Technical Data **TD02607011E**

Effective June 2011
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Metal-enclosed medium voltage power factor correction system

Contents

Medium voltage power factor correction

Product description

Eaton's metal-enclosed medium voltage capacitor systems and harmonic filters are designed for indoor or outdoor applications in commercial, industrial, and utility power systems requiring power factor correction, motor start support, harmonic filtering, and IEEE® 519 compliance, and can increase system capacity. Fixed motor start capacitors are available to assist in motor starting applications. Designs are available with a host of options and accessories to fit the requirements and desired configurations of virtually any installation. Single-stage and multi-stage, tuned or de-tuned filter banks can be supplied. Metal-enclosed medium voltage capacitor banks are designed for industrial, commercial, and utility power systems involving motors, feeder circuits, and transmission and distribution lines where power factor improvement is required.

Powering Business Worldwide

Application description

Utility customers

Metal-enclosed power factor correction systems are fully assembled, tested, and ready for installation. Very little field assembly is required. Installation and maintenance costs for metal-enclosed systems are low compared to pole and rack mounted capacitor banks. Metal-enclosed systems and harmonic filters are less vulnerable to wildlife and airborne contaminants that can cause tracking and faults. In addition, metal-enclosed systems significantly reduce the risks and the associated liability involving untrained personnel. All live parts are contained in a grounded, key interlocked enclosure, and no internal hardware is accessible. Metal-enclosed systems are aesthetically pleasing due to their low profile, and can be painted to match the surrounding architecture. These are just some of the reasons more and more customers are using metal-enclosed capacitor and harmonic filter systems.

Industrial customers

Many industrial power users can take advantage of the benefits associated with medium voltage power factor correction and harmonic filtering. Medium voltage solutions usually support the scale and scope of larger services. Medium voltage applications can be found in the following types of industries: automotive, pulp and paper, plastics, petrochemical, and heavy manufacturing. Individual fixed capacitors provide power factor correction directly at the cause of the problem, such as large horsepower MV motors. Medium voltage systems allow large industrials to correct power factor at or close to the point of common coupling (PCC), where the utility electrical system meets theirs. This allows correction for an entire facility, instead of having to correct at multiple locations. The NEMA® 3R design also allows the system to be placed outdoors, saving valuable manufacturing floor space. The savings can be significant in materials, installation costs, and floor space. In short, medium voltage solutions provide a cost-effective alternative to many local low voltage power factor correction units, while protecting the customer's entire electrical distribution system.

Commercial customers

Many commercial customers are purchasing power from their utility at higher voltages today (2.4–15 kV), and can also take advantage of medium voltage power factor correction systems. These solutions can meet the needs of large office complexes, hospitals, and universities, among others. The benefits of safety (key interlocking, no exposed live parts, etc.) and aesthetics (low profile, can be painted to match the environment) both meet the needs of these applications where there are large numbers of untrained personnel in proximity of electrical equipment.

Advantages

Eaton's purchase of the Commonwealth Sprague capacitor systems business, with its over 70 years of market experience, provides a combination that allows the end user to obtain a world-class solution to fill their power factor needs. Quality and reliability are of paramount importance to not only the Eaton engineering team, but are also the backbone of all Eaton products and services. This commitment to quality means the customer can have a great deal of confidence with the medium voltage capacitor or harmonic filter solution from Eaton.

Benefits

Ease of installation

Eaton makes installation easy. All systems are completely assembled in the factory, with all equipment pre-wired and pre-tested for easy on-site installation. Only shipping splits must be connected in the field. Splice kits connect bus systems, and control wiring is easily connected at each enclosure. Current limiting fuses, contactor assemblies, and the incoming switch assembly can be removed from the enclosure if needed. Line terminals are completely accessible from the front of the system.

Personnel safety

A positive mechanical isolating switch with visible disconnect completely grounds and isolates the unit from the line connectors. A screened barrier protects personnel from live parts. All medium voltage doors are mechanically interlocked with the disconnect switch. Key interlocks are provided standard on all enclosure doors, and can be coordinated with upstream disconnect devices. The low voltage control section has a separate door-in-door design, and is segregated from the medium voltage sections so that an operator can work in that section safely.

Ease of maintenance

All components are front-accessible, facilitating routine inspection or parts replacement. A viewing window is standard on all compartment doors.

Flexibility

Systems are expandable. The customer can add stages in the future by connecting the phase bus in the field via splice kits. Structures can be bolted together in the field.

Safety and aesthetics are just two compelling reasons to use metal-enclosed PFC systems.

Insulated splice kits allow for simple interconnection in the field.

Univar XV (5 kV class)

Univar XV fixed medium voltage PFC unit

Product description

Capacitors for medium voltage, heavy-duty applications:

- Univar capacitors are designed for power factor correction in applications where a fixed amount of capacitance (kVAR) is required
- Available in voltage ratings of 2400V, 4160V, and 4800V
- Fast economical payback
- Individual units or multiple assemblies can be designed
- Indoor dustproof/outdoor waterproof enclosures (NEMA 12, NEMA 3R)
- Floor mounting
- Two- or three-phase fused options for 2400–4800V
- NEMA 3R terminal box

Note: NEC® Article 460.8 (b)(1) requires capacitors to have overcurrent protection in all ungrounded conductors (except when connected on the load side of a motor overload protection device). Three-phase capacitors fused only on two phases will not provide adequate protection if a line-to-ground fault should occur in the unfused phase.

Application description

- Large motors
- Motor control centers
- Branch circuits
- Service entrances

Features, benefits, and functions

Standard features

Enclosure terminal box

Fourteen-gauge steel finished with durable baked-on enamel. The wiring enclosure is gasketed to create a weatherproof, dustproof seal. Universal mounting flanges are provided for floor installation. The elimination of knockouts permits indoor/outdoor use. Unit meets NEMA 1, 3R, and 12 requirements. Enclosure is painted ANSI 61 gray.

Features

- Viewing window
- Top and side entry
- Removable front cover

Fusing

Fuses are rated 50,000A symmetrical interrupting capacity. Ratings are 165% to 250% of rated current. Fuses have visual pop-up blown fuse indication standard.

Discharge resistors

These reduce the residual voltage to less than 50V residual within five minutes of de-energization.

Grounding stud

- Standard

Power line terminals

- Large size for easy connection
- Plated copper one-hole termination pad

Operating temperature

- –40°F to 115°F (–40°C to 46°C)

Optional features

- CSA® testing and labels

Technical data

Table 1. Univar Three-Phase Ratings

Volts	Hz	kVAR
2400	60	25–825
4160	60	25–900
4800	60	25–900

Table 2. Two-Phase Fused

kVAR	2400V	4160V	4800V	Dimension (A) Inches (mm)	Approximate Weight Lbs (kg)	Figure Number
25	25243MVF	25413MVF	25483MVF	34.44 (875)	70 (32)	1
50	50243MVF	50413MVF	50483MVF	34.44 (875)	70 (32)	1
75	75243MVF	75413MVF	75483MVF	34.44 (875)	70 (32)	1
100	100243MVF	100413MVF	100483MVF	36.19 (919)	75 (34)	1
125	125243MVF	125413MVF	125483MVF	36.19 (919)	83 (38)	1
150	150243MVF	150413MVF	150483MVF	36.19 (919)	88 (40)	1
175	175243MVF	175413MVF	175483MVF	36.19 (919)	93 (42)	1
200	200243MVF	200413MVF	200483MVF	36.19 (919)	99 (45)	1
225	225243MVF	225413MVF	225483MVF	41.94 (1065)	109 (49)	1
250	250243MVF	250413MVF	250483MVF	41.94 (1065)	109 (49)	1
275	275243MVF	275413MVF	275483MVF	41.94 (1065)	121 (55)	1
300	—	300413MVF	300483MVF	41.94 (1065)	121 (55)	1
300	300243MVF	—	—	36.19 (919)	172 (78)	2
325	325243MVF	325413MVF	325483MVF	36.19 (919)	177 (80)	2
350	350243MVF	350413MVF	350483MVF	36.19 (919)	182 (83)	2
375	375243MVF	375413MVF	375483MVF	36.19 (919)	188 (85)	2
400	400243MVF	400413MVF	400483MVF	36.19 (919)	194 (88)	2
425	425243MVF	425413MVF	425483MVF	41.94 (1065)	206 (93)	2
450	450243MVF	450413MVF	450483MVF	41.94 (1065)	214 (97)	2
475	475243MVF	475413MVF	475483MVF	41.94 (1065)	214 (97)	2
500	500243MVF	500413MVF	500483MVF	41.94 (1065)	214 (97)	2
525	525243MVF	525413MVF	525483MVF	41.94 (1065)	226 (103)	2
550	550243MVF	550413MVF	550483MVF	41.94 (1065)	238 (108)	2
575	—	575413MVF	575483MVF	41.94 (1065)	238 (108)	2
575	575243MVF	—	—	36.19 (919)	259 (118)	3
600	—	600413MVF	600483MVF	41.94 (1065)	238 (108)	2
600	600243MVF	—	—	36.19 (919)	265 (121)	3
625	625243MVF	625413MVF	625483MVF	41.94 (1065)	279 (127)	3
650	650243MVF	650413MVF	650483MVF	41.94 (1065)	287 (131)	3
675	675243MVF	675413MVF	675483MVF	41.94 (1065)	295 (134)	3
700	700243MVF	700413MVF	700483MVF	41.94 (1065)	295 (134)	3
725	725243MVF	725413MVF	725483MVF	41.94 (1065)	295 (134)	3
750	750243MVF	750413MVF	750483MVF	41.94 (1065)	295 (134)	3
775	775243MVF	775413MVF	775483MVF	41.94 (1065)	307 (140)	3
800	800243MVF	800413MVF	800483MVF	41.94 (1065)	319 (145)	3
825	825243MVF	825413MVF	825483MVF	41.94 (1065)	331 (151)	3
850	—	850413MVF	850483MVF	41.94 (1065)	331 (151)	3
875	—	875413MVF	875483MVF	41.94 (1065)	331 (151)	3
900	—	900413MVF	900483MVF	41.94 (1065)	331 (151)	3

Note: To be used on ungrounded delta systems or high resistance grounding systems only.

Note: Add suffix "C" for CSA label.

Table 3. Three-Phase Fused

kVAR	2400V	4160V	4800V	Dimension (A) Inches (mm)	Approximate Weight Lbs (kg)	Figure Number
25	25243MVF3	25413MVF3	25483MVF3	34.44 (875)	70 (32)	1
50	50243MVF3	50413MVF3	50483MVF3	34.44 (875)	70 (32)	1
75	75243MVF3	75413MVF3	75483MVF3	34.44 (875)	70 (32)	1
100	100243MVF3	100413MVF3	100483MVF3	36.19 (919)	75 (34)	1
125	125243MVF3	125413MVF3	125483MVF3	36.19 (919)	83 (38)	1
150	150243MVF3	150413MVF3	150483MVF3	36.19 (919)	88 (40)	1
175	175243MVF3	175413MVF3	175483MVF3	36.19 (919)	93 (42)	1
200	200243MVF3	200413MVF3	200483MVF3	36.19 (919)	99 (45)	1
225	225243MVF3	225413MVF3	225483MVF3	41.94 (1065)	109 (49)	1
250	250243MVF3	250413MVF3	250483MVF3	41.94 (1065)	109 (49)	1
275	275243MVF3	275413MVF3	275483MVF3	41.94 (1065)	121 (55)	1
300	—	300413MVF3	300483MVF3	41.94 (1065)	121 (55)	1
300	300243MVF3	—	—	36.19 (919)	172 (78)	2
325	325243MVF3	325413MVF3	325483MVF3	36.19 (919)	177 (80)	2
350	350243MVF3	350413MVF3	350483MVF3	36.19 (919)	182 (83)	2
375	375243MVF3	375413MVF3	375483MVF3	36.19 (919)	188 (85)	2
400	400243MVF3	400413MVF3	400483MVF3	36.19 (919)	194 (88)	2
425	425243MVF3	425413MVF3	425483MVF3	41.94 (1065)	206 (93)	2
450	450243MVF3	450413MVF3	450483MVF3	41.94 (1065)	214 (97)	2
475	475243MVF3	475413MVF3	475483MVF3	41.94 (1065)	214 (97)	2
500	500243MVF3	500413MVF3	500483MVF3	41.94 (1065)	214 (97)	2
525	525243MVF3	525413MVF3	525483MVF3	41.94 (1065)	226 (103)	2
550	550243MVF3	550413MVF3	550483MVF3	41.94 (1065)	238 (108)	2
575	—	575413MVF3	575483MVF3	41.94 (1065)	238 (108)	2
575	575243MVF3	—	—	36.19 (919)	259 (118)	3
600	—	600413MVF3	600483MVF3	41.94 (1065)	238 (108)	2
600	600243MVF3	—	—	36.19 (919)	265 (121)	3
625	625243MVF3	625413MVF3	625483MVF3	41.94 (1065)	279 (127)	3
650	650243MVF3	650413MVF3	650483MVF3	41.94 (1065)	287 (131)	3
675	675243MVF3	675413MVF3	675483MVF3	41.94 (1065)	295 (134)	3
700	700243MVF3	700413MVF3	700483MVF3	41.94 (1065)	295 (134)	3
725	725243MVF3	725413MVF3	725483MVF3	41.94 (1065)	295 (134)	3
750	750243MVF3	750413MVF3	750483MVF3	41.94 (1065)	295 (134)	3
775	775243MVF3	775413MVF3	775483MVF3	41.94 (1065)	307 (140)	3
800	800243MVF3	800413MVF3	800483MVF3	41.94 (1065)	319 (145)	3
825	825243MVF3	825413MVF3	825483MVF3	41.94 (1065)	331 (151)	3
850	—	850413MVF3	850483MVF3	41.94 (1065)	331 (151)	3
875	—	875413MVF3	875483MVF3	41.94 (1065)	331 (151)	3
900	—	900413MVF3	900483MVF3	41.94 (1065)	331 (151)	3

Note: Add suffix "C" for CSA label.

Dimensions

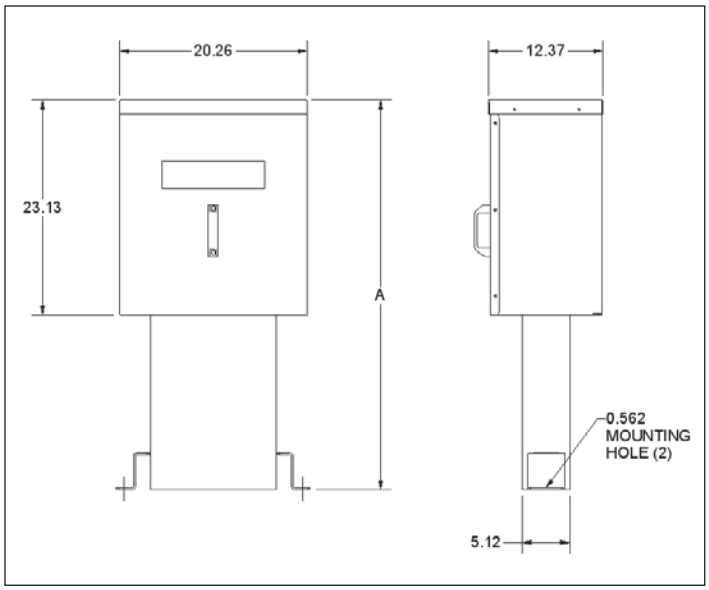


Figure 1. Univar XV Outline Drawing

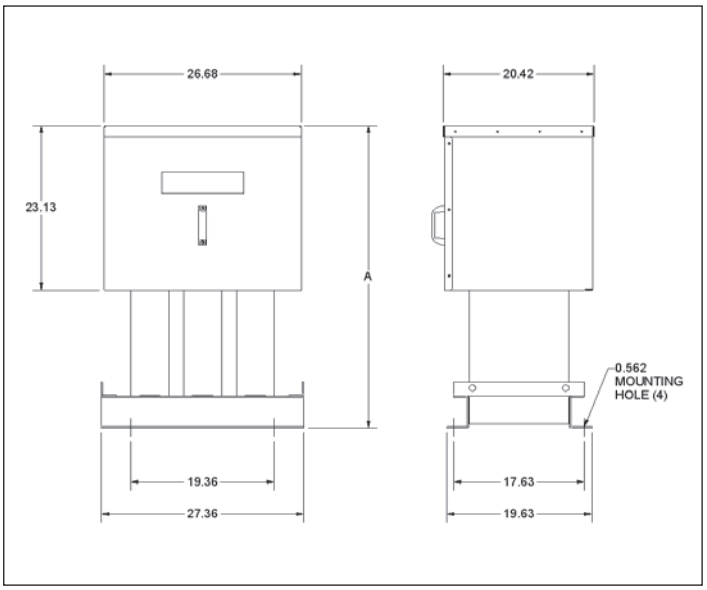


Figure 3. Univar XV Outline Drawing

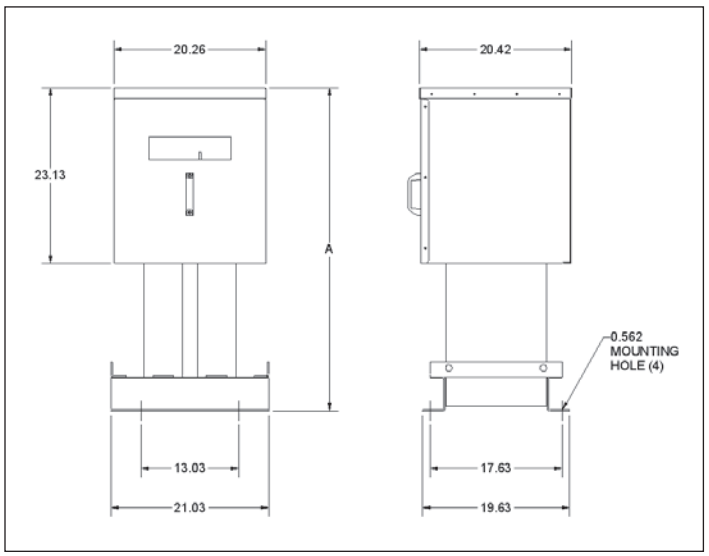
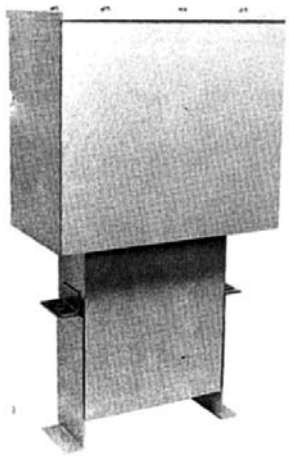


Figure 2. Univar XV Outline Drawing

Univar (15 kV class)



Univar fixed medium voltage PFC unit

Product description

Capacitors for medium voltage, heavy-duty applications:

- Univar capacitors are designed for power factor correction in applications where a fixed amount of capacitance (kVAR) is required
- Available in voltage ratings of 6.6 kV, 7.2 kV, 12.47 kV and 13.8 kV
- Fast economical payback
- Individual units or multiple assemblies can be designed
- Indoor dustproof/outdoor waterproof enclosures (NEMA 12, NEMA 3R)
- Floor mounting
- Fuses supplied on all three phases
- NEMA 3R terminal box

Application description

- Large motors
- Motor control centers
- Branch circuits
- Service entrances

Features, benefits, and functions

Standard features

Enclosure

Sixteen-gauge steel finished with durable baked-on enamel. The wiring enclosure is gasketed to create a weatherproof, dustproof seal. Universal mounting flanges are provided for floor installation. The elimination of knockouts permits indoor/outdoor use. Unit meets NEMA 1, 3R, and 12 requirements. Enclosure is painted ANSI 70 gray.

Fusing

Fuses are rated 50,000A symmetrical interrupting capacity. Ratings are 165% to 250% of rated current. Fuses have visual pop-up blown fuse indication standard.

Discharge resistors

These reduce the residual voltage to less than 50V residual within 5 minutes of de-energization.

Grounding stud

- Standard

Power line terminals

- Large size for easy connection

Operating temperature

- –40°F to 115°F (–40°C to 46°C)

Optional features

- CSA testing and labels

Technical data

Table 4. Univar Three-Phase Ratings

Volts	Hz	kVAR
6600	60	50–400
7200	60	50–400
12,470	60	50–500
13,800	60	50–500

Table 5. Standard Three Fuses (6600–13,800V)

Standard Three Fuses					Dimensions in Inches (mm)						
kVAR	6600V	7200V	12,470V	13,800V	(A)	(B)	(C)	(D)	Approx. Weight Lbs (kg)	Figure Number	Standard DWG Number
50	50663FKED3	50723FKED3	50123FKED3	50133FKED3	4.25 (108)	45.50 (1156)	14.46 (367)	0.25 (6)	198 (90)	4	5D10243
100	100663FKED3	100723FKED3	100123FKED3	100133FKED3	4.25 (108)	45.50 (1156)	14.46 (367)	0.25 (6)	198 (90)	4	5D10243
150	150663FKED3	150723FKED3	150123FKED3	150133FKED3	4.25 (108)	45.50 (1156)	14.46 (367)	0.25 (6)	198 (90)	4	5D10243
200	200663FKED3	200723FKED3	200123FKED3	200133FKED3	5.62 (143)	45.50 (1156)	14.46 (367)	0.25 (6)	220 (100)	4	5D10243
250	250FKY66323	250FKY72323	250FKY12323	250FKY13323	5.62 (143)	48.50 (1232)	17.46 (443)	0.25 (6)	246 (112)	4	5D10243
300	300FKY66323	300FKY72323	300FKY12323	300FKY13323	5.62 (143)	53.50 (1359)	17.46 (443)	0.25 (6)	246 (112)	4	5D10243
350	350FKY66323	350FKY72323	350FKY12323	350FKY13323	5.62 (143)	53.50 (1359)	17.46 (443)	0.25 (6)	246 (112)	4	5D10243
400	400FKY66323	400FKY72323	400FKY12323	400FKY13323	5.62 (143)	57.25 (1454)	22.46 (570)	0.25 (6)	281 (128)	4	5D10243
450	—	—	450FKY12323	450FKY13323	5.62 (143)	57.25 (1454)	22.46 (570)	0.25 (6)	281 (128)	4	5D10243
500	—	—	500FKY12323	500FKY13323	5.62 (143)	57.25 (1454)	26.21 (666)	0.25 (6)	336 (153)	4	5D10243

Dimensions

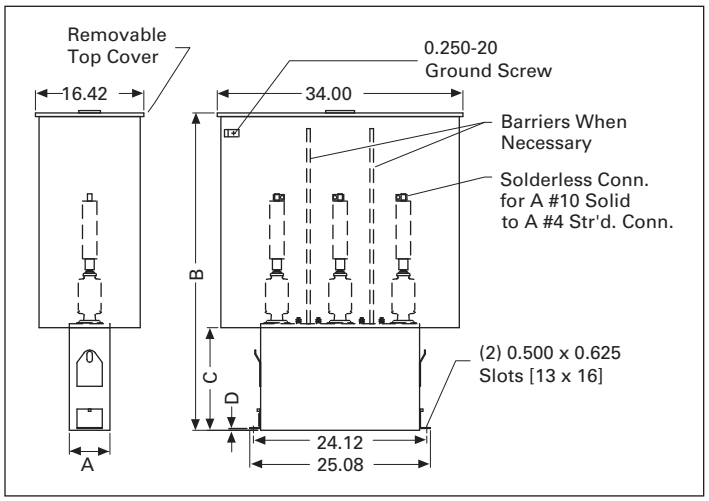


Figure 4. Drawing Number 5D10243

Autovar MV (2.4–14.4 kV)

Medium voltage metal-enclosed PFC system

Product description

Autovar medium voltage automatic power factor capacitor systems are designed for power factor correction in applications where plant power factor can be constant or changing and a custom solution is required. These systems can be a fixed amount of capacitance with a disconnect, a number of switched capacitance stages, or a combination of both. The Autovar medium voltage capacitor system can switch stages of capacitance in and out automatically based on information collected by the power factor controller on the door-in-door control panel.

Features, benefits, and functions

- Voltages from 2400 to 14,400V
- Reactive power ratings through 15 MVAR
- Harmonic tuned, de-tuned, or multi-tuned filter designs available
- Externally fused capacitor units standard
- Blown fuse indication standard
- Integral load interrupter switch with NEMA two- or four-hole termination pad for incoming cables
- Factory tested and ready for interconnection
- Integral protection and control system
- Top or bottom cable entry
- Grounding switch
- 60 kV BIL up to 4.8 kV
- 95 kV BIL from 7.2 kV to 14.4 kV
- Up to 12 automatic switched capacitor stages
- Warning labels
- Removable air filters without opening enclosure doors
- Adjustable blocking timers to prevent re-closing of a capacitor stage in less than 200 seconds
- Meets the following requirements:
  - ANSI
  - IEEE
  - NEC
  - NESC
  - CSA (when specified)
- Main incoming fuses are rated 50 kAIC to provide main bus protection, as well as backup protection for the capacitor systems
- 4.00-inch base channel is standard

Standard features

Enclosure

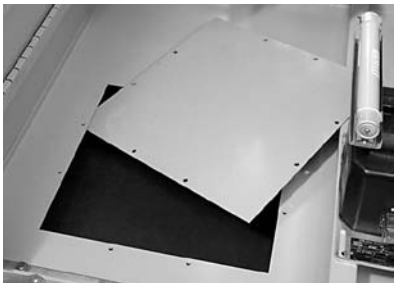
Free-standing, 11-gauge steel construction with three-point padlockable latching handles and stainless steel hinges. The enclosure is painted with a corrosion-resistant ANSI 61 light gray powder-coated paint as standard. Other colors are available as an option. NEMA 3R construction is standard; NEMA 3R stainless steel is available as an option.

Enclosure type is UL®/CSA approved. Enclosure design is modular, and future sections can be added on the left or the right.

See **Figure 5** for typical dimensions and elevations.

See **Figure 6** for a typical single-line drawing.

Medium voltage PFC enclosure



Bottom plate incoming cutout provided standard

Load interrupter air disconnect switch

Integral disconnect switch, externally operated, mechanically chain driven with visible blades is available as per NEC requirements. Disconnect switch is mechanically interlocked with the ground switch, and with the customer's upstream device (if applicable). For safety, the incoming section is front-accessible only, and a barrier isolates live components from the user.

Incoming section

Ground switch

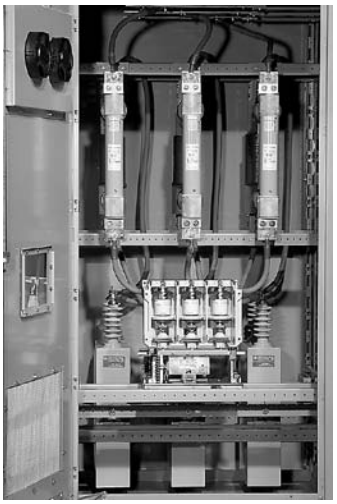
A ground switch is provided to ground the load-side terminals of the incoming switch (or MLO) for safety during maintenance. Optional controls are available to permit closing contactors after the grounding switch has been closed to ground capacitors immediately (rather than waiting 5 minutes for full discharge).

Vacuum switches and contactors rated for capacitor switching

On 2.4 to 4.8 kV multi-stage capacitor systems, each stage is controlled by low maintenance Eaton "SL" AMPGARD® three-pole vacuum contactors. On 6.6 to 14.4 kV multi-stage capacitor systems, each stage is controlled by low maintenance single-pole vacuum switches.

15 kV switched capacitor stage enclosure

The type SL power contactors are self-supporting, compact, three-pole vacuum contactors, rated for capacitor switching. The SL contactor uses a solid-state control board, allowing the user maximum flexibility to change control voltages and dropout times in the field simply by adjusting DIP switch settings. The SL contactor is available in voltage ratings from 2.4 to 4.8 kV with current ratings of 200A and 800A (the highest rated capacitor switching contactor available), and the SL contactor has interruption ratings of 8500A, allowing for better coordination with power fuses.



5 kV switched capacitor stage enclosure

Individual capacitor fusing

Each capacitor is externally fused with current limiting fuses. Fuses are equipped with blown fuse indication. Internally fused capacitors are also available as an option. Fuses are rated for capacitor protection. All fuses are rated 50 kAIC.

Environmental controls

- Exhaust fans are provided for forced air ventilation of all enclosures as standard
- Thermostats are included as standard to help maintain an acceptable internal environment for all components
- Space heaters are provided to control moisture and humidity inside all enclosures
- Each compartment has individual thermostats for fan and space heater controls

Capacitors

Low loss, double-bushing capacitors that meet or exceed IEC 871, IEEE Std. 18, and CSA standards are supplied. Capacitors are available in delta, ungrounded wye, or solidly grounded wye. The dielectric fluid is environmentally friendly and biodegradable, and contains no PCBs. Capacitor units are equipped with internal discharge resistors that reduce the residual voltage to less than 50 volts within 5 minutes of de-energization.

Harmonic filtering

Eaton's medium voltage harmonic filter systems are designed for industrial, utility, and commercial power systems to improve power factor, to reduce harmonic distortion, and to increase system capacity. The reactors are typically tuned to either the 4.2nd or the 4.7th harmonic, to filter the 5th level harmonic. Other tuning orders are available. This is the most common harmonic produced by six-pulse variable speed drives. These filters are designed to the unique specifications of each electrical distribution system. Medium voltage capacitor banks can also be configured with de-tuned anti-resonant harmonic filters, typically set to the 4.2nd harmonic. Capacitor banks tuned to the 4.2nd or 4.7th harmonic prevent parallel resonance conditions, reduce transients, and provide harmonic filtering.

Harmonic filter capacitor stage enclosure

Key interlock system

The key interlock system controls the sequential operation of the load break switch (or circuit breaker) and the ground switch to permit safe entry into the capacitor system. All capacitor stage enclosures are also interlocked with the ground switch. If applicable, the customer's upstream disconnect device can be interlocked as well. See **Figure 6** for key interlock operation on a typical single-line drawing.

Blown fuse detection system

A visual pop-up blown fuse detection system is provided as standard.

Control power transformer

A fused control power transformer rated for 1.5 kVA is provided for protection, control, and operation of the capacitor or harmonic filter system.

Surge protective device (SPD)

An SPD unit is always supplied for protection of all low voltage controls in the system, increasing the reliability of the system.

Control panel

A door-in-door NEMA 3R swing-out control panel is provided on the main incoming structure as standard. This unit includes a viewing window so that all controls and information can be viewed without opening the panel. All low voltage controls and logic are accessible from the front of the system, and are isolated from the medium voltage section.

Included:

- PFC power factor controller
- Multifunction digital meter/relay
- Full voltage LED lights for status, alarm, and trip indication
- Manual stage operation switches
- Any special controls requested by the customer

Control panel

Microprocessor-based controller

All switched metal-enclosed capacitors and harmonic filter systems come equipped with an automatic controller that switches each capacitor stage based upon power factor. The customer simply programs in the target power factor desired. The controller analyzes the present power factor, the size of each stage, and turns on and off stages to meet the customer's programmed target. The power factor controller comes with the following alarms as standard: over/under compensation, no current input, step fault, step warning, target PF not reached, total voltage harmonic distortion, total current harmonic distortion, and over/under voltage.

Up to 12 steps of capacitance can be designed into any system. Customers can exploit this feature when designing systems for future plant expansion.

Communication options

Communications of power factor data via RS-485. Modbus® is available as an option. Communicated information from the controllers:

- Voltage
- Current
- Target power factor
- Current power factor
- Active power
- Apparent power
- Reactive power
- Number of steps in the circuit
- All alarm status
- All counters
- Time and date

Inrush reactors

Series air core inrush reactors are provided as standard on all switched (non-harmonic filtered) capacitor systems for protection against transients from back-to-back switching. Reactors in harmonic filtered applications provide this same protection.

Bus

Standard main bus is continuous 1/4 x 2-inch silver-plated copper bus rated 600A and is provided throughout the lineup for easy interconnection, field installation, and future expansion.

Ground bus is continuous 1/4 x 1-inch silver-plated copper rated 300A and is provided throughout the lineup for easy interconnection, field installation, and future expansion. Ground studs are available in all structures for customer connection.

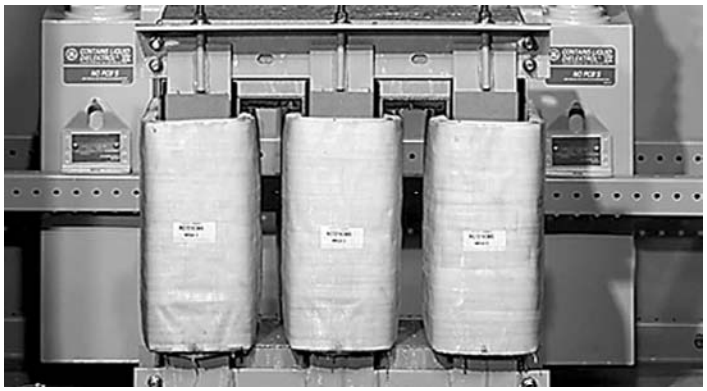
Additional standard controls and features

- Three-phase current monitoring of capacitor bank
- Unbalance alarm and unit shutdown on all wye-connected systems
- Unit alarm and isolated fail-safe contacts for customer use on all systems. Controls allow sufficient time (5 minutes) to allow the capacitors time to discharge before re-energization can occur
- Temperature alarms on all harmonic filter units
- Manual stage controls (H-O-A selector switches)

Optional features

Harmonic filter reactors

Iron core reactors provide the necessary reactance to tune the capacitor system to a desired frequency. Standard filters can be tuned to 4.2, 4.4, 4.6, or 4.7, with other tuning frequencies available if needed. Iron core reactors are 100% copper windings, 115°C rise with 220°C insulation VPI varnish.



Reactors for harmonic filter

Lightning arresters

Optional heavy-duty distribution intermediate or station class lightning arresters protect the capacitor system from lightning and switching transients.

15 kV capacitor vacuum switch

15 kV capacitor vacuum switch is available in vacuum contactor in oil dielectric or vacuum contactor in solid dielectric. Vacuum switches are certified to ANSI C37.66 standard.

Harmonic manager multifunction digital meter/relay

Multifunction harmonic manager meter/relay with current and voltage harmonic monitoring and various alarm/trip set points.

Enclosure options

NEMA 3R stainless steel construction for highly caustic environments.

Alarm strobe

Strobe light can be provided for visual indication of faults and alarms.

Unbalance protection

Neutral PT or CT-based unbalance protection for wye ungrounded capacitor configuration.

Power cable termination

Incoming power cable lugs are available when specified.

Time delayed enclosure entry interlock

Electrically controlled solenoid time delay to allow adjustable time delay between opening of main switch and entry into capacitor section.

Heavy-duty capacitor units

Capacitor units suited to the rigors of industrial power systems for power factor, harmonic filter, and excessive switching applications. Heavy-duty capacitor units have 125% continuous rms overvoltage capability, 15,000A fault handling capability, 100 kA transient current withstand capability, 131°F (55°C) ambient temperature operation, and 135% peak overvoltage capability.

Other options

- Second PT for voltage sensing of all three phases
- Special CSA label for assembly
- Individual harmonic filter current monitoring
- Overload protection

Technical data

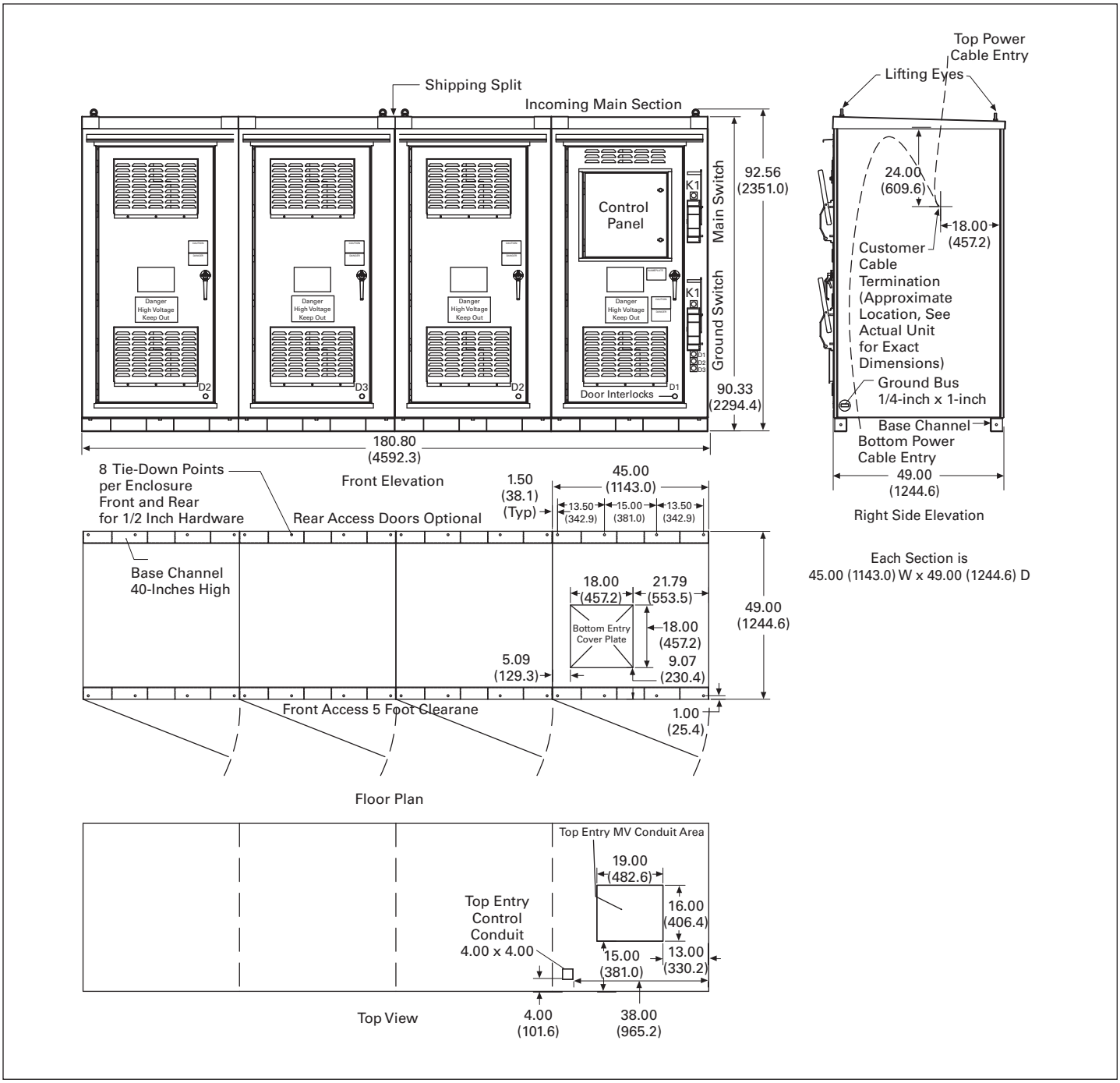


Figure 5. Typical Engineered Metal-Enclosed Power Factor Correction System Dimensional Data

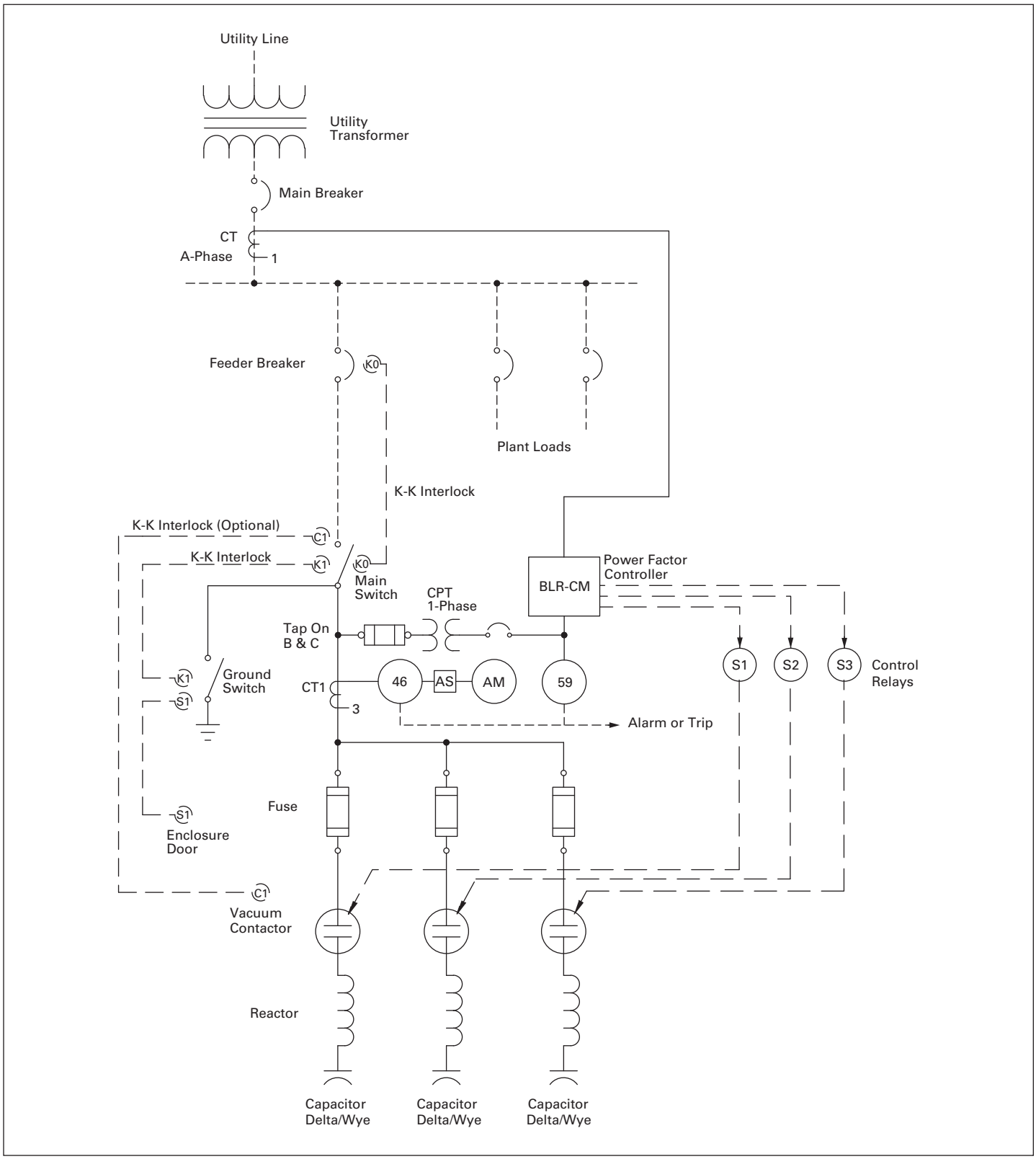


Figure 6. Typical Medium Voltage Automatic Power Factor Correction Single-Line Drawing

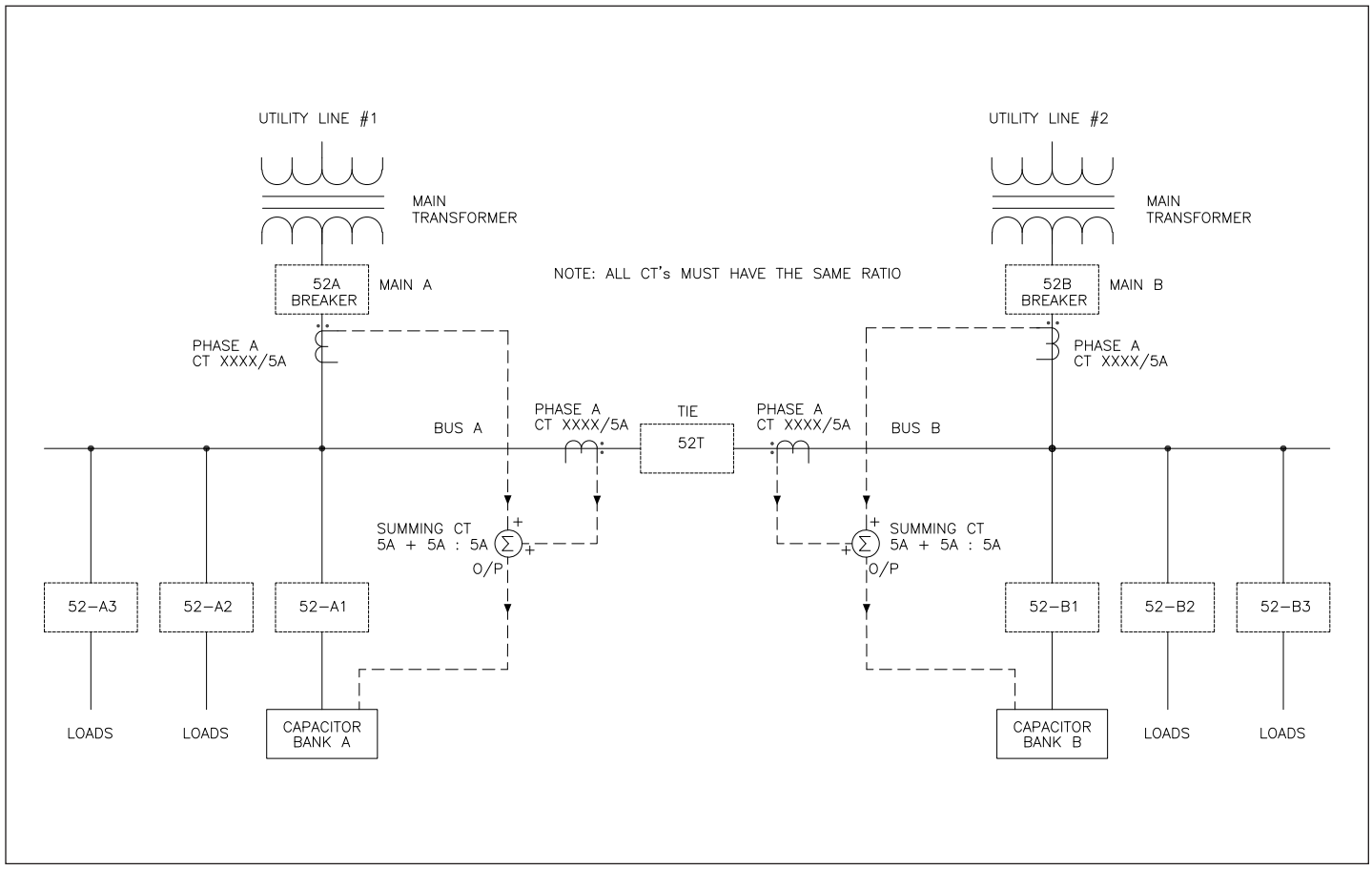


Figure 7. Automatic Capacitor Banks Medium Voltage Main-Tie-Main

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