Sectionalizers

Catalog information
# Sectionalizers catalog contents

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**Type GH hydraulically controlled sectionalizer**

**Description**

Sectionalizers are used in conjunction with source-side protective devices such as reclosers or reclosing breakers to automatically isolate faulted sections of distribution lines. After sensing a current above a preselected level, the sectionalizer counts when the source-side protective device de-energizes the circuit. The sectionalizer can be set to open after 1, 2, or 3 counts. It does not interrupt fault current, but opens the section of the line within its protective zone during the open interval of the backup protective device.

Sectionalizers can be used in place of fuses or between the reclosing device and a fuse. They only detect current above a specified level and have no time–current characteristics. This provides a current-coordination range from minimum pickup to the maximum allowable momentary value of the sectionalizer.

Sectionalizers offer these operating advantages:

- Manual load-breaking capabilities up to 2.2 times their normal load ratings as determined by the actuating coil
- Fault close-in ability completely independent of operator speed
- No accidental opening under overload due to a damaged link
- Automatic or manual operation in any weather
Ratings and characteristics
Type GH single-phase hydraulically controlled sectionalizer can be applied to distribution systems within the ratings shown in Table 1.

A simple internal mechanism operates the sectionalizer. The mechanism incorporates a series-connected actuating coil, a plunger, and a trip piston to count and trip. The sectionalizer opens automatically but must be closed manually with the yellow operating handle under the sleet hood. The sectionalizer can also be tripped manually with the operating handle.

Operation
A sectionalizer is a self-contained circuit-opening device. It automatically opens its contacts after a backup recloser or circuit breaker de-energizes the circuit. Because a sectionalizer is not designed to interrupt fault current, it is always used in series with a backup fault-interrupting device.

A sectionalizer has no time–current characteristics, making it easily applicable to both new and existing coordination schemes. Figure 1 details the internal parts of the Type GH sectionalizer.

Surge protection
Sectionalizers operate best when protected with surge arresters. On line applications, arrester protection is recommended on both sides of the sectionalizer. If protection is to be provided on one side only, install the arrester on the source side. Eaton’s Cooper Power Systems distribution-class arresters provide excellent protection; see Catalog 235-99, UltraSIL™ Polymer-Housed Evolution™ Surge Arresters.

Table 1. Ratings of Type GH Sectionalizer

<table>
<thead>
<tr>
<th>Type</th>
<th>Nom. Voltage (kV)</th>
<th>Rated Max Voltage (kV)</th>
<th>Max Cont. Current (A)</th>
<th>Max. Momentary and Making Current (asymmetrical) (A)</th>
<th>BIL (kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GH (single-phase)</td>
<td>14.4</td>
<td>15</td>
<td>140</td>
<td>6500</td>
<td>95</td>
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</table>

Table 2. Bushings; Factory-Installed

<table>
<thead>
<tr>
<th>Description</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 in. creepage bushings</td>
<td>KA278NR</td>
</tr>
</tbody>
</table>

Table 3. 125 kV BIL Accessory; Factory-Installed

<table>
<thead>
<tr>
<th>Description</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>125 kV BIL accessory; includes 7 in. creepage bushings</td>
<td>KA148GH</td>
</tr>
</tbody>
</table>

Table 4. Mounting Equipment

<table>
<thead>
<tr>
<th>Description</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crossarm-mounting hanger, one required</td>
<td>KA39H</td>
</tr>
</tbody>
</table>

Ordering information
When ordering Type GH hydraulically controlled sectionalizer, include the catalog number and description. If mounting equipment or accessories are required, order separately by catalog number and description.

Constructing a catalog number
The catalog number for the Type GH hydraulically controlled sectionalizer—with or without accessories—is constructed as shown below:

KGH1 — Basic letters for single-phase Type GH sectionalizer;

100 — Coil size corresponding to nominal load current rating.
Actuating current is 160% of nominal rating.
Coil size: 5, 10, 15, 25, 35, 50, 70, 100, and 140 A.

T2 — Number of overcurrent counts to trip: 1, 2, or 3

KGH1 100 T2 is the catalog number for a Type GH single-phase sectionalizer with a nominal load current rating of 100 A set for two overcurrent counts to trip.
ACCESSORIES

Universal Clamp-Type Terminals
Accept #8 solid through 2/0 stranded copper or aluminum conductors in horizontal or vertical position.

Lifting Strap
For hoisting sectionalizer or lifting mechanism out of tank.

Head Casting
Cast aluminum supports bushings and operating mechanism.

O-Ring Gasket
Resilient rubber confined under controlled compression to provide an effective seal between head casting and tank.

Trip Adjustment Bar
Can be easily adjusted to trip mechanism after 1, 2, or 3 overcurrent counts.

Actuating Coil and Counting Mechanism
Counts overcurrent interruptions and opens sectionalizer after preselected number of counts.

Contact Structure
Has double-break, snap action contacts, with self-wiping blades and copper-tungsten tips.

By-Pass Gap
Protects series-operating coil from lightning surges.

Manual Operating Handle
Permits manual opening and closing, indicates contact position.

Sleet Hood
Protects manual operating handle, allows easy access with switch stick.

Oil-Filled 15 kV Bushings
For low radio-influence voltage wet-process porcelain, cover clamped for easy field replacement.

Figure 1. Untanked view of Type GH sectionalizer.
Sectionalizer operation

A sectionalizer senses overcurrent interruptions and opens after 1, 2, or 3 such interruptions occur. It does this in two steps:

1. When the sectionalizer senses a current above its actuating level, it arms (prepares to count). The count occurs when current through the sectionalizer is interrupted or falls below a certain value.

2. If the predetermined number of counts are registered within a definite time period, the sectionalizer opens when the backup device has interrupted current flow to the system.

Example

Figure 2 shows a typical application. A sectionalizer is located downline from an automatic circuit recloser. Basic coordination between the sectionalizer and the recloser consists of the following:

1. Establishing the sectionalizer’s actuating level proportional to the recloser’s trip level;
2. Programming at least one less count for the sectionalizer than the number of trips to lockout of the backup recloser. In this case, the recloser might be set for four operations to lockout and the sectionalizer for its maximum of three counts.

A fault occurs downline from the sectionalizer, in its normal protection zone. The sectionalizer and the backup recloser both sense the fault current. The sectionalizer arms to count on the overcurrent. The recloser trips and de-energizes the line. Current through the sectionalizer is interrupted, and the sectionalizer counts.

If the fault is temporary, it may be cleared by the recloser’s first two fast operations. Since neither the recloser nor the sectionalizer has completed its full operations sequence, both will reset for another complete sequence.

If the fault is permanent, the recloser continues through its programmed operations and the sectionalizer counts each trip operation. After the recloser has tripped for the third time, the sectionalizer completes its sequence of counts, opens, and isolates the fault. The recloser restores the rest of the system by reclosing, and, since it has not reached its programmed number of operations to lockout, it resets for another full sequence.

Figure 2. Typical sectionalizer application.

A quick-close feature of Eaton’s Cooper Power Systems hydraulic sectionalizers allows safe closing – even on a faulted line – up to the rated making current. Closing is accomplished by springs, and contact speed is independent of operator effort.

The quick-reset provision automatically resets the sectionalizer one count as soon as it opens. If closed in on a faulted line – even immediately after tripping – the sectionalizer remains closed until its backup device has cleared the fault. The sectionalizer then opens normally while the line is de-energized.
Counting mechanism operation

The hydraulic sectionalizer is actuated when its series-actuating (solenoid) coil is subjected to a current flow exceeding 160% of its continuous-current rating. The response of the hydraulic control mechanism to an overcurrent is illustrated in Figures 3, 4, and 5.

Figure 4 shows the hydraulic control in its usual at-rest condition. The actuating component of the control – the solenoid plunger – functions as a pump. With normal load current flowing through the solenoid coil, spring pressure holds the solenoid plunger at the top of its stroke.

When current flowing through the solenoid coil reaches actuating level, the resulting magnetic field pulls the plunger down (Figure 4). This downward motion closes the check valve at the bottom and forces a charge of oil up through the plunger into the space vacated by the plunger. The oil pressure opens the check valve at the top of the plunger, permitting oil flow. The plunger is held down until the current flow through the coil drops to about 40% – or less – of its actuating level.

In a typical sectionalizer counting operation, current flow through the coil is interrupted when the backup recloser interrupts the overcurrent. With the coil de-energized, the magnetic field is lost and the plunger is returned to its up position by the compressed spring, as shown in Figure 5.

Upward movement of the plunger closes the top check valve so that the oil charge above the plunger (Figure 4) is forced upward. This raises the trip piston, and the sectionalizer now has registered one count. If the sectionalizer has been set for more than one count, the sequence is repeated with each overcurrent until the trip piston engages the trip latch and opens the sectionalizer contacts.

After each count, the trip piston begins to reset slowly. The time during which it remembers previous counts is called sectionalizer memory time. If the fault is temporary and is cleared before the sectionalizer opens, the piston resets. If the programmed number of counts is completed within the sectionalizer memory time, the sectionalizer opens and must be closed manually.
Application recommendations

The following basic coordination principles should be observed in the application of hydraulic sectionalizers:

1. The sectionalizer’s minimum-actuating-current rating should be approximately 80% of the minimum-trip rating of the source-side protective device.
   **Note:** This requirement is usually satisfied by pairing the sectionalizer with an equally continuous-current-rated hydraulic recloser. The continuous-current and minimum-actuating-current ratings of the sectionalizer correspond to – and are compatible with – hydraulic recloser ratings.

2. The sectionalizer should be set to open one count less than the total operations to lockout of the backup device.
   **Note:** This rule need not apply when several sectionalizers are in series; successive units may be set for 1, 2, or 3 counts less than backup recloser operations.

3. Momentary and short-time ratings of the sectionalizer must not be exceeded. Follow the steps below to check this requirement:
   A. To establish a cumulative time–current curve for the backup device, add the clearing-time curves for the operations that occur prior to opening of the sectionalizer.
   B. Plot this curve on the GH short-time current carrying chart (Figure 6) as applicable.
   C. Read the current at the intersection of the cumulative curve of the backup device and the applicable short-time curve of the sectionalizer.
   D. The sectionalizer should be located where available fault current does not exceed the value in Step C.

4. The backup device’s total accumulated operation time must be equal to – or less than – the sectionalizer’s memory time.
   **Note:** Hydraulically controlled sectionalizers were originally designed for use with hydraulically controlled reclosers. The hydraulically controlled recloser generally has a maximum two-second reclosing time; the hydraulically controlled sectionalizer has a memory time that is fixed, but will coordinate with any hydraulic controlled recloser.

For other electronic- or relay-controlled backup fault interrupting devices which may have longer resetting times, information to accurately determine whether or not the hydraulically controlled sectionalizer will coordinate is presented in the following paragraphs.

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**Figure 6.** Short-term current-carrying capacity.
Coordination of sectionalizer with backup protective devices

Coordination of Types GH hydraulically controlled sectionalizers with backup reclosers or breakers is a function of the sectionalizer’s maximum oil temperature and the backup device’s operating sequence.

Sectionalizer oil temperature

Sectionalizer memory time depends upon the resetting of the hydraulic counting mechanism. Thus, memory time is a function of oil viscosity which in turn depends upon oil temperature.

The temperature rise of the oil due to current flow through the coil, contacts and lead wires at various load-current levels is shown in Table 5.

Table 5. Oil-Temperature Rise at Various Load Currents

<table>
<thead>
<tr>
<th>Load Current (% coil rating)</th>
<th>Approx. Temperature Rise (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>4</td>
</tr>
<tr>
<td>50</td>
<td>13</td>
</tr>
<tr>
<td>75</td>
<td>27</td>
</tr>
</tbody>
</table>

Assuming a period of load-current flow prior to sectionalizer operation, add the temperature rise to the sectionalizer ambient temperature to determine the approximate maximum oil temperature.

Operating sequence of backup device

Figure 7 shows the portions of the backup operating sequence which must be considered when determining proper coordination. These are the appropriate fault times and reclosing times when the sectionalizer must keep the proper count. Called Total Accumulated Time (TAT), it is the time (sec) from the instant of interruption on the first fault operation to the instant of interruption on the last fault operation that the sectionalizer counts before opening.

EXAMPLE 1

For a Type GH sectionalizer set to open after counting three fault interruptions, the total accumulated time of the backup device is the sum of the first and second reclosing times and the second and third trip times: TAT=R1 + F2 + R2 + F3.

EXAMPLE 2

If the sectionalizer is set to open after two counts, total accumulated time would be the sum of the first reclosing time and the second trip time: TAT= R1 + F2.

EXAMPLE 3

If the sectionalizer is set for one-count-to-open, sectionalizer memory time is not involved and the sectionalizer will always coordinate. However, when the one-count-to-open setting is used, inrush currents must be considered. See the Effect of Inrush Current on Sectionalizer Application section in this manual.

Coordination requirements

Two requirements must be met to assure coordination of Type GH hydraulically controlled sectionalizers with backup devices:

1. At the established maximum oil temperature (ambient plus rise), TAT must not exceed the value indicated by the sectionalizer coordination curve (Figure 8).
2. The fault current on-time (F2 + F3) cannot exceed 70% of the TAT allowed by the coordination curve for the maximum oil temperature expected.
Example 1

Conditions:
Max. ambient temperature 85 °F
Sectionalizer coil size 100 A
Normal load current 50 A
Backup OCR set for 1 fast, 3 delayed operations
Sectionalizer set for 3 counts to open

Maximum oil temperature:
\[ 85 + 13 = 98 °F \]

From the coordination curve in Figure 8, allowable TAT at 98 °F is 28 seconds. Figure 9 illustrates this example, and an explanation follows.

To meet Coordination Requirement No. 2, the maximum current on-time (F2 + F3) for TAT of 28 seconds is 28 \times 0.70 = 19.6 seconds (round off to 20 seconds.) Therefore, neither F2 nor F3 can exceed 20/2 or 10 seconds.

To meet Coordination Requirement No. 1, the TAT must not exceed 28 seconds. With F2 and F3 each 10 seconds, a maximum limit can be calculated for R1 and R2 as shown below.

\[
\text{TAT} = (R1 + R2) = (F2 + F3) \\
R1 + R2 = \text{TAT} - (F2 + F3) \\
= 28 - (10 + 10) \\
= 8 \text{ seconds.}
\]

Therefore, the sum of the two reclosing times cannot exceed – but can be less than – 8 seconds.

Example 2

Conditions:
Max. ambient temperature 85 °F
Sectionalizer coil size 100 A
Normal load current 50 A
Backup OCR set for 1 fast, 3 delayed operations
Sectionalizer set for 2 counts to open

Maximum oil temperature:
\[ 85 + 13 = 98 °F \]

The allowable TAT is again at 28 seconds: with the sectionalizer set for two counts to open, there is only one fault current on-time (F2) and only one reclosing time (R1). Therefore, the fault current on-time (F2) cannot exceed 20 seconds, and the reclosing time (R1) must be 8 seconds or less.

Recloser-sectionalizer-fuse link coordination

If, for example, the backup device is set for a typical two-fast, two-delayed operating sequence, the sectionalizer counts twice on the first two operations of the recloser and, when the fuse blows on the first delayed operation of the recloser, counts the third time and opens. The sectionalizer counts the fuse clearing as the third fault-current interruption and erroneously isolates the section between it and the fuse link (Figure 10).

To properly coordinate a recloser, sectionalizer, and fuse link, the recloser must be set for one fast followed by three delayed operations.

In Figure 11, the sectionalizer counts once on the recloser’s fast operation. The fuse blows while the recloser is timing its first delayed operation, and the sectionalizer registers its second count. The fault is removed and, with no further operation, the sectionalizer and recloser both reset.

Figure 9. With backup recloser set for 1 fast and 3 delayed operations and sectionalizer set for 3 counts to open, total allowable accumulated time is 28 seconds.
Effect of inrush currents on sectionalizer application

One of the principal causes for unwanted and unexpected sectionalizer operation is inrush current, which is of two basic types:
• cold-load pickup;
• transformer magnetizing.

Although magnetizing current – determined by the connected kVA – is usually a greater factor than cold-load pickup, both types of inrush current must be considered when applying hydraulically controlled sectionalizers.

If, upon circuit energization, the current through the sectionalizer exceeds its actuating rating, the sectionalizer will arm to count immediately.

If the current then falls below 40% of the actuating rating, the sectionalizer will complete the count even though the backup protective device did not open (Figure 12).

However, for a fault on the source side of the sectionalizer, the backup device will trip. If, upon circuit re-energization, the inrush current through the sectionalizer is greater than its actuating rating, the sectionalizer will arm to count. A second trip operation of the backup device will cause the sectionalizer to complete its count.

Determining effect of inrush current

To determine if the inrush current will exceed the actuating current rating of the sectionalizer, calculate the ratio of the actuating current rating of the sectionalizer to the peak load of the circuit. The lower the ratio, the higher the possibility of inrush current exceeding the actuating rating.

A. For ratios greater than 10, inrush currents will probably not be a factor in applying the sectionalizer.
B. For ratios between 10 and 5, inrush currents may be a factor. To ensure the actuating current rating is not exceeded, a more accurate determination must be made of the circuit parameters.
C. For ratios of 5 or less, inrush currents will in all probability exceed the actuating rating; unwanted sectionalizer operation can be expected.

Figure 10. With backup device set for 2-fast, 2-delayed operation, sectionalizer erroneously counts and isolates section.

Figure 11. Proper coordination of a recloser, sectionalizer, and fuse link requires recloser to be set for 1-fast, 3-delayed operation.

Figure 12. If current falls below 40% of actuating rating, sectionalizer will complete the count even though backup protective device does not open.
Ratings and specifications

Table 6. Voltage Ratings

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal system rated voltage (kV rms)</td>
<td>14.4</td>
</tr>
<tr>
<td>Rated max voltage (kV rms)</td>
<td>15.0</td>
</tr>
<tr>
<td>Rated impulse withstand voltage (BIL; kV crest)</td>
<td>95</td>
</tr>
<tr>
<td>60 Hz insulation level withstand</td>
<td></td>
</tr>
<tr>
<td>dry, 1 min. (kV rms)</td>
<td>35</td>
</tr>
<tr>
<td>wet, 10 sec. (kV rms)</td>
<td>30</td>
</tr>
<tr>
<td>Creepage distance, standard bushings (in.)</td>
<td>9-3/4</td>
</tr>
</tbody>
</table>

Table 7. Current Ratings

<table>
<thead>
<tr>
<th>Continuous (A)</th>
<th>Interrupting Load-Break Current (A)</th>
<th>Actuating Current (A)</th>
<th>Momentary and Making (sym A)</th>
<th>1 Second (sym A)</th>
<th>10 Second (sym A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>308</td>
<td>8</td>
<td>800</td>
<td>200</td>
<td>60</td>
</tr>
<tr>
<td>10</td>
<td>308</td>
<td>16</td>
<td>1600</td>
<td>400</td>
<td>125</td>
</tr>
<tr>
<td>15</td>
<td>308</td>
<td>24</td>
<td>2400</td>
<td>600</td>
<td>190</td>
</tr>
<tr>
<td>25</td>
<td>308</td>
<td>40</td>
<td>4000</td>
<td>1000</td>
<td>325</td>
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<td>6500</td>
<td>2000</td>
<td>650</td>
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<td>308</td>
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<td>6500</td>
<td>3000</td>
<td>900</td>
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<td>100</td>
<td>308</td>
<td>160</td>
<td>6500</td>
<td>4000</td>
<td>1250</td>
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<tr>
<td>140</td>
<td>308</td>
<td>224</td>
<td>6500</td>
<td>4000</td>
<td>1800</td>
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</table>

Table 8. Weight and Oil Capacity

<table>
<thead>
<tr>
<th>Weight (lb)</th>
<th>Dry</th>
<th>With Oil</th>
<th>Oil Capacity (gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>31-1/2</td>
<td>1-1/2</td>
<td></td>
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</table>
Type GH hydraulically controlled sectionalizer

Technical Data 270-10
Effective May 2014

Figure 13. Type GH sectionalizer outline dimensions.

Note: All measurements are approximate and are given in mm (inches).
Figure 14. Mounting sectionalizer to crossarm hanger KA39H.
A sectionalizer is an automatic circuit opening device. After a circuit has been deenergized by a backup protective device - such as a recloser or recloser breaker - a sectionalizer isolates the faulted portion of a distribution line. After the fault has been isolated, the rest of the circuit is returned to service upon reclosure of the backup.

The sectionalizer counts the over-current interruptions of the backup and can be set to open after one, two, or three counts have been registered within a predetermined time span. A sectionalizer opens during the open interval of the backup. Although it cannot interrupt faults, it can be closed into them.

Sectionalizers can be used in place of fuses or between a reclosing device and a fuse. They only detect current interruptions above a predetermined level and have no time-current characteristics, permitting easy coordination with other protective devices on the system. They provide additional protection without adding a coordination step to the protective scheme.

Sectionalizers provide several advantages over fuse cutouts:

- In addition to application flexibility, they offer safety and convenience
- After a permanent fault, the fault-closing capability of the sectionalizer greatly simplifies circuit testing
- If a fault is still present, interruption takes place safely at the backup recloser
- Replacement fuse links are not required so the line can be tested and service restored with more speed, convenience, and economy
- Sectionalizers do not open accidentally under load due to a damaged link
- The possibility of error in the selection of the correct fuse link size and type is eliminated

Sectionalizers provide an economical method to further improve service on distribution lines equipped with reclosers or reclosing circuit breakers by isolating permanent faults, thus confining outages to smaller sections of line.

Sectionalizers are applied on the load-side of the fault-interrupting device and count its fault-trip operations. The open during the first, second, or third open interval of the backup protective device, depending upon the coordination scheme selected. Sectionalizers are not designed to interrupt fault currents. They can, however, be closed in against a fault. The sectionalizer will forget counts that do not reach its counts-to-open setting due to clearing of temporary faults.
When properly applied, a sectionalizer will respond to downline fault currents that are interrupted by its backup protective device. However, as with any other protective device, system conditions may produce unexpected and unwanted sectionalizer operation.

Overcurrents interrupted by a downline protective device are one cause for these occurrences; inrush current is another. Count-restraint and inrush current restraint features are built into the electronic control to block the sectionalizer’s response to these system conditions.

**Summary of ratings**

The solid-state electronic control used in the Type GN3E and GN3VE three-phase sectionalizers provides accurate and reliable operation down to 16 amps on phase-fault and 3.5 amps on ground- (earth-) fault detection. Operation is unaffected over a wide range of ambient temperatures. Basic ratings are shown in Table 1.

The sectionalizer is self-contained. Current transformers—internally mounted on the bushings—provide power to operate the electronic control and the trip mechanism. Since these CTs obtain power from the line, no external source of auxiliary power is required.

**Operation**

The Type GN3E or GN3VE sectionalizer is a three-phase device that opens all three phases simultaneously for either a phase or ground fault or when used as a loadbreak switch. Three sets of oil-insulated contacts are connected by bellcranks to a common operating mechanism. A low-energy tripping mechanism—operated by the control and low-energy tripper is obtained from the line through bushing current transformers (mounted under the head) which sense the phase- and ground-fault currents. No auxiliary power supply is required.

The solid-state electronic control provides the operating logic for automatic opening. Closing is accomplished by manually closing the yellow operating handle under the sleet hood. The sectionalizer may also be manually opened with this handle which also provides a positive visual indication of contact position.

**Surge protection**

Sectionalizers operate best when protected with surge arresters. On line applications, arrester protection is recommended on both sides of the sectionalizer. If protection is to be provided on one side only, install the arrester on the source side. Eaton’s Cooper Power Systems distribution-class arresters provide excellent protection; see Catalog 235-99, UltraSIL™ Polymer-Housed Evolution™ Surge Arresters.

**Ordering information**

When ordering a Type GN3E or GN3VE sectionalizer, include catalog number and description of basic sectionalizer and the phase and ground minimum-actuating-current plug-in resistors. A set (one each) of the phase and ground minimum-actuating-current plug-in resistors is included in the price of the basic sectionalizer. Also specify the operating settings for the inrush-current restraint. If accessories and/or mounting equipment are required, specify by catalog number and description.

---

**Table 1. Ratings of Types GN3E and GN3VE Sectionalizers**

<table>
<thead>
<tr>
<th>Type</th>
<th>Nominal Voltage (kV)</th>
<th>Rated Max Voltage (kV)</th>
<th>Max Cont. Current (amps)</th>
<th>Max. Interrupting Loadbreak Current (amps)</th>
<th>Max. Momentary and Making Current (asymmetrical amps)</th>
<th>BIL (kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GN3E</td>
<td>14.4</td>
<td>15.5</td>
<td>200</td>
<td>440</td>
<td>9000</td>
<td>110</td>
</tr>
<tr>
<td>GN3VE</td>
<td>24.9</td>
<td>27</td>
<td>200</td>
<td>440</td>
<td>9000</td>
<td>125</td>
</tr>
</tbody>
</table>

**Table 2. Basic Types GN3E and GN3VE Sectionalizers**

<table>
<thead>
<tr>
<th>Description</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type GN3E sectionalizer set for:</td>
<td></td>
</tr>
<tr>
<td>One count to open</td>
<td>KGN3EB1</td>
</tr>
<tr>
<td>Two counts to open</td>
<td>KGN3EB2</td>
</tr>
<tr>
<td>Three counts to open</td>
<td>KGN3EB3</td>
</tr>
</tbody>
</table>

| Type GN3VE sectionalizer set for: | |
| One count to open | KGN3VEB1 |
| Two counts to open | KGN3VEB2 |
| Three counts to open | KGN3VEB3 |

**Table 3. Phase and Ground Minimum Actuating-Current Plug-In Resistors**

<table>
<thead>
<tr>
<th>Type</th>
<th>Minimum Actuating Current Rating (amps)</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase</td>
<td>16, 24, 40, 56, 80, 112, 160, 224, 256, 296, or 320</td>
<td>KGN123E*</td>
</tr>
<tr>
<td>Ground</td>
<td>3, 5, 7, 16, 28, 40, 56, 80, 112, 160, 224, 320, or BLO (block)</td>
<td>KGN124E*</td>
</tr>
</tbody>
</table>

* Complete the catalog number by inserting the value (amps) of the required minimum-actuating current.

**Table 4. Operating Settings for Inrush-Current Restraint**

<table>
<thead>
<tr>
<th>Description</th>
<th>Available Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase-actuating current multiplier</td>
<td>2X, 4X, 6X, 8X, or BLOCK</td>
</tr>
<tr>
<td>Phase-inrush reset (duration the phase actuating current is to be raised)</td>
<td>5, 10, 15, or 20 cycles (60 Hz base)</td>
</tr>
<tr>
<td>Ground-inrush reset (duration the ground sensing is to be blocked)</td>
<td>0.3, 0.7, 1.5, 3.0, or 5.0 seconds</td>
</tr>
</tbody>
</table>
Accessories and mounting equipment

Table 5. Bushings: Factory-Installed

<table>
<thead>
<tr>
<th>Description</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-inch creepage bushings</td>
<td>KA18GN3</td>
</tr>
</tbody>
</table>

Table 6. Multi-Ratio Bushing-Current Transformers for Field Installation; 600:5 for Metering

<table>
<thead>
<tr>
<th>Description</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slip-on bushing current transformer kit, one BCT per kit</td>
<td>KA712L1</td>
</tr>
</tbody>
</table>

Table 7. Mounting Equipment

<table>
<thead>
<tr>
<th>Description</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double-crossarm bracket or substation hanger</td>
<td>KA19H3</td>
</tr>
<tr>
<td>Broad-side pole-mounting hanger</td>
<td></td>
</tr>
<tr>
<td>Type GN3E</td>
<td>KA116H3</td>
</tr>
<tr>
<td>Type GN3VE</td>
<td>KGN50E</td>
</tr>
<tr>
<td>Surge arrester mounting bracket for KA116H3 hanger</td>
<td>KA126H3</td>
</tr>
</tbody>
</table>

COVER-CLAMPED BUSHINGS
Wet-process porcelain; can be replaced in the field.

HEAD CASTING
Cast aluminum; supports the bushings and operating mechanism.

MANUAL OPERATING HANDLE
Permits manual opening and closing, indicates contact position.

LOW-ENERGY TRIPPER
Trips operating mechanism to open sectionalizer upon signal from electronic control.

MOVING CONTACTS
Wedge-shaped for positive engagement; easily accessible for inspection and maintenance.

STATIONARY CONTACTS
With arcing tips; easily accessible for inspection, cleaning, and replacement.

UNIVERSAL CLAMP-TYPE TERMINALS
Accept No. 6 solid through 350-MCM stranded copper or aluminum conductors in a horizontal or vertical position.

PRINTED CIRCUIT BOARD
Solid-state electronic control counts overcurrent interruptions of the backup device and actuates the low-energy tripper after present number of counts.

INRUSH-CURRENT-RESTRAINT CONTROL CABINET
Houses circuit board for inrush-current-restraint feature; provides access to actuating-current and counts-to-trip settings.

O-RING GASKET
Confined under controlled compression to provide an effective seal between head casting and tank.

BUSHING-CURRENT TRANSFORMERS
Six (one on each bushing); provide electronic control with signals proportional to current flow (both phase and ground).

Figure 1. Untanked Type GN3E sectionalizer.
The control is powered by the load and/or fault current flowing through the sectionalizer. This also charges the trip-energy-storage capacitors. For most cases, the charging time of the capacitors (Figure 4) is less than the clearing time of the three-phase reclosers from Eaton’s Cooper Power Systems with which the GN3E and GN3VE sectionalizers are specifically intended to coordinate. Some recloser fast-trip curves may have a faster clearing time at their low end than the capacitor charging time. These exceptions are listed in Table 8 (Phase Trip Coordination) and Table 9 (Ground Trip Coordination).

To verify proper coordination between the sectionalizer and its backup protective device, the charge time of the trip-energy-storage capacitors (Figure 4) can be plotted against the clearing-time curve of the backup device. Note that the capacitor charge-time curve is plotted in amps, not in % of minimum actuating current.
### Count-restraint feature

The count-restraint feature blocks the sectionalizer from generating a count pulse as long as some load current flows through the sectionalizer. Thus, the sectionalizer does not count or operate when a load-side device interrupts the overcurrent.

Figure 5 show a typical application with the sectionalizer located between two reclosers.

For a fault (F1) beyond the load-side recloser (ACR2), only the load-side recloser operates. The sectionalizer does not generate a count because the load current through the sectionalizer is not interrupted.

For a load-side fault (F2) interrupted by the source-side recloser (ACR1), the sectionalizer counts the fault interruption since the load current through the sectionalizer is interrupted.

The count-restraint feature is designed to operate with a minimum of 3-1/2 amps load current through the sectionalizer. It is a standard feature of all GN3E and GN3VE electronically controlled sectionalizer.

![Figure 5. Typical application of sectionalizer located between two reclosers.](image)

### Inrush-current restraint feature

One of the principal causes for unwanted sectionalizer operation is inrush current. If the backup device interrupts a fault on the downline side of the sectionalizer, the sectionalizer will generate and register a count pulse in the normal manner. If the fault is interrupted by a downline protective device, the count-restraint feature will block the generation of a count pulse if at least 3-1/2 amps of uninterrupted load current flows through the sectionalizer.

For a fault on the source-side of the sectionalizer (Figure 6), the backup device will trip and deenergize the circuit. However, if upon circuit reenergization, the inrush current through the sectionalizer is greater than its minimum actuating current setting, a second trip operation of the backup device will defeat the count-restraint feature (load current is interrupted) and cause the sectionalizer to generate and register a count.

The inrush-current restraint feature distinguishes between inrush current and fault current by means of a logic circuit previously described. It prevents false counting and operation of the sectionalizer due to inrush currents through the sectionalizer during operation of the source-side protective device.

![Figure 6. Typical application showing a fault on the source-side of the sectionalizer.](image)

### Low-energy tripping mechanism

The low-energy tripping mechanism operated from the electronic control, initiates the automatic-opening operation. The mechanism consists of a permanent magnet, and a solenoid and coil assembly which operate a trip lever (Figure 7).

When the sectionalizer is closed, the solenoid’s plunger is held by the magnetic force produced by the permanent magnet. In this position, the compressed spring is acting to release the plunger.

During the opening operation, the trip-energy-storage capacitors are connected across the coil of the solenoid. The counter-magnetic flux produced by the discharge of the capacitors is great enough for the compressed spring to override the net magnetic force, pull down the plunger to operate the trip lever, and open the sectionalizer contacts. As the sectionalizer contacts are opened, the spring-biased reset lever of the tripping mechanism is released to return the solenoid plunger and reset the assembly for the next opening operation.

### Application requirements

The following basic coordination principles should be observed in the application of Types GN3E and GN3VE electronically controlled sectionalizers:

1. For both phase and ground currents, the minimum actuating-current setting of the sectionalizer should be approximately 80% of the minimum trip-current setting of the backup recloser or recloser breaker.
2. The counts-to-open setting of the sectionalizer must be at least one less than the number of operations to lockout of the backup device.
3. Total accumulated time (TAT) for the operation of the backup fault-interrupting device must not exceed one minute between each operation. TAT is counted from the backup device’s first trip operation to the trip operation which causes the sectionalizer to open.
4. To assure that the trip-energy-storage capacitors are fully charged before the backup trips, the clearing time of the backup device must be greater than the charging time of the trip-energy-storage capacitors. The charging time-current curve for the trip-energy-storage capacitors is shown in Figure 4.
5. To operate the count-restraint feature, a minimum of 3-1/2 amps of load current must normally flow through the sectionalizer.
6. The momentary and short-time ratings of the sectionalizer must not be exceeded.
7. Three-phase sectionalizers must be used with backup breakers or reclosers in which all three phases open simultaneously. The counting functions of the sectionalizer do not recognize a signal as originating in a particular phase, but total the overcurrent interruptions in all three phases. Non-simultaneous three-phase tripping of the backup device could result in the sectionalizer...
interrupting fault current in one or more phases.

8. Application on multi-grounded-wye systems generally required ground-fault sensing and inrush-current restraint. Setting the phase actuating level to the ground setting of the backup device may result in erroneous counts due to inrush currents and incorrect opening of the sectionalizer for source-side faults.

**Application of inrush-current restraint**

Sectionalizers can be applied where the main feeder is divided into two feeders close to the substation (Figure 8). Inrush current will be a problem here, since the load current (and connected transformer capacity) if close to the operating settings of the sectionalizer.

A sectionalizer may also be applied to protect an important branch which may be carrying only a small portion of the total load (Figure 9). Although this example will result in fewer inrush-current problems than the previous application, inrush-current considerations should not be ignored here.

The typical sectionalizer settings shown in these illustrations are identical for both applications since they are based on the settings of the backup device.

To prevent false operation, the inrush-restraint function should be programmed so that:

1. The Multiplier setting exceeds the expected inrush current (cold-load pickup and/or transformer magnetizing);
2. The inrush current decays to below the normal actuating current setting of the sectionalizer within the duration of the Reset setting.

**Sectionalizer settings**

For proper sectionalizer operation, the following settings must be specified on the order:

- Minimum phase-actuating current
- Minimum ground-actuating current
- Number of overcurrent counts to open
- Multiple of phase minimum-actuating current
- Duration of raised phase current sensing
- Duration of ground current-sensing block

**Minimum-actuating current**

To assure that the sectionalizer will sense and count every fault-trip operation of its backup protective device, the minimum-actuating phase- and ground-trip setting should be approximately 80% of the comparable minimum-trip values of the backup device. However, in a few instances, the lower end of the back-up recloser’s fast-trip curve may be faster than the charging time of the trip-energy-storage capacitor, and proper coordination may not be attained.

The minimum-trip levels of the recloser fast curves in question and the comparable minimum-actuating levels of the sectionalizer to attain proper coordination are listed in Tables 8 and 9. Below these levels, the Type GN3E and GN3VE sectionalizer may not count the fast-curve operation.

**Table 8. Phase Trip Coordination**

<table>
<thead>
<tr>
<th>Recloser Type</th>
<th>Recloser Minimum-Trip Current (amps)</th>
<th>Sectionalizer Minimum-Actuating Current (amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W, WW, VW, VWV27</td>
<td>100 (A Curve)</td>
<td>80</td>
</tr>
<tr>
<td>WE, WVE, WVE, VSVE27</td>
<td>100 (A Curve)</td>
<td>80</td>
</tr>
</tbody>
</table>

**Table 9. Ground-Trip Coordination**

<table>
<thead>
<tr>
<th>Device</th>
<th>Minimum-Trip Current (amps)</th>
<th>Sectionalizer Minimum-Actuating Current (amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic recloser with KA510R hydraulic ground-trip accessory</td>
<td>110 (1 Curve)</td>
<td>80</td>
</tr>
<tr>
<td>Hydraulic recloser with KA1144R electronic ground-trip accessory</td>
<td>100 (1 Curve)</td>
<td>80</td>
</tr>
<tr>
<td>50 (2 Curve)</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>20 (3 Curve)</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>10 (4 Curve)</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Electronic recloser with ground-trip on ME Control</td>
<td>100 (1 Curve)</td>
<td>80</td>
</tr>
<tr>
<td>50 (4 Curve)</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>
The minimum actuating-current level is determined by plug-in resistors located on the inrush-current-restraint circuit board housed in the control cabinet (Figure 10).

The available minimum actuating-current-level values for both phase and ground have been selected to coordinate with the more popular recloser trip settings. The following values are available for phase sensing: 16, 24, 40, 56, 80, 112, 160, 224, 256, 296, and 320 amps. For ground sensing, the values available are 3.5, 5, 7, 16, 28, 40, 56, 80, 112, 160, 224, and 320 amps.

Note: If the backup protective device does not include ground-fault trip, a dummy plug-in resistor is used to deactivate the ground-sensing circuits of the sectionalizer control. See Ordering Information for proper catalog number.

Figure 10. Sectionalizer settings are located on the printed circuit board in the control cabinet.

Number of counts to open

The number of overcurrent counts to open should be at least one less than the number of trips to lockout of the backup device. One, two, or three counts are available.

This setting is determined by attaching the jumper wire to the proper terminal tab on the same printed-circuit board that holds the phase and ground plug-in resistors (Figure 10).

Inrush-current restraint Whenever circuit logic determines that the over-current is inrush current, this feature raises the minimum phase-actuating-current level of the sectionalizer by a multiple X (2, 4, 6, or 8 times) or blocks overcurrent detection entirely for a period of time Y (5, 10, 15, or 20 cycles) after current flow through the sectionalizer is restored. At the same time, ground overcurrent detection is also blocked entirely for a period Z (0.3, 0.7, 1.5, 3, or 5 seconds). To operate effectively, the values selected for X, Y, and Z should exceed the time-current parameters of the expected inrush currents.

With the inrush-current restraint set on BLOCK for phase-sensing and the ground-sensing circuit normally operating on block, the sectionalizer will not count a system fault interrupted by the backup device within the block time span.

The settings for raising the phase-current-actuating level, the duration of this raised level, and the duration of ground-current block are made by attaching jumper wires to the proper terminal tabs on the inrush-current-restraint circuit board. This circuit board is housed in the control cabinet at the back of the sectionalizer (Figure 10).
Ratings and specifications

Table 10. Basic Data for Types GN3E and GN3VE Sectionalizers

<table>
<thead>
<tr>
<th>Description</th>
<th>Type GN3E</th>
<th>Type GN3VE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal operating voltage (kV rms)</td>
<td>14.4</td>
<td>24.9</td>
</tr>
<tr>
<td>Max rated voltage (kV rms)</td>
<td>15.5</td>
<td>27</td>
</tr>
<tr>
<td>Impulse withstand (BIL) 1.2 x 50 μsec wave (kV crest)</td>
<td>110</td>
<td>125</td>
</tr>
<tr>
<td>60 Hz withstand (kV rms)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dry, 1 min. (kV rms)</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>wet, 10 sec. (kV rms)</td>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td>Rated continuous current (amps)</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Rated symmetrical load interrupting current (rms amps)</td>
<td>440</td>
<td>440</td>
</tr>
<tr>
<td>Rated making current (rms amps; asymmetrical)</td>
<td>9000</td>
<td>9000</td>
</tr>
<tr>
<td>Short-time ratings (rms amps)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 sec, symmetrical</td>
<td>2600</td>
<td>2600</td>
</tr>
<tr>
<td>1 sec, symmetrical</td>
<td>5700</td>
<td>5700</td>
</tr>
<tr>
<td>Momentary, max, asymmetrical</td>
<td>9000</td>
<td>9000</td>
</tr>
</tbody>
</table>

Table 11. Control Data for Types GN3E and GN3VE Sectionalizers

Minimum Actuating-Current Settings (amps)

<table>
<thead>
<tr>
<th>Phase-Sensing</th>
<th>Ground-Sensing</th>
<th>Number of Counts to Open</th>
<th>Memory Time* (sec)</th>
<th>Reset Time** (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16, 24, 40, 56, 80, 112, 160, 224, 256, 296, 320</td>
<td>3.5, 7, 16, 28, 40, 56, 80, 112, 160, 224, 256, 296, 320</td>
<td>1, 2, or 3</td>
<td>60</td>
<td>7</td>
</tr>
</tbody>
</table>

* Period of time sectionalizer will retain its count.

** Time required for all count retention to be lost for sectionalizer control operations that do not total the required number of counts to open.

Dimensions and weights

Figure 13. Dimensions for Types GN3E and GN3VE.
Figure 14. KA19H3 double-crossarm bracket.
Table 12. Weights and Oil Capacity

<table>
<thead>
<tr>
<th>Sectionalizer Type</th>
<th>Without Oil (lb)</th>
<th>With Oil (lb)</th>
<th>Oil Capacity (gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GN3E</td>
<td>156</td>
<td>250</td>
<td>12-1/2</td>
</tr>
<tr>
<td>GN3VE</td>
<td>156</td>
<td>250</td>
<td>12-1/2</td>
</tr>
</tbody>
</table>

Figure 15. KA116H3 pole-mounting frame for GN3E and KGN50E pole-mounting frame for Type GN3VE sectionalizers.
Types GN3E and GN3VE electronically controlled sectionalizer
Sectionalizers are automatically controlled circuit-opening devices which isolate a faulted portion of a circuit after the circuit has been deenergized by a primary protective device, such as a recloser or reclosing circuit breaker. After the fault has been isolated, the rest of the circuit can be returned to service.

**Design and application**

A sectionalizer cannot interrupt faults but can be closed in against them without being damaged. It senses the overcurrents which are interrupted by the backup protective device and will open during the first, second, or third open interval of the circuit. Since the sectionalizer does not require a time-current base for its operation, it is easily coordinated with other protective devices on the system. It provides an additional step of protection without adding a coordinating step to the protective scheme.

Because it has no time-current characteristic, a sectionalizer has distinct application advantages.

- It can be applied between two protective devices having operating curves which are close together. This is a vital feature in a location where an additional step in coordination is not practical or possible.
- It can be used on close-in taps where high available fault current prevents coordination with fuses.

Types GV and GW electronically controlled sectionalizer

Sectionalizers are automatically controlled circuit-opening devices which isolate a faulted portion of a circuit after the circuit has been deenergized by a primary protective device, such as a recloser or reclosing circuit breaker. After the fault has been isolated, the rest of the circuit can be returned to service.

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A sectionalizer cannot interrupt faults but can be closed in against them without being damaged. It senses the overcurrents which are interrupted by the backup protective device and will open during the first, second, or third open interval of the circuit. Since the sectionalizer does not require a time-current base for its operation, it is easily coordinated with other protective devices on the system. It provides an additional step of protection without adding a coordinating step to the protective scheme.

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- It can be used on close-in taps where high available fault current prevents coordination with fuses.

**Types GV and GW electronically controlled sectionalizer**

- **TYPE GV**
  - 14.4 kV

- **TYPE GW**
  - 34.5 kV

Cooper Power Systems by Eaton

Effective May 2014
Supersedes May 2002
Sectionalizers provide several advantages over fuse cutouts. In addition to application flexibility, they offer safety and convenience. After a permanent fault, the fault-closing capability of the sectionalizer greatly simplifies testing the circuit and, if the fault is still present, interruption takes place safely at the backup recloser. Replacement fuse links are not required; thus the line can be tested and service restored with far more speed, convenience, and economy. Also the possibility of error in the selection of the right size and type of replacement fuse link is eliminated.

To improve service continuity and provide more reliable coordination with backup protective devices, the Type GV and GW sectionalizers include the following operating features:

**Ground-fault sensing** – enables the sectionalizer to coordinate with ground fault tripping reclosers or breakers.

**Inrush-current restraint** – prevents false counting due to inrush currents that may occur when a circuit is reenergized.

**Count-restraint** – prevents counting overcurrents interrupted by downline protective devices.

**Count reset** – provides fast reset of the sectionalizer count memory after successful circuit recloser to better coordinate with backup protective devices.

**Ordering information**

When ordering Type GV or GW sectionalizers, include catalog number and description of basic sectionalizer and the phase and ground minimum-actuating-current plug-in resistors. Also specify the operating settings of the sectionalizer if accessories and/or mounting equipment are required, specify by catalog number and description.

**Basic sectionalizer**

Specify sectionalizer catalog number:
- Type GV sectionalizer KGVA
- Type GW sectionalizer KGWA

**Minimum-actuating-current**

Specify minimum-actuating-current resistors by catalog number:
- Phase minimum-actuating-current resistor KA176GV
  (Select from 16, 24, 40, 56, 80, 112, 160, 224, 256, 296, 320, 448, 480 or 640 amps)
- Ground minimum-actuating-current resistor KA177GV
  (Select from 3.5, 7, 16, 20, 28, 40, 56, 80, 112, 160, 224, 320 amps or BLO [Block])

**Operating settings**

Specify the following operating settings:
1. Number of counts to open: 1, 2, or 3.
2. Count reset time: 15, 30, 60, 90, 120, or 180 seconds.

**Accessories**

Sectionalizer accessories are listed in Table 1 by description and catalog number. They are applicable to both Types GV and GW sectionalizers unless otherwise noted.

**Mounting equipment**

Sectionalizer hangers are listed in Table 2 by description and catalog number.

**Summary of ratings**

The Type GV and GW electronically controlled, manually closed, three-phase sectionalizers are rated as follows:
- Type GV – 14.4 kV nominal, 400 amps continuous, 110 kV BIL
- Type GW – 34.5 kV nominal, 400 amps continuous, 150 kV BIL

The continuous current rating is independent of the minimum actuating current setting of the sectionalizer control. Also, the operating settings do not affect the capability of the sectionalizers to withstand the full short-circuit rating of 15,000 amps asymmetrical. Both units have a maximum interrupting rating of 880 amps.
Features and detailed description

Sectionalizers are an economical method of further improving service on distribution lines equipped with reclosers or reclosing circuit breakers. They isolate permanent faults and confine outages to smaller sections of line.

Sectionalizers are applied on the load side of a fault-interrupting device and count its fault-trip operations. They open during the first, second, or third open interval of the fault-interrupting device, depending upon the coordination scheme selected. Sectionalizers are not designed to interrupt fault currents. They can, however, be closed in against a fault. The sectionalizer can forget counts that do not reach its counts-to-open setting due to clearing of temporary faults.

When properly applied, a sectionalizer will respond to downline fault currents that are interrupted by its backup protective device. However, as with any other protective device, system conditions may produce unexpected and unwanted sectionalizer operation. Overcurrents interrupted by a downline device are one cause for these occurrences; inrush current is another. Count restraint and inrush-current-restraint features are built into the electronic control to block the sectionalizer’s response to these system conditions.

All three phases of the sectionalizer are actuated by a common shaft connected to an actuator located in an external cabinet which also houses the control. In both Type GV and GW sectionalizers, fault currents are sensed by internally mounted, 1000:1 ratio, bushing-type current transformers.

Phase and ground minimum-actuating-current levels are determined by individual plug-in type resistors. All other operating parameters are selected by means of programmable selector switches located on the control circuit board.
Figure 2. Internal details of Type GV sectionalizer.

Figure 3. Internal details of Type GW sectionalizer.
Figure 4. Operating mechanism and electronic control.
Description of operation

Mechanical operation

The sectionalizer consists of three sets of oil-insulated contacts linked with bell-cranks to a common shaft which is connected to the mechanism housed in the operator cabinet. Opening is initiated by a low-energy tripper mechanism operated by the electronic control. Actual opening energy is provided by springs which are charged when the sectionalizer is manually closed. Closed and open positions are indicated by a red pointer-like flag; contact opening operations are registered on a three-digit counter both are located under the sleet hood of the operator cabinet.

The sectionalizer is manually closed by pulling down the spring-biased, gray, pull ring 12 to 14 times with a hookstick (Figures 5 and 7). The sectionalizer can be manually opened by operating the yellow pull ring once (Figures 5 and 6). Both rings are clearly labeled. The sectionalizer can be programmed to open on the first overcurrent count by pulling down the one-count-to-open lever located underneath the operator cabinet between the two pull rings (Figures 5 and 8).

![Figure 5. Operating controls on bottom of operator cabinet.](image)

Figure 6. Opening sectionalizer with hookstick.

Figure 7. Closing sectionalizer with hookstick.

Figure 8. Operating one-count-to-open lever with hookstick.
**Electronic control operation**

A functional block diagram of the electronic circuitry is shown in Figure 9.

Current flowing through the sectionalizer is sensed by the bushing-current transformers. Three transformers connected in a wye (star) configuration sense phase currents. Another three bushing-current transformers connected in parallel sense the ground (earth) or zero-sequence current. These signals are rectified and are adjusted to the desired minimum-actuating-current level by the selection of the proper plug-in resistors.

To generate and register a count pulse, a current above the preset-minimum-actuating level must be flowing through the sectionalizer (downline fault) and this overcurrent must drop to zero (fault interrupted by the backup protective device). The pulse counter provides storage for up to three pulses. Depending upon the counts-to-open setting, the tripping circuit will turn on after one, two, or three count pulses have been registered. When turned on, the tripping circuit completes the discharge path for the trip-energy-storage capacitors through the coil of the low energy tripper which, in turn, trips the sectionalizer mechanism to open the sectionalizer contacts.

The pulse count reset will erase any stored pulse counts whenever load current through the sectionalizer flows without interruption for longer than the reset time programmed.

A count-restraint feature is built into the control of Types GV and GW sectionalizers to prevent the sectionalizer from counting fault currents interrupted by a downline protective device. The current restraint will block the generation of a count pulse as long as at least 5 amps of load current is flowing through the sectionalizer after the disappearance of fault current.

The control is also equipped with an inrush-current restraint feature which distinguishes between inrush current and fault current by a logic circuit functionally diagrammed in Figure 10.

If an overcurrent is present through the sectionalizer when the backup protective device opens (current is interrupted), the overcurrent present upon reclosing is assumed to be fault current and the sectionalizer operates in the normal manner as previously described. If, however, there is no overcurrent detected by the sectionalizer when the current is interrupted, the overcurrent present upon reclosing is assumed to be inrush current. To prevent the sectionalizer from counting this inrush current, the fault level detector circuit is modified to block the phase and ground actuating levels for a time of three seconds after current flow through the sectionalizer is restored. Upon expiration of this time, the sectionalizer control returns to normal operating settings.
The control is powered by the load and/or fault current flowing through the sectionalizer which also charges the trip energy storage capacitors. For most cases the charging time of the capacitors (Figure 11) is less than the clearing time of Eaton’s Cooper Power Systems three-phase reclosers with which the GV-GW sectionalizers are designed to coordinate. Some recloser fast trip curves may have a faster clearing time at their low current end than the capacitor charging time. These exceptions are listed in Table 3 (Phase Trip Coordination) and Table 4 (Ground Trip Coordination).

For these exceptions a voltage charging feature is built into the sectionalizer control as standard which requires a 120-Vac auxiliary power source (25 w min). The potential charger will fully charge the trip capacitor in less than 25 milliseconds (approximately 1-1/2 cycles).

Proper coordination between the sectionalizer and its backup protective device can be verified by plotting the charge time of the trip-energy-storage capacitors (Figure 11) against the clearing time curve of the backup device. Note that the capacitor charge time curve is plotted in amps, not percent of minimum trip.

**Voltage-restraint feature**

When energized at 120 Vac, the voltage charging board provides fast charging times for the trip energy storage capacitors. It also acts as a voltage restraint; the sectionalizer will not count an overcurrent interruption of the protective device unless the voltage at the control is also interrupted.
Count-restraint feature
The count-restraint feature blocks the sectionalizer from generating a count pulse as long as some load current flows through the sectionalizer. Thus the sectionalizer does not count or operate when a load-side device interrupts the overcurrent.

In a typical application, the sectionalizer is located between two reclosers as shown in Figure 12.

For a fault (F1) beyond the load-side recloser (ACR2), only the load-side recloser operates. The sectionalizer does not generate a count because the load current through the sectionalizer is not interrupted. For a load-side fault (F2) interrupted by the source-side recloser (ACR1) the sectionalizer counts the fault interruption since the load current through the sectionalizer is interrupted.

The count-restraint feature is designed to operate with a minimum of 5 amps load current through the sectionalizer. It is a standard feature of Types GV-GW electronically controlled sectionalizers.

Inrush-current-restraint feature
A principal cause for unwanted sectionalizer operation is inrush current. For a fault on the downline side of the sectionalizer interrupted by the backup device, the sectionalizer will generate and register a count pulse in the normal manner. If the fault is interrupted by a downline protective device, the count-restraint feature will block the generation of a count pulse if at least 5 amps of uninterrupted load current flows through the sectionalizer.

For a fault on the source side of the sectionalizer (Figure 13), the backup device will trip and deenergize the circuit. However, if upon circuit reenergization, the inrush current through the sectionalizer is greater than its minimum-actuating-current setting, a second trip operation of the backup device will defeat the count-restraint feature (load current is interrupted) and cause the sectionalizer to generate and register a count.

The inrush-current-restraint feature distinguishes between inrush current and fault current by means of a logic circuit previously described under Electronic Control Operation. It prevents false counting and operation of the sectionalizer due to inrush currents through the sectionalizer during operation of the source-side protective device for faults on other parts of the circuit.

Response-time feature
For backfed motor contribution and unsymmetrical clearing of upline faults, a response time is built into the sectionalizer control to eliminate unwanted counting of these situations. Upon detection of any current above the phase or ground actuating setting, the current must exceed the response-time characteristics as illustrated in Figure 14. Total clearing time of reclosers and breakers must exceed the response time characteristic of the sectionalizer.

Figure 12. Sectionalizer located between two reclosers.

Figure 13. Sectionalizer with source-side fault.

Figure 14. Maximum response-time characteristics.
Application requirements

The following basic coordinating principles should be observed in the application of the electronically controlled sectionalizer.

1. The minimum actuating current setting of the sectionalizer should be no greater than 80 percent of the minimum trip current setting of the backup recloser or reclosing breaker for both phase and ground currents.
2. The counts-to-open setting of the sectionalizer must be at least one less than the number of operations to lockout of the backup device.
3. The count reset time of the sectionalizer control must be greater than the reset time of the backup protective device.
4. The minimum clearing time of the backup device must be greater than the charging time of the trip-energy storage capacitors to assure that the capacitors are fully charged before the backup trips. See Minimum Actuating Current.
5. To operate the count-restraint feature, a minimum of 5 amps of load current must normally flow through the sectionalizer.
6. The momentary and short time ratings of the sectionalizer must not be exceeded.
7. Three-phase sectionalizers must be used with backup breakers or reclosers in which all three phases open simultaneously. The counting functions of the sectionalizer do not recognize a signal as originating in a particular phase, but totals the overcurrent interruptions in all three phases. Nonsimultaneous three-phase tripping of the backup could result in the sectionalizer interrupting fault current in one or more phases.
8. Application on multigrounded wye systems generally requires ground fault sensing and inrush-current-restraint. Setting the phase actuating level to the ground setting of the backup device may result in erroneous counts due to inrush currents and incorrect opening of the sectionalizer for source-side faults.
9. Ground fault actuating settings should be set at or above peak loading at the sectionalizer location. This will prevent sectionalizer sensing system unbalance during upline phase-to-ground faults which generate system imbalances.

Application of inrush-current-restraint

Sectionalizers can be applied where the main feeder is divided into two feeders close to the substation as shown in Figure 15. Here, loads are likely to be reasonably equally divided. Sectionalizers may also be applied to protect an important branch which may be carrying only a small portion of the total load as shown in Figure 16. The inrush current restraint has been designed to provide optimum protection from in rush currents. No settings are required as pick-up values will be blocked during inrush conditions. This allows flexibility in the application without concern for increased connected loading on the system.

The sectionalizer is blocked for three seconds to allow for decay of magnetizing inrush, system imbalance, and initial inductive loading after long reclose intervals.

Sectionalizer settings

For proper operation the following operating settings must be specified.

3. Number of counts to open.
4. Reset time.

All operating settings are programmed on the control circuit board in the operator mechanism cabinet (Figure 17).

Figure 15. Sectionalizer application where two feeders of system are protected.

Figure 16. Sectionalizer application where one branch system is protected.
Minimum actuating current

To assure that the sectionalizer will sense and count every overcurrent trip operation of its backup protective device, the minimum actuating current settings for phase and ground should be approximately 80% of the comparable minimum trip values of the backup device. However, in a few instances the lower current end of the backup recloser’s fast trip curve may be faster than the charging time of the trip energy storage capacitor and proper coordination may not be attained.

The minimum trip levels of the recloser fast curves in question and the comparable minimum actuating levels at which recloser-sectionalizer coordination can be attained are listed in Tables 3 and 4. Below these levels the sectionalizer may not count the fast trip operations.

Coordination below the levels shown in Tables 3 and 4 can be achieved by energizing the potential capacitor charger. With 120-Vac auxiliary power supplied to the sectionalizer, the trip capacitors are fully charged in less than 25 milliseconds (approximately 1-1/2 cycles). The potential capacitor charger, and its 120-Vac input plug and receptacle are standard features of the sectionalizer.

The minimum-actuating-current level is determined by plug-in resistors on the printed circuit board of the electronic control (Figure 17).

The available minimum actuating current level values for both phase and ground have been selected to coordinate with the more popular recloser trip settings. For phase sensing, the following values are available: 16, 24, 40, 56, 80, 112, 160, 224, 256, 296, 320, 448, 480, and 640 amps. For ground sensing, the following values are available: 3.5, 7, 16, 20, 28, 40, 56, 80, 112, 160, 224, and 320 amps. Each resistor is labeled and its function (phase or ground) and with its minimum trip rating in amps.

*Note:* If the backup does not include ground fault tripping, a dummy plug-in resistor, labeled BLOCK, is used to deactivate the ground sensing circuit of the sectionalizer control. See ordering Information for proper catalog number.

Number of counts to open

The number of counts to open the sectionalizer should be no more than one less than the number of trips to lockout of the backup device. One, two, or three counts are available. This setting is determined by the position of the COUNTS TO OPEN selector switch (Figure 17).

Count reset

This feature resets to zero any accumulated counts whenever current below the minimum trip level flows through the sectionalizer uninterrupted for longer than the programmed time. Count reset will operate with any current flow from minimum load (5 amps) to minimum actuating. To properly coordinate with its backup, the count reset time selected must be greater than the reset time of the backup.

Reset times of 15, 30, 60, 90, 120 and 180 seconds are available. This setting is determined by the position of the COUNT RESET selector switch (Figure 17).

*Note:* The count will also reset to zero whenever the sectionalizer is opened either manually or automatically.
### Table 3. Phase Trip Coordination

<table>
<thead>
<tr>
<th>Recloser Type</th>
<th>Recloser Minimum Trip Current (amps)</th>
<th>Sectionalizer Minimum Actuating Current (amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R, RX, RV, W, WV, VW, VWW</td>
<td>100—“A” Curve</td>
<td>80</td>
</tr>
<tr>
<td>RE, RXE, RVE, WE, WVE, VWE, VWVE</td>
<td>100—“A” Curve</td>
<td>80</td>
</tr>
</tbody>
</table>

### Table 4. Ground Trip Coordination

<table>
<thead>
<tr>
<th>Device</th>
<th>Minimum Trip Current (amps)</th>
<th>Sectionalizer Minimum Actuating Current (amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic recloser with KA1144R or KA1219R* electronic ground trip accessory</td>
<td>100—“1” Curve</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>50—“2” Curve</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>20—“3” Curve</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>10—“4” Curve</td>
<td>7</td>
</tr>
<tr>
<td>Electronic recloser with ground trip on ME control</td>
<td>100—“1” Curve</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>50—“4” Curve</td>
<td>40</td>
</tr>
</tbody>
</table>

*Inverse curves must be compared to Figure 12 for proper coordination.

### Ratings and specifications

### Table 5. Basic Sectionalizer Ratings

<table>
<thead>
<tr>
<th>Nominal voltage (kV)</th>
<th>Type GV</th>
<th>Type GW</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.4</td>
<td></td>
<td>34.5</td>
</tr>
<tr>
<td>Maximum design voltage (kV)</td>
<td></td>
<td>15.5 38.0</td>
</tr>
<tr>
<td>Impulse withstand 1.2 x 50 microsecond wave (BIL) (kV)</td>
<td>110</td>
<td>150</td>
</tr>
<tr>
<td>60 Hz withstand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry, 1 minute (kV)</td>
<td>50</td>
<td>70</td>
</tr>
<tr>
<td>Wet, 10 seconds (kV)</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td>Continuous current rating (amps)</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Rated symmetrical interrupting current (amps rms)</td>
<td>880</td>
<td>880</td>
</tr>
<tr>
<td>Rated making current, asymmetrical (amps rms)</td>
<td>15000</td>
<td>15000</td>
</tr>
<tr>
<td>Short-time ratings (amps rms)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-seconds symmetrical</td>
<td>3500</td>
<td>3500</td>
</tr>
<tr>
<td>1-second symmetrical</td>
<td>10000</td>
<td>10000</td>
</tr>
<tr>
<td>Momentary maximum, asymmetrical (amps rms)</td>
<td>15000</td>
<td>15000</td>
</tr>
<tr>
<td>Creepage distance, standard bushing (in.)</td>
<td>11</td>
<td>26-1/2</td>
</tr>
</tbody>
</table>

### Table 6. Operating Data

| Phase-minimum-actuating current (amps) | 16, 24, 40, 56, 80, 112, 160, 224, 256, 296, 320, 448, 480, 640 |
| Ground-minimum-actuating current (amps) | 3.5, 7.16, 20, 28, 40, 56, 80, 112, 160, 224, 320, BLOCK |
| Number of counts to open | 1, 2, 3 |
| Count reset (seconds) | 15, 30, 60, 90, 120, 180 |
Dimensional information

Figure 18. Type GV sectionalizer.

Figure 19. Type GW sectionalizer.
Figure 20. Mounting hardware for Type GV sectionalizer.
Figure 21. Type GW sectionalizer in KA146W3 suspension hanger.
Types GV and GW electronically controlled sectionalizer

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Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Eaton's Cooper Power Systems Business
2300 Badger Drive
Waukesha, WI 53188
United States
Cooperpower.com

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