Instruction Leaflet

41-161.21

Effective: May 1981

NEW INFORMATION

Type COQ Negative Sequence Generator Relay

For Class 1E applications

CAUTION

Before putting relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

1.0 APPLICATION

These relays have been specially designed and tested to establish their suitability for Class 1E applicaitons. Materials have been selected and tested to insure that the relays will perform their intended function for their design life when operated in a normal environment as defined by ANSI standard C37.90-1971, when exposed to radiation levels up to 10^4 rads, and when subjected to seismic events producing a Shock Response Spectrum within the limits of the relay rating.

“Class 1E” is the safety classification of the electric equipment and systems in nuclear power generating stations that are essential to emergency shutdown of the reactor, containment isolation, cooling of the reactor, and heat removal from the containment and reactor, or otherwise are essential in preventing significant release of radioactive material to the environment.

The COQ is used to prevent a synchronous machine from being damaged due to negative sequence fault currents.

2.0 CONSTRUCTION & OPERATION

The COQ consists of an induction disc overcurrent unit, a negative sequence filter, and an indicating contactor switch (ICS) (figures 1 and 2).

2.1 OVERCURRENT UNIT

This is an induction-disc type unit operated by negative sequence quantities supplied to an electromagnet in the rear of the relay. A voltage is induced in the secondary coil of this electromagnet by transformer action of the main coil. Both coils are located on the center leg of the electromagnet. Current flow is from the secondary coil to coils on the outer legs of the electromagnet. The reaction between the outer leg coil fluxes and the main coil flux creates an operating torque on a spiral shaped aluminum disc mounted on a vertical shaft.

2.2 INDICATING CONTACTOR SWITCH (ICS)

The dc indicating contactor switch is a small clapper type device. A magnetic armature, to which leafspring 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 contacts, 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 front spring, in addition to holding the target, provides restraint for the armature and thus controls the

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding this particular installation, operation or maintenance of this equipment, the local ABB Inc. representative should be contacted.

pickup value of the switch.

3.0 CHARACTERISTICS

3.1 OVERCURRENT UNIT

The COQ negative sequence relay is available with the following negative sequence current taps:

3 3.25 3.5 3.8 4.2 4.6 5.0

These tap values represent the current transformer secondary amperes which correspond to one per unit generator current. At these values of negative sequence current, the moving contact will leave the time dial stop and reach the stationary contacts in a time as determined by the time dial setting and as shown by figure 3. For example, with a time dial setting of "4" the relay will close its contacts in 30 seconds with the above tap currents applied to the relay.

As shown by the curves of figure 4, the relay's characteristic is defined by a generator characteristic of $I_2^2T = K$. The relay characteristic is such that it coincides with the generator characteristic at 1 per unit negative sequence current but at higher values of negative sequence current, the relay characteristic is substantially parallel and slightly less than the generator characteristic. In this manner, a suitable margin of safety is obtained between the two characteristics.

Figure 4 defines the relay characteristics for two generators – one with a permissible constant of "30" and the other with a constant of "90". The time dial settings for these constants are "4" and "11" respectively. Similar protection for other generators with I_2^2T constants between "30" and "90" is obtained by settings of the time dial. Figure 5 shows the necessary time dial settings for various I_2^2T constants. By referring to this figure, the time dial can be set so that the relay protects different generators whose I_2^2T constants range from "30" to "90".

Figure 6 demonstrates the use of a tap setting lower than the full load current of the machine to accommodate I_2^2T limits of 7 and 10 while still providing wide contact spacing. For this figure a tap setting of 3 is used with a machine full load current of 4.

Typical time-current curves of the relay are shown in figure 3. Minimum pickup is approximately 0.6 of the tap value current. See table 1 for burdens and thermal ratings.

Table 1:
OVERCURRENT UNIT BURDEN AND THERMAL RATING

INPUT CONDITION	PHASE	CONTINUOUS RATING AMPS	ONE SECOND RATING AMPS	WATTS AT 4 AMPS	VOLT AMPS AT 5 AMPS	CIRCUIT IMPEDANCE	
						Z∠θ	(R+jX)
THREE PHASE	A	5	100	8.3	8.3	0.33–0°	0.33+j 0.00
	B	5	100	1.3	3.8	0.15–110°	0.05+j 0.14
	C	5	100	2.9	4.7	0.19–52°	0.11+j 0.15
PHASE-TO-PHASE FAULT CONDITION							
PHASE TO PHASE	A-B	5	100	6.1	6.5	0.26–-161.7°	-0.24+j 0.08
	B-C	5	100	3.4	8.0	0.32–65°	0.13+j 0.29
	C-A	5	100	10.2	11.5	0.46–-152°	-0.41+j 0.22
PHASE-TO-NEUTRAL FAULT CONDITION							
PHASE TO NEUTRAL	A-N	5	100	5.1	5.2	0.321–8.7°	0.20+j 0.03
	B-N	5	100	3.5	3.8	0.51–24.3°	0.14+j 0.06
	C-N	5	100	4.8	5.5	0.22–29.0°	0.19+j 0.11

3.2 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.

The indicating instantaneous trip contacts will safely close 30 amperes at 250 volts dc, and will carry this current long enough to trip a breaker

3.3 TRIP CIRCUIT CONSTANTS

Indicating Contactor Switch Coil

Ampere Pickup	Ohms dc Resistance
0.2	8.5
1.0	0.37
2.0	0.10

4.0 SETTING CALCULATIONS

Determine from the machine manufacturer the permissible I_2^2T constant. From figure 5 find the required time dial setting.

Depending upon which curve was used in establishing the time dial setting, determine the tap value.

For I_2^2T producing an intersection on the upper curve, use a tap setting equal to or less than machine full load. For example, a conventionally cooled turbine generator may have a limit of $I_2^2T = 30$. Where I_2 is negative sequence current expressed in terms of per unit stator current at rated KVA and T is in seconds. This produces an intersection on the upper curve of figure 5 showing a time dial setting of 4. If the machine full load current (based upon the cooling conditions at which I_2^2T is stated) is 4.4 amperes, use a tap setting of 4.2 amperes.

For I_2^2T producing an inter section on the lower curve, use a tap setting equal to or lower than 3/4 of machine full load current. For example an inner-cooled turbine generator may have a limit of $I_2^2T = 10$. This produces an intersection on the lower curve of figure 5 showing a time dial setting of 2.5. If the machine full load current (based upon the cooling conditions at which I_2^2T is stated) is 4 amperes, use a tap setting of 3 amperes.

This approach gives a conservative, protective characteristic.

5.0 SETTING THE RELAY

5.1 OVERCURRENT UNIT

Insert the tap screw in the appropriate tap determined under “SETTING CALCULATIONS”.

Adjust the time dial setting to the value determined under “SETTING CALCULATIONS”.

5.2 INDICATING CONTACTOR SWITCH (ICS)

There are no settings to make on the indicating contactor switch (ICS).

6.0 INSTALLATION

The relays should be mounted on switchboard 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 the semi-flush type FT case. The mounting screws may be utilized for grounding the relay. External toothed washers are provided for use in the locations shown on the outline and drilling plan to facilitate making a good electrical connection between the relay case, its mounting screws and the relay panel. Ground wires should be affixed to the mounting screws as required for poorly grounded or insulating panels. Other electrical connections may be made directly to the terminals by means of screws for steel panel mounting.

For detail information on the FT case refer to I.L. 41-076 for semi-flush mounting.

7.0 ADJUSTMENTS & MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay no customer adjustments, other than those covered under “SETTINGS” should be required.

7.1 PERFORMANCE CHECK

The following check is recommended to insure that the relay is in proper working order:

1. Apply approximately 5 amperes, 3 phase positive sequences current on 3 amp tap and see

that relay does not operate.

2. Set relay at #11 time dial and jumper terminals 2, 6 and 8. Set tap 3 and apply 26.0 amperes into terminal 3 and out of terminal 7. (See figure 7).

   Time of operation with relay in the case should be 3.2 seconds ±±8%.

3. Repeat test with relay on 5.0 tap and 43.3 amperes through terminals 7 and 9. Time of operation should be 3.2 seconds ±8%.

7.2 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 nameplate rating. The indicator target should drop freely.

Repeat above except pass 85% of ICS nameplate rating current. Contacts should not pickup and target should not drop.

7.3 ROUTINE MAINTENANCE

All the relays should be inspected and the time of operation should be checked once a year or at such time intervals as may be dictated by experience to the suitable to the particular application. Phantom loads should not be used in testing induction-type relays because of the resulting distorted current wave form which produces a error in timing.

All contacts should be cleaned periodically. A contact burnisher Style #182A836H01 is recommended for this 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.

7.4 OVERCURRENT UNIT

Apply a single phase current of 8.66 times tap value (5 per unit negative sequence current) using the test circuit of figure 7. Check that time of operation is in accordance with figure 3.

8.0 CALIBRATION

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments disturbed. This procedure should not be used until it is apparent that the relay is not in proper working order. (See “PERFORMANCE CHECK”).

8.1 FILTER

To adjust the filter resistor tap for no response to positive-sequence current, remove the relay from case and proceed as follows:

a. Jumper switch jaws 2 and 6

b. Remove overcurrent unit, tap screw

c. Pass 10 amperes into switch jaw 3 and out switch jaw 7.

d. With a 0-15 volt high input resistance type voltmeter (2000 ohm/volt or more), measure and record voltage between switch jaw 3 and the tap plate.

e. Now measure the voltage across the resistor, between terminals 2 and 3. Adjust top filter resistor position until this voltage is 1.73 times the reading of (d) above.

8.2 OVERCURRENT UNIT

NOTE: A spring shield covers the reset spring of the overcurrent unit. To remove the spring shield, requires that the damping magnet be removed first. The screw connection holding the lead to the moving contact should be removed next. The second screw holding the moving contact assembly should then be loosened not removed. (*Caution: this screw terminates into a nut held captive beneath the molded block. If screw is removed, difficulty will be experienced in the re-assembly of the moving contact assembly.*) Slide the spring shield outward and remove from relay. Tighten the screw holding the moving contact assembly to the molded block.

Turn time dial until stationary contact is deflected against the back stop. Adjust, if necessary, so that “0” mark on time dial coincides with index. Then, with time dial at “0” wind up spring until about 5 1/2 convolutions show. From this preliminary setting, and using 3 tap and time dial setting of “11”, adjust the permanent magnet until the relay operates in 8.2 seconds with 15.6 amperes single phase or 3 per unit between terminals 3 and 7 per figure 7. This adjustment is made by means of the damping magnet screw.

Next adjust the spring tension until the relay will close contacts in 90 seconds with 5.2 amperes single phase (tap value or one per unit negative sequence current) applied between terminals 3 and 7. This adjustment is made by means of the spiral spring adjuster. All spring convolutions must be free. A final check must be made with the spring shield properly mounted over the spring.

8.3 INDICATING CONTACTOR SWITCH (ICS0

Initially adjust unit on the pedestal so that armature fingers do not touch t he yoke in the reset position (viewed from top of switch between cover and frame). This can be done by loosening the mounting screw in the molded pedestal and moving the ICS in the downward position.

a. Contact Wipe – Adjust the stationary contact so that both stationary contacts make with the moving contacts simultaneously and wipe 1/64” to 3/64” when the armature is against the core.

b. Target – Manually raise the moving contacts and check to see that the target drops at the same time as the contacts make or up to 1/16” ahead. The cover may be removed and the tab holding the target reformed slightly if necessary. However, care should be exercised so that the target will not drop with a slight jar.

c. Pickup – The unit should pickup at 98% rating and not pickup at 85% of rating. If necessary, the cover leaf springs may be adjusted. To lower the pickup current use a tweezer or similar tool and squeeze each leaf spring approximate equal by applying the tweezer between the leaf spring and the front surface of the cover at the bottom of the lower window.

   If the pickup is low, the front cover must be removed and the leaf spring bent outward equally.

9.0 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. Check with the factory to determine what effect any field repairs might have on factory certification of this relay.

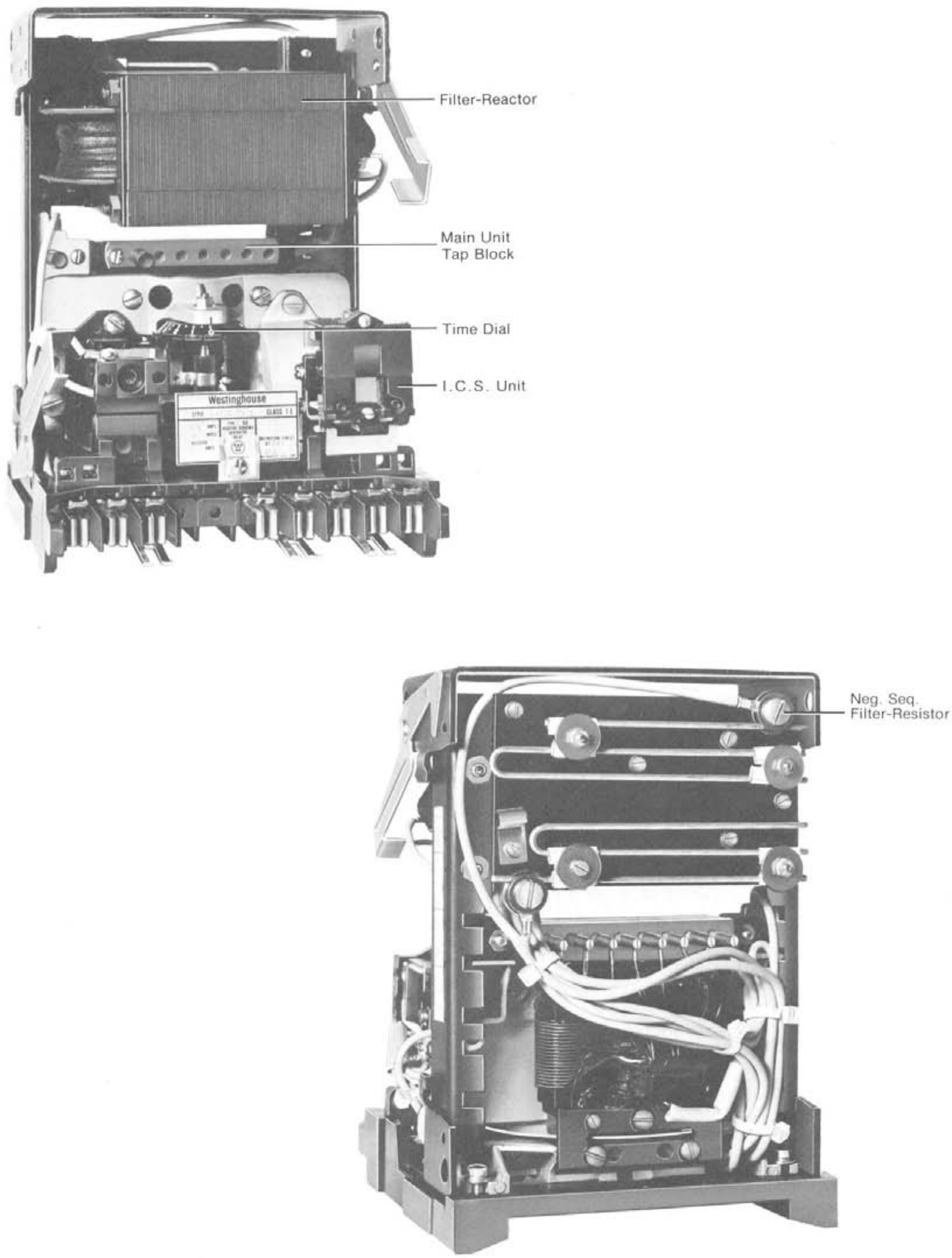

Figure 1 .Type COQ Relay (without case).

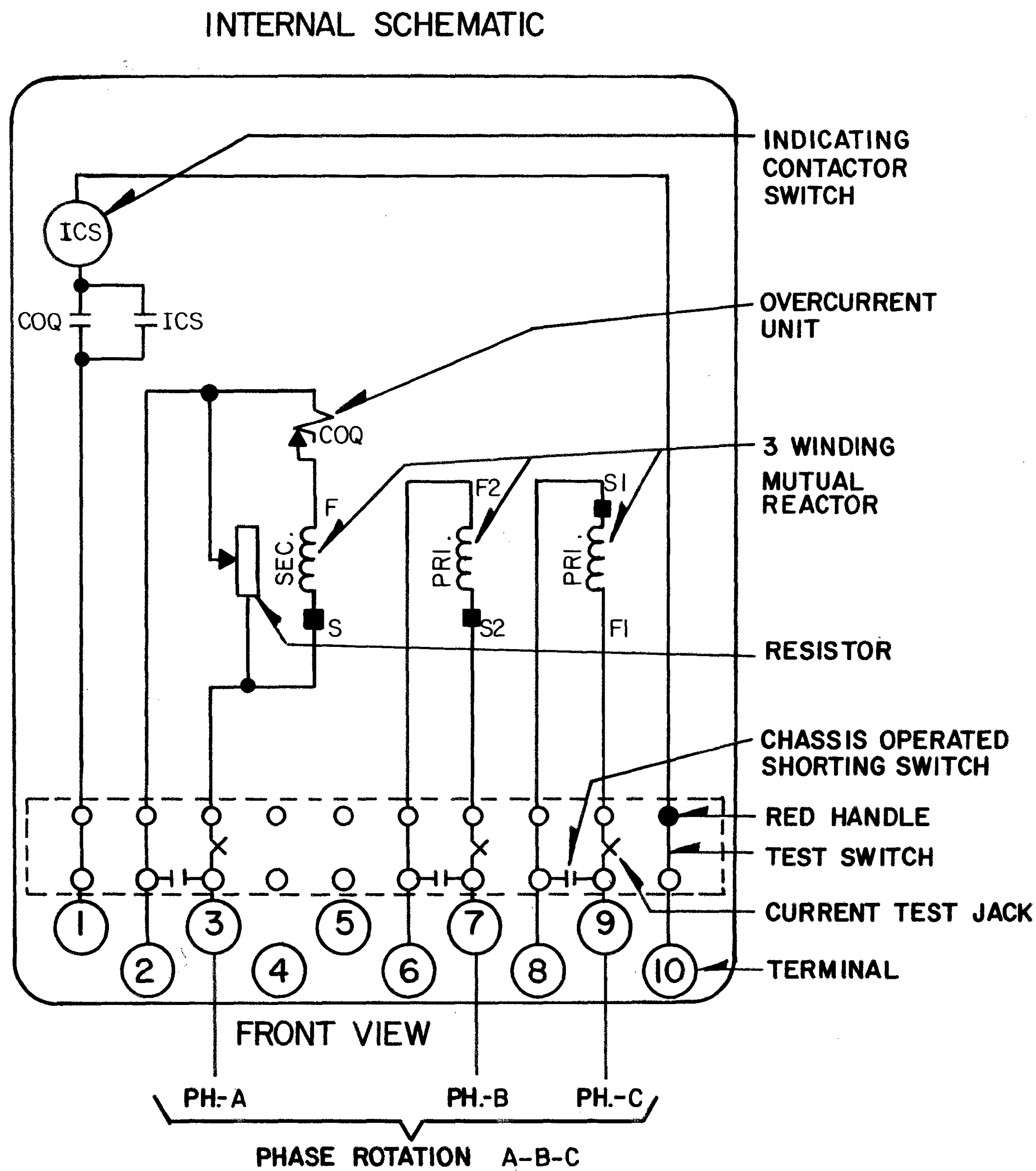

Figure 2 .Internal Schematic of the COQ Relay in the FT-21 Case.

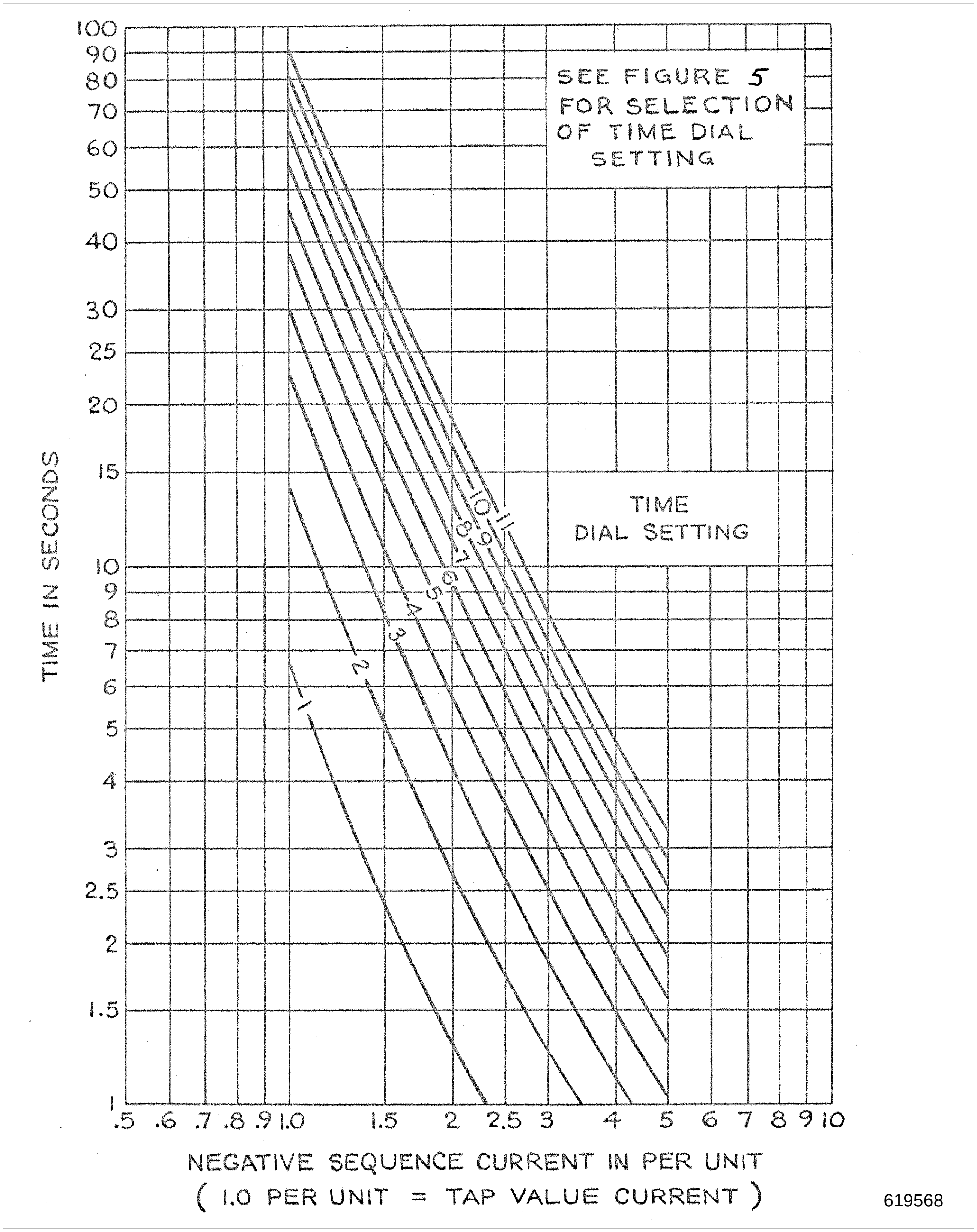

Figure 3 .Relay Time - Current Curve.

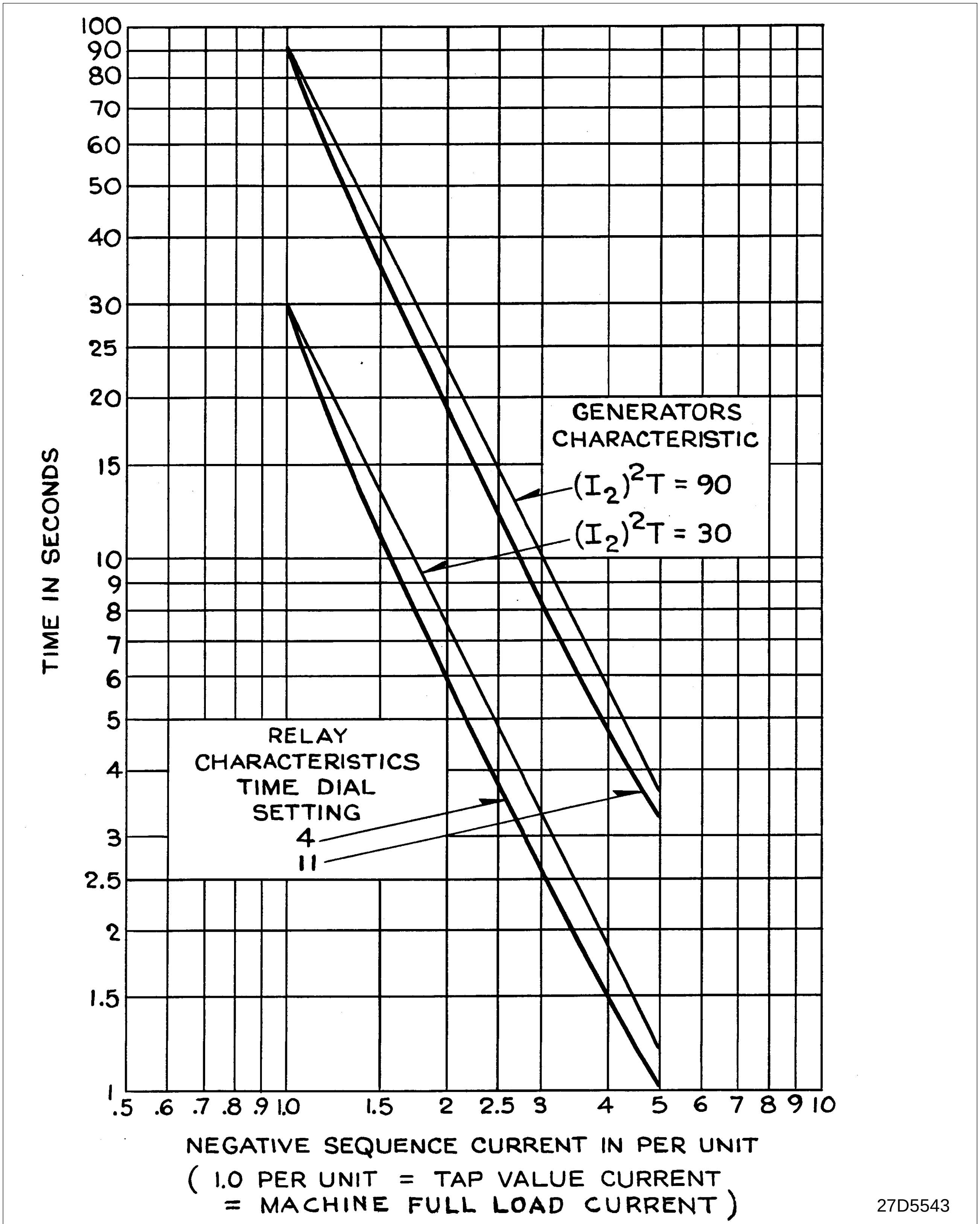

Figure 4 .Comparison of Relay and Generator Characteristics – Time versus Negative Sequence Current, For an I_2^2T Factor From 30 to 90°.

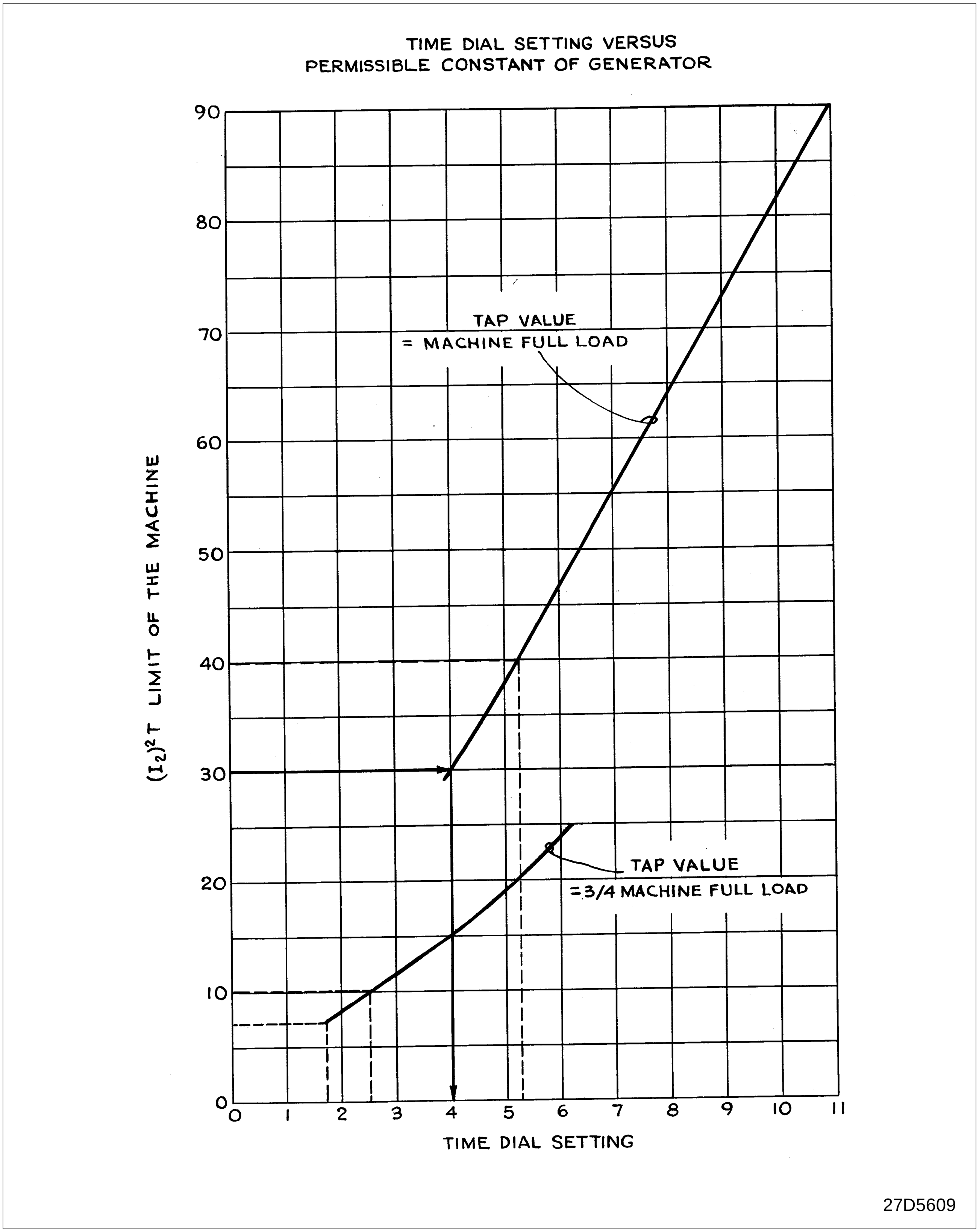

Figure 5. Required COQ Time Dial Setting versus Generator Constant.

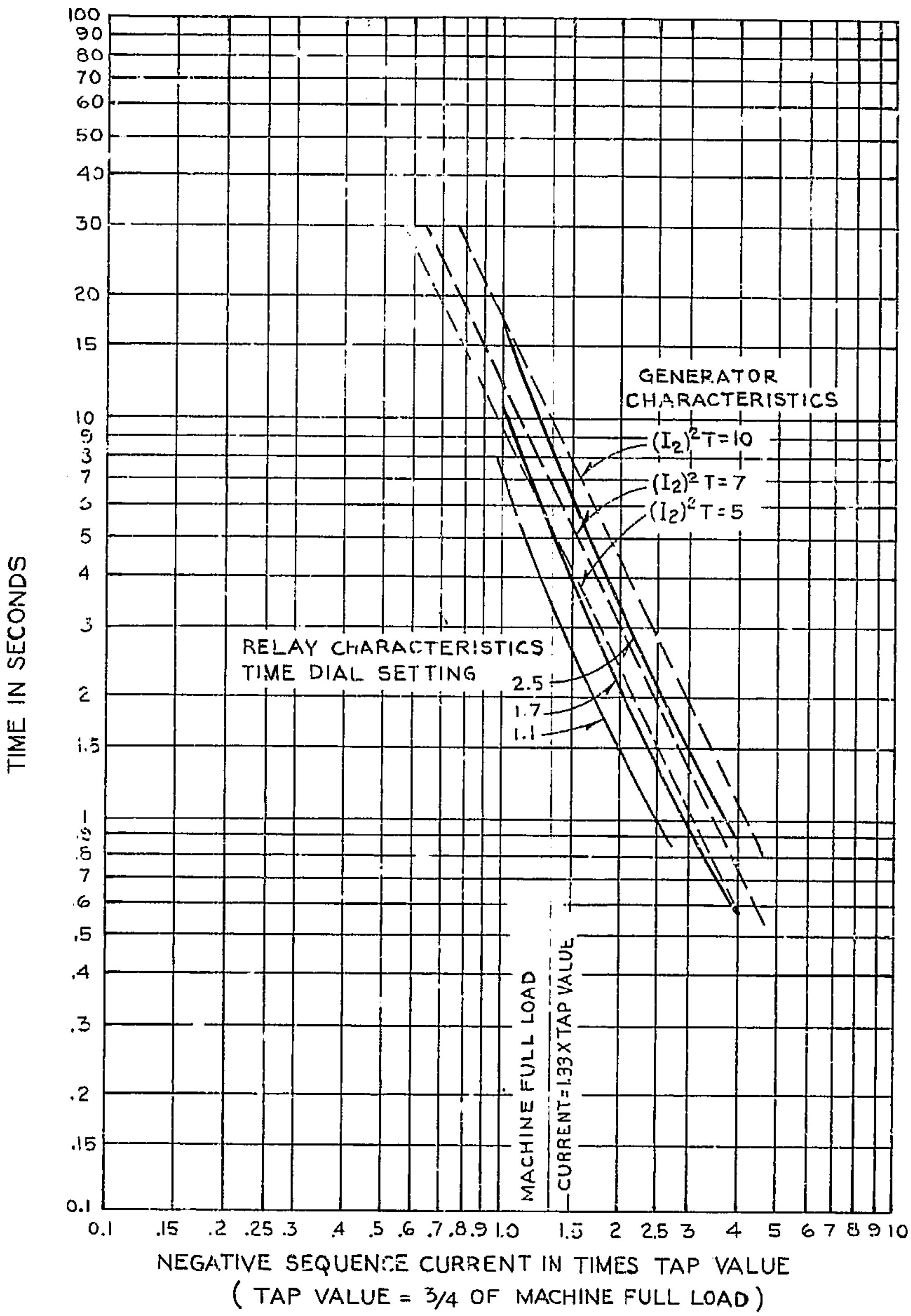

Figure 6. Comparison of Relay and Generator Characteristics, Time versus Negative Sequence Current, for an I_2^2T Factor from 7 to 10°.

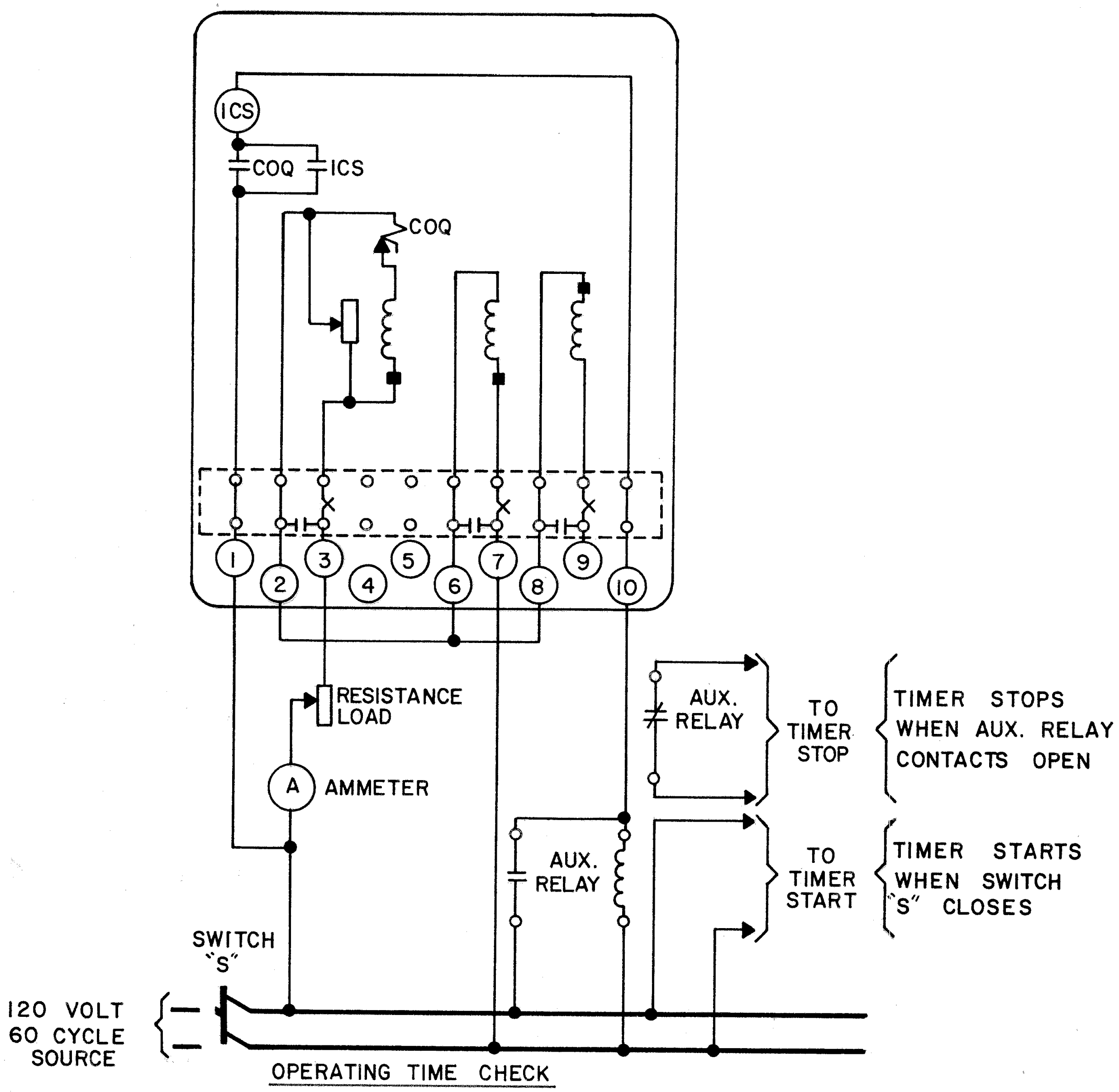

Figure 7. Diagram of Test Connections for the COQ Relay.

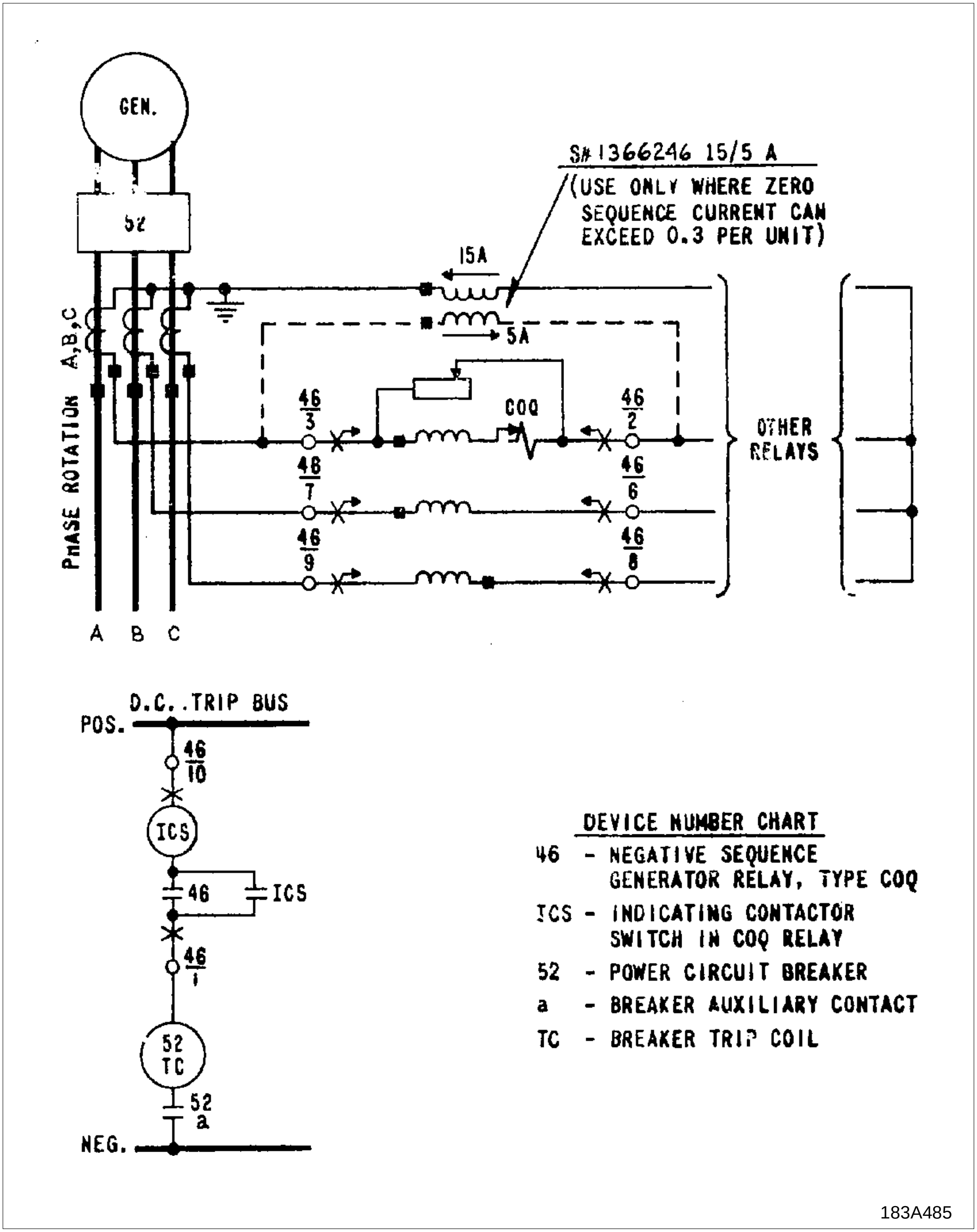

Figure 8 .External Schematic of the COQ Relay.

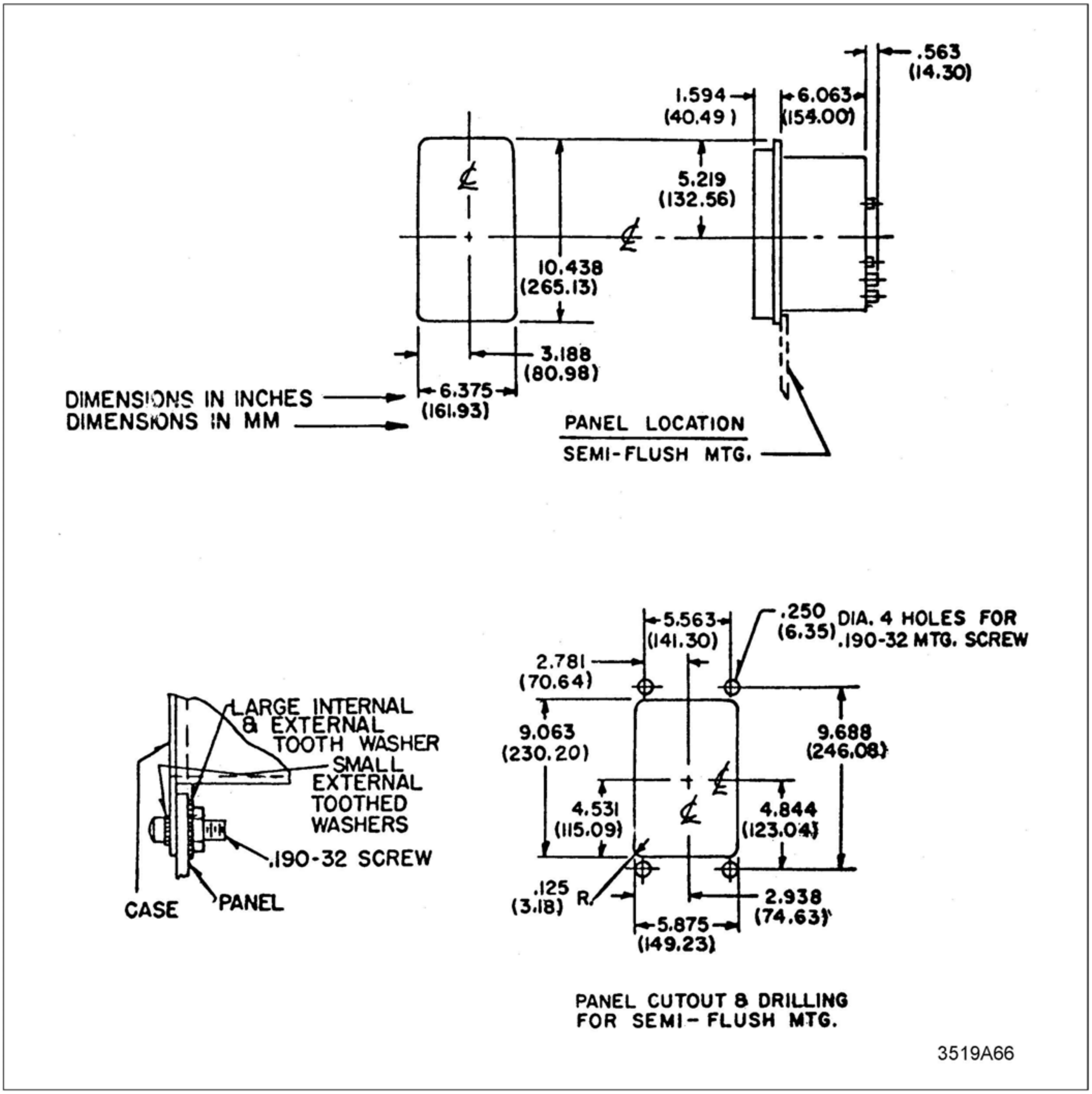

Figure 9 .Outline and Drilling Plan for the COQ Relay in the FT-21 Case.

Reserved for notes

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