TECHNICAL AND APPLICATION GUIDE

Advance® and Advance® 27

5, 15 and 27 kV ANSI, metal-clad, non-arc-resistant switchgear

Table of contents

Advance® and Advance® 27
General overview

Advance is ABB's ANSI non-arc-resistant, metal-clad switchgear line for short circuit currents at 63 kA and below and rated maximum voltages of 5 and 15 kV. Advance 27 is ABB's ANSI non-arc-resistant, metal-clad switchgear line for 27 kV applications.

Certifications
The Advance line of metal-clad switchgear is seismic certified to IBC region D with importance factor of 1.5. The manufacturing locations for the Advance line are both ISO 9001 certified. Advance switchgear is available with UL label or as a cUL certified lineup. Advance 27 is available with a UL label only.

Applicable standards
Advance is designed, built, and tested per the IEEE C37.20.2 metal-clad switchgear standard.

Construction
The Advance line is manufactured of hem bent, 14-gauge galvanized steel for superior rust and scratch protection. All non-galvanized steel parts are treated and painted ANSI 61 gray.

The Advance product utilizes many of the same structural designs used in ABB's arc-resistant Safegear product, which provides an extremely robust design.

Using a modular and bolted frame design with 19, 38, 57 or 95-inch compartment sizes, Advance provides highly flexible design configurations and field changes are made easier and faster to reduce downtime.

Outdoor enclosures
The Advance product line can be supplied in outdoor non-walk-in, outdoor sheltered-aisle enclosures or PDC (power distribution center) enclosures for outdoor applications.

Breakers used in the Advance platform
The 5-15 kV Advance platform uses ABB AMVAC and ADVAC breakers. Advance 27 is available with AMVAC breakers only. More details, including ratings tables, can be found in the ADVAC Breaker Technical Guide (1VAL050501-TG) and AMVAC Breaker Technical Guide (1VAL050601-TG).

		Rated maximum voltage level			
Characteristic	**Unit**	**5 kV**	**8.25 kV**	**15 kV**	**27 kV**
Rated nominal voltages	kV	2.4, 4.16, 4.8	4.8, 6.9, 7.2	6.9, 7.2, 8.4, 11, 12, 12.47, 13.2, 13.8, 14.4	20.78, 21.6, 20.86, 23.0, 23.9, 24.94, 28.5***
Main bus continuous current	A			1200, 2000, 3000, 4000**	1200, 2000
Short circuit current (rms)	kA			25, 31.5, 40, 50, 63	16, 25
Rated frequency	Hz			60	60
Low frequency withstand (rms)	kV	19	36	36	60
Impulse level (BIL, crest)	kV	60	95	95	125

* Ratings given are for service conditions within temperature and altitude limitations as defined by the IEEE C37.20.2 metal-clad standard.
**4000 A Ratings are achieved through forced air cooling. Continuous current de-rated to 3850 A when filters are installed at louvered openings.
*** Contact factory if this rating is required.

Instrument transformers
ABB Advance switchgear is available using SAB-1, SAB-1D, SAB 2 and SAB-2D CTs. Up to four SAB-1 and SAB-2 CTs can be fitted per phase. Higher accuracy SAB-1D and SAB-2D CTs are limited to two CTs per phase. SAB-2 and SAB-2D current transformers are used for 3000 A breakers, 4000 A frames and exclusively in the Advance 27 platform.

For ground CT requirements, the Advance line can be supplied with BYZ-S, BYZ-O or BYZ-L ground CTs. The type of CT is chosen based on the necessary window size required for cables and cable bending.

For 5 kV applications, Advance switchgear utilizes ABB VIY-60 potential transformers (PTs). For 15 kV applications, Advance uses ABB VIZ-11 and VIZ-75 PTs. For 27 kV applications, ABB VIZ-12 and VIZ-12G potential transformers are used. All PTs are available in wye-wye, open delta, line to line, and line to ground configurations.

Advance switchgear is also available with current and voltage sensors for digital switchgear designs. Type KECA 80 C184 current transformers and Type KEVA 17.5 B21 voltage sensors are used to provide low energy analogue outputs to Relion series relays specifically designed for use with these sensors.

For more information on CTs, GCTs and PTs, please see the Switchgear Components and Accessories Technical Guide (1VAL104601-TG).

Available accessories
The Advance line is available with the following accessories:
- Breaker accessory kit including breaker, PT and CPT racking handle, breaker lifting yoke
- Lift truck
- Test cabinet
- Test jumper
- SmartRack™ remote racking device
- Electrically operated ground and test device (not available for 27 kV or 63 kA ratings)
- Manually operated ground and test device (not available for 63 kA rating)
- Breaker ramps

Testing
Advance is design tested per IEEE C37.20.2 and subjected to the following production tests:
- One second dielectric test of 1800 VAC on control circuits
- Control circuit verification
- Instruments energized via the low voltage winding of instrument transformers and operated through ratings ranges.
- Mechanical check for breaker alignment and interlock verification
- Power frequency withstand test from phase to phase and phase to ground
- Static circuit check
- 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.

Options

- Installation, operation and maintenance manual by CD or printed
- Mechanical options
  - Direct roll-on-floor breakers
  - Tin-plated bus
  - Mimic bus
  - Cable supports
  - Mechanical trip on breaker doors
  - IR windows (IRISS or Fluke)
  - Channel sills
  - Surge arrestors and capacitors
  - Ground studs
  - Lexan shutters in breaker compartments (Lexan shutters are standard for 27 kV applications)
  - Mechanical breaker position indicator on front of breaker door
  - Utility metering compartments
  - Outdoor non-walk-in enclosures (ODNWI) and outdoor single or double row walk-in enclosures
- Electrical options
  - Separate or common pull-out fuse block or molded case circuit breaker trip and close coil protection
  - SwitchgearMD™ asset health monitoring-temperature, PD and humidity
  - Phase bus marking labels
  - Instrument door ground strap
  - Fault current limiters
  - Digital switchgear
  - REA arc detection system
  - UFES active arc mitigation system
  - SmartRack® electrical racking system

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Other reference documents

Document	Document number
Advance Descriptive Bulletin	1VAL107002-DB
Advance Flyer	1VAL107002-FL
Advance 27 Descriptive Bulletin	1VAL107001-DB
Advance 27 Flyer	1VAL107001-FL
Installation, Operation and Maintenance Manual for Advance	1VAL108001-MB
ADVAC Breaker Technical Guide	1VAL050501-TG
AMVAC Breaker Technical Guide	1VAL050601-TG
Instrument Transformers Technical Guide	1VAL066701-TG
Switchgear Components and Accessories Technical Guide	1VAL104601-TG
REF615 Feeder Protection Relay Product Guide	1MAC105361-PG
REF620 Feeder Protection Relay Product Guide	1MAC506635-PG
REM615 Motor Protection Relay Product Guide	1MAC251744-PG
REM620 Motor Protection Relay Product Guide	1MAC609372-PG
RET615 Transformer Protection Relay Product Guide	1MAC204375-PG
RET620 Transformer Protection Relay Product Guide	1MAC554110-PG
REA Arc Fault Protection System Product Guide	1MRS756449
ANSI MV Digital Switchgear Technical and Application Guide	1VAL108401-TG

Arrangement rules

- 2000 A lineups require at least one (1) 57-inch instrument compartment for every two (2) 2000 A breakers in order to provide a path for heat ventilation
- CPTs greater than 15 kVA single-phase require a draw-out fuse unit with stationary mounted CPT
- PTs may be mounted above a 3000 A breaker (a 57-inch auxiliary compartment or an end panel must be located directly adjacent to the 3000 A frame), a 2000 or 3000 A breaker may be placed in the top position with PTs below
- 4000 A breakers must be in their own frame in the bottom breaker position with a 57-inch instrument compartment above

SwitchgearMD™
Asset health monitoring

SwitchgearMD™ offers monitoring and diagnostic solutions for temperature, humidity and partial discharge monitoring 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 Exertherm® 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 the SENSeOR 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 Reader. The Reader 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 SENSeOR antennas are provided. The SENSeOR antennas perform the PD monitoring. Bus temp monitoring is not required to perform PD monitoring.

Digital switchgear

Digital switchgear (low or medium voltage) is switchgear where device status information, current and voltage measurements, and commands, are reliably transferred on a common communication bus. When included, the equipment condition monitoring and diagnostic information is digitally available for advanced analysis. In the case of medium voltage switchgear, communication is accomplished using the IEC 61850 protocol over Ethernet.

Digital switchgear utilizes the IEC 61850 communications protocol and couples it with the proven technologies of Rogowski coils for current sensing to replace current transformers and resistive voltage dividers for voltage sensing to replace voltage transformers and their associated drawout units.

This simplifies engineering, improves safety and reliability, and decreases life-cycle costs. All ABB ANSI medium voltage metal-clad switchgear products are available in digital versions.

For more technical information on digital switchgear, refer to the ANSI metal-clad medium voltage digital switchgear technical application guide.

Arc fault protection solutions

The occurrence of an arc fault, the most serious fault within a switchgear system, is usually associated with extremely high thermal and mechanical stresses in the area involved. There are various layers of technologies that can be used within medium voltage switchgear to address arcing faults. Bus differential protection, zone interlocking schemes and fast acting arc detection systems are some of the methods that can be used to reduce the effects of arc faults. Most notably are the Ultra-Fast Earthing Switch (UFES) and REA detection and protective relays.

The Ultra-Fast Earthing Switch (UFES) , is a combination of devices consisting of an electronic device and the corresponding primary switching elements which initiate a three-phase short-circuit to ground in the event of a fault. The extremely short switching time of the primary switching element, less than 1.5 ms, in conjunction with the rapid and reliable detection of the fault, ensures that an arc fault is extinguished almost immediately after it arises. The metallic short-circuit can then be shut down either selectively by conventional protection devices or by the circuit-breaker via an auxiliary contact in the tripping unit. With a total extinguishing time of less than 4 ms. After detection, an active protection concept with the Ultra-Fast Earthing Switch enables switchgear installations to achieve the highest possible level of protection for persons and equipment.

The Detection and Tripping Unit (DTU) is responsible for continuous monitoring of the protected zone for internal arc faults. In case the preset tripping criteria is reached, it trips the connected PSE. Three-phase current measurement is integrated for detection of the fault current. The built-in light detection unit provides for connection of up to nine lens sensors via optical fiber cables.

In addition, up to five external light detection units of type TVOC / TVOC-2 from the ABB Arc Guard system can be connected. Selector switches allow logic operations to be performed with these inputs to configure the trip conditions. The status of the DTU, the input signals and the output are signaled by LEDs and, in part, via floating changeover contacts. The DTU contains all the components required for activation and monitoring of the high-speed micro gas generator (HSMGG) and for monitoring of the corresponding wiring.

For more information on the application and technical details of the UFES system, refer to documents on the product web page at https://new.abb.com/medium-voltage/apparatus/arc-fault-protection/ultra-fast-earthing-switch-ufes.

The REA system is designed to give fast trip commands to all circuit breakers that may feed an arc fault in switchgear. In an arc situation, the fault can quickly be localized by inspecting the cover area of the sensor detecting the arc. The two sensor types include patented long fiber sensors that detect light along their entire length and light collecting lens-type sensors. These sensors are typically distributed one per compartment. The REA system is the fastest operating arc fault protection system in ABB's product portfolio, with trip command time of less than 2.5 ms.

For more information on the application and technical details of the REA arc detection system, refer to documents on the product web page at https://new.abb.com/medium-voltage/distribution-automation/arc-fault-protection/arc-fault-protection-system-rea.

Construction
Doors

— 01 Advance

— 02 Advance 27

Advance front doors consist of the breaker compartment, auxiliary unit compartments and LV compartments. These doors are provided with a single handle, multi-point latch (MPL) as standard. Bolted doors are available as an option. All doors are hinged on the left as standard (when facing the front door). Right-hand hinged doors are available as an option.

Rear doors on the Advance product are used to access the high voltage cable compartments. These doors are available in the following configurations:

- Full height hinged and bolted
- Split doors (top compartment/bottom compartment) hinged and bolted
- Full height hinged with multi-point latch (MPL) is optional
- Bolted, non-hinged full height or split doors are also available as an option

All front and rear doors are constructed using 12-gauge painted steel.

Padlock provisions are available on all front and rear doors. These padlock provisions are used to lock the door closed to prevent access to the compartment interiors. On breaker compartment doors, padlock provisions are also supplied on the racking release lever, to prevent unintended racking of the breaker.

Breaker and auxiliary compartment unit doors include a viewing window used for observing the position and status of the components inside the compartment with the door closed. These doors can also be provided with the SmartRack mounting provisions for remote racking applications.

Due to the small footprint design, installation of protection and control devices on the breaker and auxiliary unit doors are not possible without adding the optional 10-inch front extension to the front of the frame. With the 10-inch front extension, protection and control relaying can be installed on these doors.

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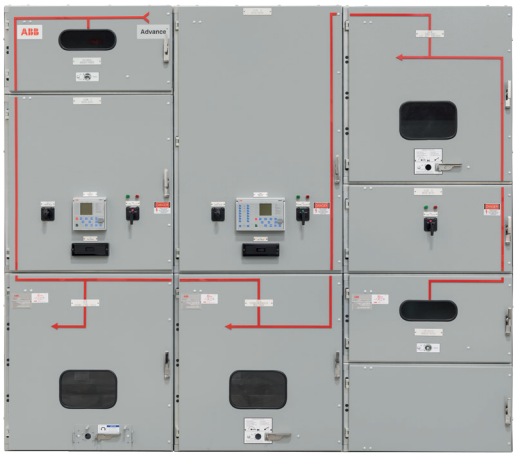

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Compartment types
Circuit breaker compartment

— 03 Circuit breaker compartment

Circuit breaker compartments
Advance circuit breaker compartments are designed for operator safety by providing one large viewing window and automatic latching, three-position, closed door racking. As an option, mechanical breaker position indicators, viewable from outside the compartment, with the door closed are available. The circuit breakers have self-aligning, fully automatic primary and secondary contacts allowing operators to keep the door closed throughout the racking operation.

Unique racking system and interlocks
The racking system is unique and features a three-position closed door system for all circuit breakers. The racking mechanism is integral to the circuit breaker, so moving parts can be inspected and maintained outside the circuit breaker compartment and away from energized primary parts.

A solid stationary ground contact engages the grounding contact of the circuit breaker prior to the coupling of the primary or secondary contacts and is continuous during the racking operation.

The three racking positions are defined as follows:
- Connected: Primary and secondary (control) contacts are engaged
- Disconnected: Primary and secondary (control) contacts are disengaged
- Test: Primary contacts are disengaged. Secondary (control) contacts are engaged for incell breaker testing

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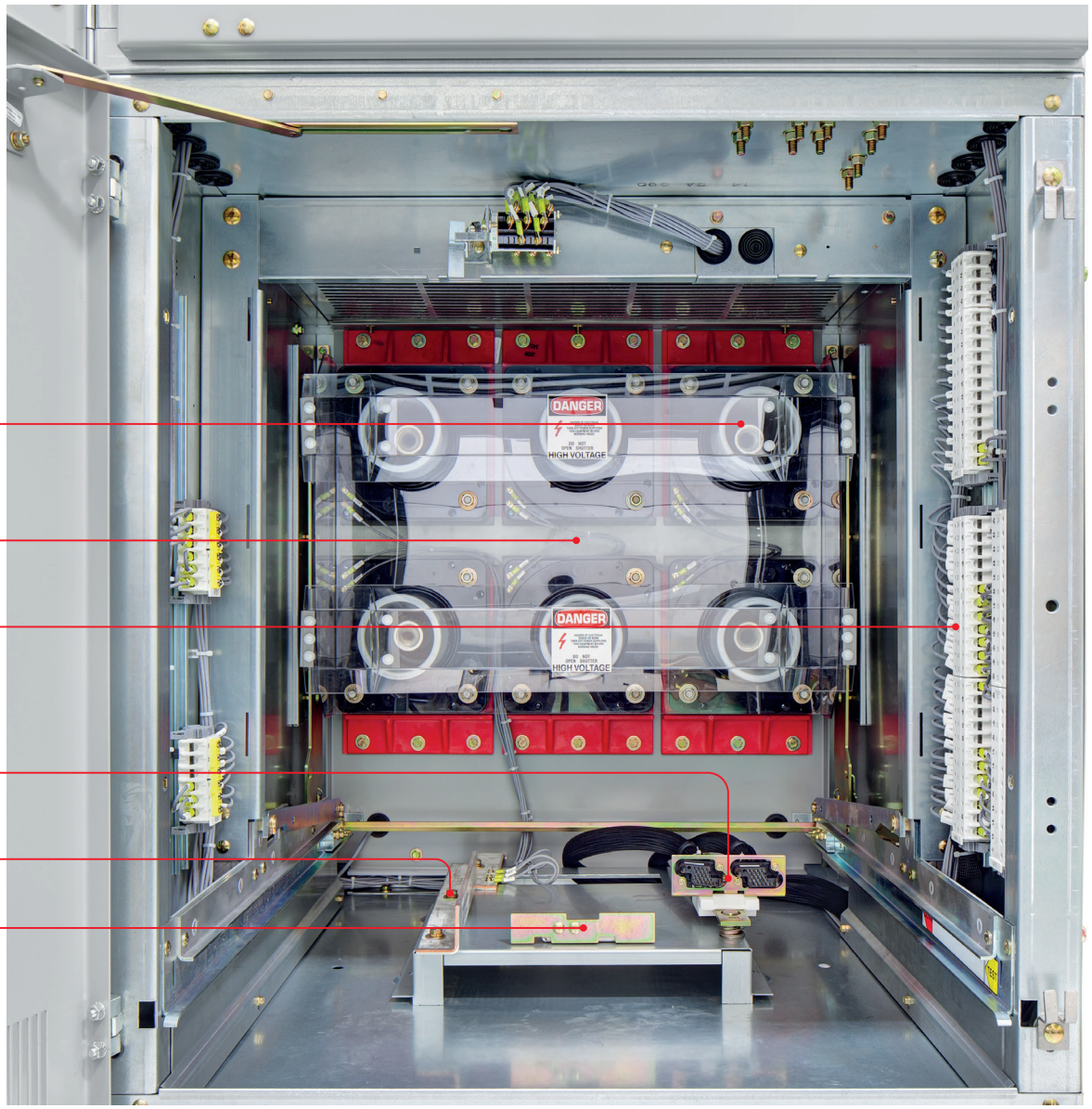
04 Terminal blocks normally covered by grounded metal barrier have been removed in this photo



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The racking system includes all necessary interlocks
in compliance with ANSI/IEEE standards to assure proper sequencing and safe operation. For improved safety, the interlocking system prohibits operation of the breaker while in an intermediate position and prohibits insertion of an improperly rated breaker.

Secondary disconnect system
A dual (50-pin) self-aligning secondary disconnect for control circuitry is provided as a standard feature. The female portion resides in the circuit breaker module.

Potentially energized contacts are recessed and are touch safe. No manual connection of secondary contacts required.

Primary shutters
Primary shutters automatically cover primary contacts when the breaker is not in the connected position. The shutters may be grounded metal or optional Lexan material. Lexan is standard for 27 kV applications. Primary shutter opening and closing is forced by circuit breaker movement, rather than relying on springs or gravity. A locking mechanism prevents opening of the shutter when the circuit breaker is removed.

Compartment types
Auxiliary modules

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05 Delrin primary probe and recessed contact assembly

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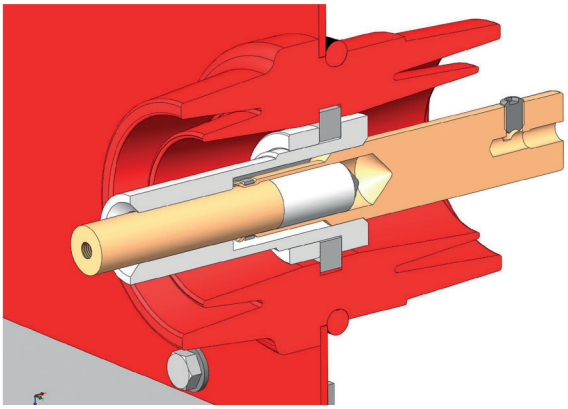
06 PT drawout assembly with three voltage transformers - the fuses can be removed without removing the PT truck from the rails

PT/CPT/Draw-out fuse compartments
Similar to breaker compartments, potential transformer, control power transformer and draw-out fuse compartments are inserted via a racking mechanism which allows for closed door racking of auxiliary equipment. The cell interface uses the same components as the circuit breaker module and is compatible with ABB's remote racking device, the SmartRack. Secondary contacts engage/disengage automatically and interlocks ensure proper operation.

All primary auxiliary compartments, including potential transformers, control power transformers and draw-out fuse compartments, use arc-quenching Delrin® technology for primary contact assemblies (Delrin® is a registered trademark of DuPont). A Delrin® tipped conductor probe is inserted into a Delrin® receptacle with recessed contacts. During load break, localized heating of the Delrin® material due to arcing cases the material to release an inert gas which fills the small isolating gap to contain the arc and extinguish it safely. Immediately after the racking process is started, and continuing into the connected position, the release handles are locked into place preventing the auxiliary unit from being withdrawn from the compartment unless the racking screw is brought completely back to the disconnect position. The PT drawout units can be withdrawn beyond the front of the frame via rails, which allow easy access to the fuses for inspection or replacement.

Control Power Transformer (CPT) and Draw-out fuses
CPT modules provide convenient mounting and operation of single-phase control power transformers in ratings up to 15 kVA, minimizing the possibility of inadvertent interruption of control power for AC operated switchgear.

Fuse modules accommodate up to three primary fuses for use with fixed-mount control power transformers. Fuse modules are provided with stationary control power transformers in ratings up to 50 kVA single phase, for Advance 27, and up to 75 kVA three-phase or 50 kVA single-phase for Advance. Fixed mounted CPTs can be mounted in the rear cable compartment or at a remote location.



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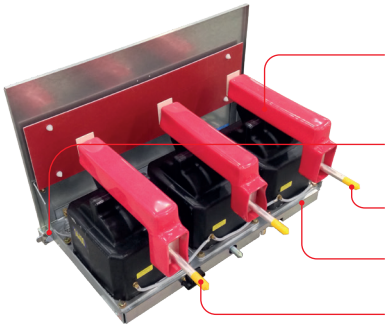

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Compartment types
Instrument compartment

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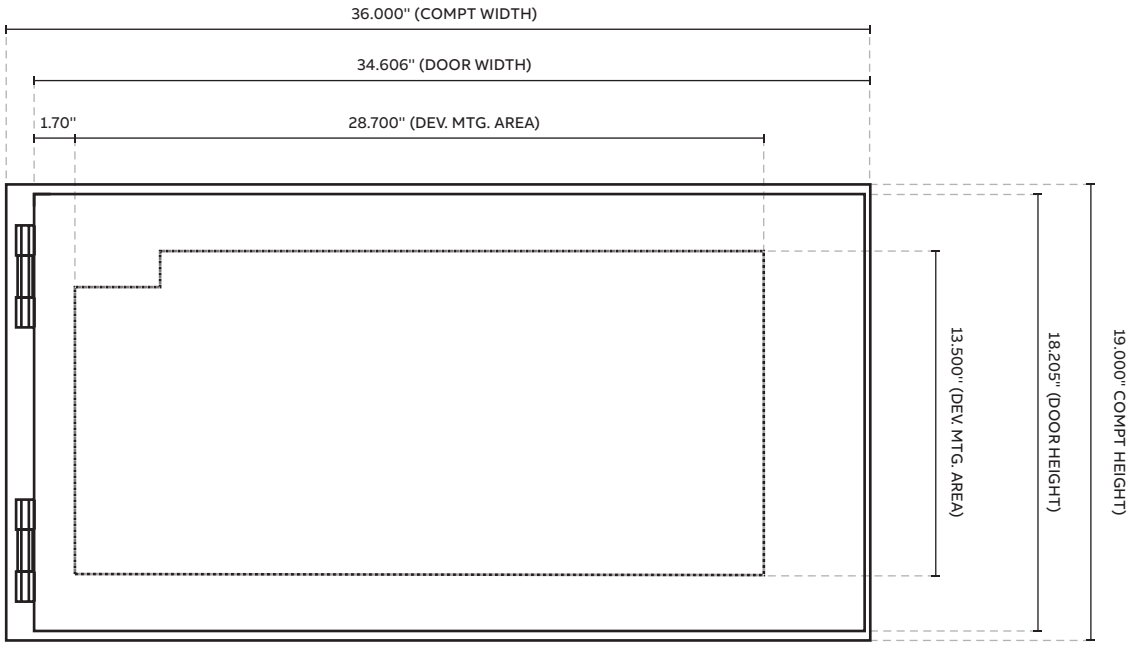
07 LVC door panel 19"

ABB mounts all protection and control devices in a dedicated low voltage compartment. Each low voltage instrument compartment is completely isolated and segregated from high-voltage components which ensures the safety of operations and maintenance personnel while they work on control and auxiliary circuits. The LV wiring pans are designed to be removeable and customizable.

Plastic enclosed wireways are used to provide protection for the wiring, as well as a neat and organized appearance. This allows for easy addition of wiring, should it be needed.

Devices and control switches are mounted on the door for easy readability and convenient access. Those devices that do not require direct access are mounted inside the compartment.

Frame-to-frame interconnect wiring is achieved through openings located in the rear of the LV compartment. Each opening is 3“ x 4“ and provided with edge guard to ensure wires do not run over sharp edges.



LVC DOOR PANEL 19"

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08 Low voltage instrument module isolated for maximum safety when workinwith low volatge circuits

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09 LVC door panel 38"

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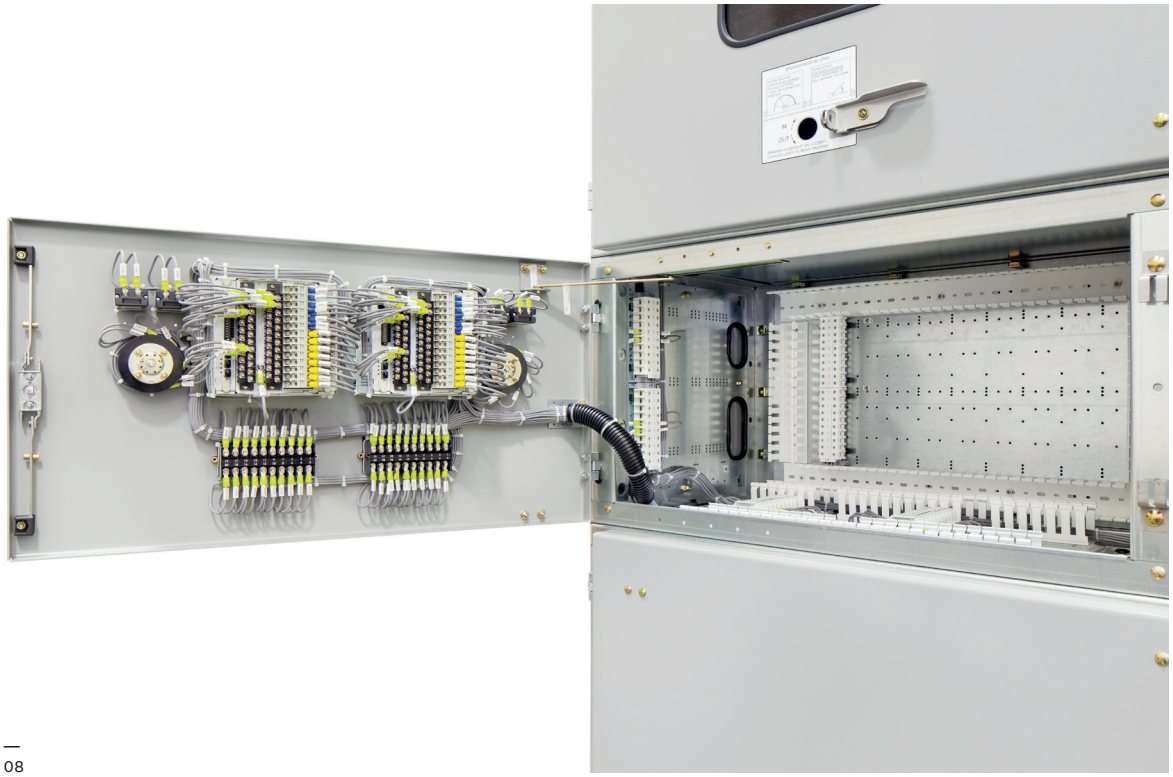
10 LVC door panel 57"



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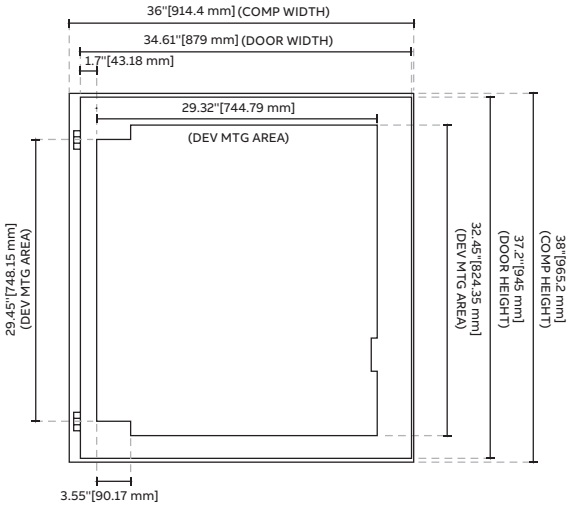

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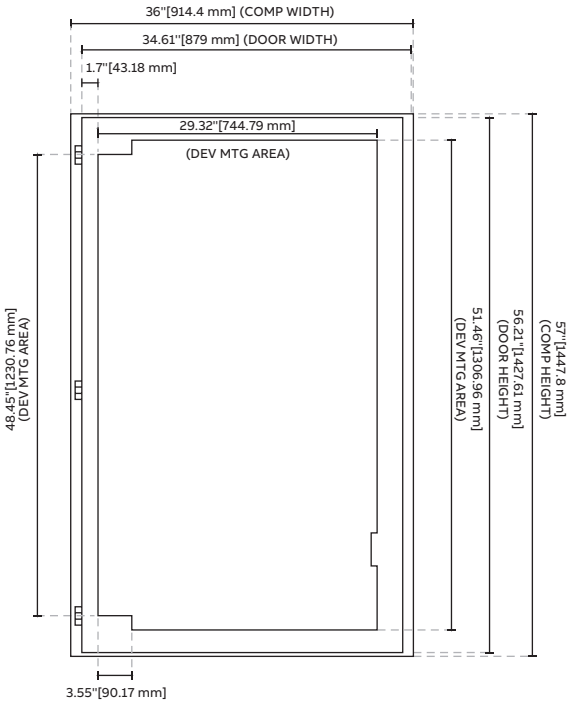

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Compartment types
Bus compartment

All primary buses are copper with a corona-free design, and are available in 1200, 2000, 3000 and 4000 A ratings. The bus is silver-plated at joints and bolted together with a minimum two (2) half-inch SAE grade 5 bolts. Proper torque is verified by calibrated tools for both safety and optimum performance. The main bus is not tapered and is easily extended at both ends to facilitate future expansion.

The bus is epoxy-insulated with an advanced powder coat system that eliminates voids and other potential defects, resulting in maximum integrity of the insulation system. Removable, reusable boots are provided at each joint to simplify access and maintenance.

Main bus design details-Advance

Continuous current	Short-circuit rating	Quantity per phase	Size
1200 A	25, 31.5 kA	1	.25” x 4”
1200 A	40, 50, 63 kA	1	.75" x 4"
2000 A	up to 63 kA	1	.75” x 4”
3000 A	up to 63 kA	2	.75” x 4”
4000 A	up to 63 kA	2	.75” x 4”

For ratings of 5/15 kV, up to 50 kA, Advance non-arc-resistant, metal-clad switchgear design certifications are based on glass polyester or porcelain primary bus supports. Epoxy is standard for standoff bus insulator supports. Primary breaker bushings and interframe main bus supports are glass polyester at 1200/2000 A and porcelain at 3000/4000 A breaker bushings (50 kA and below) and interframe main bus supports.

Separate drawings are available to indicate the position and dimensions of the epoxy compartment-mounted primary contact supports, epoxy inter-frame horizontal bus supports, and standoff insulators.

If porcelain bus supports and insulators are needed, contact factory. 3 kA Advance uses epoxy primary and main bus bushings, bus supports/post insulators exclusively.

Characteristic	Epoxy specification
Flexural strength, psi	17,400-21,700
Tensile strength, psi	10,150-13,050
Impact strength, ft-lb/in^2	4.75-7.15
Thermal class	F
Dielectric strength (short time), V/mil	> 580

Characteristic	Glass polyester	Porcelain
Flexural strength, psi	15,000-27,000	10,500
Tensile strength, psi	14,000	6,000
Izod impact, ft-lb per inch of notch	6-12	1.5
Thermal shock, cycles 32°- 2300°F	100+	1
Dielectric strength (short time), V/mil	350-375	300
Dielectric constant	4-6	6

	Rating		Safegear/Advance (5/15 kV, 50 kA)	Advance (5/15 kV, 63 kA)	Advance (27 kV, 25 kA)
Bus Insulators (Stand off Post Insulators)		Standard	EC-A Epoxy	EC-A Epoxy	Porcelain
		Option	Porcelain	None	None
CPT Truck Post Insulators		Standard	EC-A Epoxy	EC-A Epoxy	Porcelain
		Option	Porcelain	None	None
CPT/PT Compartment through Bus Supports		Standard	Glass Polyester	Glass Polyester	EC-A Epoxy
		Option	Porcelain	None	None
Main Bus Support Insulator (Inter panel bushing)	1200 A	Standard	Glass Polyester	EC-A Epoxy	Porcelain
		Option	Porcelain	None	None
	2000A	Standard	Glass Polyester	EC-A Epoxy	Porcelain
		Option	Porcelain	None	None
	3000A	Standard	Porcelain	EC-A Epoxy	N/A
		Option	None	None	N/A
	4000A	Standard	EC-A Epoxy	EC-A Epoxy	N/A
		Option	None	None	N/A
Primary Disconnect Bushing	1200A	Standard	Glass Polyester	EC-A Epoxy	Porcelain
		Option	Porcelain	None	None
	2000A	Standard	Glass Polyester	EC-A Epoxy	Porcelain
		Option	Porcelain	None	None
	3000A	Standard	Porcelain	EC-A Epoxy	N/A
		Option	None	None	N/A
	4000A	Standard	Porcelain	EC-A Epoxy	N/A
		Option	None	None	N/A

Main bus design details-Advance 27

Continuous current	Short-circuit rating	Quantity	Size
1200 A	25 kA	1	.375” x 4”
2000 A	25 kA	1	.75” x 4”

Advance 27 utilizes a special bus boot design consisting of black Plastisol joint covers encapsulating all bus joints and a special bus skirt applied to each of the bus bars. A silicone sealant is used to assure complete sealing of the skirts and the boot. All boots installations are completed by nylon hardware to seal the flanges.

Advance 27 metal-clad switchgear design certifications are based on porcelain primary bus supports.

Porcelain is standard for standoff bus insulator supports, primary breaker bushings and inter-frame main bus supports. Separate drawings are available to indicate the position and dimensions of the porcelain compartment-mounted primary contact supports, porcelain inter-frame horizontal bus supports, and standoff insulators. Physical characteristics of the porcelain material are provided in the following table.

Characteristic	Porcelain specification
Flexural strength, psi	10,500
Tensile strength, psi	6,000
Izod impact strength, ft-lb/inch of notch	1.5
Thermal shock , cycles	1
Dielectric strength (short time), V/mil	300

Compartment types
Cable compartment

The Advance cable compartment design provides an efficient layout with ample room for stress cones and a choice of cable terminations and lug types. Customers also have the flexibility of top or bottom cable entry. Top or bottom connections can also be made to bus duct. In two-high arrangements with stacked circuit breakers, steel barriers separate the compartments and isolate the primary circuits. All configurations come standard with lug boots and have the option for cable supports to make field connections more secure.

Cable compartments are available with optional readily accessible zero sequence current transformers, surge arrestors and capacitor and ground studs on the bus risers. When a draw-out fuse compartment is installed in the front of the switchgear, the rear cable compartment offers room for a large three-phase, floor-mounted control power transformer up to 75 kVA for 5/15 kV applications and up to 30 kVA for 27 kV applications.

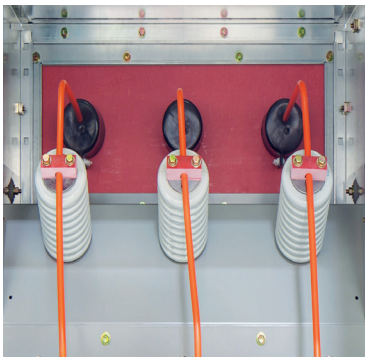
The draw-out fuse assembly can accommodate larger CPT sizes. Due to physical space contraints, these larger CPTs would be located remotely from the switchgear.

The photos below show Advance 27 frames. Advance differs only in that the boots are red and lug pads follow a standard 4-hole design.

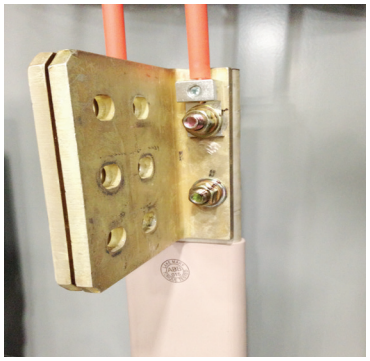
Primary cable compartments are provided with removable cover plates used to install conduit or cable sealing glands. Non-sealing conduit snub-ups are acceptable for installation in the non-arc-resistant Advance and Advance 27 products. Conduits should be sized to accommodate the cabling intended to be used for the specific application.

Non-painted 5052 aluminum 1/8” thick covers are provided as standard. 14-gauge type 304 stainless steel is available as an option.

—
11 Surge arrestors



—
12 PT line connection via Natvar



—
13 Standard 2000 A lug pad (boot removed)

—
14 Cable compartment (main bus - cover installed)

—
14

Available frame types
One-high frames

— 15 All ratings

— 16 5-15 kV ratings only

— Refer to page 32 for 5/15 kV floorplan and page 29 for 27 kV floorplan

The one-high, bottom mounted device frame consists of a 57-inch instrument compartment stacked over a 38-inch breaker, CPT or draw-out fuse compartment or two 19-inch compartments.

Cable termination information

Cable size	# of Terms single pad per phase*	# of Terms bifurcated pad per phase*	GCT option
#2 AWG	4	8	BYZ-S
#4 AWG	4	8	BYZ-S
500 MCM	4	8	BYZ-S
750 MCM	4	8	BYZ-L
1000 MCM (2-hole)	2	4	BYZ-S
1000 MCM (4-hole)	1	2	BYZ-S

*Bifurcated lug pad requires 92-inch depth

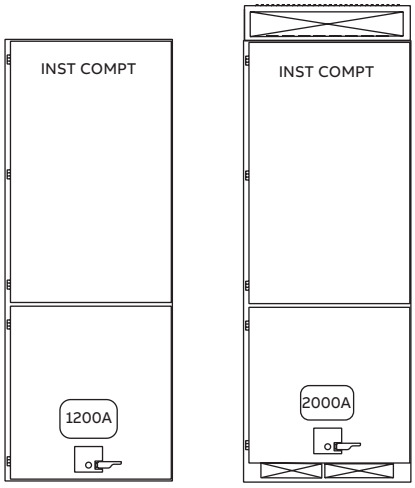
Dimensions

Frame	Width (in)	Height with vent box (in)	Depth (in)
2000/3000 A breaker	36	102.50	85 or 92*
4000 A	36	102.50	92
All other frames	36	95 (no vent)	85 or 92*

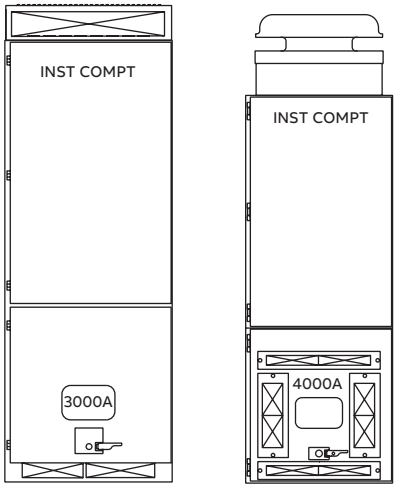
* 27 kV available in 92-inch depth only

Options

- Ground CTs
- Surge arrestors
  - Distribution
  - Intermediate
  - Station
- Surge capacitor
- Ground studs
- Space heaters
- Cable supports
- SwitchgearMD asset health monitoring
- UFES active arc mitigation device
- REA fiber optic arc detection system
- Surge monitoring devices
- IR ports
- SmartRack electric racking system



— 15



— 16

Available frame types
Two-high frames

—
17 All ratings

—
Refer to pages 32-35 for 5/15 kV floorplan and pages 30-31 for 27 kV floorplan

—
LVC=low voltage compartment/ instrument compartment

—
Contact factory for two-high configurations with 2000 A breaker compartments

The two-high breaker frame consists of two 38-inch breaker compartments with a 19-inch instrument compartment in between for two breakers in a single frame.

—
Cable termination information

Cable size	# of Terms single pad per phase	GCT option
#2 AWG	4	BYZ-S
#4 AWG	4	BYZ-S
500 MCM	4	BYZ-S
750 MCM	4	BYZ-L
1000 MCM (2-hole)	2	BYZ-S
1000 MCM (4-hole)	1	BYZ-S

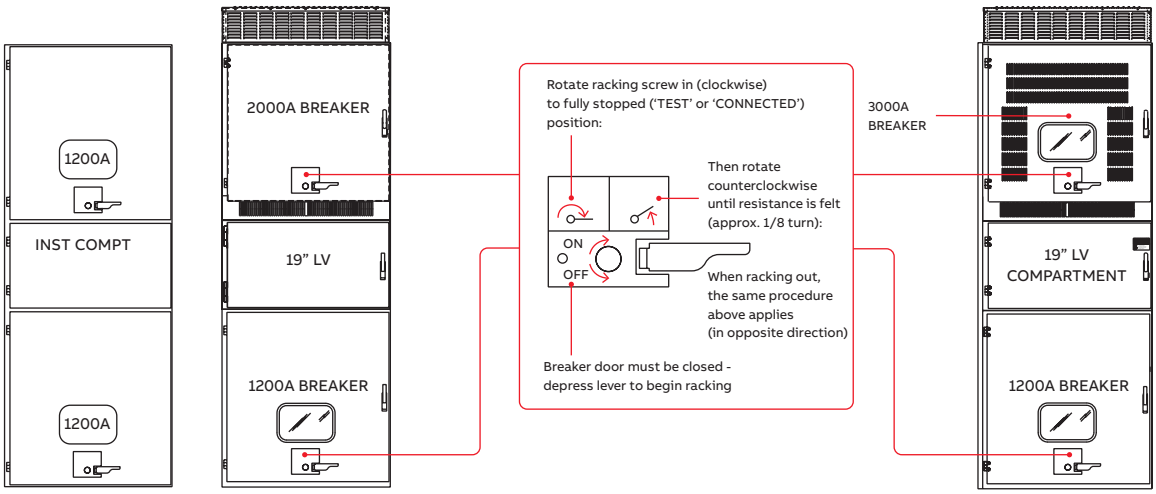
—
De-rating information

	50 kA Porcelain primary bushing	50 kA Poly bushings	Epoxy primary bushing 25-50 kA (future)	63 kA Epoxy bushings
2000 A w/ no filters	No de-rating	No de-rating	1900 A	1900 A
2000 A w/ filters	No de-rating	No de-rating	1900 A	1900 A
3000 A w/ no filters	No de-rating	N/A	2900 A	2900 A
3000 A w/ filters	2900 A	N/A	2900 A	2800 A

—
Dimensions

Frame	Width (in)	Height with vent box (in)	Depth (in)
2000/3000 A breaker	36	102.50	85 or 92
All other frames	36	95 (no box)	85 or 92
27 kV frames	36	95 (no vent)	92

Options
- Ground CTs
- Surge arrestors
  - Distribution
  - Intermediate
  - Station
- Surge capacitor
- Ground studs
- Space heaters
- Cable supports
- SwitchgearMD™ asset health monitoring
- UFES active arc mitigation device
- REA fiber optic arc detection system
- Surge monitoring devices
- IR ports
- SmartRack electric racking system



—
17

Available frame types
Breaker and auxiliary frames

—
18 All ratings breaker above

—
19 All ratings breaker below

—
Refer to page 34 for 5/15 kV floorplan and page 31 for 27 kV floorplan

—
LVC=low voltage compartment/ instrument compartment

—
CPT=control power transformer

—
PT=potential transformer

—
DOF=drawout fuse

The two-high breaker and auxiliary frame consists of one 38-inch compartment, two 19-inch compartments (that can be combined for another 38-inch compartment) with a 19-inch instrument compartment in between for one breaker and an auxiliary device in a single frame.

—
Cable termintation information

Cable size	# of Terms single pad per phase	# of Terms bifurcated pad per phase*	GCT option
#2 AWG	4	8	BYZ-S
#4 AWG	4	8	BYZ-S
500 MCM	4	8	BYZ-S
750 MCM	4	8	BYZ-L
1000 MCM (2-hole)	2	4	BYZ-S
1000 MCM (4-hole)	1	2	BYZ-S

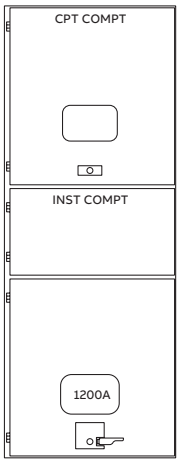
*Bifurcated lug pad requires 92-inch depth

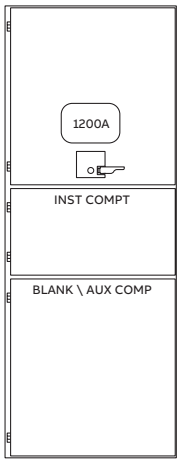
—
Dimensions

Frame	Width (in)	Height with vent box (in)	Depth (in)
2000/3000 A breaker	36	102.50	85 or 92*
All other frames	36	95 (no vent)	85 or 92*

* 27 kV available in 92-inch depth and 2000 A maximum continuous current only

Options
- Ground CTs
- Surge arrestors
  - Distribution
  - Intermediate
  - Station
- Surge capacitor
- Ground studs
- Space heaters
- Cable supports
- SwitchgearMD asset health monitoring
- UFES active arc mitigation device
- REA fiber optic arc detection system
- Surge monitoring devices
- IR ports
- SmartRack electric racking system





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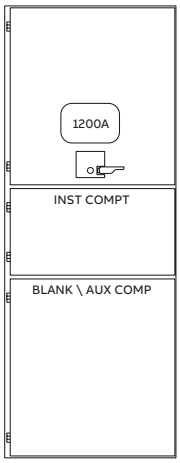
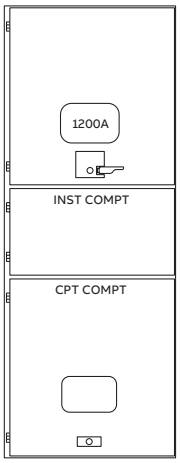
18





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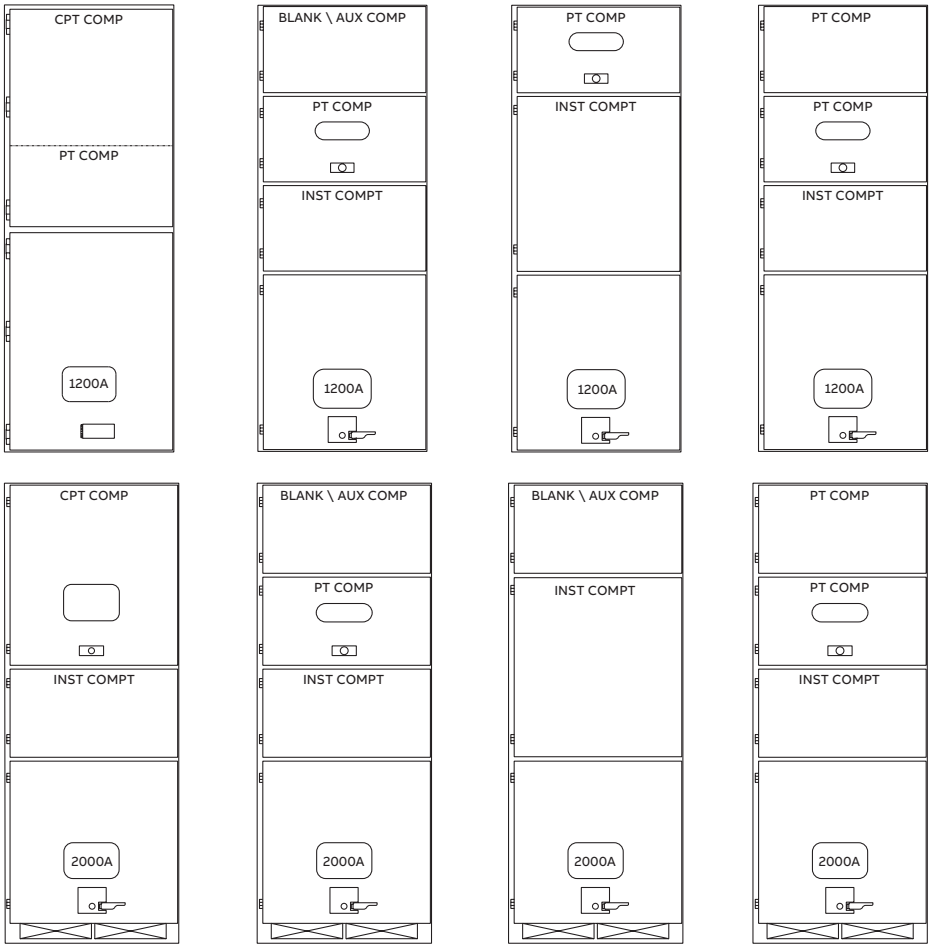
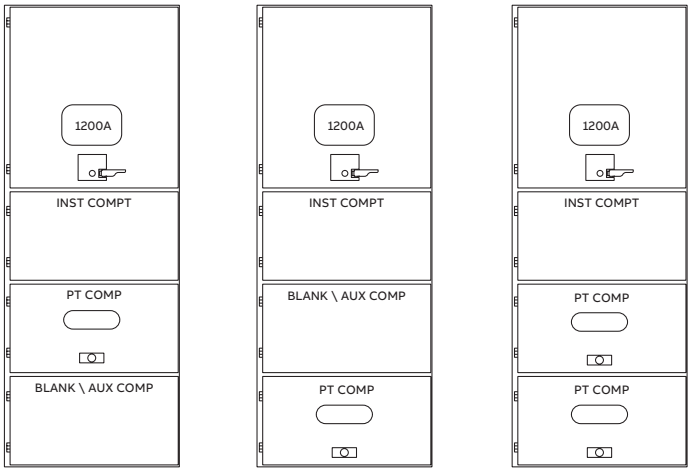
19

—
When PT or CPT units are installed over 2000 A breakers, a 57" auxiliary compartment or an end panel must be located on one side or the other of the 2000 A frame

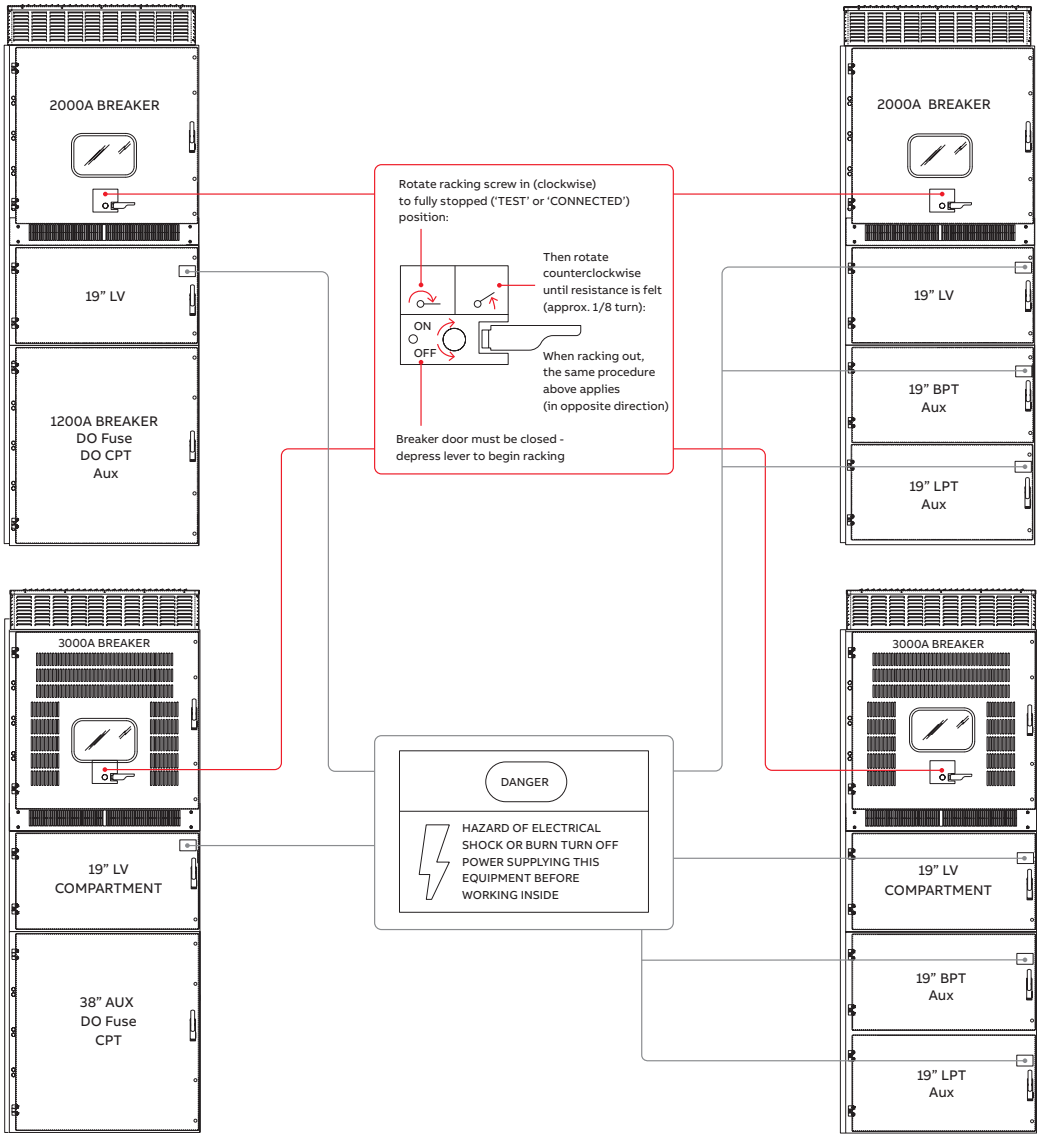
5-15 kV ratings
Breaker below



5-15 kV ratings
Breaker above



—
20 Arrangements shown for 5/15 kV ratings are also available at 2000 and 3000 ratings



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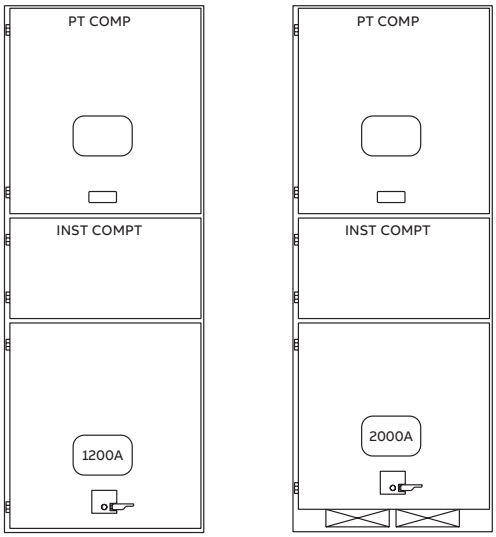
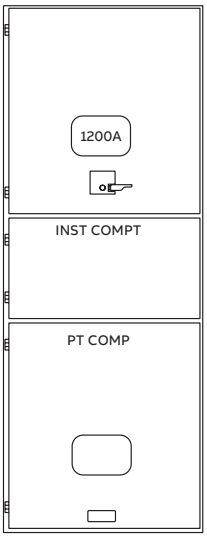
20

—
Note: For top-mounted 5/15 kV 3000 A breaker applications, one 57-inch instrument compartment or end panel must be located directly adjacent to either side of the frame.

27 kV rating
Breaker below



27 kV rating
Breaker above



Available frame types
Auxiliary frames

—
21 All ratings

—
LVC=low voltage compartment/ instrument compartment

—
CPT=control power transformer

—
PT=potential transformer

—
DOF=drawout fuse

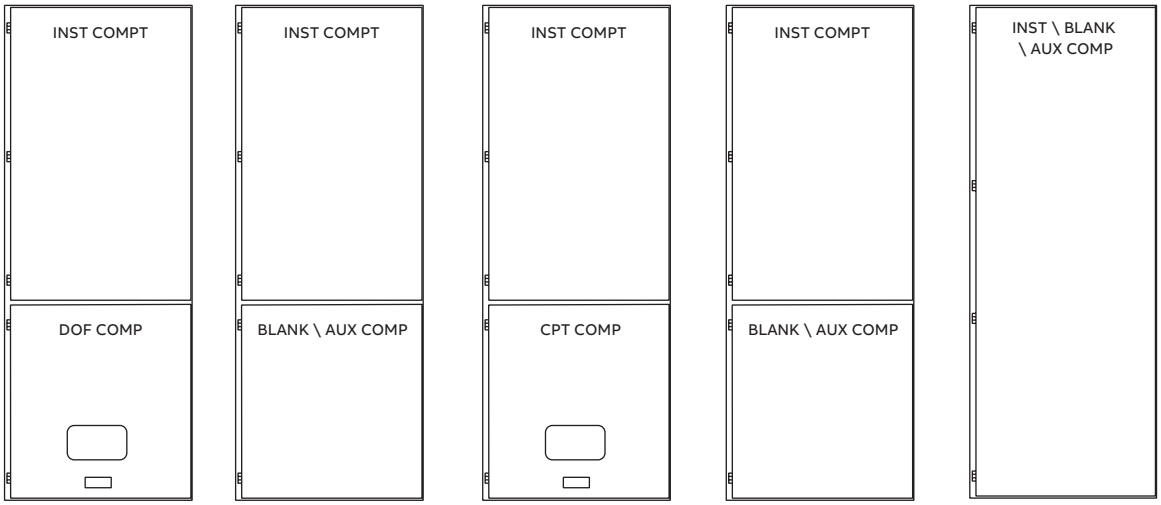
The Advance frame is designed around a 19-inch compartment concept, offering the ability to provide two 38-inch or four 19-inch compartments with a 19-inch instrument compartment in a single frame.

—
Dimensions

Frame	Width (in)	Height with vent box (in)	Depth (in)
2000/3000 A breaker	36	102.50	85 or 92*
All other frames	36	95 (no vent)	85 or 92*

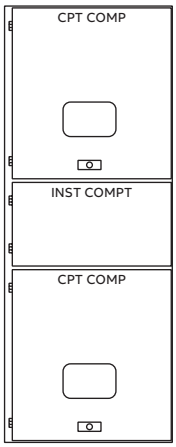
* 27 kV available in 92-inch depth only

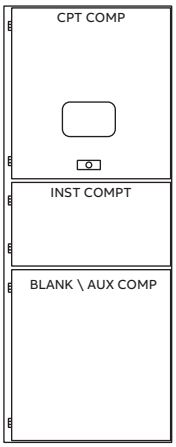
Options
- Space heaters
- SwitchgearMD asset health monitoring
- UFES active arc mitigation device
- REA fiber optic arc detection system
- Surge monitoring devices
- IR ports



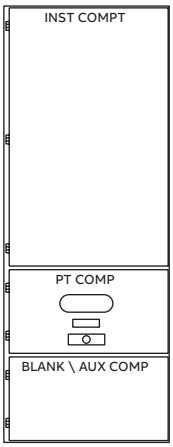
—
21

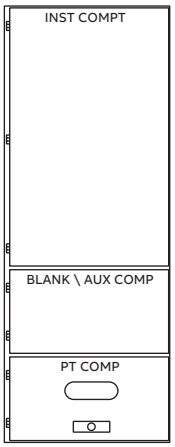
All ratings

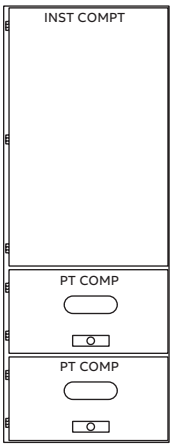


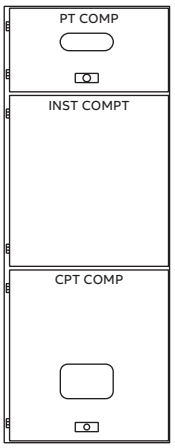


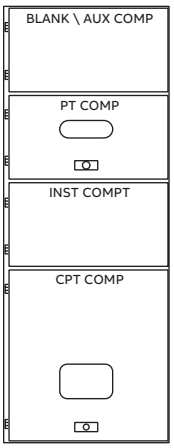
5-15 kV ratings

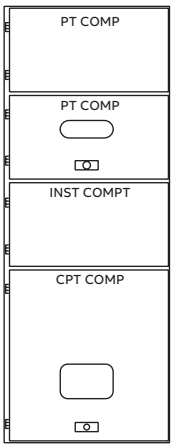


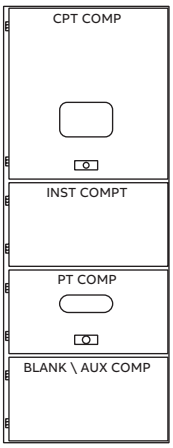


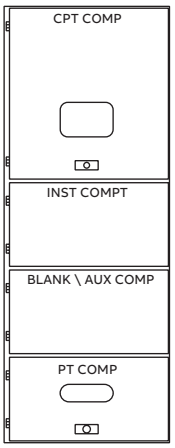




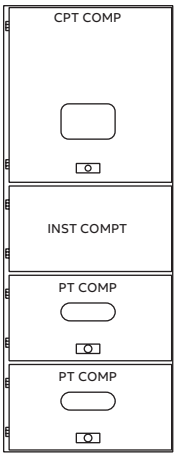


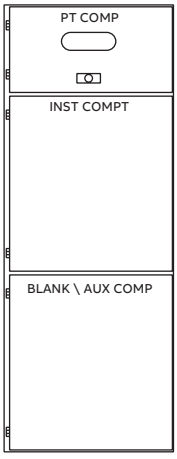


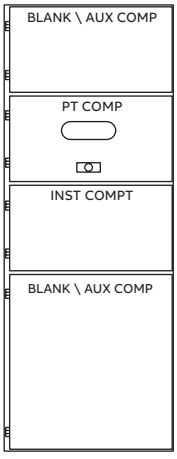


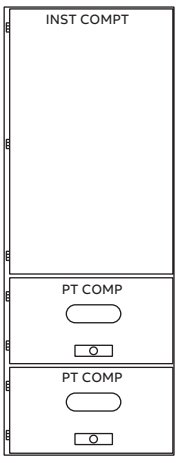


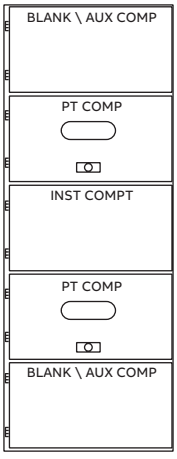
5-15 kV ratings

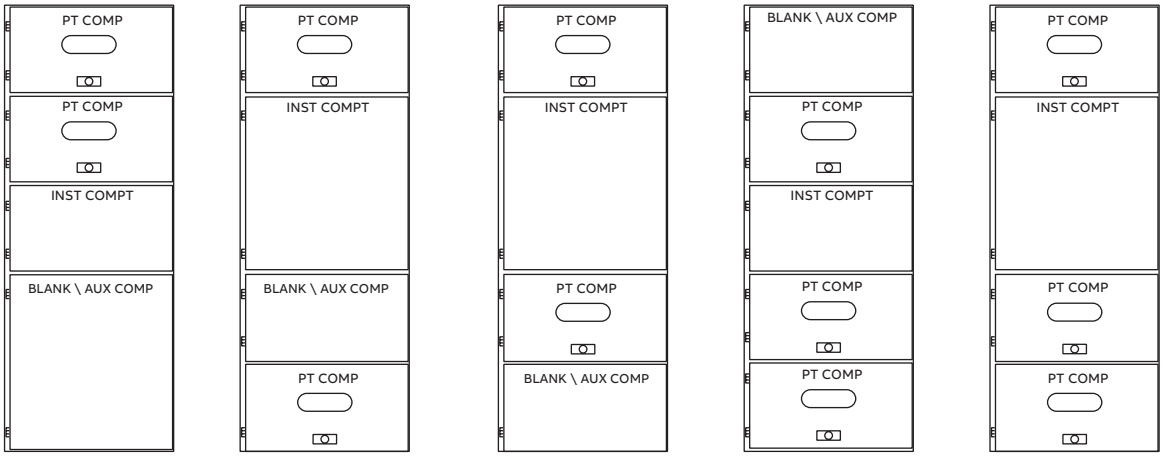




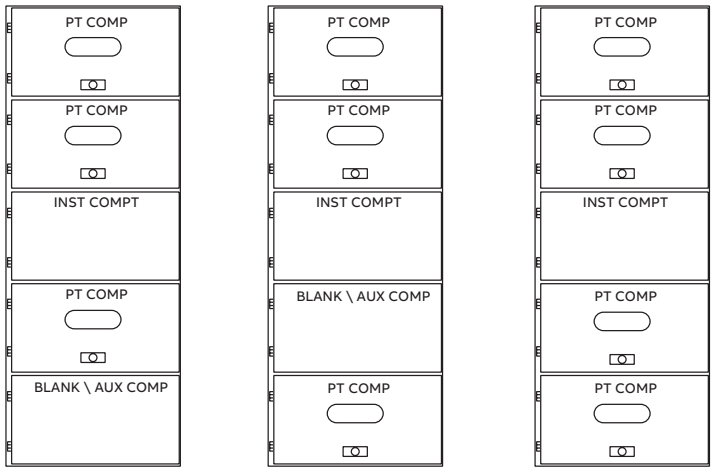




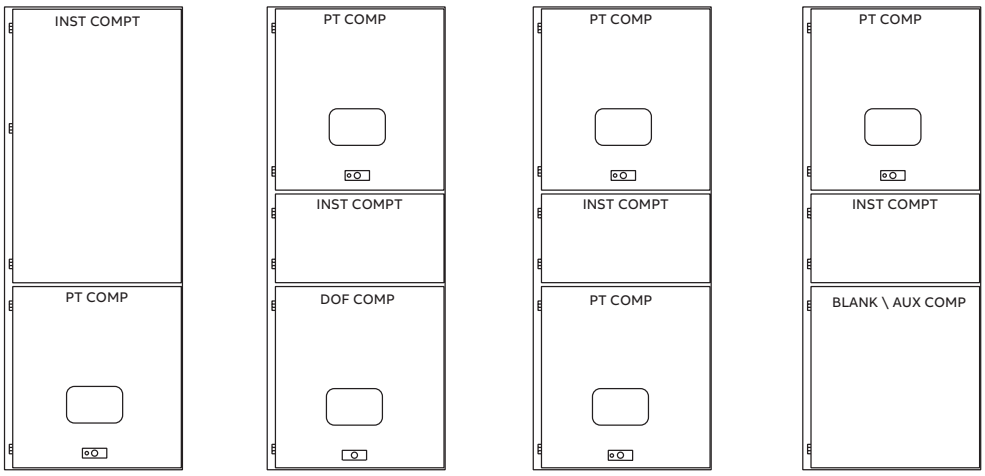




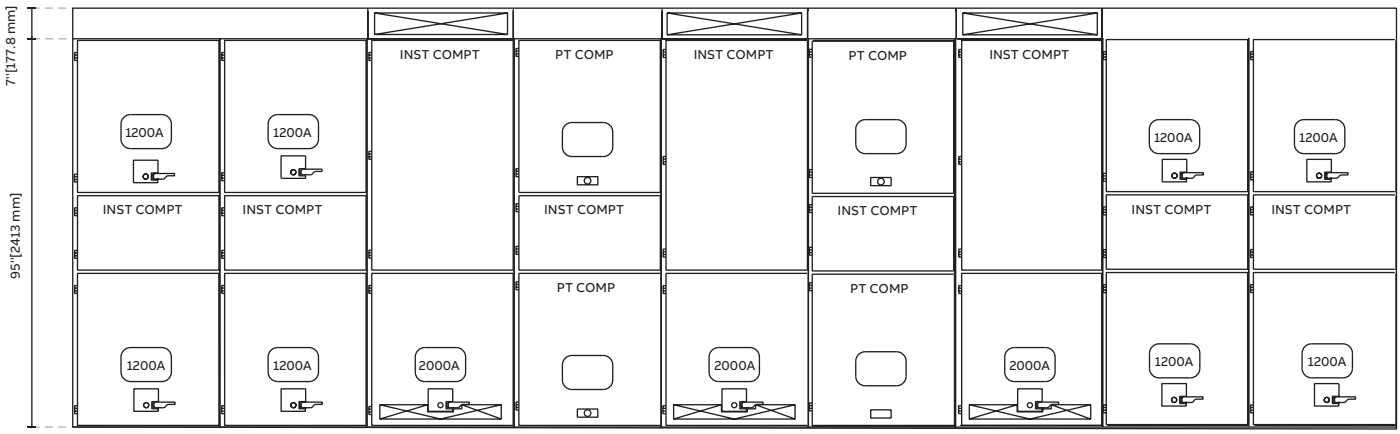
5-15 kV ratings



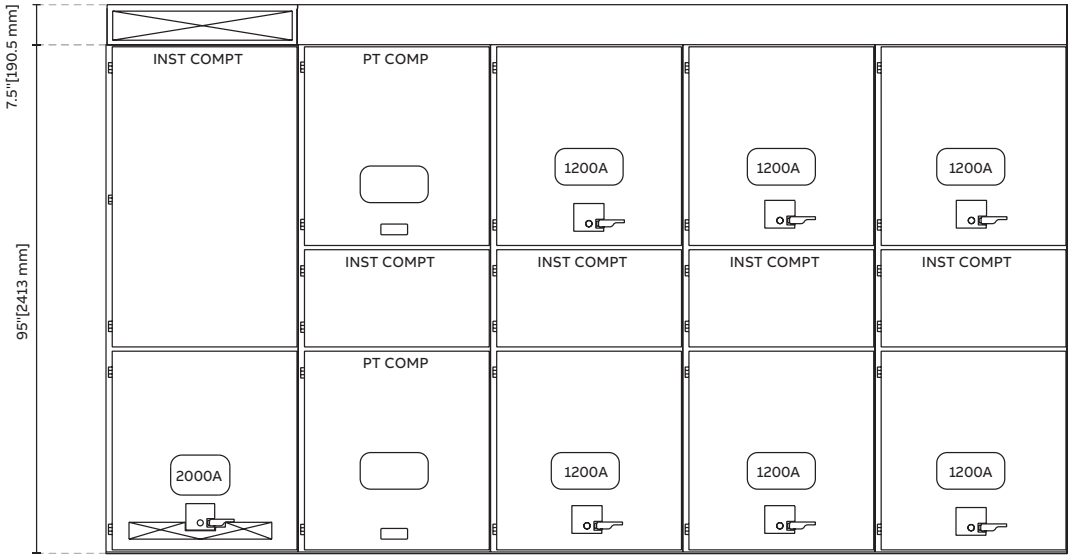
27 kV rating



Typical arrangements
27 kV, 2000A Main-Tie-Main



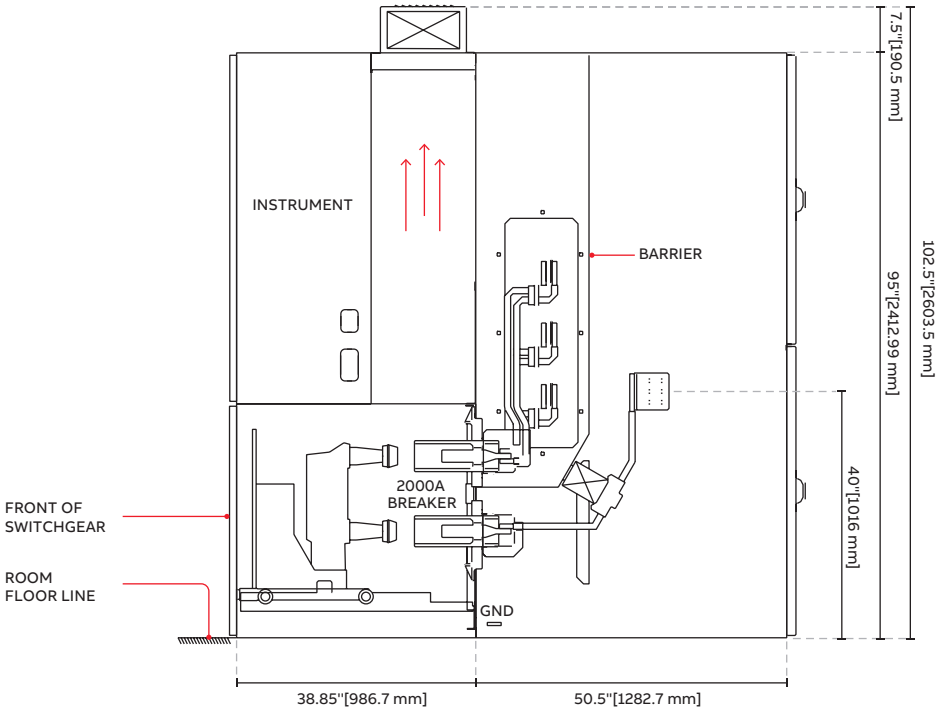
Typical arrangements
27 kV, 2000A Main with feeders



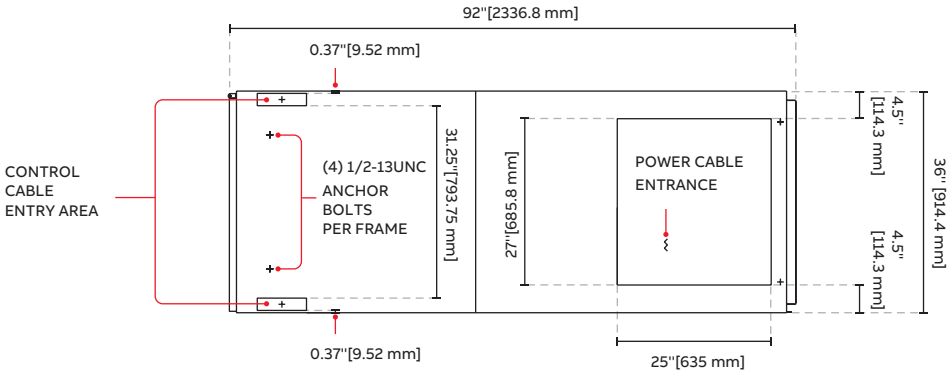
Civil engineering details

Typical side views, floor plans and clearances

Advance 27 switchgear one-high
Circuit breaker: 2000 A

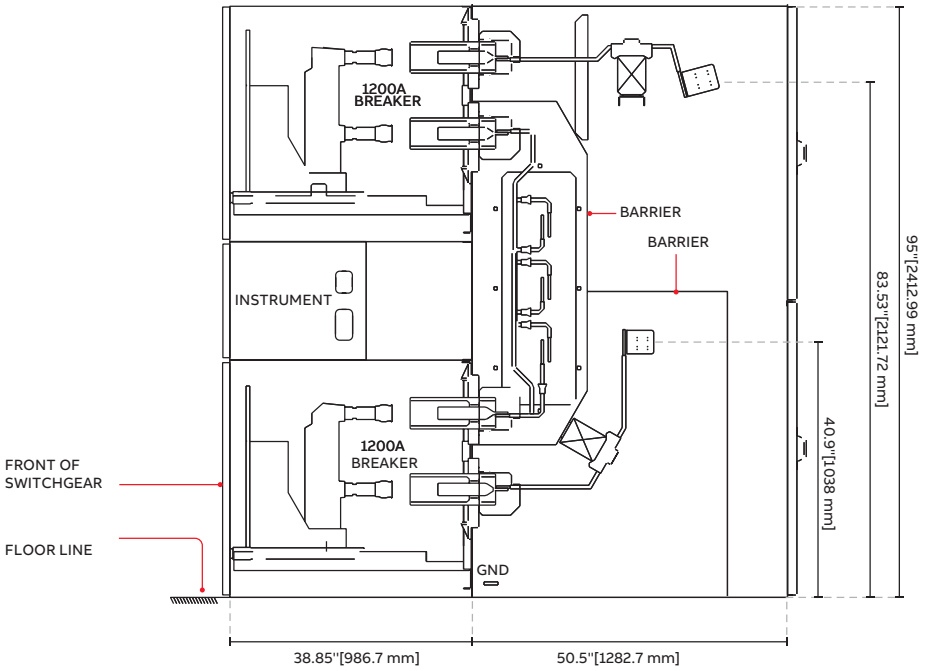


SECTION VIEW

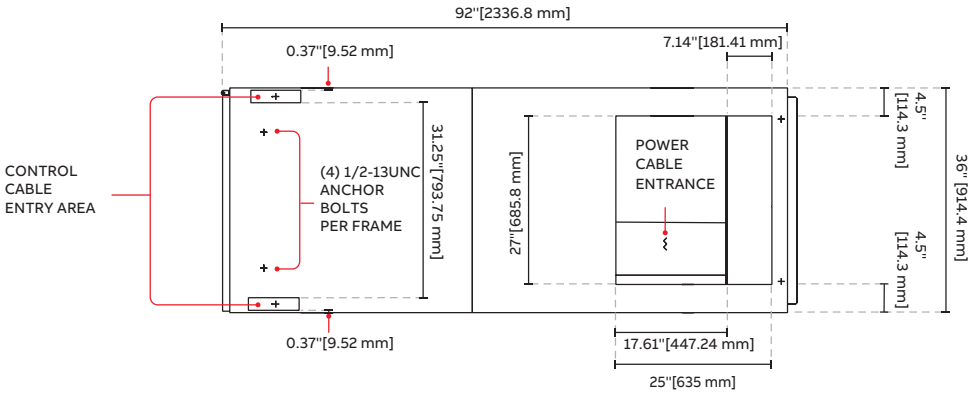


FLOOR PLAN

Advance 27 switchgear two-high
Circuit breaker: 1200 A/1200 A

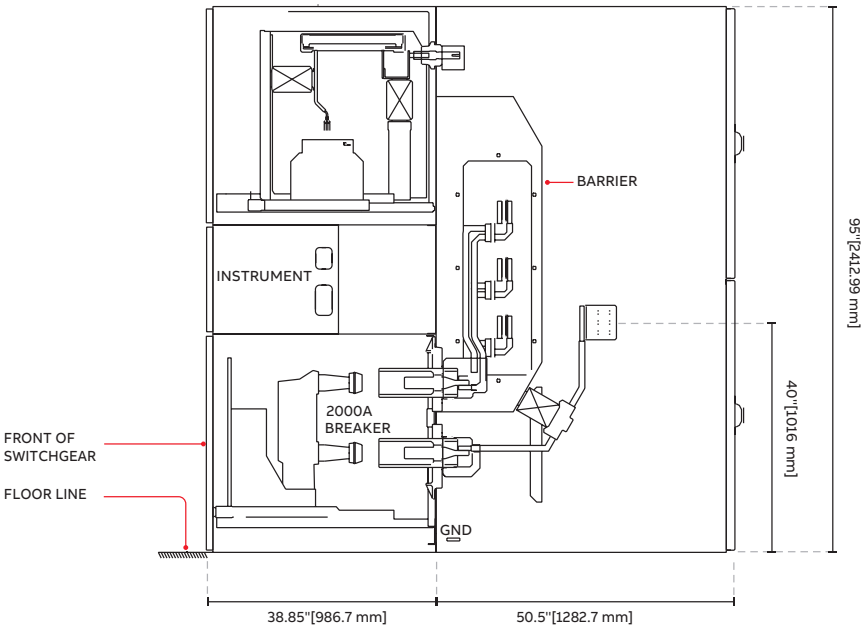


SECTION VIEW

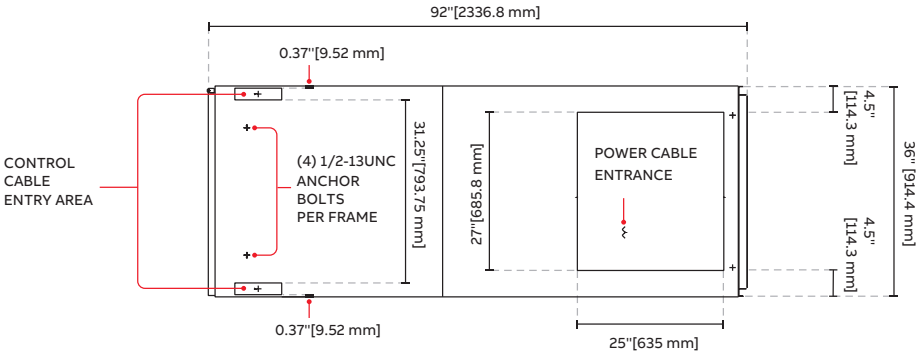


FLOOR PLAN

Advance 27 switchgear one-high with PT drawout
Circuit breaker: 2000 A

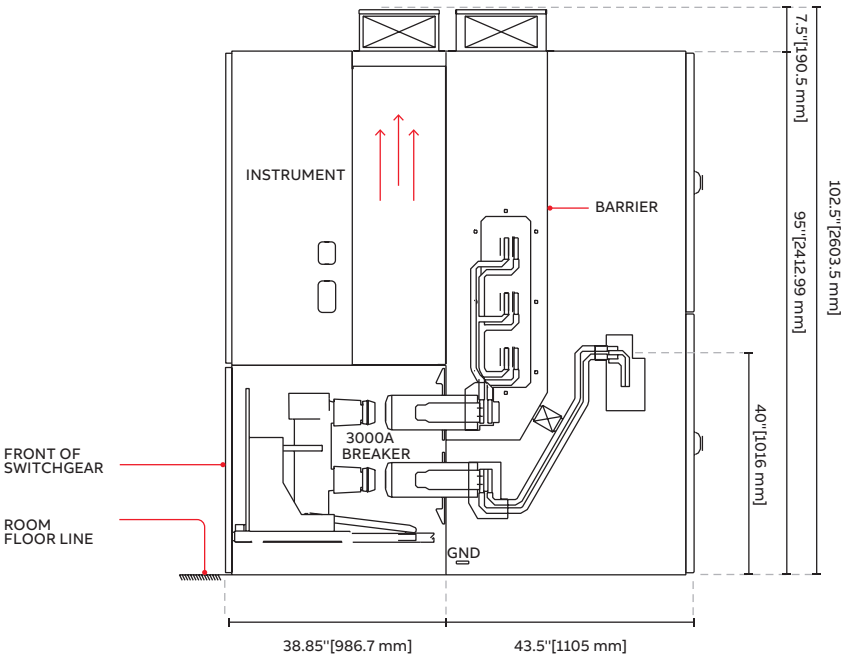


SECTION VIEW

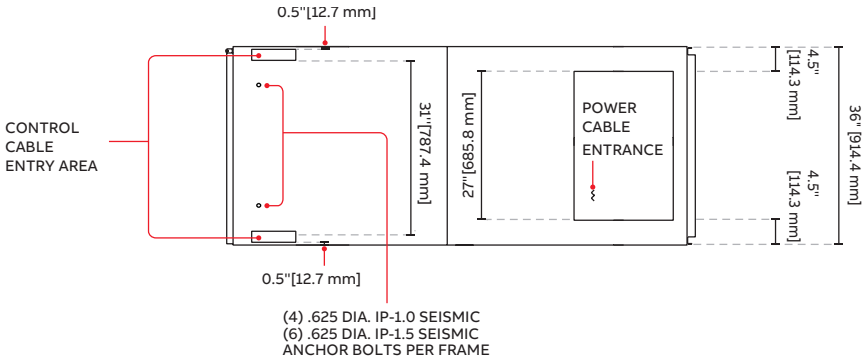


FLOOR PLAN

Advance 5-15 kV switchgear one-high
Circuit breaker: 3000 A

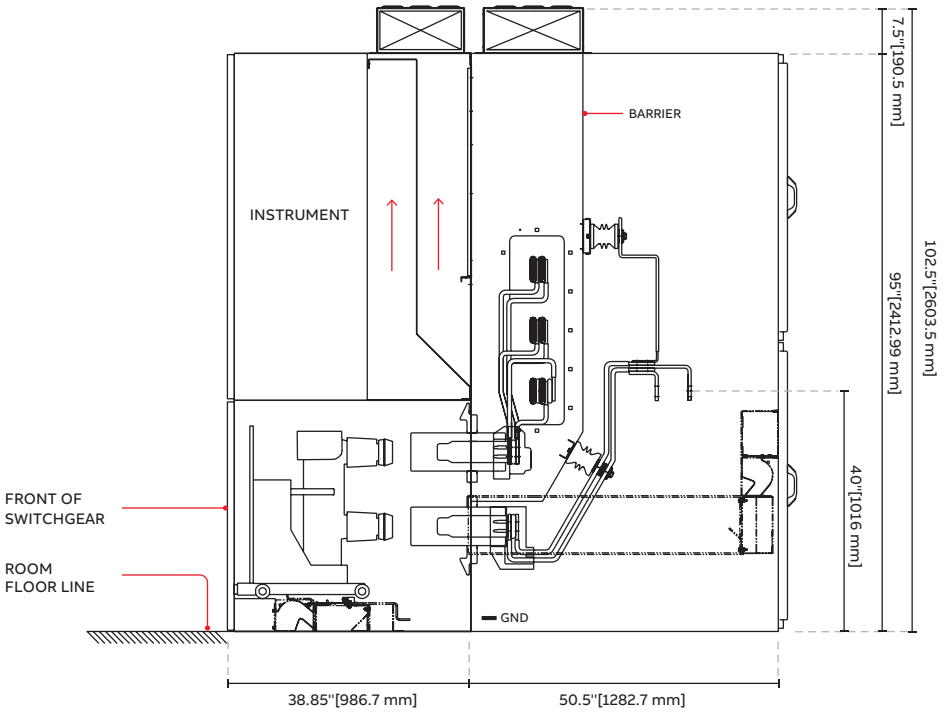


SECTION VIEW

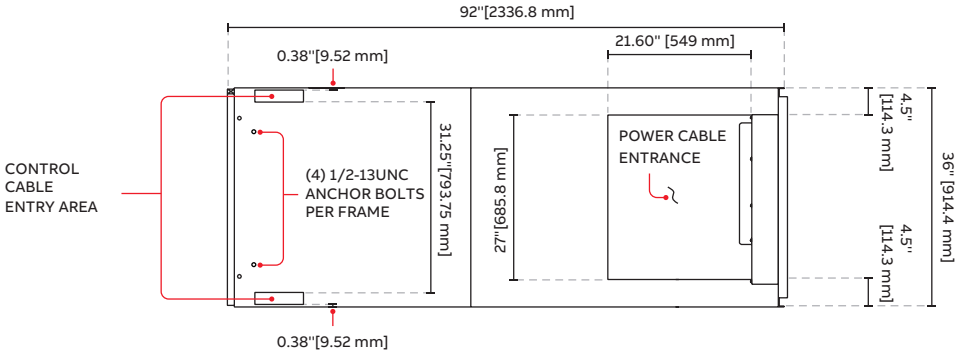


FLOOR PLAN

Advance 5-15 kV switchgear one-high
Circuit breaker: 63 kA, 4000 A only

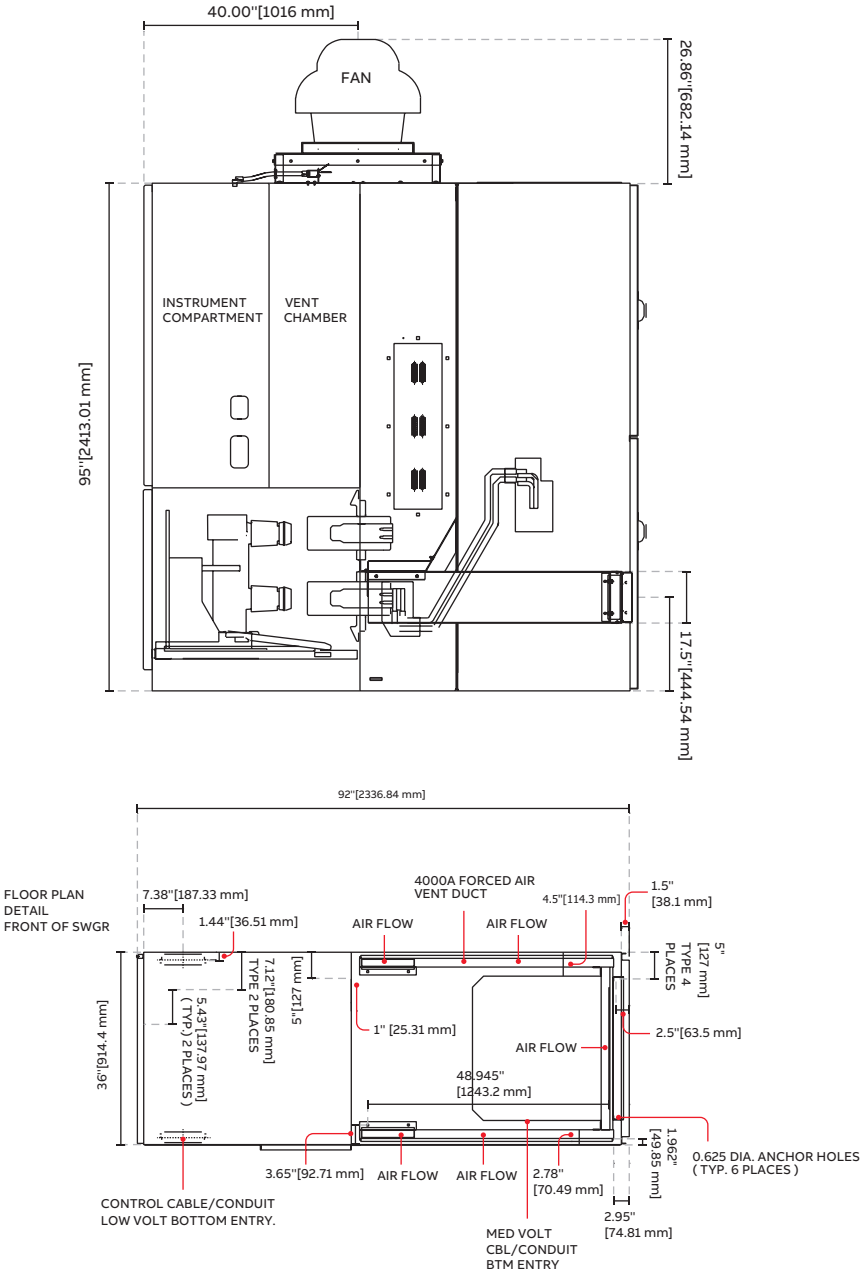


SECTION VIEW

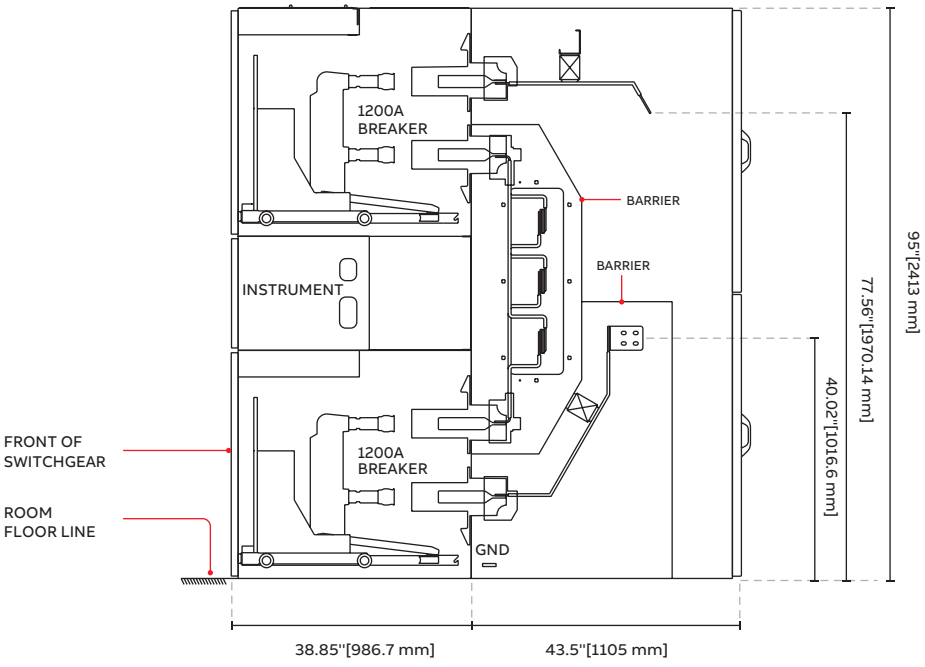


FLOOR PLAN

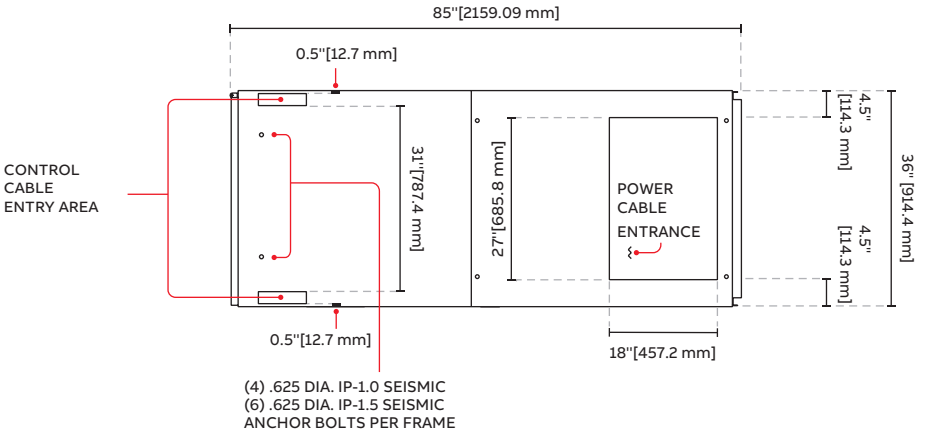
Advance 5-15 kV switchgear one-high
Circuit breaker: 50 kA, 4000 A



Advance 5-15 kV switchgear two-high
Circuit breaker: 1200/1200 A

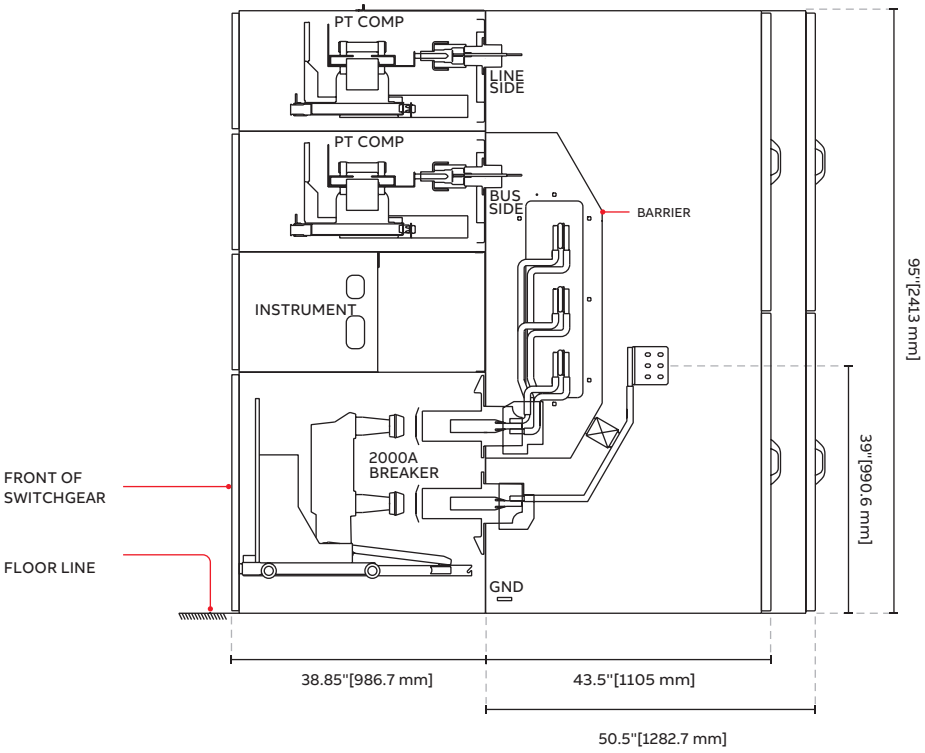


SECTION VIEW

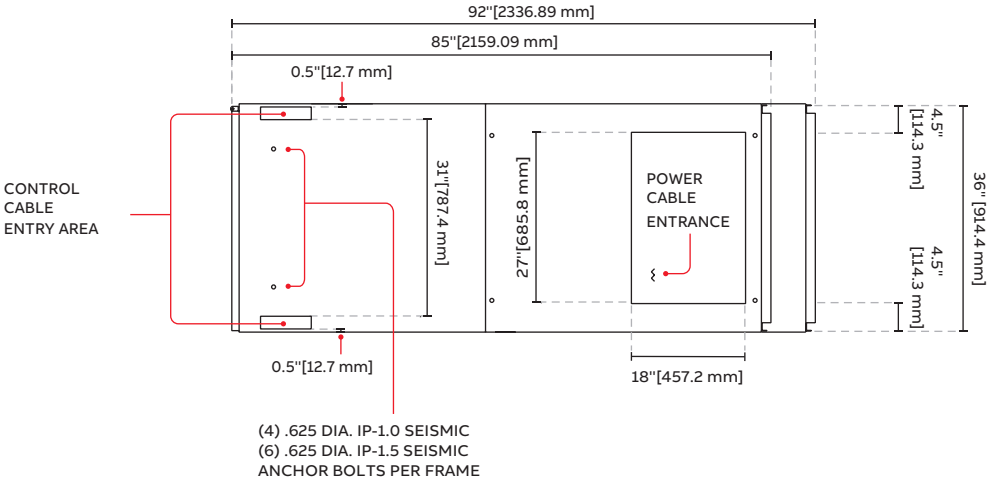


FLOOR PLAN

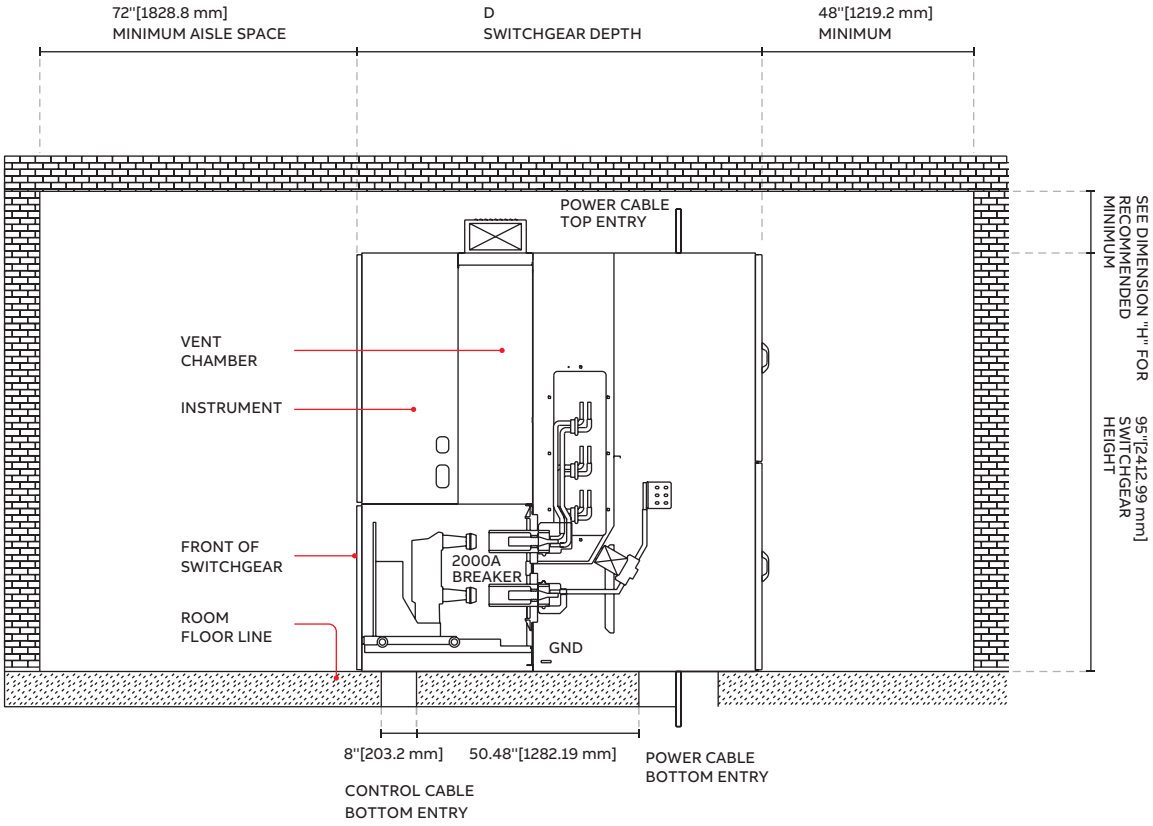
Advance 5-15 kV switchgear two PTs
Circuit breaker: 2000 A



SECTION VIEW



FLOOR PLAN



Typical civil engineering dimensions - inches	
	Depth (D)
Advance	85 or 92
Advance 27	92

Dimension H:
6 inches for 1200 A lineups
14 inches for 2000 A and 3000 A lineups
14 inches for 63 kA, 4000 A lineups
39 inches for 25-50 kA, 4000 A

Notes:
1. Additional height clearance may be needed during installation of the switchgear. Please allow for 6-inch shipping base for movement during installation.
2. For outdoor installations without a rear aisle, the switchgear can be provided for direct access via a weatherproof rear door.
3. Top-mounted box assembly required for 2000-4000 A ratings. No vent box required for 1200 A ratings.

Indoor and outdoor applications
The Advance line is available in indoor and outdoor construction. For outdoor applications, Advance can be provided in Outdoor Non-Walk-In (ODNWI), Outdoor Walk-In/Sheltered Aisle (ODWI), or installed in a PDC building. All applications offer the flexibility of one-high or two-high construction.

Standard indoor and outdoor construction meet the requirements of ANSI/IEEE standards.

Frame weight data
All frame styles

To calculate the weight of a frame, identify the current rating for each module. Select the weights from the appropriate column in the adjoining table for components.A frame consists of one bus and cable module and the appropriate circuit breaker is given separately and must be added. Low voltage modules may contain significant amounts of secondary equipment and wiring. Depending on the extent of secondary protection and control equipment, ABB recommends adding 20% to 50% of the empty weight of the low voltage module.

Basic frame configuration	Circuit breaker (rating)	Weight	
		lbs	kg
One circuit breaker	1200	1,990	903
	2000	2,245	1,018
	3000	3,210	1,456
	4000	3,330	1,510
Two circuit breakers	1200	2,800	1,270
One circuit breaker, one PT	1200	2,620	1,188
	2000	2,960	1,343
One circuit breaker, one CPT	1200	2,305	1,046
	2000	2,640	1,197

Note: These weights do not include the circuit breakers. Please reference the AMVAC or ADVAC breaker technical guides for more information

Component	Rating/ size	Weight	
		lbs	kg
AMVAC 27 kV circuit breaker (25 kA)	1200	410	182
	2000	419	193
Circuit breaker module (including bus risers, runbacks and supports)	1200	516	234
	2000	730	331
Inst com PT module (not including wiring)	19-inch	140	64
	57-inch	278	126
Bus and cable module (rating for main bus)	1200	658	298
	2000	757	357
PT module (including 3 PTs)		837	380
Fuse module (including 3 fuses)		520	236
Front extension	10-inch	60	27
Rear extension	10-inch	36	16
End panels (per lineup)		360	163

The weight of the end panels has to be considered per lineup of switchgear. Weights given are for two end panels, one on each end of the switchgear lineup.

Typical frame weights are listed below. Detailed drawings for the arrangements are located on pages 29-35. Weights include all modules and components as listed above.

5-15 kV AMVAC breaker weights

Voltage	Current	kA	lbs	kg
5/15	1200	25-31.5	334	152
5/15	1200	40	410	186
15	1200/2000	50	430	195
5	2000	25-50	419	190
15	2000	25-40	419	190
5	2000	25-50	459	208
15	2000	25-40	459	208
15	3000	50	481	218
8.25	1200	40	410	165
8.25	2000	40	419	180
8.25	3000	40	459	190

5-15 kV ADVAC breaker weights

Voltage	Current	kA	lbs	kg
5/15	1200	25-31.5	298	135
5/15	1200	40	364	165
5/15	1200	50	419	190
5/15	1200/2000	63	573	260
5/15	2000	25-40	364	165
5/15	2000	50	441	200
5/15	3000	25-40	419	190
5/15	3000	50	463	210
5/15	3000	63	650	295
8.25	1200	40	364	165
8.25	2000	40	397	180
8.25	3000	40	419	190

Normal operating conditions and service conditions

The normal operating conditions for ANSI medium voltage metal-clad switchgear are defined as all enclosure doors and/or covers properly installed and all breakers and auxiliary units in either the disconnect or connect position.

The design and performance of the switchgear are based on usual service conditions as defined by IEEE Std C37.20.2, section 4.0. The selection of equipment for a particular application can be based on the construction and ratings as defined in IEEE C37.20.2, provided that the following usual service conditions exist:

a) The temperature of the cooling air (ambient air temperature) surrounding the enclosure of the MC switchgear is no less than -30°C and no more than 40°C
b) The altitude of the installation does not exceed 1000 m (3300 ft)
c) There is no significant effect of solar radiation as per the principles of IEEE Std C37.24
d) Unusual service conditions as outlined in IEEE C37.20.2, section 8.1 do not prevail
e) The ambient air is not significantly polluted by dust, smoke, corrosive gas vapors or salt. The pollution does not exceed the Site Pollution Severity class (SPS) “light” according to IEEE Std C37.04. Reference Annex “C”.
f) The conditions of humidity are as follows:
a. The average value of the relative humidity measured over a period of 24 h does not exceed 95%.
b. The average value of the water vapor pressure, over a period of 24 h does not exceed 2.2 kPa.
c. The average value of the relative humidity over a period of one month does not exceed 90%.
d. The average value of the water vapor pressure over a period of one month does not exceed 1.8 kPa.
e. It is important to note that for these conditions, condensation may occasionally occur.

Note 1 – Condensation can be expected where sudden temperature changes occur in periods of high humidity.

Note 2 – Condensation may be prevented by special design of the building or housing, by suitable ventilation and heating of the station or by the use of dehumidifying equipment. Other options include heaters with thermostats/humidistat inside the switchgear. Condensation may also be due to ground level rainwater or for underground applications, from incoming cable raceways connected to switchgear.

Vibration due to causes external to the switchgear or earth tremors are insignificant relative to the normal operating duties of the equipment and do not exceed the low performance level defined in IEEE Std 693.

Equipment specifiers and users should review section 8.1 of IEEE C37.20.2 for unusual service conditions and other considerations when preparing specifications for MV switchgear because unusual service conditions impact equipment design and ratings.

Examples of unusual service conditions are as shown below, but not limited to:

- Ambient air temperature above 40°C
- Ambient air temperature below -30°C
- Installations at unusual altitudes
- Exposure to damaging fumes, vapors, steam, salt air, and oil vapors
- Exposure to excessive dust, abrasive dust, and magnetic or metallic dust
- Exposure to hot and humid climates
- Exposure to explosive mixtures of dust or gases
- Exposure to abnormal vibration, shocks or tilting
- Exposure to seismic shock

Note 3 – The use of filters on ventilation openings may require de-rating of the equipment. Contact the factory for de-rating factors required for specific ratings when filters are required.

Cable temperature ratings

— 22 Typical primary cables that are used for connecting to switchgear.

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.

— 22

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