RECLOSER RELAY
SLR13A,B

GENERAL ELECTRIC

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LIST OF FIGURES

Since the last edition, the section on the AC Power Supply has been added in **OPERATION**, Additional Features; Figures 2B, 10B and 17B have been added; and Figures 16 and 20 have been changed.

INTRODUCTION

The SLR13A microprocessor-based relay includes the following:

1. A recloser function that can be used to reclose a breaker up to four times following tripping by protective relays. The relay can be set to provide one high-speed (with no intentional delay or a small adjustable delay) and three time-delayed reclosures. Any, or all, of the reclosures can be selected.

2. A Breaker Operation Limiter (BOL) function or a Breaker Trip Counter (BTC) function, of which either, but not both, can be selected by the user.

Two liquid crystal displays (LCD) are provided (See Figure 1 and photograph on front cover) to select and display setting information. The LCD on the left is dedicated to the recloser function while the LCD on the right is dedicated to the BOL/BTC function.

Typical external connections to the SLR13A relay are shown in Figure 2.

DESCRIPTION

Recloser Function

The recloser function can be used to provide up to four reclosures, with one being high-speed (with no intentional or a small adjustable delay) and the other three being settable over various time ranges. Other features, to be discussed subsequently, are also included.

The Liquid Crystal Display (LCD) located on the left (Figure 1) is used to display all of the recloser settings, which are directly programmable from the front of the relay. Programming is done via a set of 4 CODE switches, a set of 4 NUMBER switches and an ENTER button (see Figure 1 for details). The CODE switches (set to 1 or 0) are used to select which setting is to be made, whereas the NUMBER switches (set to IN or OUT) are used to make the actual setting.

After the CODE and NUMBER switches have been set, the ENTER button is pushed to store the setting in the relay.

For example, to select all four reclosures, CODE (0 0 0 0) is selected by placing the four CODE switches in the "0" position, and then placing all four of the NUMBER switches in the "IN" position to indicate that all four reclosures are required. If all four reclosures are not required, the same CODE would be selected, but the NUMBER switches of the unwanted reclosures would be left in the "OUT" position. Next, the ENTER button would be pushed to enter the settings. All other settings are made in a like manner by first selecting the appropriate CODE, then selecting the NUMBER and finally pushing the ENTER button. Further details on the remaining settings can be found in the SETTINGS section.

Please note that the recloser is not enabled until all of the CODE switches are placed in the "1" position and the ENTER button pushed. The CODE switches must all then be left in the "1" position for the recloser to remain enabled. If any of the switches are set to "0", the recloser will be disabled and will not respond to any external input commands. Note that if any of the switches are set to "0", the LCD display will be blank, indicating that the recloser is disabled. When the recloser is enabled, it will display RES if it is in reset or LO and BI if it is in lockout.

It is possible to change one or more of the settings without reprogramming the entire sequence. To do this, simply select the required CODE(s) and NUMBER(s) followed by an ENTER. After the changes have been made, return all of the CODE switches to the "1" position and push ENTER to enable the recloser.

After all of the settings have been made, they can be checked by pushing the READ button, which will cause the settings to be sequentially displayed in the LCD (see READ section). In fact, the READ button can be pushed at any time to check the settings. It is also possible to have the recloser perform a self-test, by pushing the TEST button, which will cause the recloser to go through its operating sequence but without energizing the output relays (see TEST section). The READ and TEST buttons can be pushed at any time without the need for removing the recloser from service. If a reclosing operation is called for during either the TEST or READ sequence, they will be overridden and the recloser will then run through its normal operating sequence.

Once the recloser is enabled, operation is controlled by the breaker auxiliary "a" and "b" switches and the breaker control switch 52CS. Please refer to Figure 2, which shows typical external connections to the SLR13A relay.

If the breaker is closed when the recloser is enabled, it will recognize that the "a" switch is closed, that the "b" switch is open and will "awaken" in the reset (RES) position. RES will be displayed in the LCD. On the other hand, if the breaker is open when the

recloser is enabled, the auxiliary switches will be in the opposite state, the recloser will recognize this and it will awaken in the lockout (LO) position. LO and BI will be displayed in the LCD. When the breaker is closed manually, the auxiliary switches will transfer state ("a" closes, "b" opens) and the recloser will start to count down from a time equal to the reset setting (this can be observed in the LCD). At the end of the reset period, the recloser will assume the reset position and RES will be displayed in the LCD. If, on the other hand, the breaker were to trip as the recloser was counting down, the auxiliary switches would again change state and the recloser would immediately go to the lockout position, thus preventing any further reclosures. At that time, LO and BI would be displayed in the LCD.

If the breaker is tripped manually, the recloser will count down to the first reclosure selected (no countdown if instantaneous was selected) and at that time will produce an output to reclose the breaker. No reclosure will take place, however, because the 5-5C contacts of the control switch (52CS) will be open at that time. At the instant that the reclose output is produced, the recloser will check to see if the breaker auxiliary switches transfer;i.e., "b" opens and "a" closes. A time limit is built in to the recloser for this transfer to occur, and is equal to (0.9) times the TIME MULTIPLIER in seconds (see TIME MULTIPLIER setting under **Programming**). Thus, if a TIME MULTIPLIER of 1.0 is selected, the transfer of the auxiliary switches must occur within 0.9 seconds after a reclose output is called for. If the transfer does not occur within this time period the recloser will immediately go to lockout. Since reclosing is prevented by the control switch following a manual trip the recloser will go to lockout following any manual trip. NOTE THAT THE ABOVE DESCRIBED TIME LIMIT APPLIES ANYTIME THAT THE RECLOSER PRODUCES A RECLOSE OUTPUT.

If the breaker is tripped by the protective relays, the 5-5C contacts of the control switch will be closed, and the recloser will go through its programmed sequence following closure of the "b" switch. When the first reclosure point is reached, a reclose output will be produced to close the breaker. If the breaker closes successfully as indicated by a transfer of the auxiliary switches within the TIME LIMIT, the recloser will start to count down to reset. If no tripping occurs during this period, the recloser will reset and be ready to initiate another complete reclose cycle when called for. If a trip does occur during the reset period, the recloser will then go on to the next reclosure, if one has been selected. If the breaker retrips following each reclosure, the recloser will go through its complete cycle. Following the last selected reclosure, the recloser will immediately go to lockout when the breaker retrips. Note that the recloser starts a new timing and reset cycle during each reclose period;i.e., the reclose times are not cumulative and do not start from the time that the breaker is first tripped.

The basic operation of the recloser function has just been described. The following additional features are also included in each recloser function. Typical applications for each of these features will be discussed separately in the section under APPLICATION.

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Settable Delay for Instantaneous Reclose

This feature is used when the high-speed reclosing time delay is not part of the breaker-control circuitry. A timer is provided wherein an additional delay of 1 to 63 cycles (in 1 cycle steps) can be added to the instantaneous reclose time, which is normally 2 cycles.

Selective Reclosing or Two Separate Reclosing Cycles (DR input)

The delayed reclose (DR) input can be used to skip the first selected reclosure and go directly to the next reclosure, or it can be used to select either of two pre-programmed reclosing cycles.

For example, if the delayed reclose feature is selected, and if the relay has been programmed for the INSTANTANEOUS, FIRST and THIRD reclosure, an input (contact closure) at the DR input will cause the instantaneous reclosure to be skipped and allow the recloser to go directly to the first reclosure.

On the other hand, if the two-reclosing-cycle feature is selected, a DR input will cause the recloser to select the second of two pre-programmed reclosing cycles.

PAUSE Feature

A "PAUSE" feature is provided for use in delaying the **reclose** output and/or extending the **reset** time of the relay:

1. When used in the reclose mode, a reclose output will be delayed for up to the PAUSE setting or until a contact is closed at the PAUSE input to the relay. If a contact closure occurs during the PAUSE period, the reclose output will be produced immediately, otherwise the relay will go to lockout at the end of the PAUSE period. In other words, the relay cannot produce a reclose output unless the PAUSE input is present at the time a reclose is called for, or unless a PAUSE input is applied during the PAUSE period. Note that the PAUSE period begins at the time that a reclose output would normally occur. For example, if a 16-second PAUSE setting were selected, the recloser will count down to each reclosure, and at that time will reclose the breaker if a PAUSE input is present (contact closed) or will wait 16 seconds from that time for a PAUSE input to be applied. If a PAUSE input is applied during that time, reclosing will occur immediately, otherwise lockout will occur when the pause time elapses. This feature is commonly used with synchronism check functions.

2. When used in the reset mode, the reset time can be delayed for up to the pause setting. Here too, the PAUSE time will be initiated if there is no PAUSE input and the PAUSE time will be prevented, or terminated by a contact closure at the PAUSE input to the relay. In other words, a continuous PAUSE input will produce the reset times stored in memory. On the other hand, the reset time can be extended by up to the PAUSE time, or for a lesser time, by controlling the time that the PAUSE input is open

during the reset period. For example, with a PAUSE setting of 16 seconds, the reset time can be extended for 16 seconds, or less, by opening a contact at the the PAUSE input. If the contact is open for 16 seconds or longer, the reset time will be extended by 16 seconds. If the contact is open for a lesser time, then the reset time extension will be equal to the time that the the contact is open. The PAUSE input (contact opening) can be applied at any time during the reset period.

The PAUSE features described above are controlled by external contacts that are applied to the PAUSE input of the relay. Note that only one PAUSE time can be selected and it applies to both the reclose and/or reset period;i.e., independent pause settings cannot be made if both the reclose and reset modes of operation are chosen for the PAUSE feature.

An option plug is provided through which the PAUSE features described above can be implemented.

RS output

Output contacts, designated RS, are provided for use in external control circuits. The RS function can be set to be activated at any one, but only one, of the selected reclosures. The RS contacts can also be set to operate with a pickup delay and dropout delay if desired. These delays are measured starting at the reclosure selected to activate RS. For example, if RS is set to operate at the second reclosure and with a pickup time of 2 seconds and a dropout time of 6 seconds, the following will occur:

When the reclose signal is produced at the end of the second reclose period, the RS function will pick up 2 seconds later, remain picked up for 4 seconds, and then drop out. Thus, the time that the RS function remains picked up is equal to the set dropout time minus the set pickup time, because both timing periods are started at the same instant.

Delay on RESET via RS Signal

The SLR13A relay has a feature wherein the RESET can also be delayed via an internal timer (separate from PAUSE timer) that is driven by the signal that is used to drive the RS relay. The timer, which can be set over the range of 2 to 126 seconds (1 second when set to 0) in 2-second steps, will pick up and time out if the RS signal is present at any time in the RESET period, even if the RS function is set to be picked up for a time shorter than the time set on the RESET delay timer. This occurs because the operating time of the RS signal is extended for the same time set on the RESET delay timer. It should be noted that the Reset delay timer starts at reclose and will be reduced in time by the time-delay pickup of RS. For example, assume RS is set to pick up in 0 seconds and to drop out in 6 seconds, that it is set to operate at the second delayed reclosure, that the RESET delay timer is set to 10 seconds, and that the normal reset time set on the relay is 10 seconds. When the second delayed reclose output is produced, the RS function will pick up and start the RESET delay timer, which will then time out and extend the RS on time and reset time 10 seconds. There will then be

10 seconds remaining in the normal reset time, and 6 seconds remaining until the RS function drops out, because the operating time of the RS function was also extended 10 seconds. If the breaker retrips before RS has dropped out, and if the next reclose is called for before the dropout of RS, then the next reset time will also be delayed by the RESET delay timer, because RS will be up at that time. Therefore, if the RESET delay time is required during one reset period only, select the dropout time of the RS function so that it can't overlap into the next selected reclose time. Conversely, if the RESET delay time is required in more than one reset period, set the drop out time of RS accordingly.

BI Output

Output contacts, designated BI, are provided for use in external control circuits. These contacts operate with the first selected reclosure signal and remain operated up until the recloser resets. For example, if the SECOND and THIRD reclosures are selected, the BI function will operate when the second reclosure times out and produces a reclose signal to the breaker. The BI function will stay up until the recloser is reset. If the reclosure attempts are unsuccessful, the recloser will go to lockout and the BI function will stay up. In fact, the BI function will be picked up any time the recloser is in lockout, and it will stay picked up until the recloser is reset.

IP Output

An IP output is provided as an indication that a reclosing operation is in progress. The IP output will be produced whenever the recloser is not completely reset or in the lockout position. This output can be used to drive one or both of two user-selectable output relays, provided that these relays have not been selected for use with other functions.

The IP output can be set to operate at the end of the time delay associated with the delayed instantaneous reclose. This feature is implemented via a jumper in the relay and is used when it is desired to use a synchronism-check function at all reclosures except the delayed instantaneous reclosure. The normally-closed IP contacts are used at the PAUSE input (in parallel with the sync-check input) to allow the delayed instantaneous reclose to proceed immediately without waiting for a sync-check input. After the instantaneous reclosure, the IP contacts will open and allow the sync-check function to control the remaining reclosures.

LO Output

An LO output is provided to indicate that the recloser is locked out. The LO function will be energized only when the recloser is in the locked out position. This output can be used to drive one or both of two user-selectable output relays, provided that these relays have not been selected for use with other functions.

Time Multiplier

A TIME MULTIPLIER is included in the relay, wherein the range of all of the time settings related to the recloser function can be changed. Figure 1 lists the times for a TIME MULTIPLIER setting of 1.0. Note that the TIME MULTIPLIER setting applies to all times, including the reclose limit time described earlier under **Recloser Function**; i.e., it is not possible to change just one time range via the TIME MULTIPLIER.

Memory

The SLR relay is provided with a memory feature that is useful in those cases where the input power can be lost during a reclose cycle. The memory feature can be plugged in or out at the user's discretion. When it is used, it will remember where in the reclose cycle the recloser was when the power was lost, and will return to the beginning of that reclose cycle when the power is returned. For example, assume that the first reclosure was set to operate in 15 seconds and that the power was lost when the recloser was half way through the countdown. When the power is restored, the recloser will pick up in the first reclose period, but will start counting down at 15 seconds rather than at the halfway point where power was lost. When the countdown is complete, the first reclose output will be produced to close the breaker and the recloser will then go through the remainder of its set sequence. If the memory feature is not used, the recloser will "awaken" in reset if the breaker is closed when the power is restored, or it will "wake up" in lockout if the breaker is open.

The memory feature can also be used to remember the state of the BI, RS, IP and LO functions when the power is lost and then restored. This feature is implemented via the NUMBER switches when CODE (1 1 1 1) is set to enable the recloser. The NUMBER switches, reading from left to right, control the BI, RS, IP and LO functions respectively. If a NUMBER switch is "IN", and the respective function is picked up when power is lost, it will stay in that state and be there when power is restored. The state of the function will be ignored if the respective NUMBER switch is "OUT" when power is lost.

A separate memory function can be used to retain the count of the BOL/BTC function when power is lost. This memory can also be plugged in or out at the user's discretion.

Breaker Operation Limiter (BOL) function

The breaker operation limiter (BOL), as the name implies, is designed to control the number of breaker reclosures over a set period of time. The implementation consists of an up/down counter and a recovery timer. The counter can be set from 1 to 63 and the recovery timer can be set from 0.5 to 63 minutes with a resolution of one minute. The counter decrements the count by one for each trip operation of the breaker. When the count reaches zero, BOL prevents further outputs from the recloser function. The recovery timer runs continuously except when the BOL counter is at its set point. Each

time the recovery timer times out the BOL counter is incremented by one.

As an example, consider the BOL counter set at 4 and the BOL recovery timer set at 30 minutes. Assume that a galloping conductor condition exists such that faults occur every 5 minutes, preventing the reclosing function from going to lockout but causing the BOL counter to decrement from 4 to 0. At the point in time when the counter decrements to 3, the recovery timer starts timing down from 30 minutes to zero. Before the recovery timer times down to zero the counter reaches zero, indicating a BOL output, and further reclosures are prevented. At this point the breaker is open. When the recovery timer times down to zero, the counter increments to 1, the recovery timer resets to 30 minutes and begins timing down again. At this point, the reclosing relay closes the breaker, provided that a reclose is still available in the reclose cycle. If no further breaker trips occur, the counter will eventually increment back to 4, at which point the recovery timer will stop timing.

The LCD on the right-hand side of the relay is associated with the BOL function and the top part shows the count in two-digit format while the bottom part shows the recovery timer value, also in two-digit format. When the BOL count reaches zero, the BOL LCD will show the word PAUSE and a red LED will turn on. Optionally, an output contact of one or both of the user-selectable output relays can be programmed to close when a BOL output occurs, provided that these relays have not been selected for use with other functions. When the BOL counter reaches a set warning point, indication is given in the form of a yellow LED. The set point for this warning is adjustable over the range of 1 to 4 counts above zero. The warn output can be used to drive one or both of two user-selectable output relays, provided that these relays have not been selected for use with other functions.

Breaker Trip Counter (BTC) Function

The BTC function simply provides a means to count the number of breaker trips and to place the recloser function in LOCKOUT when the set count is reached. When the BTC function is used, the upper part of the LCD on the right will show the count remaining, while the bottom part shows the set warning point. When the BTC count reaches the set warning point, a yellow LED will light. The set point for this warning is adjustable over the range of 1 to 4 counts. The warn output can be used to drive one or both of two user-selectable output relays, provided that these relays have not been selected for use with other functions. When the BTC count reaches zero, a red LED will turn on, the yellow light will go out, and the recloser will be put in lockout.

APPLICATION

Reclosing Functions

The reclosing function in the SLR13A relay can be used to close a circuit breaker up to four times following tripping by protective relays. Any, or all, of the reclosures can be selected. The instantaneous reclosure can be set with an intentional time delay of

up to 63 cycles. The **remaining** reclosures and reset time can be set over the following time ranges:

RECLOSURE	SET TIME RANGE SECONDS	RESOLUTION	MULTIPLIER
FIRST	0.1 TO 15.9	0.1	
SECOND	1.0 TO 159	1.0	0.5, 1.0, 2.0 4.0
THIRD	1.0 TO 159	1.0	
RESET	1.0 TO 159	1.0	

Note that the TIME MULTIPLIER applies to the recloser function only, and works on all time ranges concurrently: i.e., it is not possible to change only one time range. The MULTIPLIER has no effect on the instantaneous reclosure, or the instantaneous reclosure delay.

Typical external connections to the SLR13A relay are shown in Figure 2. This diagram illustrates the connections to be used in simple, straightforward applications without any special requirements such as synchronism check, delayed reset, etc. These special requirements will be discussed separately. A breaker control switch (52CS) and breaker auxiliary "a" and "b" switches are required as shown in the connections. A control switch contact (5-5C) that is closed only in the "close" and "normal after close" positions is employed to prevent automatic reclosing of the breaker following a manual trip. With this switch arrangement, the relay will sense that reclosing is being prevented and it will go to lockout when it tries to close the breaker following a manual trip.

The SLR13A relay has many unique features and a great deal of flexibility in how they may be employed. Following is a description of these features along with some special applications in which they can be used. The figures used in these descriptions apply only to the pertinent input connections. Refer to the overall elementary, Figure 2, for the remainder of the connections.

Delay in Instantaneous Reclose

The Instantaneous reclose output has a minimum delay time of approximately 2 cycles, but provisions are included in the SLR13A relay whereby up to 63 cycles of additional delay can be used. This additional delay would typically be used in those applications where the breaker-control circuitry has no built-in delay. The delay is implemented using the sum of the INST. REC. DELAY switches located on the lower right side of the relay. The minimum delay of 2 cycles is obtained with all of the switches in the group set to the OUT position.

Synchronism Check

Synchronism check may be used with the SLR reclosers via the PAUSE input as shown in Figure 6. In this connection, the synchronism check contact must be closed when the system is in synchronism and open when the system is out of synchronism. In this way, reclosing will be permitted if the system is in synchronism, or blocked if the system is out of synchronism. The PAUSE time setting is the time that is permitted for a sync check input to be produced; the timing starts when a reclose output is called for. If a sync check input is not present when the PAUSE time elapses, the SLR will go immediately to lockout.

Note that a sync check input is required at all selected reclosures when the PAUSE function is implemented. If it is desired not to sync check a reclosure, some means must be used to bypass the sync check input at the reclosure, or reclosures, where sync check is not wanted. For example, the RS normally-closed contact may be used to eliminate the sync-check requirement for an instantaneous reclosure by connecting it as shown by the dotted line in Figure 6. For this connection to be effective for the described condition, RS must be set to pick up shortly after the instantaneous reclosure (1 second for example) and set to drop out at lockout. In this way sync check will be required on all delayed reclosures but not on the instantaneous reclosure. If sync check is not required on the instantaneous and the first delayed reclosure, then the RS function would be set to pick up shortly after the first delayed reclosure has been reached.

If the RS function is used for other purposes, then the IP output may be used to bypass the sync check input, but only on the instantaneous reclose, because IP picks up as soon as the reclosing process begins. Note that if the instantaneous reclose delay timer is used, then the IP output must also be delayed by the same amount of time. This is accomplished by setting the P18 jumper to the 1 to G position. If the instantaneous reclose is not delayed, set the P18 jumper to the G to 2 position so that no delay will be incurred in the IP output.

Block Instantaneous Tripping

It is sometimes desirable on distribution circuits to block the instantaneous-trip circuits after the first trip but before the first reclosure is called for, thus providing for coordination with branch-circuit fuses. This can be implemented with the normally-closed "BI" contact as shown in the simplified connection diagram of Figure 3. The diagram represents an application with time overcurrent (TOC) and instantaneous overcurrent (IOC) functions. Note that the BI contact opens at the first selected reclosure and stays open during the remainder of the reclosing cycle, and in the lockout position if reclosing proves to be unsuccessful. A contact of the breaker control switch is shown connected across the BI contact. This control switch contact, which is closed in the "close" position of the switch, is used to re-establish the instantaneous-trip circuit if the breaker is manually reclosed when the SLR relay is in the lockout position.

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It is also possible to use the normally-closed "RS" contact to block instantaneous tripping, provided RS is not used for other purposes. In this case, RS can be set to pick up after the first, or even the second, delayed reclosure and thus allow instantaneous tripping to occur two, or even three times rather than just once as can be done with the BI contact.

Note that the RS function can be set to drop out at the lockout position; thus, instantaneous tripping will be reinstated at that time and it will not be necessary to use the control switch contact described earlier.

Selective Reclosing (DR input)

The P12 plug must be be set in the 1 to E position to implement the following selective reclosing applications. Note that the "two separate reclosing" program feature cannot be used if this feature is selected.

In some applications it may be desirable to initiate instantaneous plus delayed reclosures following a high-speed trip, but, following a time-delayed trip, to allow delayed reclosures only. This can be accomplished by applying a signal from the time-delay trip bus to the "DR" input of the SLR relay, as shown in Figure 4. With this connection, the recloser will skip the instantaneous reclosure and go immediately to the next selected reclosure.

It is also possible to set the SLR relay to provide two separate single-shot reclosures, with each reclosure having a different time delay. For example, it might be desirable to provide a single-shot of reclosing with a long time delay for ground faults, but to provide a single-shot of faster reclosing for phase faults. This can be accomplished via the connections shown in Figure 5. Assume, as an example, that a single-shot instantaneous reclosure is required following phase faults, but that a single-shot time-delayed reclosure is required following ground faults. To do this, make the connections shown in Figure 5 with a contact from the ground-fault-detection circuit connected to the DR input (select single-shot No. 2) input of the SLR relay. Make the following settings:

1. Select instantaneous (INST) and first (1ST) reclosure.

2. Set the FIRST reclosure time delay to that required for ground faults.

3. Set PAUSE select jumpers on the P10 plug to the 1-H and 2-1 positions.

4. Set PAUSE time setting to zero (0)

5. Set all of the instantaneous delay timer switches to OUT.

6. Set appropriate reset time.

With these connections and settings the following will occur.

1. For phase faults - when a phase fault occurs, there will be no DR input to the SLR relay. Consequently, when the breaker trips and the "b" switch closes, the SLR relay will initiate an instantaneous reclose output to close the breaker. At the same time, the BI contacts will open to remove the PAUSE input. If the reclosure is successful, the SLR will reset following the set reset time (BI contacts will close at that time). If the reclosure is not successful and the breaker retrips, the SLR will count down the first reclose time and then try to close the breaker. Reclosing will not be permitted, however, because of the open PAUSE input, and the SLR will then immediately go to lockout. Thus, only one reclosure is permitted.

2. For ground faults - when a ground fault occurs, there will be an input applied to the DR input of the relay (must be applied before "b" closes). At that time, the instantaneous reclosure will be skipped and the SLR will start to count down to the first reclosure when the "b" switch closes. At that time, the breaker will be closed, with a delay equal to the first reclose time. If the reclosure is successful the SLR will go to reset. If the breaker retrips, the SLR will go immediately to lockout. Here too, only one reclosure is allowed.

Two Separate Reclosing Programs (DR input)

It may be desirable in some applications to switch reclosing programs for different system operating conditions. To do this, a contact applied to the DR input (see Figure 4) can be used to select either of two separate reclosing programs. The first program will be implemented when the contact is closed, whereas the second program will be implemented when the contact is open. Programming and implementation is accomplished as follows:

1. Set the P12 plug to the 1 to E position with the contact to stud 7 open and enter the program (NO. 1) to be used when the contact at the DR input is closed.

2. Set the P12 plug to the E to 2 position with the contact to stud 7 open and enter the program (NO. 2) to be used when the contact at the DR input is open.

3. LEAVE THE P12 PLUG IN THE E TO 2 POSITION TO IMPLEMENT DUAL PROGRAM SELECTION VIA THE EXTERNAL CONTACT AT THE DR INPUT. CLOSE THE CONTACT TO IMPLEMENT PROGRAM NO. 1, LEAVE IT OPEN FOR PROGRAM NO. 2.

Note that the selective reclosing feature described earlier cannot be used if the two program feature is selected.

Delayed Reset

Some applications may require a delay in the reset time in order to allow certain events to occur. For example, it may take a time-overcurrent function a very long time to operate for low-level ground faults, whereas the phase-time-overcurrent functions may operate very quickly. Thus, long reset times may be required to accommodate the low-level ground faults, whereas shorter reset times may be required

for phase faults. The PAUSE input to the SLR relay can be used to accomplish this requirement. A simplified connection diagram to meet this requirement is shown in Figure 7. Note that a sensitively set instantaneous overcurrent (IOC) function and an auxiliary function 79X are required. With this connection, the PAUSE input will be open whenever IOC operates. The PAUSE time will last as long as IOC is picked up or until the PAUSE time elapses; and the reset time will be extended accordingly. In this way, time will be allowed for the TOC to operate before the SLR resets.

PAUSE Function - Dual Use

Two separate and distinct applications have been described using the PAUSE function:

      a. synchronism check during reclose, and;

      b. delay during reset.

It is possible to use the PAUSE function during both reclose and reset but special connections are required as shown in Figure 8. Note that although the sync check and reset delay functions are totally isolated in this example, they both operate for a common PAUSE time; i.e., it is not possible to use separate PAUSE time settings when the PAUSE function is used for a dual purpose.

Delay Reset via RS Signal

It is sometimes desirable to have a longer reset time (delayed reset) after a particular reclose to prevent reset of the recloser. One such application is the operation of sectionalizing switches after a predetermined number of reclosures. To use this function:

      a. Set the RES-OFF switch to the RES position

      b. Set the delay time using the PAUSE RESET switches

      c. Select the reclosure at which RS is to implement the delay.
         Note that the reset can be extended at any, or all, reclosures by proper setting of the RS function.

      d. Set the H jumper plug (on the logic and control board) to one of the **reset** positions.

Breaker Operation Limiter (BOL) Function

The BOL function can be used any time it is required to limit the number of breaker operations over a specified period of time. To use this feature:

      a. Set the BTC/BOL switch to the BOL position

      b. Set the BOL count switches to the required count

      c. Set the BOL timer switches to the required time

d. Set the WARN switches to the required count

e. Set the H jumper plug to one of the **reclose** positions

Note that the BTC function cannot be used if the BOL function is selected.

Breaker Trip Counter (BTC) Function

The BTC function can be used any time it is required to limit or count the number of breaker operations. To use this feature:

a. Set the BOL/BTC switch to the BTC position

b. Set the BOL/BTC count switches to the required count

c. Set the WARN switches to the required count.

d. Set the H jumper plug to one of the **reclose** positions

Note that the BOL function cannot be used, and that it makes no difference where the BOL/BTC timer switches are set, if the BTC function is selected.

Output Contacts

The RS function and the BI function are provided with dedicated output relays. Two additional floating output relays are provided (see Figure 2).

The floating relays can be connected to operate from any of the following signals via the P13, P14, P15 and P16 plugs as shown in Figure 2.

1. WC (warn count) - This signal is produced when the BOL or BTC counter has counted down to the warn set point and is used to warn that the count is near zero (settable from 1 to 4).

2. ZC (zero count) - This signal is produced when the BOL or BTC counter has counted down to zero. When the BOL function is used, the reclose will be delayed until the BOL timer produces an up count. When the BTC function is used, the recloser will go to lockout.

3. IP (in progress) - This signal is used to indicate that a reclosing operation is in progress. The IP function will be picked up except when the recloser is completely reset or in lockout. If the instantaneous delay time is set, the IP signal can be delayed from operating, by the instantaneous delay time, using the the P18 jumper plug.

4. LO (lockout) - This signal is provided to indicate that the recloser is in the locked out position. The LO output will be produced only when the recloser is in the locked out position.

Note that the two relays can be tied to the same signal if so desired.

Precautions to Take if The SLR13A Relay is Used Only For Reclosing

The SLR13A relay can be used only for reclosing, but the following must be done:

    a. Set the BOL/BTC switch to the BOL position

    b. Set the BOL/BTC count switches to the maximum count

    c. Set the BOL timer switches to the minimum time; i.e., set all switches to OUT

With these settings, the BOL limit will never be reached, thus the recloser will be allowed to accomplish the complete reclosing cycle.

OPERATION

SLR13A11A Inputs and Outputs

The SLR13A11A is designed for a DC input with an input voltage of 48, 125, 250 volts DC (see Figure 9).

The recloser has 4 inputs and 5 outputs as listed below. The reclose (REC), relay spare (RS) and block instantaneous (BI) signals are brought out as dedicated outputs. The warn count (WC), zero count (ZC), in progress (IP) and lockout (LO) signals are brought out through 2 selectable outputs.

<u>Inputs</u>:

    DR   "Delayed Reclose" is used to skip the first selected reclose signal or to select one of two reclose cycles.

    P   "Pause" is used to delay the start of the reclose signal, or to extend this reset time or both.

    52a, 52b Auxiliary contacts of the circuit breaker used to indicate the state of the breaker.

<u>Outputs</u>:

    REC   "Reclose" is the reclose signal. The reclose relay is a telephone type that can have it's contacts inspected by removing the cradle from the case.

    RS   "Relay Spare" is an auxiliary relay that can be operated at any selected reclose with adjustable pickup and dropout times.

    BI   "Block Instantaneous" operates at the first reclose signal and remains on until the reclose is reset.

    WC   "Warn Count" operates when the BOL or BTC count has counted down to the warn set point (4, 3, 2, or 1 counts

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from zero). The output is removed at zero count or when the BOL count has counted up above the warn set point.

ZC   "Zero Count" operates when the BOL or BTC count has counted down to zero. The output is removed when the BOL count has counted above zero.

IP   "In Progress" is used to indicate that the reclose is in progress for a reclose or reset.

LO   "Lockout" is used to indicate the relay is in lockout.

The outputs ⊠ and ☐ (see Figure 9) are controlled by jumper plugs P13, P14, P15 and P16. By setting the jumper plugs, each output can be activated by output signal WC, ZC, IP or LO.

It should be noted that shorting bars are used across the normally-closed contacts of RS and BI to complete the circuits if the connection plug is withdrawn from the case.

Surge capacitors are installed from all input and all output circuits to surge ground.

Basic Recloser Operation

The recloser is not enabled until all of the CODE switches are placed in the "1" position and the ENTER button pushed. Note that the NUMBER switches in this case control the state of the BI, RS, IP and LO relays on loss of and return of power (see step 7 in the **Programming** section). The CODE switches must all be left in the "1" position for the recloser to remain enabled. If any of the switches are set to "0", the recloser will be disabled and will not respond to any external input commands. Furthermore, if any of the switches are set to "0", the LCD display will be blank, indicating that the recloser is disabled. When the recloser is enabled, it will display RES. if it is in reset or L.O. and B.I. if it is in lockout.

Once the recloser is enabled, operation is controlled by the breaker auxiliary "a" and "b" switches and the breaker control switch 52CS. Please refer to Figure 2.

If the breaker is closed when the recloser is enabled, it will recognize that the "a" switch is closed, and that the "b" switch is open, and will "awaken" in the reset (RES) position. RES. will be displayed on the LCD. If the breaker is open when the recloser is enabled, the auxiliary switches will be in the opposite state; the recloser will recognize this and it will "awaken" in the LO "Lockout" position. L.O. and B.I. will be displayed on the LCD. When the breaker is closed manually, the auxiliary switches will transfer state ("a" closes, "b" opens) and the recloser will start to count down from a time equal to the reset setting (this can be observed on the LCD). At the end of the reset period, the recloser will assume the reset position and RES. will be displayed on the LCD. If the breaker were to trip as the recloser was counting down, the auxiliary switches would again change state and the recloser would immediately go to the lockout position, thus preventing any further reclosures. At that time, L.O. and B.I. would be displayed on the LCD.

If the breaker is tripped manually, the recloser will count down to the first reclosure selected (no countdown if instantaneous was selected) and at that time will produce an output to reclose the breaker. No reclosure will take place, however, because the 5-5C contacts of the control switch (52CS) will open at that time. At the instant that the reclose output is produced, the recloser will check to see if the breaker auxiliary switches transfer, i.e. if "b" opens and "a" closes. A time limit is built into the recloser for this transfer to occur, and is equal to 0.9 times the time multiplier in seconds (see Set Time Multiplier in the **Programming** section).

Thus, if a time multiplier of 1.0 is selected, the transfer of the auxiliary switches must occur within 0.9 seconds after a reclose output is produced. If the transfer does not occur within this time period, the recloser will immediately go to lockout. Since reclosing is prevented by the control switch following a manual trip, the recloser will go to lockout following any manual trip. THE ABOVE-DESCRIBED TIME LIMIT APPLIES TO ANY TIME THAT THE RECLOSER PRODUCES A RECLOSE OUTPUT.

If the breaker is tripped by the protective relays, the 5-5C contacts of the control switch will be closed, and the recloser will go through its programmed sequence, following closure of the "b" switch. When the first reclosure point is reached, a reclose output will be produced to close the breaker. If the breaker closes successfully, as indicated by a transfer of the auxiliary switches within the specified time limit, the recloser will start to count down to reset. If no tripping occurs during this period, the recloser will reset and be ready to initiate another complete reclose cycle when called for. If a trip does occur during the reset period, the recloser will then go on to the next reclosure, if one has been selected. If the breaker retrips following each reclosure, the recloser will go through its complete cycle. Following the last reclosure, the recloser will immediately go to lockout when the breaker retrips. The programmed time for each reclosure is independent of previous reclosures; i.e. the reclose times are not cumulative and do not start from the time that the breaker is first tripped.

Additional Features

Delayed Reclose

A DR "Delayed Reclose" input is included to allow the first selected reclosure to be skipped and to go directly to the next reclosure. For example, if the instantaneous, first and third reclosures are selected, an input (contact closure) at the DR input will cause the instantaneous reclosure to be skipped and the recloser will go directly to the first reclosure.

Pause

A "pause" feature operated by an external input signal is provided that can be used to control a reclose output and/or the reset time of the SLR relay, as follows:

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1. When used in the reclose mode, a reclose output will be delayed for up to the pause setting (∞,1024, 256, 64, 16, 4, 1, or 0) or until a contact is closed at the pause input to the relay. If a pause input occurs during the pause period, the reclose output will be produced immediately; otherwise the relay will go directly to lockout when the pause time has expired. The relay cannot produce a reclose output unless the pause input is present at the time a reclose is called for or is applied during the pause period. The pause period begins at the time that a reclose output would normally occur. For example, if a 16-second pause setting were selected, the recloser would count down to each reclosure, and at that time would reclose the breaker if a pause input was present (contact closed) or would wait 16 seconds from that time for a pause input to be applied.

   If a pause input is applied during that time, reclosing will occur immediately; otherwise lockout will occur when the pause time elapses (provided the pause time is not set to infinity, in which case it will wait forever for a pause input).

2. When used in the reset mode, the reset time can be delayed for up to the pause setting. Here too, the pause time will be initiated if there is no pause input and the pause time will be prevented, or terminated, by a contact closure at the pause input to the relay. In other words, a continuous pause input will produce the reset times stored in memory. The reset time can be extended by up to the pause time, or for a lesser time, by controlling the time that the pause input is open during the reset period. For example, with a pause setting of 16 seconds, the reset time can be extended for 16 seconds, or less, by opening a contact at the pause input. If the contact is open for 16 seconds or longer, the reset time will be extended by 16 seconds. If the contact is open for a lesser time, then the reset time extension will be equal to the time that the contact is open. The pause input (contact opening) can be applied at any time during the reset period.

Option plugs are provided wherein the pause feature can be used for reclose only, used during reset only, or used during both reclose and reset. Only one pause setting can be made, and it applies to both the reclose and/or reset periods. The option plugs can also be used to disable an external pause signal.

Internal pause signals can be produced by the BOL function, the delayed instantaneous timing and the pause reset timing controlled by the RS signal. These special pause conditions will be explained in the detailed description of the individual functions.

Output Contacts

RS "Relay Spare" Contacts are provided for use in external control circuits. The RS contacts can be set to be activated at any one, but only one, of the selected reclosures. The RS contacts can be set to operate with a pickup delay and dropout delay if desired. These delays are measured starting at the reclosure selected to activate RS. For example, if RS is set to operate at the second reclosure and

with a pickup time of 2 seconds and a dropout time of 6 seconds, the following will occur:

When the reclose signal is applied to the breaker at the end of the second reclose period, the RS function will pick up 2 seconds later, remain picked up for 4 seconds, and then drop out. Thus, the time that the RS function remains picked up is equal to the set dropout time minus the set pickup time, because both timing periods are started at the same time.

BI "Block Instantaneous" Contacts are provided for use in external control circuits. These contacts pick up with the first reclosure signal and remain picked up until the recloser resets. For example, if the second and third reclosures are selected, the BI function will operate when the second reclosure times out and produces a reclose signal to the breaker.

The BI function will stay up until the recloser is reset. If the recloser attempts are unsuccessful, the recloser will go to lockout and the BI function will stay up. In fact, the BI function will be picked up any time the recloser is in lockout, and it will stay picked up until the recloser is reset.

The ☒ and ☐ outputs (see Figure 9) are controlled by jumper plugs P13, P14, P15 and P16. The jumper plug settings are covered in the **SETTINGS** section. The 4 output signals that can be selected operate as follows:

1. WC "Warn Count" signal is produced when the BOL or BTC counter has counted down to the warn set point and is used to warn that the count is near zero. The range of setting is 1 to 4.

2. ZC "Zero Count" signal is produced when the BOL or BTC counter has counted down to zero. When the BOL function is used, the reclose will be delayed until the BOL timer produces an up count. When the BTC function is used, the recloser will be put in lockout.

3. IP "In-Progress" signal is used to indicate that a reclosing operation is in progress. The IP function will be picked up except when the reclose is completely reset or in lockout. If the instantaneous delay time is set, the IP signal can be delayed in operating by the instantaneous delay time by using jumper plug P18.

4. LO "Lockout" signal is provided to indicate the recloser is locked out. The LO function will be picked up only when the recloser is in the locked out position.

Memory

CAUTION

When SLR13 relays are powered up, a reclose signal could be produced. See **WARNING** on page 54 .

The SLR relays are provided with a memory feature that is useful in those cases where the input power can be lost during a reclose cycle. The memory feature can be plugged in or out at the user's discretion. When it is used, it will remember where in the reclose cycle the recloser was when the power was lost, and will return at the beginning of that reclose cycle when the power is returned. For example, assume that the first reclosure was set to operate in 15 seconds and that the power was lost when the recloser was half way through the countdown. When the power is restored, the recloser will pick up in the first reclose period, but will start counting down from 15 seconds rather than at the halfway point where power was lost. When the countdown is complete, the first reclose output will be produced to close the breaker and the recloser will then go through the remainder of its set sequence. If the memory feature is not used, the recloser will "awaken" in reset if the breaker is closed when the power is restored, or it will "wake up" in lockout if the breaker is open.

The memory feature can also be used to remember the state of the BI, RS, IP and LO functions when power is lost and then restored. This feature is implemented via the NUMBER switches when CODE (1 1 1 1) is set to enable the recloser. The NUMBER switches, reading from left to right, control the BI, RS, IP and LO functions respectively. If a NUMBER switch is "IN", and the corresponding function is picked up when power is lost, it will stay in that state and be there when power is returned. The state of the function will be ignored if the corrresponding NUMBER switch is "OUT" when power is lost.

A separate memory function can be set, using a jumper plug, to retain the count of the BOL/BTC function of the relay.

Time Multiplier

A Time Multiplier is included in the SLR relays, wherein the range of all of the time settings can be changed. The nameplate of the relay (Figure 1) lists the times for a time multiplier setting of 1.0. Note that the time multiplier setting applies to all times, including the reclose-limit time described earlier on page 19 and 20; i.e., it is not possible to change just one time range via the time multiplier.

DC Power Supply

The DC power supply is designed to operate over an input voltage range of 38 to 300 VDC. The supply is a non-isolated stepdown chopper type that produces a 14 VDC regulated output and does not require any input taps for the entire input voltage range. (See Figure 10.)

An output signal PV (power valid when pulled negative) is produced to indicate the power supply is at a safe value for the electronics to operate.

AC Power Supply

The AC power supply is designed to operate at 120 or 240 VAC, 50/60 Hz. The input voltage is selected with jumper plug (P1) by setting

120 or 240. Each input voltage will work over the range of 80% to 110% of nominal. The supply is an isolated type that produces a 14 VDC regulated output and a 150 VDC unregulated output. (The 150 VDC assumes that the output is loaded and the input is nominal.) (See Figure 12).

An output signal PV__ (power valid when pulled negative) is produced to indicate the power supply is at a safe value for the electronics to operate.

BOL/BTC

The breaker operation limiter (BOL) is designed to control the number of reclosures over a period of time. This is accomplished with an up/down counter and a recovery timer. The counter can be set from 1 to 63 with switches on the front of the relay. The recovery counter can be set from 0 to 63 minutes using switches on the front of the relay. When set at 0, the timer is 30 seconds. The BOL function operates by counting down trips and causing a pause at reclosing when the count reaches zero. The recovery timer will run continuously, except when the BOL counter is at its set point. Each time the timer times out, the BOL counter is counted up. The BOL count is the top 2 digits and the BOL timer the bottom 2 digits of the BOL/BTC (right-hand) LCD. When the BOL count reaches zero, the BOL/BTC LCD will show a pause. As the count nears zero, a warn signal, which is adjustable from 1 to 4 counts above zero, is produced.

The breaker trip counter (BTC) is designed to control a specific number of trips to a lockout condition. This is accomplished with a down counter, which puts the relay in lockout when the zero count is reached. The count can be set from 1 to 63, using switches on the front of the relay.

The BTC function operates by counting down trips and putting the recloser in lockout when the count reaches zero. The BTC count is the top 2 digits and the warn setting the bottom digit of the BOL/BTC LCD. As the count nears zero, a warn signal, which is adjustable from 1 to 4 counts above zero, is produced.

A down count for the BOL and BTC functions can be skipped by setting jumper plug P17 and using the 52a input of the SLR13 relay. The count will be skipped when the contact to the 52a input is closed. The P17 setting to permit a skip count provides a continuous 52a signal to the electronics of the SLR13.

Special Functions

1. A delay timer has been included to increase the reset time. The timer can be set from 0 to 126 seconds. When the timer is set to 0, the time delay will be 1 second. The timer starts with each reclose signal and is activated with the RS signal, and requires the 52b input to be open and the RES-OFF switch to be in the RES position. A time-delay pickup of RS will shorten the Reset delay times by the RS pickup time.

2. The instantaneous function has another delay timer with a range of 2 to 64 cycles (the switch setting for this range is 0 to 63).

When set at 0, the normal total delay from input to output is approximately 2 cycles. When set above 2 cycles, the extra delay above this setting is approximately 1 cycle (the time of the switch setting is the electronic-timer time and does not include the normal output delays). See Figure 11 for the timing of the instantaneous delay.

3. The IP output can be delayed by the instantaneous timer, using jumper plug P18.

Printed-Circuit Board Assembly

The printed-circuit-board assembly includes the relay and power-supply board (see Figure 12), the logic and control board (see Figure 13), and the special-function board (see Figure 14), which are connected together with jumper cables.

The relay and power-supply board consists of the following circuits:

1. Input circuits for the 4 input signals and the input voltage. The input voltage is used as a reference and is compared to the input signals to determine their state.

2. A 5 VDC power supply for the system logic.

3. The output-relay driver circuits and the output relays except for the reclose relay.

   Output relays K1 and K2 have output jumper plugs, (P6) and (P8) respectively, so that the NO (normally-open contacts) can be changed to NC (normally closed).

> **CAUTION**
> If the normally-closed contacts are used for ☒ or ☐ (☒ and ☐ are user selectable outputs -- See Figure 2 and 9), it must be remembered that there are no shorting bars supplied to complete the circuits if the connection plug is withdrawn from the case.

   Output relay K4 (BI) has an output jumper plug (P7) to change the NC (normally-closed contact) to a NO (normally-open contact).

> **CAUTION**
> It must be remembered that a shorting bar is supplied for BI to complete the circuit if the connection plug is withdrawn from the case, and that it would short out a normally-open contact of the SLR relay. If a normally-open contact is used for BI, the shorting bar in the case can be removed if necessary.

The logic and control board consists of the following circuits:

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1. Input switches to program the reclose functions.

2. Input push buttons to read and test the reclosure functions that are programmed in.

3. Switches to set the BOL/BTC count.

4. Switches to set the BOL recovery time.

5. Switches to set the pause reset timer.

6. Switches to set the instantaneous time delay.

7. Switches to set the warn function.

8. Jumper plugs to set the following:

    a. Output relay functions WC, ZC, IP and LO (output studs 15 to 16 and 11 to 15) - Jumper plugs A, B, C and D.
    b. Delayed reclose/dual program - Jumper plug E.
    c. Skip BOL/BTC count - Jumper plug F.
    d. Delay "In Progress" - Jumper plug G.
    e. Pause options - Jumper plugs (2) for H.
    f. Recloser memory - Jumper plug I.

9. Logic and memory to produce the reclose functions and readout signals for the reclose LCD (Liquid Crystal Display).

10. LCD and LEDs (Light Emitting Diode) to indicate the BOL/BTC status.

All settings required for the logic and control board will be covered in the SETTINGS section.

The Special Function board consists of the following circuits.

1. Logic for the BOL/BTC system.

2. Timers required for BOL, Instantaneous, and pause reset.

3. Logic decoders for the BOL/BTC, LCD.

4. Jumper plug for the BOL/BTC memory.

SETTINGS

On the relay and power supply board, select the positions of jumper plugs (P6, P7 and P8) (See photograph, Figure 15).

Set P6 to select whether the K1 relay has a normally-closed or a normally-open contact.

Set P7 to select whether the K4 (BI) relay has a normally-closed or a normally-open contact. (Remember that there is a shorting

bar in the SLR relay case that shorts the BI contact when the connection plug is withdrawn from the case).

Set P8 to select whether the K2 relay has a normally-closed or a normally-open contact.

On the special-functions board, jumper plug P19 is used to select memory on power down for the BOL/BTC functions. To remember the BOL/BTC count on power down, set P19 to the IN position. In the OUT position, the BOL/BTC count will be reset on power up. (See photograph Figure 16.)

On the logic and control board, select the positions (to the left of the nameplate) of the jumper plugs (P10 through P18) (See Figure 1).

Set P10 to select the pause function. (H setting).

1. If P10 is set 1 to H and 1 to (+), pause will operate during reclose of the reclose cycle only. The pause input at connection stud 8 will be disabled.

2. If P10 is set H to 2 and 1 to (+), pause will operate during reset of the reclose cycle only. The pause input at connection stud 8 will be disabled.

3. If P10 is set (-) to 1 and 1 to (+), pause will operate during reclose and reset of the reclose cycle. The pause input at connection stud 8 will be disabled.

4. If P10 is set to 1 to H and 2 to 1, pause will operate during reclose of the reclose cycle only. The pause input at connection stud 8 will operate with external pause signals.

5. If P10 is set (-) to 1 and H to 2, pause will operate during reset of the reclose cycle only. The pause input at connection stud 8 will operate with external pause signals.

6. If P10 is set (-) to 1 and 2 to 1, pause will operate during reclose and reset of the reclose cycle. The pause input at connection stud 8 will operate with external pause signals.

Set P11 to select what action the recloser will take on power up after a power interruption to the relay. (I setting) (This does not include the BOL/BTC system.)

1. If P11 is set 1 to I, it will power up at the beginning of the time period that was in progress when power to the relay was interrupted (i.e. memory will be used).

2. If P11 is set I to 2, it will power up at reset if the breaker is closed and at lockout if the breaker is open. Where in the cycle the power was interrupted has nothing to do with the power up of the relay (i.e. memory will not be used).

Set P12 to select for delayed reclose (DR) or dual program. (E setting.)

1. If P12 is set 1 to E, a signal at connection stud 7 will produce a delayed reclose signal (the first selected reclose will be skipped).

2. If P12 is set E to 2, the absence, or presence, of a signal at connection stud 7 will each produce a separate reclose cycle.

   NOTE: Each program must be programmed separately. See **Programming** section for programming instructions.

Set P13 and P14 to select the output functions of output connection studs 11 and 15. (C and D setting).

1. If P14 is set 1 to C and P13 is set 1 to D, the output signal will be the "warn count" (WC) of BOL/BTC.

2. If P14 is set C to 2 and P13 is set 1 to D, the output signal will be the "zero count" (ZC) of BOL/BTC.

3. If P14 is set 1 to C and P13 is set D to 2, the output signal will be "in progress" (IP).

4. If P14 is set C to 2 on P13 is set D to 2, the output signal will be "lockout" (LO).

Set P15 and P16 to select the output function of output connection studs 15 and 16. (A and B setting).

1. If P16 is set 1 to A and P15 is set 1 to B, the output signal will be the "warn count" (WC) of BOL/BTC.

2. If P16 is set A to 2 and P15 is set 1 to B, the output signal will be the "zero count" (ZC) of BOL/BTC.

3. If P16 is set 1 to A and P15 is set B to 2, the output signal will be "in progress" (IP).

4. If P16 is set A to 2 and P15 is set B to 2, the output signal will be "lockout" (LO).

Set P17 to skip a breaker trip count. (F setting). (Counts will appear in the right-hand LCD.)

1. If P17 is set 1 to F, the counter for BOL/BTC will not count on a breaker opening if there is a signal at connection stud 9. (52a input). If a signal is not present at connection stud 9, the counter for BOL/BTC will count on a breaker opening.

2. If P17 is set F to 2, the counter for BOL/BTC will count on each breaker opening. Signal to stud 9 (52a) will have no effect on the count.

Set P18 to delay the "in progress" output by the instantaneous reclose delay time (G setting).

1. If P18 is set 1 to G, the "in progress" output signal will be delayed by the instantaneous reclose delay time.

2. If P18 is set G to 2, the "in progress" output signal will be produced when the input to connection stud 10 (52b input) is made for the first time in the reclose cycle.

The operation of the NUMBER, CODE, ENTER, READ AND TEST switches along with all switches for the BOL/BTC section will be covered in the **Programming, Read** and **TESTING** sections.

Programming the Recloser (Left Side of Nameplate) Section

In order to program for reclosing settings, the SLR relay must be powered up and in reset or lockout. A change in CODE from 1 1 1 1 (see nameplate, Figure 1) when the relay is in progress will be ignored until the relay reaches the reset or lockout condition. Programming is accomplished by selecting the code of the function, setting the number, and pushing ENTER. Push READ to verify a setting. (The operation of the READ switch is covered in the **Read** section.)

When the code is anything but 1 1 1 1, the relay will not respond to input changes and the outputs are inhibited from changing state.

1. Select Reclosures

```
                    CODE                NUMBER
    RECLOSE         0 0 0 0         3rd 2nd 1st INST.
```

There are 16 combinations of RECLOSE settings, all of which are valid. INST. is the instantaneous reclose signal (no intentional time delay on reclose). The 1st, 2nd and 3rd reclosures occur after an adjustable time delay. All reclosures not selected are skipped. If none of the reclosures are selected, (all numbers of the CODE entered in the OUT position), the recloser will go to lockout when the 52b contact closes.

2. Set First Reclose Time

```
                CODE                NUMBER

              ┌─ 0 0 0 1        8 4 2 1 ──┐
    FIRST  ─┤                              ├──
              └─ 0 0 1 0       .4 .2 .2 .1 ──┘── SUM
```

The FIRST (1st) reclose time can be set from .1 to 15.9 seconds. If no time is selected (all numbers of each CODE entered in the OUT position), the delay will be .1 second. The time is selected in 2 bytes. If 8 and 2 are entered for CODE 0 0 0 1 and .4 and .2 are entered for CODE 0 0 1 0, the time setting will be 10.6 seconds.

3. Set Second and Third Reclose Times and Reset Time

```
              CODE            NUMBER

         ┌─ 0 0 1 1      80 40 20 10  ─┐
SECOND  ─┤                              ├─┐
         └─ 0 1 0 0       4  2  2  1  ─┘  └─ SUM

         ┌─ 0 1 0 1      80 40 20 10  ─┐
THIRD   ─┤                              ├─┐
         └─ 0 1 1 0       4  2  2  1  ─┘  └─ SUM

         ┌─ 0 1 1 1      80 40 20 10  ─┐
RESET   ─┤                              ├─┐
         └─ 1 0 0 0       4  2  2  1  ─┘  └─ SUM
```

The SECOND (2nd) and THIRD (3rd) reclose times along with the RESET time can be set from 1 to 159 seconds. If no time is selected for the SECOND reclose, THIRD reclose or RESET time (all numbers of each CODE entered in the OUT position), the delay will be 1 second.

4. Set Time Multiplier

```
                  CODE            NUMBER

TIME            1 0 0 1        4 2 1 .5  ─┐
MULTIPLIER                                ├
                               SELECT ONE ─┘
```

The TIME MULTIPLIER multiplies the following time settings by the NUMBER selected.

    a. First reclose time
    b. Second reclose time
    c. Third reclose time
    d. Reset time
    e. Pause time
    f. RS dropout time
    g. RS pickup time
    h. *Reclose signal time limit

    *   The reclose signal time limit is the time allowed for the breaker to close following a reclose signal. If the breaker does not close in that time, as indicated by the transfer of the breaker "a" and "b" switches, the relay will go directly to lockout. The reclose time limit with a 1.0 multiplier is 0.9 seconds.

The Time Multiplier does not multiply any of the times in the BOL/BTC section of the relay.

Only one MULTIPLIER should be selected (4, 2, 1, or 0.5). If more than one MULTIPLIER is selected, the highest of the selected

MULTIPLIERS will be used. If no MULTIPLIER is selected (all numbers of the CODE entered in the OUT position), the MULTIPLIER will be 4.

5. Set Pause Time

	CODE	NUMBER	
		1024 64 4 0	
PAUSE	1 0 1 0		
	1 0 1 1	∞ 256 16 1	
		SELECT ONE	

Pause can be used to delay the start of a reclose signal output, or to insert a time delay in the reset time. The time set is a limit on the PAUSE signal. Only **one** PAUSE limit of the eight available should be selected. In order to be sure only one PAUSE limit is set, the CODE position not used should be entered with all values OUT. If more than one PAUSE limit is selected, the highest of the selected values will be used (∞ is considered the highest value). If no PAUSE limit is selected (all numbers of both codes entered in the OUT position), the pause limit will be 1024 seconds.

6. Set RS Pickup, Dropout and Operate Point

	CODE	NUMBER	
DROPOUT	1 1 0 0	L 24 12 6	
PICKUP	1 1 0 1	4 2 1 0	
RS	1 1 1 0	3rd 2nd 1st INST.	
		SELECT ONE	

The RS "Relay Spare" is an output signal that is selected to operate at, or with a time delay from, one of the four reclose signals. The PICK UP and DROP OUT time delays are both started by the selected reclose. (If DROP OUT is set at 6 and PICK UP is set at 4 and RS is set at 2nd, the RS output will operate 4 seconds after the 2nd reclose and stay picked up for 2 seconds).

If L is selected for lockout, the RS output signal will stay up until lockout.

If more than one RS position is selected, the earliest will be used. (If the 2nd and INST. were selected, INST. would be used.) If RS is selected in an unused reclose position, the nearest reclose that is earlier in the reclose cycle would be selected.

If RS is set at INST. and instantaneous is skipped because of a DR "Delayed Reclose" input, the RS timing will start with the 52b input signal.

If more than one PICK UP time is selected, the highest selected time will be used. If a PICK UP time is not selected, 0 will be used.

If more than one DROP OUT time is selected, the highest selected time will be used. (L will be considered the highest DROP OUT time). If a DROP OUT time is not selected, L will be used.

When the recloser goes to lockout, the RS output signal will drop out. (RS drops out immediately with LO and is not contingent on any PICK UP or DROP OUT timing.)

If RS is selected for an earlier time in the reclose cycle than the earliest reclose, the RS output will be picked up, except when the recloser goes to lockout. For this condition, L is substituted for whatever was programmed in the RS dropout CODE position.

The RS signal output is also used to select when the pause reset timer is used in the BOL/BTC section. If there is a RS signal and a 52b signal, the reset time of the recloser will be increased by the time set on the pause-reset timer (See Reset via RS Signal).

7. <u>Enable Recloser and Select Memory for BI, RS, IP and LO (Outputs BI, RS, ☐, ☒)</u>

	CODE	NUMBER
OPERATE	1 1 1 1	BI RS IP LO
		LATCH

After the 15 lines of CODE are entered, the CODE must be set at 1 1 1 1 and ENTER pushed for the recloser to operate. In this position, the NUMBER is used to select which outputs (BI, RS, IP, LO) are to stay latched if the input power is removed from the recloser. If the switch is IN, the output relay will stay latched without changing state if the power is removed from the recloser. If the switch is OUT, the output relay will be reset if the input power is removed· from the recloser. Being able to select whether the outputs (BI, RS, IP, LO) are to be latched or reset on power down is not contingent on the position of P11 being in the 1 to I or I to 2 position. IP and LO are normal reclose relay functions and it should be noted that IP is the output contact (☐) for connection studs 11 and 15 and LO is the output contact (☒) for connection studs 15 and 16. Both IP and LO can be WC, ZC, IP or LO (See Figure 9).

Programming the BOL/BTC (Right Side of Nameplate) Section

1. Select BOL/BTC Function

    BTC

    ☐

    BOL

    When the BOL/BTC switch is set to BTC, the BOL Timer is turned off.

2. Set the BOL/BTC Count

    BOL/BTC   32   16   8   4   2   1   SUM

    ☐ ☐ ☐ ☐ ☐ ☐ OUT
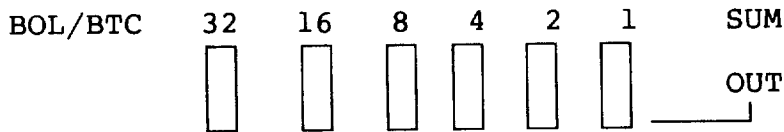
    The count is the sum of the 6 BOL/BTC switches. The count can be set from 1 to 63 counts in 1 count increments. When the count is set at 0, the count will be 1.

    Push reset to enter the BOL/BTC count.

    When using the BOL/BTC function, P10 (pause function) should be set for 1 of the following conditions:

    a. 1 to H and 1 to (+)
    b. (-) to 1 and 1 to (+)
    c. 1 to H and 2 to 1
    d. (-) to 1 and 2 to 1

    When using the BTC function, the pause time (on the left side of the nameplate) should be set at 4 or more seconds. When using the BOL function, the pause time should be set so that it is longer than the BOL time.

    The BOL/BTC count is shown as the top 2 digits of the BOL/BTC LCD. The 3 LED's indicate the condition of the count. When the count is maximum, the green reset LED will be illuminated. When the count is above 0 and up to and including the warn set point, the yellow warn LED will be illuminated. When the count is 0, the red LED will be illuminated.

3. Set BOL Time

    BOL TIME   32   16   8   4   2   1   SUM
    MINUTES   ☐ ☐ ☐ ☐ ☐ ☐ OUT
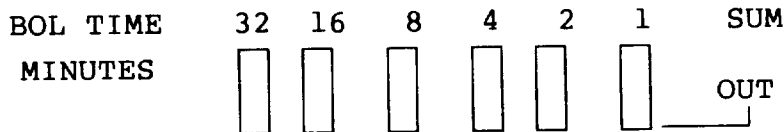
    The time is the sum of the 6 BOL time switches. The time can be set from 1 to 63 minutes in 1 minute increments. When the time is set to 0, the time is 1/2 minute.

The BOL time is shown as the bottom 2 digits of the BOL/BTC LCD. The time shown on the LCD is decremented on the 1/2 minute. When the time counts to 0, BOL is counted up 1 count. The timer is then reset. The timer is not affected by a BOL down count while it is timing.

4. Set Instantaneous Reclose Delay

```
                      2+   32   16    8    4    2    1     SUM

   INST REC DEL  ~        [ ]  [ ]  [ ]  [ ]  [ ]  [ ]
                          [ ]  [ ]  [ ]  [ ]  [ ]  [ ]       OUT
                                                          ___|
```
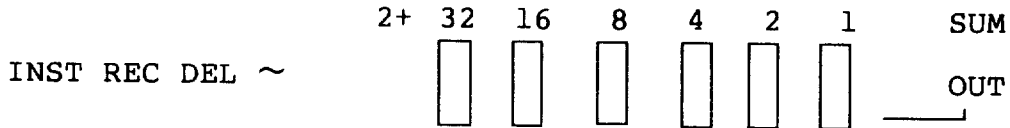
The time is the sum of the 6 instantaneous reclose delay switches in cycles. The time to the output reclose contact will increase by approximately 1 cycle longer than the setting. When the timer is set for 0 or 1, the total relay delay is approximately 2 cycles (See Figure 11).

The time is turned off with a 0 setting.

5. Set the PAUSE RECLOSE DELAY Timer

```
                            ___  64   32   10    8    4    2    SUM
                           |    [ ]  [ ]  [ ]  [ ]  [ ]  [ ]
   PAUSE RESET - SECONDS - SET RS  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]    OUT
                           |        RES                         ___|
                           |        [ ]
                           |        [ ]
                           |___     OFF
```
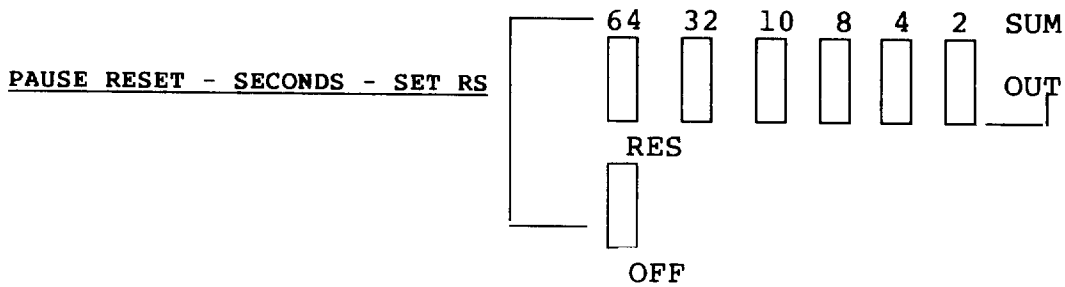
The Pause Reset switch, RES-OFF, must be turned to RES to enable the PAUSE RECLOSE DELAY timer. The time, in seconds, is the sum of the Pause Reset switches. The time can be set from 1 to 126 seconds in 2-second intervals. When the timer is set to 0, the time is 1 second.

To have the timer operate, the 52b input must be open and there must be a RS signal. If the RS is set to drop out at lockout, more than 1 Pause Reset can occur in a reclose cycle.

6. Set Warn Set

```
                      1+    2    1       SUM

   WARN   SET            [ ]  [ ]
                         [ ]  [ ]         OUT
                                       ___|
```
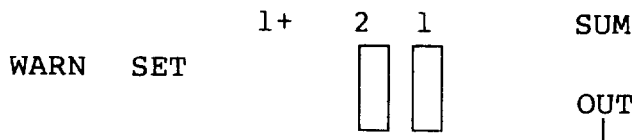
The Warn Set can be set to operate at 1,2,3, or 4 counts before zero count. If the Warn Set is set at 3 counts, it will be on at 3,2 and 1 count before zero count.

The Warn Count will operate the yellow LED. The Warn Count signal can be brought out through the output connection studs 11 and 15 and or 15 and 16. (See settings for P13, P14, P15 and P16.)

Read

The data programmed into the recloser is read out on the recloser LCD display when the READ pushbutton is operated. The data is displayed in 8 readings of 4 seconds each. Any function not used is skipped, which shortens the read cycle. The following is a description of each 4 second read.

1. Reclosure selected
    All reclosures selected will be on solid and REC. will blink for the 4 seconds.

Readout for a 4 shot recloser
(instantaneous and 3 timed)

Readout for a 2 shot recloser
(instantaneous and 1 timed)

2. Time of reclose (1st)
    The number of the timed reclosure (1) along with the time will be on solid, and REC. will blink for 4 seconds.

1st timed reclosure set at
.05 seconds

1st timed reclosure set at
14.6 seconds

3. Time of reclose (2nd)
The number of the timed reclosure (2) along with the time will be on solid, and <u>REC.</u> will blink for 4 seconds.

2nd timed reclosure set at
.5 seconds

2nd timed reclosure set at
34 seconds

4. Time of reclose (3rd)
The number of the timed reclosure (3) along with the time will be on solid and <u>REC.</u> will blink for 4 seconds.

3rd timed reclosure set at
60 seconds

3rd timed reclosure set at
107 seconds

5. Time of reset
The time for reset will be on solid, and RES. will blink for 4 seconds.

Reset time set at 89 seconds
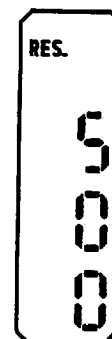
Reset time set at 500 seconds

6. Time of pause limit
The time for pause will be on solid and PAUSE will blink for 4 seconds. *If RES. is on solid, pause is for reset only, and if RES. is blinking, pause is for reclose and reset. If RES. is not on, pause is for reclose only.

Pause limit set at 0 seconds
(Reclose Only)
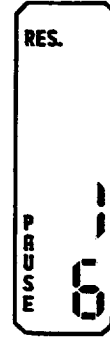
Pause limit set at 16 seconds(*)
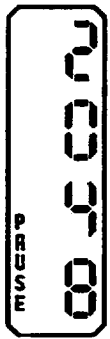
Pause limit set at 2048 seconds
(Reclose Only)
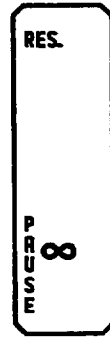
Pause limit set at ∞ (*)

7. Pickup and dropout time of RS
The pickup and dropout times will be on solid and R.S. and D.O., P.U. will blink for 4 seconds.

Pickup set at 0 and dropout set
for lockout of the recloser
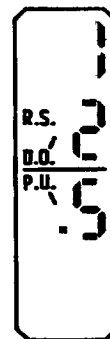
Pickup set at 0.5 seconds
and dropout set at 12 seconds

8. Reclose position of RS
   The RS start position will be on solid and R.S. will blink for 4 seconds.
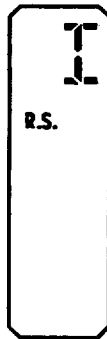
Timing of RS set to start with
the INST. reclose signal
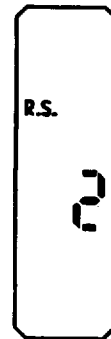
Timing of RS set to start
with the 2nd reclose signal

Power Up and Power Down

CAUTION

When SLR13 relays are powered up, a reclose signal could be produced. See <u>WARNING</u> on page 54 .

Power up and power down operate in 2 different memory modes, depending on the position of jumper plugs P11 on the logic and control board and P19 on the special-functions board.

When P11 is set 1 to I, the recloser powers up in the same part of the reclose cycle it was in at power down. When the recloser powers up, the full time is counted down even though part of the time might have been counted prior to power down (example: the recloser powers down on the 2nd reclose set at 15 seconds after 10 seconds. On power up, the recloser will count the full 15 seconds of the 2nd reclose before the reclose signal is produced). Relays, (BI, □, ⊠) will stay latched if the appropriate NUMBER switches (BI, IP, LO) are in the IN position during power down. If the NUMBER switches (BI, IP, LO) are in the OUT position, the relays (BI, □, ⊠) will be reset on power down, and will return to the state they were in on power up.

The operation of relay RS during power down and power up is controlled by its NUMBER switch, the pickup and dropout setting of RS, the reclose position selected for RS, the place in the reclose cycle the power down occurs, and the selected reclosures. The following is a summary of the operation of relay RS during power down and power up.

1. Assume RS is selected to operate at a reclosure that is earlier in the cycle than the first selected reclosure; i.e. RS is set to operate at the Instantaneous reclosure but only the 1st and 2nd reclosures have been selected. For this condition, RS will be picked up except for lockout. RS will stay picked up if power is lost and then restored, provided the NUMBER switch is in the

IN position and the relay is not in lockout. If the NUMBER switch is in the OUT position and the recloser is not in lockout, RS will drop out on power down and pick up on power up.

2. The timing diagram in the figure below is for a 4 shot reclose cycle which goes from the reset condition to the lockout condition after 5 breaker trips. RS is set to operate for the 2nd timed reclose. This example will be used to explain the operation of RS during power down and power up of the recloser.
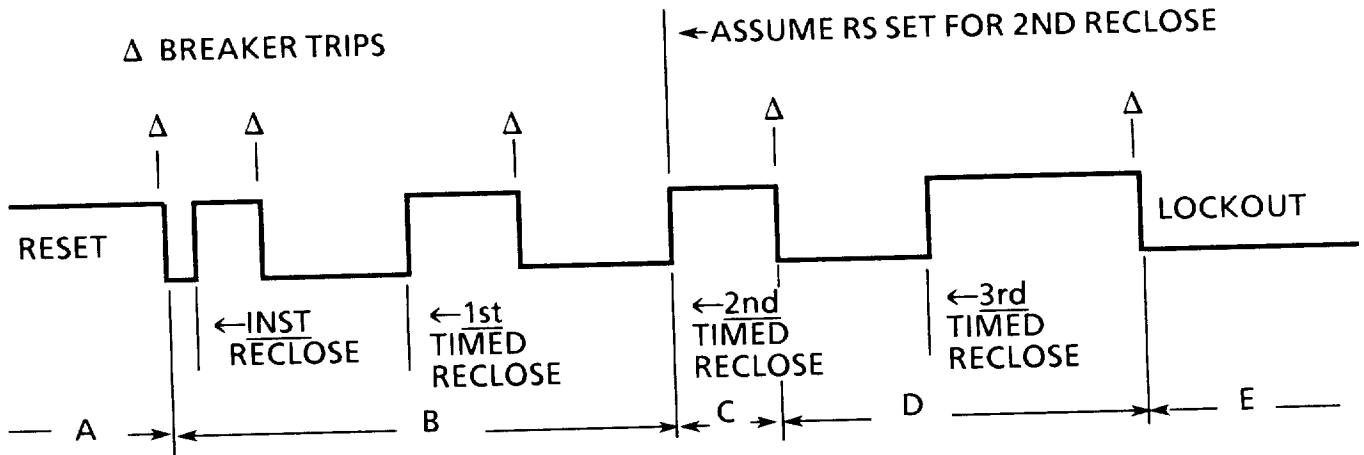
A. During the "A", "B" and "E" portions of the reclose cycle there is no effect on RS due to power down and power up because RS cannot be picked up before "C", and RS is never picked up during lockout.

B. If the dropout of RS is set for lockout and there is a power down during "C", the following will occur:

   i.   If RS was not picked up when the recloser was powered down, it will operate on power up after the pickup time.

   ii. If RS was picked up when the recloser was powered down and the NUMBER switch for RS was in the IN position, it will remain picked up during power down and after power up.

   iii. If RS was picked up when the recloser was powered down and the NUMBER switch for RS was in the OUT position, it will drop out on power down. RS will then operate on power up after the pickup time.

C. If the dropout of RS is set for lockout and there is a power down during "D", the following will occur:

   i.   If RS was not picked up when the recloser was powered down, it will operate on power up immediately, and not wait for the pickup time.

ii. If RS was picked up when the recloser was powered down and the NUMBER switch for RS was in the IN position, it will remain picked up during power down and after power up.

iii. If RS was picked up when the recloser was powered down and the NUMBER switch for RS was in the OUT position. it will drop out on power down. RS will then operate on power up immediately and not wait for the pickup time.

D. If the dropout of RS is set for a time delay and there is a power down during "C" or "D", the following will occur:

i. If RS was not picked up when the recloser was powered down, it will not pick up after power up.

ii. If RS was picked up when the recloser was powered down, and the NUMBER switch for RS was in the IN position, it will remain picked up during power down and drop out on power up.

iii. If RS was picked up when the recloser was powered down and the NUMBER switch for RS was in the OUT position, it will drop out on power down and will not pick up after power up.

When P11 is set I to 2, the recloser powers up in reset if the breaker is closed, and in lockout if the breaker is open. Relays (BI, RS, □, ⊠) will stay latched if the appropriate NUMBER switches (BI, RS, IP, LO) are in the IN position during power down. If the NUMBER switches (BI, RS, IP, LO) are in the OUT position, the relays (BI, RS, □, ⊠) will be reset on power down. Relays (BI, RS, □, ⊠) go to their normal reset or lockout conditions on power up.

When P19 is set to the IN position, the BOL/BTC count will be saved on power down. Because this count is saved with a capacitor, the time it can save the count is limited to approximately 1 week depending on ambient temperature. When the ambient temperature is hot, the memory time will be shortened. (The memory for the reclose cycle controlled by P11 uses a solid state device that can save the reclose cycle information for approximately 1 year.)

When P19 is set to the OUT position, the BOL/BTC count will be reset on power up after a power down condition.

The BOL timer will be reset on power up after power down, whether P19 is in the IN or the OUT position.

RATINGS

The SLR13A is a DC-operated relay with ratings of 48, 125 and 250 volts DC. The interrupting ratings of the telephone-type relay contacts are shown in Table I, and the interrupting ratings of the auxiliary relay contacts are shown in Table II. If the interrupting rating is exceeded on any of the SLR13 output relay contacts, a suitable breaker contact or interposing relay must be used.

TABLE I

INTERRUPTING RATINGS OF TELEPHONE-TYPE RELAY CONTACTS

CONNECTION STUDS 19 AND 20

AC VOLTS	AMPERES	
	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

** The inductive rating is based on a L/R ratio of .04 second

TABLE II

INTERRUPTING RATINGS OF AUXILIARY RELAY CONTACTS

CONNECTION STUDS 11, 12, 13, 14, 15, 16, 17 AND 18

ARRANGEMENT	1 FORM A – 1 FORM B
CONTACT MATERIAL	GOLD FLASH OVER SILVER ALLOY
INITIAL CONTACT RESISTANCE, MAX.	30 milli-ohms
RATINGS (RESISTIVE) Max. Switching Power Max. Switching Voltage Max. Switching Current	AC––2000 VA, DC––50 W 250 VAC 8A
HP Rating	1/4 HP 125, 250 VAC

The output relays have make-and-carry ratings of 3 amperes continuously and 30 amperes for 0.2 second.

BURDENS

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

TABLE III – INPUT POWER RATINGS

VOLTS DC	WATTS
250	14.0
125	9.4
48	7.7

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

TESTING

Recloser Self Test

The self-test circuit of the recloser is designed to test the electronics of the system while running the program information entered into memory. The test system operates all circuits except the input networks and output relays. During the test, the SLR relay assumes that the circuit breaker is working into a fault so that each time the circuit breaker closes it will open immediately. During the test, the output relays do not change state. Reclose signals are indicated by the reclose LED (green light-emitting diode labeled RECLOSE).

If the circuit breaker is closed during test, (52a closed and 52b open), the relay will time down all the reclose operations programmed in, wait 4 seconds in lockout, do a manual close, and count down the reset time.

If the circuit breaker is open during test (52a open and 52b closed), the relay will do a manual close, count down the reset time, wait 4 seconds in reset, and time down all the reclose operations programmed in.

A DR "Delayed Reclose" signal can be added to the test cycle by holding the TEST button down for more than 1 second. The normal test is started by holding the TEST button down for less than 1 second.

During test, all function messages on the left-hand LCD blink (RES., REC., R.S., B.I., L.O.).

The following are some typical LCD displays as test proceeds from reset to lockout and back to reset.

Normal reset condition. R.S. could be ON if it was set earlier than the first reclose.
RES. not blinking.

1st timed reclose counting down in 0.5 second intervals. REC. is blinking. B.I. not being energized indicates that instantaneous reclose was not called for, or the test button was held for more than 1 second, causing a DR input signal.
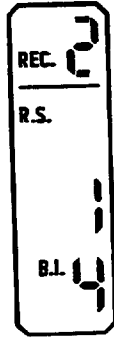
2nd timed reclose counting down in 1 second intervals. REC.,R.S. and B.I. are blinking. R.S. being on could be from being set at INST. with a time delay, or being set at 1st.

3rd timed reclose counting down in 1 second intervals. REC. and B.I.are blinking. R.S. being off indicates the dropout time has timed out.

Relay is now at lockout for 4 seconds, B.I. and L.O. are blinking.
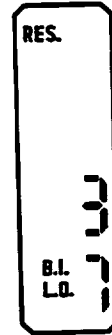
A manual close has occurred and the reset time is counting down in 1 second intervals. RES., B.I. and L.O. are blinking.

After the reset time is counted down, the test is complete and the LCD will show RES.

Dielectric Tests

The surge capacitors of Figure 9 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. (Unplug the .05 μf capacitor between the cradle and the negative of the power supply during hipot testing.)

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 |
	SLR13A
Output Contacts	11, 12, 13, 14, 15, 16, 17, 18, 19, 20
Input Signals	2, 3, 7, 8, 9, 10

An alternate test using a 500 volt Megger® can be performed between the circuit groups of Table IV, with the surge capacitors and the .05 µf capacitor between the cradle and the negative of the power supply connected in their normal manner. While this method does not test the relay to its full dielectric rating, it will detect come cases of degraded insulation.

After the hipot or Megger® testing is complete, the surge capacitors should be reconnected to the surge capacitor bus and external wiring to terminal 1 should be reconnected. Also plug in the .05 µf capacitor between the cradle and the negative of the power supply.

Functional Test

In order to run the functional test per Figure 17, set up and program the recloser as follows:

1. Make sure P6 is set for N.O., P7 is set N.C., and P8 is set for N.O. on the relay and power supply board. (See Figure 15.)

2. On the logic and control board set the following: (See Figure 1).

<div align="right">SETTING</div>

   a. P10 - (-) to 1 and 1 to (+)   H - Pause reclose and reset - no external pause

   b. P11 - I to 2   I - Power up without memory

   c. P12 - 1 to E   E - DR selected

   d. P13 - D to 2   D - Output studs 11-15,
       P14 - 1 to C   C - P8 jumper plug (IP selected)

   e. P15 - B to 2   B - Output studs 15-16,
       P16 - A to 2   A - P6 jumper plug (LO selected)

   f. P17 - F to 2   F - Count all 52b operations (no skip count)

   g. P18 - G to 2   G - Do not delay IP with INST. Delay

3. On the special functions board set P19 to the OUT position. (See photograph, Figure 16). BOL/BTC count is reset on power up.

4. On the BOL/BTC section set the switches for the following: (See Figure 1).

   a. BOL/BTC - 4 switch only

   b. BOL time - 4 switch only

   c. INST. REC Delay - 16 switch only

   d. Pause reset - 8 switch only

   e. RES/OFF - RES. (Pause Reset)

   f. BOL/BTC - set to BOL

   g. Warn Set - 1 switch only

5. Put the recloser in the case and energize the test circuit and recloser.

6. The recloser should be in lockout with B.I. and L.O. appearing on the recloser (left-hand) LCD, 4 over 4 appearing on the BOL/BTC (right-hand) LCD. The yellow POWER LED and the green RESET LED should be on.

7. Program the relay as follows:

        CODE   NUMBER

a. 0 0 0 0   IN IN IN IN   push ENTER — All reclosures IN (4)

b. 0 0 0 1   OUT OUT OUT OUT push ENTER ┐
                                        ├─SUM for 1st = .5
c. 0 0 1 0   IN OUT OUT IN push ENTER ┘

d. 0 0 1 1   OUT OUT OUT OUT push ENTER ┐
                                        ├─SUM for 2nd = 1
e. 0 1 0 0   OUT OUT OUT IN push ENTER ┘

f. 0 1 0 1   OUT OUT OUT OUT push ENTER ┐
                                        ├─SUM for 3rd = 2
g. 0 1 1 0   OUT OUT IN OUT push ENTER ┘

h. 0 1 1 1   OUT OUT OUT OUT push ENTER ┐
                                        ├─ SUM for RES. = 3
i. 1 0 0 0   OUT OUT IN IN push ENTER ┘

j. 1 0 0 1   IN OUT OUT OUT push ENTER — Multiply all times by 4

k. 1 0 1 0   IN OUT OUT OUT push ENTER ┐
                                        ├─ Pause selected = 1024
l. 1 0 1 1   OUT OUT OUT OUT push ENTER ┘

m. 1 1 0 0   IN OUT OUT OUT push ENTER — RS Dropout at lockout

n. 1 1 0 1   OUT OUT IN OUT push ENTER — RS pickup = 1

o. 1 1 1 0   IN OUT OUT OUT push ENTER — RS operate w/3rd reclose

p. 1 1 1 1   OUT OUT OUT OUT push ENTER — Recloser in lockout
                                                           ready to operate

The 4 multiplier was used to increase the reclose-signal time limit in order to avoid going to lockout while operating the Instantaneous reclose.

The recloser is now ready for test. To check the program, push READ and observe the recloser LCD as follows. It should be noted that, even though a pause limit is programmed in, the pause input will not operate because no external pause was programmed (see settings for P10 on page 23). Remember that the time multiplier is set at 4!
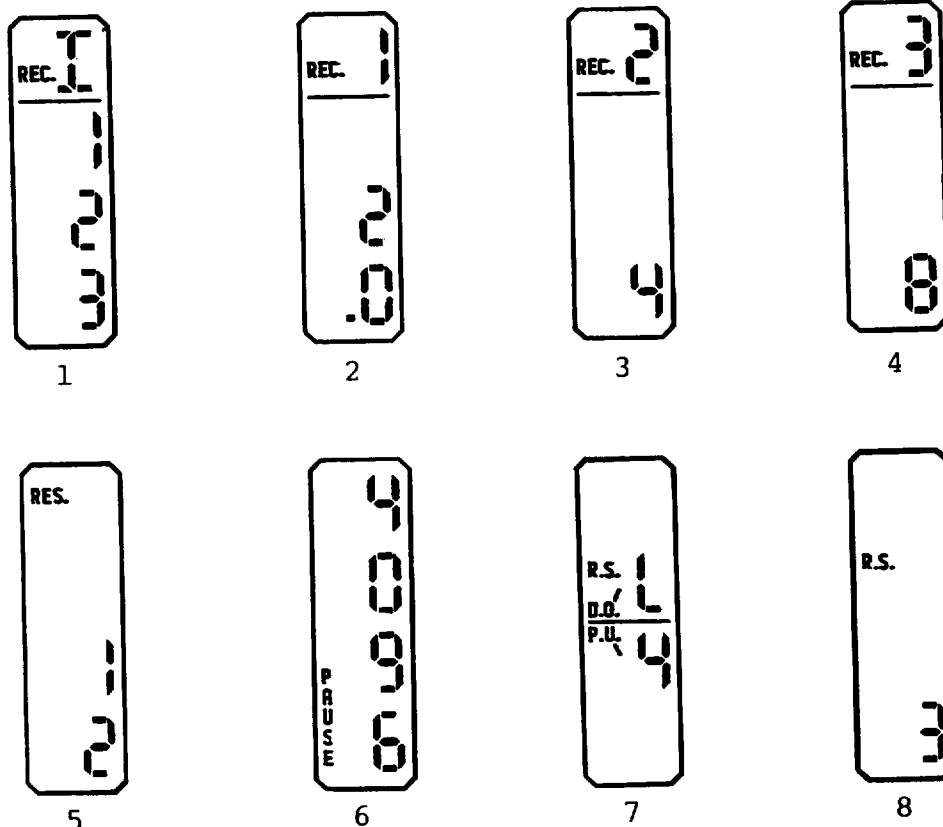
Before starting the functional testing, monitor the output contacts of interest.

Push the CLOSE button for 1 second and then release. The 52 relay of the test circuit will pick up, along with the IP "In Progress" relay □ of the recloser. RES. "Reset" of the LCD will come on and the LCD will count down the 12-second reset time. After the reset time, BI relay, LO (☒ relay) and IP □ relay will drop out and only RES. will appear on the LCD. The SLR relay is now in the reset condition.

Push the OPEN button for 1 second and then release. During the 1 second period, the following occurs:

1. The 52 relay of the test circuit drops out.

2. The IP relay □ will pick up.

3. RES of the reclose LCD will go out and the pause and 4096 will come on. The pause of the BOL/BTC LCD will also come on, the BOL count will go to 3, and the green LED will go out.

4. After 1/4 second, the BI relay and REC relay will pick up.

5. The PAUSE and 4096 of the reclose LCD will go out, along with the PAUSE of the BOL/BTC LCD.

6. The B.I. of the reclose LCD will come on and the LCD will start counting down the 3.6 second reclose signal time limit. (During

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the .75 second time period, 3 will appear for .35 second and 2 for .4 second.)

1. Start

2. After .2 Second
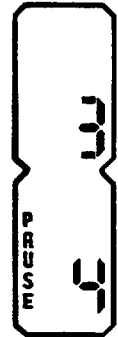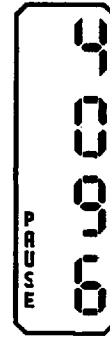
3. After .4 Second

4. After .8 Second
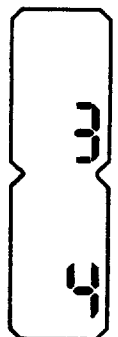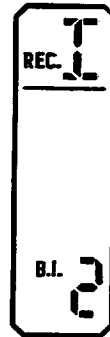
As soon as the OPEN button is released, the following occurs:

1.   The 52 relay of the test circuit picks up.

2.   The REC relay will drop out.

3.   RES. of the reclose LCD will come on and the reclose LED will go out.

4.   The LCD will start counting down the 12 second reset time.

Before the 12 second reset time is complete, push the OPEN button for 1 second and then release. As soon as the OPEN button is pushed, the RES. of the LCD will go out, REC.1 (1st reclose) of the LCD will come on, and the LCD will start counting down the 2 second 1st reclose in .5 second intervals. The BOL count on the BOL/BTC LCD will go to 2 and the yellow warn LED will come on. When the OPEN button is released, the LCD continues to count down the 2 second 1st reclose. After the 2 second 1st reclose time, the REC relay will pick up and the reclose LED will come on. The REC relay and the reclose LED will only be on until the 52 relay of the test circuit picks up and the recloser responds to the change of state of the 52 relay. Because the pickup time for 52 is short, the reclose LED will appear to have a single blink during reclose. Now that the 52 relay is picked up, REC.1 of the LCD has gone out and RES. of the LCD has come on. At this time, the recloser is counting down the 12 second reset time.

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Before the 12 second reset time is complete, push the OPEN button for 1 second and then release. The recloser will now do REC.2 (2nd reclose). The BOL count on the BOL/BTC LCD will go to 1. The 2nd reclose is similar to the 1st, except the second reclose has a time delay of 4 seconds counted down in 1 second intervals. It should be noted that the 2nd reclose is the second timed reclose and the 3rd reclose of the reclose cycle due to Instantaneous reclose being called for. With 52 picked up, the recloser is in reset and is counting down the 12 second reset time.

Before the 12 second reset time is complete, push the OPEN button for 1 second and then release. The SLR relay will now do REC.3 (3rd reclose). As soon as the OPEN button is pushed, the RES. of the reclose LCD will go out, REC.3 (3rd reclose) of the LCD will come on, and the LCD will start counting down the 8 second 3rd reclose in 1 second intervals. The BOL count on the BOL/BTC LCD will go to 0, pause on the LCD will come on, the yellow WARN LED will go off and the red PAUSE (P./L.O.) LED will come on. When the OPEN button is released, the reclose LCD continues to count down the 8 second 3rd reclose. After the 8 second reclose time the reclose LCD will show a PAUSE and 4096 and will count down in seconds until the 4 minutes of the BOL timer is counted down. At this point, the 4 minute BOL counter will be reset and the BOL counter will become 1. The red PAUSE LED will go off, and the yellow warn LED will come on. The PAUSE on both LCDs will go off and the REC relay will pick up and the reclose LED will come on. Now that the 52 relay is picked up, REC.3 of the LCD has gone out and RES. of the LCD has come on. At this time, the reclose is counting down the 12 second reset time. After 4 seconds, the RS "Relay Spare" relay picks up. The RS signal will start the PAUSE RESET time of the BOL/BTC section. PAUSE R.S. and 4096 of the reclose LCD will come on and PAUSE and RES. of the BOL/BTC LCD will come on. After 4 seconds (4 of the 8 seconds on the reset time were used waiting for RS to pick up after reclose), the PAUSE on the reclose LCD will go out and the PAUSE and RES. of the BOL/BTC LCD will go out. The reset time will now continue where it left off before the PAUSE RESET interrupted it.
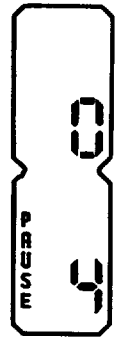
1. During reset

2. 2 seconds after trip
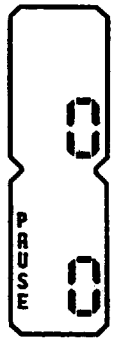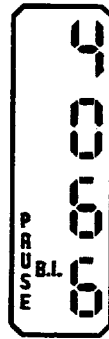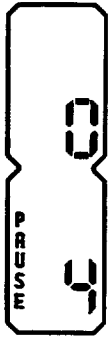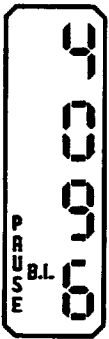
3. After 3rd reclose time

4. 30 seconds after reclose time
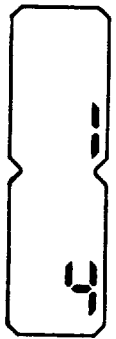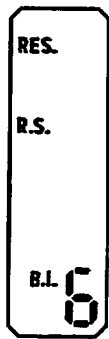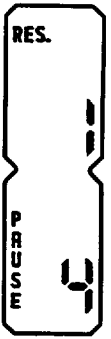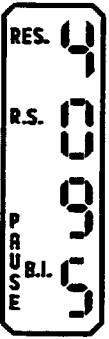
5. 5 seconds after 3rd reclose

6. 14 seconds after 3rd reclose

Before the 12 second reset time is complete, push the OPEN button for 1 second and then release. When the recloser responds to the 52 relay of the test circuit, it will proceed to lockout with the following results:

1. The IP ☐ relay and RS relay will drop out and the LO ☒ relay will pick up.

2. RES. and R.S. of the LCD will go out and L.O. of the LCD will come on.

3. The count on the BOL/BTC LCD will go to 0, the yellow warn LED will go off and the red PAUSE LED will come on.

The recloser is now back in lockout condition, where the test started, except for the BOL count.

In slightly less than 16 minutes, the BOL count will fully recover, with the recloser staying in lockout.

This functional test exercises most, but not all, of the electronics in the SLR13 relay system. In most cases, it will indicate that the relay is completely functional. The 2 inputs not used in this test (DR and P), along with other settings, in most instances can be run with the same basic test setup.

INSTALLATION

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 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.

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. At each end, 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 plugs, besides making the electrical connections between the respective blocks of

the cradle and case, also lock the latch in place. The cover, which is fastened to the case by thumbscrews, holds the connection plugs in place.

To draw out the relay unit, the cover is first removed, and the connection 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 either or both of the connecting plugs 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.

A photograph of the relay in its case with cover removed is shown on the cover of the instruction book. The photographs in Figures 15, 16, and 18 show the principal parts of the relays and their relative positions in the assembly.

Mounting

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 gauge copper wire. The panel drilling for the SLR13 relay is shown in Figure 19.

Connections

The internal connections for the SLR13A are shown in Figure 9. All contacts are shown as they are with the relay completely de-energized (reset condition).

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.

Relay Removal and Insertion

```
                            CAUTION

The condition of the memory in an SLR13 relay depends upon where
it was in the reclose cycle when its power was removed. Because
of this, a reclose signal could be produced when the recloser is
inserted in its case and its power restored. See WARNING on
page 54.
```

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 latched condition (except the reclose relay, which will remain

in its de-energized condition) until the SLR relay goes through a power-up sequence.

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 and the 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.

CAUTIONS

THE SLR13A RELAY MAY MISOPERATE IF THE BREAKER CONTROL SWITCH CONTACT (5-5C) SHOWN IN FIGURE 2 IS CONNECTED ACROSS STUDS #10 AND #19 TO AVOID USING ANOTHER 52B CONTACT.

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

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

WARNING

UNLIKE THE SLR11 RELAYS, THE SLR13 RELAYS CAN BE POWERED UP IN THE RECLOSE CYCLE. IF THE CIRCUIT BREAKER IT CONTROLS IS OPEN WHEN THE POWER IS RESTORED TO THE SLR13, A RECLOSE SIGNAL MAY BE PRODUCED. THEREFORE ANY TIME IT IS UNDESIRABLE FOR THE CIRCUIT BREAKER TO CLOSE, OR IF THE CIRCUIT BREAKER IS BEING WORKED ON, THE RECLOSE SIGNAL TO THE BREAKER SHOULD BE INTERRUPTED WITH A SWITCH SUCH AS THE 79CO SHOWN IN FIGURE 2 ON PAGE 57. OTHERWISE, ELECTRICAL SHOCK OR SEVERE PERSONAL INJURY MAY OCCUR.
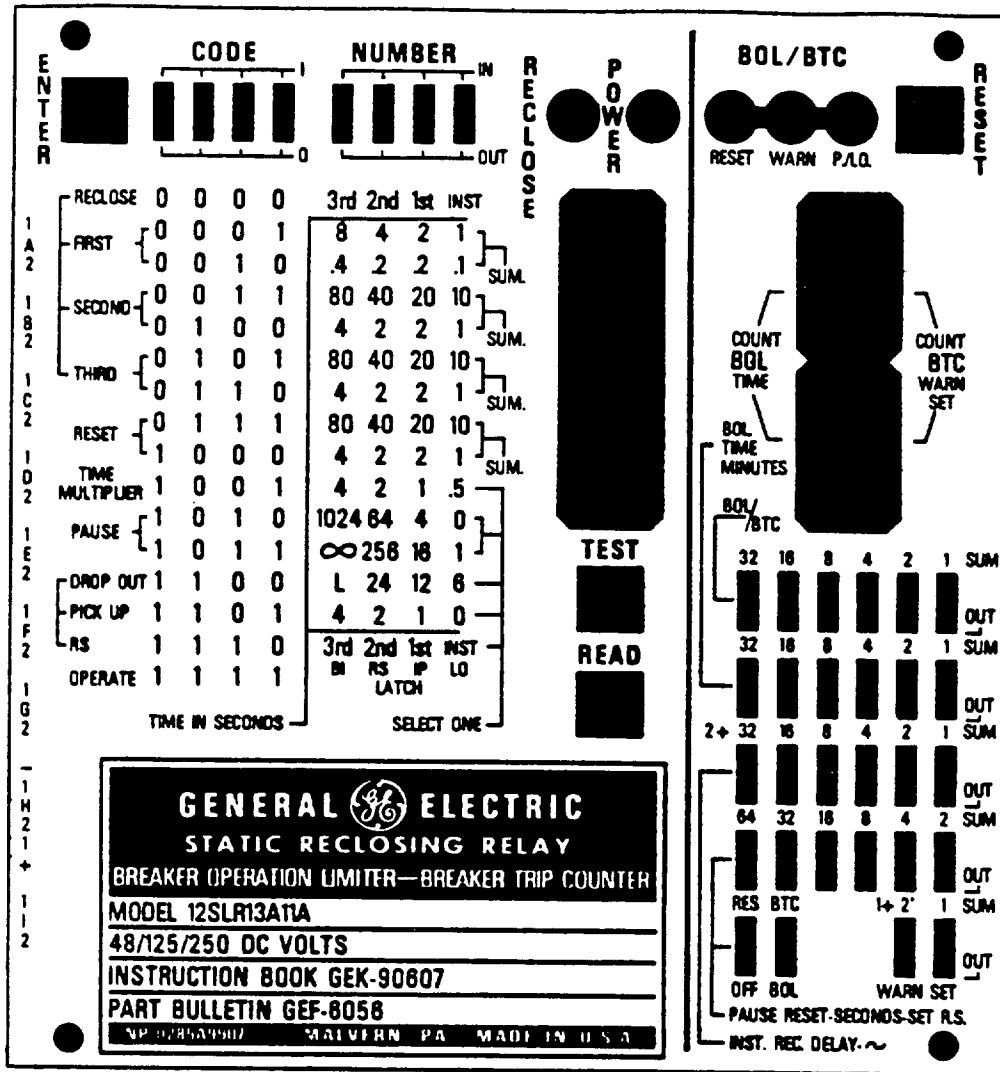
Figure 1 (0285A9907 Sh.1 [1]) SLR13 Nameplate

SET THE P13 AND P14 PLUGS TO SELECT THE OUTPUT BETWEEN RELAY STUDS 11 AND 15.

WARN (BOL/BTC)
PAUSE (BOL) L.O. BTC - ZERO COUNT
IN PROGRESS
LOCKOUT

SET THE P15 AND P16 PLUGS TO SELECT THE OUTPUT BETWEEN RELAY STUDS 15 AND 16

WARN (BOL/BTC)
PAUSE (BOL) L.O. BTC - ZERO COUNT
IN PROGRESS
LOCKOUT
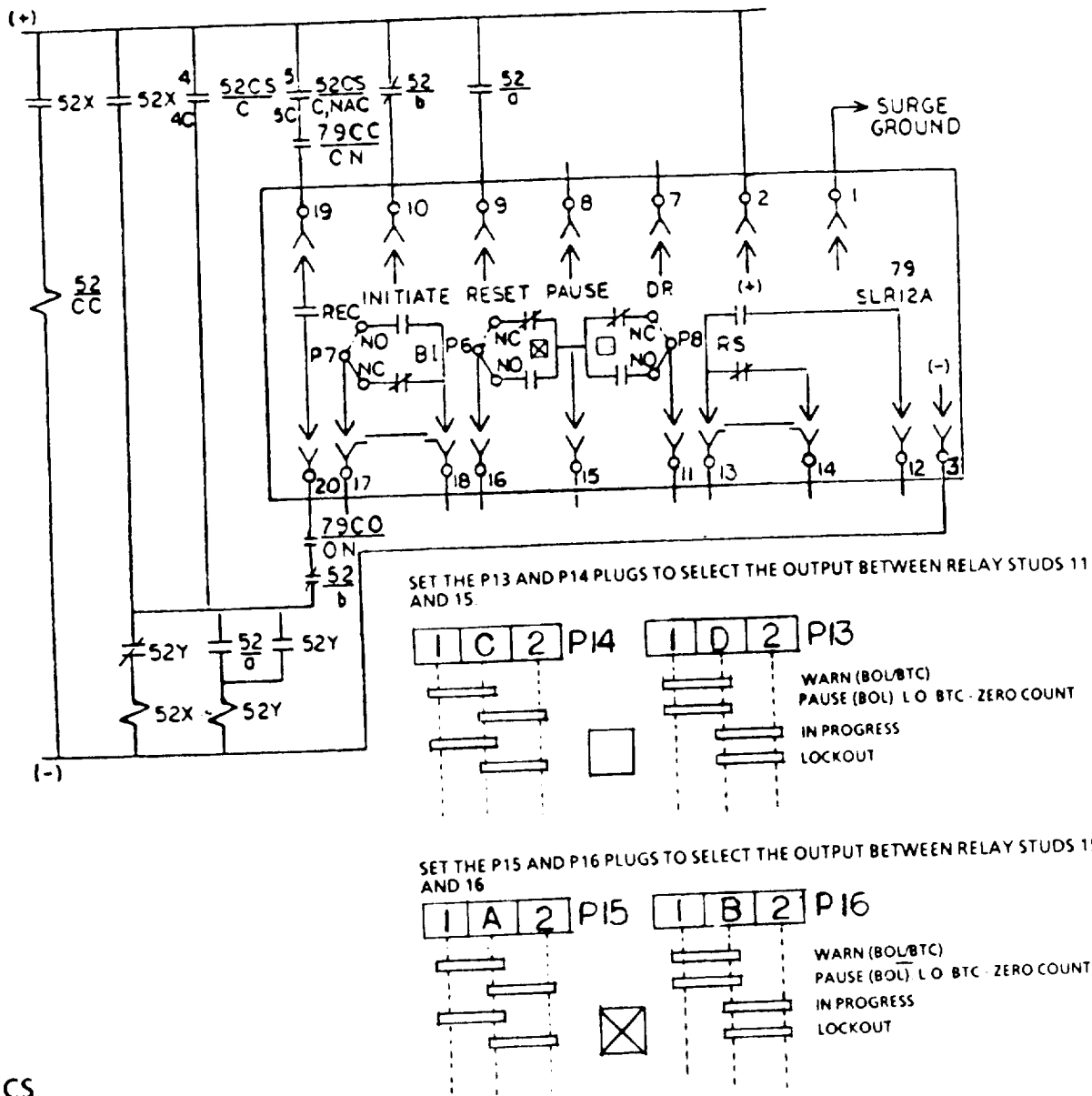
52CS

BREAKER CONTROL SW MODEL 16S81D0920STS2P					
W/ESCU 6402670 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	X	
	8	X			

Figure 2A (0286A2795) Elementary Connection Diagram for SLR13A
(DC Powered)

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Figure 2B (0286A5435) Elementary Connection Diagram for SLR13B
(AC Powered)
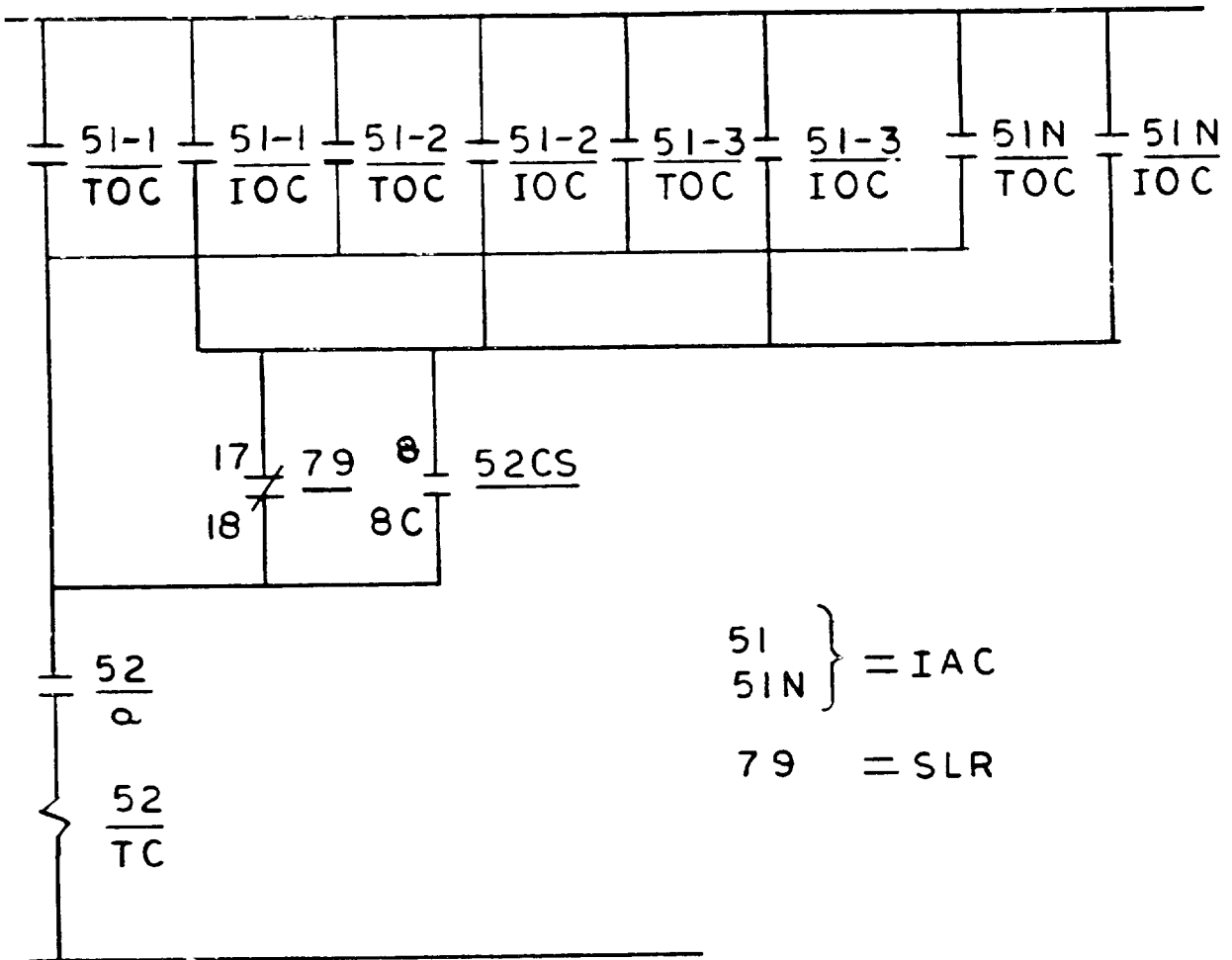
Figure 3 (0285A6294) Use of Contact to Block
Instantaneous-Trip Circuit Prior to First Reclosure
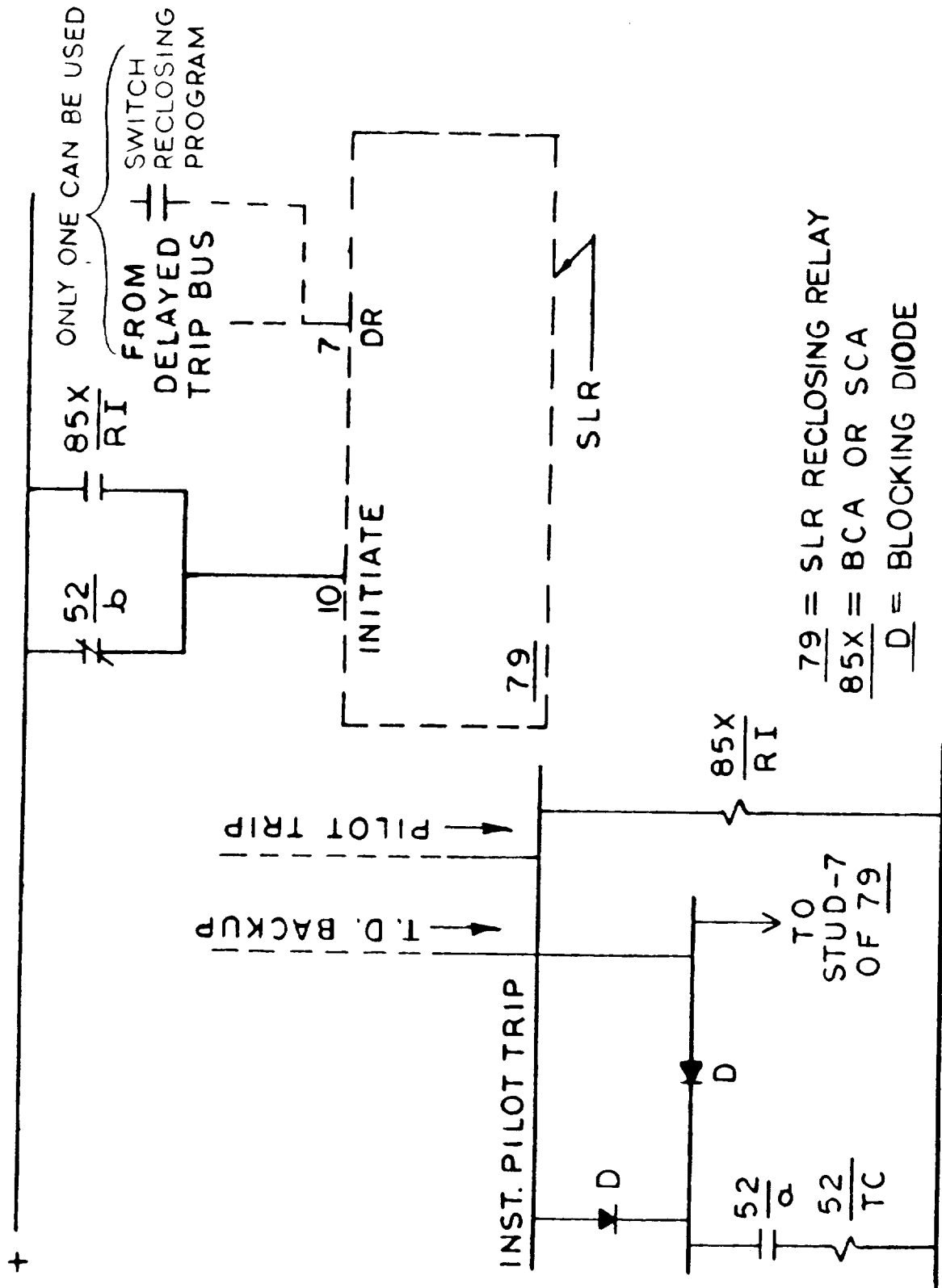
Figure 4 (0286A2790) RI and Delayed Trip or Switch Reclosing Diagrams
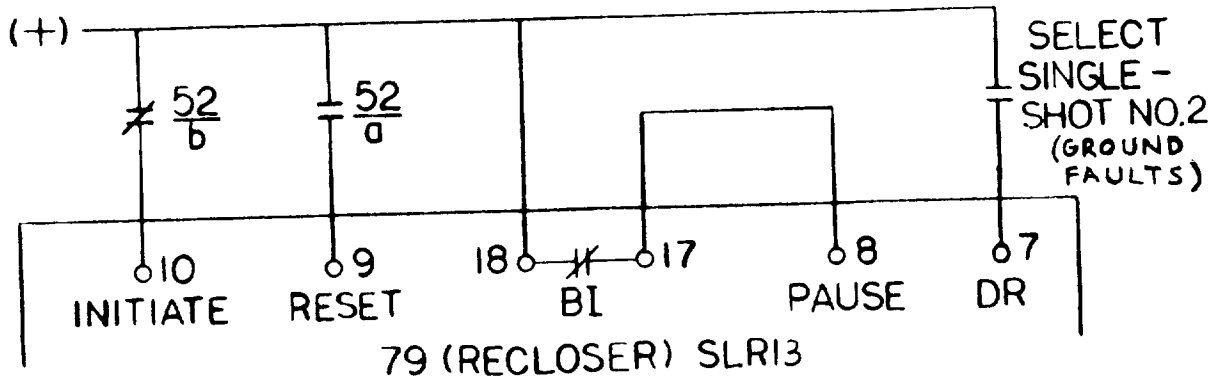
SINGLE-SHOT NO.1 : INSTANTANEOUS OR TIME DELAY
SINGLE-SHOT NO.2 : TIME DELAY ONLY

Figure 5 (0286A2796,part1) Connections for Two Separate
Single-Shot Reclosures, Each with a Different Time Delay
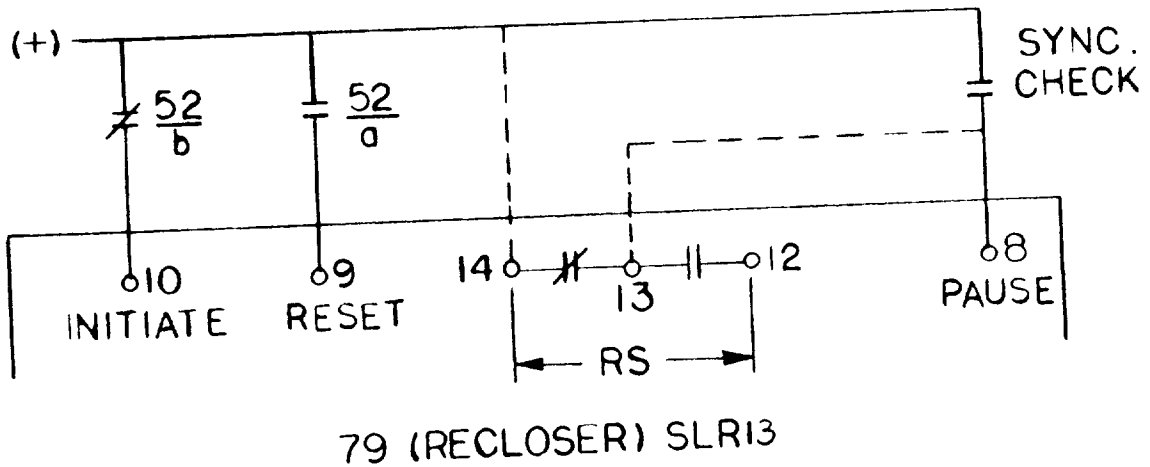
Figure 6 (0286A2796,part2) Connections for Synchronism Check Function
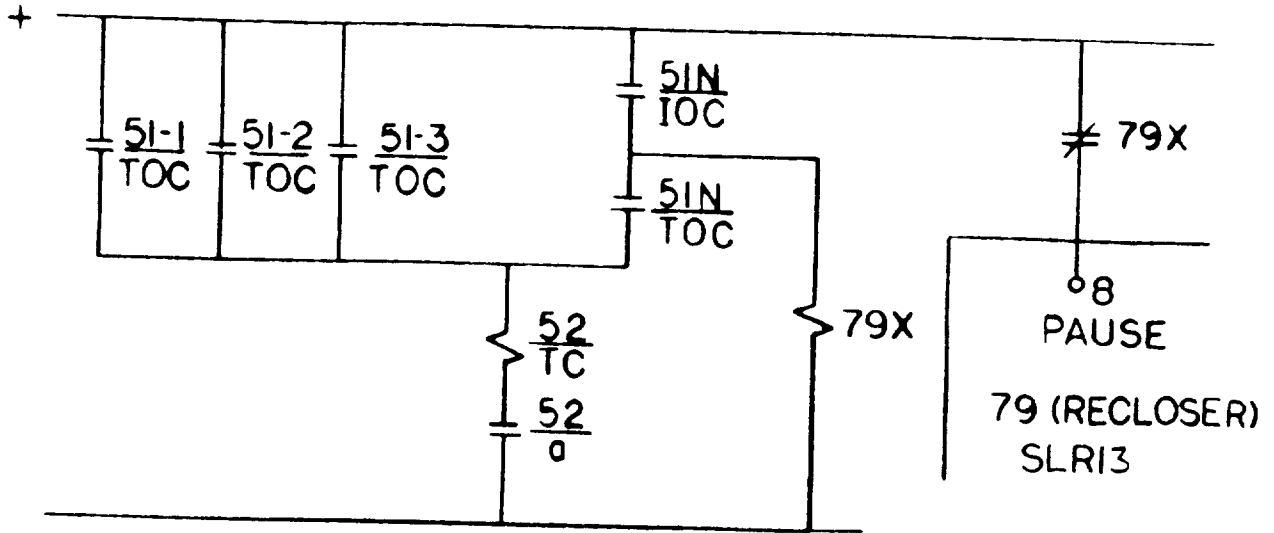
TOC - TIME OVERCURRENT
IOC - INSTANTANEOUS OVERCURRENT

Figure 7 (0286A2791,part1) Delay Reset for Ground Faults
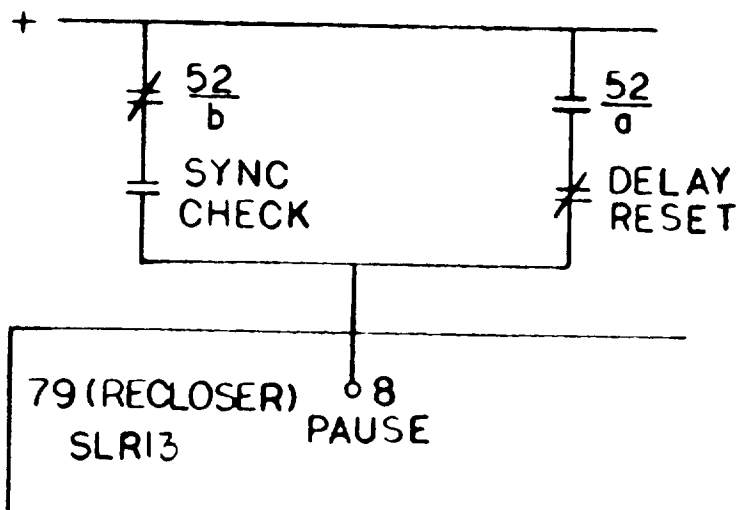
Figure 8 (0286A2791,part2) Pause Function - Dual Use

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Figure 9   (0285A9909-4)   Internal Connection for SLR13A
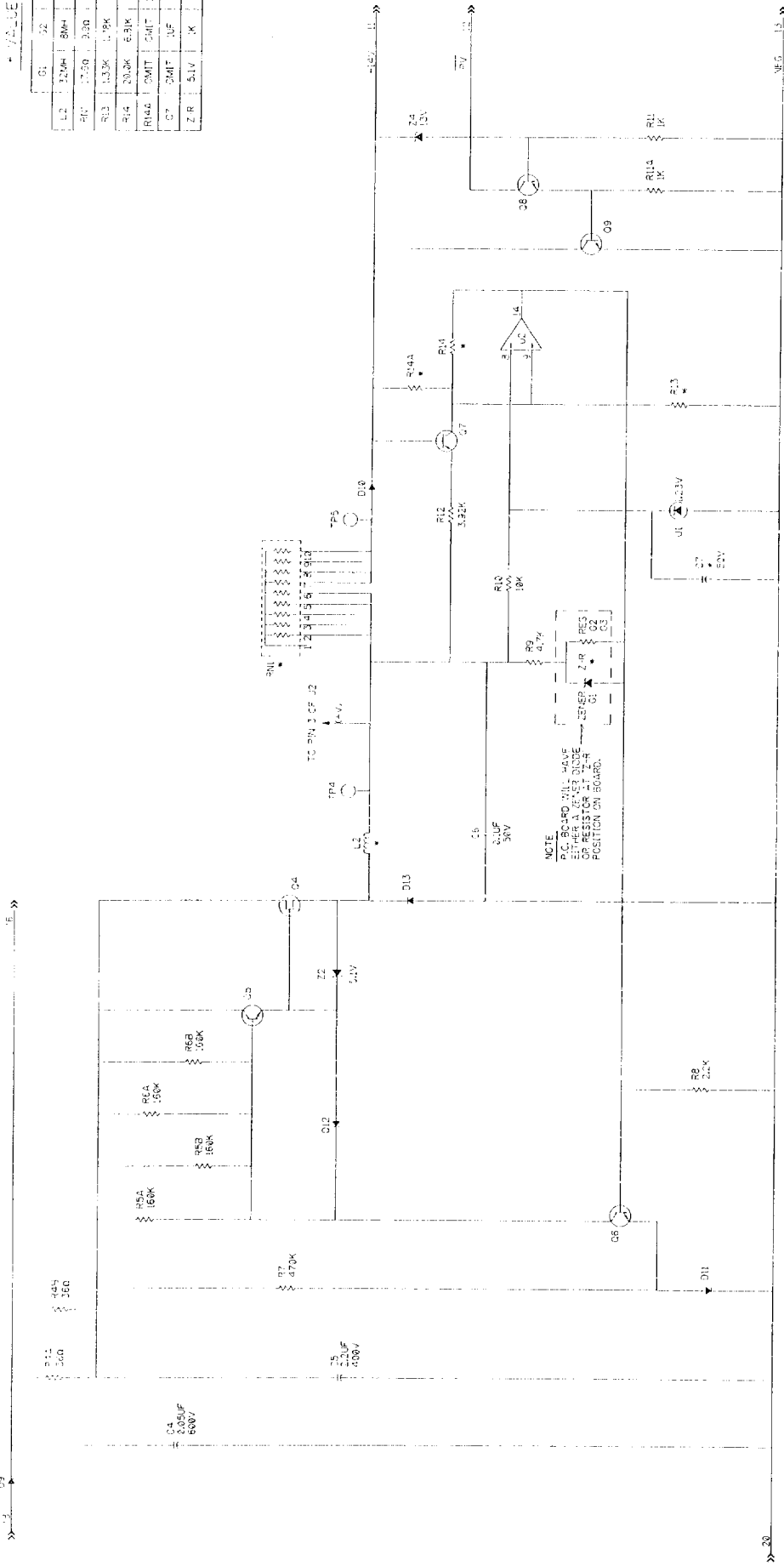
Figure 10A (0153D6583-6)
DC Power Supply
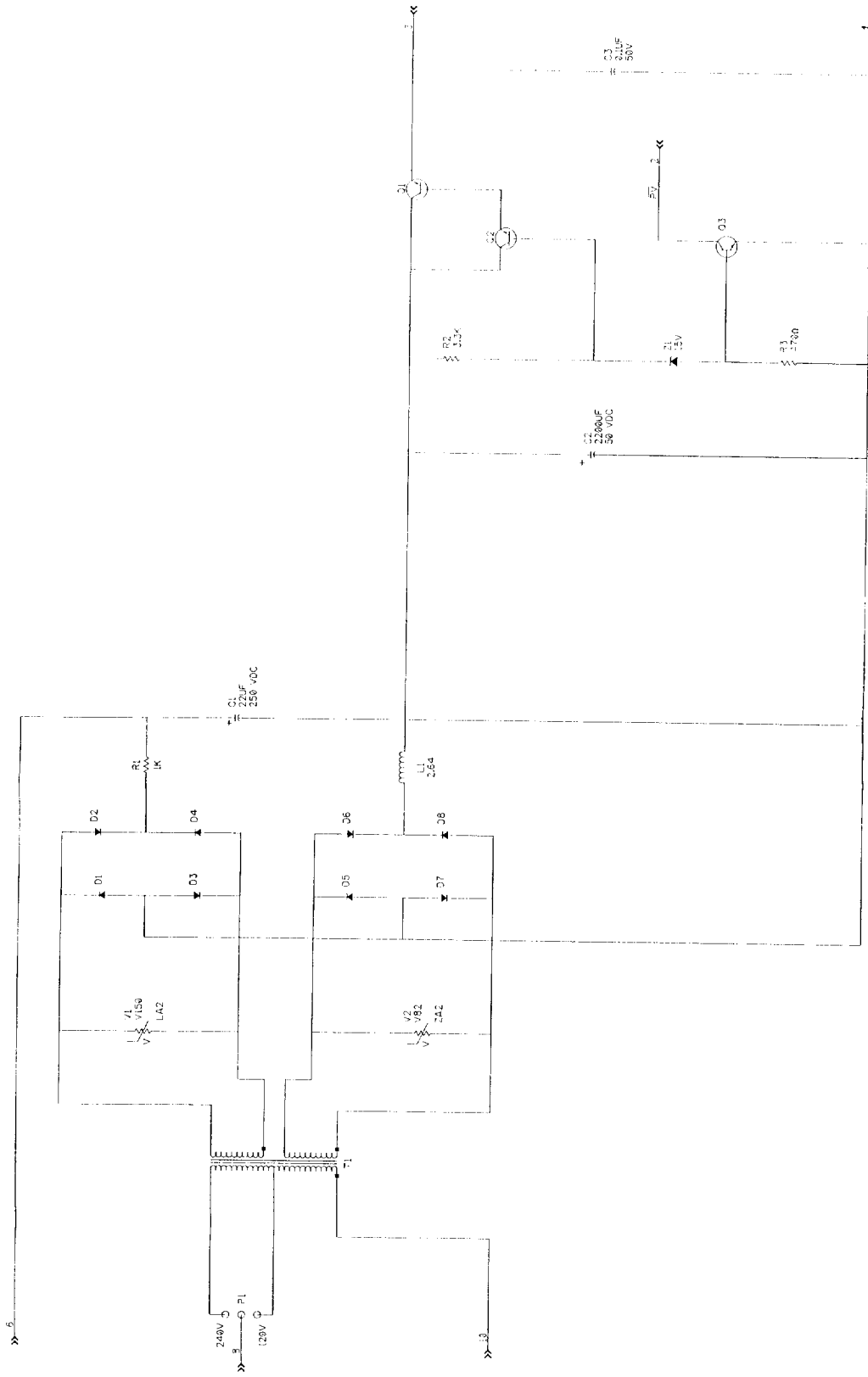
Figure 10B (0153D6584 [1])
AC Power Supply Schematic
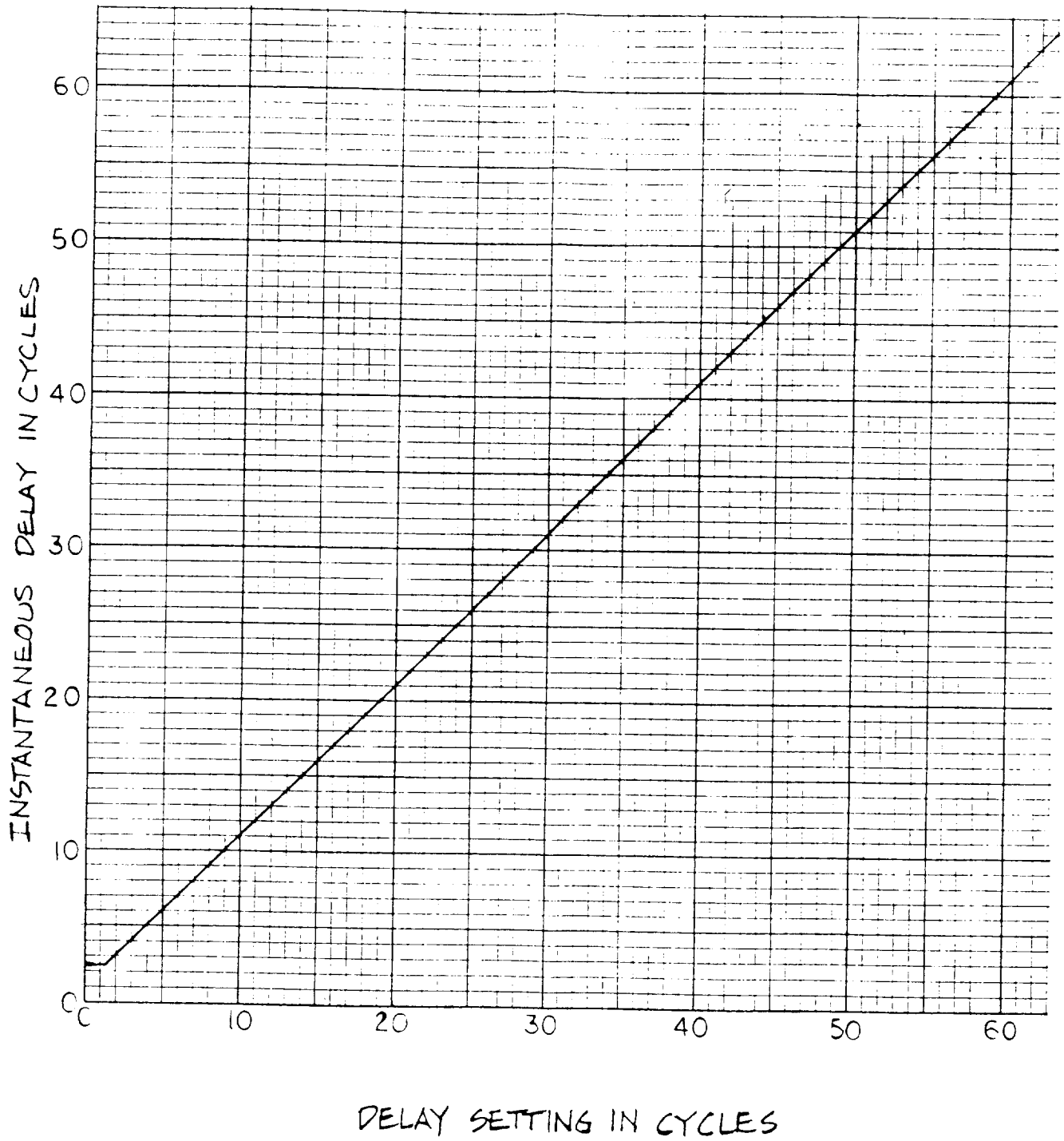
Figure 11 (0286A2788) Instantaneous Reclose Delay
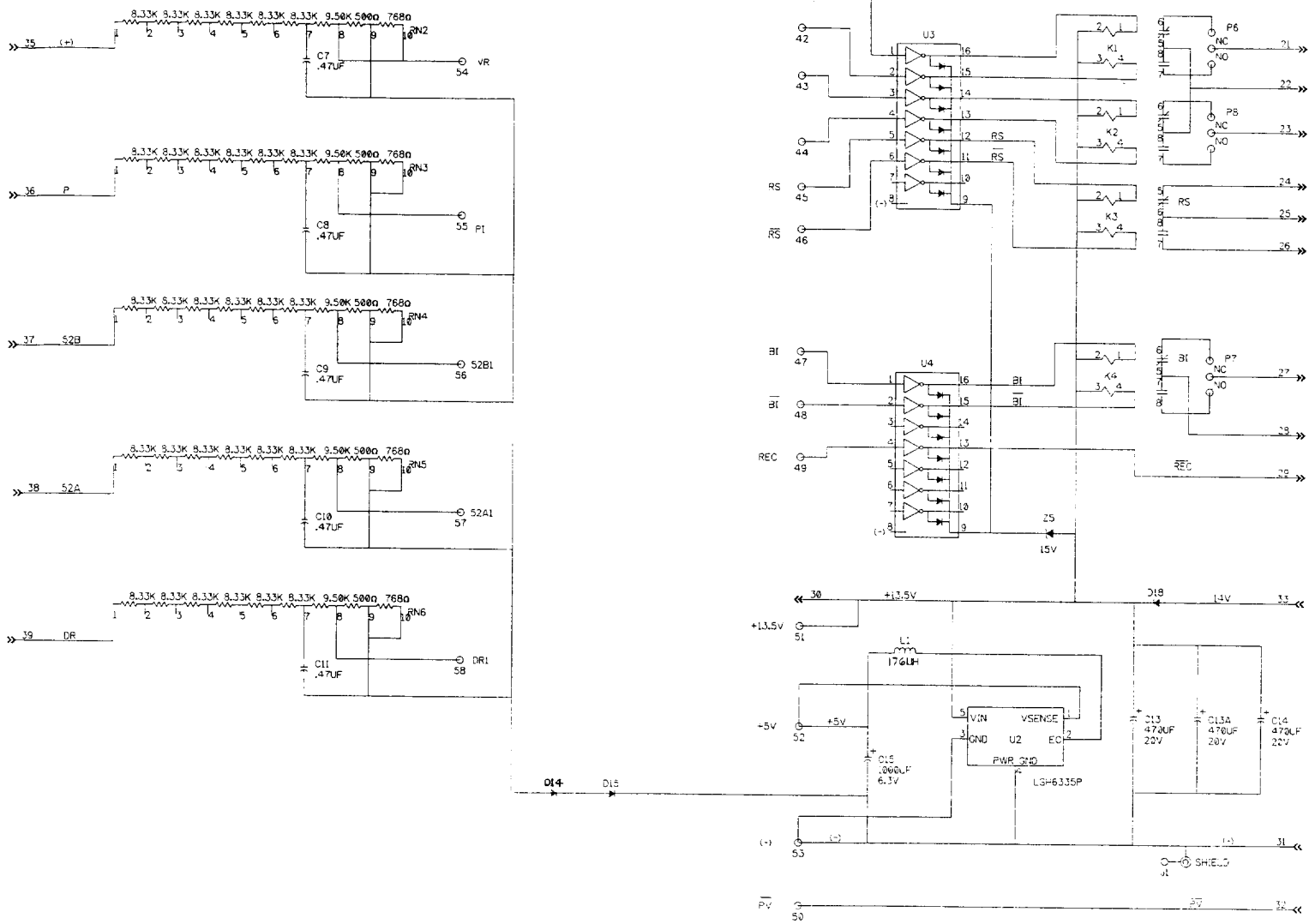
Figure 12 (0158D1107-3)
Relay and Power-Supply Board
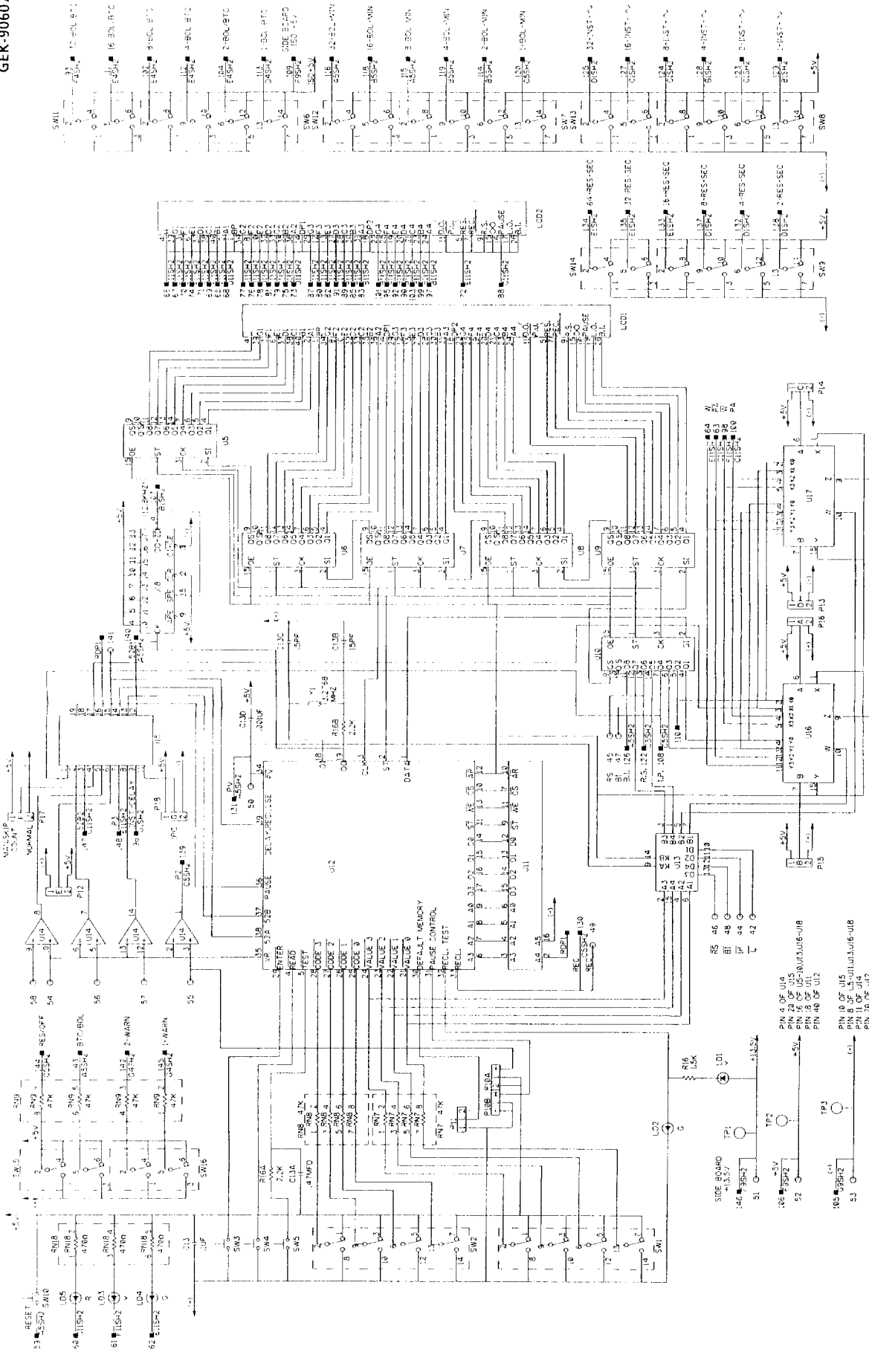
Figure 13 (0158D1151 Sh.1 [1])
Logic and Control Board
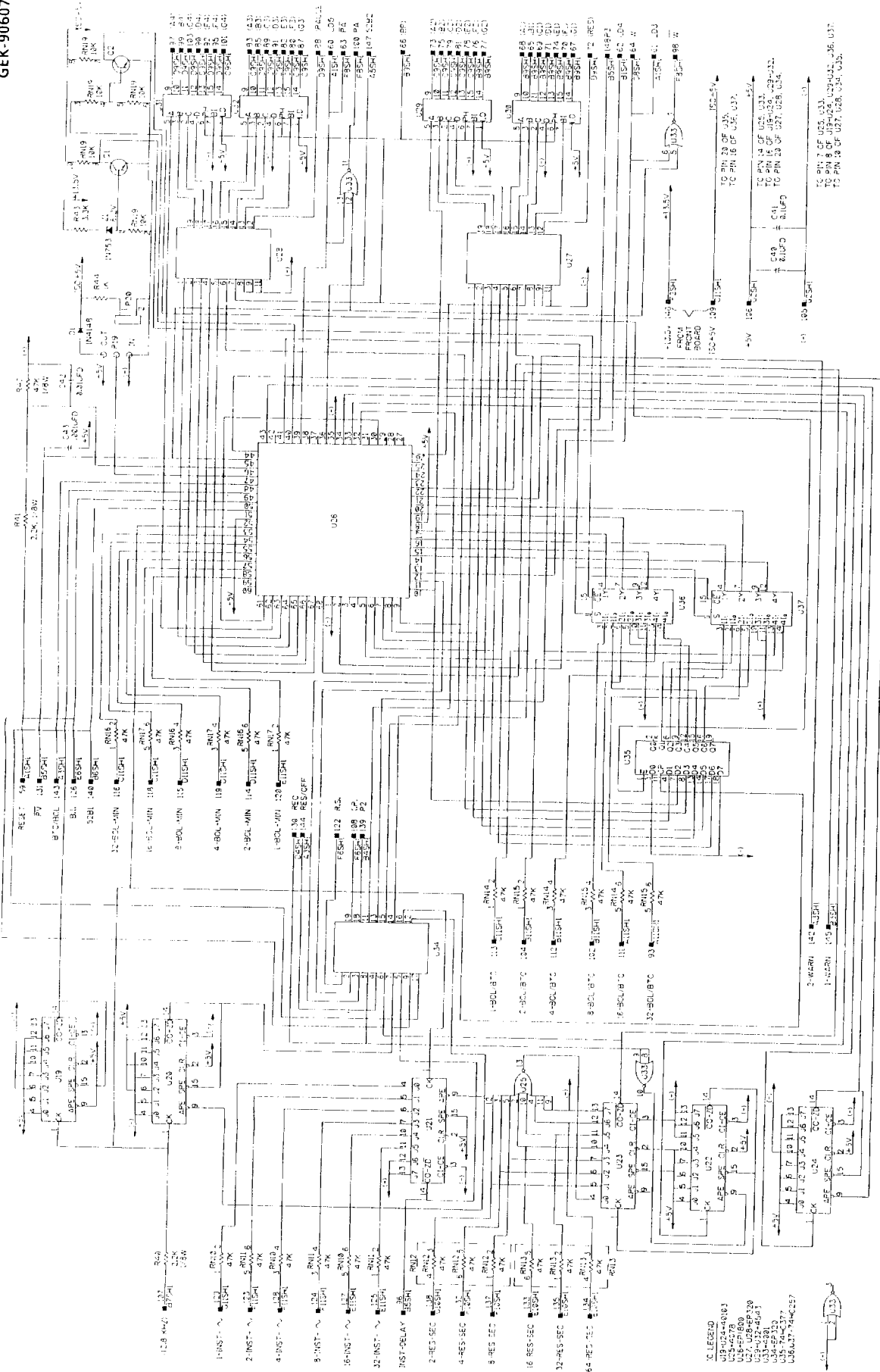
Figure 14 (0158D1151 Sh.2 [2])
Special-Function Board

P6 - OUTPUT RELAY SELECT   **P8 - OUTPUT RELAY SELECT**
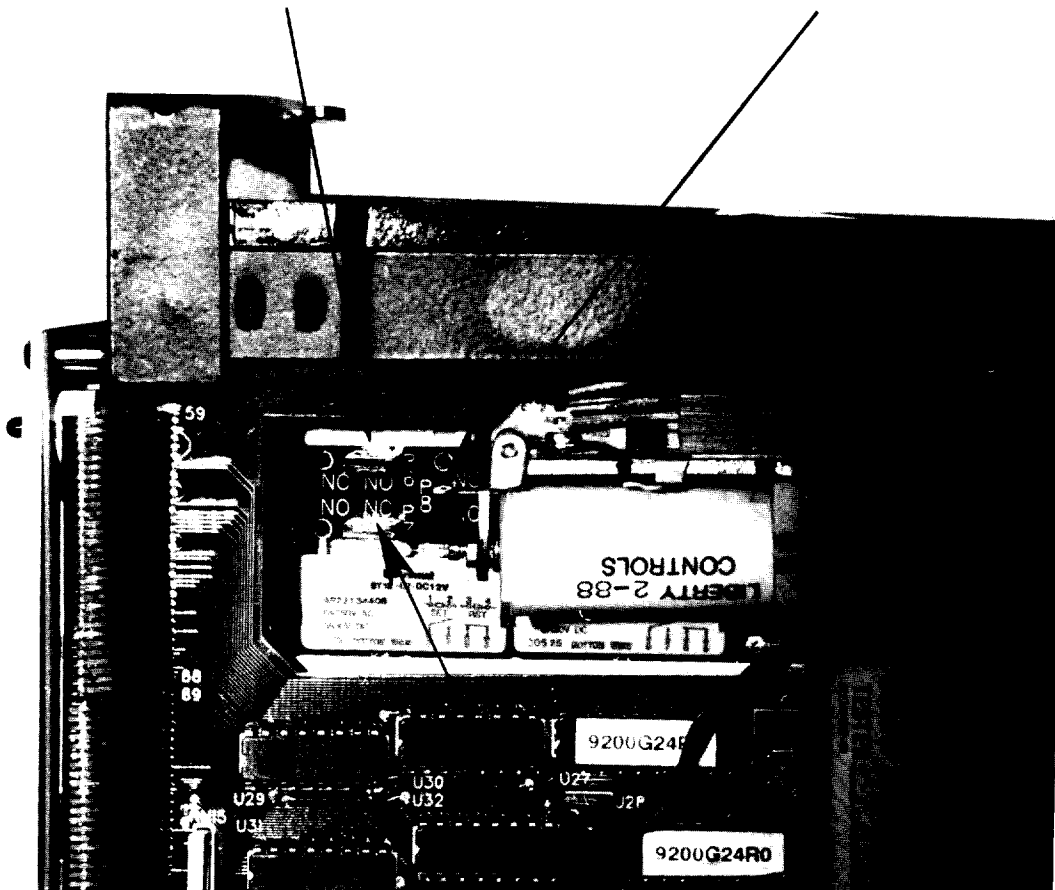
P7 - BLOCK INSTANTANEOUS SELECT

Figure 15 (8043785) P6, P7 and P8 Jumper Plugs
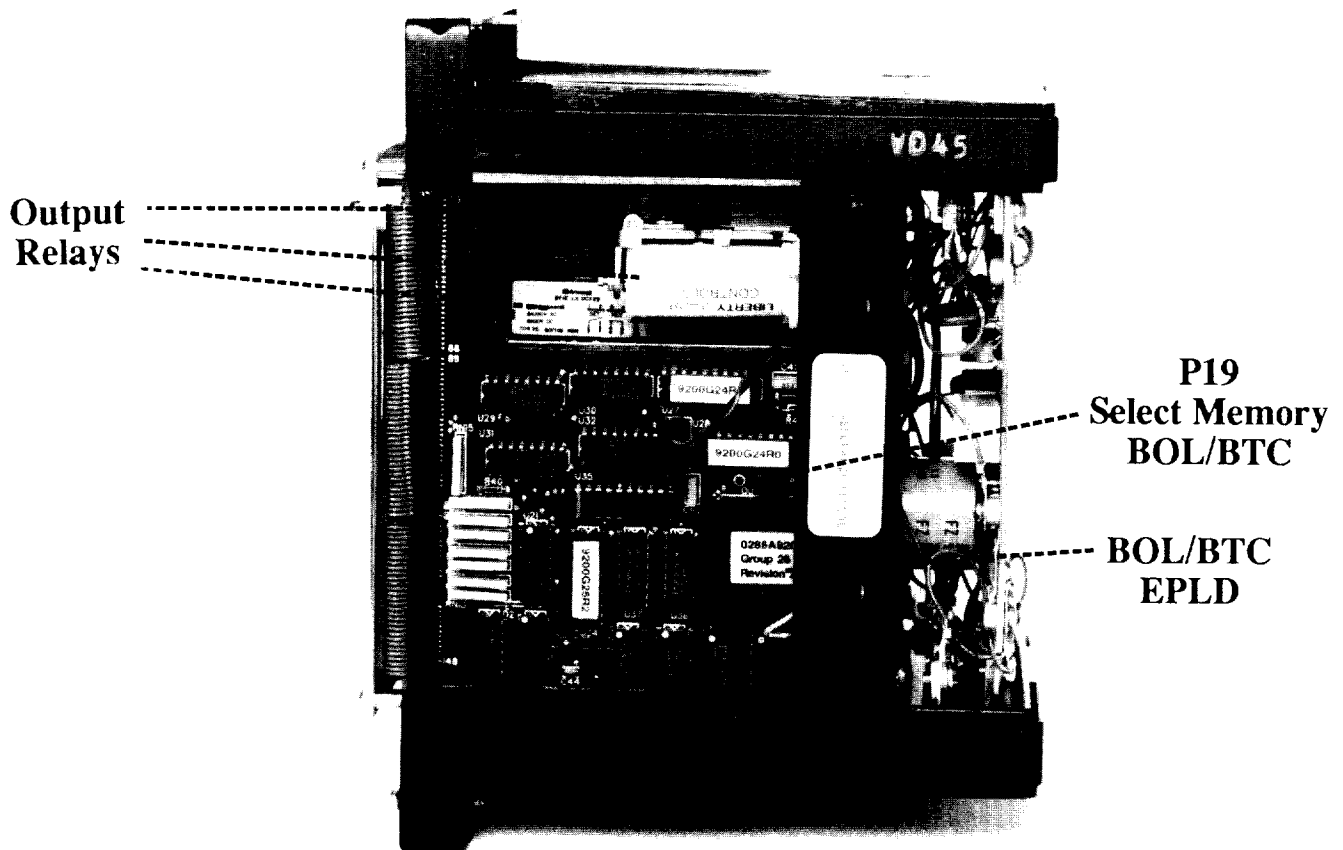
Figure 16 (8919550) SLR13 Relay, Side View
(Logic and Control Board)
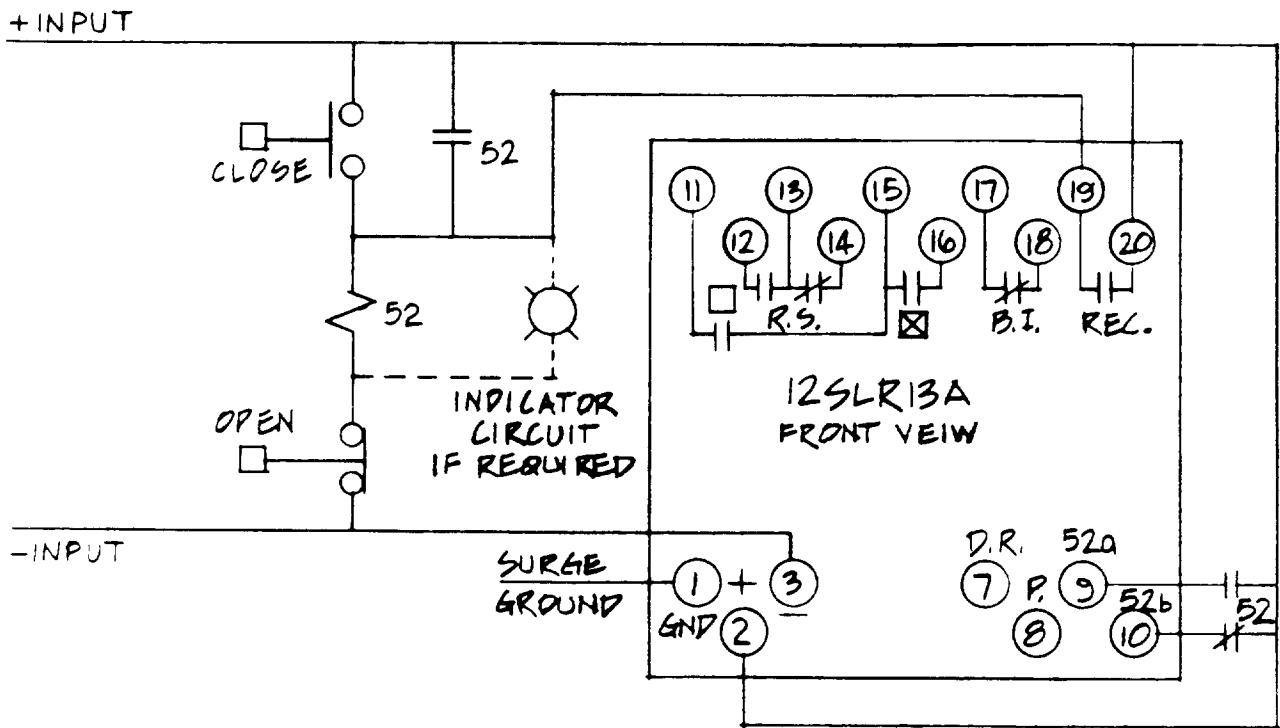
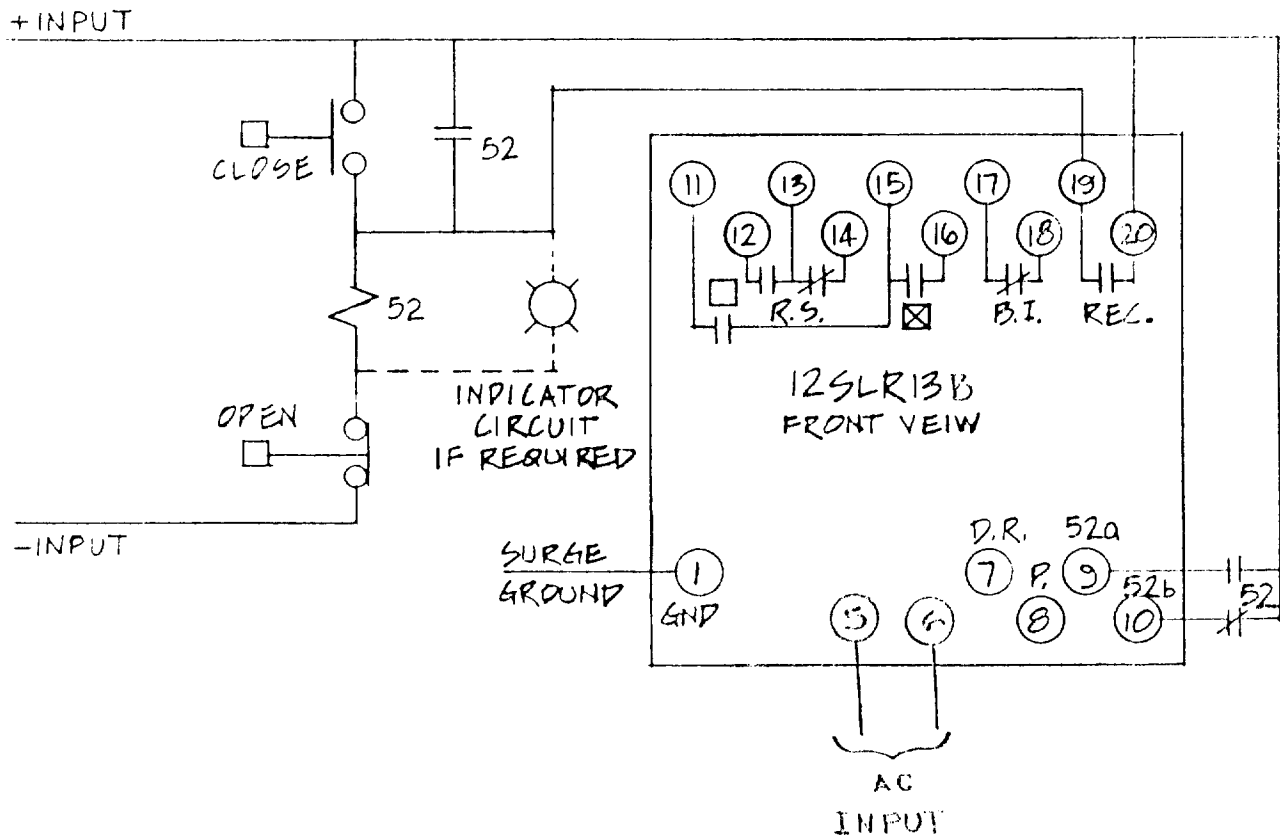Figure 17A (0286A2789) Functional Test Diagram, DC Powered

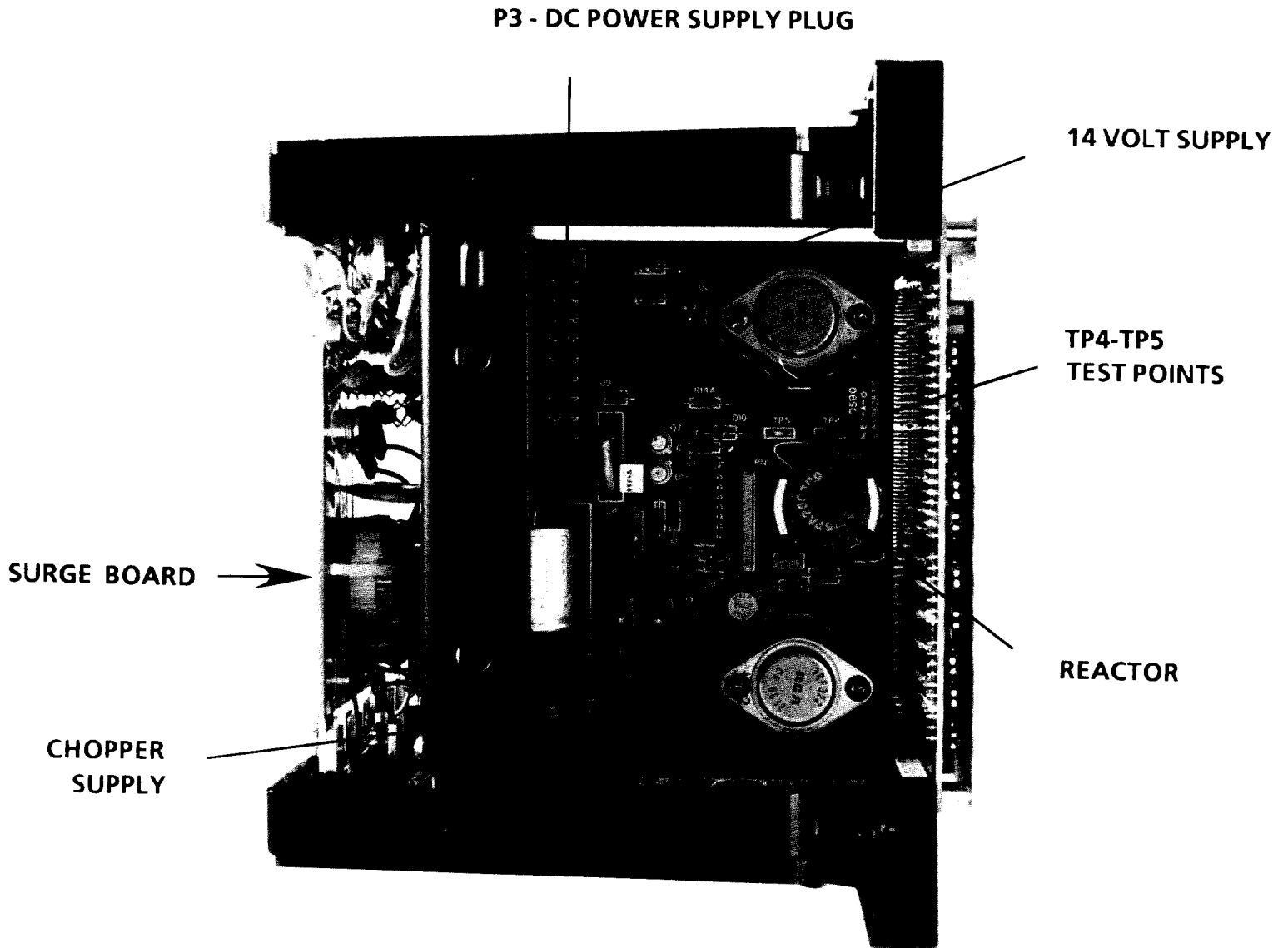Figure 17B (0286A5434) Functional Test Diagram, AC Powered

P3 - DC POWER SUPPLY PLUG

14 VOLT SUPPLY

TP4-TP5
TEST POINTS

SURGE BOARD

REACTOR

CHOPPER
SUPPLY

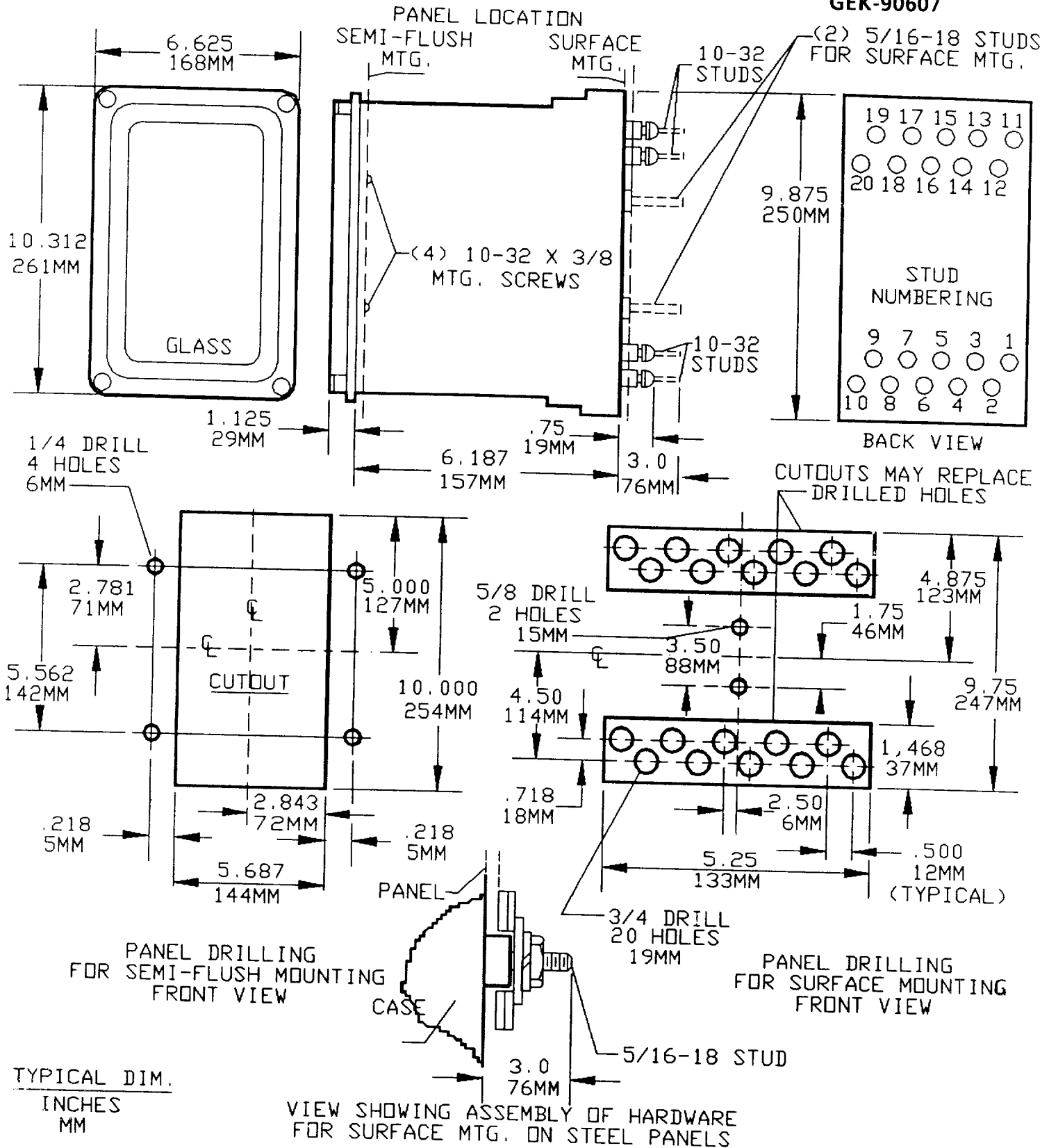Figure 18 (8043784-1) SLR13A Relay, Side View
(DC Power Supply)

Figure 19 (6209272 [7])   Outline and Panel-Drilling Dimensions
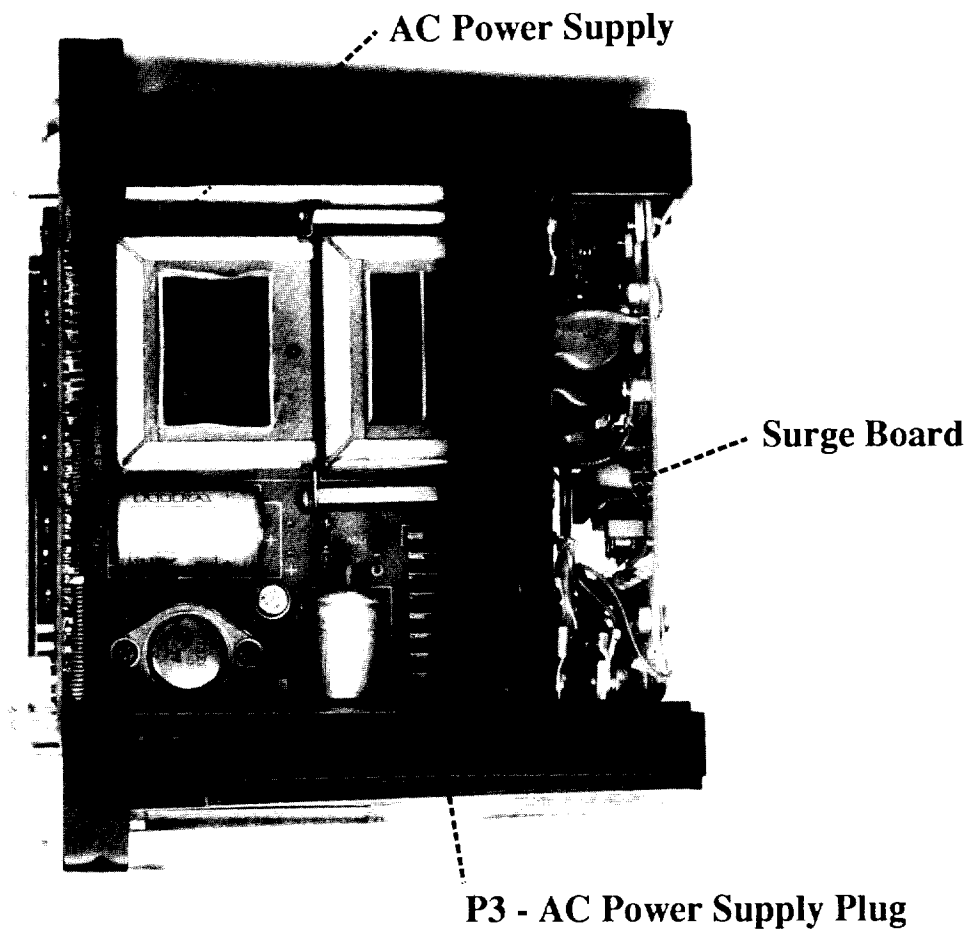for SLR Relay

Figure 20 (8919549) SLR13 Relay, Rear View (Surge Board)

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