Circuit Breaker Automatic Tripping System Using Digitrip RMS Trip Units Used with Types DS and DSL Low Voltage Power Circuit Breakers

Supplement A to
I.B. 33-790-1G

Table of Contents

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.

1.0 Supplementary Information

The instructions contained in this book supplement the instructions for Low-Voltage AC Power Circuit Breakers, Type DS and DSL covered in I.B. 33-790-1F.

Section 8 of the above book covers the circuit breaker automatic tripping system using Amptector solid-state trip units.

1.1 Amptector Trip Units

Amptector Trip Units are AC devices that employ peak current sensing principles utilizing discreet electronic components and conventional printed circuit board technology. The primary function of these devices is to analyze the secondary current signals received from the circuit breaker current sensors and to initiate tripping signals to the circuit breaker trip actuator when pre-determined current levels and time/delay settings are reached.

Amptector Trip Units may be equipped with up to five phase and two ground fault time-current settings. The exact selection of these functional, adjustable settings is optional so as to satisfy the protection needs of any specific installation.

Optional, resettable pop-up indicators are available to provide a mode of trip indication for ground fault, overload and short circuit trip operations.

All Amptector Trip Units which do not have adjustable instantaneous trip elements are provided with a making current release which is referred to as a discriminator.

The Amptector is completely self-contained requiring no supplementary control power for operation of its basic protection function.

The continuous current rating of the circuit breaker employing Amptector Trip Units is determined by the rating of the interchangeable current sensors installed in the circuit breaker. Several sensor ratings are available to satisfy specific needs of any given installation.

2.0 Digitrip RMS Trip Units

This instruction book specifically covers the application of Digitrip RMS Trip Units installed in Types DS and DSL Low-Voltage Power Circuit Breakers as illustrated in Fig. 1.

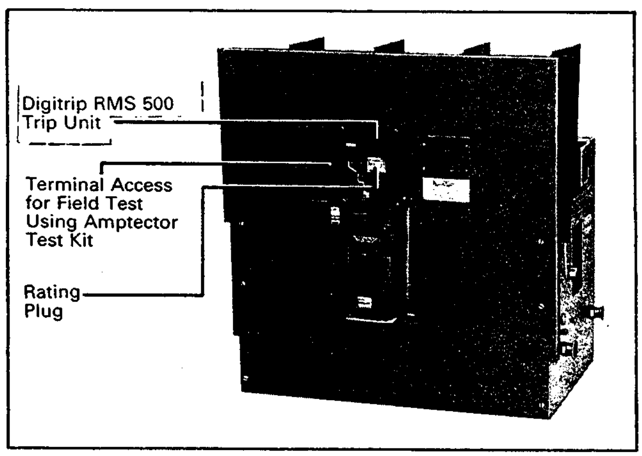


Fig. 1 *View of DS Circuit Breaker with Digitrip RMS 500 Trip Unit Installed*

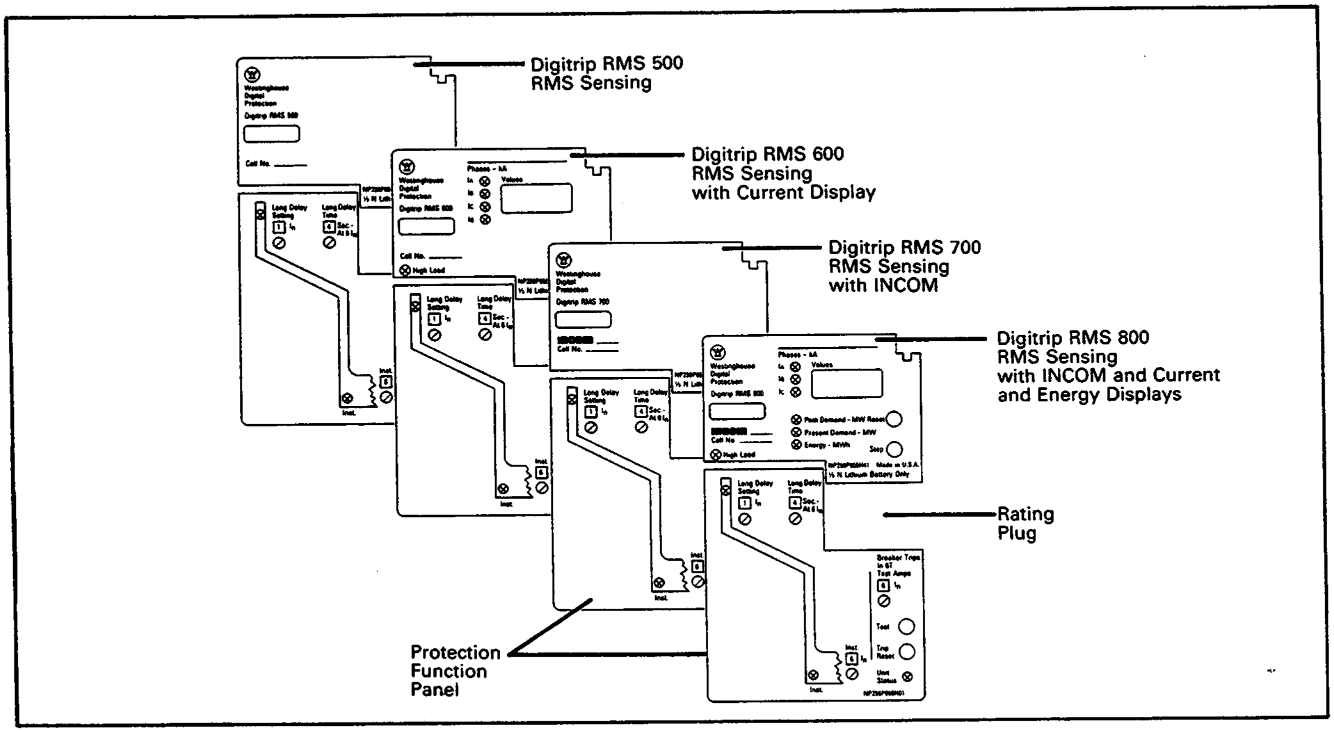


Fig. 2 *View of the Four Basic Models of the Digitrip RMS Trip Unit*

Digitrip RMS Trip Units are AC devices that employ microprocessor based type 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, which is achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuator when pre-determined current levels and time delay settings are exceeded.

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

The protection section of the Digitrip RMS Trip Unit can be equipped with up to five phase and two ground fault time current adjustments. The short delay and ground fault pick-up adjustments can be arranged for either flat or I^2t response. The exact selection of the available adjustments is optional to satisfy the protection needs of any specific installation.

LEDs are included to provide mode of trip indication for ground fault, overload and short circuit trip operations.

All Digitrip RMS Trip Units 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.

The continuous current rating of the circuit breaker employing Digitrip RMS Trip Units is determined by the rating of the interchangeable rating plug installed in the trip unit.

Digitrip RMS Trip Units are available in four basic models, as illustrated in Fig. 2. Separate instruction leaflets referenced in Section 7.2 cover the features and functions of each model.

This instruction book is arranged to describe the unique features of each type as they relate to their application in Types DS and DSL Low-Voltage AC Power Circuit Breakers. Table 1 illustrates the available characteristics of each of the four trip unit models.

The following circuit breaker accessories are available to provide supplementary protection, signaling and test functions: (Refer to Section 8.7 of I.B. 33-790-1F for details)

1) Undervoltage Trip Device
2) Portable Test Kit – See **CAUTION** on page 3.
3) Latch Check Switch
4) Auxiliary Switches

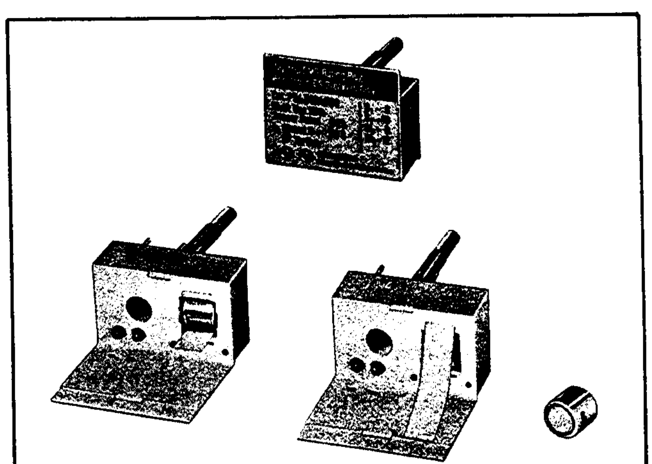


Fig. 3 *View of Interchangeable Rating Plugs for Use with Digitrip RMS Trip Units*

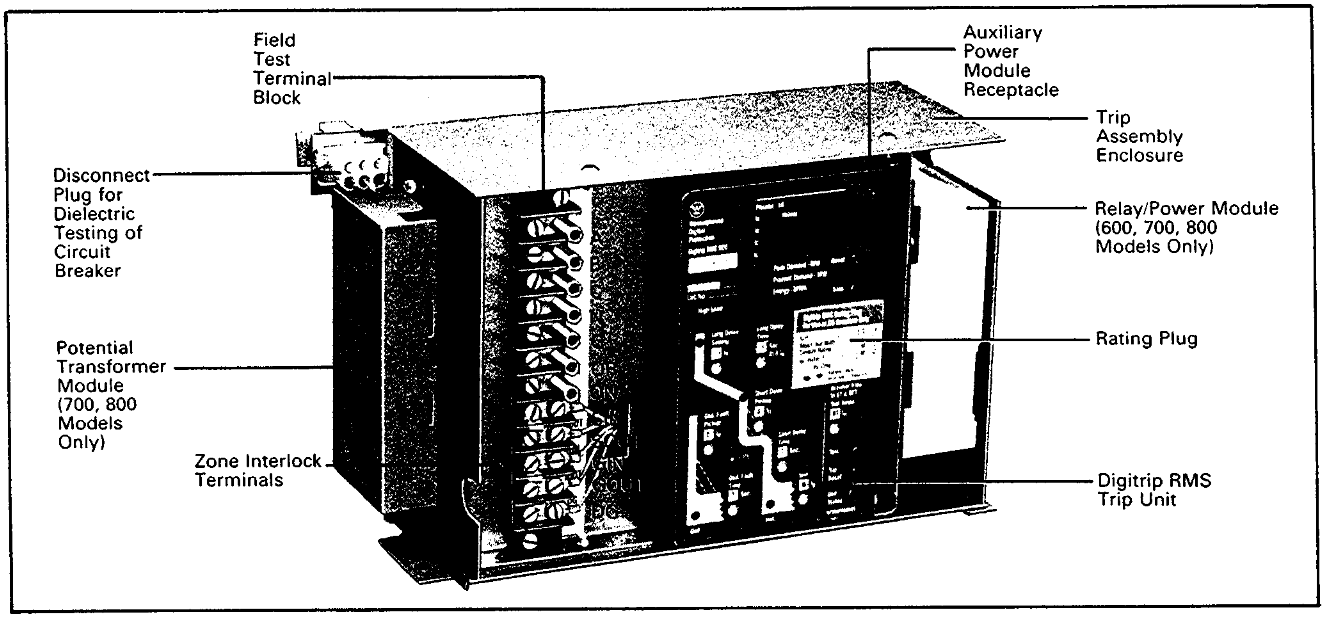


Fig. 4 *View of Trip Unit Assembly with Digitrip RMS 800 Trip Unit and Associated Components Installed*

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 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 installed sensor 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 leaflets referred to in Section 7.2 of this book.

Following a trip operation and with no supplementary control power available, such as would be required with a Power/Relay module, the battery would maintain the mode of trip LED for approximately 60 hours.

If a rating plug is removed from the trip unit while the circuit breaker is closed, the circuit breaker may trip. Therefore, the rating plug must be securely tightened in the trip unit before operating the circuit breaker.

4.0 Digitrip RMS Model Considerations

The trip unit contains a receptacle for use with an 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, a circuit breaker with a Digitrip RMS Trip Unit assembly installed can be bench tested using the integral test panel. With the circuit breaker in the closed position, it can be "tripped" when the test selector switch is in either the "6T" or "GFT" positions.

With the Auxiliary Power Module installed, the circuit breaker can also be field tested using secondary currents provided by an Amptector Trip Unit test kit as illustrated in I.B. 33-79-790-1F under Section 8.7.6.

CAUTION

ONLY AMPTECTOR TEST KIT STYLES 140D481G02R, 140D481G02RR OR 140D481G03 SHOULD BE USED. UNMODIFIED AMPTECTOR TEST KITS STYLES 140D481G01 AND 140D481G02 SHOULD NOT BE USED TO TEST BREAKERS WITH DIGITRIP RMS TRIP UNITS AS DAMAGE TO THE TRIP MAY OCCUR.

CAUTION

TESTING OF A CIRCUIT BREAKER IN THE CELL "CONNECTED" POSITION BY EITHER THE INTEGRAL TEST PROVISIONS IN THE DIGITRIP RMS TRIP UNIT OR BY THE SEPARATE AMPTECTOR TRIP UNIT TEST KIT 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 "REMOVE" CELL POSITIONS.

4.1 Digitrip RMS 500

The Digitrip RMS 500 Trip Assembly consists of a Digitrip RMS 500 Trip Unit described in I.L. 29-851, auxiliary current transformers (3 or 4), a stab-in trip unit terminal block and a test terminal block with test receptacles for external field testing mounted in an enclosure as illustrated in Figs. 4 and 5.

4.2 Digitrip RMS 600

The Digitrip RMS 600 Trip Assembly consists of a Digitrip RMS 600 Trip Unit described in I.L. 29-852, auxiliary current transformers (3 or 4), a stab-in trip unit terminal block, a test terminal block with test receptacles for external field testing and a Power/Relay Module mounted in an enclosure as illustrated in Figs. 4 and 5. The Digitrip RMS 600 Trip Unit is a Digitrip RMS 500 Trip Unit with the addition of a four-digit readout display, three phase and one ground (when supplied) current pointer LEDs along with a stepping pushbutton and high load indication LED as illustrated in Table 1. It also provides signal contacts for three remote mode of trip indications and a high load remote alarm.

The Power/Relay Module requires a 120 V., 50/60 Hz, 6 Va. control power supply for operating the readout display and internally mounted signal relays. The relay contacts are each rated 120 V., 1.0 A.

The Power/Relay Module will maintain the cause of trip history and LED's as long as the control power supply is available. If the control power supply is not available, 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 after an approximate 40 second delay when the 85% level is reached to ride through momentary conditions.

4.3 Digitrip RMS 700

The Digitrip RMS 700 Trip Assembly consists of a Digitrip RMS 700 Trip Unit described in I.L. 29-853, auxiliary current transformers (3 or 4), a stab-in trip unit terminal block, a test terminal block with test receptacles for external field testing, a Power/Relay Module and a potential transformer module with a disconnect plug for disconnecting the module during dielectric testing of the circuit breaker mounted in an enclosure as illustrated in Figs. 4 and 5. The Digitrip RMS 700 Trip Unit is a Digitrip RMS 500 Trip Unit with the addition of an INCOM module along with an adjustable INCOM address register. It also provides signal contacts for three remote mode of trip indications and a high-load remote alarm. 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 an Assemblies Electronic Monitor (AEM), as described in I.L. 17-216, the data in Table 1 referenced by note 2 can also be viewed.

An 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 using shielded, twisted pair, No. 18 AWG conductors.

The three-digit INCOM address must be set on each trip unit per instructions given in I.L. 29-853 and I.L. 17-216. To insure that each circuit breaker in an assembly is properly located after the address is set, the breaker should be identified as to its proper cell location and that reference along with the breaker INCOM address added to 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 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 Unit assembly except that the Digitrip RMS 800 Trip Unit has a four-digit readout display, three phase and one ground (when supplied) current pointer LEDs along with a stepping pushbutton, a high load indication LED, peak demand, present demand and energy consumed 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.

Table 1 – Digitrip RMS Trip Unit Characteristics

	DIGITRIP RMS Type	500	600	700	800
	Instruction Leaflet	I.L. 29-851	I.L. 29-852	I.L. 29-853	I.L. 29-854
Protection	Long Delay Setting	STD.	STD.	STD.	STD.
	Long Delay Time	STD.	STD.	STD.	STD.
	Long Time Memory	X	X	X	X
	Short Delay Pick-up	OPT.	OPT.	OPT.	OPT.
	Short Delay Time	OPT.	OPT.	OPT.	OPT.
	Flat/I²T Response	X	X	X	X
	Zone Interlocking①	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/I²T Response	X	X	X	X
	Ground Time Memory	X	X	X	X
	Zone Interlocking①	①	①	①	①
	Interchangeable Rating Plug	X	X	X	X
Local Trip Indication	Mode of Trip Indication LED's	X	X	X	X
	LED's Battery Back-up	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	X	X	X	X
Local Readouts and Indication	Power/Relay Module		X	X	X
	4 Digit Readout Display		X		X
	øA Current LED		X	②	X
	øB Current LED		X	②	X
	øC Current LED		X	②	X
	Gnd. Current LED		OPT.	②⑥	OPT.
	Display Stepping Pushbutton		X	②	X
	High Load Indication LED		X	②	X
Remote Signals	Remote Signal Contacts:				
	Long Delay Trip		X	X	X
	Short Circuit Trip		X	X	X
	Ground Fault Trip		X	X⑥	X⑥
	High Load Alarm		X	X	X
Energy Monitoring	Potential Transformer Module (PTM)			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
	Energy Consumption			④	X
	Present Demand			④	X
Communications	INCOM (Integrated Communications)			X	X
	INCOM Address Register			X	X
Transmittable Data – Local/Remote	Transmittable Parameters:				
	Individual Phase Currents			②	③
	Ground Currents			②⑥	③⑥
	Energy			④	③
	Breaker Status:				
	Open/Closed/Tripped			②	③
	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)			②⑤	③
	Program Memory Test Failure (RAM)			②⑤	③
	Missing or Defective Rating Plug			④	③
	Reverse Power Flow			④	③
	Response to Depressing Test Pushbutton			④	③
	Communication Failure			②⑤	②⑤
Control	Breaker Command: (Via INCOM)				
	Trip			X	X
	Close			OPT.⑦	OPT.⑦

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

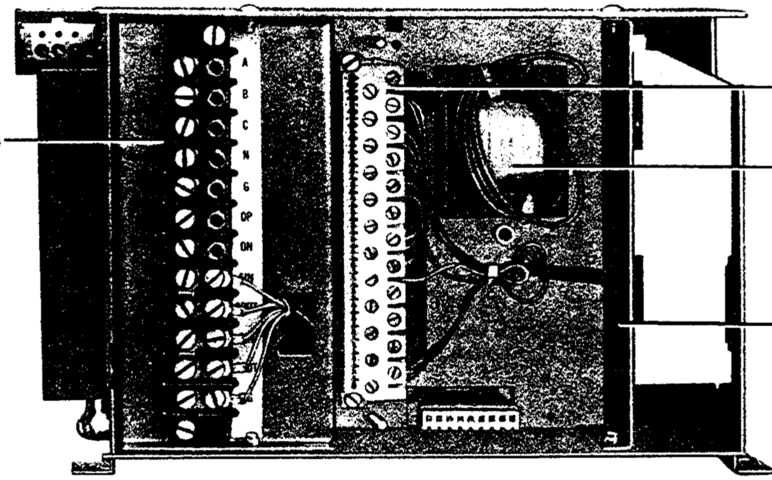


Fig. 5 *View of Trip Assembly with Digitrip RMS Trip Unit Removed to Illustrate Auxiliary CT's and Stab-in Terminal Block*

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 in the equipment assembly to show the parameters in Table 1 covered under Note 2.

Interconnections for the INCOM circuit must be connected using shielded, twisted pair No. 18 AWG conductors.

The three-digit INCOM address must be set on each trip unit per instructions given in I.L. 29-854 and I.L. 17-216. To insure that each circuit breaker in an assembly is properly located after the address is set, the breaker should be identified as to its proper cell location and that reference along with the breaker INCOM address added to 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 and closing of the circuit breaker.

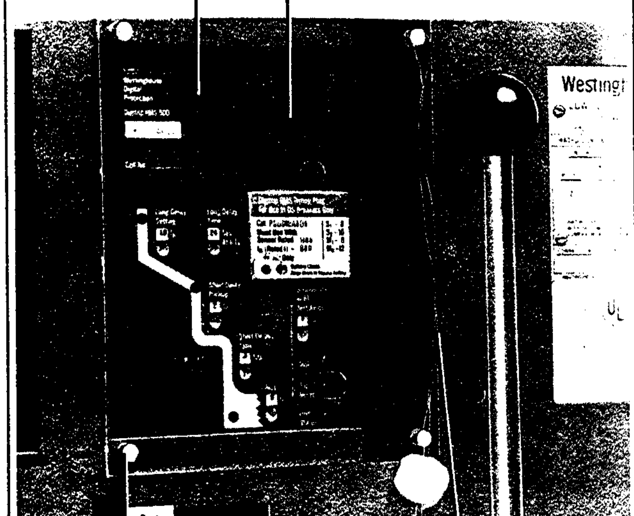


Fig. 6 *View of Installed Digitrip RMS 500 Trip Assembly with Sealed Cover*

WARNING

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 508B508 TO AVOID UNDESIRED REMOTE CLOSING OPERATIONS DURING MAINTENANCE PERIODS. ALSO PROVIDE ADEQUATE EQUIPMENT WARNINGS FOR NORMAL OPERATION PERIODS.

5.0 Principle of Operation

5.1 General

The circuit breaker is tripped on overload and short circuit conditions by combined action of three components:

1. The sensors which determine the current level.

2. The Digitrip RMS Trip Assembly, which contains the Digitrip RMS Trip Unit and provides a tripping signal when pre-determined current levels are reached.

3. The actuator which actually trips the circuit breaker.

Schematically, this may be represented as illustrated in Fig. 7. This arrangement provides a very flexible system covering a

Table 2 – Catalog Numbers of Available Rating Plugs

Rated Current (Amps I_n)	Sensor Rating (Amps)	Catalog Number 60Hz	Catalog Number 50Hz
100	200	PD6D02A010	PD5D02A010
200		PD6D02A020	PD5D02A020
200	300	PD6D03A020	PD5D03A020
250		PD6D03A025	PD5D03A025
300		PD6D03A030	PD5D03A030
200	400	PD6D04A020	PD5D04A020
250		PD6D04A025	PD5D04A025
300		PD6D04A030	PD5D04A030
400		PD6D04A040	PD5D04A040
300	600	PD6D06A030	PD5D06A030
400		PD6D06A040	PD5D06A040
600		PD6D06A060	PD5D06A063①
400	800	PD6D08A040	PD5D08A040
600		PD6D08A060	PD5D08A063①
800		PD6D08A080	PD5D08A080
600	1200	PD6D12A060	PD5D12A063①
800		PD6D12A080	PD5D12A080
1000		PD6D12A100	PD5D12A100
1200		PD6D12A120	PD5D12A125②
800	1600	PD6D16A080	PD5D16A080
1000		PD6D16A100	PD5D16A100
1200		PD6D16A120	PD5D16A125②
1600		PD6D16A160	PD5D16A160
1000	2000	PD6D20A100	PD5D20A100
1200		PD6D20A120	PD5D20A125②
1600		PD6D20A160	PD5D20A160
2000		PD6D20A200	PD5D20A200
1600	2400	PD6D24A160	PD5D24A160
2000		PD6D24A200	PD5D24A200
2400		PD6D24A240	PD5D24A240
1600	3200	PD6D32A160	PD5D32A160
2000		PD6D32A200	PD5D32A200
2400		PD6D32A240	PD5D32A240
3200		PD6D32A320	PD5D32A320
2000	4000	PD6D40A200	PD5D40A200
2400		PD6D40A240	PD5D40A240
3200		PD6D40A320	PD5D40A320
4000		PD6D40A400	PD5D40A400

① Actual Plug Rating 630 Amps
② Actual Plug Rating 1250 Amps

wide range of tripping characteristics as illustrated by the time-current curves appearing in Section 6 of this instruction book. Not only is the Digitrip RMS Trip Unit adjustable, but the variety of sensors and rating plugs provide a wide range of 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 current exceeds the functional protection settings, the Digitrip RMS Trip Unit supplies a trip signal to the actuator. Thus all tripping functions 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.

5.2 Digitrip RMS Trip Assembly

The basic Digitrip RMS Trip Assembly, as illustrated in Figs. 4 and 5, includes the following which could vary slightly depending upon the exact model of the Digitrip RMS Trip Unit installed:

1. Assembly Enclosure

2. Digitrip RMS Trip Unit

Table 3 – Ground Fault Current Pick-up Settings

Installed Rating Plug Amperes (I_n)	Pick-up (Dial) Setting Amperes①							
	A②	B②	C②	D②	E②	F	H	K
100	25	30	35	40	50	60	75	100
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
2400	600	720	840	960	1200	1200	1200	1200
3200	800	960	1120	1200	1200	1200	1200	1200
4000	1000	1200	1200	1200	1200	1200	1200	1200

① Except as noted, tolerances on pick-up levels are ±10% of values shown in chart.
② 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.

3. Rating Plug

4. Auxiliary Current Transformers (3 or 4 depending upon whether or not ground fault protection is included).

5. Stab-in Terminal Block for Trip Unit

6. Terminal Block equipped with Test Plug Receptacles for use with Portable Test Kit

7. Power/Relay Module (Digitrip RMS Trip Unit Models 600, 700 and 800 only)

8. Potential Transformer Module with Dielectric Disconnect Plug (Digitrip RMS Trip Unit Models 700 and 800 only)

As shown in Fig. 1, the Digitrip RMS Trip Unit assembly mounts at the left top front on the circuit breaker.

Fig. 7 illustrates a portion of a typical standard wiring diagram taken from Drawing 508B508. Included is a portion of the trip assembly terminal block. The terminal block is marked as follows:

A	Sensor Phase A	
B	Sensor Phase B	
C	Sensor Phase C	
N	Sensor Neutral	
G	Ground	
OP	Output Positive*	
ON	Output Negative*	
Sin	Short Delay In	Zone Interlocking Signals – jumpers are added when zone interlocking is not functionally supplied.
Sout	Short Delay Out	
Gin	Ground Fault In	
Gout	Ground Fault Out	
DG	Common	

*To Actuator Coil.

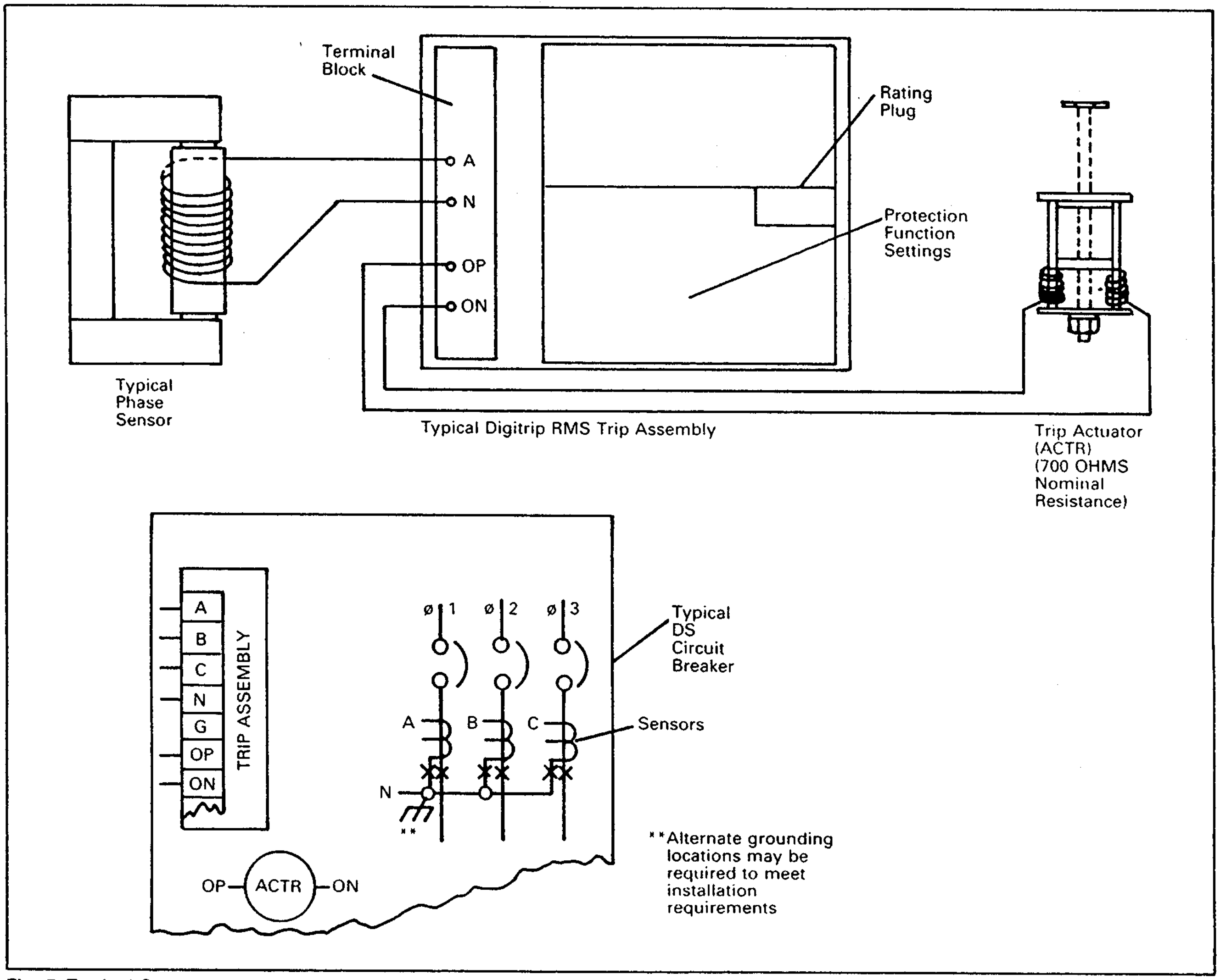


Fig. 7 *Typical Schematic Diagram Illustrating Basic Connections In Tripping System of DS Circuit Breaker*

CAUTION

THE ACTUATOR COIL HAS A POLARITY MARKING ON THE POSITIVE LEAD WHICH MUST BE OBSERVED. OTHERWISE THE BREAKER WILL NOT HAVE OVERLOAD OR FAULT PROTECTION WHICH COULD RESULT IN BODILY INJURY AND/OR SERIOUS EQUIPMENT DAMAGE.

5.3 Actuator

The actuator receives a tripping pulse from the Digitrip RMS Trip Assembly, and produces a mechanical force to trip the breaker. Refer to Figs. 64, 65 and 24 in I.B. 33-790-1F for location and details. The actuator is made up of a permanent magnet, a disc held by the magnet, a rod acted on by a spring, a lever for tripping the breaker, and a lever for mechanically resetting the actuator. The magnet cannot pull and reset the disc against the force of the spring acting on the rod, but can overcome the spring force when the disc is in contact with the magnet pole piece.

A tripping pulse from the Digitrip RMS Trip Assembly counteracts the effect of the permanent magnet, allowing the spring to separate the disc from the magnet pole piece and move the rod to actuate the trip shaft lever. The trip shaft lever then rotates the trip shaft and trips the breaker.

As the breaker opens, the left pole unit lever pin strikes the spring finger attached to the reset lever; this furnishes the assistance required to move the disc so as to close the air gap between it and the permanent magnet against the spring force.

The device is reset when the disc is in contact with the magnet. If the gap is not fully reset, the trip shaft lever will hold the breaker mechanism in the trip-free condition and the breaker cannot be re-closed.

The actuator must be replaced, if it will not stay reset, when the plunger has been moved to the top of its travel.

5.4 Ground Fault Protection

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 connected to the system.

If the system neutral is grounded but the neutral is not carried with the phase conductors, the Digitrip RMS Trip Assembly includes all of the equipment necessary for ground fault protection. The basic mode of ground fault sensing employs a residual sensing scheme which vectorially sums the outputs of the individual phase current sensors. As long as the vectorial sum is zero, then no ground fault exists.

If the system neutral is grounded and a neutral conductor is carried with the phase conductors, it is necessary to order an additional sensor for the purpose of cancelling out any residual current in the phase conductors. This sensor must be mounted separately and must be located on the neutral conductor at the point where the neutral conductor connects to the neutral bus. These sensors are duplicate of those supplied on the breaker except for the 2400A and 3200A ratings where a modified neutral sensor is required.

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 settings are given in Table 3 and on the time-current curve.

Depending upon the installation requirements, alternate ground fault sensing schemes may be employed. Two popular methods include: Ground return and zero sequence. Either method can be employed with the Digitrip RMS Trip Unit.

For either type application, a ring type current sensor, as shown in Fig. 8, is normally employed. For ground return sensing, the sensor is arranged to have the system "main bonding jumper" pass directly through the sensor. For zero sequence sensing methods, all phase and neutral conductors must pass through the sensor.

Where multi-conductor cables are required for a particular circuit and the window opening in a single BYZ sensor is too small to accommodate all cables, separate BYZ sensors may be installed on each set of cables (3 phase, neutral) and the secondaries connected in parallel. (Note: Proper polarity markings must be observed.) The resultant secondary current signal will be equivalent to a single BYZ sensor.

Two BYZ current sensors as shown in Figs. 8 and 9 are available for these applications as follows:

Window Opening (Inches)	Current Ratio	Style
4.75	100/5	592C102G03
4.75	50/5	592C102G01

When either of these sensors are used, the ground fault values shown in Table 3 are not applicable and the values shown in Table 4 should be used. One of the reasons for using the above sensors is to improve the level of sensitivity. This being the case, then the ground fault functional pick-up setting should be placed on position "A". The sensitivity of the ground element for this kind of arrangement will depend upon the ratio of the BYZ sensor used.

A variety of utilization schemes are available utilizing each of the above methods of ground fault sensing. Therefore, the individual installation requirements must be closely studied to insure proper application.

5.5 Current Sensors

The three current sensors installed in the circuit breaker are located at the rear of the circuit breaker on the lower studs. The location is shown in Fig. 66 of I.B. 33-790-1F. They 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 the current exceeds the functional protection settings.

The continuous current rating for any frame size breaker can be changed by changing the rating plug. A complete tabulation of available current sensors and rating plugs is given in Table 2. In general, plug ratings are available down through 50% of the current sensor rating.

The selection of available current sensors and rating plugs coupled with the wide range of long-delay current pick-up settings available on the Digitrip RMS Trip Unit, makes one set of sensors suitable for a number of current ratings. The Digitrip RMS Trip Unit protection function settings are standard, and are usable with any standard sensors. If sensors are changed because of changing load conditions, etc., it is only necessary to replace the rating plug and readjust the Digitrip RMS Trip Unit protection function settings to the new desired values.

To insure the non-tampering of selected protection settings, a sealable plexi-glass cover as shown in Fig. 6 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.

Table 4 – Approximate Ground Fault Pick-up Amperes Using BYZ (50/5) Sensor and "A" Position Setting on Ground Fault Pick-up(1)(2)(3)

Rating Plug Amperes	Sensor Ratings - Amperes										
	200	300	400	600	800	1200	1600	2000	2400	3200	4000
100	6.3										
200	12.5	8.3	6.3								
250		10.4	7.8								
300		12.5	9.4	6.3							
400			12.5	8.3	6.3						
600				12.5	9.4	6.3					
800					12.5	8.3	6.3				
1000						10.4	7.8	6.3			
1200						12.5	9.4	7.5	6.3		
1600							12.5	10	8.3	6.3	
2000								12.5	10.4	7.8	6.3
2400									12.5	9.4	7.5
3200										12.5	10
4000											12.5

(1) Except as noted, tolerances on pick-up levels are ± 10% of values shown in chart.
(2) 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 trip unit, ground pick-up levels can vary between the minimum and maximum values shown for each sensor rating.
(3) For BYZ (100/5) sensor, multiply above values by two.

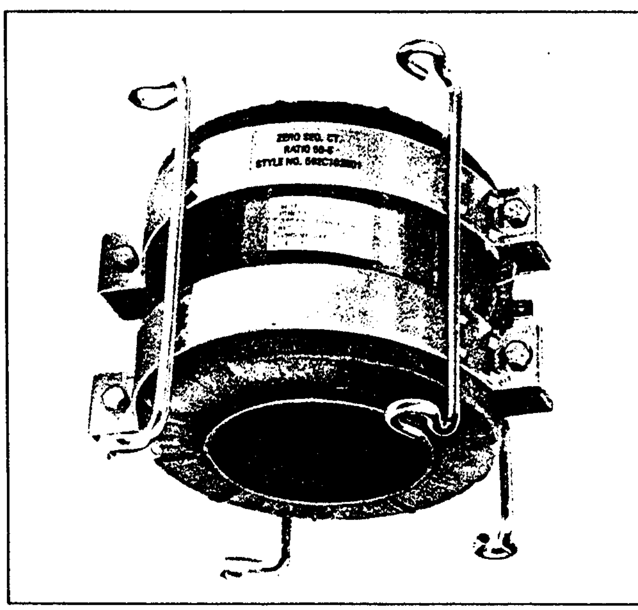
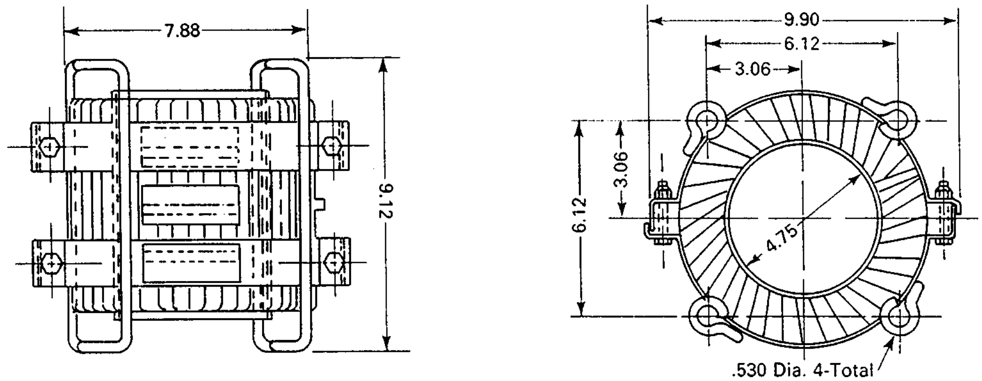


Fig. 8 *BYZ Zero-Sequence Current Transformer*

Dimensions (in Inches)



Current Ratio	Style
100/5	592C102G03
50/5	592C102G01

Fig. 9 *BYZ Zero-Sequence Current Transformer*

6.0 Time-Current Curves

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

7.0 References

7.1 Type DS Low-Voltage AC Power Circuit Breakers

I.B. 33-790-1F Instructions for Low-Voltage Power Circuit Breaker Types DS and DSL

508B508 Connection Diagram for Type DS Circuit Breakers

7.2 Digitrip RMS Trip Assemblies

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

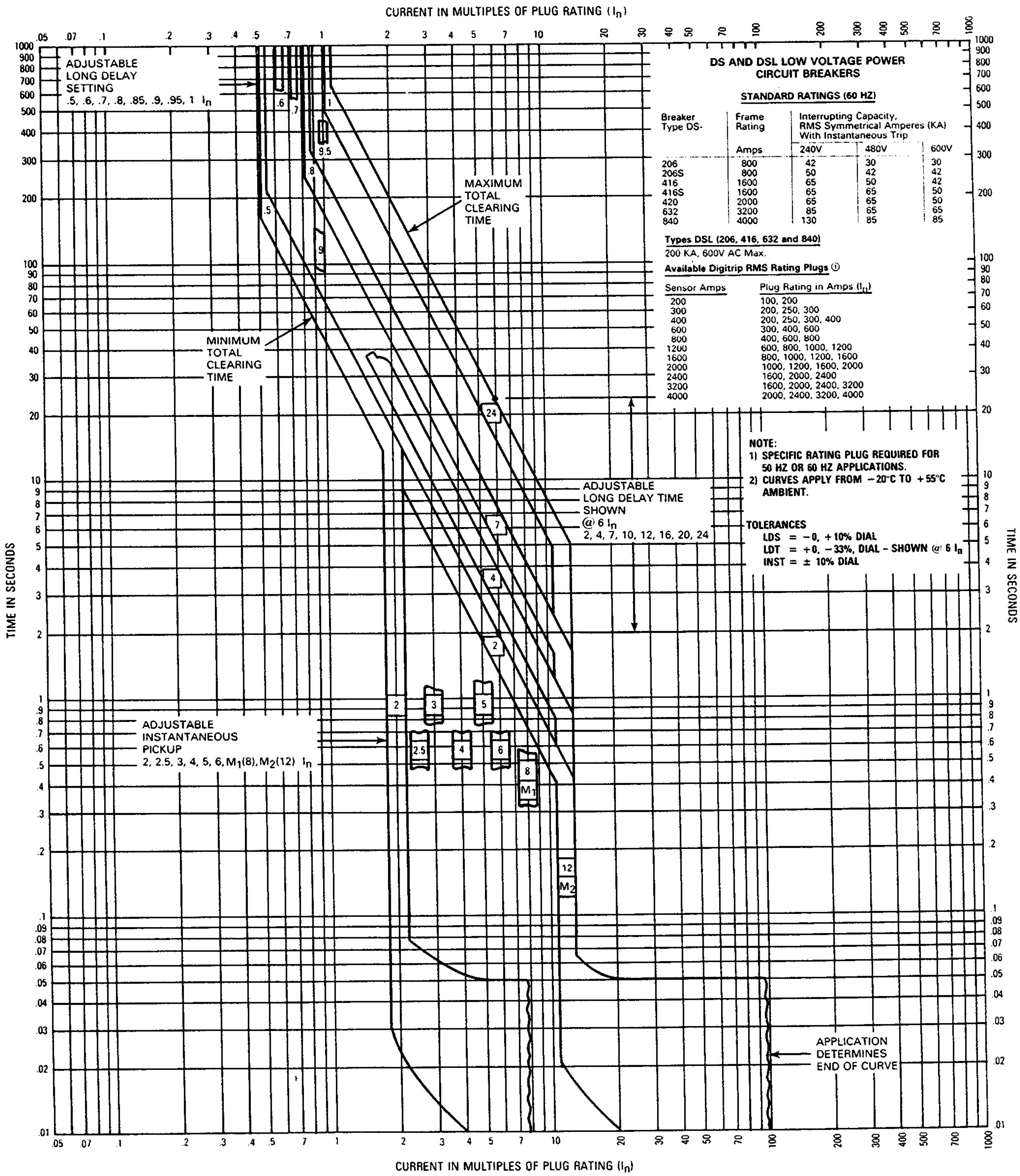
7.3 Miscellaneous

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

6.1 Long Time/Instantaneous Time-Current Curve SC4280-87A

DIGITRIP RMS 500/600/700/800

Typical Time-Current Characteristic Curve (LI) for Type DS Circuit Breakers



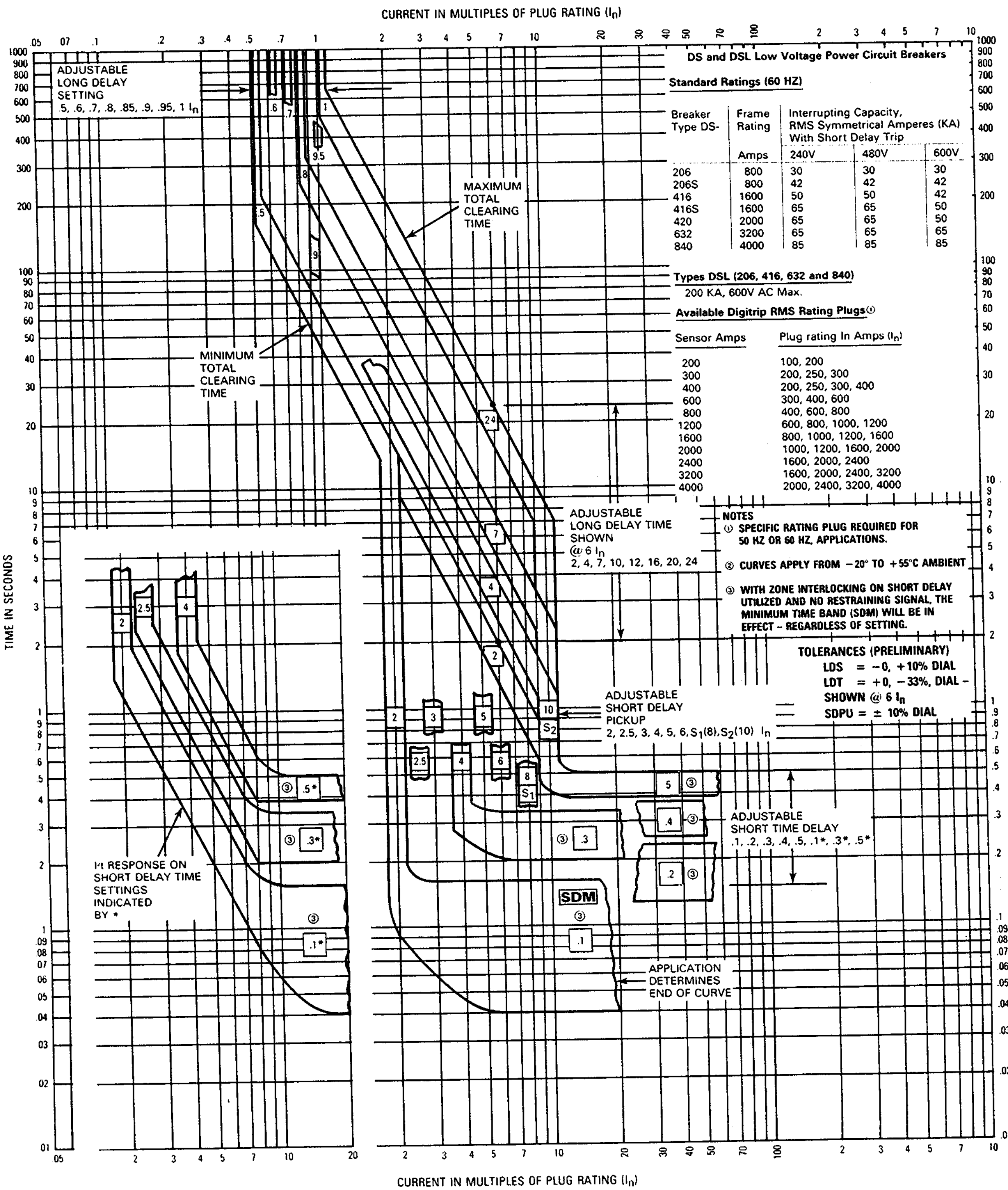
Breaker Type DS-	Frame Rating Amps	Interrupting Capacity, RMS Symmetrical Amperes (KA) With Instantaneous Trip 240V	480V	600V
206	800	42	30	30
206S	800	50	42	42
416	1600	65	50	42
416S	1600	65	65	50
420	2000	65	65	50
632	3200	85	65	65
840	4000	130	85	85

Sensor Amps	Plug Rating in Amps (I_n)
200	100, 200
300	200, 250, 300
400	200, 250, 300, 400
600	300, 400, 600
800	400, 600, 800
1200	600, 800, 1000, 1200
1600	800, 1000, 1200, 1600
2000	1000, 1200, 1600, 2000
2400	1600, 2000, 2400
3200	1600, 2000, 2400, 3200
4000	2000, 2400, 3200, 4000

6.2 Long Time/Short Time Time-Current Curve SC4281-87A

DIGITRIP RMS 500/600/700/800

Typical Time-Current Characteristic Curve (LS) for Type DS Circuit Breakers



Standard Ratings (60 HZ)

Breaker Type DS-	Frame Rating Amps	Interrupting Capacity, RMS Symmetrical Amperes (KA) With Short Delay Trip 240V	480V	600V
206	800	30	30	30
206S	800	42	42	42
416	1600	50	50	42
416S	1600	65	65	50
420	2000	65	65	50
632	3200	65	65	65
840	4000	85	85	85

Types DSL (206, 416, 632 and 840)

200 KA, 600V AC Max.

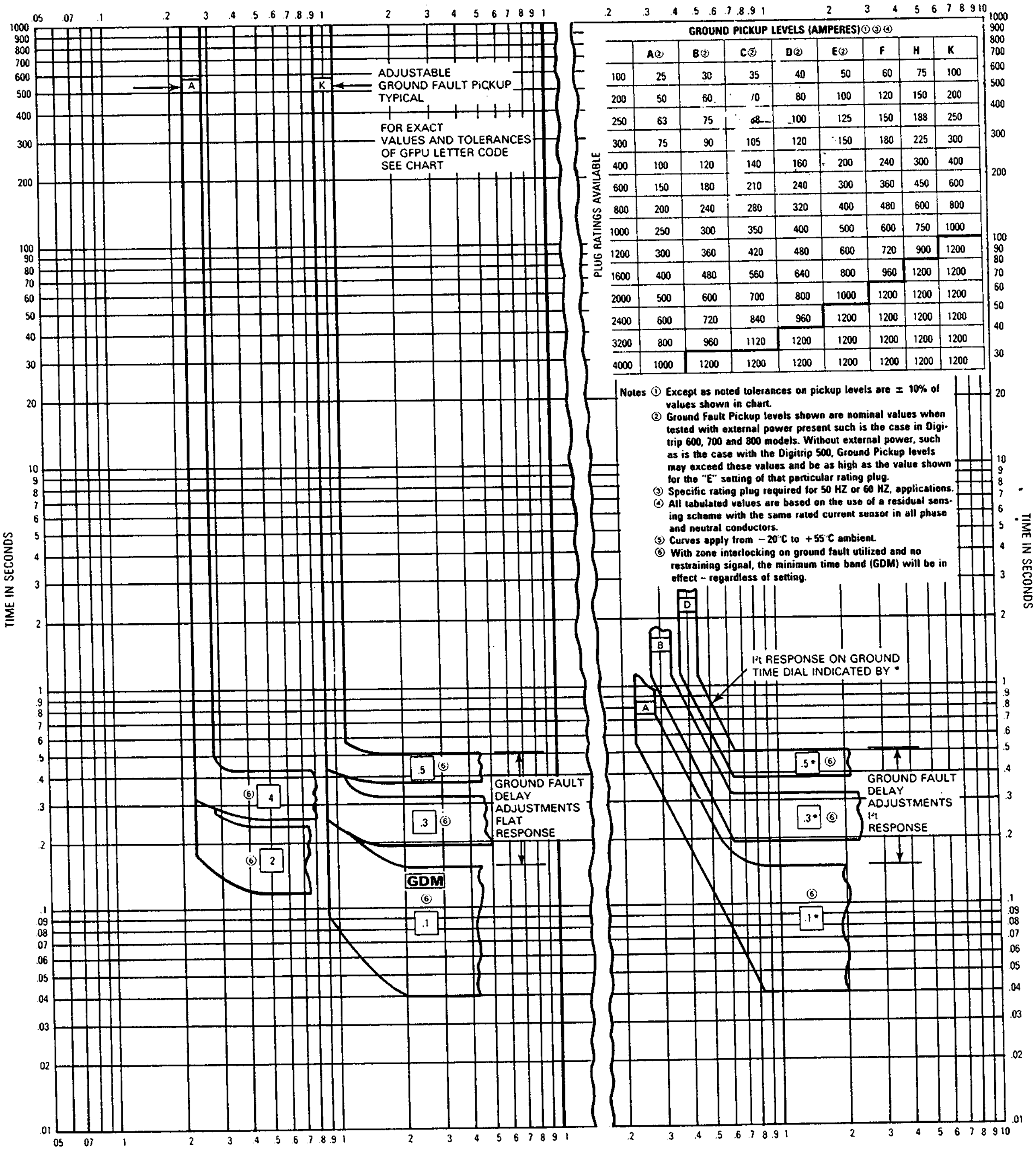
Available Digitrip RMS Rating Plugs①

Sensor Amps	Plug rating In Amps (I_n)
200	100, 200
300	200, 250, 300
400	200, 250, 300, 400
600	300, 400, 600
800	400, 600, 800
1200	600, 800, 1000, 1200
1600	800, 1000, 1200, 1600
2000	1000, 1200, 1600, 2000
2400	1600, 2000, 2400
3200	1600, 2000, 2400, 3200
4000	2000, 2400, 3200, 4000

6.3 Ground Fault Protection Time-Current Curve SC4279-87

DIGITRIP RMS 500/600/700/800

Typical Time-Current Characteristic Curve (G)
for Type DS Circuit Breakers



GROUND PICKUP LEVELS (AMPERES)①③④

Plug Ratings Available	A②	B②	C③	D②	E②	F	H	K
100	25	30	35	40	50	60	75	100
200	50	60	/0	80	100	120	150	200
250	63	75	d8	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
2400	600	720	840	960	1200	1200	1200	1200
3200	800	960	1120	1200	1200	1200	1200	1200
4000	1000	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 levels 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.