**ABB Automation Inc.**
Substation Automation and Protection Division
Coral Springs, FL 33065

Instruction Leaflet

**41-181.21A**

Effective: April 1982

Supersedes I.L. 41-181.21 dated March 1982

✪ Denotes Change Since Previous Issue

# Type CM Phase Balance Current Relay
Class 1Es

**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.

## APPLICATION

"Class IE" 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.

These relays have been specially designed and tested to establish their suitability for Class IE applications. 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.

The type CM relay is an induction type relay designed to protect polyphase electrical machinery against phase unbalance or phase failure

As shown in Fig. 6 the relay may be used with either three or two current transformers. With three ct's the accuracy class must be at least C50; with two ct's the accuracy class must be at least C70. Otherwise ct errors during motor starting may cause undesired CM tripping.

## CONSTRUCTION AND OPERATION

The type CM relay consists of two main current units and their associated resistor and an indicating contactor switch (ICS). The principal component parts of the relay and their location are shown in Fig. 1 and 2.

### Main Unit

Each main unit has a pair of electromagnets operating on a single disc. The disc is damped by a permanent magnet. Each disc carries its own set of contacts with the two sets being connected in parallel, in order that either disc may close the trip circuits. The electromagnet pair are mounted face to

***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 Power T&D Company Inc. representative should be contacted.***

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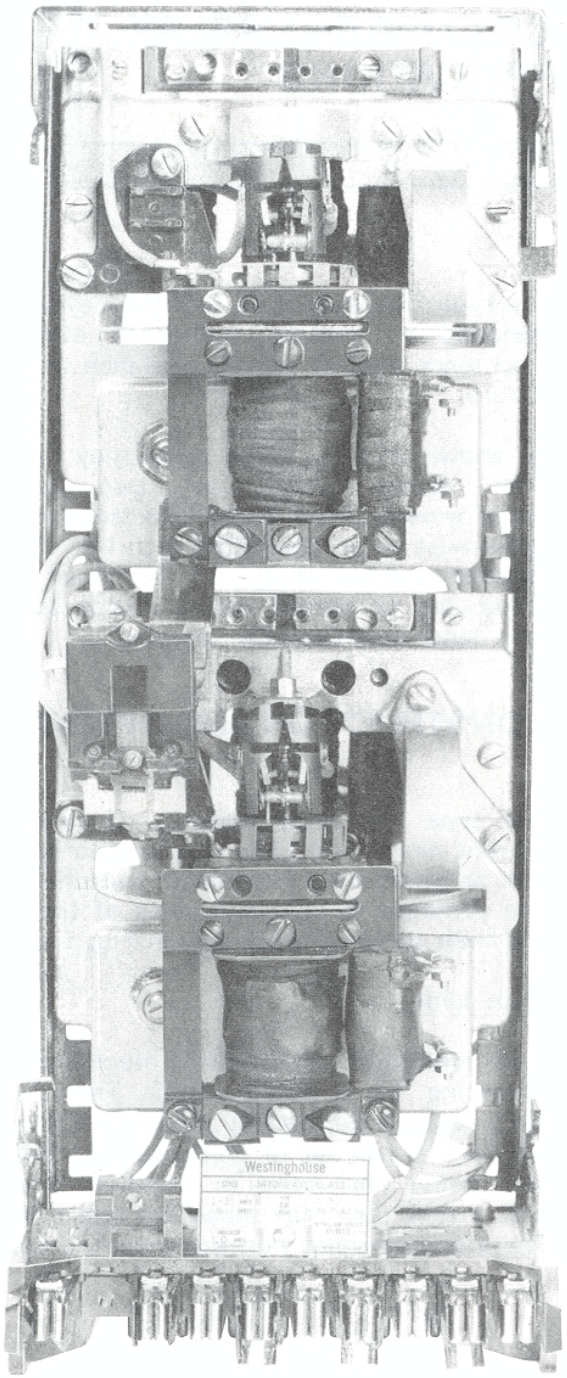


*Fig. 1. Class 1E Type CM Tapped Relay without case (Front View)*

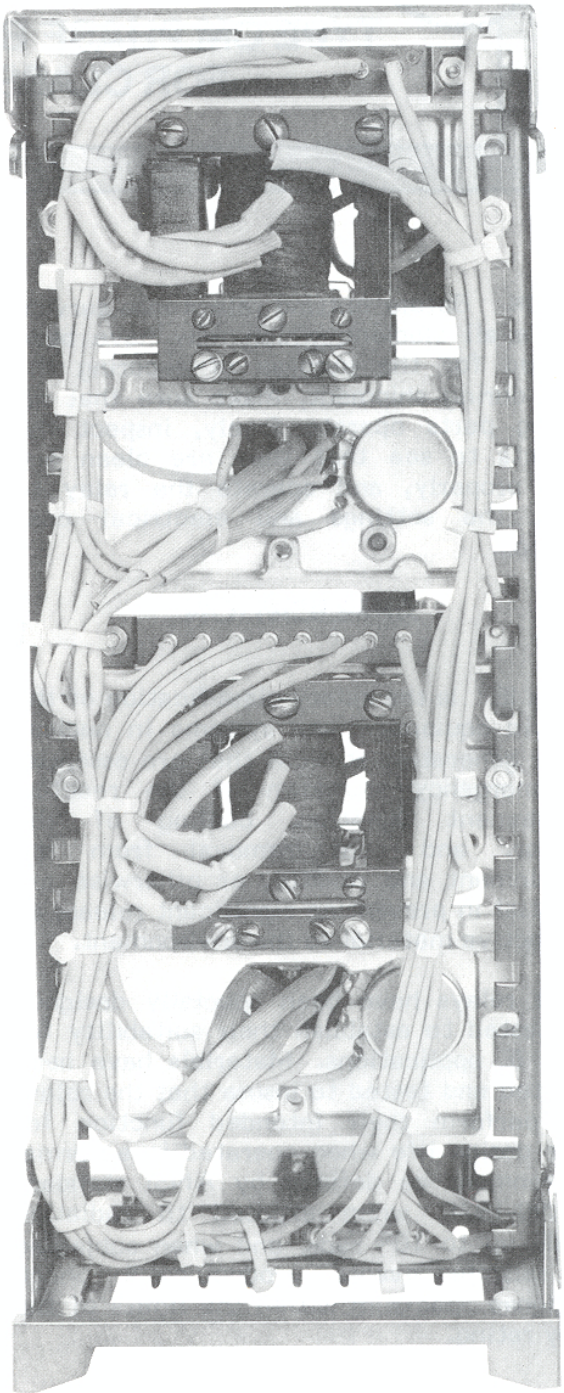

*Fig. 2. Class 1E Type CM Tapped Relay (Rear View)*

face on opposite sides of the disc, and so connected that the electrical torque of one electromagnet opposes that of the other, thus producing balanced operating torque on the disc when the magnitudes of the currents through each of the two electromagnets are equal. One of the electromagnets on the lower disc is connected in series with one of the electromagnets on the upper disc. Thus phase A current may balance phase B current on the upper disc, and phase B current balance C current on the lower disc. Consequently with balanced system conditions, no operating torque is produced on the two discs, but with unbalanced conditions or an open phase the balance on the disc is upset and one or two sets of contacts close.

Each electromagnet has a main coil located on the center leg of an "E" type laminated structure that produces a flux which divides and returns through the outer legs. A shading coil located on one of the outer legs on the "E" structure causes the flux through that leg to lag the main pole flux. The out-of-phase fluxes thus produced in the air gap will cause disc rotation. A resistor located to the rear of each main unit is used as an aid in balancing the opposing torques by controlling the current flow through the shading coils.

For some CM relays, the front electromagnet may have adjustable plugs which are used to aid in calibration.

The contacts are single pole double throw. The moving contact is fastened directly to the disc shaft and the electrical connection is made thru a spiral spring fastened to the moving contact arm and frame assembly.

### Indicating Contactor Switch Unit (ICS)

The d-c 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 energizing 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, allowing the operation indicator target to drop. The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

## CHARACTERISTICS

The non-tapped type CM relay has a minimum pickup current of one ampere and a continuous thermal rating of seven amperes. The tapped CM Relay has a minimum pickup of 1, 2 or amperes, depending on the tap setting and a continuous of 7 amperes. The minimum pickup current is defined as the pickup current of each electromagnet with the other paired electromagnet deenergized.

The relay may be utilized for continuous load currents of from one to seven amperes. The characteristic curve of the relay is shown in Figure 3.

### Trip Circuit

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

INDICATING CONTACTOR SWITCH COIL.

| Ampere Pickup | Ohms dc Resistance |
|---|---|
| 0.2 | 8.5 |
| 1.0 | 0.37 |
| 2.0 | 0.10 |

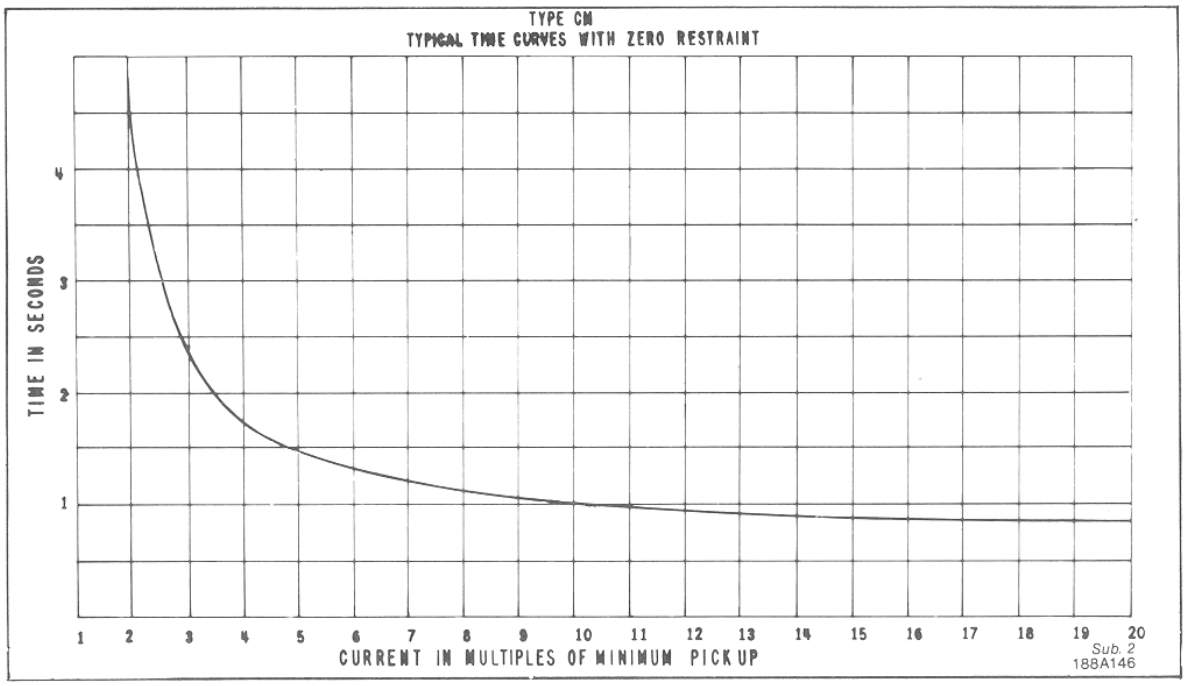


*Fig. 4. Typical Time Curve with Zero Restraint of the Type CM Relay.*

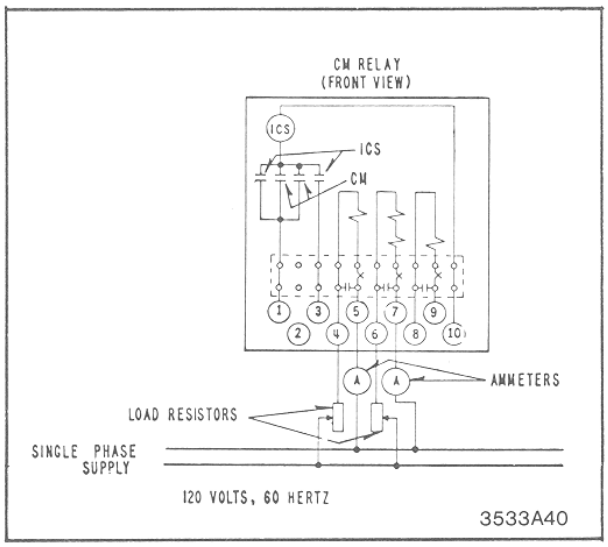


*Fig. 5. Diagram of test connection for the non-tapped Type CM Relay in the FT-31 Case. For tapped CM place tap screw in 1 amp. tap setting.*

## ADJUSTMENTS AND 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 unter "SETTINGS" should be required.

Acceptance Check

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

### MAIN UNITS

For all electrical checks refer to test diagram Fig. 5. For tapped CM, put tap screw in one amp. setting.

1. Contacts

   The stationary contact assembly should be aligned with respective marks located on scale plate, prior to checking the relay. These marks indicate approximately 1 ampere of unbalance.

2. Minimum Trip Current

   Note: The front electromagnet energized alone will produce a disc rotation to the left while a rear electromagnet energized alone will produce a disc rotation to the right.

   Mimimum trip can be checked by energizing either the front or rear electromagnets alone and noting that the moving contact makes with its respective stationary contact at one ampere.

3. Balance Check

Apply one ampere through the front and rear electromagnets simultaneously. The moving contact should remain substantially midway between the stationary contacts. A similar check should be made utilizing six amperes.

4. Time Curve

Contact travel is from balanced position to either the right or left stationary contacts.

Electromagnets are to be energized alone (zero restraint). Apply ten amperes and note that contacts make at one second ± 10%. Time curve characteristic per Fig. 4.

Indicating Contactor Switch (ICS)

Close the main relay contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should be not greater than the rating of the ICS being used. The operation indicator target should drop freely.

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

Routine Maintenance

All relays should be inspected periodically and the time of operation should be checked at least once every year or at such other time intervals as may be dictated by experience to be 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 an error in timing.

All contacts should be periodically cleaned. A contact burnisher #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.

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## 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 "Acceptance Check").

NOTE: A spring shield (See Fig. 7) covers the spiral spring on each CM element. When adjustments to the spring (s) are deemed necessary, the spring shield must be carefully removed first.

Main Units

For all electrical checks refer to test diagram Fig. 5. For tapped CM, put tap screw in one amp. tap setting.

1. Balance Setting

   a) Mechanical balance-adjust sprial spring until moving contact is located substantially in the center of the scale plate.

   b) Electrical Balance -

   1. Apply two amperes on front and rear electromagnets and adjust resistor at rear of specific unit being tested such that the moving contact is in balance, i.e., moving contact is aligned per part "a" above.

   2. Apply twenty amperes on front and rear electromagnets for approximately two seconds and note that the moving contact does not deviate from the balanced condition more than approximaterly 1/4 inch.

For CM relays with adustable magnetic plugs, only the right hand plug may be adjusted. At the factory, the right hand plug is adjusted to help obtain a balanced condition of the contact at 20 amperes. The moving contact is again checked at 2 amperes. Little adjustment, if any, is expected to be necessary in the field.

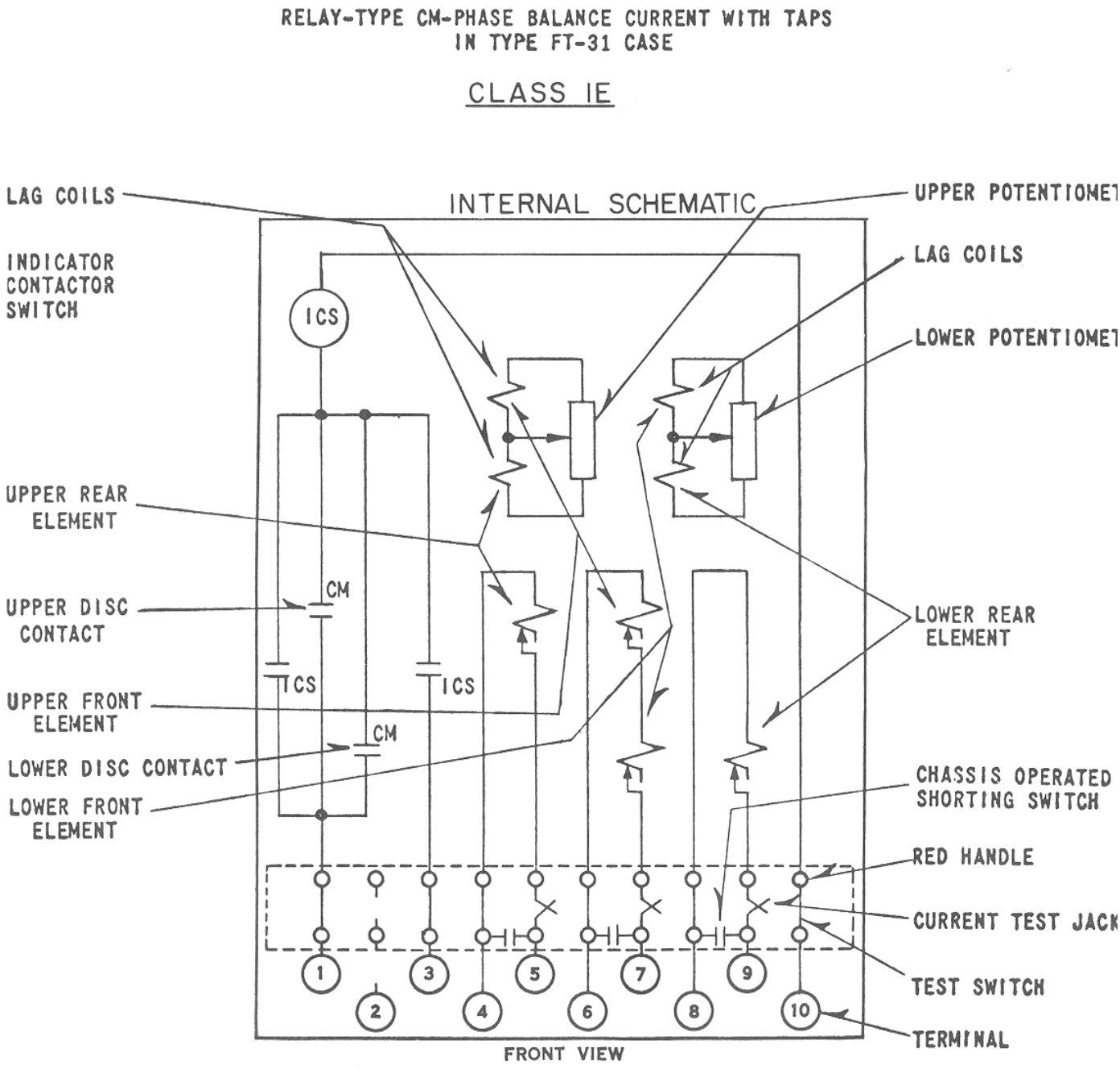


*Fig. 6. Internal Schematic of the Class 1E Type CM Relay in the Type FT-31 Case.*

2. Minimum Trip Setting

The front electromagnet energized alone should produce a disc rotation to the left while the rear electromagnet eneegized alone should produce a disc rotation to the right.

a) Apply one ampere to front electromagnet and adjust left stationary contact until it just makes with the moving contact. This setting should correspond with the marking on scale plate.

b) Apply one ampere to rear electromagnet and adjust right stationary contact until it just makes with the moving contact. This setting should correspond with marking on scale plate.

3. Operating Curve

Apply six amperes to front electromagnet and vary current flowing through rear electromagnet.

a) The moving contact should make with the right stationary contact between 6.5 and 7.1 amperes.

b) The moving contact should make with the left stationary contact between 5.5 and 5.0 amperes.

4. Time Curve

Note: Contact travel is from balanced position to either the right or left stationary contacts.

a) Apply 10 amperes to rear electromagnet (front electromagnet de-energized) and adjust permanent magnet for an operating time to right contact of 1.0 $\pm$ 0.10 second.

b) Apply 10 amperes to front electromagnet (rear electromagnet de-energized) and check to see that operating time to left contact is 1.0 $\pm$ 0.10 seconds.

## INDICATING CONTACTOR SWITCH (ICS)

Initially adjust unit on the pedistal so that armature fingers do not touch the 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.

## 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 complet nameplate data.

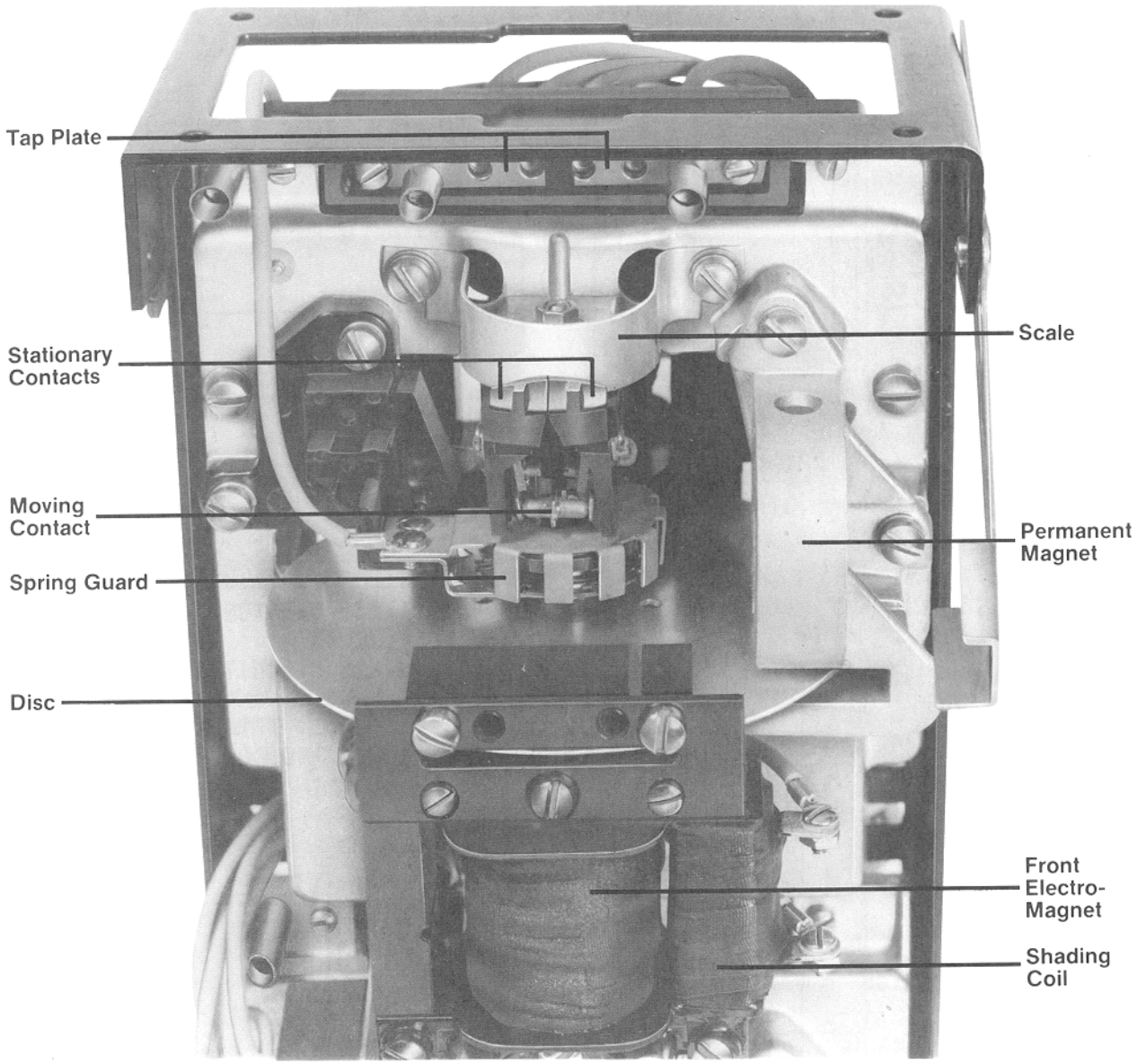


*Fig. 7. Element Assembly for CM Relay (Front View)*

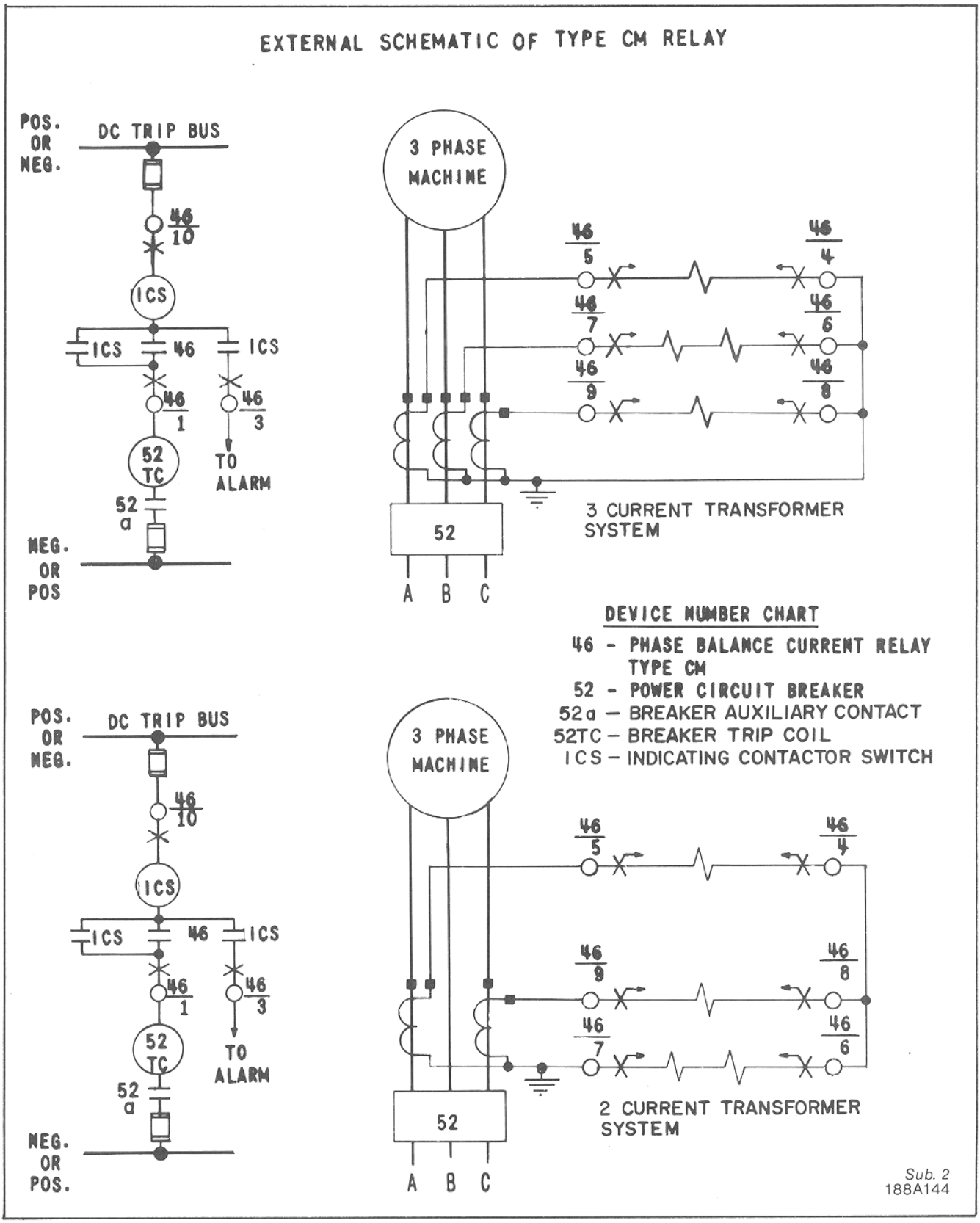


*Fig. 8. External Schematic Diagram of the Type CM Relay in the Type FT-31 Case.*

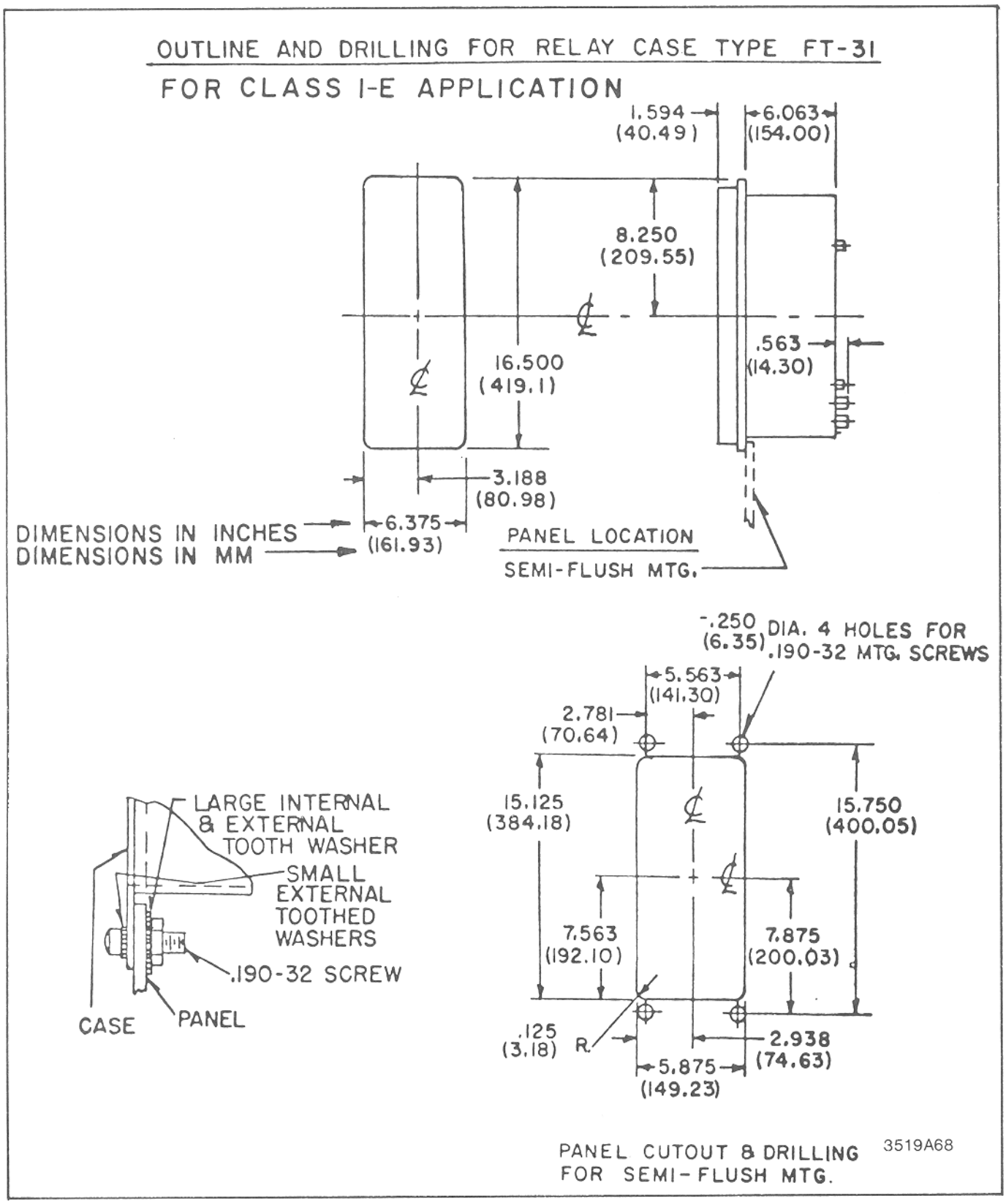


*Fig. 9. Outline and Drilling Plan for the Type CM Relay in the Type FT-31 Case.*

THIS PAGE FOR NOTES

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