TECHNICAL APPLICATION GUIDE

BreakMaster™

5 and 15 kV ANSI, metal-enclosed, load interrupter switchgear

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BreakMaster™
General overview

BreakMaster™ is an ANSI load interrupter switch providing dependable, economical load switching and protection for medium voltage applications from 2.4 kV through 15 kV in 600 to 1200 ampere load ratings.

Certifications
The BreakMaster line of metal-enclosed load interrupter switchgear is available with UL label or as a cUL certified lineup. The manufacturing location for the BreakMaster line is ISO 9001 certified.

The cUL mark indicates the product has been tested to meet Canadian Standards by the UL organization, in this case CSA C22.2 No. 31 and 193, which is comparable and valid as CSA certification.

Applicable standards
BreakMaster is designed, built, and tested per the IEEE C37.20.3 metal-enclosed switchgear standard and meets or exceeds all applicable ANSI, NEMA, and IEEE standards.

The National Electric Code (NEC) covers installation of electric conductors and equipment for installations identified in the NEC Article 90. The NEC is not intended as a design specification and acceptance of an installed load interrupter switch by a local code authority relies on factors independent of the equipment as shipped from the factory. In general, equipment which bears the UL listing mark can be installed to meet the NEC.

Construction
The BreakMaster™ Load Interrupter switch consists of a rigid, bolted frame construction enclosure. This enclosure is constructed of 11-gauge sheet steel, including the doors, back panels, and side panels. All non-galvanized steel parts are treated and painted ANSI 61 gray.

All steel doors have concealed hinges and captive screws or quarter-turn latches as standard. A foot operated doorstop is also included.

Each switch compartment and the fuse compartment are provided with individual or "split" doors.

The standard depth on the indoor enclosure is 50 inches. An optional 60-inch enclosure is available for special applications or for mounting additional devices. Each standard switch section is 35 inches wide. The split rear and side covers provide easy access. Also, the top access covers are removable for easy access.

Outdoor enclosures
The BreakMaster product line can be supplied in outdoor non-walk-in (ODNWI) or power distribution center (PDC) enclosures for outdoor applications.

Interlocks
The BreakMaster includes a mechanical switch and door interlock as standard features. These prevent the opening of the doors when the switch is in the "ON" position. They also prevent switch from closing when the door is open.

Additionally, each switch comes with provisions for up to six optional key interlocks. These interlocks provide a mechanical method to interlock two or more devices, utilizing a removable key which can only be inserted in one location at a time.

Table 1: Switch ratings (per applicable standards)

Max kV	Impulse Withstand kV (BIL)	Amperes Continuous and Interrupting	Momentary Switch Closed Asym	Fault Close Asym
4.76	60	600	40,000	40,000
4.76	60	1200	61,000	61,000
15.0	95	600	40,000	40,000
15.0	95	1200	61,000	61,000

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BreakMaster showing switch assembly

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BreakMaster showing fuse assembly

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VersaRupter switch overview
Modular design

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Applications

BreakMaster is used mainly as a primary or secondary disconnect switch for transformers, but the variety of configurations in which BreakMaster is available also make it useful for specific distribution needs. It can be used in a single circuit for on/off control of a transformer, duplex switching, and selector switch applications.

Typical applications are in oil and gas, pulp and paper, automotive, industrial processes, wastewater, petrochemical and utility-type industries.

Fuses

BreakMaster is available with a variety of different fuses to meet specific application needs. Contact the factory for fuse options.

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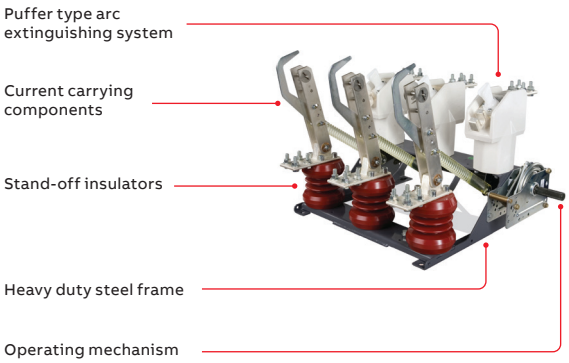
Table 2: Fuse ratings

Fuse	Fuse type	Voltage class	Ampere range
Current Limiting Fuses		5 kV	25 A - 900 A
	EJO 1	15 kV	20 A - 300 A
Expulsion Fuses	RBA200	5 kV - 15 kV	40 E - 200 E
	RBA400	5 kV - 15 kV	20 E - 300 E
	RBA800	5 kV - 15 kV	450 E - 720 E

A phase loss detection relay and PT's are installed on load side of fuses and wired to terminal blocks to provide blown fuse indication. For blown fuse trip option, a shunt trip is installed in addition to the components above and wired to terminal blocks for external power source, provided by others. Capacitive trip device can be provided but it is a manual selection and factory must quote.

Switch mechanism

The BreakMaster switch consists of a two-position (open, closed), three-pole, gang-operated, air interrupter switch utilizing two different style mechanisms for both closing and opening functions. The K-mechanism is a single spring snap action device. The switch opens or closes by charging the spring past dead center using a manual operating handle. The A-mechanism is a dual spring stored energy device that is well suited for remote tripping applications. When shunt tripping or mechanical fuse tripping is specified, the type A-mechanism must be used. In closed operation, the opening spring is charged and latched by an operating handle or by a motor operator.



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Standard features
- Silver-plated copper bus
- Full-length ground bus
- Polyester coat paint
- ANSI 61 paint color (gray)
- Oversized viewing window
- Full height interphase barriers
- 11-gauge doors, barriers and covers
- Generous cable termination area
- Permanent non-corrosive nameplate
- Individual doors over switch and fuses
- Concealed door hinges
- Switch padlock provisions
- Key interlock provisions
- Split rear and side covers
- Tungsten-tipped arc interrupting blade
- Mechanical switch and door interlocking
- Louvered ventilation at top and bottom
- Safety horizontal barrier
- Standard outdoor features
- Removable filters for louvers
- Long life space heaters
- 4-inch channel base
- Sloped roof
- Bottom closure plates
- Rodent barriers

Testing

BreakMaster is design tested per IEEE C37.20.3 and subjected to the following production tests:
- High potential insulation test on control wiring and power cabling
- Control circuit verification
- Functional operation tests on all devices
- Mechanical check for kirk locks and switch and door interlocks
- Relays checked for proper performance characteristics
- Ratio and interconnection check for potential transformers
- Polarity verification for current transformers

Factory witness testing is also available on request.

Table 3: VersaRupter switch configurations

Operating mechanism		Handle Operator (right side)		Aux Switch		Shunt trip	NM Motor (left side)
K-mech	A-mech	Chain drive	HM direct drive	6 contact	11 VDC	110 VAC	110 VAC/DC
•		•					
•			•				
•		•		•			
•			•	•			
	•		•	•	•		
	•		•	•		•	
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Optional accessories and features
- UL/cUL listing
- Copper tin-plated bus
- Insulated bus and bus boots over joints
- 80 kA momentary bus rating
- Weather and dust resistant
- NEMA 2 drip-proof enclosure
- Rear doors (full height or double)
- Vertical barriers
- Rodent barriers
- Bottom closure plates
- Tamper resistant hardware
- Auxiliary switches (3NO-3NC)
- Thermostat
- Space heater (standard on outdoor, optional on indoor)
- Porcelain insulators
- Customer metering
- Surge arresters
- Mimic bus
- Space heater switch
- Ground studs
- Convenience light
- Duplex receptacle
- Top hat
- Run back bus

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Full height interphase barriers

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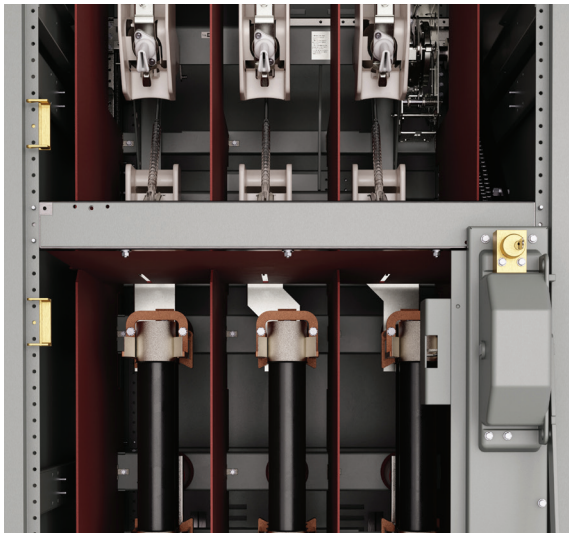
Table 4: Other reference documents

Document	Document number
BreakMaster Descriptive Bulletin	1VAL107101-DB
BreakMaster Flyer	1VAL107101-FL
Installation, Operation and Maintenance Manual for BreakMaster	1VAL108001-MB
VersaRupter MV Indoor Switch Descriptive Bulletin	1VAL206001-DB
Installation, Operation and Maintenance Manual for VersaRupter	IB2.1.2.7-4A
Switchgear Components and Accessories Technical Guide	1VAL104601-TG
REF615 Feeder Protection Relay Product Guide	1MAC105361-PG
RET615 Transformer Protection Relay Product Guide	1MAC204375-PG
REA Arc Fault Protection System Product Guide	1MRS756449
Application Guide for SwitchgearMD™ used in MV Metal-Clad Switchgear, MCC, Load Interrupter Switch & Limitamp	2RGA030591

Product design and features
BreakMaster load interrupter switches integrate the superior technology available in ABB devices such as the VersaRupter switch, featuring advanced interrupting technology. The mechanical design of the BreakMaster LIS is optimized for flexibility, personnel and equipment protection, and ease of maintenance and installation. BreakMaster LIS features, such as full height interphase barriers, split door design, horizontal barriers between the switch mechanism and fuse compartment, oversized viewing window, and a separate enclosed, low voltage panel, are designed for a higher level of reliability, safety, and convenience.



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Enclosure features
These steel-enclosed switch sections can be joined together to centralize, protect and switch loads of the most complex systems for medium voltage circuit applications, or the simplest of loads such as primary or secondary disconnect switch for transformers. As the need arises, additional sections can be added to an existing lineup in the field, often times without the need for a transition section. A paint finish is applied to all un-plated steel parts. The powder coating paint process passes 1000 hours per ASTM 117B salt spray tests for all exterior parts and provides lasting protection.

Unit features
An array of optional multi-function meters measure volts, amps, frequency, power factor, watts and VARs, and can communicate via IEC-61850 RS-232, RS-485, and Modbus. For safety, an enclosed, low voltage panel completely isolates metering components.

While accessing fuses, split door prevents access to the live side of the switch when the lower door is open. Oversized viewing window and switch position markers allow visual verification of switch position.

Full height interphase barriers are standard on all switches. Both current limiting and expulsion fuses are available. Standard 50-inch section depth provides substantial space for incoming or outgoing cables. 60-inch depth is also available when customer preference and/or specific options require additional space.

Horizontal barriers between the switch mechanism and fuse compartment are a standard safety feature.

Convenient split rear covers provide easy access to cable terminations or devices located in the rear of the section.

Nameplates
Unit service designation nameplates are furnished when specified. These nameplates can be supplied as blanks suitable for field engraving, or engraved at the factory. The standard unit service designation nameplate is of 2-ply thermoplastic material, black face with white core, 2 5/32 inches x 3 1/2 inches, or 1 inches x 3 inches depending on the unit configuration, fastened with non-corrosive nylon clips. Stainless steel screws are available as an option. Nameplates are engraved with white letters on a black background unless specified otherwise.

Wire and cable
Standard control wire size is 14 AWG. Standard control and power wire include flame-retardant, (VW-1) moisture-heat-and oil-resistant thermoplastic insulation rated 600 V, with stranded copper conductors, type MTW.
Wire is rated 90°C and terminals are rated 75 °C.
Connections to space heater terminals use 14 AWG, 600V, 250°C Teflon wire.

Per NEC 79 - 13.2.4.3, the standard colors[1] are:
AC (120/208/240 Volts)
- Black – phase 1
- Red – phase 2
- Blue – phase 3
- White – Neutral
- Green – Ground

AC (277/480 Volts)
- Brown – phase 1
- Orange – phase 2
- Yellow – phase 3
- Gray – Neutral
- Green – Ground

Optional wiring available includes SIS heat-resistant synthetic rubber-covered switchboard wire and XHHW flame-retardant cross-linked synthetic polymer, both rated 600 V with stranded copper conductors, and a VW-1 flame rating (no PVC). Wire is rated 90°C and terminals are rated 75 °C.

NOTICE **Notice:** Not all colors are available with optional wiring.

Environmental conditions
BreakMaster is designed for operation in a clean, indoor environment having a 40 °C maximum ambient temperature. The nominal minimum temperature for storage is -40 °C and for operation, -20 °C. Space heaters are recommended whenever temperature conditions below 0 °C will exist. Where extreme cold temperatures are to be encountered for long periods of time, it is recommended that the load interrupter switch be installed in heated rooms or enclosures. The average value of relative humidity, measured over a period of 24 hours, does not exceed 95% non-condensing.

For outdoor installations, NEMA 3R non-walk-in weatherproof enclosures are required. Thermostatically controlled space heaters should be considered for these applications.

The altitude limit for the standard load interrupter switch design is 6600 feet. Applications above this should be referred to the factory for recommendations. Some components have a lower altitude rating and may reduce the altitude limit of the load interrupter switch.

Fungus-proofing of organic materials is inherent. Keeping equipment dry and above the dew point is the best way of avoiding fungus-growth, and the use of space heaters is recommended for this purpose. Heaters should be energized if the load interrupter switch is to be stored for any length of time. Where export crating is involved, provisions must be made on the outside of the crate for access to space heaters.

Structure

Enclosure types
Load interrupter switches are made up of standardized vertical sections housing vertical and horizontal bus, wiring channels and compartmented control units. Sections may be bolted together to form a single panel assembly powered by line connection at a single point. Normal shipping split is three sections maximum.

NEMA type 1 – Gasketed – semi dust-tight, indoor
Intended to cushion doors and mitigate vibration. Standard finish is light-gray ANSI 61 over a phosphate rust inhibitor. All unpainted parts are zinc-plated or galvanized. Enclosures are furnished with bolt-on rear covers. Hinged rear doors are available as an option. Pan-type doors utilize quarter-turn fasteners. Gasketed doors, cover plates, and operating handles are available as an option. Two heavy-duty 3 inches by 1-1/2 inches, 12-gauge floor sills and 1/4 inch structural lifting lugs are included. Open bottom is standard.

NEMA type 2 – Drip-proof, indoor
Intended for use indoors to protect the enclosed equipment against falling noncorrosive liquids and falling dirt. Dripshields on top of the load interrupter switches and neoprene closed-cell gasketing afford protection from falling and splashing liquids.

They are not water-tight. Similar to NEMA 12 gasketed construction except with catch pan-type dripshield on top and with open bottom.

Dripshield extends four inches beyond front of load interrupter switch. Standard finish: light gray ANSI 61. Furnished with removable conduit cover plates unless otherwise specified.

NEMA type 3R – Rain-proof, outdoor
Intended for use outdoors to protect the enclosed equipment against rain. They are not dust-proof, snow-proof nor sleet proof (ice-proof). Optional lights and receptacles available. The non-walk-in enclosure consists of a specially constructed, fully gasketed section with a mating framework, which supports the labyrinth-type sloped roof and extended front. Extended front is not standard, it is option at an additional cost. The enclosure is designed for bottom cable entry and exit but top entry and exit is also available. Mesh filters are included on the ventilation louvers and the enclosure is equipped with a 90° door with wind stop and a three-point door latch. Thermostatically controlled space heaters and 4" floor channels are provided as standard.

AC power bus system
This bus is available in ratings of 600, 1200, and 2000 amperes and may be tin-plated copper, silver-plated copper or bare copper. The horizontal bus is rated 95kV basic impulse level. Mechanical strength under short-circuit currents are 25 kA RMS symmetrical for 40 kA switch, or 38 kA RMS symmetrical for 61 kA switch.

Ground bus system
The ground bus is normally located near the AC power bus on the inside rear of the enclosure. The bus provides a common termination point for all ground connections within each switch section, including the enclosing case, and offers a convenient terminal for incoming ground cables. It should be noted that the customer must make a suitable ground connection to the bus in order to make it effective. When ground bus is not provided, the ground connection may be made to the ground stud provided.

Control bus system
Control (wired) bus is a convenient means of conducting control power throughout a group of switches joined together in a lineup. Conductors from a single control power source may be terminated in one unit in the lineup and the control bus employed to distribute the power to each unit of the grouped lineup. Control bus may also be used to distribute the power from a single control transformer located in the lineup.

Control bus normally consists of properly sized insulated wire conductors run between terminal boards. Standard voltage for control bus is 120 or 240 volts AC and maximum current rating is determined by application, such as total present and anticipated future load.

Enclosure options

Space heaters
Space heaters are used to prevent moisture condensation on the inside of the load interrupter switchgear. One heater (62.5 watts at 120 V AC) is installed in the bottom of each vertical section. UL requires space heaters be controlled by a thermostat. One thermostat can control up to 23 heaters and is located in the top horizontal wireway.

A terminal board for connecting an external 120 Vac power source is standard.

The terminal board is located in the top horizontal wireway adjacent to the thermostat(s).

This is recommended since it permits the space heaters to be energized even when the load interrupter switchgear itself is de-energized. If export crating is involved, the space heater circuit can be wired to an external plug for energizing the heaters during shipment and storage.

When specified, space heater power can be provided from within the load interrupter switchgear.

Bottom plates
Plates bolt on to the bottom of each load interrupter switchgear section. They may be removed to facilitate installing conduit.

Extended height pull box (top hat)
A pull box can be mounted on top of a vertical section when specified. The standard height is 12 inches; 6-, 18-, and 24-inch heights are also available. Top, front, and end covers are removable for access.

Rodent barriers
Metal plates bolted to the bottom of each end section to close the opening between the front and rear floor sills. Not required if the floor sills will be removed or embedded in concrete.

Configurations

The complete line of BreakMaster load interrupter switches can fill most distribution system requirements. They are available in a variety of configurations to meet specific distribution needs, including single switches, duplex switches, and line-ups. Motor operators, customer metering and outdoor construction are also available.

Table 5: Standard configurations

Standard configuration features	Single	Duplex	Line-up
35" width	•		
70" width		•	
90" indoor height, 99" outdoor height	•	•	•
50" depth standard (includes arrester if required), 60" depth available	•	•	•
Available section widths: 55" mains/tie; 35" branches; 20" / 35" incoming terminal compartments; 20" / 35" / 40" auxiliary sections			•
Extension required for oil-filled transformers only (18" wide)	•	•	•
Dry type and cast coil transformers require 3" in throat for outdoor enclosure	•	•	•
Key interlocking standard between switches and fuse compartment		•	

Weights and dimensions

BreakMaster load interrupter switches vary in weight by configuration type and construction. The approximate weight for estimating purposes is included in Table 6.

Table 6: Typical weights

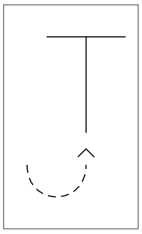
	Weight (lbs.)	
Configuration	**NEMA 1**	**NEMA 3R**
Single	1200	1550
Duplex	2500	3200
Mains/Ties	1800	2400
Branch	1200	1550
20" wide incoming cable	600	850
35" wide incoming cable	1050	1400

Cable terminals

Terminal lugs for both line and load cables are not supplied unless specified. Mechanical compression lugs or NEMA 2-hole compression-type lugs can be supplied as options. The customer must specify the number and size cable when lugs are to be supplied by ABB.

Incoming cable section

The incoming section provides an optional cable-entrance compartment and can be 20”W or 35”W.



Incoming

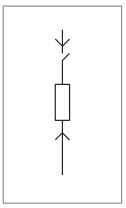
20”W Incoming
Can have top or bottom cable entry. Arresters are available to be installed only for Top Entry configuration. This meets front access only and front and rear access. Can be 50”D or 60”D and configured to feed to left or to right side.

35”W Incoming
- **Can be configured as center tap (bus provisions to extend to both sides)**
  This option can be set up with top or bottom cable entry. Arresters available on both options. CTs, PTs and CPTs available to be installed on it (PT and CPT can’t be installed at the same time). 50"D available, 60”D required for PT or CPT installation. LV box with meter or relay can be provided. This option allows more space for lugs for cable entry due to bigger lug strap included

- **Or to feed to one specific side (left or right)**
  This option can be set up with top or bottom cable entry. Arresters available on both options. CTs, PTs and CPTs available to be installed on it (PT and CPT can be installed at the same time). 50"D available, 60”D required for PT or CPT installation. LV box with meter or relay can be provided.

Transition section
BreakMaster can be close-coupled to transformers and switchgear by a transition compartment to make a continuous lineup. The transition compartment is normally 20 inches wide; however, this can vary.

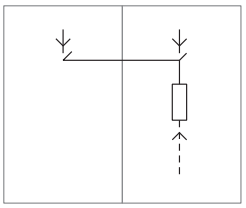
Single switch
The single switch section provides ON/OFF switching utilizing one load break switch section (fused/non-fused) that can be configured as stand-alone (cable in/out) or with transition to incoming line side and bus bar connection for transformer for load side.


Single

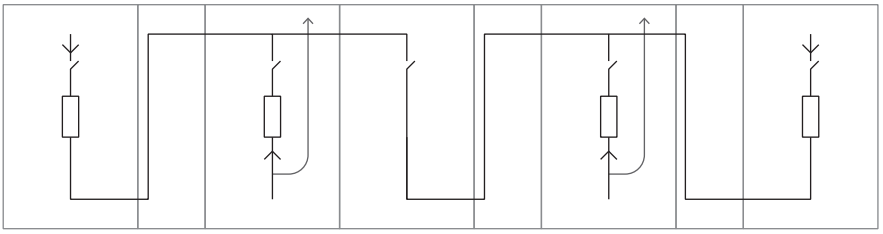
Duplex switch
The duplex switch provides on/off switching, utilizing two load break switch sections (one fused, one unfused) connected to a common load. Mechanical interlocks (key interlocks) prevent both switches from being closed at the same time.

The duplex switch functions as a switch between two power sources, such as a primary and auxiliary power source.

The features of a duplex switch include:
- Two sections 35-inches wide, connected together
- One set of power fuses
- Four key interlocks included as standard


Duplex

Lineups
Features of a line-up include:
- 600, 1200, and 2000 A horizontal through bus
- Incoming line sections, main, tie (non-fused), branch switches, auxiliary (both bused and un-bused), and transitions to other equipment are available
- Utility metering compartments are available as a factory-priced item
- All sections are front and rear aligned. Main sections are always 35 inches wide and require a 20-inch transition to branch switches
- It offers a low-cost alternative to other types of switchgear


Line-up (main-tie-main)

Enclosure outline dimensions
Single switch NEMA 1

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Front view with and without covers

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06
Side view without covers

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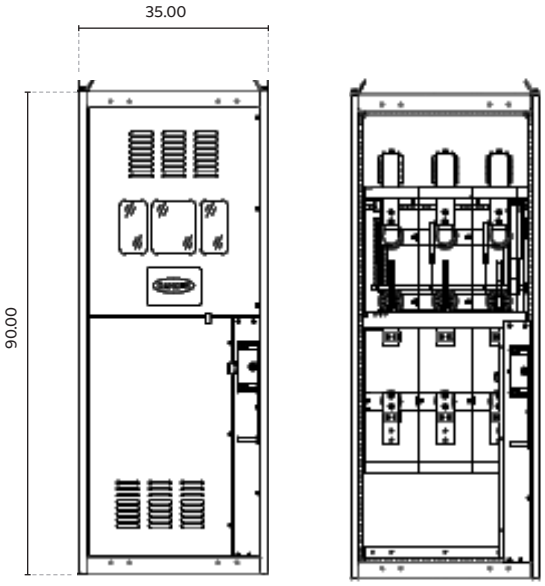
07
Right side view



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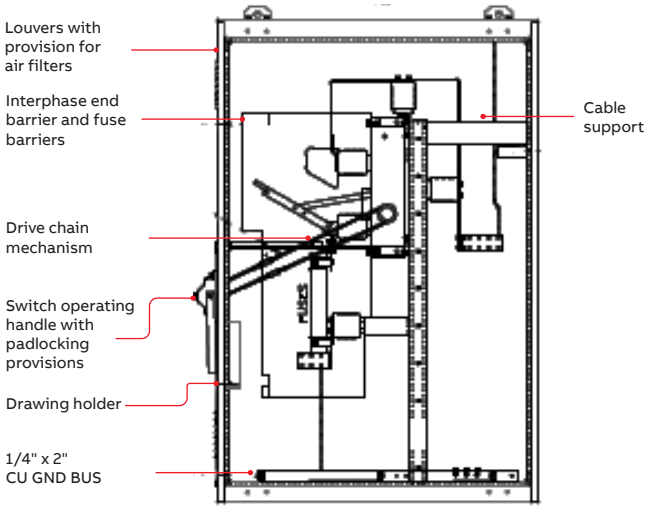

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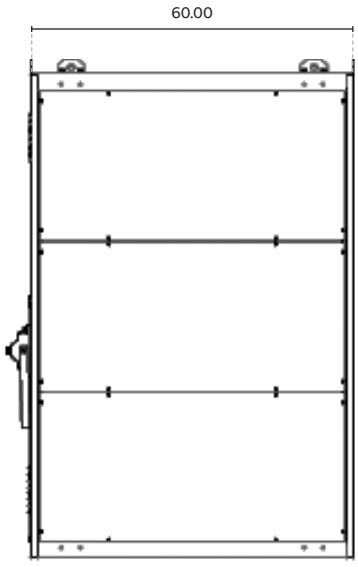

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Rear view

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09
Enclosure front top view

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Fastening floor detail: without scale

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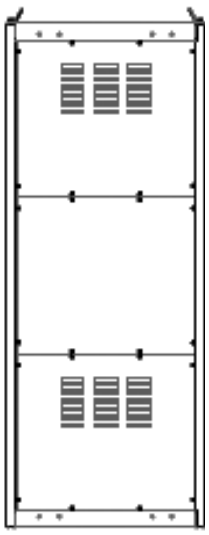
11
Section A-A partial front view



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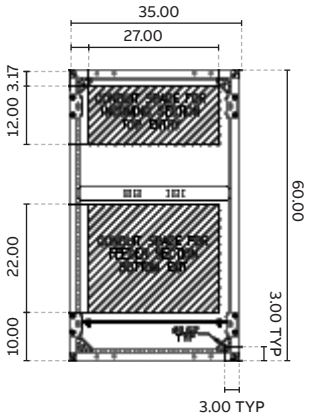

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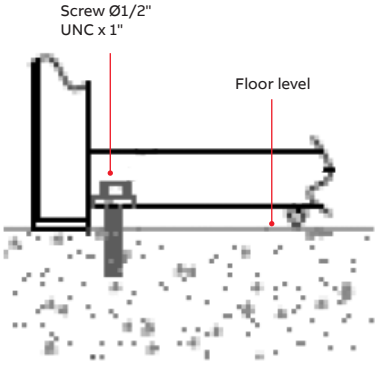
NOTICE

Notice: If anchor bolts are to be embedded in the foundation, they must be located according to the drawing furnished by ABB for the specific equipment. Anchor bolts should be 1/2 inch diameter, of Grade 2 steel (minimum) in non-seismic locations. Bolts must extend a minimum of 2 11/32 inch above grade to 3/4 inch above the floor channel.

NOTICE

Notice: For seismic applications, use 1/2-inch x 13 TPI, grade 5 bolts, torqued to 50 foot-pounds, located in each of the four corners in each section.



Anchoring front

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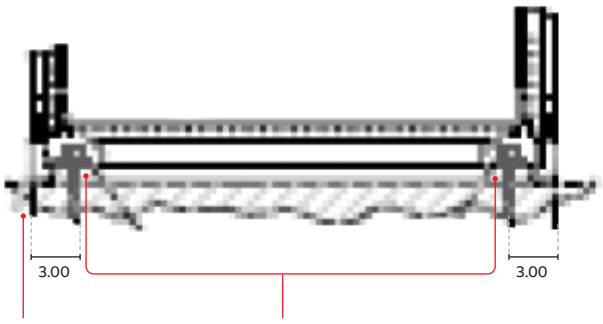

Note: Grouting gusset is 1" above floor line. Sufficient bolt length must be allowed.

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Enclosure outline dimensions
Single switch NEMA 3R

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Front view with and without covers

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Side view with covers

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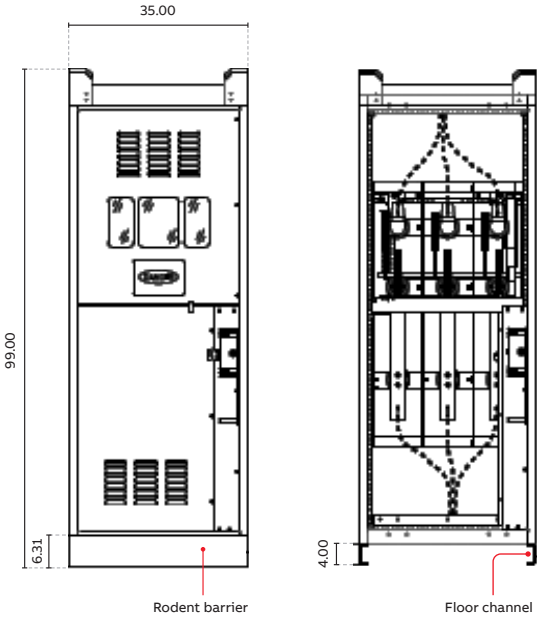
14
Side view



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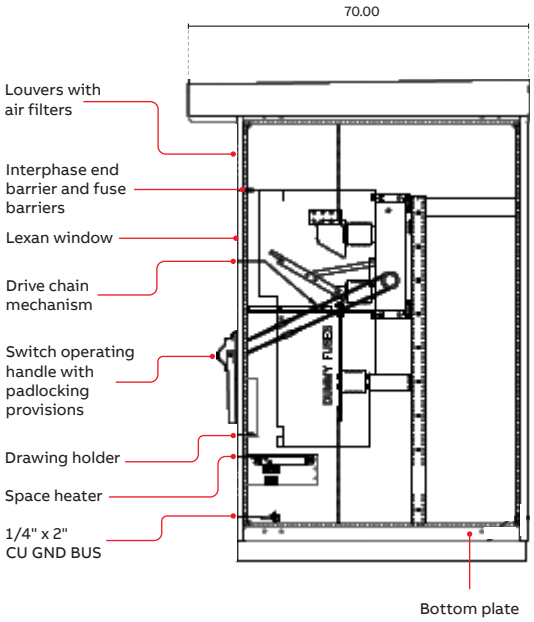

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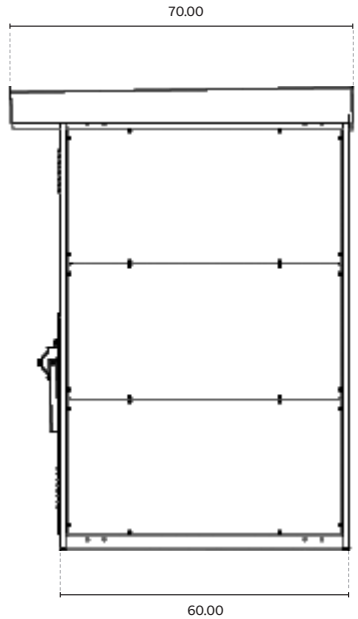

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Rear view

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Enclosure front top view

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Fastening floor detail:
without scale

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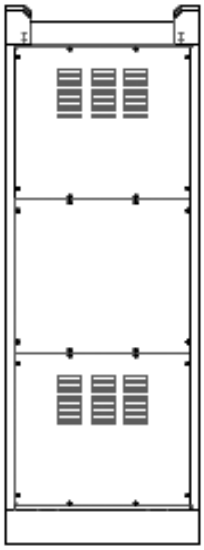
18
Section A-A partial
front view



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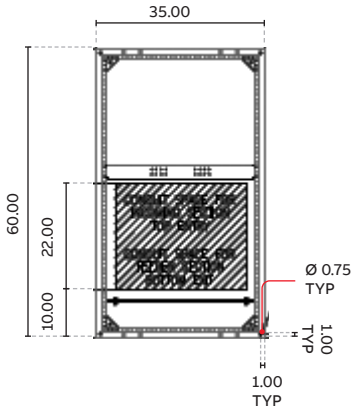

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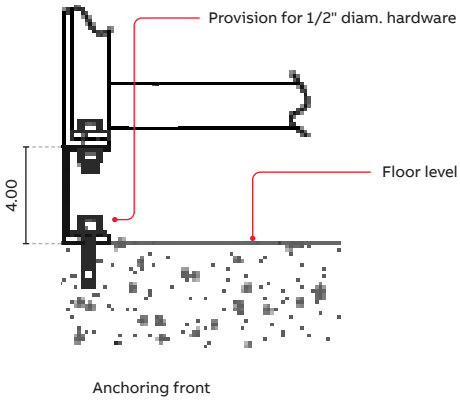

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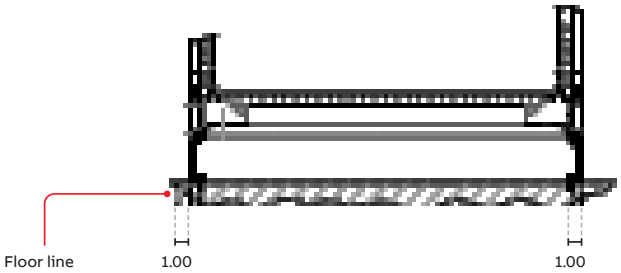

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Enclosure outline dimensions
Duplex switch NEMA 1

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19
Front view

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20
Front view without covers

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21
Side view without covers SEC 1

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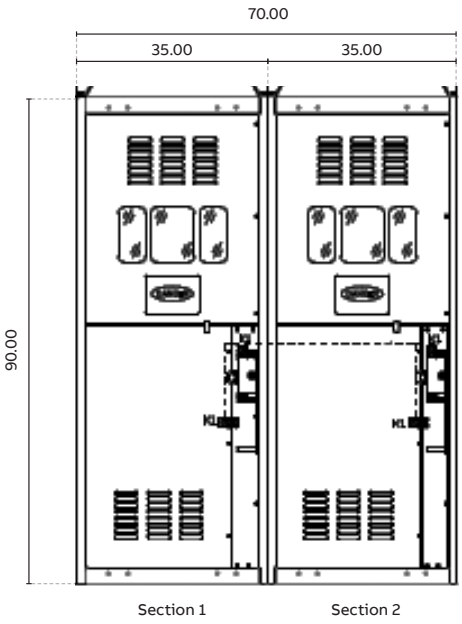
22
Side view without covers SEC 2



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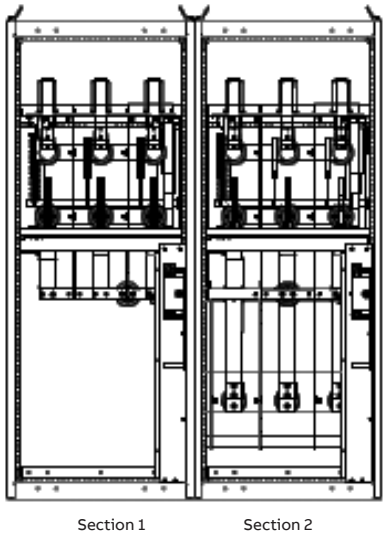

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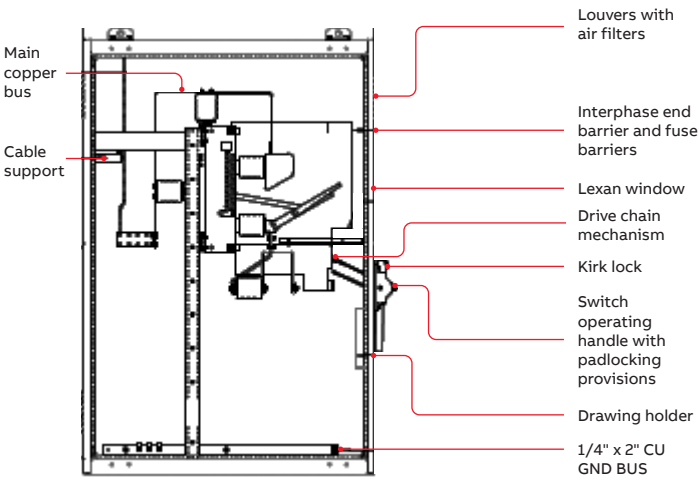

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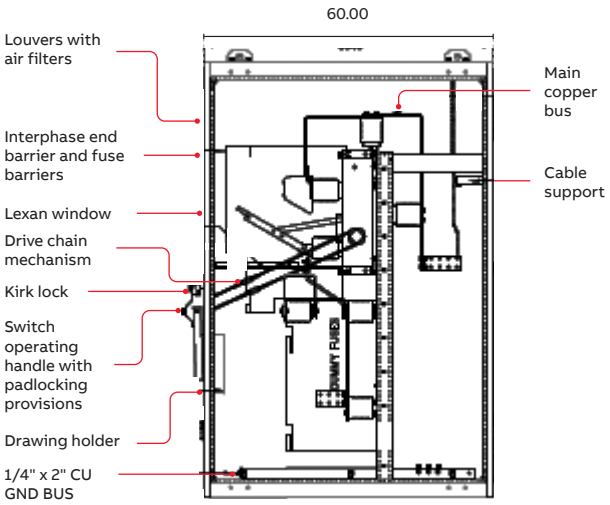

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23
Rear view

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24
Enclosure front top view

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25
Fastening floor detail: without scale

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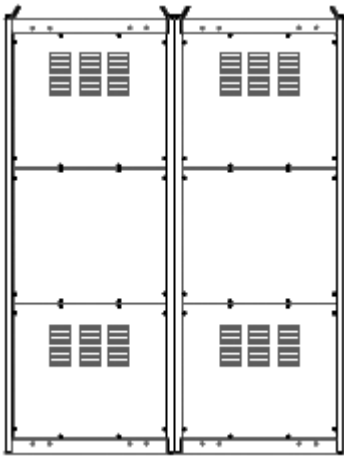
26
Section A-A partial front view



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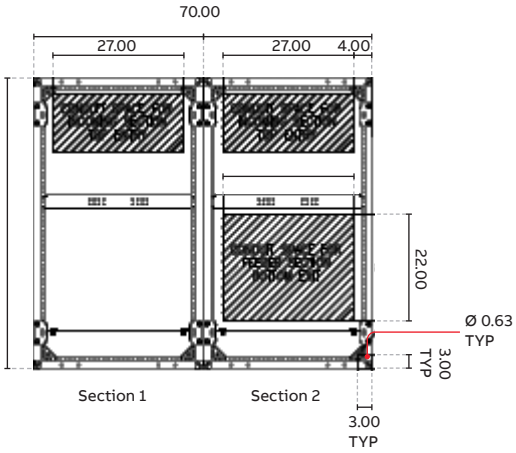

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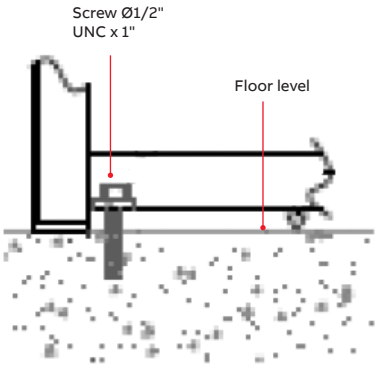

Anchoring front

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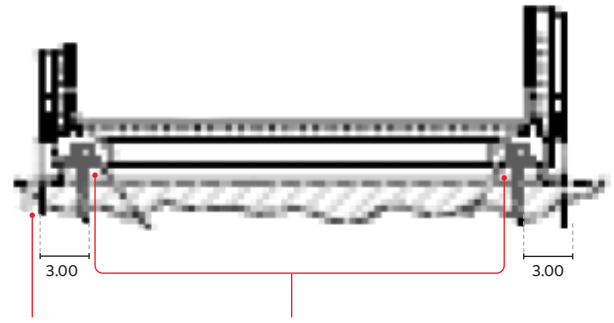

Floor line

Note: Grouting gusset is 1" above floor line. Sufficient bolt length must be allowed.

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26

Enclosure outline dimensions
Duplex switch NEMA 3R

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27
Front view

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28
Front view without covers

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29
Side view without covers SEC 1

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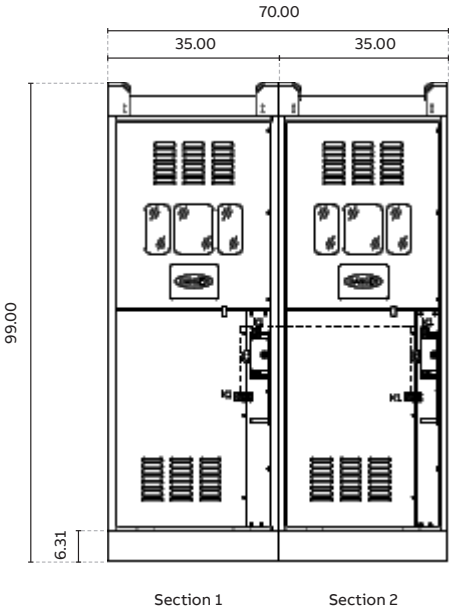
30
Side view without covers SEC 2



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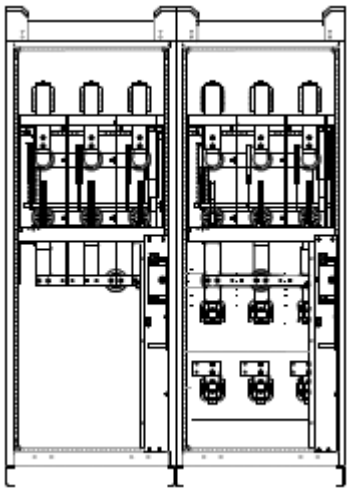

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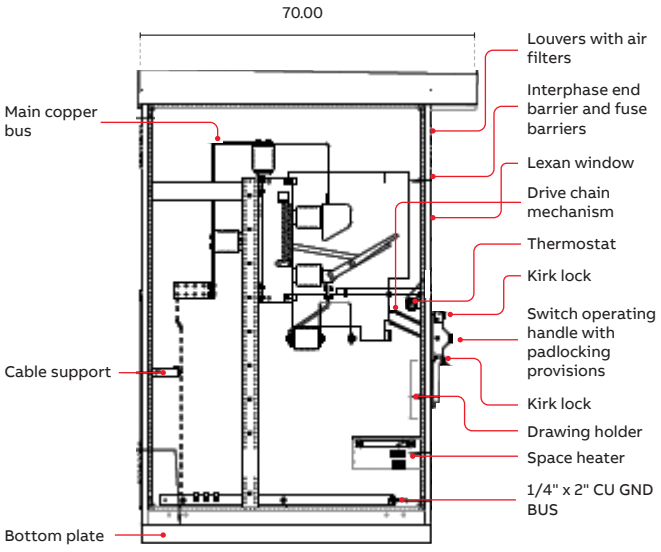

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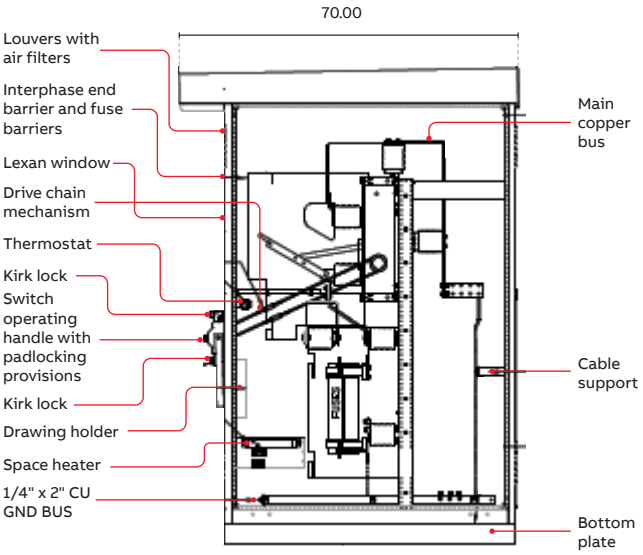

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31
Right side view

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32
Enclosure front top view

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33
Fastening floor detail:
without scale

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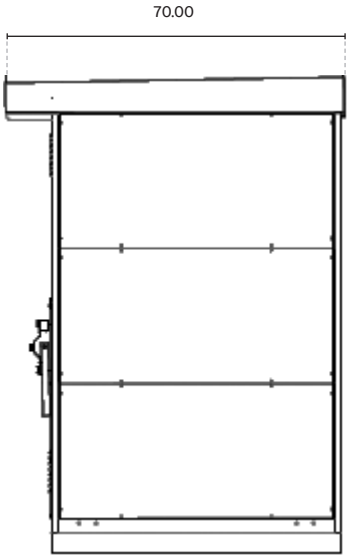
34
Section A-A partial
front view



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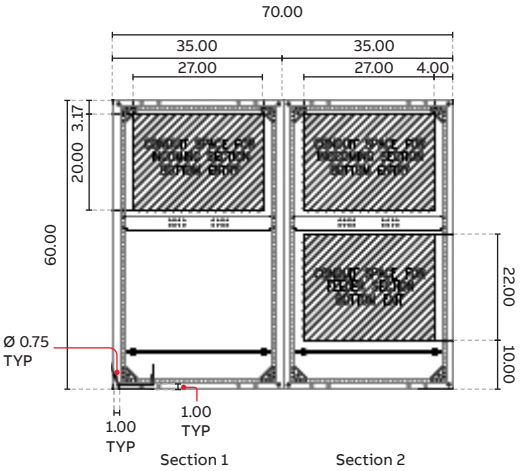

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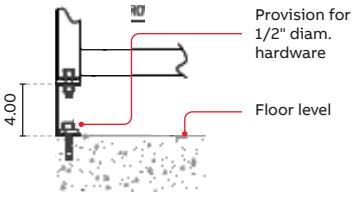

Anchoring front

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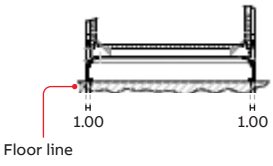

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Enclosure outline dimensions
Typical lineup NEMA 1

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35
Single line diagram

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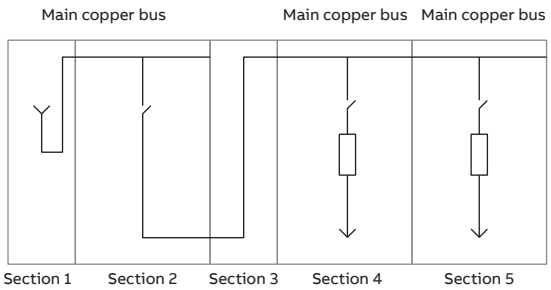
36
Front view



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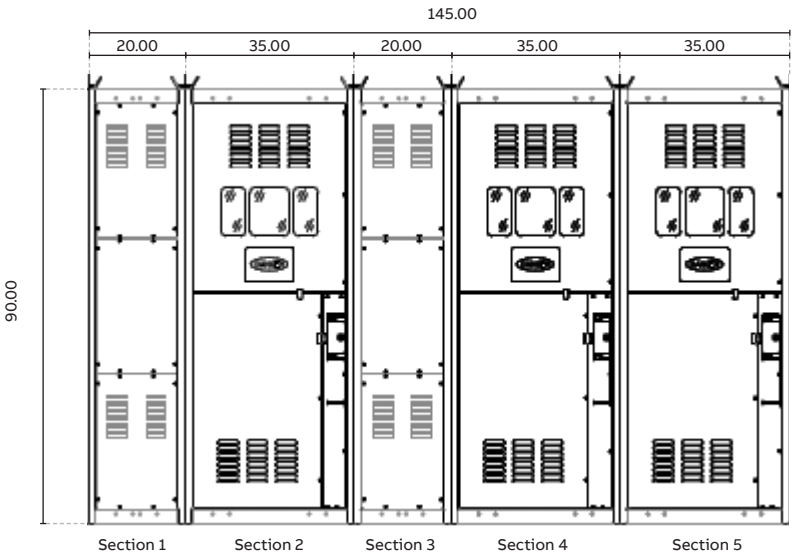

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37
Front view without covers

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38
Enclosure front top view

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39
Fastening floor detail: without scale

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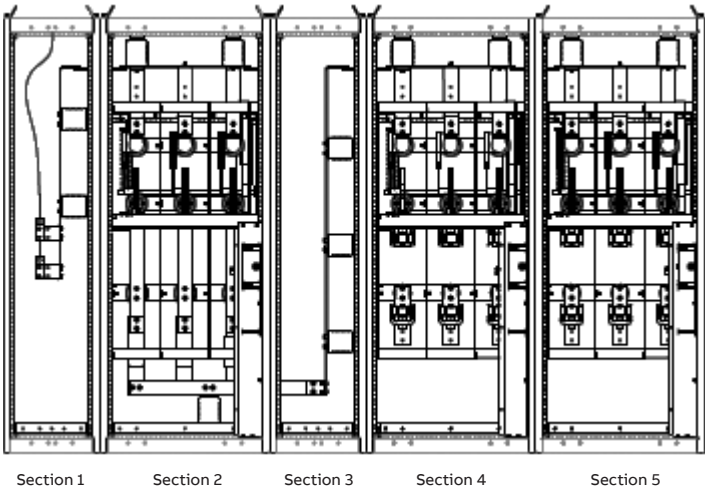
40
Section A-A partial front view



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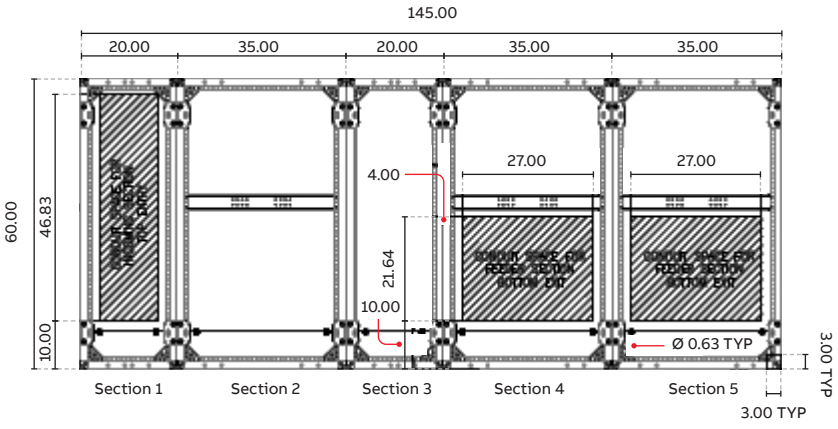

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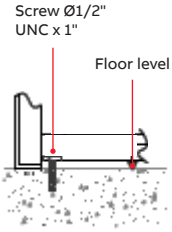

Anchoring front

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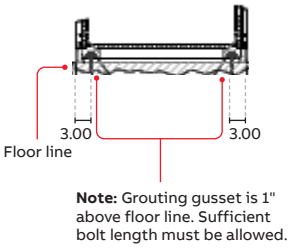

Note: Grouting gusset is 1" above floor line. Sufficient bolt length must be allowed.

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Enclosure outline dimensions
Typical lineup NEMA 3R

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41
Front view

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42
Single line diagram

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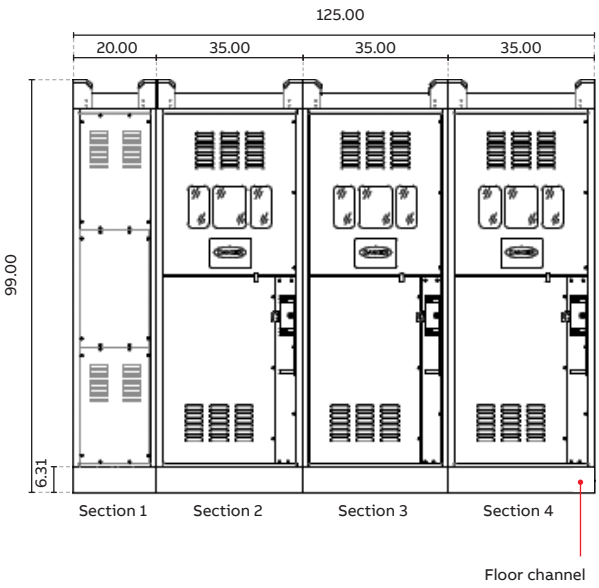
43
Front view without covers



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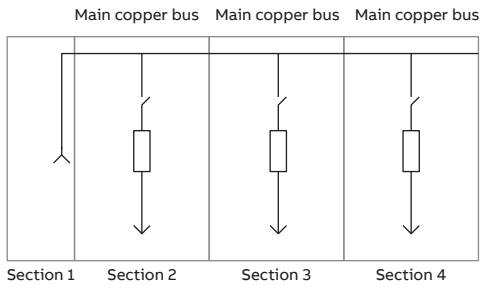

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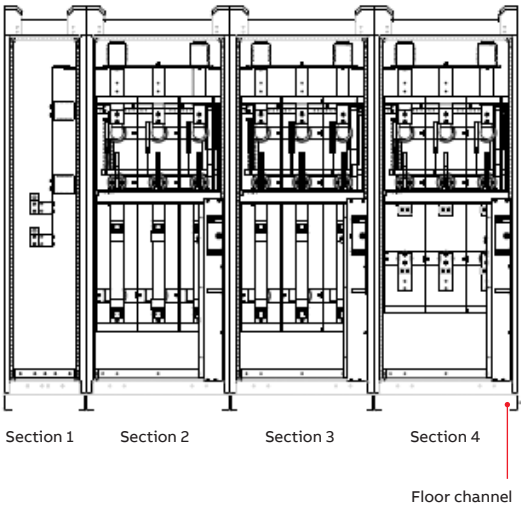

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44
Rear view

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Enclosure front top view

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46
Fastening floor detail: without scale

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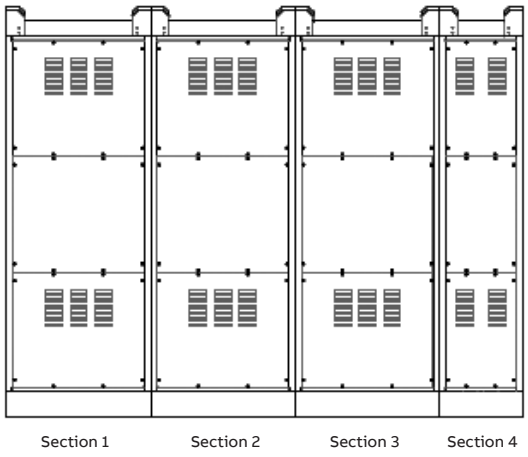
47
Section A-A partial front view



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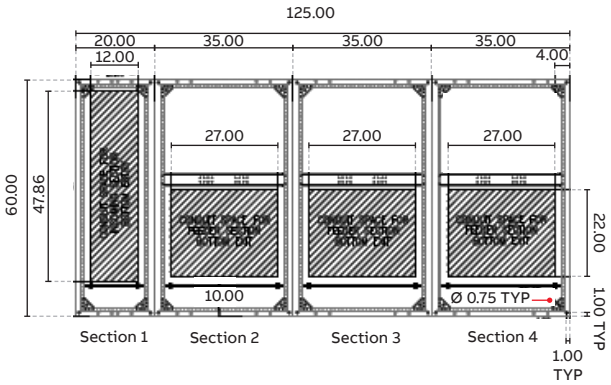

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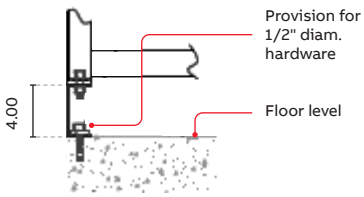

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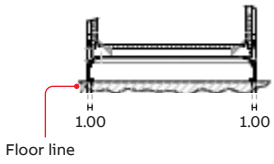

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VersaRupter® switch

VersaRupter® is a general purpose, three-pole, loadbreak switch that offers switchgear owners and assemblers the benefit of an advanced interrupting technology and proven, dependable performance in a compact design.

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48
VersaRupter
switch

Product highlights

- Puffer arc extinguishing system allows for a high number of operations without excessive wear
- Latches are not dependent on gravity which allows for flexible mounting arrangements
- Tight phase spacing without the requirement for inter-phase barriers on a majority of ratings
- Compact operating mechanisms available in stored energy or snap action varieties
- Compact motor operator provides local or remote control of VersaRupter

The standard VersaRupter switch includes a heavy-duty steel frame with stand-off insulators, a unique puffer type arc extinguishing system, an operating mechanism and current-carrying components, including blade-type interrupters with cast hinges and jaw connectors. Optional accessories and features include a variety of operating handles, a motor operator, auxiliary switches, a shunt trip device, mechanical door interlocking and key interlocking.

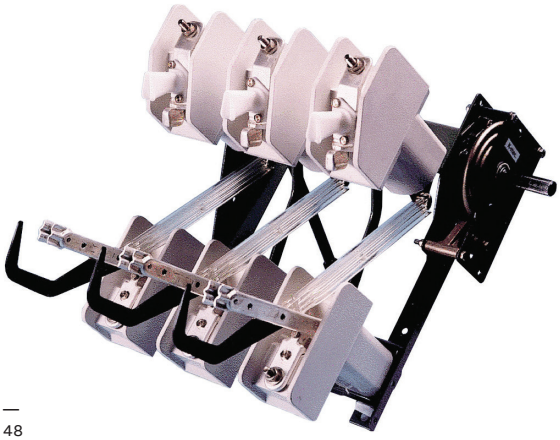

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Table 7: VersaRupter at a glance

Applications	**Metal-enclosed switchgear for utility distribution, industrial, mining and commercial installations**		
	Voltage	**Loadbreak current**	**Momentary**
Ratings	4.76-15 kV	600A	40 kA momentary / 40 kA fault close
	4.76-15 kV	1200A	61 kA momentary / 61 kA fault close
Standards			IEEE C37.20.4 (2001 and 2013) IEC 60129, 60254, 60265, 60694, 420, 62271-105 UL and CSA listings available for specific ratings
Actuators			Manual operation with choice of chain drive, side direct drive, or HE/HM shaft drive Optional motor operation, optional shunt trip with A-mech only
Options			Auxiliary switches, key interlocks
Quality			ISO-9001 Complete design type test certificates available upon request Switches are tested to a minimum of 1,000 mechanical operations, 100 open/close operations up to 600 A, and 20 open/close operations at 1200 A

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49
K-mechanism

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50
A-mechanism

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51
Arc extinguishing puffer system

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52
Front chain drive handle

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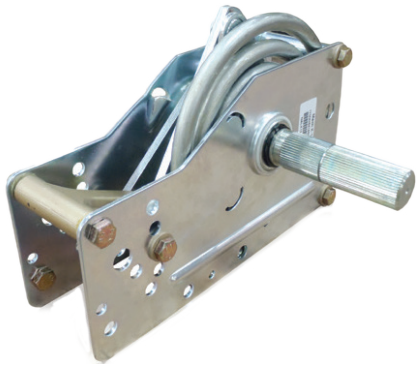
Table 8: VersaRupter switch - technical details

Rated Voltage (kV)	Rated maximum voltage (kV)	Rated current (A)	BIL (kV)	60 Hz withstand 1 minute (kV)	Pole spacing (in/mm)	Momentary asymmetrical (kA)	Fault-making asymmetrical (kA)	Short time current symmetrical (kA/sec)
13.8	15	600	95	36	9.25/235	40	40	25/2
13.8	15	1200	95	36	9.25/235	61	61	40/3

Snap action K-mechanism

The K-mechanism is a single spring snap action device. The switch opens or closes by charging the spring past dead center using one of the manual operating handles. The K-mechanism may be used with all handle options as well as with type NM motor operators. The K-mechanism cannot be used for shunt trip or fuse trip applications. Use K-mechanism if you need chain drive or front direct drive handles.



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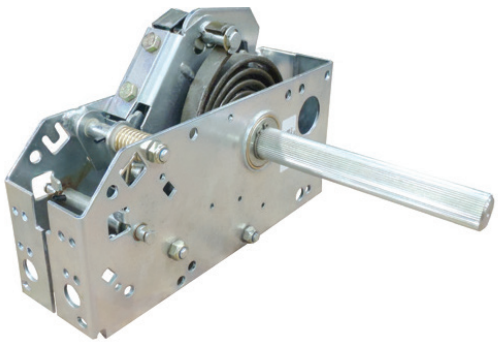
Stored energy A-mechanism

The A-mechanism is a dual spring stored energy device that is well suited for remote tripping applications. When shunt tripping or mechanical fuse tripping is specified, the type A-mechanism must be used. In closed operation, the opening spring is charged and latched by an operating handle or by a motor operator. The VersaRupter is then opened by any of several methods:

- Movement of the operating handle
- Motor operator
- Electrical signal to a shunt trip device



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Arc extinguishing puffer system

The puffer arc extinguishing system allows for a high number of operations without excessive wear with the following:

- Ablative arc chutes react to quench the arc
- A balanced combination of air and gas reliably extinguish the arc
- Extended operations at full rated current
- 100 operation at full rated current vs. 10-20 when relying on ablative chutes only
- Less maintenance required due to reduced wear on arc chutes
- Eliminates the need for interphase barriers on most ratings

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51

Front chain drive handle

- Kirk Key provisions
- Padlock provisions
- Door interlock optional
- K-mech only

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52

— 53 HM front direct drive (motor) handle

— 54 Auxiliary switch

— 55 Shunt trip

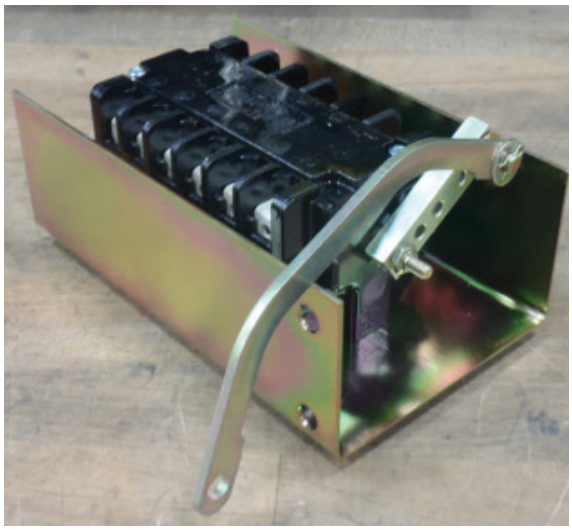
HM front direct drive (motor) handle

- Padlock provisions
- Kirk key and door interlock optional
- K-mech or A-mech

— 53

Auxiliary switch

- Changes state when the VersaRupter changes state via a mechanical linkage connected to the jack shaft
- Can be installed on all VersaRupter ratings
- Shipped with an equal number of NO and NC contacts which can be reconfigured in the field
- Must be ordered and wired in series for shunt trip applications
- Available with 6 contacts (3 NO/3NC)



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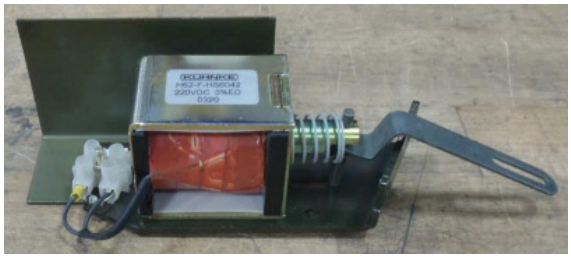
Shunt Trip

- Actuates the trip latch on the A-mech
- Can only be used on A mech
- Activate by local push button or remote
- Intermittent duty coil
- Auxiliary switch must be ordered and installed in series to remove power after VersaRupter change of state
- Can be used on all VersaRupter ratings with A mech
- Only 110 VAC or 125 VDC available on BreakMaster product



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— **Table 9: Technical data shunt trip device**

		Average current (Amps)			
Nominal coil voltage	**Voltage range**	**IN**	**Istart**	**Power (VA)**	**Resistance**
110 VAC	-15% to +10%	2.7	5.0	300	79 +/- 15%
125 VDC	-15% to +10%	1.4	1.4	155	79 +/- 15%

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56
NM motor operator

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57
Spacer mounting bracket

NM motor operator

- Provides remote or local electrical opening of the VersaRupter
- Installed directly on the operating shaft of the VersaRupter
- Mounted on left side of switch and comes with shaft extension
- Can be used with either A-mech or K-mech
- Must use HM handle if manual operation is desired
- Motor mechanically disconnects after every operation to manually operate the VersaRupter if necessary
- Spacer mounting bracket must be ordered separately dependent upon switch rating and desired mounting location
- Only 110V AC/DC available on BreakMaster product

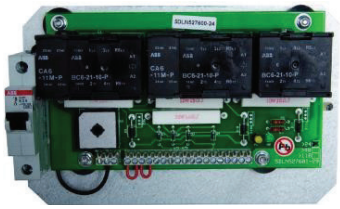

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Table 10: Technical data NH motor operator

Voltage AC/DC ±10%	**110V**
Current (A)	0.8
Power consumption (W)	85
Operating time (sec)	~4
Operating temperature (°F)	-40 to 134
Signaling time (sec)	0.5 - 2.0
Weight (lbs) (kg)	13.2 (6)
Operating voltage AC (V)	77-137
Operating voltage DC (V)	99-150

Protection and control

Surge protection
Overvoltage damages reduce the insulation life. There are many causes of accidental overvoltage whose effects may be reduced by protective means. The most prominent causes are:

- Lightning
- Physical contact with higher voltage system
- Repetitive restrike (intermittent grounds)
- Switching surges
- Resonance effects in series inductive capacitance circuits

Switching transients occur in every electrical system. Additional protection against surges may be economically attractive for system voltage installations of 2300 volts and above. This consists of a surge capacitor and lightning arresters. Lightning arresters reduce the amplitude of the voltage impulse wave. The surge capacitor further reduces the amplitude - but in addition, reduces the steepness of the wave front. Arresters may require a 20-inch wide auxiliary enclosure.

Shark 100 power meter

High accuracy power and energy measurement

Overview

Shark 100 is one of the industry's highest performance revenue grade panel meters. Based on an all new platform, this low-cost meter significantly outperforms other devices many times its price. This unit is perfect for new metering applications and as a simple replacement of existing analog meters.

Applications

- Continuous metering of electrical loads such as generator panels, feeders, switchgear etc.
- Provides remote status when used with EnerVista suite of software
- Low and medium voltage applications
- Replaces multiple analog meters saving space and installation costs

Key benefits

- High accuracy multifunction power meter
- Superior performance at competitive pricing
- Ultra compact, easy to install, program and use
- 0.2% class revenue certifiable energy and demand metering
- Total harmonic distortion (%THD)
- Fits both ANSI and DIN cutout
- Large 3 line .56 inches bright LED display for better visibility and longer life
- User programmable for different system voltages and current measurements
- Standard Modbus and DNP communications
- Optional Ethernet port for simplified integration into onto new or existing LAN infrastructures and multi-point connectivity

Features

Monitoring and Metering

- True RMS multifunction measurements including voltage, current, power, freq., energy, etc.
- Meets ANSI C12.20 (0.2%) and IEC 687 (0.2%) accuracy classes
- Future field upgradeable for added functionality, without removing installed meter
- Load percentage graphical bar for instant load visualization

Communications

- RS485 Modbus and DNP 3.0 Protocol up to 57.6K Baud (Serial Option)
- Modbus TCP Protocol through 10/100BaseTX via RJ45 (Ethernet Option)
- 3 Line .56 inches Bright Red LED Display
- Front IrDA Port laptop communication
- Pulse output for accuracy testing and energy

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58
Shark 100
power meter

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58

Shark 200 power meter

Power quality and energy cost measurement

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59
Shark 200
power meter

Overview

The Shark 200 meter provides revenue class (0.2%) three phase power metering with optional Ethernet, relay, status, and analog output communication modules. This flexible meter can be used for a wide range of high accuracy applications including disturbance recording and power quality studies.

Shark 200 can easily be mounted in a panel for generator monitoring, substation automation, power quality studies, data recording and more. The meter can also provide data to RTUs, PLCs and other control devices.

The Shark 200 is a highly accurate meter providing 0.1% accuracy for Voltage and Current. The unit's real-time clock provides time stamping of all logs as they are created. Up to 4 MB of data can be logged for analysis of historical trends, limit alarms, I/O changes power quality recording and sequence of events.

Applications

- Four quadrant energy and power monitoring of distribution feeders, transformers, reactors and generators
- Power monitoring of LV and MV industrial power control centers and motor control centers
- Energy monitoring of commercial and distribution utilities

Key benefits

- Four Quadrant Energy and Power Measurement, complying with ANSI C12.20 (0.2% Accuracy)
- Analyze power quality over long periods of time to improve network reliability through high resolution event and disturbance recording
- Ideal for monitoring industrial power centers, data centers and hospitals due to high accuracy disturbance recording (up to 512 samples/cycle)
- Retrieve archived data, capture past events and analyze disturbances through high resolution data recording (up to 4MB of data logging)
- Flexible communication options provide easy to access meter values, simplified configuration and seamless integration into new or existing automation systems

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Features

Metering
- Meets ANSI C 12.20 and IEC 687 (0.2%) accuracy
- Ia Ib Ic In
- Va Vb Vc Vab Vbc Vca
- Hz W VAR VA
- Wh VARh VAh
- Demand: W VAR VA
- Power factor
- Voltage and current angles
- Load bar

Power quality
- Harmonics to the 40th order
- Total harmonic distortion
- Disturbance recording and waveform capture
- Sag and swell

Data logging
- Up to 4 MB memory
- Disturbance recording
- Power quality studies
- Load studies

Communications
- Standard RS485 Modbus (DNP 3.0 and Modbus RTU or ASCII)
- Optional Ethernet 100BaseT
- IrDA Port
- Intuitive faceplate programming

Software
- Embedded web server
- Communicator
- Enervista integrator
- Enervista launchpad

PQM II power quality meter

Power quality and energy cost management

Overview

Multilin has set a new standard in metering technology with the introduction of the PQM II. This meter, designed on the latest industry specifications, provides accurate and reliable three-phase power metering with an optional Ethernet and fiber communications module in a small and modern package. The PQM II can be used for a variety of applications including metering of distribution feeders, transformers, generators and motors.

Applications

- Metering of distribution feeders, transformers, generators, capacitor banks and motors
- Medium and low voltage systems
- Commercial, industrial, utility
- Flexible control for demand load shedding, power factor, etc.

Key benefits

- Power quality metering with waveform capture and historical data logging
- Easy to program and use with keypad and large illuminated 40 character display
- Multiple communication ports for integration with DCS and SCADA systems
- Supports DNP 3.0 and Modbus protocols
- Digital and analog I/Os for control and alarms
- Voltage disturbance recording capability for electrical sag and swell events

Features

Monitoring and metering

- Ia Ib Ic In
- Va Vb Vc Vab Vbc Vca
- V I unbalance
- True PF crest and K factor
- Hz W var VA
- Wh varh VAh W cost
- Demand: A W var VA
- Harmonic analysis through 63rd with THD and TIF
- Event recorder - 150 events
- Waveform capture
- Data logger -98,000 events
- Voltage disturbance

Communications

- Front RS232 serial port (1,200 to 19,200 bps)
- Two rear RS485 serial ports with ModBus and DNP 3.0 protocol
- Ethernet connectivity provided by MultiNet
- EnerVista software is provided for setup and monitoring functions
- External dial-in modem capabilities

Protection and Control

- A V W var VA varh Wh PF Hz unbalance
- A W var VA demand
- Load shedding
- Power factor control
- Pulse input totalizing

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PQM II power quality meter

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Three-phase voltage monitors
Model SPVRB

General
UL Listed file No. E103039. The model SPVRB Voltage Sensing Relay is designed to protect against single phase, phase loss, phase unbalance, and phase reversal in a power system. The output contacts change their normal state only when a single phase, phase loss, phase unbalance, or phase reversal occurs for longer than the preset trip delay. A total power loss or de-energization of the SPVRB relay will not change the output contact's position. Recommended for manual reset switches and breaker applications. The SPVRB is suitable for loss of phase with motor loads.

Features
- Phase unbalance: 8%
- Adjustable Trip Delay: 1 to 10 seconds after failure occurs, prevents nuisance operations
- Output Relay: normally de-energized, form C contacts for easy circuit configuration
- Electro-mechanical indicator: retains memory of fault until manually reset
- Door or panel mounting
- Status Indicator: bi-colored LED
  - Green: Output relay de-energized (normal condition)
  - Red: Output relay energized (fault condition)
  - Dark: Output relay de-energized (input power off)
- Single phase, phase loss protection, phase unbalance, and phase reversal
- Automatic or Manual mode
  - Automatic mode: Upon removal of fault conditions, relay automatically resets to normal
  - Manual mode: Upon removal of fault conditions, relay resets to normal after local or remote reset button has been pressed

SPVRB - XXX

Input voltage:
120/208/240/480 or 575 Vac, (60 Hz)
380 or 415 Vac, (50 Hz)

[1] Bi-Colored LED Indicator
- Power system condition Normal (Green), Trip (Red)

[2] Electromechanical Diagnostic Indicator
- Phase loss

[3] Adjustable System Delay
- Phase loss
- Phase unbalance
- Single phase
- Phase reversal
- Under and over voltage

SwitchgearMD™
Asset health monitoring

SwitchgearMD™ offers monitoring and diagnostic solutions for temperature, humidity and partial discharge for switchgear up to 27 kV. Users can expect 24x7 continuous monitoring of equipment with the ability to monitor onsite via the SWICOM HMI or through a SCADA system. This enables maintenance personnel to safely identify and repair problems before equipment failures, reducing outage times and increasing reliability.

These solutions can be used on conventional or digital switchgear. There are two different sensor solutions available:

- Wireless solution for temperature, humidity and PD monitoring - SAW sensors - UHF measurements
- Wired solution for temperature and humidity monitoring - IR sensors

Sensors are available with new switchgear or retrofit applications.

Sensors used for temperature monitoring include both infrared sensors and surface acoustic wave (SAW) sensors. Both sensor options allow for real-time monitoring. When employing infrared (IR) sensors, a line of sight is required by the sensor. The infrared measurement is based on temperature rise over ambient (ΔT). This eliminates variances in panel-to-panel or site-to-site comparison. The reading is a mV output signal that is transmitted to an onsite SWICOM HMI or via control system.

IR sensors consist of a non-conductive plastic body, hermetically sealed and fully potted, that does not change mechanically or metallurgically during its service life. There are no active electronic components and no power source other than the thermoelectric effects that produce the temperature signal. Sensors have a lifetime calibration and are UL recognized and CE certified.

The other sensor type for temperature and partial discharge monitoring is a surface acoustic wave (SAW) sensor. SAW temperature sensors are wireless, surface-mount, passive components. There are no active electronic components and no power source required.

The embedded piezoelectric SAW transducer element converts a small electrical current to vibrations and then back to an electrical signature correlated to temperature. The sensor has an internal Antenna that reflects a wireless RF signal to the external Antenna. The external Antenna is passive and receives RF signals from the Transceiver. The Transceiver is active and powered by 24V DC supply to generate RF signal that the Antenna transmits.

The Radio Frequency Transceiver provides remote interrogation of multiple wireless passive SAW sensors (up to 12 sensors in 1 cubicle with 2 pairs of antennas, or 6 sensors in 3 adjacent cubicles, with 1 pair of antennas in each cubicle). This device is compact and mounted within the low voltage compartment.

The ABB standard solution is to monitor all outgoing/incoming cable connection points using the IR sensors.

When Partial Discharge (PD) monitoring is required along with temperature and/or humidity monitoring, the wireless SAW sensors must be used. If only PD monitoring is required, then only the antennas are provided. The antennas perform the PD monitoring.

Cable temperature ratings

When insulated primary cables are used for outgoing or incoming feeder connections to the switchgear bus, the recommended cable temperature rating is 90°C. The full load current rating for the cable should be based on the 90°C ratings. This is because temperature limits at connection joints for incoming or outgoing cables is limited to a 45°C rise over a 40°C ambient, for a total temperature limit of 85°C. If the bus that the cable is connected to is rated for 1200 A, then the cable size and temperature ratings should not exceed 1200 A at the 90°C temperature rating of the cable.

Using a lower temperature rating, such as a 75°C rated cable, could result in the cable being overheated if the bus connection is operated at full rated current.

Using a higher temperature rating, such as a 105°C rated cable could result in the bus bar connection being overheated if the bus connection is operated at full rated current. When using cables with higher temperature ratings than 90°C, then the cables should be sized at the 90°C ratings for full load current ratings.

Packaging and storage

Domestic packaging
Normally a BreakMaster Lineup is shipped in individual vertical sections for ease of handling. A customer can request shipping splits of 2 or 3 sections maximum. Each section or shipping split is mounted on a hardwood skid to facilitate moving by rollers or fork-lift truck. Lifting eyes are also provided for moving by crane. Shipping blocks are placed on the face of the sections to protect handles and devices. The sections are wrapped in clear stretch polyfilm to protect the equipment from the usual dust and dirt encountered during shipment. Necessary bus splice bars are included for connecting the sections together.

Export crating
The sections are bolted to a skid with a solid floor. The equipment is then enclosed in a 3/8" plywood crate with 2 x 4 reinforcing at the top and corners. Three 1 1/4" steel bands are placed horizontally around the crate for additional reinforcing.

All equipment should be protected against moisture and temperature extremes during shipment and storage (see Environmental Considerations in Overview section). For prolonged shipping periods where export crating is involved, it is recommended the equipment space heaters (when specified) be wired for connecting to an external power source while in transit, to minimize condensation.

Storage
If it is necessary to store the equipment for any length of time, the following precautions should be taken:
1. Uncrate equipment.
2. Store in a clean, dry area at moderate temperature. Cover with a suitable canvas or heavy-duty plastic cover to prevent entrance of foreign material.
3. If equipment must be stored in cool or damp areas, not only should the equipment be completely covered, but heat should be provided to prevent condensation of moisture in the equipment. Energize space heaters (if furnished in the equipment) or place a standard 120-volt lamp rated 75 watts inside the bottom of each vertical section.

Paint finish

Indoor equipment
The standard paint system consists of the following two processes:

Phase I – Cleaning
In a 7-stage spray washer, steel parts are cleaned and sprayed in the controlled cleaning solutions.

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Table 11

Stage	Temperature	Chemical solution(s)
1–Cleaning	115-120°	Ferro clean
2–Rinse	105-118°	None
3–Iron phosphate	90-105°	Secure low foam
4–Rinse	Ambient	None
5–Non chrome sealer	Ambient	Non chrome final seal
6–Rinse	Ambient	None
7–Deionized rinse	Ambient	None

Cleaned steel parts enter a drying oven at 300-350°F. The preceding operating parameters have been determined to produce an Iron Phosphate coating of a minimum of 150 milligrams per square foot to meet MIL Spec. TT-C-490.

Phase II – Painting by electro-static powder process

Primed metal parts are electro-statically coated with a powder paint consisting of the following: 670-011 ANSI-61 Polyester Paint (Light Gray) Metal parts will enter drying oven at 360°F and remain for 10 minutes. The standard color is ANSI-61 light gray with a gloss of 6-12, and a thickness of 2-4 mils. This system will withstand a minimum of 1000 hour humidity test and 1000 hours salt spray tests per ASTM 117B.

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