shielding has to be fixed at the screw that is marked with the ground symbol (rear side of the device).

LWL-Module with ST connector*

Master/Slave:	Slave
Connector:	ST-Port
Compatible Fiber:	50/125 µm, 62,5/125 µm, 100/140 µm and 200 µm HCS
Wavelength	820 nm
Minimum Optical Input Power:	-24,0 dBm
Minimum Optical Output Power:	-19,8 dBm with 50/125 µm Fiber -16,0 dBm with 62,5/125 µm Fiber -12,5 dBm with 100/145 µm Fiber -8,5 dBm with 200 µm HCS Fiber
Maximum Link Length:	2.7 km (depending on link attenuation)

Please note: The transmission speed of the optical interfaces is limited to 3 MBaud for Profibus.

Optical Ethernet module with LC connector*

Connector:	LC-Port
Compatible Fiber:	50/125 µm and 62,5/125 µm
Wavelength:	1300 nm
Minimum Optical Input Power:	-30,0 dBm
Minimum Optical Output Power:	-22,5 dBm with 50/125 µm Fiber -19,0 dBm with 62,5/125 µm Fiber

URTD-Interface*

Connector:	Versatile Link
Compatible Fiber:	1 mm
Wavelength:	660 nm
Minimum Optical Input Power:	-39,0 dBm

*availability depends on device

Analog Inputs

The following technical data only apply to devices, which are equipped with analog inputs. Please refer to the order code of your device.

The mode of each input can be individually selected between current or voltage input. Shielded cable for the analog inputs is recommended. The terminals of the HF shield should be used, when connecting the shield to ground on both sides of the cable is not possible. On one side of the cable the shield has to be directly connected to ground. In case of the use of unshielded twisted pair cables, the length must not exceed 10 m. All analog inputs have a common potential. Each input has an own common terminal.

Current mode

Range: 0-20 mA
Input resistance: 500 Ω

Voltage mode

Range: 0-10 V
Input resistance: 100 k Ω

Accuracy 0.5% of the nominal value 20 mA resp. 10 V

Influence of temperature to accuracy <1% (within the range of 0°C to +60°C (+32°F to +140°F))

Test voltage of inputs (one group)
against other electrical groups 2.5 kV

Test voltage of inputs (one group)
against ground 1.0 kV

Analog Outputs

The following technical data only apply to devices, which are equipped with analog outputs. Please refer to the order code of your device.

The mode of each output can be individually selected between current or voltage output. Shielded cable for the analog outputs is recommended. The terminals of the HF shield should be used, when connecting the shield to ground on both sides of the cable is not possible. On one side of the cable the shield has to be directly connected to ground. In case of the use of unshielded twisted pair cables, the length must not exceed 10 m. All analog outputs have a common potential. Each output has an own common terminal.

Current mode

Range: 0-20 mA
Max. load resistance: 1 k Ω

Voltage mode

Range: 0-10 V maximum output current 1 mA

Accuracy 0.5% of the nominal value 20 mA resp. 10 V

Influence of temperature to accuracy <1% (within the range of 0°C to +60°C (+32°F to +140°F))

Test voltage of outputs (one group)
against other electrical groups 2.5 kV

Test voltage of outputs (one group)
against ground 1.0 kV

Boot Phase

After switching on the power supply, the protection will be available in approximately 18 seconds. After approximately 150 seconds (depending on the configuration), the boot phase is completed (HMI and Communication initialized).

Standards

Approvals

- UL-listed file: E154862

Design Standards

Generic Standard	EN 61000-6-2 , 2005 EN 61000-6-3 , 2006
Product Standard	EC 60255-1; 2009 IEC 60255-27, 2013 EN 50178, 1998 UL 508 (Industrial Control Equipment), 2005 CSA C22.2 No. 14-95 (Industrial Control Equipment), 1995 ANSI C37.90, 2005

High Voltage Tests (IEC 60255-1)

High Frequency Interference Test

IEC 60255-22-1 IEEE C37.90.1 IEC 61000-4-18	Within one circuit	1 kV/2 s
	Circuit to ground	2.5 kV/2 s
class 3	Circuit to circuit	2.5 kV/2 s

Insulation Voltage Test

IEC 60255-27 (10.5.3.2) IEC 60255-5 EN 50178	All circuits to other circuits and exposed conductive parts	2.5 kV (eff.)/50Hz, 1 min.
	Except interfaces	1.5 kV DC, 1 min.
	Voltage measuring input	3 kV (eff.)/50 Hz, 1 min.

Impulse Voltage Test

IEC 60255-27 (10.5.3.1) IEC 60255-5		5 kV/0.5J, 1.2/50 µs

Insulation resistance test

IEC 60255-27 (10.5.3.3) EN 50178	Within one circuit	500V DC , 5s
	Circuit to circuit	500V DC , 5s

EMC Immunity Tests

Fast Transient Disturbance Immunity Test (Burst)

IEC 60255-22-4	Power supply, mains inputs	±4 kV, 2.5 kHz
IEC 61000-4-4	Other in- and outputs	±2 kV, 5 kHz (coupling network) ±4 kV, 2.5 kHz (coupling clamp)
ANSI C37.90.1		
class 4		

Surge Immunity Test (Surge)

IEC 60255-22-5	Within one circuit	2 kV
IEC 61000-4-5	Circuit to ground	4 kV
class 4		
class 3	Communication cables to ground	2 kV

Electrical Discharge Immunity Test (ESD)

IEC 60255-22-2	Air discharge	8 kV
IEC 61000-4-2 class 3	Contact discharge	6 kV

Radiated Radio Frequency Electromagnetic Field Immunity Test

IEC 60255-22-3	26 MHz – 80 MHz	10 V/m
IEC 61000-4-3	80 MHz – 1 GHz	35 V/m
	1 GHz – 3 GHz	10 V/m

Immunity to Conducted Disturbances Induced by Radio Frequency Fields

IEC 61000-4-6 class 3	150kHz - 80MHz	10 V

Power Frequency Magnetic Field Immunity Test

IEC 61000-4-8	continuous	30 A/m
class 4	3 sec	300 A/m

EMC Emission Tests*Radio Interference Suppression Test*

IEC/CISPR22	150kHz - 30MHz	Limit value class B
IEC60255-26		
DIN EN 55022		

Radio Interference Radiation Test

IEC/CISPR22	30MHz - 1GHz	Limit value class B
IEC60255-25		
DIN EN 55022		

Environmental Tests

Classification:

IEC 60068-1	Climatic Classification	20/060/56
IEC 60721-3-1	Classification of ambient conditions (Storage)	1K5/1B1/1C1L/1S1/1M2 but min. -30°C (-22°F)
IEC 60721-3-2	Classification of ambient conditions (Transportation)	2K2/2B1/2C1/2S1/2M2 but min. -30°C (-22°F)
IEC 60721-3-3	Classification of ambient conditions (Stationary use at weather protected locations)	3K6/3B1/3C1/3S1/3M2 but min. -20°C (-4°F) /max 60°C (140°F)

Test Ad: Cold

IEC 60068-2-1	Temperature Test duration	-20°C (-4°F) 16 h

Test Bd: Dry Heat

IEC 60068-2-2	Temperature Relative humidity Test duration	60°C (140°F) <50% 72 h

Test Cab: Damp Heat (Steady State)

IEC 60255 (6.12.3.6)	Temperature	60°C (140°F)
IEC 60068-2-78	Relative humidity Test duration	95% 56 days

Test Db: Damp Heat (Cyclic)

IEC 60068-2-30	Temperature Relative humidity Cycles (12 + 12-hour)	60°C (140°F) 95% 2

Test Nb: Temperature Change

IEC 60255 (6.12.3.5)	Temperature	60°C/-20°C
IEC 60068-2-14	cycle	5
	test duration	1°C/5min

Test BD: Dry Heat Transport and storage test

IEC 60255 (6.12.3.3)	Temperature	70°C
IEC 60068-2-2	test duration	16 h

Test AB: Cold Transport and storage test

IEC 60255-1 (6.12.3.4)	Temperature	-30°C
IEC 60068-2-1	test duration	16 h

Mechanical Tests

Test Fc: Vibration Response Test

IEC 60068-2-6	(10 Hz – 59 Hz)	0.0014 in. (0.035 mm)
IEC 60255-21-1	Displacement	
class 1	(59Hz – 150Hz)	0.5 gn
	Acceleration	
	Number of cycles in each axis	1

Test Fc: Vibration Endurance Test

IEC 60068-2-6	(10 Hz – 150 Hz)	1.0 gn
IEC 60255-21-1	Acceleration	
class 1	Number of cycles in each axis	20

Test Ea: Shock Test

IEC 60068-2-27	Shock response test	5 gn, 11 ms, 3 impulses in each direction
IEC 60255-21-2		
class 1	Shock resistance test	15 gn, 11 ms, 3 impulses in each direction

Test Eb: Shock Endurance Test

IEC 60068-2-29	Shock endurance test	10 gn, 16 ms, 1,000 impulses in each direction
IEC 60255-21-2		
class 1		

Test Fe: Earthquake Test

IEC 60068-3-3	Single axis earthquake vibration test	1 – 9 Hz horizontal: 0,295 in. (7.5 mm)
IEC 60255-21-3		1 – 9 Hz vertical : 0,137 in. (3.5 mm)
		1 sweep per axis
class 2		9 – 35 Hz horizontal: 2 gn,
		9 – 35 Hz vertical : 1 gn,
		1 sweep per axis

Specifications

Specifications of the Real Time Clock

Resolution:	1 ms
Tolerance:	<1 minute / month (+20°C [68°F]) <±1ms if synchronized via IRIG-B

Time Synchronization Tolerances

The different protocols for time synchronization vary in their accuracy:

<i>Used Protocol</i>	<i>Time drift over one month</i>	<i>Deviation to time generator</i>
Without time synchronization	<1 min (+20°C)	Time drifts
IRIG-B	Dependent on the time drift of the time generator	<±1 ms
SNTP	Dependent on the time drift of the time generator	<±1 ms
Modbus TCP	Dependent on the time drift of the time generator	Dependent on the network load
Modbus RTU	Dependent on the time drift of the time generator	<±1 ms
DNP3	Dependent on the time drift of the time generator	<±1 ms

Specifications of the Measured Value Acquisition

Phase and Ground Current Measuring

Frequency Range:	50 Hz / 60 Hz $\pm 10\%$ ^{*1)}
Accuracy:	Class 0.5
Amplitude Error if $I < I_n$:	$\pm 0.5\%$ of the rated current ^{*2) *3)}
Amplitude Error if $I > I_n$:	$\pm 0.5\%$ of the measured current ^{*2) *3)}
Amplitude Error if $I > 2 I_n$:	$\pm 1.0\%$ of the measured current ^{*2) *3)}
Harmonics:	Up to 20% 3rd harmonic $\pm 2\%$ Up to 20% 5th harmonic $\pm 2\%$
Frequency Influence:	$< \pm 2\%$ / Hz in the range of ± 5 Hz of the configured nominal frequency
Temperature Influence:	$< \pm 1\%$ within the range of 0°C to $+60^\circ\text{C}$ ($+32^\circ\text{F}$ to $+140^\circ\text{F}$)

*1) Wide frequency range (10..70Hz) is active outside 50Hz/60Hz $\pm 5\text{Hz}$. DFT values get more inaccurate, protective elements which have DFT values as input may be blocked automatically.

*2) Accuracy for True RMS values in wide frequency range: 30...70Hz same accuracy like specified above. $< 30\text{Hz}$ accuracy is $< 3\%$. True RMS values are updated only every full cycle (period time).

*3) For earth current sensitive the precision does not depend on the nominal value but is referenced to 100 mA (with $I_n = 1\text{ A}$) respectively. 500 mA (with $I_n = 5\text{ A}$)

Phase-to-ground and Residual Voltage Measurement

Frequency Range:	50 Hz / 60 Hz $\pm 10\%$ ^{*1)}
Accuracy for <u>measured</u> values:	Class 0.5
Amplitude error for $V < V_n$:	$\pm 0.5\%$ of rated voltage or $\pm 0.5\text{ V}$ ^{*2)}
Amplitude error for $V > V_n$:	$\pm 0.5\%$ of measured voltage or $\pm 0.5\text{ V}$ ^{*2)}
Accuracy for <u>calculated</u> values:	Class 1.0
Amplitude error for $V < V_n$:	$\pm 1.0\%$ of rated voltage or $\pm 1\text{ V}$ ^{*2)}
Amplitude error for $V > V_n$:	$\pm 1.0\%$ of calculated voltage or $\pm 1\text{ V}$ ^{*2)}
Harmonics:	Up to 20% 3rd harmonic $\pm 1\%$ Up to 20% 5th harmonic $\pm 1\%$
Frequency influence:	$< \pm 2\%$ / Hz in the range of ± 5 Hz of the configured nominal frequency
Temperature influence:	$< \pm 1\%$ within the range of 0°C up to $+60^\circ\text{C}$

*1) Wide frequency range (10..70Hz) is active outside 50Hz/60Hz $\pm 5\text{Hz}$. DFT values get more inaccurate, protective elements which have DFT values as input may be blocked automatically.

*2) Accuracy for True RMS values in wide frequency range: 30...70Hz same accuracy like specified above. $< 30\text{Hz}$ accuracy is $< 3\%$. True RMS values are updated only every full cycle (period time).

Frequency measurement

Nominal frequency:	50 Hz / 60 Hz
Precision:	$\pm 0.05\%$ of f_n within the range of 40-70 Hz at voltages >50 V
Voltage dependency:	frequency acquisition from $0.15 \times V_n$

Energy measurement*

Energy counter error	1.5% of measured energy or $1.5\% S_n \cdot 1h$

Power Measurement*

V_A , W , VAR :	$< \pm 1\%$ of the measured value or $0.1\% S_n$ (for fundamental) $< \pm 2\%$ of the measured value or $0.1\% S_n$ (for RMS)
W 1, Var 1 (pos. sequence):	$\pm 2\%$ of the measured value or $0.2\% S_n$

Power Factor Measurement*

PF:	± 0.01 of measured power factor or 1° $I > 30\% I_n$ and $S > 2\% S_n$

*)Tolerance at $0.8 \dots 1.2 \times V_n$ (with $V_n=100V$) , $|PF|>0.5$, symmetrically feeded
 $S_n=1.73 \times VT \text{ rating} \times CT \text{ rating}$

Protection Elements Accuracy

NOTICE

The tripping delay relates to the time between alarm and trip.
The accuracy of the operating time relates to the time between fault entry and the time when the protection element is picked-up.

Reference conditions for all Protection Elements: sine wave, at rated frequency, total harmonic distortion < 1%
Measuring criterion: Fundamental

Overcurrent Protection Elements: 50P[x] / 67P[x]	Accuracy ^{*1) *2)}
Pickup	±1.5% of the setting value or 1% In.
Dropout Ratio	97% or 0.5% In
t	DEFT ±1% or ±10 ms
Operating Time At testing current ≥ 2 times pickup value	<36ms (directional elements: <40ms)
Disengaging Time	<55 ms ^{*1)}

Overcurrent Protection Elements: 51P[x] / 67P[x]	Accuracy ^{*1) *2)}
Pickup	±1.5% of the setting value or 1% In.
Dropout Ratio	97% or 0.5% x In
Operating Time At testing current ≥ 2 times pickup value	<36 ms (directional elements: <40ms)
Disengaging Time	<55 ms
t-Multiplier	±5% (according to selected curve)
Reset Mode	±5% (according to selected curve)
t-reset (Reset Mode = t-delay)	±1% or ±10 ms

*1) When RMS is selected and $|f - f_n| > 5\text{Hz}$: operating and disengaging time < 4 cycles.

If $f < 30\text{Hz}$, pickup accuracy ±6% of the setting value or 5% In.

*2) For directional elements, accuracy of MTA: ±3° at $I > 20\% I_n$.

Ground Current Elements: 50X[x] / 50R[x] / 67X[x] / 67R[x]	Accuracy ^{*1) *2) *3)}
Pickup (measured ground current)	±1.5% of the setting value or 1% In
Pickup (calculated ground current)	±2.0% of the setting value or 1.5% In
Dropout Ratio	97% or 0.5% In
t	DEFT ±1% or ±10 ms
Operating Time Starting from IE higher than $1.2 \times I_E$	<45 ms
Disengaging Time	<55 ms
t-reset (Reset Mode = t-delay)	±1% or ±10 ms

Ground Current Elements: 51X[x] / 51R[x] / 67X[x] / 67R[x]	Accuracy^{*1) *2) *3)}
Pickup (measured ground current)	±1.5% of the setting value or 1% I _n
Pickup (calculated ground current)	±2.0% of the setting value or 1.5% I _n
Dropout Ratio	97% or 0.5% I _n
Operating Time	
Starting from IE higher than 1.1 x IE>	<45 ms
Disengaging Time	<55 ms
t-Multiplier	±5% (according to selected curve)
Reset Mode	±5% (according to selected curve)
t-reset (Reset Mode = t-delay)	±1% or ±10 ms

*1) When RMS is selected and $|f - f_n| > 5\text{Hz}$: operating and disengaging time < 4 cycles.

If $f < 30\text{Hz}$, pickup accuracy < ±6% of the setting value or 5% I_n.

*2) For directional elements, accuracy of MTA: ±3° at IE > 20% I_n.

*3) For earth current sensitive the precision does not depend on the nominal value but is referenced to 100 mA (with I_n = 1 A) respectively 500 mA (with I_n = 5 A)

NOTICE

Because detection of direction is based on DFT values, direction elements works only in nominal range ($f_n \pm 5\text{Hz}$).

Directional Sensitivity: 67P[x]	Value	Release Level	Blocking Level
I V (3-phases)	I V	10 mA 0.35 V	5 mA 0.25 V

Directional Sensitivity: 67X[x], 67R[x]	Value	Release Level	Blocking Level
IX 3V0	IX IX (sensitive) 3V0	10 mA 1 mA 0.35 V	5 mA 0.5 mA 0.25 V
IR 3V0	IR 3V0	18 mA 1 V	11 mA 0.8 V
IR IPol	IR IX IX (sensitive)	18 mA 10 mA 1 mA	11 mA 5 mA 0.5 mA
IX Neg, IR Neg	I2 V2	10 mA 0.35 V	5 mA 0.25 V

Phase Differential Protection: 87	Accuracy
I _d >	±3% of the setting value or 2% I _n .
Operating time	
I _d > 2 x pickup (step from zero to 200% pickup of 87-Char)	<40 ms
Typically trip time	30 ms
Shortest trip time	18 ms

Unrestrained Phase Differential Protection: 87H	Accuracy
Id >>	±3% of the setting value or 2% In.
Operating time	
Id > 1.1 x pickup:	<30 ms
Typically trip time	19 ms
Shortest trip time	13 ms

Ground Differential Protection: 87G	Accuracy
IdG >	±3% of the setting value or 2% In.
Operating time	
IdG > 2 x pickup (step from zero to 200% pickup of 87G-Char)	<40 ms
Typically trip time	30 ms
Shortest trip time	18 ms

Unrestrained Ground Differential Protection: 87GH	Accuracy
IdG >>	±3% of the setting value or 2% In.
Operating time	
IdG > 1.1 x pickup:	<30 ms
Typically trip time	19 ms
Shortest trip time	13 ms

Temperature Protection Elements: 49/38 [x] RTD Trip w /URTD	Accuracy
Trip Threshold	±1°C (1.8°F)
Alarm Threshold	±1°C (1.8°F)
t-delay Alarm	DEFT ±1% or ±10 ms
Reset Hysteresis	-2°C (-3.6°F) of threshold ±1°C (1.8°F)

Thermal Replica: ThR	Accuracy
Ib	±2% of the setting value or 1% In
Pickup ThR	±1.5 % of the setting value

Current unbalance: 46[x]	Accuracy ^{*1)}
Threshold	±2% of the setting value or 1% In
%(I2/I1)	±1%
t	DEFT ±1% or ±10 ms
Operating Time	<70 ms
Disengaging Time	<50 ms

*1) Negative-sequence current I2 must be $\geq 0.01 \times I_n$, I1 must be $\geq 0.1 \times I_n$.

Current unbalance: 46G[1]	Accuracy ^{*1)}
Threshold	±2% of the setting value or 1% FLA
t	DEFT ±1% or ±10 ms
Operating Time	<70 ms
Disengaging Time	<50 ms

Current unbalance: 46G[2]	Accuracy ^{*1)}
Threshold	±2% of the setting value or 1% FLA
K-value	±5% INV
K-reset	±5% INV
Tmax	±1% or ±10 ms
Tmin	±1% or ±10 ms
Operating Time	<70 ms
Disengaging Time	<50 ms

*1) The relation of CTprim/FLA must be less than 2. Negative-sequence current I₂ must be ≥ 0.01 I_n, I₁ must be ≥ 0.1 I_n.

Undervoltage and Overvoltage (Phase, Auxiliary and Neutral) 27M[x] / 59M[x] / 27A[x] / 59A[x] / 59N[x]	Accuracy ^{*1)}
Pickup	±1.5% of the setting value or 1% V _n
Dropout Ratio	97% or 0.5% V _n for 59[x] ^{*2)} 103% or 0.5% V _n for 27[x] ^{*3)}
t	DEFT ±1% or ±10 ms
Operating Time	<40ms 35 ms typically
Starting from V higher than 1.2 x pickup value for 59[x] or V lower than 0.8 x pickup value for 27[x]	
Disengaging Time	<45 ms

*1) When RMS is selected and |f - fn| > 5Hz: operating and disengaging time < 4 cycles or ±1%.

If f < 30Hz, pickup accuracy < ±6% of the setting value or 5% V_n.

*2) For 59M elements, the dropout is adjustable between 80 ...99%

*2) For 27M elements, the dropout is adjustable between 101...110%

Low Voltage Ride Through Protection: LVRT	Accuracy ^{*1)}
Voltage Pickup (Start)	±1.5% of the setting value or 1% V _n
Voltage Dropout Ratio (Recover)	Adjustable, at least 0.5% V _n
Tripping time delay	±1% from settings or ±10 ms
Operating Time	<35 ms
Starting from V lower than 0.9 x pickup value	
Disengaging Time	<45 ms

*1) When RMS is selected and |f - fn| > 5Hz: operating and disengaging time < 4 cycles or ±1%.

If f < 30Hz, pickup accuracy < ±6% of the setting value or 5% V_n.

Volts per Hertz: 24[x]	Accuracy
Pickup	$\pm 1\%$ ^{*1)} (20-70Hz / 0.1-1.5 Vn (with Vn=120V) / 100-150%)
t	DEFT $\pm 1\%$ or ± 10 ms
t-Multiplier	$\pm 5\% \pm 10$ ms (Volts/Hertz (%) higher than 1.1 x Pickup) INV A INV B INV C
t-reset	$\pm 1\%$ or ± 10 ms INV A INV B INV C
Operating Time Starting from Volts/Hertz (%) higher than 1.1 x Pickup	<60 ms (at fn) or < 4 cycles
Disengaging Time	<85 ms (at fn) or < 5 cycles

*1) The V/Hz function provides reliable measurements of V/Hz up to 200% for a frequency range of 5–70 Hz, if voltage (rms) is greater than 15% Vn and < 800V. U/f < 48 V/Hz.

Voltage unbalance: 47[x]	Accuracy ^{*1)}
Threshold	$\pm 2\%$ of the setting value or 1% Vn
%(V2/V1)	$\pm 1\%$
t	DEFT $\pm 1\%$ or ± 10 ms
Operating Time	<60 ms
Disengaging Time	<45 ms

*1) Negative-sequence voltage V2 must be $\geq 0.01 \times Vn$, V1 must be $\geq 0.1 \times Vn$.

Over Frequency Protection: 81O[x]	Accuracy ^{*1)}
Threshold	± 10 mHz at fn
Dropout	< 0.05% fn
t	$\pm 1\%$ or ± 10 ms
Operating time Starting from f higher than f> + 0.02 Hz + 0.1 Hz + 2.0 Hz	<100 ms typically 70 ms typically 50 ms
Disengaging time	<120 ms

Under Frequency Protection: 81U[x]	Accuracy ^{*1)}
Threshold	± 10 mHz at fn
Dropout	< 0.05% fn
t	$\pm 1\%$ or ± 10 ms
Operating time Starting from f lower than f< - 0.02 Hz - 0.1 Hz - 2.0 Hz	<100 ms typically 70 ms typically 50 ms
Disengaging time	<120 ms

Undervoltage-blocking Frequency:	Accuracy ^{*1)}
Blocking below 15% Vn	for phase-voltage frequency Vn: 0.57 * rated Main VT, for Wye connection Vn: 1.0 * rated Main VT, for Open-Delta connection.
V Block f	±1.5% of the setting value or 1% Vn
Dropout ratio	120% or 0.5% Vn

*1) Accuracy is given for rated frequency $f_n \pm 10\%$.

Rate of Change of Frequency: df/dt	Accuracy ^{*1)}
Threshold	±0.1 Hz/s ²⁾
t	±1% or ±10 ms
Operating time Starting from f_n and $df/dt > \text{pickup} + 0.1 \text{ Hz/s}$ At $df/dt > 2 \text{ times pickup}$ At $df/dt > 5 \text{ times pickup}$	<200 ms typically <100 ms typically < 70 ms
Disengaging time	<120 ms

*1) Accuracy is given for rated frequency $f_n \pm 10\%$.

*2) 10% additional tolerance per Hz deviation from nominal frequency f_n (e.g. at 45Hz, tolerance is 0.15Hz/s).

Rate of Change of Frequency: DF/DT	Accuracy
DF	±20 mHz at f_n
DT	±1% or ±10 ms

Vector surge: 78V	Accuracy
Threshold	±0.5° [1-30°] at V_n and f_n
Operating time	<40 ms

Power Factor: PF-55D/PF-55A	Accuracy
Trigger-PF	± 0.01 (absolute) or ±1°
Reset-PF	± 0.01 (absolute) or ±1°
t-trip	±1% or ±10 ms
T-Pickup Comp	±1% or ±10 ms
T-Reset Comp	±1% or ±10 ms
Operating time	^{*1)}
55D	<130 ms
55A	<200 ms

*1) The calculation of the Power Factor will be available 300 ms after the required measuring values ($I > 2.5\% I_n$ and $V > 20\% V_n$) have energized the measuring inputs.

PQ-protection: 32[x]/32V[x]	Accuracy ^{*2)}
Threshold	±3% or ±0.1% VAn
Dropout Ratio	97% or 1 VA for Over-protection 103% or 1 VA for Under-protection for setting values ≤ 0.1 Sn: 60% or 0.5 VA for Over-protection 140% or 0.5 VA for Under-protection for setting values ≤ 0.01 Sn 60% or 0.2 VA for Over-protection 140% or 0.2 VA for Under-protection
t	±1% or ±10 ms
Operating time	<100 ms 75 ms typically
Disengaging time	100 ms

*1) Common reference conditions: at |PF|>0.5, symmetrically fed, at fn and 0.8 - 1.3 x Vn (Vn=100V)

*2) When |f - fn| > 5Hz: operating and disengaging time < 6 cycles or ±1%.

f < 30Hz, pickup accuracy < ±6% of the setting value or 5% Sn. 32V[x] protection elements may be blocked when |f - fn| > 5Hz.

Loss of Excitation: 40-Z1[x] / 40-Z2[x]	Accuracy
Mho	±1.5% or ±0.01 Ohm (5 A)/ ±0.05 Ohm (1 A) (related to the maximum impedance reach)
Dropout Ratio	105% or +0.01 Ohm (5 A)/ +0.05 Ohm (1 A) (related to Mho pickup radium)
t-Mho	±1% or ±20 ms
V(Positive Sequence) < Pickup	±2% of the setting value or 1% Vn
t-V<	±1% or ±30 ms
Directional Angle Pickup	±1°
Operating Time	<50 ms

Inadvertent Energy: 50/27	Accuracy
O/C Pickup	±1.5% of the setting value or 1% In
U/V Pickup	±1.5% of the setting value or 1% In
Pickup Delay	±1% or ±10 ms
Dropout Delay	±1% or ±10 ms
O/C Pickup operating time	<35 ms
O/C Pickup disengaging time	<45 ms
U/V Pickup operating time	<30 ms
U/V Pickup disengaging time	<30 ms

Sync-Check: Sync	Accuracy
Voltage measurement	±1.5% of the setting value or 1% Vn
Slip Frequency measurement	±20 mHz at fn
Angle measurement	±2°
Angle Compensation measurement	±4°
t (all timers)	±1% or ±10 ms

Q->&V< / Decoupling	Tolerance
I min QV	±1.5% of the setting value or ±1% I _n
Dropout Ratio	95% or 0.5% I _n
VLL< QV	±1,5% of the setting value or ±1% V _n
Dropout Ratio	102% or 0.5% V _n
Phi-Power	±1°
Q min QV	±3% of the setting value or ±0.1% S _n
Dropout Ratio	95%
t1-QV	±1% or ±10 ms
t2-QV	±1% or ±10 ms
Operating Time	<40 ms
Disengaging Time	<40 ms

ReCon / Release Para	Tolerance
VLL-Release	±1.5% of the setting value or ±1% V _n
Dropout Ratio	98% or 0.5% V _n for VLL> 102% or 0.5% V _n for VLL<
f	±20 mHz at f _n
Dropout	< 0.05% f _n
t-Release	±1% or ±10 ms
Operating Time	<40 ms

Switch onto Fault: SOTF	Accuracy
Operating time	<35 ms
I<	±1.5% of the setting value or 1% I _n
t-enable	±1% or ±10 ms

Cold Load Pickup: CLPU	Accuracy
Threshold	±1.5% of the setting value or 1% I _n
Operating time	<35 ms
I<	±1.5% of the setting value or 1% I _n
t-Load OFF	±1% or ±15 ms
t-Max Block	±1% or ±15 ms
Settle Time	±1% or ±15 ms

Breaker Failure Protection: 50BF	Accuracy
I-BF>	±1.5% of the setting value or 1% I _n
t-BF	±1% or ±10 ms
Operating Time	<40 ms
Starting from I Higher than 1.3 x I-BF>	<40 ms
Disengaging Time	<40 ms

<i>Trip Circuit Monitoring: TCM</i>	<i>Accuracy</i>
t-TCM	±1% or ±10 ms

<i>Current Transformer Supervision: CTS</i>	<i>Accuracy</i>
ΔI	±2% of the setting value or 1.5% In
Dropout Ratio	94%
Pickup delay	±1% or ± 10 ms

<i>Loss of Potential: LOP</i>	<i>Accuracy</i>
t-Pickup	±1% or ±10 ms

Appendix

The following terms, abbreviations, and acronyms are used in this manual. Please refer to this section for their meanings / definitions.

A	Ampere(s), Amp(s)
AC	Alternating current
A/D	Analog to digital
Ack.	Acknowledge
AMP	Ampere(s), Amp(s)
AND	Logical gate (The output becomes true if all Input signals are true.)
ANG	Angle
ANSI	American National Standards Institute
AR	Automatic reclosure
AUX	Auxiliary
AVG, avg	Average
AWG	American wire gauge
BF	Breaker failure
BFI	Breaker failure initiate
BKR, bkr	Breaker
Blo	Blocking(s)
°C	Degrees Celsius
calc	Calculated
CB	Circuit breaker
CD	Compact disk
Char	Curve shape
CHK	Check
CHNL	Channel
Cmd.	Command
CMND	Command
CMN	Common input
COM	Common input
Comm	Communication

COMP	Compensated, comparison
CONN	Connection
CONT	Continuous, contact
CPU	Central processing unit
Cr.	Counter(s)
CRT, CRNT	Current
CSA	Canadian Standards Association
CT	Control transformer
Ctrl.	Control
CTS	Current transformer supervision
d	Day
D/A	Digital to analog
D-Sub-Plug	Communication interface
DC, dc	Direct current
DEFT	Definite time characteristic (Tripping time does not depend on the height of the current.)
DFLT	Default
DGNST	Diagnostics
DI	Digital Input
Diagn.	Diagnosis
Diagn Cr	Diagnosis counter(s)
DIFF	Differential
DIN	Deutsche Industrie Norm
DIR, dir	Directional
DMD	Demand
DPO	Dropout
DSP	Digital signal processor
dt	Rate of change
EINV	Extremely inverse tripping characteristic
EMC	Electromagnetic compatibility
EN	Europäische Norm
err. / Err.	Error
EVTcon	Parameter determines if the residual voltage is measured or calculated.

Ex	External
ExBlo	External blocking(s)
ExP	External protection
EXT	Extension, external
°F	Degrees Fahrenheit
F	Field
Fc	Function (Enable or disable functionality = allow or disallow.)
FIFO	First in first out
FIFO Principal	First in first out
FLA	Full load current
FO	Fiber optic
FTP	File transfer protocol
fund	Fundamental (ground wave)
FWD	Forward
G, g	Generator
gn	Acceleration of the earth in vertical direction (9.81 m/s ²)
GND	Ground
GPS	Global positioning system
h	Hour
HARM	Harmonic / harmonics
HMI	Human machine interface (Front of the protective relay)
HTL	Manufacturer internal product designation
HTTP	Hyper text transfer protocol
Hz	Hertz
I	Fault current
I	Current
I0	Zero current (symmetrical components), Zero sequence current
I1	Positive sequence current (symmetrical components)
I2	Negative sequence current (symmetrical components)
IA	Phase A current
IAB	Phase A minus B current
IB	Phase B current
IBC	Phase B minus C current

I-BF	Tripping threshold
IC	Phase C current
IC's	Manufacturer internal product designation
ICA	Phase C minus A current
ID	Identification
IEC	International Electrotechnical Commission
IED	Intelligent electronic device
IEEE	Institute of Electrical and Electronics Engineers
IG	Ground current (not residual)
IG	Fault current
Igd	Differential ground current
IGnom	Nominal ground current
IH1	Fundamental harmonic (1 st harmonic)
IH2	2 nd harmonic
IINV	Inverse
in.	Inch
incl.	Include, including
Info.	Information
Interl.	Interlocking
INV	Inverse characteristic (The tripping time will be calculated depending on the height of the current)
I/O	Input / output
IOC	Instantaneous overcurrent
IOV	Instantaneous overvoltage
IR	Calculated ground current
IRIG	Input for time synchronization (Clock), Inter-range instrumentation group
ISO	International Standards Organization
IT	Thermal Characteristic
I2T	Thermal Characteristic
I4T	Thermal Characteristic
IUV	Instantaneous undervoltage
IX	4 th measuring input of the current measuring assembly group (either ground or neutral current)
J	Joule

kA	Kiloampere
kg	Kilogram
kHz	Kilohertz
kV	Kilovolt(s)
kVdc or kVDC	Kilovolt(s) direct current
L1	Phase A
L2	Phase B
L3	Phase C
I/In	Ratio of current to nominal current.
LED	Light emitting diode
lb-in	Pound-inch
LINV	Long time inverse tripping characteristic
LV	Low voltage
m	Meter
M	Machine
mA	Milliampere(s), Milliamp(s)
MAG	Magnitude
MAN, man.	Manual / manually
MAX, max.	Maximum
meas	Measured
MIN, min.	Minimum
min.	Minute
MINV	Moderately Inverse Tripping Characteristic
MK	Manufacturer Internal Product Designation Code
mm	Millimeter
MMU	Memory mapping unit
MRT	Minimum response time
ms	Milli-second(s)
MTA	Maximum torque angle
MTR	Motor
MV	Medium voltage
mVA	Milli volt amperes (Power)

MVA	Mega volt-ampere (total 3-phase)
MVA A	Mega volt-ampere (phase A)
MVA B	Mega volt-ampere (phase B)
MVA C	Mega volt-ampere (phase C)
MVAR	Mega Var (total 3-phase)
MVAR A	Mega Var (phase A)
MVAR B	Mega Var (phase B)
MVAR C	Mega Var (phase C)
MVARH	Mega Var-Hour
MW	Megawatt(s) (total 3-phase)
MW A	Megawatt(s) (phase A)
MW B	Megawatt(s) (phase B)
MW C	Megawatt(s) (phase C)
MWH	Megawatt-Hour(s)
N	Neutral
N/A, n/a	Not applicable
N.C.	Not connected
NEG	Negative
NINV	Normal inverse tripping characteristic
Nm	Newton-meter
No	Number
N.O.	Normal open (Contact)
NOM, Nom.	Nominal
NT	Manufacturer internal product designation code
O	Over
OC, O/C	Overcurrent
O/P, Op, OUT	Output
OV	Overvoltage
OVERFREQ	Overfrequency
OVL	Overload
P	Phase
Para.	Parameter
PC	Personal computer
PCB	Printed circuit board

PE	Protected Earth
p.u.	per unit (per-unit system)
PF	Power factor (total 3-phase)
PF A	Power factor (phase A)
PF B	Power factor (phase B)
PF C	Power factor (phase C)
Ph	Phase
POS	Positive
PRESS	Pressure
PRI, pri	Primary
PROT, Prot	Protection Module (Master Module), protection
PS1	Parameter set 1
PS2	Parameter set 2
PS3	Parameter set 3
PS4	Parameter set 4
PSet	Parameter set
PSS	Parameter set switch (Switching from one parameter set to another)
pu	Per unit
PWM	Pulse width modulated
PWR	Power
R	Reset
rec.	Record
REF	Reference
rel	Relative
REM	Remote
res	Reset
ResetFct	Reset function
REV	Reverse
RevData	Review data
RMS	Root mean square
RO	Relay Output
RO1	1 st Relay Output
RO2	2 nd Relay Output

RO3	3 rd Relay Output
Rst	Reset
RTD	Resistance-temperature detector
RX (Rx)	Receive, receiver
s	Second
S	Sensitive
SAT	CT saturation
SC	Supervision contact
Sca	SCADA
SCADA	Communication module, supervisory control and data acquisition
sec	Second(s)
SEC, sec	Secondary
SENS	Sensitive
SEQ	Sequence
Sig.	Signal
SNTP	Simple network time protocol
SRC	Source
StartFct	Start function
STATS	Statistics
Sum	Summation
SUPERV	Supervision
SW	Software
SYNC	Sync-check, Synchrocheck
SYNCHCHK	Sync-check, Synchrocheck
Sys.	System
t or t.	Time
t	Tripping delay
T	Time, transformer
Tcmd	Trip command
TCP	Transmission control protocol
TCP/IP	Communication protocol
TEMP, temp	Temperature
THD	Total harmonic distortion

TI	Manufacturer internal product designation code
TOC	Time overcurrent
TOV	Time overvoltage
TRANS	Transient
TripCmd	Trip command
TX (Tx)	Transmit, transmitter
txt	Text
UC	Undercurrent
UL	Underwriters Laboratories
UMZ	DEFT (definite time tripping characteristic)
URTD	Universal resistance-temperature detector
USB	Universal serial bus
V	Volts
V0	Zero sequence voltage
V1	Positive sequence voltage
V2	Negative sequence voltage
VA	Phase A voltage
VAB	Phase A to B voltage
Vac / V ac	Volts alternating current
VAG	Phase A to ground voltage
VARH	Var-hour voltage
VB	Phase B voltage
VBA	Phase B to A voltage
VBG	Phase B to ground voltage
VC	Phase C voltage
VCA	Phase C to A voltage
VCG	Phase C to ground voltage
Vdc / V dc	Volts direct current
VDE	Verband Deutscher Elektrotechnik
VDEW	Verband der Elektrizitätswirtschaft
VE	Residual voltage
V/Hz	Volts per Hertz
VINV	Very inverse tripping characteristic

VT	Voltage transformer
VTs	Voltage transformer supervision
W	Watt(s)
WDC	Watch dog contact (supervision contact)
WDG	Winding
WH	Watthour
www	World wide web
X	Reactance
XCT	4 th current measuring input (ground or neutral current)
XInv	Inverse characteristic
Z	Impedance, zone

Instantaneous Current Curves (Phase)

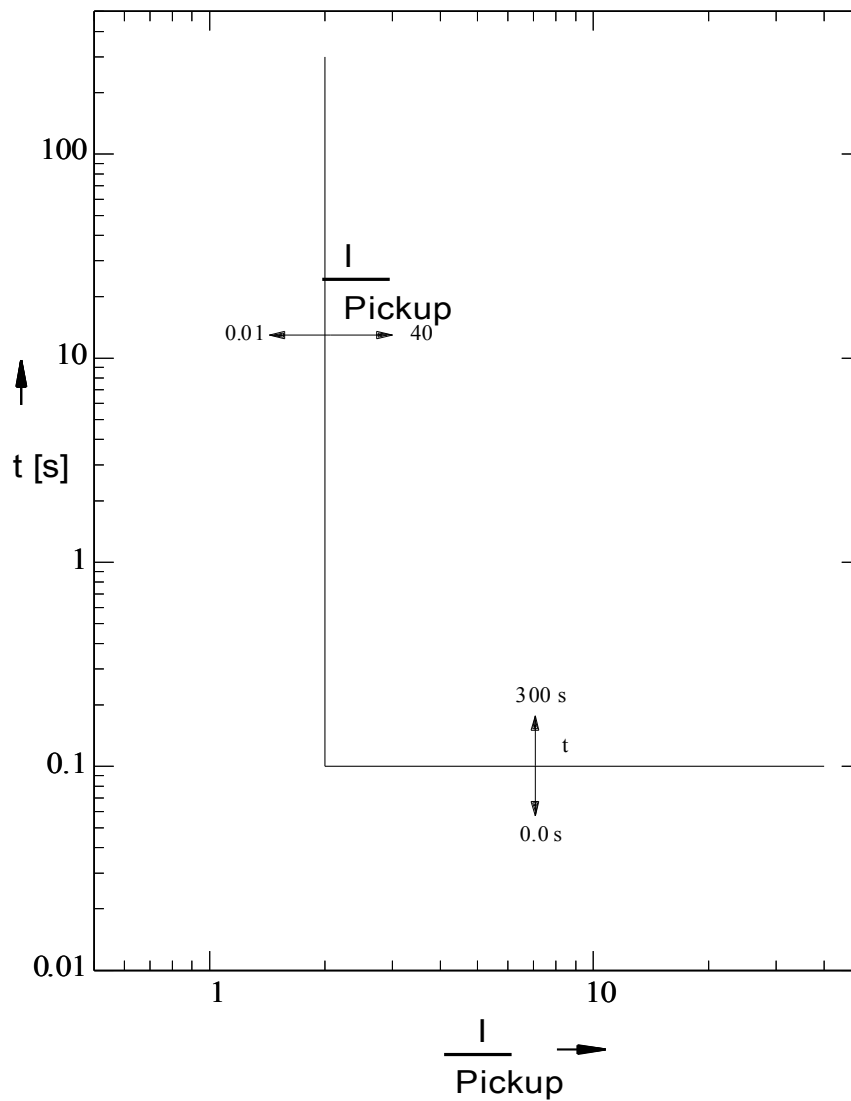
Explanation:

t = Tripping delay

I = Fault current

Pickup = If the pickup value is exceeded, the module/element starts to time out to trip .

DEFT



Time Current Curves (Phase)

The following characteristics are available:

- NINV (IEC/XInv);
- VINV (IEC/XInv);
- LINV (IEC/XInv);
- EINV (IEC/XInv);
- MINV (ANSI/XInv);
- VINV (ANSI/XInv);
- EINV (ANSI/XInv);
- Thermal Flat;
- Therm Flat IT;
- Therm Flat I2T; and
- Therm Flat I4T.

Explanation:

t = Tripping delay

t-multiplier = Time multiplier/tripping characteristic factor . The setting range depends on the selected tripping curve.
I = Fault current

Pickup = If the pickup value is exceeded, the module/element starts to time out to trip .

IEC NINV

**Notice!**

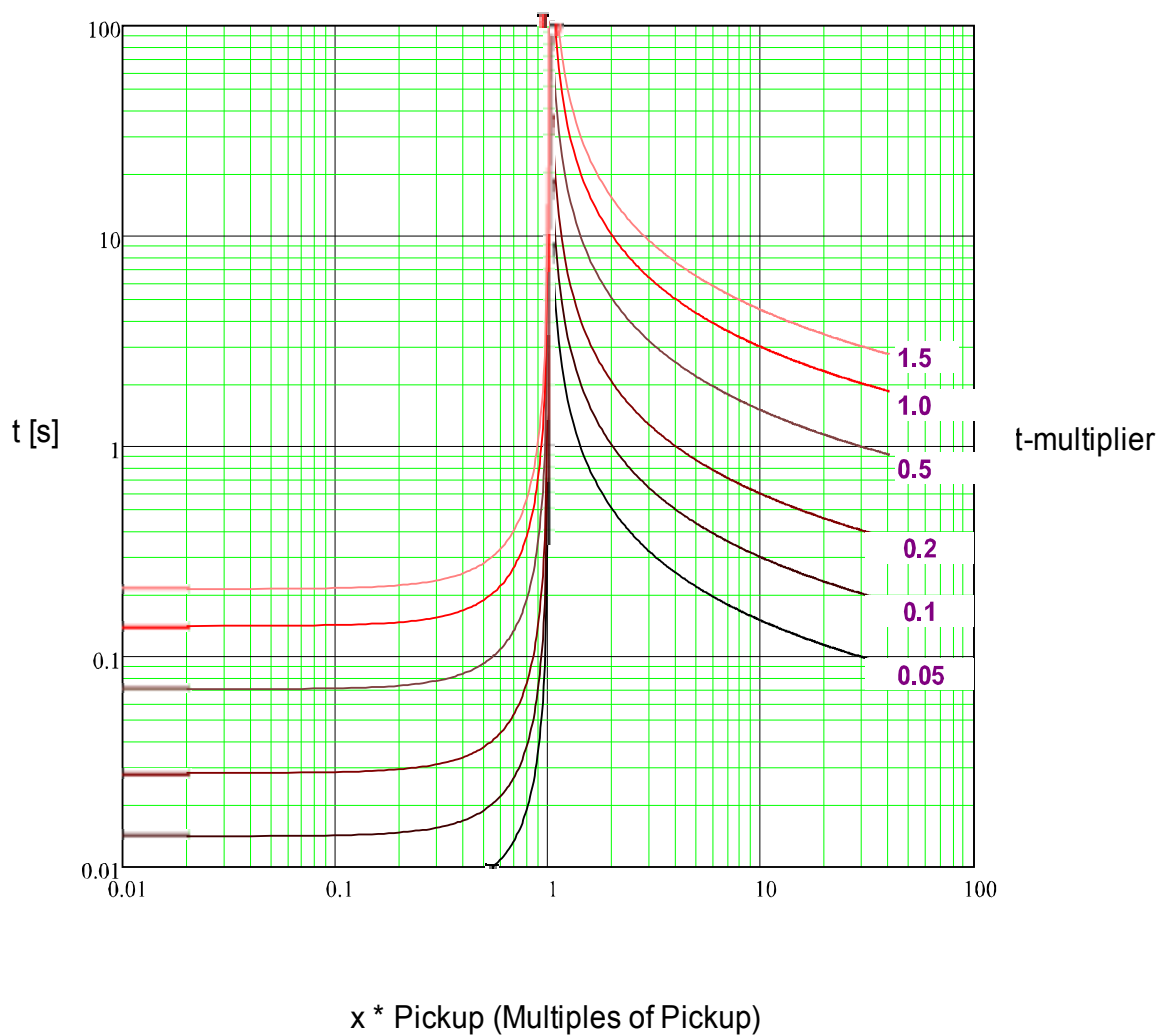
Various Reset Modes are available . Resetting via characteristic, delayed, and instantaneous .

Reset

$$t = \left| \frac{0.14}{\left(\frac{I}{I_{Pickup}} \right)^2 - 1} \right| * t\text{-multiplier [s]}$$

Trip

$$t = \frac{0.14}{\left(\frac{I}{I_{Pickup}} \right)^{0.02} - 1} * t\text{-multiplier [s]}$$



IEC VINV

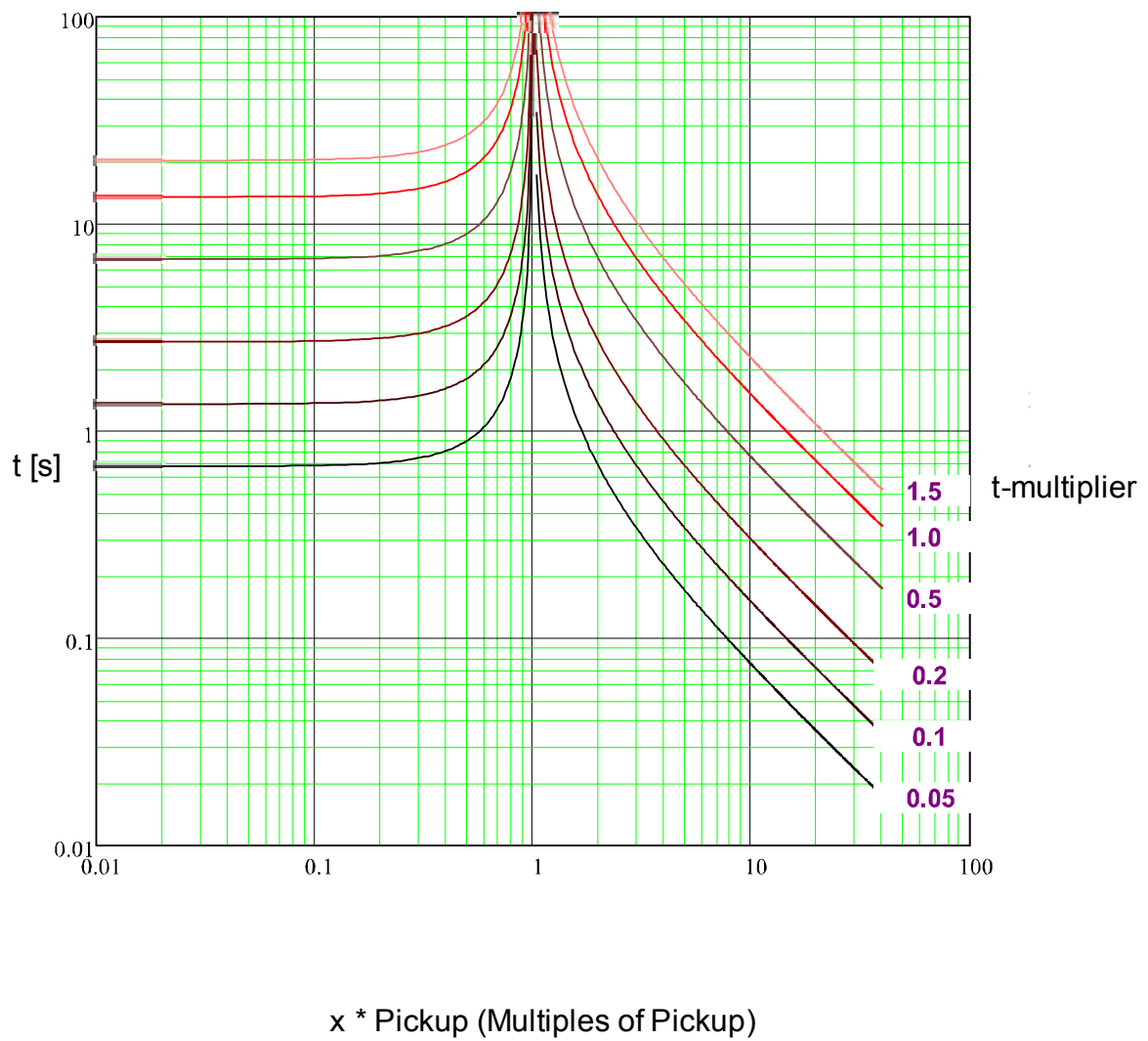
**Notice!**

Various Reset Modes are available . Resetting via characteristic, delayed , and instantaneous .

Reset**Trip**

$$t = \left| \frac{13.5}{\left(\frac{I}{I_{Pickup}}\right)^2 - 1} \right| * t\text{-multiplier [s]}$$

$$t = \frac{13.5}{\left(\frac{I}{I_{Pickup}}\right)^2 - 1} * t\text{-multiplier [s]}$$



IEC LINV



Notice!

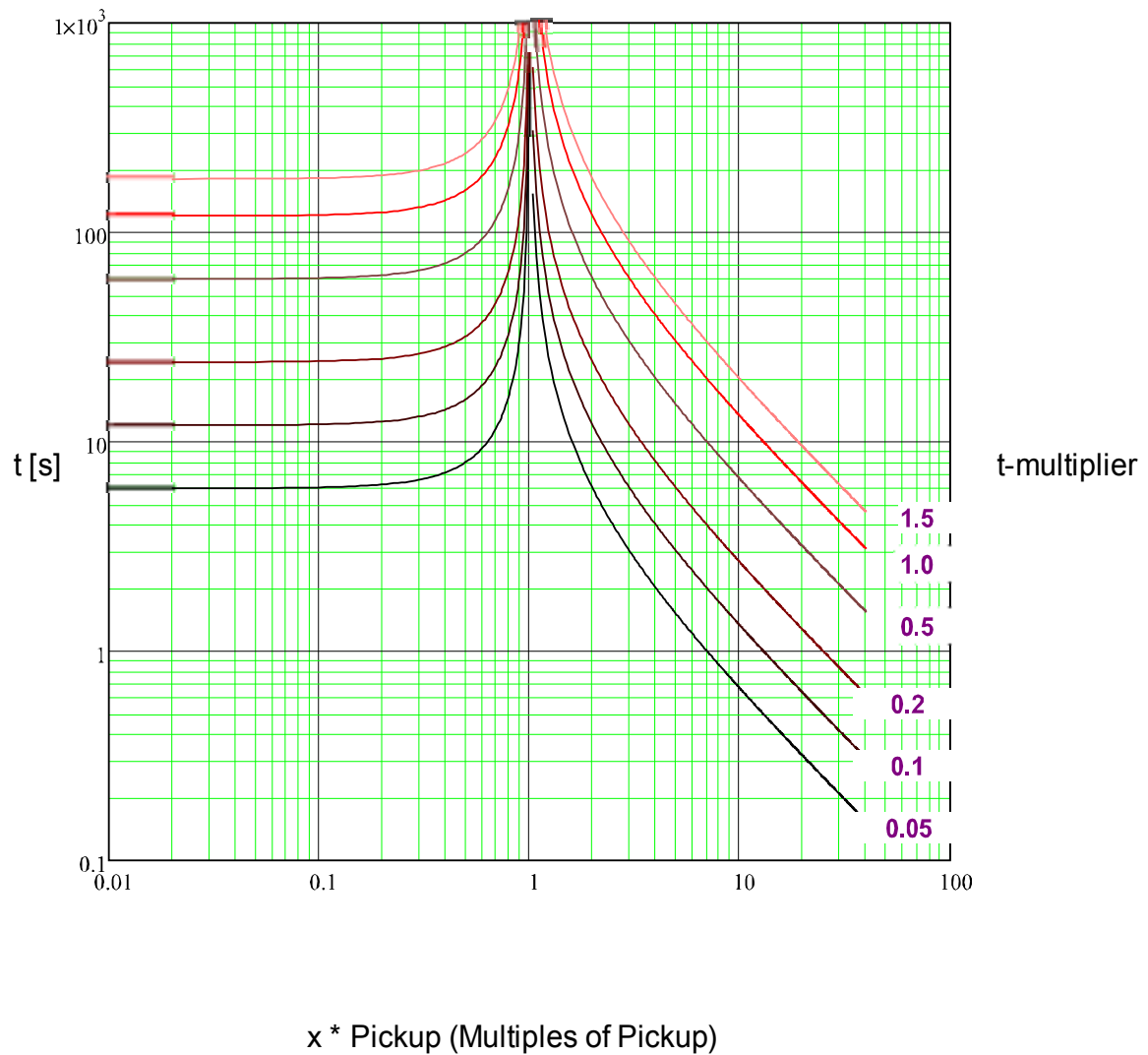
Various Reset Modes are available . Resetting via characteristic, delayed , and instantaneous .

Reset

Trip

$$t = \left| \frac{120}{\left(\frac{I}{I_{Pickup}}\right)^2 - 1} \right| * t\text{-multiplier [s]}$$

$$t = \frac{120}{\left(\frac{I}{I_{Pickup}}\right)^2 - 1} * t\text{-multiplier [s]}$$



IEC EINV

**Notice!**

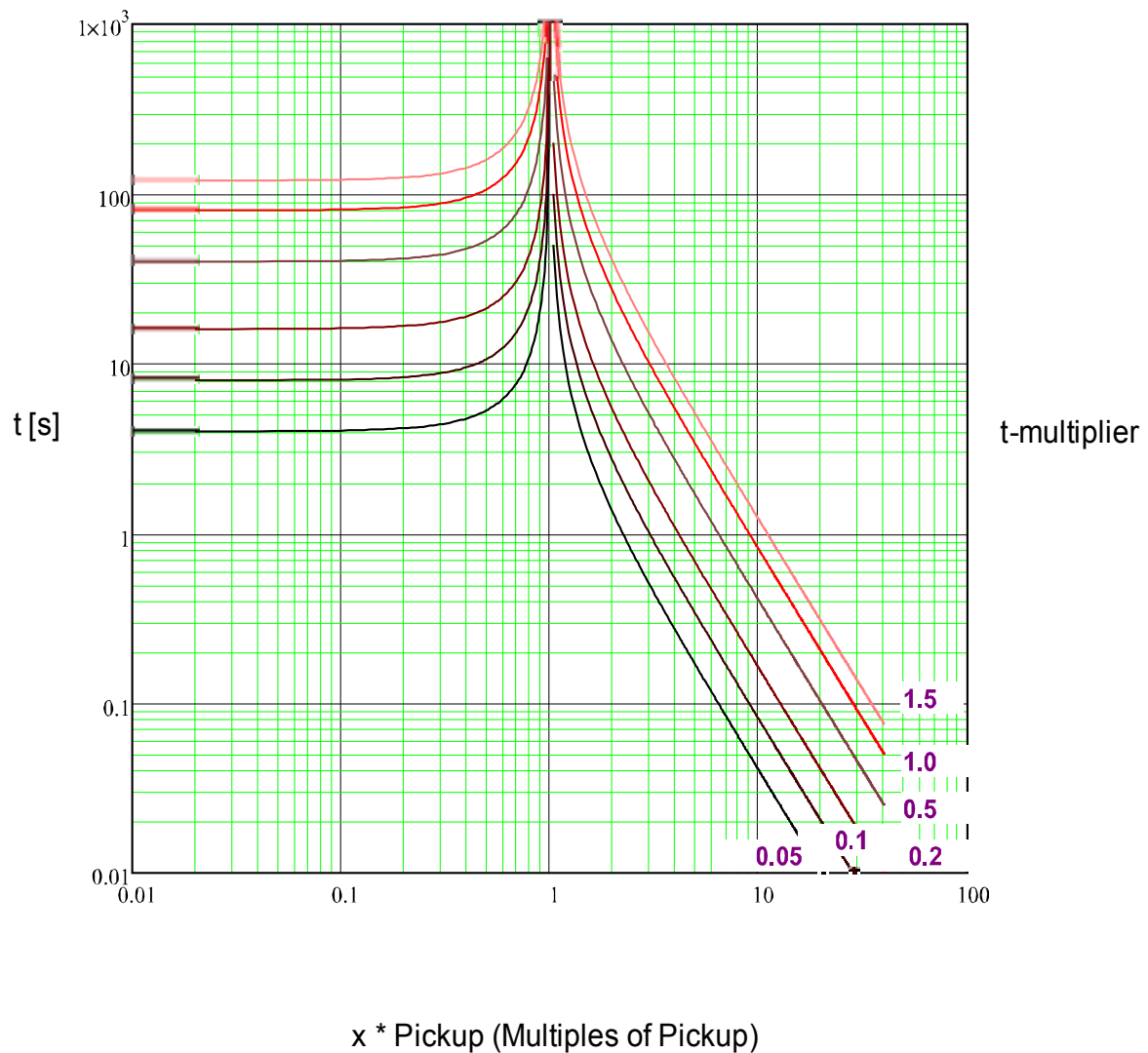
Various Reset Modes are available . Resetting via characteristic, delayed , and instantaneous .

Reset

$$t = \left| \frac{80}{\left(\frac{I}{I_{Pickup}}\right)^2 - 1} \right| * t\text{-multiplier [s]}$$

Trip

$$t = \frac{80}{\left(\frac{I}{I_{Pickup}}\right)^2 - 1} * t\text{-multiplier [s]}$$



ANSI MINV**Notice!**

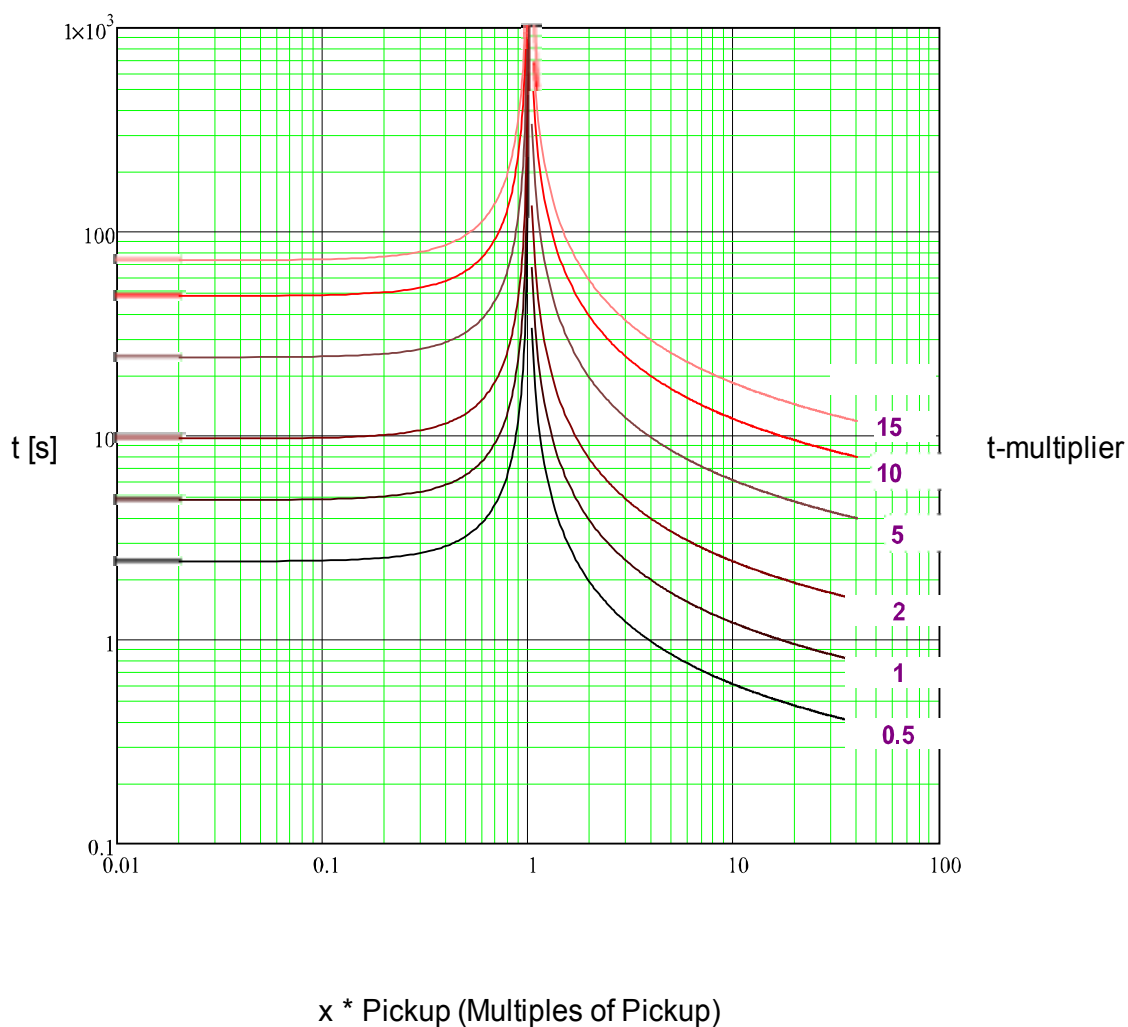
Various Reset Modes are available . Resetting via characteristic, delayed, and instantaneous .

Reset

$$t = \left| \frac{4.85}{\left(\frac{1}{\text{Pickup}}\right)^2 - 1} \right| * t\text{-multiplier [s]}$$

Trip

$$t = \left(\frac{0.0515}{\left(\frac{1}{\text{Pickup}}\right)^{0.02} - 1} + 0.1140 \right) * t\text{-multiplier [s]}$$



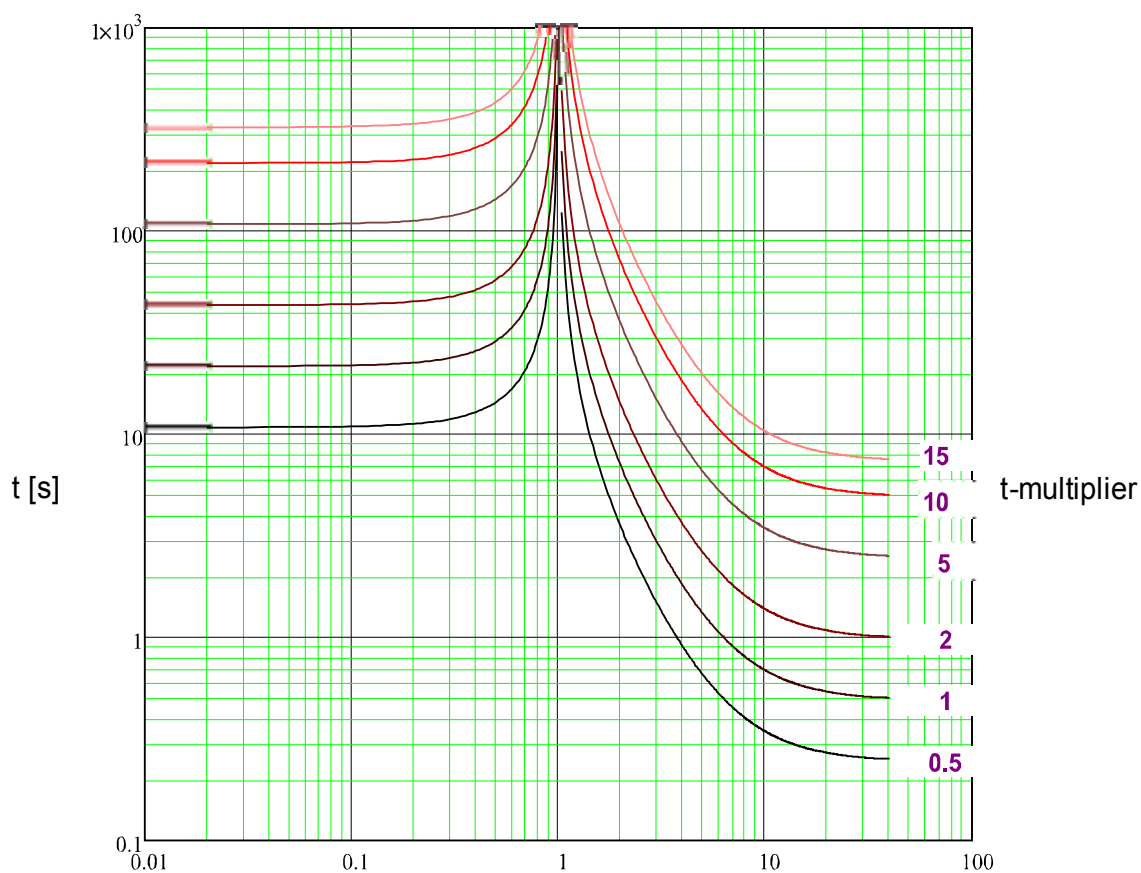
ANSI VINV

**Notice!**

Various Reset Modes are available . Resetting via characteristic, delayed , and instantaneous .

Reset**Trip**

$$t = \left| \frac{21.6}{\left(\frac{1}{\text{Pickup}}\right)^2} \right| * t\text{-multiplier [s]} \quad t = \left(\frac{19.61}{\left(\frac{1}{\text{Pickup}}\right)^2} + 0.491 \right) * t\text{-multiplier [s]}$$



$x * \text{Pickup}$ (Multiples of Pickup)

ANSI EINV



Notice!

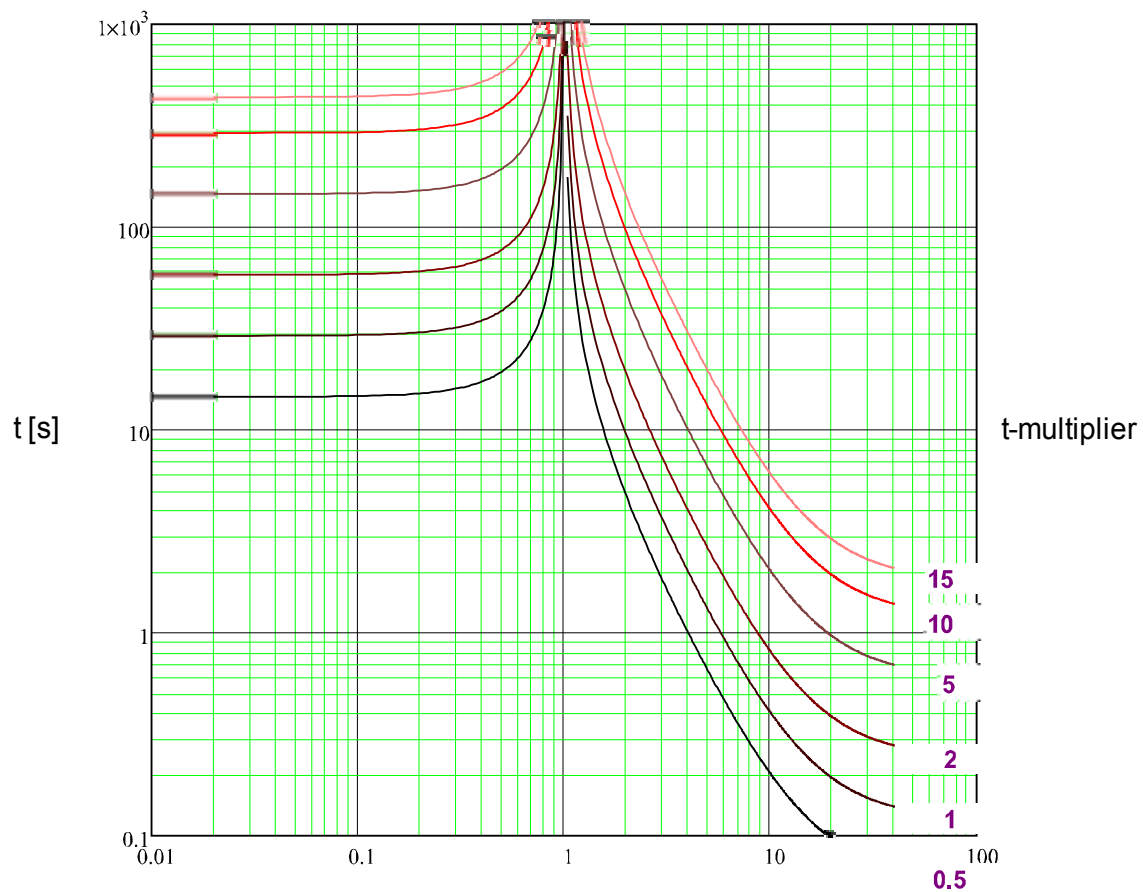
Various Reset Modes are available . Resetting via characteristic, delayed, and instantaneous .

Reset

$$t = \left| \frac{29.1}{\left(\frac{1}{\text{Pickup}}\right)^2 - 1} \right| * t\text{-multiplier [s]}$$

Trip

$$t = \left(\frac{28.2}{\left(\frac{1}{\text{Pickup}}\right)^2 - 1} + 0.1217 \right) * t\text{-multiplier [s]}$$



$x * \text{Pickup}$ (Multiples of Pickup)

Therm Flat

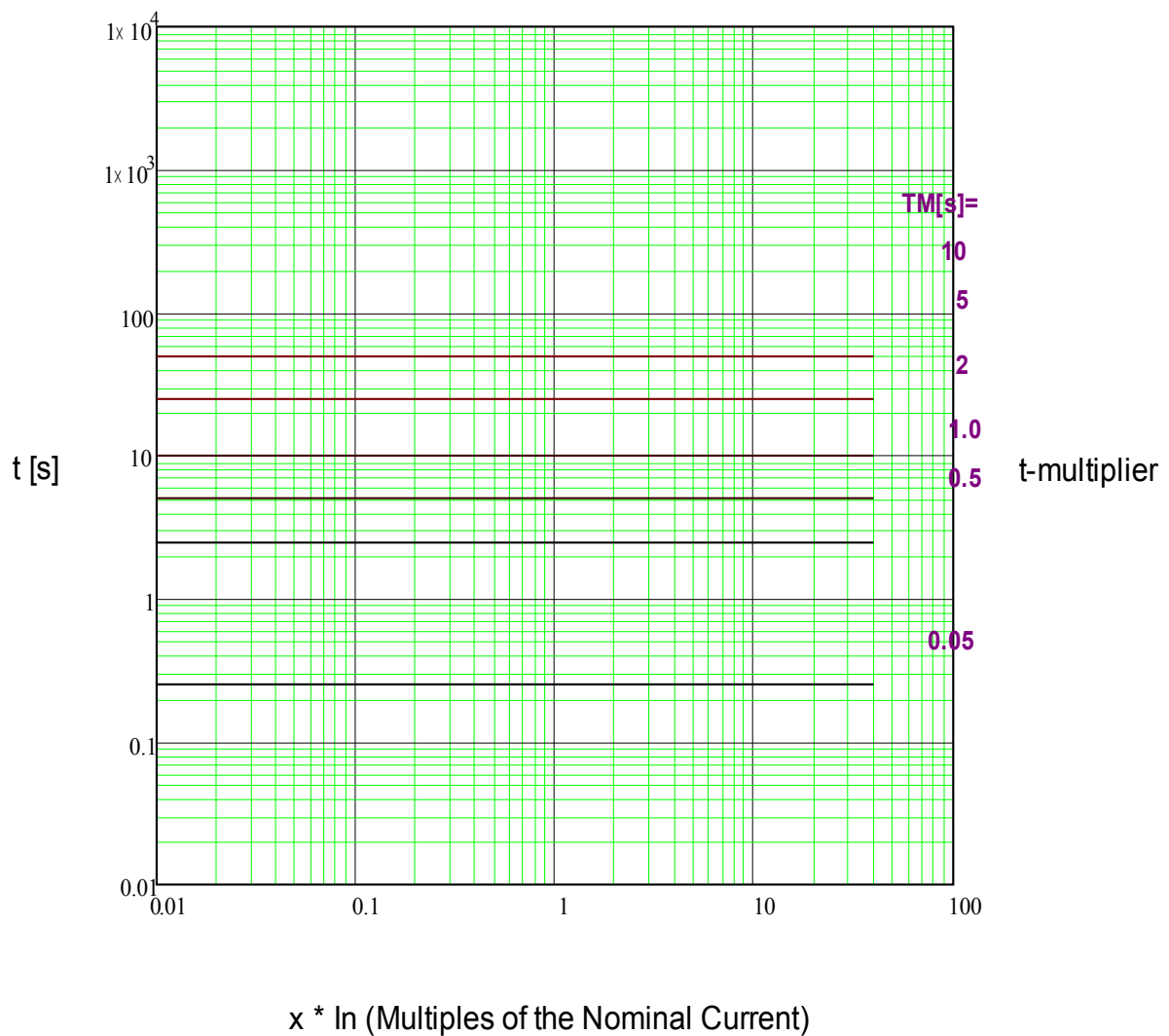


Notice!

Various Reset Modes are available . Resetting via characteristic, delayed , and instantaneous .

$$t = \left| \frac{5 \cdot 3^2}{\left(\frac{I}{I_n}\right)^0} \right| * t\text{-multiplier [s]} \quad \text{Reset} \quad t = \frac{5 \cdot 1^2}{\left(\frac{I}{I_n}\right)^0} * t\text{-multiplier [s]} \quad \text{Trip}$$

$$t = 45 * t\text{-multiplier [s]}$$



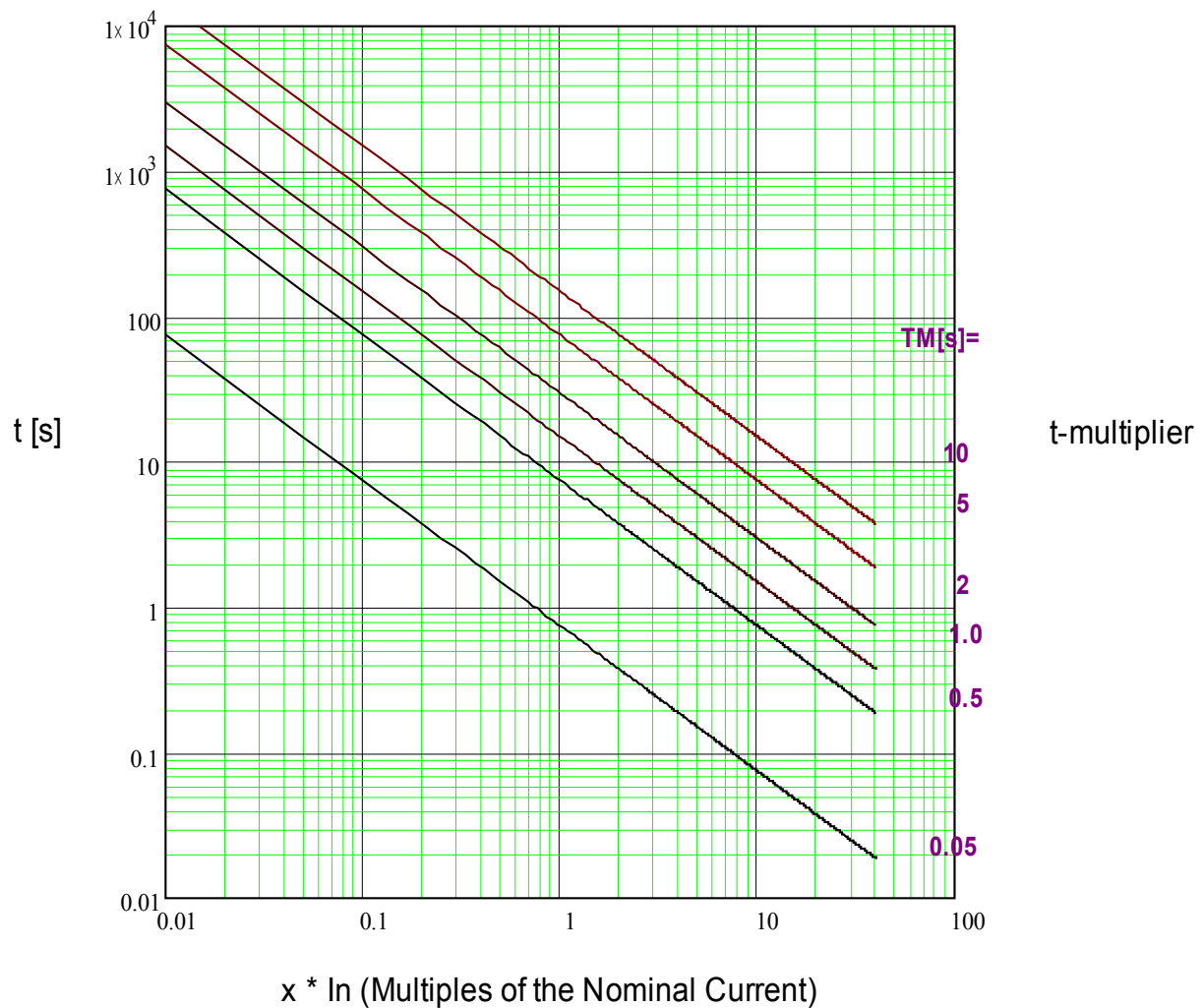
IT

**Notice!**

Various Reset Modes are available . Resetting via characteristic, delayed , and instantaneous .

Reset**Trip**

$$t = \left| \frac{5 \cdot 3^2}{\left(\frac{I}{I_n}\right)^0} \right| \cdot t\text{-multiplier [s]} \quad t = \frac{5 \cdot 3^1}{\left(\frac{I}{I_n}\right)^1} \cdot t\text{-multiplier [s]}$$

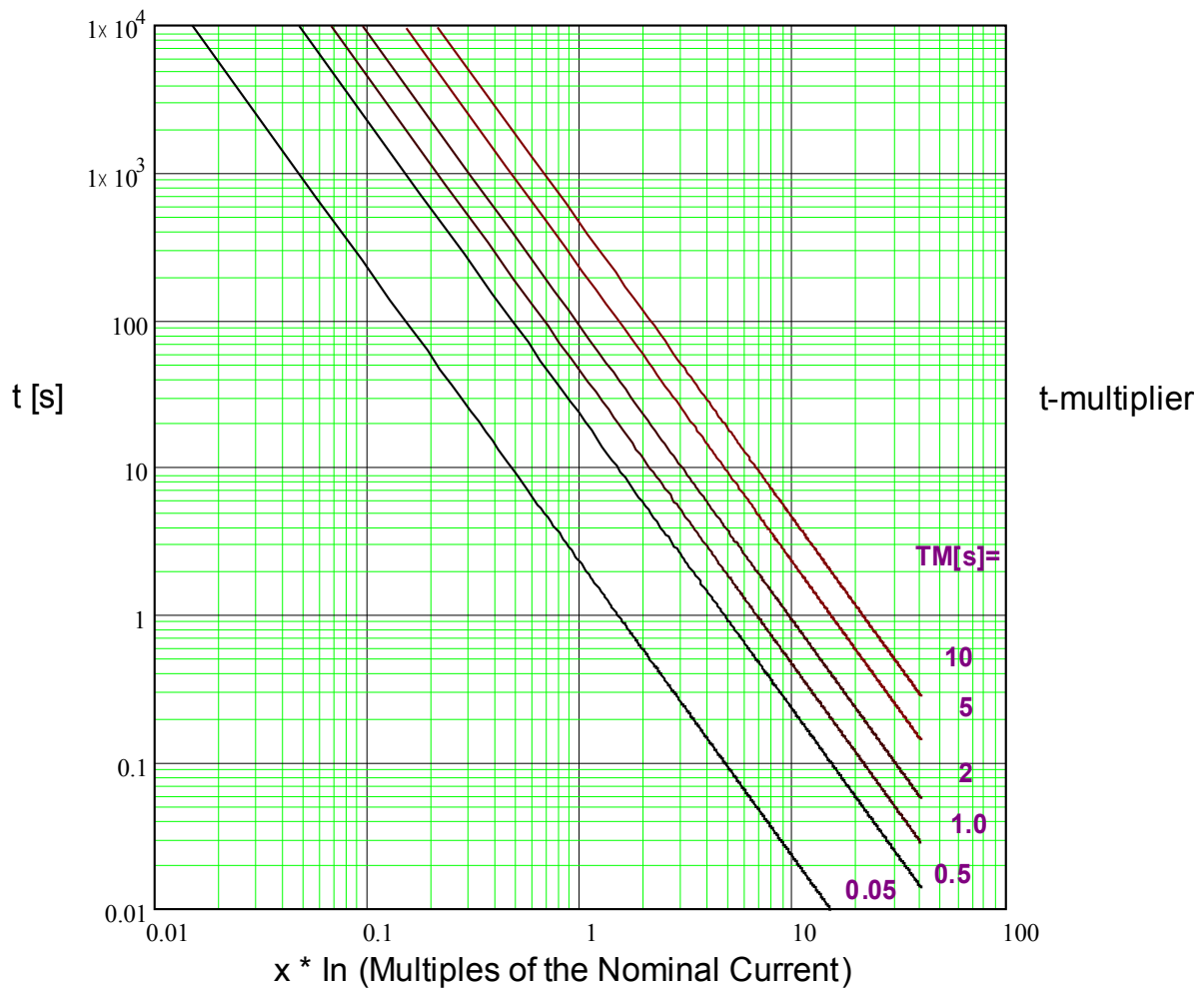


I²T**Notice!**

Various Reset Modes are available . Resetting via characteristic, delayed , and instantaneous .

Reset**Trip**

$$t = \left| \frac{5 \cdot 3^2}{\left(\frac{I}{I_n}\right)^0} \right| * t\text{-multiplier [s]} \quad t = \frac{5 \cdot 3^2}{\left(\frac{I}{I_n}\right)^2} * t\text{-multiplier [s]}$$

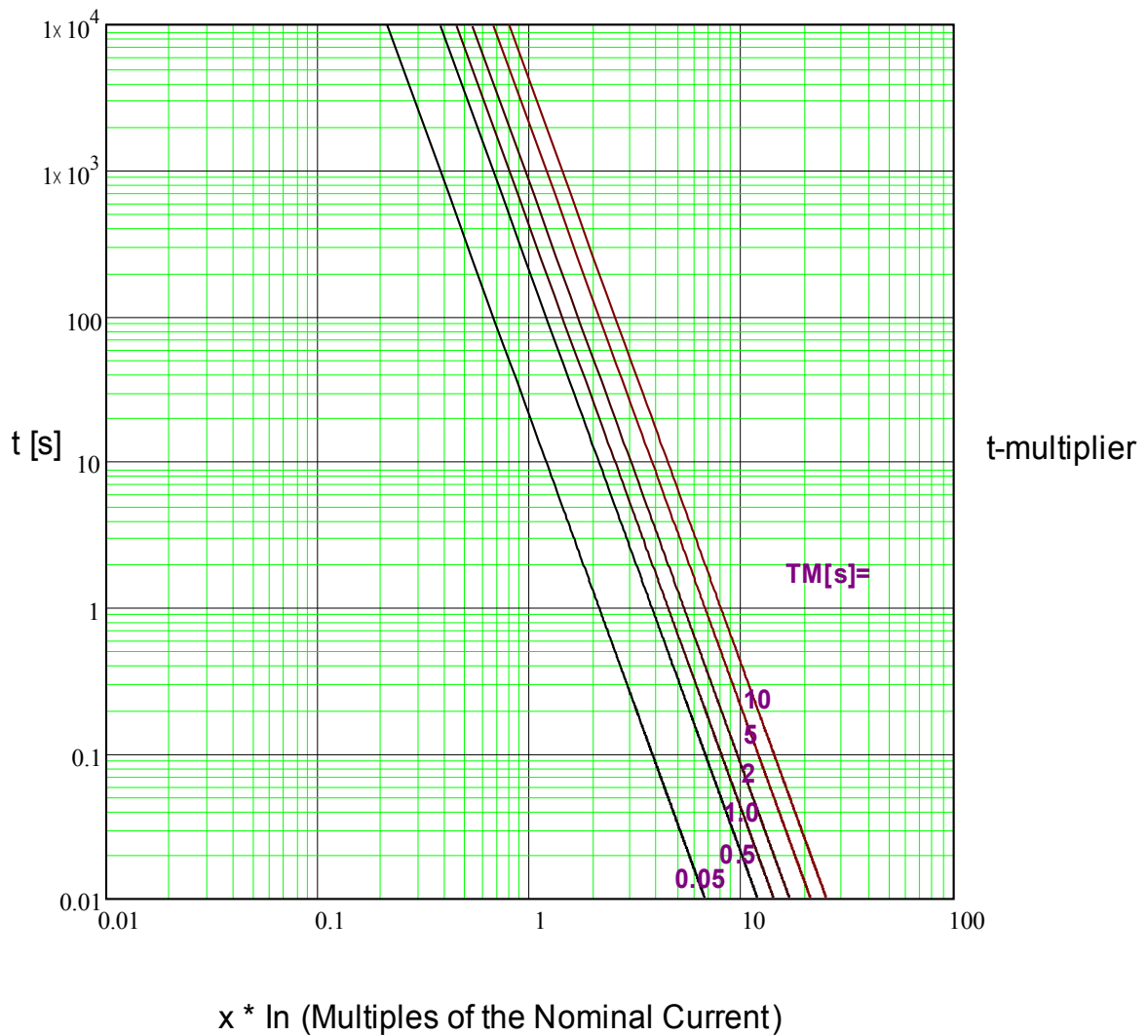


I4T**Notice!**

Various Reset Modes are available . Resetting via characteristic, delayed, and instantaneous .

Reset**Trip**

$$t = \left| \frac{5 \cdot 3^2}{\left(\frac{I}{I_n}\right)^0} \right| * t\text{-multiplier [s]} \quad t = \frac{5 \cdot 3^4}{\left(\frac{I}{I_n}\right)^4} * t\text{-multiplier [s]}$$



Instantaneous Current Curves (Ground Current Calculated)

The following characteristics is available:

- DEFT (definite time).

Explanation:

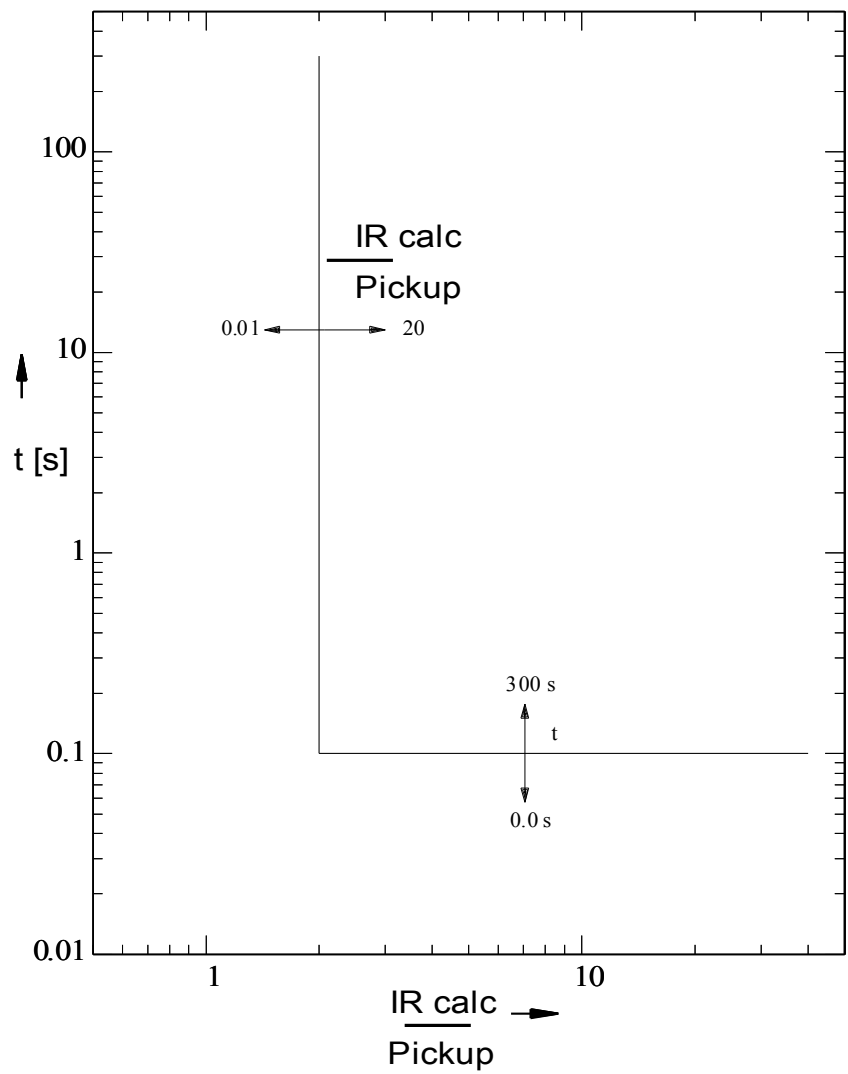
t = Tripping delay

IG = Fault current

Pickup = If the pickup value is exceeded, the module/element starts to time out to trip .

The ground current can be measured either directly via a zero sequence transformer or detected by a residual connection. The ground current can alternatively be calculated from the phase currents; but this is only possible if the current transformers are Wye-connected.

DEFT



Instantaneous Current Curves (Ground Current Measured)

The following characteristics is available:

- DEFT (definite time).

Explanation:

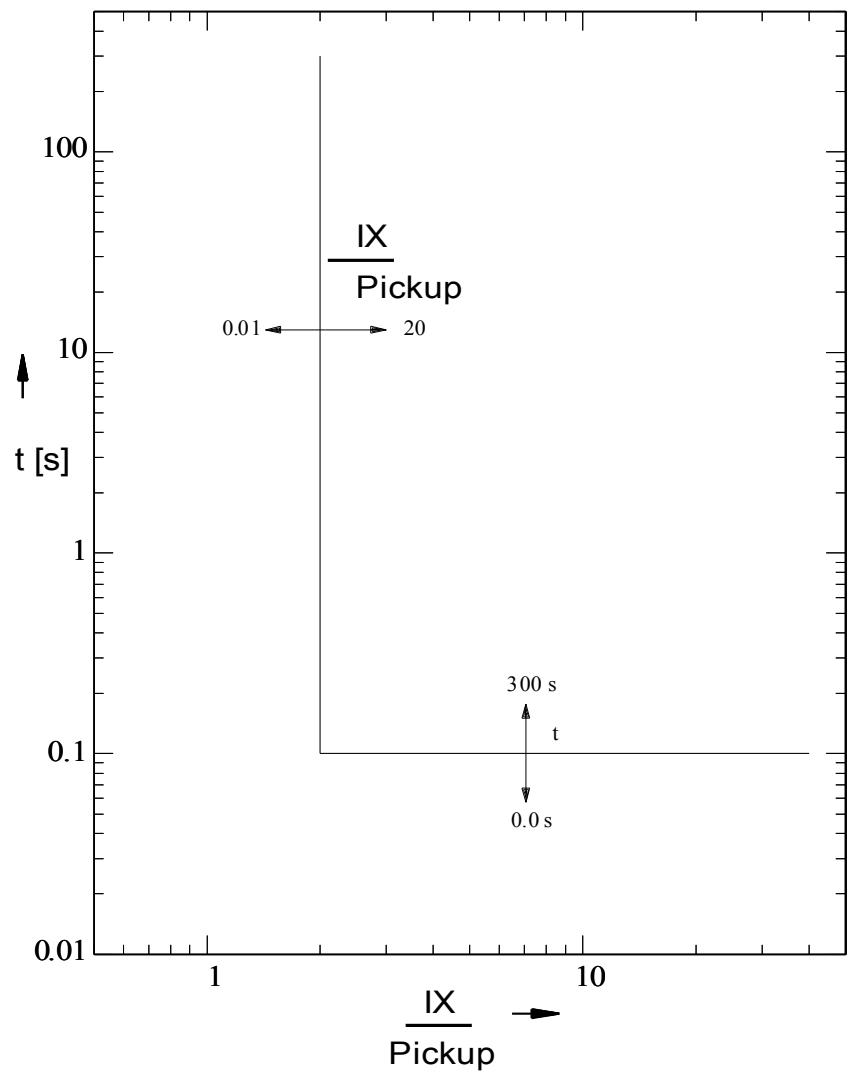
t = Tripping delay

I_X = Fault current

Pickup = If the pickup value is exceeded, the module/element starts to time out to trip .

The ground current can be measured either directly via a zero sequence transformer or detected by a residual connection. The ground current can alternatively be calculated from the phase currents; but this is only possible if the current transformers are Wye-connected.

DEFT



Time Current Curves (Ground Current)

The following characteristics are available:

- NINV (IEC/XInv);
- VINV (IEC/XInv);
- LINV (IEC/XInv);
- EINV (IEC/XInv);
- MINV (ANSI/XInv);
- VINV (ANSI/XInv);
- EINV (ANSI/XInv);
- Thermal Flat;
- Therm Flat IT;
- Therm Flat I2T; and
- Therm Flat I4T.

Explanation:

t = Tripping delay

t -multiplier = Time multiplier/tripping characteristic factor. The setting range depends on the selected tripping curve.
 I_G = Fault current

Pickup = If the pickup value is exceeded, the module/element starts to time out to trip .

The ground current can be measured either directly via a zero sequence transformer or detected by a residual connection. The ground current can alternatively be calculated from the phase currents; but this is only possible if the current transformers are Wye-connected.

IEC NINV



Notice!

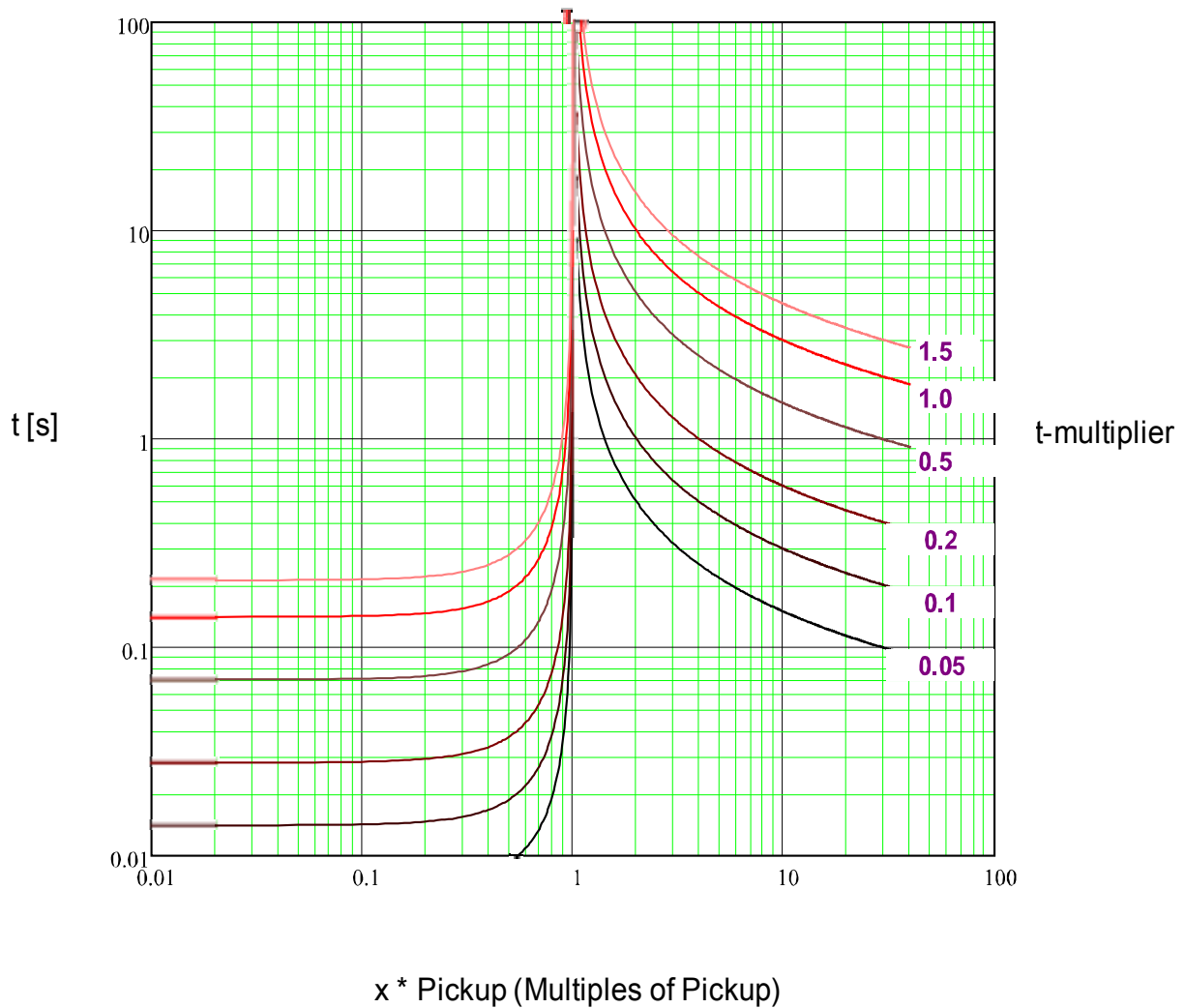
Various Reset Modes are available . Resetting via characteristic, delayed, and instantaneous .

Reset

Trip

$$t = \left| \frac{0.14}{\left(\frac{IG}{Pickup} \right)^2 - 1} \right| * t\text{-multiplier [s]}$$

$$t = \frac{0.14}{\left(\frac{IG}{Pickup} \right)^{0.02} - 1} * t\text{-multiplier [s]}$$



IEC VINV

**Notice!**

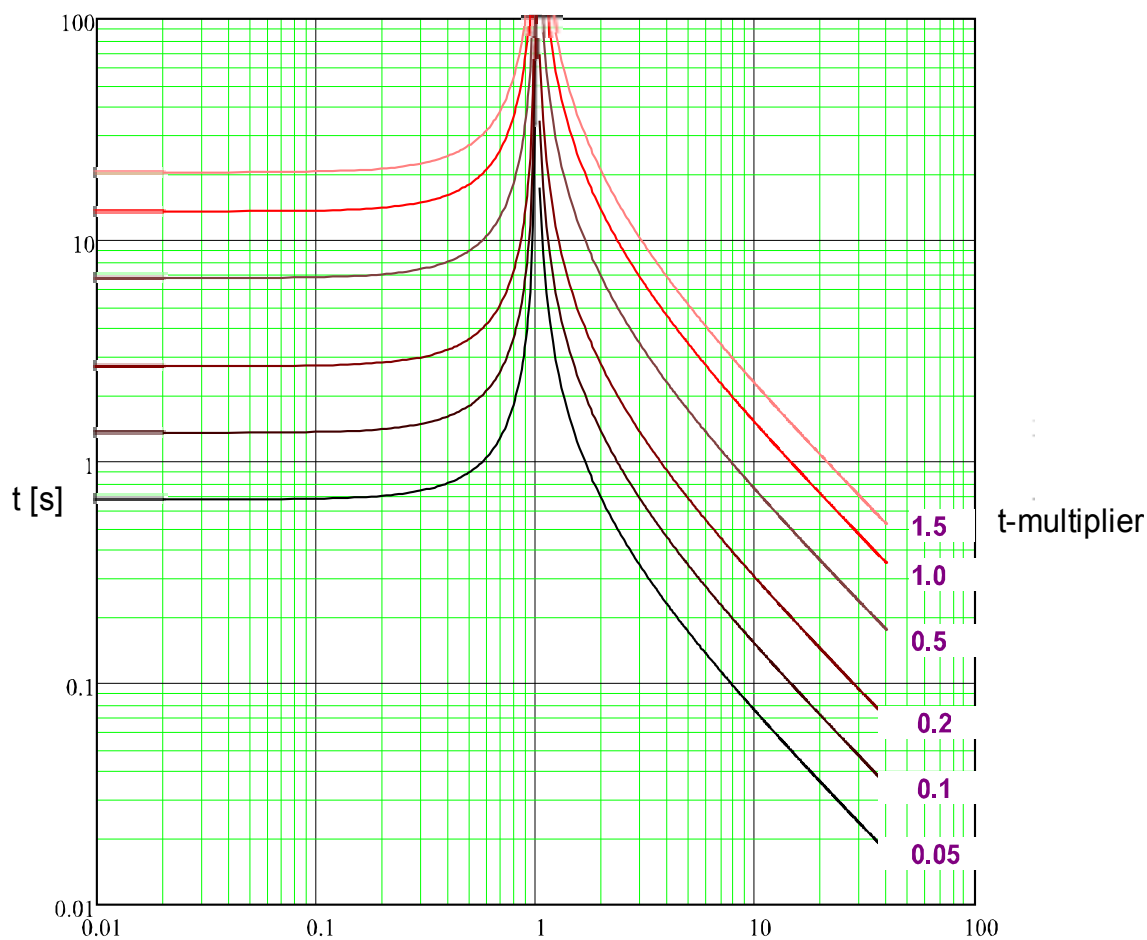
Various Reset Modes are available . Resetting via characteristic, delayed , and instantaneous .

Reset

$$t = \left| \frac{13.5}{\left(\frac{IG}{Pickup} \right)^2 - 1} \right| * t\text{-multiplier [s]}$$

Trip

$$t = \frac{13.5}{\left(\frac{IG}{Pickup} \right)^2 - 1} * t\text{-multiplier [s]}$$



$x * Pickup$ (Multiples of Pickup)

IEC LINV

**Notice!**

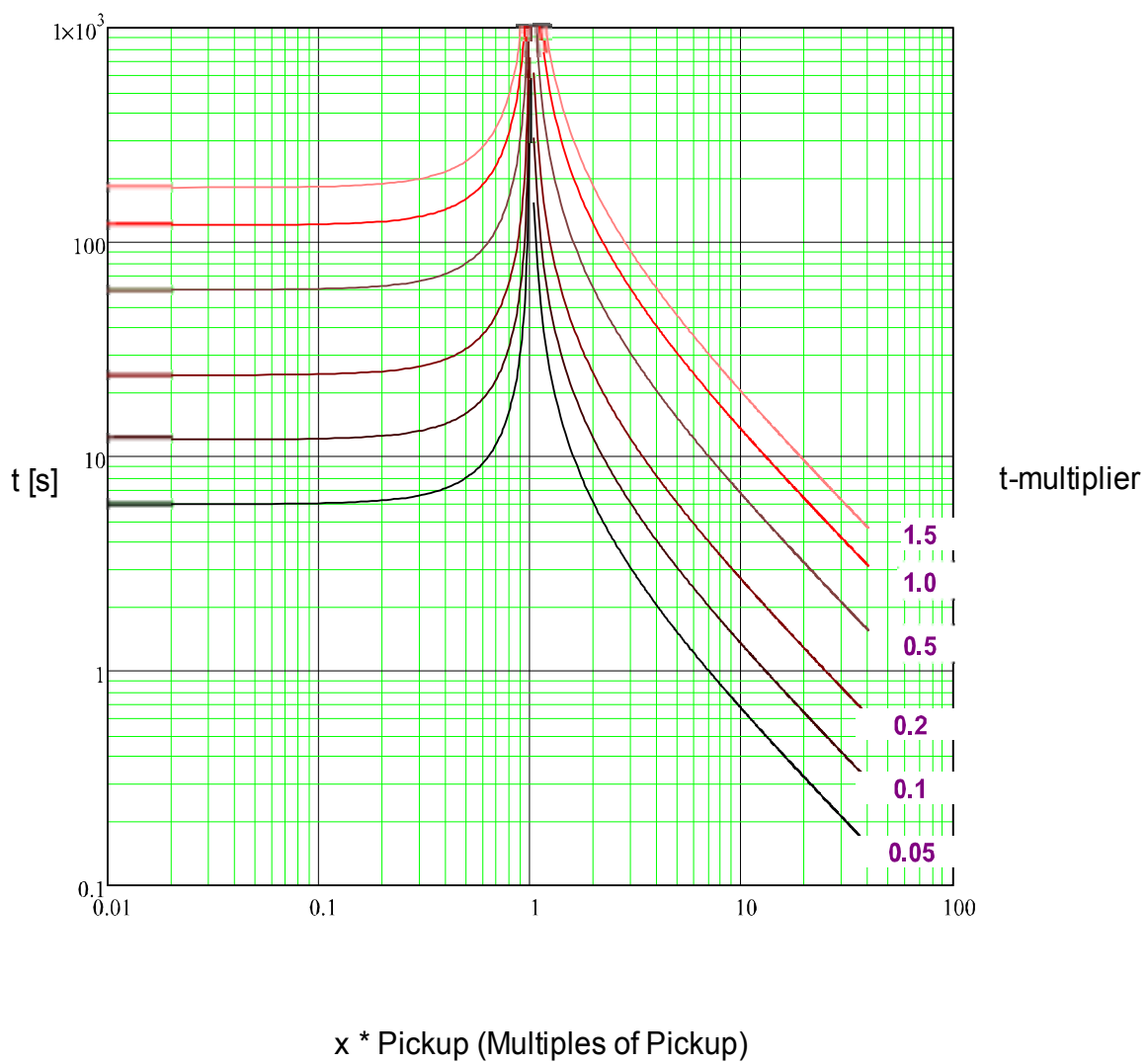
Various Reset Modes are available . Resetting via characteristic, delayed, and instantaneous .

Reset

$$t = \left| \frac{120}{\left(\frac{IG}{\text{Pickup}} \right)^2} \right| * t\text{-multiplier [s]}$$

Trip

$$t = \frac{120}{\left(\frac{IG}{\text{Pickup}} \right)^2} * t\text{-multiplier [s]}$$



IEC EINV



Notice!

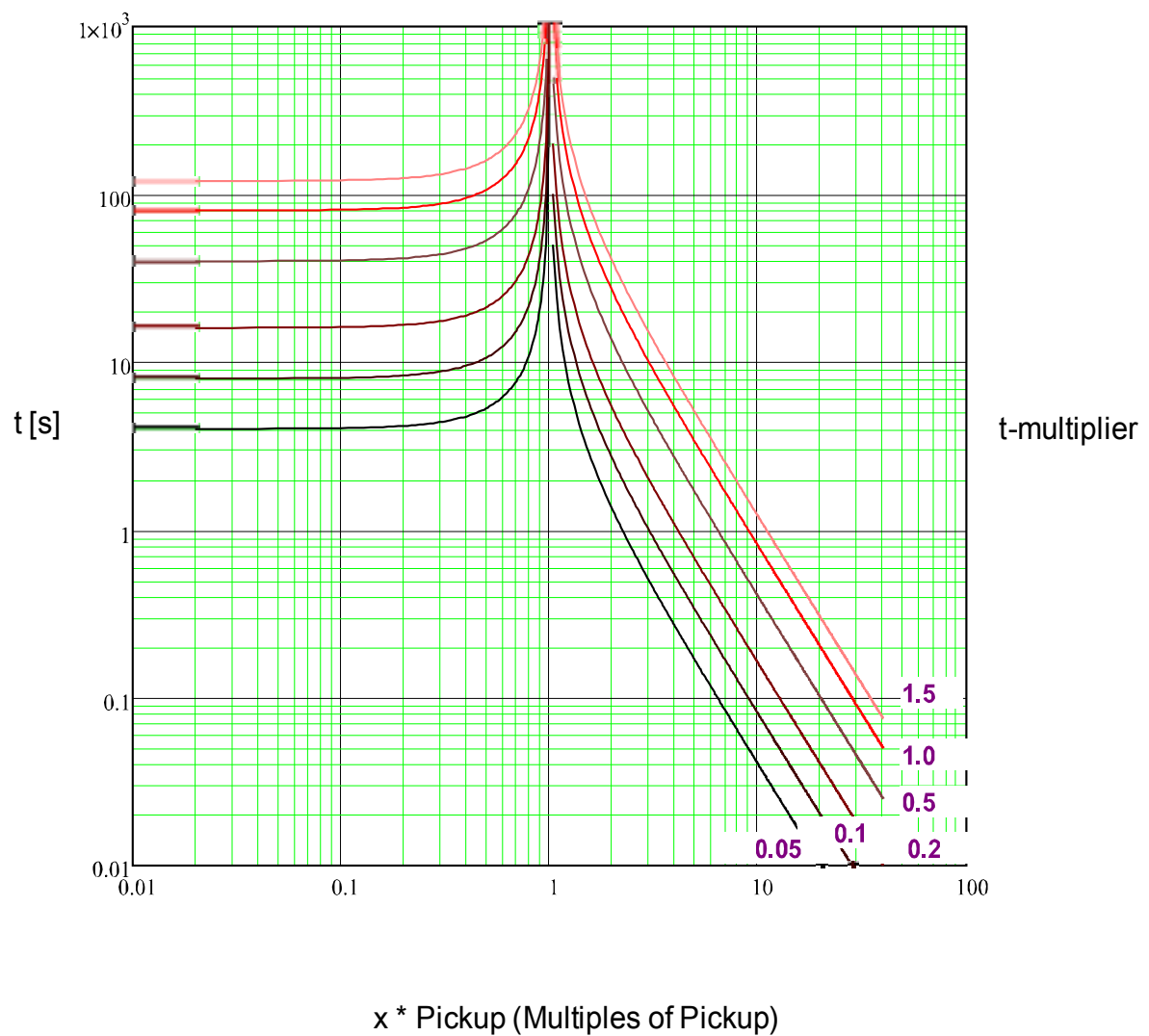
Various Reset Modes are available . Resetting via characteristic, delayed , and instantaneous .

Reset

$$t = \left| \frac{80}{\left(\frac{IG}{Pickup} \right)^2 - 1} \right| * t\text{-multiplier [s]}$$

Trip

$$t = \frac{80}{\left(\frac{IG}{Pickup} \right)^2 - 1} * t\text{-multiplier [s]}$$



ANSI MINV



Notice!

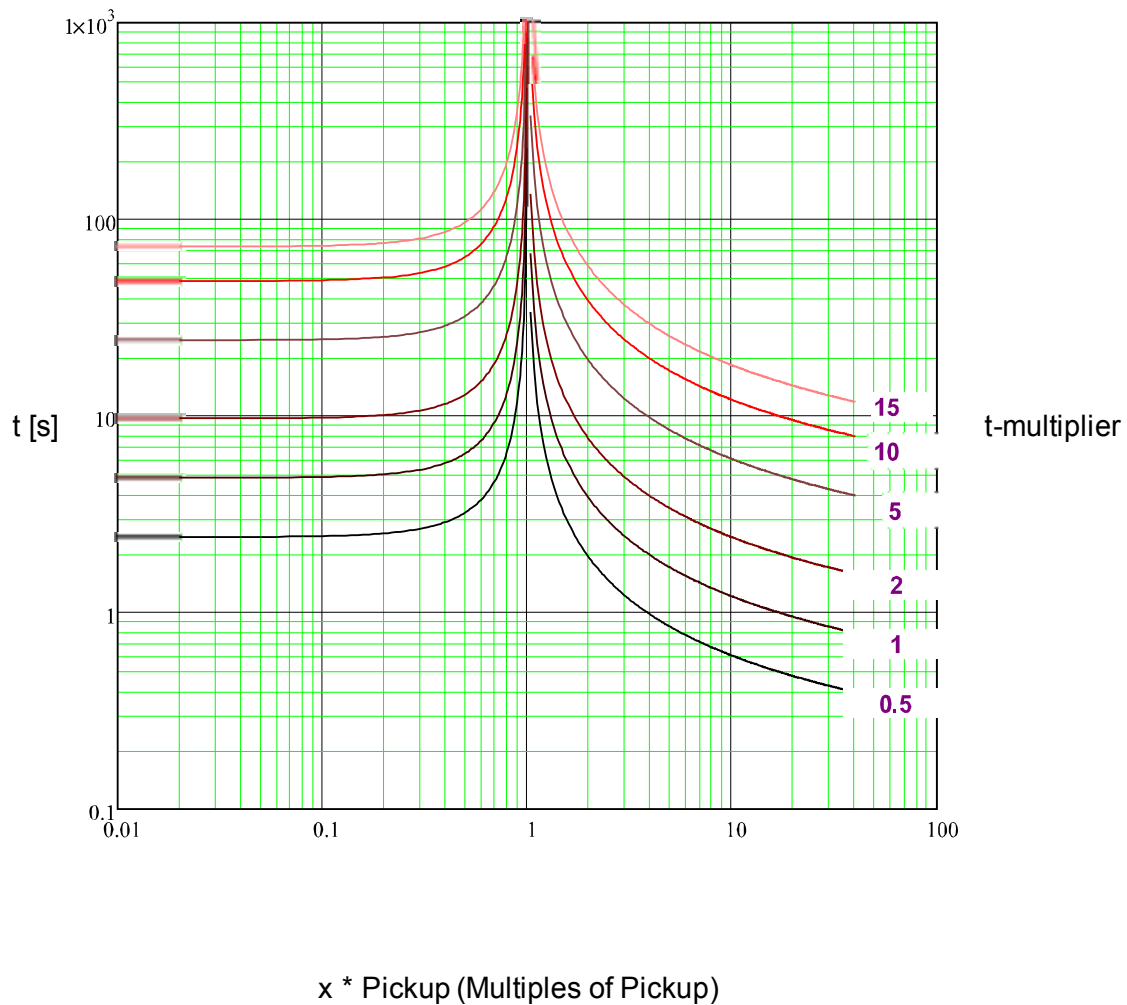
Various Reset Modes are available . Resetting via characteristic, delayed , and instantaneous .

Reset

Trip

$$t = \left| \frac{4.85}{\left(\frac{IG}{Pickup} \right)^2 - 1} \right| * t\text{-multiplier [s]}$$

$$t = \left(\frac{0.0515}{\left(\frac{IG}{Pickup} \right)^{0.02} - 1} + 0.1140 \right) * t\text{-multiplier [s]}$$



ANSI VINV**Notice!**

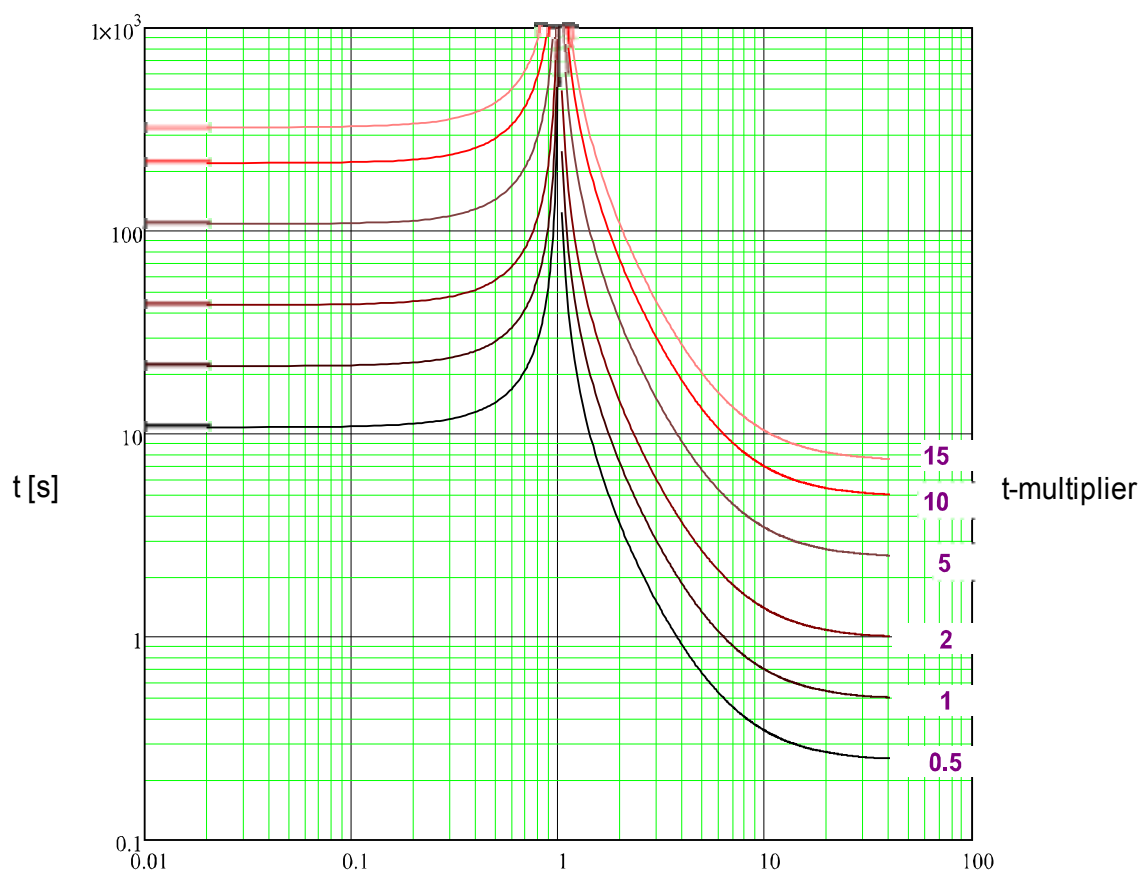
Various Reset Modes are available . Resetting via characteristic, delayed, and instantaneous .

Reset

$$t = \left| \frac{21.6}{\left(\frac{IG}{Pickup}\right)^2 - 1} \right| * t\text{-multiplier [s]}$$

Trip

$$t = \left(\frac{19.61}{\left(\frac{IG}{Pickup}\right)^2 - 1} + 0.491 \right) * t\text{-multiplier [s]}$$



$x * Pickup$ (Multiples of Pickup)

ANSI EINV**Notice!**

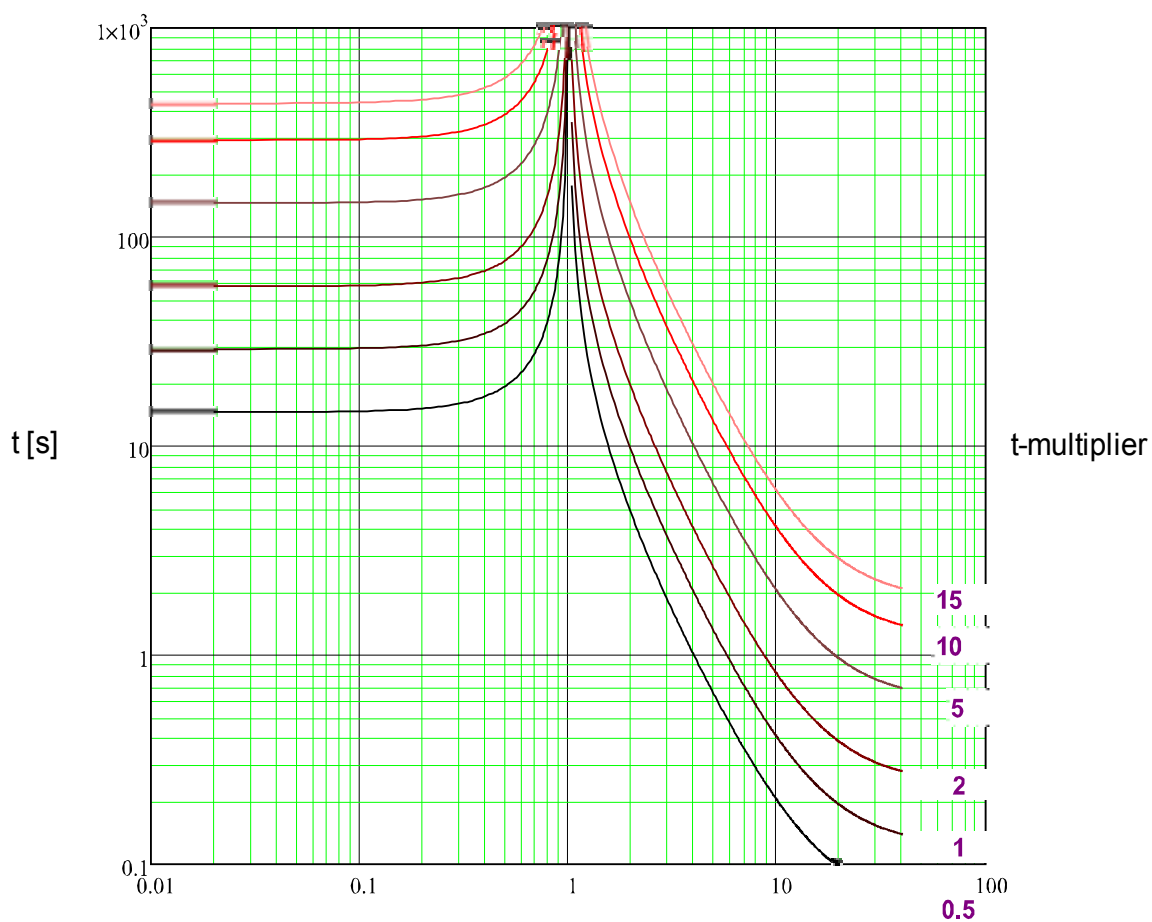
Various Reset Modes are available . Resetting via characteristic, delayed , and instantaneous .

Reset

$$t = \left| \frac{29.1}{\left(\frac{IG}{\text{Pickup}} \right)^2 - 1} \right| * t\text{-multiplier [s]}$$

Trip

$$t = \left(\frac{28.2}{\left(\frac{IG}{\text{Pickup}} \right)^2 - 1} + 0.1217 \right) * t\text{-multiplier [s]}$$



$x * \text{Pickup}$ (Multiples of Pickup)

Therm Flat**Notice!**

Various Reset Modes are available . Resetting via characteristic, delayed , and instantaneous .

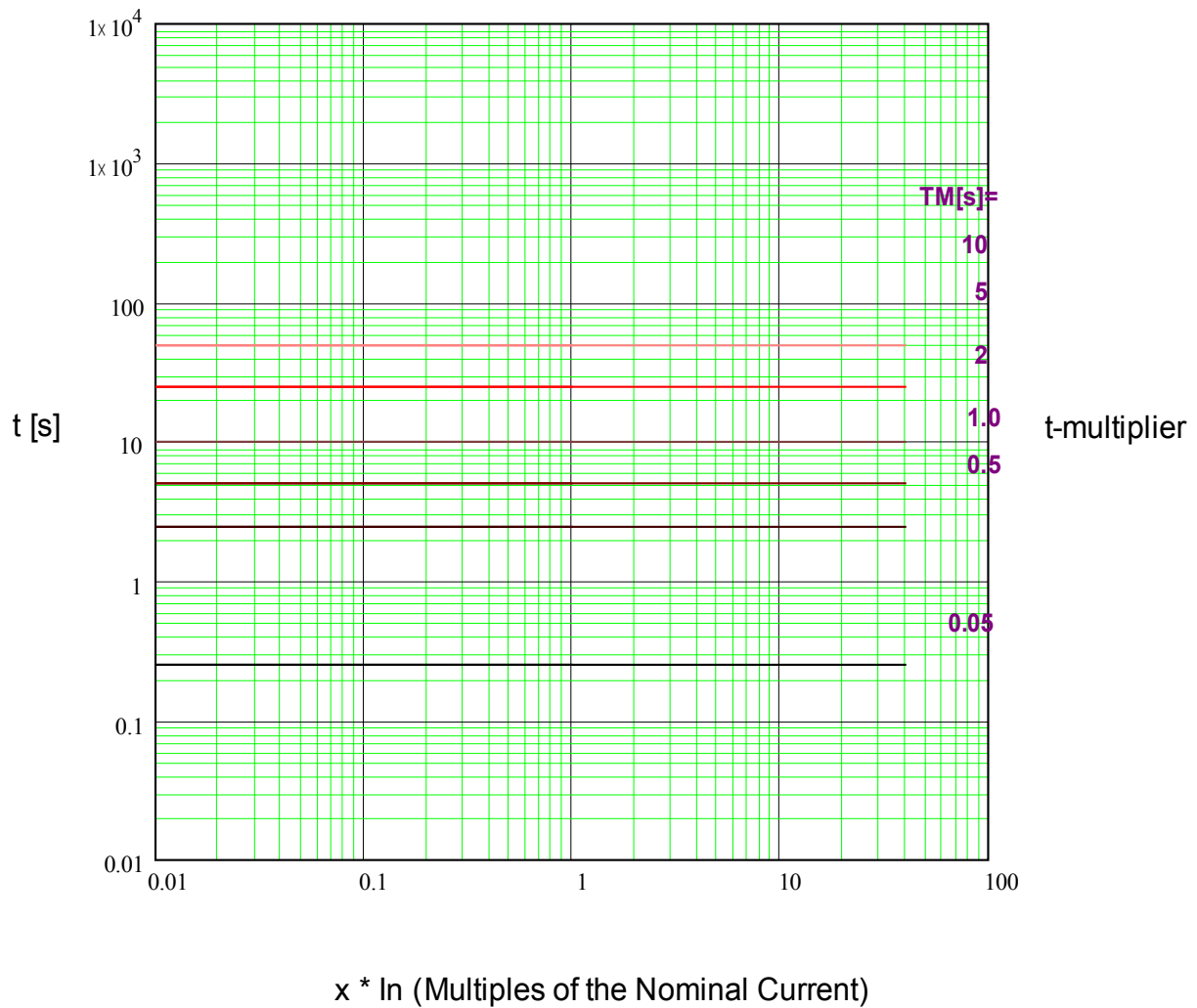
Reset

$$t = \left| \frac{5 \cdot 1^2}{\left(\frac{IG}{IG_{nom}} \right)^0} \right| \cdot t\text{-multiplier [s]}$$

Trip

$$t = \frac{5}{\left(\frac{IG}{IG_{nom}} \right)^0} \cdot t\text{-multiplier [s]}$$

$$t = 5 \cdot t\text{-multiplier [s]}$$



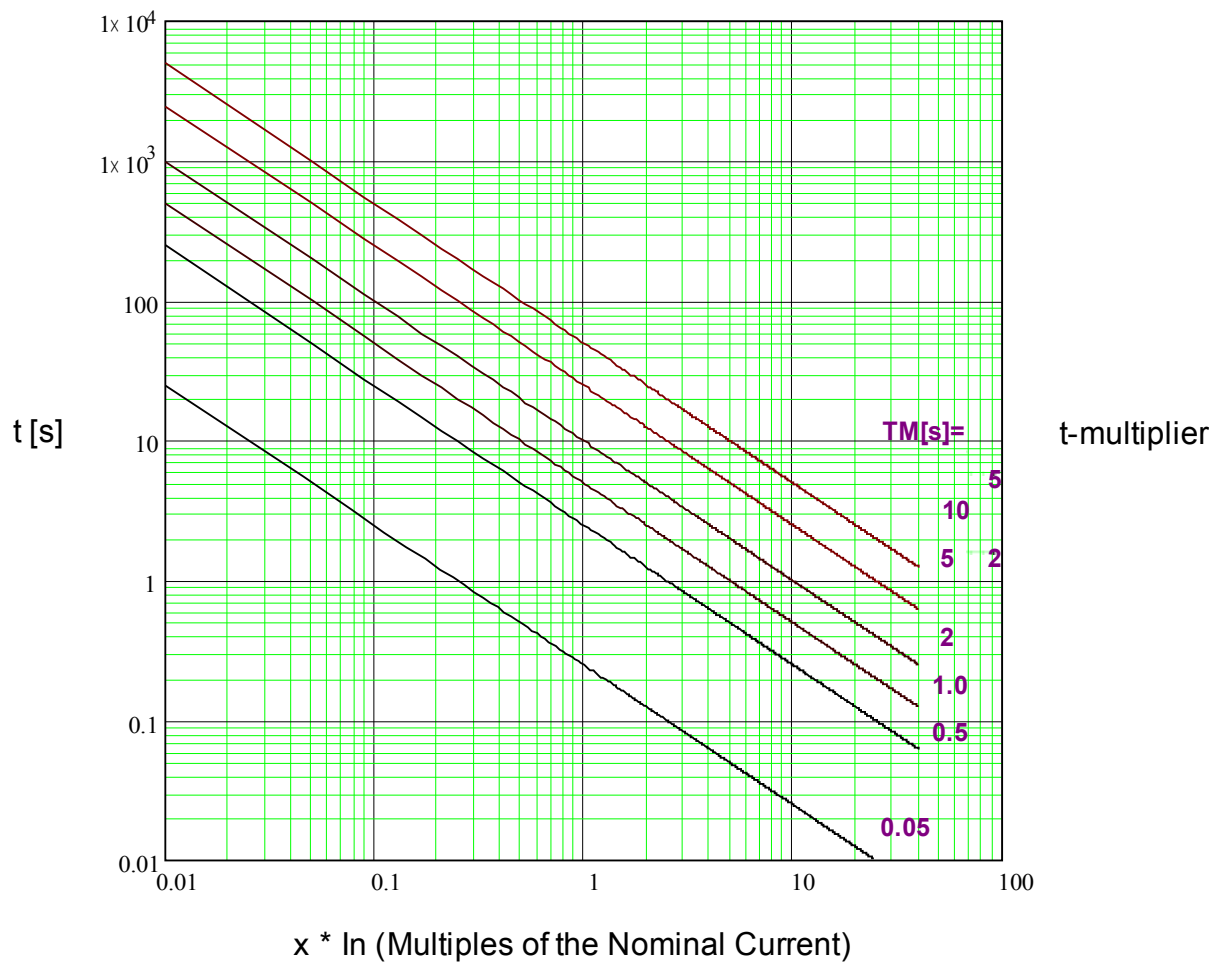
IT

**Notice!**

Various Reset Modes are available . Resetting via characteristic, delayed, and instantaneous .

Reset**Trip**

$$t = \left| \frac{5 \cdot 1^2}{\left(\frac{IG}{IG_{nom}}\right)^0} \right| \cdot t\text{-multiplier [s]} \quad t = \frac{5 \cdot 1^1}{\left(\frac{IG}{IG_{nom}}\right)^1} \cdot t\text{-multiplier [s]}$$



I²T**Notice!**

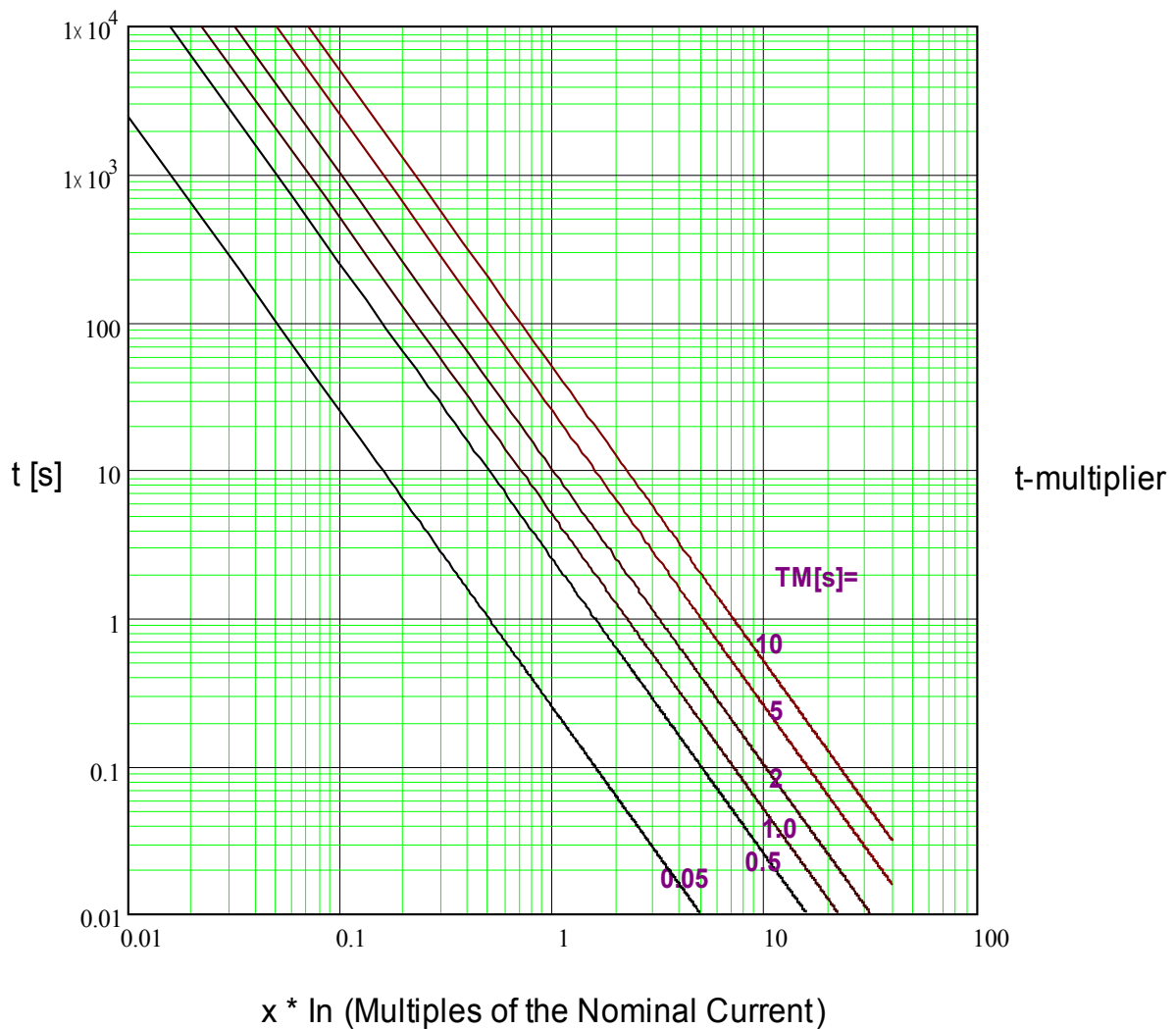
Various Reset Modes are available . Resetting via characteristic, delayed, and instantaneous .

Reset

$$t = \left| \frac{5 \cdot I^2}{\left(\frac{IG}{IG_{nom}}\right)^0} \right| \cdot t\text{-multiplier [s]}$$

Trip

$$t = \frac{5 \cdot I^2}{\left(\frac{IG}{IG_{nom}}\right)^2} \cdot t\text{-multiplier [s]}$$



I⁴T**Notice!**

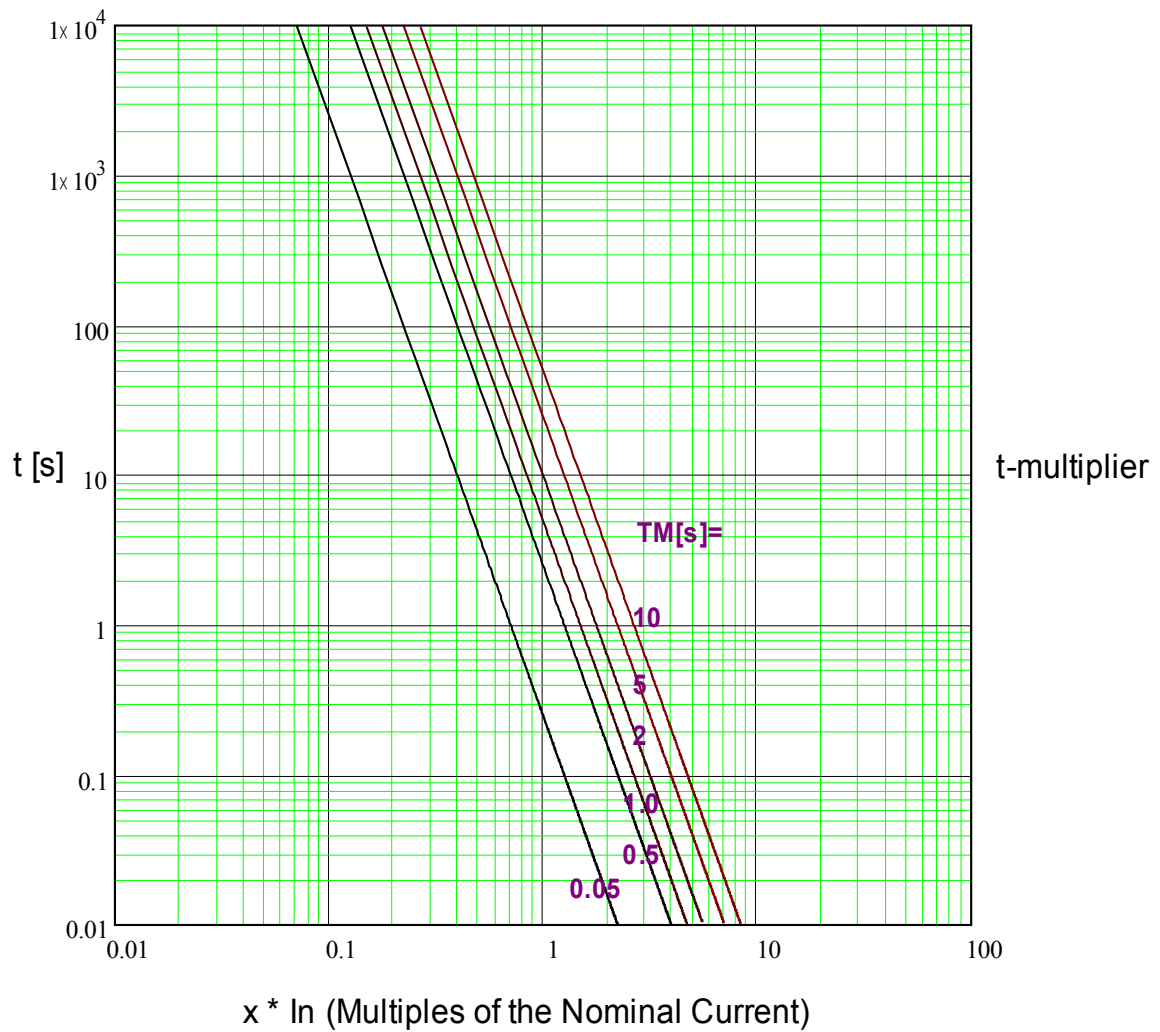
Various Reset Modes are available . Resetting via characteristic, delayed, and instantaneous .

Reset

$$t = \left| \frac{5 \cdot 1^2}{\left(\frac{IG}{IG_{nom}}\right)^0} \right| * t\text{-multiplier [s]}$$

Trip

$$t = \frac{5 \cdot 1^4}{\left(\frac{IG}{IG_{nom}}\right)^4} * t\text{-multiplier [s]}$$



Assignment List

The »ASSIGNMENT LIST« below summarizes all module outputs (signals) and inputs (e.g.: states of the assignments).

Name	Description
-.-	No assignment
Prot.Available	Signal: Protection is available.
Prot.Active	Signal: Active
Prot.ExBlo	Signal: External Blocking
Prot.Pickup Phase A	Signal: General Pickup Phase A
Prot.Pickup Phase B	Signal: General Pickup Phase B
Prot.Pickup Phase C	Signal: General Pickup Phase C
Prot.Pickup IX or IR	Signal: General Pickup - Ground Fault
Prot.Pickup	Signal: General Pickup
Prot.Trip Phase A	Signal: General Trip Phase A
Prot.Trip Phase B	Signal: General Trip Phase B
Prot.Trip Phase C	Signal: General Trip Phase C
Prot.Trip IX or IR	Signal: General Trip Ground Fault
Prot.Trip	Signal: General Trip
Prot.Res FaultNo a GridFaultNo	Signal: Resetting of fault number and grid fault number.
Prot.I dir fwd	Signal: Phase current failure forward direction
Prot.I dir rev	Signal: Phase current failure reverse direction
Prot.I dir n poss	Signal: Phase fault - missing reference voltage
Prot.IR dir fwd	Signal: IR Ground fault (calculated) forward
Prot.IR dir rev	Signal: IR Ground fault (calculated) reverse direction
Prot.IR dir n poss	Signal: IR Ground fault (calculated) direction detection not possible
Prot.IX dir fwd	Signal: IX Ground fault (measured) forward
Prot.IX dir rev	Signal: IX Ground fault (measured) reverse direction
Prot.IX dir n poss	Signal: IX Ground fault (measured) direction detection not possible
Prot.f(VABC)<10Hz	Frequency of the measuring channels 1-3 (VA,VB,VC) is lower than 10Hz.
Prot.f(VABC)>10Hz	Frequency of the measuring channels 1-3 (VA,VB,VC) is greater than 10Hz.
Prot.f(VABC)<70Hz	Frequency of the measuring channels 1-3 (VA,VB,VC) is lower than 70Hz.
Prot.f(VABC)>70Hz	Frequency of the measuring channels 1-3 (VA,VB,VC) is greater than 70Hz.
Prot.DFT Invalid	DFT values of fundamental and harmonics (except VX) are not valid. They depend on period time of frequency and measured channels 1-3 (VA/VAB,VB/VBC,VC/VCA).
Prot.DFT Valid	DFT values of fundamental and harmonics (except VX) are valid. They depend on period time of frequency and measured channels 1-3 (VA/VAB,VB/VBC,VC/VCA).
Prot.f(VX)<10Hz	Frequency of the measuring channel 4 (VX) is lower than 10Hz.
Prot.f(VX)>10Hz	Frequency of the measuring channel 4 (VX) is greater than 10Hz.

Name	Description
Prot.f(VX)<70Hz	Frequency of the measuring channel 4 (VX) is lower than 70Hz.
Prot.f(VX)>70Hz	Frequency of the measuring channel 4 (VX) is greater than 70Hz.
Prot.DFT Invalid (VX)	DFT values of fundamental and harmonics of VX (only) are not valid.
Prot.DFT Valid (VX)	DFT values of fundamental and harmonics of VX (only) are valid.
Prot.ExBlo1-I	Module Input State: External Blocking1
Prot.ExBlo2-I	Module Input State: External Blocking2
Generator.Running Hours Alarm	Running Hours Alarm
Generator.Res Running hours	Reset Running hours
Ctrl.Local	Switching Authority: Local
Ctrl.Remote	Switching Authority: Remote
Ctrl.SG Indeterm	Minimum one Switchgear is moving (Position cannot be determined).
Ctrl.SG Disturb	Minimum one Switchgear is disturbed.
Bkr.SI SingleContactInd	Signal: The Position of the Switchgear is detected by one auxiliary contact (pole) only. Thus indeterminate and disturbed Positions cannot be detected.
Bkr.Pos not CLOSE	Signal: Pos not CLOSE
Bkr.Pos CLOSE	Signal: Breaker is in CLOSE-Position
Bkr.Pos OPEN	Signal: Breaker is in OPEN-Position
Bkr.Pos Indeterm	Signal: Breaker is in Indeterminate Position
Bkr.Pos Disturb	Signal: Breaker Disturbed - Undefined Breaker Position. The feed-back signals (Position Indicators) contradict themselves. After expiring of a supervision timer this signal becomes true.
Bkr.Ready	Signal: Breaker is ready for operation.
Bkr.Interl CLOSE	Signal: One or more IL_Close inputs are active.
Bkr.Interl OPEN	Signal: One or more IL_Open inputs are active.
Bkr.CES succesf	Signal: Command Execution Supervision: Switching command executed successfully.
Bkr.CES Disturbed	Signal: Command Execution Supervision: Switching Command unsuccessful. Switchgear in disturbed position.
Bkr.CES Fail TripCmd	Signal: Command Execution Supervision: Command execution failed because trip command is pending.
Bkr.CES SwitchgDir	Signal: Command Execution Supervision respectively Switching Direction Control: This signal becomes true, if a switch command is issued even though the switchgear is already in the requested position. Example: A switchgear that is already OPEN should be switched OPEN again (doubly). The same applies to CLOSE commands.
Bkr.CES CLOSE d OPEN	Signal: Command Execution Supervision: CLOSE Command during a pending OPEN Command.
Bkr.CES SG not ready	Signal: Command Execution Supervision: Switchgear not ready
Bkr.CES Field Interl	Signal: Command Execution Supervision: Switching Command not executed because of field interlocking.
Bkr.CES SyncTimeout	Signal: Command Execution Supervision: Switching Command not executed. No Synchronization signal while t-sync was running.
Bkr.CES SG removed	Signal: Command Execution Supervision: Switching Command unsuccessful, Switchgear removed.
Bkr.TripCmd	Signal: Trip Command
Bkr.Ack TripCmd	Signal: Acknowledge Trip Command

Name	Description
Bkr.Bwear Slow Breaker	Signal: Slow Breaker Alarm
Bkr.Res Bwear SI Breaker	Signal: Resetting the slow breaker alarm
Bkr.CLOSE Cmd	Signal: CLOSE command issued to the switchgear. Depending on the setting the signal may include the CLOSE command of the Prot module.
Bkr.OPEN Cmd	Signal: OPEN command issued to the switchgear. Depending on the setting the signal may include the OPEN command of the Prot module.
Bkr.CLOSE Cmd manual	Signal: CLOSE Cmd manual
Bkr.OPEN Cmd manual	Signal: OPEN Cmd manual
Bkr.Sync CLOSE request	Signal: Synchronous CLOSE request
Bkr.CinBkr-52a-I	Module Input State: Feed-back signal of the Bkr (52a)
Bkr.CinBkr-52b-I	Module Input State: Feed-back signal of the Bkr. (52b)
Bkr.Ready-I	Module Input State: Breaker Ready
Bkr.Sys-in-Sync-I	State of the module input: This signals has to become true within the synchronization time. If not, switching is unsuccessful.
Bkr.Ack TripCmd-I	State of the module input: Acknowledgment Signal (only for automatic acknowledgment). Module input signal
Bkr.Interl CLOSE1-I	State of the module input: Interlocking of the CLOSE command
Bkr.Interl CLOSE2-I	State of the module input: Interlocking of the CLOSE command
Bkr.Interl CLOSE3-I	State of the module input: Interlocking of the CLOSE command
Bkr.Interl OPEN1-I	State of the module input: Interlocking of the OPEN command
Bkr.Interl OPEN2-I	State of the module input: Interlocking of the OPEN command
Bkr.Interl OPEN3-I	State of the module input: Interlocking of the OPEN command
Bkr.SC CLOSE-I	State of the module input: Switching CLOSE Command, e.g. the state of the Logics or the state of the digital input
Bkr.SC OPEN-I	State of the module input: Switching OPEN Command, e.g. the state of the Logics or the state of the digital input
Bkr.Operations Alarm	Signal: Service Alarm, too many Operations
Bkr.Isum Intr trip: IA	Signal: Maximum permissible Summation of the interrupting (tripping) currents exceeded: IA
Bkr.Isum Intr trip: IB	Signal: Maximum permissible Summation of the interrupting (tripping) currents exceeded: IB
Bkr.Isum Intr trip: IC	Signal: Maximum permissible Summation of the interrupting (tripping) currents exceeded: IC
Bkr.Isum Intr trip	Signal: Maximum permissible Summation of the interrupting (tripping) currents exceeded in at least one phase.
Bkr.Res TripCmdCr	Signal: Resetting of the Counter: total number of trip commands
Bkr.Res Isum trip	Signal: Reset summation of the tripping currents
Bkr.WearLevel Alarm	Signal: Breaker Wear curve Alarm
Bkr.WearLevel Lockout	Signal: Breaker Wear Curve Lockout Level
Bkr.Res Bwear Curve	Signal: Reset of the Breaker Wear maintenance curve.
Bkr.Isum Intr ph Alm	Signal: Alarm, the per hour Sum (Limit) of interrupting currents has been exceeded.
Bkr.Res Isum Intr ph Alm	Signal: Reset of the Alarm, "the per hour Sum (Limit) of interrupting currents has been exceeded".
50P[1].Active	Signal: Active

<i>Name</i>	<i>Description</i>
50P[1].ExBlo	Signal: External Blocking
50P[1].Rvs Blo	Signal: Reverse Blocking
50P[1].Blo TripCmd	Signal: Trip Command blocked
50P[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
50P[1].Pickup IA	Signal: Pickup IA
50P[1].Pickup IB	Signal: Pickup IB
50P[1].Pickup IC	Signal: Pickup IC
50P[1].Pickup	Signal: Pickup
50P[1].Trip	Signal: Trip
50P[1].TripCmd	Signal: Trip Command
50P[1].DefaultSet	Signal: Default Parameter Set
50P[1].AdaptSet 1	Signal: Adaptive Parameter 1
50P[1].AdaptSet 2	Signal: Adaptive Parameter 2
50P[1].AdaptSet 3	Signal: Adaptive Parameter 3
50P[1].AdaptSet 4	Signal: Adaptive Parameter 4
50P[1].ExBlo1-I	Module Input State: External Blocking1
50P[1].ExBlo2-I	Module Input State: External Blocking2
50P[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
50P[1].Rvs Blo-I	Module Input State: Reverse Blocking
50P[1].AdaptSet1-I	Module Input State: Adaptive Parameter1
50P[1].AdaptSet2-I	Module Input State: Adaptive Parameter2
50P[1].AdaptSet3-I	Module Input State: Adaptive Parameter3
50P[1].AdaptSet4-I	Module Input State: Adaptive Parameter4
50P[2].Active	Signal: Active
50P[2].ExBlo	Signal: External Blocking
50P[2].Rvs Blo	Signal: Reverse Blocking
50P[2].Blo TripCmd	Signal: Trip Command blocked
50P[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
50P[2].Pickup IA	Signal: Pickup IA
50P[2].Pickup IB	Signal: Pickup IB
50P[2].Pickup IC	Signal: Pickup IC
50P[2].Pickup	Signal: Pickup
50P[2].Trip	Signal: Trip
50P[2].TripCmd	Signal: Trip Command
50P[2].DefaultSet	Signal: Default Parameter Set
50P[2].AdaptSet 1	Signal: Adaptive Parameter 1
50P[2].AdaptSet 2	Signal: Adaptive Parameter 2

<i>Name</i>	<i>Description</i>
50P[2].AdaptSet 3	Signal: Adaptive Parameter 3
50P[2].AdaptSet 4	Signal: Adaptive Parameter 4
50P[2].ExBlo1-I	Module Input State: External Blocking1
50P[2].ExBlo2-I	Module Input State: External Blocking2
50P[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
50P[2].Rvs Blo-I	Module Input State: Reverse Blocking
50P[2].AdaptSet1-I	Module Input State: Adaptive Parameter1
50P[2].AdaptSet2-I	Module Input State: Adaptive Parameter2
50P[2].AdaptSet3-I	Module Input State: Adaptive Parameter3
50P[2].AdaptSet4-I	Module Input State: Adaptive Parameter4
50P[3].Active	Signal: Active
50P[3].ExBlo	Signal: External Blocking
50P[3].Rvs Blo	Signal: Reverse Blocking
50P[3].Blo TripCmd	Signal: Trip Command blocked
50P[3].ExBlo TripCmd	Signal: External Blocking of the Trip Command
50P[3].Pickup IA	Signal: Pickup IA
50P[3].Pickup IB	Signal: Pickup IB
50P[3].Pickup IC	Signal: Pickup IC
50P[3].Pickup	Signal: Pickup
50P[3].Trip	Signal: Trip
50P[3].TripCmd	Signal: Trip Command
50P[3].DefaultSet	Signal: Default Parameter Set
50P[3].AdaptSet 1	Signal: Adaptive Parameter 1
50P[3].AdaptSet 2	Signal: Adaptive Parameter 2
50P[3].AdaptSet 3	Signal: Adaptive Parameter 3
50P[3].AdaptSet 4	Signal: Adaptive Parameter 4
50P[3].ExBlo1-I	Module Input State: External Blocking1
50P[3].ExBlo2-I	Module Input State: External Blocking2
50P[3].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
50P[3].Rvs Blo-I	Module Input State: Reverse Blocking
50P[3].AdaptSet1-I	Module Input State: Adaptive Parameter1
50P[3].AdaptSet2-I	Module Input State: Adaptive Parameter2
50P[3].AdaptSet3-I	Module Input State: Adaptive Parameter3
50P[3].AdaptSet4-I	Module Input State: Adaptive Parameter4
51P[1].Active	Signal: Active
51P[1].ExBlo	Signal: External Blocking
51P[1].Rvs Blo	Signal: Reverse Blocking

Name	Description
51P[1].Blo TripCmd	Signal: Trip Command blocked
51P[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
51P[1].Pickup IA	Signal: Pickup IA
51P[1].Pickup IB	Signal: Pickup IB
51P[1].Pickup IC	Signal: Pickup IC
51P[1].Pickup	Signal: Pickup
51P[1].Trip	Signal: Trip
51P[1].TripCmd	Signal: Trip Command
51P[1].DefaultSet	Signal: Default Parameter Set
51P[1].AdaptSet 1	Signal: Adaptive Parameter 1
51P[1].AdaptSet 2	Signal: Adaptive Parameter 2
51P[1].AdaptSet 3	Signal: Adaptive Parameter 3
51P[1].AdaptSet 4	Signal: Adaptive Parameter 4
51P[1].ExBlo1-I	Module Input State: External Blocking1
51P[1].ExBlo2-I	Module Input State: External Blocking2
51P[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
51P[1].Rvs Blo-I	Module Input State: Reverse Blocking
51P[1].AdaptSet1-I	Module Input State: Adaptive Parameter1
51P[1].AdaptSet2-I	Module Input State: Adaptive Parameter2
51P[1].AdaptSet3-I	Module Input State: Adaptive Parameter3
51P[1].AdaptSet4-I	Module Input State: Adaptive Parameter4
51P[2].Active	Signal: Active
51P[2].ExBlo	Signal: External Blocking
51P[2].Rvs Blo	Signal: Reverse Blocking
51P[2].Blo TripCmd	Signal: Trip Command blocked
51P[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
51P[2].Pickup IA	Signal: Pickup IA
51P[2].Pickup IB	Signal: Pickup IB
51P[2].Pickup IC	Signal: Pickup IC
51P[2].Pickup	Signal: Pickup
51P[2].Trip	Signal: Trip
51P[2].TripCmd	Signal: Trip Command
51P[2].DefaultSet	Signal: Default Parameter Set
51P[2].AdaptSet 1	Signal: Adaptive Parameter 1
51P[2].AdaptSet 2	Signal: Adaptive Parameter 2
51P[2].AdaptSet 3	Signal: Adaptive Parameter 3
51P[2].AdaptSet 4	Signal: Adaptive Parameter 4

Name	Description
51P[2].ExBlo1-I	Module Input State: External Blocking1
51P[2].ExBlo2-I	Module Input State: External Blocking2
51P[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
51P[2].Rvs Blo-I	Module Input State: Reverse Blocking
51P[2].AdaptSet1-I	Module Input State: Adaptive Parameter1
51P[2].AdaptSet2-I	Module Input State: Adaptive Parameter2
51P[2].AdaptSet3-I	Module Input State: Adaptive Parameter3
51P[2].AdaptSet4-I	Module Input State: Adaptive Parameter4
51P[3].Active	Signal: Active
51P[3].ExBlo	Signal: External Blocking
51P[3].Rvs Blo	Signal: Reverse Blocking
51P[3].Blo TripCmd	Signal: Trip Command blocked
51P[3].ExBlo TripCmd	Signal: External Blocking of the Trip Command
51P[3].Pickup IA	Signal: Pickup IA
51P[3].Pickup IB	Signal: Pickup IB
51P[3].Pickup IC	Signal: Pickup IC
51P[3].Pickup	Signal: Pickup
51P[3].Trip	Signal: Trip
51P[3].TripCmd	Signal: Trip Command
51P[3].DefaultSet	Signal: Default Parameter Set
51P[3].AdaptSet 1	Signal: Adaptive Parameter 1
51P[3].AdaptSet 2	Signal: Adaptive Parameter 2
51P[3].AdaptSet 3	Signal: Adaptive Parameter 3
51P[3].AdaptSet 4	Signal: Adaptive Parameter 4
51P[3].ExBlo1-I	Module Input State: External Blocking1
51P[3].ExBlo2-I	Module Input State: External Blocking2
51P[3].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
51P[3].Rvs Blo-I	Module Input State: Reverse Blocking
51P[3].AdaptSet1-I	Module Input State: Adaptive Parameter1
51P[3].AdaptSet2-I	Module Input State: Adaptive Parameter2
51P[3].AdaptSet3-I	Module Input State: Adaptive Parameter3
51P[3].AdaptSet4-I	Module Input State: Adaptive Parameter4
50X[1].Active	Signal: Active
50X[1].ExBlo	Signal: External Blocking
50X[1].Rvs Blo	Signal: Reverse Blocking
50X[1].Blo TripCmd	Signal: Trip Command blocked
50X[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command

<i>Name</i>	<i>Description</i>
50X[1].Pickup	Signal: Pickup IX or IR
50X[1].Trip	Signal: Trip
50X[1].TripCmd	Signal: Trip Command
50X[1].DefaultSet	Signal: Default Parameter Set
50X[1].AdaptSet 1	Signal: Adaptive Parameter 1
50X[1].AdaptSet 2	Signal: Adaptive Parameter 2
50X[1].AdaptSet 3	Signal: Adaptive Parameter 3
50X[1].AdaptSet 4	Signal: Adaptive Parameter 4
50X[1].ExBlo1-I	Module Input State: External Blocking1
50X[1].ExBlo2-I	Module Input State: External Blocking2
50X[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
50X[1].Rvs Blo-I	Module Input State: Reverse Blocking
50X[1].AdaptSet1-I	Module Input State: Adaptive Parameter1
50X[1].AdaptSet2-I	Module Input State: Adaptive Parameter2
50X[1].AdaptSet3-I	Module Input State: Adaptive Parameter3
50X[1].AdaptSet4-I	Module Input State: Adaptive Parameter4
50X[2].Active	Signal: Active
50X[2].ExBlo	Signal: External Blocking
50X[2].Rvs Blo	Signal: Reverse Blocking
50X[2].Blo TripCmd	Signal: Trip Command blocked
50X[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
50X[2].Pickup	Signal: Pickup IX or IR
50X[2].Trip	Signal: Trip
50X[2].TripCmd	Signal: Trip Command
50X[2].DefaultSet	Signal: Default Parameter Set
50X[2].AdaptSet 1	Signal: Adaptive Parameter 1
50X[2].AdaptSet 2	Signal: Adaptive Parameter 2
50X[2].AdaptSet 3	Signal: Adaptive Parameter 3
50X[2].AdaptSet 4	Signal: Adaptive Parameter 4
50X[2].ExBlo1-I	Module Input State: External Blocking1
50X[2].ExBlo2-I	Module Input State: External Blocking2
50X[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
50X[2].Rvs Blo-I	Module Input State: Reverse Blocking
50X[2].AdaptSet1-I	Module Input State: Adaptive Parameter1
50X[2].AdaptSet2-I	Module Input State: Adaptive Parameter2
50X[2].AdaptSet3-I	Module Input State: Adaptive Parameter3
50X[2].AdaptSet4-I	Module Input State: Adaptive Parameter4

<i>Name</i>	<i>Description</i>
51X[1].Active	Signal: Active
51X[1].ExBlo	Signal: External Blocking
51X[1].Rvs Blo	Signal: Reverse Blocking
51X[1].Blo TripCmd	Signal: Trip Command blocked
51X[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
51X[1].Pickup	Signal: Pickup IX or IR
51X[1].Trip	Signal: Trip
51X[1].TripCmd	Signal: Trip Command
51X[1].DefaultSet	Signal: Default Parameter Set
51X[1].AdaptSet 1	Signal: Adaptive Parameter 1
51X[1].AdaptSet 2	Signal: Adaptive Parameter 2
51X[1].AdaptSet 3	Signal: Adaptive Parameter 3
51X[1].AdaptSet 4	Signal: Adaptive Parameter 4
51X[1].ExBlo1-I	Module Input State: External Blocking1
51X[1].ExBlo2-I	Module Input State: External Blocking2
51X[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
51X[1].Rvs Blo-I	Module Input State: Reverse Blocking
51X[1].AdaptSet1-I	Module Input State: Adaptive Parameter1
51X[1].AdaptSet2-I	Module Input State: Adaptive Parameter2
51X[1].AdaptSet3-I	Module Input State: Adaptive Parameter3
51X[1].AdaptSet4-I	Module Input State: Adaptive Parameter4
51X[2].Active	Signal: Active
51X[2].ExBlo	Signal: External Blocking
51X[2].Rvs Blo	Signal: Reverse Blocking
51X[2].Blo TripCmd	Signal: Trip Command blocked
51X[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
51X[2].Pickup	Signal: Pickup IX or IR
51X[2].Trip	Signal: Trip
51X[2].TripCmd	Signal: Trip Command
51X[2].DefaultSet	Signal: Default Parameter Set
51X[2].AdaptSet 1	Signal: Adaptive Parameter 1
51X[2].AdaptSet 2	Signal: Adaptive Parameter 2
51X[2].AdaptSet 3	Signal: Adaptive Parameter 3
51X[2].AdaptSet 4	Signal: Adaptive Parameter 4
51X[2].ExBlo1-I	Module Input State: External Blocking1
51X[2].ExBlo2-I	Module Input State: External Blocking2
51X[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command

<i>Name</i>	<i>Description</i>
51X[2].Rvs Blo-I	Module Input State: Reverse Blocking
51X[2].AdaptSet1-I	Module Input State: Adaptive Parameter1
51X[2].AdaptSet2-I	Module Input State: Adaptive Parameter2
51X[2].AdaptSet3-I	Module Input State: Adaptive Parameter3
51X[2].AdaptSet4-I	Module Input State: Adaptive Parameter4
50R[1].Active	Signal: Active
50R[1].ExBlo	Signal: External Blocking
50R[1].Rvs Blo	Signal: Reverse Blocking
50R[1].Blo TripCmd	Signal: Trip Command blocked
50R[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
50R[1].Pickup	Signal: Pickup IX or IR
50R[1].Trip	Signal: Trip
50R[1].TripCmd	Signal: Trip Command
50R[1].DefaultSet	Signal: Default Parameter Set
50R[1].AdaptSet 1	Signal: Adaptive Parameter 1
50R[1].AdaptSet 2	Signal: Adaptive Parameter 2
50R[1].AdaptSet 3	Signal: Adaptive Parameter 3
50R[1].AdaptSet 4	Signal: Adaptive Parameter 4
50R[1].ExBlo1-I	Module Input State: External Blocking1
50R[1].ExBlo2-I	Module Input State: External Blocking2
50R[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
50R[1].Rvs Blo-I	Module Input State: Reverse Blocking
50R[1].AdaptSet1-I	Module Input State: Adaptive Parameter1
50R[1].AdaptSet2-I	Module Input State: Adaptive Parameter2
50R[1].AdaptSet3-I	Module Input State: Adaptive Parameter3
50R[1].AdaptSet4-I	Module Input State: Adaptive Parameter4
50R[2].Active	Signal: Active
50R[2].ExBlo	Signal: External Blocking
50R[2].Rvs Blo	Signal: Reverse Blocking
50R[2].Blo TripCmd	Signal: Trip Command blocked
50R[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
50R[2].Pickup	Signal: Pickup IX or IR
50R[2].Trip	Signal: Trip
50R[2].TripCmd	Signal: Trip Command
50R[2].DefaultSet	Signal: Default Parameter Set
50R[2].AdaptSet 1	Signal: Adaptive Parameter 1
50R[2].AdaptSet 2	Signal: Adaptive Parameter 2

<i>Name</i>	<i>Description</i>
50R[2].AdaptSet 3	Signal: Adaptive Parameter 3
50R[2].AdaptSet 4	Signal: Adaptive Parameter 4
50R[2].ExBlo1-I	Module Input State: External Blocking1
50R[2].ExBlo2-I	Module Input State: External Blocking2
50R[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
50R[2].Rvs Blo-I	Module Input State: Reverse Blocking
50R[2].AdaptSet1-I	Module Input State: Adaptive Parameter1
50R[2].AdaptSet2-I	Module Input State: Adaptive Parameter2
50R[2].AdaptSet3-I	Module Input State: Adaptive Parameter3
50R[2].AdaptSet4-I	Module Input State: Adaptive Parameter4
51R[1].Active	Signal: Active
51R[1].ExBlo	Signal: External Blocking
51R[1].Rvs Blo	Signal: Reverse Blocking
51R[1].Blo TripCmd	Signal: Trip Command blocked
51R[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
51R[1].Pickup	Signal: Pickup IX or IR
51R[1].Trip	Signal: Trip
51R[1].TripCmd	Signal: Trip Command
51R[1].DefaultSet	Signal: Default Parameter Set
51R[1].AdaptSet 1	Signal: Adaptive Parameter 1
51R[1].AdaptSet 2	Signal: Adaptive Parameter 2
51R[1].AdaptSet 3	Signal: Adaptive Parameter 3
51R[1].AdaptSet 4	Signal: Adaptive Parameter 4
51R[1].ExBlo1-I	Module Input State: External Blocking1
51R[1].ExBlo2-I	Module Input State: External Blocking2
51R[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
51R[1].Rvs Blo-I	Module Input State: Reverse Blocking
51R[1].AdaptSet1-I	Module Input State: Adaptive Parameter1
51R[1].AdaptSet2-I	Module Input State: Adaptive Parameter2
51R[1].AdaptSet3-I	Module Input State: Adaptive Parameter3
51R[1].AdaptSet4-I	Module Input State: Adaptive Parameter4
51R[2].Active	Signal: Active
51R[2].ExBlo	Signal: External Blocking
51R[2].Rvs Blo	Signal: Reverse Blocking
51R[2].Blo TripCmd	Signal: Trip Command blocked
51R[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
51R[2].Pickup	Signal: Pickup IX or IR

<i>Name</i>	<i>Description</i>
51R[2].Trip	Signal: Trip
51R[2].TripCmd	Signal: Trip Command
51R[2].DefaultSet	Signal: Default Parameter Set
51R[2].AdaptSet 1	Signal: Adaptive Parameter 1
51R[2].AdaptSet 2	Signal: Adaptive Parameter 2
51R[2].AdaptSet 3	Signal: Adaptive Parameter 3
51R[2].AdaptSet 4	Signal: Adaptive Parameter 4
51R[2].ExBlo1-I	Module Input State: External Blocking1
51R[2].ExBlo2-I	Module Input State: External Blocking2
51R[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
51R[2].Rvs Blo-I	Module Input State: Reverse Blocking
51R[2].AdaptSet1-I	Module Input State: Adaptive Parameter1
51R[2].AdaptSet2-I	Module Input State: Adaptive Parameter2
51R[2].AdaptSet3-I	Module Input State: Adaptive Parameter3
51R[2].AdaptSet4-I	Module Input State: Adaptive Parameter4
87.Active	Signal: Active
87.ExBlo	Signal: External Blocking
87.Blo TripCmd	Signal: Trip Command blocked
87.ExBlo TripCmd	Signal: External Blocking of the Trip Command
87.Alarm A	Signal: Pickup System Phase A
87.Alarm B	Signal: Pickup System Phase B
87.Alarm C	Signal: Pickup System C
87.Pickup	Signal: Pickup
87.Trip A	Signal: Trip System Phase A
87.Trip B	Signal: Trip System Phase B
87.Trip C	Signal: Trip System Phase C
87.Trip	Signal: Trip
87.TripCmd	Signal: Trip Command
87.Slope Blo	Signal: Differential protection was blocked by current transformer saturation. The tripping characteristic was lifted because of current transformer saturation.
87.Restricting	Signal: Restraining of the differential protection by means of rising the tripping curve.
87.Slope Blo: A	Slope Blo: A
87.Slope Blo: B	Slope Blo: B
87.Slope Blo: C	Slope Blo: C
87.Restricting: A	Restraining: A
87.Restricting: B	Restraining: B
87.Restricting: C	Restraining: C

<i>Name</i>	<i>Description</i>
87.ExBlo1-I	Module Input State: External Blocking1
87.ExBlo2-I	Module Input State: External Blocking2
87.ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
87H.Active	Signal: Active
87H.ExBlo	Signal: External Blocking
87H.Blo TripCmd	Signal: Trip Command blocked
87H.ExBlo TripCmd	Signal: External Blocking of the Trip Command
87H.Alarm A	Signal: Pickup System Phase A
87H.Alarm B	Signal: Pickup System Phase B
87H.Alarm C	Signal: Pickup System C
87H.Pickup	Signal: Pickup
87H.Trip A	Signal: Trip System Phase A
87H.Trip B	Signal: Trip System Phase B
87H.Trip C	Signal: Trip System Phase C
87H.Trip	Signal: Trip
87H.TripCmd	Signal: Trip Command
87H.ExBlo1-I	Module Input State: External Blocking1
87H.ExBlo2-I	Module Input State: External Blocking2
87H.ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
87GD.Active	Signal: Active
87GD.ExBlo	Signal: External Blocking
87GD.Blo TripCmd	Signal: Trip Command blocked
87GD.ExBlo TripCmd	Signal: External Blocking of the Trip Command
87GD.Pickup	Signal: Pickup
87GD.Trip	Signal: Trip
87GD.TripCmd	Signal: Trip Command
87GD.ExBlo1-I	Module Input State: External Blocking1
87GD.ExBlo2-I	Module Input State: External Blocking2
87GD.ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
87GDH.Active	Signal: Active
87GDH.ExBlo	Signal: External Blocking
87GDH.Blo TripCmd	Signal: Trip Command blocked
87GDH.ExBlo TripCmd	Signal: External Blocking of the Trip Command
87GDH.Pickup	Signal: Pickup
87GDH.Trip	Signal: Trip
87GDH.TripCmd	Signal: Trip Command
87GDH.ExBlo1-I	Module Input State: External Blocking1

<i>Name</i>	<i>Description</i>
87GDH.ExBlo2-I	Module Input State: External Blocking2
87GDH.ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
49.Active	Signal: Active
49.ExBlo	Signal: External Blocking
49.Blo TripCmd	Signal: Trip Command blocked
49.ExBlo TripCmd	Signal: External Blocking of the Trip Command
49.Alarm	Signal: Alarm Thermal Overload
49.Trip	Signal: Trip
49.TripCmd	Signal: Trip Command
49.Res Thermal Cap	Signal: Resetting Thermal Replica
49.ExBlo1-I	Module Input State: External Blocking1
49.ExBlo2-I	Module Input State: External Blocking2
49.ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
27M[1].Active	Signal: Active
27M[1].ExBlo	Signal: External Blocking
27M[1].Blo TripCmd	Signal: Trip Command blocked
27M[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
27M[1].Pickup Phase A	Signal: Pickup Phase A
27M[1].Pickup Phase B	Signal: Pickup Phase B
27M[1].Pickup Phase C	Signal: Pickup Phase C
27M[1].Pickup	Signal: Pickup Voltage Element
27M[1].Trip	Signal: Trip
27M[1].TripCmd	Signal: Trip Command
27M[1].ExBlo1-I	Module Input State: External Blocking1
27M[1].ExBlo2-I	Module Input State: External Blocking2
27M[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
27M[2].Active	Signal: Active
27M[2].ExBlo	Signal: External Blocking
27M[2].Blo TripCmd	Signal: Trip Command blocked
27M[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
27M[2].Pickup Phase A	Signal: Pickup Phase A
27M[2].Pickup Phase B	Signal: Pickup Phase B
27M[2].Pickup Phase C	Signal: Pickup Phase C
27M[2].Pickup	Signal: Pickup Voltage Element
27M[2].Trip	Signal: Trip
27M[2].TripCmd	Signal: Trip Command
27M[2].ExBlo1-I	Module Input State: External Blocking1

Name	Description
27M[2].ExBlo2-I	Module Input State: External Blocking2
27M[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
59M[1].Active	Signal: Active
59M[1].ExBlo	Signal: External Blocking
59M[1].Blo TripCmd	Signal: Trip Command blocked
59M[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
59M[1].Pickup Phase A	Signal: Pickup Phase A
59M[1].Pickup Phase B	Signal: Pickup Phase B
59M[1].Pickup Phase C	Signal: Pickup Phase C
59M[1].Pickup	Signal: Pickup Voltage Element
59M[1].Trip	Signal: Trip
59M[1].TripCmd	Signal: Trip Command
59M[1].ExBlo1-I	Module Input State: External Blocking1
59M[1].ExBlo2-I	Module Input State: External Blocking2
59M[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
59M[2].Active	Signal: Active
59M[2].ExBlo	Signal: External Blocking
59M[2].Blo TripCmd	Signal: Trip Command blocked
59M[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
59M[2].Pickup Phase A	Signal: Pickup Phase A
59M[2].Pickup Phase B	Signal: Pickup Phase B
59M[2].Pickup Phase C	Signal: Pickup Phase C
59M[2].Pickup	Signal: Pickup Voltage Element
59M[2].Trip	Signal: Trip
59M[2].TripCmd	Signal: Trip Command
59M[2].ExBlo1-I	Module Input State: External Blocking1
59M[2].ExBlo2-I	Module Input State: External Blocking2
59M[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
27A[1].Active	Signal: Active
27A[1].ExBlo	Signal: External Blocking
27A[1].Blo TripCmd	Signal: Trip Command blocked
27A[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
27A[1].Pickup	Signal: Pickup Residual Voltage Supervision-Element
27A[1].Trip	Signal: Trip
27A[1].TripCmd	Signal: Trip Command
27A[1].ExBlo1-I	Module Input State: External Blocking1
27A[1].ExBlo2-I	Module Input State: External Blocking2

Name	Description
27A[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
27A[2].Active	Signal: Active
27A[2].ExBlo	Signal: External Blocking
27A[2].Blo TripCmd	Signal: Trip Command blocked
27A[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
27A[2].Pickup	Signal: Pickup Residual Voltage Supervision-Element
27A[2].Trip	Signal: Trip
27A[2].TripCmd	Signal: Trip Command
27A[2].ExBlo1-I	Module Input State: External Blocking1
27A[2].ExBlo2-I	Module Input State: External Blocking2
27A[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
59A[1].Active	Signal: Active
59A[1].ExBlo	Signal: External Blocking
59A[1].Blo TripCmd	Signal: Trip Command blocked
59A[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
59A[1].Pickup	Signal: Pickup Residual Voltage Supervision-Element
59A[1].Trip	Signal: Trip
59A[1].TripCmd	Signal: Trip Command
59A[1].ExBlo1-I	Module Input State: External Blocking1
59A[1].ExBlo2-I	Module Input State: External Blocking2
59A[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
59A[2].Active	Signal: Active
59A[2].ExBlo	Signal: External Blocking
59A[2].Blo TripCmd	Signal: Trip Command blocked
59A[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
59A[2].Pickup	Signal: Pickup Residual Voltage Supervision-Element
59A[2].Trip	Signal: Trip
59A[2].TripCmd	Signal: Trip Command
59A[2].ExBlo1-I	Module Input State: External Blocking1
59A[2].ExBlo2-I	Module Input State: External Blocking2
59A[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
59N[1].Active	Signal: Active
59N[1].ExBlo	Signal: External Blocking
59N[1].Blo TripCmd	Signal: Trip Command blocked
59N[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
59N[1].Pickup	Signal: Pickup Residual Voltage Supervision-Element
59N[1].Trip	Signal: Trip

<i>Name</i>	<i>Description</i>
59N[1].TripCmd	Signal: Trip Command
59N[1].ExBlo1-I	Module Input State: External Blocking1
59N[1].ExBlo2-I	Module Input State: External Blocking2
59N[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
59N[2].Active	Signal: Active
59N[2].ExBlo	Signal: External Blocking
59N[2].Blo TripCmd	Signal: Trip Command blocked
59N[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
59N[2].Pickup	Signal: Pickup Residual Voltage Supervision-Element
59N[2].Trip	Signal: Trip
59N[2].TripCmd	Signal: Trip Command
59N[2].ExBlo1-I	Module Input State: External Blocking1
59N[2].ExBlo2-I	Module Input State: External Blocking2
59N[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
LVRT [1].Active	Signal: Active
LVRT [1].ExBlo	Signal: External Blocking
LVRT [1].Blo TripCmd	Signal: Trip Command blocked
LVRT [1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
LVRT [1].Pickup Phase A	Signal: Pickup Phase A
LVRT [1].Pickup Phase B	Signal: Pickup Phase B
LVRT [1].Pickup Phase C	Signal: Pickup Phase C
LVRT [1].Pickup	Signal: Pickup Voltage Element
LVRT [1].Trip	Signal: Trip
LVRT [1].TripCmd	Signal: Trip Command
LVRT [1].t-LVRT is running	Signal: t-LVRT is running
LVRT [1].ExBlo1-I	Module Input State: External Blocking1
LVRT [1].ExBlo2-I	Module Input State: External Blocking2
LVRT [1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
LVRT [2].Active	Signal: Active
LVRT [2].ExBlo	Signal: External Blocking
LVRT [2].Blo TripCmd	Signal: Trip Command blocked
LVRT [2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
LVRT [2].Pickup Phase A	Signal: Pickup Phase A
LVRT [2].Pickup Phase B	Signal: Pickup Phase B
LVRT [2].Pickup Phase C	Signal: Pickup Phase C
LVRT [2].Pickup	Signal: Pickup Voltage Element
LVRT [2].Trip	Signal: Trip

Name	Description
LVRT [2].TripCmd	Signal: Trip Command
LVRT [2].t-LVRT is running	Signal: t-LVRT is running
LVRT [2].ExBlo1-I	Module Input State: External Blocking1
LVRT [2].ExBlo2-I	Module Input State: External Blocking2
LVRT [2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
46[1].Active	Signal: Active
46[1].ExBlo	Signal: External Blocking
46[1].Blo TripCmd	Signal: Trip Command blocked
46[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
46[1].Pickup	Signal: Pickup Negative Sequence
46[1].Trip	Signal: Trip
46[1].TripCmd	Signal: Trip Command
46[1].ExBlo1-I	Module Input State: External Blocking1
46[1].ExBlo2-I	Module Input State: External Blocking2
46[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
46[2].Active	Signal: Active
46[2].ExBlo	Signal: External Blocking
46[2].Blo TripCmd	Signal: Trip Command blocked
46[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
46[2].Pickup	Signal: Pickup Negative Sequence
46[2].Trip	Signal: Trip
46[2].TripCmd	Signal: Trip Command
46[2].ExBlo1-I	Module Input State: External Blocking1
46[2].ExBlo2-I	Module Input State: External Blocking2
46[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
46G[1].Active	Signal: Active
46G[1].ExBlo	Signal: External Blocking
46G[1].Blo TripCmd	Signal: Trip Command blocked
46G[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
46G[1].Pickup	Signal: Pickup Negative Sequence
46G[1].Trip	Signal: Trip
46G[1].TripCmd	Signal: Trip Command
46G[1].ExBlo1-I	Module Input State: External Blocking1
46G[1].ExBlo2-I	Module Input State: External Blocking2
46G[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
46G[2].Active	Signal: Active
46G[2].ExBlo	Signal: External Blocking

Name	Description
46G[2].Blo TripCmd	Signal: Trip Command blocked
46G[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
46G[2].Pickup	Signal: Pickup Negative Sequence
46G[2].Trip	Signal: Trip
46G[2].TripCmd	Signal: Trip Command
46G[2].ExBlo1-I	Module Input State: External Blocking1
46G[2].ExBlo2-I	Module Input State: External Blocking2
46G[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
47[1].Active	Signal: Active
47[1].ExBlo	Signal: External Blocking
47[1].Blo TripCmd	Signal: Trip Command blocked
47[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
47[1].Pickup	Signal: Pickup Voltage Asymmetry
47[1].Trip	Signal: Trip
47[1].TripCmd	Signal: Trip Command
47[1].ExBlo1-I	Module Input State: External Blocking1
47[1].ExBlo2-I	Module Input State: External Blocking2
47[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
47[2].Active	Signal: Active
47[2].ExBlo	Signal: External Blocking
47[2].Blo TripCmd	Signal: Trip Command blocked
47[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
47[2].Pickup	Signal: Pickup Voltage Asymmetry
47[2].Trip	Signal: Trip
47[2].TripCmd	Signal: Trip Command
47[2].ExBlo1-I	Module Input State: External Blocking1
47[2].ExBlo2-I	Module Input State: External Blocking2
47[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
81[1].Active	Signal: Active
81[1].ExBlo	Signal: External Blocking
81[1].Blo by V<	Signal: Module is blocked by undervoltage.
81[1].Blo TripCmd	Signal: Trip Command blocked
81[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
81[1].Pickup 81	Signal: Pickup Frequency Protection
81[1].Pickup df/dt DF/DT	Pickup instantaneous or average value of the rate-of-frequency-change
81[1].Pickup Vector Surge	Signal: Pickup Vector Surge
81[1].Pickup	Signal: Pickup Frequency Protection (collective signal)

Name	Description
81[1].Trip 81	Signal: Frequency has exceeded the limit.
81[1].Trip df/dt DF/DT	Signal: Trip df/dt or DF/DT
81[1].Trip Vector Surge	Signal: Trip delta phi
81[1].Trip	Signal: Trip Frequency Protection (collective signal)
81[1].TripCmd	Signal: Trip Command
81[1].ExBlo1-I	Module Input State: External Blocking1
81[1].ExBlo2-I	Module Input State: External Blocking2
81[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
81[2].Active	Signal: Active
81[2].ExBlo	Signal: External Blocking
81[2].Blo by V<	Signal: Module is blocked by undervoltage.
81[2].Blo TripCmd	Signal: Trip Command blocked
81[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
81[2].Pickup 81	Signal: Pickup Frequency Protection
81[2].Pickup df/dt DF/DT	Pickup instantaneous or average value of the rate-of-frequency-change
81[2].Pickup Vector Surge	Signal: Pickup Vector Surge
81[2].Pickup	Signal: Pickup Frequency Protection (collective signal)
81[2].Trip 81	Signal: Frequency has exceeded the limit.
81[2].Trip df/dt DF/DT	Signal: Trip df/dt or DF/DT
81[2].Trip Vector Surge	Signal: Trip delta phi
81[2].Trip	Signal: Trip Frequency Protection (collective signal)
81[2].TripCmd	Signal: Trip Command
81[2].ExBlo1-I	Module Input State: External Blocking1
81[2].ExBlo2-I	Module Input State: External Blocking2
81[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
81[3].Active	Signal: Active
81[3].ExBlo	Signal: External Blocking
81[3].Blo by V<	Signal: Module is blocked by undervoltage.
81[3].Blo TripCmd	Signal: Trip Command blocked
81[3].ExBlo TripCmd	Signal: External Blocking of the Trip Command
81[3].Pickup 81	Signal: Pickup Frequency Protection
81[3].Pickup df/dt DF/DT	Pickup instantaneous or average value of the rate-of-frequency-change
81[3].Pickup Vector Surge	Signal: Pickup Vector Surge
81[3].Pickup	Signal: Pickup Frequency Protection (collective signal)
81[3].Trip 81	Signal: Frequency has exceeded the limit.
81[3].Trip df/dt DF/DT	Signal: Trip df/dt or DF/DT
81[3].Trip Vector Surge	Signal: Trip delta phi

Name	Description
81[3].Trip	Signal: Trip Frequency Protection (collective signal)
81[3].TripCmd	Signal: Trip Command
81[3].ExBlo1-I	Module Input State: External Blocking1
81[3].ExBlo2-I	Module Input State: External Blocking2
81[3].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
81[4].Active	Signal: Active
81[4].ExBlo	Signal: External Blocking
81[4].Blo by V<	Signal: Module is blocked by undervoltage.
81[4].Blo TripCmd	Signal: Trip Command blocked
81[4].ExBlo TripCmd	Signal: External Blocking of the Trip Command
81[4].Pickup 81	Signal: Pickup Frequency Protection
81[4].Pickup df/dt DF/DT	Pickup instantaneous or average value of the rate-of-frequency-change
81[4].Pickup Vector Surge	Signal: Pickup Vector Surge
81[4].Pickup	Signal: Pickup Frequency Protection (collective signal)
81[4].Trip 81	Signal: Frequency has exceeded the limit.
81[4].Trip df/dt DF/DT	Signal: Trip df/dt or DF/DT
81[4].Trip Vector Surge	Signal: Trip delta phi
81[4].Trip	Signal: Trip Frequency Protection (collective signal)
81[4].TripCmd	Signal: Trip Command
81[4].ExBlo1-I	Module Input State: External Blocking1
81[4].ExBlo2-I	Module Input State: External Blocking2
81[4].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
81[5].Active	Signal: Active
81[5].ExBlo	Signal: External Blocking
81[5].Blo by V<	Signal: Module is blocked by undervoltage.
81[5].Blo TripCmd	Signal: Trip Command blocked
81[5].ExBlo TripCmd	Signal: External Blocking of the Trip Command
81[5].Pickup 81	Signal: Pickup Frequency Protection
81[5].Pickup df/dt DF/DT	Pickup instantaneous or average value of the rate-of-frequency-change
81[5].Pickup Vector Surge	Signal: Pickup Vector Surge
81[5].Pickup	Signal: Pickup Frequency Protection (collective signal)
81[5].Trip 81	Signal: Frequency has exceeded the limit.
81[5].Trip df/dt DF/DT	Signal: Trip df/dt or DF/DT
81[5].Trip Vector Surge	Signal: Trip delta phi
81[5].Trip	Signal: Trip Frequency Protection (collective signal)
81[5].TripCmd	Signal: Trip Command
81[5].ExBlo1-I	Module Input State: External Blocking1

Name	Description
81[5].ExBlo2-I	Module Input State: External Blocking2
81[5].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
81[6].Active	Signal: Active
81[6].ExBlo	Signal: External Blocking
81[6].Blo by V<	Signal: Module is blocked by undervoltage.
81[6].Blo TripCmd	Signal: Trip Command blocked
81[6].ExBlo TripCmd	Signal: External Blocking of the Trip Command
81[6].Pickup 81	Signal: Pickup Frequency Protection
81[6].Pickup df/dt DF/DT	Pickup instantaneous or average value of the rate-of-frequency-change
81[6].Pickup Vector Surge	Signal: Pickup Vector Surge
81[6].Pickup	Signal: Pickup Frequency Protection (collective signal)
81[6].Trip 81	Signal: Frequency has exceeded the limit.
81[6].Trip df/dt DF/DT	Signal: Trip df/dt or DF/DT
81[6].Trip Vector Surge	Signal: Trip delta phi
81[6].Trip	Signal: Trip Frequency Protection (collective signal)
81[6].TripCmd	Signal: Trip Command
81[6].ExBlo1-I	Module Input State: External Blocking1
81[6].ExBlo2-I	Module Input State: External Blocking2
81[6].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
32[1].Active	Signal: Active
32[1].ExBlo	Signal: External Blocking
32[1].Blo TripCmd	Signal: Trip Command blocked
32[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
32[1].Pickup	Signal: Pickup Power Protection
32[1].Trip	Signal: Trip Power Protection
32[1].TripCmd	Signal: Trip Command
32[1].ExBlo1-I	Module Input State: External Blocking
32[1].ExBlo2-I	Module Input State: External Blocking
32[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
32[2].Active	Signal: Active
32[2].ExBlo	Signal: External Blocking
32[2].Blo TripCmd	Signal: Trip Command blocked
32[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
32[2].Pickup	Signal: Pickup Power Protection
32[2].Trip	Signal: Trip Power Protection
32[2].TripCmd	Signal: Trip Command
32[2].ExBlo1-I	Module Input State: External Blocking

Name	Description
32[2].ExBlo2-I	Module Input State: External Blocking
32[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
32[3].Active	Signal: Active
32[3].ExBlo	Signal: External Blocking
32[3].Blo TripCmd	Signal: Trip Command blocked
32[3].ExBlo TripCmd	Signal: External Blocking of the Trip Command
32[3].Pickup	Signal: Pickup Power Protection
32[3].Trip	Signal: Trip Power Protection
32[3].TripCmd	Signal: Trip Command
32[3].ExBlo1-I	Module Input State: External Blocking
32[3].ExBlo2-I	Module Input State: External Blocking
32[3].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
32V[1].Active	Signal: Active
32V[1].ExBlo	Signal: External Blocking
32V[1].Blo TripCmd	Signal: Trip Command blocked
32V[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
32V[1].Pickup	Signal: Pickup Power Protection
32V[1].Trip	Signal: Trip Power Protection
32V[1].TripCmd	Signal: Trip Command
32V[1].ExBlo1-I	Module Input State: External Blocking
32V[1].ExBlo2-I	Module Input State: External Blocking
32V[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
32V[2].Active	Signal: Active
32V[2].ExBlo	Signal: External Blocking
32V[2].Blo TripCmd	Signal: Trip Command blocked
32V[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
32V[2].Pickup	Signal: Pickup Power Protection
32V[2].Trip	Signal: Trip Power Protection
32V[2].TripCmd	Signal: Trip Command
32V[2].ExBlo1-I	Module Input State: External Blocking
32V[2].ExBlo2-I	Module Input State: External Blocking
32V[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
32V[3].Active	Signal: Active
32V[3].ExBlo	Signal: External Blocking
32V[3].Blo TripCmd	Signal: Trip Command blocked
32V[3].ExBlo TripCmd	Signal: External Blocking of the Trip Command
32V[3].Pickup	Signal: Pickup Power Protection

<i>Name</i>	<i>Description</i>
32V[3].Trip	Signal: Trip Power Protection
32V[3].TripCmd	Signal: Trip Command
32V[3].ExBlo1-I	Module Input State: External Blocking
32V[3].ExBlo2-I	Module Input State: External Blocking
32V[3].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
PF-55D[1].Active	Signal: Active
PF-55D[1].ExBlo	Signal: External Blocking
PF-55D[1].Blo TripCmd	Signal: Trip Command blocked
PF-55D[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
PF-55D[1].Pickup	Signal: Pickup Power Factor
PF-55D[1].Trip	Signal: Trip Power Factor
PF-55D[1].TripCmd	Signal: Trip Command
PF-55D[1].Compensator	Signal: Compensation Signal
PF-55D[1].Impossible	Signal: Pickup Power Factor Impossible
PF-55D[1].ExBlo1-I	Module Input State: External Blocking
PF-55D[1].ExBlo2-I	Module Input State: External Blocking
PF-55D[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
PF-55D[2].Active	Signal: Active
PF-55D[2].ExBlo	Signal: External Blocking
PF-55D[2].Blo TripCmd	Signal: Trip Command blocked
PF-55D[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
PF-55D[2].Pickup	Signal: Pickup Power Factor
PF-55D[2].Trip	Signal: Trip Power Factor
PF-55D[2].TripCmd	Signal: Trip Command
PF-55D[2].Compensator	Signal: Compensation Signal
PF-55D[2].Impossible	Signal: Pickup Power Factor Impossible
PF-55D[2].ExBlo1-I	Module Input State: External Blocking
PF-55D[2].ExBlo2-I	Module Input State: External Blocking
PF-55D[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
PF-55A[1].Active	Signal: Active
PF-55A[1].ExBlo	Signal: External Blocking
PF-55A[1].Blo TripCmd	Signal: Trip Command blocked
PF-55A[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
PF-55A[1].Pickup	Signal: Pickup Power Factor
PF-55A[1].Trip	Signal: Trip Power Factor
PF-55A[1].TripCmd	Signal: Trip Command
PF-55A[1].Compensator	Signal: Compensation Signal

Name	Description
PF-55A[1].Impossible	Signal: Pickup Power Factor Impossible
PF-55A[1].ExBlo1-I	Module Input State: External Blocking
PF-55A[1].ExBlo2-I	Module Input State: External Blocking
PF-55A[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
PF-55A[2].Active	Signal: Active
PF-55A[2].ExBlo	Signal: External Blocking
PF-55A[2].Blo TripCmd	Signal: Trip Command blocked
PF-55A[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
PF-55A[2].Pickup	Signal: Pickup Power Factor
PF-55A[2].Trip	Signal: Trip Power Factor
PF-55A[2].TripCmd	Signal: Trip Command
PF-55A[2].Compensator	Signal: Compensation Signal
PF-55A[2].Impossible	Signal: Pickup Power Factor Impossible
PF-55A[2].ExBlo1-I	Module Input State: External Blocking
PF-55A[2].ExBlo2-I	Module Input State: External Blocking
PF-55A[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
Q->&V<.Active	Signal: Active
Q->&V<.ExBlo	Signal: External Blocking
Q->&V<.Fuse Fail VT Blo	Signal: Blocked by Fuse Failure (VT)
Q->&V<.Pickup	Signal: Pickup Reactive Power Undervoltage Protection
Q->&V<.Decoupling Distributed Generator	Signal: Decoupling of the (local) Energy Generator/Resource
Q->&V<.Decoupling PCC	Signal: Decoupling at the Point of Common Coupling
Q->&V<.Power Angle	Signal: Admissable power angle exceeded
Q->&V<.Reactive Power Thres	Signal: Admissable Reactive Power Threshold exceeded
Q->&V<.VLL too low	Signal: Line-to-Line voltage too low
Q->&V<.ExBlo1-I	Module Input State: External Blocking1
Q->&V<.ExBlo2-I	Module Input State: External Blocking2
ReCon.Active	Signal: Active
ReCon.ExBlo	Signal: External Blocking
ReCon.Blo by Meas Ciruit Superv	Signal: Module blocked by measuring cirucuit supervision
ReCon.Release Energy Resource	Signal: Release Energy Resource.
ReCon.ExBlo1-I	Module Input State: External Blocking1
ReCon.ExBlo2-I	Module Input State: External Blocking2
ReCon.V Ext Release PCC-I	Module input state: Release signal is being generated by the PCC (External Release)
ReCon.PCC Fuse Fail VT-I	State of the module input: Blocking if the fuse of a voltage transformer has tripped at the PCC.

Name	Description
ReCon.reconnected-I	This signal indicates the state "reconnected" (mains parallel).
ReCon.Decoupling1-I	Decoupling signal that triggers the reclosure.
ReCon.Decoupling2-I	Decoupling signal that triggers the reclosure.
ReCon.Decoupling3-I	Decoupling signal that triggers the reclosure.
ReCon.Decoupling4-I	Decoupling signal that triggers the reclosure.
ReCon.Decoupling5-I	Decoupling signal that triggers the reclosure.
ReCon.Decoupling6-I	Decoupling signal that triggers the reclosure.
Sync-check.Active	Signal: Active
Sync-check.ExBlo	Signal: External Blocking
Sync-check.LiveBus	Signal: Live-Bus flag: 1=Live-Bus, 0=Voltage is below the LiveBus threshold
Sync-check.LiveLine	Signal: Live Line flag: 1=Live-Line, 0=Voltage is below the LiveLine threshold
Sync-check.SynchronRunTiming	Signal: SynchronRunTiming
Sync-check.SynchronFailed	Signal: This signal indicates a failed synchronization. It is set for 5s when the breaker is still open after the Synchron-Run-timer has timed out.
Sync-check.SyncOverridden	Signal: Synchronism Check is overridden because one of the Synchronism overriding conditions (DB/DL or ExtBypass) is met.
Sync-check.VDiffTooHigh	Signal: Voltage difference between bus and line too high.
Sync-check.SlipTooHigh	Signal: Frequency difference (slip frequency) between bus and line voltages too high.
Sync-check.AngleDiffTooHigh	Signal: Phase Angle difference between bus and line voltages too high.
Sync-check.Sys-in-Sync	Signal: Bus and line voltages are in synchronism according to the system synchronism criteria.
Sync-check.In-Sync Allowed	Signal: In-Sync Allowed
Sync-check.ExBlo1-I	Module Input State: External Blocking1
Sync-check.ExBlo2-I	Module Input State: External Blocking2
Sync-check.Bypass-I	State of the module input: Bypass
Sync-check.BkrCloseInitiate-I	State of the module input: Breaker Close Initiate with synchronism check from any control sources (e.g. HMI / SCADA). If the state of the assigned signal becomes true, a Breaker Close will be initiated (Trigger Source).
ZI.Active	Signal: Active
ZI.ExBlo	Signal: External Blocking
ZI.Blo TripCmd	Signal: Trip Command blocked
ZI.ExBlo TripCmd	Signal: External Blocking of the Trip Command
ZI.Bkr Blo	Signal: Blocked by Breaker Failure
ZI.Phase Pickup	Signal: Zone Interlocking Phase Pickup
ZI.Phase Trip	Signal: Zone Interlocking Phase Trip
ZI.Ground Pickup	Signal: Zone Interlocking Ground Pickup
ZI.Ground Trip	Signal: Zone Interlocking Ground Trip
ZI.Pickup	Signal: Pickup Zone Interlocking
ZI.Trip	Signal: Zone Interlocking Trip

Name	Description
ZI.TripCmd	Signal: Zone Interlocking Trip Command
ZI.Phase OUT	Signal: Zone Interlocking Phase OUT
ZI.Ground OUT	Signal: Zone Interlocking Ground OUT
ZI.OUT	Signal: Zone Interlocking OUT
ZI.IN	Signal: Zone Interlocking IN
ZI.ExBlo1-I	Module Input State: External Blocking1
ZI.ExBlo2-I	Module Input State: External Blocking2
ZI.ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
40-Z1[1].Active	Signal: Active
40-Z1[1].ExBlo	Signal: External Blocking
40-Z1[1].Blo TripCmd	Signal: Trip Command blocked
40-Z1[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
40-Z1[1].Pickup	Signal: Pickup Loss of Excitation
40-Z1[1].Trip	Signal: Trip
40-Z1[1].TripCmd	Signal: Trip Command
40-Z1[1].V< Acc Trip	Signal: V< Acc Trip
40-Z1[1].MeasCircuitSupv Blo	Blocked by Measuring Circuit Supervision
40-Z1[1].ExBlo1-I	Module Input State: External Blocking1
40-Z1[1].ExBlo2-I	Module Input State: External Blocking2
40-Z1[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
40-Z2[1].Active	Signal: Active
40-Z2[1].ExBlo	Signal: External Blocking
40-Z2[1].Blo TripCmd	Signal: Trip Command blocked
40-Z2[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
40-Z2[1].Pickup	Signal: Pickup Loss of Excitation
40-Z2[1].Trip	Signal: Trip
40-Z2[1].TripCmd	Signal: Trip Command
40-Z2[1].V< Acc Trip	Signal: V< Acc Trip
40-Z2[1].MeasCircuitSupv Blo	Blocked by Measuring Circuit Supervision
40-Z2[1].ExBlo1-I	Module Input State: External Blocking1
40-Z2[1].ExBlo2-I	Module Input State: External Blocking2
40-Z2[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
40-Z1[2].Active	Signal: Active
40-Z1[2].ExBlo	Signal: External Blocking
40-Z1[2].Blo TripCmd	Signal: Trip Command blocked
40-Z1[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
40-Z1[2].Pickup	Signal: Pickup Loss of Excitation

Name	Description
40-Z1[2].Trip	Signal: Trip
40-Z1[2].TripCmd	Signal: Trip Command
40-Z1[2].V< Acc Trip	Signal: V< Acc Trip
40-Z1[2].MeasCircuitSupv Blo	Blocked by Measuring Circuit Supervision
40-Z1[2].ExBlo1-I	Module Input State: External Blocking1
40-Z1[2].ExBlo2-I	Module Input State: External Blocking2
40-Z1[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
40-Z2[2].Active	Signal: Active
40-Z2[2].ExBlo	Signal: External Blocking
40-Z2[2].Blo TripCmd	Signal: Trip Command blocked
40-Z2[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
40-Z2[2].Pickup	Signal: Pickup Loss of Excitation
40-Z2[2].Trip	Signal: Trip
40-Z2[2].TripCmd	Signal: Trip Command
40-Z2[2].V< Acc Trip	Signal: V< Acc Trip
40-Z2[2].MeasCircuitSupv Blo	Blocked by Measuring Circuit Supervision
40-Z2[2].ExBlo1-I	Module Input State: External Blocking1
40-Z2[2].ExBlo2-I	Module Input State: External Blocking2
40-Z2[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
24[1].Active	Signal: Active
24[1].ExBlo	Signal: External Blocking
24[1].Blo TripCmd	Signal: Trip Command blocked
24[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
24[1].Pickup	Signal: Pickup
24[1].Trip	Signal: Trip
24[1].TripCmd	Signal: Trip Command
24[1].ExBlo1-I	Module Input State: External Blocking1
24[1].ExBlo2-I	Module Input State: External Blocking2
24[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
24[2].Active	Signal: Active
24[2].ExBlo	Signal: External Blocking
24[2].Blo TripCmd	Signal: Trip Command blocked
24[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
24[2].Pickup	Signal: Pickup
24[2].Trip	Signal: Trip
24[2].TripCmd	Signal: Trip Command
24[2].ExBlo1-I	Module Input State: External Blocking1

Name	Description
24[2].ExBlo2-I	Module Input State: External Blocking2
24[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
50/27.Active	Signal: Active
50/27.ExBlo	Signal: External Blocking
50/27.Blo TripCmd	Signal: Trip Command blocked
50/27.ExBlo TripCmd	Signal: External Blocking of the Trip Command
50/27.Pickup	Signal: Inadvertent Energization
50/27.Trip	Signal: Trip
50/27.TripCmd	Signal: Trip Command
50/27.MeasCircuitSupv Blo	Blocked by Measuring Circuit Supervision
50/27.ExBlo1-I	Module Input State: External Blocking1
50/27.ExBlo2-I	Module Input State: External Blocking2
50/27.ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
SOTF.Active	Signal: Active
SOTF.ExBlo	Signal: External Blocking
SOTF.Rvs Blo	Signal: Reverse Blocking
SOTF.enabled	Signal: Switch Onto Fault enabled. This Signal can be used to modify Overcurrent Protection Settings.
SOTF.I<	Signal: No Load Current.
SOTF.ExBlo1-I	Module Input State: External Blocking
SOTF.ExBlo2-I	Module Input State: External Blocking
SOTF.Rvs Blo-I	Module Input State: Reverse Blocking
SOTF.Ext SOTF-I	Module Input State: External Switch Onto Fault Alarm
CLPU.Active	Signal: Active
CLPU.ExBlo	Signal: External Blocking
CLPU.Rvs Blo	Signal: Reverse Blocking
CLPU.enabled	Signal: Cold Load enabled
CLPU.detected	Signal: Cold Load detected
CLPU.I<	Signal: No Load Current.
CLPU.Load Inrush	Signal: Load Inrush
CLPU.Settle Time	Signal: Settle Time
CLPU.ExBlo1-I	Module Input State: External Blocking
CLPU.ExBlo2-I	Module Input State: External Blocking
CLPU.Rvs Blo-I	Module Input State: Reverse Blocking
ExP[1].Active	Signal: Active
ExP[1].ExBlo	Signal: External Blocking
ExP[1].Blo TripCmd	Signal: Trip Command blocked
ExP[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command

<i>Name</i>	<i>Description</i>
ExP[1].Alarm	Signal: Alarm
ExP[1].Trip	Signal: Trip
ExP[1].TripCmd	Signal: Trip Command
ExP[1].ExBlo1-I	Module Input State: External Blocking1
ExP[1].ExBlo2-I	Module Input State: External Blocking2
ExP[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
ExP[1].Alarm-I	Module Input State: Alarm
ExP[1].Trip-I	Module Input State: Trip
ExP[2].Active	Signal: Active
ExP[2].ExBlo	Signal: External Blocking
ExP[2].Blo TripCmd	Signal: Trip Command blocked
ExP[2].ExBlo TripCmd	Signal: External Blocking of the Trip Command
ExP[2].Alarm	Signal: Alarm
ExP[2].Trip	Signal: Trip
ExP[2].TripCmd	Signal: Trip Command
ExP[2].ExBlo1-I	Module Input State: External Blocking1
ExP[2].ExBlo2-I	Module Input State: External Blocking2
ExP[2].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
ExP[2].Alarm-I	Module Input State: Alarm
ExP[2].Trip-I	Module Input State: Trip
ExP[3].Active	Signal: Active
ExP[3].ExBlo	Signal: External Blocking
ExP[3].Blo TripCmd	Signal: Trip Command blocked
ExP[3].ExBlo TripCmd	Signal: External Blocking of the Trip Command
ExP[3].Alarm	Signal: Alarm
ExP[3].Trip	Signal: Trip
ExP[3].TripCmd	Signal: Trip Command
ExP[3].ExBlo1-I	Module Input State: External Blocking1
ExP[3].ExBlo2-I	Module Input State: External Blocking2
ExP[3].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
ExP[3].Alarm-I	Module Input State: Alarm
ExP[3].Trip-I	Module Input State: Trip
ExP[4].Active	Signal: Active
ExP[4].ExBlo	Signal: External Blocking
ExP[4].Blo TripCmd	Signal: Trip Command blocked
ExP[4].ExBlo TripCmd	Signal: External Blocking of the Trip Command
ExP[4].Alarm	Signal: Alarm

<i>Name</i>	<i>Description</i>
ExP[4].Trip	Signal: Trip
ExP[4].TripCmd	Signal: Trip Command
ExP[4].ExBlo1-I	Module Input State: External Blocking1
ExP[4].ExBlo2-I	Module Input State: External Blocking2
ExP[4].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
ExP[4].Alarm-I	Module Input State: Alarm
ExP[4].Trip-I	Module Input State: Trip
URTD.WD1 Superv	Signal: Supervision Channel WD1
URTD.WD2 Superv	Signal: Supervision Channel WD2
URTD.WD3 Superv	Signal: Supervision Channel WD3
URTD.WD4 Superv	Signal: Supervision Channel WD4
URTD.WD5 Superv	Signal: Supervision Channel WD5
URTD.WD6 Superv	Signal: Supervision Channel WD6
URTD.MB1 Superv	Signal: Supervision Channel MB1
URTD.MB2 Superv	Signal: Supervision Channel MB2
URTD.LB1 Superv	Signal: Supervision Channel LB1
URTD.LB2 Superv	Signal: Supervision Channel LB2
URTD.Aux1 Superv	Signal: Supervision Channel Aux1
URTD.Aux2 Superv	Signal: Supervision Channel Aux2
URTD.Superv	Signal: URTD Supervision Channel
URTD.active	Signal: URTD active
URTD.Outs forced	Signal: The State of at least one Relay Output has been set by force. That means that the state of at least one Relay is forced and hence does not show the state of the assigned signals.
RTD.Active	Signal: Active
RTD.ExBlo	Signal: External Blocking
RTD.Blo TripCmd	Signal: Trip Command blocked
RTD.ExBlo TripCmd	Signal: External Blocking of the Trip Command
RTD.Alarm	Alarm RTD Temperature Protection
RTD.Trip	Signal: Trip
RTD.TripCmd	Signal: Trip Command
RTD.WD 1 Trip	Winding 1 Signal: Trip
RTD.WD 1 Alarm	Winding 1 Alarm RTD Temperature Protection
RTD.WD 1 Timeout Alarm	Winding 1 Timeout Alarm
RTD.WD 1 Invalid	Winding 1 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.WD 2 Trip	Winding 2 Signal: Trip
RTD.WD 2 Alarm	Winding 2 Alarm RTD Temperature Protection
RTD.WD 2 Timeout Alarm	Winding 2 Timeout Alarm

Name	Description
RTD.WD 2 Invalid	Winding 2 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.WD 3 Trip	Winding 3 Signal: Trip
RTD.WD 3 Alarm	Winding 3 Alarm RTD Temperature Protection
RTD.WD 3 Timeout Alarm	Winding 3 Timeout Alarm
RTD.WD 3 Invalid	Winding 3 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.WD 4 Trip	Winding 4 Signal: Trip
RTD.WD 4 Alarm	Winding 4 Alarm RTD Temperature Protection
RTD.WD 4 Timeout Alarm	Winding 4 Timeout Alarm
RTD.WD 4 Invalid	Winding 4 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.WD 5 Trip	Winding 5 Signal: Trip
RTD.WD 5 Alarm	Winding 5 Alarm RTD Temperature Protection
RTD.WD 5 Timeout Alarm	Winding 5 Timeout Alarm
RTD.WD 5 Invalid	Winding 5 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.WD 6 Trip	Winding 6 Signal: Trip
RTD.WD 6 Alarm	Winding 6 Alarm RTD Temperature Protection
RTD.WD 6 Timeout Alarm	Winding 6 Timeout Alarm
RTD.WD 6 Invalid	Winding 6 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.MB 1 Trip	Motor Bearing 1 Signal: Trip
RTD.MB 1 Alarm	Motor Bearing 1 Alarm RTD Temperature Protection
RTD.MB 1 Timeout Alarm	Motor Bearing 1 Timeout Alarm
RTD.MB 1 Invalid	Motor Bearing 1 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.MB 2 Trip	Motor Bearing 2 Signal: Trip
RTD.MB 2 Alarm	Motor Bearing 2 Alarm RTD Temperature Protection
RTD.MB 2 Timeout Alarm	Motor Bearing 2 Timeout Alarm
RTD.MB 2 Invalid	Motor Bearing 2 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.LB 1 Trip	Load Bearing 1 Signal: Trip
RTD.LB 1 Alarm	Load Bearing 1 Alarm RTD Temperature Protection
RTD.LB 1 Timeout Alarm	Load Bearing 1 Timeout Alarm
RTD.LB 1 Invalid	Load Bearing 1 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.LB 2 Trip	Load Bearing 2 Signal: Trip
RTD.LB 2 Alarm	Load Bearing 2 Alarm RTD Temperature Protection
RTD.LB 2 Timeout Alarm	Load Bearing 2 Timeout Alarm

Name	Description
RTD.LB 2 Invalid	Load Bearing 2 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.Aux1 Trip	Auxiliary 1 Signal: Trip
RTD.Aux1 Alarm	Auxiliary 1 Alarm RTD Temperature Protection
RTD.Aux1 Timeout Alarm	Auxiliary 1 Timeout Alarm
RTD.Aux1 Invalid	Auxiliary 1 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.Aux2 Trip	Auxiliary 2 Signal: Trip
RTD.Aux2 Alarm	Auxiliary 2 Alarm RTD Temperature Protection
RTD.Aux2 Timeout Alarm	Auxiliary 2 Timeout Alarm
RTD.Aux2 Invalid	Auxiliary 2 Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.Trip WD Group	Trip all Windings
RTD.Alarm WD Group	Alarm all Windings
RTD.TimeoutAlmWDGrp	Timeout Alarm all Windings
RTD.WD Group Invalid	Winding Group Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.Trip MB Group	Trip all Motor Bearings
RTD.Alarm MB Group	Alarm all Motor Bearings
RTD.TimeoutAlmMBGrp	Timeout Alarm all Motor Bearings
RTD.MB Group Invalid	Motor Bearing Group Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.Trip LB Group	Trip all Load Bearings
RTD.Alarm LB Group	Alarm all Load Bearings
RTD.TimeoutAlmLBGrp	Timeout Alarm all Load Bearings
RTD.LB Group Invalid	Load Bearing Group Signal: Invalid Temperature Measurement Value (e.g caused by an defective or interrupted RTD Measurement)
RTD.Trip Any Group	Trip Any Group
RTD.Alarm Any Group	Alarm Any Group
RTD.TimeoutAlmAnyGrp	Timeout Alarm Any Group
RTD.Voting Trip Grp 1	Voting Trip Group 1
RTD.Voting Trip Grp 2	Voting Trip Group 2
RTD.Timeout Alarm	Alarm timeout expired
RTD.Trip Aux Group	Trip Auxiliary Group
RTD.Alarm Aux Group	Alarm Auxiliary Group
RTD.TimeoutAlmAuxGrp	Timeout Alarm Auxiliary Group
RTD.AuxGrpInvalid	Invalid Auxiliary Group
RTD.ExBlo1-I	Module Input State: External Blocking1
RTD.ExBlo2-I	Module Input State: External Blocking2

Name	Description
RTD.ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
BF.Active	Signal: Active
BF.ExBlo	Signal: External Blocking
BF.Waiting for Trigger	Waiting for Trigger
BF.Pickup	Signal: BF-Module Started (Pickup)
BF.Trip	Signal: Breaker Failure Trip
BF.Lockout	Signal: Lockout
BF.Res Lockout	Signal: Reset Lockout
BF.ExBlo1-I	Module Input State: External Blocking1
BF.ExBlo2-I	Module Input State: External Blocking2
BF.Trigger1-I	Module Input: Trigger that will start the BF
BF.Trigger2-I	Module Input: Trigger that will start the BF
BF.Trigger3-I	Module Input: Trigger that will start the BF
TCM.Active	Signal: Active
TCM.ExBlo	Signal: External Blocking
TCM.Pickup	Signal: Pickup Trip Circuit Supervision
TCM.Not Possible	Not possible because no state indicator assigned to the breaker.
TCM.CinBkr-52a-I	Module Input State: Feed-back signal of the Bkr (52a)
TCM.CinBkr-52b-I	Module Input State: Feed-back signal of the Bkr. (52b)
TCM.ExBlo1-I	Module Input State: External Blocking1
TCM.ExBlo2-I	Module Input State: External Blocking2
CTS.Active	Signal: Active
CTS.ExBlo	Signal: External Blocking
CTS.Pickup	Signal: Pickup Current Transformer Measuring Circuit Supervision
CTS.ExBlo1-I	Module Input State: External Blocking1
CTS.ExBlo2-I	Module Input State: External Blocking2
LOP.Active	Signal: Active
LOP.ExBlo	Signal: External Blocking
LOP.Pickup	Signal: Pickup Loss of Potential
LOP.LOP Blo	Signal: Loss of Potential blocks other elements
LOP.ExBlo1-I	Module Input State: External Blocking1
LOP.ExBlo2-I	Module Input State: External Blocking2
ECr.Cr Oflw VAh Net	Signal: Counter Overflow VAh Net
ECr.Cr Oflw Wh Net	Signal: Counter Overflow Wh Net
ECr.Cr Oflw Wh Fwd	Signal: Counter Overflow Wh Fwd
ECr.Cr Oflw Wh Rev	Signal: Counter Overflow Wh Rev
ECr.Cr Oflw VArh Net	Signal: Counter Overflow VArh Net

Name	Description
ECr.Cr Oflw VArh Lag	Signal: Counter Overflow VArh Lag
ECr.Cr Oflw VArh Lead	Signal: Counter Overflow VArh Lead
ECr.VAh Net Res Cr	Signal: VAh Net Reset Counter
ECr.Wh Net Res Cr	Signal: Wh Net Reset Counter
ECr.Wh Fwd Res Cr	Signal: Wh Fwd Reset Counter
ECr.Wh Rev Res Cr	Signal: Wh Rev Reset Counter
ECr.VArh Net Res Cr	Signal: VArh Net Reset Counter
ECr.VArh Lag Res Cr	Signal: VArh Lag Reset Counter
ECr.VArh Lead Res Cr	Signal: VArh Lead Reset Counter
ECr.Res all Energy Cr	Signal: Reset of all Energy Counters
ECr.Cr OflwW VAh Net	Signal: Counter VAh Net will overflow soon
ECr.Cr OflwW Wh Net	Signal: Counter Wh Net will overflow soon
ECr.Cr OflwW Wh Fwd	Signal: Counter Wh Fwd will overflow soon
ECr.Cr OflwW Wh Rev	Signal: Counter Wh Rev will overflow soon
ECr.Cr OflwW VArh Net	Signal: Counter VArh Net will overflow soon
ECr.Cr OflwW VArh Lag	Signal: Counter VArh Lag will overflow soon
ECr.Cr OflwW VArh Lead	Signal: Counter VArh Lead will overflow soon
SysA.Active	Signal: Active
SysA.ExBlo	Signal: External Blocking
SysA.Alarm Watt Power	Signal: Alarm WATTS peak
SysA.Alarm VAr Power	Signal: Alarm VArS peak
SysA.Alarm VA Power	Signal: Alarm VAS peak
SysA.Alarm Watt Demand	Signal: Alarm WATTS demand value
SysA.Alarm VAr Demand	Signal: Alarm VARs demand value
SysA.Alarm VA Demand	Signal: Alarm VAS demand value
SysA.Alm Current Demd	Signal: Alarm Current demand value
SysA.Alarm I THD	Signal: Alarm Total Harmonic Distortion Current
SysA.Alarm V THD	Signal: Alarm Total Harmonic Distortion Voltage
SysA.Trip Watt Power	Signal: Trip WATTS peak
SysA.Trip VAr Power	Signal: Trip VArS peak
SysA.Trip VA Power	Signal: Trip VAS peak
SysA.Trip Watt Demand	Signal: Trip WATTS demand value
SysA.Trip VAr Demand	Signal: Trip VARs demand value
SysA.Trip VA Demand	Signal: Trip VAS demand value
SysA.Trip Current Demand	Signal: Trip Current demand value
SysA.Trip I THD	Signal: Trip Total Harmonic Distortion Current
SysA.Trip V THD	Signal: Trip Total Harmonic Distortion Voltage

<i>Name</i>	<i>Description</i>
SysA.ExBlo-I	Module Input State: External Blocking
Wired Inputs.Bkr Trouble-I	Breaker Trouble
Wired Inputs.52a M1-I	State of the module input: Main 1 Breaker Closed
Wired Inputs.52b M1-I	State of the module input: Main 1 Breaker Open
Wired Inputs.TOCa M1-I	State of the module input: Main 1 Breaker Connected
Wired Inputs.43/10 M1-I	State of the module input: Main 1 Breaker Selected To Trip
Wired Inputs.52a M2-I	State of the module input: Main 2 Breaker Closed
Wired Inputs.52b M2-I	State of the module input: Main 2 Breaker Open
Wired Inputs.TOCa M2-I	State of the module input: Main 2 Breaker Connected
Wired Inputs.43/10 M2-I	State of the module input: Main 2 Breaker Selected To Trip
Wired Inputs.52a T-I	State of the module input: Tie Breaker Closed
Wired Inputs.52b T-I	State of the module input: Tie Breaker Open
Wired Inputs.TOCa T-I	State of the module input: Tie Breaker Connected
Wired Inputs.43/10 T-I	State of the module input: Tie Breaker Selected To Trip
Wired Inputs.43 M-I	State of the module input: System In Manual
Wired Inputs.43 A-I	State of the module input: System in Auto
Wired Inputs.43 P1-I	State of the module input: Preferred Source 1
Wired Inputs.43 P2-I	State of the module input: Preferred Source 2
DI-8P X1.DI 1	Signal: Digital Input
DI-8P X1.DI 2	Signal: Digital Input
DI-8P X1.DI 3	Signal: Digital Input
DI-8P X1.DI 4	Signal: Digital Input
DI-8P X1.DI 5	Signal: Digital Input
DI-8P X1.DI 6	Signal: Digital Input
DI-8P X1.DI 7	Signal: Digital Input
DI-8P X1.DI 8	Signal: Digital Input
DI-8 X5.DI 1	Signal: Digital Input
DI-8 X5.DI 2	Signal: Digital Input
DI-8 X5.DI 3	Signal: Digital Input
DI-8 X5.DI 4	Signal: Digital Input
DI-8 X5.DI 5	Signal: Digital Input
DI-8 X5.DI 6	Signal: Digital Input
DI-8 X5.DI 7	Signal: Digital Input
DI-8 X5.DI 8	Signal: Digital Input
RO-4Z X2.ZI OUT	Signal: Zone Interlocking OUT
RO-4Z X2.RO 1	Signal: Relay Output
RO-4Z X2.RO 2	Signal: Relay Output

Name	Description
RO-4Z X2.RO 3	Signal: Relay Output
RO-4Z X2.RO 4	Signal: Relay Output
RO-4Z X2.DISARMED!	Signal: CAUTION! RELAYS DISARMED in order to safely perform maintenance while eliminating the risk of taking an entire process off-line. (Note: Zone Interlocking and Supervision Contact cannot be disarmed). YOU MUST ENSURE that the relays are ARMED AGAIN after maintenance
RO-4Z X2.Outs forced	Signal: The State of at least one Relay Output has been set by force. That means that the state of at least one Relay is forced and hence does not show the state of the assigned signals.
RO-4 X5.RO 1	Signal: Relay Output
RO-4 X5.RO 2	Signal: Relay Output
RO-4 X5.RO 3	Signal: Relay Output
RO-4 X5.RO 4	Signal: Relay Output
RO-4 X5.DISARMED!	Signal: CAUTION! RELAYS DISARMED in order to safely perform maintenance while eliminating the risk of taking an entire process off-line. (Note: Zone Interlocking and Supervision Contact cannot be disarmed). YOU MUST ENSURE that the relays are ARMED AGAIN after maintenance
RO-4 X5.Outs forced	Signal: The State of at least one Relay Output has been set by force. That means that the state of at least one Relay is forced and hence does not show the state of the assigned signals.
AnIn[1].Broken wire	Signal: Broken wire. This signal is only valid, if the analog input is used in the 4..20 mA mode.
AnIn[1].Input forced	The value of analog Input has been set by force. That means that the value of the analog Input is forced and does not represent the real measured value.
AnIn[2].Broken wire	Signal: Broken wire. This signal is only valid, if the analog input is used in the 4..20 mA mode.
AnIn[2].Input forced	The value of analog Input has been set by force. That means that the value of the analog Input is forced and does not represent the real measured value.
FldC[1].Active	Signal: Active
FldC[1].ExBlo	Signal: External Blocking
FldC[1].Blo TripCmd	Signal: Trip Command blocked
FldC[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
FldC[1].Pickup	Signal: Pickup
FldC[1].Trip	Signal: Trip
FldC[1].TripCmd	Signal: Trip Command
FldC[1].ExBlo1-I	Module Input State: External Blocking1
FldC[1].ExBlo2-I	Module Input State: External Blocking2
FldC[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
FldC[2].Active	Signal: Active
FldC[2].ExBlo	Signal: External Blocking
FldC[2].Pickup	Signal: Pickup
FldC[2].Alarm	Alarm
FldC[2].ExBlo1-I	Module Input State: External Blocking1
FldC[2].ExBlo2-I	Module Input State: External Blocking2
Pres[1].Active	Signal: Active
Pres[1].ExBlo	Signal: External Blocking

<i>Name</i>	<i>Description</i>
Pres[1].Blo TripCmd	Signal: Trip Command blocked
Pres[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
Pres[1].Pickup	Signal: Pickup
Pres[1].Trip	Signal: Trip
Pres[1].TripCmd	Signal: Trip Command
Pres[1].ExBlo1-I	Module Input State: External Blocking1
Pres[1].ExBlo2-I	Module Input State: External Blocking2
Pres[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
Pres[2].Active	Signal: Active
Pres[2].ExBlo	Signal: External Blocking
Pres[2].Pickup	Signal: Pickup
Pres[2].Alarm	Alarm
Pres[2].ExBlo1-I	Module Input State: External Blocking1
Pres[2].ExBlo2-I	Module Input State: External Blocking2
Tmp[1].Active	Signal: Active
Tmp[1].ExBlo	Signal: External Blocking
Tmp[1].Blo TripCmd	Signal: Trip Command blocked
Tmp[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
Tmp[1].Pickup	Signal: Pickup
Tmp[1].Trip	Signal: Trip
Tmp[1].TripCmd	Signal: Trip Command
Tmp[1].ExBlo1-I	Module Input State: External Blocking1
Tmp[1].ExBlo2-I	Module Input State: External Blocking2
Tmp[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
Tmp[2].Active	Signal: Active
Tmp[2].ExBlo	Signal: External Blocking
Tmp[2].Pickup	Signal: Pickup
Tmp[2].Alarm	Alarm
Tmp[2].ExBlo1-I	Module Input State: External Blocking1
Tmp[2].ExBlo2-I	Module Input State: External Blocking2
Vibr[1].Active	Signal: Active
Vibr[1].ExBlo	Signal: External Blocking
Vibr[1].Blo TripCmd	Signal: Trip Command blocked
Vibr[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
Vibr[1].Pickup	Signal: Pickup
Vibr[1].Trip	Signal: Trip
Vibr[1].TripCmd	Signal: Trip Command

Name	Description
Vibr[1].ExBlo1-I	Module Input State: External Blocking1
Vibr[1].ExBlo2-I	Module Input State: External Blocking2
Vibr[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
Vibr[2].Active	Signal: Active
Vibr[2].ExBlo	Signal: External Blocking
Vibr[2].Pickup	Signal: Pickup
Vibr[2].Alarm	Alarm
Vibr[2].ExBlo1-I	Module Input State: External Blocking1
Vibr[2].ExBlo2-I	Module Input State: External Blocking2
Fuel[1].Active	Signal: Active
Fuel[1].ExBlo	Signal: External Blocking
Fuel[1].Blo TripCmd	Signal: Trip Command blocked
Fuel[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
Fuel[1].Pickup	Signal: Pickup
Fuel[1].Trip	Signal: Trip
Fuel[1].TripCmd	Signal: Trip Command
Fuel[1].ExBlo1-I	Module Input State: External Blocking1
Fuel[1].ExBlo2-I	Module Input State: External Blocking2
Fuel[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
Fuel[2].Active	Signal: Active
Fuel[2].ExBlo	Signal: External Blocking
Fuel[2].Pickup	Signal: Pickup
Fuel[2].Alarm	Alarm
Fuel[2].ExBlo1-I	Module Input State: External Blocking1
Fuel[2].ExBlo2-I	Module Input State: External Blocking2
Spd[1].Active	Signal: Active
Spd[1].ExBlo	Signal: External Blocking
Spd[1].Blo TripCmd	Signal: Trip Command blocked
Spd[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
Spd[1].Pickup	Signal: Pickup
Spd[1].Trip	Signal: Trip
Spd[1].TripCmd	Signal: Trip Command
Spd[1].ExBlo1-I	Module Input State: External Blocking1
Spd[1].ExBlo2-I	Module Input State: External Blocking2
Spd[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
Spd[2].Active	Signal: Active
Spd[2].ExBlo	Signal: External Blocking

<i>Name</i>	<i>Description</i>
Spd[2].Pickup	Signal: Pickup
Spd[2].Alarm	Alarm
Spd[2].ExBlo1-I	Module Input State: External Blocking1
Spd[2].ExBlo2-I	Module Input State: External Blocking2
VBat[1].Active	Signal: Active
VBat[1].ExBlo	Signal: External Blocking
VBat[1].Blo TripCmd	Signal: Trip Command blocked
VBat[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
VBat[1].Pickup	Signal: Pickup
VBat[1].Trip	Signal: Trip
VBat[1].TripCmd	Signal: Trip Command
VBat[1].ExBlo1-I	Module Input State: External Blocking1
VBat[1].ExBlo2-I	Module Input State: External Blocking2
VBat[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
VBat[2].Active	Signal: Active
VBat[2].ExBlo	Signal: External Blocking
VBat[2].Pickup	Signal: Pickup
VBat[2].Alarm	Alarm
VBat[2].ExBlo1-I	Module Input State: External Blocking1
VBat[2].ExBlo2-I	Module Input State: External Blocking2
Ems[1].Active	Signal: Active
Ems[1].ExBlo	Signal: External Blocking
Ems[1].Blo TripCmd	Signal: Trip Command blocked
Ems[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
Ems[1].Pickup	Signal: Pickup
Ems[1].Trip	Signal: Trip
Ems[1].TripCmd	Signal: Trip Command
Ems[1].ExBlo1-I	Module Input State: External Blocking1
Ems[1].ExBlo2-I	Module Input State: External Blocking2
Ems[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
Ems[2].Active	Signal: Active
Ems[2].ExBlo	Signal: External Blocking
Ems[2].Pickup	Signal: Pickup
Ems[2].Alarm	Alarm
Ems[2].ExBlo1-I	Module Input State: External Blocking1
Ems[2].ExBlo2-I	Module Input State: External Blocking2
AnaP[1].Active	Signal: Active

Name	Description
AnaP[1].ExBlo	Signal: External Blocking
AnaP[1].Blo TripCmd	Signal: Trip Command blocked
AnaP[1].ExBlo TripCmd	Signal: External Blocking of the Trip Command
AnaP[1].Pickup	Signal: Pickup
AnaP[1].Trip	Signal: Trip
AnaP[1].TripCmd	Signal: Trip Command
AnaP[1].ExBlo1-I	Module Input State: External Blocking1
AnaP[1].ExBlo2-I	Module Input State: External Blocking2
AnaP[1].ExBlo TripCmd-I	Module Input State: External Blocking of the Trip Command
AnaP[2].Active	Signal: Active
AnaP[2].ExBlo	Signal: External Blocking
AnaP[2].Pickup	Signal: Pickup
AnaP[2].Alarm	Alarm
AnaP[2].ExBlo1-I	Module Input State: External Blocking1
AnaP[2].ExBlo2-I	Module Input State: External Blocking2
AnOut[1].Force Mode	For commissioning purposes or for maintenance, Analog Outputs can be set by force. By means of this function the normal Analog Outputs can be overwritten (forced).
AnOut[2].Force Mode	For commissioning purposes or for maintenance, Analog Outputs can be set by force. By means of this function the normal Analog Outputs can be overwritten (forced).
Event rec.Res all rec	Signal: All records deleted
Waveform rec.Recording	Signal: Recording
Waveform rec.Memory full	Signal: Memory Full
Waveform rec.Clear fail	Signal: Clear Failure in Memory
Waveform rec.Res all rec	Signal: All records deleted
Waveform rec.Res record	Signal: Delete Record
Waveform rec.Man. Trigger	Signal: Manual Trigger
Waveform rec.Start1-I	State of the module input:: Trigger event / start recording if:
Waveform rec.Start2-I	State of the module input:: Trigger event / start recording if:
Waveform rec.Start3-I	State of the module input:: Trigger event / start recording if:
Waveform rec.Start4-I	State of the module input:: Trigger event / start recording if:
Waveform rec.Start5-I	State of the module input:: Trigger event / start recording if:
Waveform rec.Start6-I	State of the module input:: Trigger event / start recording if:
Waveform rec.Start7-I	State of the module input:: Trigger event / start recording if:
Waveform rec.Start8-I	State of the module input:: Trigger event / start recording if:
Fault rec.Res record	Signal: Delete Record
Trend rec.Hand Reset	Hand Reset
SSV.System Error	Signal: Device Failure
SSV.SelfSuperVision Contact	Signal: SelfSuperVision Contact

<i>Name</i>	<i>Description</i>
Comm.Comm connected	At least one Communication system is connected to the device.
Comm.Comm not connected	No Communication system is connected to the device.
DNP.busy	This message is set if the protocol is started. It will be reset if the protocol is shut down.
DNP.ready	The message will be set if the protocol is successfully started and ready for data exchange.
DNP.active	The communication with the Master (Scada) is active.
DNP.BinaryOutput0	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput1	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput2	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput3	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput4	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput5	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput6	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput7	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput8	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput9	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput10	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput11	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput12	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput13	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput14	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput15	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput16	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput17	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput18	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput19	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput20	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput21	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput22	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput23	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput24	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput25	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput26	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput27	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput28	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput29	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput30	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.
DNP.BinaryOutput31	Virtual Digital Output (DNP). This corresponds to a virtual binary input of the protective device.

<i>Name</i>	<i>Description</i>
Modbus.Comm Cmd 10	Communication Command
Modbus.Comm Cmd 11	Communication Command
Modbus.Comm Cmd 12	Communication Command
Modbus.Comm Cmd 13	Communication Command
Modbus.Comm Cmd 14	Communication Command
Modbus.Comm Cmd 15	Communication Command
Modbus.Comm Cmd 16	Communication Command
Modbus.Config Bin Inp1-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp2-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp3-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp4-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp5-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp6-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp7-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp8-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp9-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp10-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp11-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp12-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp13-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp14-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp15-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp16-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp17-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp18-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp19-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp20-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp21-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp22-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp23-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp24-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp25-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp26-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp27-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp28-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp29-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp30-I	State of the module input: Config Bin Inp

Name	Description
Modbus.Config Bin Inp31-I	State of the module input: Config Bin Inp
Modbus.Config Bin Inp32-I	State of the module input: Config Bin Inp
IEC61850.MMS Client connected	At least one MMS client is connected to the device
IEC61850.All Goose Subscriber active	All Goose subscriber in the device are working
IEC61850.VirtInp1	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp2	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp3	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp4	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp5	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp6	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp7	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp8	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp9	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp10	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp11	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp12	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp13	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp14	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp15	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp16	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp17	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp18	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp19	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp20	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp21	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp22	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp23	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp24	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp25	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp26	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp27	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp28	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp29	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp30	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp31	Signal: Virtual Input (IEC61850 GGIO Ind)
IEC61850.VirtInp32	Signal: Virtual Input (IEC61850 GGIO Ind)

<i>Name</i>	<i>Description</i>
IEC61850.Quality of GGIO In1	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In2	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In3	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In4	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In5	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In6	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In7	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In8	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In9	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In10	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In11	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In12	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In13	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In14	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In15	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In16	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In17	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In18	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In19	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In20	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In21	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In22	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In23	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In24	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In25	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In26	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In27	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In28	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In29	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In30	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In31	Self-Supervision of the GGIO Input
IEC61850.Quality of GGIO In32	Self-Supervision of the GGIO Input
IEC61850.SPCSO1	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO2	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO3	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).

[illegible]

<i>Name</i>	<i>Description</i>
IEC61850.SPCSO26	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO27	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO28	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO29	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO30	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO31	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.SPCSO32	Status bit that can be set by clients like e.g. the Master Communication System (Single Point Controllable Status Output).
IEC61850.VirtOut1-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut2-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut3-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut4-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut5-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut6-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut7-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut8-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut9-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut10-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut11-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut12-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut13-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut14-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut15-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut16-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut17-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut18-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut19-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut20-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut21-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut22-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut23-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut24-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut25-I	Module input state: Binary state of the Virtual Output (GGIO)

Name	Description
IEC61850.VirtOut26-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut27-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut28-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut29-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut30-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut31-I	Module input state: Binary state of the Virtual Output (GGIO)
IEC61850.VirtOut32-I	Module input state: Binary state of the Virtual Output (GGIO)
Profibus.Data OK	Data within the input field are OK (Yes=1)
Profibus.SubModul Err	Assignable Signal, Failure in Sub-Module, Communication Failure.
Profibus.Connection active	Connection active
Profibus.Comm Cmd 1	Communication Command
Profibus.Comm Cmd 2	Communication Command
Profibus.Comm Cmd 3	Communication Command
Profibus.Comm Cmd 4	Communication Command
Profibus.Comm Cmd 5	Communication Command
Profibus.Comm Cmd 6	Communication Command
Profibus.Comm Cmd 7	Communication Command
Profibus.Comm Cmd 8	Communication Command
Profibus.Comm Cmd 9	Communication Command
Profibus.Comm Cmd 10	Communication Command
Profibus.Comm Cmd 11	Communication Command
Profibus.Comm Cmd 12	Communication Command
Profibus.Comm Cmd 13	Communication Command
Profibus.Comm Cmd 14	Communication Command
Profibus.Comm Cmd 15	Communication Command
Profibus.Comm Cmd 16	Communication Command
IRIG-B.IRIG-B active	Signal: If there is no valid IRIG-B signal for 60 sec, IRIG-B is regarded as inactive.
IRIG-B.High-Low Invert	Signal: The High and Low signals of the IRIG-B are inverted. This does NOT mean that the wiring is faulty. If the wiring is faulty no IRIG-B signal will be detected.
IRIG-B.Control Signal1	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal2	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal3	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal4	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal5	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).

Name	Description
IRIG-B.Control Signal6	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal7	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal8	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal9	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal10	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal11	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal12	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal13	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal14	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal15	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal16	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal17	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
IRIG-B.Control Signal18	Signal: IRIG-B Control Signal. The external IRIG-B generator can set these signals. They can be used for further control procedures inside the device (e.g. logic funtions).
SNTP.SNTP active	Signal: If there is no valid SNTP signal for 120 sec, SNTP is regarded as inactive.
Statistics.ResFc all	Signal: Resetting of all Statistic values (Current Demand, Power Demand, Min, Max)
Statistics.ResFc I Demand	Signal: Resetting of Statistics - Current Demand (avg, peak avg)
Statistics.ResFc P Demand	Signal: Resetting of Statistics - Power Demand (avg, peak avg)
Statistics.ResFc Max	Signal: Resetting of all Maximum values
Statistics.ResFc Min	Signal: Resetting of all Minimum values
Statistics.StartFc I Demand-I	State of the module input: Start of Statistics of the Current Demand (Update the displayed Demand)
Statistics.StartFc P Demand-I	State of the module input: Start of Statistics of the Active Power Demand
Logic.LE1.Gate Out	Signal: Output of the logic gate
Logic.LE1.Timer Out	Signal: Timer Output
Logic.LE1.Out	Signal: Latched Output (Q)
Logic.LE1.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE1.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE1.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE1.Gate In3-I	State of the module input: Assignment of the Input Signal

<i>Name</i>	<i>Description</i>
Logic.LE1.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE1.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE2.Gate Out	Signal: Output of the logic gate
Logic.LE2.Timer Out	Signal: Timer Output
Logic.LE2.Out	Signal: Latched Output (Q)
Logic.LE2.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE2.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE2.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE2.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE2.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE2.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE3.Gate Out	Signal: Output of the logic gate
Logic.LE3.Timer Out	Signal: Timer Output
Logic.LE3.Out	Signal: Latched Output (Q)
Logic.LE3.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE3.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE3.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE3.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE3.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE3.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE4.Gate Out	Signal: Output of the logic gate
Logic.LE4.Timer Out	Signal: Timer Output
Logic.LE4.Out	Signal: Latched Output (Q)
Logic.LE4.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE4.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE4.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE4.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE4.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE4.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE5.Gate Out	Signal: Output of the logic gate
Logic.LE5.Timer Out	Signal: Timer Output
Logic.LE5.Out	Signal: Latched Output (Q)
Logic.LE5.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE5.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE5.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE5.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE5.Gate In4-I	State of the module input: Assignment of the Input Signal

<i>Name</i>	<i>Description</i>
Logic.LE5.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE6.Gate Out	Signal: Output of the logic gate
Logic.LE6.Timer Out	Signal: Timer Output
Logic.LE6.Out	Signal: Latched Output (Q)
Logic.LE6.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE6.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE6.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE6.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE6.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE6.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE7.Gate Out	Signal: Output of the logic gate
Logic.LE7.Timer Out	Signal: Timer Output
Logic.LE7.Out	Signal: Latched Output (Q)
Logic.LE7.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE7.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE7.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE7.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE7.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE7.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE8.Gate Out	Signal: Output of the logic gate
Logic.LE8.Timer Out	Signal: Timer Output
Logic.LE8.Out	Signal: Latched Output (Q)
Logic.LE8.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE8.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE8.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE8.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE8.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE8.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE9.Gate Out	Signal: Output of the logic gate
Logic.LE9.Timer Out	Signal: Timer Output
Logic.LE9.Out	Signal: Latched Output (Q)
Logic.LE9.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE9.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE9.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE9.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE9.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE9.Reset Latch-I	State of the module input: Reset Signal for the Latching

<i>Name</i>	<i>Description</i>
Logic.LE10.Gate Out	Signal: Output of the logic gate
Logic.LE10.Timer Out	Signal: Timer Output
Logic.LE10.Out	Signal: Latched Output (Q)
Logic.LE10.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE10.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE10.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE10.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE10.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE10.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE11.Gate Out	Signal: Output of the logic gate
Logic.LE11.Timer Out	Signal: Timer Output
Logic.LE11.Out	Signal: Latched Output (Q)
Logic.LE11.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE11.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE11.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE11.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE11.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE11.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE12.Gate Out	Signal: Output of the logic gate
Logic.LE12.Timer Out	Signal: Timer Output
Logic.LE12.Out	Signal: Latched Output (Q)
Logic.LE12.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE12.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE12.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE12.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE12.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE12.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE13.Gate Out	Signal: Output of the logic gate
Logic.LE13.Timer Out	Signal: Timer Output
Logic.LE13.Out	Signal: Latched Output (Q)
Logic.LE13.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE13.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE13.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE13.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE13.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE13.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE14.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE14.Timer Out	Signal: Timer Output
Logic.LE14.Out	Signal: Latched Output (Q)
Logic.LE14.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE14.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE14.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE14.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE14.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE14.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE15.Gate Out	Signal: Output of the logic gate
Logic.LE15.Timer Out	Signal: Timer Output
Logic.LE15.Out	Signal: Latched Output (Q)
Logic.LE15.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE15.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE15.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE15.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE15.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE15.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE16.Gate Out	Signal: Output of the logic gate
Logic.LE16.Timer Out	Signal: Timer Output
Logic.LE16.Out	Signal: Latched Output (Q)
Logic.LE16.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE16.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE16.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE16.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE16.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE16.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE17.Gate Out	Signal: Output of the logic gate
Logic.LE17.Timer Out	Signal: Timer Output
Logic.LE17.Out	Signal: Latched Output (Q)
Logic.LE17.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE17.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE17.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE17.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE17.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE17.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE18.Gate Out	Signal: Output of the logic gate
Logic.LE18.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE18.Out	Signal: Latched Output (Q)
Logic.LE18.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE18.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE18.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE18.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE18.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE18.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE19.Gate Out	Signal: Output of the logic gate
Logic.LE19.Timer Out	Signal: Timer Output
Logic.LE19.Out	Signal: Latched Output (Q)
Logic.LE19.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE19.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE19.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE19.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE19.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE19.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE20.Gate Out	Signal: Output of the logic gate
Logic.LE20.Timer Out	Signal: Timer Output
Logic.LE20.Out	Signal: Latched Output (Q)
Logic.LE20.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE20.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE20.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE20.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE20.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE20.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE21.Gate Out	Signal: Output of the logic gate
Logic.LE21.Timer Out	Signal: Timer Output
Logic.LE21.Out	Signal: Latched Output (Q)
Logic.LE21.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE21.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE21.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE21.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE21.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE21.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE22.Gate Out	Signal: Output of the logic gate
Logic.LE22.Timer Out	Signal: Timer Output
Logic.LE22.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE22.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE22.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE22.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE22.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE22.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE22.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE23.Gate Out	Signal: Output of the logic gate
Logic.LE23.Timer Out	Signal: Timer Output
Logic.LE23.Out	Signal: Latched Output (Q)
Logic.LE23.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE23.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE23.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE23.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE23.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE23.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE24.Gate Out	Signal: Output of the logic gate
Logic.LE24.Timer Out	Signal: Timer Output
Logic.LE24.Out	Signal: Latched Output (Q)
Logic.LE24.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE24.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE24.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE24.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE24.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE24.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE25.Gate Out	Signal: Output of the logic gate
Logic.LE25.Timer Out	Signal: Timer Output
Logic.LE25.Out	Signal: Latched Output (Q)
Logic.LE25.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE25.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE25.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE25.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE25.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE25.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE26.Gate Out	Signal: Output of the logic gate
Logic.LE26.Timer Out	Signal: Timer Output
Logic.LE26.Out	Signal: Latched Output (Q)
Logic.LE26.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE26.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE26.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE26.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE26.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE26.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE27.Gate Out	Signal: Output of the logic gate
Logic.LE27.Timer Out	Signal: Timer Output
Logic.LE27.Out	Signal: Latched Output (Q)
Logic.LE27.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE27.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE27.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE27.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE27.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE27.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE28.Gate Out	Signal: Output of the logic gate
Logic.LE28.Timer Out	Signal: Timer Output
Logic.LE28.Out	Signal: Latched Output (Q)
Logic.LE28.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE28.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE28.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE28.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE28.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE28.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE29.Gate Out	Signal: Output of the logic gate
Logic.LE29.Timer Out	Signal: Timer Output
Logic.LE29.Out	Signal: Latched Output (Q)
Logic.LE29.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE29.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE29.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE29.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE29.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE29.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE30.Gate Out	Signal: Output of the logic gate
Logic.LE30.Timer Out	Signal: Timer Output
Logic.LE30.Out	Signal: Latched Output (Q)
Logic.LE30.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE30.Gate In1-I	State of the module input: Assignment of the Input Signal

<i>Name</i>	<i>Description</i>
Logic.LE30.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE30.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE30.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE30.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE31.Gate Out	Signal: Output of the logic gate
Logic.LE31.Timer Out	Signal: Timer Output
Logic.LE31.Out	Signal: Latched Output (Q)
Logic.LE31.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE31.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE31.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE31.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE31.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE31.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE32.Gate Out	Signal: Output of the logic gate
Logic.LE32.Timer Out	Signal: Timer Output
Logic.LE32.Out	Signal: Latched Output (Q)
Logic.LE32.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE32.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE32.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE32.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE32.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE32.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE33.Gate Out	Signal: Output of the logic gate
Logic.LE33.Timer Out	Signal: Timer Output
Logic.LE33.Out	Signal: Latched Output (Q)
Logic.LE33.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE33.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE33.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE33.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE33.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE33.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE34.Gate Out	Signal: Output of the logic gate
Logic.LE34.Timer Out	Signal: Timer Output
Logic.LE34.Out	Signal: Latched Output (Q)
Logic.LE34.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE34.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE34.Gate In2-I	State of the module input: Assignment of the Input Signal

<i>Name</i>	<i>Description</i>
Logic.LE34.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE34.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE34.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE35.Gate Out	Signal: Output of the logic gate
Logic.LE35.Timer Out	Signal: Timer Output
Logic.LE35.Out	Signal: Latched Output (Q)
Logic.LE35.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE35.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE35.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE35.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE35.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE35.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE36.Gate Out	Signal: Output of the logic gate
Logic.LE36.Timer Out	Signal: Timer Output
Logic.LE36.Out	Signal: Latched Output (Q)
Logic.LE36.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE36.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE36.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE36.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE36.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE36.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE37.Gate Out	Signal: Output of the logic gate
Logic.LE37.Timer Out	Signal: Timer Output
Logic.LE37.Out	Signal: Latched Output (Q)
Logic.LE37.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE37.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE37.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE37.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE37.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE37.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE38.Gate Out	Signal: Output of the logic gate
Logic.LE38.Timer Out	Signal: Timer Output
Logic.LE38.Out	Signal: Latched Output (Q)
Logic.LE38.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE38.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE38.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE38.Gate In3-I	State of the module input: Assignment of the Input Signal

<i>Name</i>	<i>Description</i>
Logic.LE38.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE38.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE39.Gate Out	Signal: Output of the logic gate
Logic.LE39.Timer Out	Signal: Timer Output
Logic.LE39.Out	Signal: Latched Output (Q)
Logic.LE39.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE39.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE39.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE39.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE39.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE39.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE40.Gate Out	Signal: Output of the logic gate
Logic.LE40.Timer Out	Signal: Timer Output
Logic.LE40.Out	Signal: Latched Output (Q)
Logic.LE40.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE40.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE40.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE40.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE40.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE40.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE41.Gate Out	Signal: Output of the logic gate
Logic.LE41.Timer Out	Signal: Timer Output
Logic.LE41.Out	Signal: Latched Output (Q)
Logic.LE41.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE41.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE41.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE41.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE41.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE41.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE42.Gate Out	Signal: Output of the logic gate
Logic.LE42.Timer Out	Signal: Timer Output
Logic.LE42.Out	Signal: Latched Output (Q)
Logic.LE42.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE42.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE42.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE42.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE42.Gate In4-I	State of the module input: Assignment of the Input Signal

<i>Name</i>	<i>Description</i>
Logic.LE42.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE43.Gate Out	Signal: Output of the logic gate
Logic.LE43.Timer Out	Signal: Timer Output
Logic.LE43.Out	Signal: Latched Output (Q)
Logic.LE43.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE43.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE43.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE43.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE43.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE43.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE44.Gate Out	Signal: Output of the logic gate
Logic.LE44.Timer Out	Signal: Timer Output
Logic.LE44.Out	Signal: Latched Output (Q)
Logic.LE44.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE44.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE44.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE44.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE44.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE44.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE45.Gate Out	Signal: Output of the logic gate
Logic.LE45.Timer Out	Signal: Timer Output
Logic.LE45.Out	Signal: Latched Output (Q)
Logic.LE45.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE45.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE45.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE45.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE45.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE45.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE46.Gate Out	Signal: Output of the logic gate
Logic.LE46.Timer Out	Signal: Timer Output
Logic.LE46.Out	Signal: Latched Output (Q)
Logic.LE46.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE46.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE46.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE46.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE46.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE46.Reset Latch-I	State of the module input: Reset Signal for the Latching

<i>Name</i>	<i>Description</i>
Logic.LE47.Gate Out	Signal: Output of the logic gate
Logic.LE47.Timer Out	Signal: Timer Output
Logic.LE47.Out	Signal: Latched Output (Q)
Logic.LE47.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE47.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE47.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE47.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE47.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE47.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE48.Gate Out	Signal: Output of the logic gate
Logic.LE48.Timer Out	Signal: Timer Output
Logic.LE48.Out	Signal: Latched Output (Q)
Logic.LE48.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE48.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE48.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE48.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE48.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE48.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE49.Gate Out	Signal: Output of the logic gate
Logic.LE49.Timer Out	Signal: Timer Output
Logic.LE49.Out	Signal: Latched Output (Q)
Logic.LE49.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE49.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE49.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE49.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE49.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE49.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE50.Gate Out	Signal: Output of the logic gate
Logic.LE50.Timer Out	Signal: Timer Output
Logic.LE50.Out	Signal: Latched Output (Q)
Logic.LE50.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE50.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE50.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE50.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE50.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE50.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE51.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE51.Timer Out	Signal: Timer Output
Logic.LE51.Out	Signal: Latched Output (Q)
Logic.LE51.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE51.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE51.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE51.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE51.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE51.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE52.Gate Out	Signal: Output of the logic gate
Logic.LE52.Timer Out	Signal: Timer Output
Logic.LE52.Out	Signal: Latched Output (Q)
Logic.LE52.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE52.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE52.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE52.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE52.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE52.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE53.Gate Out	Signal: Output of the logic gate
Logic.LE53.Timer Out	Signal: Timer Output
Logic.LE53.Out	Signal: Latched Output (Q)
Logic.LE53.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE53.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE53.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE53.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE53.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE53.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE54.Gate Out	Signal: Output of the logic gate
Logic.LE54.Timer Out	Signal: Timer Output
Logic.LE54.Out	Signal: Latched Output (Q)
Logic.LE54.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE54.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE54.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE54.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE54.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE54.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE55.Gate Out	Signal: Output of the logic gate
Logic.LE55.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE55.Out	Signal: Latched Output (Q)
Logic.LE55.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE55.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE55.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE55.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE55.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE55.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE56.Gate Out	Signal: Output of the logic gate
Logic.LE56.Timer Out	Signal: Timer Output
Logic.LE56.Out	Signal: Latched Output (Q)
Logic.LE56.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE56.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE56.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE56.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE56.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE56.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE57.Gate Out	Signal: Output of the logic gate
Logic.LE57.Timer Out	Signal: Timer Output
Logic.LE57.Out	Signal: Latched Output (Q)
Logic.LE57.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE57.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE57.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE57.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE57.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE57.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE58.Gate Out	Signal: Output of the logic gate
Logic.LE58.Timer Out	Signal: Timer Output
Logic.LE58.Out	Signal: Latched Output (Q)
Logic.LE58.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE58.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE58.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE58.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE58.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE58.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE59.Gate Out	Signal: Output of the logic gate
Logic.LE59.Timer Out	Signal: Timer Output
Logic.LE59.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE59.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE59.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE59.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE59.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE59.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE59.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE60.Gate Out	Signal: Output of the logic gate
Logic.LE60.Timer Out	Signal: Timer Output
Logic.LE60.Out	Signal: Latched Output (Q)
Logic.LE60.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE60.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE60.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE60.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE60.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE60.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE61.Gate Out	Signal: Output of the logic gate
Logic.LE61.Timer Out	Signal: Timer Output
Logic.LE61.Out	Signal: Latched Output (Q)
Logic.LE61.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE61.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE61.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE61.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE61.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE61.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE62.Gate Out	Signal: Output of the logic gate
Logic.LE62.Timer Out	Signal: Timer Output
Logic.LE62.Out	Signal: Latched Output (Q)
Logic.LE62.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE62.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE62.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE62.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE62.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE62.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE63.Gate Out	Signal: Output of the logic gate
Logic.LE63.Timer Out	Signal: Timer Output
Logic.LE63.Out	Signal: Latched Output (Q)
Logic.LE63.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE63.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE63.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE63.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE63.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE63.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE64.Gate Out	Signal: Output of the logic gate
Logic.LE64.Timer Out	Signal: Timer Output
Logic.LE64.Out	Signal: Latched Output (Q)
Logic.LE64.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE64.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE64.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE64.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE64.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE64.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE65.Gate Out	Signal: Output of the logic gate
Logic.LE65.Timer Out	Signal: Timer Output
Logic.LE65.Out	Signal: Latched Output (Q)
Logic.LE65.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE65.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE65.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE65.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE65.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE65.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE66.Gate Out	Signal: Output of the logic gate
Logic.LE66.Timer Out	Signal: Timer Output
Logic.LE66.Out	Signal: Latched Output (Q)
Logic.LE66.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE66.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE66.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE66.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE66.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE66.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE67.Gate Out	Signal: Output of the logic gate
Logic.LE67.Timer Out	Signal: Timer Output
Logic.LE67.Out	Signal: Latched Output (Q)
Logic.LE67.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE67.Gate In1-I	State of the module input: Assignment of the Input Signal

<i>Name</i>	<i>Description</i>
Logic.LE67.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE67.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE67.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE67.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE68.Gate Out	Signal: Output of the logic gate
Logic.LE68.Timer Out	Signal: Timer Output
Logic.LE68.Out	Signal: Latched Output (Q)
Logic.LE68.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE68.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE68.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE68.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE68.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE68.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE69.Gate Out	Signal: Output of the logic gate
Logic.LE69.Timer Out	Signal: Timer Output
Logic.LE69.Out	Signal: Latched Output (Q)
Logic.LE69.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE69.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE69.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE69.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE69.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE69.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE70.Gate Out	Signal: Output of the logic gate
Logic.LE70.Timer Out	Signal: Timer Output
Logic.LE70.Out	Signal: Latched Output (Q)
Logic.LE70.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE70.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE70.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE70.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE70.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE70.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE71.Gate Out	Signal: Output of the logic gate
Logic.LE71.Timer Out	Signal: Timer Output
Logic.LE71.Out	Signal: Latched Output (Q)
Logic.LE71.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE71.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE71.Gate In2-I	State of the module input: Assignment of the Input Signal

<i>Name</i>	<i>Description</i>
Logic.LE71.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE71.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE71.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE72.Gate Out	Signal: Output of the logic gate
Logic.LE72.Timer Out	Signal: Timer Output
Logic.LE72.Out	Signal: Latched Output (Q)
Logic.LE72.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE72.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE72.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE72.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE72.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE72.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE73.Gate Out	Signal: Output of the logic gate
Logic.LE73.Timer Out	Signal: Timer Output
Logic.LE73.Out	Signal: Latched Output (Q)
Logic.LE73.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE73.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE73.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE73.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE73.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE73.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE74.Gate Out	Signal: Output of the logic gate
Logic.LE74.Timer Out	Signal: Timer Output
Logic.LE74.Out	Signal: Latched Output (Q)
Logic.LE74.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE74.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE74.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE74.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE74.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE74.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE75.Gate Out	Signal: Output of the logic gate
Logic.LE75.Timer Out	Signal: Timer Output
Logic.LE75.Out	Signal: Latched Output (Q)
Logic.LE75.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE75.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE75.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE75.Gate In3-I	State of the module input: Assignment of the Input Signal

<i>Name</i>	<i>Description</i>
Logic.LE75.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE75.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE76.Gate Out	Signal: Output of the logic gate
Logic.LE76.Timer Out	Signal: Timer Output
Logic.LE76.Out	Signal: Latched Output (Q)
Logic.LE76.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE76.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE76.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE76.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE76.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE76.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE77.Gate Out	Signal: Output of the logic gate
Logic.LE77.Timer Out	Signal: Timer Output
Logic.LE77.Out	Signal: Latched Output (Q)
Logic.LE77.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE77.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE77.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE77.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE77.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE77.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE78.Gate Out	Signal: Output of the logic gate
Logic.LE78.Timer Out	Signal: Timer Output
Logic.LE78.Out	Signal: Latched Output (Q)
Logic.LE78.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE78.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE78.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE78.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE78.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE78.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE79.Gate Out	Signal: Output of the logic gate
Logic.LE79.Timer Out	Signal: Timer Output
Logic.LE79.Out	Signal: Latched Output (Q)
Logic.LE79.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE79.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE79.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE79.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE79.Gate In4-I	State of the module input: Assignment of the Input Signal

Name	Description
Logic.LE79.Reset Latch-I	State of the module input: Reset Signal for the Latching
Logic.LE80.Gate Out	Signal: Output of the logic gate
Logic.LE80.Timer Out	Signal: Timer Output
Logic.LE80.Out	Signal: Latched Output (Q)
Logic.LE80.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE80.Gate In1-I	State of the module input: Assignment of the Input Signal
Logic.LE80.Gate In2-I	State of the module input: Assignment of the Input Signal
Logic.LE80.Gate In3-I	State of the module input: Assignment of the Input Signal
Logic.LE80.Gate In4-I	State of the module input: Assignment of the Input Signal
Logic.LE80.Reset Latch-I	State of the module input: Reset Signal for the Latching
Sgen.Running	Signal: Measuring value simulation is running
Sgen.Ex Start Simulation-I	State of the module input: External Start of Fault Simulation (Using the test parameters)
Sgen.ExBlo	Module Input State: External Blocking
Sgen.Ex ForcePost-I	State of the module input: Force Post state. Abort simulation.
Sys.PS 1	Signal: Parameter Set 1
Sys.PS 2	Signal: Parameter Set 2
Sys.PS 3	Signal: Parameter Set 3
Sys.PS 4	Signal: Parameter Set 4
Sys.PSS manual	Signal: Manual switch over of a Parameter Set
Sys.PSS via Comm	Signal: Parameter Set Switch via Scada. Write into this output byte the integer of the parameter set that should become active (e.g. 4 => Switch onto parameter set 4).
Sys.PSS via Inp fct	Signal: Parameter Set Switch via Input Function
Sys.Min. 1 param changed	Signal: At least one parameter has been changed
Sys.Program Mode Bypass	Signal: Short-period bypass of the Program Mode.
Sys.Maint Mode Active	Signal: Arc Flash Reduction Maintenance Active
Sys.Maint Mode Inactive	Signal: Arc Flash Reduction Maintenance Inactive
Sys.MaintMode Manually	Signal: Arc Flash Reduction Maintenance Manual Mode
Sys.Maint Mode Comm	Signal: Arc Flash Reduction Maintenance Comm Mode
Sys.Maint Mode DI	Signal: Arc Flash Reduction Maintenance Digital Input Mode
Sys.Ack LED	Signal: LEDs Acknowledgment
Sys.Ack RO	Signal: Acknowledgment of the Relay Outputs
Sys.Ack Comm	Signal: Acknowledge Communication
Sys.Ack TripCmd	Signal: Reset Trip Command
Sys.Ack LED-HMI	Signal: LEDs Acknowledgment :HMI
Sys.Ack RO-HMI	Signal: Acknowledgment of the Relay Outputs :HMI
Sys.Ack Comm-HMI	Signal: Acknowledge Communication :HMI
Sys.Ack TripCmd-HMI	Signal: Reset Trip Command :HMI

<i>Name</i>	<i>Description</i>
Sys.Ack LED-Comm	Signal: LEDs Acknowledgment :Communication
Sys.Ack RO-Comm	Signal: Acknowledgment of the Relay Outputs :Communication
Sys.Ack Counter-Comm	Signal: Reset of all Counters :Communication
Sys.Ack Comm-Comm	Signal: Acknowledge Communication :Communication
Sys.Ack TripCmd-Comm	Signal: Reset Trip Command :Communication
Sys.Ack LED-I	Module Input State: LEDs Acknowledgment by Digital Input.
Sys.Ack RO-I	Module Input State: Acknowledgment of the Relay Outputs.
Sys.Ack Comm-I	Module Input State: Acknowledge Communication via Digital Input. The replica that Communication has received from the device is to be reset.
Sys.PS1-I	State of the module input, respectively of the signal, that should activate this Parameter Setting Group.
Sys.PS2-I	State of the module input, respectively of the signal, that should activate this Parameter Setting Group.
Sys.PS3-I	State of the module input, respectively of the signal, that should activate this Parameter Setting Group.
Sys.PS4-I	State of the module input, respectively of the signal, that should activate this Parameter Setting Group.
Sys.Maint Mode-I	Module Input State: Arc Flash Reduction Maintenance Switch

Special Assignment List for all Digital Input Signals and all Logic Outputs

Name	Description
-.-	No assignment
DI-8P X1.DI 1	Signal: Digital Input
DI-8P X1.DI 2	Signal: Digital Input
DI-8P X1.DI 3	Signal: Digital Input
DI-8P X1.DI 4	Signal: Digital Input
DI-8P X1.DI 5	Signal: Digital Input
DI-8P X1.DI 6	Signal: Digital Input
DI-8P X1.DI 7	Signal: Digital Input
DI-8P X1.DI 8	Signal: Digital Input
DI-8 X5.DI 1	Signal: Digital Input
DI-8 X5.DI 2	Signal: Digital Input
DI-8 X5.DI 3	Signal: Digital Input
DI-8 X5.DI 4	Signal: Digital Input
DI-8 X5.DI 5	Signal: Digital Input
DI-8 X5.DI 6	Signal: Digital Input
DI-8 X5.DI 7	Signal: Digital Input
DI-8 X5.DI 8	Signal: Digital Input
Logic.LE1.Gate Out	Signal: Output of the logic gate
Logic.LE1.Timer Out	Signal: Timer Output
Logic.LE1.Out	Signal: Latched Output (Q)
Logic.LE1.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE2.Gate Out	Signal: Output of the logic gate
Logic.LE2.Timer Out	Signal: Timer Output
Logic.LE2.Out	Signal: Latched Output (Q)
Logic.LE2.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE3.Gate Out	Signal: Output of the logic gate
Logic.LE3.Timer Out	Signal: Timer Output
Logic.LE3.Out	Signal: Latched Output (Q)
Logic.LE3.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE4.Gate Out	Signal: Output of the logic gate
Logic.LE4.Timer Out	Signal: Timer Output
Logic.LE4.Out	Signal: Latched Output (Q)
Logic.LE4.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE5.Gate Out	Signal: Output of the logic gate
Logic.LE5.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE5.Out	Signal: Latched Output (Q)
Logic.LE5.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE6.Gate Out	Signal: Output of the logic gate
Logic.LE6.Timer Out	Signal: Timer Output
Logic.LE6.Out	Signal: Latched Output (Q)
Logic.LE6.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE7.Gate Out	Signal: Output of the logic gate
Logic.LE7.Timer Out	Signal: Timer Output
Logic.LE7.Out	Signal: Latched Output (Q)
Logic.LE7.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE8.Gate Out	Signal: Output of the logic gate
Logic.LE8.Timer Out	Signal: Timer Output
Logic.LE8.Out	Signal: Latched Output (Q)
Logic.LE8.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE9.Gate Out	Signal: Output of the logic gate
Logic.LE9.Timer Out	Signal: Timer Output
Logic.LE9.Out	Signal: Latched Output (Q)
Logic.LE9.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE10.Gate Out	Signal: Output of the logic gate
Logic.LE10.Timer Out	Signal: Timer Output
Logic.LE10.Out	Signal: Latched Output (Q)
Logic.LE10.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE11.Gate Out	Signal: Output of the logic gate
Logic.LE11.Timer Out	Signal: Timer Output
Logic.LE11.Out	Signal: Latched Output (Q)
Logic.LE11.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE12.Gate Out	Signal: Output of the logic gate
Logic.LE12.Timer Out	Signal: Timer Output
Logic.LE12.Out	Signal: Latched Output (Q)
Logic.LE12.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE13.Gate Out	Signal: Output of the logic gate
Logic.LE13.Timer Out	Signal: Timer Output
Logic.LE13.Out	Signal: Latched Output (Q)
Logic.LE13.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE14.Gate Out	Signal: Output of the logic gate
Logic.LE14.Timer Out	Signal: Timer Output
Logic.LE14.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE14.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE15.Gate Out	Signal: Output of the logic gate
Logic.LE15.Timer Out	Signal: Timer Output
Logic.LE15.Out	Signal: Latched Output (Q)
Logic.LE15.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE16.Gate Out	Signal: Output of the logic gate
Logic.LE16.Timer Out	Signal: Timer Output
Logic.LE16.Out	Signal: Latched Output (Q)
Logic.LE16.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE17.Gate Out	Signal: Output of the logic gate
Logic.LE17.Timer Out	Signal: Timer Output
Logic.LE17.Out	Signal: Latched Output (Q)
Logic.LE17.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE18.Gate Out	Signal: Output of the logic gate
Logic.LE18.Timer Out	Signal: Timer Output
Logic.LE18.Out	Signal: Latched Output (Q)
Logic.LE18.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE19.Gate Out	Signal: Output of the logic gate
Logic.LE19.Timer Out	Signal: Timer Output
Logic.LE19.Out	Signal: Latched Output (Q)
Logic.LE19.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE20.Gate Out	Signal: Output of the logic gate
Logic.LE20.Timer Out	Signal: Timer Output
Logic.LE20.Out	Signal: Latched Output (Q)
Logic.LE20.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE21.Gate Out	Signal: Output of the logic gate
Logic.LE21.Timer Out	Signal: Timer Output
Logic.LE21.Out	Signal: Latched Output (Q)
Logic.LE21.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE22.Gate Out	Signal: Output of the logic gate
Logic.LE22.Timer Out	Signal: Timer Output
Logic.LE22.Out	Signal: Latched Output (Q)
Logic.LE22.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE23.Gate Out	Signal: Output of the logic gate
Logic.LE23.Timer Out	Signal: Timer Output
Logic.LE23.Out	Signal: Latched Output (Q)
Logic.LE23.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE24.Gate Out	Signal: Output of the logic gate
Logic.LE24.Timer Out	Signal: Timer Output
Logic.LE24.Out	Signal: Latched Output (Q)
Logic.LE24.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE25.Gate Out	Signal: Output of the logic gate
Logic.LE25.Timer Out	Signal: Timer Output
Logic.LE25.Out	Signal: Latched Output (Q)
Logic.LE25.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE26.Gate Out	Signal: Output of the logic gate
Logic.LE26.Timer Out	Signal: Timer Output
Logic.LE26.Out	Signal: Latched Output (Q)
Logic.LE26.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE27.Gate Out	Signal: Output of the logic gate
Logic.LE27.Timer Out	Signal: Timer Output
Logic.LE27.Out	Signal: Latched Output (Q)
Logic.LE27.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE28.Gate Out	Signal: Output of the logic gate
Logic.LE28.Timer Out	Signal: Timer Output
Logic.LE28.Out	Signal: Latched Output (Q)
Logic.LE28.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE29.Gate Out	Signal: Output of the logic gate
Logic.LE29.Timer Out	Signal: Timer Output
Logic.LE29.Out	Signal: Latched Output (Q)
Logic.LE29.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE30.Gate Out	Signal: Output of the logic gate
Logic.LE30.Timer Out	Signal: Timer Output
Logic.LE30.Out	Signal: Latched Output (Q)
Logic.LE30.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE31.Gate Out	Signal: Output of the logic gate
Logic.LE31.Timer Out	Signal: Timer Output
Logic.LE31.Out	Signal: Latched Output (Q)
Logic.LE31.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE32.Gate Out	Signal: Output of the logic gate
Logic.LE32.Timer Out	Signal: Timer Output
Logic.LE32.Out	Signal: Latched Output (Q)
Logic.LE32.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE33.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE33.Timer Out	Signal: Timer Output
Logic.LE33.Out	Signal: Latched Output (Q)
Logic.LE33.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE34.Gate Out	Signal: Output of the logic gate
Logic.LE34.Timer Out	Signal: Timer Output
Logic.LE34.Out	Signal: Latched Output (Q)
Logic.LE34.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE35.Gate Out	Signal: Output of the logic gate
Logic.LE35.Timer Out	Signal: Timer Output
Logic.LE35.Out	Signal: Latched Output (Q)
Logic.LE35.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE36.Gate Out	Signal: Output of the logic gate
Logic.LE36.Timer Out	Signal: Timer Output
Logic.LE36.Out	Signal: Latched Output (Q)
Logic.LE36.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE37.Gate Out	Signal: Output of the logic gate
Logic.LE37.Timer Out	Signal: Timer Output
Logic.LE37.Out	Signal: Latched Output (Q)
Logic.LE37.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE38.Gate Out	Signal: Output of the logic gate
Logic.LE38.Timer Out	Signal: Timer Output
Logic.LE38.Out	Signal: Latched Output (Q)
Logic.LE38.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE39.Gate Out	Signal: Output of the logic gate
Logic.LE39.Timer Out	Signal: Timer Output
Logic.LE39.Out	Signal: Latched Output (Q)
Logic.LE39.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE40.Gate Out	Signal: Output of the logic gate
Logic.LE40.Timer Out	Signal: Timer Output
Logic.LE40.Out	Signal: Latched Output (Q)
Logic.LE40.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE41.Gate Out	Signal: Output of the logic gate
Logic.LE41.Timer Out	Signal: Timer Output
Logic.LE41.Out	Signal: Latched Output (Q)
Logic.LE41.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE42.Gate Out	Signal: Output of the logic gate
Logic.LE42.Timer Out	Signal: Timer Output

<i>Name</i>	<i>Description</i>
Logic.LE42.Out	Signal: Latched Output (Q)
Logic.LE42.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE43.Gate Out	Signal: Output of the logic gate
Logic.LE43.Timer Out	Signal: Timer Output
Logic.LE43.Out	Signal: Latched Output (Q)
Logic.LE43.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE44.Gate Out	Signal: Output of the logic gate
Logic.LE44.Timer Out	Signal: Timer Output
Logic.LE44.Out	Signal: Latched Output (Q)
Logic.LE44.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE45.Gate Out	Signal: Output of the logic gate
Logic.LE45.Timer Out	Signal: Timer Output
Logic.LE45.Out	Signal: Latched Output (Q)
Logic.LE45.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE46.Gate Out	Signal: Output of the logic gate
Logic.LE46.Timer Out	Signal: Timer Output
Logic.LE46.Out	Signal: Latched Output (Q)
Logic.LE46.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE47.Gate Out	Signal: Output of the logic gate
Logic.LE47.Timer Out	Signal: Timer Output
Logic.LE47.Out	Signal: Latched Output (Q)
Logic.LE47.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE48.Gate Out	Signal: Output of the logic gate
Logic.LE48.Timer Out	Signal: Timer Output
Logic.LE48.Out	Signal: Latched Output (Q)
Logic.LE48.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE49.Gate Out	Signal: Output of the logic gate
Logic.LE49.Timer Out	Signal: Timer Output
Logic.LE49.Out	Signal: Latched Output (Q)
Logic.LE49.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE50.Gate Out	Signal: Output of the logic gate
Logic.LE50.Timer Out	Signal: Timer Output
Logic.LE50.Out	Signal: Latched Output (Q)
Logic.LE50.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE51.Gate Out	Signal: Output of the logic gate
Logic.LE51.Timer Out	Signal: Timer Output
Logic.LE51.Out	Signal: Latched Output (Q)

<i>Name</i>	<i>Description</i>
Logic.LE51.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE52.Gate Out	Signal: Output of the logic gate
Logic.LE52.Timer Out	Signal: Timer Output
Logic.LE52.Out	Signal: Latched Output (Q)
Logic.LE52.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE53.Gate Out	Signal: Output of the logic gate
Logic.LE53.Timer Out	Signal: Timer Output
Logic.LE53.Out	Signal: Latched Output (Q)
Logic.LE53.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE54.Gate Out	Signal: Output of the logic gate
Logic.LE54.Timer Out	Signal: Timer Output
Logic.LE54.Out	Signal: Latched Output (Q)
Logic.LE54.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE55.Gate Out	Signal: Output of the logic gate
Logic.LE55.Timer Out	Signal: Timer Output
Logic.LE55.Out	Signal: Latched Output (Q)
Logic.LE55.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE56.Gate Out	Signal: Output of the logic gate
Logic.LE56.Timer Out	Signal: Timer Output
Logic.LE56.Out	Signal: Latched Output (Q)
Logic.LE56.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE57.Gate Out	Signal: Output of the logic gate
Logic.LE57.Timer Out	Signal: Timer Output
Logic.LE57.Out	Signal: Latched Output (Q)
Logic.LE57.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE58.Gate Out	Signal: Output of the logic gate
Logic.LE58.Timer Out	Signal: Timer Output
Logic.LE58.Out	Signal: Latched Output (Q)
Logic.LE58.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE59.Gate Out	Signal: Output of the logic gate
Logic.LE59.Timer Out	Signal: Timer Output
Logic.LE59.Out	Signal: Latched Output (Q)
Logic.LE59.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE60.Gate Out	Signal: Output of the logic gate
Logic.LE60.Timer Out	Signal: Timer Output
Logic.LE60.Out	Signal: Latched Output (Q)
Logic.LE60.Out inverted	Signal: Negated Latched Output (Q NOT)

<i>Name</i>	<i>Description</i>
Logic.LE61.Gate Out	Signal: Output of the logic gate
Logic.LE61.Timer Out	Signal: Timer Output
Logic.LE61.Out	Signal: Latched Output (Q)
Logic.LE61.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE62.Gate Out	Signal: Output of the logic gate
Logic.LE62.Timer Out	Signal: Timer Output
Logic.LE62.Out	Signal: Latched Output (Q)
Logic.LE62.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE63.Gate Out	Signal: Output of the logic gate
Logic.LE63.Timer Out	Signal: Timer Output
Logic.LE63.Out	Signal: Latched Output (Q)
Logic.LE63.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE64.Gate Out	Signal: Output of the logic gate
Logic.LE64.Timer Out	Signal: Timer Output
Logic.LE64.Out	Signal: Latched Output (Q)
Logic.LE64.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE65.Gate Out	Signal: Output of the logic gate
Logic.LE65.Timer Out	Signal: Timer Output
Logic.LE65.Out	Signal: Latched Output (Q)
Logic.LE65.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE66.Gate Out	Signal: Output of the logic gate
Logic.LE66.Timer Out	Signal: Timer Output
Logic.LE66.Out	Signal: Latched Output (Q)
Logic.LE66.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE67.Gate Out	Signal: Output of the logic gate
Logic.LE67.Timer Out	Signal: Timer Output
Logic.LE67.Out	Signal: Latched Output (Q)
Logic.LE67.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE68.Gate Out	Signal: Output of the logic gate
Logic.LE68.Timer Out	Signal: Timer Output
Logic.LE68.Out	Signal: Latched Output (Q)
Logic.LE68.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE69.Gate Out	Signal: Output of the logic gate
Logic.LE69.Timer Out	Signal: Timer Output
Logic.LE69.Out	Signal: Latched Output (Q)
Logic.LE69.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE70.Gate Out	Signal: Output of the logic gate

<i>Name</i>	<i>Description</i>
Logic.LE70.Timer Out	Signal: Timer Output
Logic.LE70.Out	Signal: Latched Output (Q)
Logic.LE70.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE71.Gate Out	Signal: Output of the logic gate
Logic.LE71.Timer Out	Signal: Timer Output
Logic.LE71.Out	Signal: Latched Output (Q)
Logic.LE71.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE72.Gate Out	Signal: Output of the logic gate
Logic.LE72.Timer Out	Signal: Timer Output
Logic.LE72.Out	Signal: Latched Output (Q)
Logic.LE72.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE73.Gate Out	Signal: Output of the logic gate
Logic.LE73.Timer Out	Signal: Timer Output
Logic.LE73.Out	Signal: Latched Output (Q)
Logic.LE73.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE74.Gate Out	Signal: Output of the logic gate
Logic.LE74.Timer Out	Signal: Timer Output
Logic.LE74.Out	Signal: Latched Output (Q)
Logic.LE74.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE75.Gate Out	Signal: Output of the logic gate
Logic.LE75.Timer Out	Signal: Timer Output
Logic.LE75.Out	Signal: Latched Output (Q)
Logic.LE75.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE76.Gate Out	Signal: Output of the logic gate
Logic.LE76.Timer Out	Signal: Timer Output
Logic.LE76.Out	Signal: Latched Output (Q)
Logic.LE76.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE77.Gate Out	Signal: Output of the logic gate
Logic.LE77.Timer Out	Signal: Timer Output
Logic.LE77.Out	Signal: Latched Output (Q)
Logic.LE77.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE78.Gate Out	Signal: Output of the logic gate
Logic.LE78.Timer Out	Signal: Timer Output
Logic.LE78.Out	Signal: Latched Output (Q)
Logic.LE78.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE79.Gate Out	Signal: Output of the logic gate
Logic.LE79.Timer Out	Signal: Timer Output

Name	Description
Logic.LE79.Out	Signal: Latched Output (Q)
Logic.LE79.Out inverted	Signal: Negated Latched Output (Q NOT)
Logic.LE80.Gate Out	Signal: Output of the logic gate
Logic.LE80.Timer Out	Signal: Timer Output
Logic.LE80.Out	Signal: Latched Output (Q)
Logic.LE80.Out inverted	Signal: Negated Latched Output (Q NOT)

List of the Digital Inputs

The following list comprises all Digital Inputs. This list is used in various Protective Elements (e.g. TCS...). The availability and the number of entries depends on the type of device.

Name	Description
-.-	No assignment
DI-8P X1.DI 1	Signal: Digital Input
DI-8P X1.DI 2	Signal: Digital Input
DI-8P X1.DI 3	Signal: Digital Input
DI-8P X1.DI 4	Signal: Digital Input
DI-8P X1.DI 5	Signal: Digital Input
DI-8P X1.DI 6	Signal: Digital Input
DI-8P X1.DI 7	Signal: Digital Input
DI-8P X1.DI 8	Signal: Digital Input
DI-8 X5.DI 1	Signal: Digital Input
DI-8 X5.DI 2	Signal: Digital Input
DI-8 X5.DI 3	Signal: Digital Input
DI-8 X5.DI 4	Signal: Digital Input
DI-8 X5.DI 5	Signal: Digital Input
DI-8 X5.DI 6	Signal: Digital Input
DI-8 X5.DI 7	Signal: Digital Input
DI-8 X5.DI 8	Signal: Digital Input

List of ANSI Codes

ANSI	Functions
14	Underspeed
24	Overexcitation Protection (Volts per Hertz)
25	Synchronizing or Synchronism-check via 4 th measuring channel of voltage measurement card
26	Temperature Protection
27	Undervoltage Protection
27(t)	Undervoltage (time dependent) Protection
27A	Undervoltage Protection (Auxiliar) via 4 th measuring channel of voltage measurement card
27M	Undervoltage (time dependent) Phase Protection (Main)
27N	Neutral Undervoltage via 4 th measuring channel of voltage measurement card
27TN	Third Harmonic Neutral Undervoltage via 4 th measuring channel of voltage measurement card
32	Directional Power Protection
32F	Forward Power Protection
32R	Reverse Power Protection
37	Undercurrent / Under Power
38	Temperature Protection (optional via Interface/external Box)
40	Loss of Excitation / Loss of Field
46	Unbalanced Current Protection
46G	Unbalanced Generator Current Protection
47	Unbalanced Voltage Protection
48	Incomplete Sequence (Start-up time Supervision)
49	Thermal Protection
49M	Thermal Motor Protection
49R	Thermal Rotor Protection
49S	Thermal Stator Protection
50BF	Breaker Failure
50	Overcurrent (instantaneous)
50J	Jam (locked Rotor)
50P	Phase Overcurrent (instantaneous)
50N	Neutral Overcurrent (instantaneous)
50Ns	Sensitive Neutral Overcurrent (instantaneous)
51	Overcurrent
51P	Phase Overcurrent
51N	Neutral Overcurrent
51Ns	Sensitive Neutral Overcurrent
51LR	Locked Rotor
51LRS	Locked Rotor Start (during start sequence)
51C	Voltage Controlled Overcurrent (via adaptive Parameters)
51Q	Negative Phase Sequence Overcurrent (multiple trip characteristics)
51V	Voltage Restrained Overcurrent
55	Power Factor Protection
56	Field Application Relay
59	Overvoltage Protection
59M	Phase Overvoltage Protection (Main)
59TN	Third Harmonic Neutral Overvoltage via 4 th measuring channel of voltage measurement card
59A	Overvoltage Protection via 4 th (Auxiliar) measuring channel of voltage measurement card
59N	Neutral Overvoltage Protection

ANSI	Functions
60FL	Voltage Transformer Supervision
60L	Current Transformer Supervision
64R	Rotor Earth Fault Protection
64REF	Restricted Ground Fault Protection
66	Starts per h (Start Inhibit)
67	Directional Overcurrent
67N	Directional Neutral Overcurrent
67Ns	Sensitive Directional Neutral Overcurrent
74TC	Trip Circuit Supervision
78V	Vector Surge Protection
79	Auto Reclosure
81	Frequency Protection
81U	Underfrequency Protection
81O	Overfrequency Protection
81R	ROCOF (df/dt)
86	Lock Out
87	Differential Protection (Generator/Transformer/Busbar)
87GD	Ground Differential Protection
87M	Motor Differential Protection
87U	Unit Differential Protection (protected zone includes generator and step-up transformer)
87UP	Unit Phase Differential Protection (protected zone includes generator and step-up transformer)

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