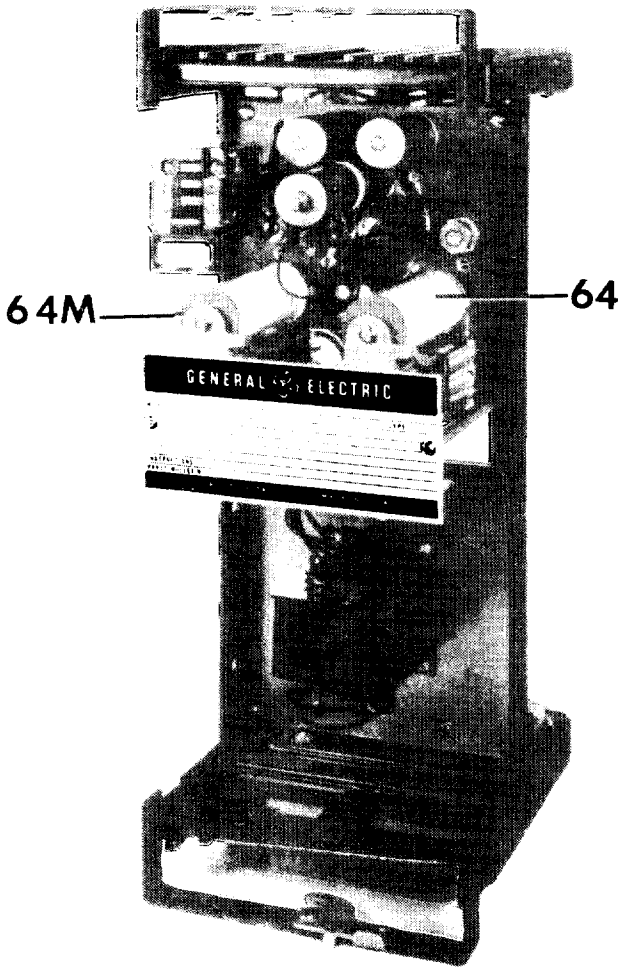
INSTRUCTIONS

GEK-49858B

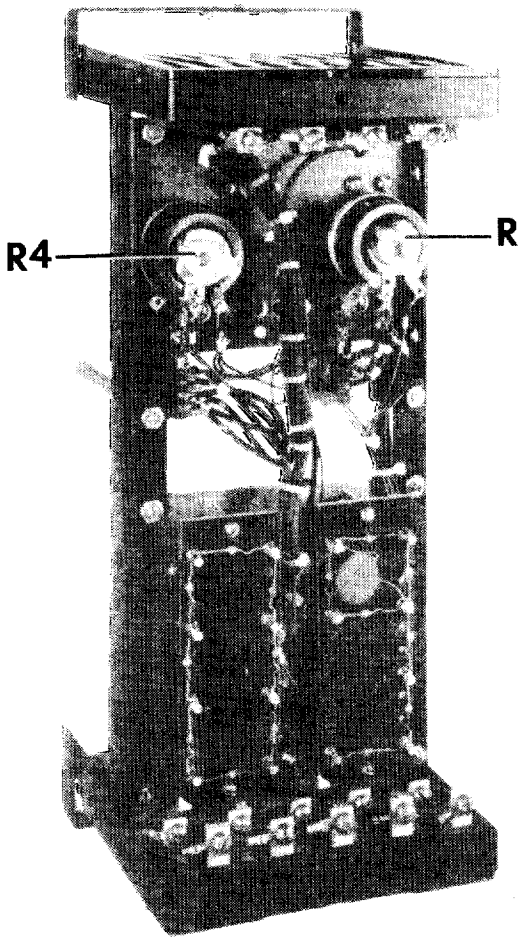
STRUCTURE GROUND RELAY

TYPE NBG12A

GENERAL ELECTRIC



(8043292)
Front View



(8043293)
Rear View

Fig. 1 Type NBG12A Relay Removed from Case

STRUCTURE GROUND RELAY
TYPE NBG12A

INTRODUCTION

These instructions furnish the information needed to test and install the General Electric NBG12A relay.

DESCRIPTION

The NBG12A relay is designed to detect the accidental grounding of an ungrounded structure surrounding a dc bus. It is also capable of detecting contact between the dc bus and the ungrounded structure and between the rectifier ac supply and the ungrounded structure.

The relay includes two telephone relays, a monitoring function (64M) and a tripping function (64). Also included is an ac isolation transformer, two single-phase full wave bridge rectifier circuits, and a shunt target device. The relay is mounted in a double-unit, double-ended (M2) drawout case and the outline and panel drilling dimensions are shown in Fig. 5. The relay internal connections are shown in Fig. 2.

APPLICATION

The NBG12A relay is designed to detect the accidental grounding of an ungrounded structure surrounding a dc bus. It is also capable of detecting contact between the dc bus and the ungrounded structure and between the rectifier ac bus and the ungrounded structure. The relay is designed for application to structures which enclose dc buses rated 250 to 1200 volts.

The application of the relay depends upon either one or the other polarity of the dc bus being solidly grounded or, if not intentionally grounded, having a moderate resistance to ground connection. The latter case is typified by a rail transit system where the rails are not intentionally grounded since they are needed for a signalling or communication system. However, the rails are in contact with their supporting ties and with the road bed. Thus there is a connection to ground thru a moderate level of resistance.

The relay uses a single-phase ac isolation transformer and a full wave rectifier bridge to apply a dc voltage between the protected ungrounded structure and ground. This is shown in the elementary diagram of Fig. 3 as the circuitry between points B and C. With the structure ungrounded, this dc voltage will cause a monitoring current to flow down thru the circuit D to A. This current is sufficient to pick up the 64M monitoring function but it is less than the pickup of the 64 tripping function. The dc resistance of circuit DA is approximately 500 ohms. An accidental ground on the structure will bypass the monitoring current around the 64M function and will cause it to drop out to provide an alarm. An accidental ground of up to 350 ohms will produce a 64M dropout at rated ac input voltage to the isolation transformer of the relay.

The elementary diagram of Fig. 3 assumes that the negative dc bus is solidly grounded or grounded thru a moderate resistance R_G. To apply the relay to systems where the positive dc bus has the connection to ground, interchange the connections of relay studs 6 and 7; i.e., stud 7 connects to the structure at point C and stud 6 connects to ground point B. Note that the C and D connections to the structure and the

A and B connections to ground should be separate and distinct points of connection. They should never be connected to the structure or ground respectively by a single common lead. A single common lead could become open circuited and the monitoring circuit could not detect a ground on the structure. The magnitude of the resistance R_G will not affect the operation of the structure ground monitoring function described in the preceding paragraph.

With the enclosing structure ungrounded, accidental contact of the positive dc bus with the structure applies the dc bus potential to the 64 function circuit 16-17 thru ground and back to the negative dc bus thru resistance R_G. If R_G is zero as it would be for a solid ground, any dc bus voltage from 250 to 1200 volts would provide adequate current thru the 64 function to provide a trip output. The source of ac voltage to the relay isolation transformer should be reliable and stable within ±10 percent of rated 120 or 240 volts. The use of a phase-to-phase voltage is recommended and not a phase-to-neutral voltage to avoid any voltage increase due to possible neutral shift caused by phase-to-ground faults or other disturbances.

With the enclosing structure ungrounded and the dc bus not intentionally grounded, the magnitude of the resistance to ground R_G will determine the relay response to the accidental contact of the positive dc bus with the structure. Table A shows the relation between the rated voltage of the dc bus and the maximum value of R_G that can be tolerated and still produce a 64 function trip output. The detection of the accidental contact of the rectifier ac supply with the ungrounded structure will also depend upon the magnitude of the resistance to ground R_G and the magnitude of the rectifier ac supply voltage.

TABLE A

DC BUS VOLTS	MAX R_G OHMS
250	3100
500	6700
750	10300
1000	13900
1200	16800

RATINGS

The NBG12A relay is rated for use on dc systems with 250 to 1200 volts with a crest voltage rating of 2000 volts. The crest voltage is defined in ANSI C44.2 - 1968 (Rev. 1973) paragraph 2.3.7. The relay has a dual rated transformer of 120/240 volts RMS which, if not specified is wired for 240 volts ac.

TARGET

The target circuit (studs 5-15) can be connected across a 125 volt dc bus and the target will operate when the 64 unit closes. The coil resistance is 5600 ohms ±10 percent. It will operate if the dc voltage is 106 volts dc or higher. The target is latched in when it operates and can be reset by the reset button on the cover.

CONTACT CIRCUITS

The contact interrupting rating of the 64 unit and 64M unit is given in the table below.

These contacts will make and carry three amperes continuously or 30 amperes for two seconds.

INTERRUPTING RATINGS

AC VOLTS	AMPS	
	INDUCTIVE**	NON-INDUCTIVE
115	0.75	2.0
230	0.5	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 the inductance of an average tripping coil.

AMBIENT TEMPERATURE

The type NBG relay is designed to operate from $-20^{o}C$ ($-4^{o}F$) to $+55^{o}C$ ($131^{o}F$).

SURGE WITHSTAND CAPABILITY

The NBG will withstand the following test voltage waveform without incorrect operation or damage to any component.

The test voltage 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 six microseconds. The test voltage is applied between relay surge ground and each of the other relay terminals.

For this test terminals 7 and 17 are both connected to surge ground.

BURDEN

The relay burden is approximately 14.4 volt amperes.

CHARACTERISTICS

If the structure to be protected is ungrounded and the negative bus in the structure is normally grounded, the relay should be connected as shown in Fig. 3. For systems with the positive bus grounded normally, connections to studs 6 and 7 should be interchanged.

If the protection is to be self resetting the 64X (hand reset type HEA) relay is not required.

With the relay connected as shown in Fig. 3 its operation is as follows:

Normally a current is circulated, from the bridge across the ac source, out from stud 6 to the structure, then out of the structure back into the relay thru stud 16, then thru 64M unit and 64 unit coils to ground (stud 17), out of the ground into stud 7 and back to the bridge. This circulating current is enough to pick up the 64M unit but not the 64 unit. The 64M unit will remain picked up even if the ac voltage on studs 9 and 10 drops to 80 percent of rated voltage. However if the monitoring circuit should become open circuited, then the 64M unit will drop out and initiate an alarm circuit.

If the structure should be grounded, the relay circuit across studs 16 and 17 is shunted by the ground. If the resistance to ground is less than 350 ohms, the current thru the 64M will be low enough to cause the 64M to drop out and initiate the alarm circuit.

If the ungrounded bus in the structure should come in contact with the structure, the current thru the 64 unit will become high enough to cause the 64 unit to pick up and initiate the breaker trip circuit or the lockout relay (64X) if used.

CONSTRUCTION

CASE

The components of each relay are mounted on a cradle assembly which can be easily removed from the relay case. The cradle is locked in the case by means of latches at the top and bottom. The electrical connections between the case blocks and cradle blocks are completed through removable connection plugs. Separate test plugs can be inserted in place of the connection plugs to permit testing the relay in its case. The cover is attached to the front of case and includes two interlock arms which prevent the cover from being replaced until the connection plugs have been inserted.

The case is suitable for semiflush mounting on panels. Hardware is available for surface mounting on all panel thicknesses up to two inches, but panel thickness must be specified on the order to insure that the proper hardware will be provided. Outline and panel drilling dimensions are shown in Fig. 5. A front view of the relay is included in Fig. 1.

RECEIVING, HANDLING AND STORAGE

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

Reasonable care should be exercised in unpacking the relay in order that none of the parts are injured or the adjustments disturbed.

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

ACCEPTANCE TESTS

GENERAL

The relay should be examined and tested upon delivery to ensure that no damage has been sustained in shipment and that the relay functions properly. If the examination or acceptance tests indicate that re-adjustment is necessary, refer to the section on SERVICING.

The following tests may be performed as part of the installation of the relay at the discretion of the user. Since most operating companies use different procedures for acceptance and installation tests, the following section includes all applicable tests that may be performed on the relays.

VISUAL INSPECTION

Remove the relay from its case and check that there are no broken or cracked molded parts or other signs of physical damage, and that all the screws are tight.

MECHANICAL INSPECTION

1. The armature and contacts of the target unit should move freely when operated by hand.

2. The target must come into view and latch when the armature is operated by hand and should unlatch when the target release level is operated.

3. The telephone relay units used in these relays should be checked to have a contact gap of at least ten mils and contact wipe of five mils. The contact wipe may be checked by inserting a five mil shim between the armature and pole piece and operating the armature by hand. The normally open contacts should make contact with the shim in place when the armature is operated by hand.

4. Make sure that the fingers in the relay cradle and case blocks agree with the internal connections diagram. The internal connections diagram is included here as Fig. 2.

DRAWOUT CASE

Since all drawout relays in service operate in their cases, it is recommended that they be tested in their cases or an equivalent steel case. In this way any magnetic effects of the enclosure will be accurately duplicated during testing. A relay may be tested without removing it from the panel by using a 12XLA13A test plug. This plug makes connections only with the relay. Of course, the 12XLA12A test plug may also be used. Although this test plug allows greater testing flexibility, it also requires the exercise of greater care since connections are made to both the relay and the external circuitry.

TESTS

The relay has been set at the factory and the following points may be checked, although field tests will be required:

1. The transformer primary will be connected for 240 volt operation unless otherwise specified when ordered. If 120 volt operation is desired reconnect the transformer primary as shown in the insert of Fig. 2.

2. Apply a source of dc current to studs 16 and 17.

   (a) The 64 unit (on right, front view) should pick up at 0.066 amperes $\pm$ 10 percent.

   (b) The 64M unit (on left, front view) should pick up at 0.050 amperes and drop out at 0.030 amperes.

3. Remove the dc current source and apply rated ac voltage to the transformer (studs 9 and 10) and use a high resistance dc voltmeter (ohms/volt). The output voltage measured across studs 6 and 7 should be 100 volts plus or minus five percent.

4. Connect stud 6 to 16, and stud 7 to 17 and with rated ac voltage applied to studs 9 and 10, the 64M unit should pick up. Reducing the ac input voltage to 80 percent of rating should not cause the 64M unit to drop out. Increasing the ac input voltage to 110 percent of rating should not cause the 64 unit to pick up.

5. The dc resistance of the 6-7 circuit is 400 to 1900 ohms depending on setting of R_1. The dc resistance of the 16-17 circuit is approximately 500 ohms.

LOCATION AND 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 using at least No. 12 B and S gage copper wire. The panel drilling for the relay is shown in Fig. 5.

CONNECTIONS

Internal connections are shown in Fig. 2. Typical external connections are shown in Fig. 3.

Note that on the external connection diagrams (Fig. 3) the ground connections (A and B) must be physically separate. The reason for this can be seen in Fig. 4.

If studs 6 and 16 are connected together (Point a) and one lead is run to station ground, should a-g become open circuited the 64M unit will not detect this open circuit and the 64 unit would not operate for fault detection.

For this same reason, it is recommended that the connections to dc structure be made at separate locations.

MAINTENANCE

FIELD TESTS

Although as previously described under the ACCEPTANCE TESTS section, the relay has been set at the factory, it must be checked in the field for several reasons:

1. Although the dc structure is normally ungrounded (except for the ground connection through the relay) a high resistance path to ground always exists such as leakage across the insulators.

2. The same is true of the ungrounded bus in relation to the dc structure.

3. The system ac voltage may be somewhat more or less than 120 or 240 volts.

The existence of the above conditions may make it desirable to readjust the sensitivity of the 64M unit to structure grounds. To do this, the relay should be connected as shown in Fig. 3 with the dc bus energized. Connect a source of variable ac voltage to studs 9 and 10 (after removing normal supply). Vary the input voltage as in Step 4 of the ACCEPTANCE TESTS section, noting that the operation of the 64 and 64M units should be as indicated. If, when the test voltage is reduced to 80 percent of rating, the 64M unit drops out, this indicates that the output of the diode bridge is being shunted by the leakage path pointed out in (1) above. To check for leakage as pointed out in (2) above, connect an ammeter between stud 17 and ground. The difference in current flow when the bus is energized is the leakage current. To prevent the 64M unit from dropping out when the ac voltage is reduced to 80 percent of rating, rheostat R1 can be readjusted. Decreasing R1 causes more current output from the diode bridge for a given input voltage and thus lowers the dropout of the 64M relay. If R1 (left hand potentiometer, front view) is decreased, it will be necessary to check that the 64 unit does not pick up when the ac voltage is increased to 110 percent of rating. Should the 64 unit pick up, it will be necessary to readjust its pickup level. To increase the pickup level decrease the resistance of rheostat R4 (right hand potentiometer, front view) which is in parallel with the 64 unit coil. Since increasing the pickup of the 64 unit desensitizes it to faults involving the dc bus and the dc structure the pickup should be increased to a level no more than necessary to prevent its operating when the supply voltage is increased to 110 percent of rating. After the above tests have been completed, remove the test voltage and reconnect the supply voltage to studs 9 and 10.

The following tests are not necessary to insure the operation of the relay and are listed here only if the user wishes to have these values for further references:

To determine the sensitivity of the relay to dc structure grounds, connect variable resistor from the station ground mat to the structure. Decrease this resistor until the 64M drops out. This value may be recorded for future reference.

To determine the sensitivity of the relay to faults involving the dc structure and the dc bus, connect a variable resistor from the dc structure to the bus and decrease this resistor value until 64 drops out. Record this value.

CAUTION: Since the bus voltage may be 250 to 1200 volts, safety precautions must be exercised if this value is to be determined.

SERVICING

Contacts

For cleaning fine silver contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with an etched roughened surface, resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet corroded material will be removed rapidly and thoroughly. The flexibility of the tool insures the cleaning of the actual points of contact.

Fine silver contacts should not be cleaned with knives, files or abrasive paper or cloth. Knives or files may leave scratches which increase arcing and deterioration of the contacts. Abrasive paper or cloth may leave minute particles of insulating abrasive material in the contacts, thus preventing closing.

The burnishing tool described above can be obtained from the factory.

RENEWAL PARTS

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

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

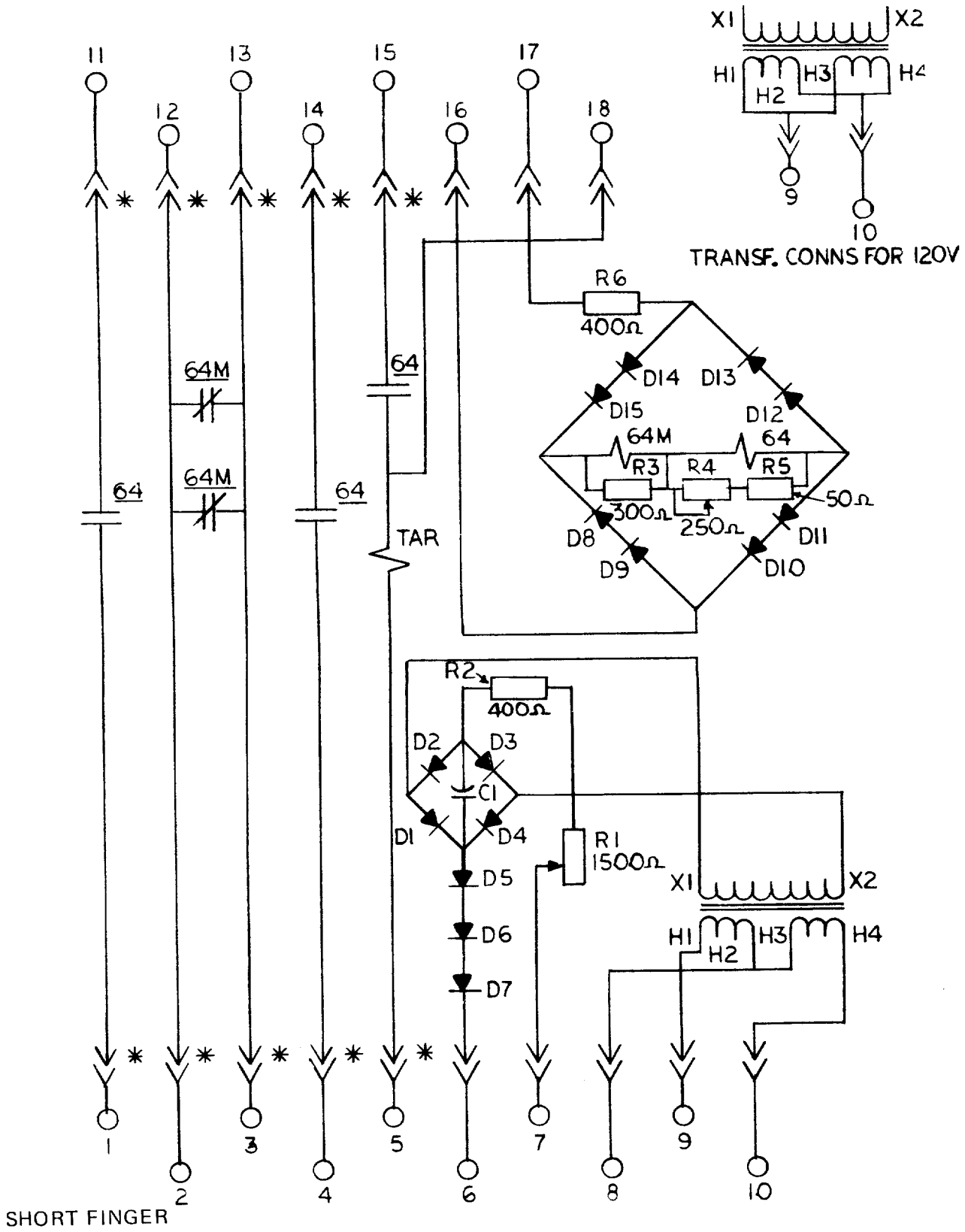


Fig. 2 (0257A9784-2) Internal Connections for NBG12A

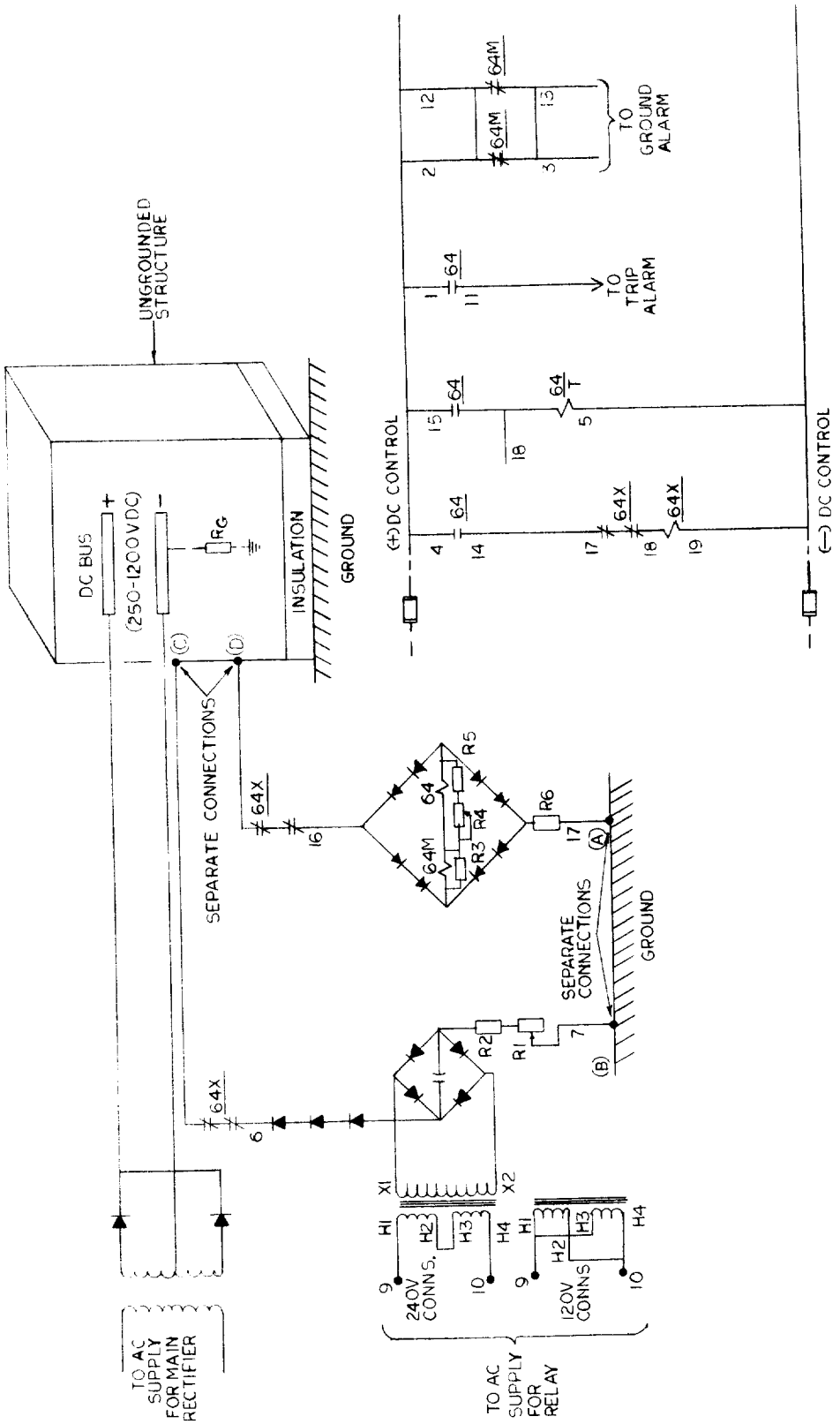


Fig. 3 (138B7268-0) External Connections for NBG12A

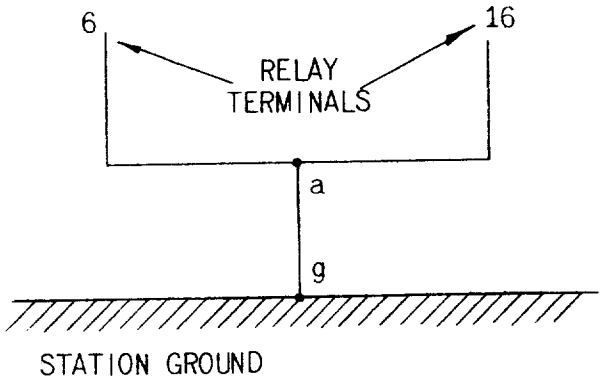
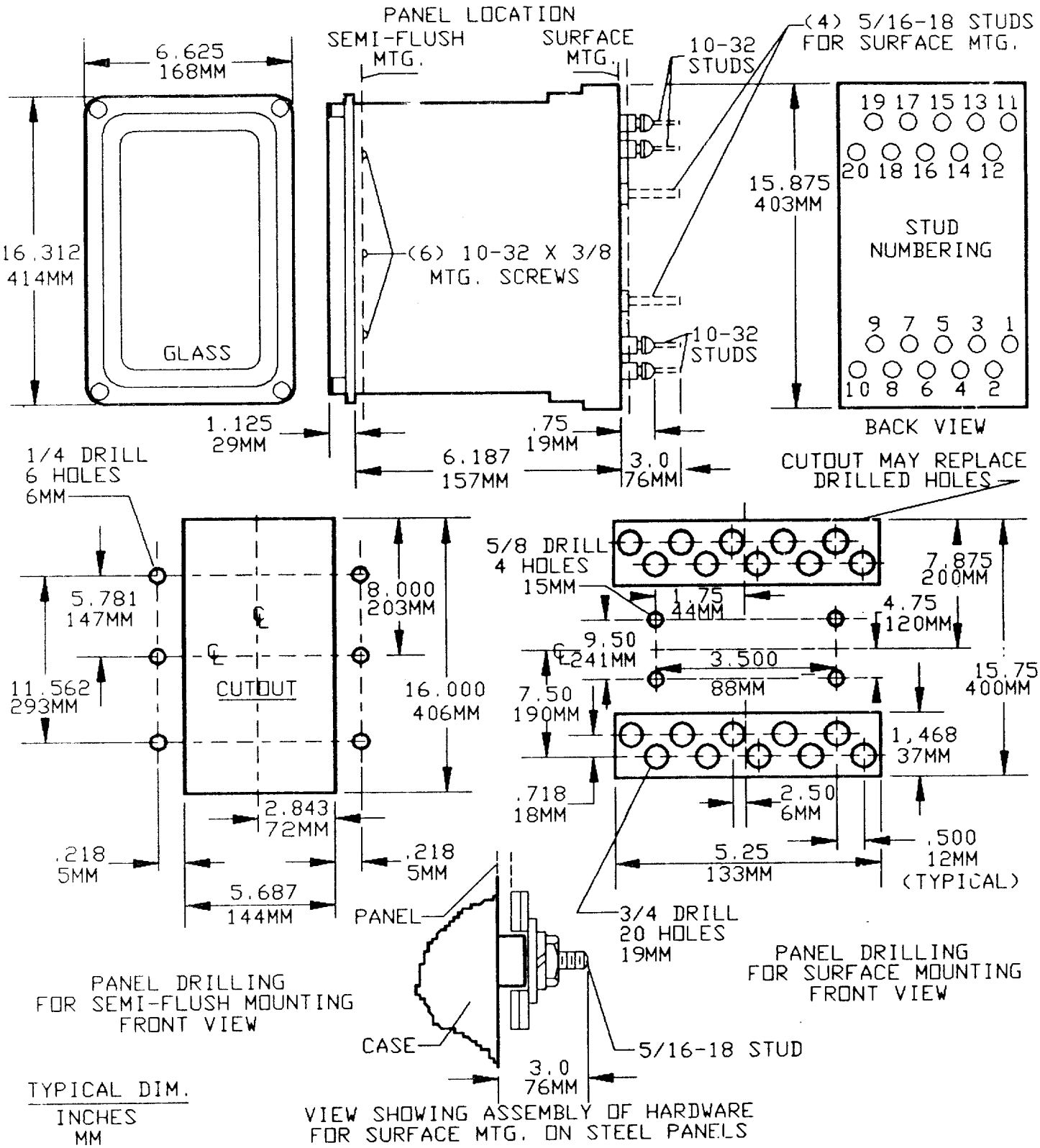


Fig. 4 (0459A0286-1) Non-recommended Connections



* Fig. 5 (006209274 (6)) Outline and Panel Drilling Dimensions for Type NBG12A

* Indicates Revision

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