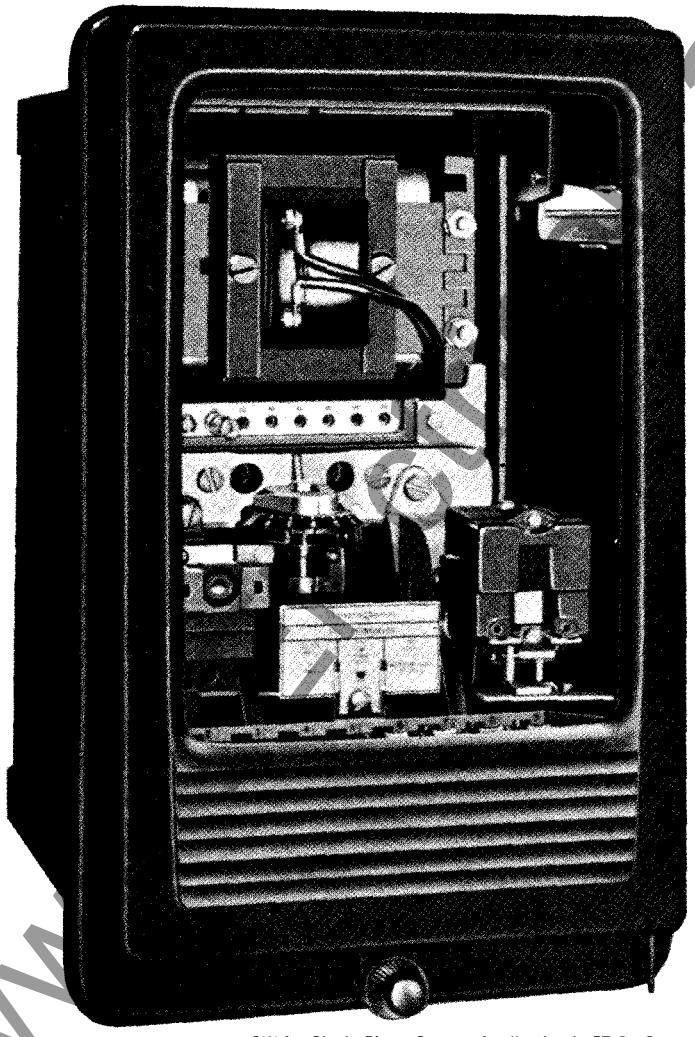
Westinghouse Electric Corporation
Relay-Instrument Division
Newark, N. J. 07101

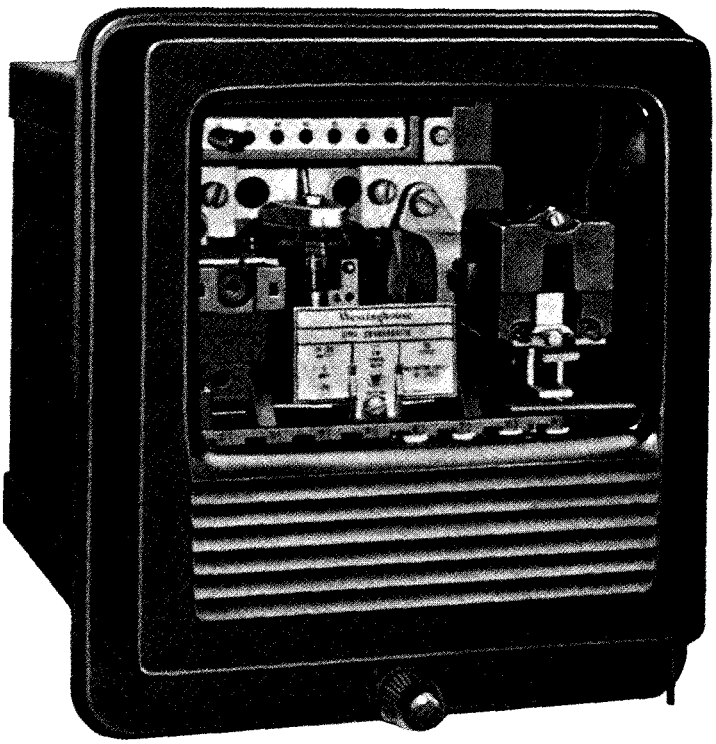
November, 1976
Supersedes DB 41-245, dated July, 1971
E, D, C/2014/DB

For Excessive or Reverse
Power Detection

Type CW Power Relay



CW for Single Phase System Application in FT-21 Case



CW for Three Phase System Application in FT-11 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.

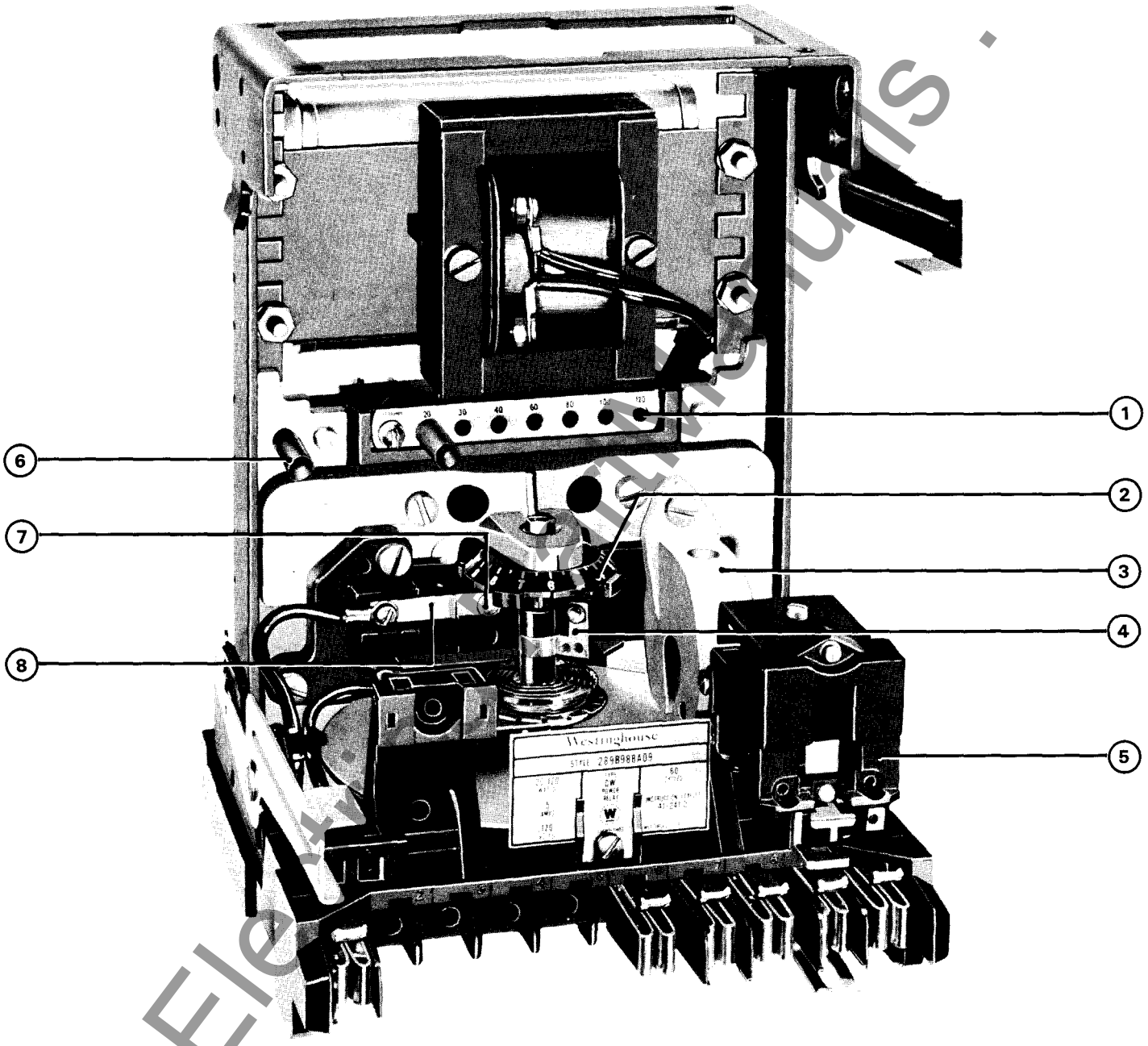
When the ICS.is energized, two figures on the armature yolk deflect a leaf-spring located on the front of the switch, allowing the operation indicator target to drop. The target is reset external to the case by a push rod located at the bottom of the relay case cover.

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

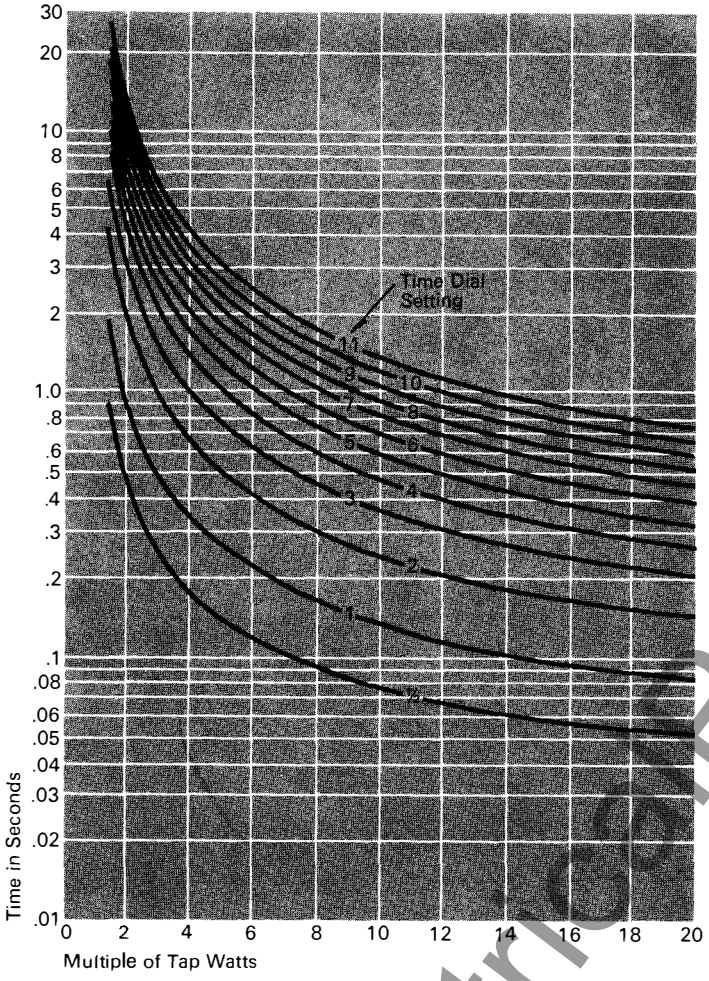


Figure 1 184A600

Type CW High Watt Relays Typical Time Curves

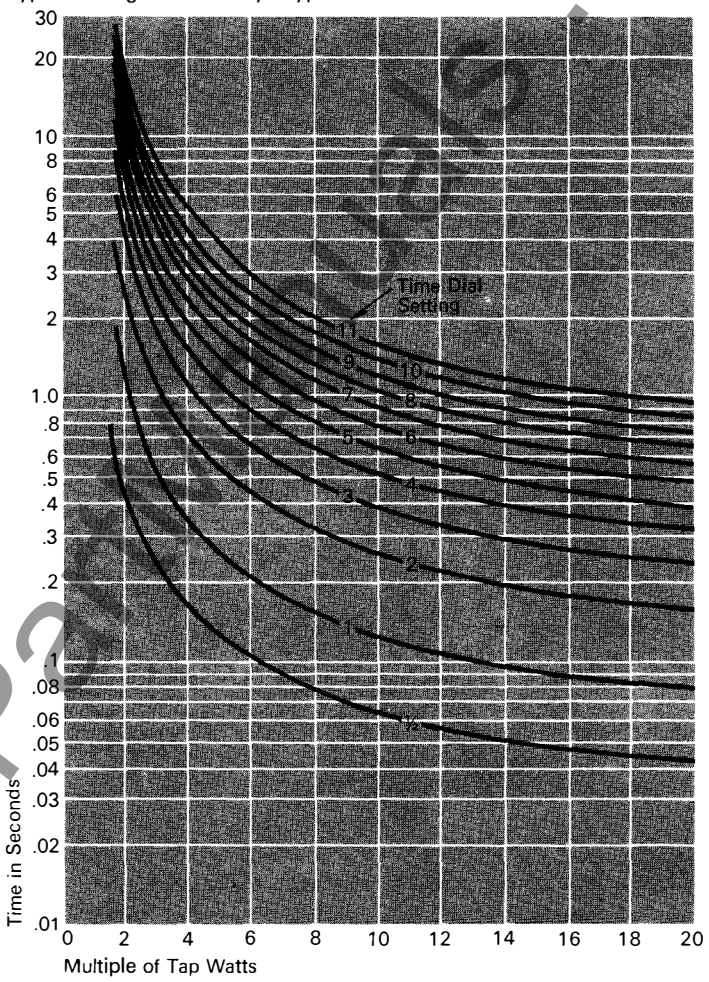


Figure 2 184A601

Setting

Product Unit

Two adjustments are required to set the CW relay:

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

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.

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 the relay equals the three phase primary power divided by the quantity ($\sqrt{3}$ times the current and potential transformer ratios).

$$TAP = \frac{\sqrt{3}\,PI\varnothing}{R_c R_v} = \frac{P3\varnothing}{\sqrt{3}\,R_c R_v}$$

Characteristic Settings

Operating Ranges

Single-Phase Application

Volts	Single-Phase Watts	
	Range	Taps
120	20-120	20- 30- 40- 60- 80-100-120
	100-600	100-150-200-300-400-500-600

Three-Phase Application

Volts: Line-Line	$\left(\sqrt{3}\ I_L V_{LL}\right)$ Single Phase Watts	
	Range	Taps
120	20-120	20- 30- 40- 60- 80-100-120
	100-600	100-150-200-300-400-500-600
208	35-200	35- 50- 70-100-140-175-200
	175-1000	175-250-350-500-700-875-1000

Burden Data on 60 Hertz

CW Relay Application	Relay Range: Watts	Potential Circuit			Current Circuit			
		Voltage	Volt-Amperes	Current Lags by:	Current	Relay Tap	Volt-Amperes	Current Lags by:
Single-Phase	20-120	120	5.4	26.5°	5 Amp	20	16.2	78°
	100-600	120	5.9	20°	5 Amp	100	5.4	67°
Three-Phase	20-120	120	17.9	60°	5 Amp	20	16.2	78°
	100-600	120	17.9	60°	5 Amp	100	5.4	77°
	35-200	208	18.8	59°	5 Amp	35	16.2	78°
	175-1000	208	18.8	59°	5 Amp	175	5.4	77°

Current Coil Ratings

Relay Range: Watts	Ac Amperes	
	Continuous	1-Second
20-120	5	230
35-200		
100-600	8	370
175-1000		

Trip Circuit Data

ICS Tap: Amps Dc	Coil Rating in Amps: Dc		Resistance in Ohms
	Continuous	1-Second	
0.2	0.4	11.5	6.5
2.0	3.2	88.0	0.15

Shipping Weights and Carton Dimensions

CW Relay Application	Flexitest Case Size	Weight, Lbs., (kg) Approx.		Domestic Shipping Carton
		Net	Shipping	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)

Potential Coil Ratings

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

Internal Wiring

For Single-Phase Application, SPST Contacts—FT-21 Case

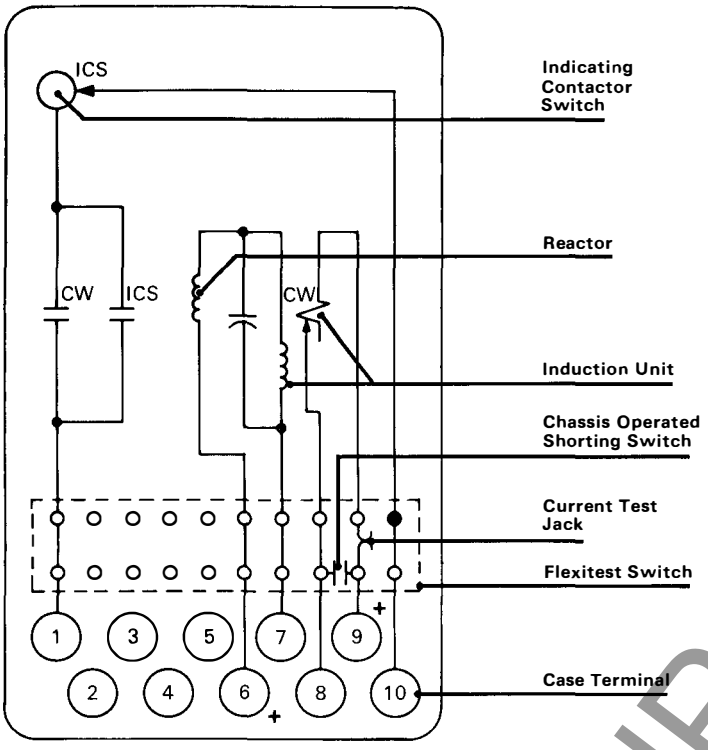


Figure 3 183A773—Sub. 1

For Single-Phase Application, DPST Contacts—FT-21 Case

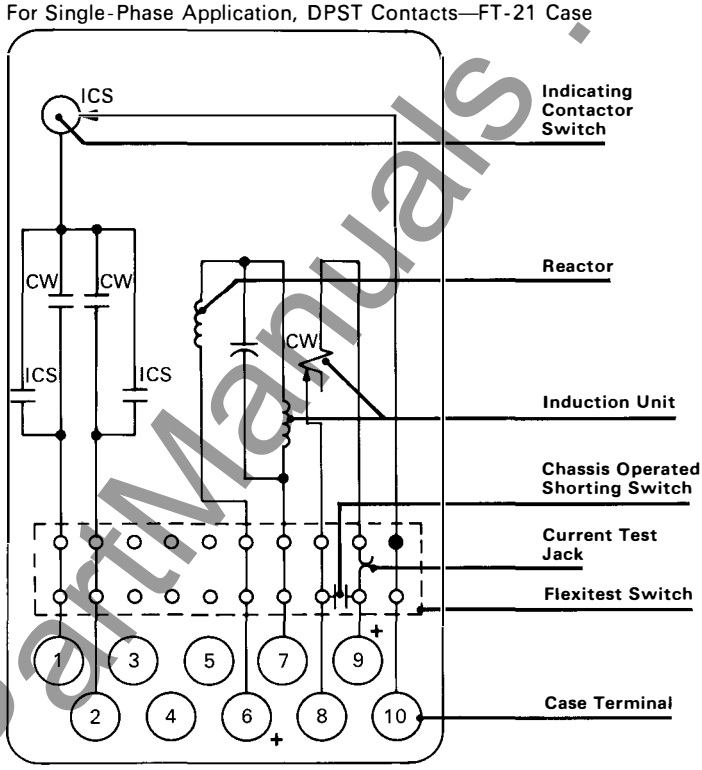


Figure 4 183A774—Sub. 1

For Three-Phase Application DPST contacts—FT-11 Case

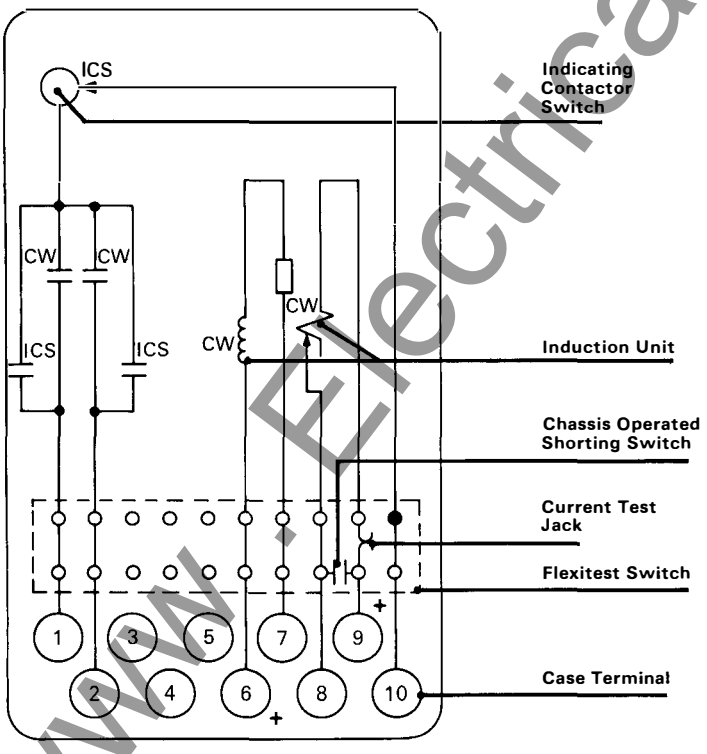


Figure 5 184A554—Sub. 1

For Three-Phase Application—FT-11 Case

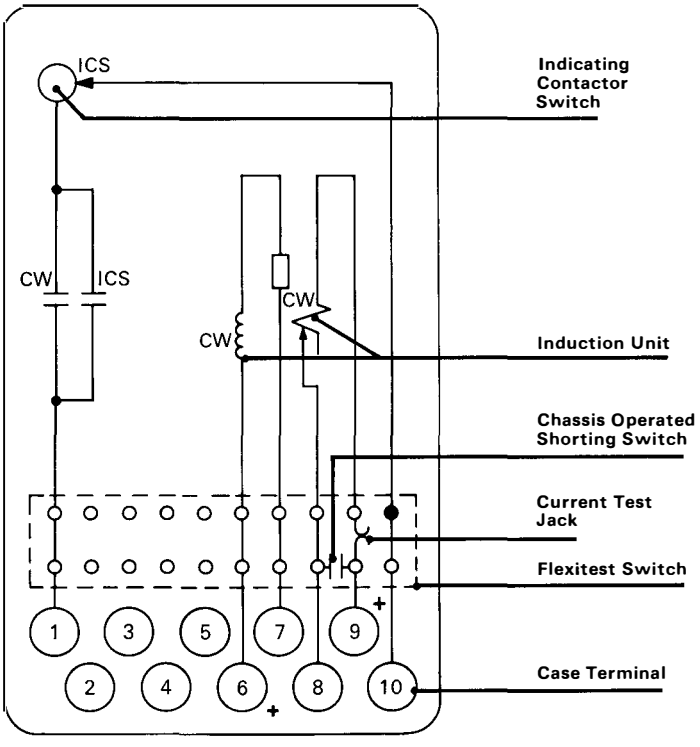


Figure 6 183A776—Sub. 1

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

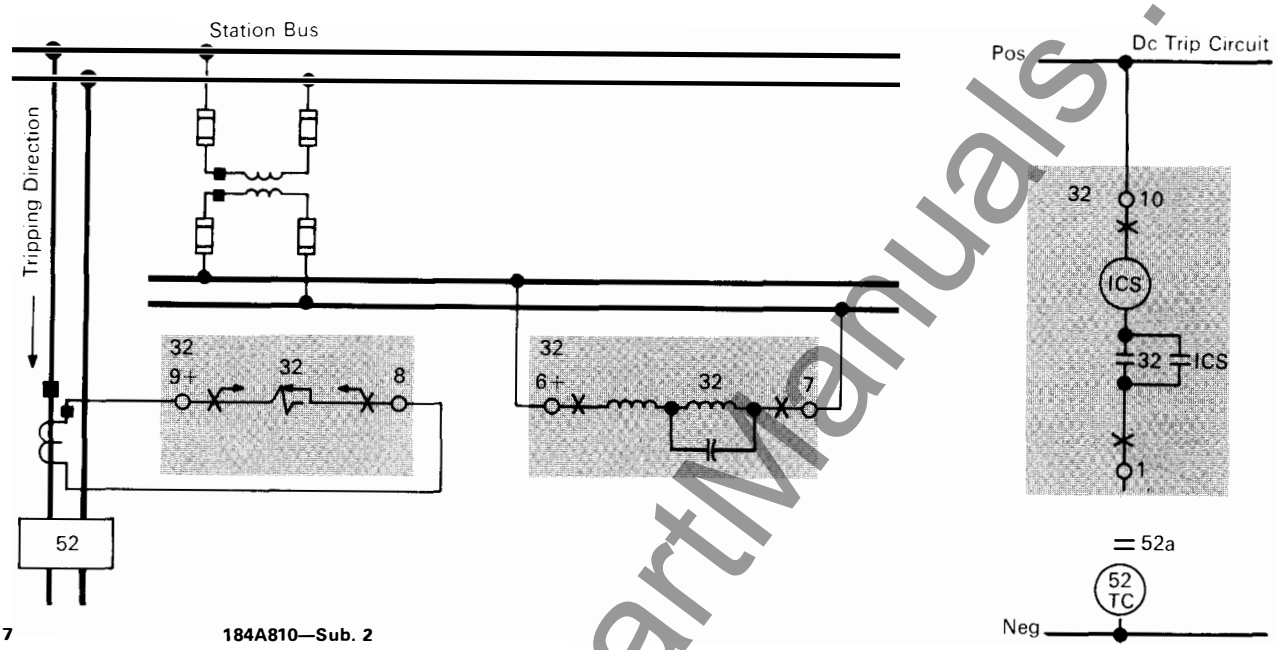


Figure 7 **184A810—Sub. 2**

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

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

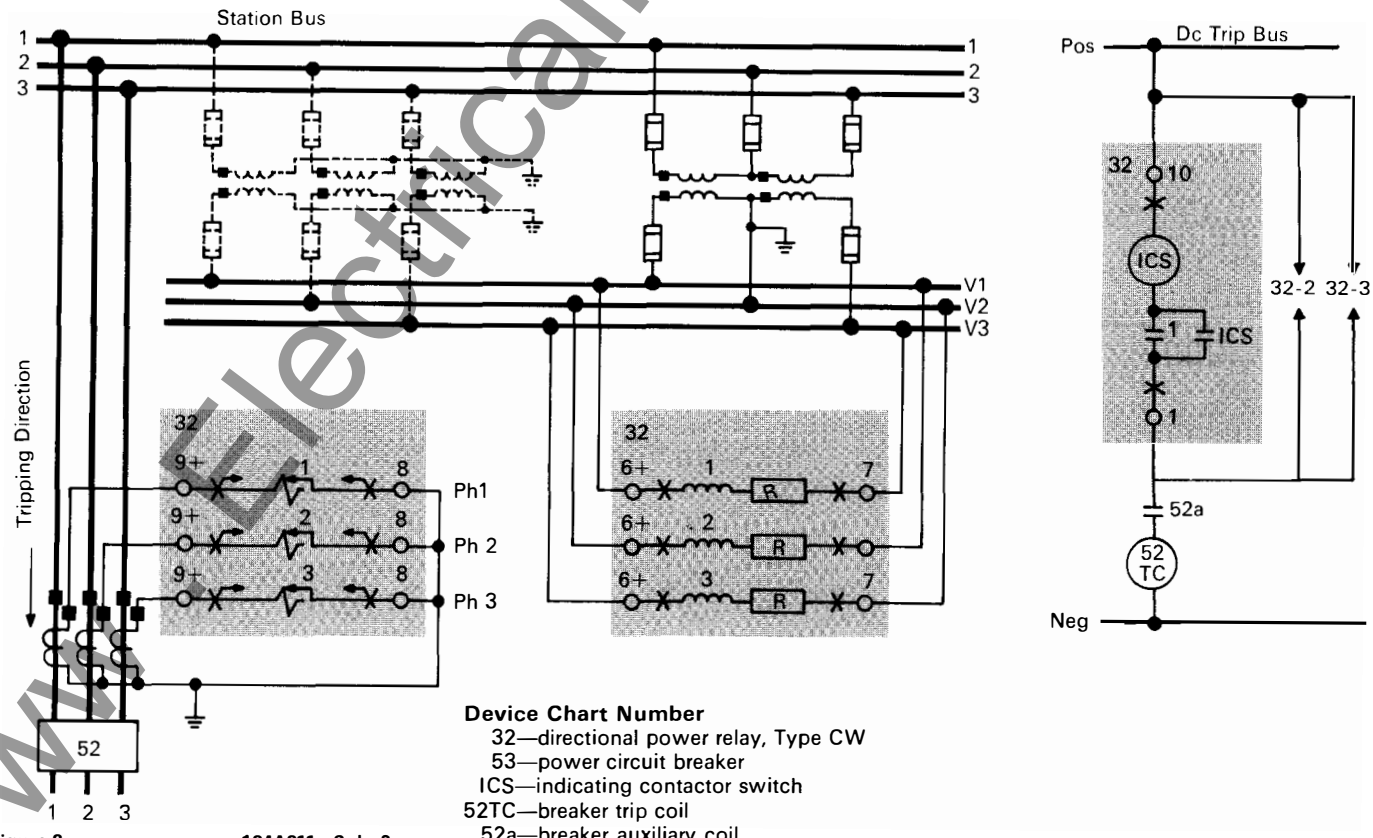


Figure 8 **184A811—Sub. 3**

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

Further Information

Styles and Ordering Information	Technical Data 41-020 T WE A
Prices	Price List 41-020 P WE A
Flexitest Case	Descriptive Bulletin 41-075
Instructions	Single-Phase Application: Instruction Leaflet 41-241.2 Three-Phase Application: Instruction Leaflet 41-241.3
Other protective relays	Selector Guide 41-000 A & B

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