Digitrip RMS Trip Units Used with Type SPB Systems Pow-R Breakers

I.L. 29-855-A

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WARNING

DO NOT ATTEMPT TO INSTALL OR PERFORM MAINTENANCE ON EQUIPMENT WHILE IT IS ENERGIZED. DEATH OR SEVERE PERSONAL INJURY CAN RESULT FROM CONTACT WITH ENERGIZED EQUIPMENT. ALWAYS VERIFY THAT NO VOLTAGE IS PRESENT BEFORE PROCEEDING WITH THE TASK, AND ALWAYS FOLLOW GENERALLY ACCEPTED SAFETY PROCEDURES.

THE WESTINGHOUSE ELECTRIC CORPORATION IS NOT LIABLE FOR THE MISAPPLICATION OR MISINSTALLATION OF ITS PRODUCTS.

The user is cautioned to observe all recommendations, warnings and cautions relating to the safety of personnel and equipment, as well as all general and local health and safety laws, codes, and procedures.

The recommendations and information contained herein are based on Westinghouse experience and judgement, but should not be considered to be all inclusive or covering every application or circumstance which may arise. If any questions arise, contact Westinghouse Electric Corporation for further information or instructions.

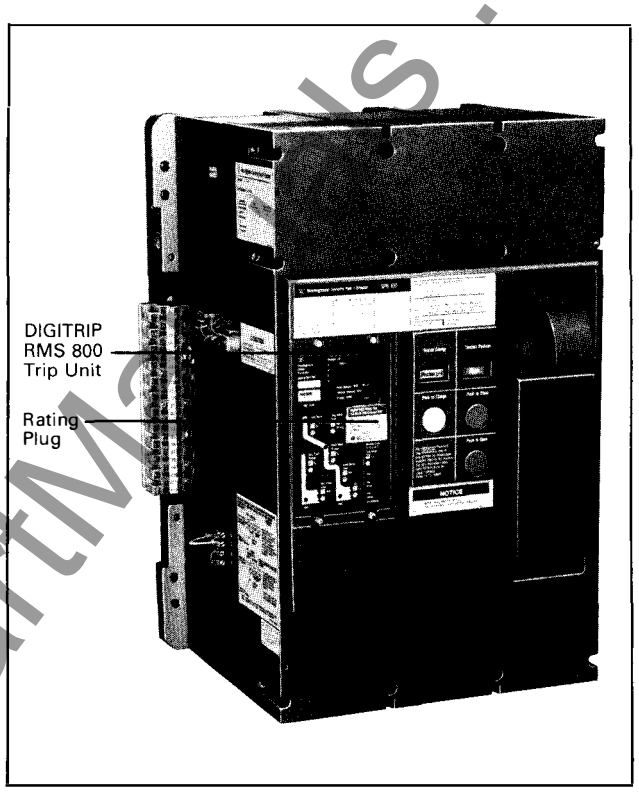


Fig. 1 *View of SPB Circuit Breaker Shown with Digitrip RMS 800 Trip Unit Installed*

1.0 Supplementary Information

The instructions contained in this book supplement the instructions for type SPB Systems Pow-R Breakers covered in I.L. 29-801 (I.B. 15082).

2.0 Digitrip RMS Trip Units

This instruction book specifically covers the application of Digitrip RMS Trip Units installed in type SPB Systems Pow-R Breakers as illustrated in Fig. 1.

Digitrip RMS Trip Units are AC devices that employ microprocessor based technology that provides true RMS current sensing means for proper correlation with thermal characteristics of conductors and equipment. The primary function of the Digitrip RMS Trip Unit is circuit protection. This is achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker shunt trip when pre-set current levels and time delay settings are exceeded.

In addition to the basic protection function, all Digitrip RMS Trip Unit models provide mode of trip information and integral test provisions.

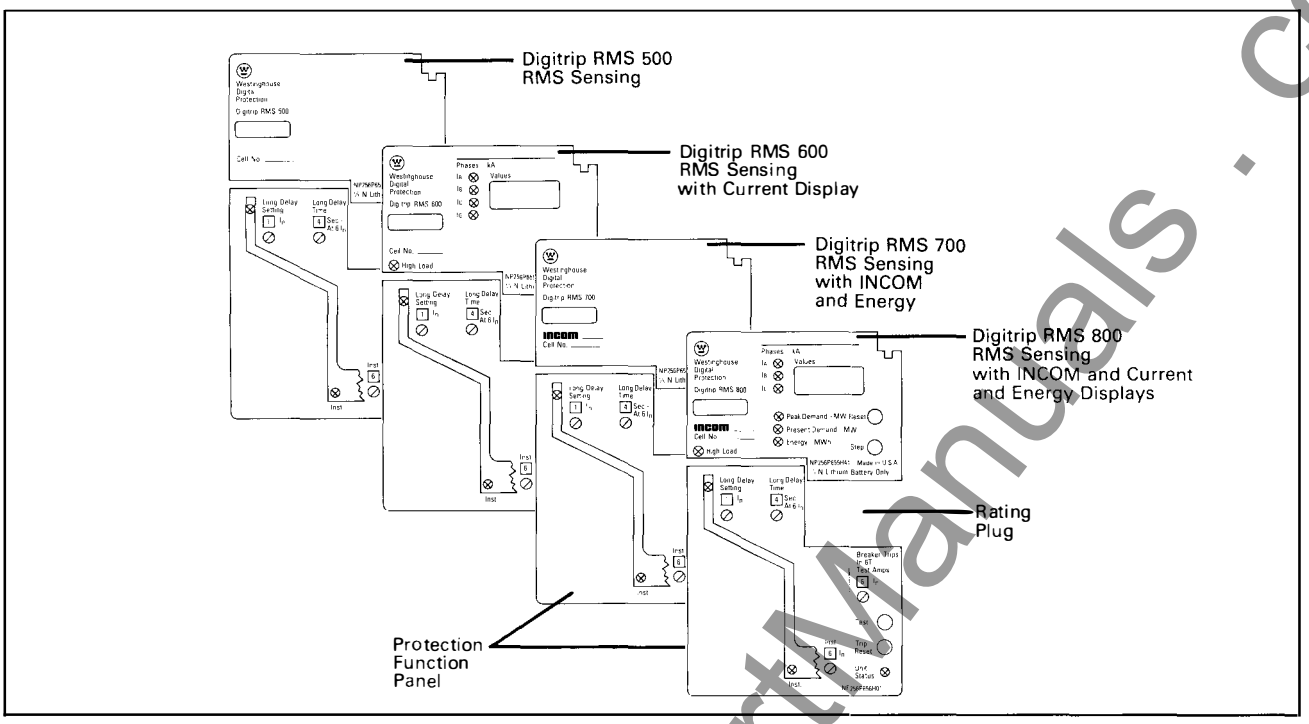


Fig. 2 *View of the Four Basic Models of the Digitrip RMS Trip Unit*

The protection section of the Digitrip RMS Trip Unit can be equipped with a maximum of five phase and two ground (time current) curve shaping adjustments. The exact selection of the available protection function adjustments is optional to satisfy the protection needs of any specific installation. The short delay and ground fault pick-up adjustments can be set for either flat or I^2t response. A pictorial representation of the applicable time-current curve for the selected protection functions is provided on the face of the trip unit for user reference.

Red LEDs that are placed in the Time-Current curves depicted on the face of the trip unit provide mode of trip indication for ground fault, overload and short circuit trip operations.

All Digitrip RMS Trip Units that are not equipped with an adjustable instantaneous trip element (LS and LSG) are provided with a making current release which is referred to as a discriminator. In addition, a high-level instantaneous override circuit is provided to insure rapid circuit clearing under abnormal fault current conditions.

Digitrip RMS Trip Units are available in four basic models, as illustrated in Fig. 2, 500, 600, 700 and 800. Separate instruction leaflets referenced in Section 7.2 cover the basic functions and features of each model. This instruction book is arranged to describe the unique features of each type as they relate to their application in Type SPB, Systems Pow-R Breakers. Table 1 illustrates the available functions and features of each of the four trip unit models.

3.0 Rating Plugs

Rating Plugs, as illustrated in Fig. 3, determine the continuous current rating of the circuit breaker. All protection function settings on the face of the trip unit are expressed in per unit multiples of the plug ampere rating (I_n).

Available rating plugs are shown in Table 2. Plugs must be selected to match the desired continuous current rating of the circuit breaker as well as the frame rating and the system frequency, i.e., 50 or 60 Hz.

Rating plugs are equipped with a back-up battery, as illustrated in Fig. 3, to maintain the mode of trip operation following a circuit breaker tripping operation when external control power is not available. The battery is a long-life lithium type, that is replaceable from the front of the trip unit, when required, without removing the rating plug. Replacement types and instructions are provided in the Digitrip RMS Trip Unit instruction leaflet referred to in Section 7.2 of this book.

Following a trip operation and with no supplementary control power available, the battery will maintain the mode of trip LED for approximately 60 hours.

> **Note**: The rating plug must be securely tightened in the trip unit before operating the circuit breaker.

4.0 Digitrip RMS Model Considerations

4.1 Digitrip RMS 500

The Digitrip RMS 500 Trip Assembly consists of a Digitrip RMS 500 Trip Unit as described in I.L. 29-851, 3 or 4 auxiliary current transformers and a stab-in trip unit terminal block as shown in Figs. 4 and 5.

The fourth auxiliary current transformer is supplied when the optional ground fault protection function is selected in the trip unit. Also, a side mounted 4-point terminal block is provided to pre-wire the mode of ground fault sensing used, i.e., residual, source ground or zero sequence.

The trip unit contains a receptacle for use with an optional Auxiliary Power module (Cat. No. PRTAAPM). When this module is in place on the trip unit and connected to a 120 V. 50/60 Hz supply, the circuit breaker can be bench tested using the integral test panel. With the circuit breaker in the closed posi-

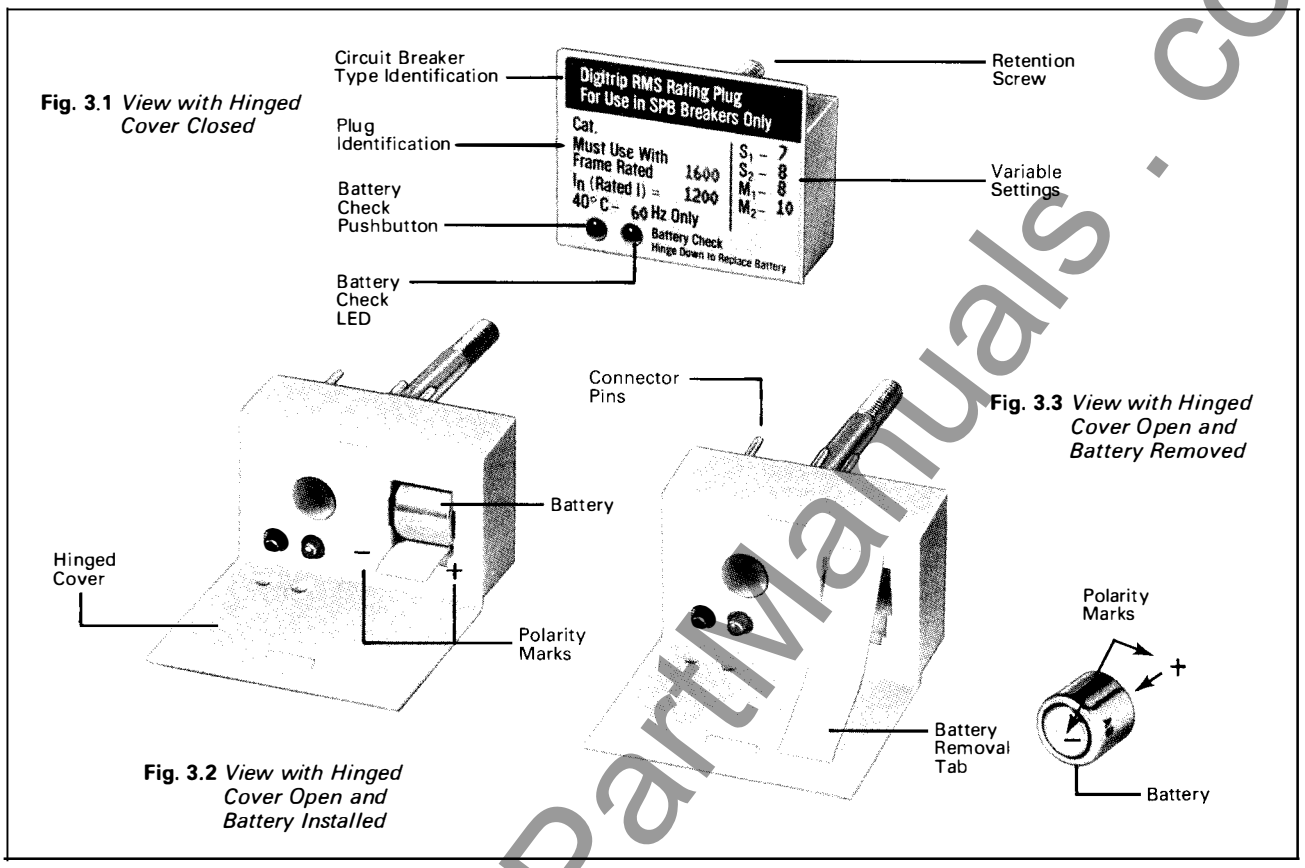


Fig. 3.1 *View with Hinged Cover Closed*

Fig. 3.2 *View with Hinged Cover Open and Battery Installed*

Fig. 3.3 *View with Hinged Cover Open and Battery Removed*

Fig. 3 *Typical Rating Plug*

tion, it can be "tripped" when the test selector switch is in either the "6T" or "GFT" positions.

CAUTION

TESTING OF A CIRCUIT BREAKER BY INITIATING A TRIP OPERATION WHILE IN THE CELL "CONNECTED" POSITION BY THE INTEGRAL TEST PROVISIONS IN THE DIGITRIP RMS TRIP UNIT IS NOT RECOMMENDED.

THE TRIPPING OPERATION OF THE CIRCUIT BREAKER WILL CAUSE DISRUPTION OF SERVICE AND POSSIBLY PERSONAL INJURY RESULTING FROM UNNECESSARY SWITCHING OF CONNECTED EQUIPMENT.

TESTING OF A CIRCUIT BREAKER SHOULD BE DONE ONLY IN THE "TEST", "DISCONNECTED" OR "WITHDRAWN" CELL POSITIONS.

4.2 Digitrip RMS 600

The Digitrip RMS 600 Trip Assembly consists of a Digitrip RMS 600 Trip Unit as described in I.L. 29-852, 3 or 4 auxiliary current transformers, a stab-in trip unit terminal block and a Power/Relay module mounted as illustrated in Figs. 4 and 5. The Digitrip RMS 600 Trip Unit is similar to a Digitrip RMS 500 Trip Unit with the addition of a four-digit display, three phase (I_A, I_B, I_C) and one ground current (I_G) green pointer LEDs along with a stepping pushbutton, a red High Load LED as illustrated in Table 1. Signal contacts are provided for hard wiring three remote mode of trip indicators (long delay, short circuit, ground fault) and a High-Load remote alarm.

The ground current pointer LED and ground fault mode of trip signal contact are supplied only when the ground fault protection function is provided in the trip unit.

A 120 V, 50/60 Hz 6 VA Power/Relay module is standard for operating the display and internally mounted signal relays. The relay contacts are each rated 120 V, 1.0 A. A 230 V 50/60 Hz 6 VA power relay module is also available.

The Power/Relay module will maintain the cause of trip LEDs history and trip history as long as the control power supply is available. With loss of the control power supply, only the cause of trip LEDs will be maintained by the back-up battery located in the rating plug.

The High-Load LED and remote alarm switch are pre-set at 85% of the value of the long delay setting. The High-Load relay operates and the LED turns "ON" when the 85% level is exceeded only after an approximate 40 second delay to ride through momentary High-Load conditions.

4.3 Digitrip RMS 700

The Digitrip RMS 700 Trip Assembly consists of a Digitrip RMS 700 Trip Unit as described in I.L. 29-853, 3 or 4 auxiliary current transformers, a stab-in trip unit terminal block, a Power/Relay module and a Potential Transformer module with a disconnect plug for dielectric testing of the circuit breaker mounted as partially illustrated in Figs. 4 and 5. The Digitrip RMS 700 Trip Unit is similar to a Digitrip RMS 500 Trip Unit with the addition

Table 1 – Digitrip RMS Trip Unit Characteristics

	Digitrip RMS Type	500	600	700	800
	Instruction Leaflet No.	I.L. 29-851	I.L. 29-852	I.L. 29-853	I.L. 29-854
Protection	Long Delay Setting	X	X	X	X
	Long Delay Time	X	X	X	X
	Long Time Memory	X	X	X	X
	Short Delay Pick-up	OPT.	OPT.	OPT.	OPT.
	Short Delay Time	OPT.	OPT.	OPT.	OPT.
	Flat/I^2T Response	X	X	X	X
	Zone Interlocking	①	①	①	①
	Instantaneous Pick-up	OPT.	OPT.	OPT.	OPT.
	Ground Fault Pick-up	OPT.	OPT.	OPT.	OPT.
	Ground Fault Time	OPT.	OPT.	OPT.	OPT.
	Flat/I^2T Response	X	X	X	X
	Ground Time Memory	X	X	X	X
	Zone Interlocking	①	①	①	①
	Interchangeable Rating Plug	X	X	X	X
Local Trip Indication	Mode of Trip LED's	X	X	X	X
	Battery – for Mode of Trip LEDS	X	X	X	X
	Battery Status LED	X	X	X	X
	Battery Test Pushbutton	X	X	X	X
Test	Integral Test Provisions	X	X	X	X
	Trip Unit Status Indication LED	X	X	X	X
	Auxiliary Power Module	OPT.	OPT.	OPT.	OPT.
Local Display On Trip Unit	Power/Relay Module		X	X	X
	4 Digit Display		X		X
	øA Current LED		X	②	X
	øB Current LED		X	②	X
	øC Current LED		X	②	X
	Gnd. Current LED		⑥	②⑥	⑥
	Display Stepping Pushbutton		X		X
	High Load LED		X		X
Remote Signals	Remote Signal Contacts:				
	Long Delay Trip		X	X	X
	Short Circuit Trip		X	X	X
	Ground Fault Trip		⑥	⑥	⑥
	High Load Alarm		X	X	X
Energy Monitoring	Potential Transformer Module			X	X
	PTM Disconnect Plug for Dielectric Testing of Circuit Breaker			X	X
	Energy Monitoring: Parameters				
	Peak Demand			④	X
	Peak Demand Reset PB			④	X
	Present Demand			④	X
	Energy Consumption			④	X
Communications	INCOM (Integrated Communications)			X	X
	INCOM Address Register			X	X
Transmittable Data	Transmittable Parameters:				
	Individual Phase Currents			②	③
	Ground Currents			②⑥	③⑥
	Energy			④	③
	Breaker Status:				
	Open/Closed/Tripped			●	●
	Mode of Trip:				
	Override			②	③
	Instantaneous			②	③
	Discriminator			②	③
	Short Delay			②	③
	Ground Fault			②⑥	③⑥
	Long Delay			②	③
	Long Delay Pick-up				③
	Information:				
	External Trip Command (Over INCOM)			②	③
	Data Memory Test Failure (RAM)			②⑥	③
	Program Memory Test Failure (ROM)			②⑥	③
	Missing or Defective Rating Plug			④	③
	Reverse Power Flow Response to Depressing Test Pushbutton			④	③
	Communication Failure			②⑥	②⑥
Control	Breaker Command (Via INCOM):				
	Trip			X	X
	Close			OPT.●	OPT.⑦

OPT = Optional
① Use of zone interlocking is optional with breaker wiring modification.
② Remote location only unless optional AEM local monitor is used.
③ Local (on face of trip unit) or remote via INCOM.
④ Remote only.
⑤ On AEM denoted by absence of response from addressed breaker.
⑥ Supplied only when trip unit is equipped with ground fault protection option.
⑦ Requires spring release or electrical operator option.

of an INCOM module along with an adjustable INCOM address register. Signal contacts are provided for hard-wiring three remote mode of trip indicators (long delay, short delay, ground fault) and a High-Load remote alarm. The ground fault mode of trip signal contact is supplied only when the ground fault protection function is provided in the trip unit. These additions, along with the transmittable data possibilities, are illustrated in Table 1.

Only the mode of trip LED indicators provide data on the face of the trip unit. However, with the addition of a locally mounted Assemblies Electronic Monitor (AEM), as described in I.L. 17-216, the data in Table 1 referenced by Note 2 can also be viewed.

The Assemblies Electronic Monitor (AEM) is a microprocessor-based, self-contained, door-mounted device designed to monitor circuit breakers equipped with Digitrip RMS 700 or Digitrip RMS 800 Trip Units.

Network interconnections for the INCOM circuit must be connected as shown in I.L. 29-853, Figs. 9A, 9B, and 9C using twisted pair (shielding preferred), No. 18 AWG conductors.

The three-digit INCOM address must be set on each trip unit per instructions given in I.L. 29-853. To insure that each circuit breaker in an assembly is properly located after the address is set, the breaker should be identified with its proper cell location and that reference along with the breaker INCOM address should be marked on the face of the trip unit in the spaces provided. In addition to the communication of breaker data, the INCOM module allows for remote tripping (via the low energy shunt trip) and closing of the circuit breaker.

4.4 Digitrip RMS 800

The Digitrip RMS 800 Trip Assembly is similar to the Digitrip RMS 700 Trip Assembly with the addition of a four-digit display, three phase (I_A, I_B, I_C) and one ground current (I_G) green pointer LEDs along with a stepping pushbutton, a red High Load LED, peak demand, present demand and energy consumed green pointer LEDs along with a peak demand reset pushbutton as illustrated in Table 1. The Digitrip RMS 800 Trip Unit is described in I.L. 29-854.

The Trip Assembly provides for both local displays on the face of the trip unit and remote communications via an INCOM communication network signal link as illustrated in Table 1.

In addition, if desired, an Assemblies Electronic Monitor (AEM) as described in I.L. 17-216, may also be installed to show the parameters in Table 1 covered under Note 2.

Interconnections for the INCOM circuit must be connected as shown in I.L. 29-854, Figs. 9A, 9B and 9C using twisted pair (shielding preferred) No. 18 AWG conductors.

The three-digit INCOM address must be set on each trip unit per instructions given in I.L. 29-854. To insure that each circuit breaker in an assembly is properly located after the address is set, the breaker should be identified with its proper cell location and that reference along with the breaker INCOM address marked on the face of the trip unit in the spaces provided.

In addition to the communication of the breaker data, the INCOM module allows for remote tripping (via the low energy shunt trip) and closing of the circuit breaker.

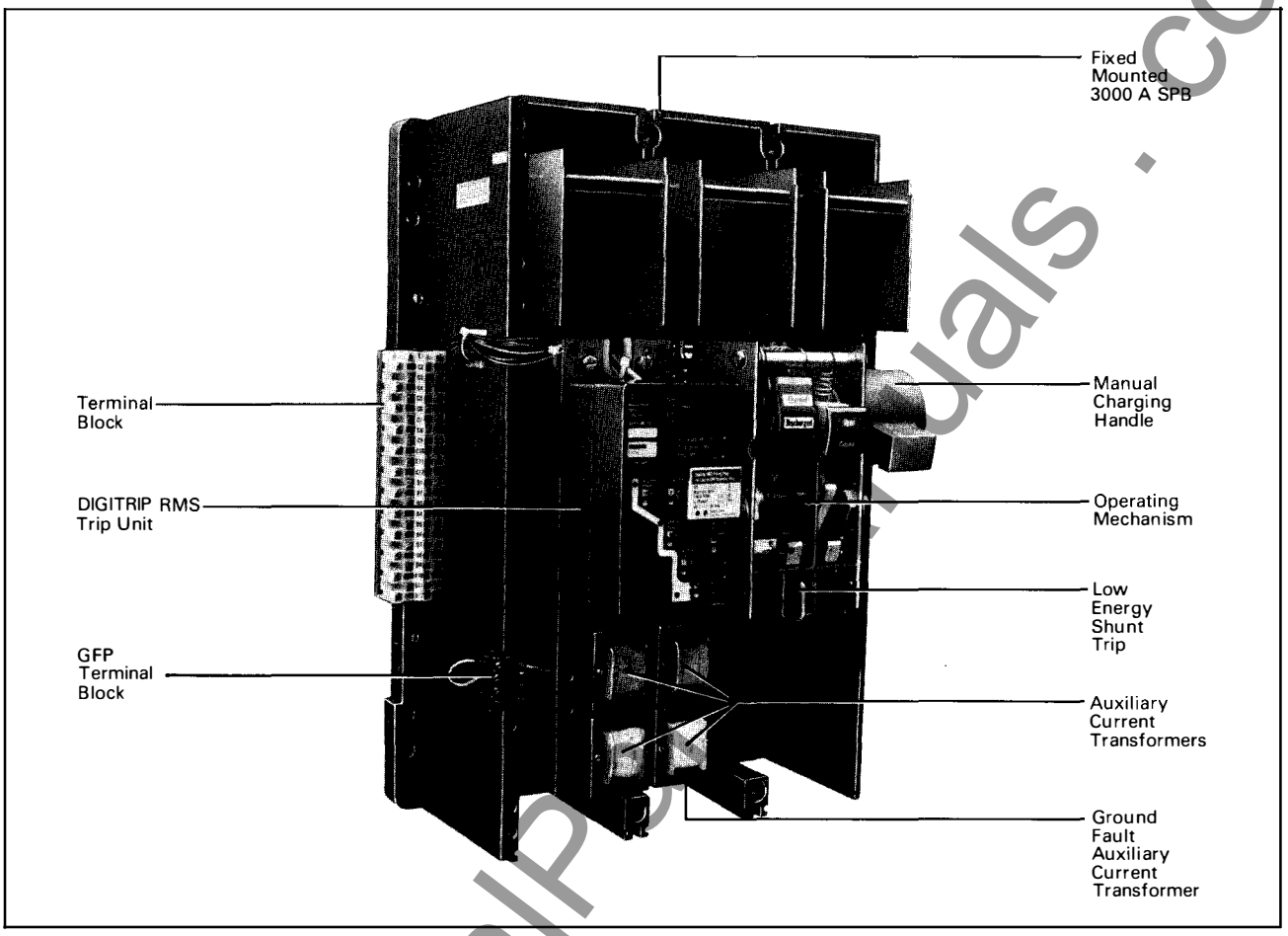


Fig. 4 *View of 3000 A Circuit Breaker with Front Cover Removed to Expose Digitrip RMS Trip Unit*

WARNING

CARELESSLY PLANNED AUTOMATIC CIRCUIT BREAKER CLOSING OPERATIONS INITIATED BY INCOM COMMUNICATION SIGNALS DURING MAINTENANCE PERIODS COULD CAUSE SEVERE PERSONAL INJURY OR DEATH.

INSTALL APPROPRIATE PERMISSIVE CONTROL MEANS AS ILLUSTRATED IN CONNECTION DIAGRAM I.S. 15545 (SHEETS 40, 41 AND 42) TO AVOID UNDESIRED REMOTE CLOSING OPERATIONS DURING MAINTENANCE PERIODS. ALSO, PROVIDE ADEQUATE EQUIPMENT WARNINGS FOR NORMAL OPERATION PERIODS.

4.5 Reset Operation

Following a overload, short circuit or ground fault tripping event, the Digitrip's "Trip Reset" push button must be depressed before the circuit breaker can be reclosed.

5.0 Principle of Operation

5.1 General

The circuit breaker is tripped automatically on fault current conditions by the combined action of three components:

1. The sensors which determine the current level.
2. The Digitrip RMS Trip Unit, which provides a tripping signal to the Low Energy Shunt Trip when current and time delay settings are exceeded.
3. The low energy shunt trip which actually trips the circuit breaker.

Schematically, this may be represented as illustrated in Fig. 6 for a 3000A. Pow-R Breaker. This arrangement provides a very flexible system covering a wide range of tripping characteristics as illustrated by the Time-Current curves appearing in Sections 6.1, 6.2 and 6.3 of this instruction book. Not only is the Digitrip RMS Trip Unit adjustable, but selection of rating plugs provides a wide range of continuous current ratings.

The automatic overload and short circuit tripping characteristics for a specific circuit breaker are determined by the ratings of the installed current sensors, rating plugs and the selected functional protection settings. Specific setting instructions are provided in the applicable trip unit instruction leaflet referenced in Section 7.2 of this instruction book.

When the functional protection settings are exceeded, the Digitrip RMS Trip Unit supplies a trip signal to the low energy shunt trip. Thus all tripping operations initiated by the protection functions of the Digitrip RMS Trip Unit are performed by secondary control circuitry, with no mechanical or direct magnetic action between the primary current and the mechanical tripping parts of the breaker and with no external control power required.

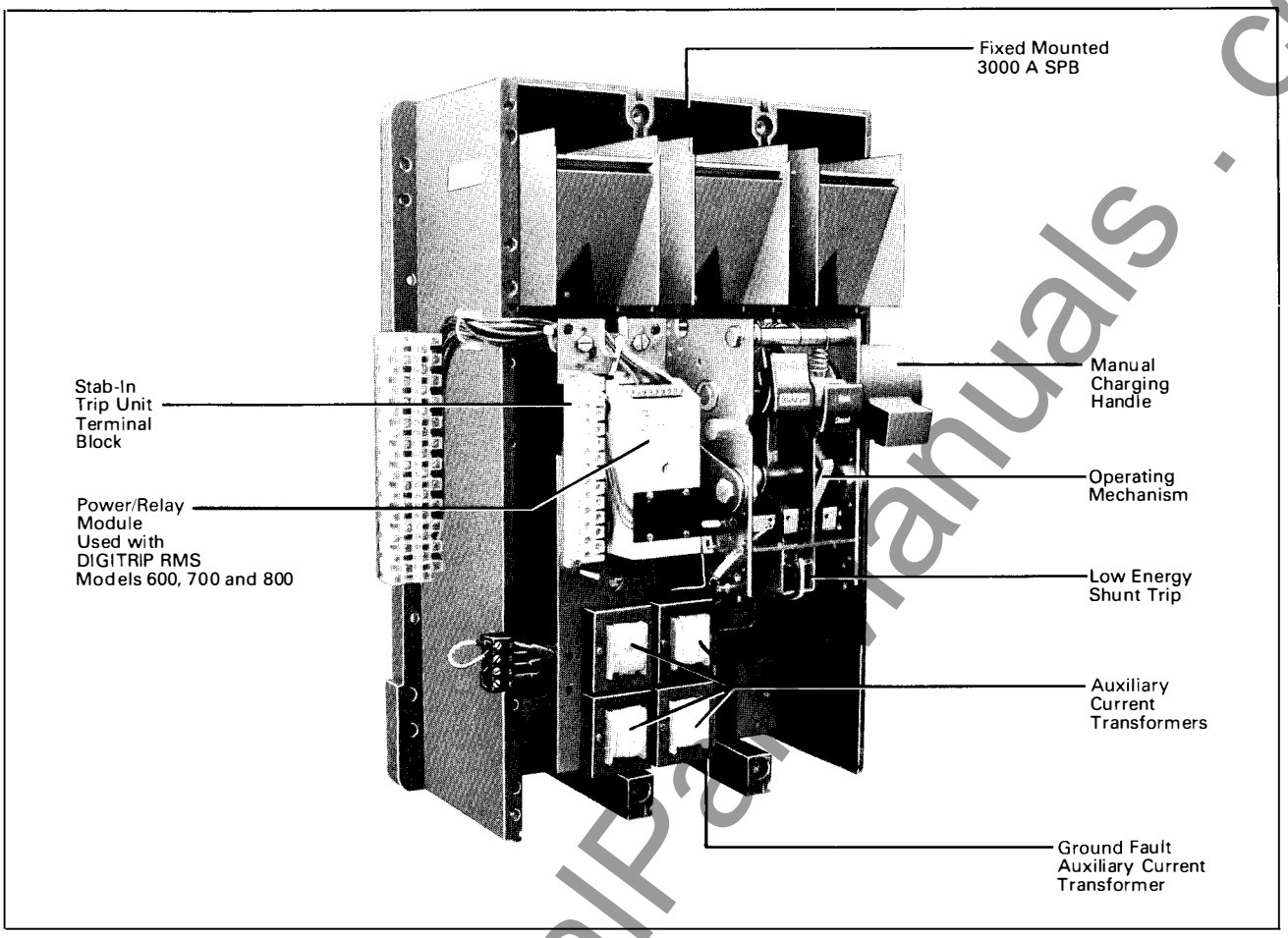


Fig. 5 *View of 3000 A Circuit Breaker with Front Cover and Digitrip RMS Trip Unit Removed to Expose Power/Relay Module and Stab-In Terminal Block*

5.2 Digitrip RMS Trip Assembly

The basic Digitrip RMS Trip Assembly, as illustrated in Figs. 1, 2 and 4, includes the following which could vary slightly depending upon the exact model of the Digitrip RMS Trip Unit installed:

1. Digitrip RMS Trip Unit
2. Rating Plug
3. Auxiliary Current Transformers – 3 or 4 depending upon whether or not ground fault protection is included. Not required on 400-2000 C.
4. Stab-in Terminal Block for Trip Unit
5. Power/Relay module (Digitrip RMS Trip Unit Models 600, 700 and 800 only)
6. Potential Transformer module with Dielectric Test Disconnect Plug (Digitrip RMS Trip Unit Models 700 and 800 only)

As shown in Figs. 1 and 4, the Digitrip RMS Trip Unit assembly mounts in the left hand pole of a Systems Pow-R Breaker.

The Systems Pow-R Breaker is factory wired in accordance with the applicable pages of connection diagram I.S. 15545. Any field installation or modification must be made in accordance with the applicable pages of this same document.

CAUTION

IMPROPER POLARITY CONNECTIONS ON THE LOW ENERGY SHUNT TRIP COIL WILL VOID OVERLOAD AND SHORT CIRCUIT PROTECTION WHICH COULD RESULT IN PERSONAL INJURY.

OBSERVE POLARITY MARKINGS ON THE SHUNT TRIP LEADS AND CONNECT PROPERLY WITH INSTRUCTIONS PROVIDED SHOULD ANY CHANGES BE MADE.

5.3 Low Energy Shunt Trip

The mechanical force required to initiate the tripping action of a type SPB Systems Pow-R Breaker is provided by a special low energy shunt trip. It is mounted, as shown in Fig. 4, on the underneath side of the mechanism housing. It contains a permanent magnet assembly, moving and stationary core assemblies along with a spring and coil. The circuit breaker mechanism assembly contains a mechanism actuated reset lever and a rotating trip lever to actuate the tripping action of the circuit breaker.

When the Low Energy Shunt Trip is reset by the operating mechanism, the moving core assembly is held in readiness against the force of the compressed spring by the permanent magnet. When a tripping action is initiated, the Low Energy Shunt Trip coil receives a tripping pulse from the Digitrip RMS

Trip Unit. This pulse overcomes the holding effect of the permanent magnet, and the moving core is released to trigger the tripping operation via the rotating trip lever.

5.4 Ground Fault Protection

5.4.1 General

When the Digitrip RMS Trip Assembly includes ground fault protection, the distribution system characteristics, i.e., system grounding, number of sources, number and location of ground points, etc. must be considered as well as the manner and location in which the circuit breaker is applied to the system.

Three modes of sensing ground fault currents are generally used: residual, source ground and zero sequence. Systems Pow-R Breakers are internally prewired to accommodate all three types. A side mounted 4-point terminal block, as shown in Fig. 4, is provided to revise connections required to accommodate each method. A nameplate is provided on the side of the circuit breaker that illustrates the required connections. Applicable connection variations are illustrated in Figs. 8 and 10.

If the system neutral is grounded, but no phase to neutral loads are used, the Digitrip RMS Trip Assembly includes all of the components necessary for ground fault protection.

5.4.2 Residual Sensing

The standard mode of ground fault sensing in Systems Pow-R Breakers is Residual Sensing. This mode utilizes one current sensor on each phase conductor and one on the neutral. This mode of sensing vectorially sums the outputs of the four individual current sensors. As long as the vectorial sum is zero, then no ground fault exists. The neutral sensor must have characteristics which are identical to the three internally mounted phase current sensors. Available types of neutral sensors are illustrated in Figs. 12, 13 and 14. Residual ground fault sensing means are adaptable to main and feeder breaker applications. Available ground fault pick-up settings employing Residual Sensing means are given in Table 3.

5.4.3 Ground Return Sensing

Depending upon the installation requirements, alternate ground fault sensing schemes may be dictated. The ground return method is most applicable where ground fault protection is desired only on the main circuit breaker in a simple radial system. This method is also applicable on double-ended systems where a mid-point grounding electrode is employed. For this mode of sensing, a single current sensor mounted on the equipment bonding jumper measures directly the total ground current flowing in the grounding electrode conductor and all other equipment grounding conductors.

The values shown in Table 3 will apply when the neutral sensors shown in Figs. 12, 13 and 14 are employed in a ground return sensing scheme provided the neutral sensor is the same as the frame rating.

> **Note:** Regardless of the mode of sensing employed, the polarity of the sensor connections is critical. Always observe the polarity markings on the installation drawings. To insure correct ground fault equipment performance, conduct field tests to comply with National Electrical Code requirements under Article 230-95(C).

Table 2 – Catalog Numbers of Available Rating Plugs

Rated Current (Amps I_n)	Frame Rating (Amps)	Catalog Number 60 Hz	Catalog Number 50 Hz
200	400	PD6S04A020	PD5S04A020
250		PD6S04A025	PD5S04A025
300		PD6S04A030	PD5S04A030
400		PD6S04A040	PD5S04A040
400	800	PD6S08A040	PD5S08A040
600		PD6S08A060	PD5S08A063①
800		PD6S08A080	PD5S08A080
600	1200	PD6S12A060	PD5S12A063①
800		PD6S12A080	PD5S12A080
1000		PD6S12A100	PD5S12A100
1200		PD6S12A120	PD5S12A125②
800	1600	PD6S16A080	PD5S16A080
1000		PD6S16A100	PD5S16A100
1200		PD6S16A120	PD5S16A125②
1600		PD6S16A160	PD5S16A160
1000	2000C	PD6S21A100	PD5S21A100
1200		PD6S21A120	PD5S21A125②
1600		PD6S21A160	PD5S21A160
2000		PD6S21A200	PD5S21A200
1600	2000	PD6S20A160	PD5S20A160
2000		PD6S20A200	PD5S20A200
1600	2500	PD6S25A160	PD5S25A160
2000		PD6S25A200	PD5S25A200
2500		PD6S25A250	PD5S25A250
1600	3000	PD6S30A160	PD5S30A160
2000		PD6S30A200	PD5S30A200
2500		PD6S30A250	PD5S30A250
3000		PD6S30A300	PD5S30A300
2000	4000	PD6S40A200	PD5S40A200
2500		PD6S40A250	PD5S40A250
3000		PD6S40A300	PD5S40A300
3200		PD6S40A320	PD5S40A320
4000		PD6S40A400	PD5S40A400
3000	5000	PD6S50A300	PD5S50A300
3200		PD6S50A320	PD5S50A320
4000		PD6S50A400	PD5S50A400
5000		PD6S50A500	PD5S50A500

① Actual plug rating 630A.
② Actual plug rating 1250A.

Table 3 – Ground Fault Current Pick-up Settings Using Residual Sensing Mode

Installed Rating Plug Amperes (I_n)	Pick-up (Dial) Setting Amperes③							
	A④	B④	C④	D④	E④	F	H	K
200	50	60	70	80	100	120	150	200
250	63	75	88	100	125	150	188	250
300	75	90	105	120	150	180	225	300
400	100	120	140	160	200	240	300	400
600	150	180	210	240	300	360	450	600
800	200	240	280	320	400	480	600	800
1000	250	300	350	400	500	600	750	1000
1200	300	360	420	480	600	720	900	1200
1600	400	480	560	640	800	960	1200	1200
2000	500	600	700	800	1000	1200	1200	1200
2500	625	750	875	1000	1200	1200	1200	1200
3000	750	900	1050	1200	1200	1200	1200	1200
3200	800	960	1120	1200	1200	1200	1200	1200
4000	1000	1200	1200	1200	1200	1200	1200	1200
5000	1200	1200	1200	1200	1200	1200	1200	1200

③ Except as noted, tolerances on pick-up levels are ±10% of values shown in chart.
④ Ground fault pick-up levels shown are nominal values when tested with external control power present. Without external control power, such as is the case with the Digitrip RMS 500, ground pick-up levels may exceed these values and be as high as the value shown for the "E" setting of that particular rating plug.

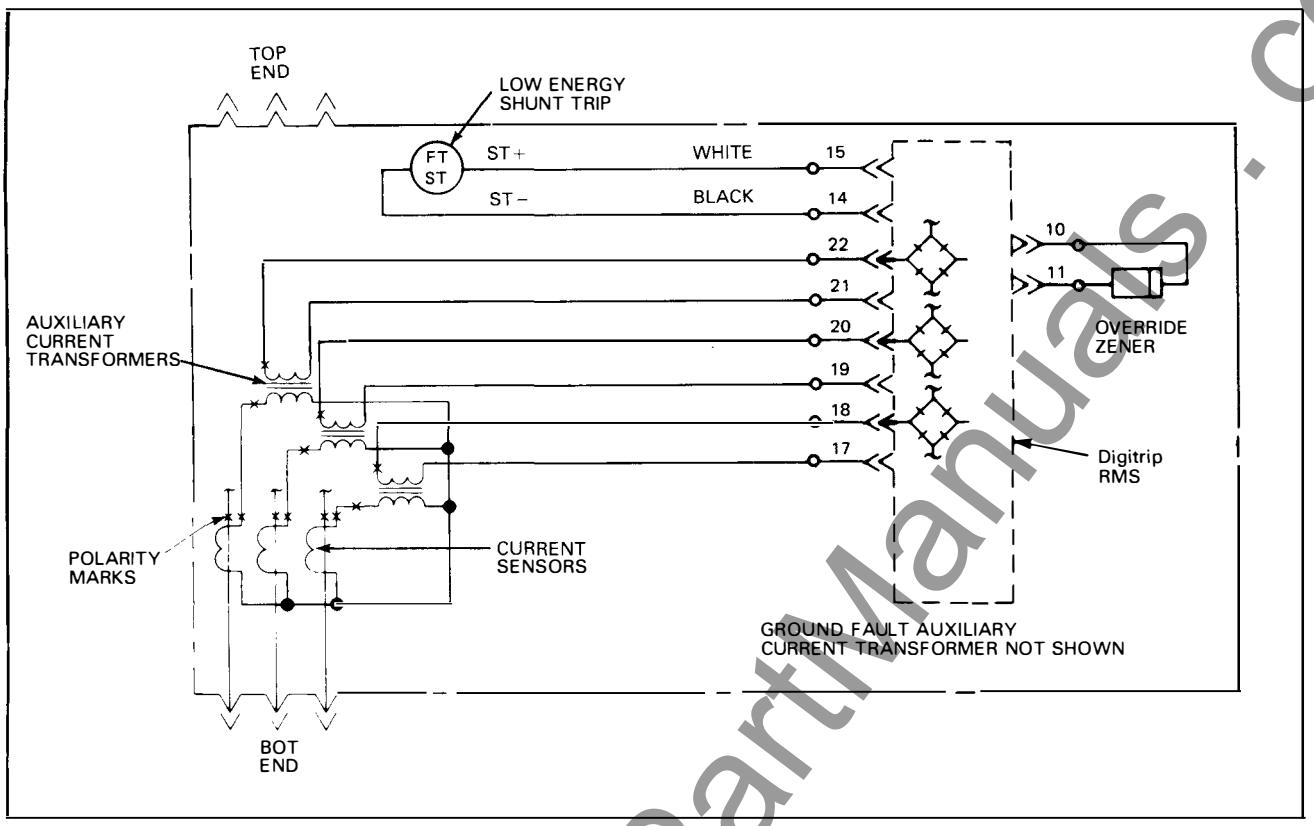


Fig. 6 *Partial Internal Connections of a 3000 A Systems Pow-R Breaker*

5.4.4 Zero Sequence Sensing

Zero Sequence Sensing (also referred to as vectorial summation) is applicable to mains, feeders and special schemes involving zone protection. Since most ground fault sensing requirements can be resolved by using either the residual, the ground return or a combination of the two, the Zero Sequence mode of sensing is seldom used. For specific applications requiring this mode of sensing, contact Westinghouse.

5.4.5 Ground Fault Settings

The adjustment of the ground fault functional settings is illustrated in the applicable Digitrip RMS Trip Unit instruction leaflet referenced in Section 7.2 of this instruction book. Either flat response or I^2t response settings may be selected. The effect of these settings is illustrated in the ground fault Time-Current curve included in Section 6 of this instruction book. Applicable residual ground fault pick-up settings and current values are given in Table 3 as well as on the "G" Time-Current curve.

5.5 Current Sensors

The three primary current sensors installed in the circuit breaker are located internally on the lower conductors which are normally on the load side of the main contacts. The physical location is shown in Fig. 7.

In the larger frame ratings, 2000A. through 5000A., the auxiliary current transformers are mounted as shown in Fig. 4. The ground fault auxiliary current transformer is supplied only when the ground fault protection function is supplied in the Digitrip RMS Trip Unit. A partial internal schematic is shown in Fig. 6 as well as in the residual diagram shown in Fig. 11.

In the smaller frame ratings, 400A. through 2000A. (compact 16 inch high frame), the auxiliary current transformer supplied is a 5-winding transformer as shown in the residual diagram in Fig. 9. The physical location is shown in Fig. 7.

The primary current sensors produce an output proportional to the load current and furnish the Digitrip RMS Trip Assembly with the intelligence and energy to trip the circuit breaker when functional protection settings are exceeded.

5.6 Digitrip RMS Accessories

5.6.1 Power/Relay Module

The Power/Relay Module which is supplied with Digitrip RMS Trip Unit models 600, 700 and 800 is mounted in the left pole of the Systems Pow-R Breaker as shown in Figs. 5 and 7. This module provides control power for operating the 4-digit display and internally mounted signal relays.

5.6.2 Potential Transformer Module

The Potential Transformer Module is supplied with Digitrip RMS Trip Unit models 700 and 800. It is mounted in the left pole of the Systems Pow-R Breaker as shown in Fig. 7. This module provides voltage for computing the energy monitoring parameters.

The potential disconnect plug (not shown) is mounted on the left side of the Systems Pow-R Breaker just above the 4-point GFP terminal block as shown in Figs. 4 and 5. This plug must be removed prior to any dielectric testing of the circuit breaker.

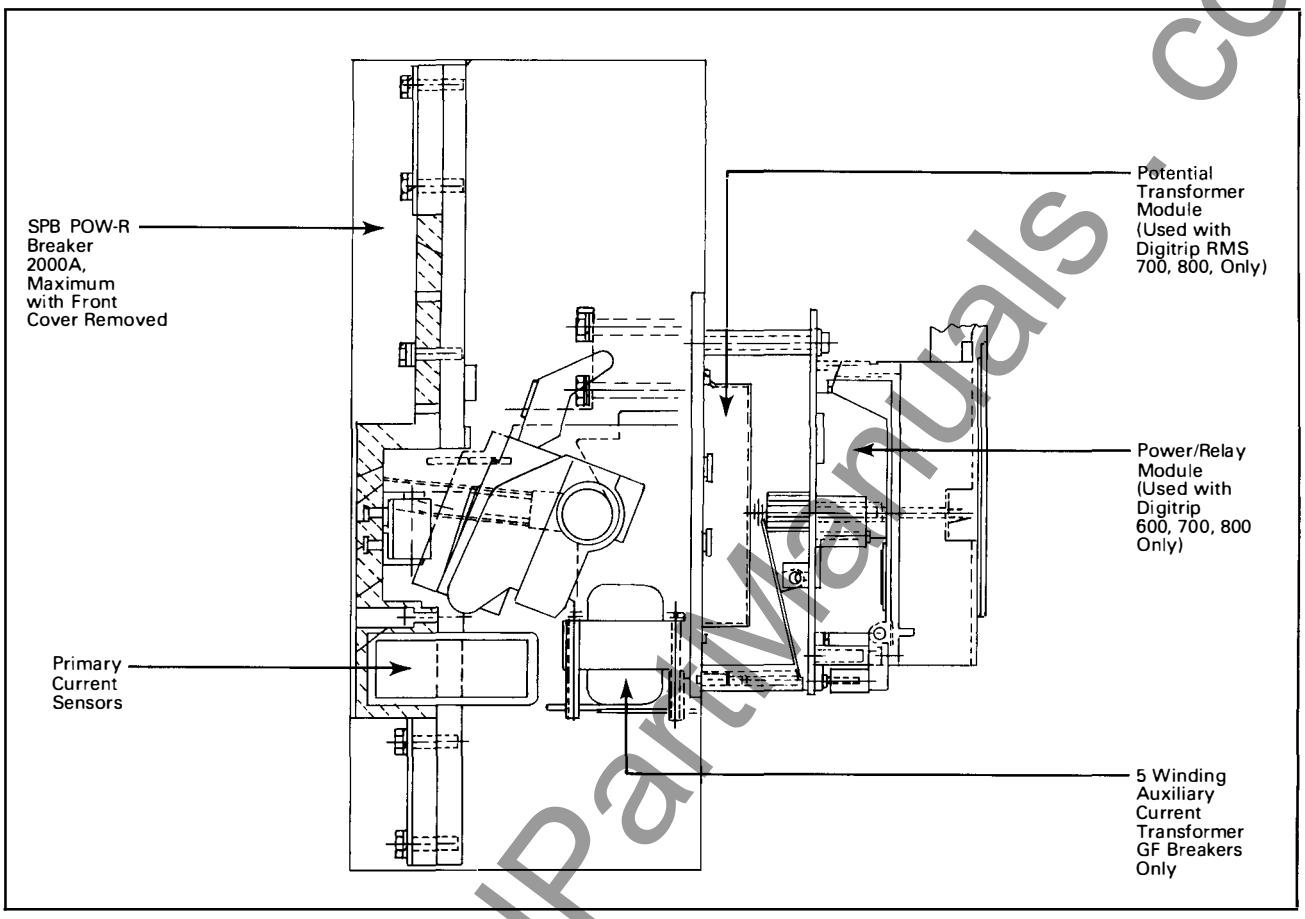


Fig. 7 *Side View of 2000 A Maximum Pow-R Breaker*

5.6.3 Dielectric Testing

DIELECTRIC TESTING OF THE CIRCUIT BREAKER WITH THE DIELECTRIC DISCONNECT PLUG INSTALLED WILL DAMAGE THE POTENTIAL TRANSFORMER MODULE AND DIGITRIP RMS 700 OR 800 TRIP UNIT.

REMOVE THE DISCONNECT PLUG PRIOR TO DOING ANY DIELECTRIC TESTING OF THE CIRCUIT BREAKER. REPLACE THE PLUG AFTER ALL DIELECTRIC TESTING IS COMPLETED AND PRIOR TO CLOSING THE CIRCUIT BREAKER PER THE ESTABLISHED OPERATING PROCEDURES.

5.7 Connection Diagram

A complete master connection diagram for the Systems Pow-R Breaker employing a Digitrip RMS Trip Unit is given in I.S. 15545. Each circuit breaker shipped from the factory includes a copy of the pages from this document that are applicable to the equipment included in the breaker.

5.8 Trip Unit Settings Protection

To insure the non-tampering of selected protection settings, a sealable plexi-glass cover as shown in Fig. 15 is provided. The cover is held in place by four cover screws. The non-tamperability is insured by the insertion of a standard meter seal through the holes in two of the cover retention screws.

6.0 Time-Current Curves

The following Time-Current curves illustrate the adjustability and configuration of the resultant Time-Current characteristic curves of the Digitrip RMS Trip Unit family. All protection function time-current settings should be made following the recommendations of the specifying engineer in charge of the installation.

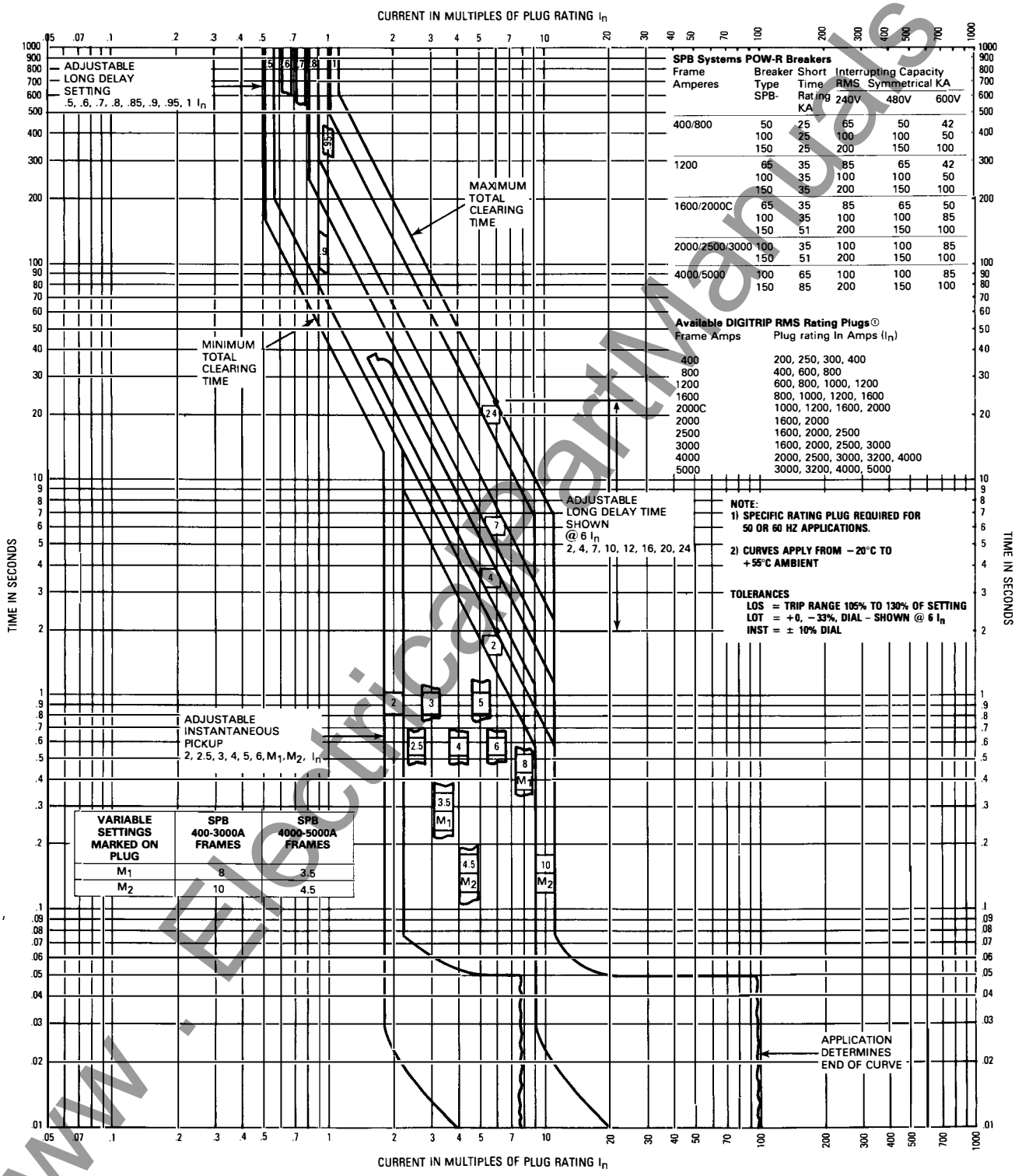
NOTICE

THE PROVISION FOR ZONE INTERLOCKING IS STANDARD ON ALL SYSTEM POW-R BREAKERS WITH DIGITRIP RMS HAVING EITHER SHORT TIME OR GROUND FAULT FUNCTION. APPROPRIATE JUMPERS MUST BE ADDED ON BREAKER IF ZONE INTERLOCKING IS NOT DESIRED OR IF FIELD TESTING IS DESIRED (REF. I.S. 15545 SHEET 3).

6.1 Long Time/Instantaneous Time-Current Curve SC-4283-87

DIGITRIP RMS 500/600/700/800

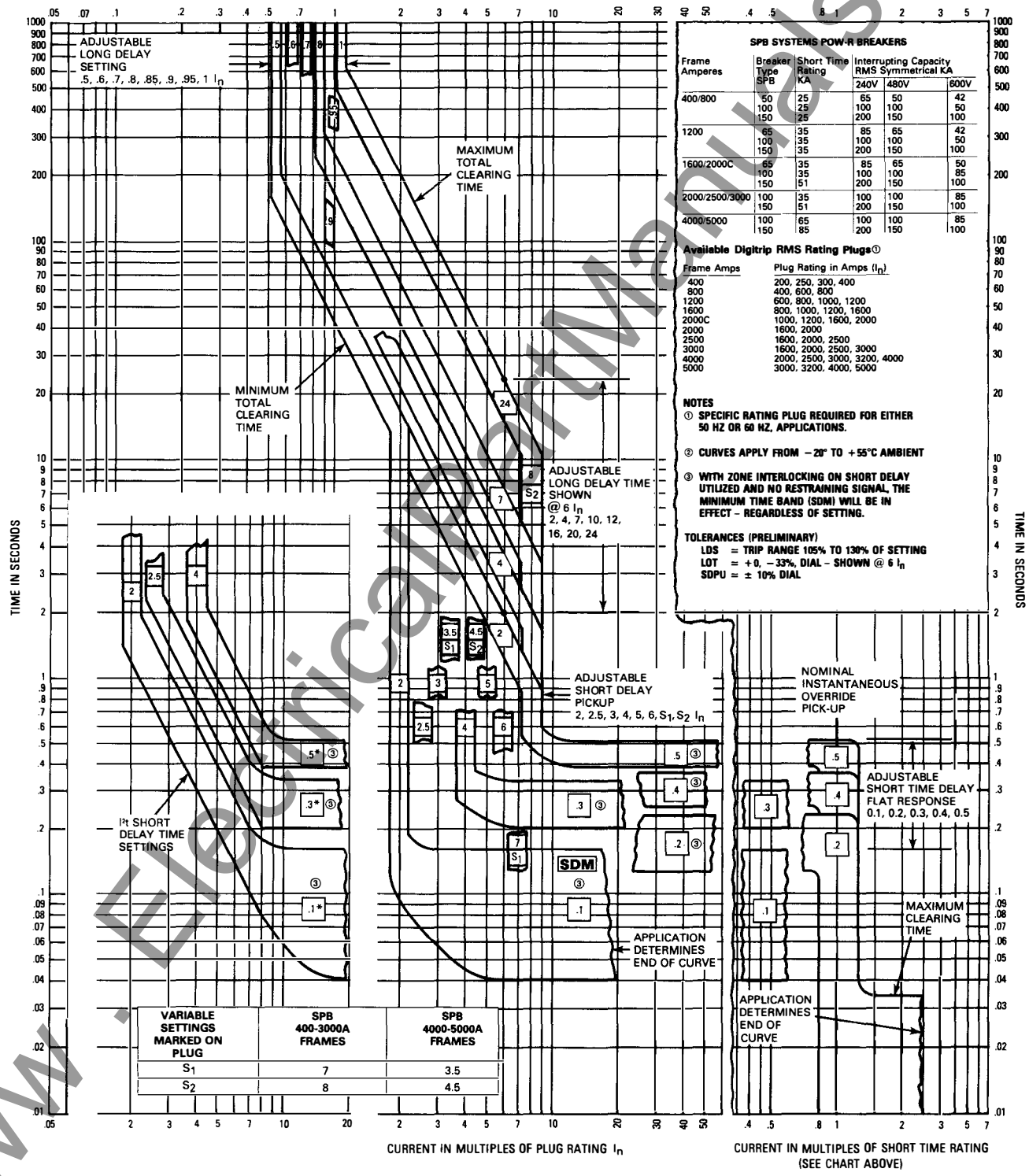
Typical Time-Current Characteristic Curve (LI)
for Type SPB Systems Pow-R Breakers



6.2 Long Time/Short Time Time-Current Curve SC-4284-87

DIGITRIP RMS 500/600/700/800

Typical Time-Current Characteristic Curve (LS) for Type SPB Systems Pow-R Breakers



SPB SYSTEMS POW-R BREAKERS

Frame Amperes	Breaker Type SPB	Short Time Rating KA	Interrupting Capacity RMS Symmetrical KA 240V	480V	600V
400/800	50	25	65	50	42
	100	25	100	100	50
	150	25	200	150	100
1200	65	35	85	65	42
	100	35	100	100	50
	150	35	200	150	100
1600/2000C	65	35	85	65	50
	100	35	100	100	85
	150	51	200	150	100
2000/2500/3000	100	35	100	100	85
	150	51	200	150	100
4000/5000	100	65	100	100	85
	150	85	200	150	100

Available Digitrip RMS Rating Plugs①

Frame Amps	Plug Rating in Amps (I_n)
400	200, 250, 300, 400
800	400, 600, 800
1200	600, 800, 1000, 1200
1600	800, 1000, 1200, 1600
2000C	1000, 1200, 1600, 2000
2000	1600, 2000
2500	1600, 2000, 2500
3000	1600, 2000, 2500, 3000
4000	2000, 2500, 3000, 3200, 4000
5000	3000, 3200, 4000, 5000

NOTES

① SPECIFIC RATING PLUG REQUIRED FOR EITHER 50 HZ OR 60 HZ, APPLICATIONS.

② CURVES APPLY FROM −20° TO +55°C AMBIENT

③ WITH ZONE INTERLOCKING ON SHORT DELAY UTILIZED AND NO RESTRAINING SIGNAL, THE MINIMUM TIME BAND (SDM) WILL BE IN EFFECT – REGARDLESS OF SETTING.

TOLERANCES (PRELIMINARY)

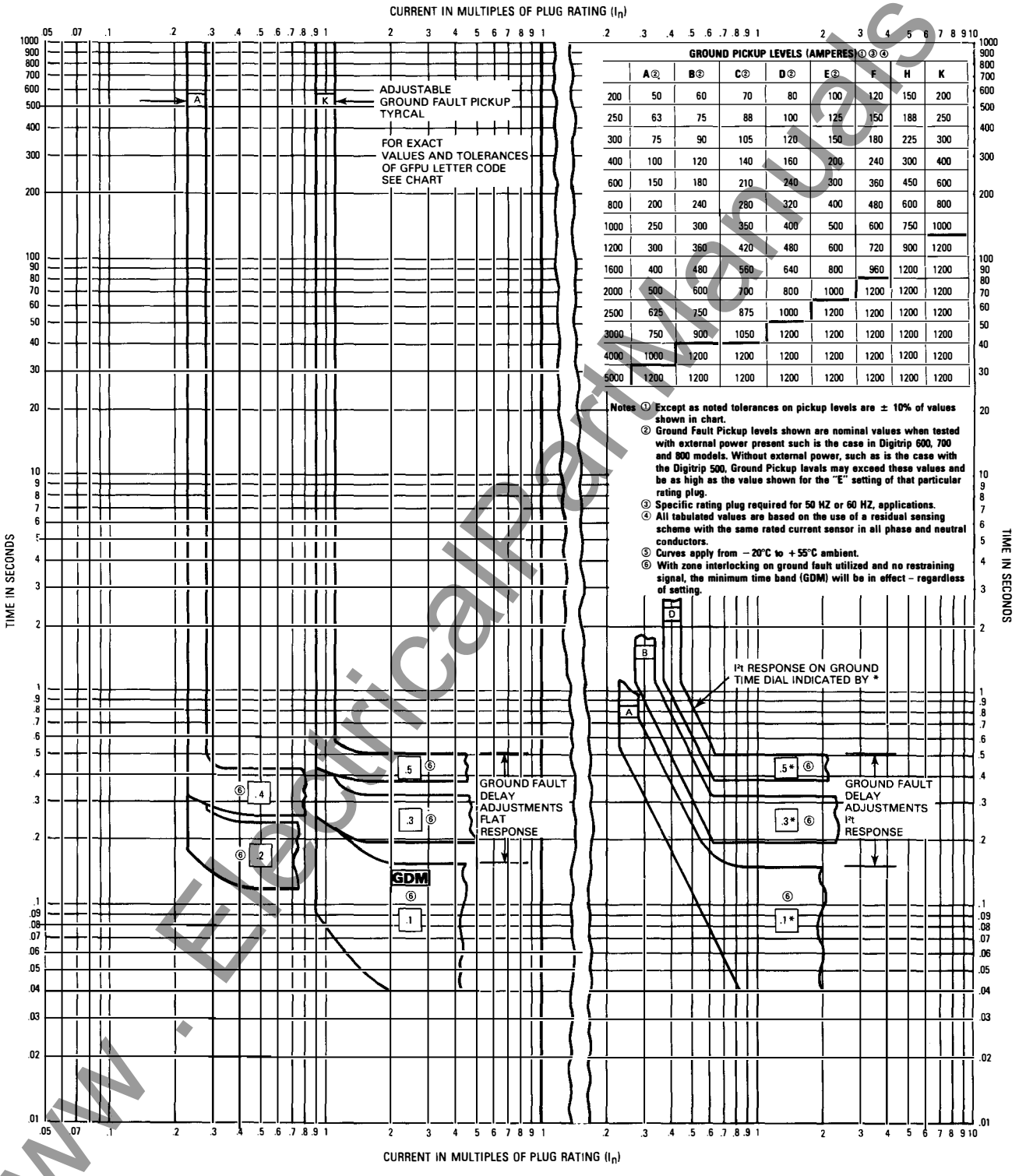
LDS = TRIP RANGE 105% TO 130% OF SETTING
LOT = +0, −33%, DIAL – SHOWN @ 6 I_n
SDPU = ± 10% DIAL

VARIABLE SETTINGS MARKED ON PLUG	SPB 400-3000A FRAMES	SPB 4000-5000A FRAMES
S_1	7	3.5
S_2	8	4.5

6.3 Ground Fault Protection Time-Current Curve SC-4282-87

DIGITRIP RMS 500/600/700/800

Typical Time-Current Characteristic Curve (G)
for Type SPB Systems Pow-R Breakers



GROUND PICKUP LEVELS (AMPERES) ① ③ ④

	A ②	B ②	C ②	D ②	E ②	F	H	K
200	50	60	70	80	100	120	150	200
250	63	75	88	100	125	150	188	250
300	75	90	105	120	150	180	225	300
400	100	120	140	160	200	240	300	400
600	150	180	210	240	300	360	450	600
800	200	240	280	320	400	480	600	800
1000	250	300	350	400	500	600	750	1000
1200	300	360	420	480	600	720	900	1200
1600	400	480	560	640	800	960	1200	1200
2000	500	600	700	800	1000	1200	1200	1200
2500	625	750	875	1000	1200	1200	1200	1200
3000	750	900	1050	1200	1200	1200	1200	1200
4000	1000	1200	1200	1200	1200	1200	1200	1200
5000	1200	1200	1200	1200	1200	1200	1200	1200

Notes ① Except as noted tolerances on pickup levels are ± 10% of values shown in chart.
② Ground Fault Pickup levels shown are nominal values when tested with external power present such is the case in Digitrip 600, 700 and 800 models. Without external power, such as is the case with the Digitrip 500, Ground Pickup lavals may exceed these values and be as high as the value shown for the "E" setting of that particular rating plug.
③ Specific rating plug required for 50 HZ or 60 HZ, applications.
④ All tabulated values are based on the use of a residual sensing scheme with the same rated current sensor in all phase and neutral conductors.
⑤ Curves apply from −20°C to +55°C ambient.
⑥ With zone interlocking on ground fault utilized and no restraining signal, the minimum time band (GDM) will be in effect – regardless of setting.

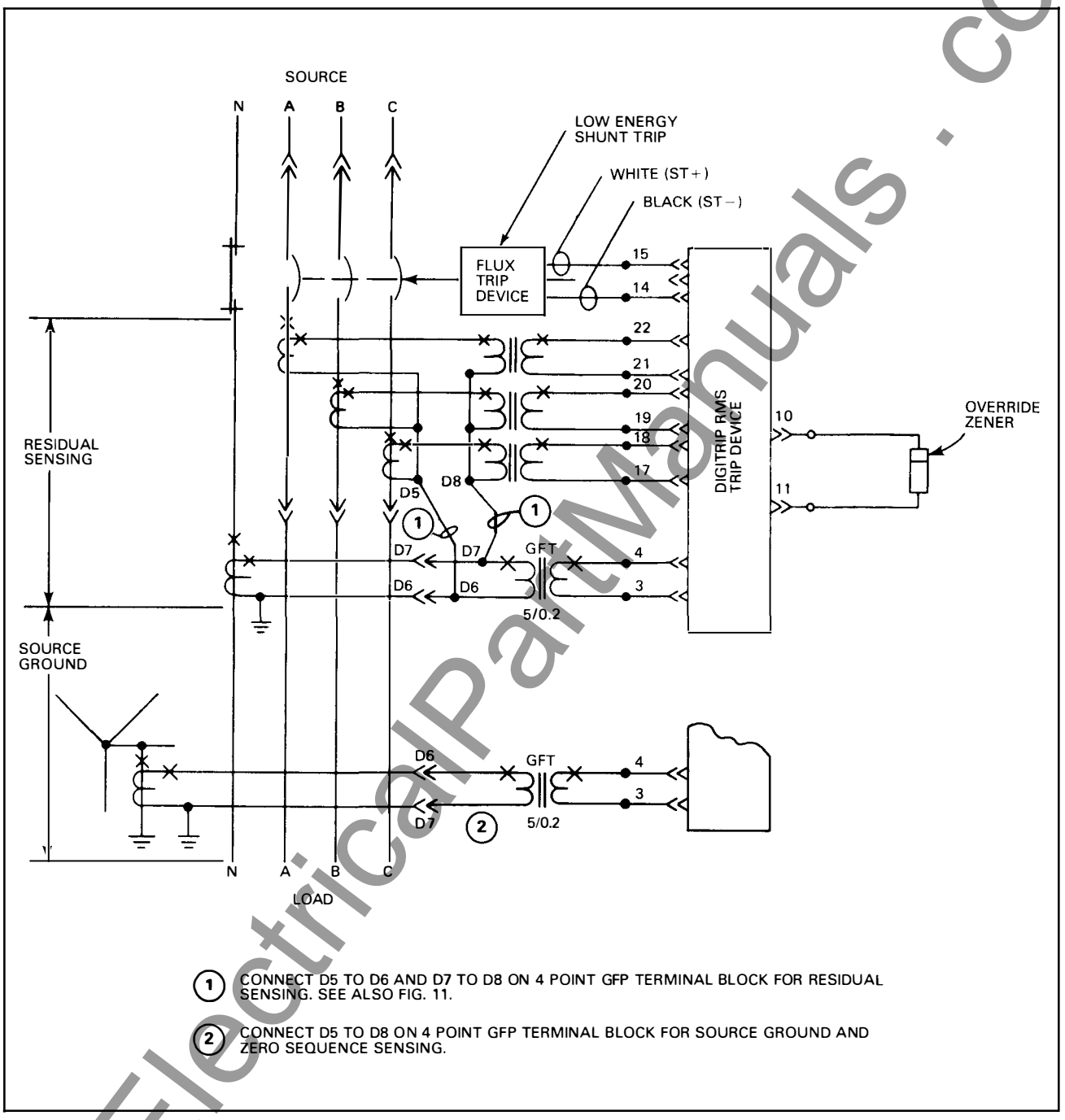


Fig. 8 *SPB Master Connection Diagram Typical Current Sensor Connections for 2000 A and Greater Frame Ratings*

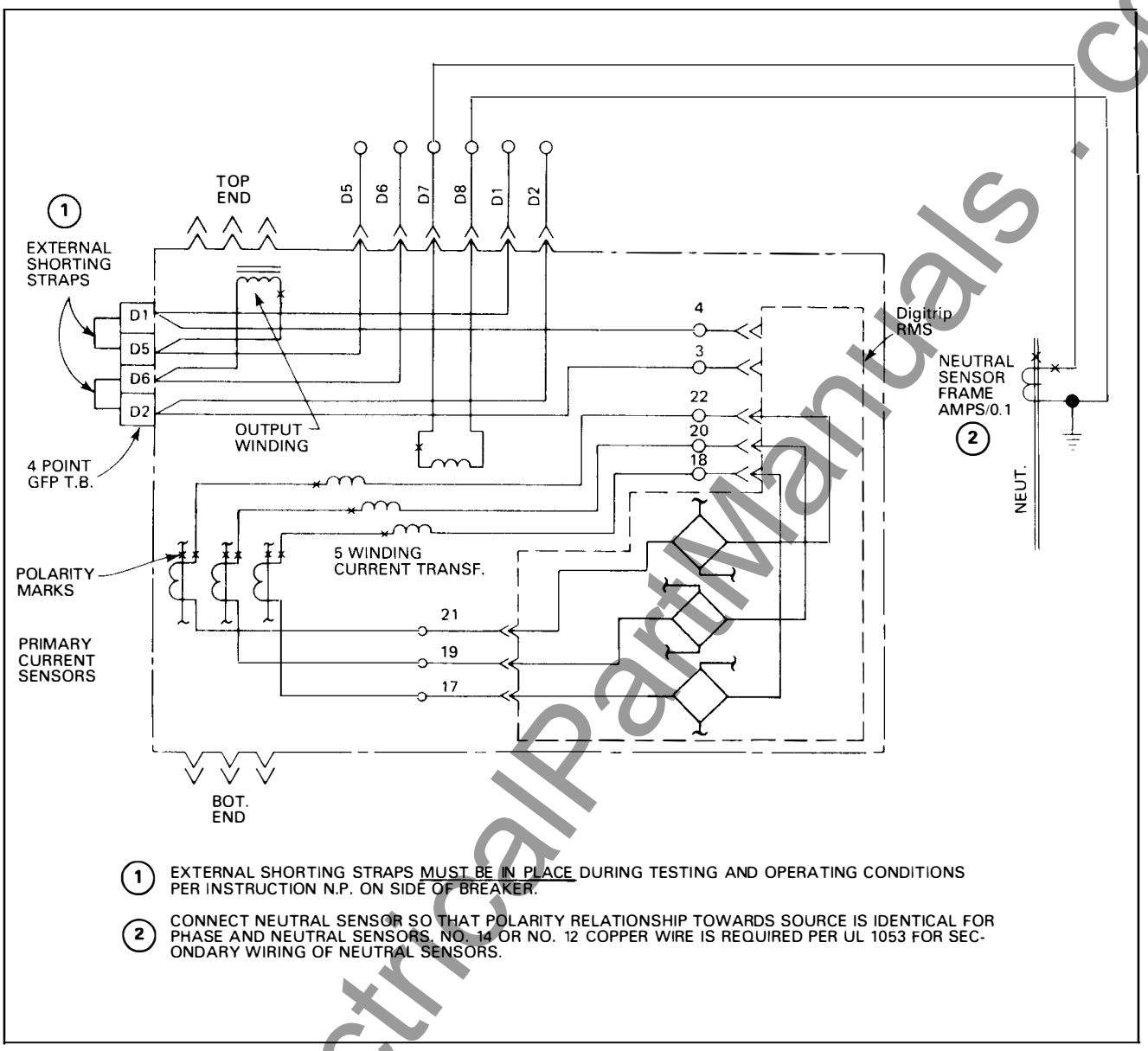


Fig. 9 *SPB Master Connection Diagram Ground Fault External Connection 3PH, 4W., Residual, 400/800/1200/1600/2000 A Breakers (2000 A in Compact, 16 in. High Frame)*

7.0 References

7.1 Type SPB Systems Pow-R Breakers

I.L. 29-801 Type SPB Systems Pow-R Breakers
I.S. 15545 Master Connection Diagram for Type SPB Systems Pow-R Breakers

7.2 Digitrip RMS Trip Units

I.L. 29-851 Instructions for Digitrip RMS 500 Trip Unit
I.L. 29-852 Instructions for Digitrip RMS 600 Trip Unit
I.L. 29-853 Instructions for Digitrip RMS 700 Trip Unit
I.L. 29-854 Instructions for Digitrip RMS 800 Trip Unit

7.3 Miscellaneous

I.L. 17-216 Assemblies Electronic Monitor (AEM)

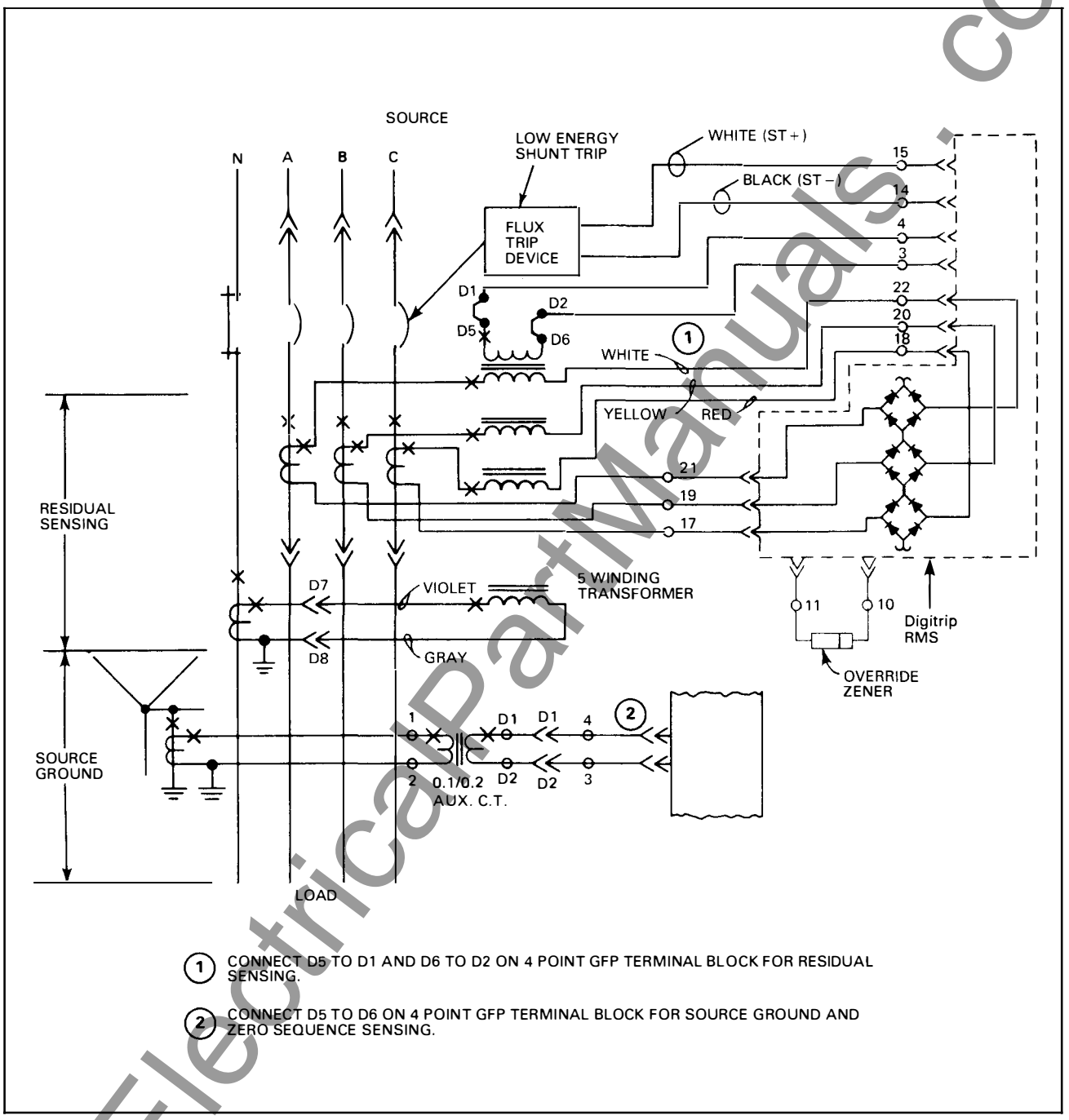


Fig. 10 *SPB Master Connection Diagram Typical Current Sensor Connections for 2000 A (Compact) and Less Frame Ratings*

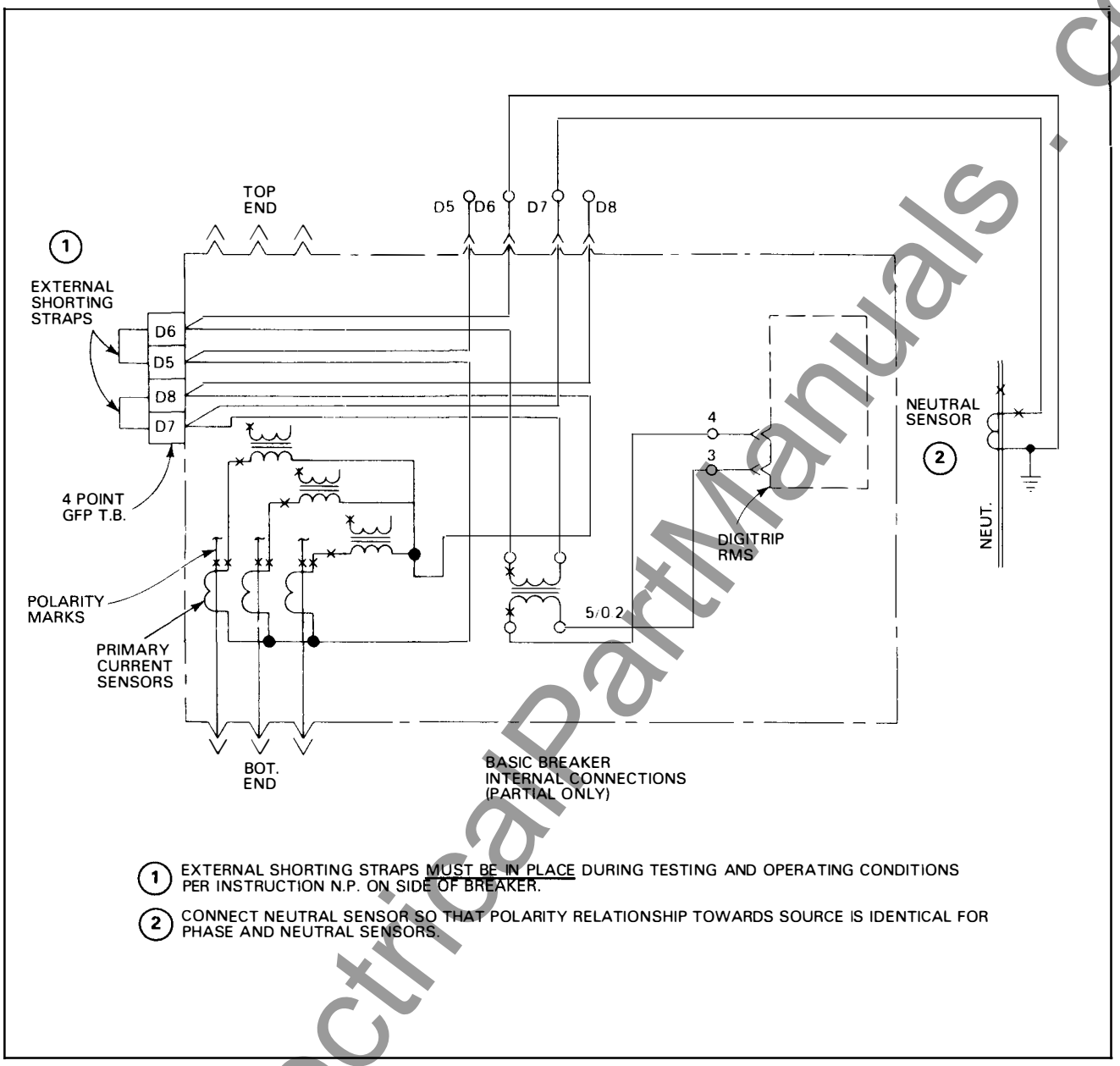
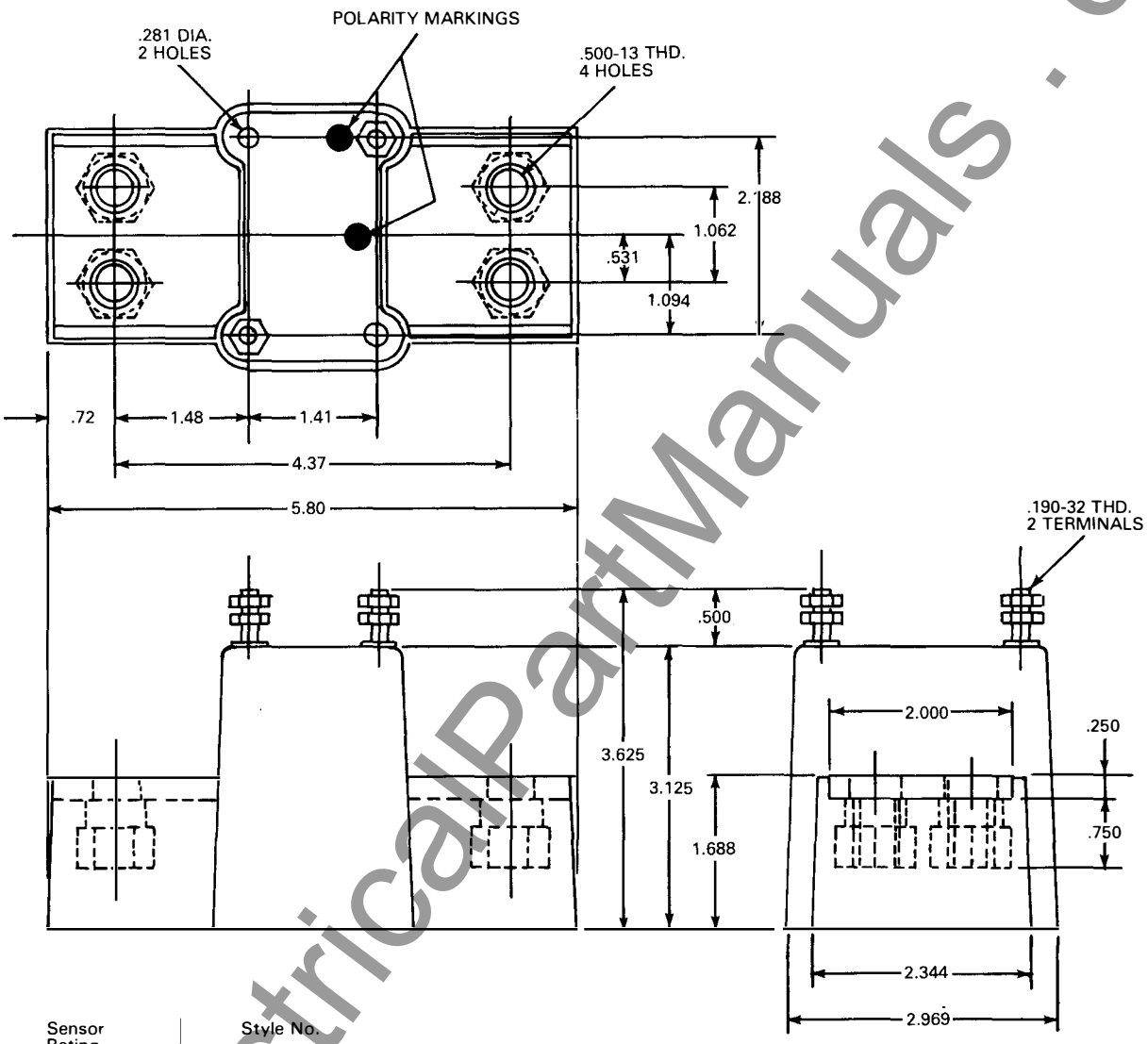


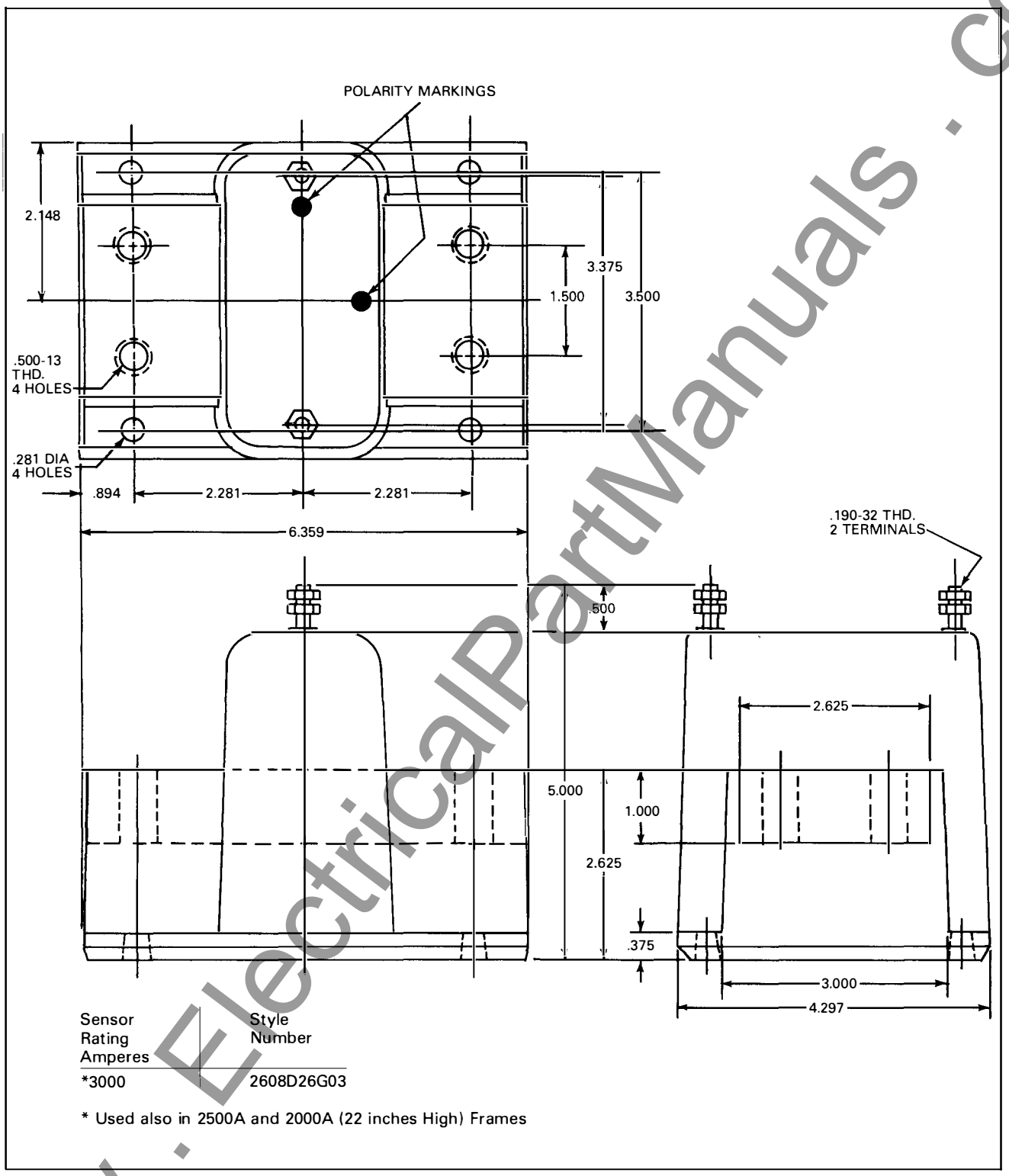
Fig. 11 *SPB Master Connection Diagram Ground Fault External Connections 3PH., 4W., Residual, 2000/2500/3000/4000/5000 A Breakers (2000 A in 22 in. High Frame)*



Sensor Rating Amperes	Style No.
400	2608D25G11
800	2608D25G03
1200	2608D25G04
1600	2608D25G02
2000C *	2608D25G05

* "C" denotes 2000 amp in 16 inch frame.

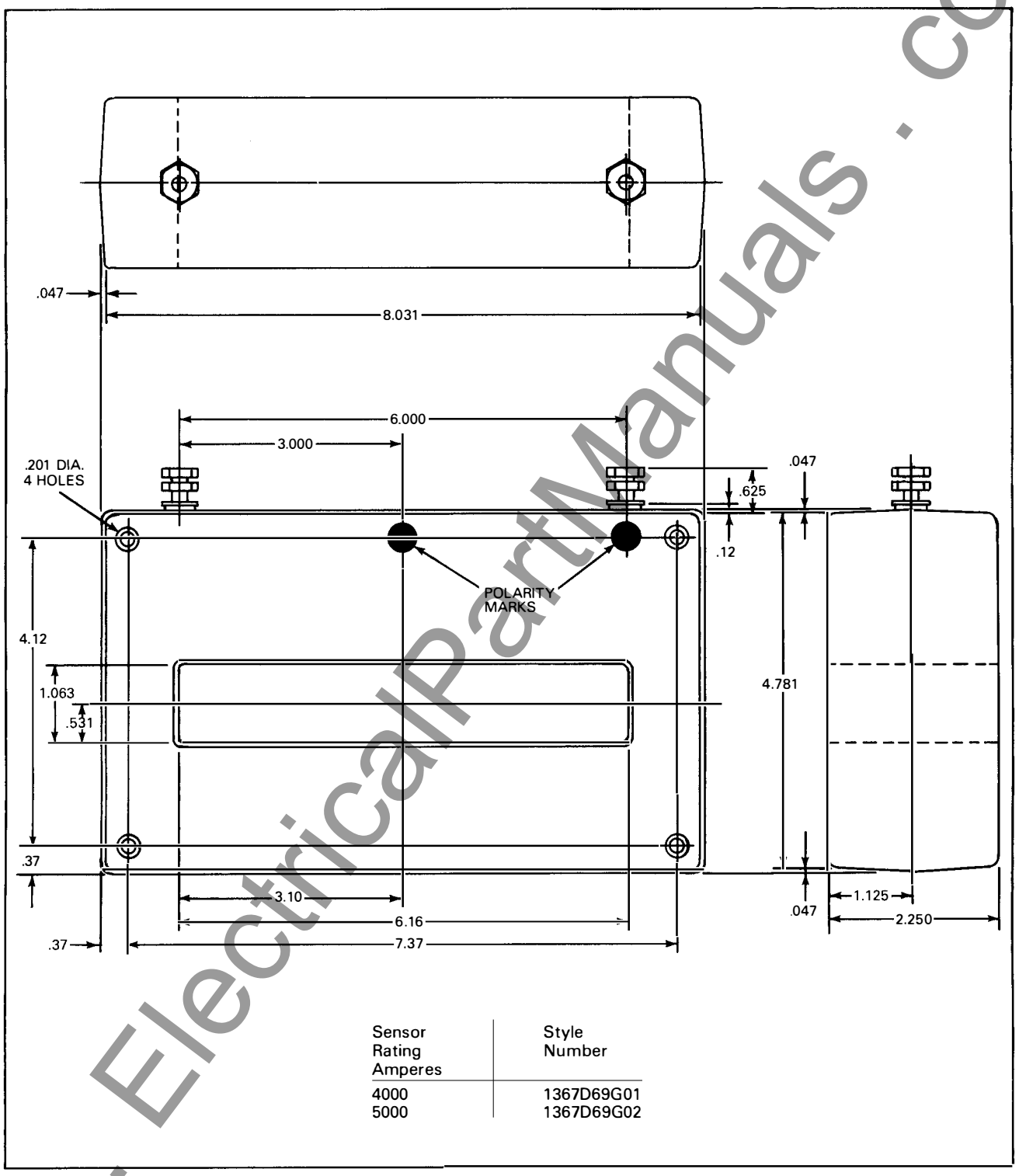
Fig. 12 *Neutral Current Sensor (400-2000C A)*



Sensor Rating Amperes	Style Number
*3000	2608D26G03

* Used also in 2500A and 2000A (22 inches High) Frames

Fig. 13 *Neutral Current Sensor (3000, 2500, 2000 A)*



Sensor Rating Amperes	Style Number
4000	1367D69G01
5000	1367D69G02

Fig. 14 *Neutral Current Sensor (4000, 5000 A)*

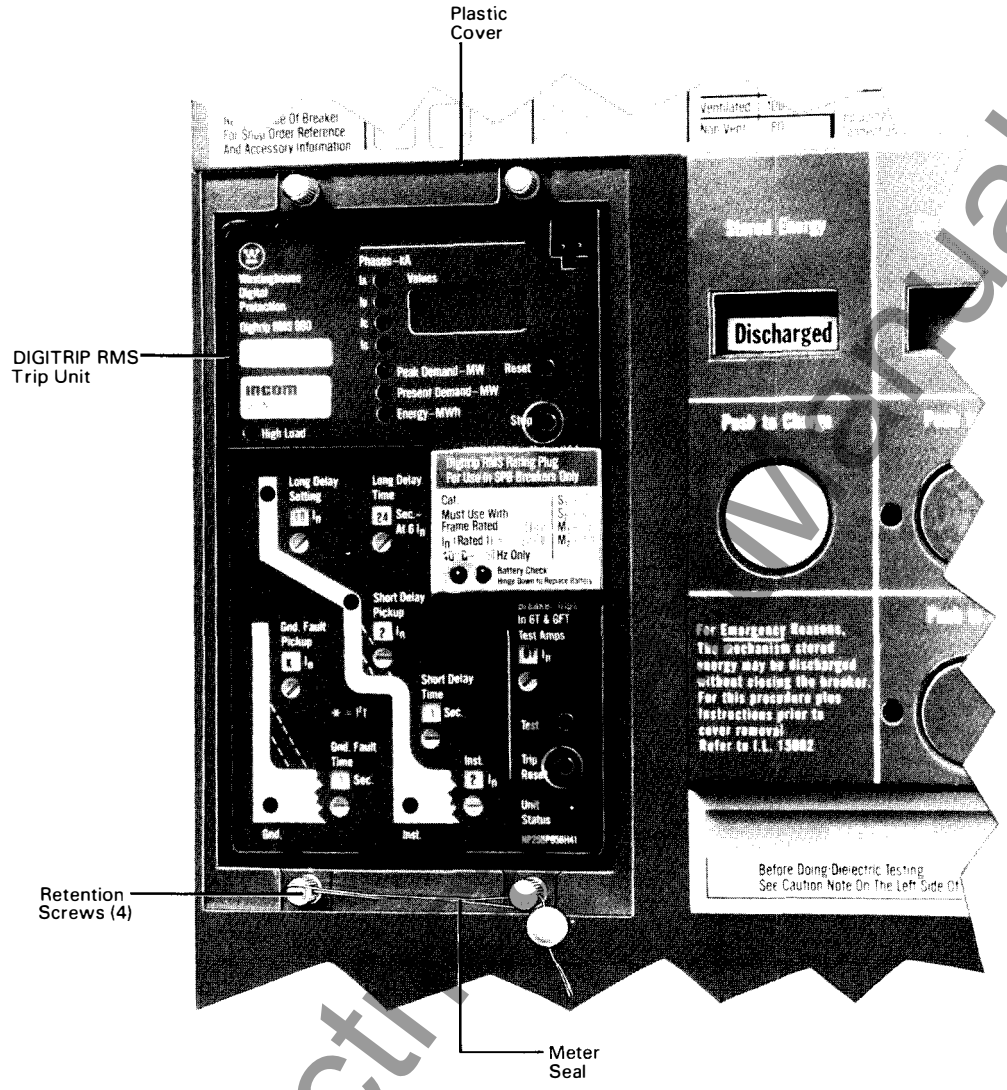


Fig. 15 *View of Installed Digitrip RMS Trip Unit with Sealed Cover*