INSTRUCTIONS

GEH-1784C
Supplement to GEI-83965
Supersedes GEH-1784B

REACTIVE POWER RELAYS

TYPES ICW53A, ICW53C

GENERAL ELECTRIC

TABLE OF CONTENTS

NOTE: This instruction book has had a major revision. Please check your previous revision to compare material.

REACTIVE POWER RELAYS

VAR RELAYS

TYPES ICW53A AND ICW53C

INTRODUCTION

These relays are similar to the Type ICW51B relay covered by attached GEI-83965.

The ICW51B relay is connected to receive line current and line-to-neutral voltage and responds to the power (watts).

The ICW53A and ICW53C are connected to receive line current and the quadrature line-to-line voltage. Since the quadrature line-to-line voltage is 90 degrees from the line-to-neutral voltage, the type ICW53A and ICW53C relays respond to the reactive component of power (VARS).

The Type ICW53A relays are rated for 40, 50 or 60 hertz and have the capacitor mounted inside the relay drawout case.

The Type ICW53C relay is rated 25 hertz and for this design the capacitor is too large to fit inside the drawout case and must be mounted externally.

The Type ICW53A and ICW53C relays have double throw contacts (one normally open and one normally closed). They do not have a target or seal-in unit.

APPLICATION

The Type ICW53A and ICW53C relays are commonly used to measure reactive kilo-voltamperes and thereby control power-factor correcting equipment. By changing the tap settings, two of these relays can be used as controlling units in a capacitor installation as they function to switch capacitor steps in or out. If these relays are used for such applications, a sufficient margin between individual settings must be allowed in order to prevent pumping. Fig. 3 shows the external connections for one of these relays.

DESCRIPTION

The Type ICW53A and ICW53C relays are single phase var relays without a seal-in unit or time dial. They have double throw, single-circuit contacts with the right contact (front view) closed when the relay is de-energized. The right contact closes at a value 10 percent below the left contact-closing value. Operation is practically instantaneous for vars in excess of tap setting. The calibration is in vars based on line current and line-to-line voltage. Connections are so arranged that at three-phase unity power factor these quantities are at right angles, and no torque is produced. As the power factor decreases the torque increases until a maximum is reached at zero power factor (zero phase angle between Phase 1 current and Phase 2 to Phase 3 voltages). Three-phase var pickup is $\sqrt{3}$ times the tap setting.

ADJUSTMENTS

PICKUP

The magnitude of reactive power (vars) above which the normally open contacts will close is determined by the setting of the lower control spring. To calibrate the relay to operate at a desired value of reactive power, apply the desired pickup value of reactive power to the relay and adjust the lower control spring until the left contact just closes. The lower control spring is adjusted by inserting the blade of a screwdriver in one of the notches in the periphery of the control-spring adjusting ring and turning the adjusting ring counterclockwise to raise the pickup or clockwise to lower the pickup.

DROPOUT

The magnitude of reactive power below which the normally closed contact will be closed is determined by the contact gaps and the pickup setting. After the pickup setting is made as described above, the contact gap is adjusted by loosening the two lock screws in the clamp bar at the top of the shaft. The moving contact of the normally closed contact is connected to this clamp bar and can be turned relative to the moving contact of the normally open contact. The lead-in spring for the upper moving contact is also connected to this clamp bar, therefore, changing the position of the upper clamp bar will change the pickup setting setting slightly. This can be reset by changing the lower control spring as described above. When both the pickup and dropout are set to the desired value, the locking screws of the top clamp bar should again be tightened.

TIME SETTING

The time required to close the contacts is a function of the pickup and dropout setting. It is possible to set any two of the three variables. For instance, if the pickup vars and dropout time are important, ther the pickup value can be set as given above. The dropout time can be adjusted by adjusting the contact gap until the desired dropout time is obtained. The value of dropout vars will be determined by the gap setting that was made to get the dropout time and cannot be set to another value without changing the dropout time.

BURDENS

POTENTIAL

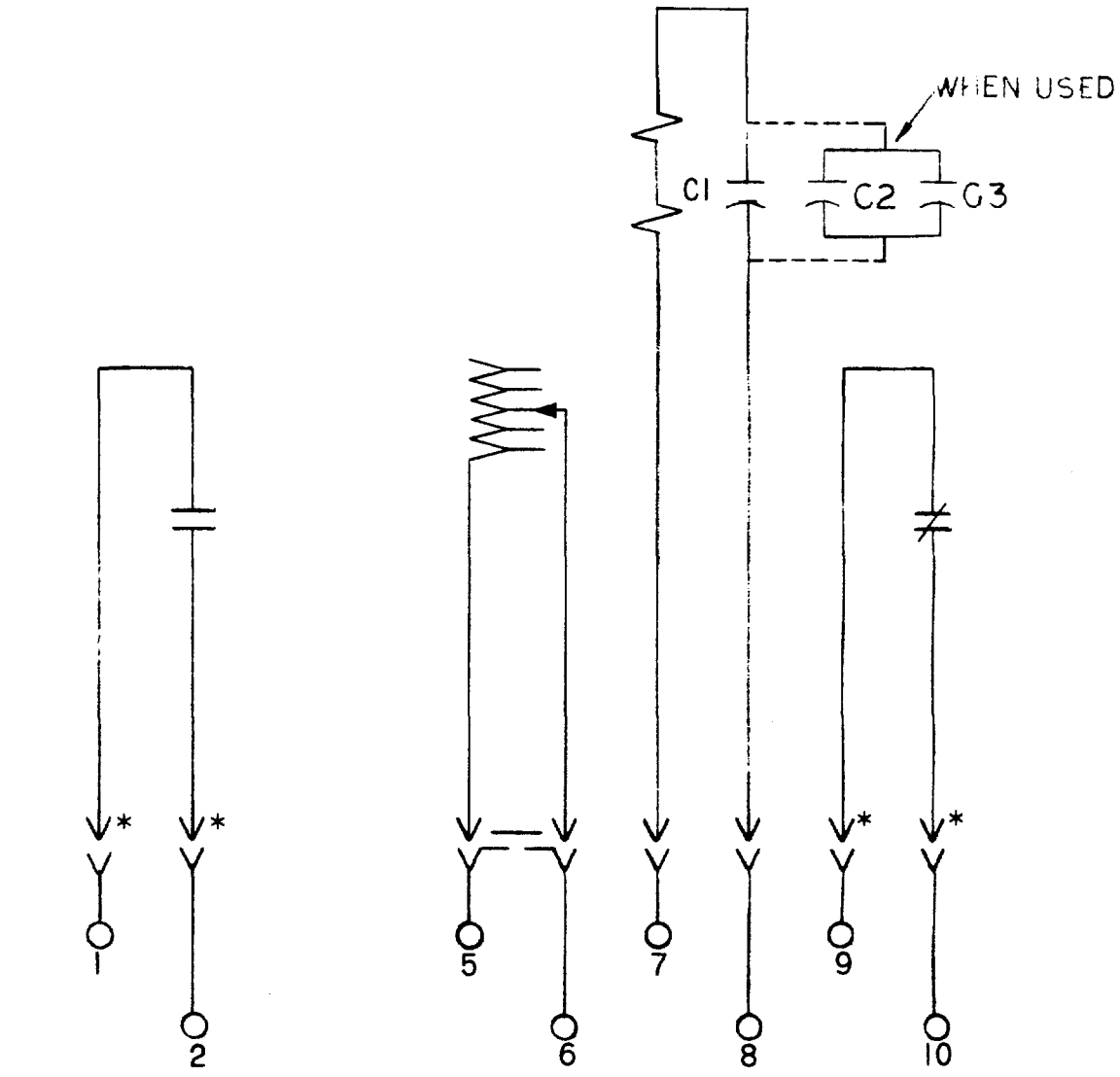
The potential burden at rated voltage and frequency is as shown below:

RATED		WATTS	VARS	VOLT-AMPS
VOLTAGE	FREQUENCY			
120	60	2.20	15.5	15.6
208	60	3.5	15.4	15.8
120	50	2.8	17.9	18.1
120	40	4.2	24.3	24.7
120	25	3.1	34.9	35.0

CURRENT

The current burden at five amperes and rated frequency is as shown below:

RATED FREQUENCY	TAP RANGE	WATTS	VARS	VOLT-AMPS
60	15-150	10.2	17.6	20.3
60	80-400	0.51	0.62	0.80
50	15-150	8.5	14.7	16.9
40	15-150	7.5	11.7	13.9
25	24-240	4.2	11.4	12.2



* = SHORT FINGER

Fig. 1 (362A632-3) Internal Connections For Type ICW53A Relay (Front View)

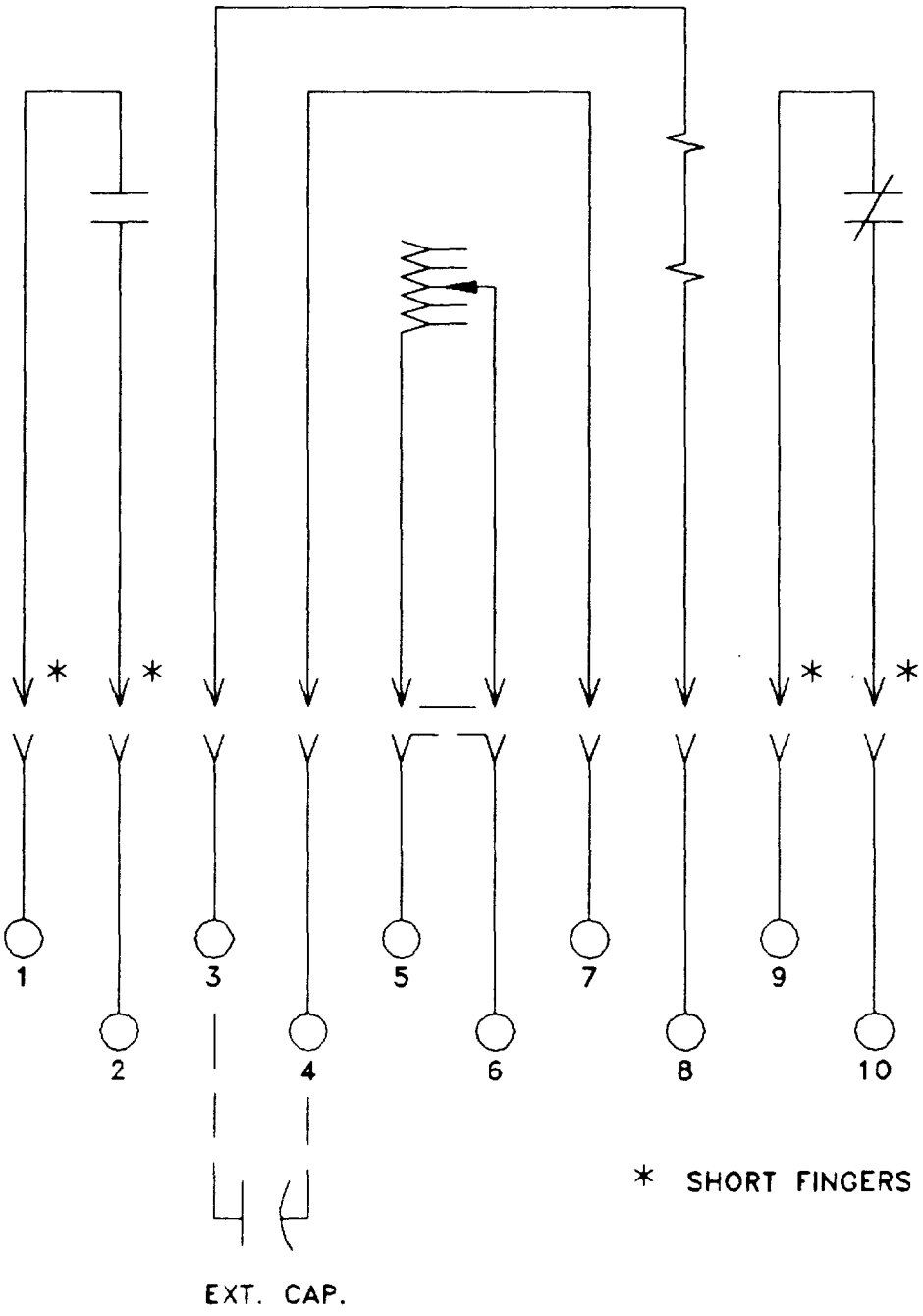
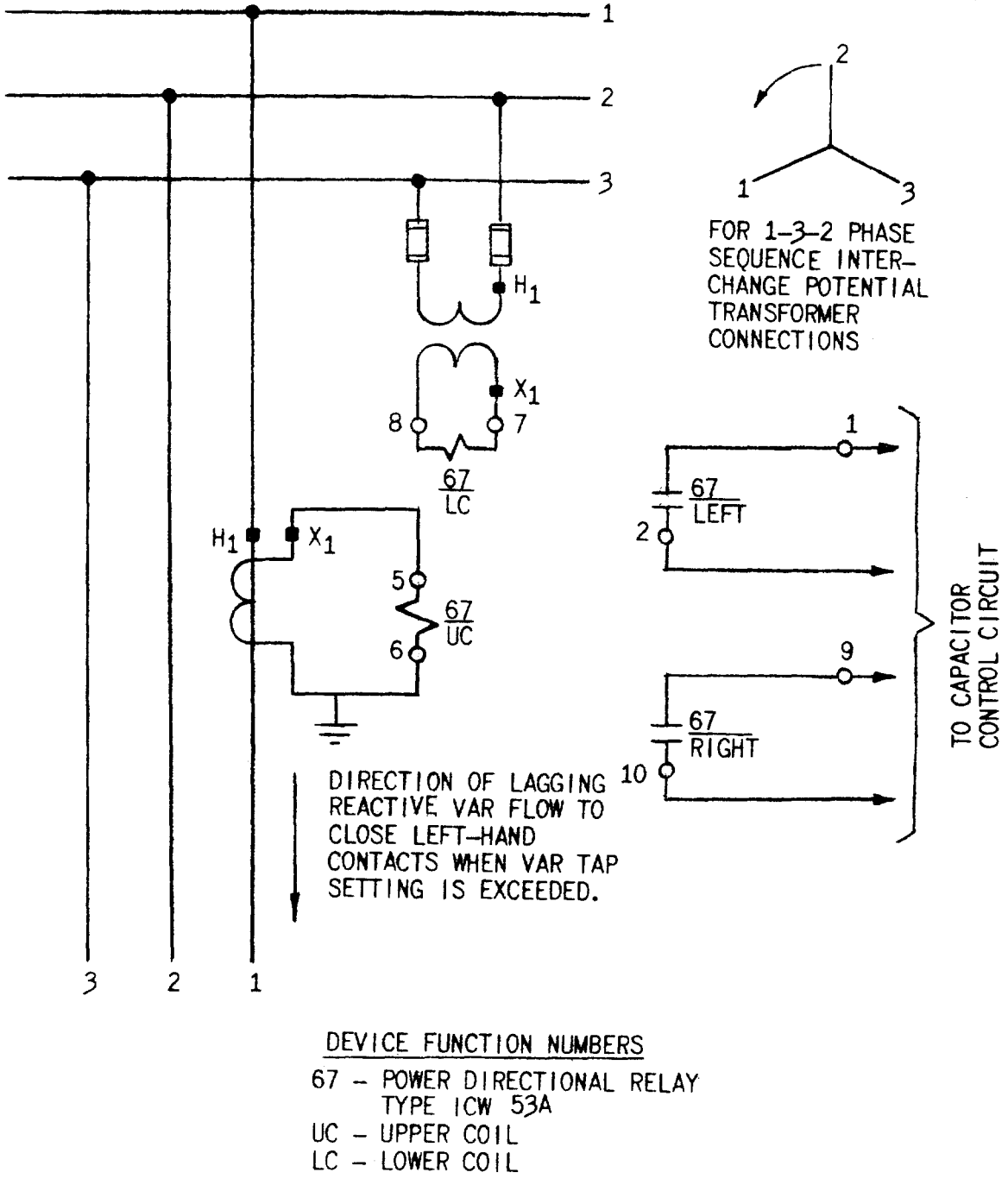


Fig. 2 (0195A9107-1) Internal Connection Diagram for Relay Type ICW53C. (Front View)



DEVICE FUNCTION NUMBERS

67 - POWER DIRECTIONAL RELAY TYPE ICW 53A
UC - UPPER COIL
LC - LOWER COIL

Fig. 3 (376A957-**3**) External Connections for The Type ICW53A Relay

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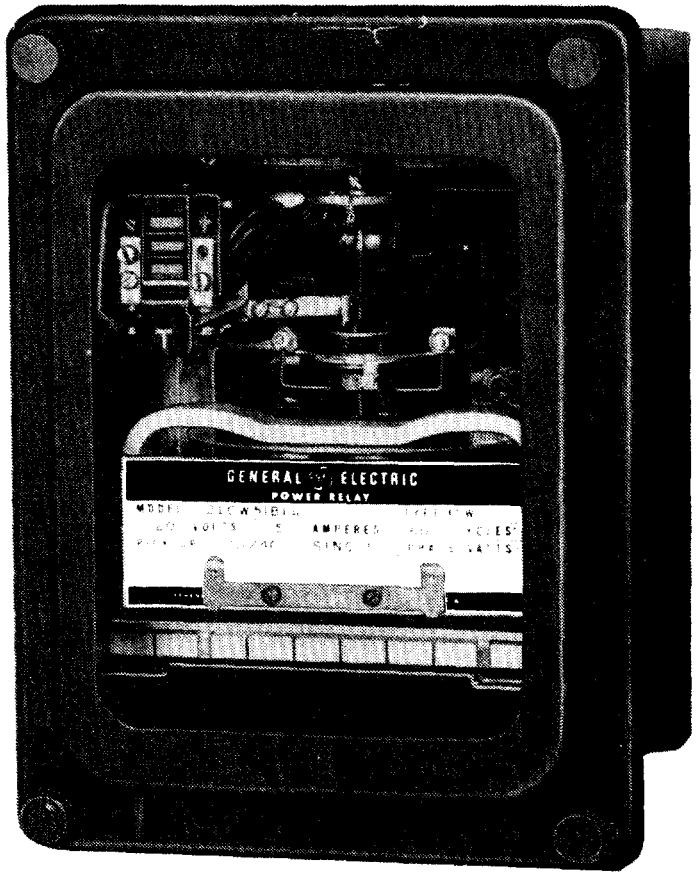
INSTRUCTIONS

GEI-83965B

DIRECTIONAL POWER RELAY

TYPE ICW51B



GENERAL ELECTRIC

DIRECTIONAL POWER RELAY
TYPE ICW51B

INTRODUCTION

The ICW51B is a single phase, induction disk time delay directional power relay. The relay is available in several ranges and its pickup is adjustable by means of taps. It has one normally open contact, a target seal-in unit and is supplied in an S1 case. Since this relay is designed to operate at or near normal rated voltage, it is not suitable for use as a fault protective or power regulating device.

RATINGS

The ICW51B power directional relay covered by these instructions are available with 120 volt potential coils, 50 or 60 cycles and with tapped current coils which provide calibration ranges given in Table A and have ratings as listed.

TABLE A

RATED VOLTS	RANGE	SINGLE PHASE WATTS TAPS	CURRENT COILS	
			CONTIN.	1 SEC.
120	10-40	10-12-16-20-25-32-40	5A	185A
	25-100	25-32-40-50-63-80-100	5A	185A
	50-200	50-63-80-100-125-160-200	5A	265A
	100-400	100-125-160-200-240-300-400	5A	265A
	200-800	200-240-300-400-480-600-800	5A	265A

APPLICATION

The ICW51B relay is designed for application where a real power directional time delay characteristic is required. On three phase systems this relay requires phase-to-neutral potential and the corresponding phase current. Thus, regardless of system conditions, these relays will measure the real power that is flowing in the particular phase to which the relay is connected. For balance three phase conditions, the three phase watts will be three times the individual single phase watts so only one ICW51B will be required to measure three phase watts. If the three phase currents and voltages are reasonably balanced, one relay should still be sufficient to measure 3-phase power. If both the voltages and currents are considerably unbalanced, an ICW51B can measure correctly only the power in the phase to which it is connected and three relays may be required, one per phase. Since the ICW51B relay measures phase-to-netural voltage and the associated current, it is conveniently calibrated in terms of single phase watts. Also because of these conditions the ICW51B may be used as a directional power relay on single phase as well as three phase systems. The external connections for the ICW51B on three phase systems are illustrated in Fig. 8.

The ICW51B finds specific application on power systems where a relay with time delay reverse power characteristics is required and extreme sensitivity is not essential or on systems where it is desired to detect an overpower condition in a given direction. Worked examples illustrating applications on both single phase and balanced three phase systems appear under the heading of CALCULATIONS OF SETTINGS.

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.

When the target and seal-in unit is used, 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.

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	3.0 Amps	0.30 Amps
Carry 30 Amps For	4 Secs.	---------
Carry 10 Amps For	30 Secs.	0.2 Secs.

Cover (8014258)

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.

If the main contacts are not by-passed by seal-in unit contacts, 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.

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

The tap values listed in Table A are the single phase secondary watts required to close the contact. The relays are suitable for operation at the continuous ratings listed above in a maximum ambient of 40 degrees C.

CHARACTERISTICS

OPERATING PRINCIPLES

The induction disk unit of the ICW relays covered by these instructions is similar in operating principles to the familiar watthour-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 and the polarizing voltage are in-phase. Consequently maximum torque will occur when the power system line current is at unity power factor.

PICKUP

The ICW51B relay can be set to pick up, i.e. close its contact, at the single phase watts listed in Table A. The relay pickup will be within ± 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.

OPERATING AND RESET TIMES

Pickup time curves for the ICW51B overpower relay as a function of multiples of tap setting with rated voltage on the potential circuit are shown in Fig. 1.

Dropout time for the ICW51B relay, i.e. time to reopen the 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 less for lower time dial settings.

BURDEN

The burden imposed on the potential transformer by the 120V, 60 cycle coil is 2.2 watts and 15.7 V.A. for the 10-40 watt relay and 0.66 watts and 4.68 V.A. for all other ranges.

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

CALCULATIONS OF SETTINGS

The following two examples indicate the procedure involved in calculating the relay settings based on the requirements of the specific application.

Consider first a balanced three-phase interconnection at 13.8 KV where the normal power flow is in a given direction and it is desired to open the interconnection if reverse three-phase power in excess of 500 KW occurs and persists for some short time. Assume a CT ratio of 300/5 and a phase-to-neutral PT with a ratio of 8400/120 volts.

The secondary single-phase watts for this condition are

$$P_{sec} = \frac{P_{prim}}{3\ (CT\ Ratio)\ (PT\ Ratio)} \text{ watts per phase}$$

$$P_{sec} = \frac{500{,}000}{3\ (60)\ (70)} = 39.7 \text{ single-phase secondary watts}$$

In order to obtain this setting, the 25-100 watt relay should be selected.

TABLE D

CURRENT BURDEN AT 60 CYCLES					BURDENS IN OHMS IMPEDANCE AT:			
RATING		BURDEN AT MIN. PICKUP*						
RANGE	Rated Amps	Eff. Res. Ohms	Reactance Ohms	Imped. Ohms	5 Amps	10 Amps	20 Amps	40 Amps
10-40 watts	5	0.42	1.26	1.31	1.31	1.21	0.85	0.60
25-100	5	0.33	1.0	1.04	1.04	0.96	0.68	0.47
50-200	5	0.08	0.25	0.26	0.26	0.26	0.24	0.17
100-200	5	0.02	0.063	0.07	0.07	0.07	0.07	0.06

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.

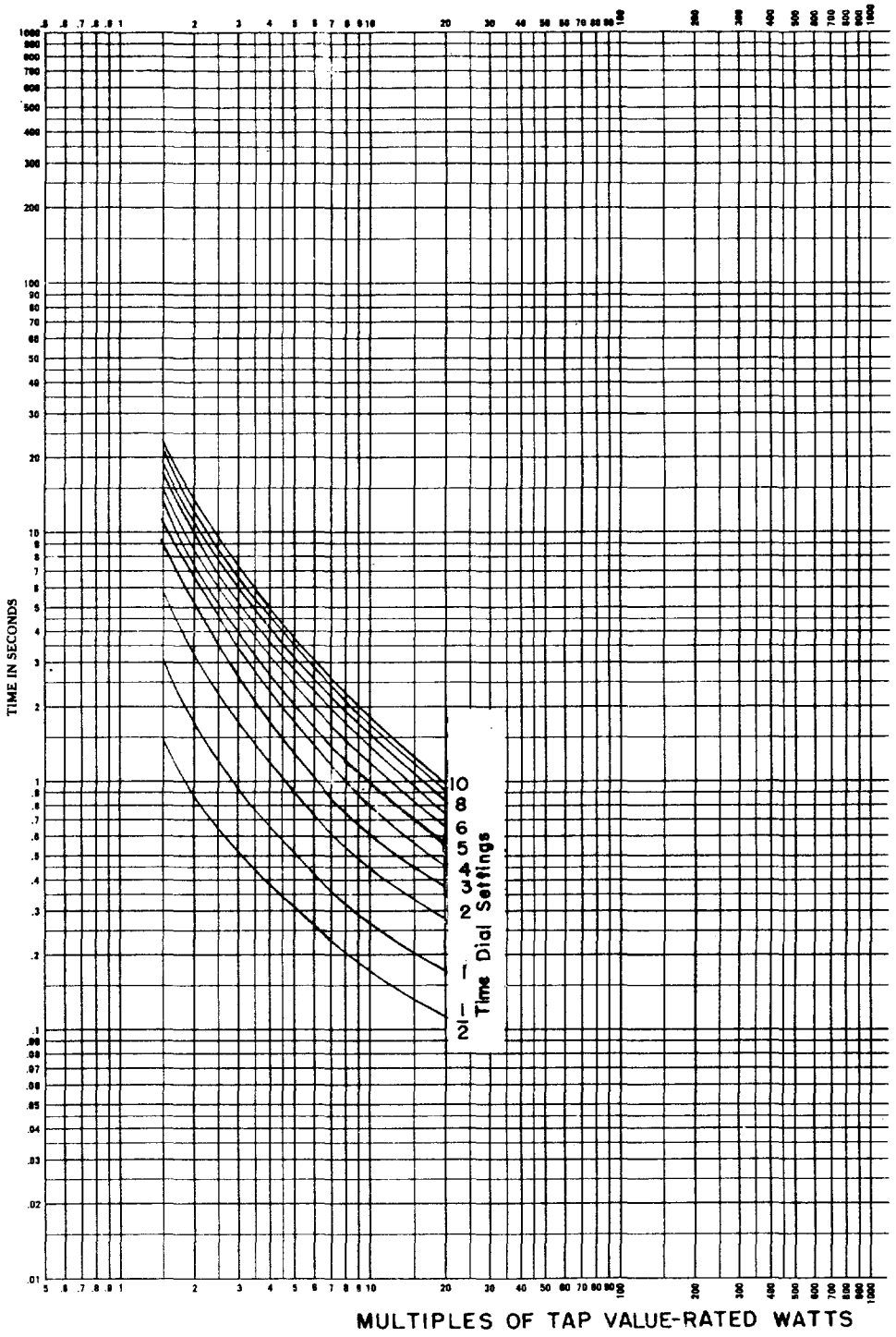


Fig. I Time Watt Curves For ICW51 Relays (0891B0460-1)

Consider now a single-phase system of 600 volts on which it is desired to detect a reverse power condition in excess of 20 KW. Assume a 100/5 CT and a 600/120 volt PT.

The secondary watts for this condition are

$$P_{sec} = \frac{P_{prim}}{(\text{CT Ratio})\ (\text{PT Ratio})}$$

$$P_{sec} = \frac{20{,}000}{(20)\ (5)} = 200 \text{ secondary watts}$$

To accommodate this setting, select the relay with a 100-400 watt range.

CONSTRUCTION

The main element of the Type ICW relays is a wattmetric unit similar to that used in the standard watthour 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 which rides 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 plished pin which projects into a bronze guide ring located at the top of the shaft. This shaft assembly carries the moving contact. 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 it also acts as the lead-in conductor to the moving contact. A calibrated time dial controls the pickup time by determining the distance of travel of the moving contact. The time dial is locked in position by two screws in the die-cast frame. The relay is 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 is picked 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 ICW51B are shown in Fig. 2.

The relay is mounted in a cradle assembly which is latched into a drawout case when the relay is in operation but it can be easily removed when desired. To do this, the relay is first disconnected by removing the connection plug which completes the electrical connections between the case block and the cradle block. To test the relay in its case this connection plug can be replaced by a test plug. The cover, which is attached to the front of the relay case, contains the target reset mechanism and an interlock arm which prevents the cover from being replaced until the connection plug has been inserted. The relay case is suitable for either semi-flush or surface mounting on all panels up to 2 inches thick and appropriate hardware is available. However panel thickness must be indicated on the relay order to insure that proper hardware will be included. For outline and drilling dimensions, see Fig. 9.

Every circuit in the drawout case has an auxiliary brush as shown in Fig. 3 to provide adequate overlap when the connecting plug is withdrawn or inserted. Some circuits are equipped with shorting bars (see Fig. 2) and on these circuits it is especially important that the auxiliary brush makes contact as indicated in Fig. 3 with adequate pressure to prevent the opening of C.T. secondary circuits or important interlock circuits.

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.

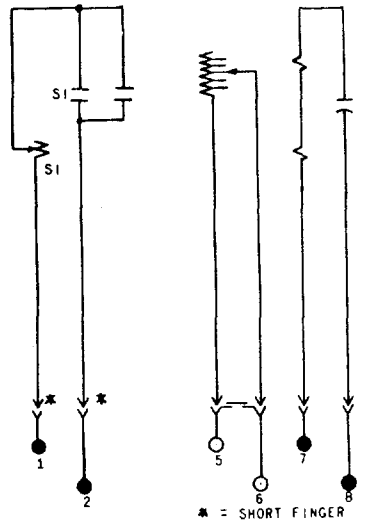


Fig. 2 Internal Connections (Front View) of ICW51B Relay (362A631-2)

ACCEPTANCE TESTS

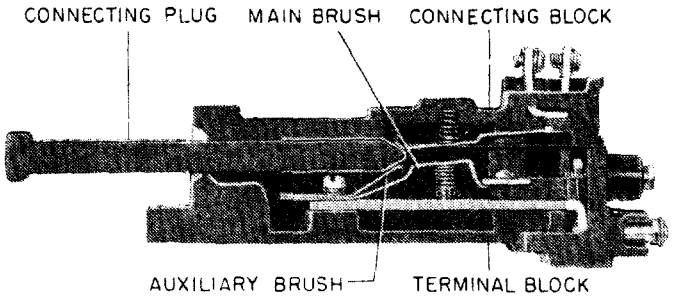
Immediately upon receipt of the relay an inspection and acceptance test should be made to insure that no damage has been sustained in shipment and that the relay calibrations have not been disturbed.

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.

Check that the shorting bars are in the correct locations as indicated in Fig. 2 and that the auxiliary brushes are properly adjusted.



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

Fig. 3 Cross Section of Drawout Case Showing Position of Auxiliary Brush (8025039)

MECHANICAL INSPECTION

It is recommended that the following mechanical adjustments be checked:

1. 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.

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.

3. On Type ICW51B relay there is a stop arm assembly located near the top of the disk shaft. There should be approximately 1/64" deflection of this leaf spring.

4. The armature and contacts of the target and seal-in unit 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 contact closes. 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. 7. 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 ± 5 percent of the value obtained from the following equation:

$$I_{pu} = \frac{T_m}{V} \qquad (1)$$

Where:

T_m = Minimum tap in watts

V = Rated

2. Pickup Time - Using the test connections of Fig. 7, 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.

3. 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 OF 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 single 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 then should be checked using the test connections of Fig. 4, 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. Time Setting - The 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, 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 ± 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 should be checked using the test connections in Fig. 4.

3. 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 role 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.

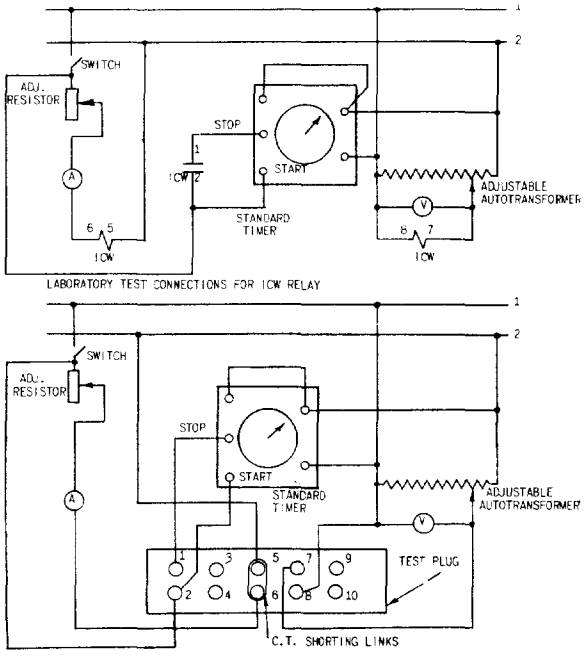


Fig. 4 Field Test Connections (0165A7511-0)

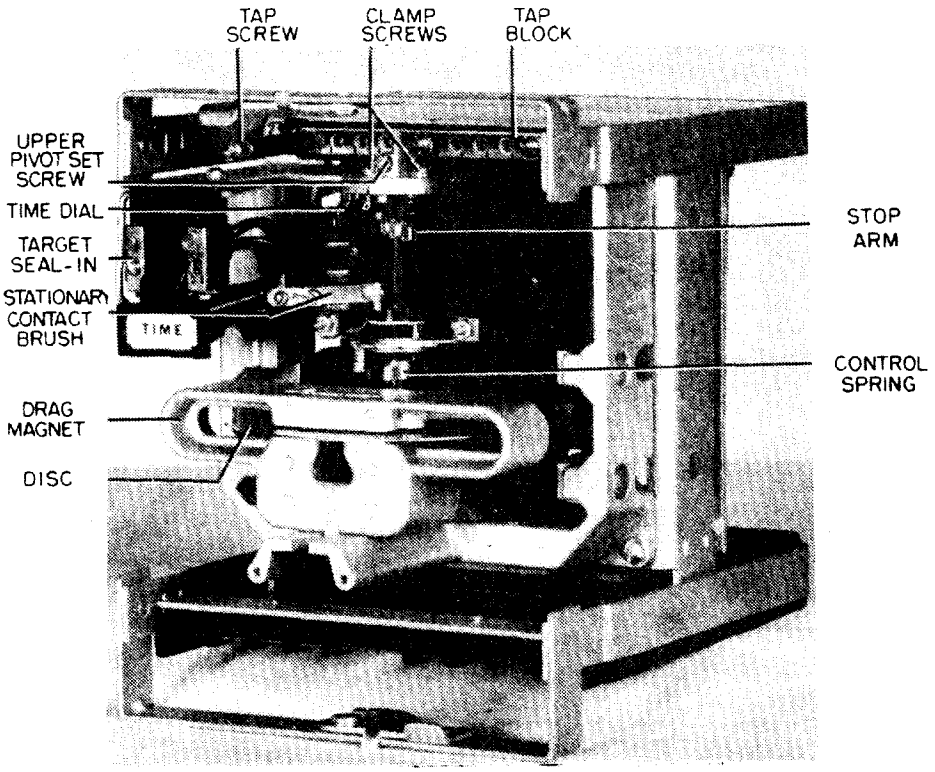


Fig. 5 ICW51B Relay Removed From Case (Front View) (8029638)

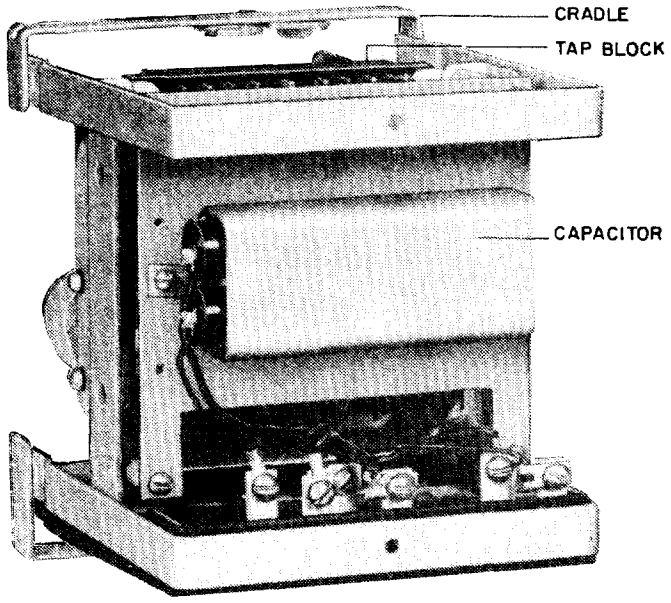


Fig. 6 ICW51B Relay Removed From Case (Rear View) (8014257)

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 contacts 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. 4. 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 ± 3 percent of the corresponding reading recorded during INSTALLATION.

Using the connections of Fig. 4 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 ± 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 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 - 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 the upper pivot. Both baring and pivot are held in position by means of set screws in the diecast supporting frame. The lower jewel must be located so that the disk is approximately centered in the air gaps 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 and 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 contact 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. 7 if the test is being made in the laboratory, or as in Fig. 4 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:

$$I = \frac{T}{V}$$

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.

4. 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. 4, adjust the position of the drag magnet on the shelf 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 requisition number on which the relay was furnished.

Since the last edition, Figure 9 and the caption of Figure 2 have been changed

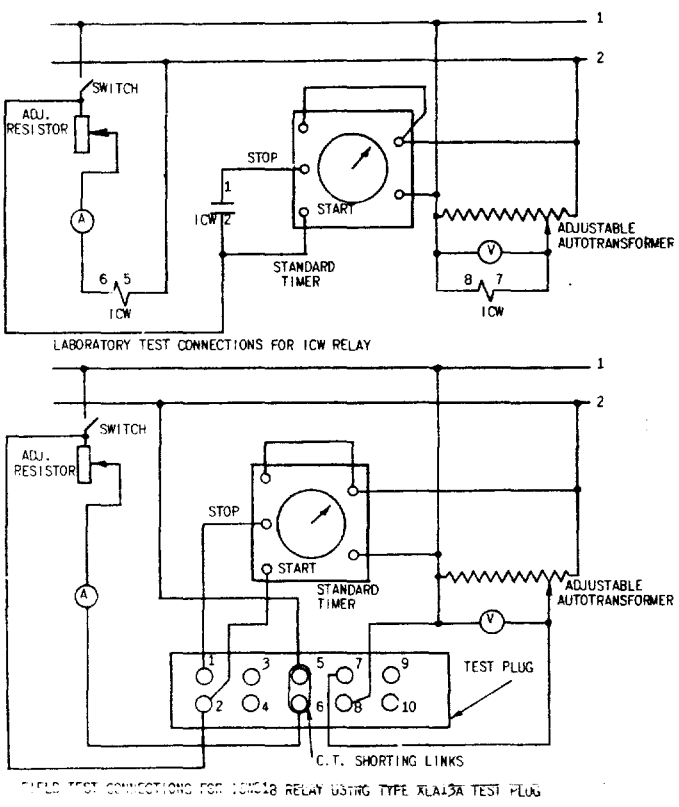


Fig. 7 Laboratory Test Connections (0165A7511-0)

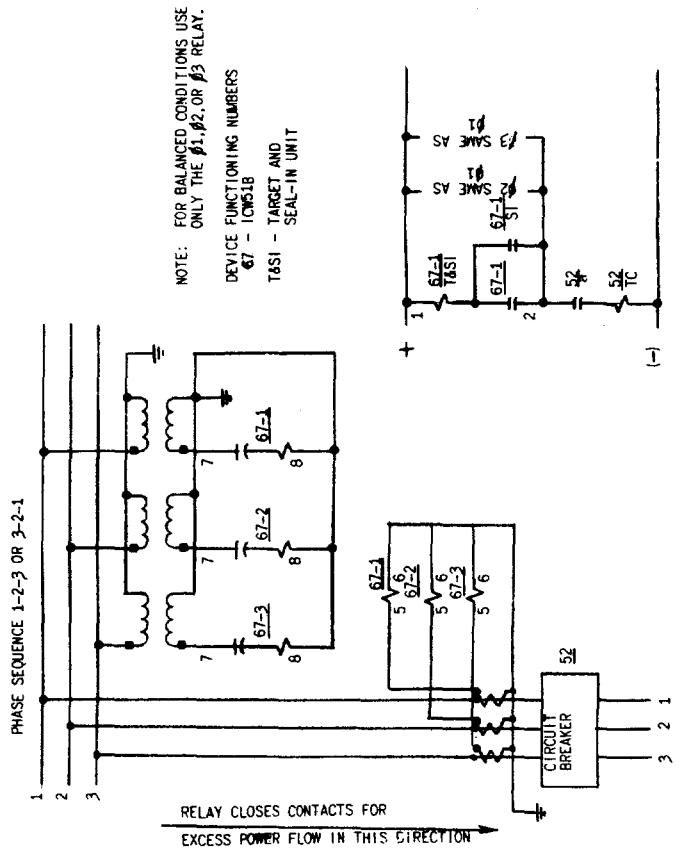


Fig. 8 External Connections For ICW51B Relay As Used On A 3 Phase Grounded System (0165A7512-0)

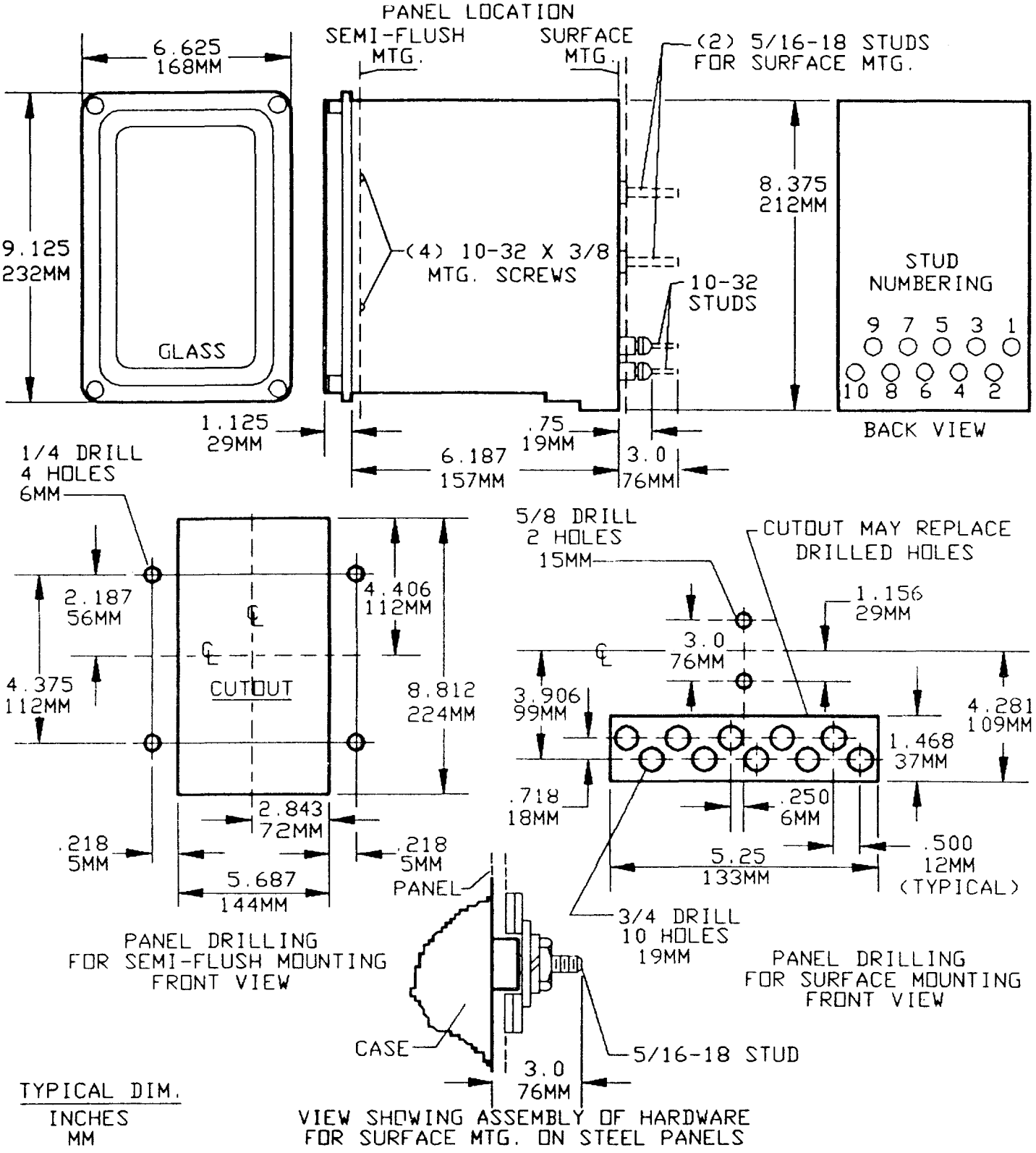


Fig. 9 Outline and Panel Drilling Dimensions for Type ICW Relays (6209271 [8])