Type CW Power Relay

Application
The CW power relay is a self-contained single-phase induction-disc type relay used to detect excessive or reverse power flow. It is designed to operate at rated voltage. Consequently, it is not intended to be a fault-detecting relay, since voltage under fault conditions is generally of reduced value.

Two types are available: one for single-phase application, the other for three-phase application.

Single-Phase Application: The CW relay for single-phase application uses line voltage and line current. It operates on single-phase watts, with maximum torque occurring when the voltage and current are in phase.

Three-Phase Application: The CW relay for three-phase application uses phase-to-phase voltage and line current, with maximum torque occurring when the relay current leads the relay voltage by 30°. It operates when the volt-ampere product (with current leading the voltage applied to the relay by 30°) exceeds the setting of the relay. One CW relay is required for balanced three-phase systems, and three are required for unbalanced conditions.

Both CW relay types are self-contained (requiring no external reactors), and are available for 120 or 208 volt systems.

Single-Phase Application
This relay operates on single-phase watts. The power to operate it equals the primary single-phase power divided by the current and potential transformer ratios. This relay power, expressed as multiples of the selected tap watts, locates a point on the abscissa of the time-power curves (Figures 1 and 2). The relay operating time for various time dial settings can be then observed on the ordinate.

Example:
Assume: Current transformer ratio, $R_c = 200:5 \approx 40:1$  
Potential transformer ratio, $R_p = 2400:120 \approx 20:1$  
Unity power factor, $\cos \phi = 1.0$  
Primary current, $I_p = 200$ amperes  
Primary voltage, $E_p = 2400$ volts

Single phase primary power  
$$ P = \frac{E_p I_p \cos \phi}{(2400)(200)} \approx 480,000 \text{ watts} $$
Calculating secondary watts available to operate the CW relay:

primary watts: \( P_R \)
secondary watts: \( P_{\text{sec}} \)

Using the 20-120 watt relay (single-phase application) on the 100 watt tap yields

\[ \frac{600}{100} = 6 \text{ multiples of tap watts} \]

Referring to Figure 1, a time dial setting of #2 yields an operating time of 0.43 second.

**Three-Phase Application**

The CW relay for three-phase system application has taps which represent system secondary three-phase watts divided by \( \sqrt{3} \) above which the relay will operate. Consider a three-phase system with 2400 volts line-to-line and having the same \( P_R, R \), current and power factor as in the single-phase example.

\[ P_{\text{sec}} = \frac{\sqrt{3}}{2} \times 2400^2 \times 0.8 \]

\[ P_{\text{sec}} = 631.4 \text{ secondary watts} \]

To obtain relay response, this value is divided by \( \sqrt{3} \):

\[ P = \frac{631.4}{\sqrt{3}} \]

Using 120 watt tap of the 20-120 watt, 120 volt relay, the multiple of tap value would be:

\[ \frac{600}{120} = 5 \]

Figure 1 shows an operating time of 0.52 seconds on the #2 dial setting.

**Construction Features**

Out-of-phase air gap fluxes create the necessary operating torque. Since the voltage is independent of the direction of power flow, disc rotation is determined by the direction of line current flow.

**Single-phase application:** The CW relay for single-phase application has a capacitor in parallel with the potential coils and a reactor in series with the parallel combination of capacitor and potential coils, to create a maximum torque angle when the relay current leads the relay voltage by 30° at system unity power factor.

**Three-phase application:** The CW relay for three-phase application has a reactor in series with the electromagnet potential coils to create maximum torque angle when the relay current leads the relay voltage by 30° at system unity power factor.

1. Tap Block
   Watt values indicated on the tap block are the minimum number of single-phase watts required to operate the relay.

2. Time Dial
   Time settings from indexed positions #6 to #11 provide variable operating time values as shown on the time-power curves, Figures 1 and 2.

3. Damping Magnet
   A high strength alnico magnet controls relay operating time at low values of operating current.

4. Moving Contact
   Made of silver and clamped to insulated portion of the induction disc shaft. Electrical connection is made through the spiral spring from the moving contact through the spring adjuster frame to the relay terminal.

The contacts will close 30 amperes at 250 volts dc.

5. Indicating Contactor Switch (ICS)
   The dc indicating contactor switch unit is a small clapper type device having a magnetic armature to which leaf-spring mounted contacts are attached. The armature is attracted to the core when the coil is energized at or above pick-up value, causing the moving contact to bridge two stationary contacts, completing the trip circuit. The ICS contacts are connected in parallel with the main relay contacts, and relieve them of carrying heavy trip currents. The main relay contacts will close 30 amperes at 250 volts dc, and the ICS contacts will safely carry this current long enough to trip a circuit breaker.

6. Spare Tap Screw
   To avoid open-circuiting current transformers when changing from one value to another, the spare tap screw is inserted into the desired new tap before the other is removed.

7. Stationary Contact
   Made of silver, with sufficient wipe to assure positive contact. On double trip relays, vernier adjusting screws are provided on the stationary contact assembly to provide the desired contact wipe.

8. Contact Plate
   In fast breaker reclosing schemes which require quick-opening relay contacts, the metal contact plate is reversed to hold the stationary contact fixed against the back-stop.

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Setting

Product Unit

Two adjustments are required to set the CW relay:

1. Selection of the desired current tap on the electromagnet.

2. Setting of the time dial for the required time of operation as shown on the time-power curves, Figures 1 and 2.

CW Relay (Single Phase)
The power to operate the relay equals the primary power divided by the current and potential transformer ratios.

Potential Coil Ratings
CW relay potential circuits will withstand 110% of rated voltage, continuously.

CW Relay (Three Phase)
The CW relay for three-phase applications has taps which represents single phase watts multiplied by \( \sqrt{3} \). The power to operate the relay equals the three phase primary power divided by the quantity \( \sqrt{3} \) times the current and potential transformer ratios.

| TAP \ R,R, \ P3φ \ 3 R,R, |

Shipping Weights and Carton Dimensions

<table>
<thead>
<tr>
<th>CW Relay</th>
<th>Flexitest Case Size</th>
<th>Weight, Lbs. (kg)</th>
<th>Approx. Net</th>
<th>Shipping</th>
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<tbody>
<tr>
<td>Single Phase</td>
<td>FT-21</td>
<td>11 (5)</td>
<td>14 (6.4)</td>
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</tr>
<tr>
<td>Three Phase</td>
<td>FT-11</td>
<td>7 (3.2)</td>
<td>10 (4.5)</td>
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</tr>
</tbody>
</table>

Domestic Shipping Carton Dimensions: Inches (mm)
- Single Phase: 9 x 12 x 13 (229 x 305 x 330)
- Three Phase: 9 x 9 x 10 (229 x 229 x 254)
External Wiring of One Type CW Relay on a Single Phase System

Figure 3  184A810

External Wiring of 3 Type CW Relays on a Three Phase System
Note: For Balanced 3-Phase Conditions, Only One Relay is Required.

Figure 4  184A811

Device Chart Number
32—directional power relay, Type CW
52—power circuit breaker
ICS—indicating contactor switch
a—breaker auxiliary contact
TC—breaker trip coil

Further Information
List Prices: PL 41-020
Technical Data: TD 41-025
Instructions:
Single Phase Application, IL 41-241.2
Three Phase Application, IL 41-241.3
Renewal Parts: RPD 41-926
Flexiflex Case Dimensions: DB 41-076
Contactor Switches: DB 41-081
Other Protective Relays:
Application Selector Guide, TD 41-016

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### Type CW Power Relay

#### Over or Reverse Power (Device Number: 32)

<table>
<thead>
<tr>
<th>Type</th>
<th>Application and Relay Rating</th>
<th>Contacts</th>
<th>Indicating Contactor Switch</th>
<th>Maximum Torque Angle</th>
<th>Relay Data</th>
<th>Case Size</th>
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<tbody>
<tr>
<td>Single unit relay</td>
<td>Vols Single Phase</td>
<td>Volts Line to Line</td>
<td>Three Phase Volts W's</td>
<td>3</td>
<td>183A773</td>
<td>2898988A09</td>
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<td>120-20-120</td>
<td>100-600</td>
<td>20-120</td>
<td>183A774</td>
<td>2898988A10</td>
<td>FT-11</td>
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<td>120-20-120</td>
<td>100-600</td>
<td>20-120</td>
<td>183A775</td>
<td>2898988A11</td>
<td>FT-12</td>
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<td>120-20-120</td>
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<td>20-120</td>
<td>183A776</td>
<td>2898988A12</td>
<td>FT-13</td>
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<td></td>
<td>120-20-120</td>
<td>100-600</td>
<td>20-120</td>
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<th>Indicating Contactor Switch</th>
<th>Maximum Torque Angle</th>
<th>Relay Data</th>
<th>Case Size</th>
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<td>Single unit relay</td>
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<td>Three Phase Volts W's</td>
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#### Over and Underpower, Three Phase (Device Number: 32)

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<th>Type and Contacts</th>
<th>Volts Line to Line</th>
<th>Amps</th>
<th>L x V</th>
<th>Maximum Torque Angle</th>
<th>Relay Data</th>
<th>Case Size</th>
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<tr>
<td>CWD&lt;sup&gt;3&lt;/sup&gt;</td>
<td>120</td>
<td>5</td>
<td>10-60</td>
<td>Without</td>
<td>188A024</td>
<td>2898332A10</td>
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<td>5</td>
<td>20-120</td>
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<td>208</td>
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<td>35-200</td>
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<tr>
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<td>208</td>
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<td>175-1000</td>
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<td>2898332A12</td>
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<tr>
<td>Spdt-cc and co</td>
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</table>

<sup>3</sup> Denotes item available from stock.
<sup>3</sup> dc relay contacts and auxiliaries, can be supplied at same price. Order 'Similar to Style Number', except 50 Hz only.
<sup>3</sup> Externally common moving contact.

<sup>3</sup> ICS indicating Contactor Switch (DC current operated) having seal-in contacts and indicating target which are actuated when the ICS coil is energized at above pickup current setting. Suitable for dc current voltages up to and including 250 volts dc. Two current ranges available: (1) 0-200 amps dc, with taped coil. (2) 1.0 amp dc, without taps.

Rating of ICS unit used in specific types of relays is shown in price tables. All other ratings must be negotiated. When ac current is necessary in a control circuit, the ICS unit can be replaced by an ACS unit. The ACS unit may be supplied in place of an ICS unit at no additional cost. Specify system voltage rating on order.