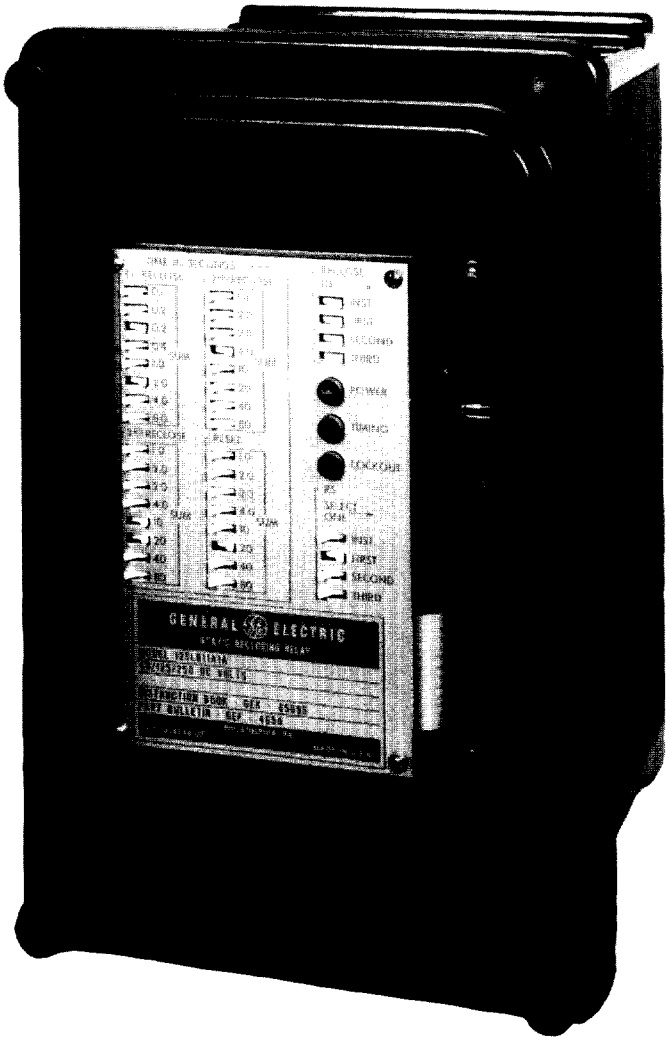
INSTRUCTIONS

RECLOSING RELAYS

TYPE SLR11A AND SLR11B



GE Meter and Control
205 Great Valley Parkway
Malvern, PA 19355-0715

CONTENTS

RECLOSING RELAYS

TYPE SLR11A AND SLR11B

DESCRIPTION

The Type SLR relays are solid state, multi-shot reclosing relays designed to initiate multiple reclosures of a circuit breaker on distribution, subtransmission or transmission circuits. The relays are capable of initiating up to four reclosures of a circuit breaker, with the first reclosure being high-speed, and the other three reclosures having independently adjustable intervals. Any combination of reclosures can be selected. The relay will reset after an adjustable time interval following a successful reclose.

The Type SLR11A relay is designed for operation on DC from the station battery. The Type SLR11B relay is designed for operation from an AC source. Both relays include provisions for blocking instantaneous tripping prior to the first reclosure, blocking automatic tap changing during the reclosing cycle, and for sounding a lockout alarm.

The relays are mounted in an S2 drawout case, the outline and panel drilling dimensions of which are shown in Fig. 13. The internal connections for the SLR11A and SLR11B are shown in Fig. 1 and 2, respectively.

APPLICATION

The Type SLR reclosing relays covered by these instructions are applied to reclose a circuit breaker up to four times after it has been tripped by protective relays. When three reclosures or less are required, the initial reclosure can be either high-speed or delayed. If four reclosures are required, the initial reclosure must be high-speed. The relays can be employed on radial distribution circuits, or on subtransmission or transmission lines.

Typical external connection diagrams are shown in Fig. 1 for the SLR11A and in Fig. 2 for the SLR11B. These typical diagrams indicate the use of contacts of the circuit breaker control switch (52CS), as well as circuit breaker auxiliary switch contacts. A control switch contact that is closed only in the "close" and "normal after close" positions is employed to prevent the breaker from being automatically reclosed after it has been tripped by the control switch.

The external connection diagram in Fig. 1 for the SLR11A relay shows the reclosing contact connected to a typical X-Y circuit breaker control scheme, which on DC applications provides pump-free operation. However, if the breaker closing circuit is not pump-free, the SLR relay itself, when connected as shown, provides pump-free performance. This is true because opening of 52/b and closing of 52/a during the breaker closing stroke will cause the SLR "reclose" contact to reopen. Consequently, if the breaker retrips following the reclosure, the "reclose" contact will be open before 52/b recloses so only one reclosure will be initiated at each reclose point in the SLR cycle.

It is important to note that an auxiliary closing relay must be interposed between the SLR "reclose" contact and the circuit breaker closing coil. In the schemes shown in Fig. 1 and 2, the 52X unit of the X-Y scheme is interposed. When other breaker closing circuits are involved, the SLR reclose contact must not be connected directly to the breaker closing coil.

When selecting the number of reclosures and the time for each reclosure, the following two points must be considered:

1. Interrupting Rating of the Circuit Breaker

The derating factor applying to the interrupting rating of the power circuit breaker must be checked prior to the application of a reclosing relay or the selection of a reclosing cycle.

2. Associated Protective Relays

When high-speed reclosing is employed, the circuit breaker closing time must be compared with the dropout time of the protective relays that initiate the trip-out. If high-speed reclosing is to be successful, the protective relays that tripped the breaker obviously must reopen their contacts before the breaker recloses. Otherwise the breaker will be tripped again, even though the fault has been cleared.

In addition to the wide choice of settings for reclosing and reset, the relays have output contacts on the external connection diagrams in Fig. 1 and 2 that are typically used for the following functions:

1. Block Instantaneous Trip

On applications of the reclosing relays on distribution circuits, it is sometimes necessary to provide coordination with branch circuit fuses by blocking the instantaneous trip circuit of the breaker after the first trip-out but before the first reclosure is completed. This can be accomplished by means of the normally closed contact labelled, "Block Instantaneous Trip," on the external connection diagrams in Fig. 1 and 2. This function is shown in more detail on the simplified diagram in Fig. 3. This represents an application with induction disk time overcurent relays (TOC) equipped with instantaneous units (IOC). The blocking contact operates at the first reclosure point selected in the SLR reclosing cycle, including the high-speed initial reclosure. But once the blocking contact has opened, it will remain open during the remainder of the reclosing cycle, and in the lockout position of the reclosing relay.

A contact of the breaker control switch (52CS) is connected across the blocking contact. This contact is closed in the "CLOSE" position of the control switch and is intended to re-establish the instantaneous trip circuit when the breaker is manually reclosed when the reclosing relay is in the lockout position. It is also possible to reinstate the instantaneous trip circuit prior to lockout by means of the RS contact, as described later.

2. Block Automatic Tap Changer

The output contact labelled "BLOCK LRC" in Fig. 1 and 2, is normally used to block the automatic tap changer (i.e., load ratio control) circuit during the reclosing

cycle. It would normally be set to open at the start of the reclosing cycle and reclose essentially at the lockout point.

3. Selective Reclosing

On some applications it may be desirable to initiate a high speed initial reclosure following an instantaneous trip, but to prevent an instantaneous reclosure following a delayed trip. This can be accomplished by applying a signal from the time delay trip bus to the input labelled "Prevent Instantaneous Reclose," as shown on the external connection diagrams in Fig. 1 and 2.

This is shown in more detail in Fig. 4, which shows the separation of the instantaneous pilot trip bus and the time delay trip bus. The reclose initiation function (RI) in the receiver auxiliary relay can be connected to initiate the reclose cycle piror to the closure of the breaker "b" switch.

4. Lockout Alarm

A "Lockout Alarm" output is provided to indicate that all reclosures have been unsuccessful and that the reclosing relay is in its lockout condition. The "lockout" alarm output occurs on the trip following the final reclosure selected.

5. Other Uses of RS Contacts

If the RS contacts are not to be used in the tap changing circuit, they can be employed as follows in the instantaneous trip circuit.

The normally closed RS contact can be used to block instantaneous tripping after, rather than prior to, the initial reclosure. This permits two instantaneous trips of the breaker before the shift is made to time delay. To accomplish this, the RS contact is set to change position at the second reclosure point in the SLR reclosing cycle, so that the blocking contact will have opened to block instantaneous tripping before the breaker is reclosed the second time.

With this arrangement, the RS contact will close again when the lockout position is reached. Thus the instantaneous trip circuit will be reinstated when the SLR relay is in its lockout position.

SETTINGS

The Type SLR reclosing relays provide a wide choice of adjustments for reclosing and resetting. The choice depends to a great extent on the user's reclosing philosophy. However, the two factors stated in the **APPLICATION** section, the derating factor applying to the interrupting rating of the circuit breaker, and the dropout time of the associated protective relays, must be considered when applying the relay. The following settings must be made by the user:

1. Number of reclosures
2. Initial reclosure, high-speed or delayed
3. Time of each delayed reclosure
4. Reset time after successful reclosure

5. Point in the cycle of RS contact operation
6. The AC or DC input voltage level.

Detailed instructions for making the above settings are provided in a later section entitled **ADJUSTMENTS.**

RATINGS

The SLR11A is a DC operated relay with ratings of 48, 125 and 250 volts DC. The SLR11B is an AC operated relay with ratings of 120 and 240 volts AC, 50/60 hertz. The interrupting rating of the telephone-type relay contacts are shown in Table I, and the interrupting rating of the auxiliary relay contacts are shown in Table II.

TABLE I

INTERRUPTING RATINGS OF TELEPHONE-TYPE RELAY CONTACTS

CONNECTION STUDS 19 AND 20

	AMPERES	
AC VOLTS	INDUCTIVE**	NON-INDUCTIVE
120	0.75	2.0
240	0.50	1.5
DC VOLTS		
48	1.0	3.0
125	0.5	1.5
250	0.25	1.0

TABLE II

INTERRUPTING RATINGS OF AUXILIARY RELAY CONTACTS

CONNECTION STUDS 12, 13, 14, 15, 16, 17 and 18

	AMPERES	
AC VOLTS	INDUCTIVE**	NON-INDUCTIVE
120	0.50	1.5
240	0.30	1.0
DC VOLTS		
48	0.7	1.0
125	0.2	0.3
250	0.15	0.25

**The inductive rating is based on a L/R ratio of 0.04 second

*Indicates Revision

The output relays have make and carry ratings of three amperes continuously and 30 amperes for 0.2 second.

BURDENS

The burdens shown in Table III assume the relay is either in reset or lockout with a nominal input voltage.

TABLE III - INPUT VA AND POWER RATINGS

VOLTS	FREQUENCY	RESET		LOCKOUT	
		VA	WATTS	VA	WATTS
250	DC	--	5.6	--	10.8
125	DC	--	2.2	--	4.8
48	DC	--	0.7	--	1.7
240	60	3.6	3.0	6.1	5.8
240	50	6.6	3.3	7.9	6.2
120	60	3.6	2.7	6.1	5.6
120	50	6.6	3.0	7.9	6.0

The burdens of Table III will be slightly higher during reclose.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as 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 in order that none of the parts are injured or the adjustments disturbed.

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.

DESCRIPTION OF CIRCUITS

The type SLR relay consists of a power supply, crystal oscillator, switches to program the timing and functions and a recloser-controller integrated circuit. The input and output signals are interfaced with relays. The DC model operates directly from the station battery while the AC model is isolated from the line with a transformer rectifier. The relay is assembled in a size S2 case.

A photograph of the relay in its case with cover in place is shown on the cover of this instruction book. The series of photographs in Fig. 5 shows the principal parts of the relays and their relative positions in the assembly.

CASE

The case is suitable for either surface or semi-flush panel mounting and an assortment of hardware is provided for either. The cover attaches to the case and has screws with provision for a sealing wire.

The case has studs or screw connections at both ends for the external connections. The electrical connections between the relay and case studs are made through spring-backed contact fingers mounted in stationary molded inner and outer blocks between which nests a removable connection plug, which completes the circuit. The outer blocks, attached to the case, have the studs for the external connections, and the inner blocks have the terminals for the internal connections.

The relay electronics are mounted in a steel framework called the cradle, which is a complete unit, with all leads being terminated at the inner blocks. This cradle is held firmly in the case with a latch at the top and bottom, and by a guide pin at the back of the case. The case and cradle are so constructed that the relay cannot be inserted in the case upside down. The connection plug, besides making the electrical connections between the respective blocks of the cradle and case, also locks the latch in place. The cover, which is fastened to the case by thumbscrews, holds the connection plug in place.

To draw out the relay unit, the cover is first removed, and the plugs drawn out. The latches are then released, and the relay can be easily drawn out. To replace the relay unit, the reverse order is followed.

A separate testing plug can be inserted in place of the connecting plug to test the relay in place on the panel, either from its normal source of power or from other sources. The relay can also be withdrawn for testing, and replaced by a spare relay unit.

INSTALLATION

The relay should be mounted on a vertical surface in a location reasonably free from excessive heat, moisture, dust and vibration. The relay case may be grounded, if desired, using at least #12 B&S gage copper wire. The panel drilling for the SLR relays is shown in Fig. 13.

CONNECTIONS

The internal connections for the SLR11A are shown in Fig. 6A, and the internal connections for the SLR11B are shown in Fig. 6B. All contacts are shown as they are with the relay completely de-energized.

Shorting bars are furnished between terminals 13 and 14 and between terminals 17 and 18 to complete the circuits if the connection plug is withdrawn from the case.

On SLR11B relays, the 125 volt DC line is brought out to be used as power for the input relays through external contacts.

PRINCIPLES OF OPERATION

POWER SUPPLY

The SLR11A is operated from the station battery. The voltage input is selected with a link which controls two resistor dividers. CR19 is used to protect the relay if the station battery is connected inadvertently in the reverse polarity.

The SLR11B is operated from an AC source. The AC power supply is shown in Fig. 9.

Q9 is the power transistor used in the series regulator to reduce the input voltage to 50 volts DC. The balance of the series regulator, along with the rest of the power supply, is shown in Fig. 7, which is the diagram for the relay and power supply circuit. Q6, R11, R12, Z4, C5 and C6 make up the balance of the series regulator.

Q5, R9, R10 and Z1 are connected to produce approximately ten milliamperes as a current source for the electronic circuits. The ten milliampere current flowing through Z2 produces five volts across V_{DD} and V_{SS}. The ten milliampere current then flows from V_{SS} to the light emitting diode circuit on the logic and switch board, which is shown on Fig. 8. The ten milliampere current is returned to the relay and power supply board as V_{EE}. Z3 is used as a bypass in the event of an open circuit between V_{SS} and V_{EE}.

INPUT RELAY CIRCUIT

There are four input circuits brought into the relay. The 52a and 52b, which are respectively the normally open and normally closed auxiliary contacts of the circuit breaker, are used to indicate if the breaker is closed or open. The DR (delayed reclose) input is used to bypass the instantaneous reclose position. The MC (manual close) input is used to start the reset timer of the recloser.

R32, R33, R34 and R35 are current limiting resistors for the input signals. The four input signals enter the relay and power supply board, which is shown in Fig. 7, and operate four reed relays. The reed relays are used to isolate the input wiring from the electronic circuits. The contacts of the relays are filtered to minimize the effect of contact bounce. The filtered outputs of the input signals are then connected to the recloser controller IC6 of Fig. 8.

LIGHT EMITTING DIODE CIRCUIT

Light emitting diode PS (CR11) is used to indicate that current is flowing from the electronics of the circuit. Light emitting diode L (CR13) is used to indicate that the relay is in lockout when the light is on. Light emitting diode T (CR12) is used to indicate that the relay is timing when the light is blinking. Q7, Q8, R23, R24, R25 and R26 are used to control CR12 and CR13 with signals from the recloser controller IC6.

TIMING

The timing of the system is controlled by a crystal oscillator, O1, which is connected to the OI input of the recloser controller, IC6. The timing switches, first reclose, second reclose, third reclose and reset, and function switches, reclose and RS, are multiplexed with IC1, IC2, IC3, IC4 and IC5. The serial output of each multiplexer is fed into IC6. The timing for the multiplexers is provided by IC6 with signals Q1, Q2, and Q3.

OUTPUT RELAY CIRCUIT

All signals for the output relays are produced by IC6. The signals are amplified by transistors Q1, Q2, Q3 and Q4. Relays L, RS and B are mounted on a printed circuit board. Relay R is mounted separately in the relay case.

TESTING

DIELECTRIC TESTS

The surge capacitors of Fig. 6A and 6B used in the type SLR relay do not have voltage ratings to withstand AC hipot voltage; therefore, caution must be exercised when hipotting to avoid damaging these capacitors.

If hipot tests are to be performed, these tests should be accomplished on a bench with the relay in its case. If the relay is to be tested together with other apparatus in an equipment, all external connections to terminal 1 (surge ground) must be removed.

The hipot test voltage should be 1,500 volts RMS, 50 or 60 hertz for new relays, or 1,125 volts RMS, 50 or 60 hertz for other relays. New relays are defined as those which have not been in service, which are not more than one year old from the date of shipment, and which have been suitably stored to prevent deterioration. The duration of application of the test voltage for both old and new relays should be 60 seconds or less.

Common Mode Hipot Tests (all terminals to case)

Temporary connections should be made to tie all relay terminals, including terminal 1, together. Hipot voltage can then be applied between the common connection and the relay case.

Transverse Mode Hipot Tests (between circuits)

For hipot tests between circuits of the relay, the surge capacitors must be temporarily disconnected from the surge capacitor bus inside the relay. The relay terminals should be jumpered to provide the groups of circuits shown in Table IV. Hipot voltage can then be applied between each pair of groups of circuits.

TABLE IV - HIPOT CIRCUIT GROUPS

CIRCUIT GROUP	JUMPER BETWEEN TERMINAL NUMBERS	
	12SLR11A	12SLR11B
DC Potential		2, 3
AC Potential	5, 6	
Output Contacts	12, 13, 14, 15, 16, 17, 18, 19, 20	12, 13, 14, 15, 16 17, 18, 19, 20
Input Signals	7, 8, 9, 10	7, 8, 9, 10
Output DC Potential		4

An alternate test using a 500 volt megger can be performed between the circuit groups of Table IV with the surge capacitors connected in their normal manner. While this method does not test the relay to its full dielectric rating, it will detect some cases of degraded insulation.

After the hipot or megger testing is complete, the surge capacitor should be reconnected to the surge capacitor bus and external wiring to terminal 1 should be reconnected.

FUNCTIONAL TEST

In order to run the functional test per Fig. 10, set up the relay as follows:

1. Set its reset time at ten seconds
2. Put all the reclose switches "IN"
3. Select the instantaneous RS switch.

Turn the power on and observe the following:

1. The power LED will come on immediately.
2. The lockout LED will come on in approximately two seconds. The L and B relays will pick up at the same time.
3. The RS relay will remain dropped out.

Next, push and release the close push button and observe the following:

1. The timing light will come on in one second and stay on for one second. This will be repeated for a total of ten seconds.
2. During the timing the L, B and RS functions will remain unchanged.
3. At the end of the timing, the lockout LED will go out and the L and B relays will drop out.

Next take the instantaneous reclose switch out. This will cause the RS relay to pick up. Return the instantaneous reclose switch to the in position.

The trip push button should be operated for two seconds with the following results:

1. The R relay will close for one half-second
* 2. The B relay will pick up immediately
3. The RS relay will pick up immediately and drop out in one half-second
4. The lockout LED will come on in one half-second. The L relay will operate at the same time.

This functional test exercises most, but not all of the electronics in the relay system. In most cases it will indicate that the relay is completely functional.

ADJUSTMENT AND TIMING SEQUENCE

There are four timing adjustments available on the relay. They include the first, second and third timed reclosures and the reset time. Each adjustment is from one second to 159 seconds, except the first timed reclosure, which is one-tenth the time. If a time is set for zero, the circuit will adjust the time at one second except for the first reclosure, which will be one-tenth of a second.

The reclosures can be set in any of the sixteen combinations. If none of the reclosures are called for, the relay will go directly to lockout when the breaker trips.

Only one RS position should be selected. The RS relay will pick up on reclose of the position selected and drop out at lockout. If RS is selected at an earlier position than that of the reclose cycle, the RS relay will be picked up until lockout.

To show an example of reclose timing, Fig. 11 will indicate the relay settings and Fig. 12 will be used for a timing of the relay functions. These short times are selected as an example only.

The settings of Fig. 11 are as follows:

First reclose	0.4 seconds
Second reclose	2 seconds
Third reclose	4 seconds
Reset time	6 seconds
Reclosures	Four
RS	Third timed reclose

52a, 52b, MC and DR of Fig. 12 are the input signals to the relay. All other signals are relay outputs.

MANUAL OPERATION OF BREAKER

When the breaker is opened manually, the control switch will prevent an automatic
* reclosure. When this occurs the relay will go to lockout one half second after the first selected reclose time. The relay going to lockout is caused by the control switch preventing a reclose of the breaker.

When the breaker is closed manually the relay will stay in lockout during the reset time. If there is a trip during the reset time, the relay will remain in lockout. If the reclosure is successful and the reset time is completed, the relay will reset

* Revised since last issue

* automatically. The contact of the control switch connected to the manual close input (terminal 8) is momentary, and starts the reset time. If the manual close input is not used, the reset time of a manual close is not predictable.

RELAY REMOVAL AND INSERTION

When the SLR relay is removed, the normally closed circuits are shorted in the relay case. This shorting takes place when the upper connection plug is removed.

After the SLR relay is inserted into the case, the connection plugs can be inserted in either order. The output relays will remain in their de-energized condition until the relay goes through a power up sequence. The power up takes approximately two seconds.

CAUTION

DO NOT REMOVE THE SOLDERED FLEXIBLE CONNECTION BETWEEN THE PRINTED CIRCUIT BOARDS. SOME OF THE PROTECTION FOR THE CMOS IS MOUNTED ON THE OTHER SIDE OF THE FLEXIBLE CONNECTION.

BEFORE ASSEMBLING THE NAMEPLATE, PLACE ALL SWITCHES IN THE RIGHT-HAND POSITION. TIGHTEN THE NAMEPLATE SCREWS SO THAT THE SWITCH HANDLES CLEAR THE NAEMPLATE, THEN CHECK TO MAKE SURE ALL SWITCHES MOVE FREELY.

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.

Should a printed circuit card become inoperative, it is recommended that this card be replaced with a spare. In most instances, the user will be anxious to return the equipment to service as soon as possible and the insertion of a spare card represents the most expeditious means of accomplishing this. It is recommended that a faulty printed circuit card be returned to the factory for repair.

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

* SERVICING

CAUTION

Remove ALL power from the relay before removing or inserting any of the printed-circuit boards. Failure to observe this caution may result in damage to and/or misoperation of the relay.

* Revised since last issue

LIST OF ILLUSTRATIONS

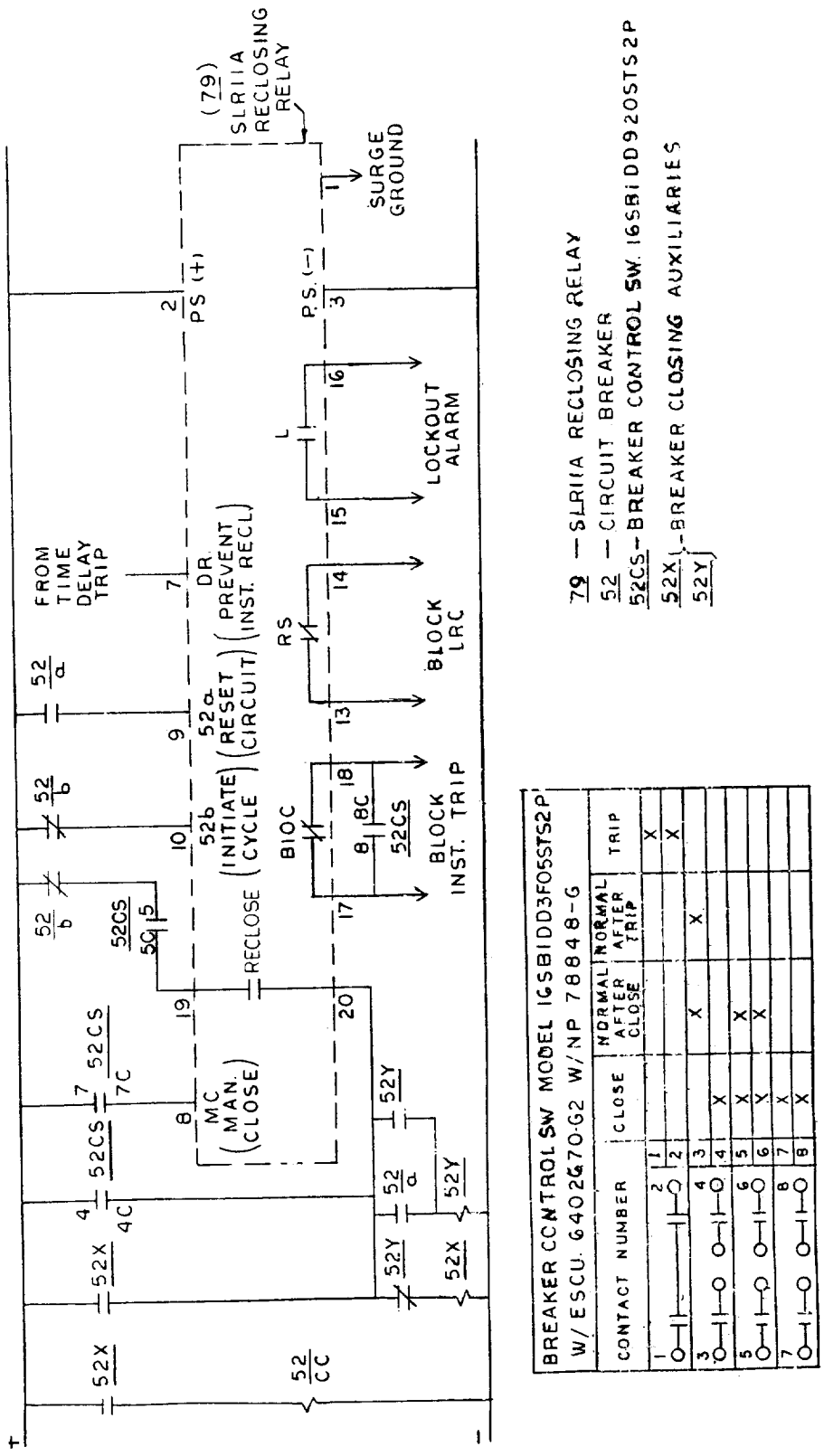
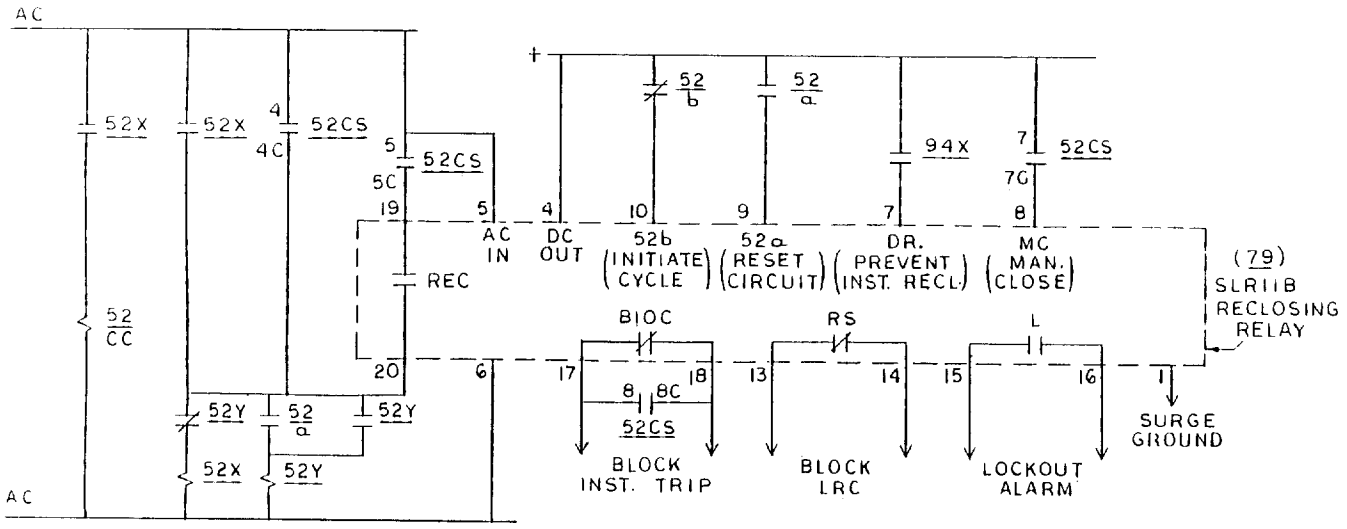


*Fig. 1 (0138B7610 [3]) External Connections Diagram

* Revised since last issue



BREAKER CONTROL SW. MODEL 16SBIDD3F05 STS2P W/ESCU.6402670-G2 W/NP 78848-G					
CONTACT NUMBER		CLOSE	NORMAL AFTER CLOSE	NORMAL AFTER TRIP	TRIP
1 2	1				X
	2				X
3 4	3		X	X	
	4	X			
5 6	5	X	X		
	6	X	X		
7 8	7	X			
	8	X			

79 — SLR11B RECLOSING RELAY
52 — CIRCUIT BREAKER
52CS — BREAKER CONTROL SW. 16SBIDD3F05 STS2P
52X, 52Y — BREAKER CLOSING AUXILIARIES
94X — AUX RELAY FROM DELAYED TRIP BUS (IF USED)

* Fig. 2 (0138B7609-1) External Connections Diagram

*Indicates Revision

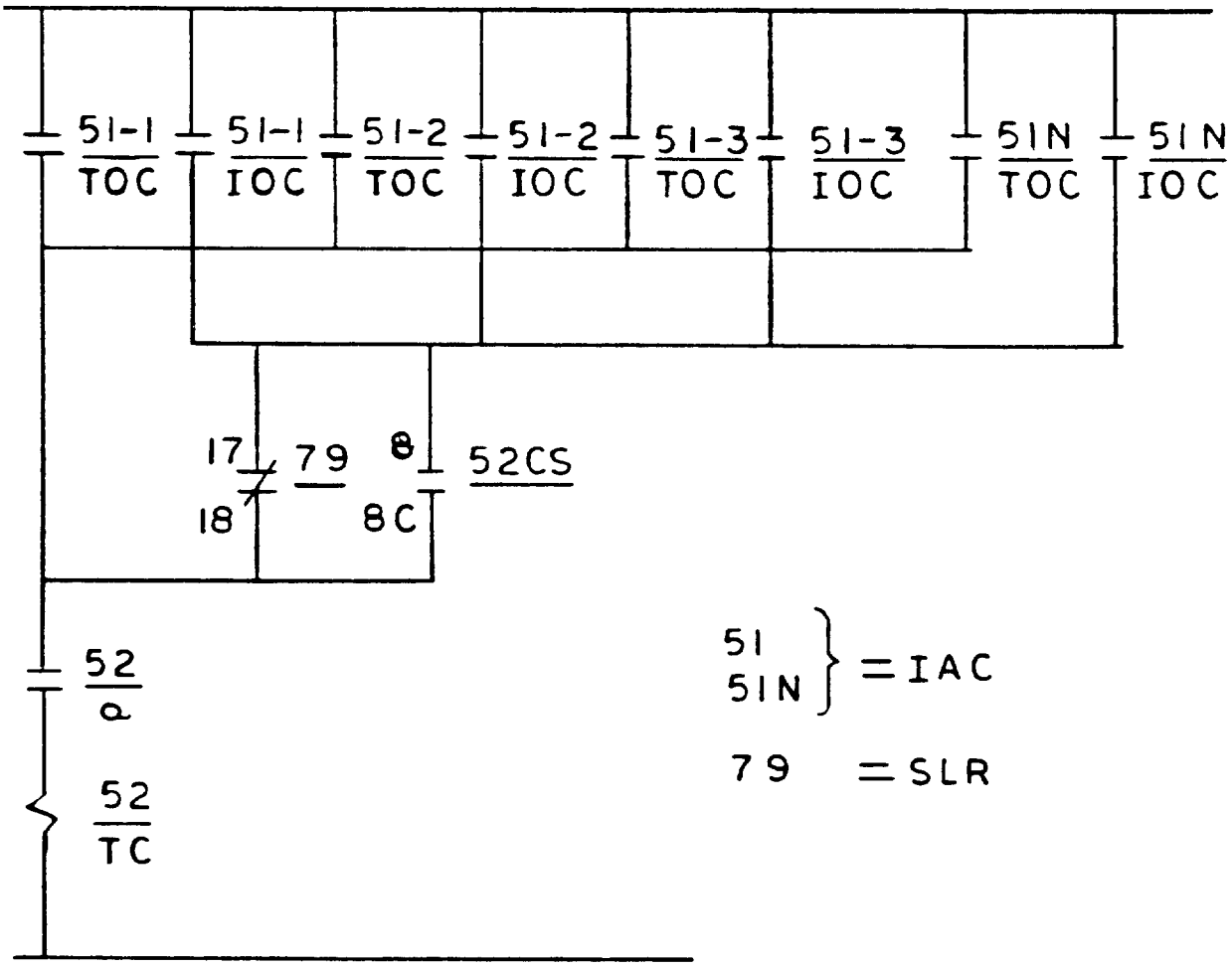
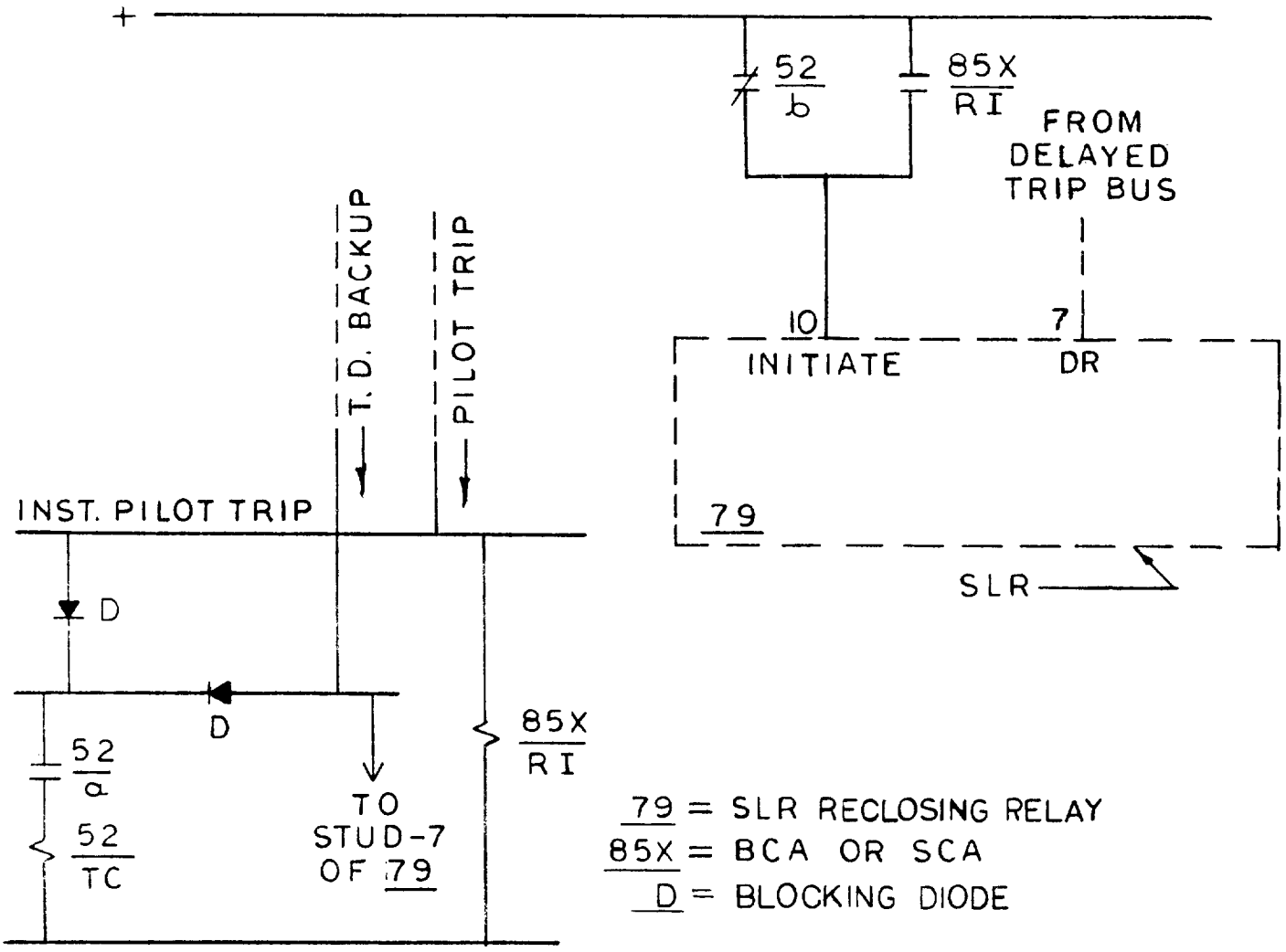


Fig. 3 (0285A6294-0) Use of Contact to Block Instantaneous Trip Circuit Prior to First Reclosure



* Fig. 4 (0285A6293[2]) RI and Delayed Trip Diagram

* Revised since last issue

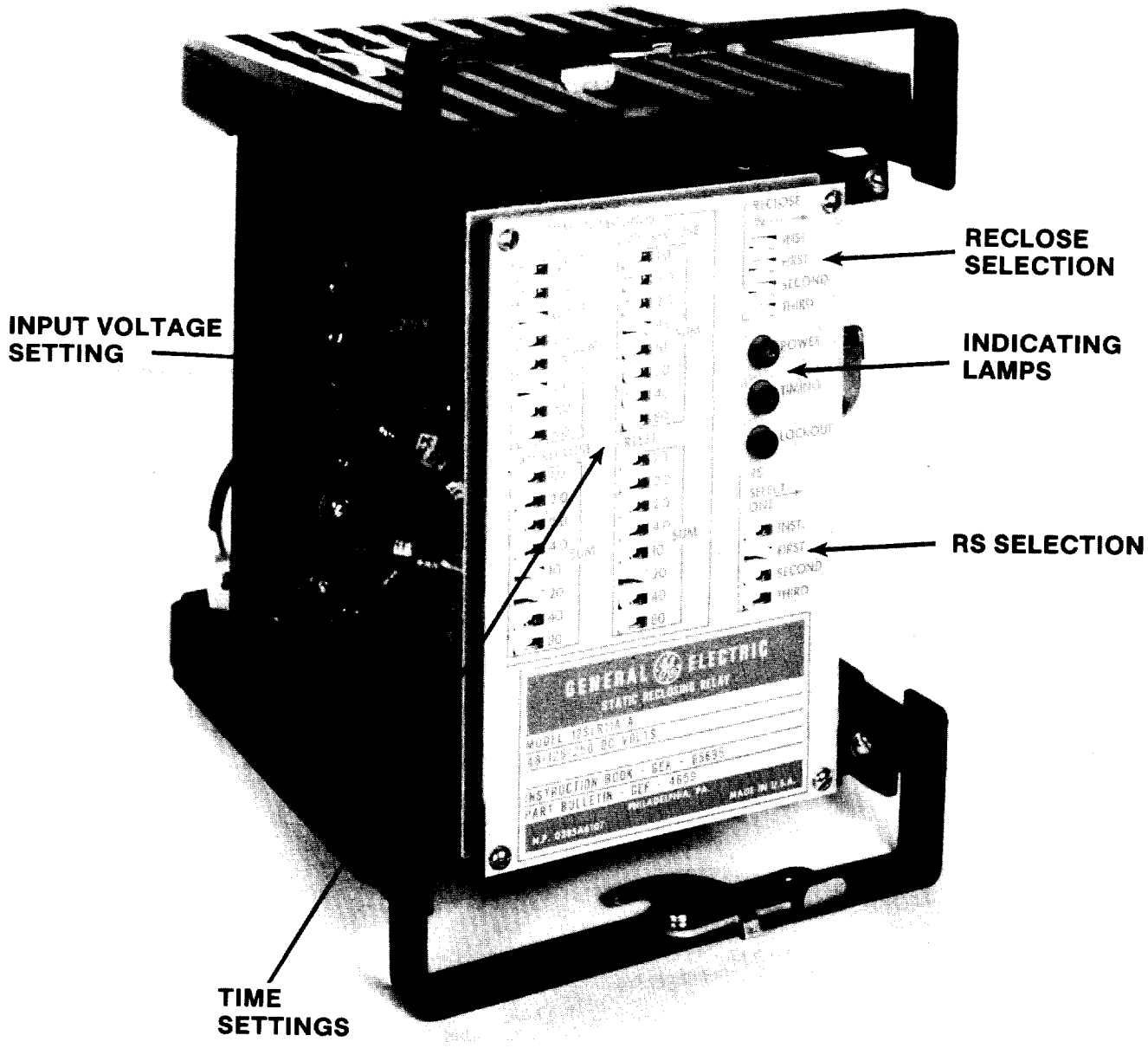


Fig. 5A (8043710-0) SLR Relay, Front View

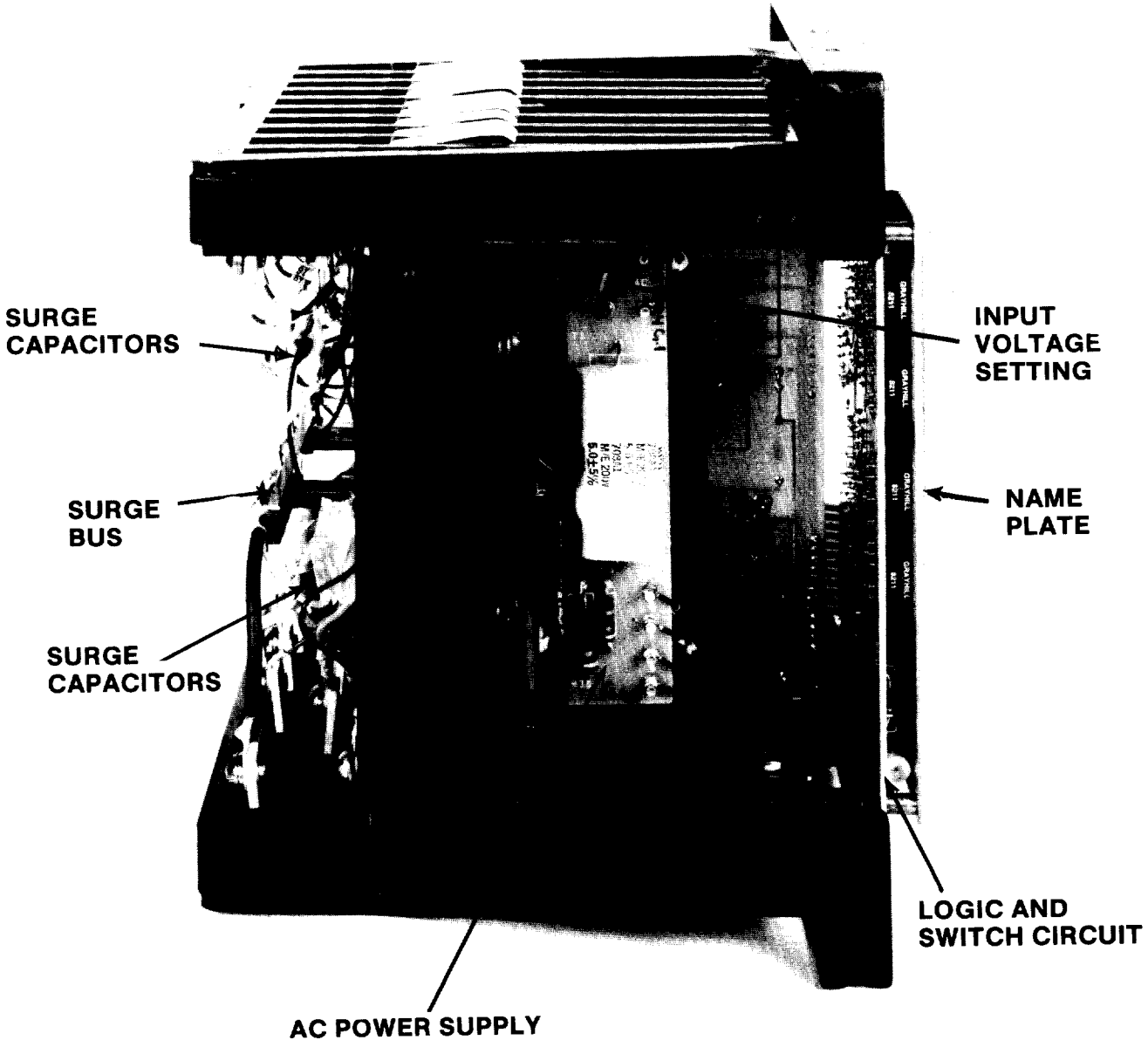


Fig. 5B (8043716-0) SLR Relay, Side View

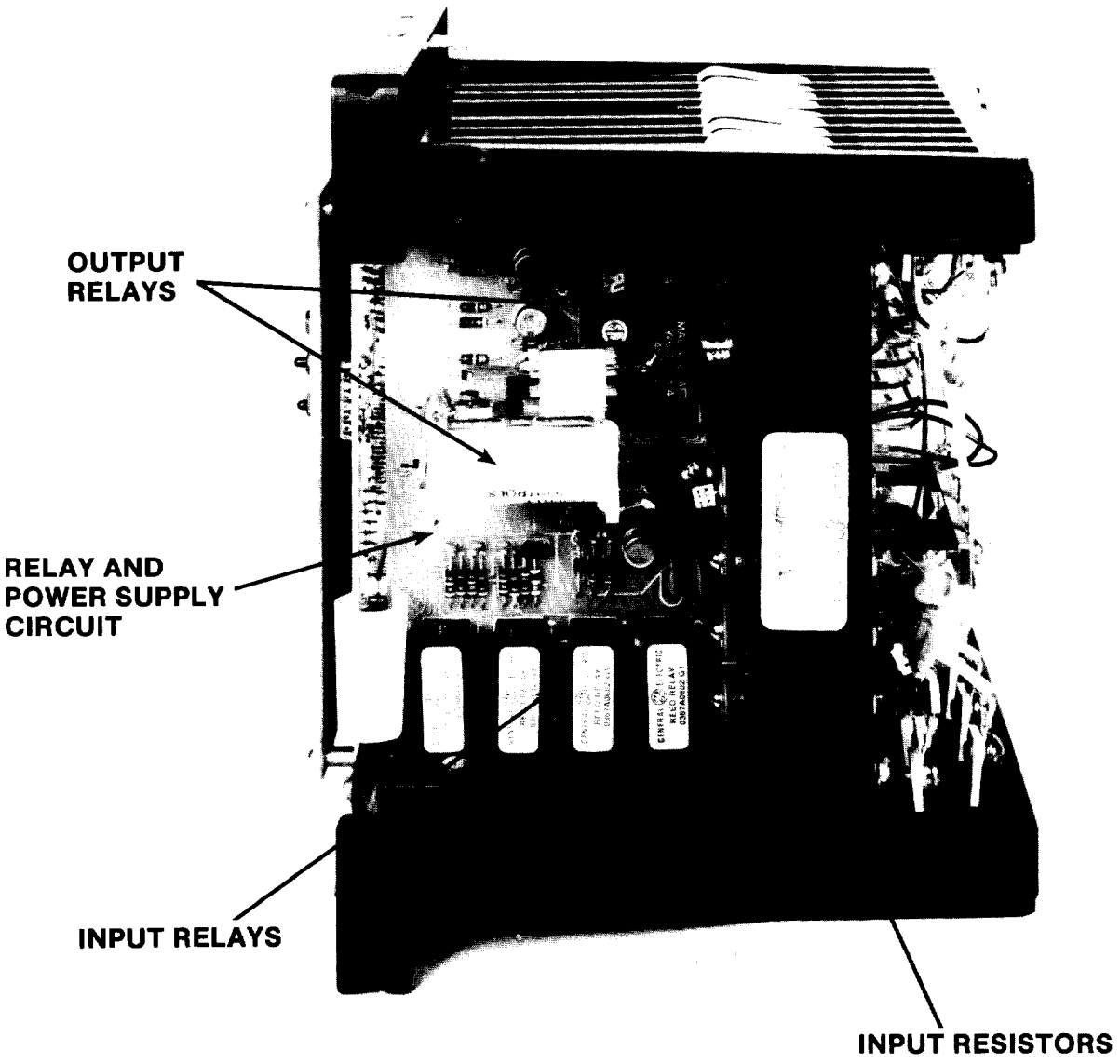


Fig. 5C (8043717-0) SLR Relay, Side View

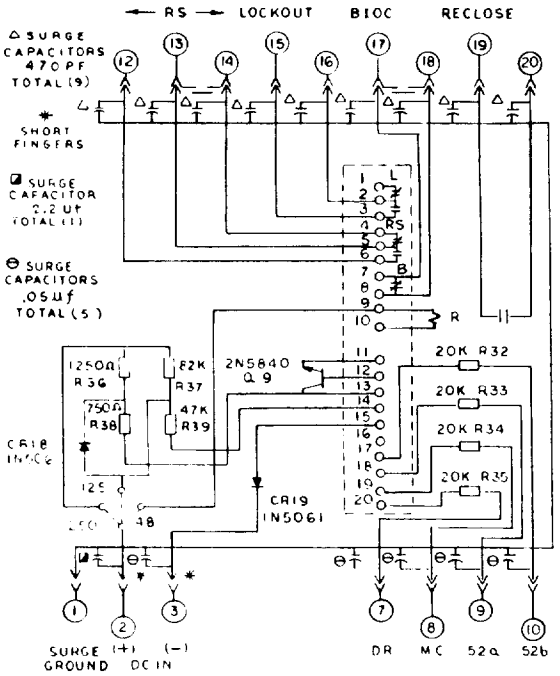


*Fig. 6A (0285A5824 [1]) Internal Connections for 12SLR11A

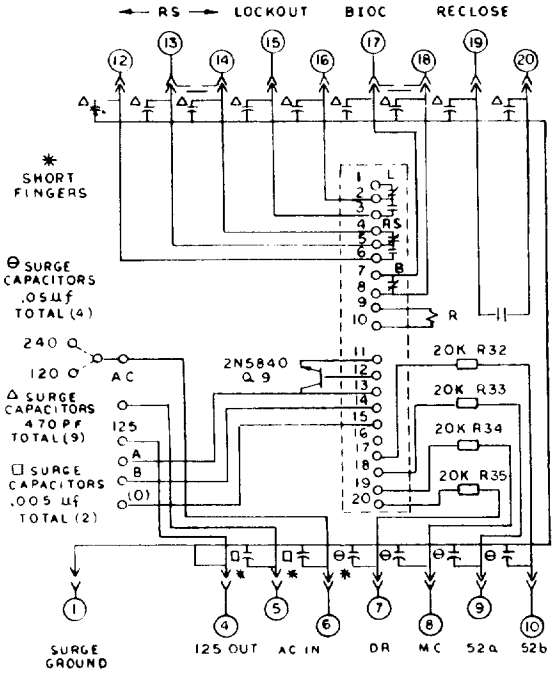


*Fig. 6B (0285A5823 [1]) Internal Connections for 12SLR11B

* Revised since last issue

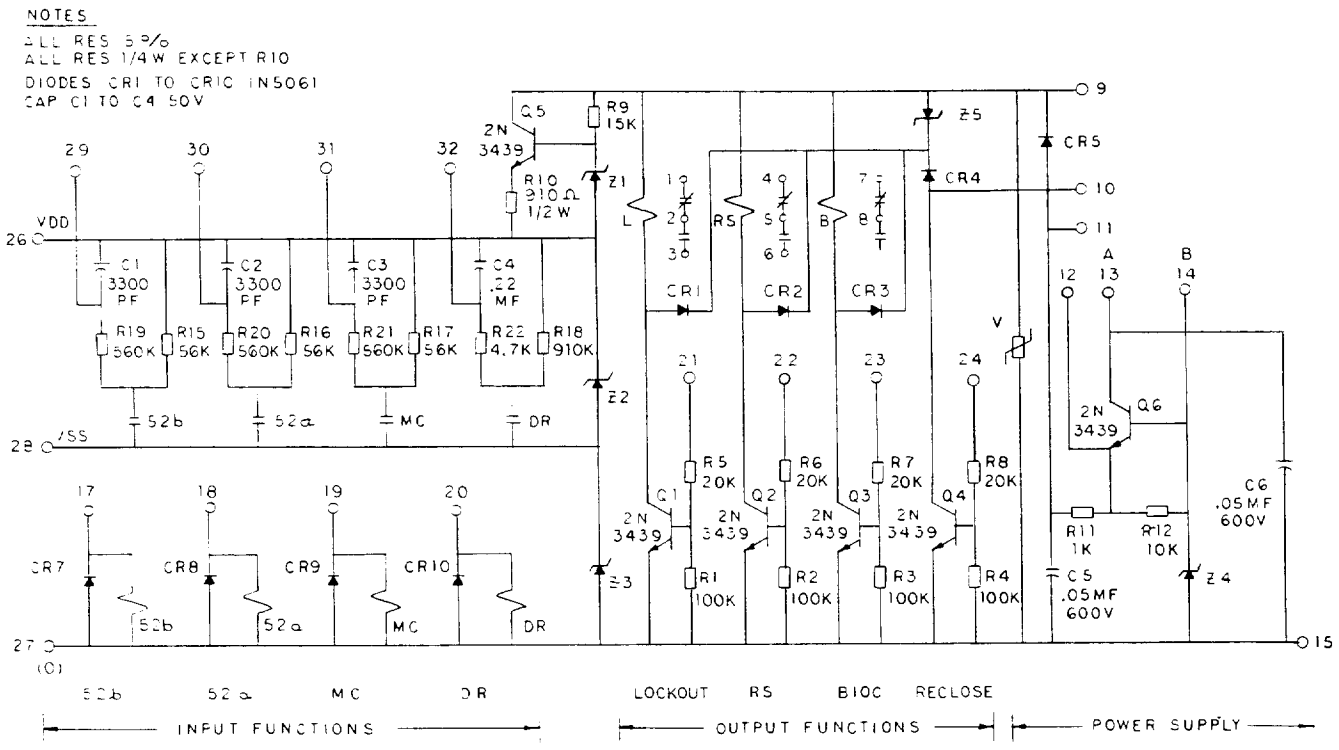


Fig. 7 (0184B5731-0) Relay and Power Supply Circuit

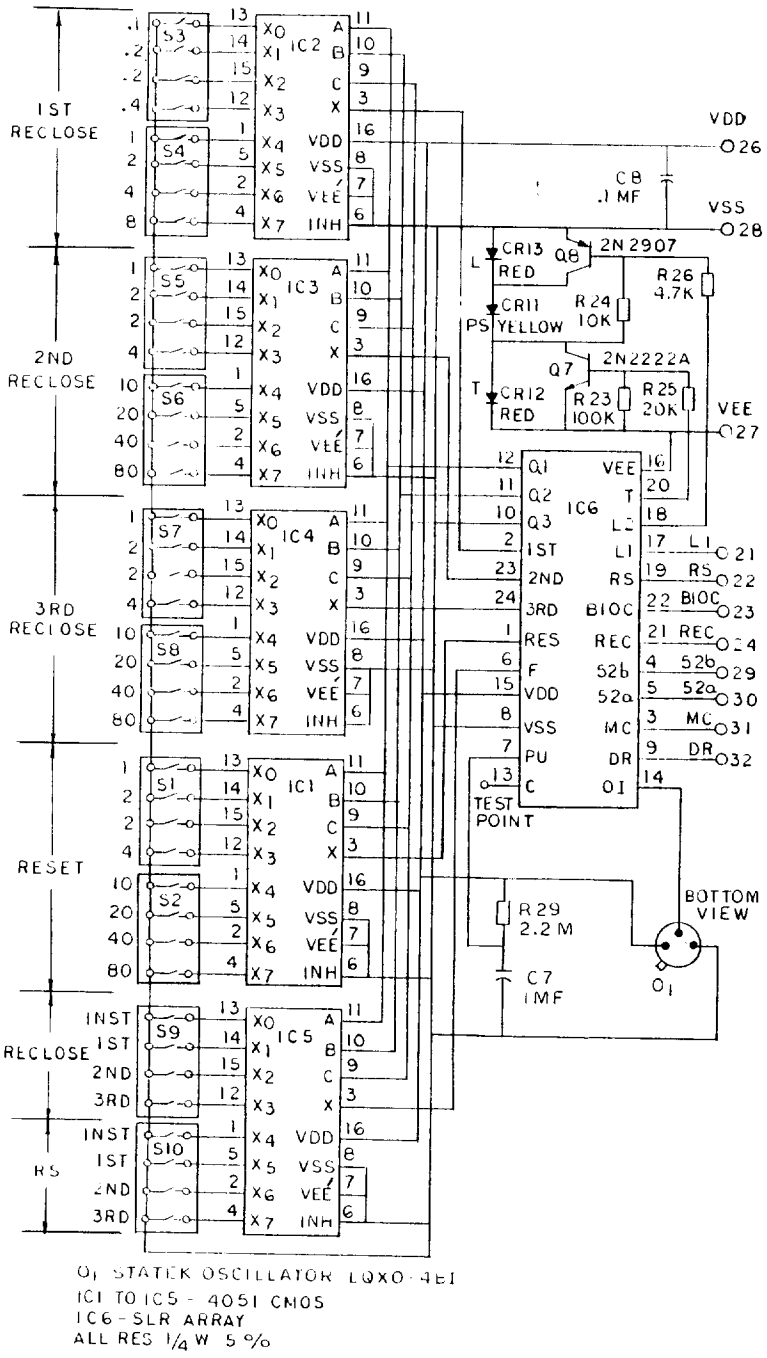
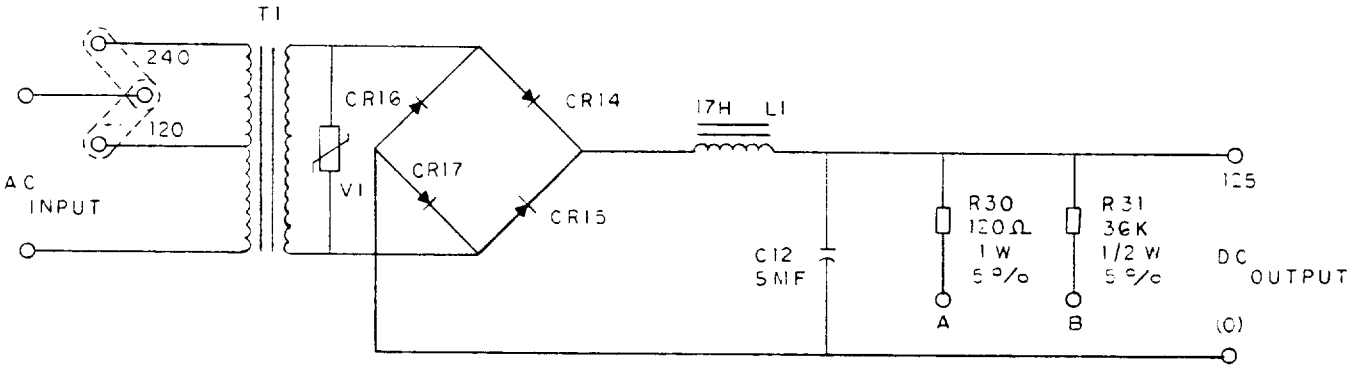


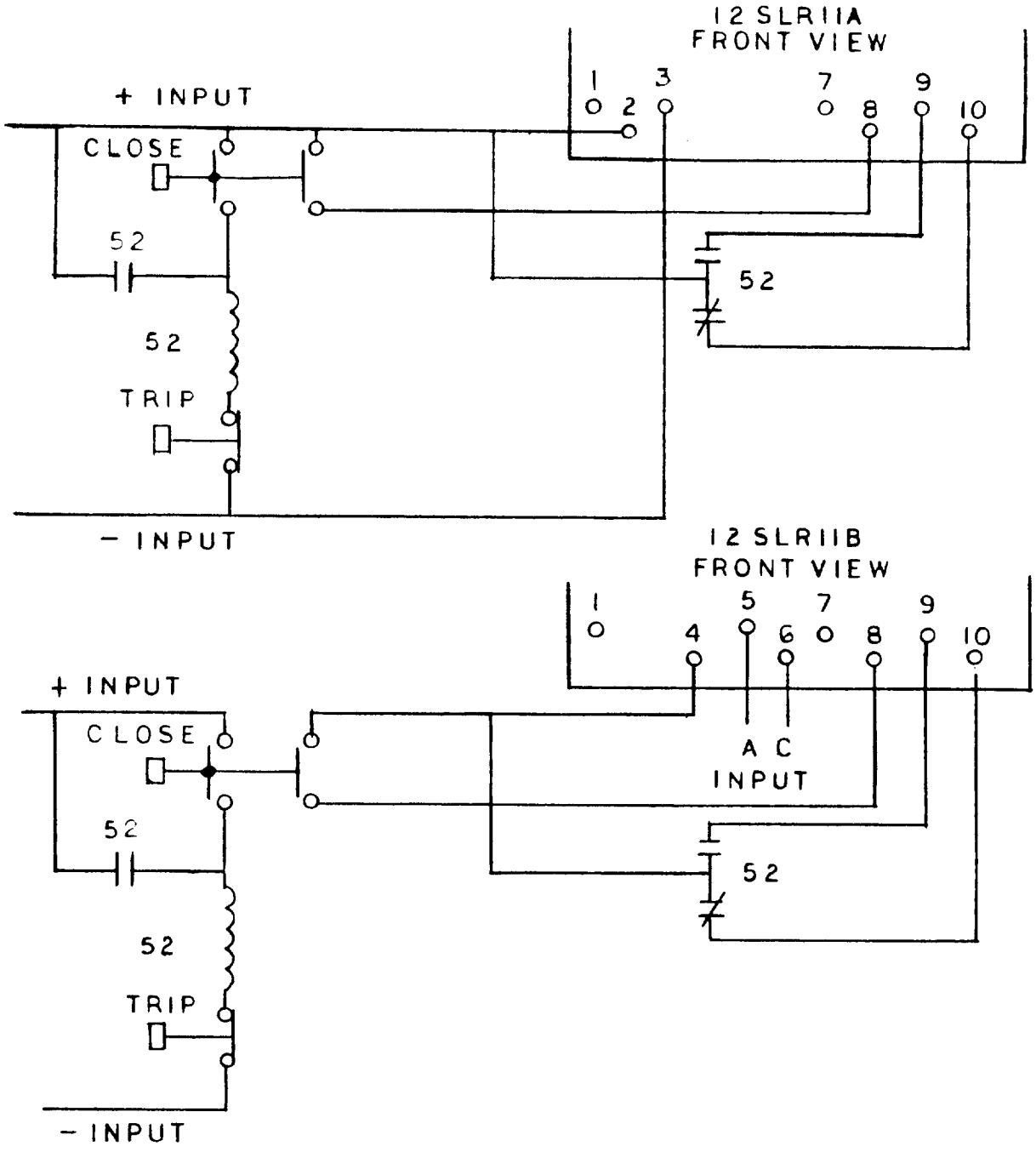
Fig. 8 (0184B5732-0) Logic and Switch Circuit



NOTE

ALL DIODES IN3061

Fig. 9 (0184B5734-0) AC Power Supply Circuit



NOTE: THE SWITCHES ON THE ABOVE CIRCUITS ARE MOMENTARY
THE 52 RELAY COIL SHOULD BE RATED FOR THE INPUT VOLTAGE.

Fig. 10 (0285A6292-0) Functional Test Circuit of SLR Relay, Front View

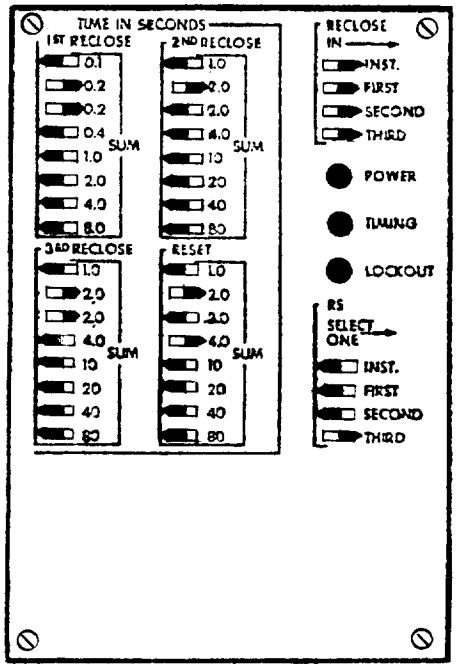


FIGURE A

Fig. 11 (0285A5895-0) Relay Settings for Reclose Timing Example

SLR RECLOSER

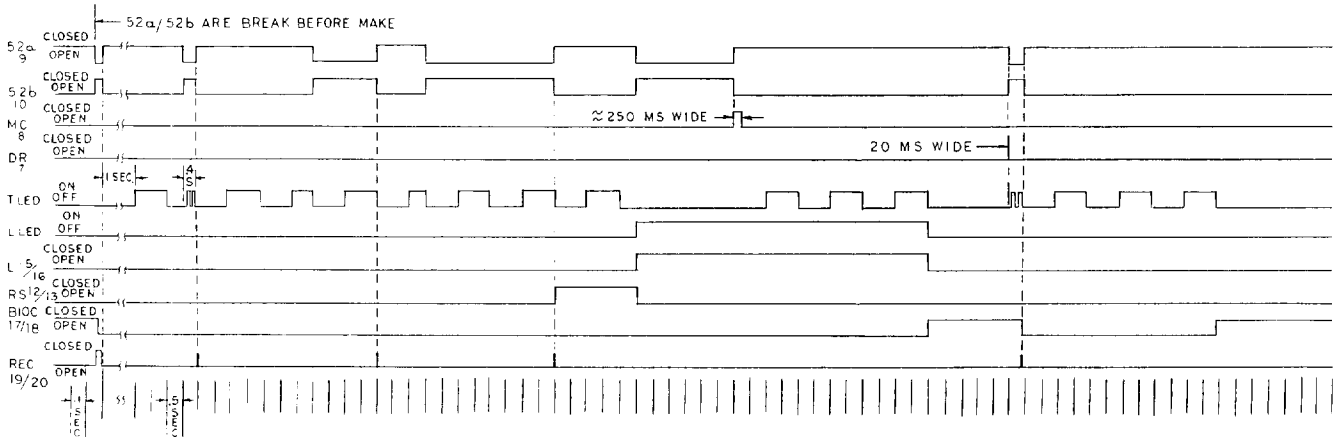


Fig. 12 (0179C6299-1) Relay Timing Example

*Indicates Revision

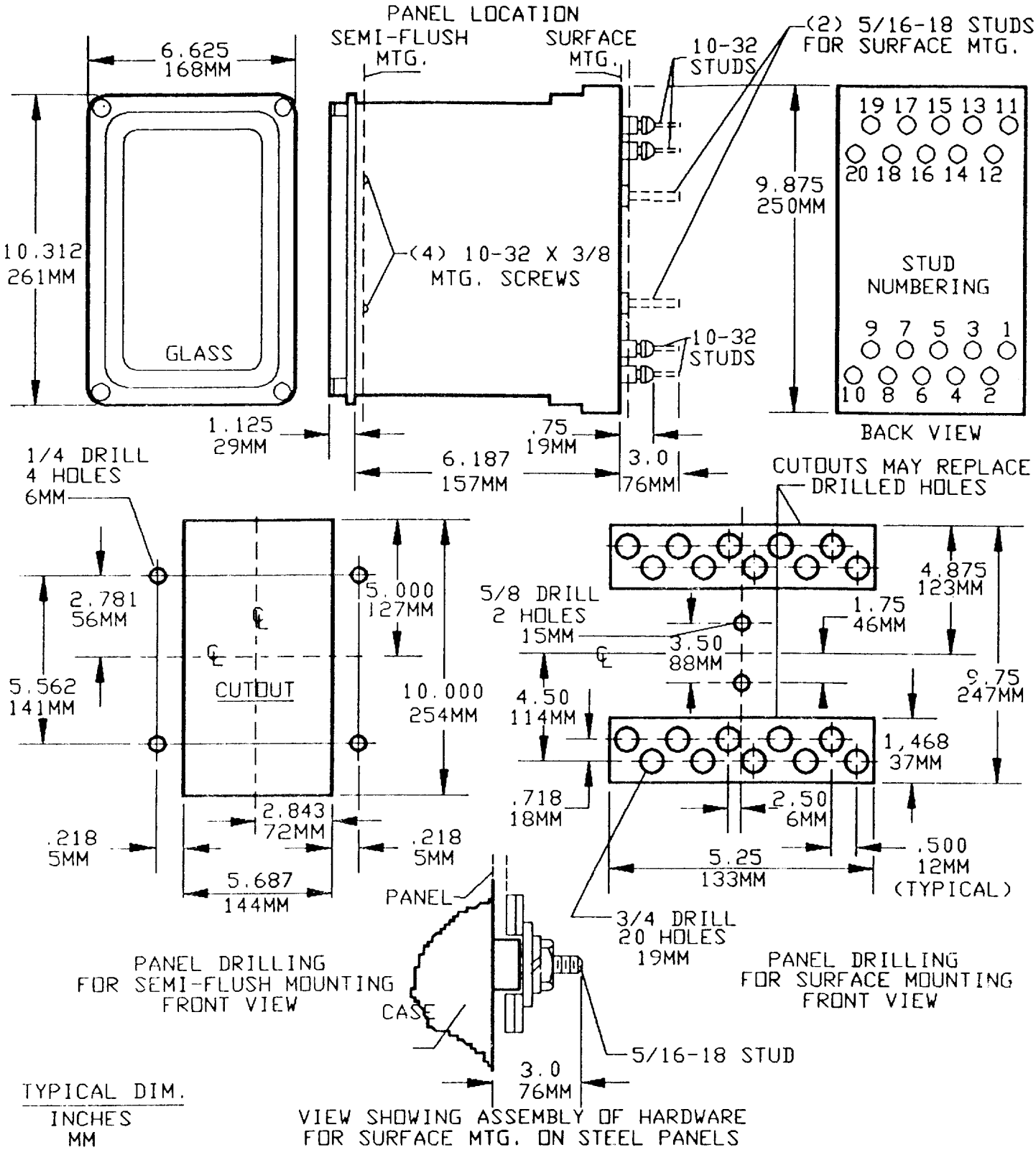


*Figure 13 (K-6209272 [6]) Outline and Panel Drilling Dimensions for SLR Relay

* Revised since last issue

(7/91) (200) **GENERAL ELECTRIC METER AND CONTROL BUSINESS DEPT., MALVERN, PA 19355**