

Metal-Enclosed Switchgear MEB & MSB Medium Voltage Vacuum Breakers

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Specifications

See Eaton's *Product Specification Guide*, available on CD or on the Web.

CSI Format:	1995	2010
MEB	Section 16347A	Section 26 13 19.11
MSB	Section 16347B	Section 26 13 19.16



Metal-Enclosed Switchgear

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General Description

MEB Metal-Enclosed Drawout Breaker**General Description**

Eaton's MEB (metal-enclosed breaker) switchgear assembly consists of a single-high drawout vacuum circuit breaker (Type VCP-W) in a metal-enclosed cabinet. This equipment has been designed primarily where metal-clad switchgear is not required and a switch or switch and fuse combination are not suitable. As primary protection for single-ended substations, it can eliminate the need for a secondary main circuit breaker. It can also be applied as the primary main device and integrated with fused or unfused feeder switches in an Eaton Type MVS load interrupter switchgear assembly. Two and three breaker automatic transfer schemes are also available. **For drawout vacuum circuit breaker metal-clad switchgear, Eaton Type VacClad-W, see Tab 5.**

For drawout vacuum circuit breaker metal-enclosed front access only, Type MEF switchgear, see Tab 6.

A Type MEB switchgear assembly is classified as an overcurrent protective device that provides increased system protection and increased coordination with upstream and downstream devices where these benefits cannot be achieved with a switch and fuse combination. Vacuum circuit breakers provide the following features:

- High interrupting capacity suitable for use with ground fault equipment and differential relay schemes
- High duty cycle
- Adjustable overcurrent protection
- Expanded protective relay functions, such as those provided in the EDR-5000 (refer to **Tab 4**)
- Three-phase tripping; no single phasing on tripping
- Maintainable
- Long equipment life
- Special applications, such as capacitor switching, are possible with breakers

Type MEB switchgear provides a minimal footprint using vacuum breaker technology. All protective devices and metering are conveniently mounted on the switchgear structure door.

Type VCP-W vacuum circuit breakers have been designed with a V-Flex™ current transfer system that provides a unique non-sliding current transfer arrangement, no maintenance, excellent electrical and thermal transfer, and long vacuum interrupter life.

Both indoor and outdoor non-walk-in enclosures are available. Uses are single or multiple circuits, transformer primaries and mains for MVS applications. Configurations with an automatic transfer control system can be easily accommodated. Drawout vacuum breakers are ideal for high duty cycle, as well as applications requiring rapid return to service after a load fault.

Type MEB switchgear is one product of choice for ground fault interruption when air interrupters alone would be potentially hazardous if called on to operate above their assigned interrupting ratings. Capacitor switching is easily handled by MEB, avoiding the restrike hazard presented by air switches.

Standardized designs cover most common applications, while custom designs are also available for unusual requirements.

Type MEB vacuum switchgear meets or exceeds the following industry standards: ANSI/IEEE® C37.20.3, ANSI/IEEE C37.20.4, ANSI C37.22, ANSI C37.57, ANSI C37.58, NEMA® SG5, NEMA SG6, CSA® 22.2 No. 31-04, EEMAC G8-3.3. It is also CSA listable for Canada and U.S. markets.

MEB circuit breaker sections are easily mixed with MVS fused switch sections in lineups. No bus transitions are required between them except where bus runs from top to bottom locations, such as between main and feeder sections.

Seismic Qualification

Refer to **Tab 1** for information on seismic qualification for this and other Eaton products.

General Description—Technical Data

Construction

Current and voltage transformers associated with protection devices such as the EDR-3000 or EDR-5000 electronic overcurrent relays are applied using the same ratings as drawout metal-clad switchgear. Metering and protective relay devices are mounted on the single front hinged door. The front door may be opened at any time to provide access to low voltage components and to the front of the circuit breaker without being exposed to high voltage.

The IQ family of electronic meters is normally used when metering functions are required.

The circuit breaker is racked into or out of position, but can easily be drawn out and removed from the enclosure with grounded steel shutters, preventing accidental contact with primary voltage connections. Routine maintenance can be performed on the circuit breaker mechanism in the enclosure.

If AC control power is used, a capacitor trip device is provided as standard. A Digitrip™ 3010 relay with dual source power supply may be used for over-current protection, thus eliminating the need for an uninterruptible power source for continuous fault current protection.

Once the circuit breaker is closed and the closing spring is recharged, the breaker can open, close and open without spring recharge.



EDR-3000 Overcurrent Protective Relay



EDR-5000 Multifunction Protective Relay



The VCP-W vacuum circuit breaker is easily accessible for routine inspection and maintenance. User-friendly, front panel controls and indicators are functionally grouped together for easy operation.

Overcurrent Protection

Eaton's MEB breaker can be furnished with an Eaton Type EDR-3000 or EDR-5000 relay to provide overcurrent and fault protection. Optional zero sequence 50/51G ground fault protection is shown below. Refer to **Tab 4** for more details.

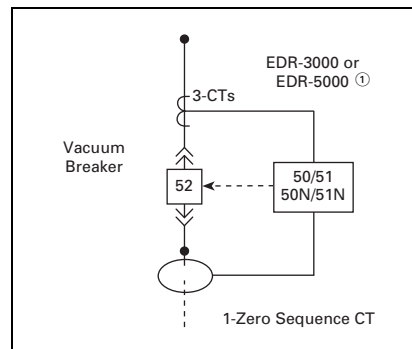


Figure 7.1-1. Typical MEB Single-Section One-Line Diagram

① Use of EDR-5000 requires VTs.

Table 7.1-1. Protective Relays ①

Relay Type	Protective Relay IECIE Functions	Metering
EDR-3000	50/51; 50/51G	Amperes and ampere demand
EDR-5000	25, 27, 32, 46, 47, 50N/G, 51N/G, 50/51, 50BF, 51V, 59, 67N, 67	Amps; volts; pf, energy, power; THD; waveform

① See **Tab 4** for available relays, selection and application details.

MEB with Complete Access to Control Switches, Overcurrent Relays and Meters, as well as Breakers

Standard MEB insulators are NEMA rated glass polyester or optional epoxy. Control power is required. The AC control power can be supplied integrally if specified. The DC control power, if required, must be furnished by others.

Technical Data

Assembly Ratings

Table 7.1-2. MEB Assembly Main Bus Ratings ①

Rated Maximum Volts kV	Rated BIL kV	Rated Main Bus Current Amperes	Rated Momentary Current kA rms Asymmetrical	Rated Short-Time (2 Seconds) Current kA Symmetrical
4.76	60	600	40	25
4.76	60	600	61	38
4.76	60	600	80	50
4.76	60	1200	40	25
4.76	60	1200	61	38
4.76	60	1200	80	50
4.76	60	1200	101	63
4.76	60	2000	40	25
4.76	60	2000	61	38
15	95	600	40	25
15	95	600	61	38
15	95	600	80	50
15	95	1200	40	25
15	95	1200	61	38
15	95	1200	80	50
15	95	1200	101	63

① The switchgear assembly is designed for use with Type VCP-W, VCP-WC and VCP-WG circuit breakers. However, please note that certain VCP-WC circuit breakers may have higher capabilities than required by ANSI standards. In such cases, switchgear assembly ratings as given in this table will apply.

Table 7.1-3. Available Type VCP-W, VCP-WC and VCP-WG Vacuum Circuit Breakers Rated per ANSI Standards

Circuit Breaker Type ②③④⑤	Rated Maximum Voltage	Rated Voltage Range Factor	Rated Continuous Current	Rated Short-Circuit Current at Rated Maximum Voltage	Maximum Symmetrical Interrupting and 3-Second Short-Time Current Carrying Capability	Closing and Latching Capability (Momentary)	
	V	K	I	K * I	2.6 * K * I	1.6 * K * I	
	kV rms		Amperes	kA rms Symmetrical	kA rms Symmetrical	kA Crest	kA rms Asym
50 VCP-W 250	4.76	1.24	1200	29	36	97	58
50 VCP-W 350	4.76	1.19	1200	41	49	132	78
50 VCP-W 500	4.76	1.0	1200	63	63	170	101
75 VCP-W 500	8.25	1.25	1200	33	41	111	66
150 VCP-W 500	15	1.3	1200	18	23	62	37
150 VCP-W 750	15	1.3	1200	28	36	97	58
150 VCP-W 1000	15	1.3	1200	37	48	130	77
150 VCP-W 1500	15	1.0	1200	63	63	170	101
50 VCP-W 25	4.76	1.0	1200	25	25	65	40
50 VCP-W 40	4.76	1.0	1200	40	40	104	64
50 VCP-W 50	4.76	1.0	1200	50	50	130	80
50 VCP-W 63	4.76	1.0	1200	63	63	164	100.8
75 VCP-W 50	8.25	1.0	1200	50	50	130	80
150 VCP-W 25	15	1.0	1200	25	25	65	40
150 VCP-W 40	15	1.0	1200	40	40	104	64
150 VCP-W 50	15	1.0	1200	50	50	130	80
150 VCP-W 63	15	1.0	1200	63	63	164	100.8
50 VCP-WG 50	4.76	1.0	1200	50	50	137	82
50 VCP-WG 63	4.76	1.0	1200	63	63	173	103
150 VCP-WG 50	15	1.0	1200	50	50	137	82
150 VCP-WG 63	15	1.0	1200	63	63	173	103

② For detailed ratings of Type VCP-W circuit breakers, refer to **Tab 5, Table 5.4-1A**.

③ For detailed ratings of Type VCP-WC circuit breakers, refer to **Tab 5, Table 5.4-2**.

④ For detailed ratings of Type VCP-WG circuit breakers, refer to **Tab 5, Table 5.4-3 and 5.4-4**.

⑤ Please note certain Eaton breakers may have higher capabilities than required by ANSI standards. When these breakers are applied in an MEB switchgear assembly, the assembly ratings as given in **Table 7.1-2** will apply.

Breaker Control Ratings

Table 7.1-4. VCP-W Breaker Stored Energy Mechanism Control Power Requirements

Rated Control Voltage	Spring Charge Motor			Close or Trip Amperes	Voltage Range	
	Inrush Amperes	Run Amperes	Time Seconds		Close	Trip
48 Vdc	36.0	9.0	6	16	38–56	28–56
125 Vdc	16.0	4.0	6	7	100–140	70–140
250 Vdc	9.2	2.0	6	4	200–280	140–180
120 Vac	16.0	4.0	6	6	104–127	104–127
240 Vac	9.2	2.0	6	3	208–254	208–254

Layout—Dimensions

Typical Arrangements—5 kV and 15 kV

The sketches in this section represent the most common arrangements. Layouts shown are for rear-accessible equipment. Front-accessible designs are available—refer to Eaton. See **Tab 8** for detailed layout information on load interrupter switchgear. Many other configurations and combinations are available. Two voltage transformers (fixed or drawout) for metering or

one control transformer for AC breaker control can be mounted in the structures shown. For control power above 1 kVA, additional space is required. Depth of units will vary due to cable entrance and exit requirements, the addition of lightning arresters, instrument transformers, special cable terminators, and so on. Cables are shown out top and bottom for layout

only. Top or bottom must be selected for incoming and for outgoing cables. Please note that rear access is required for installation.

Cable sizing is based on **two** 500 kcmil XLP or EPR insulated **cables per phase** using preformed slip-on cable termination devices. For unit substation alignment details, see **Tabs 13** and **14**.

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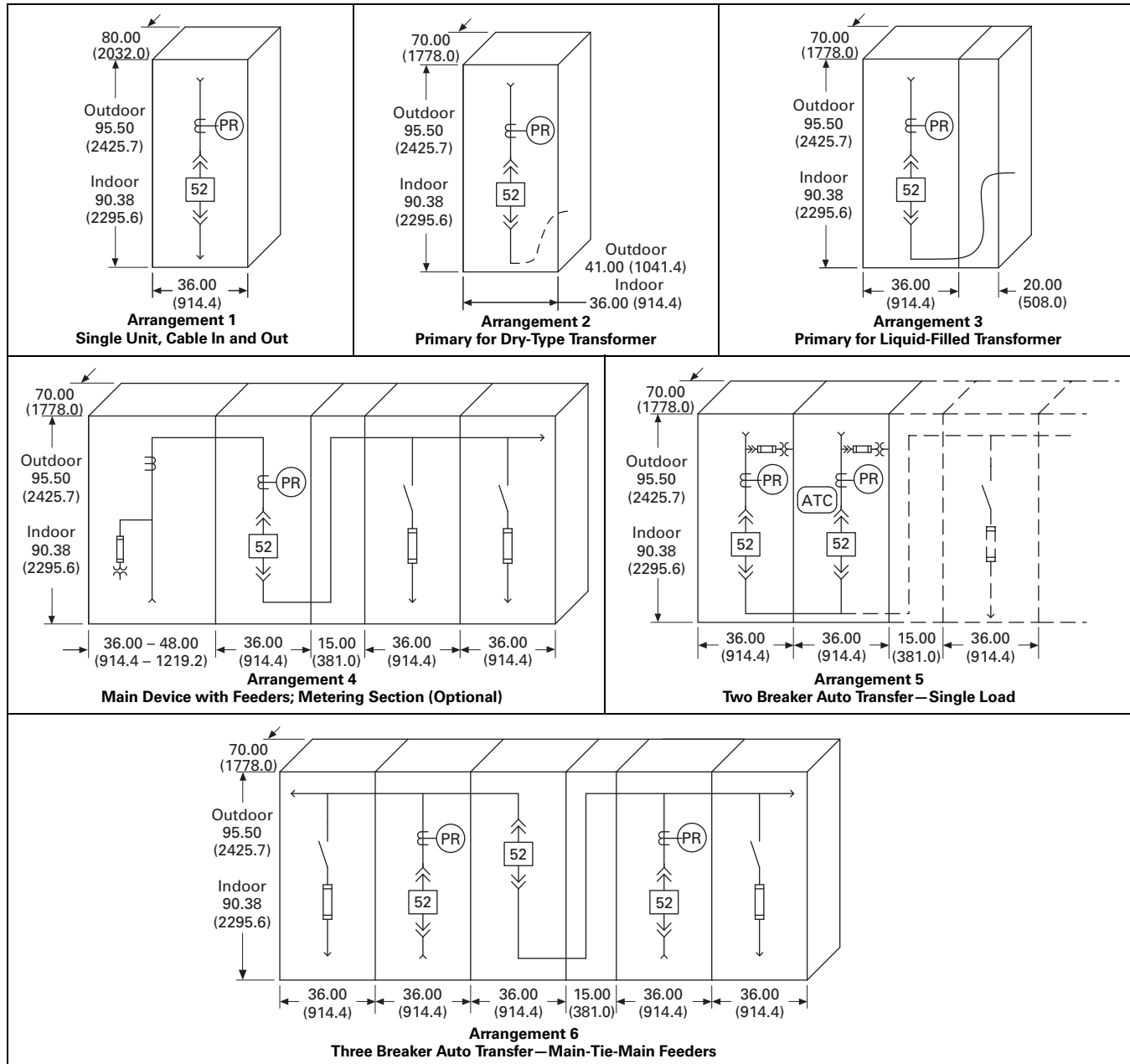


Figure 7.1-2. Layouts and Dimensions in Inches (mm)

Note: PR—Overcurrent protective relay, typical functions—50/51, 50/51N or 50/51G. Eaton EDR-3000 or EDR-5000.

Note: ATC—Automatic Transfer Controller.

Dimensions in inches (mm). Not to be used for construction purposes unless approved.

Layout—Dimensions

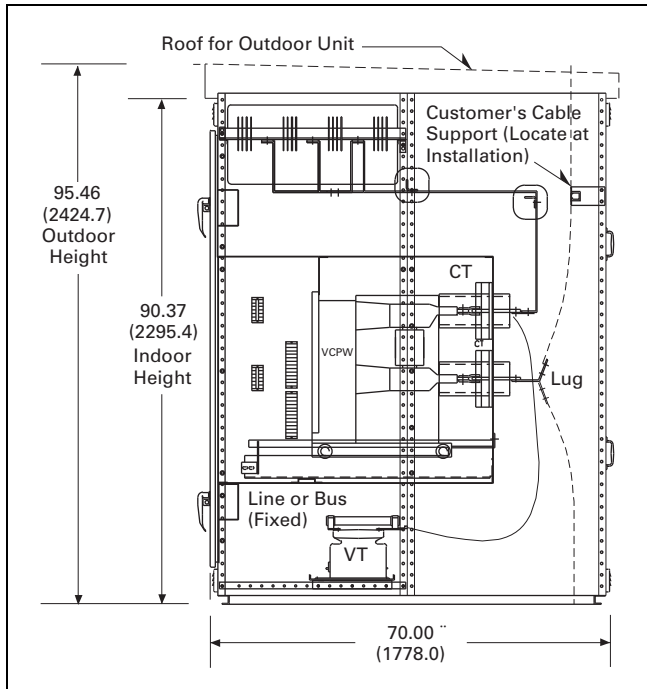


Figure 7.1-3. 5 and 15 kV MEB with Main Bus, Main Breaker and Fixed Line or Bus VTs

① Depth shown is based on the use of (2)-500 kcmil cables per phase. For stand-alone cable in and cable out in the same section, minimum 80.00-inch (2032.0 mm) depth is required.

Note: Drawout VTs are not available in MEB switchgear. Use Type VCP-W or MEF designs.

Table 7.1-5. Approximate Weights in Lb (kg)

5 or 15 kV Class	Indoor	Outdoor
MEB section	1600 (726)	1900 (863)
MVS section (non-fused)	1500 (681)	1800 (817)
Fuses (three) add	200 (91)	200 (91)
Transition section	300 (136)	—

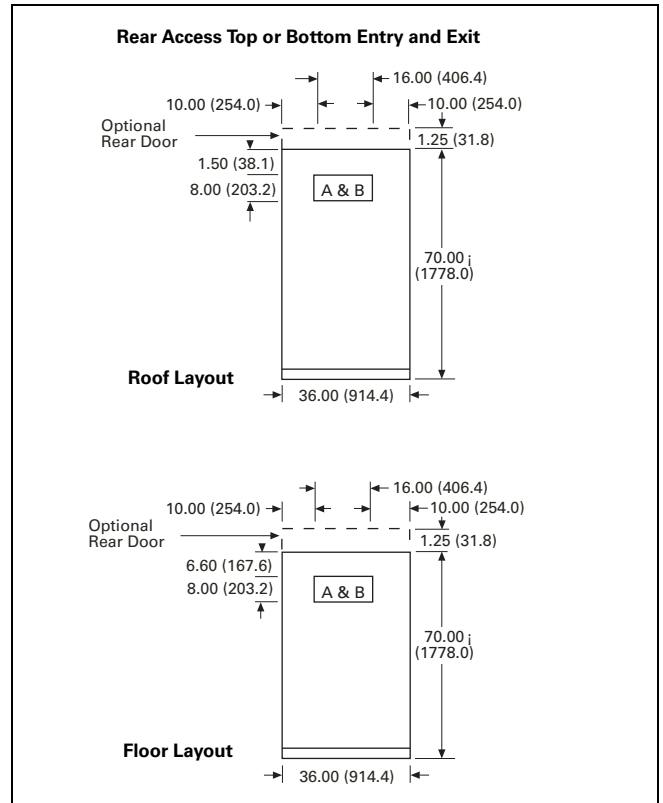


Figure 7.1-4. 5 and 15 kV Roof Layouts and Floor Layouts

② For cable in and cable out in same section, 80.00-inch (2032.0 mm) depth is required.

Note: A = Power cable to load, B = Power cable from source.

Layout—Dimensions

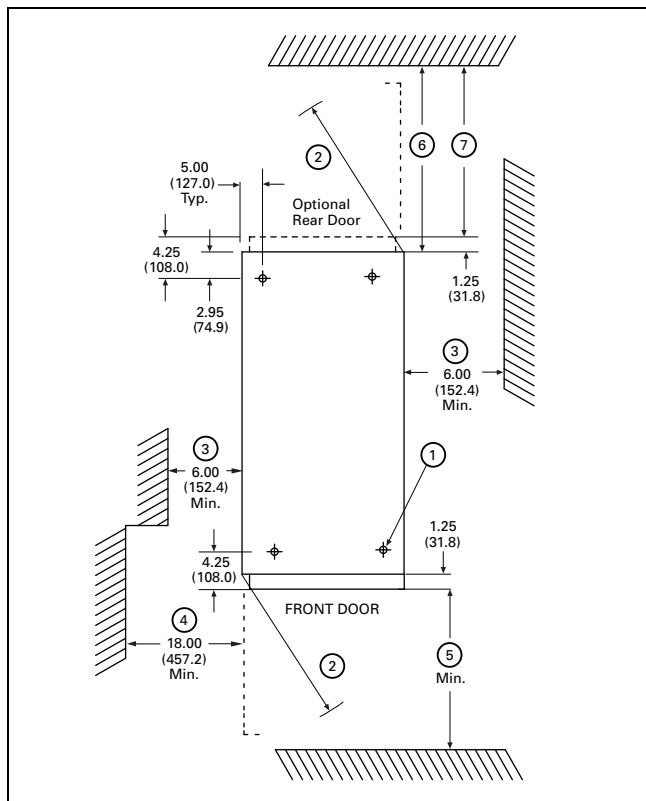


Figure 7.1-5. Typical Anchor Plan for MEB, Indoor or Outdoor

- ① Locations for tie-down 0.65 (16.5 mm) diameter holes. Four places. Customer provided bolts for anchoring should be 0.50–13 min. SAE Grade 5, (M12 x 1.75 min. CL 10.9), and tightened to 75 ft-lb (101.7 Nm).
- ② Door swing equals unit width at 90°.
- ③ The standard minimum clearances on side. 24.00 inches (609.6 mm) may need to be added for passage from front to rear. The authority having jurisdiction may require a larger distance.
- ④ Clearance required for additional door swing to insert or remove breaker, and for metering/relays on front of door. Left hand side only. The authority having jurisdiction may require a larger distance.
- ⑤ Minimum distance in front is 72.00 inches (1828.8 mm) for breaker insertion and removal. The authority having jurisdiction may require a larger distance.
- ⑥ The standard minimum recommended distance is 30.00 inches (762.0 mm) for assemblies requiring rear access for installation and maintenance. The authority having jurisdiction may require a larger distance.
- ⑦ If optional rear door is supplied, the minimum is the width of the widest vertical section plus 1.00 inch (25.4 mm). The authority having jurisdiction may require a larger distance.
- ⑧ Finished foundation's surface shall be level within 0.06-inch (1.5 mm) in 36.00 inches (914.4 mm) left-to-right, front-to-back and diagonally, as measured by a laser level.

General Description

MSB Metal-Enclosed Switch
and Vacuum Breaker

General Description

Eaton's assembly designated MSB (metal-enclosed switch and breaker) consists of a load interrupter switch (Type MVS) in series with a vacuum circuit breaker (Type VCP-TR for 5–15 kV) in a metal-enclosed cabinet. This combination has been designed primarily where a vacuum circuit breaker is required for its higher interrupting capacity and a switch is required to provide a visible means of disconnect. As primary protection for single-ended substations, it can eliminate the need for a secondary main circuit breaker. It can also be applied as the primary main device and integrated with fused or unfused feeder switches in a lineup of MVS switchgear. Two and three breaker automatic transfer schemes are also available.

For drawout vacuum circuit breaker metal-enclosed switchgear, Type MEB, see Page 7.1-1.

For drawout vacuum circuit breaker metal-clad switchgear, Type VacClad-W, see Tab 5.

For drawout vacuum circuit breaker metal-enclosed front access only, Type MEF switchgear, see Tab 6.

With the vacuum circuit breaker, Type MSB switchgear is classified as an overcurrent protective device that provides increased system protection and increased coordination with upstream and downstream devices where these benefits cannot be achieved with a switch and fuse combination. Vacuum circuit breakers provide the following features:

- High interrupting capacity suitable for use with ground fault equipment and differential relay schemes
- Load Break Switch providing visible means of disconnect without opening the door
- High duty cycle
- Adjustable overcurrent protection
- Expanded protective relay functions, such as those provided in the EDR-5000 (refer to **Tab 4**)
- Three-phase tripping; no single phasing on tripping
- Maintainable
- Long equipment life
- Special applications, such as capacitor switching, are possible with breakers

Eaton Type MSB switchgear provides a small footprint using vacuum breaker technology where the breaker rating does not exceed 1200A continuous and the interrupting ratings shown. All protective devices and metering are conveniently mounted on the switchgear structure door.

The VCP-TR vacuum breaker is a fully rated two-step stored energy circuit breaker with an "open-close-open" duty cycle. It is rated for 25 or 40 kA interrupting ratings at all voltages from 4.76 to 15 kV and has a front access mechanism. Type VCP-TR circuit breakers can be supplied with integral trip unit for phase and ground overcurrent protection.

The vacuum circuit breakers have been designed with a flex current transfer system that provides a unique non-sliding current transfer arrangement, no maintenance, excellent electrical and thermal transfer, and long vacuum interrupter life.

Visible disconnect means is ensured by the load break air interrupter switch and viewing window. Both indoor and outdoor non-walk-in enclosures are available. Applications are single units, lineups and transformer primary applications. Configurations with an automatic transfer control system can be easily accommodated. Fixed vacuum breakers are ideal for high duty cycle, as well as applications requiring rapid return to service after a load fault.

Type MSB switchgear is the product of choice for ground fault interruption when air interrupters alone would be potentially hazardous if called on to operate above their assigned ratings. Capacitor switching is easily handled by MSB avoiding the restrike hazard presented by air switches.

Standardized designs cover most common applications while custom designs are also available for unusual requirements.

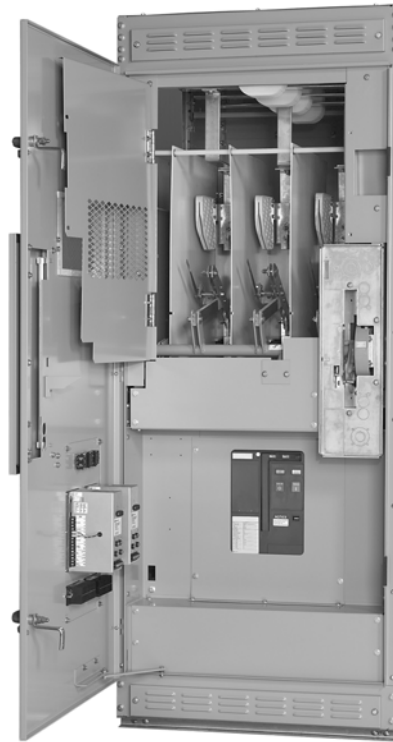
Type MSB vacuum switchgear meets or exceeds the following industry standards:

- ANSI/IEEE C37.20.3
- ANSI/IEEE C37.20.4
- ANSI C37.22
- ANSI C37.57
- ANSI C37.58
- NEMA SG5
- NEMA SG6
- CSA 22.2 No. 31
- EEMAC G8-3.3
- CSA listable for Canada and U.S. markets

Refer to **MVS Tab 8**. MVS switch sections are easily mixed with MSB sections in lineups. No bus transitions are required between them except where bus runs from top to bottom locations, such as between main and feeder sections.

General Description**Seismic Qualification**

Refer to **Tab 1** for information on seismic qualification for this and other Eaton products.



5/15 kV MSB Assembly

Construction

Eaton’s Type MSB switchgear uses the same proven enclosure and air switch mechanism as MVS switchgear. It differs in the addition of the fixed-mounted Eaton VCP-TR (5–15 kV) vacuum breaker in place of fuses. Current and voltage transformers associated with protection devices such as the EDR-3000 or EDR-5000 electronic protective relays are applied using the same ratings as drawout metal-clad switchgear. Integral over-current protective devices with the Arclash Reduction Maintenance System™ mode switch, such as DT 520MCV and DT-1150V, are also available. Devices are mounted on the single front-hinged door. The front door may be opened at any time to provide access to low voltage components and the front of the circuit breaker without being exposed to high voltage.

Eaton’s IQ family of electronic meters is normally used when metering functions are required.

The circuit breaker is bolted into position, but can be unbolted and removed from the enclosure. Routine maintenance can be performed on the circuit breaker mechanism in the enclosure.

Standard switch insulators are NEMA rated glass polyester or optional epoxy. Control power will be required as detailed below. The AC can be supplied integrally if specified. The DC control power, if required, must be furnished by others.

If AC control power is used, a capacitor trip device is provided.

Once the circuit breaker is closed and the closing spring is recharged, the breaker can open, close and open without spring recharge.



MSB with Control Switches, Digitrip 3000® Overcurrent Relay with Optional Metering Shown

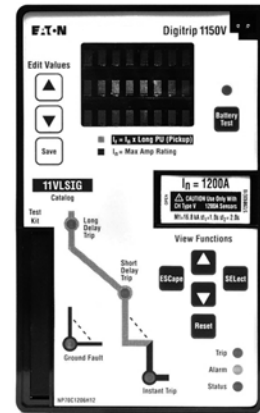
Overcurrent Protection



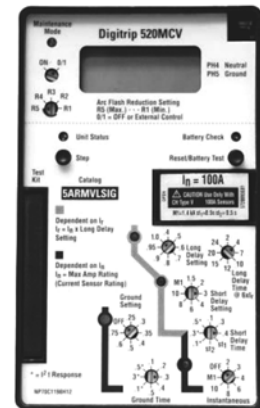
EDR-3000 Overcurrent Protective Relay



EDR-5000 Multifunction Protective Relay



Digitrip 1150V



Digitrip 520MCV

Technical Data

Overcurrent Protection

Eaton's MSB breaker can be furnished with an Eaton Type EDR-3000 or EDR-5000 relay to provide overcurrent and fault protection. Optional zero sequence 50/51G ground fault protection is shown below. Refer to **Tab 4** for more details.

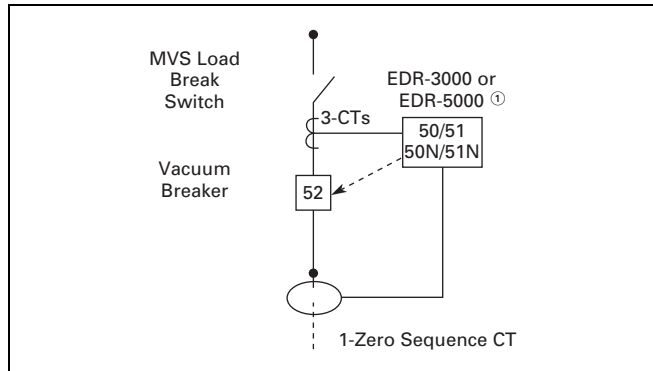


Figure 7.2-1. Typical MSB Single-Section One-Line Diagram

① Use of EDR-5000 requires VTs.

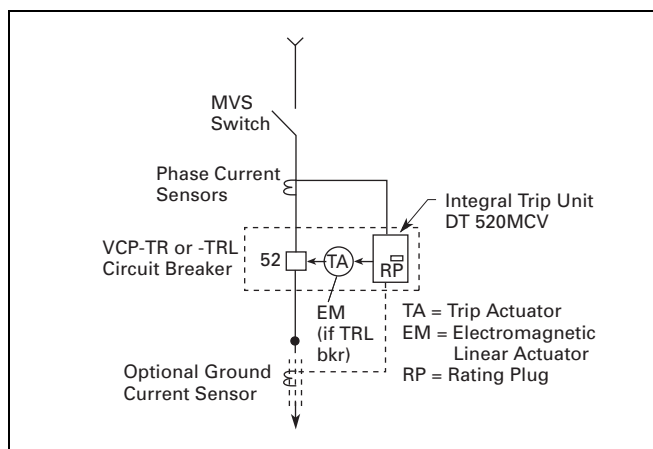


Figure 7.2-2. Typical MSB One-Line Diagram with DT 520MCV

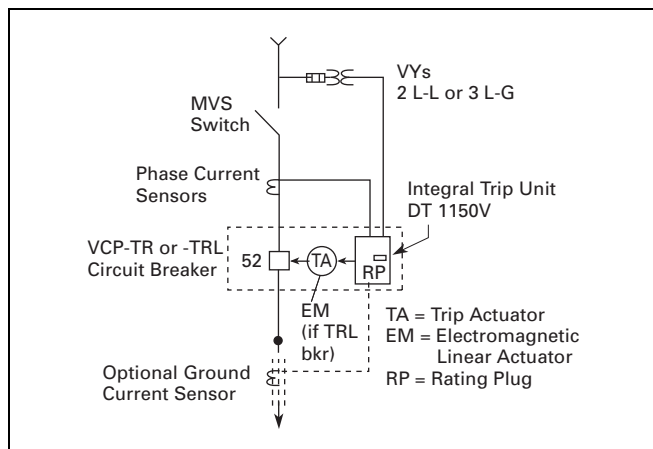


Figure 7.2-3. Typical MSB One-Line Diagram with DT-1150V

Table 7.2-1. Integral Protective Relays ①

Relay Type	Protective Relay IEEE Functions	Metering
DT 520MCV	50, 50T, 51, 50G, 51G	Amperes
DT-1150V	50, 50T, 51, 51G, 50G, 37, 46, 27, 59, 32, 47, 74, 81U, 81-0	Amperes, voltage, VA, VAR, Watt, Wh, VAh, THD

① See **Tab 6, Pages 6.0-10, 6.0-11 and 6.0-12** for details.

Table 7.2-2. Protective Relays ②

Relay Type	Protective Relay IEEE Functions	Metering
EDR-3000	50/51; 50/51G	Amperes and ampere demand
EDR-5000	25, 27, 32, 46, 47, 50N/G, 51N/G, 50/51, 50BF, 51VR, 59, 67N, 67	Amps; volts; pf, energy, power; THD; waveform

② See **Tab 4** available relays selection and application details.

Assembly Ratings

Table 7.2-3. MSB Switchgear Assembly Ratings

Rated Maximum Volts kV	Rated BIL kV	Rated Main Bus Current Amperes	Rated Momentary Current kA rms Asymmetrical	Rated Short-Time (2 Seconds) Current kA Symmetrical
4.76	60	600, 1200, 2000	40	25
4.76	60	600, 1200, 2000	64	40
15	95	600, 1200	40	25
15	95	600, 1200	64	40

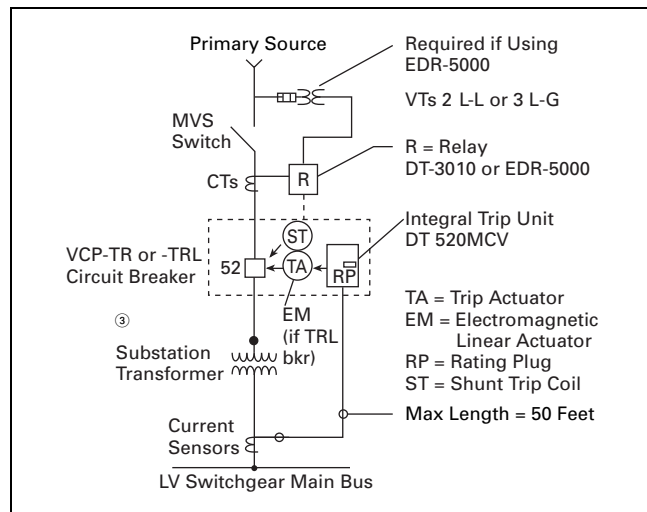


Figure 7.2-4. Transformer Primary Breaker with Secondary Bus Overcurrent Protection

③ Surge protection device, such as RC snubber, EHZ or Protec Z is highly recommended for transformer protection. Refer to **Tab 5, Page 5.4-17 to Page 5.4-20** for Eaton's recommendations for surge protection.

Technical Data

Circuit Breaker Ratings

Type MSB assemblies can be supplied with Type VCP-TR or VCP-TRC (stored energy operator) or with Type VCP-TRL or VCP-TRLC (electromagnetic linear actuator operator) circuit breakers. Type VCP-TRC and VCP-TRLC circuit breakers are

identical to VCP-TR and VCP-TRL breakers except they are rated for additional capacitor switching capability as indicated in **Table 7.2-5**.

Table 7.2-4. Available Type VCP-TR and VCP-TRL Vacuum Circuit Breakers Rated per ANSI Standards

Circuit Breaker Type ①②	Rated Maximum Voltage	Insulation Level		Rated Continuous Current	Rated Short-Circuit Current at Rated Maximum Voltage	Rated Voltage Range Factor	Maximum Symmetrical Interrupting & 2-Second Short-Time Current Carrying Capability	Closing and Latching Capability (Momentary)	Cable Charging Breaking Current	Three-Phase MVA at Rated Maximum Voltage (for Reference Only)	Mechanical Endurance No Load C-O Operations	
		Power Frequency Withstand Voltage 60 Hz, 1 Minute	Impulse Withstand Voltage (BIL) 1.2 x 50 microsec									
	V				I	K	K * I	2.6 * K * I		1.732 * V * I		
	kV rms	kV rms	kV Peak	Amperes	kA rms sym		kA rms sym	kA Crest	Amperes	MVA	Vacuum Interrupter	Mechanism
50VCP-TR25	4.76	19	60	600, 1200	25	1	25	65	25	210	30,000	10,000
50VCP-TRL25	4.76	19	60	600, 1200	25	1	25	65	25	210	30,000	100,000
50VCP-TR40	4.76	19	60	600, 1200	40	1	40	104	25	330	30,000	10,000
150VCP-TR25	15	36	95	600, 1200	25	1	25	65	25	650	30,000	10,000
150VCP-TRL25	15	36	95	600, 1200	25	1	25	65	25	650	30,000	100,000
150VCP-TR40	15	36	95	600, 1200	40	1	40	104	25	1040	30,000	10,000

① Rated interrupting time for all VCP-T circuit breakers is 3 cycle (50 ms).
② Operating duty for all VCP-T circuit breakers is O-0.3sec-CO-3min-CO.

Table 7.2-5. Available Type VCP-TRC Vacuum Circuit Breakers Rated per ANSI Standards (Definite Purpose, Tested for Capacitor Switching)

Type VCP-TRC (stored energy operator) circuit breakers have same ratings as Type VCP-TR breakers, plus additional capacitor switching capabilities as follows.

Circuit Breaker Type	Cable Charging	Grounded Capacitor Banks	
		Single Bank	Back-to-Back
VCP-TRC (40 kA ratings)	25 A	250 and 1000 A	250 A with inrush current of 4 kA peak at 5.9 kHz and 1000A with inrush current of 15 kA peak at 25 kHz

Breaker Control Ratings

Table 7.2-6. Breaker Stored Energy Mechanism Control Power Requirements

Rated Control Voltage ③	Spring Charge Motor		Close or Trip Amperes	Voltage Range	
	Run Amperes	Time Seconds		Close	Trip
48 Vdc	4.0	5	5.2	38-56	28-56
125 Vdc	3.0	5	3.6	100-140	70-140
250 Vdc	2.0	5	1.8	200-280	140-180
120 Vac	3.0	5	3.6	104-127	104-127
240 Vac	2.0	5	1.8	208-254	208-254

③ Inrush current is 4 times running amperes.

Layout—Dimensions

Typical Arrangements—5 kV and 15 kV

The sketches in this section represent the most common switch arrangements. Many other configurations and combinations are available. Layouts shown are for rear-accessible equipment. Front-accessible designs are available—refer to Eaton.

Depth of units will vary due to cable entrance and exit requirements, the addition of lightning arresters, instrument transformers, special cable terminators, and so on.

Cables are shown out top and bottom for layout only. Top or bottom must be selected for incoming and for outgoing cables. Cable sizing is based on two 500 kcmil XLP or EPR insulated cables per phase using preformed slip-on cable termination devices. Rear access is required for installation. For unit substation alignment details, see **Tabs 13 and 14**.

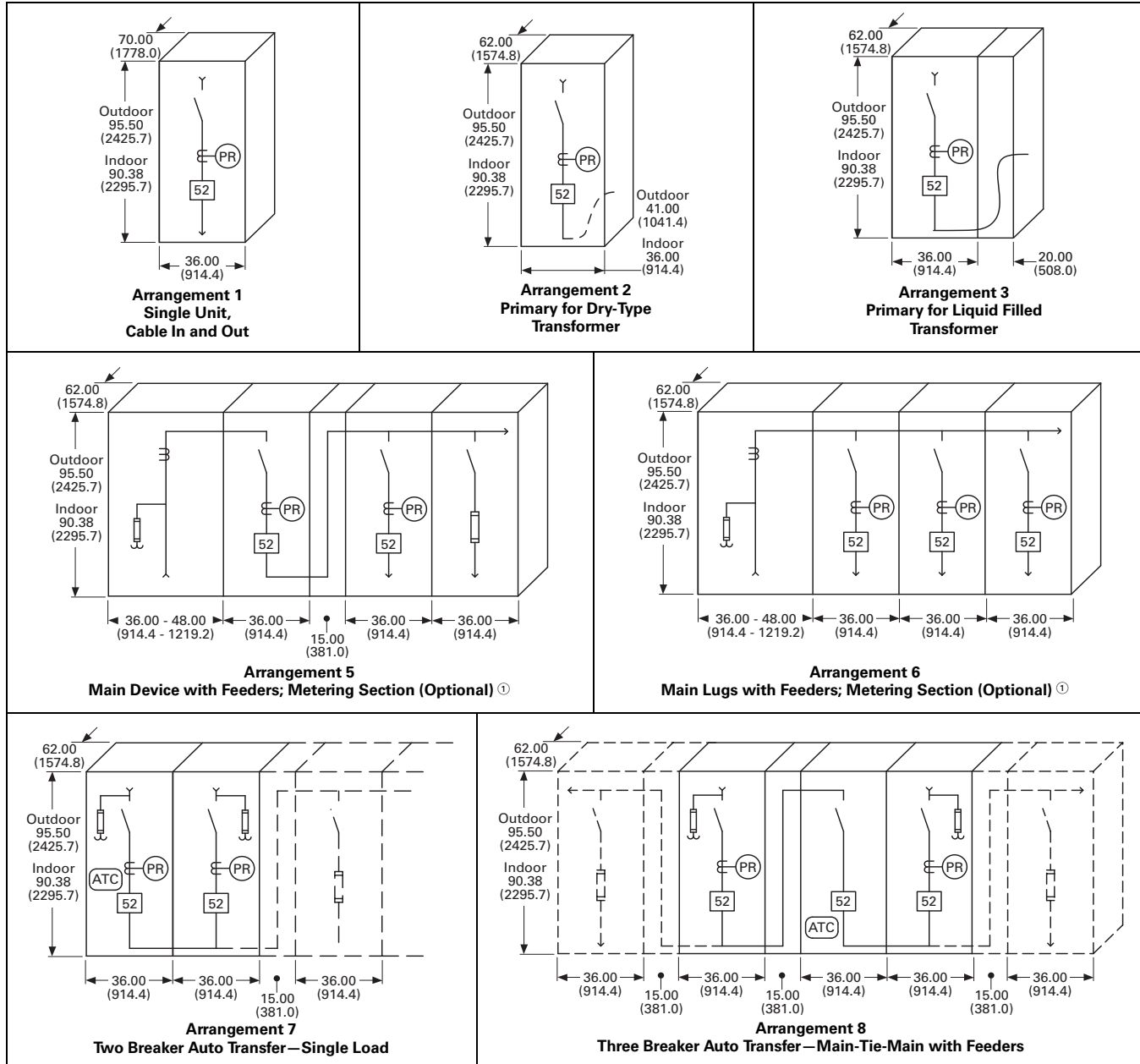


Figure 7.2-5. Layouts and Dimensions in Inches (mm)

① Width of metering compartment may vary depending on utility requirements.

Note: PR—Overcurrent protective relay, typical functions—50/51, 50/51N or 50/51G. Eaton’s EDR-3000 or EDR-5000.

Dimensions in inches (mm). Not to be used for construction purposes unless approved.

Layout—Dimensions

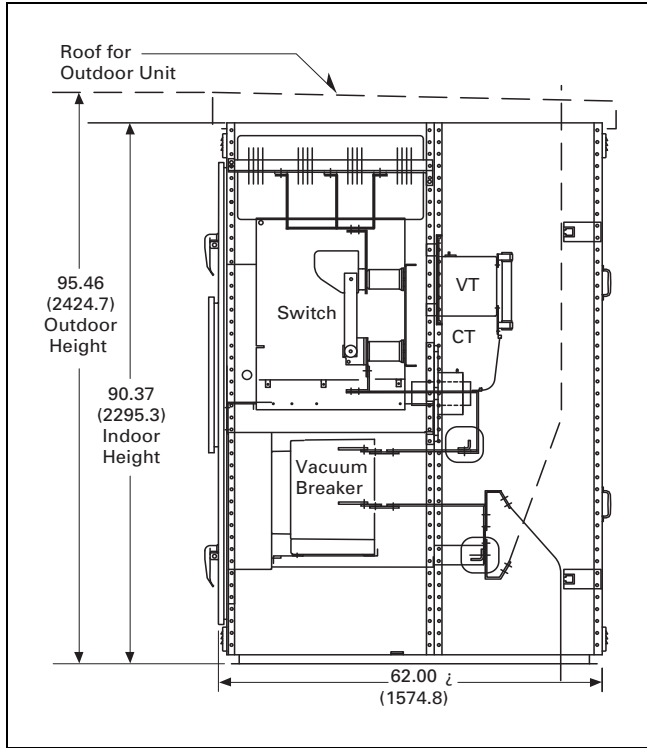


Figure 7.2-6. 5, 15 kV MSB with Main Bus

① Minimum depth 70.00 inches (1778.0 mm) if two sets of CTs are required.

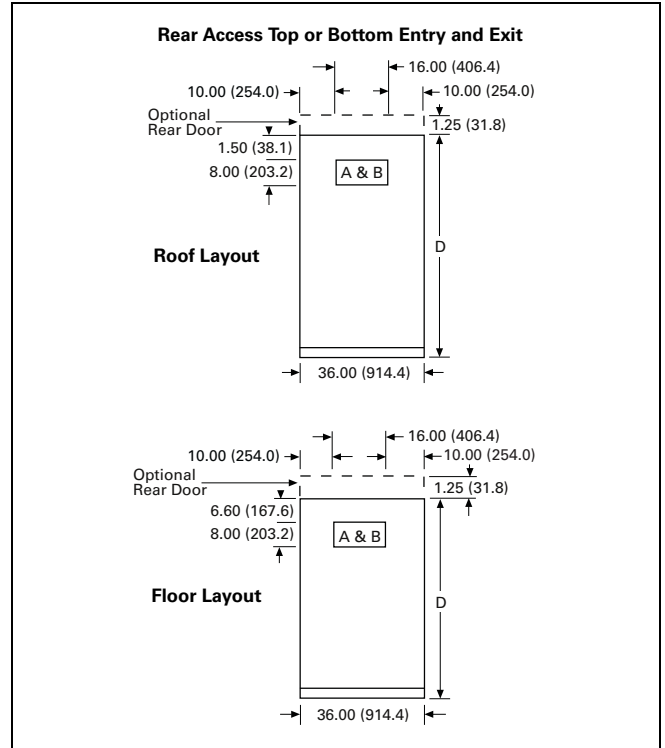


Figure 7.2-8. 5 kV and 15 kV Roof Layouts and Floor Layouts

③ Cable location B not available with main bus.

Note: A = Power cable to load, B = Power cable from source.

Note: For D dimension, refer to Page 7.1-4.

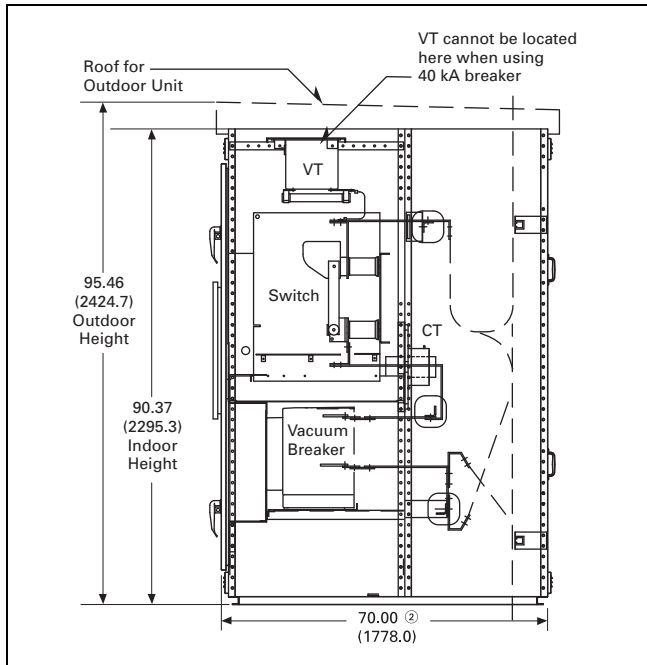


Figure 7.2-7. 5, 15 kV MSB without Main Bus

② Minimum depth 80.00 inches (2032.0 mm) if two sets of CTs are required.

Dimensions in inches (mm).

Not to be used for construction purposes unless approved.

Layout—Dimensions

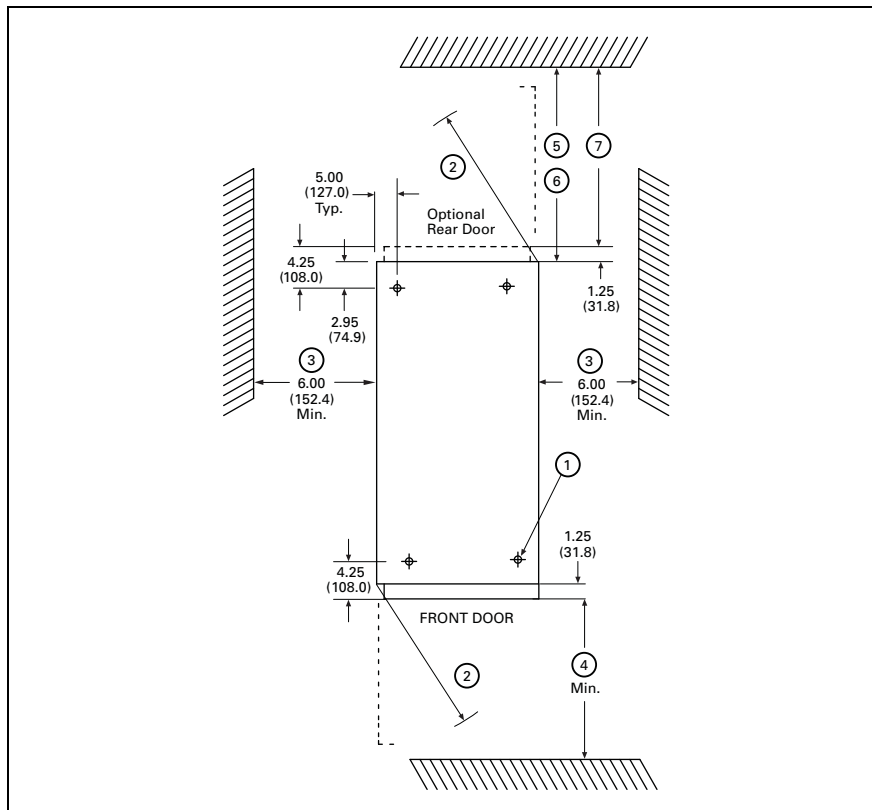


Figure 7.2-9. Typical Anchor Plan for MSB, Indoor or Outdoor

Table 7.2-7. Approximate Weights in Lb (kg)

5 or 15 kV Class	Indoor	Outdoor
MSB section	1700 (773)	2000 (909)
MVS section (non-fused)	1500 (681)	1800 (817)
Fuses (three) add	200 (91)	200 (91)
Transition section	300 (136)	—

- ① Locations for tie-down 0.65 inches (16.5 mm) diameter holes for four places. Customer provided bolts for anchoring should be 0.50–13 min. (M12 x 1.75 min. CL 10.9) and tightened to 75 ft-lb (101.7 Nm).
- ② Door swing equals unit width at 90°.
- ③ The standard minimum clearances on side. 24.00 inches (609.6 mm) may need to be added for passage from front to rear. The authority having jurisdiction may require a larger distance.
- ④ Minimum clearance in front is the width of the widest vertical section plus 1.00 inch (25.4 mm). The authority having jurisdiction may require a larger distance.
- ⑤ The standard minimum recommended distance is 30.00 inches (762.0 mm) for assemblies requiring rear access for installation and maintenance. The authority having jurisdiction may require a larger distance.
- ⑥ For MVS only. If the application is specifically provided by contract as not requiring rear access as stated in 5, then the minimum recommended distance is 6.00 inches (152.4 mm).
- ⑦ If optional rear door is supplied, the minimum is the width of the widest vertical section plus 1.00 inch (25.4 mm). The authority having jurisdiction may require a larger distance.
- ⑧ Finished foundation's surface shall be level within 0.06-inch (1.5 mm) in 36.00 inches (914.4 mm) left-to-right, front-to-back and diagonally, as measured by a laser level.

Dimensions in inches (mm).

Not to be used for construction purposes unless approved.

Application Examples

Application Examples

Low Resistance Ground Schemes

Medium voltage low resistance ground schemes are typically used for medium voltage 5 kV class systems feeding 5 kV class motor loads. The resistor affords both full selectivity in tripping on ground faults, while limiting ground fault magnitudes to low values (typically 50–400 A). Reducing the current levels to a faulted motor greatly reduces the damage to the motor and subsequent rewind and repair costs.

System tripping during a ground fault on the line side of the secondary main breaker must be cleared by sending a trip signal to the transformer primary side protective device. Fusible switches on the primary side of the step-down transformer (typically rated 5–15 kV) may not be used for this purpose. Any ground fault sensed may escalate as the switch is being signaled to trip thereby exceeding its typical 600 A maximum current breaking capacity.

Eaton’s MEB and MSB breaker, being a fully rated interrupting device, may be tripped regardless of fault level up to its interrupting rating (for example, 28 kA). Only this type of overcurrent device or a metal-clad switchgear drawout breaker may be safely used.

Single-Ended Substation Designs

In this configuration, the MEB or MSB serves as both primary and secondary protection for the transformer. Savings in both floor space and cost result, due to elimination of the secondary main device. This scheme is only recommended where cost and space prevent the use of secondary main device.

Note: Two sets of current transformers are used to protect against secondary ground faults, overloads and short circuits, as well as primary winding faults.

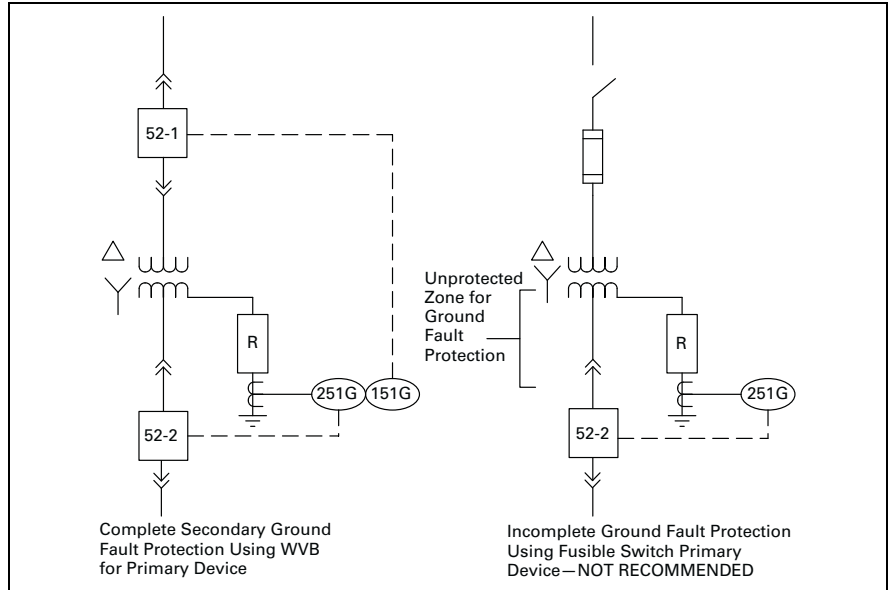


Figure 7.3-1. Low Resistance Ground Scheme (Phase and Primary Ground Fault Protection not Shown)

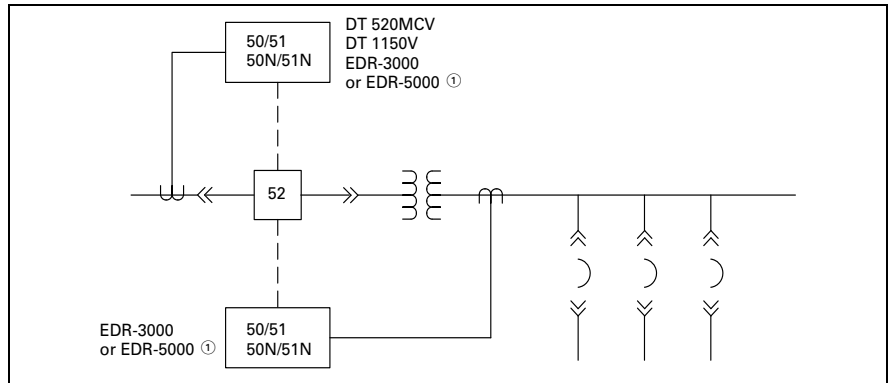


Figure 7.3-2. Single-Ended Unit Substations Using Primary Breaker Protection (MEB)

① Use of DT-1150V or EDR-5000 requires VTs.

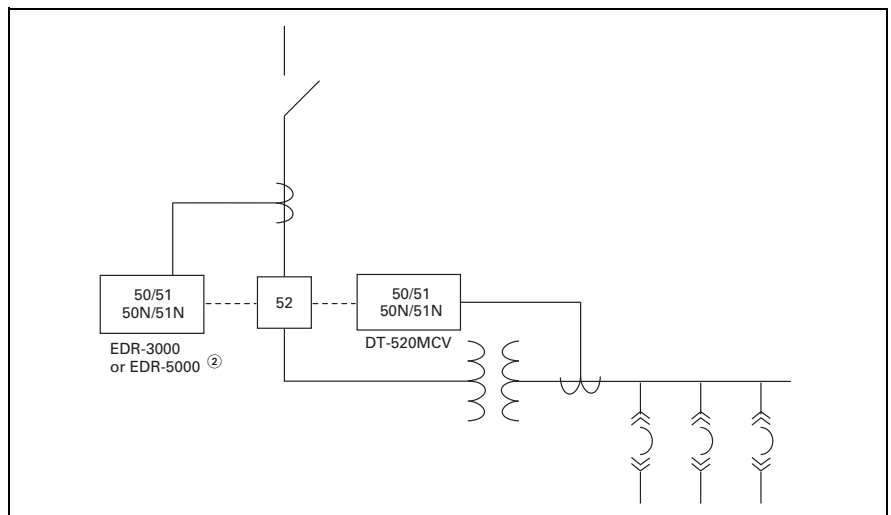


Figure 7.3-3. Single-Ended Unit Substations Using Primary Breaker Protection (MSB)

② Use of DT-1150V or EDR-5000 requires VTs.

Optional Accessories (MEB and MSB)

Surge Arresters

IEEE Standard C62.11 for metal-oxide surge arresters lists the maximum rated ambient temperature as 40 °C. The ambient temperature inside an MEB and MSB switchgear vertical section may exceed this temperature, especially in outdoor applications

where solar radiation may produce a significant contribution to the temperature. **Table 7.3-1** lists the recommended minimum duty cycle voltage rating for various system grounding methods based on switchgear temperatures not exceeding 55 °C.

Table 7.3-1. Suggested Minimum Ratings (kV) for Metal-Oxide Surge Arresters Located in Metal-Enclosed Switchgear

Service Voltage Line-to-Line kV	Distribution Class Arresters						Station Class Arresters					
	Solidly Grounded System		Low Resistance Grounded System		High Resistance or Ungrounded System		Solidly Grounded System		Low Resistance Grounded System		High Resistance or Ungrounded System	
	Arrester Ratings kV						Arrester Ratings kV					
	Nominal	MCOV	Nominal	MCOV	Nominal	MCOV	Nominal	MCOV	Nominal	MCOV	Nominal	MCOV
2.30	3	2.55	3	2.55	3	2.55	3	2.55	3	2.55	3	2.55
2.40	3	2.55	3	2.55	6	5.10	3	2.55	3	2.55	6	5.10
3.30	3	2.55	3	2.55	6	5.10	3	2.55	3	2.55	6	5.10
4.00	3	2.55	6	5.10	6	5.10	3	2.55	6	5.10	6	5.10
4.16	6	5.10	6	5.10	6	5.10	6	5.10	6	5.10	6	5.10
4.76	6	5.10	6	5.10	9	7.65	6	5.10	6	5.10	9	7.65
4.80	6	5.10	6	5.10	9	7.65	6	5.10	6	5.10	9	7.65
6.60	6	5.10	6	5.10	9	7.65	6	5.10	6	5.10	9	7.65
6.90	6	5.10	6	5.10	9	7.65	6	5.10	9	7.65	9	7.65
7.20	6	5.10	6	5.10	10	8.40	6	5.10	9	7.65	10	8.40
8.32	9	7.65	9	7.65	12	10.20	9	7.65	9	7.65	12	10.20
8.40	9	7.65	9	7.65	12	10.20	9	7.65	9	7.65	12	10.20
11.00	9	7.65	9	7.65	15	12.70	9	7.65	10	8.40	15	12.70
11.50	9	7.65	10	8.40	18	15.30	9	7.65	12	10.20	18	15.30
12.00	10	8.40	10	8.40	18	15.30	10	8.40	12	10.20	18	15.30
12.47	10	8.40	12	10.20	18	15.30	10	8.40	12	10.20	18	15.30
13.20	12	10.20	12	10.20	18	15.30	12	10.20	12	10.20	18	15.30
13.80	12	10.20	12	10.20	18	15.30	12	10.20	15	12.70	18	15.30
14.40	12	10.20	12	10.20	21	17.00	12	10.20	15	12.70	21	17.00

Note: MCOV = Maximum Continuous Operating Voltage.

Optional Accessories (MEB and MSB)

**MEB and MSB Switchgear
with Automatic Transfer Control****Application**

Eaton's MEB and MSB switchgear with an automatic transfer control system is an integrated assembly of drawout VCP-W breakers, sensing devices and control components. Available in 5–15 kV classes.

It is typically applied where the continuity of service for critical loads from two power sources in either a two-breaker (one load) or three-breaker (two loads) configuration is desired.

MEB and MSB switchgear with an automatic transfer control system can meet most automatic throwover requirements as it has a wide variety of operational sequences embodied in one standard automatic transfer control system.

**Typical Two-Breaker Automatic Transfer
Using ATC Controller**

Eaton's ATC-900 controller continuously monitors all three phases on both sources for correct voltages. Should the voltage of the normal source be lost while the voltage of the alternate source remains normal, the voltage sensing function in the ATC controller will change state starting the time delay function. If the voltage of the normal source is not restored by the end of the time delay interval, the normal breaker will open and the alternate source breaker will close, restoring power to the load.

ATC Controller

Eaton's ATC-900 controller is equipped to display history information either via the front panel or over the PowerNet power monitoring system. ATC-900 controller stores 320 time stamped events. Oscillographic data for last 10 events can be downloaded via USB port or displayed in the controller's display window. Controller allows communications via RS-232 or Modbus through RS-485 port, Ethernet or via USB interface.

**ATC Controller****Standard Features**

- Voltage sensing on both sources is provided by the ATC controller
- Lights to indicate status of switches, sources, and so forth
- Interlocking to prevent paralleling of sources via software
- Control power for the automatic transfer control system is derived from the sensing voltage transformers
- Manual override operation
- Selectable closed with sync check or open transition on return to normal
- Programmable time delays on both sources, "OFF DELAY" and "ON DELAY"
- Four programmable digital inputs and outputs
- Single-source responsibility; all basic components are manufactured by Eaton

Optional Features

- Lockout on phase and/or ground overcurrents and/or internal bus faults
- Load current, power and PF metering with optional DCT module
- 24 Vdc control power input
- Up to four additional I/O modules each with four programmable digital inputs and digital outputs

**Typical Three-Breaker
(Two Mains and Normally Open Tie)
Automatic Transfer Control**

The automatic transfer switchgear assembly includes two main breakers and one tie breaker, and an integrated automatic transfer control system containing sensing devices, low voltage logic control and auxiliary equipment. The transfer control system monitors both sources for correct voltages. An automatic-manual transfer selector switch is provided for selection of manual or automatic operating mode. In manual mode, all three breakers can be manually operated. Interlocking is provided in manual mode of operation to prevent closing all three breakers at the same time. In the automatic mode, the basic sequence of operation based upon two normally energized sources is carried out as follows. Normal operation is with the main breakers closed and the tie breaker open. Upon detection of an undervoltage(s) to the line side of a main breaker, and after a field-adjustable time delay, that main breaker opens and after an additional field-adjustable time delay, the tie breaker closes to restore power to the affected portion of the facility. Upon restoration of voltage to the line side of the main breaker, and after a field-adjustable time delay, the tie breaker opens and after a field-adjustable time delay, the opened main breaker closes. Interlocking is provided to prevent closing all three breakers simultaneously in manual mode.

Optional Accessories (MEB and MSB)

Partial Discharge Sensing and Monitoring for Switchgear



Coupling Capacitor
Type PD Sensor



RFCT Sensor



InsulGard Relay
(PD Monitoring)

Partial Discharge in Switchgear

Partial discharge (PD) is a common name for various forms of electrical discharges such as corona, surface tracking and discharges internal to the insulation. It partially bridges the insulation between the conductors. These high-frequency discharges are essentially small arcs occurring in or on the surface of the insulation system when voltage stress exceeds a critical value. With time, airborne particles, contaminants and humidity lead to conditions that result in partial discharges. Partial discharges start at a low level and increase as more insulation becomes deteriorated. Examples of partial discharge in switchgear are surface tracking across bus insulation, or discharges in the air gap between the bus and a support, such as where a bus passes through an insulating window between the sections of the switchgear. If partial discharge process is not detected and corrected, it can develop into a full-scale insulation failure followed by an electrical fault. Most switchgear flash-over and bus failures are a result of insulation degradation caused by various forms of partial discharges.

Sensing and Monitoring

Eaton's Type MEB and MSB metal-enclosed switchgear (2.4–15 kV) is corona-free by design. By making switchgear assemblies corona-free, Eaton has made its standard switchgear more reliable. However, as indicated above, with time, airborne particles, contaminants and humidity lead to conditions that cause partial discharges to develop in switchgear operating at voltages 4000V and above. Type MEB and MSB switchgear can be equipped with factory-installed partial discharge sensors and partial discharge sensing relay for continuous monitoring of the partial discharges under normal operation. Timely detection of insulation degradation through increasing partial discharges can identify potential problems so that corrective actions can be planned and implemented long before permanent deterioration develops. Partial discharge detection can be the foundation of an effective predictive maintenance program. Trending of partial discharge data over time allows prediction of failures, which can be corrected before catastrophic failure occurs.

The PD sensing and monitoring system consists of Eaton's InsulGard™ relay and PD sensors specifically developed for application in the switchgear to work with the relay.

Partial discharges within the MEB switchgear compartment are detected by the installation of a small donut type radio frequency current transformer

(RFCT) sensor over floating stress shields of the specially designed bus or line side primary bushings. Partial discharge in the customer's power cables (external discharges) are detected by the installation of the RFCT around ground shields of the incoming or outgoing power cables termination.

Partial discharges within the MSB switchgear compartment are detected by installation of coupling capacitor type sensor connected to the main bus or on the load side of the feeder breakers. Partial discharges in the customer's power cables (external discharges) are detected by the installation of the RFCT around ground shields of the incoming or outgoing power cables termination.

Output signals from sensors (coupling capacitor and RFCT) are wired out to terminal blocks for future or field use, or connected to the InsulGard relay. One InsulGard relay can monitor up to 15 output signals, and temperature and humidity. The temperature and humidity sensors are included with each InsulGard relay system. The "relay continuously monitors the switchgear primary system for partial discharges and provides an alarm signal (contact closure) when high PD level is detected. Data analysis and diagnostics performed by Eaton engineers can also be provided by remote communication with the InsulGard relay.

The sensors and InsulGard relay are optional in MEB and MSB switchgear.

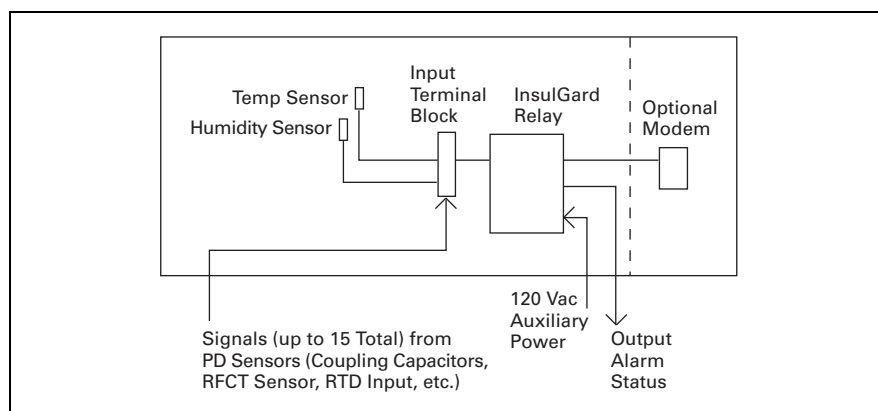


Figure 7.3-4. InsulGard Relay System

Partial Discharge Sensors and Monitoring for Switchgear

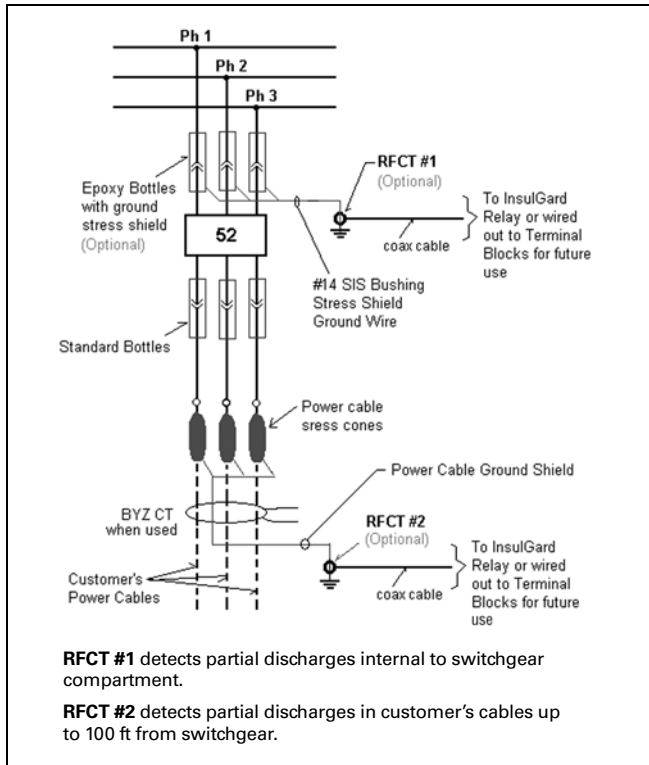


Figure 7.3-5. Typical Partial Discharge Sensor Connections in MEB Switchgear (5–15 kV)

Note: Use one set of epoxy bottles with ground stress shield on bus side (either in the top or bottom compartment) at every two vertical sections. Use standard bottles at all other locations.

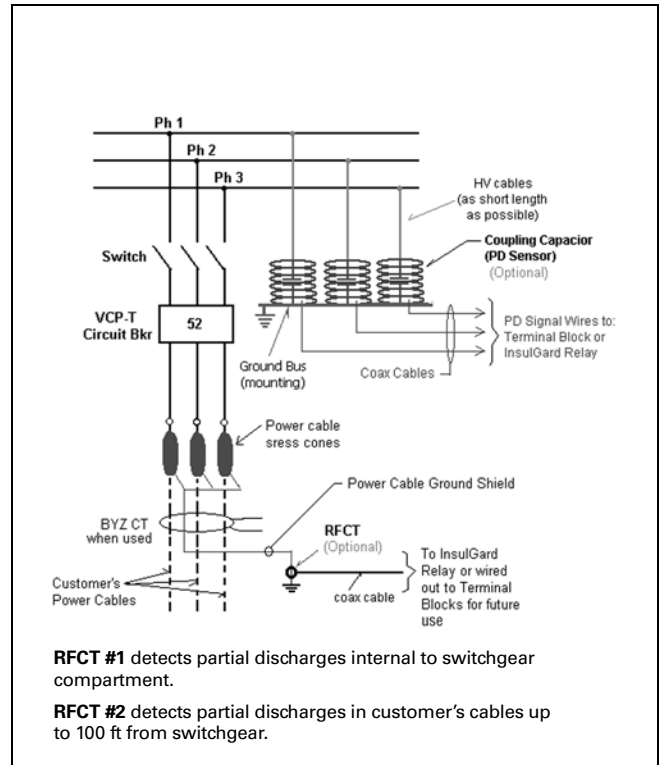


Figure 7.3-6. Typical Partial Discharge Sensor Connections in MSB Switchgear (5–15 kV)

Note: Use one set of PD sensing capacitors at every two vertical sections, or portion thereof. Use one RFCT at each incoming/outgoing cable circuit.

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