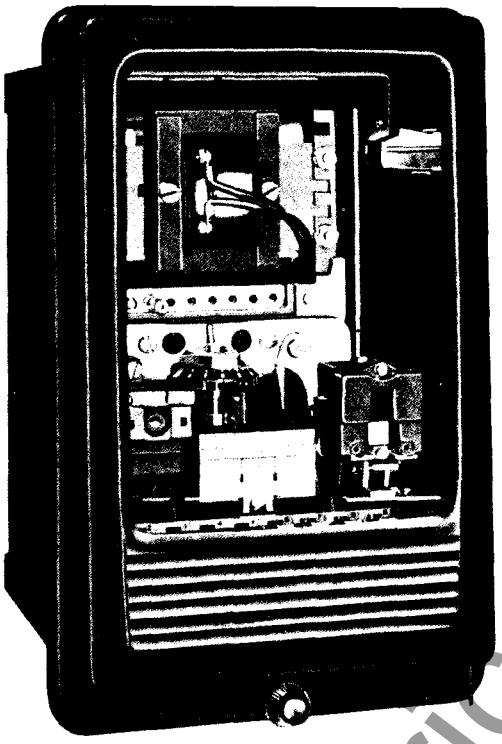
ABB Power T&D Company Inc.
Relay Division
Coral Springs, FL
Allentown, PA

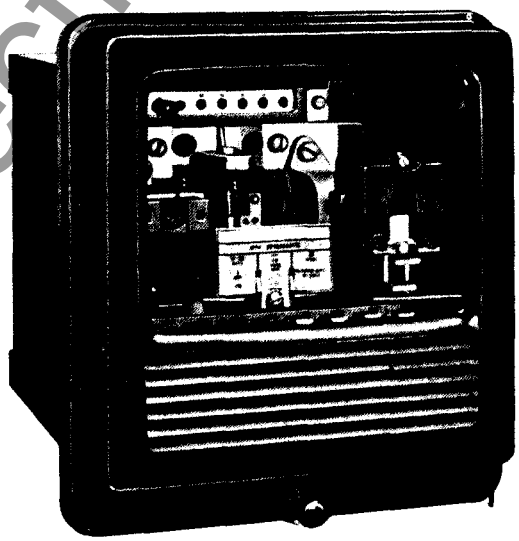
September, 1990
Supersedes DB 41-245, pages 1-4, dated June, 1989
E, D, C/41-200A

For Excessive or Reverse Power Detection
Device Number: 32

Type CW Power Relay



CW for Three Phase System Application in FT-11 Case



CW for Single Phase System Application in FT-21 Case

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,
$R_c = 200:5 = 40:1$
Potential transformer ratio,
$R_v = 2400:120 = 20:1$
Unity power factor, $\cos\theta = 1.0$
Primary current, $I = 200$ amperes
Primary voltage, $E = 2400$ volts

Single phase primary power $= E\ I \cos\theta$
$= (2400)\ (200)\ (1.0)$
$= 480{,}000$ watts

Calculating secondary watts available to operate the CW relay:

$$\frac{\text{primary watts}}{R_c R_v} = \text{secondary watts}$$

$$\frac{480{,}000}{(40)\ (20)} = 600 \text{ watts}$$

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

$$\left(\frac{600}{100}\right) = 6 \text{ multiples of tap watts}$$

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 R_v, R_c current and power factor as in the single-phase example.

$$P_{3\phi} = \sqrt{3}\ (2400)\ (200)\ \cos\phi = 831{,}400 \text{ primary watts}$$

$$P_{3\phi} = \frac{831{,}400}{(40)\ (20)} = 1039 \text{ secondary watts}$$

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

$$P = \frac{1039}{\sqrt{3}} = 600$$

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

$$m = \frac{600}{120} = 5$$

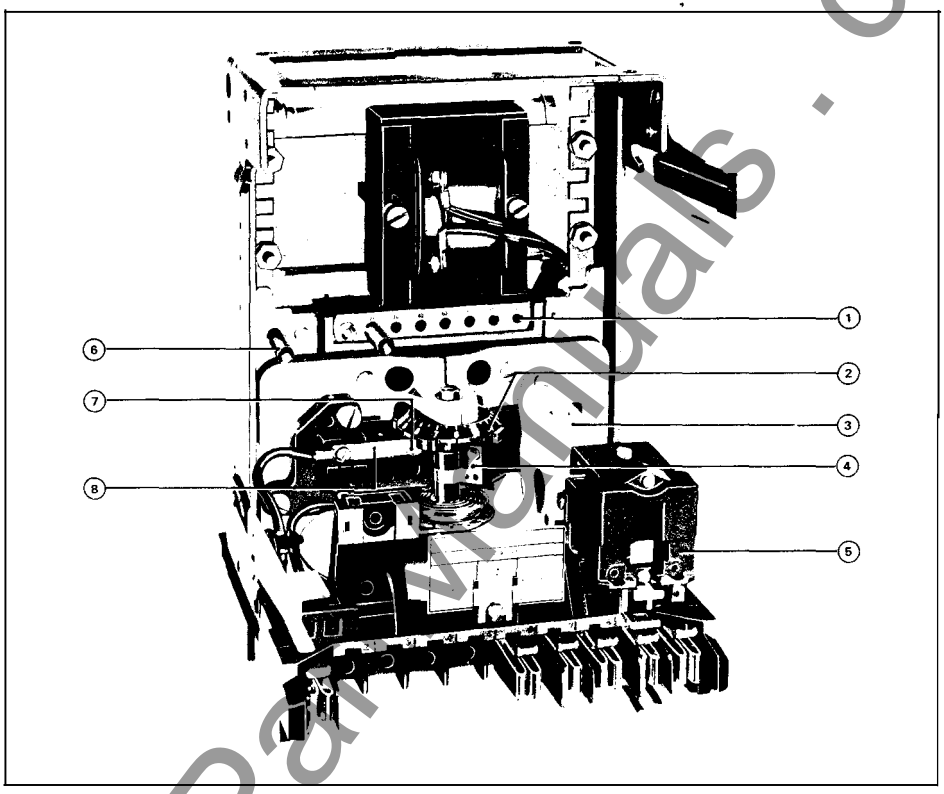
Figure 1 shows an operating time of 0.52 seconds on the #2 dial setting.

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 and voltage are in phase.

Three-phase application: The CW relay for three-phase application has a resistor 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 #½ 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.

When the ICS is energized, two fingers on the armature yolk deflect a leaf-spring located on the front of the switch, allowing the operation indicator target to drop. The target is reset external to the case by a push rod located at the bottom of the relay case cover.

Taps on the front of the relay provide connection for either 0.2 (left) or 2.0 (right) ampere dc minimum pick-up setting. When the protective relay energizes a WL relay rated 125 or 250 volts dc, the 0.2 ampere tap is recommended. The 2.0 ampere tap is used on 24 or 48 volt dc circuits.

(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 backstop.

Time Power Curves

Type CW Low Watt Relays Typical Time Curves

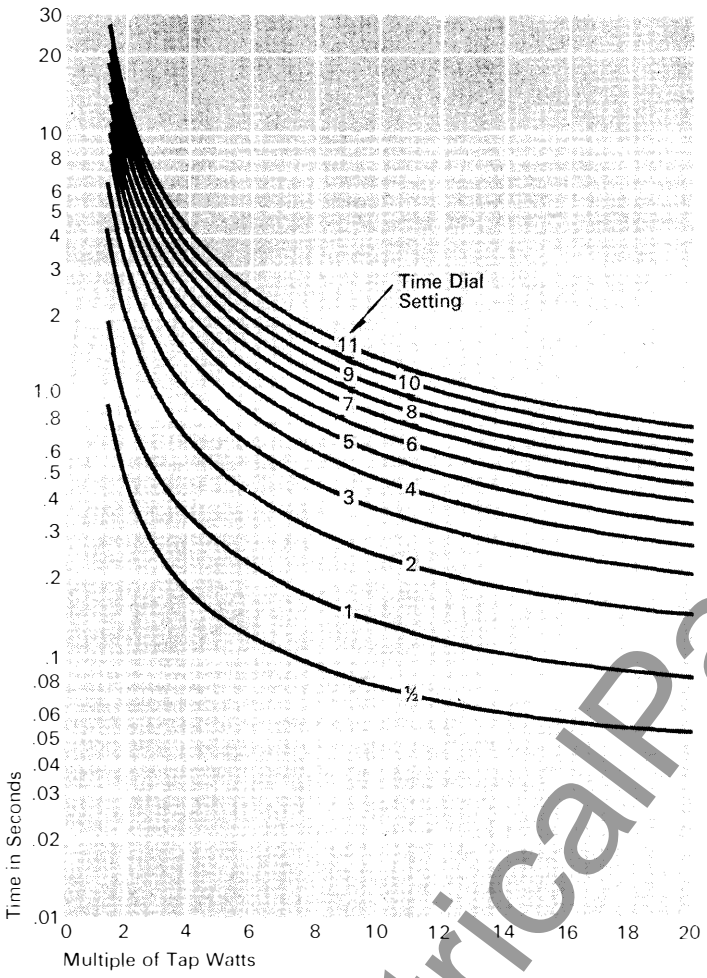


Figure 1 184A600

Type CW High Watt Relays Typical Time Curves

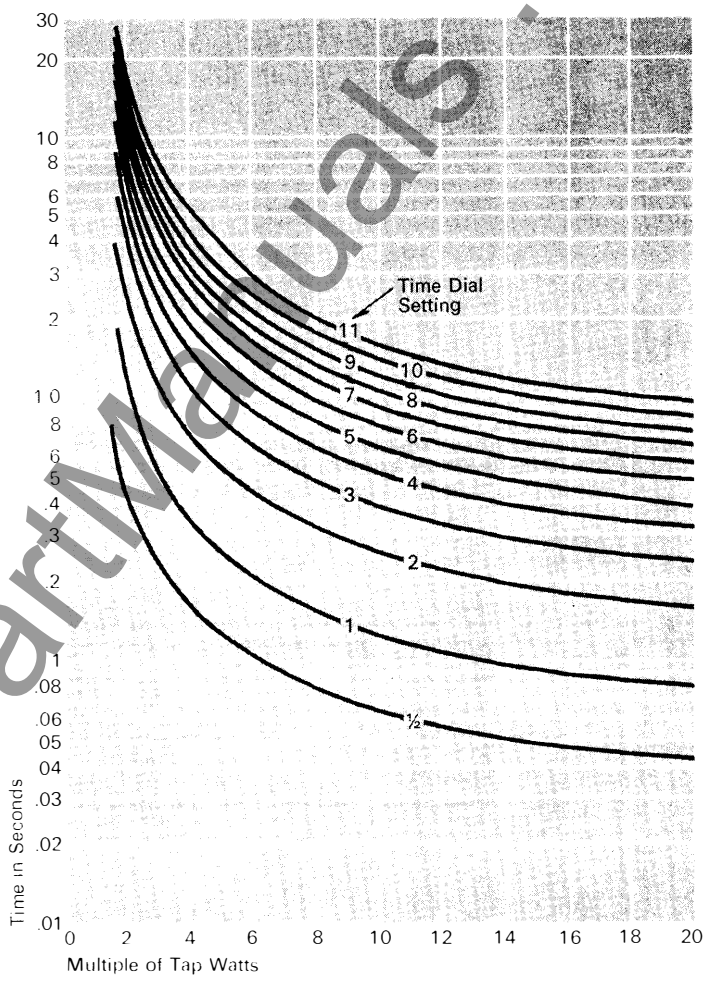


Figure 2 184A601

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.

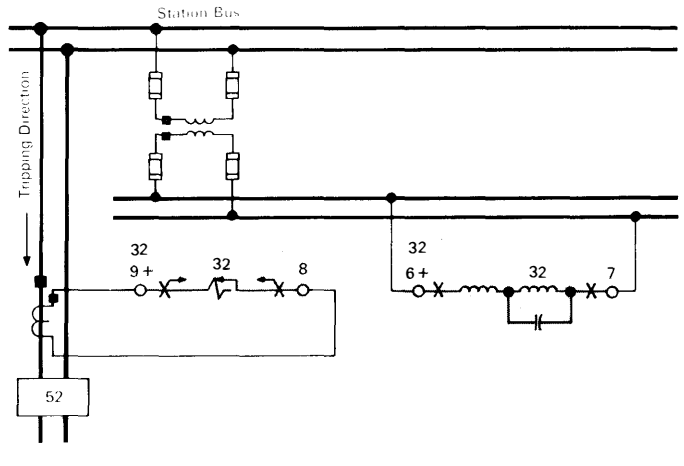
CW Relay (Three Phase)
The CW relay for three-phase applications has taps which represents single phase watts multiplied by √3. The power to operate the relay equals the three phase primary power divided by the quantity (√3 times the current and potential transformer ratios).

$$TAP = \frac{\sqrt{3}\ P1\phi}{R_t R_v} = \frac{P3\phi}{\sqrt{3}\ R_t R_v}$$

Shipping Weights and Carton Dimensions

CW Relay Application	Flexitest Case Size	Weight, Lbs., (kg) Approx. Net	Shipping	Domestic Shipping Carton Dimensions: Inches (mm)
Single Phase	FT-21	11 (5)	14 (6.4)	9 x 12 x 13 (229 x 305 x 330)
Three Phase	FT-11	7 (3.2)	10 (4.5)	9 x 9 x 10 (229 x 229 x 254)

External Wiring of One Type CW Relay on a Single Phase System



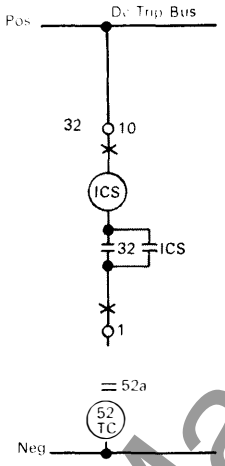
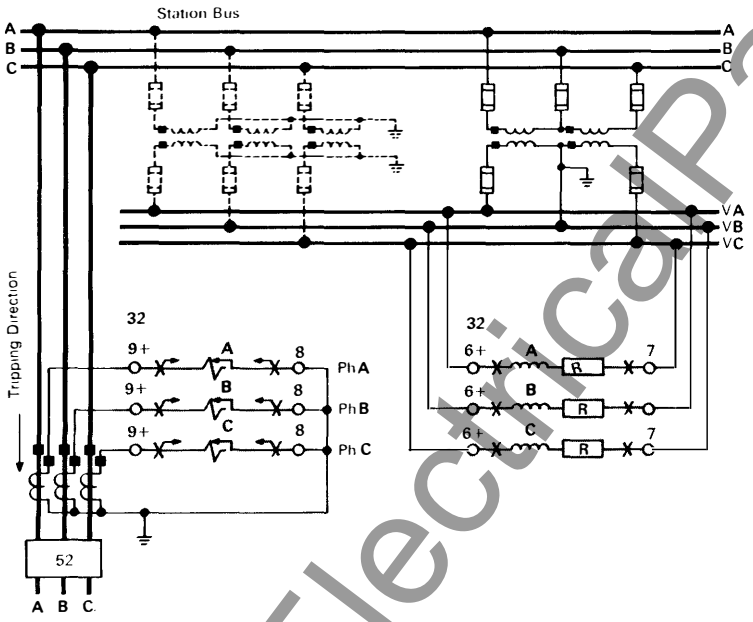


Figure 3 184A810

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

External Wiring of 3 Type CW Relays on a Three Phase System

Note: For Balanced 3-Phase Conditions,
Only One Relay is Required.



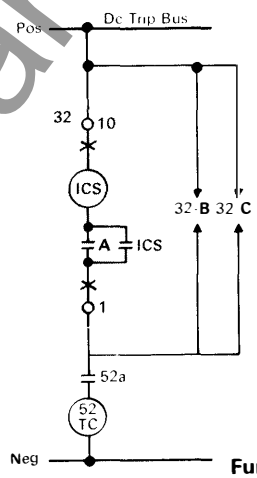


Figure 4 184A811

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
Flexitest Case Dimensions: DB 41-076
Contactor Switches: DB 41-081
Other Protective Relays:
Application Selector Guide, TD 41-016

Printed in U.S.A.

ABB Power T&D Company Inc.
Relay Division
Coral Springs, FL
Allentown, PA

December, 1990
Supersedes TD 41-020, Type CW on page 59, dated November, 1987
Mailed to: E, D, C/41-200A

For Excessive or Reverse Power Detection

Type CW Power Relay

Over or Reverse Power (Device Number: 32)

Type	Application and Relay Rating				Contacts	Indicating Contactor Switch③	Maximum Torque Angle	Relay Data		
	Single Phase		Three Phase					Internal Schematic	Style Number	Case Size
	Volts	Single Phase Watts	Volts Line to Line	Three Phase Watts/$\sqrt{3}$						
CW①	120	20-120 100-600	... ...	....	Spst-cc	0.2/2.0 amps dc	I in phase with V	183A773	289B988A09 289B988A10	**FT-21**
Single unit relay	120	20-120 100-600	... ...	....	Dpst-cc			183A744	289B988A11 289B988A12	
	... ...	....	120	20-120 100-600	Spst-cc		I leads V by 30°	183A776	289B988A17⑤ 289B988A18	**FT-11**
	...	.....	240	35-200	Spst-cc			183A776	289B988A25	
	...	.....	208	35-200 175-1000	Spst-cc			183A776	289B988A21 289B988A22	
	...	.....	120	20-120 100-600	Dpst-cc			183A554	289B988A19 289B988A20	
	...	.....	120	20-120 100-600	Spst-cc and co②	None		629A173	289B988A23 289B988A24	

Under Power (Device Number: 32)

Type	Application and Relay Rating				Contacts	Indicating Contactor Switch③	Maximum Torque Angle	Relay Data		
	Single Phase		Three Phase					Internal Schematic	Style Number	Case Size
	Volts	Single Phase Watts	Volts Line to Line	Three Phase Watts/$\sqrt{3}$						
CW①	120	20-120 100-600	... ...	....	Spst-co	0.2/2.0 amps dc	I in phase with V	184A954	289B988A14 289B988A15	**FT-21**
Single unit relay										

Over and Underpower, Three Phase (Device Number: 32)

Type and Contacts	Volts Line to Line	Amps	$I_L \times V_{L-L}$ / $\sqrt{3}$ Single Phase Watts		Maximum Torque Angle	Relay Data		
			Range	Taps		Internal Schematic	Style Number	Case Size
CWD①	120	5	10-60 20-120 50-300 100-600	Without	I leads V by 30°	188A024	292B332A18 292B332A09 292B332A11 292B332A10	**FT-11**
Spdt-cc and co		8	150-900				292B332A19	
	120	5 8	20-120 100-600	With		188A396	292B332A26 292B322A27	
	208	5 8	35-200 175-1000				292B332A28 292B332A25	

⑤ Denotes item available from stock.
① 50 Hertz relays and auxiliaries can be supplied at same price. Order "Similar to Style Number ....., except 50 Hertz".
② Electrically common moving contact.

③ **ICS:** Indicating Contactor Switch (dc current operated) having seal-in contacts and indicating target which are actuated when the ICS coil is energized at or above pickup current setting. Suitable for dc control voltages up to and including 250 volts dc. Two current ranges available:
(1) 0.2/2.0 amps dc, with tapped 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 trip 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.