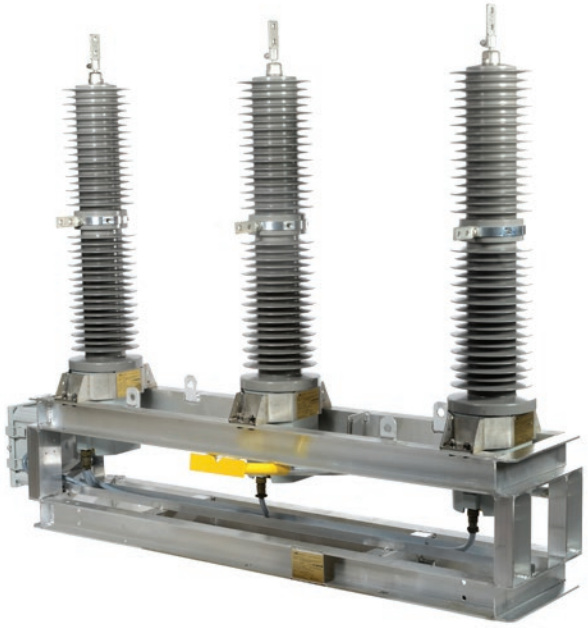
Power Capacitors
Catalog Data
CA230013EN

Effective February 2022
New Issue

COOPER POWER SERIES

TriSync three-phase capacitor switch



General

Eaton's Cooper Power™ series three-phase TriSync™ capacitor switch provides an efficient and reliable capacitor switching solution for power generation, transmission and distribution electrical systems. The TriSync switch is designed and manufactured in accordance with IEEE Std C37.66™ and IEEE Std. C37.100.2™ standards, and is available in 15 kV, 25 kV and 38kV class ratings for system applications up to 66 kV.

Each phase of the TriSync switch includes a single vacuum bottle with permanent magnet solenoid mechanism. The single vacuum bottle design eliminates the need for complicated calibration processes and tedious maintenance requirements. The TriSync switch delivers an environmentally friendly solution in a compact installation footprint while providing repeatable, reliable performance.

The switch features a lightweight high strength 6061-T6 aluminum alloy free standing frame. Frames are available in 150 kV and 200 kV BIL insulation levels. Wildlife protectors are available to protect high voltage terminals from incidental contact while energized. To ensure a rapid installation process, all control wiring connections are prewired, and optional wildlife protection installed, at Eaton's Greenwood, SC, capacitor facility.

The TriSync capacitor switch incorporates superior cycloaliphatic epoxy insulation resulting in a switch that is highly resistant to ozone, moisture, contamination and ultraviolet light. This material is capable of withstanding severe electrical-mechanical conditions and is uniquely suited for the demands of capacitor switching. The switch can be used with any industry capacitor control, including Eaton's Cooper Power series CBC-8000 capacitor control, to provide Integrated Volt/VAR Control (IVVC), leading to overall cost savings.

Each voltage class is available in zero voltage closing (ZVC) compatible designs. The ZVC TriSync package is ideal for loads adversely affected by transients caused by switching capacitor banks or applications where inrush current and frequency may impact scope of supply. TriSync's ZVC solution utilizes the Valquest™ zero crossing Z-Cap™ capacitor control which is compatible with Eaton's CBC-8000 control, eliminating the need for field calibration.

Powering Business Worldwide

Features and detailed description

The TriSync capacitor switch uses a permanent magnetic latching solenoid (no cams, linkages, or struts). See Figure 1.

This unique design offers the following benefits:

- Low energy requirements to close and open the switch
- Separate open and close coils eliminate the need for circuit boards or relays in the body of the switch
- Critical opening operation powered by a heavy-duty precision spring which provides consistent opening speeds that are effectively immune to variations in ambient temperature

All TriSync capacitor switches can be opened and closed electrically by applying rated control voltage to the proper terminals of the actuator receptacle. Consistent operating speeds make the TriSync capacitor switch ideal for zero voltage closing (ZVC) applications.

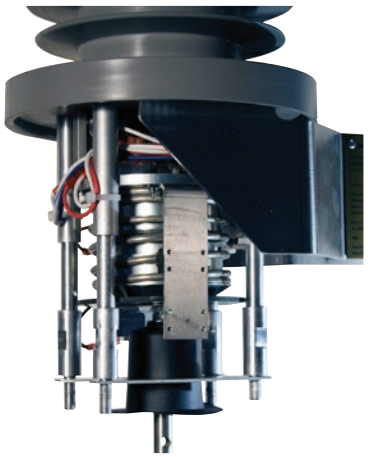


Figure 1. Operating mechanism.

Manual open

The TriSync switch features a manual gang open operation, operating all three phases simultaneously. The manual trip works with or without supply power. Each phase of the switch includes a switch position indicator.

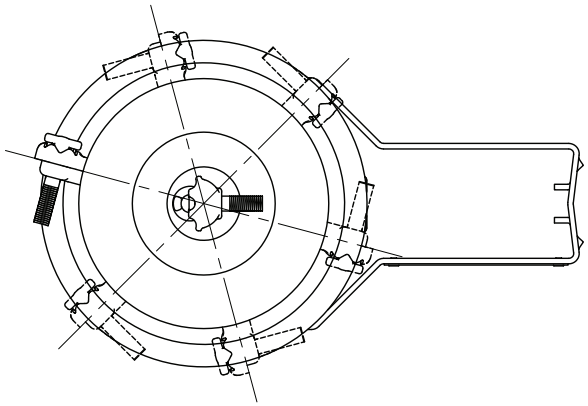


Figure 2. The FlexConnect™ 360-degree terminal ring provides installation flexibility.

Vacuum interruption

Eaton vacuum interrupters, specifically designed for capacitor switching, include greatly enhanced contact life. Fast mechanism operation combined with the superior interrupting capabilities of our vacuum interrupter limits prestrike and restrike of switch contacts. Additionally, the high-temperature rated contacts further extend switch mechanical life.

A break on the single phase is accomplished by separating contacts inside the vacuum interrupter. All arcing is contained within the vacuum envelope.

Figure 3. Vacuum interrupter used in 15 kV, 25 kV and 38 kV switch ratings.

Construction

Solid dielectric insulation eliminates the need for insulating gas, foam, or oil, thereby greatly reducing life-cycle maintenance costs. The design ensures maintenance-free performance throughout an operating temperature range as shown in Table 1.

Environmental performance

Cycloaliphatic epoxy resists damage caused by ultraviolet radiation. Over 30 years of proven experience of cycloaliphatic epoxy in harsh climates confirms that the TriSync capacitor switch will maintain a smooth, self-cleansing, unblemished surface with low-adhesion to contaminants when exposed to ultraviolet radiation.

Hydrophobicity

Cycloaliphatic epoxy maintains excellent hydrophobicity and is highly resistant to moisture absorption. This prevents the continuous sheets of water that could form leakage current paths which, when heated by continuous flow, create a dry band path that deteriorates the creepage withstand level. The cycloaliphatic epoxy's exceptional ability to resist electrical tracking reduces both flashovers and the associated cost of repairs. The epoxy combines surface-tracking characteristics with robust alternating shed designed per IEC 60815 to provide maintenance free service even in extreme pollution conditions.

Frame structure

The TriSync capacitor switch features a lightweight high-strength welded 6061-T6 aluminum alloy frame. This frame is designed and tested to operate effectively in the harshest of environments. Its free-standing design includes integrated lifting lugs and streamlined mounting options for ease of installation.

Junction box

All TriSync switch connections are pre-wired and routed to a junction box mounted on the switch frame structure. Quick connections can be made at the junction box via two (2) receptacles. The 12-pin receptacle is used for power and functional operation and the 10-pin receptacle for use in switching auxiliary equipment. The junction box enclosure is constructed from high impact strength, ultraviolet (UV) resistant polymer material.

Control box

The TriSync control box houses the switch controller modules and is offered with a variety of wire lengths allowing for mounting in convenient accessible locations. The control box can be ordered with a variety of controller options including Eaton's Cooper Power series CBC-8000 control, a jaw-mount provision for off the shelf capacitor control and Valquest Z-Cap control for use in ZVC applications.

Ratings and specifications

Table 1. General Specifications

Voltage Class	**15 kV**	**25 kV**	**38 kV**
Switch Type	**110 BIL**	**150 BIL**	**200 BIL**
Rated Maximum Voltage, 50/60 Hz			
Ungrounded capacitor banks, L-L (kV)	15.6	25	38
Solidly grounded capacitor banks, L-L (kV)	27	38	66
Impulse Withstand Voltage			
Open contact kV (BIL)	95	125	200
Line to ground (kV BIL)	110	150	200
Withstand Voltage, 50/60 Hz			
Power Frequency Dry Withstand (kV)	50	70	70
Power Frequency Wet Withstand (kV)	45	60	60
Continuous current 50/60 Hz (A)	200,400	200	400
Capacitive switching current 50/60 Hz (A)	200,400	200	400
Fault making peak current (A)	15,000	15,000	32,500
Symmetrical fault making current (A)	6,000	6,000	12,500
Withstand peak current (A)	15,000	15,000	32,500
Short-time symmetrical withstand current (A)	4,500	4,500	6,250
High frequency transient making peak current (A)	9,000/12,000*	9,000	10,000
Rated transient inrush frequency (Hz)	6,000	6,000	6,000
Creepage Distance			
Terminal to terminal (mm)	600	813	1,628
Terminal to ground (mm)	610	813	1,696
Operating Voltage Range, 50/60 Hz**			
110/120 Vac (V)	75-130	75-130	95-130
240 Vac (V)	150-260	150-260	N/A
Nominal Control Current			
110/120 Vac	27	27	36 open, 24 close
240 Vac	18	18	N/A
Open and close cycle time (msec)	100/100	100/100	125/100
Assembly weight, excluding control box (lb/kg)	225/102	225/102	475/215
Operating temperature range	-40° C to +60° C	-40° C to +60° C	-40° C to +55° C, -50° C consult product line
Mechanical operations	50,000	50,000	50,000
Aux. Contact Rating			
110/120 Vac (A)	15	15	15
240 Vac (A)	15	15	N/A
110/120 Vdc (A)	0.20	0.20	0.20

* The 15.6 kV rated TriSync capacitor switch is available with an optional high frequency transient making peak current of 12 kA. Contact factory for additional information.
** Contact factory for more information regarding dc control voltages.
Note: The durability of the TriSync capacitor switch was demonstrated by completing a minimum of 50,000 mechanical operations after performing the Mechanical Life Test in accordance with IEEE Std C37.66™ standard. One operation is defined as 1 close and 1 open operation.

Ordering information

Table 2. TriSync Capacitor Switch Numbering System

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
T	**C**	**S**	**A**	**1**	**1**	**1**	**A**	**1**	**1**	**1**	**A**	**1**	**1**	**1**

Catalog Number Digits

1-3 TriSync Capacitor Switch

Digit 4 Maximum Rated Voltage/Continuous Current

A	15.6 kV / 200 A
B	25.0 kV / 200 A
C	Empty
E	38.0 kV / 400 A
F	15.6 kV / 400 A

Digit 5 Open Contact Bushing Creepage Distance (Upper Bushing)

1	17.3" (440)
2	23.6" (600)
3	32.0" (813)
4	64.1" (1628)

Note: Earlier selections may limit configuration options.

Digit 6 Terminal-to-Ground Bushing Creepage Distance (Lower Bushing)

1	19.6" (498)
2	24.0" (610)
3	32.0" (813)
4	66.8" (1696)

Note: Earlier selections may limit configuration options.

Digit 7 Open Contact (Upper Bushing) and Terminal-to-Ground (Lower Bushing) BIL Level

1	95 kV BIL/95 kV BIL
2	95 kV BIL/125 kV BIL
3	125 kV BIL/150 kV BIL
4	125 kV BIL/125 kV BIL
5	95 kV BIL/110 kV BIL
6	200 kV BIL/200 kV BIL

Note: Earlier selections may limit configuration options.

Digit 8 Switch Frame Selection

N	No Frame (Eliminates Gang Operated Trip Capability)
A	150 kV BIL Frame
B	200 kV BIL Frame

Note: Earlier selections may limit configuration options.

Digit 9 Control Voltage Type

1	120 VAC
2	240 VAC
3	125 VDC
4	ZVC – 120 VAC OPEN/ PULSED CLOSED
5	ZVC – PULSED OPEN/ PULSED CLOSED

Note: Earlier selections may limit configuration options.

Digit 10 Direct Aux. Contacts

3	1 NC (15/25 kV Only)
2	1 NO 1 NC (38 kV Only)
1	1 NO (15/25 kV Only)
0	WITHOUT DIR. AUX. CONTACTS (Allows 15/25 kV to have ind. Aux. contacts)

Note: Earlier selections may limit configuration options.

Digit 11 Indirect Aux. Contacts

1	3 NO 3 NC (38 kV, or 15/25 if digit 10 is 0)
0	WITHOUT IND. AUX. CONTACTS

Note: Earlier selections may limit configuration options.

Digit 12 Load Terminal Options

A	2-Hole NEMA
B	4-Hole NEMA
C	Eyebolt (Maximum 250 MCM)

Note: Earlier selections may limit configuration options.

Digit 13 Wildlife Protector Options

0	None
1	IEEE Std. 1656 compliant wildlife protectors
2	Legacy kits for 15 kV and 25 kV

Note: Earlier selections may limit configuration options.

Digit 14 Control Cabinet Selection Options

0	None
1	STD cabinet with CBC8000 with std. 30' cables
2	ZVC cabinet with CBC8000 and Valquest with std. 30' cables
3	ZVC cabinet with Valquest and jaw mount for control with std. 30' cables
4	STD cabinet with CBC8000 with std. 12' cables
5	ZVC cabinet with CBC8000 and Valquest with std. 12' cables
6	ZVC cabinet with Valquest and jaw mount for control with std. 12' cables
7	STD cabinet with CBC8000 with std. 45' cables
8	ZVC cabinet with CBC8000 and Valquest with std. 45' cables
9	ZVC cabinet with Valquest and jaw mount for control with std. 45' cables
A	STD cabinet with CBC8000
B	ZVC cabinet with CBC8000 and Valquest
C	ZVC cabinet with Valquest and jaw mount for control

Note: All configurations with cables lengths shown will include both the 12-pin control cable and 10-pin auxiliary cable in this length.

Digit 15 Customer Special Option

0	Standard TriSync Capacitor Switch

Dimensional information

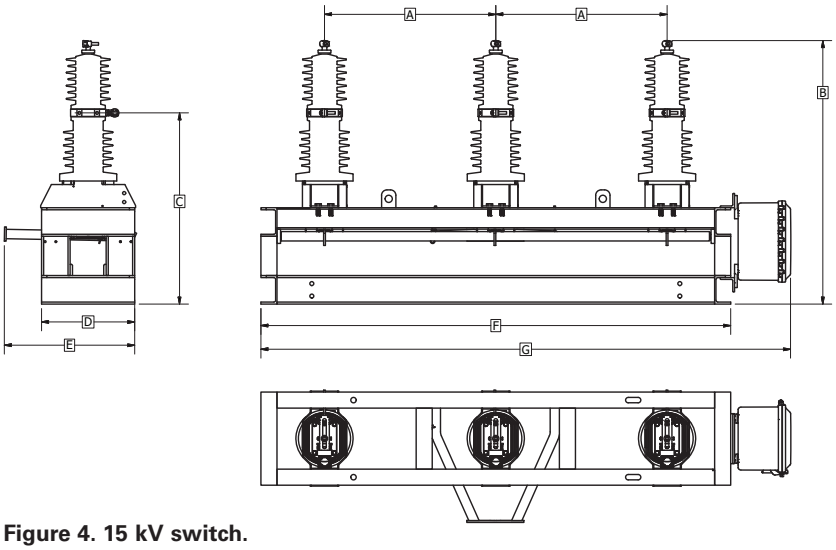


Figure 4. 15 kV switch.

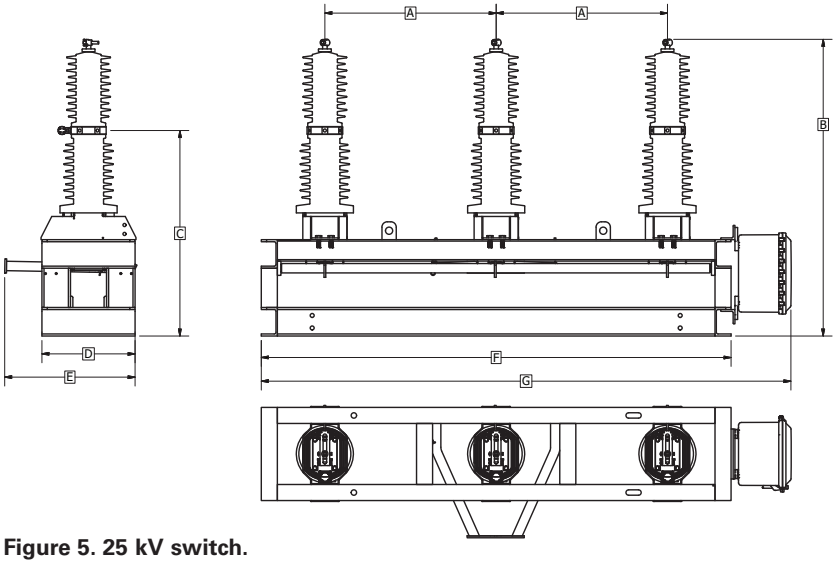


Figure 5. 25 kV switch.

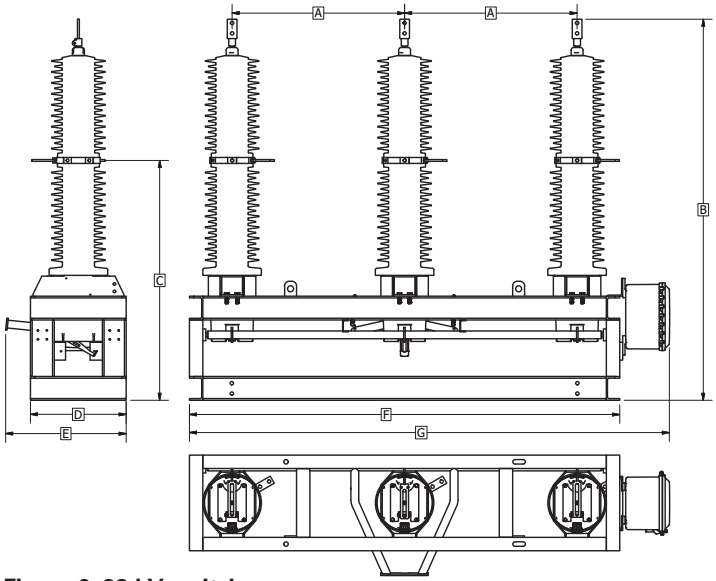


Figure 6. 38 kV switch.

Table 3. Dimensions

	15 kV
"A"	24.00" (610 mm)
"B"	36.92" (938 mm)
"C"	26.79" (680 mm)
"D"	13.05" (331 mm)
"E"	18.27" (464 mm)
"F"	65.81" (1672 mm)
"G"	74.20" (1885 mm)

	25 kV
"A"	24.00" (610 mm)
"B"	41.56" (1056 mm)
"C"	28.79" (731 mm)
"D"	13.05" (331 mm)
"E"	18.27" (464 mm)
"F"	65.81" (1672 mm)
"G"	74.20" (1885 mm)

	38 kV
"A"	29.00" (737 mm)
"B"	64.07" (1627 mm)
"C"	40.33" (1024 mm)
"D"	16.09" (409 mm)
"E"	20.20" (513 mm)
"F"	72.34" (1837 mm)
"G"	80.68" (2049 mm)

Lifting instructions

When lifting the switch during installation, customers should utilize the four (4) 1″ diameter lifting fixtures as shown in drawings. Spreader bars and/or elongated straps are recommended to prevent damage during installation. For detailed planning please utilize the dimensions as shown in Figures 7, 8 and 9 for your specific switch needs.

Note - switch has relatively low center of gravity which should be taken into account when installing.

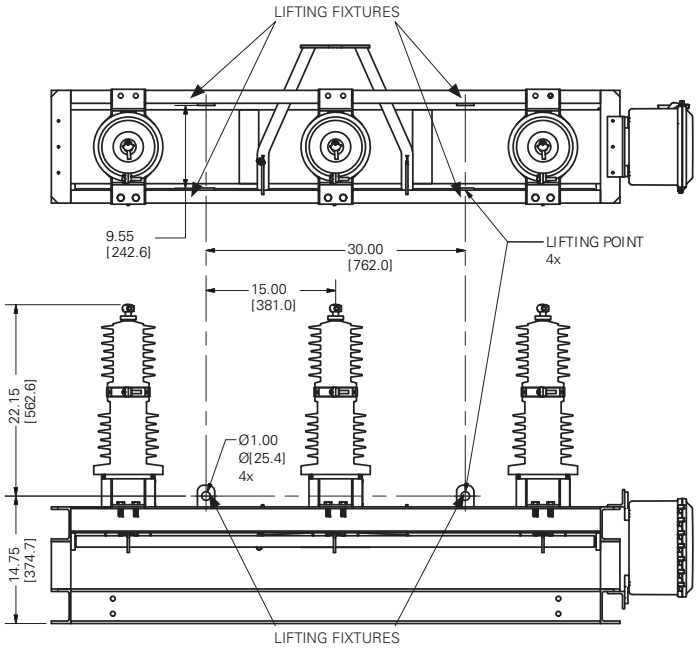


Figure 7. 15 kV lifting fixtures.

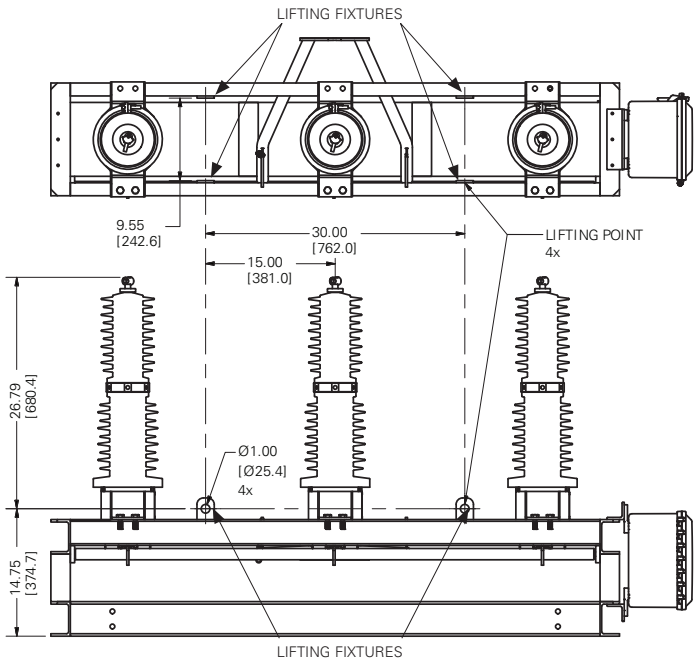


Figure 8. 25 kV lifting fixtures.

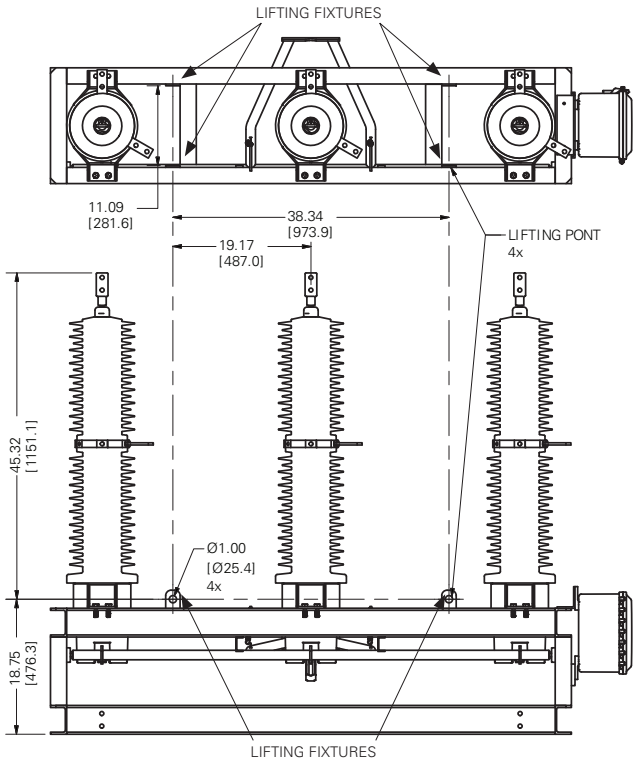


Figure 9. 38 kV lifting fixtures.

Installation instructions

Each TriSync capacitor switch frame has a four (4) integral grounding locations utilizing NEMA 2-hole grounding as shown in Figures 10, 11 and 12.

When mounting switch, installers should utilize the two (2) 0.75" diameter holes and two (2) 0.75" x 1.38" slotted holes on the bottom for the switch frame as shown below.

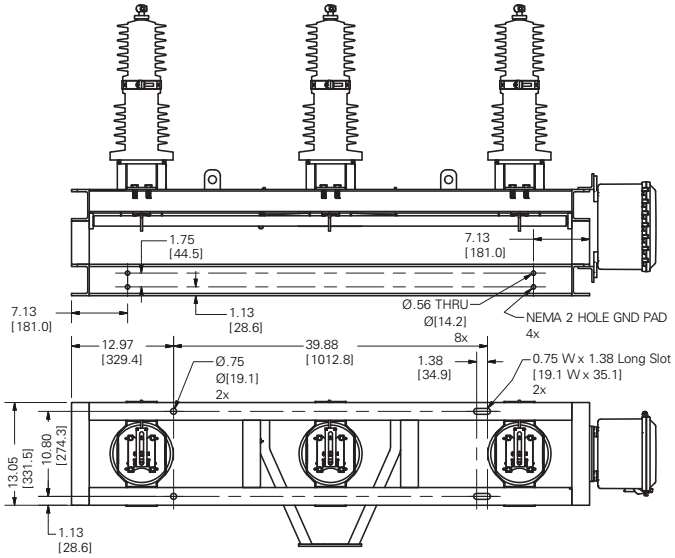


Figure 10. 15 kV switch.

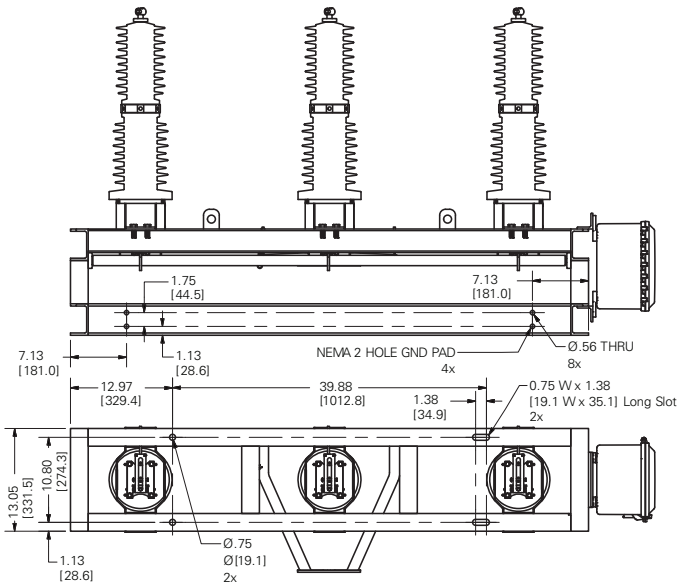


Figure 11. 25 kV switch.

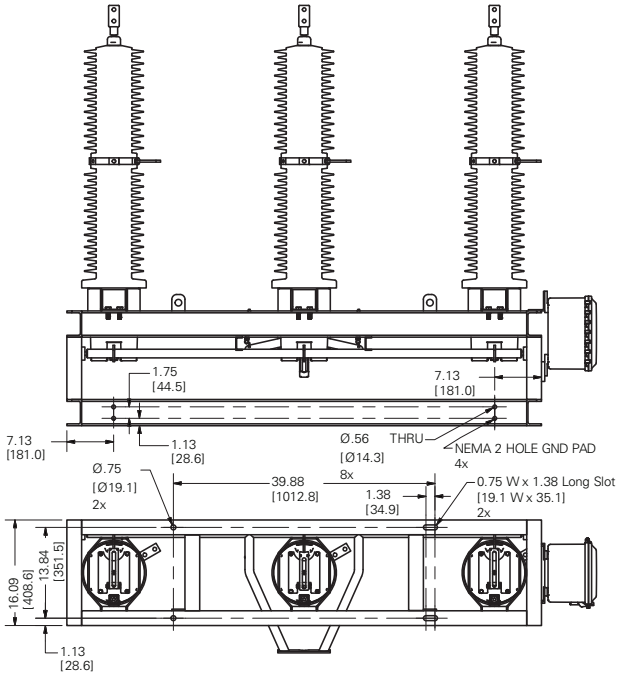


Figure 12. 38 kV switch.

Options and accessories

Control power transformer

Table 4: Control Power Transformer Technical Data

Primary Voltage (kV L-G)	2,400 to 19,920*
kVa*	0.5, 1.0, 1.5, 2.0, 3.0, 5.0, other**
Primary Bushings	1, 2
Primary Bushing (BIL)	95, 110, 125, 150, 200, other**
Control Voltage (V)	115, 120, 220, 230, 240, 480, other**
Design Standards	IEEE®

* Minimum 2.0 kVa recommended for 38 kV switch.

**Consult factor for non-standard kVa, BIL and voltage options

UltraSIL™ distribution-class surge arrester

Table 5: UltraSIL Distribution Class Surge Arrester Technical Data

Arrester Housing	Silicone Rubber
Arrester Type	Metal Oxide Varistor (MOV)
Arrester Rating	3, 6, 9, 10, 12, 15, 18, 21, 24, 27, 30, 36
Arrester Type	Heavy Duty (UHS) or Riser Pole (URS)
Wildlife Protectors	Standard, Line Terminal and Ground Terminal Wildlife Guards
Mounting	Rack frame, NEMA® X-ARM
Isolator	Dot Compliant
Design Standard	IEEE®, IEC

Supporting Documentation

Description	Reference Document
IEEE Catalog Section	CA235005EN
Instruction Sheet	S235-35-1
Certified Test Report	Bulletin 95062

*Consult factory for surge protection recommendations for 34.5kV Delta circuits.

Refer to Group Capacitor Fusing recommendations available on-line at www.eaton.com/cooperpowerseries.

Controls and connections

Control box

The TriSync switch's control box houses the switch controller modules and is offered with a variety of wire lengths allowing for mounting in convenient accessible locations. The control box can be ordered with a variety of controller options, including Cooper Power series CBC-8000 capacitor controller, a jaw mount provision for off-the-shelf capacitor controls and Valquest Z-Cap control for use in ZVC applications.

Once the control box is mounted, the user will simply connect the control and auxiliary cables between the control box and junction box via the receptacle/connector mating. For additional details please see Figures 13, 14 and 15.

Note – User is responsible for mounting the control box.

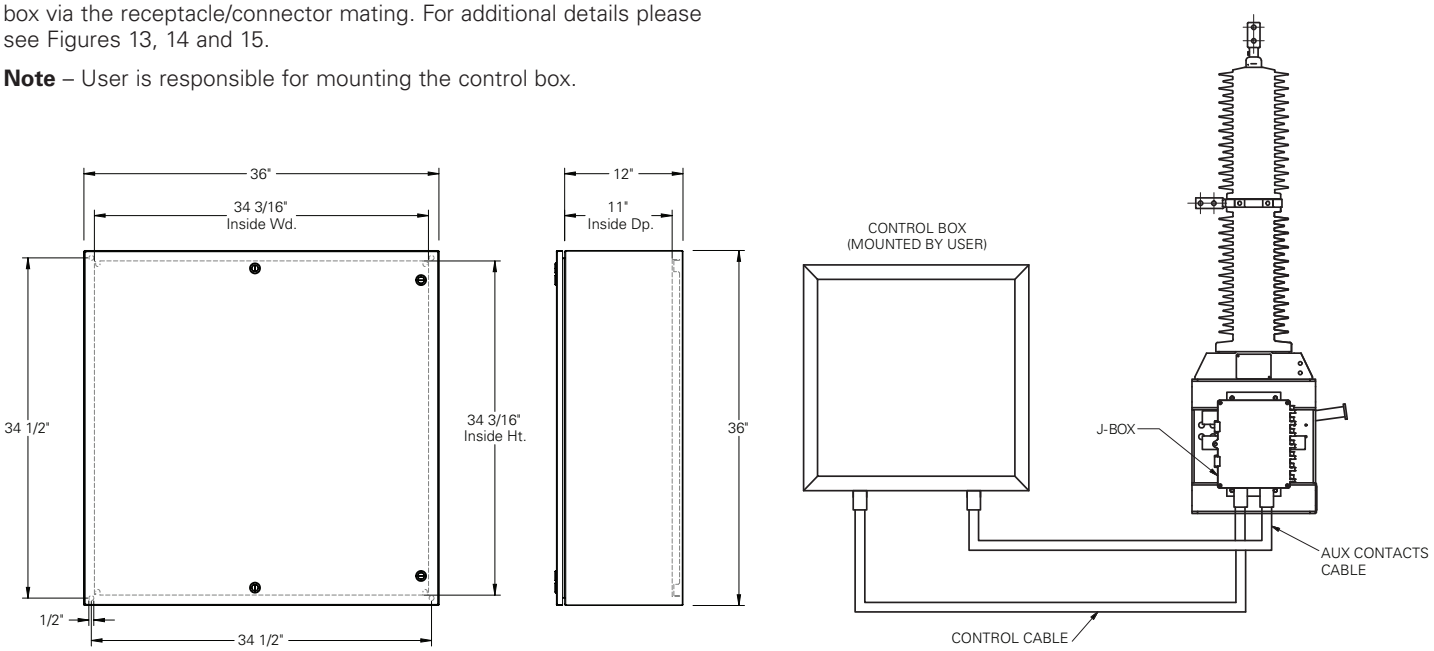


Figure 13. Control box dimensions.

Figure 14. Control box, door open.

Figure 15. Control box, door closed.

Junction box

All TriSync switch connections are pre-wired and routed to a junction box, as shown in Figure 16, mounted on the switch frame structure. Quick connections can be made at the junction box via two (2) receptacles. The junction box enclosure is constructed from a high-impact strength, ultraviolet (UV) resistant polymer material.

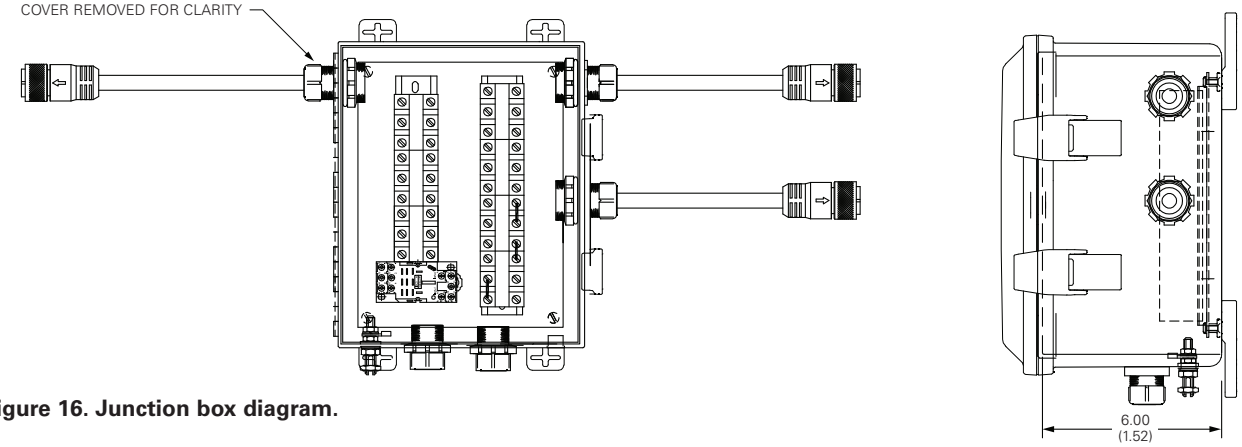


Figure 16. Junction box diagram.

Control and auxiliary cables

The TriSync switch's control and auxiliary cables come with male and female connectors for quick installation. The 12-pin receptacle is used for power and functional operation, and the 10-pin receptacle is use for switching auxiliary equipment. Cable lengths are determined by **Digit 14** of the **TriSync Capacitor Switch Numbering System**. See Figures 17 and 18 for additional cable details. For custom requests, please contact the factory.

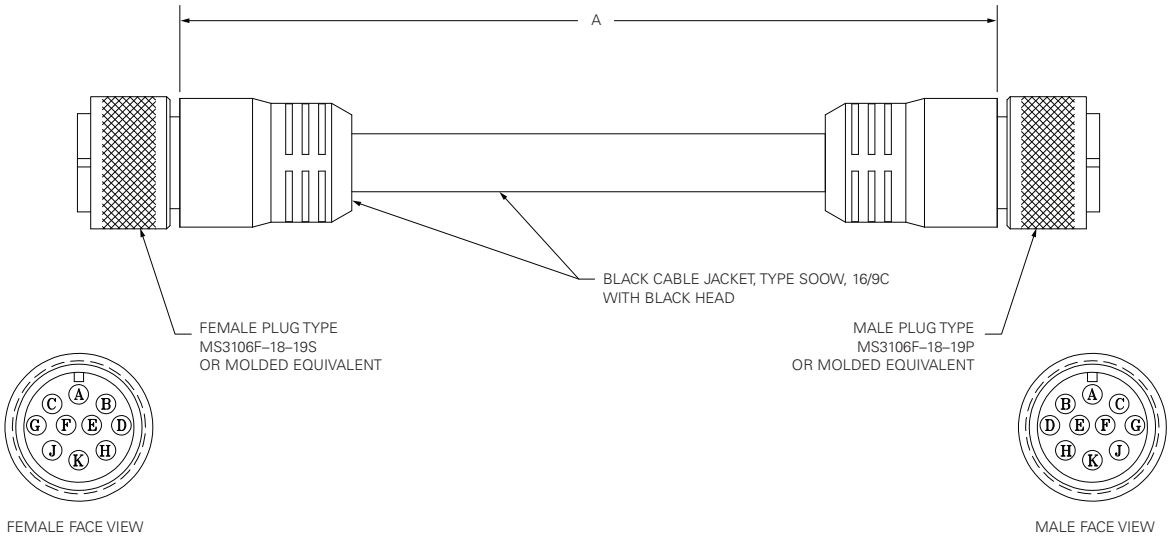


Figure 17. 10-pin auxiliary cable (CCR088P).

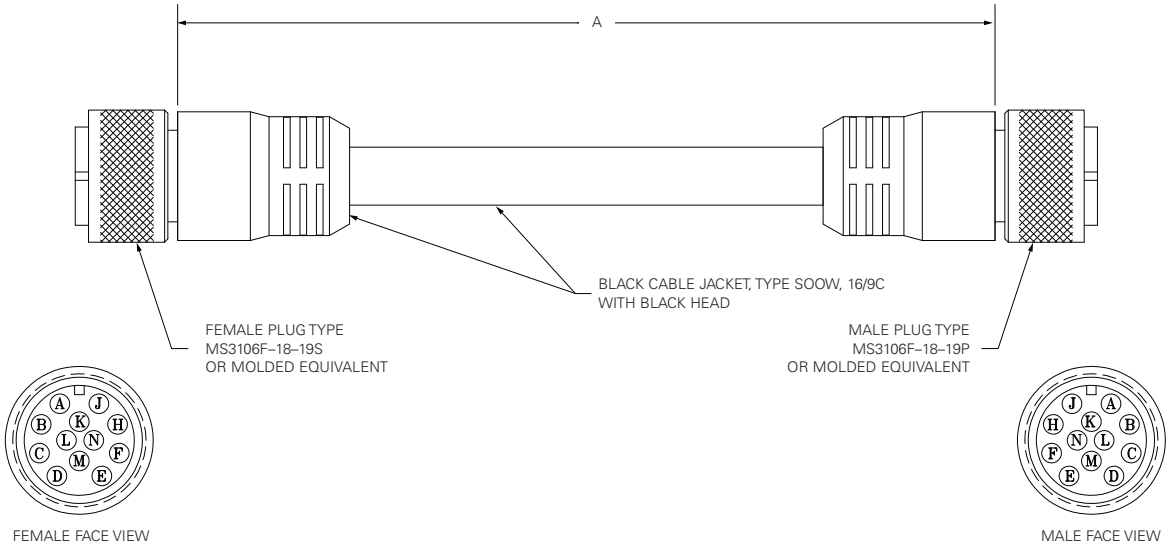


Figure 18. 12-pin control cable (CCR090P).

CBC-8000 capacitor bank control

CBC-8000 capacitor bank control description

Eaton's CBC-8000 capacitor bank control is a state-of-the-art control system specifically designed to operate capacitor banks. This versatile, fully integrated capacitor control may be programmed for site-ready control strategies such as:

- Remote operation
- Voltage
- VAR
- Time schedule
- Temperature
- Current
- Line current or voltage inputs

The CBC-8000 capacitor bank control includes a USB data port for on-site PC access to programming and data retrieval running ProView™ NXG software. The CBC-8000 capacitor bank control is DNP3 Level 2 compliant and easily integrates with cellular modems, radios, radio networks and SCADA to enhance efficiency and power quality. TriSync switches are available with the CBC 8000 control, mounted and pre-wired in the switch control box. This allows for rapid field installation by only requiring cable connection between control cabinet and frame mounted junction box. These connections are made rapidly using quick connector interfaces. Refer to catalog section CA916001EN for further information and available options.

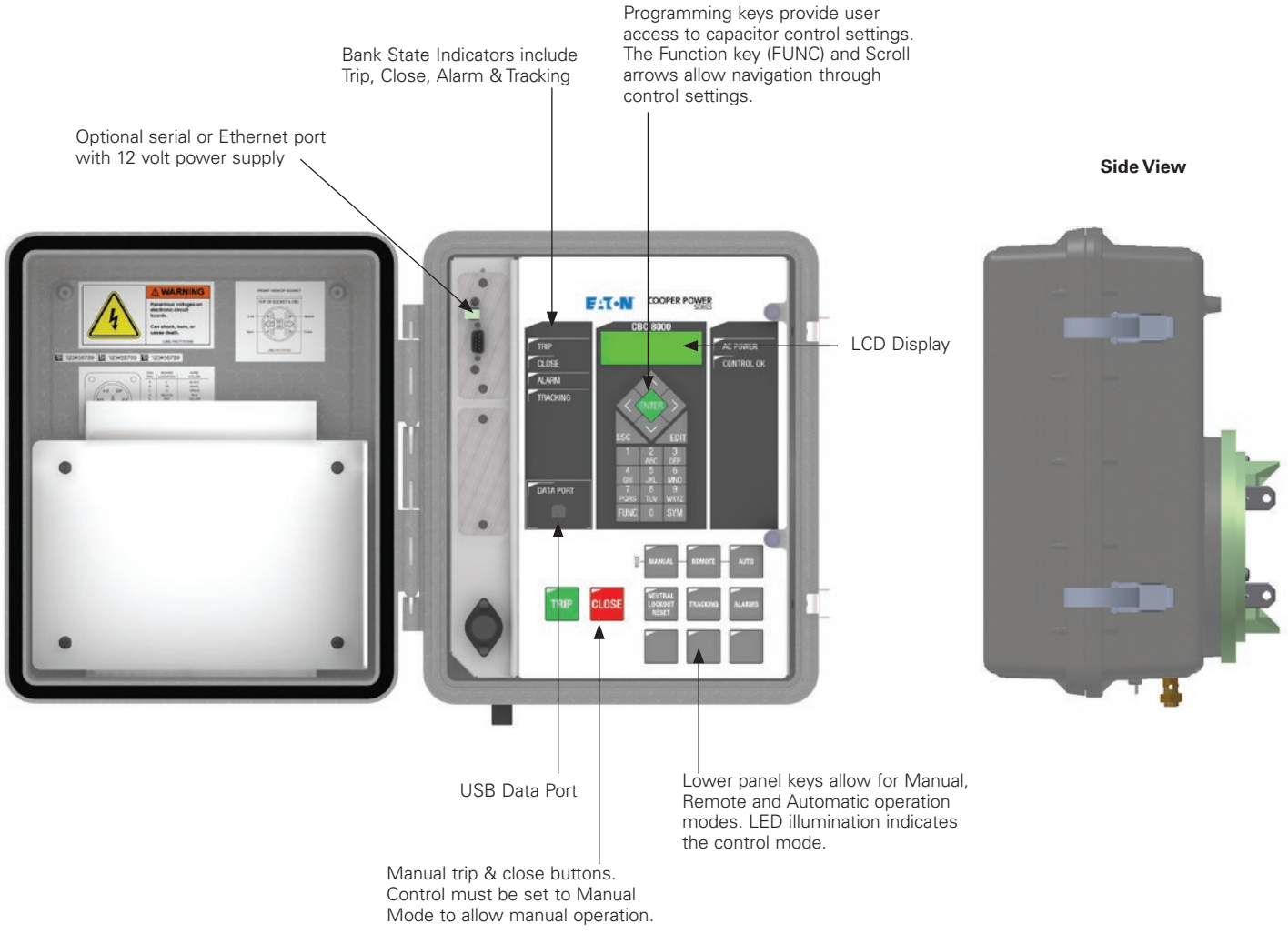


Figure 19. CBC-8000 capacitor control.

Table 6. CBC-8000 Capacitor Bank Control Technical Data

Capacitor Control Model	CBC-8000
Control Mode	Automatic, Manual, Remote
Control Strategy	Voltage, VAR, Schedule, Temp, Current, Line Inputs
Communications	Stand Alone (no comm.), Ethernet-IP Stack, Ethernet-IP Stack with Power over Ethernet (PoE), RS232 Serial Port, On-site configuration using USB Interface
Control Voltage	120/240 Vac
Frequency	50/60 Hz
Temperature Range	-40 °C to +85 °C
Mounting Options	Pole bracket, Meter socket* (4-jaw, 6-jaw)
Control Cable Lengths	None, Varying Lengths (35" std.)
Analog Input Configuration	None, 7 Pin DIN, 14 Pin DIN†, 5 Pin Din, Custom**
Control Accessories	Neutral Current Sensor, Serial Comm. Card, Ethernet Comm. Card
Optional Current Sensors††	Lindsey® Manufacturing, Fisher Pierce®, Piedmont™ Line Post Sensors
Design Standards	IEEE®, IEC, NEMA® 4X, IP 45 (Enclosure)

* Refer to catalog section 1160-80 for available meter socket mounting options.

** Refer to catalog section 1160-80 for available receptacle pin orientation. Contact factory for non-standard receptacle configurations.

† Accommodates 3-phase sensing.

†† The CBC-8000 sensor inputs only accept voltage. The range is 0-10 volts.

Supporting documentation

Description	Reference document
CBC-8000 Capacitor Bank Control Installation and Operation Instructions	MN916001EN
CBC-8000 Capacitor Bank ProView NXG Application Software Programming Guide	MN916002EN
CBC-8000 Capacitor Bank Control Communications	MN916003EN
Communications Point Data Base for Serial and Ethernet Communications Protocol DNP3	TD916001EN
Guide Form Specification	PS916001EB
Integrated Volt/VAR Capacitor Bank Control	B1160-12066
Catalog Ordering Guide	CA916001EN

Valquest Z-Cap Zero Voltage Closing Control

(Photograph courtesy of Valquest Systems, INC.)

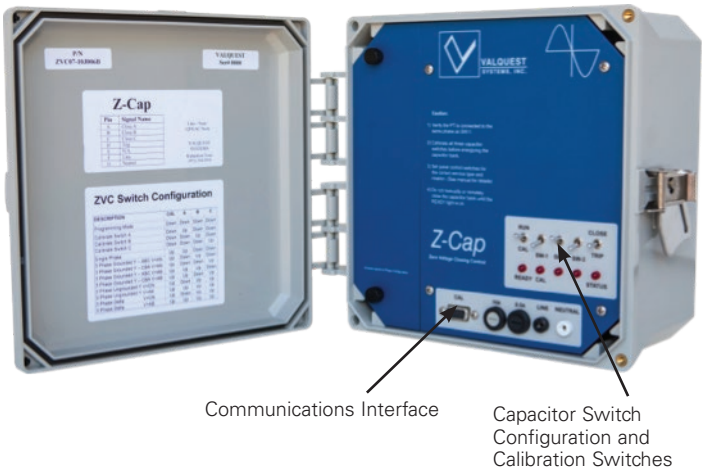


Figure 20. Valquest Z-Cap zero voltage closing control.

Z-Cap (ZVC) Description

Eaton's TriSync capacitor switch offering includes the Valquest Z-Cap zero voltage closing control as part of a comprehensive switching solution for electrical systems through 66 kV (grounded wye). Zero voltage closing reduces switching-related transients during operation and is an ideal solution for multi-step applications where inrush current and frequency may impact the scope of the capacitor solution. Our revolutionary TriSync capacitor switch, combined with the Valquest Z-Cap control, can be used with any industry capacitor control, such as the Cooper Power series CBC-8000 capacitor control, to provide Integrated Volt/VAR Control (IVVC). The Valquest Z-Cap control product brochure is available online at www.valquest.com.

Z-Cap Zero Voltage Closing Control Specifications

Operating Voltage	110 to 140Vac
Accuracy	+/- 0.45 millisecond
Power Requirements	2W
Enclosure	NEMA 4R
Frequency	60Hz*
Temperature Range	-20° C to +140° F
Design Standards	IEEE®

*Consult factor for 50Hz applications

Table 7: Z-Cap Zero Voltage Closing Control Supported Configuration

Bank Configuration	Phase Rotation	CPT Connection
3-Phase, Grounded WYE	ABC	Phase-to-Neutral
3-Phase, Grounded WYE	CBA	Phase-to-Neutral
3-Phase, Grounded WYE	ABC	Phase-to-Phase
3-Phase, Grounded WYE	CBA	Phase-to-Phase
3-Phase, Un-Grounded WYE	Rotation does not matter	Phase-to-Neutral
3-Phase, Un-Grounded WYE	Rotation does not matter	Phase-to-Phase
3-Phase, Delta	Rotation does not matter	Phase-to-Neutral
3-Phase, Delta	Rotation does not matter	Phase-to-Phase

Wildlife protection

Table 8. Wildlife Protector Options

Legacy Wildlife Protectors

Description	Catalog Number
15 and 25 kV Standard Design - includes Line Terminal Guard (Figure 21), Ring Terminal Guard (Figure 23) and Load Terminal Guard (Figure 24)	CCM051A3
15 and 25 kV 250 MCM Design - includes Line Terminal Guard (Figure 22), Ring Terminal Guard (Figure 23) and Load Terminal Guard (Figure 24)	CCM051A4
38 kV	N/A

IEEE Std. 1656 Compliant Wildlife Protectors

Description	Catalog Number
15 and 25 kV Design - includes Line Terminal Guard (Figure 25), Adapter Plate (Figure 27) and Load Terminal Guard (Figure 29)	CCM055A2
38 kV Design - includes Line Terminal Guard (Figure 26), Adapter Plate (Figure 28) and Load Terminal Guard (Figure 30)	CCM056A2

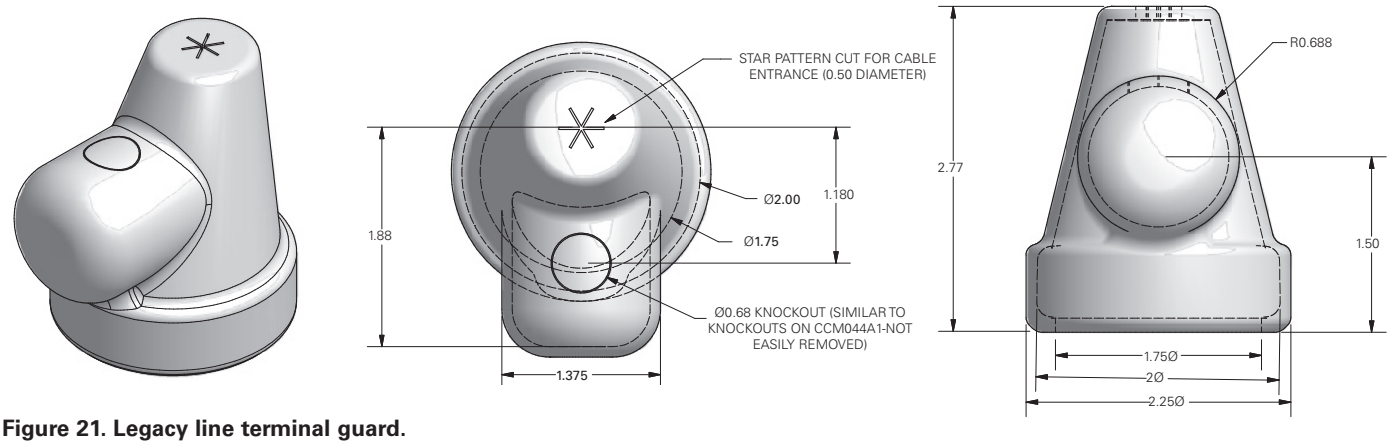


Figure 21. Legacy line terminal guard.

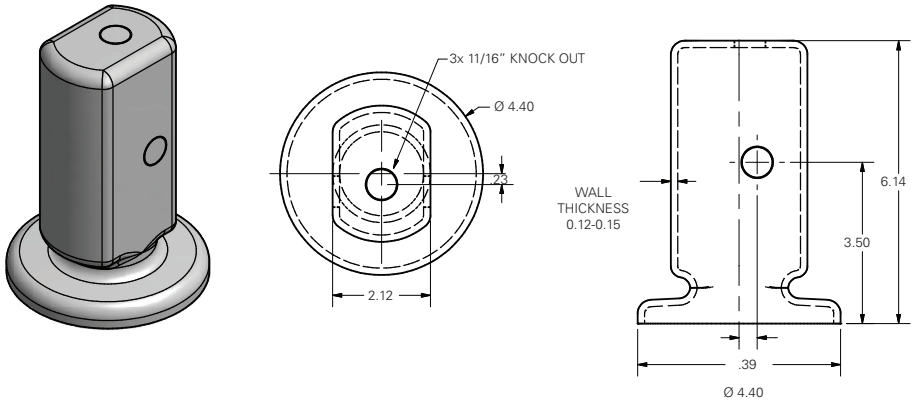


Figure 22. Required for 250 MCM eyebolt.

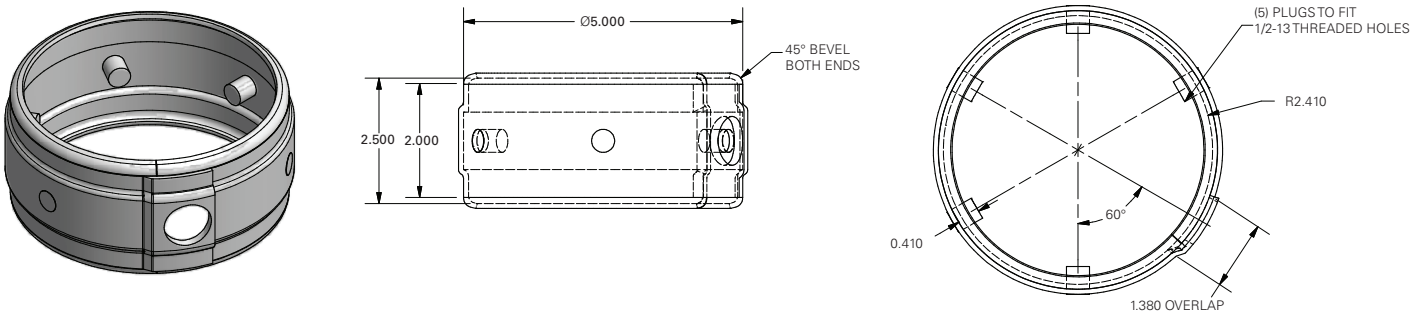


Figure 23. Ring terminal guard.

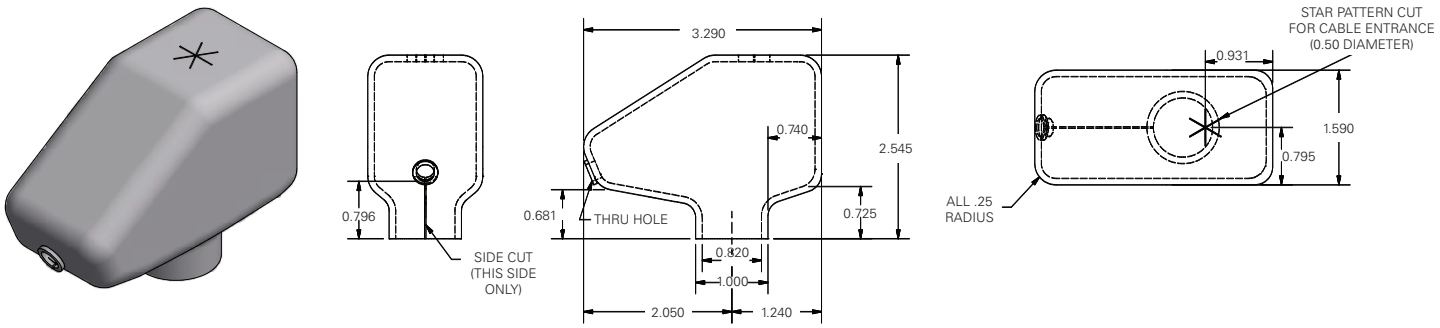


Figure 24. Load terminal guard.

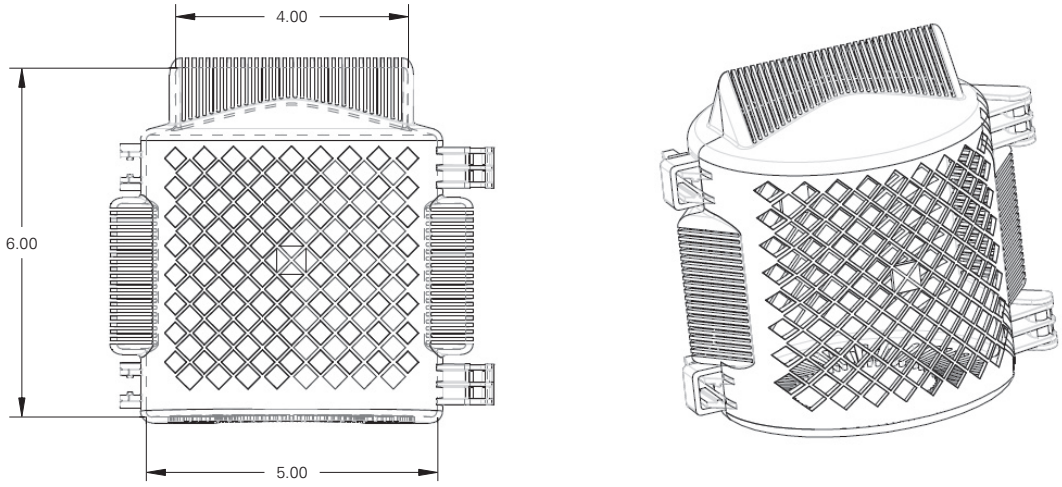


Figure 25. 15 and 25 kV line terminal guard.

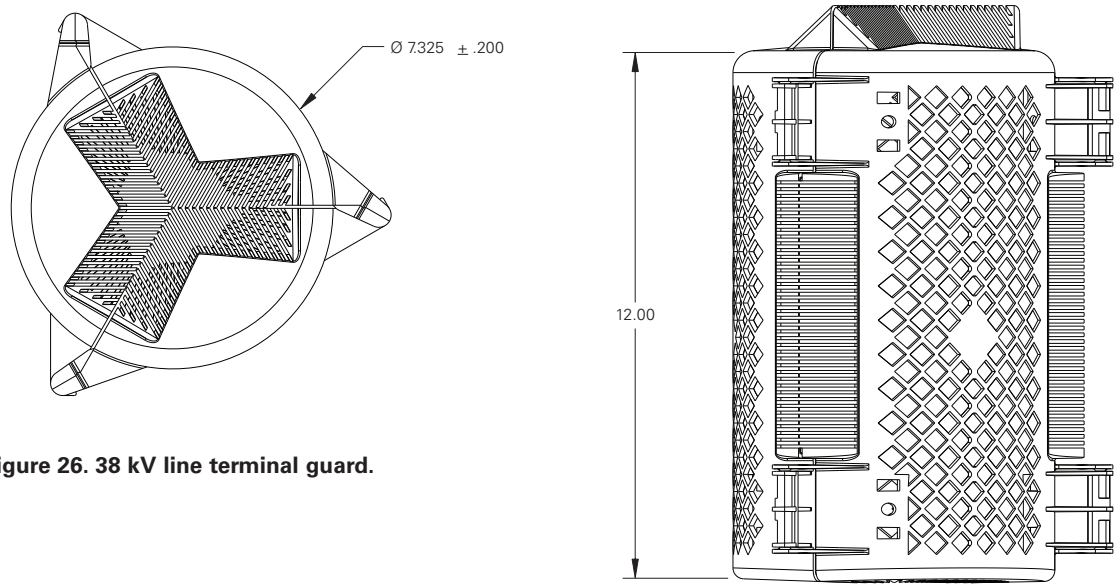


Figure 26. 38 kV line terminal guard.

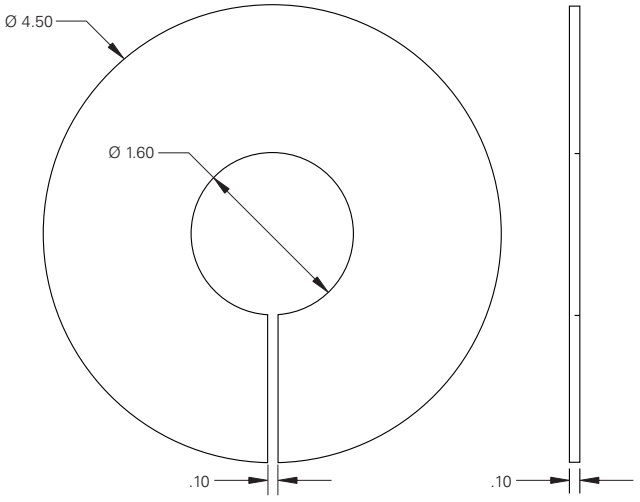


Figure 27. 15 and 25 kV adapter plate.

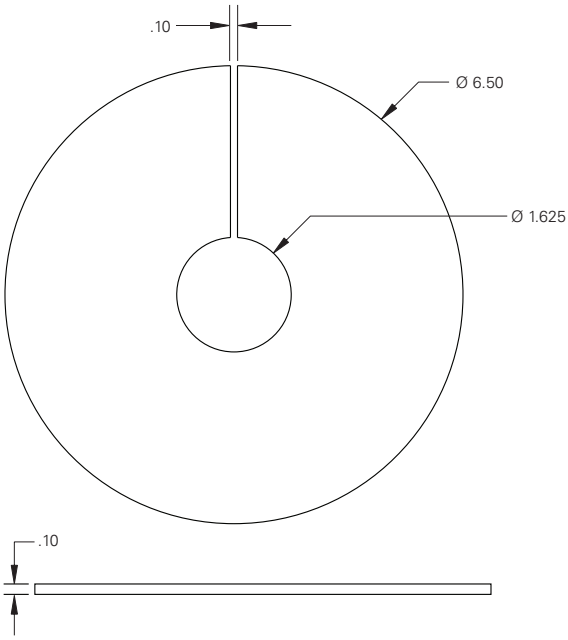


Figure 28. 38 kV adapter plate.

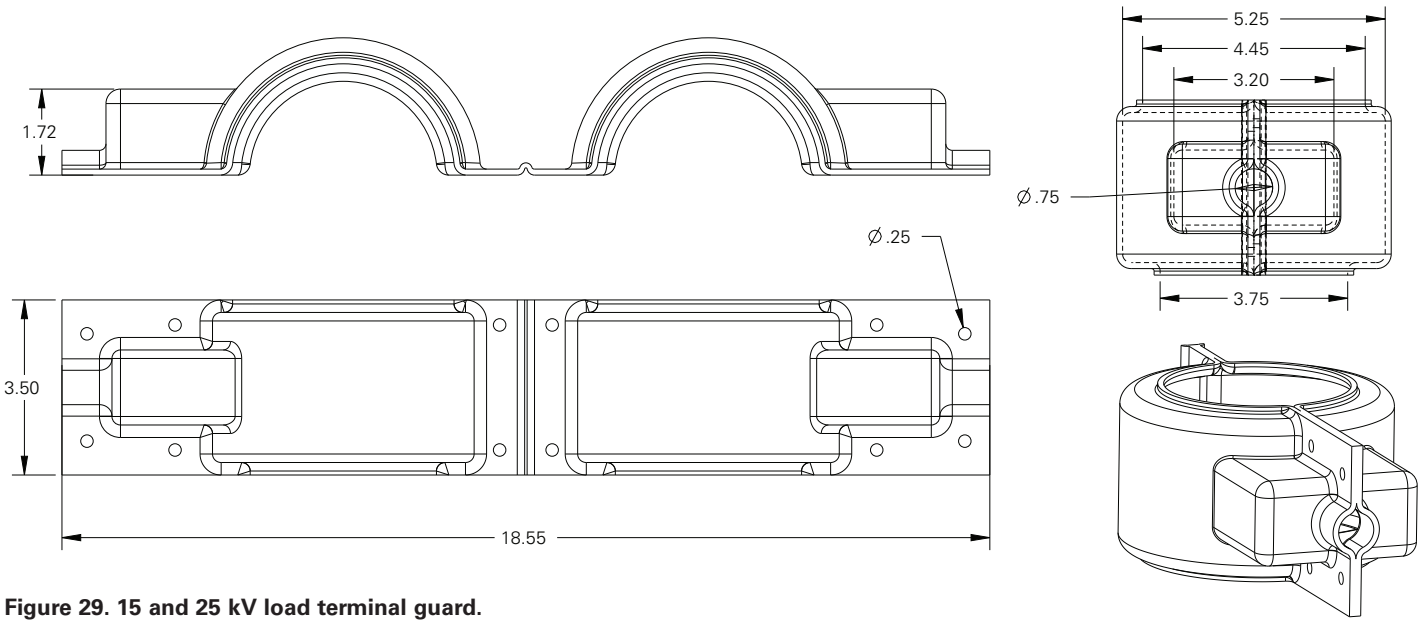


Figure 29. 15 and 25 kV load terminal guard.

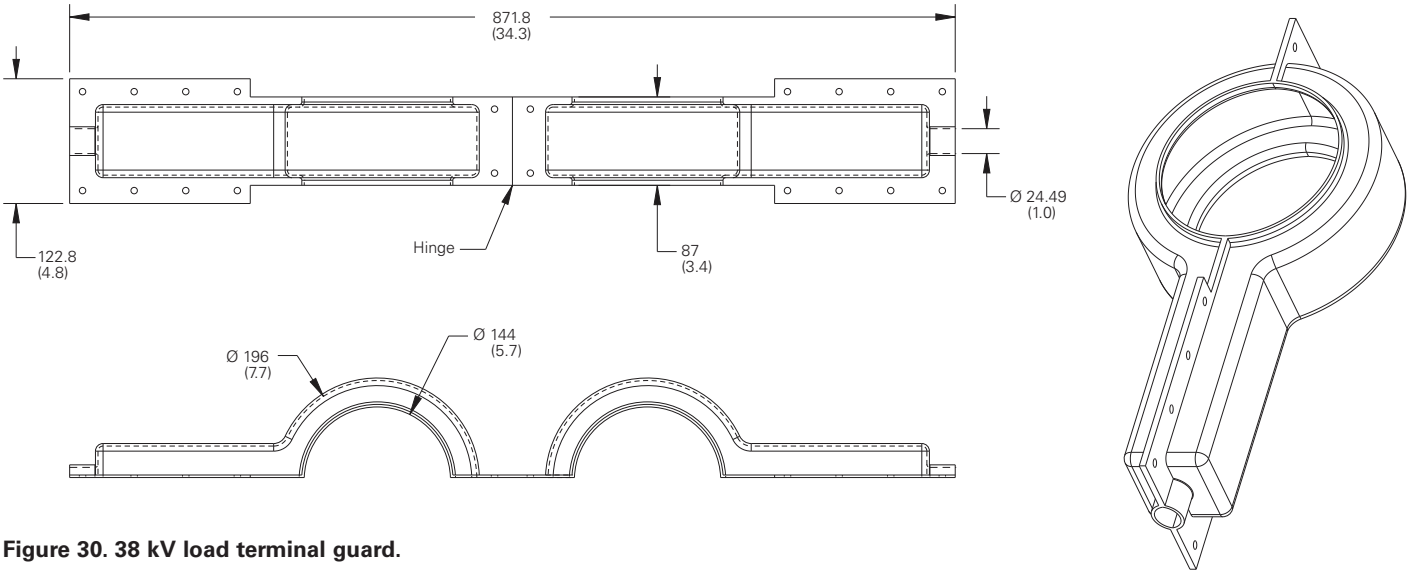


Figure 30. 38 kV load terminal guard.

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