Instruction Leaflet
41-241.3L

Type CW Power Relay
30° Characteristics for Three Phase Systems

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(▌) Denotes Change Since Previous Issue

CAUTION

It is recommended that the user of this equipment become acquainted with the information in this instruction leaflet before energizing the relay. Failure to do so may result in injury to personnel or damage to the equipment, and may affect the equipment warranty.

Before putting relay into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment. Operate the relay to check the settings and electrical contacts.

1.0 APPLICATION

The type CW relay for three-phase applications is a single phase induction type relay providing over power or reverse power protection for electrical equipment or circuits and synchronous motor loss-of-field protection. It is not intended for use as a fault protective relay.

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° at system unity power factor. Tap value is the volt-Amperes at which the contacts close with relay current leading relay voltage by 30°. One CW relay is required for balanced three phase system and three relays are required for unbalanced conditions.

When used for motor protection, the relay is connected in such a way that current (I_A) leads voltage, (V_{BA}), by 150 degrees when the motor is operating at unity power factor. Loss of excitation to the motor causes a large var flow into the motor without appreciable change in the watt flow. As the current goes more lagging, operation of the CW permits tripping or alarm action.

2.0 CONSTRUCTION

The relay consists of a product operated unit, a phase shifter and an indicating contactor switch (ICS), shown in Figure 1.

2.1 Product Type Unit

The electromagnet for the main element has a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. This is shown schematically in Figures 2 and 3. Operating torque is obtained by energizing the tapped coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current leads the voltage by 30 degrees. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon direction of the line current. See phasor diagram, Figure 4. The combination of voltage and current produces an operating torque proportional to power.

2.2 Phase Shifter

The phase shifter network consist of a resistor in series with the potential coils.

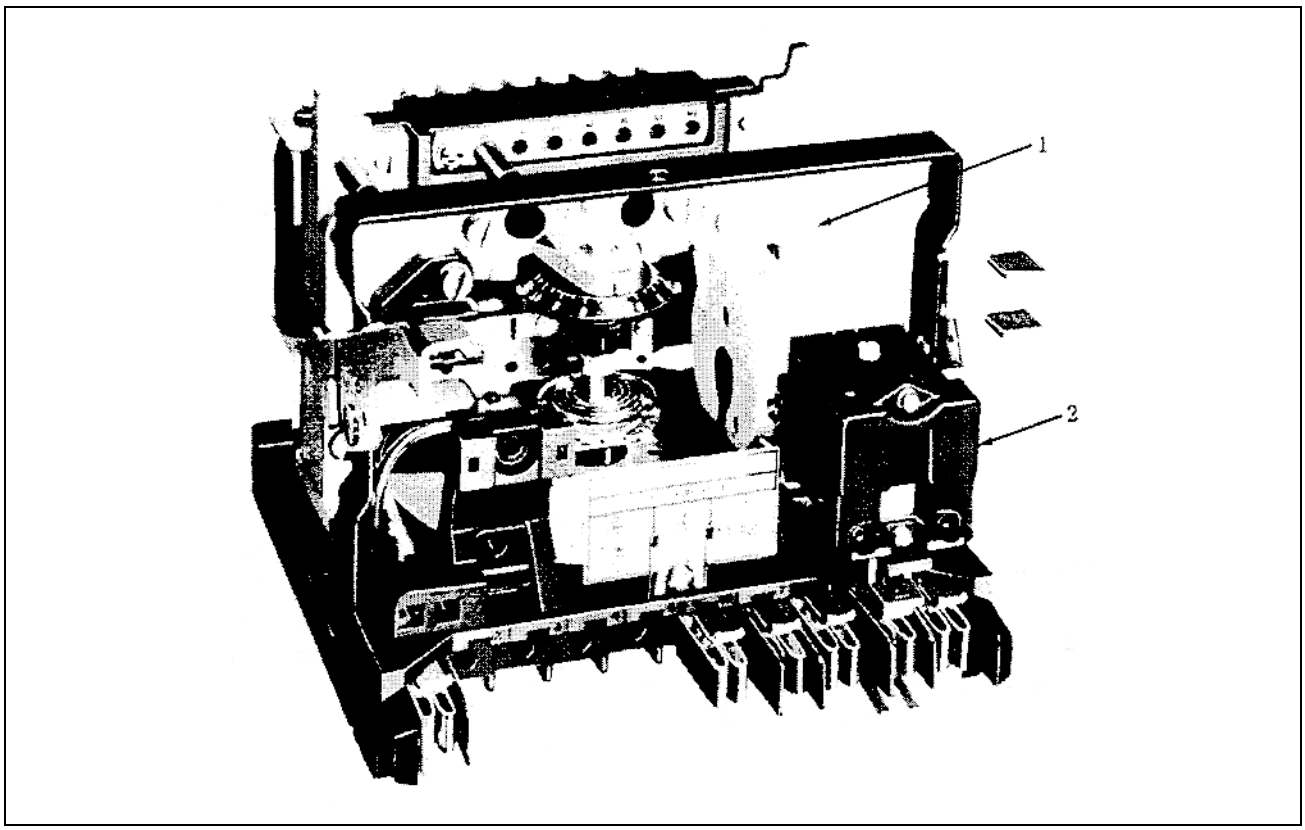

Figure 1. Time-Power Unit. 2. Indicating Contactor Switch (ICS). Note: Phase shifting resistor is mounted in rear.

2.3 Indicating Contactor Switch Unit (ICS)

The dc indicating contactor switch is a small clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contact, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch, which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

3.0 CHARACTERISTICS

Type CW relays are available in the following ranges and taps:

Volts Line-to Line	(I_L V_{LL}) (3 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

Typical 60 hertz Time-Power Curves are shown in Figures 5 and 6. The curves are taken at maximum torque which occurs with the current leading the voltage by 30 degrees. (within ±4°) The time curves apply ±5% at rated voltage.

3.1 Trip Circuit

The main contacts will safely close 30 Amperes at 250 volts dc and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker.

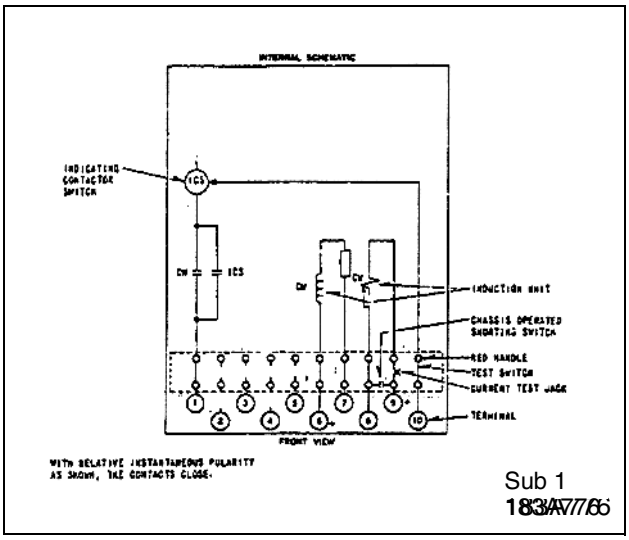

Figure 2. Internal Schematic of the Type CW Relay in the Type FT 11 Case.

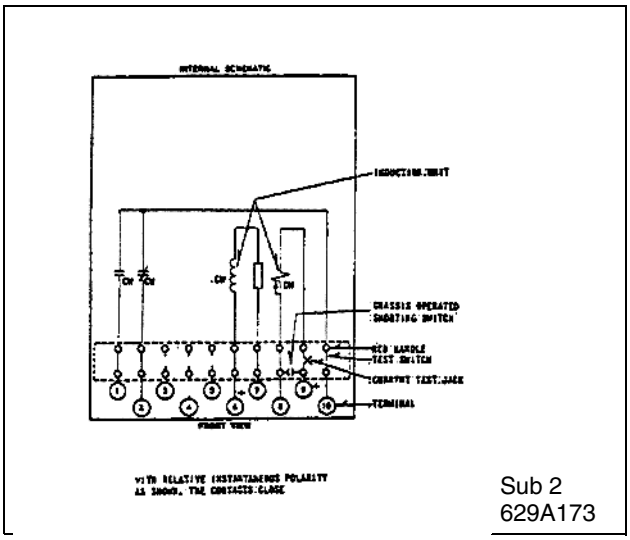

Figure 3. Internal Schematic of the Type CW Relay with SPDT Contacts in Type FT 11 Case.

The indicating contactor switch has two taps that provide pickup setting of 0.2 or 2 Amperes. To change taps requires connecting the lead located in front of the tap block to the desired setting by means of a screw connection.

3.2 Trip Circuit Constants

Indicating Contactor Switch (ICS)
0.2 ampere tap 6.5 ohms dc resistance
2.0 ampere tap 0.15 ohm dc resistance

4.0 INSTALLATION

The relays should be mounted on switch board panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the four mounting holes on the flange for semi-flush mounting or by means of the rear mounting stud or studs for projection mounting. Either a mounting stud or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench.

For detailed FT case information refer to I.L. 41-076.

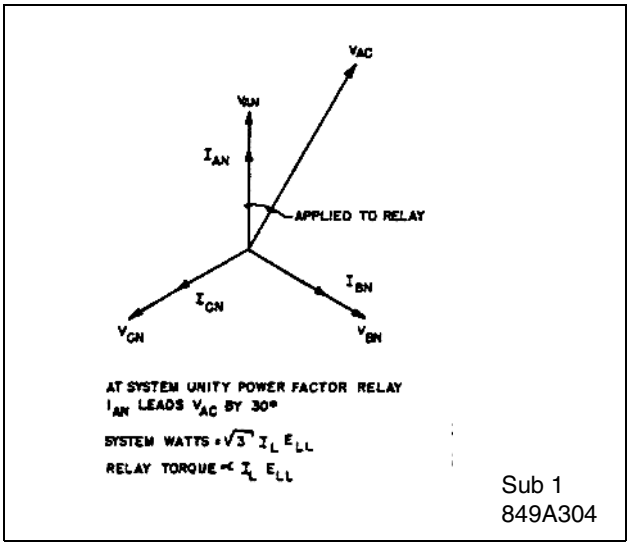

Figure 4. Current and Voltage Phasors at System Unity Power Factor Applied to Type CW Relay.

5.0 SETTINGS

The watt tap, the time dial setting and the ICS tap must be selected.

5.1 Overwatt Application

The CW for three phase applications has taps which represents the minimum balanced three phase watts divided by $\sqrt{3}$ that will cause the disc to move. Tap value is also volt-Amperes at which the disc will begin to move with current leading voltage applied to the relay by 30 degrees. When connected for watt sensing, the relay current leads relay voltage by 30

Assume:

R_C = ct ratio = 600:5 = 120
R_V = vt ratio = 4200:120 = 35
P = power = 1000 primary kilowatts (3 Ø)desired trip level

Direct Solution:

$$T = \frac{P}{R_C R_V \sqrt{3}} = \frac{1,000,000}{120(35)\sqrt{3}} = 137.5$$

Indirect Solution:

$$I_P = \frac{P}{\sqrt{3} V_{LL}} = \frac{1,000,000}{\sqrt{3}4160} = 138.8 \text{ A primary}$$

I_S = 138.8/120 = 1.157 A secondary
V_S = 4160/35 = 118.86 volts line-to-line
T = $I_S V_S$ = 1.157 (118.86)=137.5

Use Tap 150 (closest to 137.5) on 100-600 watt relay.

P = 150/137.5 (1000)=1091 kW actual

Time dial 2 will give 2 second operation at 2182 kilowatts. (See Figure 5.)

degrees when the system current and line-to neutral voltage are in phase (see Figure 7).

5.2 Motor Loss of Field Application

The usual setting of the CW relay for this application (Figure 8) is 20 watts, time dial 2 on the 20-120 watt relay. When, on loss of field, the motor power factor goes approximately 30 degrees lagging (watts and vars into the motor) and more, the contacts of the CW close after the time delay established by the time dial settings.

In this application, the CW would operate during motor starting and a field breaker 41a switch may be used to prevent this by controlling the voltage circuit. This allows the motor to be accelerated, and the field breaker closed before the CW is operative.

Note that the use of field breaker 41a switch control, prevents loss of field detection on accidental field breaker opening. Other provisions must be incorporated to trip the controller when 41a is used and the field breaker opens following field application. If 41a is not used directly, it may drive a timer that closes the coil circuit when 41 closes and has time delay release when 41 opens.

This same relay will detect loss of synchronism in the first slip cycle provided the slip frequency is sufficiently low that the CW current stays in the “operate” area long enough to produce operation.

5.3 ICS Setting

The ICS (indicating contactor switch) has two taps. The 2.0 ampere tap is used when direct tripping is used. The 0.2 ampere tap is used with the 125 or 250 volt dc type WL relay switch or equivalent. For the 48 volt dc type WL the 2.0 ampere tap is used.

⚠ CAUTION

Since the tap block screw carries operating current, be sure that the screws are turned tight.

***In order to avoid opening current transformer circuits when changing taps under load, start with RED handles FIRST and open all switchblades.*Chassis operating shorting switches on the case will short the secondary of the current transformer. The taps may then be changed with the relay either inside or outside of the case. Then reclose all switchblades making sure the RED handles are closed LAST.**

ENERGY REQUIREMENTS

The 60 Hertz burdens of the type CW Relay Three-Phase Application are as follows:

Relay Range	Potential Circuit			Current Circuit			
Watts	Voltage	Volt-Amperes	Current lags by	Current	Relay Tap	Volt-Amperes	Current lags by
20-120	120	17.96	60°	5 A	20	16.2	78°
100-600	120	17.96	60°	5 A	100	5.4	77°
35-200	208	18.8	59°	5 A	35	16.2	78°
175-1000	208	18.8	59°	5 A	175	5.4	77°

6.0 ADJUSTMENT AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

All contacts should be cleaned periodically. a contact burnisher S# 182A836H01 is recommended for the purpose. The use of abrasive material for cleaning contacts is not recommended because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

6.1 Product Unit

6.1.1 Contacts

The index mark on the movement frame will coincide with the “0” mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the “0” mark by approximately.020”. The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-current curves.

6.1.2 Minimum Trip Volt Amperes

Connect the relay per Figure 9. Set the time dial to position 6. Using the lowest tap setting, alternately apply tap value volt-amperes plus 3% and tap value volt-amperes minus 3% with the current leading the voltage by 30°. The moving contact should leave the backstop at tap value plus 3% and should return to the backstop at tap value minus 3%. The relay should be calibrated with 10 times tap value at the number six time dial position. Check several points on the typical time curves. Time curve calibration is affected by adjusting the position of the permanent magnet keeper. *Note that with current leading voltage by 30 degrees the actual watts applied to the relay are.866 time tap value at pickup.*

6.2 Indicating Contactor Switch (ICS)

Close the main relay contacts and pass sufficient dc current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

6.3 Current Coil Ratings:

		Continuous	1Sec.
A.	20-120 Watt Range 35-200 Watt Range	5 Amperes	230 Amperes
B.	100-600 Watt Range 175-1000 Watt Range	8 Amperes	370 Amperes

7.0 RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts always give the complete nameplate data.

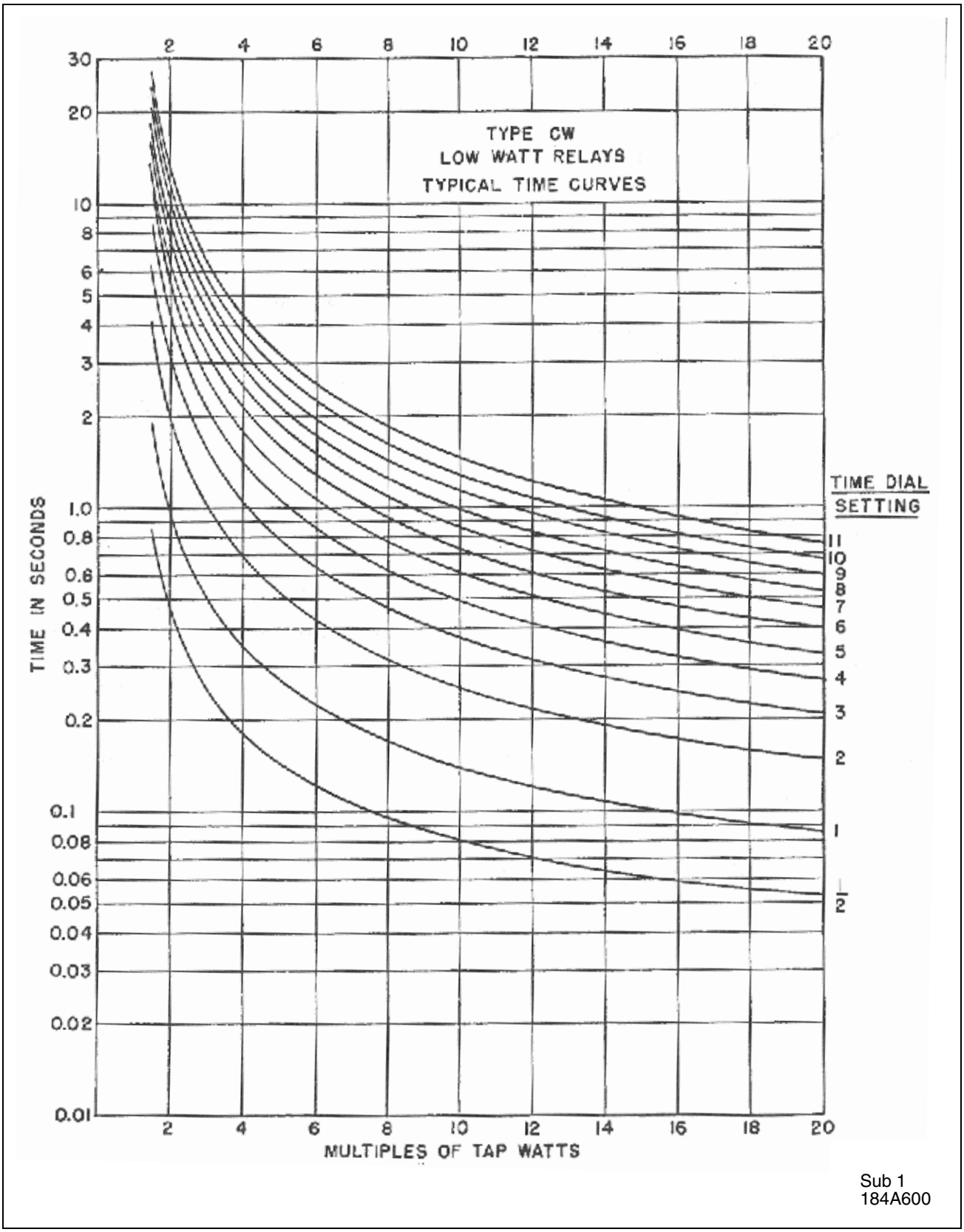

Figure 5. Typical 60 Hertz Time Curves of the 20-120 and 35-200 Watt Type CW Relay.

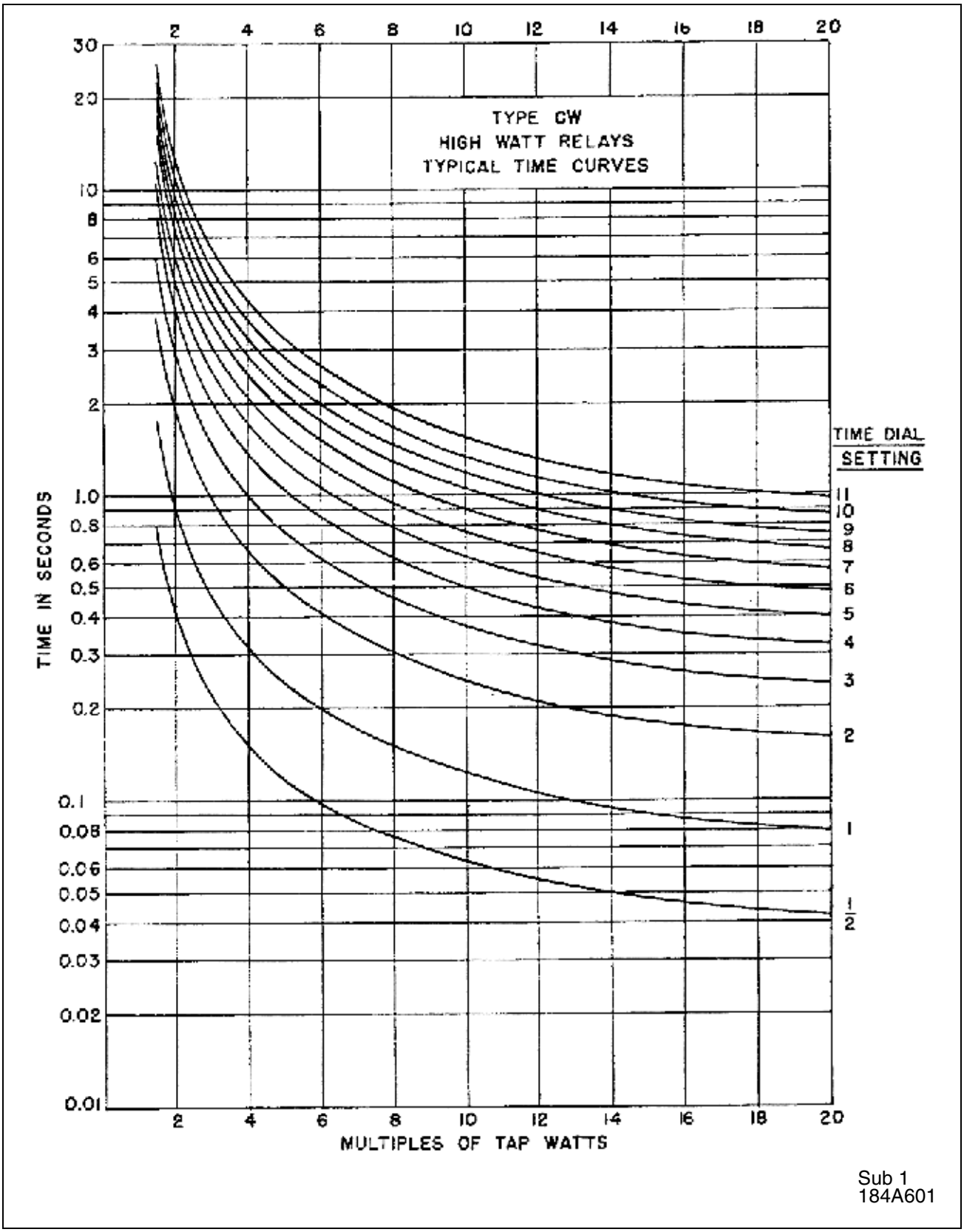

Figure 6. Typical 60 Hertz Time Curves of the 100-600 and 175-1000 Watt Type CW Relay.

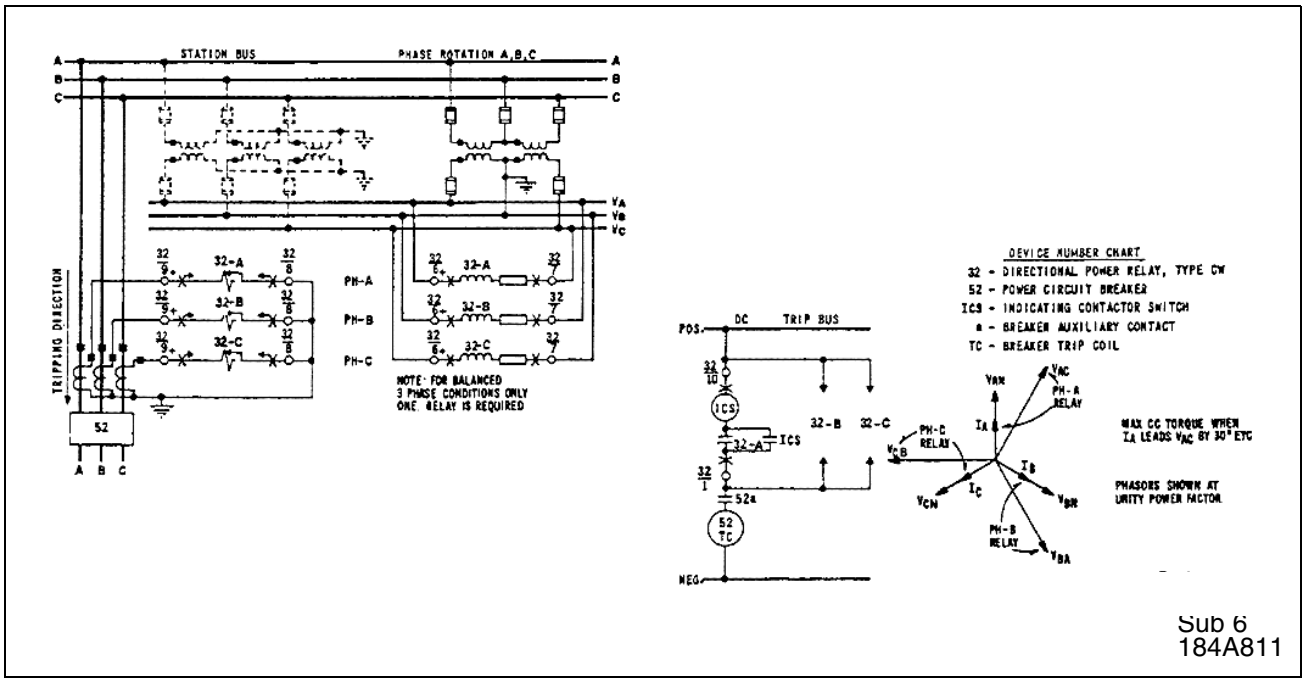

Figure 7. External Schematic of Three Type CW Relays on a Three-Phase System.
Note: For balanced Three Phase Conditions only one CW Relay is required.

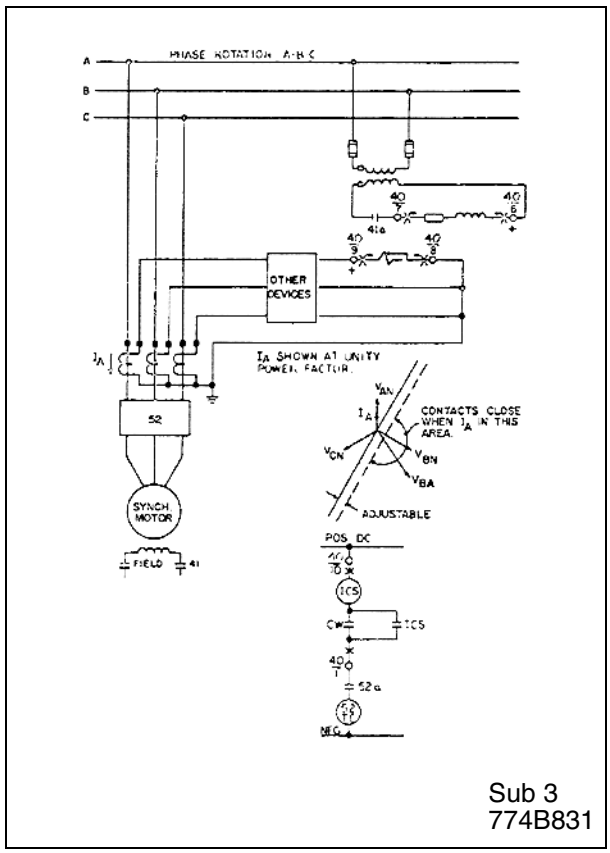

Figure 8. External Schematic of One CW Relay for Loss of Field Protection.

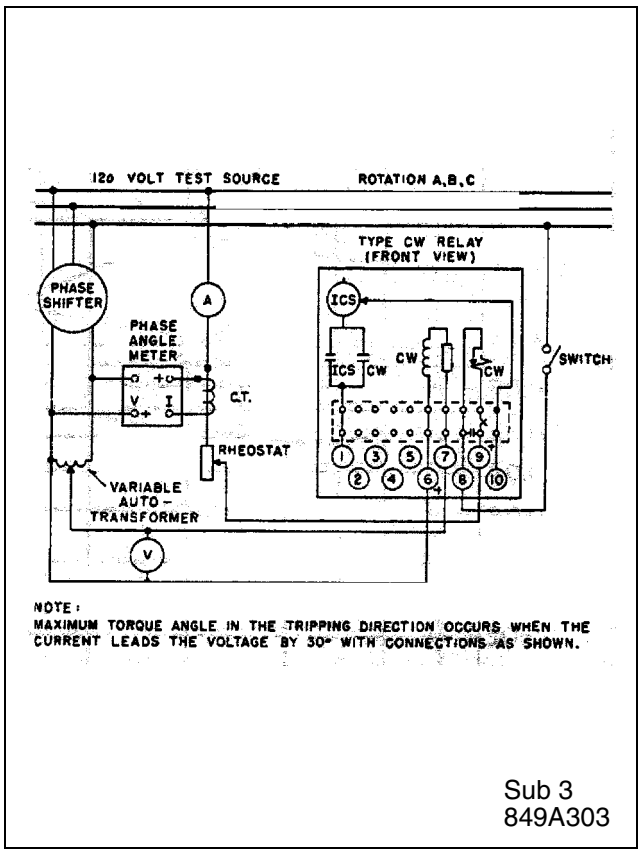

Figure 9. Diagram of Test Connections for Type CW Relay in FT 11 Case.

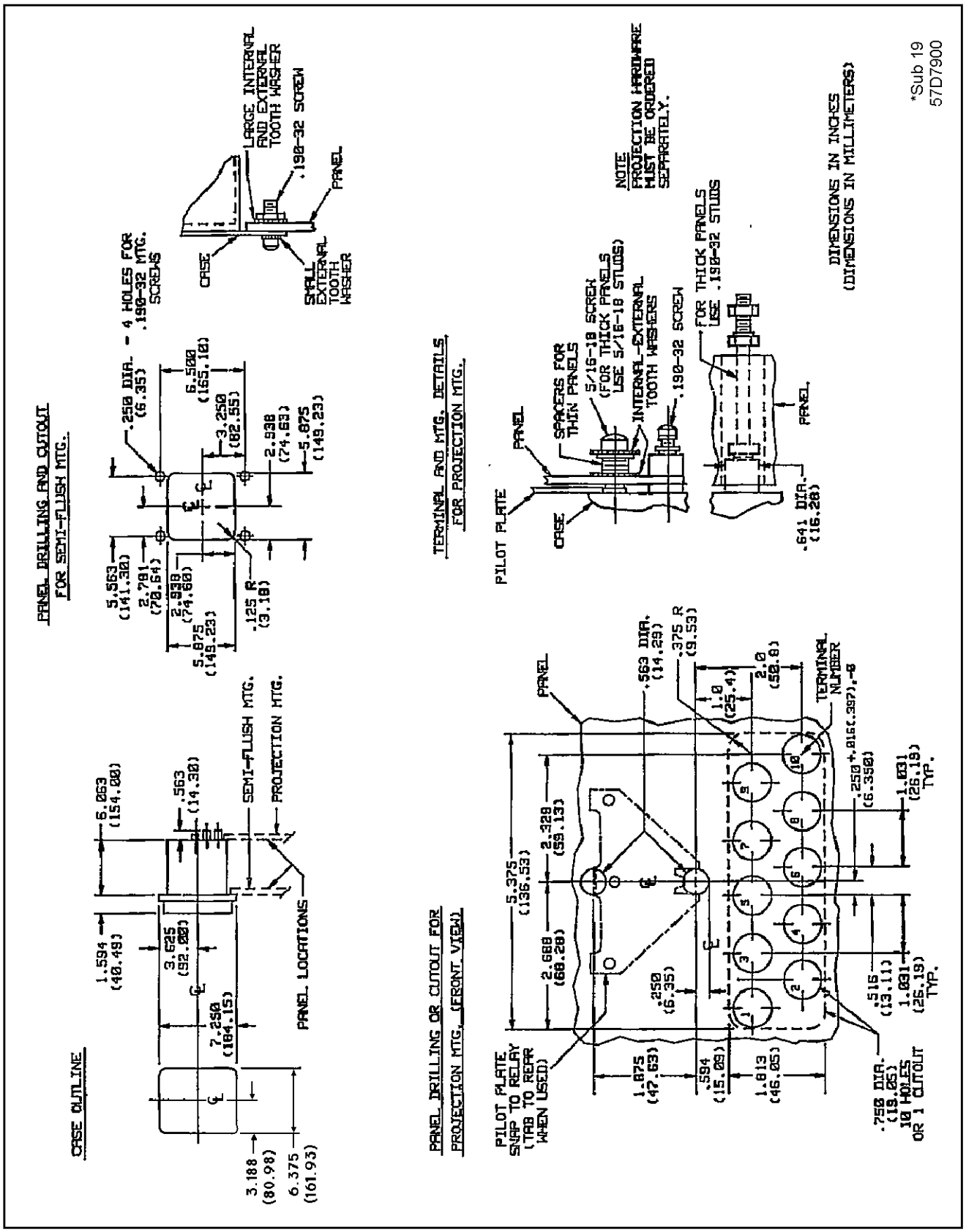

Figure 10. Outline and Drilling Plan for CW Relay in FT-11 Case

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