

VFI underground distribution switchgear



General

Eaton's Cooper Power Systems VFI underground distribution switchgear provides superior overcurrent protection through the use of proven, reliable vacuum fault interrupters from Eaton's Cooper Power Systems. The resettable vacuum fault interrupter allows immediate service restoration, eliminating the added expense and downtime associated with stocking and replacing fuses.

Deadfront construction provides a higher level of safety for operating personnel. With the addition of visible-break switches, circuits can be isolated and grounded without disconnecting or moving terminations.

A sealed insulation system offers the further advantage of low-maintenance, and permits construction of a compact, low-profile unit that is less obtrusive than a comparable air-insulated design. Insulation options include the environmentally-preferred high-fire-point E200™ fluid and Envirotemp™ FR3™ fluid, as well as mineral oil and Sulfur Hexafluoride (SF₆) gas.

VFI switchgear is used for commercial/industrial and utility applications, and can be easily coordinated in the field without a PC, using field-selectable settings to meet distribution system protection requirements. Ratings of VFI switchgear are shown in Table 1.

**Cooper
Power Systems**
by **EATON**

Table 1. Ratings for VFI Switchgear and Load-Break Switch*

Nominal Voltage		15 kV	15 kV	25 kV	35 kV
Maximum Design Voltage, kV		15.5	15.5	27.0	38.0
BIL, kV		95	95	125	150
1-minute Withstand Voltage (60 Hz), kV		35	35	60	70
Momentary Current, 10 cycles (sym.), kA		12.5	16.0	12.5	12.5
1-second Withstand Current (sym.), kA		12.5	16.0	12.5	12.5
Vacuum Fault Interrupter	Continuous Current, (max.), A	600**	600**	600**	600
	Interrupting Current (sym./asym.), kA	12.5/20.0	16/25.8	12.5/20.0	12.5/20.0
	Making Current (sym.), kA	12.5	16.0	12.5	12.5
	Cable Charging Interrupting Current, A	10.0	10.0	25.0	40.0
Load-Break Switch	Continuous Current, (max), A	600	600	600	600
	Load Switching, A	600	600	600	600
	Fault Making (sym./asym.), kA	12.5/20.0	16/25.8	12.5/20.0	12.5/20.0

* Continuous and short-circuit currents may be limited by ratings of selected bushings.

** 900 A and 1200 A continuous-current ratings are also available.

Features and detailed description

VFI switchgear

Eaton's Cooper Power Systems VFI underground distribution switchgear provides a simple, economical approach to protective requirements for 5, 15, 25, and 35 kV underground systems.

The deadfront construction of VFI switchgear improves safety for utility personnel and the general public. Inside, all terminations are covered with insulating rubber that is grounded. All internal parts are completely sealed in a steel tank to reduce maintenance and eliminate the problems of moisture, dirt, and wildlife.

This fluid-insulated, sealed design offers an added advantage: an unobtrusive, low-profile appearance.

VFI switchgear is versatile in its application. It is suited for commercial/industrial and utility requirements.

Single-sided compact style VFI switchgear units are ideal for areas where access is limited; such as next to a transformer, behind a building, against a wall, or in a vault. The VFI vault-style unit is suitable for indoor applications including commercial and industrial electrical equipment rooms. 5- and 6-way units are ideal for large retail complexes and campuses (military, university, industrial park) with multiple loads.



Figure 1. Compact single-sided units are available in vault and pad-mounted styles.



Figure 2. VFI switchgear 6-way unit.

For sustained reliability, Eaton's Cooper Power Systems VFI switchgear has 30 years of excellent field performance. The VFI switchgear's interrupting duty cycle is unmatched in the industry, providing a full 232 interruptions per IEEE Std C37.60™-2003 standard (see Table 2).

Tri-Phase control

The Tri-Phase electronic control provides a flexible solution for time-current-curve coordination. The Tri-Phase control offers over 100 minimum trip settings and an assortment of time-current curves. With standard instantaneous trip and optional ground trip and minimum response characteristics, the Tri-Phase control will satisfy system protection and coordination needs. A wide selection of TCCs and minimum trip settings make it easily adaptable to distribution systems.

Edison™ Idea™ relays

Edison™ Idea™ relays allow enhanced functionality in protection and communication.

The IDEA Workbench™ embedded within the ProView™ software allow unsurpassed flexibility in customizing the relay protection and control functions through downloadable Custom Software Modules.

Depending on the relay selected, Edison Idea relays can provide protective functions such as overcurrent with or without ground detection, over/under voltages, reverse power, and negative sequence to name a few.

IMPORTANT

For applications requiring SF₆ insulated switchgear, contact your Eaton's Cooper Power Systems representative when selecting a relay/controller that has metering and protective elements requiring potential transformers.

Advanced metering and analytics are also available which are critical to providing Distribution Automation capability.

Single- or three-phase tripping

Most commercial loads consist of large three-phase transformers. Many transformers are protected with single-phase fuses. Typically, only one of the fuses will open during an overcurrent condition. This "single-phases" three-phase commercial loads, and may cause damage to three-phase motors and other equipment. VFI switchgear solves this problem by providing three-phase ganged tripping. An overcurrent on any phase automatically opens all three phases simultaneously.

VFI switchgear can also be specified with single-phase trip, to provide individual phase protection for single-phase residential applications.

VFI switchgear can also serve as a vacuum loadbreak switch. Tap switching has traditionally been accomplished by pulling loadbreak elbows. With VFI switchgear, the tap can be switched with a simple push-pull of the operating handle.

Table 2. Interrupting Duty Cycle

Minimum Full Life Fault Interrupting Duty Cycle per IEEE Std C37.60™-2003 standard (2 duty cycles)		Number of Operations
Percent of Interrupting Current Rating:	15-20%	88
	45-55%	112
	90-100%	32
Total		232

Vacuum loadbreak switch

Source switching is accomplished by three-phase, vacuum loadbreak switches. The ratings for the vacuum switches are in Table 1.

Visible-break switch

Visible-break switches are available in two versions—a two-position switch (closed/open) and a three-position switch, (closed/open/ground). Visible-break is accomplished by a separate switch operated from the side of the unit—away from the high voltage compartment. This switch is mechanically interlocked such that the vacuum load-break switch or the vacuum fault interrupter mechanism first interrupts the current and then the visible-break switch may be operated. The visible-break switch is rated 600 A continuous current and has a making current rating up to 16 kA (sym). The ground position allows the cables to be grounded without disconnecting or moving the terminations. The switch contact positions are visible via a large viewing window above the associated bushings. Only VFI switchgear with liquid dielectric may be equipped with a visible-break feature.

Types of insulation

Eaton's Cooper Power Systems offers underground distribution switchgear with the widest availability of dielectric media in the industry. Fire-resistant E200 fluid and Envirotemp™ FR3™ fluid, as well as commonly used mineral oil and SF₆ gas, are offered as insulation media for VFI switchgear.

E200 fluid

E200 fluid is fire-resistant biodegradable, polyol ester-based, non-toxic low viscosity fluid with excellent dielectric, thermal and physical properties. The low viscosity characteristic allows it to be used in VFI switchgear down to -30 °C. Its fire point is greater than 300 °C (572 °F), a requirement for less flammable fluids.

The performance of the switchgear equipment containing E200 fluid is further enhanced by the fluid's other important properties:

- Excellent thermal properties
- High dielectric strength
- Oxidation stability
- Clear bright appearance

Envirotemp™ FR3™ fluid

Envirotemp™ FR3™ fluid is formulated from edible vegetable oils and food grade performance enhancing additives. It does not contain any petroleum, halogens, silicones, or any other questionable material. It quickly and thoroughly biodegrades in both soil and aquatic environments. The fluid tested non-toxic in aquatic toxicity tests.

Mineral oil

Mineral oil is a petroleum-based, time-proven insulation and has reliable electrical insulating properties.

SF₆

SF₆ is non-flammable, odorless, colorless gas that requires a gas-tight design and gas monitoring and handling systems.

Table 3. Available Dielectric Media—Minimum Application Limits

E200 Fluid	-30 °C
Envirotemp™ FR3™ Fluid	0 °C
Mineral Oil	-30 °C
SF ₆ Gas	-30 °C

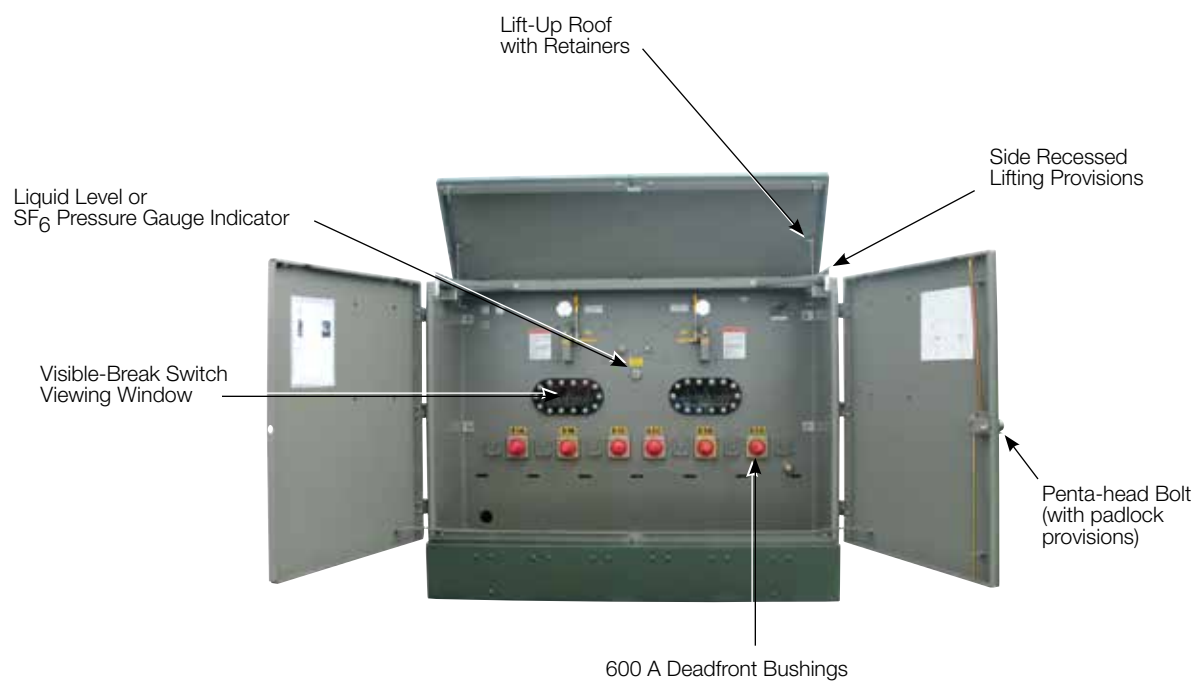


Figure 3. VFI switchgear source-side switch components (some optional components shown).



Figure 4. VFI switchgear tap-side components (some optional components shown).

Low Profile sealed construction

VFI switchgear features a low-profile cabinet design, with sealed tank construction. This means that VFI switchgear can be used in locations where air-insulated switchgear cannot, such as flood areas or high-contaminant industrial sites. It is resistant to attacks from dust, ice, vegetation, and wildlife.

Stainless steel

VFI switchgear may be specified in 100% stainless steel construction for the ultimate in corrosion protection. With VFI switchgear from Eaton's Cooper Power Systems, the entire unit is designed in stainless steel, including the tank and cable compartments. All details and accessories are stainless steel as well. This construction meets the requirements of IEEE Std C57.12.29™-2005 standard, Standard for Pad-Mounted Equipment—Enclosure Integrity for Coastal Environments.

Trip-free operation

The vacuum fault interrupter mechanism can be quickly and easily reset manually by pulling the handle to the “reset” position and then moving it to the closed position. However, if a fault is present when the vacuum fault interrupter mechanism is closed, the trip-free feature will prevent the mechanism from being held in the closed position and it will clear the circuit fault.

UL® Listed and Labeled

VFI switchgear and a number of its features can be UL® listed and labeled to meet customer requirements as necessary. These features are available for the family of VFI switchgear products as follows:

- 15 kV and 25 kV voltage ratings
- 600 A continuous current rating
- 12.5 kA symmetrical interrupting rating
- Fluid Dielectrics (mineral oil, E200 and Envirotemp™ FR3™ fluids)
- Visible-break switch (two- and three-position)
- Mild and stainless steel construction
- Tri-phase and TPG control
- All standard combinations of load switches and fault interrupters

Low maintenance

Both load and fault interruption take place within the sealed vacuum fault interrupter with no arcing by-products to contaminate the insulating medium. Advanced technology vacuum fault interrupters are reliable, have long life and require no maintenance. Eaton's Cooper Power Systems patented design reduces the arc energy—resulting in far less contact erosion and the longest life of any vacuum fault interrupter in the industry. Since there are no expulsion fuses or switching by-products to contaminate the insulation medium, maintenance intervals are greatly increased.

Edison™ Idea™ relay and Tri-Phase control

Eaton's Cooper Power Systems Edison™ Idea™ relay and Tri-Phase control makes use of internally mounted 1000:1 current transformers (CT), one on each phase, to monitor line current. If the current in any phase exceeds the minimum trip level setting, the control begins a user selectable time-current-curve (TCC) delay sequence.

At the completion of the programmed TCC delay, a signal is issued to trip the vacuum fault interrupter mechanism.

CT circuits

The Tri-Phase control is self-powered by the line current. It requires no external voltage supply or battery backup. Since the Tri-Phase control is powered by the sensing CT circuits, it is not affected by system voltage conditions.

Edison Idea relays require a 120 Vac power source to power their internal battery source. The standard battery provided is an 13 Ah. 18 Ah batteries are an option.



Figure 5. TPG control with SCADA shown.

Tri-Phase control settings

The minimum-trip setting for each phase is selectable. This permits convenient field configuration of the Tri-Phase control, to meet specific application requirements.

The control features an assortment of field replaceable TCC modules, each provides a fixed time-current-curve characteristic. The variety of modules available provides coordination flexibility between the Tri-Phase control and other protective equipment.

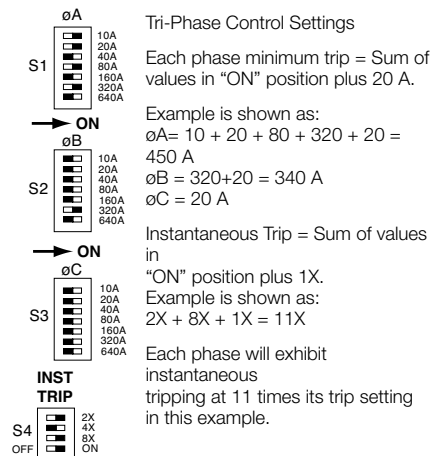


Figure 6. Tri-Phase control settings.



Figure 7. Typical Tri-Phase with ground trip control (TPG) module.

Tri-Phase control normal load

At normal system current, the Tri-Phase control is effectively dormant. Load current is continuously being compared to the selected minimum-trip settings, but the TCC and trip circuits are not activated.

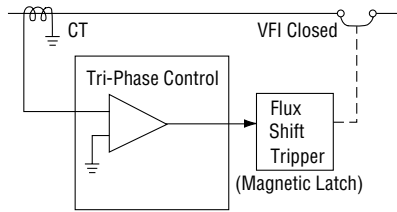


Figure 8. Normal load diagram.

Tri-Phase control overcurrent protection

The TCC circuit is activated when current above the pre-selected minimum trip value is sensed. Once activated, the TCC circuit uses the magnitude of the overcurrent to establish a time delay. At the completion of the delay, the trip circuit pulses the Flux Shift Tripper, which causes it to trip open the vacuum fault interrupter mechanism.

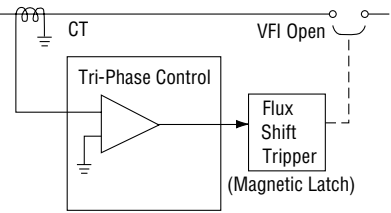
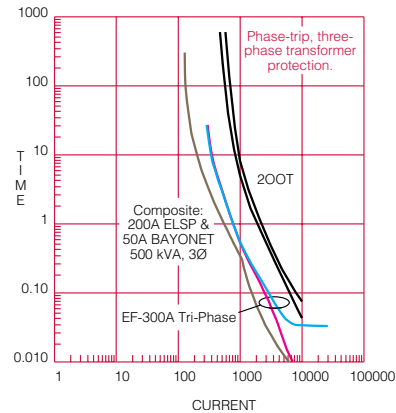


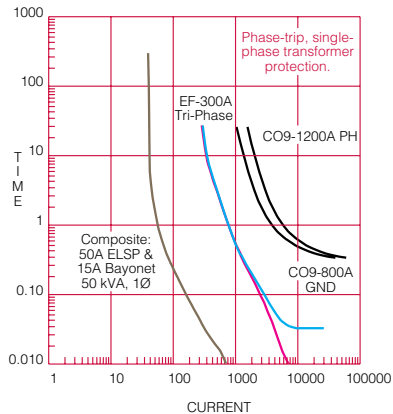
Table 9. Tri-Phase control overcurrent protection diagram.

Tri-Phase control coordination flexibility

The E time-current curve has long been an industry standard for underground distribution switchgear fusing. However, when several protective devices are present on the same line, it can become difficult to obtain proper system coordination. The Tri-Phase control, with the EF TCC installed, combines classic switchgear protection with state-of-the-art vacuum fault interrupter technology. The Tri-Phase control eliminates the problems normally associated with fuses, but preserves and extends the familiar E-shaped curve to higher currents.



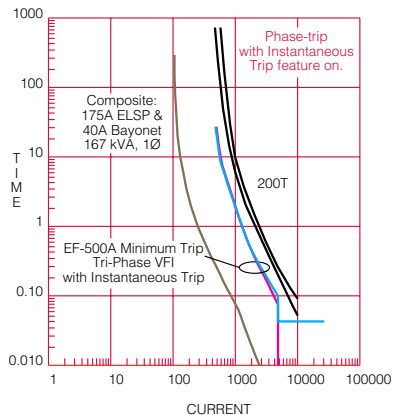
Coordination and application of the Tri-Phase control is identical to fuse application, but with the benefit of a greatly expanded offering of trip ratings and timing curves. In the following example, the EF TCC provides ideal coordination when protecting single-phase distribution transformer loop schemes. The cable can be protected to its rated load with sufficient margin between the EF and the substation breaker.



Tri-Phase control instantaneous trip

Instantaneous trip, a standard feature of the Tri-Phase control, extends the range of coordination with upstream devices, at higher fault levels. A switch on the control circuit board enables the instantaneous trip feature and programs a multiplier that is applied to the standard minimum trip setting. When current above the predetermined fault level is sensed, the instantaneous trip feature causes the control to bypass the normal TCC delay and trip immediately; thus eliminating any intentional time delay. For faults below this actuation level, the control operates according to its normal settings.

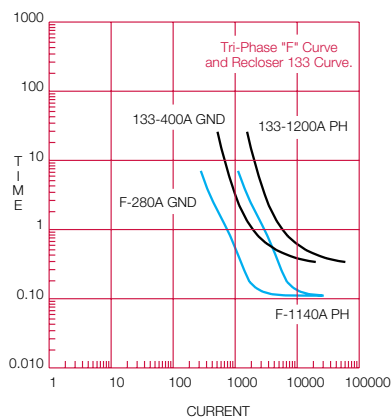
In the example, the EF curve coordinates well with the transformer fusing, although instantaneous trip is required to extend coordination with the upstream T-Link.



Optional Tri-Phase with ground trip control (TPG)

The optional TPG control operates under the same algorithm as the standard Tri-Phase control for phase protection. In addition, the TPG control has a separate zero-sequence circuit and settings for ground protection. Settings for ground trip vary from 10 A to 640 A in 10 A increments, and are field selectable by the user.

In some applications, such as a switchgear tap that feeds both underground and overhead feeders, the TPG control is necessary. As shown below, the F curve achieves coordination with both the phase and ground settings of the upline recloser.

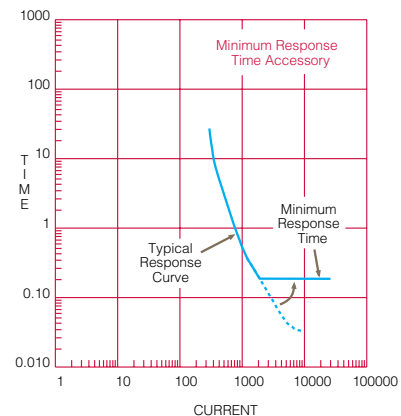


Tri-Phase control accessories

Minimum response time

The minimum response time accessory is used to achieve coordination between in-line protective interrupting devices, located where fault-level currents would normally cause simultaneous tripping.

The accessory inhibits tripping until a predetermined minimum time has elapsed; available minimum response times are adjustable at 0.050, 0.100, 0.145, 0.205, 0.260, 0.335, 0.405, 0.495, or 0.580 seconds. Refer to the example below.



Minimum trip multiplier

The minimum trip multiplier accessory allows the user to increase the programmed minimum trip setting, to a predetermined alternate setting, by operating a toggle switch. Typical applications for an alternate minimum trip settings include: preplanned or emergency load transfers, maintenance, or other routine switching conditions where line or feeder load temporarily exceeds the normally anticipated levels.

TPG ground trip control

The TPG control includes phase and ground-fault protection for systems where increased sensitivity is required. If a ground-fault is detected, the control will begin a time-current curve delay sequence. At the completion of the programmed delay, a signal is issued to trip the vacuum fault interrupter mechanism.

Since the ground-fault curves are more sensitive than the phase curves, they can offer a distinct advantage in those special applications where increased sensitivity and speed in overcurrent protection are required. As a result, coordination with upstream devices (i.e., electronic reclosers) can be obtained where TCC coordination is difficult.

TPG SCADA accessory

VFI switchgear, when ordered with the TPG control, may also be supplied with an optional SCADA accessory. The SCADA accessory provides the user with remote functionality, along with Status and Fault indicators, for each TPG-controlled vacuum fault interrupter mechanism. For additional information, refer to *Service Bulletin S285-75-1, Tri-Phase, TPG, and TPG with SCADA Electronic Control Installation and Operation Instructions*.

Edison Idea and IdeaPLUS™ relays

IMPORTANT

For applications requiring SF₆ insulated switchgear, contact your Eaton's Cooper Power Systems representative when selecting a relay/controller that has metering and protective elements requiring potential transformers.

Edison Idea and IdeaPLUS™ relays offer advanced protection and control options for the most demanding applications. Three different relays are available:

iDP-210 relay-provides multi-function protection elements for one source or tap. The iDP-210 relay is available in the Idea and IdeaPLUS platforms.

iTAP-265 relay-provides overcurrent protection for two three-phase taps. Available in IdeaPLUS platform only.

iTAP-260 relay-provides overcurrent protection for two three-phase taps with independent settings for each phase. Each phase can be independently tripped. Available in IdeaPLUS platform only.

Edison Idea and IdeaPLUS relays meet all applicable relay standards, including IEEE Std C37.90™-2005 and IEEE Std 1547™-2003 standards.

All relays include the following features and functions:

- Incipient Cable Splice Fault (ICSF) Detector
- Sequence of Event recorder with capacity to store the most recent 250 events in non-volatile memory
- Oscillography for fault analysis
- Programmable Data Profiler to record any combination of the available metering data
- Metering – instantaneous current, voltage, power factor, power, energy, demand, and harmonics
- Communications protocols shall include DNP3 via serial and TCP/IP, and Modbus via serial
- Graphical programming environment for custom logic and communication point maps
- Virtual Test Set™ for testing relay settings without the need for an external test set
- Integral breaker Interface panel, including illuminated Trip and Close pushbuttons, Close Inhibit switch, and close circuit disable link
- Twenty-five front panel LED targets to indicate relay status

iDP-210 feeder protection relay

The iDP-210 is a full-featured relay suitable for a variety of protection applications, including source protection, feeder protection, and distributed generation inter-ties. Integral motor control logic for the VFI switchgear operator is included as standard. The protective elements in the iDP-210 relay are listed below.

- Phase instantaneous, definite time, and inverse time overcurrent (50/51)
- Ground instantaneous, definite time, and inverse time overcurrent (50N/51N)
- Negative Sequence instantaneous, definite time, and inverse time overcurrent (50Q/51Q)
- Directional phase, ground, and negative sequence elements (67P, 67N, 67Q)
- Reverse Power (32)
- Voltage elements: Definite time undervoltage (27), Definite time overvoltage (59), Negative sequence, and zero sequence overvoltage (59N)



Figure 10. The iDP-210 is a member of Eaton's Cooper Power Systems Edison Idea line of protective relays.

- Frequency elements: definite time underfrequency (81U) and definite time overfrequency (81O)
- Sync-check (25)
- Highly configurable four-shot recloser (79)
- Breaker failure (BF52)

iTAP-265 dual overcurrent relay

The iTAP-265 relay provides overcurrent protection for two three-phase taps. Additional functionality can be programmed in the IDEA Workbench feature of ProView™ software.

- Phase instantaneous/definite time, and inverse time overcurrent (50/51) for each three-phase tap
- Ground instantaneous/definite time, and inverse time overcurrent (50N/51N) for each three-phase tap

iTAP-260 dual overcurrent relay

The iTAP-260 relay provides overcurrent protection for two tap with independent settings for each phase. Additional functionality can be programmed in the IDEA Workbench feature of ProView software.

- Phase instantaneous/definite time, and inverse time overcurrent (50/51) for each phase. Six elements total
- Ground instantaneous/definite time, and inverse time overcurrent (50N/51N) for each phase. Two elements total.



Figure 11. Edison Idea iTAP-260 relays.

Customize with the IDEA Workbench

Edison Idea and IdeaPLUS relays are fully functional relays, ready to use right out of the box. However, there are applications where custom control logic, or custom functions need to be added to the relay. The IDEA Workbench is a revolutionary graphical software programming environment which permits the user to customize the relays.

- Add new features or protective functions by means of IDEA Workbench Custom Modules. These operate in the same fashion as the plug-ins for popular internet browsers. Your investment in the relay is protected as future needs and developments may be addressed through new Custom Modules.
- Create custom control and protection logic using over 400 programming signals and tools, all selectable from drag-off Toolboxes. Logic created using these tools can then be saved as Custom Modules to be reused or shared with associates.
- Monitor and control practically every aspect of the relay's operation
- Create custom metering and measurement quantities
- Create custom sequence of event records
- Configure communication protocols to match existing SCADA system mappings

The IDEA Workbench offers the user the ability to rapidly and accurately create customizations by working the way the engineer thinks, by using logic diagram and flowchart construction methods. No equation-based or command-based logic programming is required.

The IDEA Workbench also addresses some of the more difficult questions associated with custom relay programming, namely:

Clarity: Compared to that offered by equation and command based programming techniques, graphical programming results in customizations whose operation is intuitive.

Testing: ProView provides a Virtual Test Set (VTS), which can be used to test the developed logic with realistic fault signals. During test, the logic diagrams become "live" showing the state of all variables, logic gates, contacts, counters, etc. To avoid any question of how the custom logic interacts with the relay itself, the VTS environment models the entire relay in addition to the custom programming. Unlike other programming environments, the IDEA Workbench does not require the user to have an actual relay or relay test set on hand to verify the proper operation of the programmed logic.

Documentation: Notes regarding how the custom logic operates may be embedded within the IDEA Workbench. This improves the ability of others to quickly understand how the logic is designed to work. Links to external files may also be embedded in the IDEA Workbench, providing fast access to larger documents stored on company's network servers.

Portability: If the original data files are lost, the entire IDEA Workbench may be uploaded from the relay, complete with logic diagrams, embedded notes and external reference links.

Event records and analysis tools

The iDP-210 relay shares the same event records and analysis tools as all Edison Idea relays. The Edison Idea allows for the display of event records in a variety of formats including waveforms (oscillography), magnitude plots, phasor diagrams, symmetrical component diagrams and more. ProView, the software for the Edison Idea relay, also provides a unique Application Diagram View that provides a one-screen view of everything that is going on in the relay. Many of these event views are also available in On-Line View mode, where it is possible to monitor the status of the relay in real-time, including phasor diagrams, which is ideal for verifying CT phasing during commissioning. The iDP-210 relay also includes distance to fault indication.

Relay Replay™

To evaluate the effect different settings would have on the relay, the Relay Replay™ feature of the Edison Idea software allows the user to make any number of setting changes and replay an existing event using these new settings without the need for an actual relay or expensive test equipment. The operation of every aspect of the relay's performance, from which elements pick-up, the response time of those elements that do and the operation of any custom programming made via the IDEA Workbench can be observed. This tool provides unprecedented "what-if" analysis capabilities.

Virtual Test Set (VTS)

To evaluate settings against any arbitrary fault, the Edison Idea software permits the user to create a virtual event record through use of the software's VTS feature. The VTS allows complete control over:

- Pre-fault and post-fault voltage and current levels
- Selection of phase-ground, phase-phase, phase-phase-ground and three-phase fault types
- Fault duration
- Selection of system and fault impedances
- Selection of DC time constant
- Control over fault dynamics to verify reclosing sequences and sequence coordination
- Control of frequency change, rate of change, and acceleration during faults
- Control over simulated breaker open and close times
- Voltage and current parameters derived from a built-in power system model or entered manually.

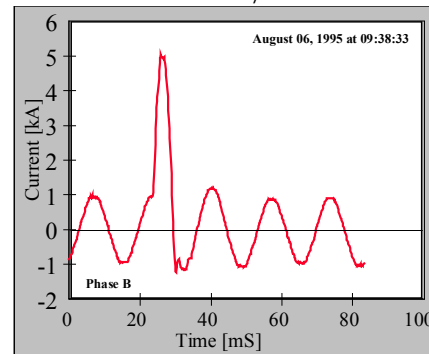


Figure 12. Typical self-clearing fault detected by the iDP-210 relay ICSF algorithm.

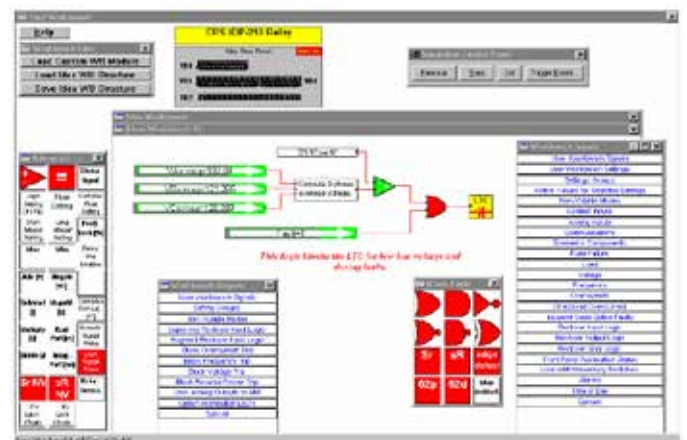


Figure 13. The IDEA Workbench graphical customization environment.

Communications

Both Modbus RTU and DNP 3.0 communication protocols are included with the iDP-210 relay. A Communications Workbench™ provides the user the ability to customize communication maps, add or delete information, add control points, and even create new signals to be brought out through communications. The iDP-210 relay features two RS-232 auto-baud (57600 kbps max) communication ports and one port configurable for RS-485, serial fiber optic, and various Ethernet options (RJ-45, multi-mode fiber, single-mode fiber). Contact your Eaton's Cooper Power Systems representative for availability of other communication protocols.

Incipient cable splice fault detector (ICSF)

One of the most common causes of buried cable failure is from moisture ingress to buried cable splices. When sufficient water accumulates in the splice, a line-to-ground fault briefly occurs. The fault is cleared as the water is suddenly converted in to steam. Over time, the insulation is damaged and the cable splice eventually fails. The iDP-210 relay contains an algorithm to recognize the unique waveform characteristics of these self-clearing faults. See Figure 12. By counting how often these events occur over a moving time window, the iDP-210 relays are able to give advance notice of pending cable splice failures. This permits cable maintenance to be scheduled rather than addressed on an emergency basis.

Overcurrent protection

The iDP-210 relay offers inverse time, definite time (2 levels) and instantaneous elements for phase, residual and negative sequence overcurrent protection. An additional definite time ground overcurrent element is provided for a separate zero-sequence flux summing CT. This fourth current channel input may also be ordered in a sensitive earth fault version which may be set as low as 0.005 A secondary. Each overcurrent element may be independently selected to be non-directional, forward- or reverse-directional. Inverse time elements may be set for disk-like or instantaneous reset characteristics. Complete fuse-fail detection logic is also included to selectively non-directionalize or disable directional elements during loss of bus potential.

Motor operators

VFI switchgear may be specified with motor operators and an associated control to allow for local or remote opening and closing of the switches and vacuum fault interrupters via SCADA command.

Motor control is available either via the Edison Idea relays or with a separate DC Motor Controller.

Edison Idea relays can control up to two (2) individual motors on the operating handles. With this option, the motor control is integral to the relay.

The stand alone DC Motor Controller may operate up to six (6) individual motors on the operating handles. Additional motor controllers can be supplied if more than six (6) motors are required.

Applicable standards

IEEE Std C37.74™-2003 standard, Standard Requirements for Subsurface, Vault, and Pad-Mounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems Up to 38 kV.

IEEE Std C37.60™-2003 standard, Standard Requirements for Overhead, Pad-Mounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for Alternating Current Systems Up to 38 kV.

IEEE Std C57.12.28™-2005 standard, Standard for Pad-Mounted Equipment—Enclosure Integrity.

IEEE Std C57.12.29™-2005 standard, Standard for Pad-Mounted Equipment—Enclosure Integrity for Coastal Environments – applicable when stainless steel construction is specified.

IEEE Std 386™-2006 standard, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.

IEEE Std C37.90™-2005 standard, Standard for Relays and Relay Systems Associated with Electric Power Apparatus.

IEEE Std C37.90.2™-2004 standard, Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.

See page 25 for a list of additional information that is available from Eaton's Cooper Power Systems.

Specifiers guide

Standard unit configuration:

- Mild-Steel construction
- Side-hinged (for pad-mounted style) doors
- Visible-Break not included
- Motor operators/provisions not included
- Three-Phase trip
- Tri-Phase control with “EF” TCC curve for the vacuum fault interrupter tap ways
- Bell Green/Munsell 7GY paint
- Ground Connector in each high voltage compartment
- 600 A deadbreak bushings on 600 A ways, 200 A bushing wells on 200 A ways

Example:

To specify a VFI unit use the following procedure:

1. Build the descriptor by completing the fields based on the Switchgear requirements:

For example, **KPDE-VF9-32** is the descriptor for the following standard unit:

- **Pad-Mounted, Double-Sided unit**
- **E200 Fluid insulation**
- **15 kV, 600 A deadbreak bushings on source ways, 200 A loadbreak bushing wells on tap ways**
- **Model 9 - Two switched source ways and Two vacuum fault interrupter protected Tap ways**
- **Mild-Steel construction**
- **Side-hinged doors**
- **Tri-phase control for the vacuum fault interrupter tap ways** (Tri-Phase control with “EF” TCC curve is the standard control that ships with the VFI unit. If a different control is required, select the appropriate control from Table 10 and the desired TCC curve from Table 11.)
- **Unit is of standard Bell Green/Munsell 7GY paint. If custom color is required, refer to Table 12.**

2. Identify the options or accessories for inclusion with the standard unit. Refer to Tables 7-21.

3. Submit the descriptor with a list of options and accessories to your Eaton's Cooper Power Systems representative for a quotation.

Table 4. Constructing a VFI Switchgear Descriptor

Three-Phase* • 15, 25 and 35 kV Nominal
200 and 600** A Max Continuous • 12500† A Interrupting Rating
Pad-Mounted • Electronically Controlled • Vacuum Fault Interrupters
• Deadfront Construction

KP Unit Style

KP for Pad-Mounted style

KV for Vault-Mounted style (no cabinets)

D Unit configuration

D for Double-Sided configuration

S for Single-Sided configuration

E Insulating Medium

O for Mineral Oil insulation

F for Envirottemp™ FR3™ fluid (consult factory)

E for E200 Fluid

S for SF₆ insulation

VF Type of unit

VF for VFI unit

RV for RVAC unit (model 13A & 10)

9 Model number of the unit

refer to column “model” in Table 4 for double-sided unit or for single-sided unit.

3 Unit Phase type

3 for Three-Phase unit

1 for Single-Phase unit

2 Bushing Configuration

Digit represents ampere rating of bushing and voltage rating of gear per Table 5, below.

KP D E - VF 9- 3 2 is the required descriptor†

Table 5. Bushing Configuration

Voltage Rating	Amperage Rating (Source/Tap)		
	600 A/600 A	600 A/200 A	200 A/200 A
15 kV	1	2	3
25 kV	4	5	6
35 kV	7	8	9

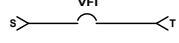
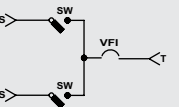
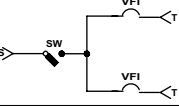
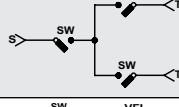
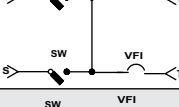
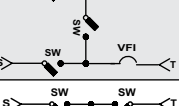
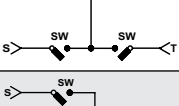
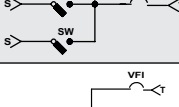
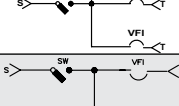
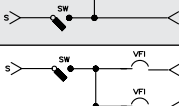
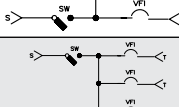
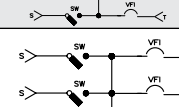
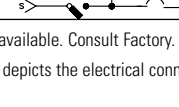
* Single-Phase units available. Consult Factory.

** For 900 A continuous rating. Consult Factory.

† For 16000 A interrupting rating. Consult Factory.

† The descriptor is not the catalog number, but a shorthand method of describing the unit.

Table 6. Basic Models

Model*	One-Line Diagram**	Nominal Voltage (kV)	DOUBLE-SIDED, FRONT & BACK ACCESS		
			OIL INSULATED	E200 INSULATED [†]	SF ₆ INSULATED
			Descriptor	Descriptor	Descriptor
5		15	KPDO-VF5-32	KPDE-VF5-32	KPDS-VF5-32
		25	KPDO-VF5-35	KPDE-VF5-35	KPDS-VF5-35
		35	KPDO-VF5-38	KPDE-VF5-38	KPDS-VF5-38
6		15	KPDO-VF6-32	KPDE-VF6-32	KPDS-VF6-32
		25	KPDO-VF6-35	KPDE-VF6-35	KPDS-VF6-35
		35	KPDO-VF6-38	KPDE-VF6-38	KPDS-VF6-38
7		15	KPDO-VF7-32	KPDF-VF7-32	KPDS-VF7-32
		25	KPDO-VF7-35	KPDE-VF7-35	KPDS-VF7-35
		35	KPDO-VF7-38	KPDE-VF7-38	KPDS-VF7-38
13A ‡		15	KPDO-RV13A-32	KPDE-RV13A-32	KPDS-RV13A-32
		25	KPDO-RV13A-35	KPDE-RV13A-35	KPDS-RV13A-35
		35	KPDO-RV13A-38	KPDE-RV13A-38	KPDS-RV13A-38
9		15	KPDO-VF9-32	KPDE-VF9-32	KPDS-VF9-32
		25	KPDO-VF9-35	KPDE-VF9-35	KPDS-VF9-35
		35	KPDO-VF9-38	KPDE-VF9-38	KPDS-VF9-38
9T		15	KPDO-VF9T-32	KPDE-VF9T-32	KPDS-VF9T-32
		25	KPDO-VF9T-35	KPDE-VF9T-35	KPDS-VF9T-35
		35	KPDO-VF9T-38	KPDE-VF9T-38	KPDS-VF9T-38
10 ‡		15	KPDO-RV10-32	KPDE-RV10-32	KPDS-RV10-32
		25	KPDO-RV10-35	KPDE-RV10-35	KPDS-RV10-35
		35	KPDO-RV10-38	KPDE-RV10-38	KPDS-RV10-38
11		15	KPDO-VF11-32	KPDE-VF11-32	KPDS-VF11-32
		25	KPDO-VF11-35	KPDE-VF11-35	KPDS-VF11-35
		35	KPDO-VF11-38	KPDE-VF11-38	KPDS-VF11-38
12		15	KPDO-VF12-32	KPDE-VF12-32	KPDS-VF12-32
		25	KPDO-VF12-35	KPDE-VF12-35	KPDS-VF12-35
		35	KPDO-VF12-38	KPDE-VF12-38	KPDS-VF12-38
14		15	KPDO-VF14-32	KPDE-VF14-32	KPDS-VF14-32
		25	KPDO-VF14-35	KPDE-VF14-35	KPDS-VF14-35
		35	KPDO-VF14-38	KPDE-VF14-38	KPDS-VF14-38
5W2		15	KPDO-VF5W2-32	KPDE-VF5W2-32	KPDS-VF5W2-32
		25	KPDO-VF5W2-35	KPDE-VF5W2-35	KPDS-VF5W2-35
		35	KPDO-VF5W2-38	KPDE-VF5W2-38	KPDS-VF5W2-38
6W2		15	KPDO-VF6W2-32	KPDE-VF6W2-32	KPDS-VF6W2-32
		25	KPDO-VF6W2-35	KPDE-VF6W2-35	KPDS-VF6W2-35
		35	KPDO-VF6W2-38	KPDE-VF6W2-38	KPDS-VF6W2-38
6W3		15	KPDO-VF6W3-32	KPDE-VF6W3-32	KPDS-VF6W3-32
		25	KPDO-VF6W3-35	KPDE-VF6W3-35	KPDS-VF6W3-35
		35	KPDO-VF6W3-38	KPDE-VF6W3-38	KPDS-VF6W3-38

* Other models are available. Consult Factory.

** One-Line Diagram depicts the electrical connectivity, not the physical arrangement. Standard "source" and "tap" designation indicated by "S" and "T" on one-line diagrams.

‡ RVAC Models

† Envirotemp™ FR3™ fluid insulation is available. Consult Factory.

Table 6. Basic Models (continued)

Model*	One-Line Diagram**	Nominal Voltage (kV)	SINGLE-SIDED, COMPACT ¹ FRONT ACCESS		
			OIL INSULATED Descriptor	E200 INSULATED† Descriptor	SF ₆ INSULATED Descriptor
5		15	KPSO-VF5-32	KPSE-VF5-32	KPSS-VF5-32
		25	KPSO-VF5-35	KPSE-VF5-35	KPSS-VF5-35
		35	KPSO-VF5-38	KPSE-VF5-38	KPSS-VF5-38
6		15	KPSO-VF6-32	KPSE-VF6-32	KPSS-VF6-32
		25	KPSO-VF6-35	KPSE-VF6-35	KPSS-VF6-35
		35	KPSO-VF6-38	KPSE-VF6-38	KPSS-VF6-38
7		15	KPSO-VF7-32	KPSE-VF7-32	KPSS-VF7-32
		25	KPSO-VF7-35	KPSE-VF7-35	KPSS-VF7-35
		35	KPSO-VF7-38	KPSE-VF7-38	KPSS-VF7-38
13A ‡		15	KPSO-RV13A-32	KPSE-RV13A-32	KPSS-RV13A-32
		25	KPSO-RV13A-35	KPSE-RV13A-35	KPSS-RV13A-35
		35	KPSO-RV13A-38	KPSE-RV13A-38	KPSS-RV13A-38
9		15	KPSO-VF9-32	KPSE-VF9-32	KPSS-VF9-32
		25	KPSO-VF9-35	KPSE-VF9-35	KPSS-VF9-35
		35	KPSO-VF9-38	KPSE-VF9-38	KPSS-VF9-38
9T		15	KPSO-VF9T-32	KPSE-VF9T-32	KPSS-VF9T-32
		25	KPSO-VF9T-35	KPSE-VF9T-35	KPSS-VF9T-35
		35	KPSO-VF9T-38	KPSE-VF9T-38	KPSS-VF9T-38
10 ‡		15	KPSO-RV10-32	KPSE-RV10-32	KPSS-RV10-32
		25	KPSO-RV10-35	KPSE-RV10-35	KPSS-RV10-35
		35	KPSO-RV10-38	KPSE-RV10-38	KPSS-RV10-38
11		15	KPSO-VFT11-32	KPSE-VF11-32	KPSS-VF11-32
		25	KPSO-VFT11-35	KPSE-VF11-35	KPSS-VF11-35
		35	KPSO-VFT11-38	KPSE-VF11-38	KPSS-VF11-38
12		15	KPSO-VF12-32	KPSE-VF12-32	KPSS-VF12-32
		25	KPSO-VF12-35	KPSE-VF12-35	KPSS-VF12-35
		35	KPSO-VF12-38	KPSE-VF12-38	KPSS-VF12-38
14		15	KPSO-VF14-32	KPSE-VF14-32	KPSS-VF14-32
		25	KPSO-VF14-35	KPSE-VF14-35	KPSS-VF14-35
		35	KPSO-VF14-38	KPSE-VF14-38	KPSS-VF14-38
5W2		15	KPSO-VF5W2-32	KPSE-VF5W2-32	KPSS-VF5W2-32
		25	KPSO-VF5W2-35	KPSE-VF5W2-35	KPSS-VF5W2-35
		35	KPSO-VF5W2-38	KPSE-VF5W2-38	KPSS-VF5W2-38
6W2		15	KPSO-VF6W2-32	KPSE-VF6W2-32	KPSS-VF6W2-32
		25	KPSO-VF6W2-35	KPSE-VF6W2-35	KPSS-VF6W2-35
		35	KPSO-VF6W2-38	KPSE-VF6W2-38	KPSS-VF6W2-38
6W3		15	KPSO-VF6W3-32	KPSE-VF6W3-32	KPSS-VF6W3-32
		25	KPSO-VF6W3-35	KPSE-VF6W3-35	KPSS-VF6W3-35
		35	KPSO-VF6W3-38	KPSE-VF6W3-38	KPSS-VF6W3-38

* Other models are available. Consult Factory.

** One-Line Diagram depicts the electrical connectivity, not the physical arrangement. Standard "source" and "tap" designation indicated by "S" and "T" on one-line diagrams.

¹ Compact units are designed with bushings in a diagonal fashion. Models 5, 6, 7, 13A, 9, 10, 11, 12, and 14 can be designed single-sided with in-line bushings. Consult Factory.

‡ RVAC Models

† Envirotemp™ FR3™ fluid insulation is available. Consult Factory.

Optional features

Table 7. Vacuum Fault Interrupter Operation

Type	Description	Location
Vacuum Fault Interrupter Type (select One)	Three-Phase Ganged Trip (STANDARD)	All Fault Interrupters
	Single-Phase Trip	All Fault Interrupters
	Mixture of Single-Phase and Three-Phase Trip	Specify location for each type

Table 8. Visible-Break Switch* Options

Description	Visible-Break Positions
No Visible-Break (STANDARD)	N/A
Two-position Visible-Break—close-open	All Source ways
	All Source & Tap ways
Three-position Visible-Break—close-open-ground	All Source ways
	All Source & Tap ways

* Visible-Break Switch available only for double-sided, fluid-filled switchgear.

Table 9. Bushing Options

Current Rating	Description
200 A Ways (select only one)	Bushing wells (STANDARD)
	Bushing wells with loadbreak inserts**
	Single-piece large interface, integral, loadbreak bushings*
600 A Ways (select only one)	600 A deadbreak bushings (STANDARD)
	PUSH-OP™ bushings
	U-OP™ systems with aluminum Visible-Break Junctions & U-connectors**
	U-OP provisions**
600 A & 200 A	Externally Replaceable Bushing/Wells (on all ways)†

Note: Aluminum is standard for bushing material.

* Only for 35 kV units, Eaton's Cooper Power Systems large interface design.

** Only for 15, 25 kV units

† All SF₆ units include this feature at no-charge.

Table 10. Controls*†

Control Type	Overcurrent	Ground	Metering	SCADA	Comms	Advanced Functions
Tri-Phase control (STANDARD)	X					
TPG control (Tri-Phase control with ground)	X	X				
TPG with SCADA	X	X		X		
Edison Idea iTAP-265 relay (Three-Phase Trip)	X	X	X**	X	X	
Edison Idea iTAP-260 relay (Single-Phase Trip)	X	X	X**	X	X	
Edison Idea iDP-210 relay	X	X	X**	X	X	X**

* Consult factory for automation options using advanced controllers and communications.

** For metering and advanced functions requiring potential transformers in SF₆ insulated switchgear, contact your Eaton's Cooper Power Systems representative.

† Select the TCC curve and the optional Minimum Response Time curve from Table 11.

Table 11. Tri-Phase/TPG Control Options

Time-Current Curve Card (TCC) (select only one)	EF Curve (STANDARD)
	KF Curve
	TF Curve
	H Curve
	F Curve
Minimum Response Timing Accessory (select only one)	EFR Curve (STANDARD)
	KFR Curve
	TFR Curve
	HR Curve
	FR Curve
Ground Trip Block Switch	for TPG only
CT Shorting Switch	for TPG only

Table 12. Construction

Tank Style	Material	Construction
Vault-Mounted Style*	Tank Material	Mild Steel construction with non-corrosive hardware (STANDARD)
		304L Stainless steel construction
Pad-Mounted Style	Tank/Cabinet Material	Mild Steel construction with non-corrosive hardware (STANDARD)
		304L Stainless steel construction
Paint color		Bell Green/Munsell 7GY (STANDARD)
		Other paint color, top coat on external surfaces only (specify the Federal Spec Paint number)

* Change first two digits of descriptor from Table 4 from "KP" to "KV" as shown on page 8.

Table 13. Distribution Automation*

Description	Motor Operator Positions
No motor operators/provisions (STANDARD)	N/A
Motor operator provisions	Specify the ways: Source, Tap, or All
Motor operators**	

* Advanced automation and control options are available. Consult Factory.

** Motor operators require semaphores.

Table 14. Auxiliary Switch

Type	Position
Two-Stage Auxiliary Switch	Specify the ways: Source, Tap, or All

Table 15. Indicators

Description	Indicator Positions
Operation counter	Specify the ways: Source, Tap, or All
Semaphore*	Specify the ways: Source, Tap, or All

* Position indicator linked directly to operating mechanism and viewable through tank window.

Table 16. Grounding Options (select only one)**Ground Stud (STANDARD)**

1/2" Round copper ground-bus

3" stand-off bracket for 1/2" round bus

NEMA® Ground Pad (welded to tank)

Flat copper ground-bus

Table 17. Fault Indicator Provisions (select only one)

No Fault Indicator provisions

Provisions for Fault Circuit Indicators (FCI) (1.06" dia. hole with removable SS backing plate)*

Provisions for S.T.A.R.™ FCI with large FISHEYE™

Provisions for S.T.A.R. FCI with small remote

Provisions for LED Display Indicator

* Accommodates future installation of S.T.A.R. FCI type indicators

Table 18. Service Items**Description**

1" drain plug with 3/8" sampler (STANDARD)*

Select only one

1" drain valve with 3/8" sampler*

Penta-head door bolt (STANDARD)

Select only one

Hex-head door bolt

* Not applicable to SF₆ units**Table 19. Service Items-Accessories****Description**SF₆ refill kit; hoses, valves, regulator

Select only one

SF₆ refill kit; hoses and valves (without regulator)

Bracket to convert single-phase trip unit into three-phase trip unit

Select only one

Hotstick tool for three-phase manual operation of single-phase trip unit

(only for units with single-phase trip ways)

* Prices listed are for all Models

Table 20. Key Interlocks**Description**

Provisions for key interlocks

Key interlocks to prevent paralleling of source 1 and source 2 *

* Furnish name of ultimate user at time of ordering

Table 21. Decals

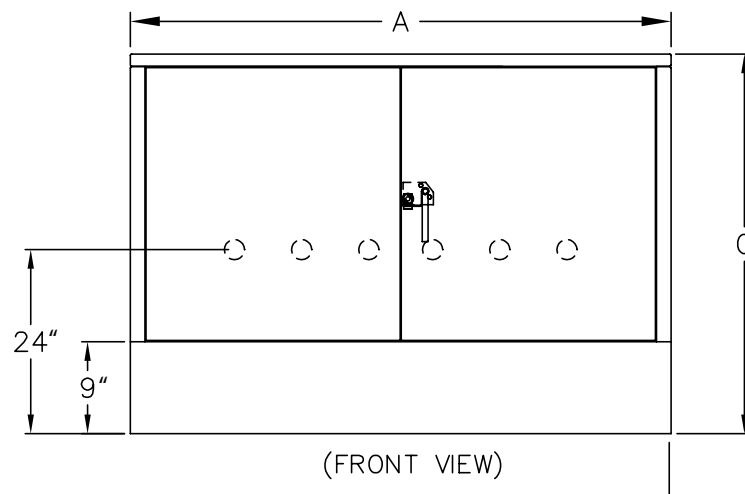
Danger High Voltage

Internal Mr. Ouch, bilingual

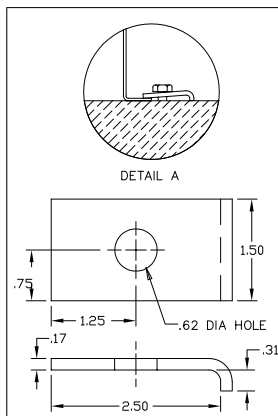
Specify Location

External Mr. Ouch, bilingual

Non PCB

Dimensions

Detail A



Note: Detail A is the same for all units.

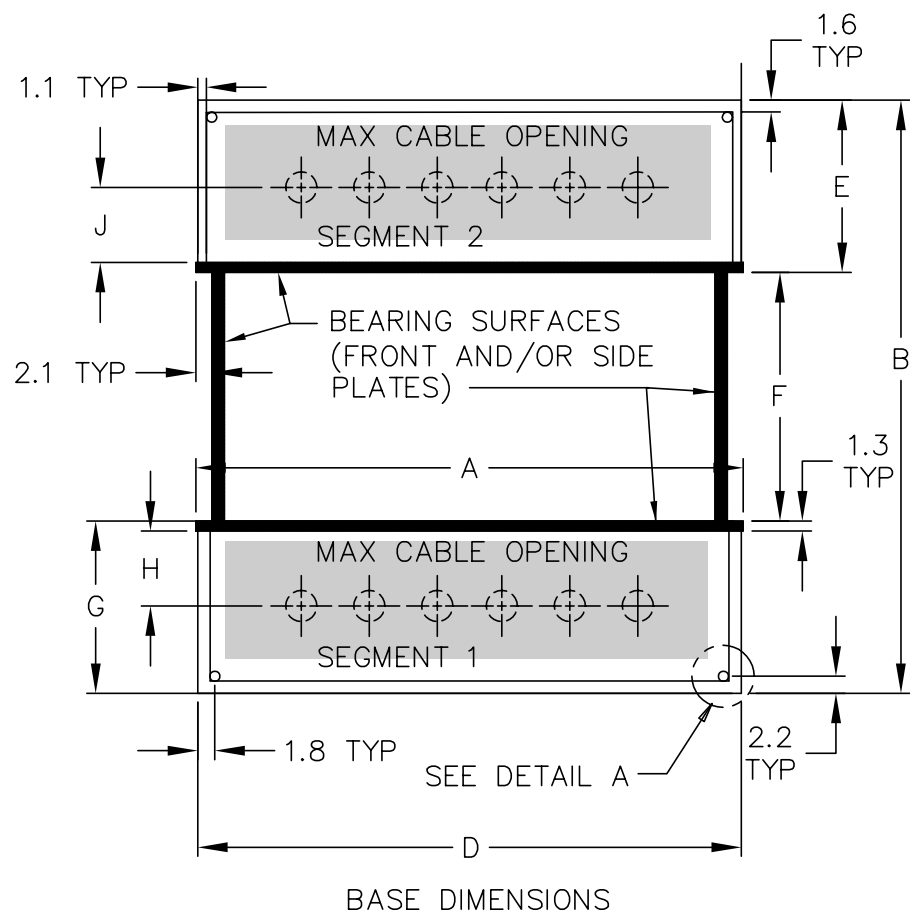


Figure 14. Double-sided VFI switchgear (without visible-break switch).

Table 22. Double-Sided VFI Switchgear (Without Visible-Break Switch)
(All dimensions shown in inches).

kV Class	Dimension	Source/Tap Current Ratings												Model
		600 A Segment 1, 600 A Segment 2				600 A Segment 1, 200 A Segment 2				200 A Segment 1, 200 A Segment 2				
			6 7 9 10* 11 13 A*	9T 10T*	12	5	6 7 9 10* 11 13 A*	9T 10T*	12	5	6 7 9 10* 11 13 A*	9T 10T*	12	
15 kV	A	40.50	70.50	84.50	70.50	40.50	70.50	84.50	70.50	40.50	70.50	84.50	70.50	
	B	68.40	76.40	79.40	81.40	68.40	76.40	79.40	81.40	68.40	76.40	79.40	81.40	
	C	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	
	D	40.00	70.00	84.00	70.00	40.00	70.00	84.00	70.00	40.00	70.00	84.00	70.00	
	E	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	
	F	24.00	32.00	35.00	37.00	24.00	32.00	35.00	37.00	24.00	32.00	35.00	37.00	
	G	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	
	H	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	6.80	6.80	6.80	6.80	
	J	5.20	5.20	5.20	5.20	6.80	6.80	6.80	6.80	6.80	6.80	6.80	6.80	
25 kV	A	40.50	70.50	84.50	70.50	40.50	70.50	84.50	70.50	40.50	70.50	84.50	70.50	
	B	68.40	76.40	79.40	81.40	68.40	76.40	79.40	81.40	68.40	76.40	79.40	81.40	
	C	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	
	D	40.00	70.00	84.00	70.00	40.00	70.00	84.00	70.00	40.00	70.00	84.00	70.00	
	E	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	
	F	24.00	32.00	35.00	37.00	24.00	32.00	35.00	37.00	24.00	32.00	35.00	37.00	
	G	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	
	H	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	8.00	8.00	8.00	8.00	
	J	5.20	5.20	5.20	5.20	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	
35 kV	A	40.50	70.50	84.50	70.50	40.50	70.50	84.50	70.50	40.50	70.50	84.50	70.50	
	B	80.40	87.40	89.40	95.40	76.40	83.40	85.40	91.40	72.40	81.40	83.40	87.40	
	C	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	49.50	
	D	40.00	70.00	84.00	70.00	40.00	70.00	84.00	70.00	40.00	70.00	84.00	70.00	
	E	26.00	26.00	26.00	26.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	
	F	28.00	35.00	37.00	39.00	28.00	35.00	37.00	43.00	28.00	37.00	39.00	43.00	
	G	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	22.00	22.00	22.00	22.00	
	H	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	8.75	8.75	8.75	8.75	
	J	6.20	6.20	6.20	6.20	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	

* RVAC models. 'RVAC' is the nameplate designation for models with only load-break switches (no fault interrupters).

For dimensions of models not listed, consult factory.

Note: This table provides standard product dimensional information only. Dimensions are NOT for construction purposes. Foundation construction should comply with local building or construction codes as required. If needed, request engineering drawings for approval or drawings for record purposes with your order.

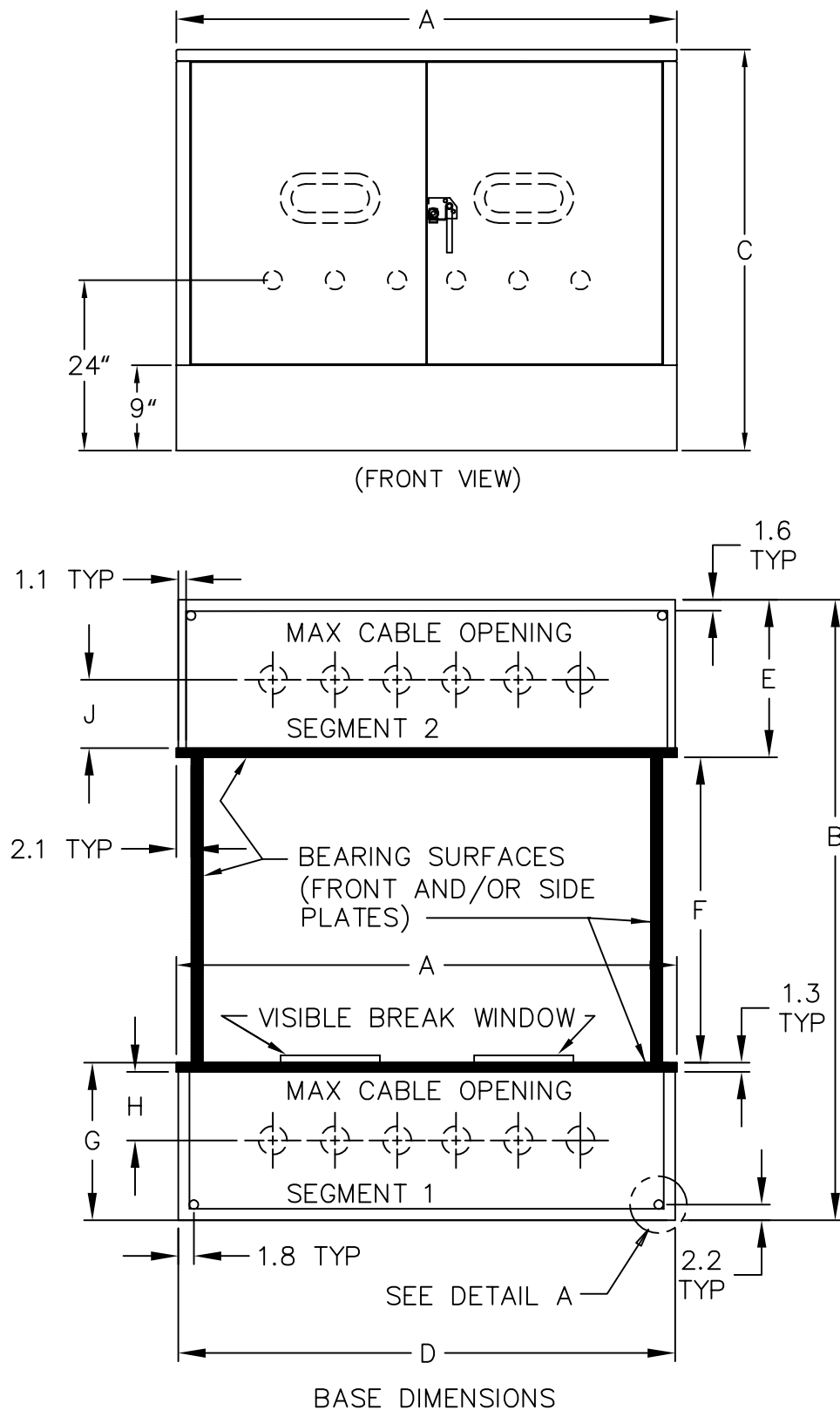


Figure 15. Double-sided VFI switchgear (with visible-break switch on sources only).

Table 23. Double-Sided VFI Switchgear (With Visible Break Switch on Sources Only)
(All dimensions shown in inches).

kV Class	Dimension	Source/Tap Current Ratings															Model	
		600 A Segment 1, 600 A Segment 2					600 A Segment 1, 200 A Segment 2					200 A Segment 1, 200 A Segment 2						
			6 7 9 10* 13A*	9T 10T*					6 7 9 10* 13A*	9T 10T*					6 7 9 10* 13A*	9T 10T*		
		5			11	12	5			10T*	11	12	5			10T*	11	12
15 kV	A	40.50	70.50	84.50	70.50	70.50	40.50	70.50	84.50	70.50	70.50	40.50	70.50	84.50	70.50	70.50		
	B	72.40	87.40	90.40	87.40	90.40	72.40	87.40	90.40	87.40	90.40	72.40	87.40	90.40	87.40	90.40		
	C	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50		
	D	40.00	70.00	84.00	70.00	70.00	40.00	70.00	84.00	70.00	70.00	40.00	70.00	84.00	70.00	70.00		
	E	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00		
	F	28.00	37.00	43.00	43.00	43.00	28.00	37.00	43.00	43.00	43.00	28.00	37.00	43.00	43.00	43.00		
	G	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00		
	H	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	6.80	6.80	6.80	6.80	6.80		
	J	5.20	5.20	5.20	5.20	5.20	6.80	6.80	6.80	6.80	6.80	6.80	6.80	6.80	6.80	6.80		
25 kV	A	40.50	70.50	84.50	70.50	70.50	40.50	70.50	84.50	70.50	70.50	40.50	70.50	84.50	70.50	70.50		
	B	72.40	87.40	90.40	87.40	90.40	72.40	87.40	90.40	87.40	90.40	72.40	87.40	90.40	87.40	90.40		
	C	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50		
	D	40.00	70.00	84.00	70.00	70.00	40.00	70.00	84.00	70.00	70.00	40.00	70.00	84.00	70.00	70.00		
	E	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00		
	F	28.00	37.00	43.00	43.00	43.00	28.00	37.00	43.00	43.00	43.00	28.00	37.00	43.00	43.00	43.00		
	G	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00		
	H	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	8.00	8.00	8.00	8.00	8.00		
	J	5.20	5.20	5.20	5.20	5.20	8.00	8.00	6.80	8.00	6.80	8.00	8.00	8.00	8.00	8.00		
35 kV	A	40.50	70.50	84.50	70.50	70.50	40.50	70.50	84.50	70.50	70.50	40.50	70.50	84.50	70.50	70.50		
	B	80.40	95.40	98.40	95.40	98.40	76.40	91.40	94.40	91.40	94.40	72.40	87.40	90.40	87.40	90.40		
	C	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50		
	D	40.00	70.00	84.00	70.00	70.00	40.00	70.00	84.00	70.00	70.00	40.00	70.00	84.00	70.00	70.00		
	E	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	22.00	22.00	22.00	22.00	22.00		
	F	28.00	37.00	43.00	43.00	43.00	28.00	37.00	43.00	43.00	43.00	28.00	37.00	43.00	43.00	43.00		
	G	26.00	26.00	26.00	26.00	26.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00		
	H	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	8.75	8.75	8.75	8.75	8.75		
	J	6.20	6.20	6.20	6.20	6.20	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75		

* RVAC models. 'RVAC' is the nameplate designation for models with only load-break switches (no fault interrupters).

For dimensions of models not listed, consult factory.

Note: This table provides standard product dimensional information only. Dimensions are NOT for construction purposes. Foundation construction should comply with local building or construction codes as required. If needed, request engineering drawings for approval or drawings for record purposes with your order.

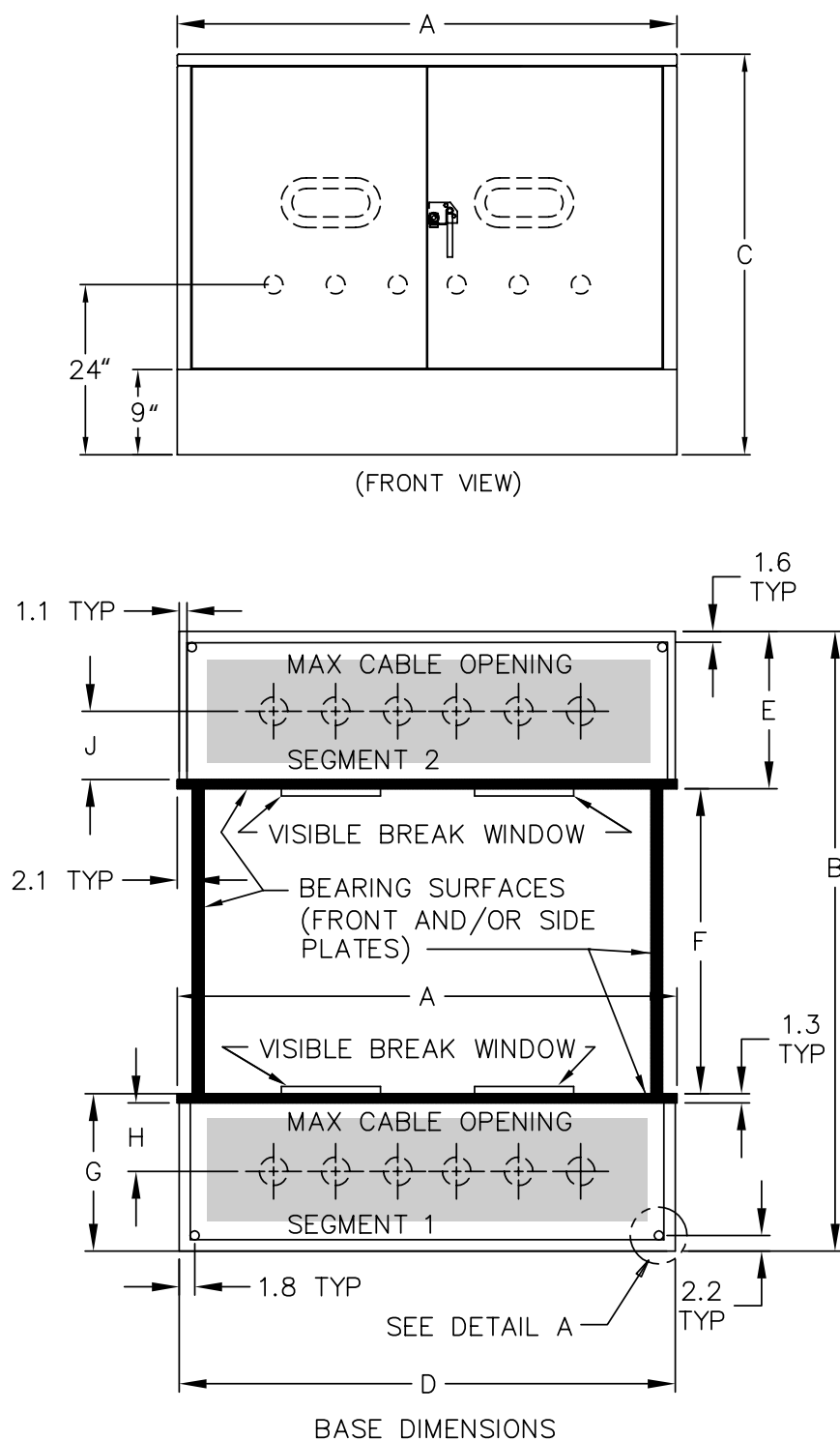


Figure 16. Double-sided VFI switchgear (with visible-break switches on all ways).

Table 24. Double-Sided VFI Switchgear (With Visible-Break Switches on all ways)
(All dimensions in inches).

kV Class	Dimension	Source/Tap Current Ratings												Model
		600 A Segment 1, 600 A Segment 2				600 A Segment 1, 200 A Segment 2				200 A Segment 1, 200 A Segment 2				
		5	6 7 9 10* 11 13 A*	9T 10T*	12	5	6 7 9 10* 11 13 A*	9T 10T*	12	5	6 7 9 10* 11 13 A*	9T 10T*	12	
15 kV	A	40.50	70.50	84.50	70.50	40.50	70.50	84.50	70.50	40.50	70.50	84.50	70.50	
	B	72.40	87.40	90.40	90.40	72.40	87.40	90.40	90.40	72.40	87.40	90.40	90.40	
	C	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	
	D	40.00	70.00	84.00	70.00	40.00	70.00	84.00	70.00	40.00	70.00	84.00	70.00	
	E	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	
	F	28.00	43.00	46.00	46.00	28.00	43.00	46.00	46.00	28.00	43.00	46.00	46.00	
	G	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	
	H	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	6.80	6.80	6.80	6.80	
	J	5.20	5.20	5.20	5.20	6.80	6.80	6.80	6.80	6.80	6.80	6.80	6.80	
25 kV	A	40.50	70.50	84.50	70.50	40.50	70.50	84.50	70.50	40.50	70.50	84.50	70.50	
	B	72.40	87.40	90.40	90.40	72.40	87.40	90.40	90.40	72.40	87.40	90.40	90.40	
	C	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	
	D	40.00	70.00	84.00	70.00	40.00	70.00	84.00	70.00	40.00	70.00	84.00	70.00	
	E	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	
	F	28.00	43.00	46.00	46.00	28.00	43.00	46.00	46.00	28.00	43.00	46.00	46.00	
	G	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	
	H	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	8.00	8.00	8.00	8.00	
	J	5.20	5.20	5.20	5.20	8.00	8.00	6.80	6.80	8.00	8.00	8.00	8.00	
35 kV	A	40.50	70.50	84.50	70.50	40.50	70.50	84.50	70.50	40.50	70.50	84.50	70.50	
	B	80.40	95.40	98.40	98.40	76.40	91.40	94.40	94.40	72.40	87.40	90.40	90.40	
	C	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	56.50	
	D	40.00	70.00	84.00	70.00	40.00	70.00	84.00	70.00	40.00	70.00	84.00	70.00	
	E	26.00	26.00	26.00	26.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	
	F	28.00	43.00	46.00	46.00	28.00	43.00	46.00	46.00	28.00	43.00	46.00	46.00	
	G	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	22.00	22.00	22.00	22.00	
	H	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	8.75	8.75	8.75	8.75	
	J	6.20	6.20	6.20	6.20	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	

* RVAC models. 'RVAC' is the nameplate designation for models with only load-break switches (no fault interrupters).

For dimensions of models not listed, consult factory.

Note: This table provides standard product dimensional information only. Dimensions are NOT for construction purposes. Foundation construction should comply with local building or construction codes as required. If needed, request engineering drawings for approval or drawings for record purposes with your order.



Table 25. Single-Sided Compact VFI Switchgear
(All dimensions shown in inches).

kV Class	Dimension	Source/ Tap Current Ratings				Model
		600 A		200 A		
		6 7 10* 13 A*	9 11 12	6 7 10* 13 A*	9 11 12	
15 kV	A	62.50	62.50	62.50	62.50	
	B	53.60	53.60	53.60	53.60	
	C	43.50	43.50	43.50	43.50	
	D	62.30	62.30	62.30	62.30	
	E	30.00	30.00	30.00	30.00	
	F	22.00	22.00	22.00	22.00	
	G	11.50	11.50	11.50	11.50	
	H	6.00	6.00	6.00	6.00	
	J	6.00	6.00	6.00	6.00	
	Z	3.00	3.00	5.00	5.00	
	ZZ	7.00	7.00	9.00	9.00	
25 kV	A	62.50	62.50	62.50	62.50	
	B	53.60	53.60	53.60	53.60	
	C	43.50	43.50	43.50	43.50	
	D	62.30	62.30	62.30	62.30	
	E	30.00	30.00	30.00	30.00	
	F	22.00	22.00	22.00	22.00	
	G	11.50	11.50	11.50	11.50	
	H	6.00	6.00	6.00	6.00	
	J	6.00	6.00	6.00	6.00	
	Z	3.00	3.00	6.00	6.00	
	ZZ	7.00	7.00	10.00	10.00	
35 kV	A	62.50	62.50	62.50	62.50	
	B	65.60	65.60	65.60	65.60	
	C	43.50	43.50	43.50	43.50	
	D	62.30	62.30	62.30	62.30	
	E	30.00	30.00	30.00	30.00	
	F	34.00	34.00	34.00	34.00	
	G	11.50	11.50	11.50	11.50	
	H	6.00	6.00	6.00	6.00	
	J	6.00	6.00	6.00	6.00	
	Z	4.00	4.00	6.75	6.75	
	ZZ	8.00	8.00	10.75	10.75	

* RVAC models. 'RVAC' is the nameplate designation for models with only load-break switches (no fault interrupters).

For dimensions of models not listed, consult factory.

Note: This table provides standard product dimensional information only. Dimensions are NOT for construction purposes. Foundation construction should comply with local building or construction codes as required. If needed, request engineering drawings for approval or drawings for record purposes with your order.

Additional information

165-210, iDP-210 Feeder Protection Relay

165-260, iTAP-260 Dual Overcurrent Relay

165-265, iTAP-265 Dual Overcurrent Relay

S285-10-1, VFI Oil-Insulated Installation Instructions

S285-10-2, VFI SF₆-Insulated, Vacuum Fault Interrupter; installation, Operation and Maintenance Instructions

S285-10-3, SF₆ Gas Top-Off Kit Operation Instructions

S285-10-4, Visible Break Switch Accessory Operation Instructions

S285-10-5, VFI Fault Interrupter w/Tri-Phase Control Single-Phase Trip to Three-Phase Trip Conversion Kit Instructions

S285-10-7, VFI Tester Operation Instructions

S285-75-1, Tri-Phase, TPG, and TPG with SCADA Electronic Control Installation and Operation Instructions

B165-06047, iDP-210 Feeder Protection Relay Bulletin

B285-01041, VFI Underground Distribution Switchgear - Environmentally Preferred Switchgear

B285-09042, VFI Underground Distribution Switchgear Frequently Asked Questions

R285-10-1, Guide for Atmospheric Retrofilling of 38 kV (or lower) Fluid-filled Switchgear

B285-13011, Smart VFI for Solar Applications

B285-13012, Smart VFI Underground Distribution Switchgear

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