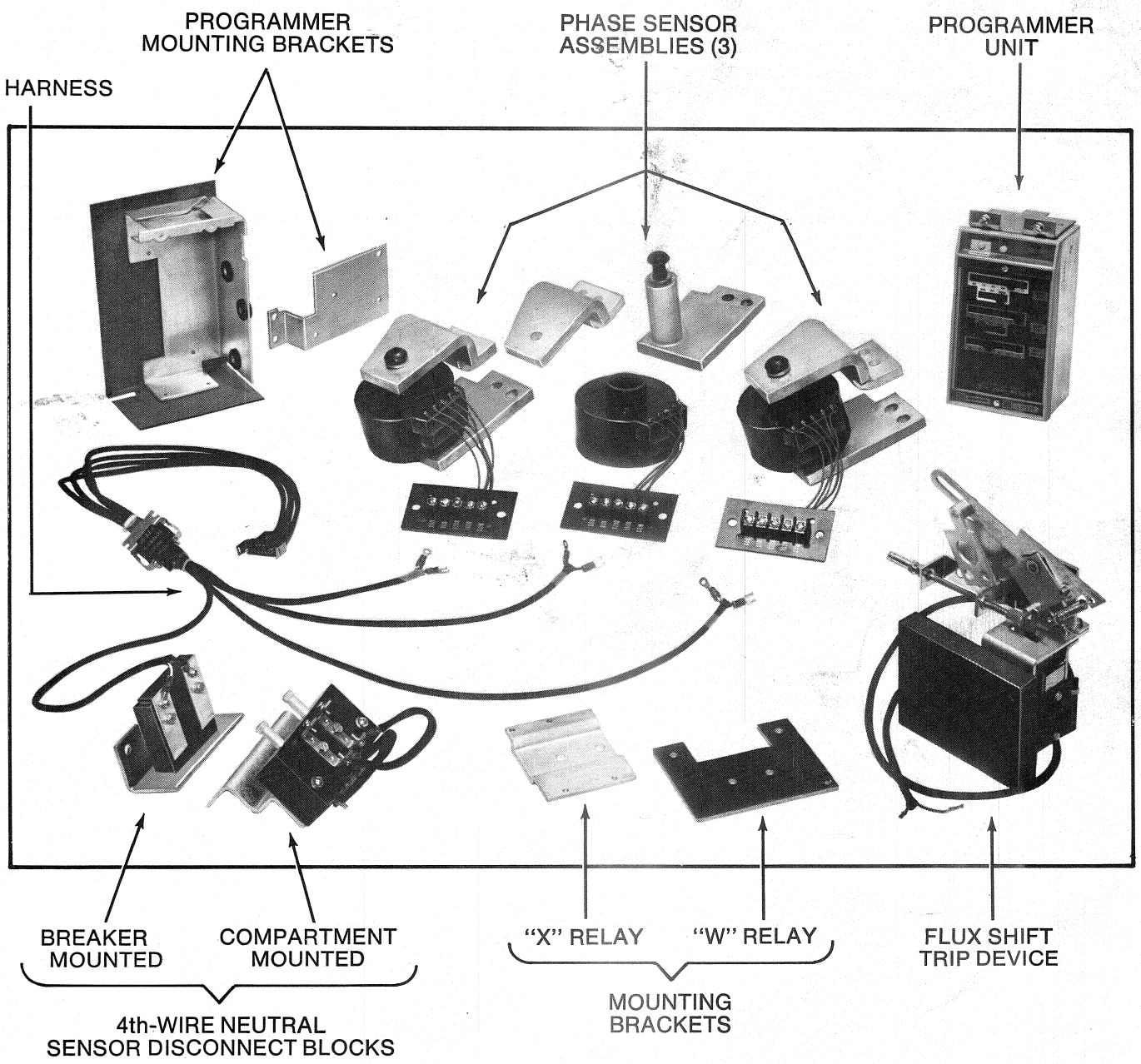
INSTRUCTIONS

GEI-86154

CONVERSION KITS

For Installing the SST Solid State Overcurrent Trip Device on Low Voltage Power Circuit Breaker Types AK/AKU-50 and AKT-50



Components of SST Conversion Kit for AK/AKT-50

These instructions do not purport to cover all details or variations in equipment nor to 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.

DISTRIBUTION EQUIPMENT DIVISION
PLAINVILLE, CONNECTICUT USA

GENERAL ELECTRIC

CONVERTING AK/AKT-50 BREAKERS TO THE SST TRIP DEVICE

CONTENTS

		PAGE
I.	Introduction	2
II.	Breaker Disassembly	5
III.	Front Frame Conversion	5
IV.	Back Frame Conversion	11
V.	Breaker Reassembly	11
VI.	Equipment Modifications	20
VII.	Testing	23

I. INTRODUCTION

These instructions cover installation of the SST solid state overcurrent trip device conversion kits on AK/AKT-50 frame breakers originally equipped with EC or Power Sensor type trip devices. Each kit contains the variety of material necessary to convert either type. The kits are designed specifically for use on the breakers listed in Table 1.

Kit installation is straightforward but does require careful workmanship and attention to these instructions. Familiarity with the breaker itself is highly desirable. The general approach is to first strip the breaker of its existing trip devices (either EC or Power Sensor), then install the SST components. Following this, the converted breaker is performance tested prior to restoring it to service.

For the majority of breaker models listed in Table 1, kit installation does not require any customized assembly work. However, some conversions may involve unusual mounting circumstances or accessory combinations which necessitate minor modification/relocation of a component(s). In most instances this supplementary work can be done on site.

Preparatory to beginning the conversion, the installer should verify that the correct kit, current sensors and programmer unit have been furnished — see Tables 2, 3 and 4. Whenever the Ground Fault trip element is furnished for breakers applied on 4-wire systems, note that, in addition to installing the kit on the breaker, an associated neutral sensor (CT) is required for separate mounting in the equipment. Insure also that retrofitted breakers are applied within their short circuit ratings; for example, assuming that as part of a conversion the breaker's trip elements are to be changed from LI to LS, then the short time rating would govern the application.

For identification purposes, all kit materials are itemized on the parts lists included with each kit. The item numbers on those parts lists correspond to the part numbers used on the illustrations herein. Any original breaker parts that are to be reused bear the designation RE.

Users are reminded that installation of SST kits provides an excellent opportunity to perform normal maintenance on the breaker proper, particularly while the front and back frames are separated. Such procedures are covered in Maintenance Manual GEK-7303; renewal parts are available as listed in Bulletin GEF-4150. Copies of these publications are included in each kit.

NOTE

Although designed specifically for the breaker models in Table 1, these kits in many instances can be employed for conversion of the earlier AK-1-50 types. Such conversions should be considered a local undertaking and may involve additional modification depending upon the breaker's vintage and its accessory complement.

TOOLS REQUIRED

- Socket Set
- Open End Wrenches
- Screwdrivers
- Allen Wrenches
- Tru-arc Pliers
- Pliers
- Electric Drill
- 6″ Scale
- Crimping Tool

Table 1 — Convertible Breaker Models

A-C Frame Size (Amp)	Breaker Type			Trip Device	
	Stationary	Drawout		EC	Power Sensor
		AKD	AKD-5		
1600	AK-2-50	AK-2-50	AK-2A-50	X	
	AK-2-50H	AK-2-50H	AK-2A-50H	X	
	—	AKU-2-50	AKU-2A-50	X	
	AK-3-50	AK-3-50	AK-3A-50		X
	AK-3-50H	AK-3-50H	AK-3A-50H		X
	—	AKU-3-50	AKU-3A-50		X
2000	AKT-2-50	AKT-2-50	AKT-2A-50	X	
	AKT-2-50H	AKT-2-50H	AKT-2A-50H	X	
	AKT-3-50	AKT-3-50	AKT-3A-50		X
	AKT-3-50H	AKT-3-50H	AKT-3A-50H		X

Table 2 — Basic Conversion Kits for Breakers in Table 1

Breaker Mounting Type	Basic Kit Cat. 343L696 — (Gp.)			
	With 4th-Wire Neutral Sensor		W/O 4th-Wire Neutral Sensor	
	Man.	Elec.	Man.	Elec.
Stationary	G3	G4	G1	G2
AKD & AKD-5 Drawout	G5	G6		

Table 3 — Tapped Current Sensors

Breaker Type	Sensor Ampere Range	Cat. No.	
		Phase Sensors	4th-Wire Neutral Sensor
		343L696-(Gp.)	343L650-(Gp.)
AK-50	300- 800	G68	G13
	600-1600	G69	G14
AKT-50	800-2000	G70	G28

Table 4 — Programmer Units

Breaker Frame	Trip Elements ①	Cat. No. 343L696-(Gp.) Short-time Pickup		
		None	1.75L-4L	3L-10L
UNITS WITHOUT GROUND FAULT				
AK-50 AKT-50	LS	—	37	13
	LST	—	39	16
	LI	14	—	—
	LIT	17	—	—
	LSI	—	38	15
	LSIT	—	40	18
UNITS WITH GROUND FAULT				
AK-50	LSG	—	41	19
	LSGT	—	43	22
	LIG	20	—	—
	LIGT	23	—	—
	LSIG	—	42	21
	LSIGT	—	44	24
AKT-50	LSG	—	49	31
	LSGT	—	51	34
	LIG	32	—	—
	LIGT	35	—	—
	LSIG	—	50	33
	LSIGT	—	52	36

① Trip Element Abbreviations

L = Long Time
S = Short Time
I = Instantaneous
G = Ground Fault

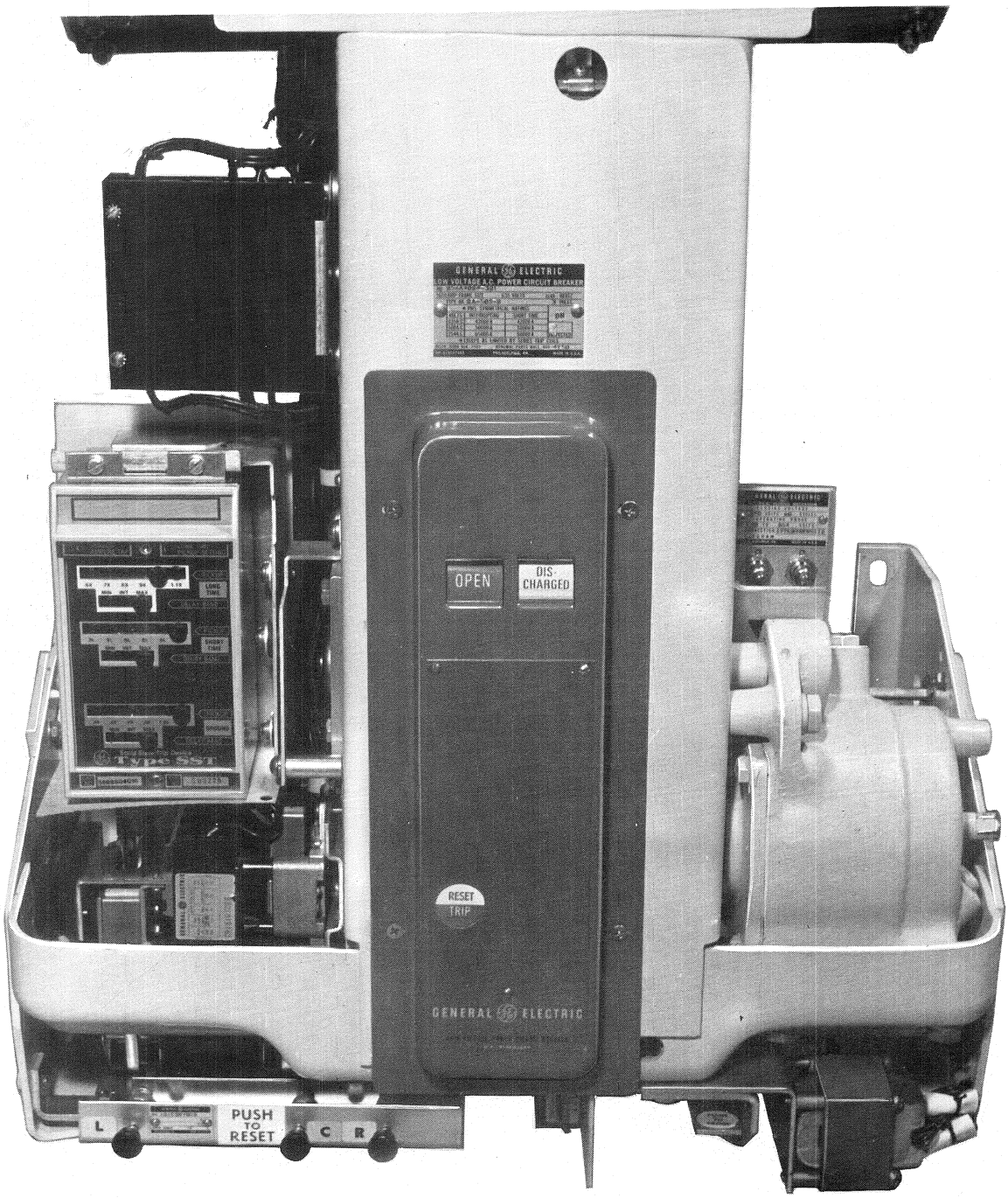


Fig. 1 — SST programmer unit mounted on AKU-50 breaker.

II. BREAKER DISASSEMBLY

WARNING: Before starting any work, disconnect the breaker from all power sources (primary and secondary) and place in a clean work area.

1. Be sure the breaker is open.
2. Remove the arc quencher retaining bar.
3. Remove the arc quenchers, lifting them clear of the movable arcing contacts. Remove the two inter-phase barriers.
4. Separate the breaker front frame from its back frame. Refer to GEK-7303, Page 7. For Power Sensor-equipped breakers, see pp. 35-39 for additional information.
5. Remove the overcurrent trip devices, referring to maintenance manual GEK-7303 as follows:
   — For EC types, pp. 29-32.
   — For Power Sensor type, pp. 35-39.

III. FRONT FRAME CONVERSION

1. Referring to Figs. 1, 4 & 5, install the programmer mounting brackets 70 and 75 on the breaker's center channel.

Note 1
On some breakers the holes for mounting screws 71 and 73 already exist; if they do not, then layout, drill and tap the three holes per Fig. 2.

Note 2
On electrically operated AK-2/2A-breakers of the quick-close variety, it may be necessary to relocate the anti-pump relay "W" to make space for the SST programmer unit. On these breakers the "W" relay normally mounts on the left side of the center channel, sharing a common mounting bracket with control relay "X". Remove the "W" relay and relocate it to the upper left of the front frame as shown in the BEFORE and AFTER views of Fig. 3. In the process, remove the "X" relay, discard its original mounting bracket and then remount it in the same location using new bracket 207.

2. The next step is to mount the flux shift trip device, proceeding as follows:
   a. Layout and drill three (3) .209 DIA. mounting holes in the left side of the front frame as shown in Fig. 6.
   b. Mount the flux shift trip device assembly 40 to the side of the front frame per Figs. 5 and 6, being sure to position insulating sheet 41 and the connector support plate 50 next to the mounting base as indicated.

Note
If the breaker is an AKU-50 fused type, take care to position the flux shift trip device sufficiently upward to avoid interference with the coil of the open fuse lockout (OFLO) device.

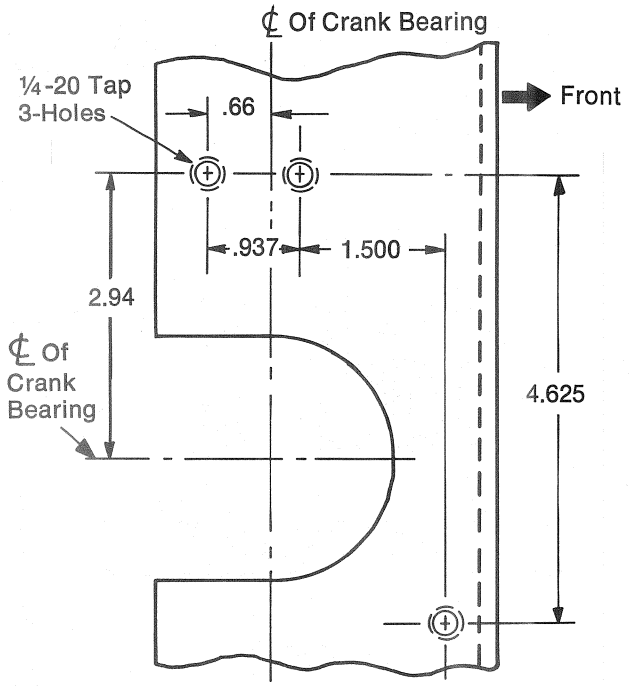


Fig. 2 — Left side view of center channel — drilling plan for programmer mounting bracket.

   c. Identify the programmer wire harness (part 142 or 143) and mount its male connector (P2 on Fig. 6) to support plate 50 using screws 51.
   d. Insert the two sleeve-terminated ends of harness X (the leads from the flux shift trip device) into female connector P1 on the opposite end of the programmer harness — red wire into socket B, black wire into socket E. See Table 5 and the applicable harness connection diagram — Fig. 16, 19 or 21.

Note
Each kit contains a special Amp tool for removing leads from the connector sockets, should the need arise.

   e. Mount trip paddle 45 onto the breaker trip shaft per Fig. 6. Adjust the length of the trip rod on the flux shift trip device per Fig. 9. A front frame with flux shift trip device mounting completed is shown in Fig. 10.

3. For stationary breakers that are to be equipped with 4-wire ground fault, the kit includes an additional harness Y (part 145) with terminal board TB4 attached to one end. See Fig. 21A. Drill mounting holes for TB4 in the left corner of the front frame and mount it as shown in Fig. 23. Then insert the sleeve terminals on the other end of harness Y into harness connector P1 — white wire to socket L, black wire to socket N.
4. Form harness X (and harness Y, when used) along with the programmer harness and wire tie them to the front frame per Fig. 5.

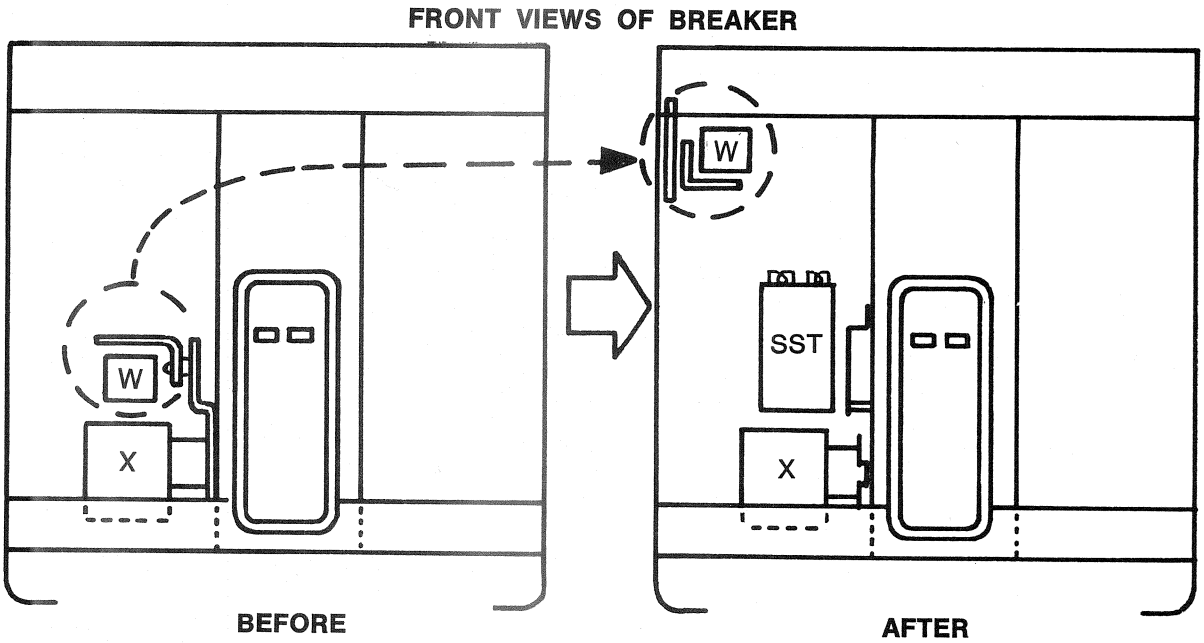
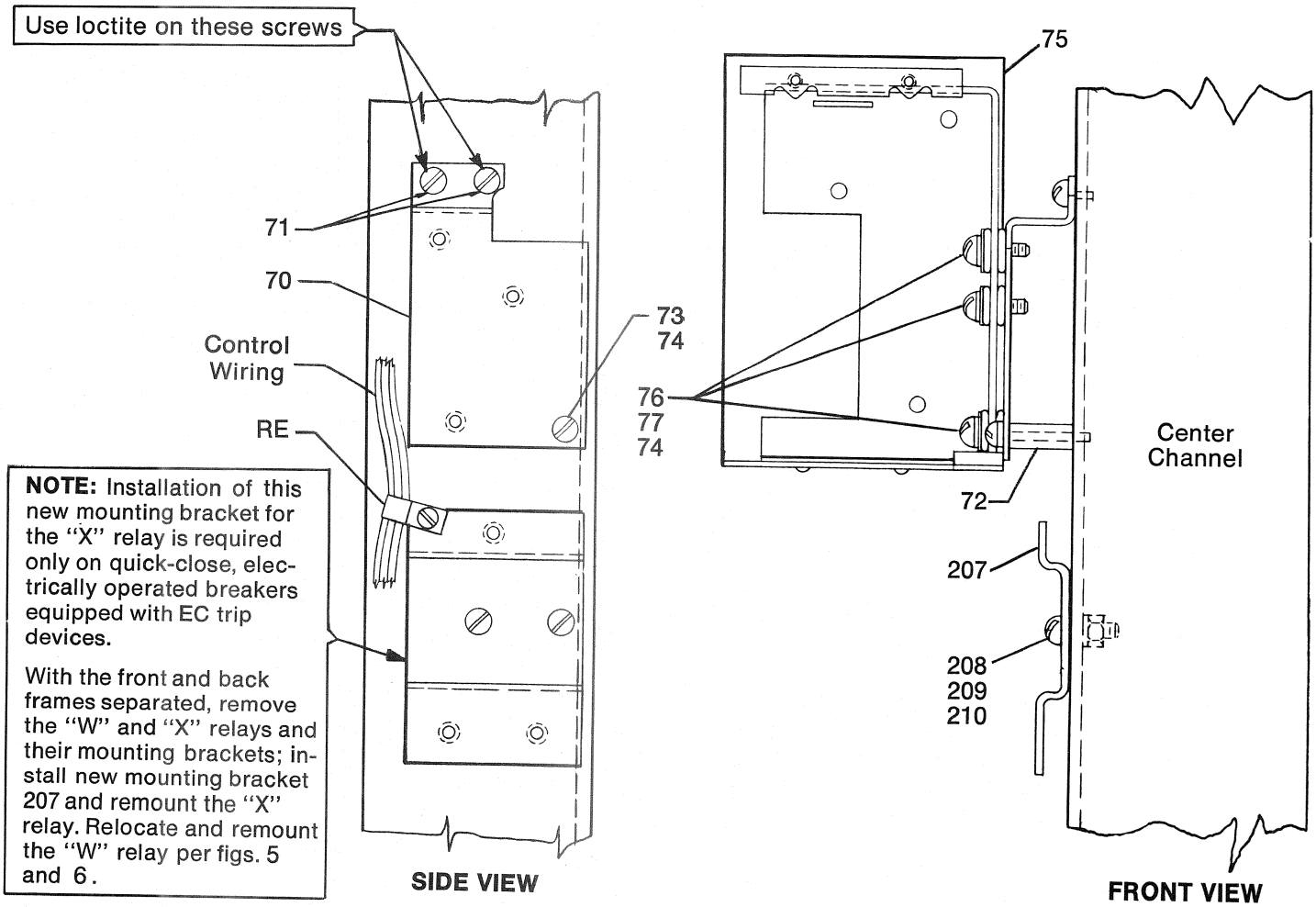


Fig. 3 — Remounting of "W" and "X" relays — required only on quick-close, electrically operated breakers equipped with EC trip devices.



NOTE: Installation of this new mounting bracket for the "X" relay is required only on quick-close, electrically operated breakers equipped with EC trip devices.

With the front and back frames separated, remove the "W" and "X" relays and their mounting brackets; install new mounting bracket 207 and remount the "X" relay. Relocate and remount the "W" relay per figs. 5 and 6.

Fig. 4 — Installing SST programmer mounting bracket on center channel of front frame; remounting the "X" relay.

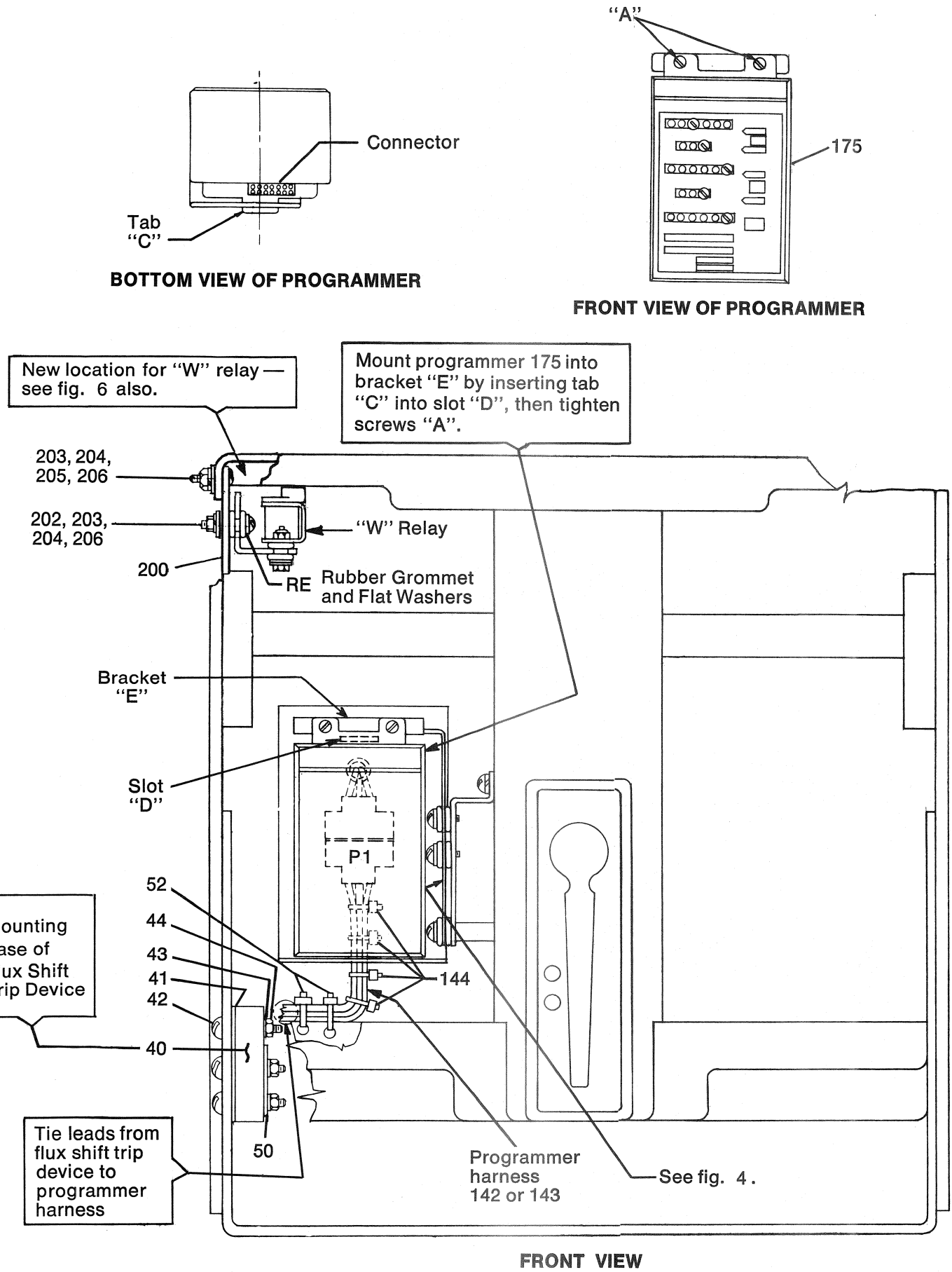


Fig. 5 — Converted front frame

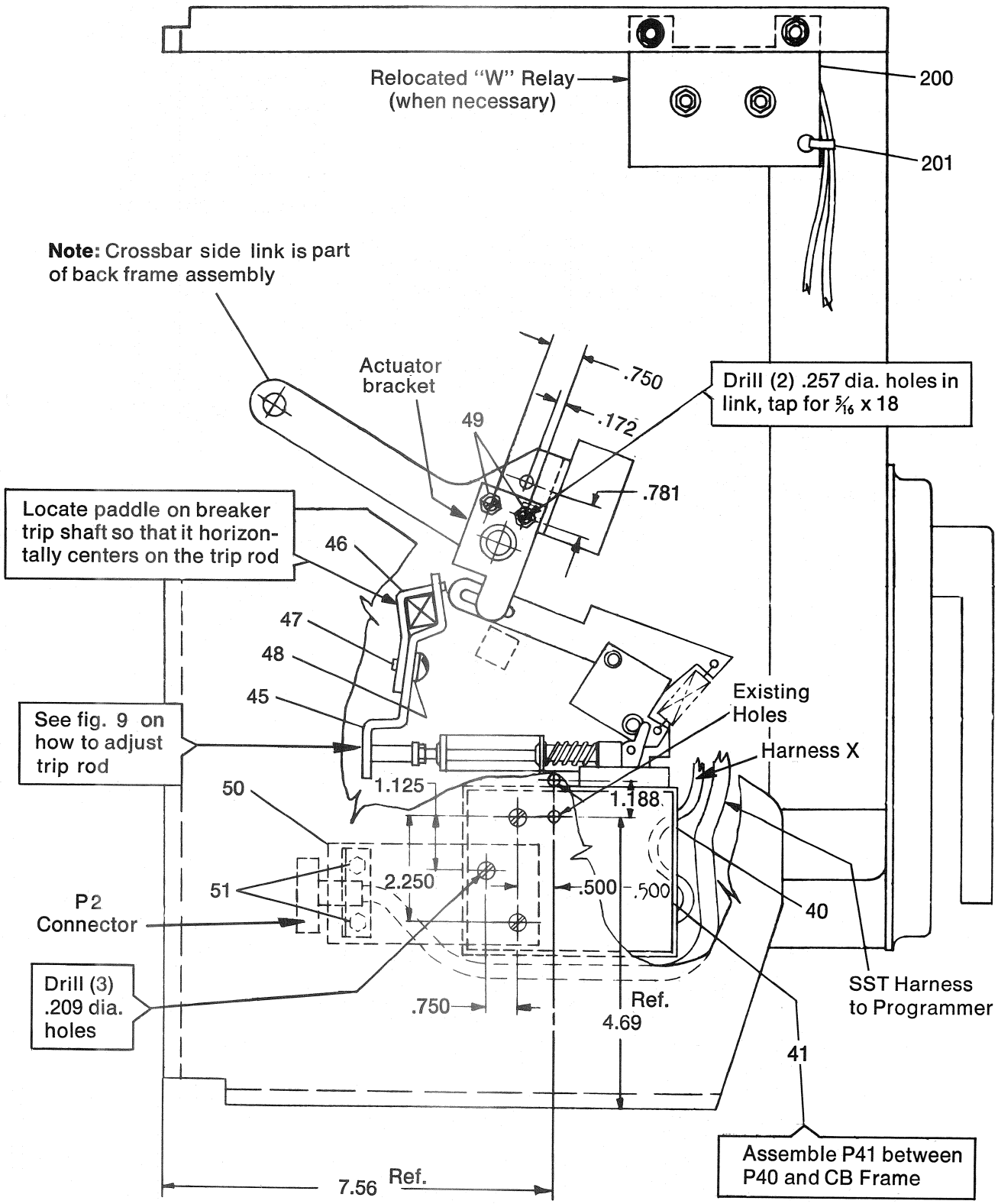


Fig. 6 — Side view of front frame showing mounting of flux shift trip device.

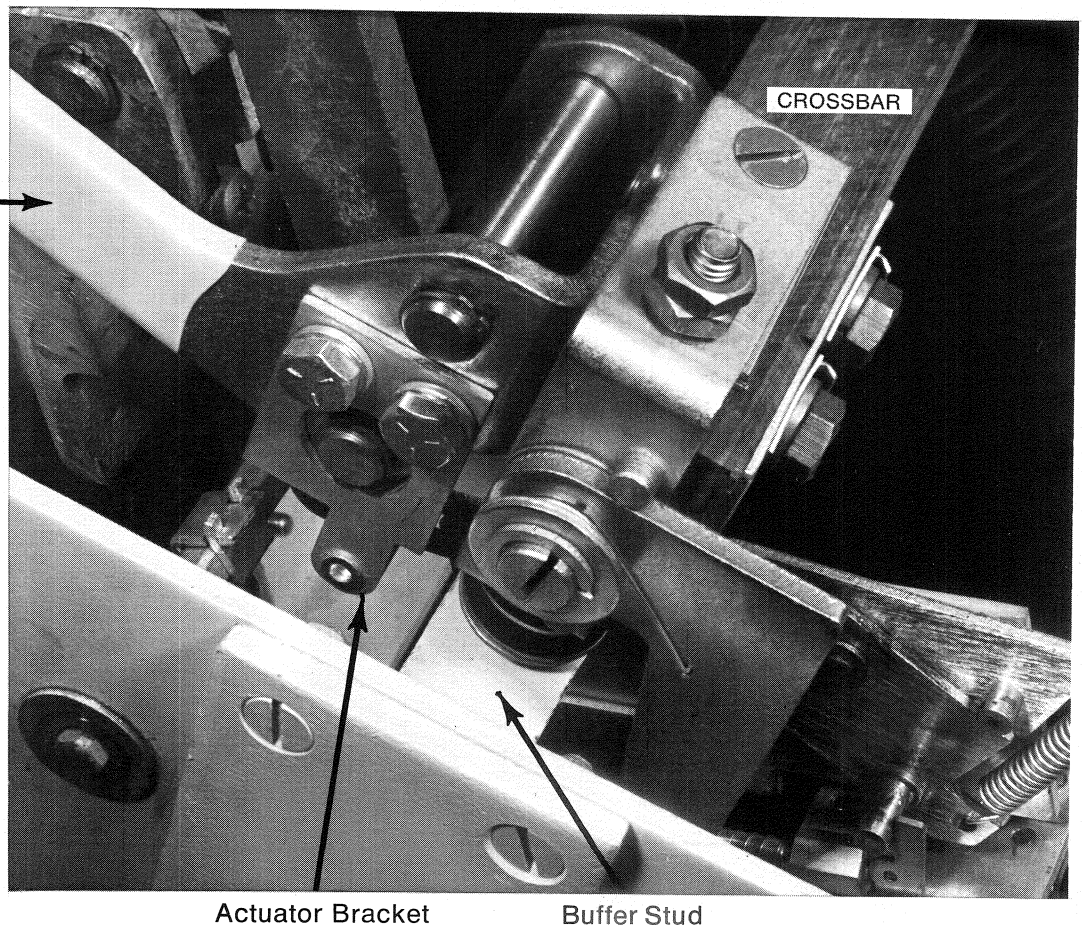
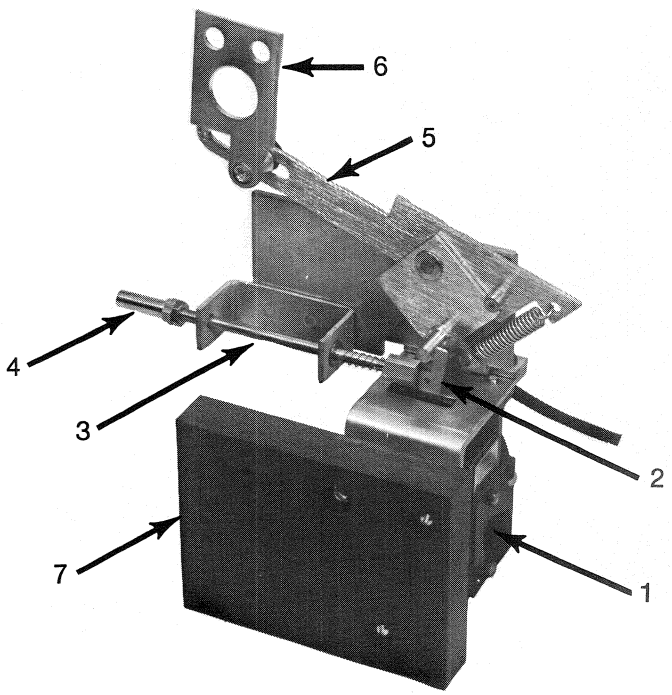
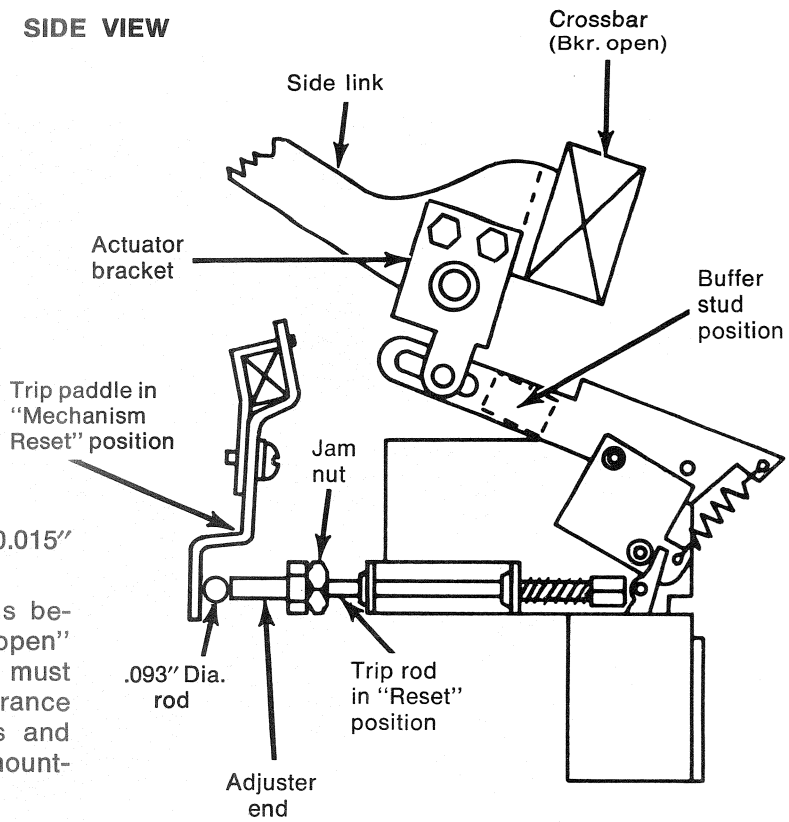


Fig. 7 — Flux shift trip device — reset linkage attachment.



1. Actuator
2. Actuator arm
3. Trip rod
4. Trip rod adjuster end
5. Reset linkage
6. Actuator bracket
7. Mounting base

Fig. 8 — Flux shift trip device assembly with operating linkages.



ADJUSTMENTS:

1. Trip rod length: Adjust gap to 0.093″ ± 0.015″ using 0.093″ diam. rod as shown.
2. Actuator bracket: As the crossbar travels between the "breaker closed" and "breaker open" positions, the tang of the actuator bracket must clear the buffer stud. If insufficient clearance exists, loosen it's two mounting screws and rotate the bracket clockwise to take up mounting hole slack. Retighten screws.

Fig. 9 — Flux shift trip device adjustments.

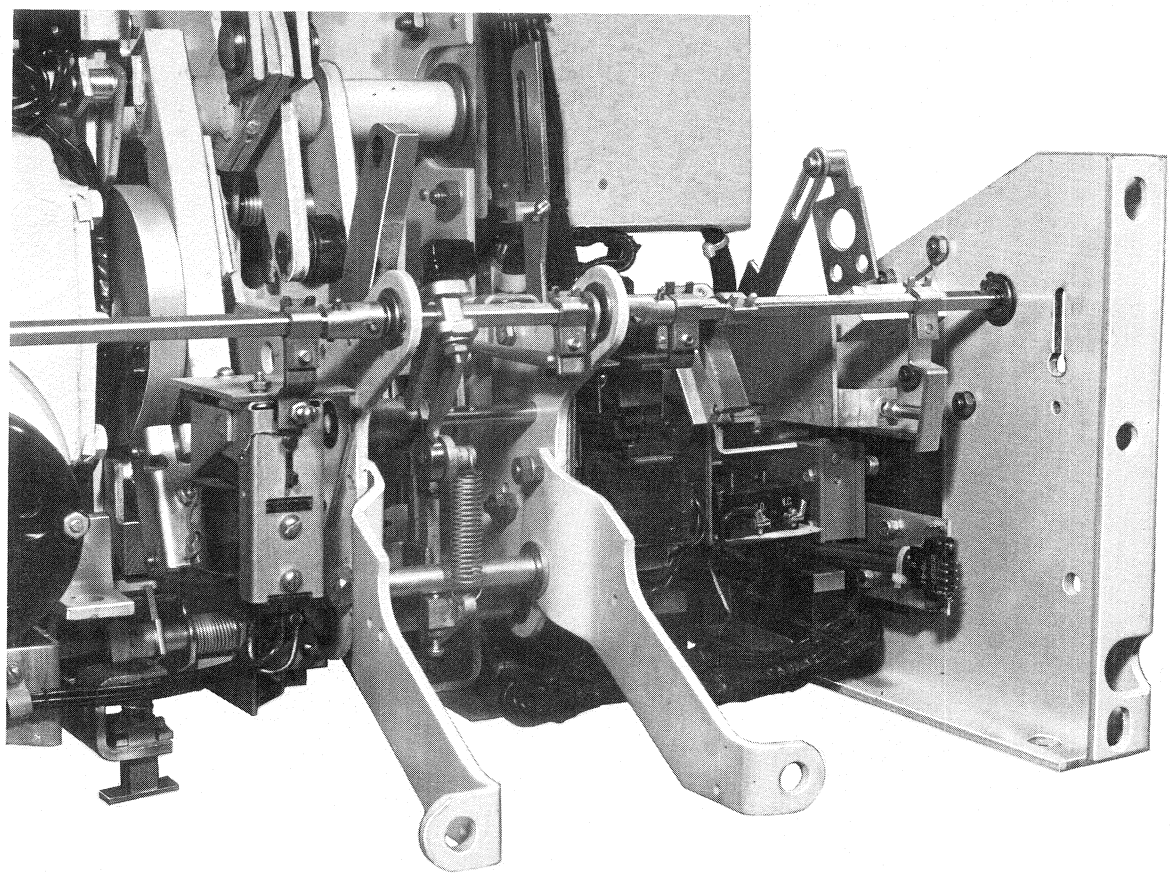


Fig. 10 — Rear view of front frame showing mounting of the flux shift trip device.

IV. BACK FRAME CONVERSION

1. Identify the crossbar side link on the left side of the breaker's left pole; layout, drill and tap the two .257 DIA. holes in it as shown in Fig. 6. These holes are used later (step V.2.) to attach the trip device actuator bracket.
2. Mount the three (3) phase sensors (100) and their terminal boards as shown in Figs. 11, 12 and 13.
3. On drawout breakers being equipped with 4-wire ground fault, mount the neutral sensor disconnect block 225 on the rear surface of the back frame per Figs. 14 and 15, using existing holes.
4. Install the back frame wire harness (part 140 or 141) per view B of connection diagram Fig. 16, 19 or 21, whichever applies; position each tap lead (black) on the ampere rating selected. Form and tie per Figs. 12 and 13.

V. BREAKER REASSEMBLY

1. Rejoin the front and back frames. Refer to GEK-7303 page 7 as necessary.
2. Referring to Figs. 6 and 7, attach the flux shift trip device actuator bracket to the left pole crossbar side link (previously drilled in Section IV). Be sure it clears the buffer stud as described in Fig. 9.
3. Install the programmer unit 175 into its mounting bracket on the breaker front frame as shown in Fig. 5. Join the female connector P1 of the breaker harness to the male connector on the rear of the programmer.

CAUTION: To avoid shock hazard and possible damage to wire harness and sensor coils, insure that all harness connectors (P1, P2 and P3) are securely engaged before any attempt is made to energize the breaker.

Conversion of the breaker is now complete. Manually close and trip the breaker several times to insure proper mechanical operation. Use the maintenance handle to do this on electrically operated breakers. Recheck the flux shift trip device linkage and adjustments per Fig. 9.

Proceed next to Section VI — EQUIPMENT MODIFICATIONS. If these are not required, go directly to Section VII — TESTING.

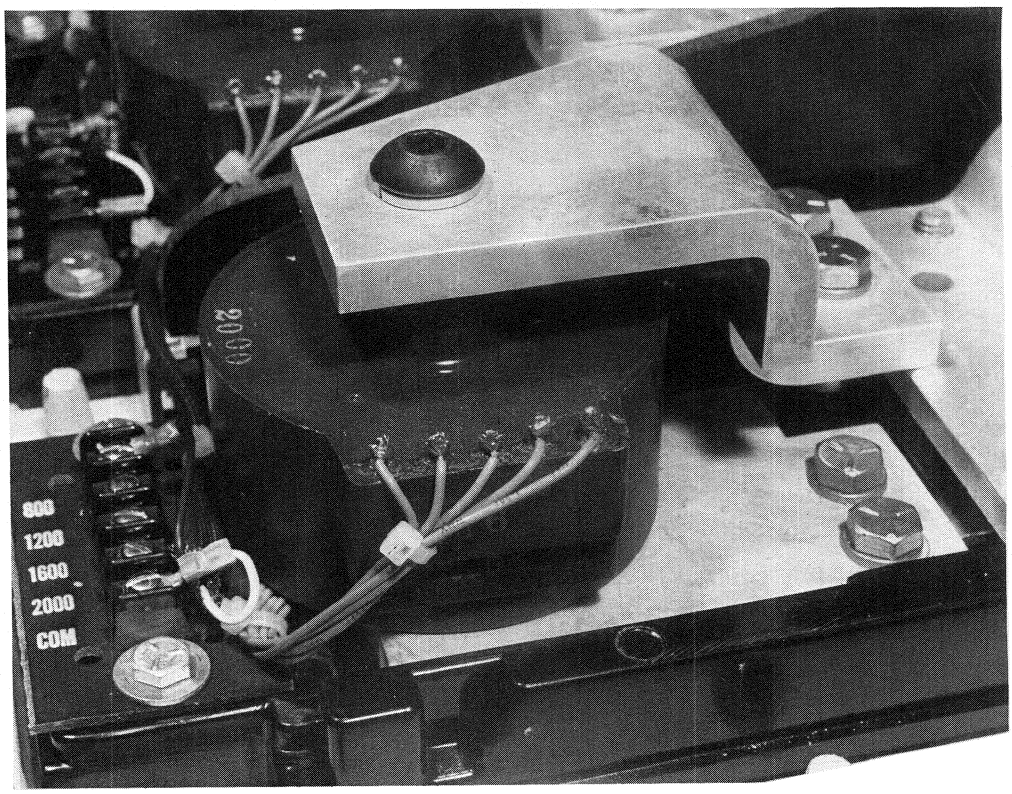


Fig. 11 — SST current sensor mounting.

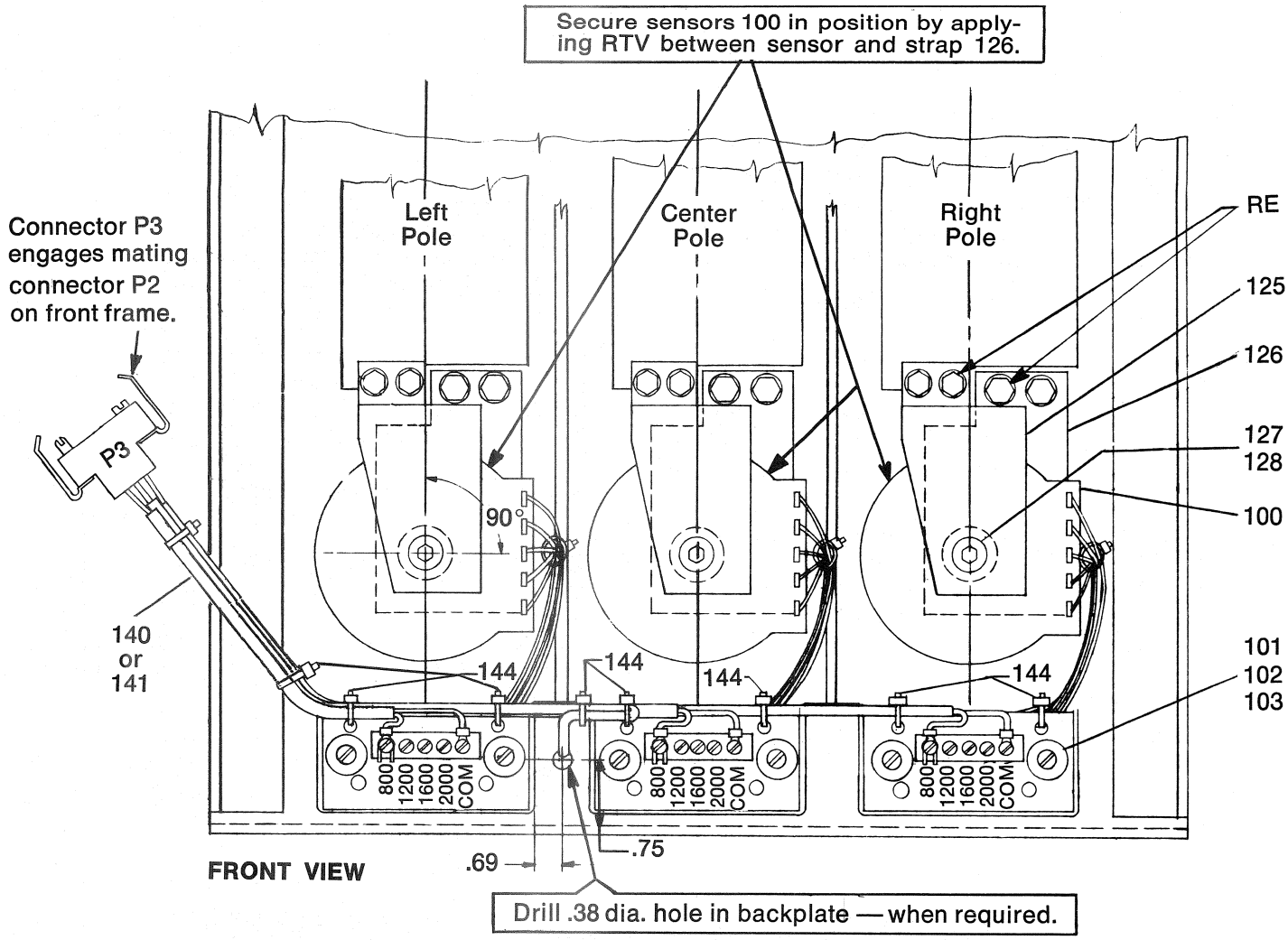


Fig. 12 — Converted back frame showing SST sensors, terminal boards and harness.

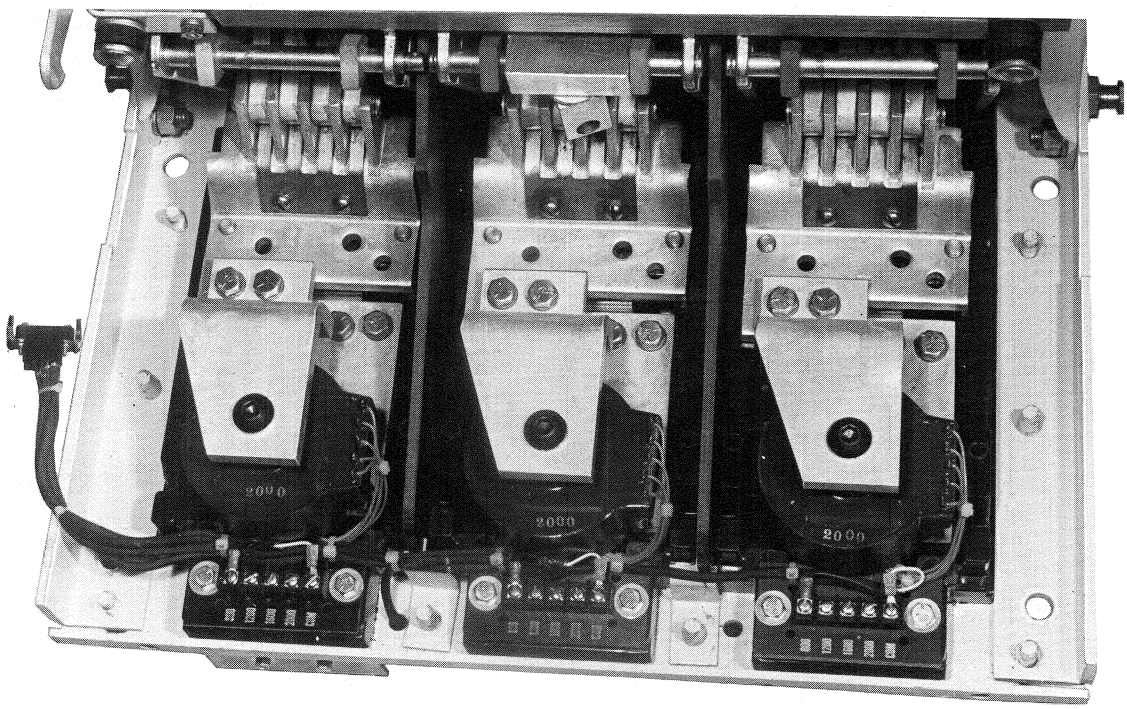


Fig. 13 — Front view of drawout breaker back frame after SST conversion.

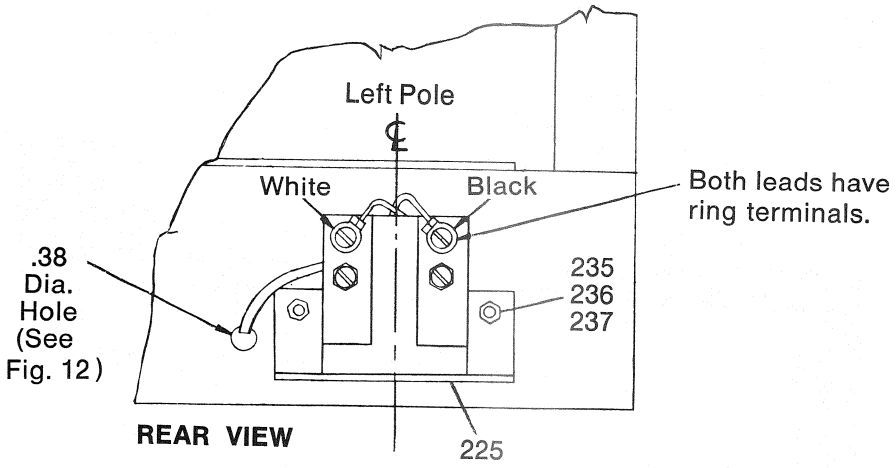


Fig. 14 — Mounting of 4th-wire neutral sensor disconnect block on drawout breaker (when used). See fig. 15.

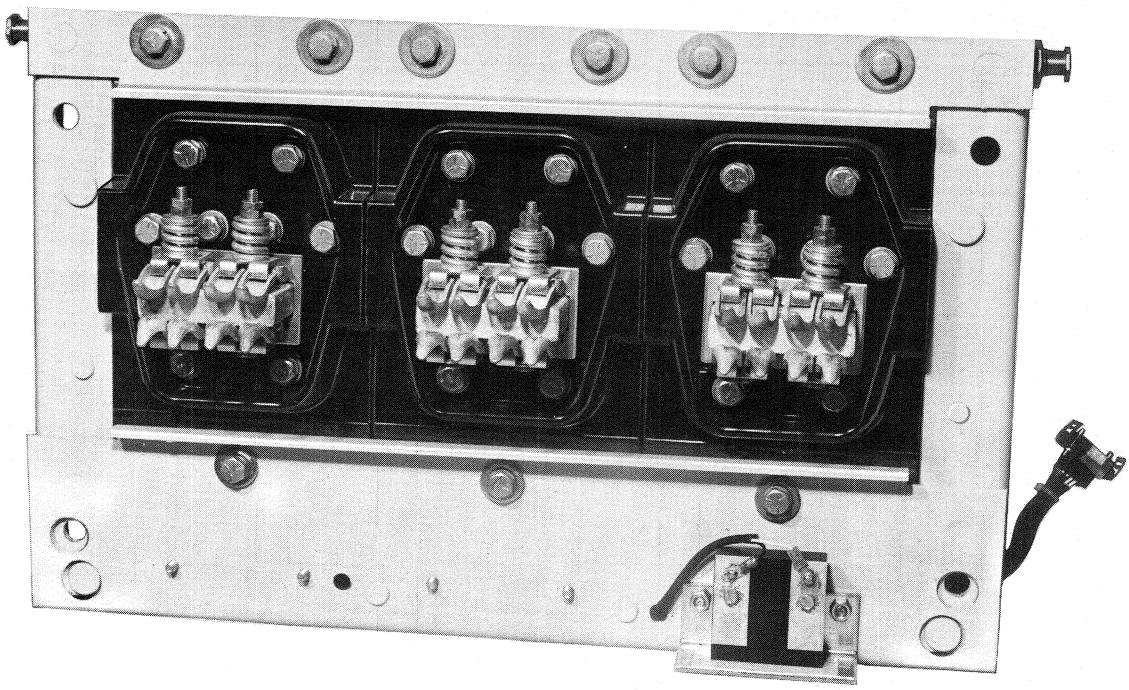


Fig. 15 — Rear view of drawout breaker back frame equipped with SST 4th-wire neutral sensor disconnect block.

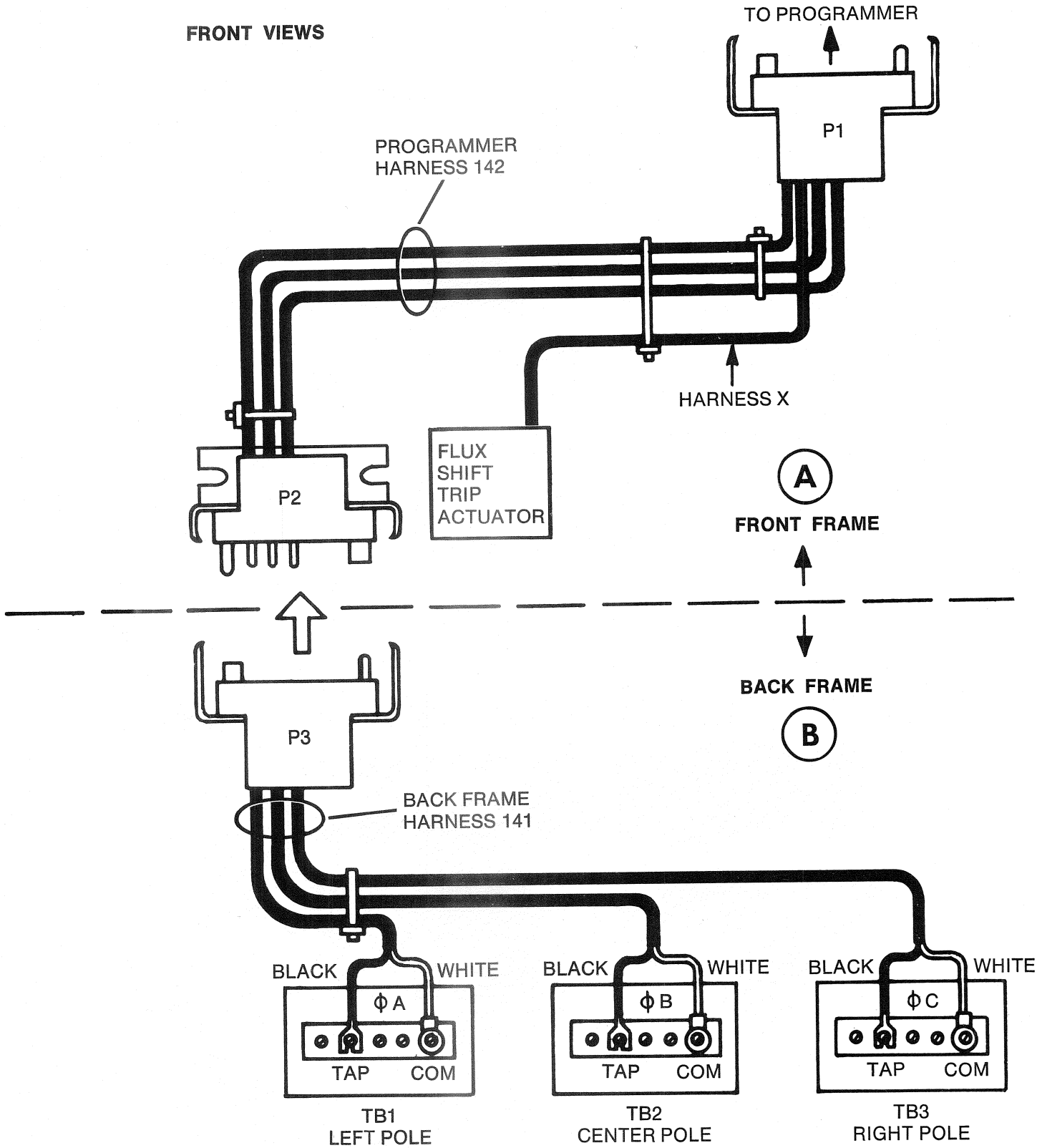


Fig. 16 — Harness connections for drawout and stationary breakers used on 3-wire systems — with and without ground fault. For elementary diagrams see Figs. 17 and 18.

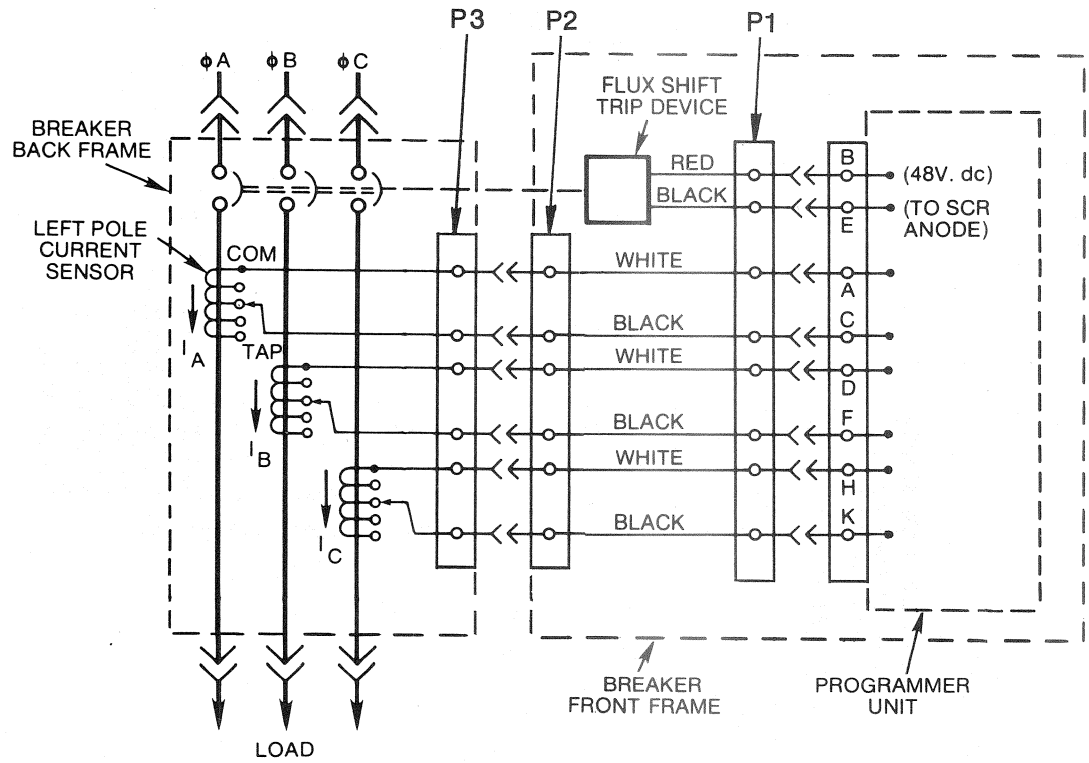


Fig. 17 — Elementary diagram — breakers without ground fault.

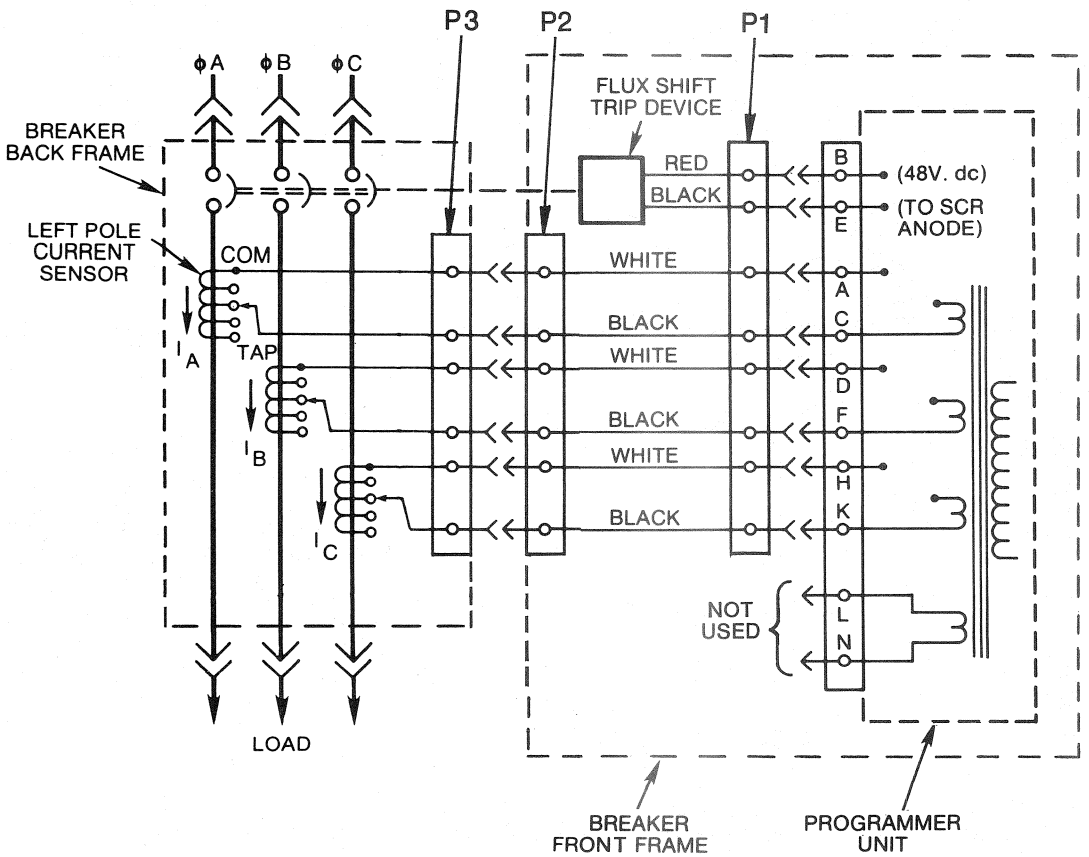


Fig. 18 — Elementary diagram — breakers with 3-wire ground fault.

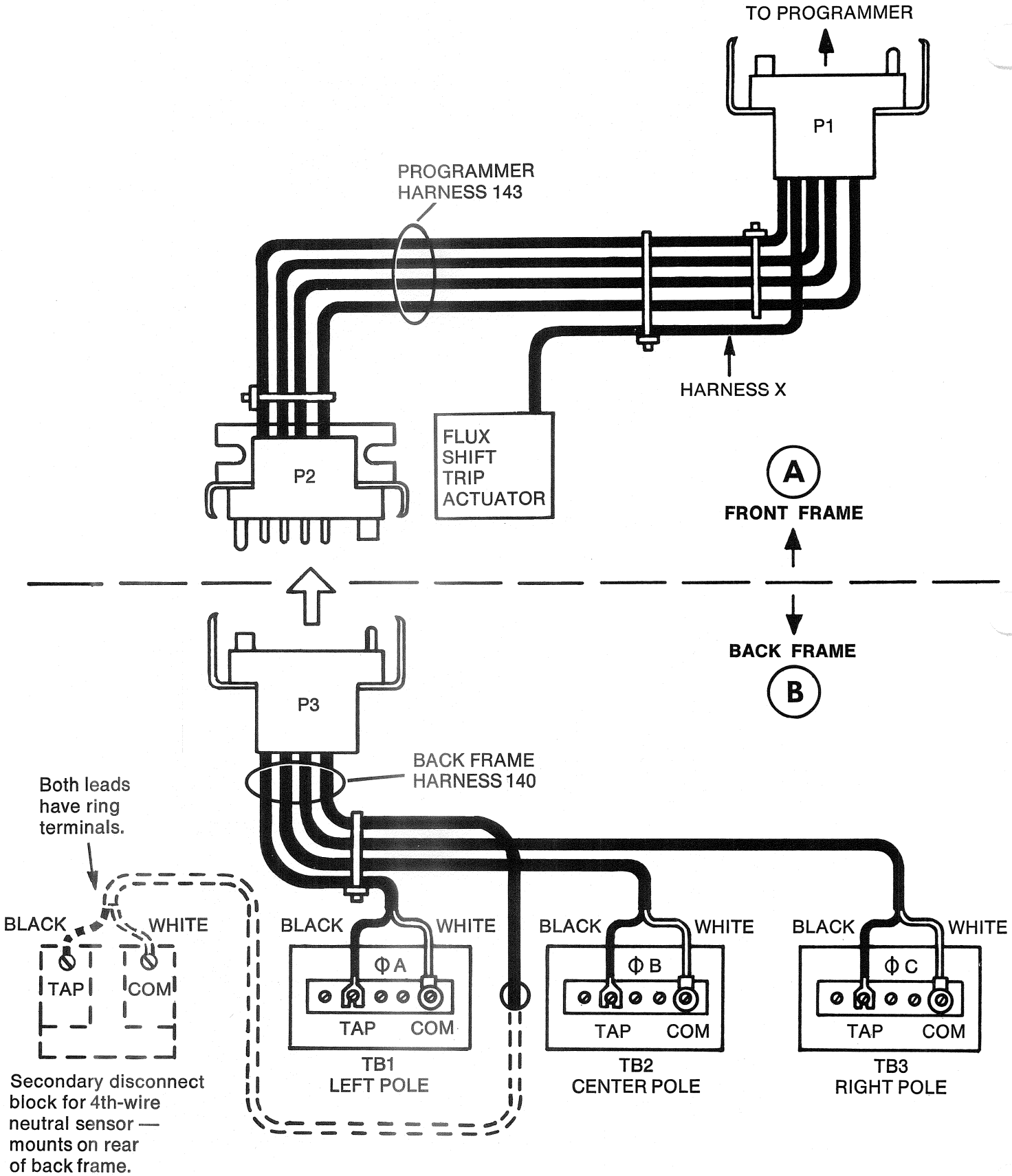


Fig. 19 — Harness connections for drawout breakers equipped with 4-wire ground fault. For elementary diagram see Fig. 20.

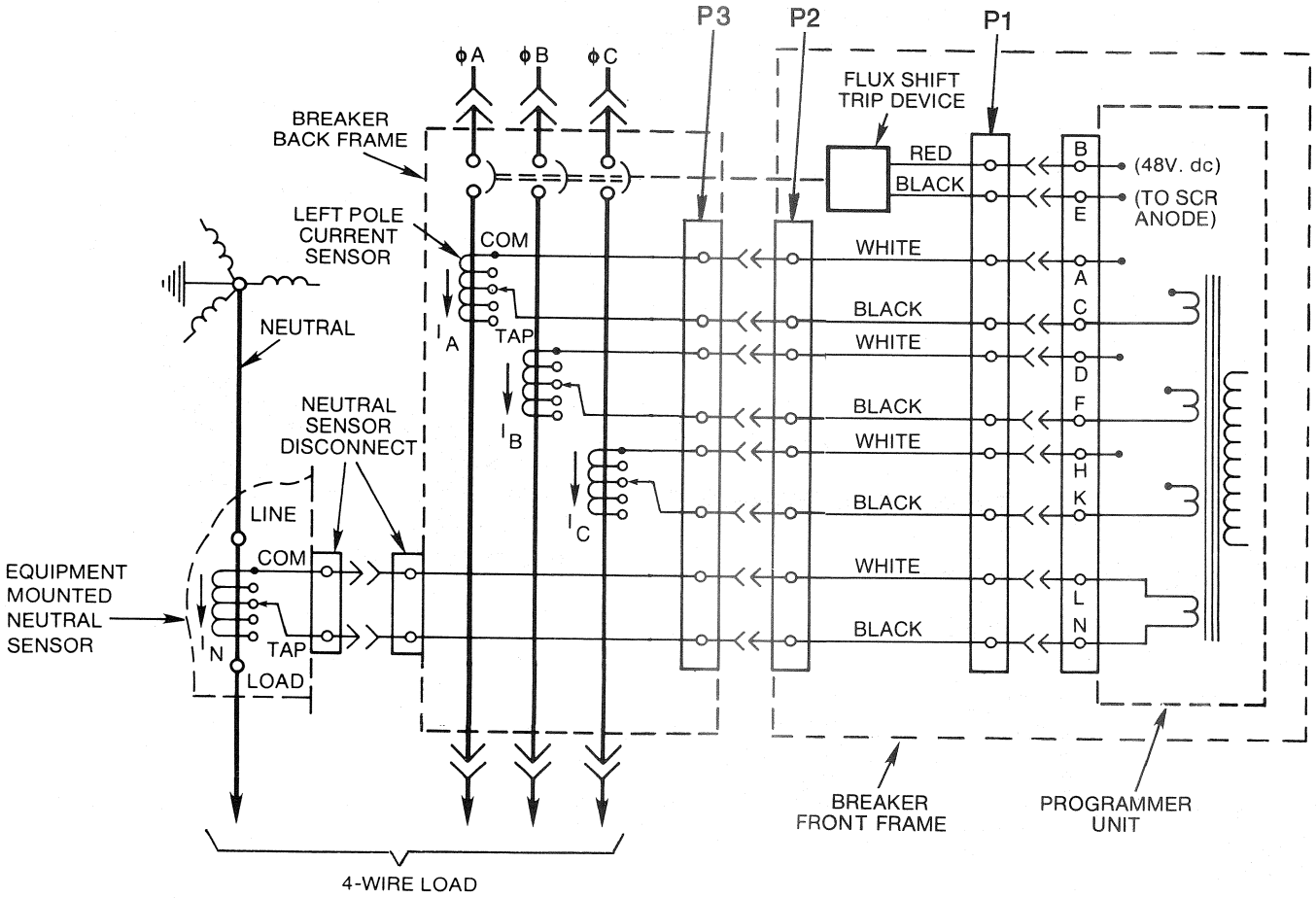
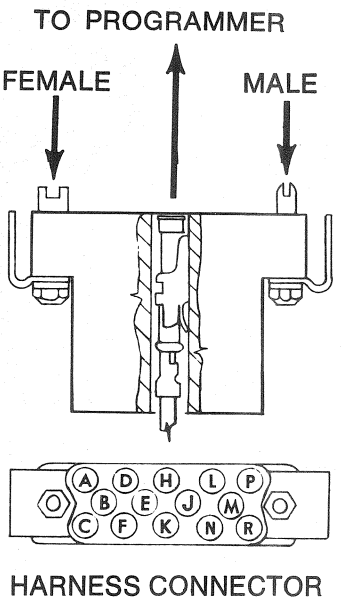


Fig. 20 — Elementary diagram — drawout breaker with 4-wire ground fault.

Table 5 — SST Harness Wire Table

FROM		TO
Harness Connector Socket Number	Wire Color	
A C	White Black	TB1 (ϕA)
D F	White Black	TB2 (ϕB)
H K	White Black	TB3 (ϕC)
B E	Red Black	Flux Shift Trip Device
L N	White Black	4th-wire Neutral Disconnect Block (or TB4) when used



HARNESS CONNECTOR

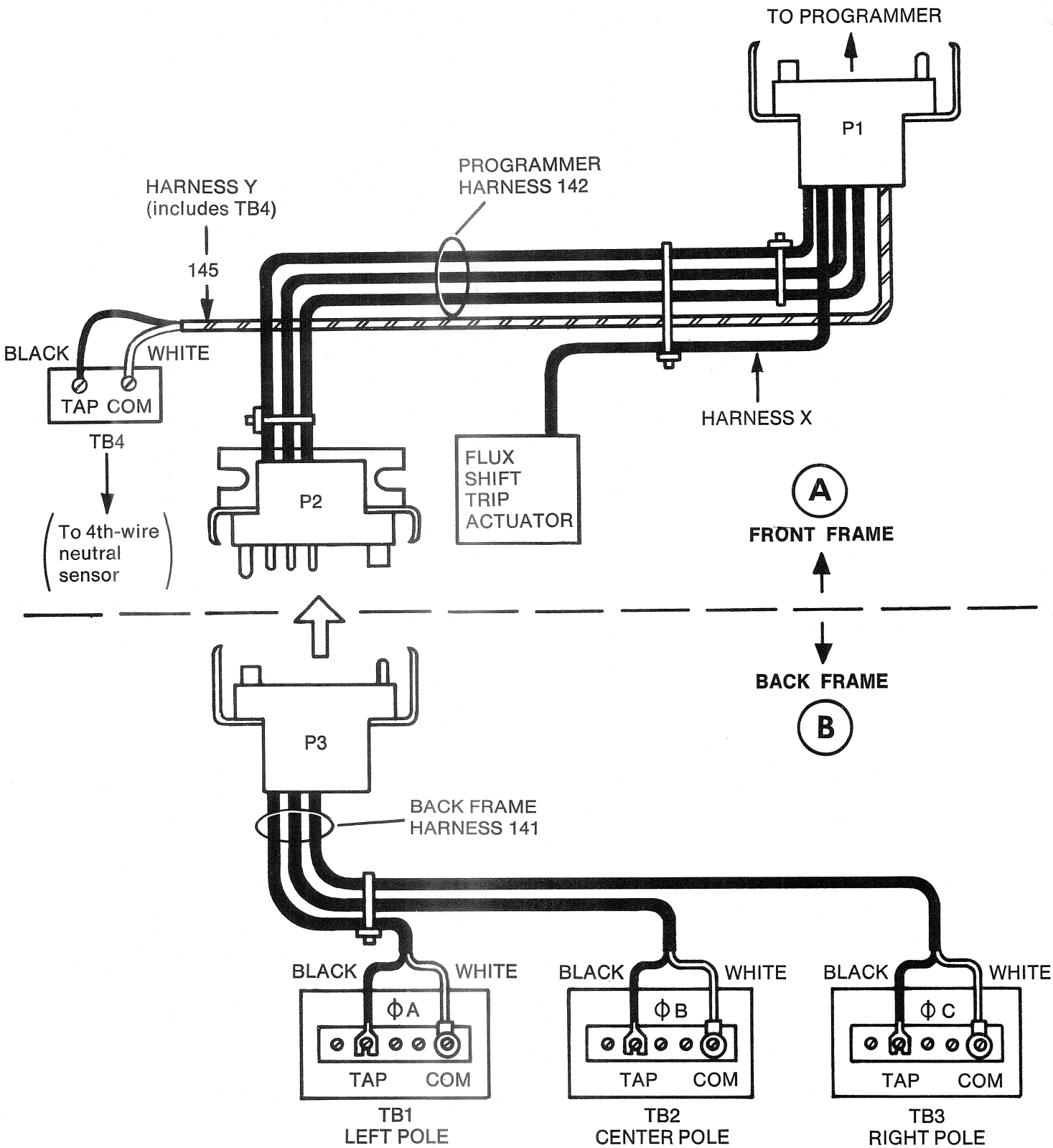


Fig. 21 — Harness connections for stationary breakers equipped with 4-wire ground fault. For elementary diagram see Fig. 22.

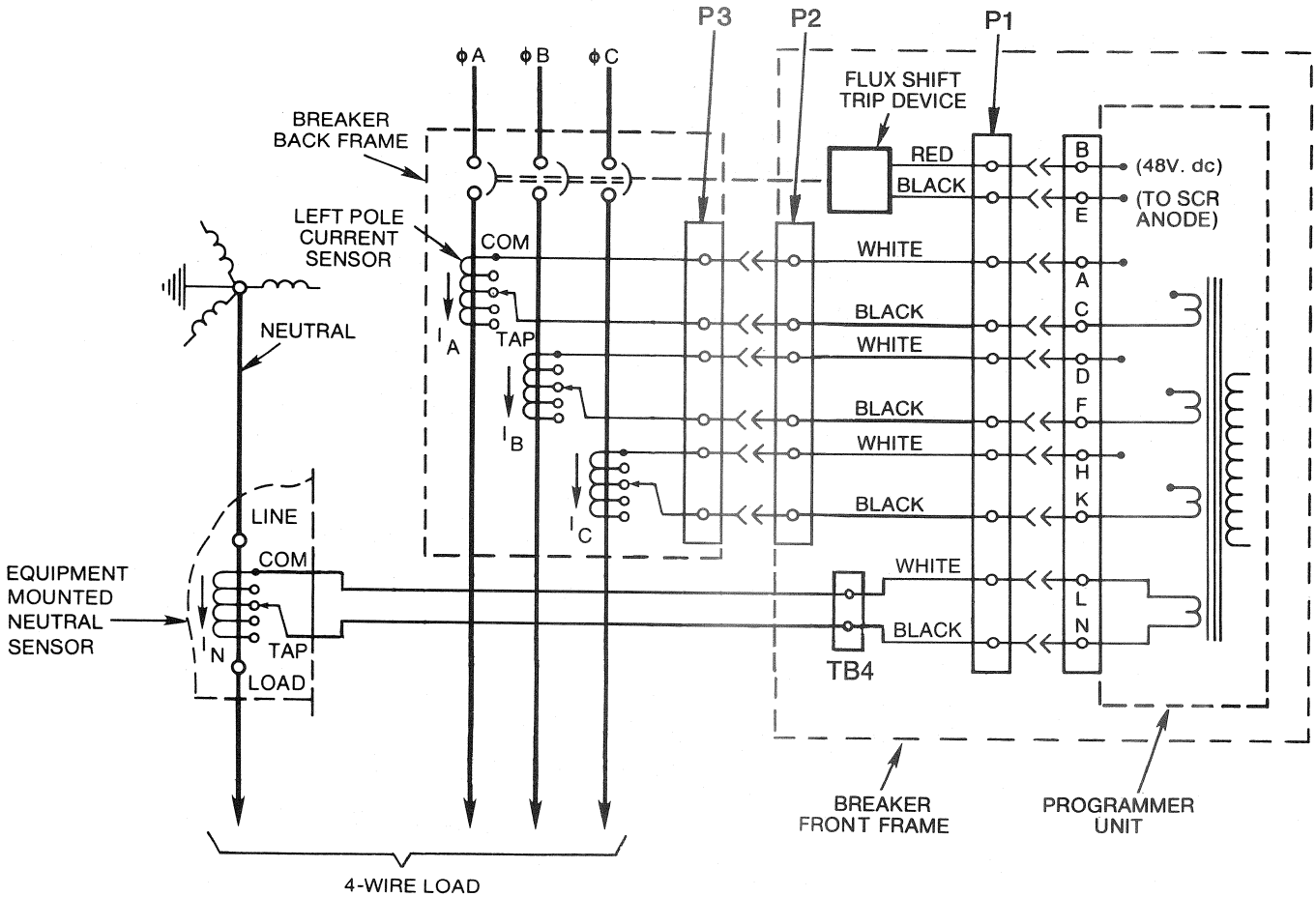


Fig. 22 — Elementary diagram — stationary breaker with 4-wire ground fault.

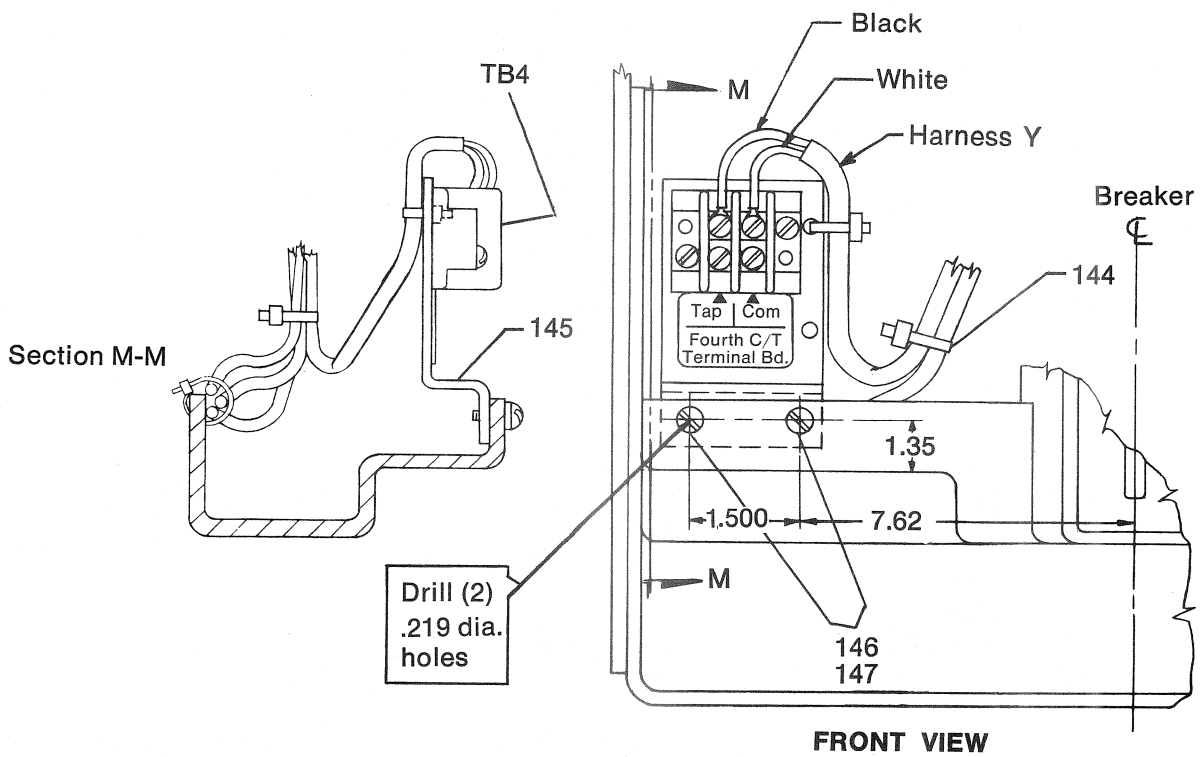


Fig. 23 — For stationary breakers only — mounting of terminal board TB4 for connection to equipment-mounted 4th-wire neutral sensor.

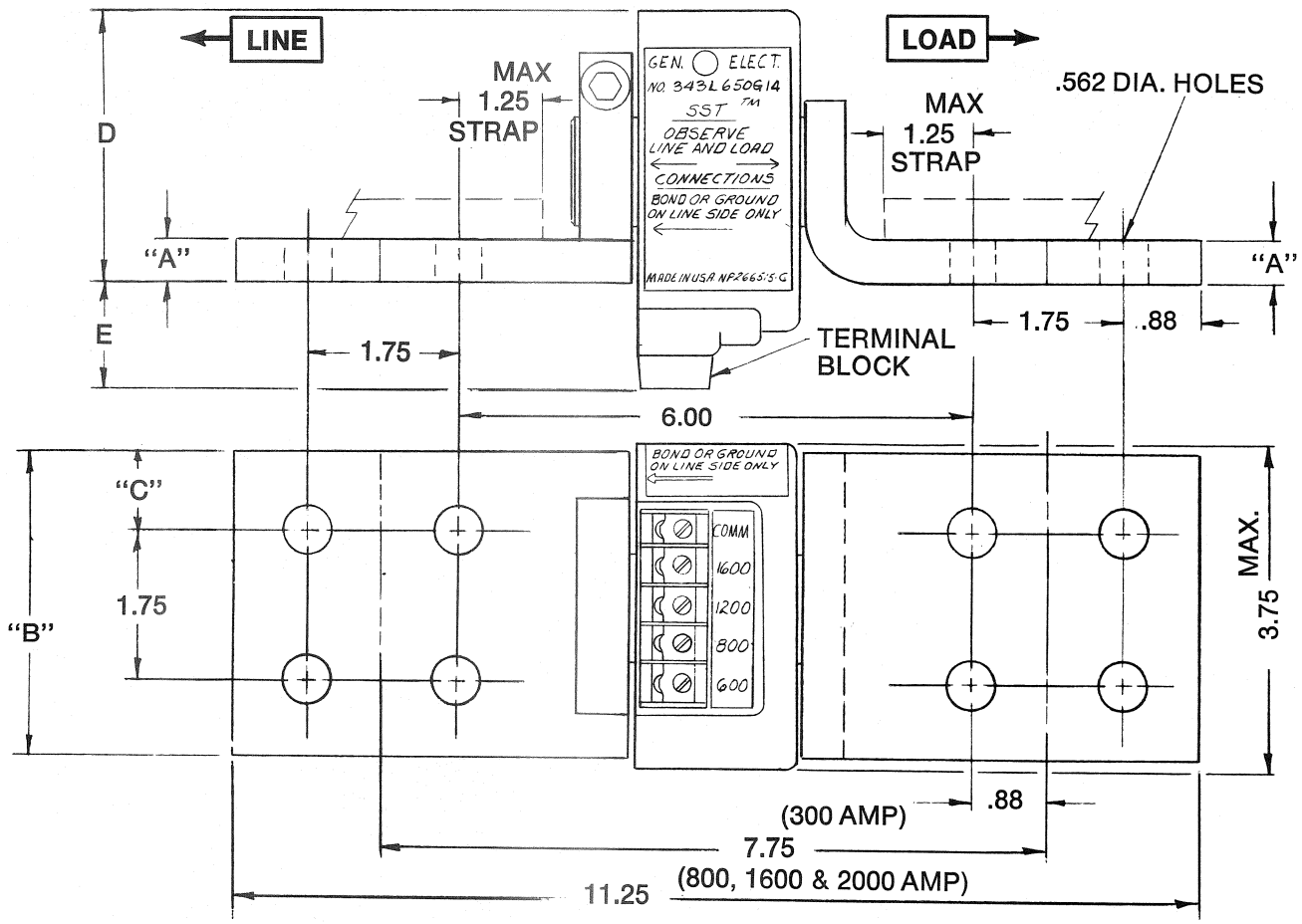
VI EQUIPMENT MODIFICATIONS

The following modifications are required ONLY in conjunction with breakers being equipped with 4-wire Ground Fault trip elements.

1. Mount the neutral sensor in the outgoing neutral lead, normally in the equipment's bus or cable compartment. *Be sure to observe the sensor's LINE & LOAD directional markings.* See Fig. 24 for the sensor's bar drilling plan. Check to insure that the neutral and phase sensors match, i.e., have the same ampere range.

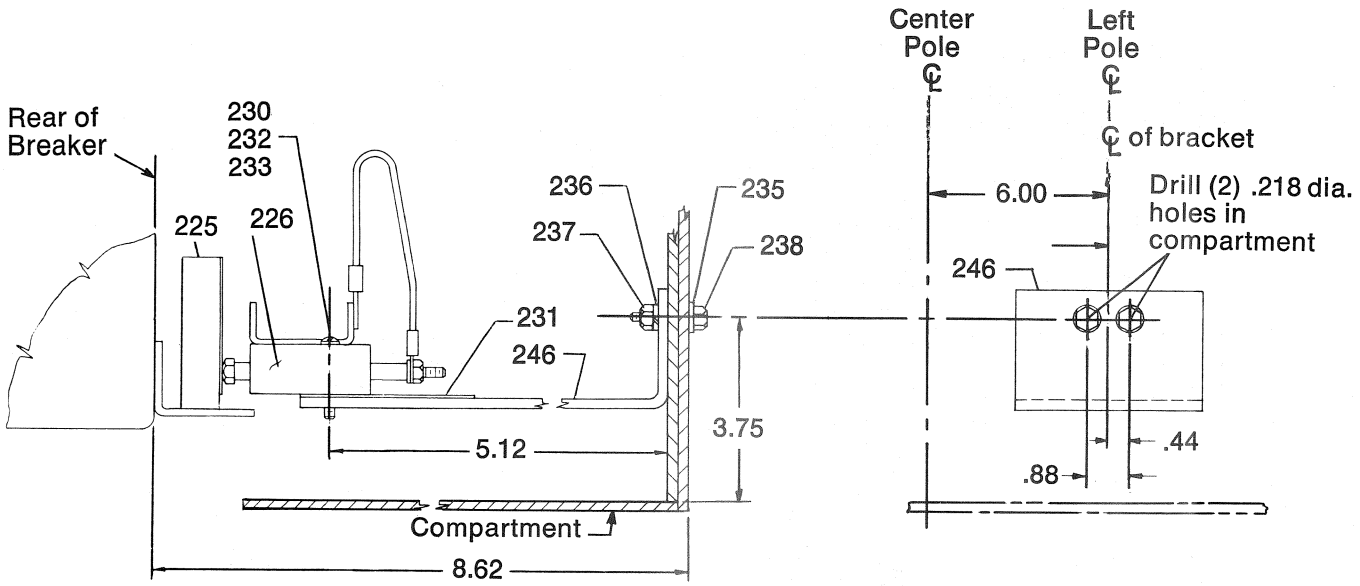
2. On drawout type breakers, mount the 4th-wire neutral sensor stationary disconnect block 226 inside the breaker compartment at the lower rear as shown in Fig.25. Be careful to select the correct mounting bracket (Part 245 or 246).

3. Connect the neutral sensor to disconnect block 226 per wiring instructions of Fig. 26. For stationary breakers, the neutral sensor is connected to TB4.



SENSOR CAT. NO.	AMPERE RANGE	A	B	C	D	E
343L650G13	300-800	.250	3.25	.75	3.20	1.30
343L650G14	600-1600	.500	3.62	.94	3.20	1.30
343L650G28	800-2000	.625	3.25	.75	3.33	1.18

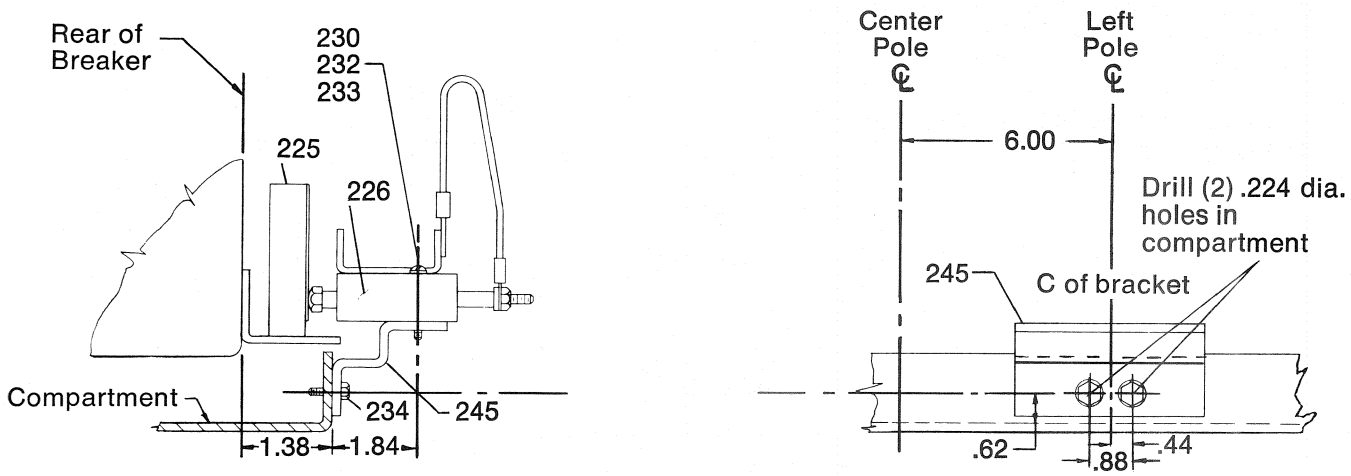
Fig. 24 — Outline of SST 4th-wire neutral sensors (from outline dwg. 568B220).



Side view of compartment.

View looking at rear of compartment.

AKD TYPE



Side view of compartment

View looking at rear of compartment

AKD-5 TYPE

Fig. 25 — Mounting the 4th-wire neutral sensor disconnect block in AKD/ AKD-5 drawout compartments.

INSTALLATION NOTES

- Observe LINE and LOAD markings when making bus or cable connections.
- Bond sensor on LINE side only.
- Maintain polarity of sensor secondary leads when connecting to breaker, i.e., TAP to TAP, COM to COM.

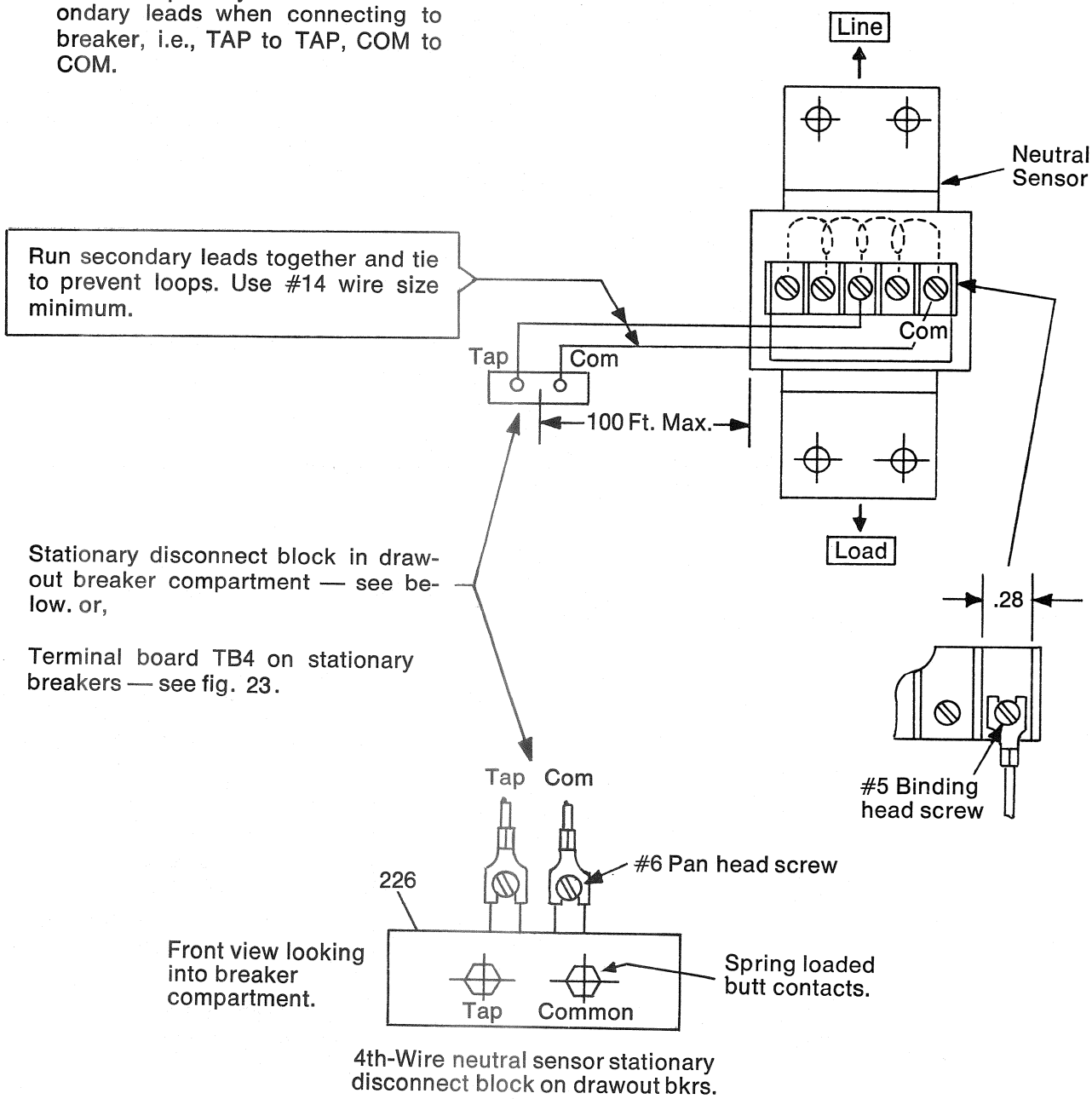


Fig. 26 — Connecting the 4th-wire neutral sensor.

VII. TESTING

Before reinstalling the breaker to service, perform steps 1 & 2 below:

1. Megger breaker primary circuit using a 1000V megger.

2. Perform either of the following tests:

A — Using ECS/SST test set Catalog #TAK-TS1, test per Instructions GEK-64454 to assure proper operation of the breaker and its trip device. Alternately, test set Catalog #TAK-TS2 with Instructions GEK-73300-1 can be used.

B — Using a single-phase, high current-low voltage test set, test each trip element (L, S, I, G) to assure proper protective device operation. Compare results with applicable time-current characteristic curves reproduced on pages 25, 26 & 27.

NOTE:

When testing units equipped with a ground fault trip element, the latter must be deactivated by using Ground Fault Defeat Cable Catalog #TGFD as shown in Fig. 27 below. If this defeat cable is not available, the breaker can be tested with two poles connected in series.

3. For use in troubleshooting, the tap-to-tap resistances of the sensors are provided in Table 6. These data apply both to phase and neutral sensors.

Table 6 — Sensor Resistance Values

Breaker Frame Size	Ampere Tap	Resistance in ohms between COMMON and TAP Terminals
AK-50	300	5.3-6.1
	400	7.2-8.2
	600	10.8-12.4
	800	14.6-16.9
	600	6.4-7.6
	800	8.8-10.4
	1200	13.5-15.8
	1600	19.4-22.8
AKT-50	800	10.2-12.0
	1200	15.8-18.6
	1600	22.0-25.9
	2000	28.5-33.6

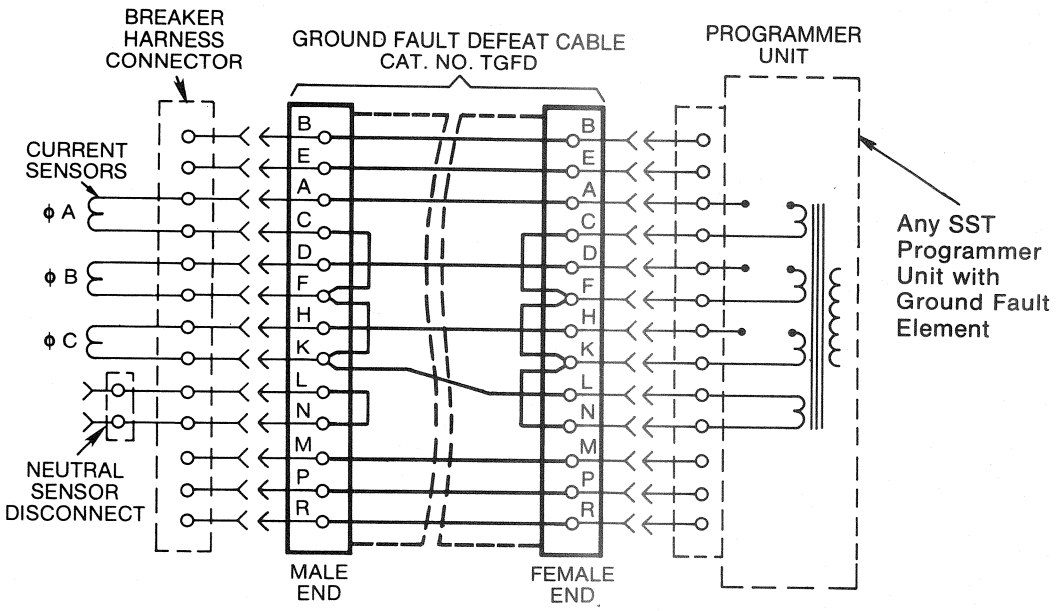


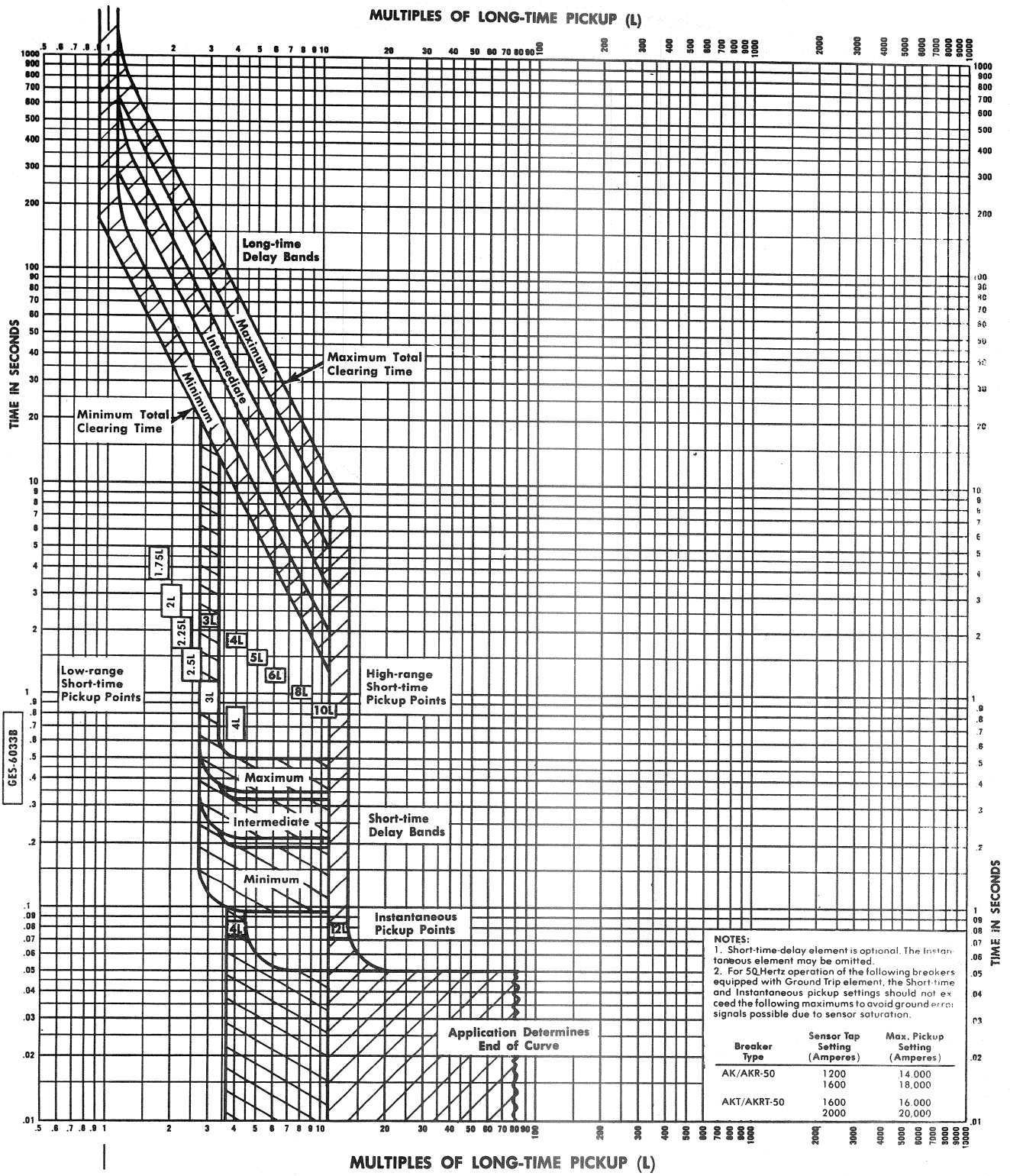
Fig. 27 — Cabling diagram with Ground Fault Defeat Cable inserted between breaker harness and SST Programmer Unit — for use during single-phase, high current-low voltage testing.

TABLE 7 — TRIP CHARACTERISTICS — SST CONVERSION KITS

Applicable time-current Curves: GES-6033B, 6034A, 6035B

Breaker Frame Type	Frame Size (Amperes)	Sensor Taps (X) (Amperes)	SST Programmer Adjustment Range (Set Points)						
			Ground Fault		Long Time		Short Time		Instantaneous Pickup (Multiple of L)
			Pickup (Multiple of X)	Delay Band (Seconds)	Pickup (L) (Multiple of X)	Delay Band (Seconds)	Pickup (Multiple of L)	Delay Band (Seconds)	
AK-15	225	70, 100, 150, 225	.5, .6, .8, 1, 1.5, 2 (X)	Maximum 0.30	.6, .7, .8, .9, 1, 1.1 (X)	Maximum 22	1.75, 2, 2.25, 2.5, 3, 4 (L)	Maximum 0.35	4, 5, 6, 8, 10, 12 (L)
AK-25	600	70, 100, 150, 225 or 200, 300, 400, 600							
AK-50	1600	300, 400, 600, 800 or 600, 800, 1200, 1600	.25, .3, .4, .5, .6, .7 (X)	Intermed. 0.165		Intermed. 10	or	Intermed. 0.21	
AKT-50	2000	800, 1200, 1600, 2000	.2, .25, .3, .4, .5, .6 (X)	Minimum 0.065		Minimum 4	3, 4, 5, 6, 8, 10 (L)	Minimum 0.095	
AK-75	3000	1200, 1600, 2000, 3000	.2, .22, .25, .3, .35, .37 (X)						
AK-100	4000	1600, 2000, 3000, 4000	.18, .2, .22, .25, .27, .3 (X)						
NOTES		①	②	④	②	③	②	④	②

① × = Sensor ampere tap = trip rating
② Pickup tolerance = ± 10%
③ Time delay at lower limit of band @ 6L
④ Time delay at lower limit of band



NOTES:
1. Short-time-delay element is optional. The Instantaneous element may be omitted.
2. For 50 Hertz operation of the following breakers equipped with Ground Trip element, the Short-time and Instantaneous pickup settings should not exceed the following maximums to avoid ground error signals possible due to sensor saturation.

Breaker Type	Sensor Tap Setting (Amperes)	Max. Pickup Setting (Amperes)
AK/AKR-50	1200	14,000
	1600	18,000
AKT/AKRT-50	1600	16,000
	2000	20,000

GENERAL ELECTRIC

AK/AKR LOW-VOLTAGE POWER CIRCUIT BREAKERS

SST™ SOLID-STATE OVERCURRENT TRIP DEVICE

Long-time-delay, Short-time-delay and Instantaneous Time-current Curves

Curves apply at 50/60 Hertz
From − 20C to + 70C Programmer Ambient

GES-6033B

X = Current Sensor Taps (Amperes)

AK-15	70, 100, 150, 225
AK-25	70, 100, 150, 225 or 200, 300, 400, 600
AKR-30	100, 150, 225, 300 or 300, 400, 600, 800
AK/AKR-50	300, 400, 600, 800 or 600, 800, 1200, 1600
AKT/AKRT-50	800, 1200, 1600, 2000
AK-75	1200, 1600, 2000, 3000
AKR-75	1200, 1600, 2000, 3200
AK/AKR-100	1600, 2000, 3000, 4000

Programmer Set Points

PICKUP
Long-time: .6, .7, .8, .9, 1.0 & 1.1 multiples of current sensor tap setting (X). (Settings higher than 100% of the frame size do not increase the continuous current rating).
Short-time: 1.75, 2, 2.25, 2.5, 3 & 4 or 3, 4, 5, 6, 8 & 10 multiples of Long-time pickup setting (L). For 50 Hz. operation, see Note 2.
Instantaneous: 4, 5, 6, 8, 10 & 12 multiples of Long-time pickup setting (L). For 50 Hz. operation, see Note 2.
TIME DELAY BANDS
Long-time and Short-time: Max., Int. & Min.

2-78 (3M)

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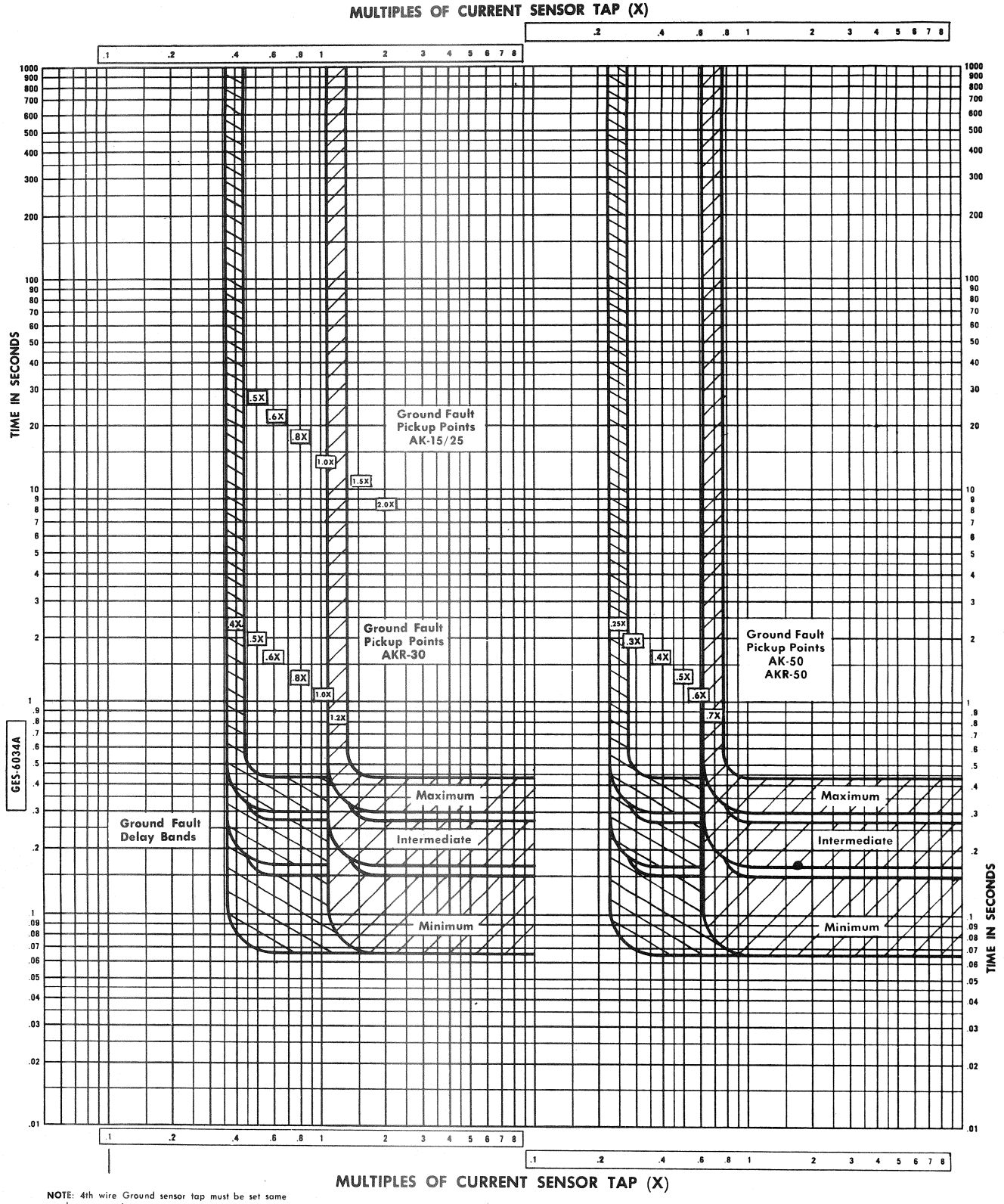

NOTE: 4th wire Ground sensor tap must be set same as phase sensor tap.

GENERAL ELECTRIC

TYPE AKR LOW-VOLTAGE POWER CIRCUIT BREAKERS

SST™ SOLID-STATE OVERCURRENT TRIP DEVICE

Ground Trip Time-current Curves

GES-6034A

	Current Sensor Taps (Amperes)
AK-15	70, 100, 150, 225
AK-25	70, 100, 150, 225 or 200, 300, 400, 600
AKR-30	100, 150, 225, 300 or 300, 400, 600, 800
AK AKR-50	300, 400, 600, 800 or 600, 800, 1200, 1600

Curves apply at 50/60 Hertz
From − 20C to + 70C Programmer Ambient

Programmer Set Points

Ground Fault Pickup:

AK-15/25	.5x, .6x, .8x, 1.0x, 1.5x, & 2.0x
AKR-30	.4x, .5x, .6x, .8x, 1.0x, & 1.2x
AK/AKR-50	.25x, .3x, .4x, .5x, .6x, & .7x

Where X = sensor tap setting

Ground Fault Delay Bands:
Maximum, Intermediate & Minimum

2-78 13M1

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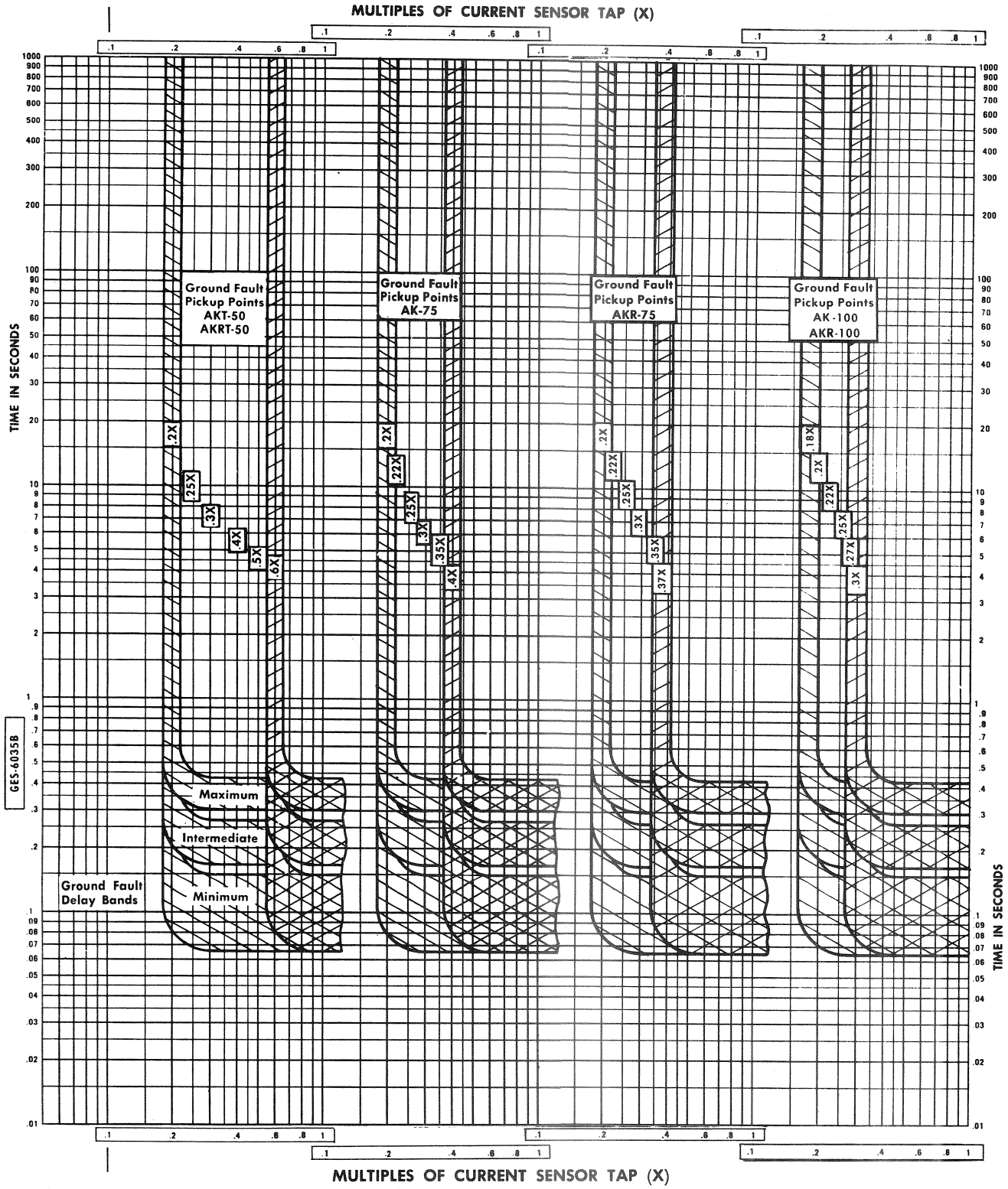

NOTE: 4th wire Ground sensor tap must be set same as phase sensor tap.

GENERAL ELECTRIC

AK/AKR LOW-VOLTAGE POWER CIRCUIT BREAKERS

SST™ SOLID-STATE OVERCURRENT TRIP DEVICE

Ground Trip Time-current Curves

Curves apply at 50/60 Hertz
From − 20C to + 70C Programmer Ambient

GES-6035B

X = Current Sensor Taps (Amperes)	
AKT AKRT-50	800, 1200, 1600, 2000
AK-75	1200, 1600, 2000, 3000
AKR-75	1200, 1600, 2000, 3200
AK/AKR-100	1600, 2000, 3000, 4000

Programmer Set Points

Ground Fault Pickup:

AKT/AKRT-50	.2x, .25x, .3x, .4x, .5x, & .6x
AK-75	.2x, .22x, .25x, .3x, .35x, & .4x
AKR-75	.2x, .22x, .25x, .3x, .35x & .37x
AK/AKR-100	.18x, .2x, .22x, .25x, .27x & .3x

Where X = sensor tap setting

Ground Fault Delay Bands
Maximum, Intermediate & Minimum

2-78 (3M)

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