Arc energy reduction relay switching devices product platforms

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WARNING

(1) ONLY QUALIFIED ELECTRICAL PERSONNEL SHOULD BE PERMITTED TO WORK ON THE EQUIPMENT.

(2) DO NOT ATTEMPT TO INSTALL OR PERFORM MAINTENANCE ON THE EQUIPMENT WHILE ENERGIZED. ALWAYS VERIFY THAT NO VOLTAGE IS PRESENT BEFORE PROCEEDING.

(3) ALWAYS DE-ENERGIZE PRIMARY AND SECONDARY CIRCUITS BEFORE REMOVING CIRCUIT BREAKER.

FAILURE TO FOLLOW THESE STEPS FOR ALL PROCEDURES DESCRIBED IN THIS INSTRUCTION LEAFLET COULD RESULT IN DEATH, BODILY INJURY, OR PROPERTY DAMAGE.

CAUTION

SPECIFIC OPERATING PROCEDURES MUST BE DEVELOPED BY THE RESPONSIBLE PARTY, BECAUSE OF THE UNIQUE APPLICATION AND VAST VARIETY OF SYSTEM AND USER REQUIREMENTS. FAILURE TO DEVELOP SPECIFIC PROCEDURES COULD LEAD TO IMPROPER USE OR OTHER MORE SERIOUS CONSEQUENCES.

DANGER

HAZARDOUS VOLTAGE. WILL CAUSE SEVERE INJURY OR DEATH. DO NOT OPEN SHUTTER IF THE EQUIPMENT IS ENERGIZED.

Product description
Arc energy reduction relay switching devices

Arc fault/overcurrent/ground fault relay
- Provides arc energy reduction per NEC® 240.67
- Provides class 1 ground fault protection
- Provides overcurrent protection

Ratings
- Input power options: 120 Vac
- Frequency: 50/60 Hz
- Ground fault: Trip currents settings 100–1200 A (adjustable)
- Input withstand: 200,000 amperes rms for 3 cycles, 50/60 Hz
- Ambient temperature range: –30 to +60 °C

Contact ratings
Ground fault
- 1NO, dry-type, 120 Vac, 5 A continuous

Overload/arc reduction
- 1NO, dry-type, 120 Vac, 5 A continuous

Note: Additional contacts available based on application and final product assembly.

Product assembly platforms
Product platforms integrating the arc energy reduction relay
- Heavy-duty shunt trip safety switches
- Pringle™ bolted pressure contact switches
- Fusible panelboard switches

Relay capabilities
- Arc energy reduction
- Overcurrent protection
- Class 1 ground fault protection
- Ground fault relay zone interlock option

Ratings

Certifications
Relay standards and certifications
- UL®

Relays must be used with the correct tested and listed sensors.
## Relay features

![Diagram of relay features](image.png)

### Legend

<table>
<thead>
<tr>
<th>Item number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground fault current level indicating bar</td>
</tr>
<tr>
<td></td>
<td>Indicates level of ground fault.</td>
</tr>
<tr>
<td>2</td>
<td>Current injection test button(s)</td>
</tr>
<tr>
<td></td>
<td>Provide primary current injection to current transformers to comply with 230.99(C). Current injection will trip relay for each phase or neutral CT. Trip bypass button may be depressed simultaneously to avoid tripping the switch during the test. Power to relay is required.</td>
</tr>
<tr>
<td>3</td>
<td>Positive visual trip indicator</td>
</tr>
<tr>
<td></td>
<td>Physical indicator and reset for overcurrent condition</td>
</tr>
<tr>
<td>4</td>
<td>Overcurrent trip test</td>
</tr>
<tr>
<td></td>
<td>Overcurrent trip test select to comply with NEC 240.67(C)</td>
</tr>
<tr>
<td>5</td>
<td>Indicator for overcurrent condition</td>
</tr>
<tr>
<td></td>
<td>Blinking LED during Time Delay and Solid Red LED after Trip, if power is still available</td>
</tr>
<tr>
<td>6</td>
<td>Overcurrent time delay dial</td>
</tr>
<tr>
<td></td>
<td>Sets the overcurrent response curve to allow coordination with the fuse time/current curve (see examples on page 6)</td>
</tr>
<tr>
<td>7</td>
<td>Maintenance Mode selector switch and indicating light</td>
</tr>
<tr>
<td></td>
<td>Maintenance switch provides physical means to activate energy reducing maintenance mode.</td>
</tr>
<tr>
<td></td>
<td>• Both the Mode switch on the panel and the remote switch (if used) must be in the OFF (closed) position for the unit to be in “Normal Mode”</td>
</tr>
<tr>
<td></td>
<td>• If the remote switch is not used, a jumper must be placed across the terminals</td>
</tr>
<tr>
<td></td>
<td>• If the AFGF detects a ground fault while in the Maintenance Mode, the relay will trip instantaneously when the Pick Up Amps setting is reached, regardless of the time delay setting</td>
</tr>
<tr>
<td></td>
<td>• While in Maintenance Mode, the Overcurrent trip setting is reduced to instantaneous trip at 250% switch rating</td>
</tr>
<tr>
<td></td>
<td>• Indications: LED (Red) = Unit in Maintenance Mode; LED (Green) = Unit in Normal Mode</td>
</tr>
<tr>
<td>8</td>
<td>Ground fault time delay setting</td>
</tr>
<tr>
<td></td>
<td>If the ground fault level exceeds the setpoint for the duration of the time delay, the ground fault contacts will change state. If power is still available, the AFGF will continue to indicate the level the ground fault current was at the time of the trip. The ground fault must be present for the full length of the time delay.</td>
</tr>
<tr>
<td>9</td>
<td>Ground fault Pick Up Amps setting</td>
</tr>
<tr>
<td></td>
<td>If the ground fault exceeds the set level, “Pick Up Amps”, the GF time delay will begin. The ground fault amperage level does not affect the time delay</td>
</tr>
<tr>
<td>10</td>
<td>Ground fault shunt trip bypass</td>
</tr>
<tr>
<td></td>
<td>See page 24 for relay test instructions</td>
</tr>
<tr>
<td>11</td>
<td>Ground fault trip indicator</td>
</tr>
<tr>
<td></td>
<td>Physical indicator and reset for ground fault condition</td>
</tr>
</tbody>
</table>
Overcurrent trip settings

**Example 1**

<table>
<thead>
<tr>
<th>Overcurrent</th>
<th>Trip time</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400 A</td>
<td>200 seconds</td>
</tr>
<tr>
<td>3600 A</td>
<td>60 seconds</td>
</tr>
<tr>
<td>4800 A</td>
<td>12 seconds</td>
</tr>
<tr>
<td>6000 A</td>
<td>6 seconds</td>
</tr>
<tr>
<td>7200 A</td>
<td>Instantaneous</td>
</tr>
</tbody>
</table>

**Example 2**

<table>
<thead>
<tr>
<th>Overcurrent</th>
<th>Trip time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1600 A</td>
<td>100 seconds</td>
</tr>
<tr>
<td>2400 A</td>
<td>30 seconds</td>
</tr>
<tr>
<td>3200 A</td>
<td>6 seconds</td>
</tr>
<tr>
<td>4000 A</td>
<td>3 seconds</td>
</tr>
<tr>
<td>4800 A</td>
<td>Instantaneous</td>
</tr>
</tbody>
</table>

Arc energy reduction

NEC requirement

NFPA 70, NEC, article 240.67 focuses on fusible devices rated 1200 A and higher. Below is the specific article verbiage:

240.67 Arc Energy Reduction. Where fuses rated 1200 A or higher are installed, 240.67(A) and 240.67(B) shall apply. This requirement shall become effective January 1, 2020.

240.67(A) Documentation. Documentation shall be available to those authorized to design, install, operate, or inspect the installation as to the location of the fuses.

Documentation shall also be provided to demonstrate that the method chosen to reduce the clearing time is set to operate at a value below the available arcing current.

240.67(B) Method to Reduce Clearing Time. A fuse shall have a clearing time of 0.07 seconds or less at the available arcing current, or one of the following shall be provided and shall be set to operate at less than the available arcing current:

1. Differential relaying
2. Energy-reducing maintenance switching with local status indicator
3. Energy-reducing active arc flash mitigation system
4. Current limiting electrically actuated fuses
5. An approved equivalent means.

**Informational note 1:** An energy-reducing maintenance switch allows a worker to set a disconnect switch to reduce the clearing time while the worker is working within an arc-flash boundary as defined in NFPA 70E-2018, Standard for Electrical Safety in the Workplace, and then to set the disconnect switch back to a normal setting after the potentially hazardous work is complete.

**Informational note 2:** An energy-reducing active arc-flash mitigation system helps in reducing arcing duration in the electrical distribution system. No change in the disconnect switch or the settings of other devices is required during maintenance when a worker is working within an arc-flash boundary as defined in NFPA 70E-2018, Standard for Electrical Safety in the Workplace.

**Informational note 3:** IEEE® 1584-2002. IEEE Guide for Performing Arc Flash Hazard Calculations, is one of the available methods that provides guidance in determining arcing current.

240.67(C) Performance Testing. The energy reduction protection system shall be performance tested by primary current injection testing or another approved method when first installed on-site. This testing shall be performed by a qualified person(s) in accordance with the manufacturer’s instructions.

A written record of this testing shall be made and shall be available to the authority having jurisdiction.

**Informational note:** Some energy reduction protection systems cannot be tested using a test process of primary current injection due to either the protection method being damaged such as with the use of fuse technology or because current is not the primary method of arc detection.

NEC 240.67 Compliance

The arc fault ground fault (AFGF) relay complies with NEC 240.67 by:

240.67(A). The AFGF relay maintenance mode is designed to always operate at 250% of the switch rating.

240.67(B). The AFGF relay incorporates energy-reducing maintenance switch with local status indication. The relay senses current above 250% and sends a trip signal to the switch. See page 3, item number 6.

240.67(C). Current injection testing functionality is built into the relay and current transformer combination with a push to test feature.

Relay operation in maintenance mode

The AFGF relay measures the current in the system and determines in milliseconds if a fault is occurring and changes the state of the relay output. State changes without delay above 250% of the switch rating in maintenance mode. The relay may open the switch to clear the fault before the fuse has time to clear (depending on the fault level and the fuse chosen). The fuse will clear high-level arcing faults for which they are designed. For faults that are between high-level and low-level arcing faults, both the fuse will clear and the relay will open the switch.

Relay operation in normal mode

State changes without delay above 600% of the switch rating in normal mode.
**Incident energy reduction**

NEC 240.67 does not specifically address the highest levels of arcing developed by low-level arcing faults. A method has been published by IEEE to determine the incident energy at a point in a system. IEEE 1584-2018, IEEE Guide for Performing Arc-Flash Hazard Analysis Calculations, details the accepted method to determine arc energy in calories per cm².

A summary of the process to perform these calculations per IEEE 1584-2018 is described on page 6, and these calculations are summarized in graphical form on page 6–page 13. The calculations show that as the level of bolted fault current increases, the arc energy decreases after 5–10 times the fuse current rating is reached. The arc energy at the higher bolted fault current is lower due to the fuse clearing faster as the current increases.

For low arcing currents and specific fuse types, the arc energy may be 20 times higher than high arcing currents because the time for the fuse to clear is longer.

*Examples of incidents leading to low arcing currents are:*
- Dropping hardware or un-insulated tools onto live conductors
- Crossing opposite phases of uninsulated sections of probes or tools
- Dirt build-up that creates a path between conductors
- Overheating leading to insulation breakdown
- Poor maintenance that leads to insulation breakdown
- Water ingress between phases

*Examples of incidents leading to high arcing currents are:*
- Crossed phases during conductor installation
- Fault in overcurrent device (maintenance or application)

**System diagram**

**Fault location**

The location of the arc sensing and the location of where an arc is interrupted is important to the safety of the user.

Figure 2 shows a simple diagram of a typical fusible switch and fuse installation. In the figure, the arc fault ground fault relay sensors are installed before the fuse and the trippable switch. In this scenario, the relay will detect an arcing fault downstream of the sensors and through all connected devices. The relay would detect arcing faults on the line and load side of feeder and branch protective devices.

The line side of the trippable switch to which the relay is connected is not part of the protected system. The line side of the switch is not protected in any other scenario listed as options in NEC 240.67(B).

In the scenario shown, arcing energy is not reduced on the load side of the switch to the line side of the fuse for current-limiting electrically actuated fuses or when only the fuse having a clearing time of 0.7 seconds or less is alone employed to reduce arc energy.

![Figure 2. System diagram—fault location](image-url)
Incident energy calculation description

The calculation of the arc energy enables the system user to predict arc flash incident energy to which employees could be exposed during operations and maintenance work. Incident thermal energy estimation helps to predict appropriate protection for employees (PPE).

Arc flash hazard calculation guideline

The following is a summary of the method used to calculate the arc energy for various fuse, voltage, and current ratings using IEEE 1584-2018, IEEE Guide for Performing Arc-Flash Hazard Analysis Calculations.

- Incident energy calculations is divided into two parts based on system open-circuit voltage
  - 208 V to 600 V
  - 600 V to 15 kV

- The actual equipment conductor orientation and arrangement that most closely resembles the five electrode arrangement should be established:
  - VCB
  - VCBB
  - HCB
  - VOA
  - HOA

- The IEEE guide specifies a two-step (average and interpolated) process for arc current, incident energy, and arc flash boundary to determine final values
- Enclosure (box) size correction factors are applied to adjust the results

\(\text{(1) Only 208 and 480 Vac applications considered in the following arc incident energy calculations.}\)
\(\text{(2) Electrode configuration VCBB is considered worst case in typical downstream devices connected to switching devices.}\)

Incident energy reduction curves

Incident energy reduction curves—208 V

![Incident energy plot of AFGF with FRS-R Class RK5, 400 A fuse](image)

Figure 3. Incident energy plot of AFGF with FRS-R Class RK5, 400 A fuse
Incident energy reduction curves—208 V, continued

Figure 4. Incident energy plot of AFGF with FRS-R Class RK5, 600 A fuse

Figure 5. Incident energy plot of AFGF with JJN Limitron Class T, 800 A fuse
Incident energy reduction curves—208 V, continued

Figure 6. Incident energy plot of AFGF with JJN Limitron Class T, 1200 A fuse

Incident energy reduction curves—480 V

Figure 7. Incident energy plot of AFGF with FRS-R Class RK5, 400 A fuse
Incident energy reduction curves—480 V, continued

Figure 8. Incident energy plot of AFGF with FRS-R Class RK5, 600 A fuse

Figure 9. Incident energy plot of AFGF with KRP-C Class L, 800 A fuse
Incident energy reduction curves—480 V, continued

Figure 10. Incident energy plot of AFGF with KRP-C Class L, 1200 A fuse

Figure 11. Incident energy plot of AFGF with KRP-C Class L, 1600 A fuse
Incident energy reduction curves—480 V, continued

Figure 12. Incident energy plot of AFGF with KRP-C Class L, 2000 A fuse

Figure 13. Incident energy plot of AFGF with KRP-C Class L, 2500 A fuse
Incident energy reduction curves—480 V, continued

Figure 14. Incident energy plot of AFGF with KRP-C Class L, 3000 A fuse

Figure 15. Incident energy plot of AFGF with KRP-C Class L, 4000 A fuse
Incident energy reduction curves—480 V, continued

Figure 16. Incident energy plot of AFGF with KRP-C Class L, 5000 A fuse

Incident arcing energy comparison

Table 3. 480 V, VCBB electrode configuration

<table>
<thead>
<tr>
<th>Switch rating (A)</th>
<th>Fuse type and class</th>
<th>Maximum incident energy with fuse (cal./cm²)</th>
<th>Maximum incident energy with fuse + AFGF relay (cal./cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>FRS-R, RK-5</td>
<td>10.70</td>
<td>0.7</td>
</tr>
<tr>
<td>600</td>
<td>FRS-R, RK-5</td>
<td>20.50</td>
<td>1.2</td>
</tr>
<tr>
<td>800</td>
<td>KRP-C, L</td>
<td>24.00</td>
<td>1.4</td>
</tr>
<tr>
<td>1200</td>
<td>KRP-C, L</td>
<td>32.10</td>
<td>1.8</td>
</tr>
<tr>
<td>1600</td>
<td>KRP-C, L</td>
<td>42.90</td>
<td>2.6</td>
</tr>
<tr>
<td>2000</td>
<td>KRP-C, L</td>
<td>63.30</td>
<td>3.4</td>
</tr>
<tr>
<td>2500</td>
<td>KRP-C, L</td>
<td>72.60</td>
<td>4.5</td>
</tr>
<tr>
<td>3000</td>
<td>KRP-C, L</td>
<td>103.50</td>
<td>5.8</td>
</tr>
<tr>
<td>4000</td>
<td>KRP-C, L</td>
<td>144.90</td>
<td>6.4</td>
</tr>
<tr>
<td>5000</td>
<td>KRP-C, L</td>
<td>186.30</td>
<td>6.4</td>
</tr>
</tbody>
</table>

Table 4. 480 V, VCBB electrode configuration

<table>
<thead>
<tr>
<th>Switch rating (A)</th>
<th>Fuse type and class</th>
<th>Maximum incident energy with fuse (cal./cm²)</th>
<th>Maximum incident energy with fuse + AFGF relay (cal./cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>FRS-R, RK-5</td>
<td>4.90</td>
<td>0.2</td>
</tr>
<tr>
<td>600</td>
<td>FRS-R, RK-5</td>
<td>7.40</td>
<td>0.3</td>
</tr>
<tr>
<td>800</td>
<td>KRP-C, L</td>
<td>11.20</td>
<td>0.5</td>
</tr>
<tr>
<td>1200</td>
<td>KRP-C, L</td>
<td>20.90</td>
<td>0.9</td>
</tr>
</tbody>
</table>
**Wiring diagram**

![Wiring Diagram](image)

**Figure 17. Sensor and relay wiring diagram**

**Ground fault response curve**

Regarding the time delay curve, the ground fault must be present for the full length of the time delay. The ground fault amperage level does not affect the time delay. (i.e., The time delay will always be as set regardless of the amperage of the ground fault.)

![Ground Fault Response Curve](image)

**Figure 18. Ground fault response curve**
Zone interlock

Ground fault relay zone interlock

Figure 19. Ground fault relay zone interlock

Operation

Example

When a branch relay detects a ground fault, the associated feeders and main relays will detect it at the same time. The time delay will begin on all the relays; however, the branch unit will send a “No Trip” signal to the upstream feeder relay. The feeder relay will send a “No Trip” signal to the main relay. Once the branch relay time delay has expired, the unit will trip and remove the “No Trip” signal from the upstream units. If the ground fault is still present and the time delay has expired, the feeder unit will trip and remove the “No Trip” signal from the main relay. If the ground fault is still present, and the main relay’s time delay has expired, the main relay will trip.

Note: All zone interlock wiring must be wire size 16–20 AWG twisted pair. A limit of 10 upstream units are to be used to a single output.
Trip curves

Figure 20. 800 A AFGF relay with KRP-C Class L fuse curves
Figure 21. 1200 A AFGF relay with KRP-C Class L fuse curves
Figure 22. 1600 A AFGF relay with KRP-C Class L fuse curves
Figure 23. 2000 A AFGF relay with KRP-C Class L fuse curves
Figure 24. 2500 A AFGF relay with KRP-C Class L fuse curves
Figure 25. 3000 A AFGF relay with KRP-C Class L fuse curves
# Catalog number structures

## Table 5. STS catalog numbering system example

<table>
<thead>
<tr>
<th>Switch series</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STS</strong> = Shunt trip switch (UL)</td>
</tr>
<tr>
<td><strong>CTS</strong> = Shunt trip switch (CSA)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of poles</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 = Two-pole</td>
</tr>
<tr>
<td>3 = Three-pole</td>
</tr>
<tr>
<td>4 = Four-pole</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum system voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 = 240 Vac</td>
</tr>
<tr>
<td>6 = 600 Vac</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amperes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = 30 A</td>
</tr>
<tr>
<td>2 = 60 A</td>
</tr>
<tr>
<td>3 = 100 A</td>
</tr>
<tr>
<td>4 = 200 A</td>
</tr>
<tr>
<td>5 = 400 A</td>
</tr>
<tr>
<td>6 = 600 A</td>
</tr>
<tr>
<td>7 = 800 A</td>
</tr>
<tr>
<td>8 = 1200 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F</strong> = Fusible without neutral</td>
</tr>
<tr>
<td><strong>N</strong> = Fusible with neutral</td>
</tr>
<tr>
<td><strong>U</strong> = Non-fusible</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NEMA Type enclosure rating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D</strong> = NEMA 12/3R/1</td>
</tr>
<tr>
<td><strong>P</strong> = NEMA 4 (painted steel)</td>
</tr>
<tr>
<td><strong>W</strong> = NEMA 4X, Stainless 304</td>
</tr>
<tr>
<td><strong>X</strong> = NEMA 4X, Stainless 316</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shunt trip coil voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = 24 Vac</td>
</tr>
<tr>
<td>2 = 48 Vac</td>
</tr>
<tr>
<td>3 = 120 Vac</td>
</tr>
<tr>
<td>4 = 240 Vac</td>
</tr>
<tr>
<td>5 = 480 Vac</td>
</tr>
<tr>
<td>6 = 24 Vdc</td>
</tr>
<tr>
<td>7 = 48 Vdc</td>
</tr>
<tr>
<td>8 = 125 Vdc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of protective relay</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0</strong> = No relay</td>
</tr>
<tr>
<td><strong>A</strong> = Arc energy relay reduction</td>
</tr>
<tr>
<td><strong>B</strong> = Ground fault relay</td>
</tr>
<tr>
<td><strong>C</strong> = Arc energy relay reduction/ground fault combination relay</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CPT voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = 24 Vac</td>
</tr>
<tr>
<td>2 = 48 Vac</td>
</tr>
<tr>
<td>3 = 120 Vac</td>
</tr>
<tr>
<td>4 = 240 Vac</td>
</tr>
<tr>
<td>5 = 480 Vac</td>
</tr>
<tr>
<td>6 = 24 Vdc</td>
</tr>
<tr>
<td>7 = 48 Vdc</td>
</tr>
<tr>
<td>8 = 125 Vdc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Auxiliary switch</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blank</strong> = No auxiliary switches</td>
</tr>
<tr>
<td>1 = 1NO/1NC alarm switch only</td>
</tr>
<tr>
<td>2 = 1NO/1NC auxiliary contact only</td>
</tr>
<tr>
<td>3 = 2NO/2NC auxiliary contacts only</td>
</tr>
<tr>
<td>4 = 1NO/1NC auxiliary contact and 1NO/1NC alarm switch</td>
</tr>
<tr>
<td>5 = 2NO/2NC auxiliary contacts and 1NO/1NC alarm switch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional options/modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>00</strong> = No accessories</td>
</tr>
<tr>
<td><strong>CL</strong> = Copper lugs</td>
</tr>
<tr>
<td><strong>CP</strong> = Control pole</td>
</tr>
<tr>
<td><strong>0J</strong> = Factory-converted provisions for Class J fusing</td>
</tr>
<tr>
<td><strong>0N</strong> = Factory-installed neutral for non-fused switch</td>
</tr>
<tr>
<td><strong>0T</strong> = Factory-converted provisions for Class T fusing</td>
</tr>
<tr>
<td><strong>0W</strong> = Viewing window over switch blades</td>
</tr>
</tbody>
</table>

1. Ground fault relays can only be used with fusible switches.
2. Available for 600 Vac switches only.
3. Shunt trip safety switch with relay protection must use 120 Vac coils.
4. Only one relay option allowed.
5. Relay viewing window standard with relay option.
6. Available for 400–1200 A fusible switches only.
### Table 6. Pringle bolted pressure contact switches catalog numbering system example

<table>
<thead>
<tr>
<th>Switch type</th>
<th>Number of poles</th>
<th>Voltage control</th>
<th>System voltage</th>
<th>Interlock</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB</td>
<td>2 = Two-pole</td>
<td>120 = 120 V</td>
<td>208 = 208 V</td>
<td>D = Door interlock</td>
</tr>
<tr>
<td>QA</td>
<td>3 = Three-pole</td>
<td></td>
<td>480 = 480 V</td>
<td>K = Key interlock provision</td>
</tr>
<tr>
<td>FP</td>
<td>4 = Four-pole</td>
<td></td>
<td>600 = 600 V</td>
<td>L = Both D and K above</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amperes</th>
<th>Wire type</th>
<th>Feed entry</th>
<th>Additional option</th>
</tr>
</thead>
<tbody>
<tr>
<td>08 = 800 A</td>
<td>2 = Two-wire</td>
<td>B = Bottom</td>
<td>NF = Non-fused</td>
</tr>
<tr>
<td>12 = 1200 A</td>
<td>3 = Three-wire</td>
<td>T = Top</td>
<td></td>
</tr>
<tr>
<td>16 = 1600 A</td>
<td>4 = Four-wire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 = 2000 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 = 2500 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 = 3000 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 = 4000 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 = 5000 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 = 6000 A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Auxiliary contact</th>
<th>Control power transformer</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 = 1NO/1NC</td>
<td>6 = With handle suitable to meet 6-foot 6-inch requirements</td>
</tr>
<tr>
<td>7 = 2NO/2NC</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blown fuse detector (BFD)</th>
<th>Phase failure relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = BFD with three normally ON lights (does NOT trip)</td>
<td>R = Single-phase voltage relay with capacitor trip device (SPVR)</td>
</tr>
<tr>
<td>AO = BFD with three normally OFF lights (does NOT trip)</td>
<td></td>
</tr>
<tr>
<td>AX = BFD with NO lights (trips switch)</td>
<td></td>
</tr>
<tr>
<td>A9 = BFD with three normally ON lights (trips switch)</td>
<td></td>
</tr>
<tr>
<td>AR = BFD with three normally OFF lights (trips switch)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Arc energy reduction / ground fault</th>
<th>Type of protective relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>C = Arc energy reduction relay / ground fault combination relay</td>
<td>0 = No relay</td>
</tr>
<tr>
<td>E = Arc energy reduction relay</td>
<td>A = Arc energy reduction relay</td>
</tr>
<tr>
<td>G = Ground fault with control power transformer</td>
<td>B = Ground fault relay</td>
</tr>
<tr>
<td>GNX = Ground fault without control power transformer</td>
<td>C = Arc energy reduction relay / ground fault combination relay</td>
</tr>
</tbody>
</table>

#### Table 7. FDPK catalog numbering system example

<table>
<thead>
<tr>
<th>Switch type</th>
<th>Number of poles</th>
<th>Voltage</th>
<th>CPT voltage</th>
<th>Fuse class</th>
<th>Additional options/modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDPK</td>
<td>2 = Two-pole</td>
<td>2 = 240 V</td>
<td>0 = No CPT</td>
<td>L = Class L</td>
<td>00 = No additional options/modifications</td>
</tr>
<tr>
<td></td>
<td>3 = Three-pole</td>
<td>6 = 600 V</td>
<td>1 = 480 Vac</td>
<td></td>
<td>0VW = Viewing window</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amperes</th>
<th>Mounting</th>
<th>CPT voltage</th>
<th>Type of protective relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 = 1200 A</td>
<td>H = Horizontal</td>
<td>02 = 1NO/1NC auxiliary contacts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>V = Vertical</td>
<td>03 = 2NO/2NC auxiliary contacts</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CL = Copper lugs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0T = Factory provisions for class T fuses</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feed entry</th>
<th>CPT voltage</th>
<th>Fuse class</th>
<th>Type of protective relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>B = Bottom</td>
<td>0 = No relay</td>
<td></td>
<td>A = Arc energy reduction relay</td>
</tr>
<tr>
<td>T = Top</td>
<td></td>
<td>L = Class L</td>
<td>B = Ground fault relay</td>
</tr>
</tbody>
</table>

© Switch with relay protection must use 120 V control voltage.
Relay test instruction

Relay test instructions on AFGF relay

⚠️ CAUTION
THIS TEST SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY.

To determine if the neutral is grounded in only one place at the service entrance in accordance with the NEC:

1. De-energize equipment. (Disconnect Power)
2. Remove ground bond link.
3. Using a megger, measure resistance of each phase and the neutral to ground. (In accordance with NEC requirements, the resistance should be 1 mega ohm.)
4. Reconnect bond link.
5. Reconnect power and check power indication (LED).

To test the ground fault protection and sensors only:

1. Verify control power LED indicator is illuminated.
2. Press and hold the “Shunt Trip Bypass” pushbutton on the AFGF relay.
3. Press the “Push to Test” pushbutton. (The ground fault relay will trip.)
4. Reset the relay, and then release the “Shunt Trip Bypass” pushbutton.

To test the entire system (including the disconnect device):

Testing ground fault protection:

1. Verify control power LED indicator is illuminated.
2. Press the “Push to Test” pushbutton on the AFGF relay. (The trip indicator will go to the tripped position and the disconnect device will open.)
3. Reset the relay and then the disconnect device.

Testing overcurrent protection:

1. Verify control power LED indicator is illuminated.
2. Press the “Test Select” and “Push to Test” pushbuttons simultaneously. (The overcurrent trip indicator will go to the tripped position and the disconnect device will open.)
3. Reset the relay and then the disconnect device.