INSTRUCTIONS

RECLOSING RELAY

TYPE NLR21E

GENERAL ELECTRIC

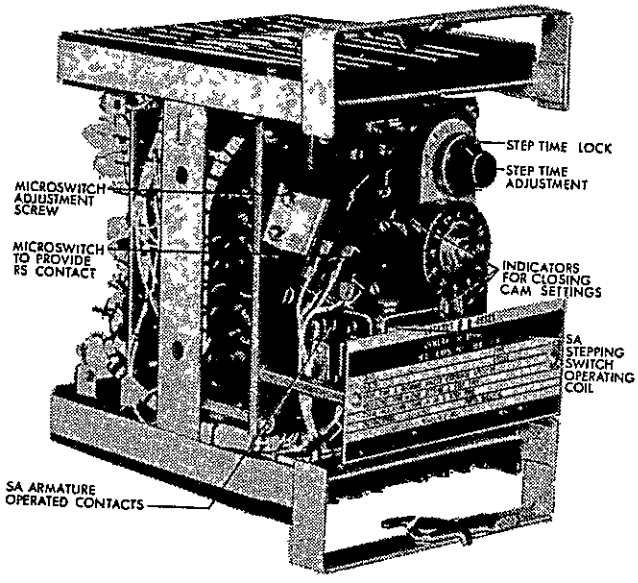

Figure 1 (8041770) Type NLR21E Relay Removed from Case (Front View)

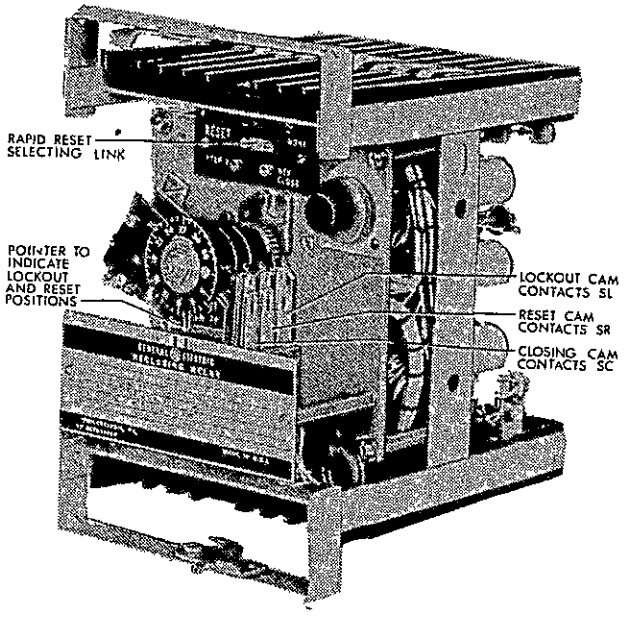

Figure 2 (8041775) Type NLR21E Relay Removed from Case (Front View)

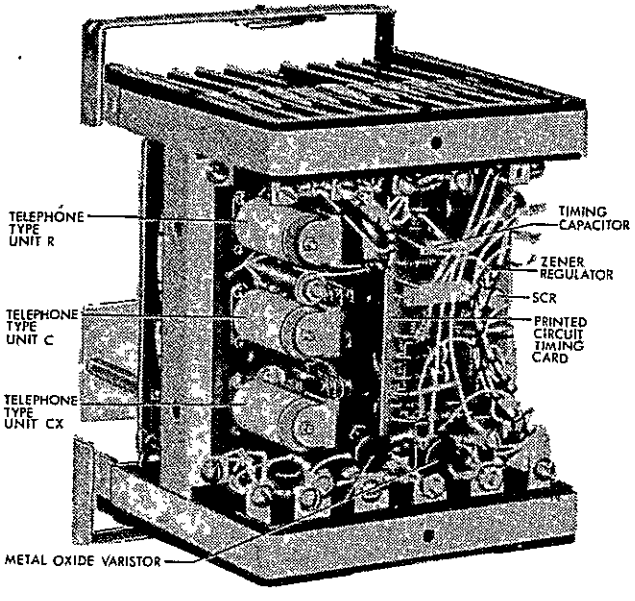

Figure 3 (8041772) Type NLR21E Relay Removed from Case (Back View)

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RECLOSING RELAY
TYPE NLR21E

DESCRIPTION

The Type-NLR21E relay is a multi-shot reclosing relay designed to initiate reclosures of a circuit breaker. The relay is generally employed to provide four-shot reclosing on transmission and subtransmission lines. It is capable of initiating one high-speed reclosure and one, two, or three independently adjustable time-delay reclosures of a circuit breaker. If it is desired to omit one or two of the delayed reclosures, that adjustable cam or cams must be removed and the spacers supplied with the relay must be put in their places. The relay contains provisions for initiating a high-speed reclosure whenever a high-speed protective-relay tripout occurs. For any subsequent high-speed tripping and all time-delay tripping, the relay provides only time-delay reclosures that can be supervised by an external synchronism-check relay. At each point in the cycle where the NLR21E provides a delayed-reclose-output signal it will stop timing and wait for the circuit-breaker mechanism to respond (as indicated by a change in position of the 52/b contact) before it continues to time. With this arrangement, when the NLR21E is used with a synchronism-check device, the NLR will always wait for the synchronism-check relay to operate and energize the circuit-breaker-closing circuit before it continues to time out. One complete cycle of the NLR21E relay is adjustable in the range from 18 to 180 seconds. A quick-reset feature is also available so that the relay may be adjusted to reset after a successful reclosure. The front, side, and back views of the relay are shown in Figures 1, 2, and 3 respectively.

The Type-NLR21E relay includes contact outputs for initiating a synchronism-check relay and sounding a lockout alarm. It is designed for DC operation from the station battery, and contains no target. One such reclosing relay per circuit breaker is generally applied. The auxiliary equipment required in addition to the NLR21E depends upon the user's reclosing philosophy. Some general factors that should be considered in the application of this relay are stated in the section entitled APPLICATION.

The Type-NLR21E relay is contained in an S2 drawout case. The internal-connection diagram and the outline and panel-drilling diagrams are shown in Figures 4 and 5 respectively.

APPLICATION

The Type-NLR21E reclosing relay is applied to reclose a circuit breaker one, two, three, or four times after the circuit breaker has been tripped by its protective relays. It is generally employed on transmission and subtransmission lines. Other Type-NLR relays are available for multi-shot reclosing on radial distribution circuits.

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

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

A typical external-connections diagram is shown in Figure 6. All cam-operated contacts are shown with the relay in the RESET position, which is position #0. A fixed lobe is placed in position #0 operating the step contacts (SC in Figure 2). Contacts SC1 and SC3 are closed and SC2 is open in the RESET position. When the relay is initiated for a high-speed reclosure by the closing of a contact of the auxiliary relay, RI (Reclose Initiate), the stepping switch takes an immediate step and the SC contacts reverse position. SC2 closes to provide an immediate reclosure.

Time-delay reclosures are obtained by placing the SC lobes in any non-adjacent positions in steps 2 to 33 inclusive. A maximum of three time-delay reclosures can be set. The minimum first time-delay reclosure is obtained by placing the first SC lobe in the Step #2 position, because it is the first non-adjacent position to Step #0 in which a fixed lobe is placed for a high-speed reclosure. With this setting, the first time-delay reclosure occurs after a two-step time interval. The time delay between steps is adjustable between 0.5 and 5.0 seconds. If it is desired to omit one or two of the delayed reclosures, that adjustable cam or cams must be removed and the spacers supplied with the relay must be put in their places.

The relay can be set for a maximum of four reclosures in a variety of combinations. When selecting the number of reclosures and the time delays between reclosures, the following factors should be considered.

1. Interrupting Rating of Power Circuit Breaker - The derating factor applying to the interrupting rating of the power circuit breaker should be checked prior to the application of a reclosing relay or the selection of a reclosing cycle.

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

The typical external-connections diagram of Figure 6 indicates the use of circuit-breaker-control-switch contacts (52CS) as well as circuit-breaker-auxiliary-switch contacts. A control-switch contact that is closed in the normal 'after-close' and 'close' positions is employed to prevent the breaker from being automatically reclosed when it has been tripped by the control switch. If the circuit breaker is manually closed into a faulted line, an operator should immediately place the control switch in the Trip position in order to prevent a subsequent time-delay reclosure from occurring. With the control switch in the Trip position, the relay would run to lockout; but there would be no relay-closing signals applied to the breaker-closing circuit.

The resetting of the relay following a successful reclosure is accomplished by setting the "Rapid Reset Selecting Link." The link can be set in any one of the three following positions.

1. STEP 2 Position - where the relay resets two time steps after a successful reclosure.

2. NEXT CLOSE - where the relay resets after a successful reclosure, but at the next reclose set point.

3. NONE - where the relay resets one time step after the LOCKOUT position.

With the link placed in one of the two Rapid-Reset positions, the R unit will seal in when the rapid reset is initiated. If the breaker should trip again during this transition period, the NLR21E relay will continue to reset, since the R unit has sealed in, and will then initiate another cycle of reclosures.

In addition to the wide choice of adjustments for reclosing and resetting, the relay has output contacts, as shown in Figure 6, that are normally used for the following functions.

1. Activate Synchronism-Check Relay - A contact of the CX unit (CX_4) is connected to studs 7 and 8. This contact is generally used to activate a synchronism-check relay by applying the AC potential to its operating-coil circuit. The CX_4 contact is closed when the NLR21E provides a 'close' output; and it is opened after the circuit-breaker mechanism responds.

2. Bypass Synchronism-Check Relay - the cam that operates the RS contact is dimensioned to hold that contact in the operated position for four adjacent steps of the stepping switch. Thus, the RS1 contact shown closed will be closed for 4 steps and open for the remaining 32 steps of the cycle. The RS1 contact is factory adjusted to open on the second step. With this setting, it is closed in the Step #34, LOCKOUT, RESET, and Step #1 positions; and as shown in Figure 6, it is generally employed to bypass the synchronism-check relay during a high-speed reclosure.

3. Alarm Circuit - When the relay steps to the LOCKOUT position, contact SL3 (Step Lockout) in the alarm circuit will close. If the breaker is open, the 52/b switch and contact R5 will be closed and the lockout alarm circuit will be completed.

RATINGS

The NLR21E is a DC-operated relay with ratings of 48, 125, and 250 VDC. Table A lists the ratings of the relay contacts.

TABLE A
CONTACT RATINGS

RATINGS	CONTINUOUS CURRENT AMPS	TRIP DUTY AMPS	INTERRUPTING CURRENT AMPS	
			INDUCTIVE	NON-INDUCTIVE
48 VDC	1	30	1.0	3.0
125 VDC	1	30	0.5	1.5
250 VDC	1	30	0.25	0.75
115V 60 Hz	1	30	0.75	2.0
230V 60 Hz	1	30	0.5	1.0

The NLR21E will operate in an ambient temperature of -40°C to +60°C .

SURGE WITHSTAND CAPABILITY

The NLR21E relay will withstand the following test voltage waveform without damage to any component.

The test voltage waveform consists of a high-frequency damped oscillation with a frequency of 1.5 megahertz. The source has an internal impedance of 150 ohms. The initial value (zero to peak) is 2500 volts and the damping is such that the envelope of the waveform decays to half the initial value (1250 volts) in 6.0 microseconds. The test voltage is applied between the relay case and each of the relay terminals across the input circuit (DC input) and across the closing circuit.

BURDENS

The burden of the NLR21E relay is approximately as given in Table B.

TABLE B
BURDENS

VOLTS	FREQUENCY	RESISTANCE-OHMS MINIMUM
250	DC	1500
125	DC	400
48	DC	70

The resistance values given are the relay resistance when the stepping-switch coil is energized. The stepping-switch coil is energized for about 8 milliseconds when the switch steps. At other times, when the timer is running the relay resistance is approximately 10 times the values given in Table B. When the relay is in reset, it has zero (0) burden.

CHARACTERISTICS

The NLR21E relay will perform properly over a range of applied DC voltage from 80% to 110% of rated voltage. In addition to the four basic units, there is a means of selecting the relay operation after a successful reclosing.

TIMING CIRCUIT

The timing circuit consists of two basic units, a timer and a stepping switch.

Timer - consists of an RC-type (Resistor Capacitor) timer that has an adjustable step time between 0.5 and 5.0 seconds. The timer will operate in ambient temperatures of -20° to +60°C with a maximum time variation of 6% and down to -40°C with a maximum variation of 10%.

Stepping Switch - The stepping switch is a spring-driven mechanism that rotates a series of cams that actuate contacts affixed to cantilever springs. There are a total of 36 steps in one complete revolution and the total time is a function of the timer. Therefore, to find the total time one has to multiply the step time by 36. Example: Step time is set for 0.5 seconds, giving a total time of 18 seconds for one complete revolution.

MICRO SWITCH

The NLR21E contains a micro-switch that operates off an adjustable cam in the stepping switch.

TELEPHONE RELAY

There are three telephone-type relays, one to maintain the closing signal, another to provide rapid reset, and a third for an auxiliary function.

SETTINGS

The Type NLR21E relay provides a wide choice of adjustments for reclosing and resetting. The choice depends upon the user's reclosing philosophy. However, the factors stated in the section entitled APPLICATION should be considered when applying the relay. The following settings are required.

1. Number of Time-Delay Reclosures - The number of time-delay reclosures is determined by the number of SC lobes employed on the closing cam. A maximum of three reclosures can be set on Steps 2 to 33 inclusive, in any three non-adjacent positions.

2. Time Between Reclosures - The time between reclosures is determined by the position of the SC lobes and the step time. The step time is normally set at the factory for 5 seconds; but it can be adjusted in the field to provide a step time from 0.5 to 5 seconds.

3. Position of the Rapid-Reset Selecting Link - The link can be set in either the STEP 2, NEXT CLOSE, or NONE position.

OPERATING PRINCIPLES

INTRODUCTION

The NLR21E is basically a timing device that automatically provides reclosing signals to a circuit breaker that has been tripped by its protective relay. Basically, the NLR21E consists of a static timer and a stepping switch that serves as a memory device. There are three adjustable lobes on the outside cam (SC) on the stepping switch, which provide adjustable breaker-closing signals, and one fixed lobe (in zero position) for instantaneous reclosure. Three auxiliary telephone-type relays ensure complete breaker closing and rapid reset.

PRINTED-CIRCUIT CARD

The printed-circuit card as shown in figure 7 basically consists of an RC timer. The timer is adjustable between 0.5 and 5.0 seconds by means of a potentiometer. The RC timer, which is zener regulated by Z11, consists of R1 (the potentiometer located in the front of the relay) and C25. C25 is charged up through R1, and when C25 reaches about 55% of the zener voltage it fires the unijunction, T11, which in turn provides a short pulse of current to flow through R24. The voltage drop across R24 is impressed on the SCR (silicon-controlled rectifier) gate and turns on the SCR. D17, D18, C23 and R23 are used as snubber circuits. The rest of the components are part of the logic of the relay and will be discussed elsewhere.

STEPPING SWITCH

When the SCR (SCR11 of the printed-circuit card) turns on, it allows current to flow through the SA (Step Armature) coil, which operates the stepping-switch armature.

The armature movement opens the SA1 contact and closes the SA2 contact, as shown in Figure 6 and Figure 8. The opening of the SA1 contact turns the SCR off and the closing of the SA2 contact completely discharges the capacitor, located on the

printed-circuit card, to reset the timing circuit. When the armature picks up it also raises the driving spring enough to clear the next tooth on the ratchet wheel and the driving spring snaps into the next notch. When the SCR is turned off by the SA contact, the armature coil is de-energized and its main spring rotates the ratchet wheel 10°. At this point the timer starts timing again, and it will rotate the stepping-switch ratchet wheel another 10° after another time interval has elapsed. All stepping-switch operations will have the same time interval.

The ratchet wheel of the stepping switch is solidly connected to a cam shaft that contains three main cams (SC, SL, SR). The two cams nearest to the ratchet wheel (shown in Figure 8) have only one lobe each and therefore raise their associated contact-operating springs only during one step interval for each revolution of the ratchet wheel. A third cam (not shown in Figure 8) has one fixed and three adjustable lobes, and these lobes may be set to raise their associated contact-operating spring on any desired step. When the adjustable cam lobes raise their contact-operating spring, they close two SC contacts shown in Figure 6, and one of these supplies the breaker-closing signal. Since the adjustable cam lobes can be set to close the SC contact on any step of the ratchet wheel, they can provide a breaker-closing signal at RESET (an instantaneous breaker-reclosing signal) and/or on any subsequent step until the LOCKOUT position is reached, which is 35 steps after RESET. The schematic diagram, Figure 8, shows the ratchet wheel in the LOCKOUT position. In this position, the lockout cam opens its SL contacts to open up the breaker-closing circuit and the timing circuit (which prevents any further operation of the stepping switch until the breaker is manually closed, as explained later) and closes an SL contact to ring an alarm. When the stepping-switch armature coil is energized again, the switch steps from LOCKOUT to the RESET position (as explained later).

The lockout (SL) cam has 3 contacts, 1 normally open and 2 normally closed.

The reset cam (SR) has 3 contacts, 1 normally open and 2 normally closed.

The adjustable cam (SC) (close) has 3 contacts, 2 normally open and 1 normally closed.

An additional adjustable cam is provided to operate the RS contact. The auxiliary cam operates a micro switch to provide the RS contact. The auxiliary cam is held by friction and is released by loosening the locknut on the cam shaft. The cam shaft must be firmly held when loosening or tightening the lock nut. When the lock nut is loose, the auxiliary cam can easily be moved to any position and the lock nut retightened. The cam is dimensioned to hold the switch in one position for 4 steps and in the other position for 32 steps.

OVERALL OPERATION

The overall operation of the NLR21E reclosing relay can best be described with the aid of the typical external-connection diagram in Figure 6.

High-speed Initial Reclosure

All contacts in Figure 6 are shown as they would be with the NLR relay in its RESET position and no fault on the line. Cam-operated contacts SC1, SC3, and SR3 are held closed by a cam lobe and will open on the first step of the stepping switch, while SC2 is held open and will close on the first step. Contacts RS1 and RS2 are held in the positions shown by a cam lobe, but will not change positions until the switch steps the second time.

If the primary pilot relays operate, they will energize RI and the breaker trip coil at the same time. Closure of RI will energize the CX auxiliary unit through SR3, and will also energize the timing circuit through diode D2. Operation of CX will pick up C through contacts CX1 and CX2 and diode D4. Contact CX3 will discharge the timing capacitor. Closure of contact C7 will energize the SA coil and cause the stepping switch to step once immediately, closing SC2 and setting up the circuit to the breaker-closing circuit. When the 52/b contacts close, the breaker-closing circuit will be energized through contacts CX1, C2, SC2, and RS1. Note that the immediate step also opens SC1, SC3 and SR3. However, the RS1 contacts are still closed, since the cam was set to cause the RS contacts to change position only on the second step.

The RI unit will reset when the fault is cleared, and 52/b will reopen during the initial reclosure. Hence, the CX unit will drop out and the path to the breaker-closing circuit will be open if the breaker should retrip. The C unit will remain sealed in.

When the CX unit drops out, the timing capacitor will start to charge through SR1 and SL2. At the end of the first time interval, the SCR will be gated. The C unit will reset, but there will be no step, since C4 was open when the SCR was gated. This sequence "regains" the immediate step that occurred when the C unit picked up. The overlapping C5 and C6 contacts will discharge the capacitor as C drops out.

Delayed Reclosures Following Immediate Reclosure

If the fault is permanent, the breaker will be retripped by the primary relaying and the RI contact will again close. A second immediate reclosure will be prevented because the CX unit has dropped out, and contact SR3 is open so the RI contact cannot pick up CX again. The NLR will now step to the first delayed reclosure point, where a cam will open SC2 and close SC1. The SCI contact will pick up CX through the RS2 contact, and closure of the CX contacts will pick up C, which seals in. The CX3 contact will short out the timing capacitor, thus preventing further operation of the step timer while CX is up. However, the C7-SC3 contact combination will energize SA, causing the switch to step once more to reclose SC2 and open SC1 and SC3. Closure of SC2 completes the closing circuit up to the synchronism-check circuit (or live line/dead bus or live bus/dead line check). The NLR relay will wait at this point, because CX will remain picked up. When the check circuits permit a reclosure, the CX unit will drop out, permitting the timing circuit to commence functioning again.

Delayed Initial Reclosure

If the breaker is initially tripped by time-delay backup relays, the RI unit will not pick up. Closure of the "b" switch will start the timer, and diode D2 prevents CX from picking up, and in turn operating C. On the first time step, SC1 and SC3 will open and SC2 will close. On the second time step, the RS contacts will reverse position.

When the first delayed reclosure position is reached, the cam will open SC2 and close SC1 and SC3. Closure of SC1 will pick up CX, since the RS2 contact is now closed, and this in turn will operate C. The sequence will not be the same as described in the previous section, headed "Delayed Reclosures Following Immediate Reclosure", where the delayed reclosure is controlled by the synchronism-check circuit.

Reset Circuits

In the preceding discussions it was assumed that the fault was permanent, so that the breaker retripped following each reclosure, and that the NLR relay consequently stepped through its complete cycle until the LOCKOUT position was reached. A RESET selection link is available, which can be set to provide reset following a successful reclosure. There are three choices of link position: (1) STEP-2 position, which resets the NLR two step-time intervals after any successful breaker reclosure; (2) NEXT CLOSE position, which initiates reset after a successful reclosure when the NLR ratchet has reached the step where the next reclosing signal would be given; and (3) the NONE position, in which the rapid-reset feature is eliminated and the NLR will not reset after any successful reclosure until the relay has stepped through its complete time cycle to one time interval after the LOCKOUT position.

The elementary diagram in Figure 6 shows the selection link in the STEP-2 Position. Consider the immediate initial reclosure sequence previously described. The reclosure attempt occurs after the immediate step, which takes place when C picks up and seals in. If the reclosure is successful, breaker auxiliary switch 52/a will remain closed, which sets up the circuit through SR2, the coil of the R unit, and the selection link to contact C4, which will be open. After the first time interval, the SCR drops out C but, since the SCR cuts off before contact C4 closes, there will be no step and unit R will not pick up. On the next time step when SCR fires, unit R will pick up, seal in through contacts R2 and R3, and block the reclose circuit at contact R1. The SA unit will then repetitively pick up and drop out and the stepping switch will run without time delay until it "homes" in the RESET position, where contacts SR1 and SR2 will reopen and the R unit will drop out. The NLR relay is now reset, and all contacts will again be in the position shown in Figure 6. The same rapid-reset sequence will occur after a successful delayed reclosure.

With the selection link in the NEXT CLOSE position, the R unit will not pick up following a successful reclosure until contact SC3 closes at the next reclose position of the stepping switch. At that point, R picks up and seals in, and the stepping switch will run without time delay, as previously described, until it "homes" in the RESET position.

If the selection link is in the NONE position, there will be no rapid reset after a successful reclosure, and the NLR relay will run through its normal cycle until the LOCKOUT position is reached. At this point, contacts SL1 and SL2 will open, but if 52/a is closed, the timer will time out one more interval and the switch will step one more notch to the RESET position.

ACCEPTANCE TESTS

MECHANICAL TESTS

Operate the telephone-type relay units and the stepping switch manually to check that all operate smoothly without binds.

ELECTRICAL TESTS

With the NLR relay in the LOCKOUT position, connect rated voltage to the NLR relay as follows.

For DC-operated relays, connect plus (+) to stud 13 and minus (-) to stud 11.

Check that there is no relay operation.

Note that the indicating pointer points to the LOCKOUT line on the nameplate and that the 15-16 light and 1-2 lights are on.

Connect a jumper between studs 13 and 4 and note that the stepping switch steps once after a 5 second interval (or one step time interval, if set for other than 5 seconds) and stays in the RESET position. Note that the indicator points to RESET and the 15-16 light is out. With the stepping switch still in RESET position, with a jumper between studs 13 and 4, and the Reset Link in the NONE position, connect indicating lights to NLR as shown in Figure 9. Jumper stud 13 to stud 14 for one step time.

Note that the relay runs in 5 second steps (or step time if it is other than 5 seconds) through all positions to RESET.

Note that the indicating light (studs 1-2) lights when the auxiliary cam does not touch the micro-switch-operating button.

Put the Reset Link in NONE.

Jumper studs 13 to 5.

Jumper studs 18 to 11.

Jumper studs 13 to 4.

Apply rated DC voltage to stud 13 (+) and stud 11(-).

With the relay in the RESET position, jumper studs 13 to 10. The relay should take one instantaneous step and stop. The CX and C relays should be picked up and the stud 7-8 indicating light should go on.

Move the Reset Link to the STEP 2 position. Remove the stud 13-10 jumper and note that the CX relay drops out instantaneously, the stud 7-8 light goes out, but the C relay remains picked up for one step time, then drops out. After one additional step time, the NLR relay will rapidly reset to the RESET position and stop. Note that during the rapid-reset function the stud 7-8 and the stud 15-16 indicating lights do **not** go on.

With the relay in the RESET position, jumper studs 13 to 10. The relay should take one instantaneous step and stop. The CX and C relays should be picked up and the stud 7-8 indicating light should go on.

Move the Reset Link to the NEXT reclose position. Remove the stud 13-10 jumper and note that the CX relay drops out instantaneously and the stud 7-8 light goes out, but the C relay remains picked up for one step time, then drops out. The NLR relay will now step time until it reaches the next reclosing lobe, where the NLR relay will then rapidly reset to its RESET position and stop.

INSTALLATION PROCEDURE

INTRODUCTION

The location should be clean and dry, free from dust and excessive vibration, and well lighted to facilitate inspection and testing.

The relay should be mounted on a vertical surface. The outline and panel diagram is shown in Figure 5.

The internal-connection diagram is shown in Figure 4. Refer to Figure 6 for typical external connections.

The relay may be tested without removing it from the panel by using a 12XLA13A test plug. This plug makes connections only with the relay, and does not disturb any shorting bars in the case. Of course, the 12XLA12A test plug may also be used. Although this test plug allows greater testing flexibility, it also requires CT (Current Transformer) shorting jumpers and the exercise of greater care, since connections are made to both the relay and the external circuitry. Additional information on the XLA test plugs may be obtained from GEI-25372.

All devices operated on alternating current (AC) are affected by frequency. A non-sinusoidal waveform can be analyzed as a fundamental frequency plus harmonics of that fundamental frequency. AC relays (and AC devices in general) are significantly affected by the application of non-sinusoidal waveforms. Therefore, in order to test AC relays properly it is essential to use a test voltage and/or current waveform that is sinusoidal.

MECHANICAL TESTS

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

Check that the adjustable cam lobes are set in the proper positions to provide breaker reclosing impulses at the desired times. The fixed lobe in the zero (0) position will provide an immediate reclosing impulse when the NLR relay is in the RESET position and the breaker trips. A second lobe in position 3 will provide a second reclosing impulse 3 times the step-time interval (or 15 seconds) after the first breaker trip when the NLR is set for the standard step time. Likewise, a third lobe in position 9 will provide a reclosing impulse 9 × 5 (or step time) or 45 seconds after the first breaker trip. The final lobe in position 21 will provide a reclosing impulse 105 seconds after the first breaker trip.

Set the Reset Link in the position that will provide the desired time delay before rapid reset.

ELECTRICAL TESTS

Make connections to the NLR relay as shown in Figure 10. With the NLR relay in LOCKOUT position, close S2 and check that the stepping switch steps to RESET after approximately 5 seconds (or one step-time interval) and remains in the RESET position. Note that indicating light 3 turns on at reset.

Open S2 and close S1 for one step time, and check that the NLR relay initiates reclosing impulses (shown by indicating light 1 turning on) at the desired intervals. Also check that the stepping switch stops in LOCKOUT. Also check that the auxiliary cam (see Figure 1) operates the micro switch to open (or close) the RS contact on the desired step, as shown by indicating light 3. Adjust the auxiliary cam if necessary, as described in the section on ADJUSTMENTS.

Close S2, and after the NLR has reset, close S1 and note that the stepping switch starts its rapid reset after the desired time interval following the closing impulse.

If adjustments are necessary, check the section on ADJUSTMENTS for instructions.

ADJUSTMENTS

INTRODUCTION

The following adjustments may be made in any order, but due to a physical interference, the adjustable SC cams cannot be set on adjacent positions. To obtain a setting such as 0-5-5-5 seconds, it is recommended that the step time be set to 2.5 seconds and the reclosing interval set to the zero (0), two (2), four (4) and six (6) time-dial positions.

RECLOSING INTERVAL

To change the time interval between reclosing impulses, proceed as follows:

Loosen the locknut and run it back to the end of the cam shaft. HOLD THE CAMS FIRMLY WITH ONE HAND WHILE LOOSENING THE NUT, TO LIMIT THE STRAIN ON THE CAM SHAFT. Pull the indicating dial forward far enough to permit moving the adjustable cam rings. Then slide the rights that hold the contact-operating lobes forward until the lobes are out of the locating sockets. No the rings can be rotated to locate the three lobes in the desired location. After changing the setting of one lobe, be sure all lobes are in the desired locations.

STEP TIME

To adjust the step time, loosen the locknut on the rheostat (see Figure 1) and turn the rheostat counterclockwise to decrease the step-time interval. Connect the relay as shown in Figure 12, connect the Reset Link to the NONE position, and close the S1 switch momentarily (1/2 second or less). The stepping switch will run with time-delay steps to the LOCKOUT position and stop. Then, by closing switch S2, it will move on to reset after one step-time interval. By timing the 35 steps and adjusting the rheostat to produce the correct total time, the step-time interval can be set very accurately. After setting the step time, lock the rheostat and place the Reset Link on the position that will provide the desired reset time.

RS CONTACT AND MICRO SWITCH

The RS contact connected to studs 1 and 2 is a micro-switch contact operated by the auxiliary cam (see Figure 1). The micro-switch-operating button is depressed in all but six steps of the 36 steps that make up one revolution of the cam shaft of the stepping switch. By loosening the locknut on the end of the cam shaft slightly, the auxiliary cam can be rotated to permit the micro-switch button to snap to its extended position on any desired step. The stepping-switch armature can be depressed manually to step the switch to check that the RS contact operates on the desired step. By holding the stepping-switch armature in the depressed position, the cam shaft can be rotated in a counter-clockwise direction without any steps, to speed up the check of the RS contact setting.

The contact connected to studs 1 and 2 closes when the micro-switch-operating button is released, and opens 4 steps later.

If, for any reason, the micro-switch mounting or the stepping-switch mounting has been disturbed, the location of the micro switch with respect to its operating cam must be rechecked. Loosen the screws holding the micro-switch bracket enough to permit the bracket to be moved slightly in either direction. By moving the

bracket, locate the micro switch so that the distance between the micro-switch case and the cam, when the button is fully depressed, is 0.025 to 0.045 inches.

When the micro switch is properly positioned, the cam will depress the button two steps after the RESET position, and the button should snap out three-to-five steps before the LOCKOUT position. With the one step between LOCKOUT and RESET, this amounts to a total of six-to-eight steps during which the micro switch is closed.

PERIODIC CHECKS AND ROUTINE MAINTENANCE

In view of the vital role of protective relays in the operation of a power system, it is important that a periodic test program be followed. It is recognized that the interval between periodic checks will vary, depending upon environment, type of relay, and the user's experience with periodic testing. Until the user has accumulated enough experience to select the test interval best suited to his individual requirements, it is suggested that the points listed under INSTALLATION PROCEDURE be checked at an interval of from one to two years.

CONTACT CLEANING

For cleaning fine silver relay contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with an etch-roughened surface, resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet it will clean off any corrosion thoroughly and rapidly. Its flexibility ensures the cleaning of the actual points of contact. Do not use knives, files, abrasive paper or cloth of any kind to clean relay contacts.

SERVICING

Should servicing of the relay become necessary, follow the test procedures as explained in the ACCEPTANCE and ADJUSTMENTS sections. Telephone-relay-contact cleaning is located in the section entitled PERIODIC CHECKS AND ROUTINE MAINTENANCE. Also, see the section on RENEWAL PARTS for servicing printed-circuit cards.

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 nor 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.

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.

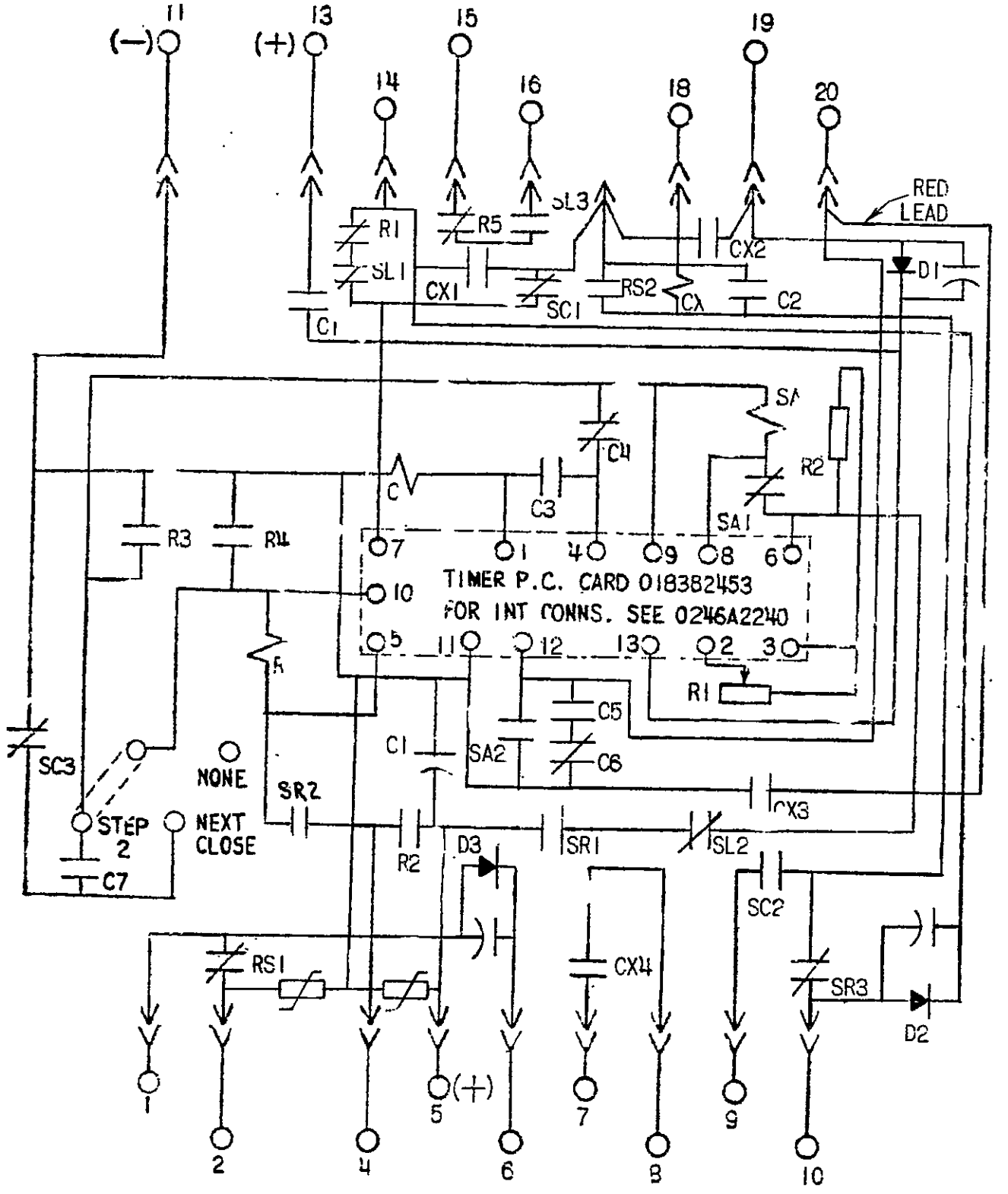
Should a printed-circuit card become inoperative, it is recommended that this card be replaced with a spare. In most instances, the user will be anxious to return the equipment to service as soon as possible, and the insertion of a spare card represents the most expeditious means of accomplishing this.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

Although it is not generally recommended, it is possible, with the proper equipment and trained personnel, to repair cards in the field. This means that a troubleshooting program must isolate the specific component on the card that has failed. By referring to the internal-connection diagram for the card, it is possible to trace through the card circuit by signal checking, and hence determine which component has failed. This, however, may be time consuming and if the card is being checked in place in its unit, as is recommended, will extend the outage time of the equipment.

CAUTION:

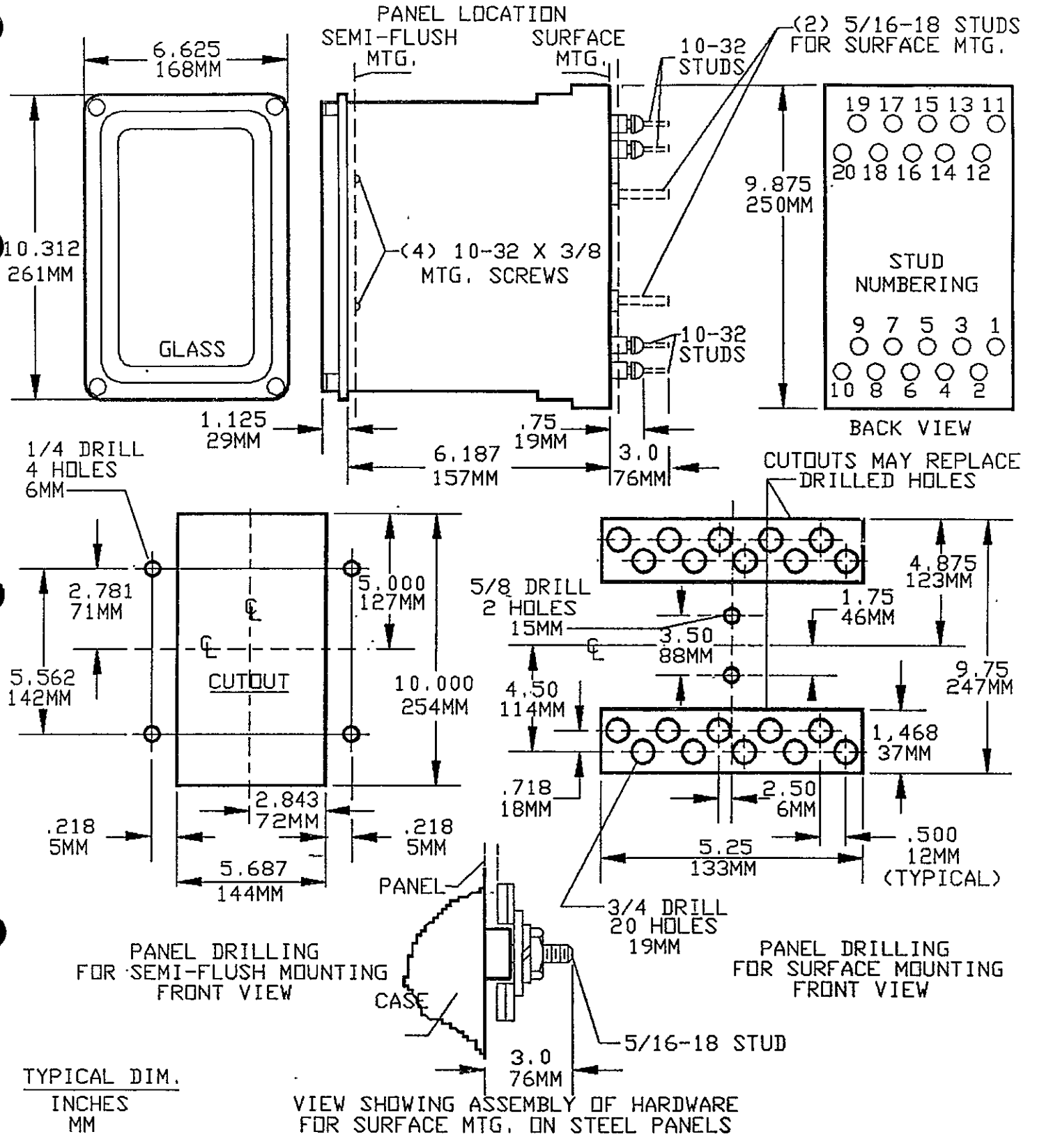
Great care must be taken in replacing components on the printed-circuit cards. Special soldering equipment suitable for use on the delicate solid-state components must be used and, even then, care must be taken not to cause thermal damage to the components, and not to damage or bridge over the printed-circuit buses. The repaired area must be re-coated with a suitable high-dielectric plastic coating to prevent possible breakdowns across the printed-circuit buses due to moisture or dust.

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 complete model number of the relay for which the part is required. If possible give the General Electric requisition number on which the relay was furnished.



○ = POST NO. ON PRINTED CIRCUIT CARD

Figure 4 (0246A3329 Sh.1 [1] Type NLR21E Relay Internal Connections



TYPICAL DIM.
INCHES
MM

* Figure 5 (K-6209272 [7]) Type NLR21E Relay Outline and Panel-drilling Diagram

* Indicates revision

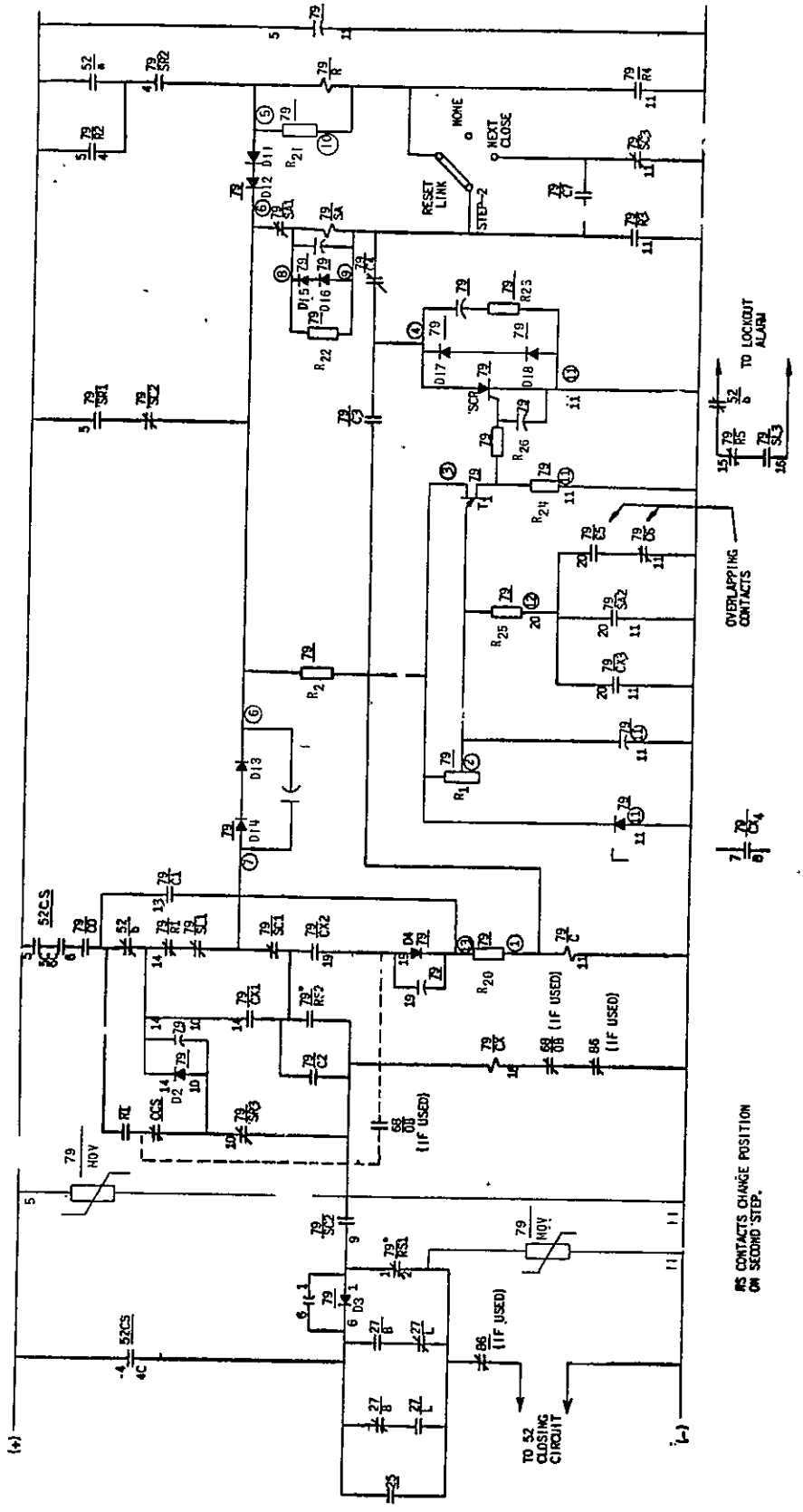
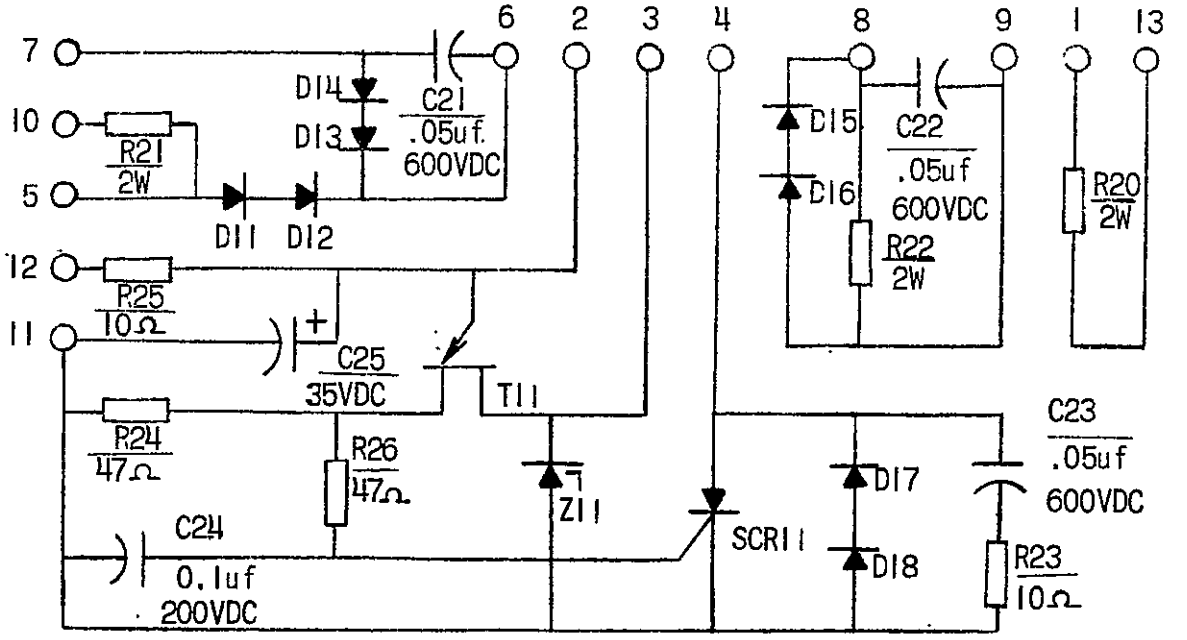
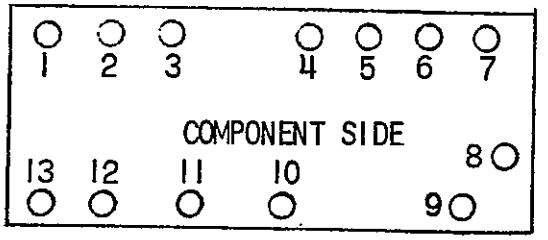


Figure 6 (0165B2633 Sh.1 [2]) Type NLR21E Relay External Connections





CONNECTOR LOCATION ON PRINTED CIRCUIT CARD

TOP VIEW

T11
2N1671B

SCR11
MCR2604L-6
2N4190

NOTE: ALL RESISTORS 1/2 WATT ±10% UNLESS OTHERWISE NOTED.
ALL DIODES 1N5061 UNLESS OTHERWISE NOTED.

DRAWING NO.	GROUP NUMBER						
0183B2453	1	2	3	4	5		
RESISTANCE VALUE IN OHMS							
R21	8200	3900	1500	8200	1000		
R22	8200	3900	1500	8200	1000		
R20	2200	1000	390	2200	240		
ZENER DIODE, TRANSISTOR OR SCR NOMENCLATURE							
SCR11	2N4190	MCR-2604L-6	MCR-2604L-6	2N4190	MCR-2604L-6		
Z11	1N965A	1N965A	1N965A	1N965A	1N965A		
T11	2N1671B	2N1671B	2N1671B	2N1671B	2N1671B		
CAPACITANCE VALUE							
C25	8.2uf	8.2uf	8.2uf	15uf	8.2uf		

Figure 7 (0246A2240-2) Printed-Circuit Card Type NLR21 Relay

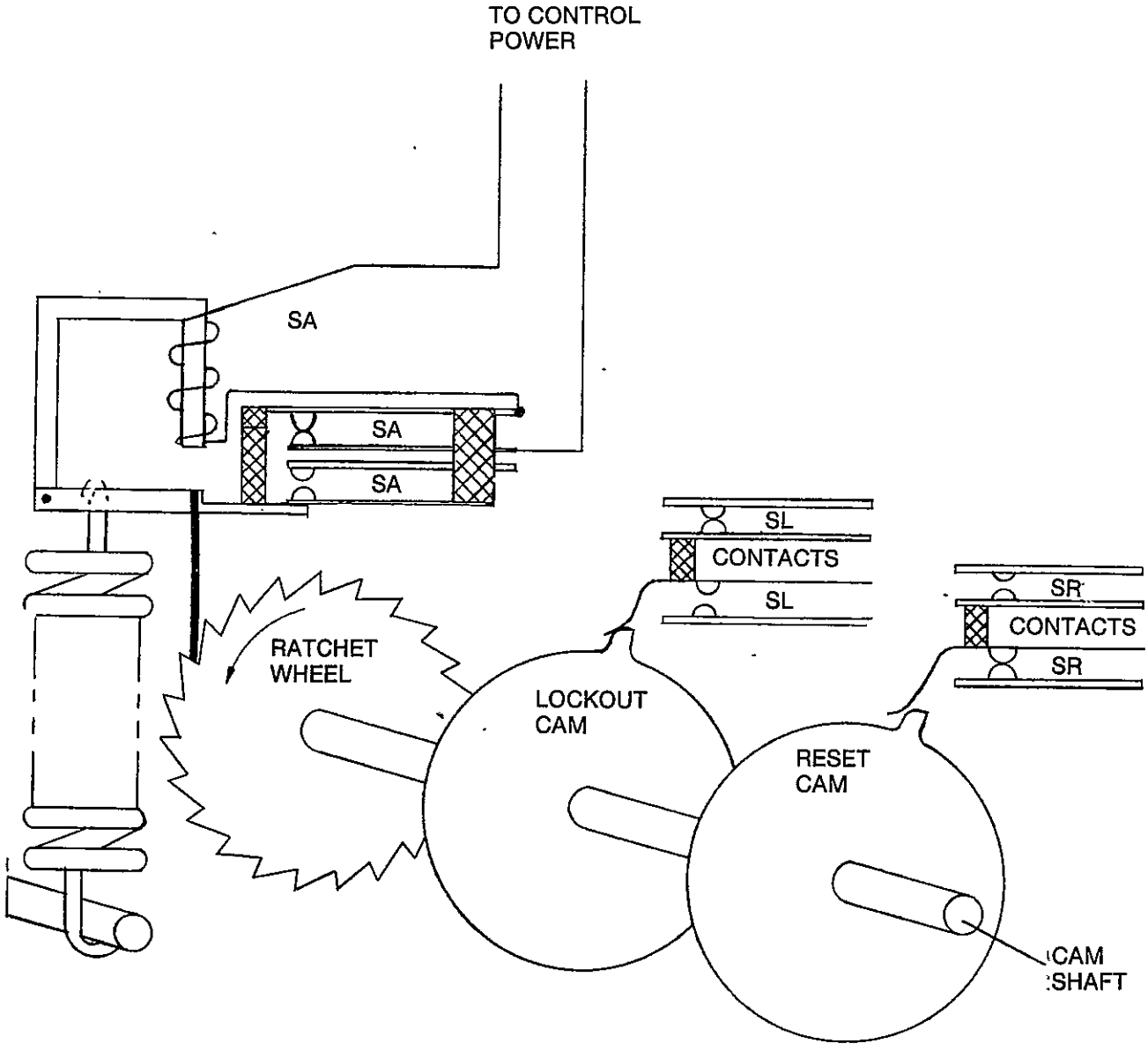


Figure 8 (0178A9144) Stepping Switch for NLR Relay

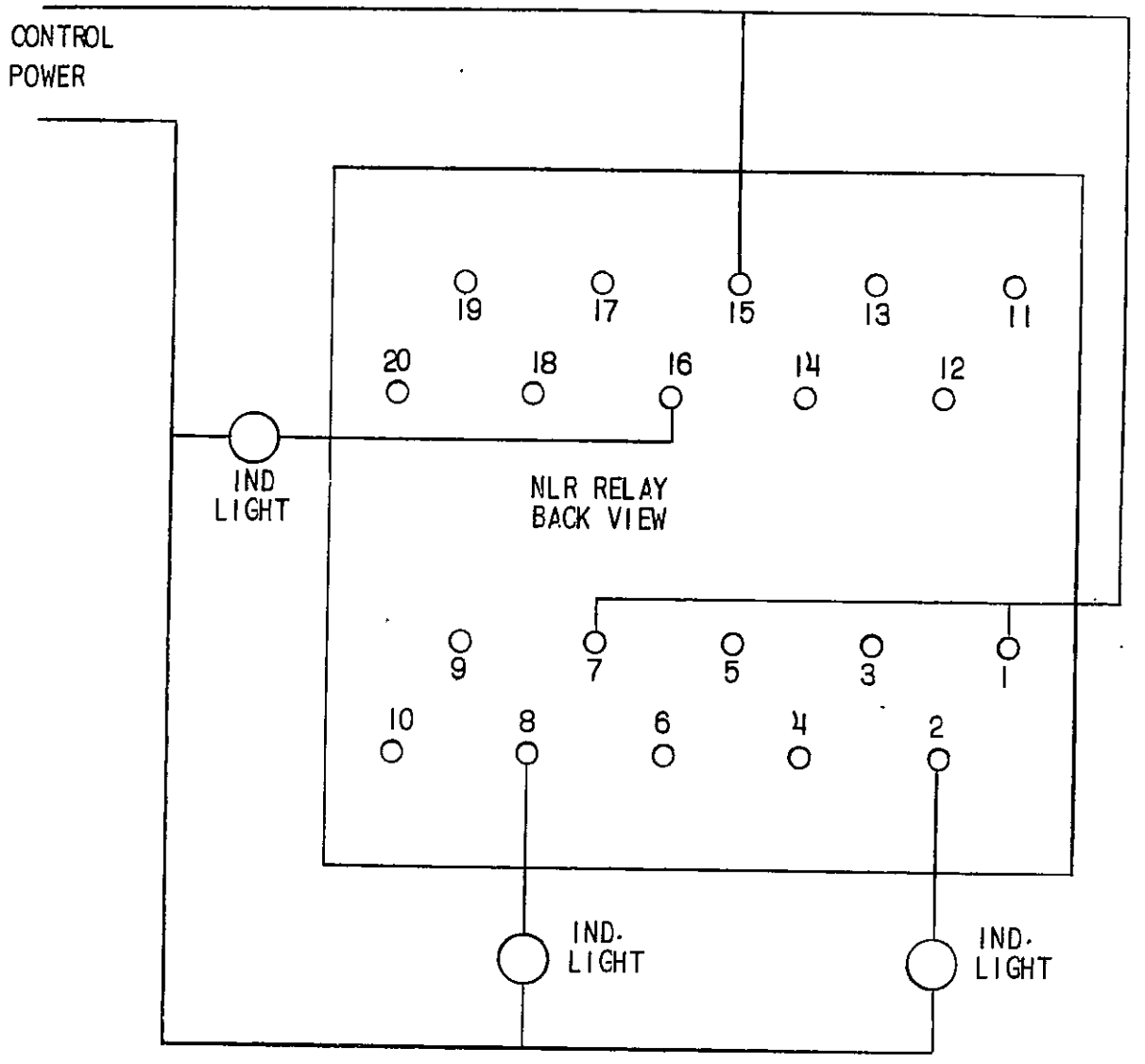


Figure 9 (0246A6855) Test Connections for the NLR Type Relay

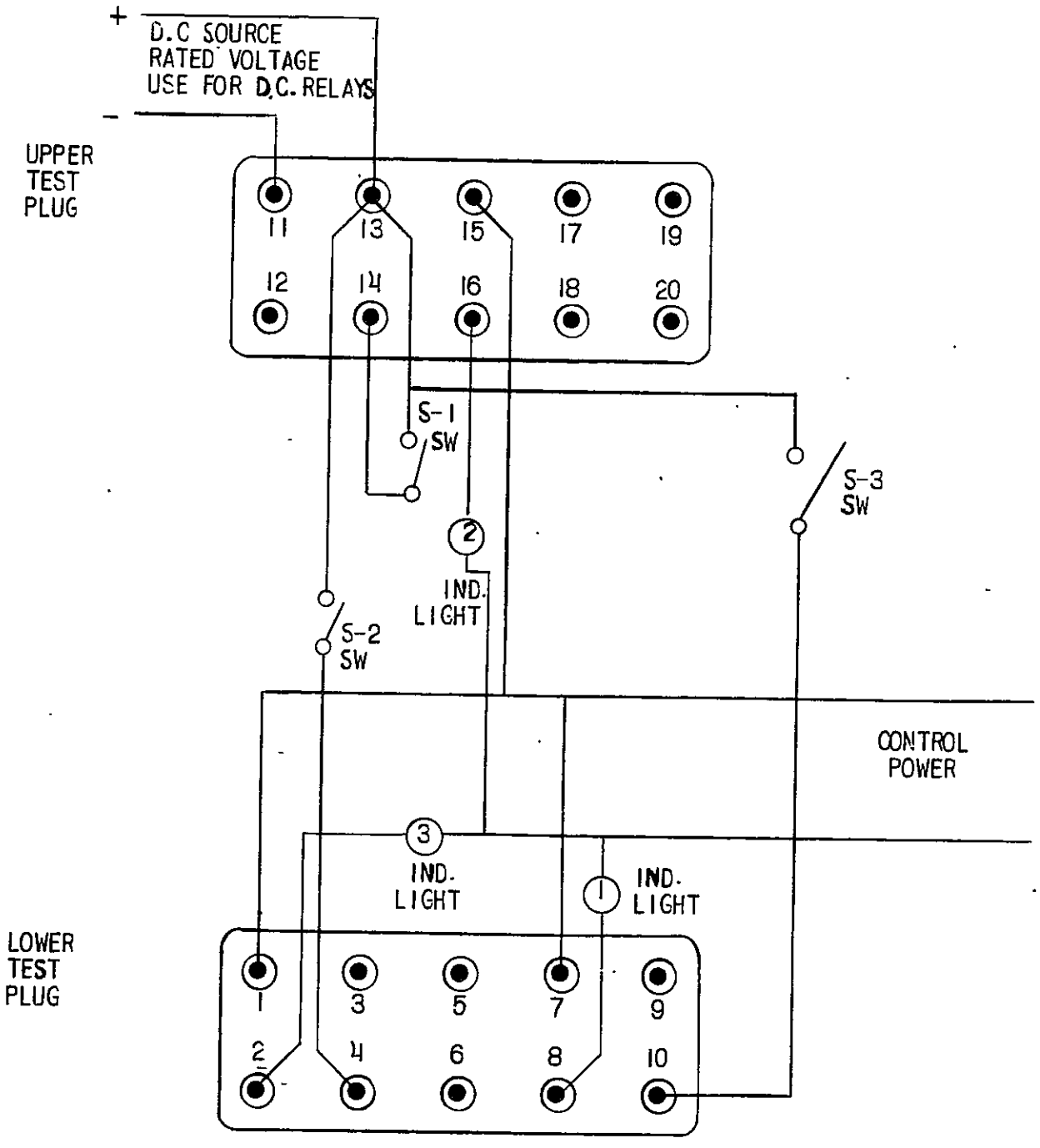


Figure 10 (0246A6859) Field Test Connections for the NLR Type Relay