INSTRUCTIONS

GEI-44083D
Supersedes GEI-44083C

RELAYS

OUT-OF-STEP AUXILIARY RELAY

TYPE – NAA19B

GENERAL ELECTRIC

CONTENTS

OUT-OF-STEP AUXILIARY RELAY
TYPE NAA19B

INTRODUCTION

The NAA19B is an auxiliary relay that was specifically designed for use in conjunction with the angle impedance relay Type CEX17E for tripping on system out of step conditions. The relay contains a number of telephone type auxiliary relays plus a PJC type overcurrent unit and one target seal-in unit all in an M1 case.

APPLICATION

In general the NAA19B is applied in conjunction with the CEX17E as illustrated in Fig. 3 to detect system out-of-step conditions and to initiate tripping of the proper local and/or remote breakers in order to separate the system. It is important to note that these relays should be applied at those locations where system studies indicate that an out-of-step condition can be detected. However, the breaker(s) that should be tripped, to properly separate the system, with generation balancing load, may be remotely located. If this is the case some sort of transferred or remote tripping scheme will be required in addition to the CEX17E and NAA19B relays.

In this scheme, the relays detect the out-of-step condition by the sequential operation of the angle impedance units in the CEX17E relay as the apparent impedance sweeps across the R-X diagram in the manner outlined in Fig. 2 and the text under PRINCIPLES OF OPERATION. From Fig. 2 it is apparent that the angle impedance characteristics extend, almost without practical limit, in both the "forward" and "reverse" directions. During light load conditions on the system, it is possible, due to reactive power transfer, that the apparent (load) impedance as seen by the CEX relay will plot in the vicinity of the CEX characteristics rather than near the R axis as in the case of appreciable real power flow. With slight variations in this load it is possible for the apparent impedance to vary in such a manner as to wander across the angle impedance characteristics at a point quite remote from the origin of the R-X diagram. This would appear as an out-of-step condition to the CEX-NAA combination except for the instantaneous overcurrent unit which supervises the scheme.

In the NAA19B relay the instantaneous overcurrent unit serves to limit the "reach" of the scheme and in this way eliminate the possibility of false operation during light load-reactive transfer conditions. Since the overcurrent unit is of the plunger PJC type it is not designed to be operated continuously in the picked up position. Thus, the overcurrent unit in the NAA19B must always be set with a pickup that is at least 15 percent higher than maximum full load current. This will automatically prevent any false operation during light load conditions.

One CEX17E relay plus one NAA19B relay are required per terminal.

RATINGS AND BURDENS

TELEPHONE UNITS

The ratings of the telephone relays are given on the nameplate. The resistance of the telephone relay coils and their series resistors are shown on the internal connection diagram Fig. 1.

* INSTANTANEOUS OVERCURRENT UNIT

The instantaneous overcurrent units are rated 25/60 hertz and are available with the ratings shown below:

PICKUP AMPERES	CONTINUOUS RATING	1 SECOND RATING	BURDEN AT 5 AMPERES, 60 HERTZ			
			WATTS	VOLT-AMPS	R	Z
0.5-2	1.5 Amps	70	51.2	170.0	2.05	6.82
0.8-3.2	2.4 Amps	110	20.0	66.2	0.80	2.65
2-8	6.0 Amps	290	3.2	10.6	0.128	0.426
4-16	12 Amps	500	0.8	2.65	0.032	0.106

TARGET SEAL-IN UNIT

The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts. The current-carrying ratings are affected by the selection of the tap on the target and seal-in coil as indicated in the following table:

Function	Amperes, AC or DC	
	2-Amp Tap	0.2 Amp Tap
Tripping Duty	30	5
Carry Continuously	4	0.4

The 2-ampere tap has a DC resistance of 0.13 ohms and a 60 cycle impedance of 0.53 ohms while the 0.2-ampere tap has a 7 ohm DC resistance and a 52 ohm 60 cycle impedance. The tap setting used on the seal-in unit is determined by the current drawn by the trip coil.

The 0.2-ampere tap is for use with trip coils that operate on currents ranging from 0.2 up to 2.0 amperes at the minimum control voltage. If this tap is used with trip coils requiring more than 2 amperes, there is a possibility that the 7-ohm resistance will reduce the current to so low a value that the breaker will not be tripped.

The 2-ampere tap should be used with trip coils that take 2 amperes or more at minimum control voltage, provided the tripping current does not exceed 30 amperes at the maximum control voltage. If the tripping current exceeds 30 amperes an auxiliary relay should be used, the connections being such that the tripping current does not pass through the contacts or the target and seal-in coils of the protective relay.

RECEIVING, HANDLING AND STORAGE

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

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

DESCRIPTION

The NAA19B relay consists of six telephone relay units and their associated series resistors, an instantaneous overcurrent relay unit, and a target seal-in unit mounted in a double unit, single end drawout case.

* Indicates revision

The case is suitable for either surface or semi-flush panel mounting and an assortment of hardware is provided for either mounting. The cover attaches to the case and also carries the reset mechanism when one is required. Each cover screw has provision for a sealing wire.

The case has studs or screw connections at both ends or at the bottom only for the external connections. The electrical connections between the relay units and the case studs are made through spring backed contact fingers mounted in stationary molded inner and outer blocks between which nests a removable connecting plug which completes the circuits. 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 mechanism is mounted in a steel framework called the cradle and is a complete unit with all leads being terminated at the inner block. This cradle is held firmly in the case with a latch at the top and the bottom and by a guide pin at the back of the case. The cases and cradles are so constructed that the relay cannot be inserted in the case upside down. The connecting plug, besides making the electrical connections between the respective blocks of the cradle and case, also locks the latch in place. The cover, which is fastened to the case by thumbscrews, holds the connecting plug in place.

To draw out the relay unit the cover is first removed, and the plug drawn out. Shorting bars are provided in the case to short the current transformer circuits. The latches are then released, and the relay unit can be easily drawn out. To replace the relay unit, the reverse order is followed.

A separate testing plug can be inserted in place of the connecting plug to test the relay in place on the panel either from its own source of current and voltage, or from other sources. Or, the relay unit can be drawn out and replaced by another which has been tested in the laboratory.

INSTALLATION

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 drilling dimensions are shown in Fig. 4.

The internal connections for the NAA19B are shown in Fig. 1. Typical external connections are shown in Fig. 3.

PRINCIPLES OF OPERATION

In the R-X diagram of Fig. 2, the two parallel lines represent the operating characteristics of the CEX17E angle impedance units. In the top unit the right contact (B_2) closes when the system impedance as viewed by the relay, plots to the right of the characteristic. The left contact (B_1) closes when this impedance plots to the left of the characteristic. In the bottom unit the left contact (A_2) closes when the system impedance, as viewed by the relay, plots to the right of the characteristic while the right contact (A_1) closes when this impedance plots to the left of the characteristic. Thus, if the apparent system impedance is Z_m, contacts A_2 and B_2 are closed. For an impedance Z_o, contacts A_2 and B_1 are closed; for an impedance Z_p, contacts A_1 and B_1 are closed.

When an out-of-step condition appears on a system, the apparent impedance as viewed by the CEX relay will sweep across the R-X diagram either from right to left or from left to right in a manner similar to that illustrated by the dashed line in Fig. 2. If, for example the swing is from right to left, the impedance will change progressively from Z_m to Z_o to Z_p. While this is taking place, the A_1, A_2, B_1 and B_2 contacts in the CEX relay will open and close in the following sequence. For impedance Z_m, contacts A_2 and B_2 are closed while A_1 and B_1 are open. These contact positions are maintained until the impedance locus crosses the top unit characteristic. Such a position would be represented by impedance Z_o. At this time, contact B_2 opens and B_1 closes while A_1 and A_2 remain as before. As the out-of-step continues to progress, the impedance locus moves to the left of the bottom unit characteristic as represented by impedance Z_p. When this occurs, contact A_2 opens and A_1 closes while B_1 remains closed and B_2 remains open.

The interconnections between the CEX17E and the NAA19B relays plus the interlocking between the various units in the NAA combine to give a trip signal only if the sequence of CEX contact operations indicates that the impedance locus crossed both CEX unit characteristics either from right to left or from left to right. Fig. 3 illustrates the external connections and may be referred to in reviewing the overall operation of the scheme.

Consider a case where the system conditions are such that the system swing starts at the right in Fig. 2. For this condition, contacts A_2 and B_2 are closed but nothing happens until the swing has progressed far enough to produce sufficient current to pick up the instantaneous overcurrent unit I. At this point the X relay coil is energized and the X contacts close. This in turn picks up the X_1 relay through the B_2 contacts which are also closed. If at this point the swing recedes and the system settles back to normal, the instantaneous overcurrent unit I drops out resetting X and X_1.

If the swing continues to the point where the impedance locus crosses the tap unit characteristic (Fig. 2), contact B_2 opens and B_1 closes while A_2 remains closed. As soon as B_2 opens it deenergizes X_1 but the X_1 relay has time delay dropout characteristics. (See ADJUSTMENT and INSPECTION Section).

Since B_1 closes immediately after B_2 opens, the X_2 relay gets picked up through the X, B_1, A_2 and X_1 contacts in series. The X_1 contacts are still closed because of the time delay dropout characteristics. A contact on X_2 seals in around the X_1 contact which opens shortly. If at this point the swing recedes, contact B_1 opens dropping out X_2 and the I contact opens somewhat later resetting X.

If on the other hand the swing continues to the point where the impedance locus crosses the bottom unit characteristic (Fig. 2) contact A_2 opens and A_1 closes immediately afterward while B_1 remains closed. This deenergizes the X_2 coil and energizes the X_4 coil circuits. Since the X_2 relay has time delay dropout characteristics, the X_4 contacts get closed before the X_2 contacts open and the X_3 coil gets energized. One X_3 contact seals in around the X_2 contact which soon drops out. A second X_3 contact trips the circuit breaker. This is the desired operation because the swing is now truly an out of step condition and the two portions of the system have slipped a pole. Note that this relay operates to trip immediately after the first pole has been slipped.

Had the system swing come from left to right, a similar sequence of events would have resulted.

PERIODIC CHECKS AND ROUTINE MAINTENANCE

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

ADJUSTMENT AND INSPECTION

The relay has been adjusted at the factory to secure the performance described under PRINCIPLES OF OPERATION. If a check shows that the adjustments have been disturbed, the following points should be observed in restoring them:

Telephone type relays X and X_3 pick up instantaneously and drop out in approximately 0.1 second. Telephone type relays X_1, X_2, X_4, and X_5 pick up instantaneously and drop out in approximately 0.2 second. The wipe on the contacts, with the unit in the picked up position, should be checked by inserting a 0.006 inch shim between the residual screw and the pole piece. With the relay operated by hand, the normally open contacts should just make when the residual screw strikes the shim.

The time delay on dropout may be adjusted by means of the brass residual screw in the center of each armature. Moving the screw out slightly will increase the time delay and vice versa. Time delay may also be increased slightly by bending the moving contact springs away from the armature. However, the contact pressure should never be less than 10 grams, measured at the contact tips, and the contact wipe should never be less than 0.005 inch. After each adjustment of the residual screw the contact gap and wipe must be readjusted.

The instantaneous overcurrent unit has a pickup calibration range of 4 to 16 amperes and drops out at approximately 90% of pickup value. It is not designed for continuous operation in the picked up position and therefore it should always be set at least at 115 percent of maximum load.

TARGET AND SEAL-IN UNIT

When used with trip coils operating on currents from 0.2 to 2.0 amperes at the minimum control voltage, the target seal-in tap plug should be set in the 0.2 ampere tap. When the trip coil current ranges from 2 to 30 amperes at the minimum control voltage, the tap plug should be placed in the 2.0 ampere tap.

The target seal-in unit tap plug is the screw holding the right hand stationary contact. To change the tap setting, first remove the connecting plug. Then take a screw from the left hand stationary contact and place it in the desired tap. Next, remove the screw from the other tap and place it back in the left hand contact. This procedure is necessary to prevent the right hand stationary contact from getting out of adjustment. If tap plugs are left in both taps, the pickup will be less than 2.0 amperes on DC but the seal-in unit will take longer to close its contacts. On AC , the unit will not pick up with screws in both taps.

CONTACT CLEANING

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. Sometimes an ordinary file cannot reach the actual points of contact because of some obstruction from some other part of the relay.

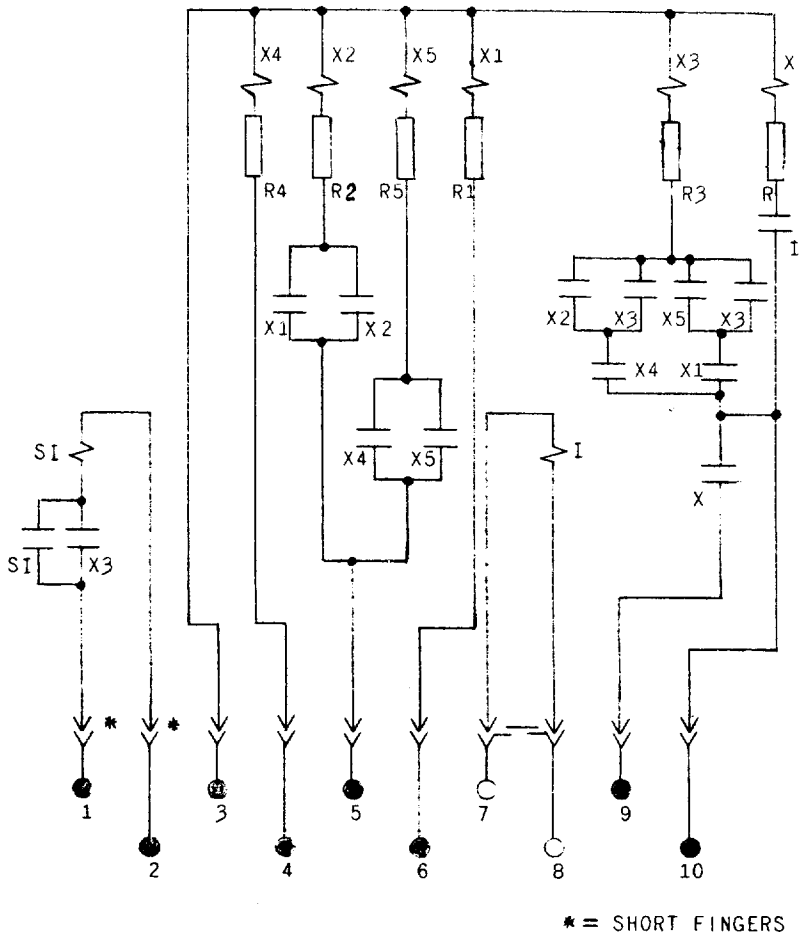
Fine silver contacts should not be cleaned with knives, files, or abrasive paper or cloth. Knives or files may leave scratches which increase arcing and deterioration of the contacts. Abrasive paper or cloth may leave minute particles of insulating abrasive material in the contacts and thus prevent closing.

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, including serial number. If possible, give the General Electric Company requisition number on which the relay was furnished.



D-C RESISTANCE (OHMS)												
	COILS						RESISTIC					
GROUP	X	X1	X2	X3	X4	X5	R	R1	R2	R3	R4	R5
1	1200	1200	1200	800	1200	1200	2500	2500	2500	2000	2500	2500
2							2500	2500	2500	2000	2500	2500
3							2000	2000	2000	1650	2000	2000
4							6200	6200	6200	4800	6200	6200
5							2500	2500	2500	2000	2500	2500
6							5000	5000	5000	4000	5000	5000
7							2000	2000	2000	1650	2000	2000
8	175	175	175	125	175	175	350	350	350	300	350	350
9	1200	1200	1200	800	1200	1200	5000	5000	5000	4000	5000	5000
10							6200	6200	6200	4800	6200	6200
11							5000	5000	5000	4000	5000	5000
12							2500	2500	2500	2000	2500	2500

Fig. 1 (0389A0765-1 Sh. 1 and 0389A0765-0 Sh. 2) Internal Connections for Type NAA19B Relay

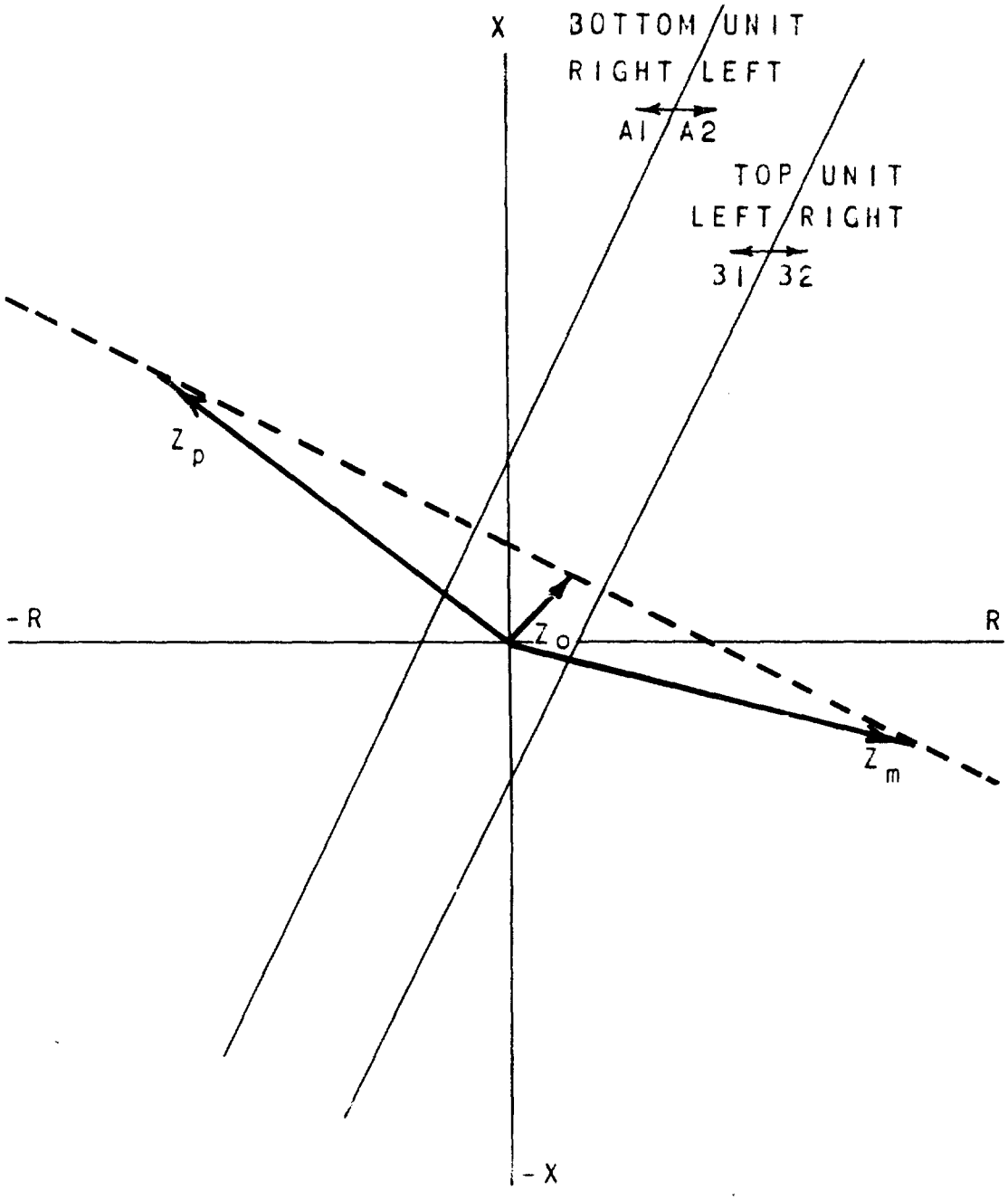


Fig. 2 (6556547-0) Operating Characteristics for Type CEX17 Relay

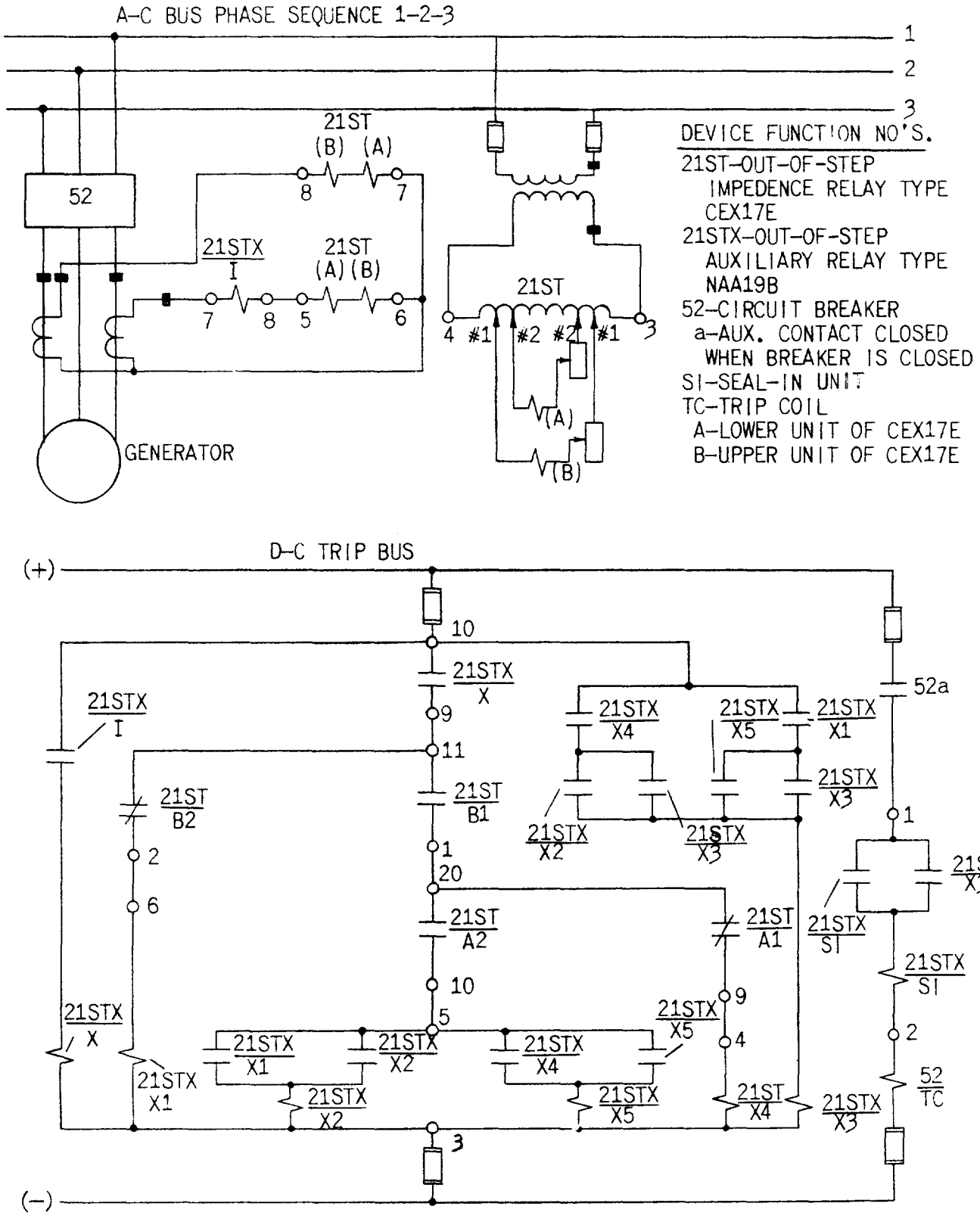


Fig. 3 (418A761-2) Typical External Connections for Type NAA19B and CEX17E Relay

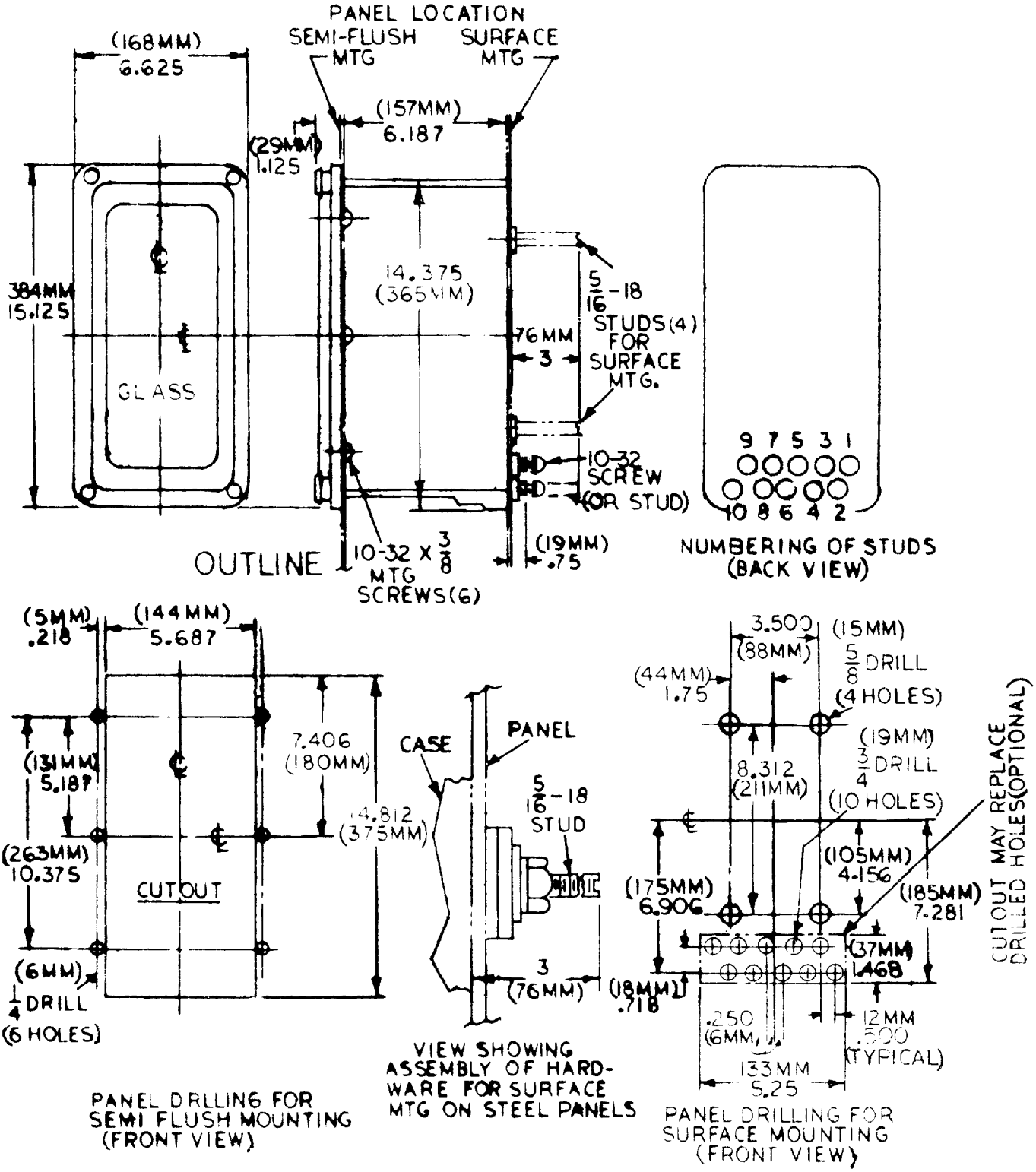


Fig. 4 (6209273-4) Outline and Panel Drilling for Type NAA19B Relay

GE Power Management

215 Anderson Avenue
Markham, Ontario
Canada L6E 1B3
Tel: (905) 294-6222
Fax: (905) 201-2098
www.ge.com/indsys/pm