



## INSTRUCTIONS

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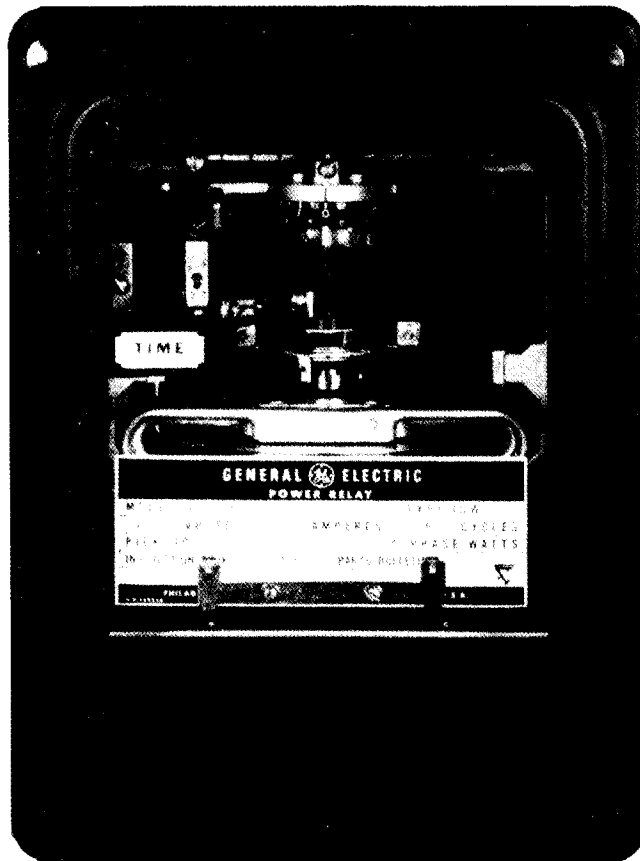
# POWER RELAYS

### Types

ICW51A

ICW52A

ICW52B



GENERAL  ELECTRIC

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# POWER RELAYS TYPE ICW

## DESCRIPTION

The several types of ICW Relays covered by this instruction book are single phase, time delay, power directional relays in size S1 drawout cases for use on 3-phase power systems. In general these relays are designed for operation at rated system voltage to detect an abnormal power flow in a given direction. For balanced load conditions only one relay is required per terminal. The different types of relays are listed in the following table:

Relay Type	Application	Contacts	Target Seal-In
ICW51A	Overpower	1-Normally Open	Yes
ICW52A	Over & Underpower	1-Normally Open	No
ICW52B	Overpower	1-Normally Closed 2-Normally Open	Yes

The available ranges and ratings are given in this book under the section on RATINGS.

## APPLICATION

### ICW51A AND ICW52B RELAYS

The ICW51A and ICW52B relays are applied on 3-phase systems where time delay over-power or reverse-power protection is required for electrical equipments and circuits. These relays are not intended for use as fault protective relays.

Specifically, both of these relays are very well suited for the protection of generators against motoring on loss of input energy to the prime mover. Since the relays are calibrated in 3-phase watts, if the balanced 3-phase motoring energy in secondary watts taken by the generator exceeds the pick-up setting of the relay it will operate. In general the relays will be suitable for application on all gas turbines, all reciprocating engines, some hydraulic turbines and some small steam turbine generators. However, calculations should always be made to check the application and select the proper relay range. See the section on CALCULATIONS OF SETTINGS for a worked example. If a more sensitive device is required the Type GGP relay should be used.

Only one ICW51A or one ICW52B is required per terminal for balanced 3-phase systems but three can be used for unbalanced conditions. The external connections for these relays are illustrated in Fig. 1.

### ICW52A RELAY

The ICW52A relay is applied on equipment and circuits where over-and/or under-power supervision is required. It is not intended for use as a fault protective relay. This relay is calibrated in 3-phase watts and only one relay is required per terminal for balanced 3-phase systems, but three can be used for unbalanced conditions if desired. Since the

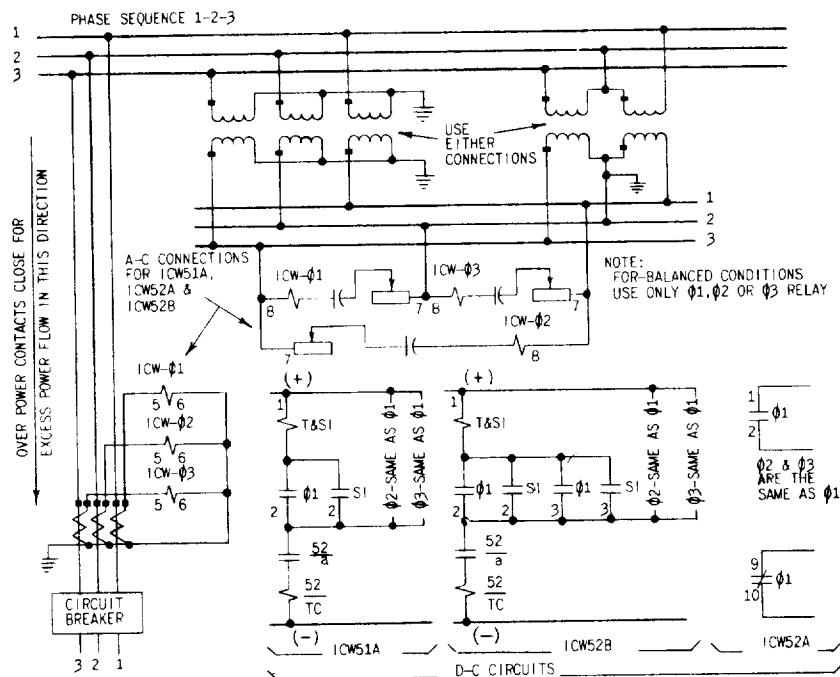


Fig. 1 External Connection Diagrams For ICW51A, 52A And 52B Power Relays

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

To the extent required the products described herein meet applicable ANSI, IEEE and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

TABLE A

VOLTS		3-PHASE SECONDARY WATTS	CURRENT COILS	
LINE TO LINE	RANGE		CONTIN.	1-SEC.
120	15-60	15-20-25-32-40-50-60	3.5A	130A
	25-100	25-32-40-50-63-80-100	5	185
	50-200	50-63-80-100-125-160-200	5	265
	100-400	100-125-160-200-240-300-400	5	265
	200-800	200-240-300-400-480-600-800	5	265
208	26-104	26-35-44-55-70-87-104	3.5A	130A
	44-175	44-55-70-87-110-140-175	5	185
	87-350	87-110-140-175-215-275-350	5	265
	175-700	175-215-275-350-415-520-700	5	265
	350-1400	350-415-520-700-830-1000-1400	5	265

relay provides a control or supervising function, it has no target seal-in unit. The external connections for this relay are illustrated in Fig. 1. Sample calculations are provided in the section under CALCULATIONS OF SETTINGS.

**RATINGS**

The Type ICW power directional relays covered by these instructions are available with potential circuits rated for 120 or 208 volts line to line, 50 or 60 cycles, and with calibration ranges and taps, and current coil ratings as shown in Table A.

**CONTACTS**

The main contacts of the relay will carry 2.0 amperes continuously and will close and carry 30 amperes DC momentarily for tripping duty at control voltages of 250V DC or less. The breaker trip coil circuit should, however, always be opened by a circuit breaker auxiliary switch or other suitable means. If the tripping current exceeds 30 amperes an auxiliary tripping relay should be used.

On those relays which include a combination target and seal-in unit (see DESCRIPTION) the current-carrying rating of the associated main contact circuit is determined by the tap setting of the seal-in coil as shown in Table B:

When the main contacts are not by-passed by seal-in unit contacts, as in the ICW52A, they may be required to interrupt the circuit. The interrupting ratings of the main contacts for inductive and non-inductive loads are shown in Table C:

The tap values listed in the table are the 3-phase secondary watts required to close the left contact. In the case of the Type ICW52A over- and under-power relay the right contact can be set to close over a range of 50 to 95 percent of tap value. The relays are suitable for operation at the continuous ratings listed above in a maximum ambient of 40 degrees C.

TABLE B  
TARGET AND SEAL-IN UNIT

	2 Amp Tap	0.2 Amp Tap
DC Resistance	0.13 ohms	7 ohms
Minimum Operating	2.0 amps	0.2 amps
Carry Continuously	3.5 amps	0.35 amps
Carry 30 amps for	4 secs	-----
Carry 10 amps for	30 secs	0.2 secs
60-cycle Impedance	0.53 ohms	52 ohms

TABLE C  
INTERRUPTING RATINGS OF MAIN CONTACTS

VOLTS	INTERRUPT			
	INDUCTIVE		NON-INDUCTIVE	
	AC	DC	AC	DC
125	0.6A	0.14A	1.5A	0.30A
250	0.3	0.07	0.75	0.15

**CHARACTERISTICS**

**OPERATING PRINCIPLES**

The induction disk unit of the ICW relays covered by these instructions is similar in operating principles to the familiar watt-hour-meter unit. Operating torque results from the interaction of the magnetic fluxes produced by the current coil (upper) and potential coils (lower). Maximum operating torque occurs when the operating current at the relay terminals leads the polarizing voltage by 90 degrees. Consequently if quadrature polarizing voltage is used (see APPLICATION) maximum torque will occur when the power system line current is at unity power factor.

to tap setting with rated voltage on the potential circuit are shown in Fig. 2. Pickup and reset time curves for the Type ICW52A over-and-under-power relay in terms of percent of the power required to close the left contact with rated voltage on the potential circuit are shown in Fig. 3.

Dropout time for the ICW51A and ICW52B relays, i.e. time to reopen the left contact when the relay is deenergized, is approximately 0.05 secs. Reset time, i.e. the time required for the contact and shaft assembly to reset against the stop, will of course depend upon the time dial setting. It is approximately 22 seconds for the No. 10 time dial setting and will be proportionately lower for lower time dial settings.

**PICKUP**

The relays can be set to pick up, i.e. close the left hand contact, at the 3-phase secondary watts listed in Table A (RATINGS). Pickup will be within  $\pm 5$  percent of the tap value selected. Closer adjustment of pickup watts, or adjustment for a pickup point between tap positions, can be obtained by adjusting the lower control spring as described under INSTALLATION PROCEDURE. The relays will drop out, i.e. open the left hand contact, at approximately 98 percent of the pickup setting.

**BURDEN**

\* Potential Burden at Rated Voltage:

RATED		Watts	Vars	Volt-amp	P.F.
Volts	Freq.				
120	60	4.62	1.01	4.73	0.98
208	60	7.43	1.09	7.51	0.99
240	60	9.80	2.00	10.0	0.98
480	60	61.3	6.1	61.6	0.99
120	50	4.38	0.66	4.43	0.99
208	50	5.12	0.79	5.18	0.99

**OPERATING AND RESET TIMES**

Pickup time curves for the Types ICW51A and ICW52B overpower relays as a function of multiples

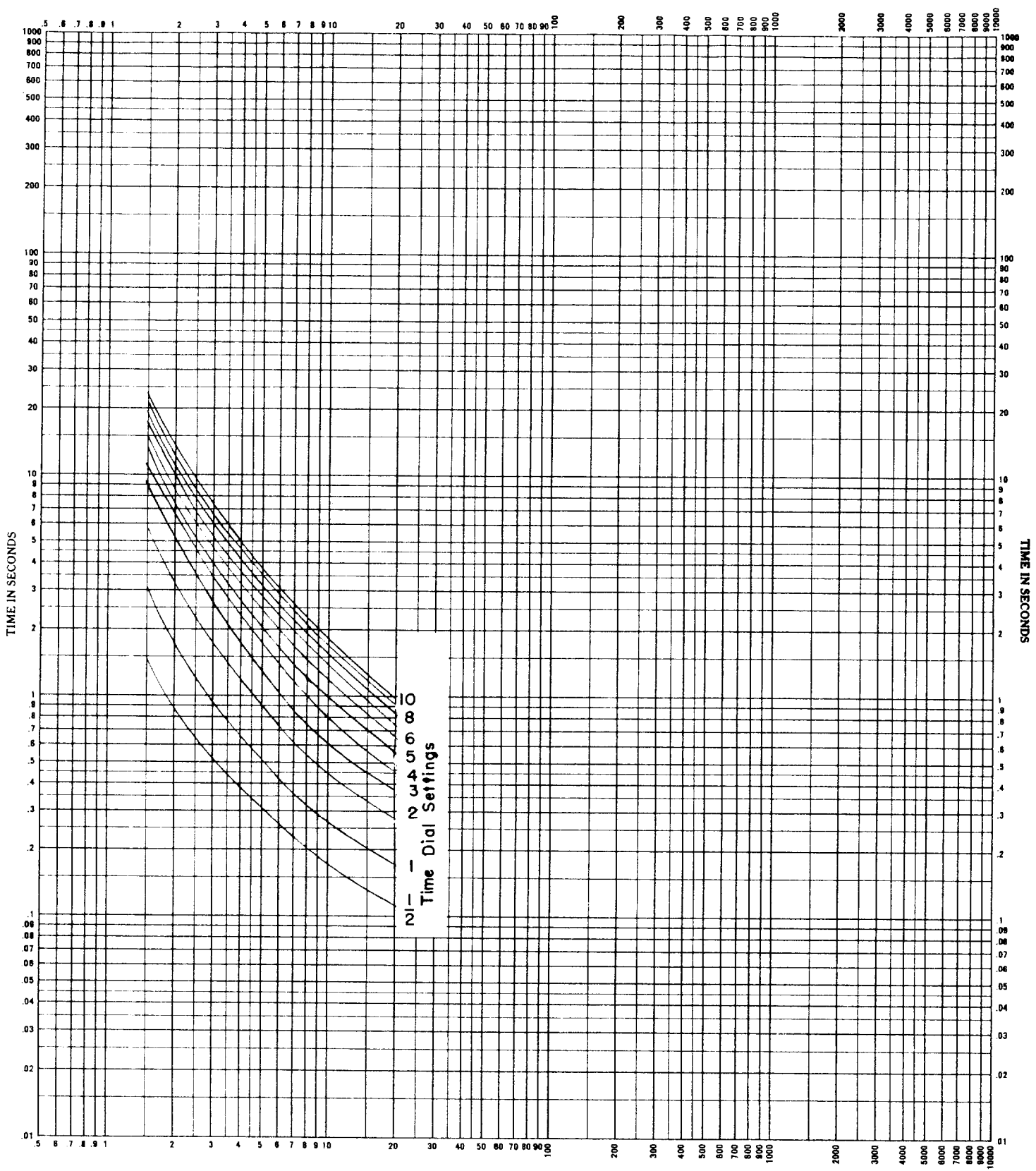
\* The burdens imposed on the current transformer are shown in Table D.

\* TABLE D

RATINGS			** BURDEN AT MINIMUM PICKUP			BURDEN IN OHMS IMPEDANCE AT:			
RANGE	V	Freq.	R	X	Z	5 Amp	10 Amp	20 Amp	40 Amp
10-40	120	60	2.08	6.4	6.7	5.70	3.82	2.88	2.34
15-60	120	60	0.92	2.8	2.9	2.80	2.70	1.40	1.10
26-104	208								
15-60	120	50	0.80	2.3	2.4	2.32	1.74	1.16	0.91
20-80	120	60	0.52	1.6	1.7	1.70	1.44	0.97	0.73
25-100	120	60	0.33	1.0	1.04	1.04	0.96	0.68	0.47
44-175	208								
100-400	480								
25-100	120	50	0.30	0.80	0.85	0.85	0.79	0.55	0.39
50-200	208	60	0.25	0.75	0.78	0.78	0.76	0.55	0.37
50-200	208	50	0.21	0.62	0.65	0.65	0.64	0.46	0.31
50-200	120	60	0.08	0.25	0.26	0.26	0.26	0.24	0.17
87-350	208								
100-400	240								
50-200	120	50	0.07	0.21	0.22	0.22	0.22	0.20	0.14
100-400	120	60	0.02	0.063	0.07	0.07	0.07	0.07	0.06
175-700	208								
200-800	120	60	0.005	0.016	0.017	0.017	0.017	0.017	0.017
350-1400	208								
200-800	120	50	0.004	0.013	0.014	0.014	0.014	0.014	0.014
100-1000	120	60	0.23	0.70	0.74	0.74	0.74	0.53	0.36
100-1000	120	50	0.20	0.58	0.60	0.60	0.60	0.43	0.29

\*\* The values given are those for the minimum tap of each relay. The values for other taps at pickup (Tap Rating) varies approximately inversely as the square of the tap rating. Burdens are on the basis of the pickup current with rated voltage applied to the potential circuit.

\*Indicates revision



MULTIPLES OF TAP VALUE - RATED WATTS

Figure 2 (0891B0460-1) Time-Watt Curve for ICW51 Relays

### CALCULATION OF SETTINGS

#### ICW51A AND ICW52B RELAYS

Consider a 3-phase 13.8 KV, 2,500 KVA diesel driven generator for which it is desired to provide protection against motoring. Assume that the 3-phase motoring real power losses for this machine are given by the manufacturer as 15 per cent of the full load KVA rating. Thus, the 3-phase motoring power is  $(2500)(0.15) = 375$  KW

Since the full load current on this unit is:

$$\frac{2500}{13.8 \sqrt{3}} = 102.5 \text{ primary amperes,}$$

assume that 150/5 CT's are employed. Assume also that the PT's provide 120 secondary phase-to-phase volts with a 120/1 ratio.

The 3-phase secondary motoring power taken by the generator is:

$$\begin{aligned} \text{Secondary Watts} &= \frac{\text{Primary Watts} = 375000}{(\text{CT Ratio})(\text{PT Ratio})(30)(120)} \\ &= 104 \text{ Watts} \end{aligned}$$

Refer to Fig. 2 showing the operating time curves of the relays and select an operating time which is long enough to override system swings and which will not hinder the process of synchronizing the unit onto the system.

Assume that a 2.0 second operating time is desired. Fig. 2 gives a number of combinations of time dial setting and multiple of tap that will yield an operating time of 2.0 seconds. If it is desired to set the pick up for 25 secondary 3-phase watts, this will give a multiple of tap setting of

$$\frac{104}{25} = 4.16$$

From Fig. 2 set the time dial at approximately 3.6 to obtain 2 seconds operating time.

The tap setting of 25 watts may be obtained with either the 15-60 watt relay or the 25-100 watt relay. Either range may be used as long as the maximum load current does not exceed the continuous rating of the relay selected. In this case maximum full load secondary current is:

$$102.5 \times \frac{5}{150} = 3.41 \text{ secondary amperes}$$

Thus, either range may be used.

The target seal-in units in these relays have two taps. The available taps, operating currents, and resistances for this unit are given in the section under RATINGS. Since the higher of the two taps has the lower resistance, it should be used except when the minimum trip current through the unit is less than 1.5 times tap value. In this case the lower tap should be used.

Fig. 3 (389A764-0)

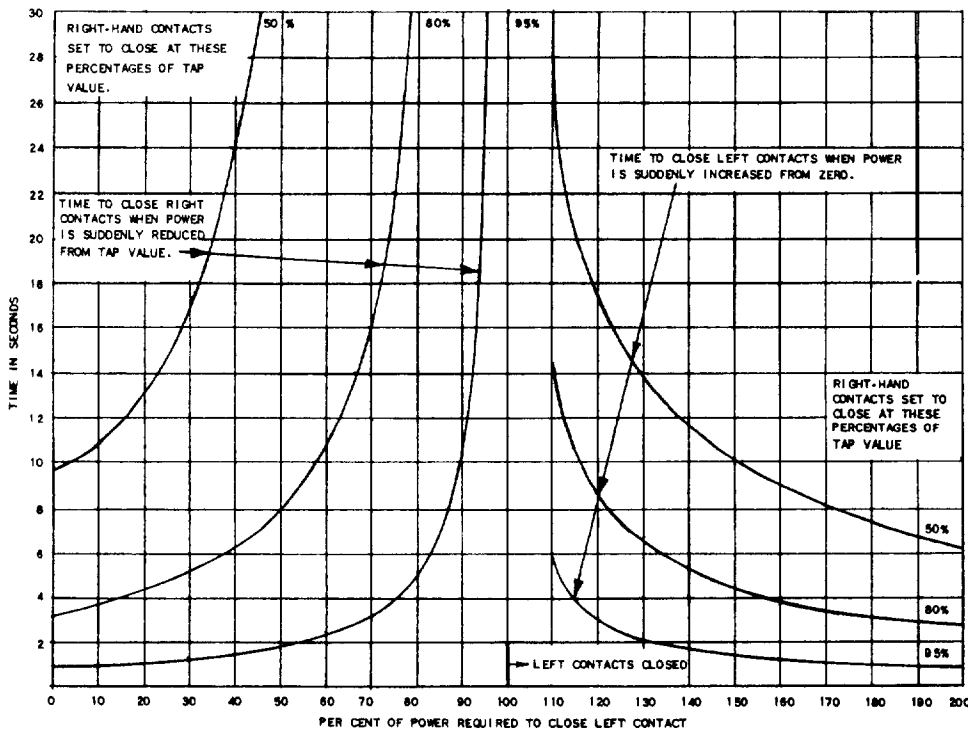


Fig. 3 Typical Time-Watt Characteristics Of ICW52A Relay With Rated Voltage Applied

**ICW52A RELAY**

Consider a 3-phase 4.18 KV circuit that normally supplies a continuous balanced load of 2,900 KVA at 0.8 power factor (2,320KW). Suppose it is desired to provide alarm and control when the load increases above 2,800 KW and when the load falls below 1,800 KW.

The maximum full load can be as high as:

$$\frac{2800}{0.8} = 3500 \text{ KVA;}$$

at 4.18 KV this is:

$$\frac{3500}{4.18 \sqrt{3}} = 480 \text{ amperes}$$

Assume 600/5 CT's and PT's having a secondary line-to-line voltage of 208 volts with a ratio of 20/1.

The overpower setting in secondary 3-phase watts is:

$$\text{Secondary Watts} = \frac{\text{Primary Watts}}{(\text{CT Ratio}) (\text{PT Ratio})} = \frac{2,800,000}{(120) (20)} = 1,170 \text{ Watts}$$

The underpower setting in secondary 3-phase watts is:

$$\text{Secondary Watts} = \frac{1,800,000}{(120) (20)} = 750 \text{ Watts}$$

Referring to the section under RATINGS it will be noted that the 350-1400 watt range is required.

**CONSTRUCTION**

The main element of the Type ICW relays is a wattmetric unit similar to that used in the standard watt-hour meter. It includes one current coil (upper) and two potential coils (lower) assembled on a common magnetic structure. Interaction between the fluxes produced by these coils results in an operating torque on the aluminum disk, which in turn drives the moving contact and shaft assembly. Motion of the disk is damped by an Alnico drag magnet which is encased in an aluminum jacket. The lower bearing for the shaft assembly consists of a polished pin driven into the shaft and riding on a sapphire jewel, spring mounted in a screw-type assembly. The upper bearing consists of an adjustable pivot assembly mounted on the frame and having a polished pin which projects into a bronze guide ring located at the top of the shaft. The shaft assembly carries the moving contact or contacts. In the case of the ICW51A the single contact circuit is completed when the moving contact touches the stationary contact brush. The spiral spring restrains the movement of the disk and shaft assembly thus determining the pickup point, and also acts as the lead-in conductor to the moving contact. A calibrated time

dial determines the distance of travel of the moving contact thus controlling the pickup time. The time dial is located in position by two screws in the die-cast frame. The ICW52B is similar except that it has two normally-open contacts, with a common lead-in spiral and moving contact. Both relays are equipped with a combination target seal-in unit whose coil is connected in series with the main contact circuit, and whose contacts are connected to by-pass the main contacts of the relay when the unit picks up. The target seal-in unit is a small hinged armature type relay consisting of a "U" shaped magnet frame, fixed pole piece, armature, and a tapped coil. The armature carries a "T" shaped moving contact which bridges the two stationary contacts, and also operates a hand reset target.

Internal connections for the ICW51A and ICW52B are shown in Fig. 4 and 5 respectively.

The ICW52A has two electrically separate moving contacts on the shaft assembly. The bottom spiral spring is the lead-in for the lower moving contact which completes the normally open contact circuit when the relay picks up. The top spiral spring is the lead-in for the upper moving contact which completes the normally closed contact circuit when the relay resets. The relative position of the two contacts on the shaft is adjustable, providing the means for controlling the spread between pickup and reset watts. The relay has no time dial or target seal-in unit. The internal connections are shown in Fig. 6.

The components of each relay are mounted on a cradle assembly which can be easily removed from the relay case. The cradle is locked in the case by means of latches at the top and bottom. The electrical connections between the case block and cradle block are completed through a removable connection plug. A separate testing plug can be inserted in place of the connection plug to permit testing the relay in its case. The cover attaches to the case from the front and includes the target reset mechanism and an interlock arm to prevent the cover from being replaced until the connection plug has been inserted.

The case is suitable for either semiflush or surface mounting on panels up to two inches thick. Hardware is available for all panel thickness up to two inches, but panel thickness must be specified on the order to insure that the proper hardware will be provided. Outline and panel drilling dimensions are shown in Fig. 12.

**RECEIVING, HANDLING AND STORAGE**

These relays, when not included as a part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Apparatus Sales Office.



Reasonable care should be exercised in unpacking the relay. If the relays are not to be installed immediately, they should be stored in their original cartons in a place that is free from moisture, dust, and metallic chips. Foreign matter collected on the outside of the case may find its way inside when the cover is removed and cause trouble in the operation of the relay.

## ACCEPTANCE TESTS

Immediately upon receipt of the relay an inspection and acceptance test should be made to insure that no damage has been sustained in shipment and that the relay calibrations have not been disturbed.

### VISUAL INSPECTION

Check the nameplate stamping to insure that the model number, rating and calibration range of the relay received agree with the requisition.

Remove the relay from its case and check by visual inspection that there are no broken or cracked molded parts or other signs of physical damage, and that all screws are tight. The drag magnet should be fastened securely in position on its mounting shelf. There must not be any metallic particles or other foreign matter in the air gap of either the wattmetric drive magnet or the drag magnet.

### MECHANICAL INSPECTION

It is recommended that the following mechanical adjustments be checked:

1. On relays with an adjustable time dial (ICW51A and ICW52B), the time dial will be locked at the No. 0 position by means of the two screws projecting through the upper shelf of the die-case frame. With the time dial at the zero position the moving contact should just touch the stationary contact. There should be sufficient clearance between the stationary contact brush and its backing strip to allow for at least 1/32" wipe. Loosen the two screws so that the time dial can be turned. Then set the dial at the approximate setting which will be used when the relay is installed. On over-and-under-power relays (ICW52A) the relative positions of the upper and lower contacts will have been set at the factory to obtain the percent reset specified on the requisition, or for 80 percent reset if no value was specified. This setting should not be disturbed.

2. The disk and shaft assembly should have a vertical end play of from 1/64" to 1/32". The set screws for the upper pivot and lower jewel screw must be tight. The disk should be approximately centered in the air gap of both the wattmetric magnet assembly and the drag magnet. The minimum permissible clearance between the disk and either the wattmetric or drag magnet is .008". The disk and shaft assembly should turn freely without noticeable friction.

On Type ICW51A and ICW52B there is a stop arm assembly located near the top of the disk shaft. There should be approximately 1/64" deflection of the leaf spring.

4. Check the location of the contact brushes on the cradle and case blocks against the internal connection for the relay. Be sure that the shorting bars are in the proper locations on the case block and that the long and short brushes on the cradle block agree with the internal connection diagram. Fig. 7 shows a sectional view of the case and cradle blocks with connection plug in place. Note that there is an auxiliary brush in each position on the case block. This brush should be formed high enough so that when the connection plug is inserted it engages the auxiliary brush before striking the main brush. This is especially important in current circuits and other circuits with shorting bars since an improper adjustment of the auxiliary brush could result in a CT secondary circuit being momentarily open circuited.

5. The armature and contacts of the target and seal-in unit (Type ICW51A and ICW52B) should move freely when operated by hand. There should be a screw in only one of the tap positions on the right stationary contact strip. Operate the armature by hand and be sure the target latches in its exposed position before the contacts close. There should be at least 1/32" wipe on the seal-in contacts. With the cover fastened securely in place, check that the target resets positively when the reset button at the bottom of the cover is operated.

### ELECTRICAL TESTS

It is recommended that the following electrical checks be made immediately upon receipt of the relay. Note that all tests should be made with the relay in its case and in a level position. The relay should be "preheated" by energizing the potential coil circuit at rated voltage for at least 15 minutes prior to the tests.

1. Pickup - Connect the polarizing and operating coil circuits of the relay as shown in Fig. 8. With rated voltage applied to the potential circuit, and the tap screw in the minimum tap position, the current required to just close the left hand contact should be within  $\pm 5$  percent of the value obtained from the following equation:

$$I_{pu} = \frac{2}{3} \left( \frac{T_m}{V} \right) \quad (1)$$

Where:  $T_m$  = Minimum tap in watts

$V$  = Rated volts

2. Dropout - In the case of the Type ICW52B relay the dropout watts, i.e. the watts at which the right hand contact will reclose as current in the operating circuit is reduced, can also be checked by means of Fig. 8. Dropout has been set at the factory as specified on the requisition, or at 80 percent of pickup watts if no value was specified. This dropout value should check within  $\pm 5$  percent.

3. Pickup Time (ICW51A & ICW52B) - Using the test connections of Fig. 8, check operating time from the No. 5 time dial setting with the tap screw

in the minimum tap position. Note that the two clamping screws must be loosened before the time dial can be turned. With an operating current of five times the pickup current determined in equation (1) above and rated voltage on studs 7 and 8, the pickup time should be 1.90 to 2.10 seconds. Then check the time with an operating current of 10 times the pickup determined in equation (1). Pickup time should be 0.85 to 0.95 seconds.

**4. Target Seal-In Unit** - With the target in the "down" or unexposed position, check pickup on both the 0.2 and 2.0 ampere taps with the watt-metric unit contact held closed by hand. Use a DC source with the circuit arranged so the test current through studs 1-2 can be gradually increased to the pickup point. Pickup current should be tap rating or less. With pickup current still flowing, open the wattmetric unit contact and check that the seal-in unit remains picked up. Refer to the section on Target Seal-In Unit settings under INSTALLATION PROCEDURE for the recommended steps to change the tap setting.

## INSTALLATION PROCEDURE

If after the ACCEPTANCE TESTS the relay is held in storage before shipment to the job site, it is recommended that the visual and mechanical inspection described under the section on ACCEPTANCE TESTS be repeated before installation.

Before any of the following electrical adjustments are made the relay should be in its case, preferably mounted in its permanent location, and should be "preheated" by energizing the potential coil circuit at rated voltage for at least 15 minutes.

### RELAY SETTINGS

Refer to the section on CALCULATIONS AND SETTINGS for a discussion of suggested procedures for determining pickup and operating time settings for a specific application.

**1. Pickup** - Wattmetric unit pickup in terms of 3-phase watts can be set by inserting the tap screw in the desired position. If the pickup adjustment is being made on a relay already in service, be sure to remove the relay connection plug before changing the tap screw position. The tap screw must be securely tightened if its position has been changed. The actual pickup should then be checked using the test connections of Fig. 9, which shows test plug connections for testing the relay from the front of the panel.

In most instances a setting obtainable by one of the tap positions will be satisfactory and no further adjustment will be required. In some cases, however, it may be desirable to have a pickup setting which falls between available tap positions. Such intermediate settings may be obtained by placing the tap screw in the tap position nearest to the required pickup and adjusting the lower control spring until the required pickup is obtained. Refer to the section on SERVICING for a more detailed description of pickup adjustment.

**2. Dropout** - For over- and under-power relays (Type ICW52A) the magnitude of power below which the normally closed (right-hand) contact will be closed is determined by the pickup setting and the contact gap. If the desired dropout was not specified on the requisition, it will have been set at 80 percent of pickup at the factory and the desired value will have to be set during installation. The recommended procedure for setting the dropout point on over-and under-power relays is described in the section on SERVICING.

**3. TIME SETTING** - On over-power relays (ICW51A and ICW52B) operating time at a given multiple of pickup watts is determined by the setting of the time dial. If the required operating time is known (see CALCULATION AND SETTINGS), the necessary time dial setting can be determined from the pickup time curves in Fig. 2 and the dial set at the required position. Note that before the time dial setting can be changed, the two locking screws projecting through the shelf on the die-cast frame must be loosened. When thus adjusted the relay will have an operating time accuracy of  $\pm 8$  percent of the value shown in Fig. 2. It is suggested that after the time dial has been set in accordance with the pickup time curves, the actual operating time be checked using the test connections of Fig. 9.

On over- and under-power relays (Type ICW52A) the contact closing time is determined by the pickup and dropout settings as indicated in Fig. 3. It is possible to set any two of the three variables. For instance, if pickup and dropout are set for specific values as described in preceding paragraphs 1 and 2, then the time characteristics are determined by the resulting gap setting and cannot be varied without also affecting the dropout watts. If pickup watts and dropout time are the important characteristics, then the pickup value can be set as described in paragraph 1 and the contact gap adjusted until the desired dropout time is obtained. The value of dropout watts will then be fixed by the gap and cannot be changed without affecting dropout time.

**4. TARGET SEAL-IN UNIT** - As shipped from the factory the tap screw of the target seal-in unit will be in the 2.0A tap. To change the tap setting remove the spare tap screw from the left stationary contact member and insert it in the vacant tap on the right stationary contact member. Then remove the original screw from the right contact member and place it in the spare position on the left contact member. This procedure is necessary to avoid disturbing the adjustment of the right stationary contact. Screws should never be left in both tap positions on the right contact member.

## PERIODIC CHECKS AND ROUTINE MAINTENANCE

In view of the vital roll of protective relays in the operation of a power system it is important that a periodic test program be followed. It is recognized that the interval between periodic checks will vary depending upon environment, type of relay, and the user's experience with periodic testing. Until the user has accumulated enough experience to select

the test interval best suited to his individual requirements it is suggested that the following points be checked at an interval of from one to two years.

### MECHANICAL CHECKS

Operate the disk and shaft assembly by hand and check that the contacts are making with the proper wipe. Allow the disk to reset and check that there is no sign of excessive friction or tendency to bind. If there are signs of friction refer to the paragraph on friction in **SERVICING**.

Examine the contact surfaces for signs of tarnishing or corrosion. Fine silver contact should be cleaned with a burnishing tool, which consists of a flexible strip of metal with an etched, roughened surface. Burnishing tools designed especially for cleaning relay contacts can be obtained from the factory. Do not use knives, files, or abrasive paper or cloth of any kind to clean relay contacts.

Operate the target seal-in unit by hand and check that the target latches before the contacts make, and that the contacts have at least 1/32" wipe. With the cover replaced check that the target resets when the reset button is operated.

### ELECTRICAL CHECKS

Connect the relay as shown in Fig. 9. Preheat the relay by applying rated voltage to the potential circuit for 15 minutes. If the relay was continuously energized prior to this test the preheat time can of course be omitted. With rated voltage applied to the potential polarizing circuit check the pickup current. This should be within  $\pm 3$  percent of the corresponding reading recorded during **INSTALLATION**.

Using the connections of Fig. 9 make a spot check of the pickup time. This check should be made at three points on the time characteristic, say at 3, 5 and 10 times pickup. The recorded times should be within  $\pm 3$  percent of the times recorded for the same pickup multiples during **INSTALLATION**.

It is not recommended that the relay be readjusted when minor deviations from the previous test, within the prescribed limits, are noted. Such deviation can be introduced by differences in test equipment or by human error.

**NOTE:-** The test source should be at least 120 volts (rated frequency) of good wave form and constant frequency. A resistive load box should be used in the supply to the current circuits. Low voltage transformers or "phantom loads" should not be used for testing induction relays since the distorted wave forms which may result will affect relay performance.

### SERVICING

If any of the mechanical or electrical check points described in the previous sections are found to be out of limits, the following points should be observed in restoring them.

### MECHANICAL ADJUSTMENTS

**1. Moving Contact Adjustment** - On relays with an adjustable time dial, the moving contact should just touch the stationary contact when the time dial is set at the zero position.

If readjustment is necessary loosen the two clamping screws which fasten the stop arm to the shaft and change the position of the stop arm relative to the moving contact until the contacts just touch with the time dial set at zero. A fine adjustment can be obtained by moving the stationary contact brush in or out by means of its adjusting screw. However, in the final adjustment the contact brush must be positioned so that there is at least 1/32" wipe with the contacts fully closed. Be sure that the clamping screws on the stop arm are securely tightened after the moving contact has been correctly positioned.

The leaf spring on the stop arm should be so formed that there is approximately 1/64" deflection. The deflection can be increased if necessary by forcing a thin screwdriver blade between the leaf spring and the stop arm.

**2. Shaft End Play** - End play is determined by the relative positions of the lower jewel bearing and upper pivot. Both bearing and pivot are held in position by means of set screws in the die-cast supporting frame. The lower jewel must be located so that the disk is approximately centered in the airgaps of the wattmetric magnet and the drag magnet. The upper pivot should then be located so that the shaft has 1/64" to 1/32" end play. Be sure that both set screws are securely tightened after the adjustment is completed.

**3. Friction** - If a tendency to bind or excessive friction is evident, first check for obstructions to the disk travel. Dirt or metallic particles in the wattmetric or drag magnet gaps can interfere with the motion of the disk.

**4. Target & Seal-In Unit** - There should be at least 1/32" wipe on the contacts of the target and seal-in unit, measured at the end of the armature adjacent to the contacts. If wipe is too small, it can be increased by lowering the position of the stationary contact members. In the final adjustment the contacts should make approximately at the same instant when the armature is operated by hand, and the target should latch in the exposed position slightly before the contacts close.

### ELECTRICAL ADJUSTMENTS

**1. Pickup Adjustment** - If it is necessary to readjust pickup or if a pickup point is desired which falls between tap positions, the following procedure is recommended. Connect the relay as shown in Fig. 8 if the test is being made in the laboratory, or as in Fig. 9 if the relay is being tested in position on the panel. Determine the pickup current corresponding to the desired tap setting or intermediate pickup watts from the following equation:

$$I = \frac{2}{3} \times \left( \frac{T}{V} \right)$$

Where: T = Desired pickup in watts  
V = Rated voltage

Set the current in the operating circuit at the value thus determined. Apply rated voltage to the polarizing circuit, and adjust the lower control spring until the contacts just close. The lower control spring is adjusted by inserting a screwdriver in one of the notches in the periphery of the spring adjusting ring and then turning the ring using the screwdriver blade as a lever. Turning the ring counterclockwise increases the pickup, while turning it clockwise decreases pickup.

**2. Dropout Adjustment (Type ICW52A)** - For over- and under-power relays the magnitude of power below which the normally closed (right hand) contact will be closed is determined by the pickup setting and contact gap. Unless otherwise specified dropout will be set for 80 percent of pickup. If it is desired to change this ratio of dropout to pickup watts, loosen the two locking screws in the clamp bar at the top of the shaft. The moving contact associated with the normally closed contact is fastened to this clamp bar and hence can be turned relative to the other moving contact. The spread between these two moving contacts should be set so that the right contact closes at the desired percentage of the watts required to close the left contact. Since the lead-in spring for the upper moving contact is also connected to the clamp bar, changing the position of the clamp bar will change the pickup slightly. Pickup must then be restored by adjusting the lower control spring as described in paragraph 1 on PICKUP. After both pickup and dropout have been set for the desired values the locking screws on the upper clamp bar should be tightened.

**3. Pickup Time** - If pickup time is found to be outside the limits mentioned in ACCEPTANCE TESTS and PERIODIC CHECKS it can be restored by changing the position of the drag magnet on its supporting shelf. Using the test diagram of Fig. 9, adjust the position of the drag magnet on the self until the operating time falls within the limits specified in ACCEPTANCE TESTS.

**RENEWAL PARTS**

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any that are worn, broken, or damaged.

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specify quantity required, name of part wanted, and give complete nameplate data. If possible, give the General Electric Company requisition number on which the relay was furnished.

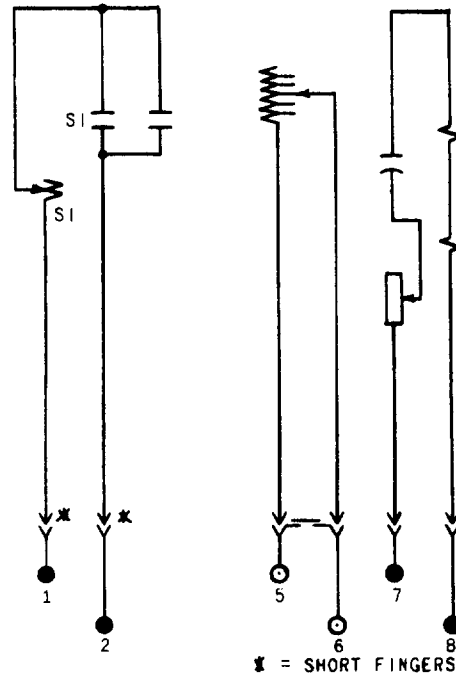


Fig. 4 Internal Connections (Front View) of ICW51A Relay

Fig. 4 (362A630-1)

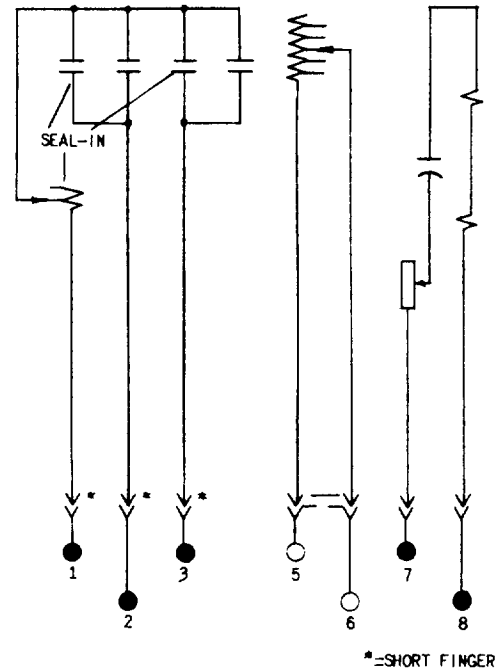
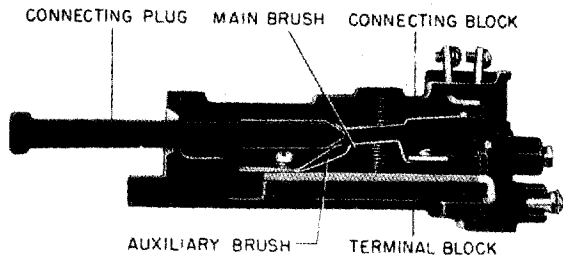
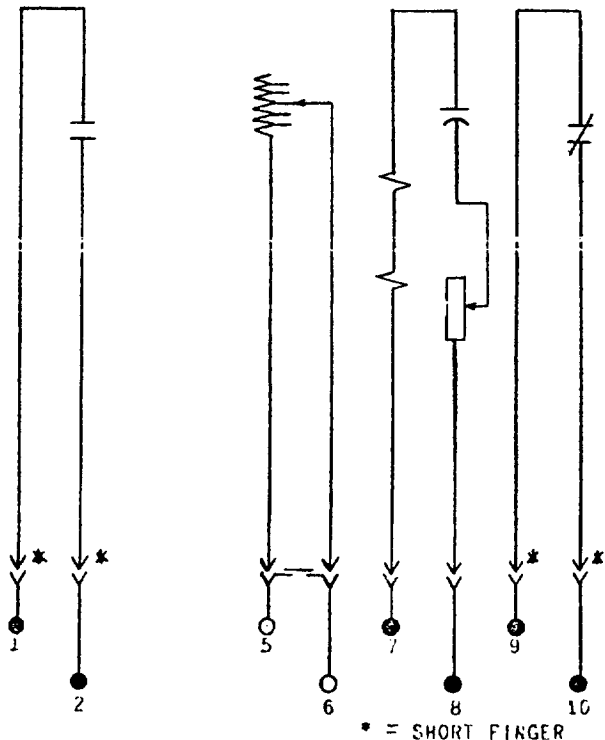


Fig. 5 Internal Connections (Front View) of ICW52B Relay

Fig. 5 (418A990-0)

Fig. 6 (362A628-2)

Fig. 7 (8025039)



NOTE: AFTER ENGAGING AUXILIARY BRUSH, CONNECTING PLUG TRAVELS 1/4 INCH BEFORE ENGAGING THE MAIN BRUSH ON THE TERMINAL BLOCK.

\*Fig. 6 Internal Connections (Front View) of ICW 52A Relay

Fig. 7 Cross Section Of Drawout Case Showing Position Of Auxiliary Brush

Fig. 8 (0148A3994A-0)

Fig. 9 (0148A3994B-0)

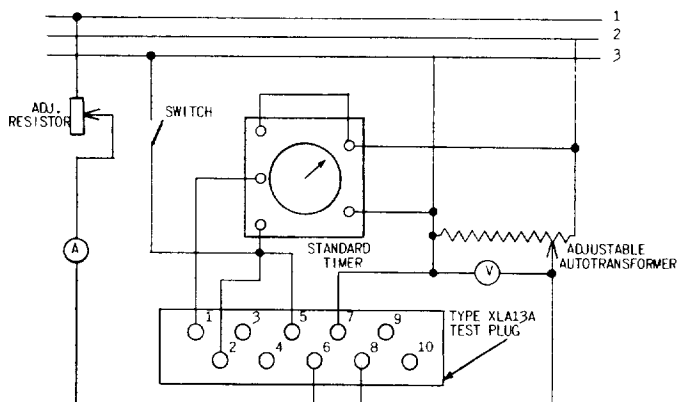
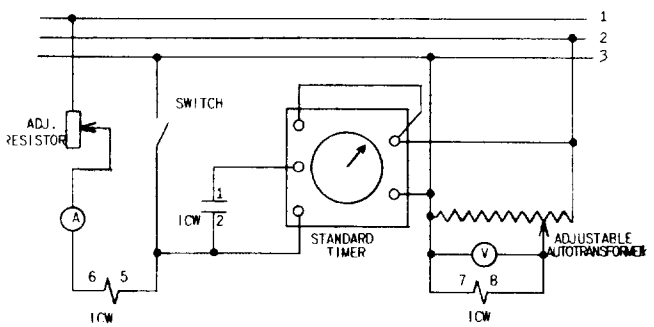


Fig. 8 Laboratory Test Connections For ICW Relay

Fig. 9 Field Test Connections For ICW Relay Using Type XLA13A Test Plug

\*Denotes change since superseded issue.

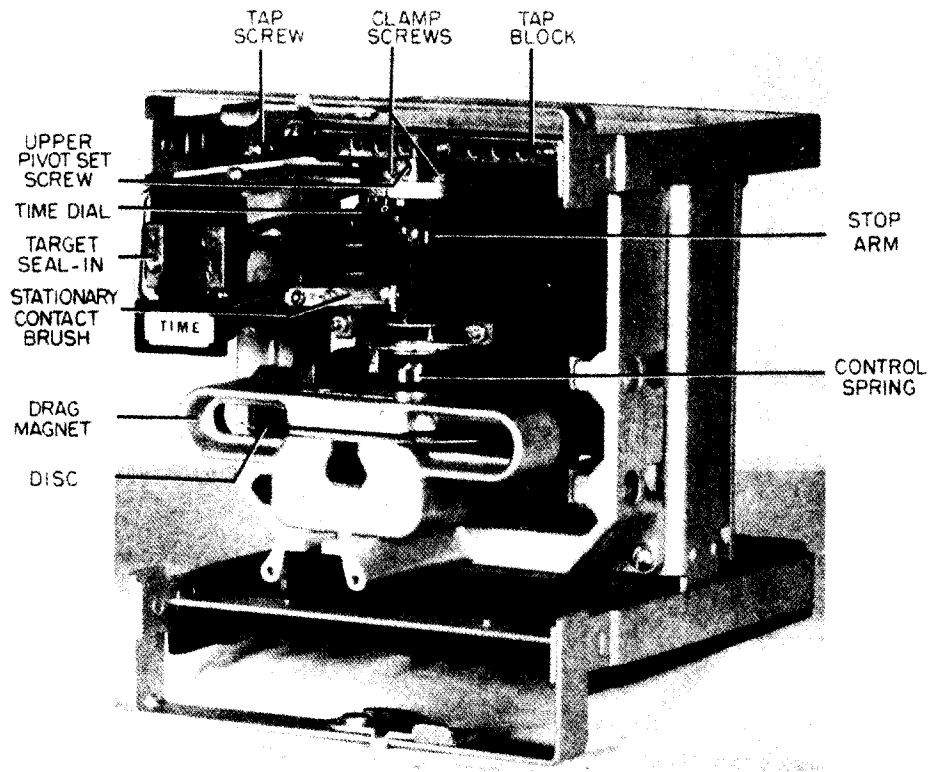


Fig. 10 ICW51A Relay Removed From Case (Front View)

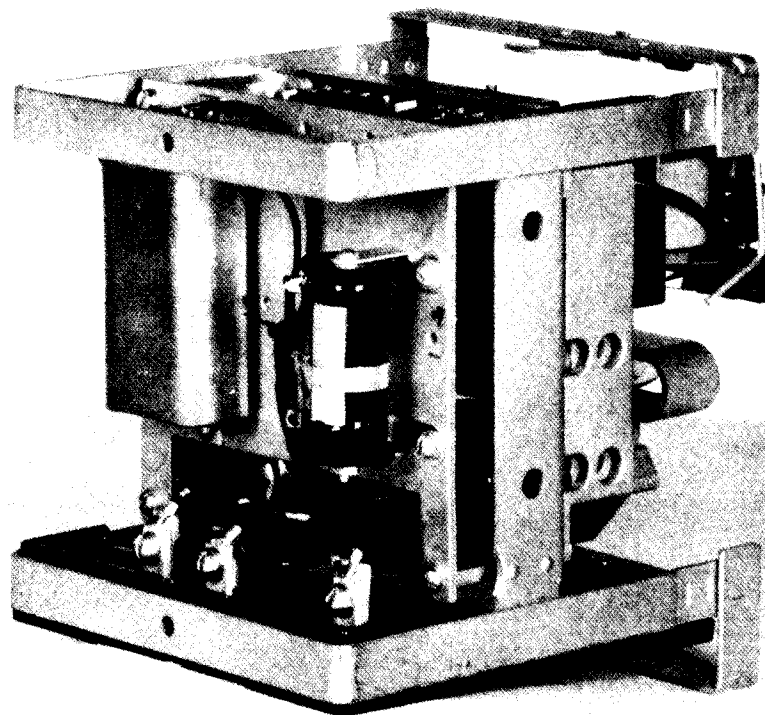
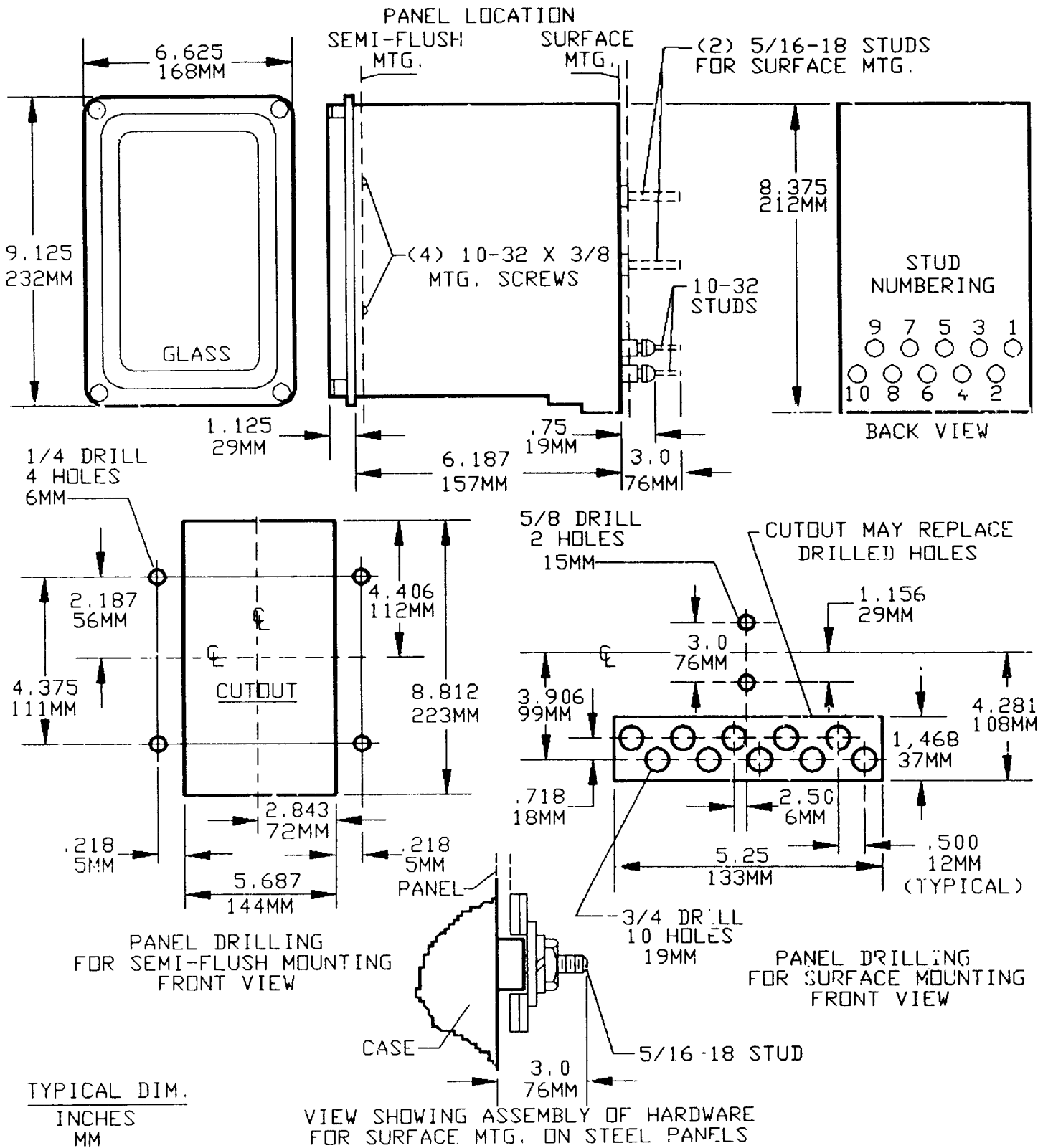


Fig. 11 ICW51A Relay Removed From Case (Rear View)

Fig. 10 (8029638)

Fig. 11 (8029639)



\* Fig. 12 (K-6209271 (8)) Outline and Panel Drilling Dimensions for Type ICW Relays

\* Indicates Revision



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