Instructions for Digitrip RMS 600 Trip Unit

I.L. 29-852-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.

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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 General Description

1.1 Protection

The Digitrip RMS 600 Trip Unit, illustrated in Fig. 1, is a microprocessor based type trip unit suitable for use in type SPB Systems Pow-R circuit breakers and types DS and DSL low voltage AC power circuit breakers and Series C® R-Frame molded case circuit breaker.

The trip unit provides true RMS current sensing for proper correlation with thermal characteristics of conductors and equipment. Interchangeable rating plugs are provided to establish the continuous current rating of each circuit breaker.

The Digitrip RMS 600 Trip Unit is completely self-contained and when the circuit breaker is closed, requires no external control power to operate its **protection systems**. It operates from current signal levels and control power derived through current sensors integrally mounted in the circuit breaker.

The Digitrip RMS 600 Trip Unit is available in six optional protection models. Each trip unit may be equipped with a maximum of five phase and two ground (time-current) adjustments to meet specific application requirements. These protection models include the following types which are further illustrated in the nameplate examples shown in Fig. 2.

Figure	Type Protection	Identifier
2.1	Long Time/Instantaneous	(LI)
2.2	Long Time/Short Time	(LS)
2.3	Long Time/Short Time/Instantaneous	(LSI)
2.4	Long Time/Instantaneous/Ground	(LIG)
2.5	Long Time/Short Time/Ground	(LSG)
2.6	Long Time/Short Time/Instantaneous/Ground	(LSIG)

1.2 Information/General

In addition to the protection function, the Digitrip RMS 600 Trip Unit is equipped with a four-digit, alpha-numeric readout display, three phase and one ground (when supplied) current pointer green LEDs along with a stepping pushbutton as illustrated in Figs. 1 and 2. A Power/Relay module is included to provide control power for operating the readout display and internally mounted signal relays. The signal relays provide contacts for three remote mode of trip indicators (long delay, short circuit, ground fault) and a High-Load remote alarm.

Red LED indicators are provided on the face of the trip unit to indicate the mode of an automatic trip operation as well as a High-Load alarm.

Green LED indicators are provided to indicate the operational status of the trip unit and the status of the back-up battery mounted in the rating plug.

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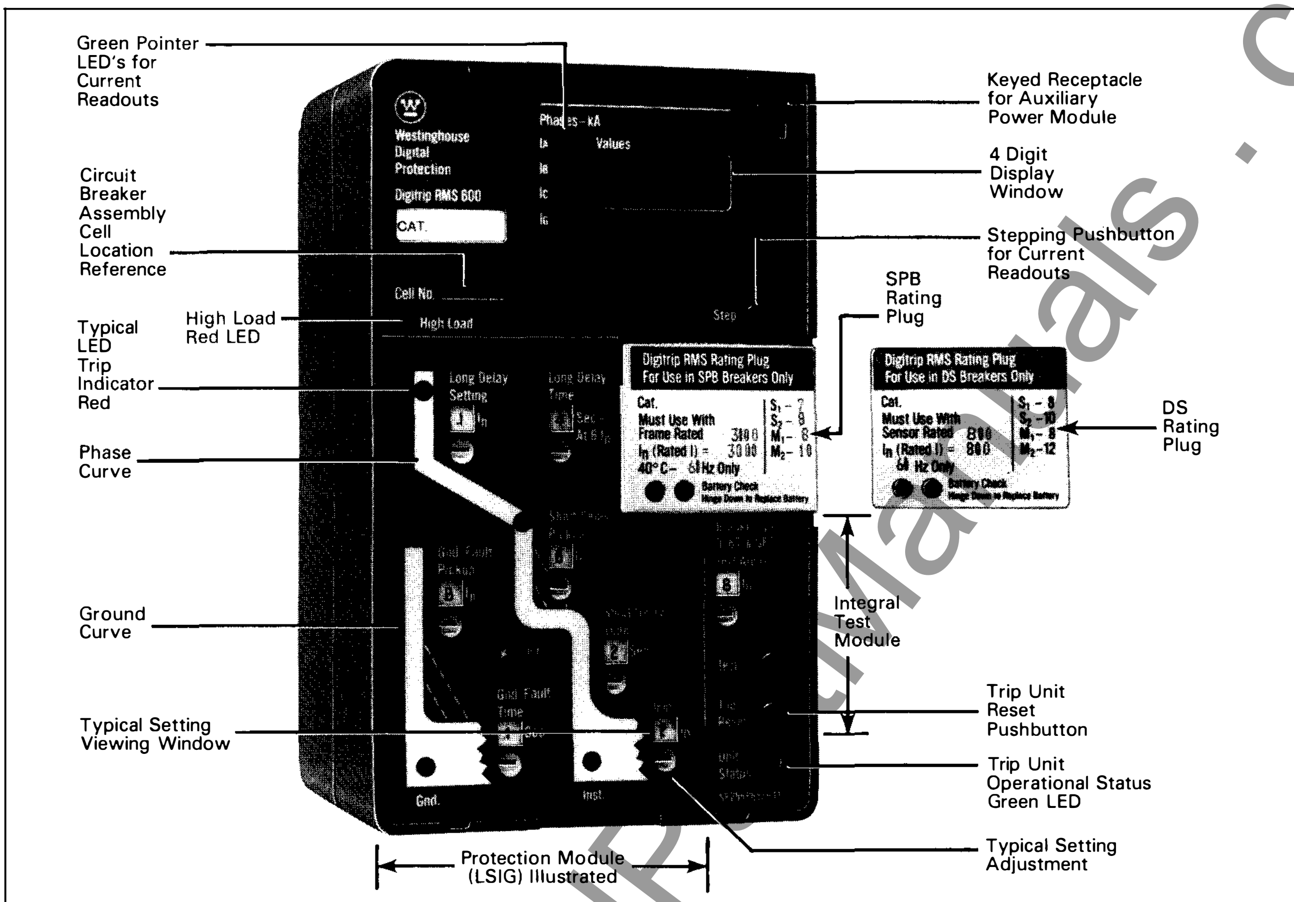


Fig. 1 *Typical Digitrip RMS 600 Trip Unit with Rating Plug Installed*

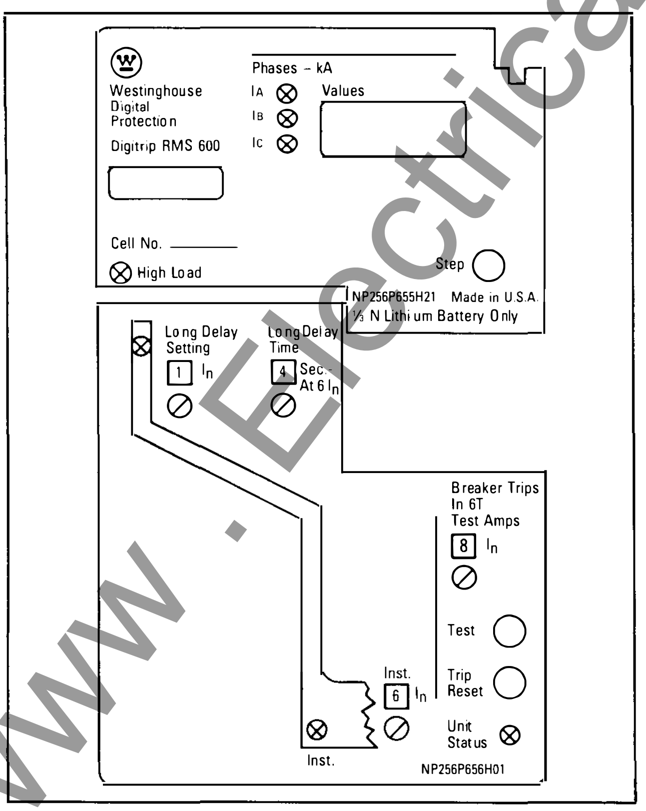


Fig. 2.1 *Long Time/Instantaneous Protection (LI) Nameplate*

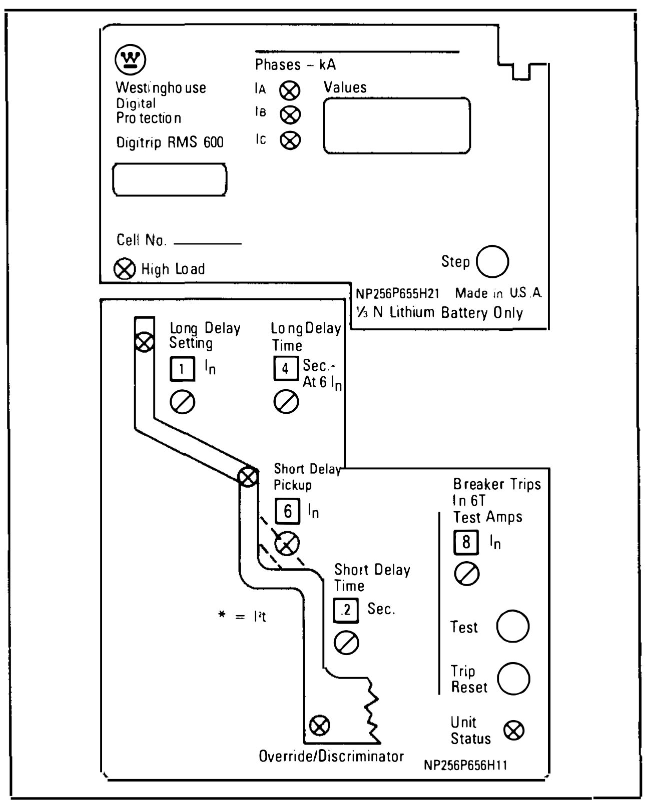


Fig. 2.2 *Long Time/Short Time Protection (LS) Nameplate*

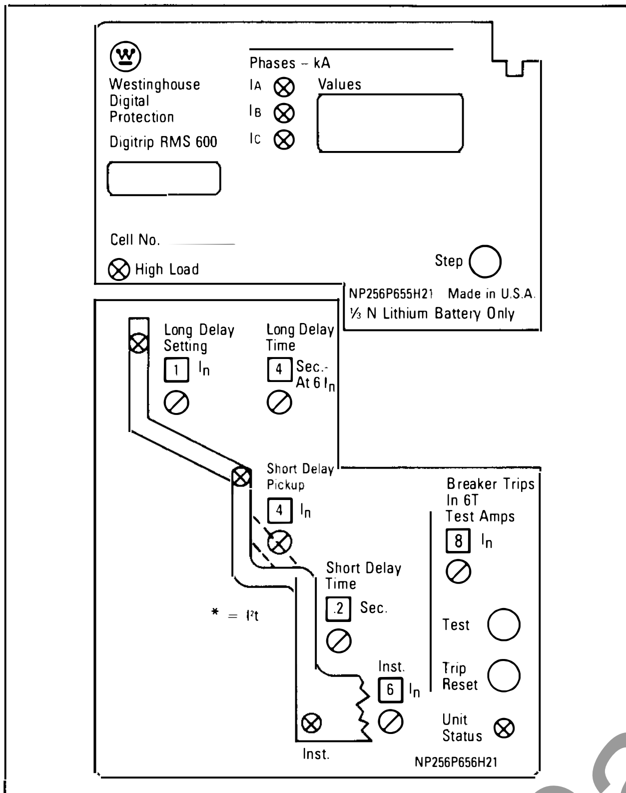


Fig. 2.3 *Long Time/Short Time/Instantaneous Protection (LSI) Nameplate*

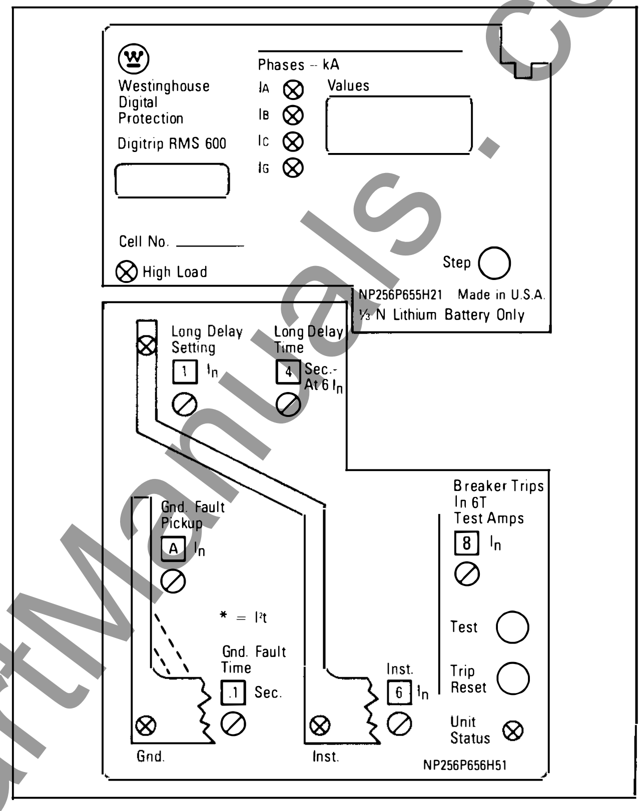


Fig. 2.4 *Long Time/Instantaneous/Ground Protection (LIG) Nameplate*

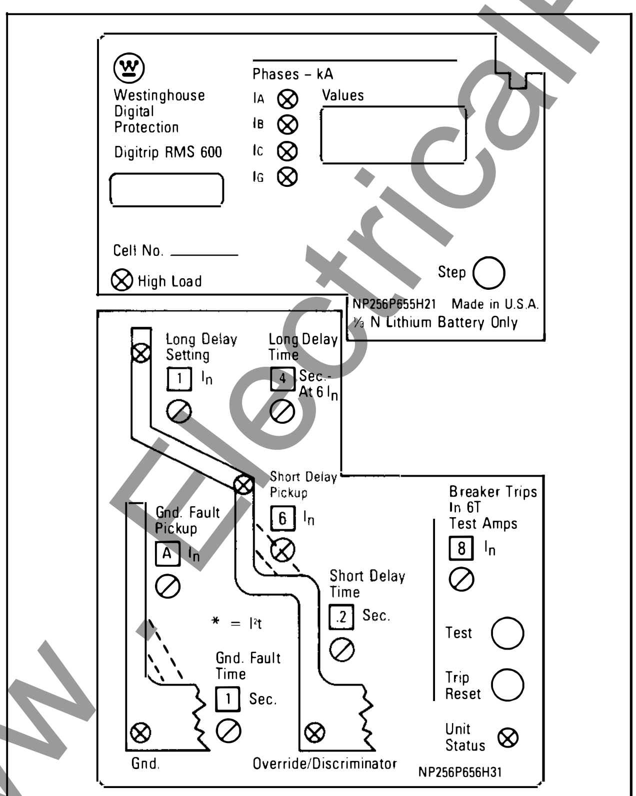


Fig. 2.5 *Long Time/Short Time/Ground Protection (LSG) Nameplate*

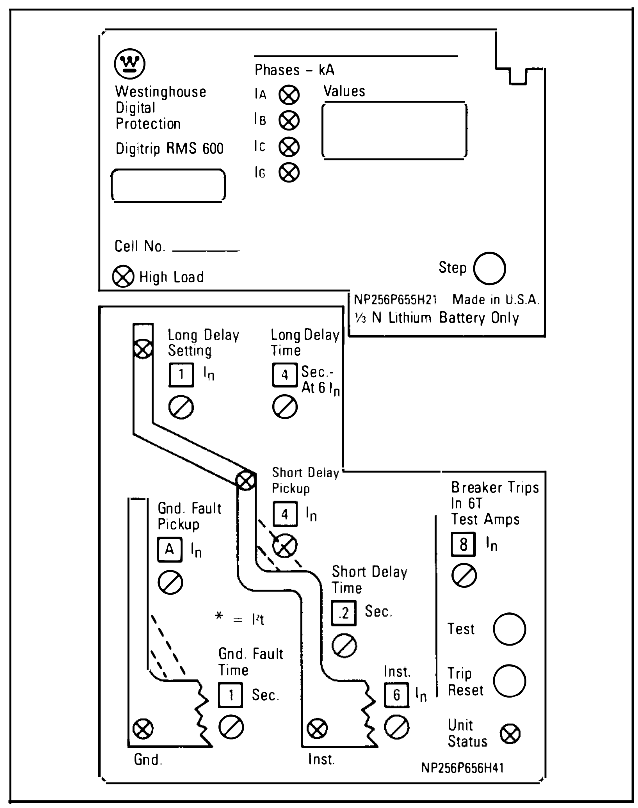


Fig. 2.6 *Long Time/Short Time/Instantaneous/Ground Protection (LSIG) Nameplate*

The back-up battery is provided to maintain the mode of trip LED indicators following an automatic trip operation and simultaneous loss of control power to the Power/Relay module. It does not provide control power for the microprocessor.

1.3 Testing

Integral test provisions with selectable "Trip" and "No Trip" test positions are provided. For phase testing, five "No Trip" test settings and one "Trip" test setting are provided. For ground fault testing, one "No Trip" and one "Trip" setting are provided. Test and Trip Reset pushbuttons are provided.

2.0 UL Listed Devices

Digitrip RMS 600 Trip Units are listed by the Underwriters Laboratories, Inc. for use in types SPB, DS and DSL and Series C R-Frame circuit breakers under U.L. File E7819.

3.0 Principle of Operation

3.1 General

The Digitrip RMS 600 Trip Unit provides three basic functions: Protection, Information and Testing. A typical trip unit and rating plug are illustrated in Fig. 1. Individual product instruction leaflets referenced in Sections 9.1 and 9.2 illustrate typical Digitrip RMS Trip Units installed in specific breakers.

The trip unit uses the INTEL MCS-51 family of microcomputers to perform its numeric and logic functions. The principle of operation can best be described by referring to the block diagram shown in Fig. 3.

In the Digitrip RMS 600 Trip Unit all required sensing and tripping power to operate its **protection function** is derived from the current sensors in the circuit breaker. The secondary current signals from these sensors provide the correct magnitude of current for protection functions as well as tripping power during normal circuit breaker operating periods. Using these current signals in the protection function, analog voltages are developed across various calibrating resistors including:

1) Phase current
2) Ground fault current (when supplied)
3) Rating plug

The resulting analog voltages are multiplexed into an analog-to-digital converter and the output data fed into the microcomputer chip along the data bus.

The microcomputer, in cyclic fashion, repeatedly scans the resultant voltage values across each calibrating resistor and enters these values into its RAM or Read/Write Memory. This data, which is used to calculate true RMS current values, is repeatedly compared with the pre-set protection function pick-up settings and other operating data stored in the ROM or Read Only Memory. The microcomputer software program is then used, in decision tree fashion, to initiate protection functions including tripping actions through the low energy flux transfer trip coil in the circuit breaker.

3.2 Making Current Release (Discriminator)

When the Digitrip RMS 600 Trip Unit is not equipped with an adjustable instantaneous protection setting, i.e., types LS or LSG, a making current release (or discriminator) circuit is provided. This circuit will prevent the circuit breaker from being

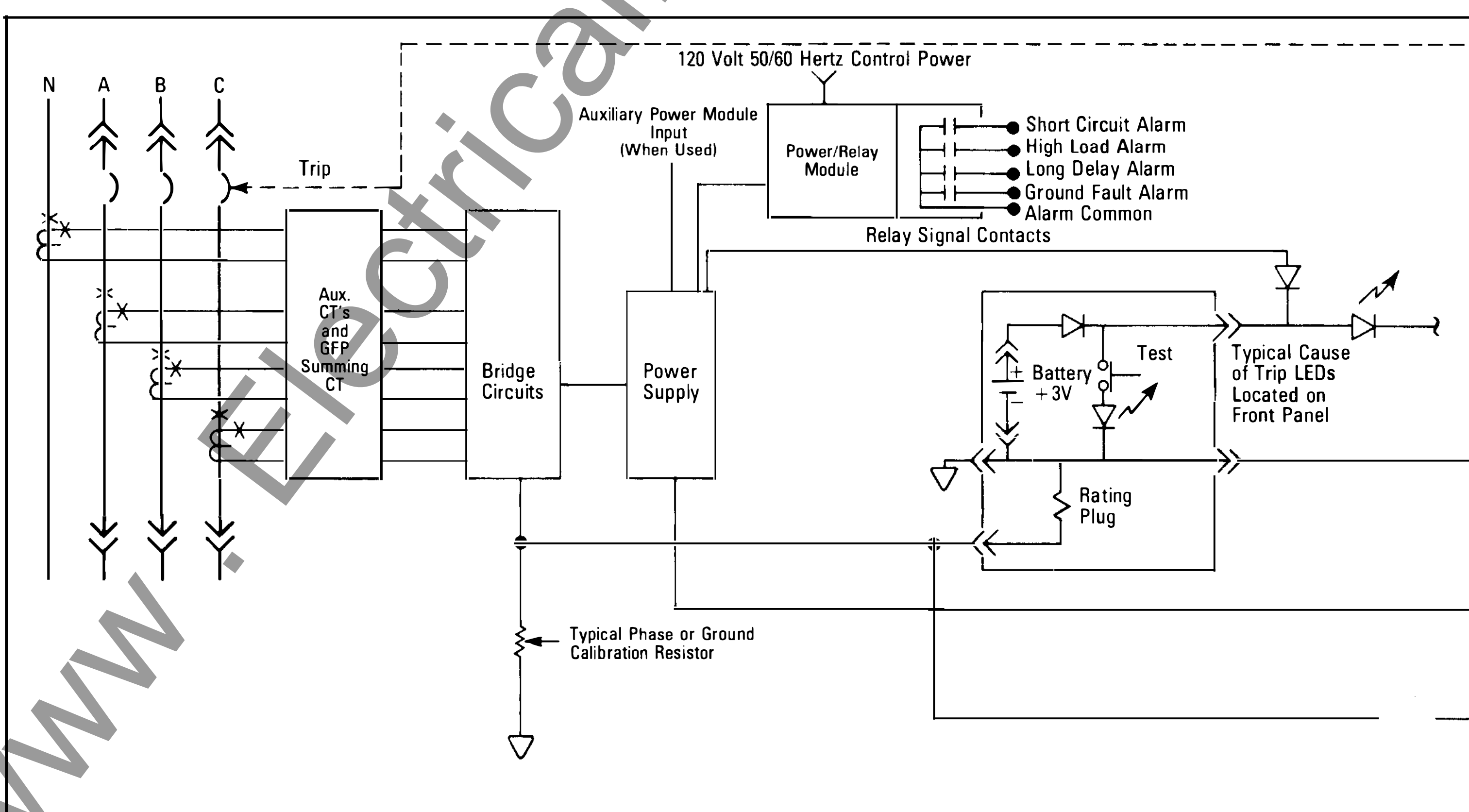


Fig. 3 *Digitrip RMS 600 Block Diagram with Breaker Interface*

closed and latched-in on a faulted circuit. The non-adjustable release is pre-set at eleven (11) times the installed rating plug ampere rating (I_n).

The making current release is armed only for the first ten (10) cycles following an initial circuit breaker closing operation provided the load current exceeds approximately 10% of the circuit breaker frame or sensor rating. Should the load current through the circuit breaker drop to a value less than this, the release will re-arm. The release, once armed, will remain armed until approximately 10% load current passes through the breaker for 10 cycles. Any trip operation initiated by the making current release will trip the circuit breaker instantaneously.

3.3 Instantaneous Override

In addition, when the Digitrip RMS 600 Trip Unit is not equipped with an adjustable instantaneous setting, i.e., types LS or LSG, a high-set non-adjustable instantaneous override trip circuit is provided. This high level tripping action is preset to a specific value that reflects the short time withstand rating of the circuit breaker in which the trip unit is installed. Specific values vary between circuit breaker types and ratings. For specific information, refer to the supplementary leaflets and/or Time-Current curves referenced in Sections 9.1 and 9.2.

3.4 Zone Interlocking

As indicated in the block diagram in Fig. 3, zone interlock signals are provided. For Digitrip RMS 600 Trip Units equipped with either ground fault or short time protection functions or both, separate zone interlocking circuits are provided. When utilized, these input/output signals must be connected in the ultimate equipment assembly in line with details provided with the specific circuit breaker connection diagrams supplied with the circuit breaker and referenced in Sections 9.1 and 9.2. Similarly, if the zone interlocking function is chosen not to be used, defeater connections on each circuit must be added as illustrated in the same referenced diagrams.

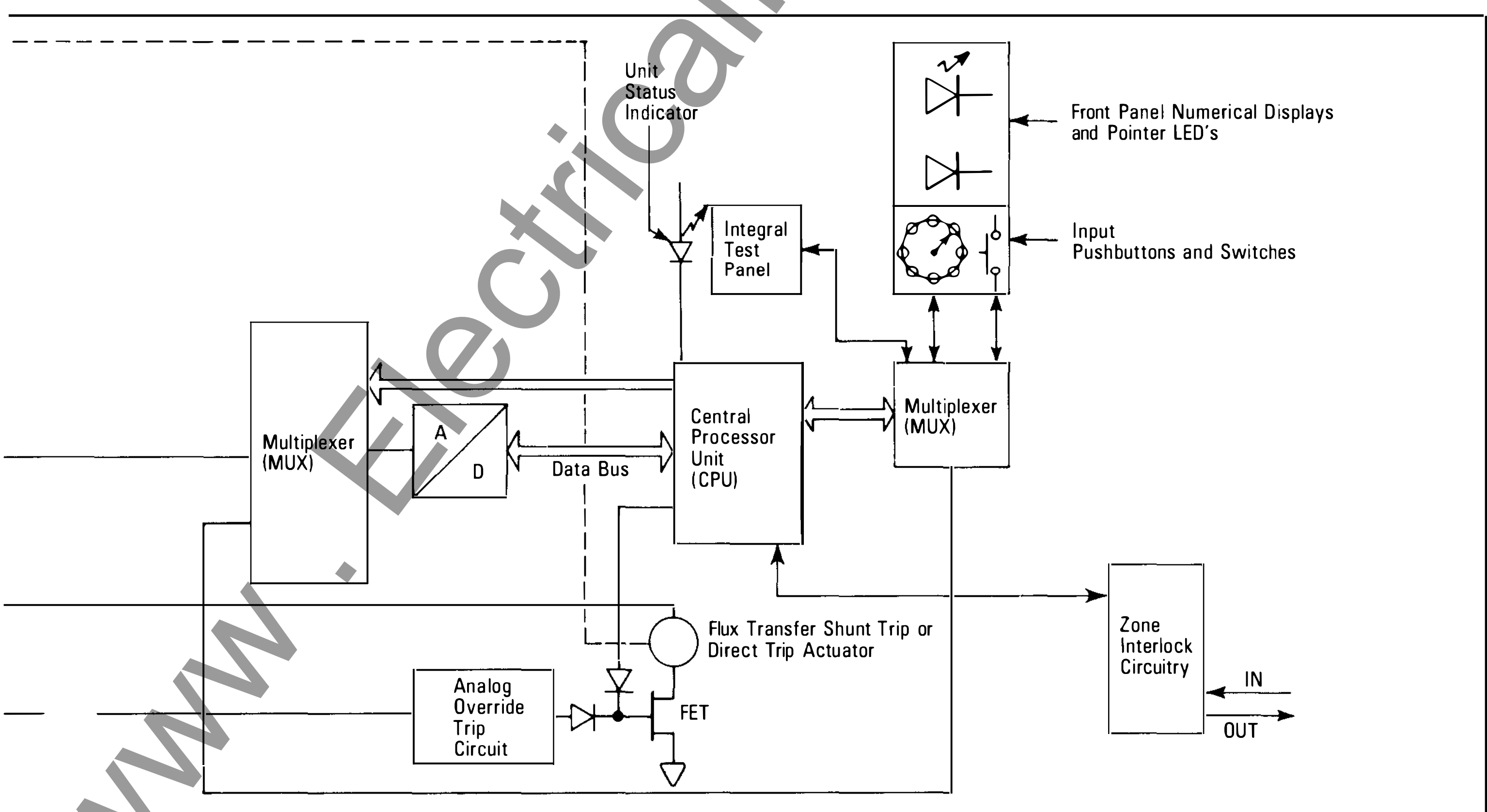
3.5 Trip and Operation Indicators

Red colored LEDs, as shown in Figs. 1 and 2, also indicate on the face of the trip unit the mode of trip of any automatic trip operation. As indicated in Fig. 2, each LED is strategically located in the related segment of the Time-Current curve depicted on the face of the trip unit. The mode of trip is identified by the segment of the Time-Current curve in which the LED is turned "On".

External control power is required to operate the Power/Relay module. The power/relay module maintains the mode of trip LED indicators in their "On" position following an automatic trip operation as long as the control power is available. With a loss of control power following an automatic trip operation, a back-up battery as illustrated in Figs. 3 and 5 is provided to perform this function.

A green colored battery check, LED and test pushbutton, as shown in Figs. 1 and 5, are provided to check the status of the battery.

A green colored LED, as shown in Fig. 1, indicates the operational status of the trip unit. With external control power available at the Power/Relay module (or via the external Auxiliary Power module during bench testing operations), the green LED will flash "On" and "Off" once each second. A flashing green LED is an indication of a properly operating trip unit.



A red colored LED, as shown in Fig. 1, indicates that the load current through the circuit breaker has reached 85% of the preset value of the Long Delay Setting. The High-Load LED will turn "On" and the High-Load relay, located internally in the Power/Relay module shown in Fig. 4, will pick-up after an approximate 40 second delay. This delay allows the alarm to ride-through a momentary high-load condition thus avoiding nuisance alarms.

3.6 Readout Display

The four-digit alpha-numeric readout display window, illustrated in Figs. 1 and 2, serves two basic purposes: instrumentation and mode of trip or trouble indication.

Instrumentation

During normal service conditions, with the circuit breaker closed, it serves an ammeter instrumentation function. It displays the individual phase currents (I_A, I_B, I_C) and ground current (I_G) provided integral ground fault protection is included in the trip unit. Current values are displayed in kA. The actual current value being displayed is indicated by the marked LED that is turned "On". A stepping pushbutton is provided to step among the different currents.

Mode of Trip and Trouble Indication

Following an automatic circuit breaker trip operation and with control power available to the Power/Relay module, the Readout Display indicates the mode of trip using coded messages such as, INST (Instantaneous Trip), SDT (Short Delay Trip), LTD (Long Delay Trip) and GNDT (Ground Fault Trip). The coded message will lock-in position until the Stepping Pushbutton is depressed. Afterwards, the Display will indicate the value of current (in kA) at the time of the trip initiation by the protection function involved.

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. Following an automatic trip operation of the circuit breaker, it will maintain the cause of the trip history and the mode of trip LEDs as long as the external control power supply is available. Each signal relay contact is rated 120 V., 50/60 Hz, 1.0 A.

3.6.1 Readout Display Messages

The Readout Display provides ammeter instrumentation under normal service conditions of the circuit breaker and alpha-numeric coded messages after an automatic trip. To properly understand the actions of the trip unit, each coded message must be understood as well as any required follow-up operational action. Messages can be divided into two categories: Normal service and after trip or trouble conditions.

3.6.1.1 Normal Service

Normal service messages are those that serve the ammeter instrumentation function. In Fig. 1, four green colored LEDs serve a pointer function, i.e., phase A current (I_A), phase B current (I_B), phase C current (I_C) and ground current (I_G). The ground current LED will be included only if integral ground fault protection is included as an integral part of the trip unit protections functions.

Each LED, when turned "On", will indicate the current being displayed in the four-digit display window. The current displayed in the window will remain in view until a change is implemented. A step pushbutton is provided to step among the available currents.

3.6.1.2 After Trip or Trouble

For the after trip and trouble conditions, one of the following coded messages will appear in the display window:

Message	Condition	Action/Comment
LDPU	Overload in Progress	Indication is warning signal. Trip will occur if condition persists.
LDT	Overload Trip	Trip action initiated as result of an overload. Clear overload, reset trip unit and reclose breaker as required.
SDT	Short Delay Trip	Trip action initiated as result of fault exceeding trip setting. Examine breaker to insure reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been corrected.
INST	① Instantaneous Trip	Trip action initiated as result of fault exceeding trip setting. Examine breaker to insure reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been corrected.
GNDT	Ground Fault Trip	Trip action initiated as result of ground fault exceeding trip setting. Examine breaker to insure reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been corrected.
DISC	① Making Current Release (Discriminator) Trip	Trip action initiated by Discriminator – most likely on initial breaker closing action. Examine breaker to insure that reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been cleared.
ORID	②③ Override Trip	Trip action initiated by override circuit indicative of a high level fault. Examine breaker to insure that reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been cleared.

Message	Condition	Action/Comment
TEST	Test in Progress	This message will appear when the integral test pushbutton is depressed and will disappear when the test pushbutton is released (indicating test has started). The test message only appears when a complete breaker trip test is selected, i.e., 6T or GFT (see Fig. 7)
PLUG	Rating Plug Problem	This message will appear should there be a missing, improperly installed or defective rating plug.
RAM	Data Memory Problem	This message will appear in response to a data memory test failure. Depress trip unit Trip Reset to reconfirm message. If message reappears, replace trip unit.
ROM	Program Memory Problem	This message will appear in response to a program memory test failure. Depress trip unit Trip Reset to reconfirm message. If message reappears, replace trip unit.

Notes:

① All values of current displayed were present prior to initiation of the trip signal. In the case of a high-level fault condition where fast tripping is desirable, the trip unit will operate before a complete RMS current value can be calculated. For this reason, the displayed value may be less than the actual RMS fault current.

② In the case of very high fault levels outside the range of normal current sensor accuracy ranges, the message "ORNG" (indicating over range) will appear at each phase readout position when the trip message "ORID" (indicating override) is interrogated by the stepping pushbutton.

③ The override value in the trip unit is set to operate at approximately 100 X the frame/sensor ampere rating For circuit breakers having lower withstand ratings, other details are provided in the breaker to insure proper applications within the breaker withstand rating.

3.6.1.3 Analyzing "After Trip" Coded Messages

As indicated in Section 3.6, as long as control power is available to the Power/Relay Module, coded messages will lock-in position on the Readout Display until the stepping pushbutton is depressed. Likewise, the individual values of phase and ground current, if any, at the time the automatic trip was initiated will also lock-in position and remain until the trip unit is reset by depressing the reset pushbutton. The manner that these coded messages operate can best be understood by referring to the following examples:

Given A 1600 amp circuit breaker with a 1000 amp rating plug installed.

3.6.1.3.1 Case 1 – Overload Trip Operation

Assume a prolonged overload condition which results in an automatic breaker trip operation. The following will occur:

1. The Long Delay Trip LED will turn "On" (see Fig. 1)
2. The coded message LDT will appear in the Display Window (see Fig. 1)
3. The Long Delay Relay in the Power/Relay Module (see Figs. 3 and 4) will operate to transmit a remote Long Delay alarm signal.

Operator Actions

1. Observe the mode of trip LED and coded alpha-numeric message in the Display Window.
2. Depress Stepping Pushbutton twice (see Fig. 1). This action will clear the coded cause of trip message in the Display Window.
3. View value of phase current in Display Window (see Fig. 1) e.g., 1.50 (in kA).

   Note: The phase current shown will be that referenced by the Pointer LED (see Fig. 1) that is turned "On," assume "I_A". (It may not be the faulted phase).

4. Depress the Stepping Pushbutton to move from LED "I_A" to LED "I_B" to LED "I_C". At each position, the related value of phase current (in kA) at the time of the trip operation will appear in the Display Window.
5. Reset the trip unit by depressing the "Trip Reset" pushbutton (see Fig. 1). All coded messages and current values in the display window, the cause of trip LED and the signal relay in the Power/Relay module will turn "Off".

Notice

On trip operations initiated by the long delay trip (LDT) function it is essential that any cause of overload trip be corrected prior to reclosing the circuit breaker. Should it not be corrected and the circuit breaker be reclosed too soon, then because of the inherent Long Time Memory Function, the Long Delay trip time will operate faster than the related time-current curve indicates.

The amount of time required to clear the memory circuit is a factor of the Long Delay time setting (see Fig. 6.2). The longer the delay setting, the longer the time required to reset the memory. Total memory clearing time could vary from one to twelve (12) minutes depending upon the time delay setting selected.

The memory function, as in any conventional thermal type (bimetal) circuit breaker, serves a useful function by allowing the load conductors to cool down.

6. After correcting the cause of the overload trip (LDT) and allowing for the memory circuit to reset, reclose the circuit breaker as required following established operating procedures.

Note: During the overload condition, prior to the automatic trip operation, the following trip unit indications would have been visible:

1. The "High-Load" LED (Fig.1) would have been turned "On" if the overload condition had existed for 40 seconds or longer.
2. The "High-Load" relay in the Power/Relay Module (see Figs. 3 and 4) would have picked-up (after a 40 second delay,) to close a contact for a remote High-Load alarm.
3. The Long Delay LED (Fig.1) would have been flashing "On" and "Off".
4. The coded message LDPU would have been flashing in the Display Window.

3.6.1.3.2 Case 2 – Instantaneous Trip Operation

Assume a high-level fault above the instantaneous trip setting – Assume 8 x I_n – (see Fig. 1). Following the trip operation, the following will occur:

1. The Instantaneous Trip LED will turn "On" (see Fig. 1).
2. The coded message INST will appear in the Display Window (see Fig. 1).
3. The Short Circuit Relay in the Power/Relay Module (see Figs. 3 and 4) will operate to close a contact for a remote Short Circuit Alarm.

Operator Actions

1. Observe the mode of trip LED and coded message in the Display Window.
2. Depress Stepping Pushbutton (see Fig. 1). This action will clear the coded cause of trip message in the Display Window.

Fig. 4 *Power/Relay Module.*

3. View value of phase current in Display Window (see Fig. 1) e.g., 12.0 (in kA).

   Note: The phase current shown will be that referenced by the Pointer LED (see Fig. 1) that is turned "On" (It may not be the faulted phase), assume "I_A".

4. Depress the Stepping Pushbutton to move from LED "I_A" to LED "I_B" to LED "I_C". At each position, the related value of phase current (in kA) at the time of the trip operation will appear in the Display Window.

   Note: Should the level of fault current be very high, then, the coded message ORID could appear in the Display Window. When the step pushbutton is depressed, the coded message ORNG rather than a numerical current value would appear. This would be indicative of a very high fault level outside the range of normal current sensor accuracy ranges.

5. Reset the trip unit by depressing the "Trip Reset" pushbutton (see Fig. 1). All coded messages and/or current values in the display window, the cause of trip LED and the signal relay in the Power/Relay module will turn "Off".
6. Following any corrective actions in the system and inspections of the circuit breaker and related equipment, reclose the circuit breaker as required.

3.6.1.3.3 Other Cases

Similar type indications will occur and similar operator actions will be required as described in the above two cases following an automatic trip operation initiated by any other of the Protection Functions, including Short delay and ground fault.

3.7 Test Provisions

An integral test panel including a test selector switch and test and reset pushbuttons is provided to test the circuit breaker in either a TRIP or NO-TRIP test mode under qualified conditions. See Section 5.

For bench testing of the trip unit alone or of the trip unit while it is installed in the circuit breaker, an optional Auxiliary Power module (Catalog No. PRTAAPM) as shown in Fig. 7 is available. This Auxiliary Power module, which operates from a separate 120Vac, supply, may also be used when a drawout type circuit breaker is in any of its four cell positions, i.e., "Connected", "Test", "Disconnected" and "Withdrawn" (or "Removed").

4.0 Protection Settings

4.1 General

Prior to placing any circuit breaker in operation, all available protection settings should be set using values as recommended by the specifying engineer responsible for the installation. The number of settings that must be made will be a factor of the protection model supplied as illustrated in Figs. 2.1 through 2.6. Each setting is made with an eight position rotary switch using a small screwdriver. The selected setting for each adjustment will appear in the small rectangular opening as illustrated in Fig. 1.

The installed rating plug establishes the maximum continuous current rating of the circuit breaker. All current pick-up settings in the protection module are defined in per unit multiples of the ampere rating (I_n) of the installed rating plug.

To illustrate the portion of the protection curve being adjusted, simulated Time-Current curves are pictured on the face of the trip unit. The particular setting to be adjusted is located in close proximity to its portion of the simulated Time-Current curve. Should an automatic trip occur as a result of a fault current exceeding the preselected value in this portion of the Time-Current curve, the red LED shown in this segment of the simulated Time-Current curve will turn "On".

The available settings, along with the illustrated effect of changing the settings, are given in Figs. 6.1 through 6.7.

4.2 Long Delay Settings

Eight (8) available settings, as indicated in Fig. 6.1, range from 0.5 to 1.0 (I_n). Each setting is expressed as a multiple of the maximum ampere rating (I_n) of the installed rating plug.

4.3 Long Delay Time Settings

Eight (8) available settings, as illustrated in Fig. 6.2, range from 2 to 24 seconds. These settings represent total clearing times at a current value equal to six (6) times the installed rating plug ampere rating (I_n).

4.4 Short Delay Pick-up Settings

As illustrated in Fig. 6.3, eight (8) available settings range from 2 to 6 (I_n) with two variable settings of S1 and S2. These variable settings depend upon the type of circuit breaker in which the trip unit is installed. Specific information on these settings is given in the supplemental instruction leaflet referenced in Sections 9.1 and 9.2 that is supplied with the circuit breaker. Specific information is also shown on the rating plug and on the applicable Time-Current curve.

4.5 Short Delay Time Settings

As illustrated in Fig. 6.4, two different curve configurations are possible, i.e., flat or I^2t response. The configuration selected will be a factor of the type of selective coordination being developed. The I^2t response will provide a longer time delay in the low-end of the short delay pick-up range than will the flat response setting.

Five flat (0.1, 0.2, 0.3, 0.4, 0.5 sec.) and three I^2t (0.1, 0.3, 0.5 sec.) response time delay settings are provided. The I^2t response settings are identified by the suffix asterisk (*) that appears in the setting viewing window. The I^2t response is applicable only up to eight (8) times the ampere rating of the installed rating plug (I_n). After this value is exceeded, the I^2t response configuration reverts to a flat response.

4.6 Instantaneous Pick-up Settings

As illustrated in Fig. 6.5, eight (8) available settings range from 2 to 6 (I_n) with two variable settings M1 and M2. These variable settings depend upon the type of circuit breaker in which the trip unit is installed. Specific information on these settings is given in the supplemental instruction leaflet referenced in Sections 9.1 and 9.2 that is supplied with the circuit breaker. Specific information is also shown on the rating plug and on the applicable Time-Current curve.

4.7 Ground Fault Current Pick-up Settings

As illustrated in Fig. 6.6, eight (8) available settings are given in alphabetical notations from A to K (there is no "G" notation). Specific setting values are a function of the installed rating plug. In general, the pick-up settings range from 0.25 to 1.0 times the ampere rating (I_n) of the installed rating plug up to a maximum pick-up value of 1200A.

Specific current pick-up values are tabulated in Table 1 and on the ground fault Time-Current curve of the applicable circuit breaker. Under primary injection test conditions conducted with the breaker outside of its cell and the external Auxiliary Power module shown in Fig. 8 is used, the tabulated values should be in effect.

The tabulated values shown in Table 1 are based on the use of a residual current sensing scheme with the same rated current sensor for all phase and neutral conductors. Refer to the applicable supplemental circuit breaker instruction leaflet shown in Sections 9.1 and 9.2 for values applicable to alternate sensing schemes.

Table 1 – Ground Fault Current Pickup Settings

INSTALLED RATING PLUG AMPERES (I_n)③	PICKUP SETTINGS GROUND FAULT CURRENTS (AMPERES)①							
	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
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

① Tolerances on pickup levels are ±10% of values shown in chart.
② Ground fault pickup levels shown are nominal values when tested with external control power present. This could be with the Power/Relay Module energized or with the auxiliary power module energized. Without external control power, the pick-up level may be as high as the value shown for the "E" setting of that particular plug.
③ Refer to Type DS, Type SPB or Type Series C R-Frame supplemental instruction leaflets given in Section 9 for list of available rating plugs with each type circuit breaker.

4.8 Ground Fault Time Delay Settings

As illustrated in Fig. 6.7, two different curve configurations are possible, i.e., flat or I^2t response. The configuration selected will be a factor of the type of selective coordination being developed. The I^2t response will provide a longer time delay in the low-end of the ground fault pick-up range than will the flat response setting.

Five flat (0.1, 0.2, 0.3, 0.4, 0.5, sec) and three I^2t (0.1, 0.3, 0.5 sec) response time delay settings are provided. The I^2t response settings are identified by the suffix asterisk (*) that appears in the setting viewing window. The I^2t response is applicable only up to 0.625 times the ampere rating of the installed rating plug (I_n). Beyond this value, the I^2t response configuration reverts to a flat response.

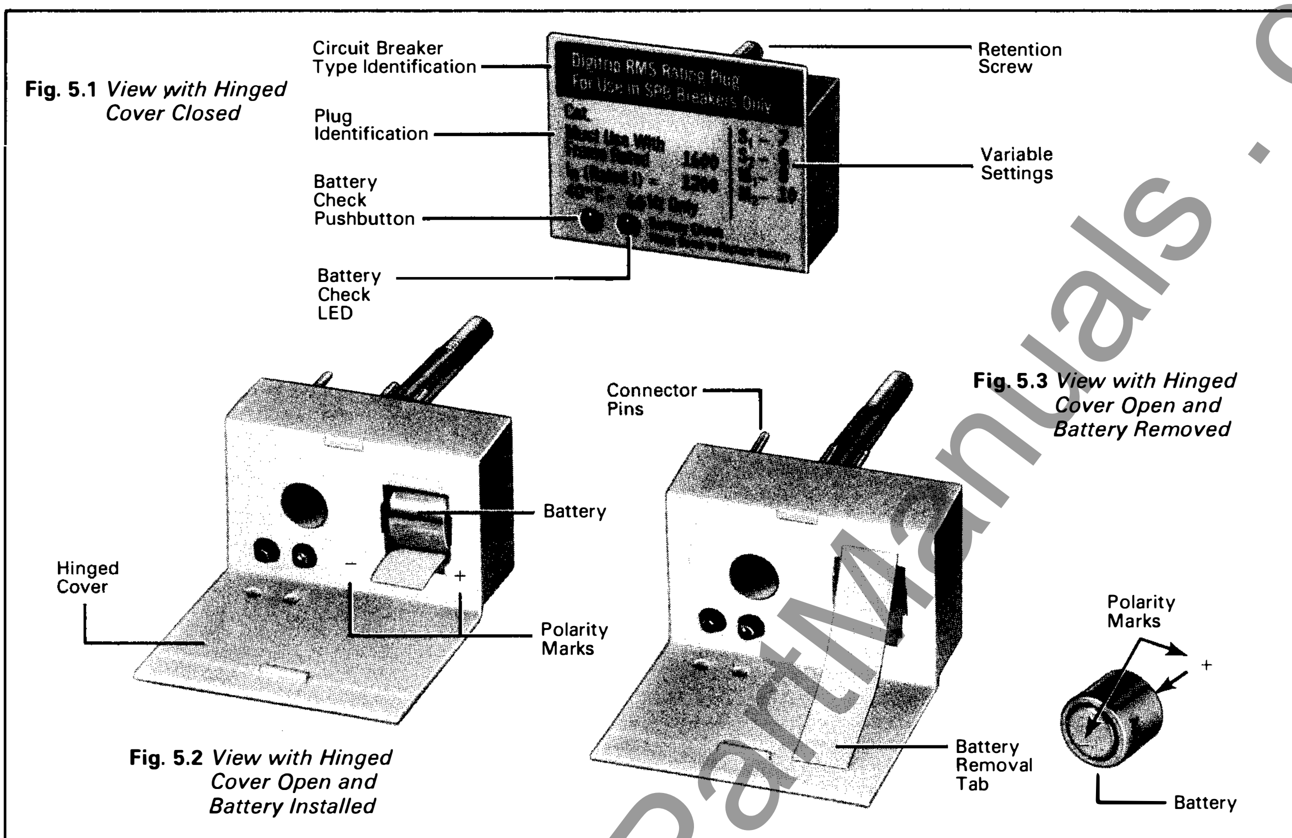


Fig. 5 *Typical Rating Plug*

5.0 Integral Test Panel – Test Procedure

5.1 General

As illustrated in Figs. 1 and 7, an integral test panel is provided to test the Digitrip RMS 600 Trip Unit.

Adequate no-trip settings are provided to insure that the trip unit is operational without tripping the circuit breaker.

CAUTION

THE TRIPPING OF A CIRCUIT BREAKER UNDER "TEST CONDITIONS" WHILE IT IS IN SERVICE AND CARRYING LOAD CURRENT, WHETHER DONE BY INTEGRAL OR EXTERNAL TEST MEANS, IS NOT RECOMMENDED.

ANY SUCH TRIPPING OPERATION WILL CAUSE DISRUPTION OF SERVICE AND POSSIBLE PERSONAL INJURY RESULTING FROM UNNECESSARY SWITCHING OF CONNECTED EQUIPMENT.

Testing of a circuit breaker that results in the tripping of the circuit breaker should be done only with the circuit breaker in the "Test" or "Disconnected" cell positions or while the circuit breaker is on a test bench.

To preserve the primary protection function of the trip unit, all in-service testing under "Trip" or "No-Trip" conditions must be done at load current values no greater than 40% of the plug rating (I_n). Any attempt to conduct in-service testing above this value will be ***automatically aborted** by the trip unit.

Since the Digitrip RMS 600 Trip Unit requires external control power to operate the Power/Relay Module, any in-service testing elected to be done may be conducted without the insertion of the Auxiliary Power Module.

5.2 When to Test

Tests can be conducted with the breaker in the "connected" cell position while carrying load current. However, as stated in the caution note in Section 5.1, good practice will limit circuit breaker in-service "trip tests", where required, to maintenance periods during times of minimum load conditions. Testing, prior to start-up can best be accomplished with the breaker out of its cell or in the "Test", "Disconnect" or "Withdrawn" (or "Removed") cell positions.

Note: Since time-current settings are based on desired system coordination and protection schemes, the protection settings selected and preset under Section 4.0 above should not be altered during or as a part of any routine test sequence.

5.3 Test Provision

As indicated in Fig. 7, six different test settings (1, 2, 3, 6T, 8 and 10 x I_n) are available for testing the phase elements of the trip unit and two (GF, GFT) are provided for testing the ground elements. One setting under each test mode (6T and GFT) will initiate a tripping action of the circuit breaker.

---

*No abort signal will occur for tests conducted unless the circuit breaker is carrying load current.

With appropriate preset selections of the phase protection settings, an ample range of settings under the "No Trip" condition are available to test the long time, short time and instantaneous trip settings without tripping the circuit breaker.

In the "GF" test position, the amount of test current is adequate to prove the operating condition of the trip unit without tripping the circuit breaker. This is not to be construed as a calibration test. The value of the simulated test current is 1.0 per unit of the rating plug value.

5.4 Mode of Conducting Tests

5.4.1 Control Power

Should the circuit breaker be in the "Disconnected" cell position or withdrawn from its cell entirely, install the Auxiliary Power module (Catalog No. PRTAAPM) to insure control power is available for testing. Should the circuit breaker be in the "Connected" or "Test" position and have control power available to the "Power/Relay" Module, then the Auxiliary Power Module is not required.

5.4.2 By Not Tripping the Breaker

1. Should the circuit breaker be in the cell "Connected" position and carrying load current, make sure that the circuit breaker is carrying no more than 40% of the plug ampere rating.

2. Place the test selector switch in one of the six "No Trip" test settings, i.e., 1, 2, 3, 8, 10, or GF.

3. Depress the "Test" pushbutton and release it – the test is initiated when the pushbutton is released.

4. Should any of the various protection settings be less than the selected "No Trip" test value, then the LED related to that function will turn "On" signifying successful completion of the test action and the time delay value (in seconds) that would have been allowed before initiating the trip will appear in the display window. Operation of the stepping pushbutton between the pointer LED's will not change the time value indicated in the Display Window. **Current** values will not be displayed following "No Trip" tests.

   Note: When a "No Trip" test is in progress the "Display Window" will show the time clock as it counts. The maximum time value that the clock will display is 99.9 seconds. This means for a trip time in excess of 99.9 seconds, the value in the display window will "Roll-Over", i.e., an actual trip time of 125 sec wound read 25.1 (99.9 plus 25.1) sec.

5. Reset the trip unit by depressing and releasing the "Trip Reset" pushbutton provided. All LEDs turned on by the "No Trip" test action should turn "Off". The time delay value in the Display Window will disappear.

Should an actual overload or fault condition occur during an in-service, "No Trip Test" sequence, the protection function will override the test function, and the circuit breaker will trip automatically as pre-programmed with the various Time-Current settings.

Note: The "Trip Reset" pushbutton may be depressed at any time. However, should a test initiated via the integral test panel be in progress, it would be aborted. A test initiated via the integral test panel may be aborted at any time by depressing the "trip reset" pushbutton.

5.4.3 By Tripping the Breaker

1. Make sure that the circuit breaker is carrying no more than 40% of the plug rating (I_n).

2. Place the test selector switch in one of the two "Trip" test settings, i.e., 6T or GFT.

3. Depress the "Test" pushbutton and release it – the test is initiated when the pushbutton is released. With the "Test" pushbutton depressed, the coded message "Test" will appear in the Test Window. When the pushbutton is released, the display window will show the time clock counting.

4. Should any of the various protection settings be less than the selected "Trip" test value, the circuit breaker will trip and the LED related to that function will turn on following the test action and a coded message will appear in the display window.

5. Depress the Step Pushbutton (twice for a LDT Test). The coded message will disappear and if the pointer LED is on I_A for "6T" or I_G for "GFT" the value of test current (in kA) that initiated the trip action will be displayed. If the pointer LED is on other than I_A for "6T" or I_G for "GFT", depress the Step Pushbutton until the position of the pointer LED is in the appropriate position.

   Trip Time values will not be displayed in the "Trip" test positions.

6. Reset the trip unit by depressing and releasing the "Trip Reset" pushbutton. All LEDs turned on resulting from the "Trip" test action should turn off. The value of trip current in the Display Window will disappear. If the pointer LED is not on I_A, it will return to I_A.

7. Reset and reclose the circuit breaker per established operating procedures.

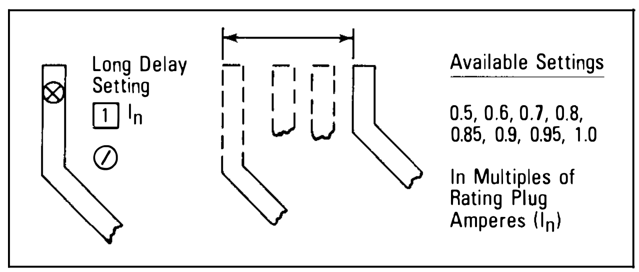


Fig. 6.1 *Long Delay Ampere Pickup Settings*

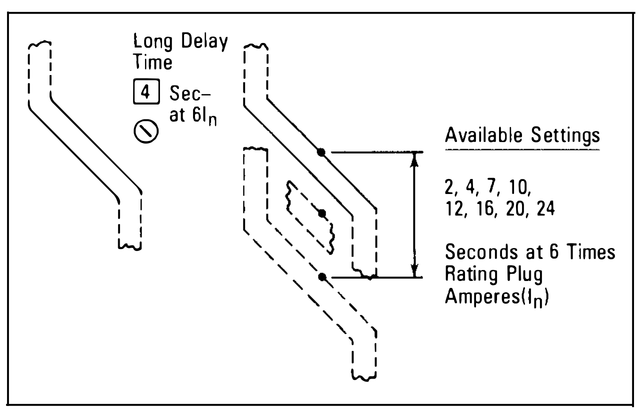


Fig. 6.2 *Long Delay Time Settings*

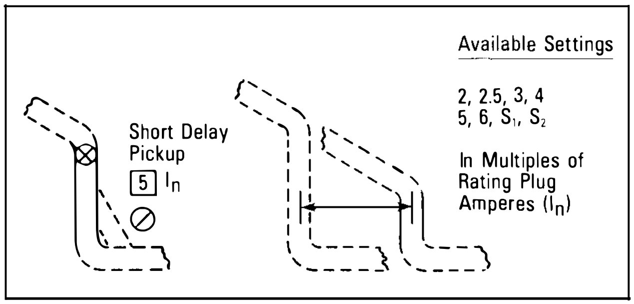


Fig. 6.3 *Short Delay Current Pickup Settings*

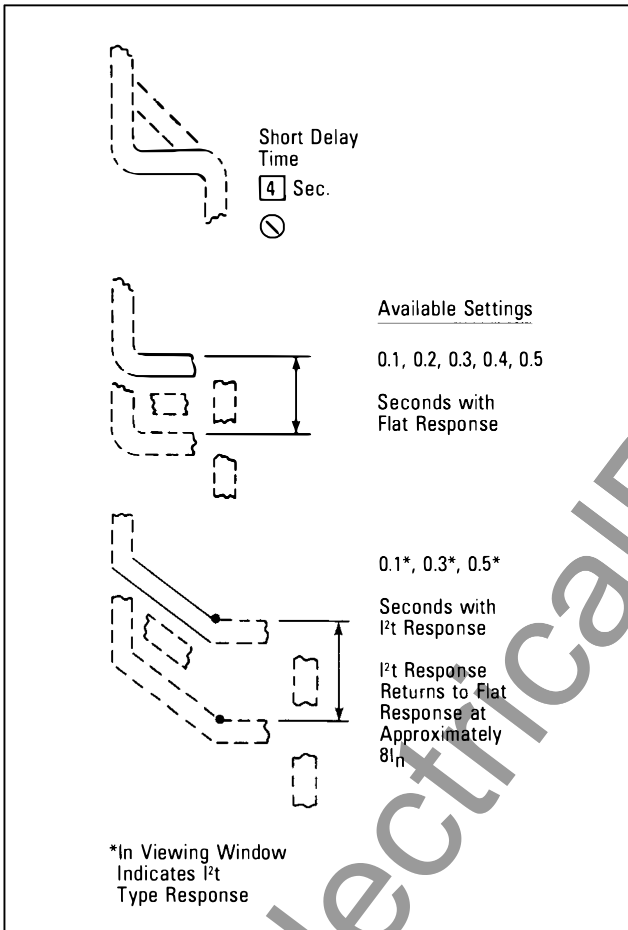


Fig. 6.4 *Short Delay Time Settings*

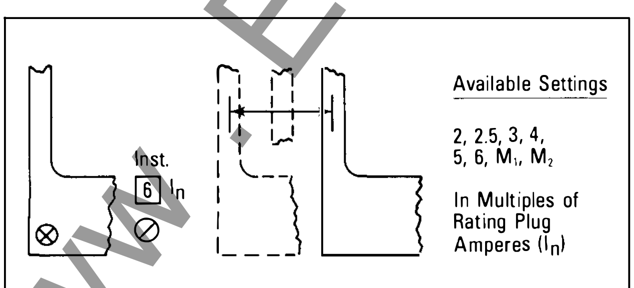


Fig. 6.5 *Instantaneous Current Pickup Settings*

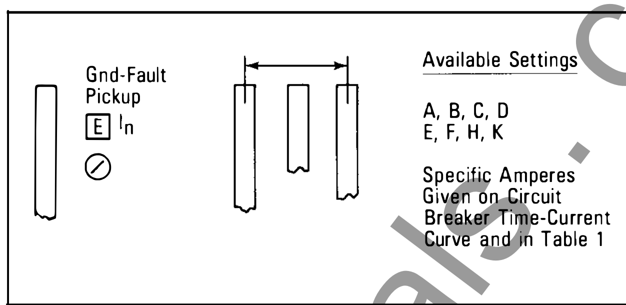


Fig. 6.6 *Ground Fault Current Pickup Settings*

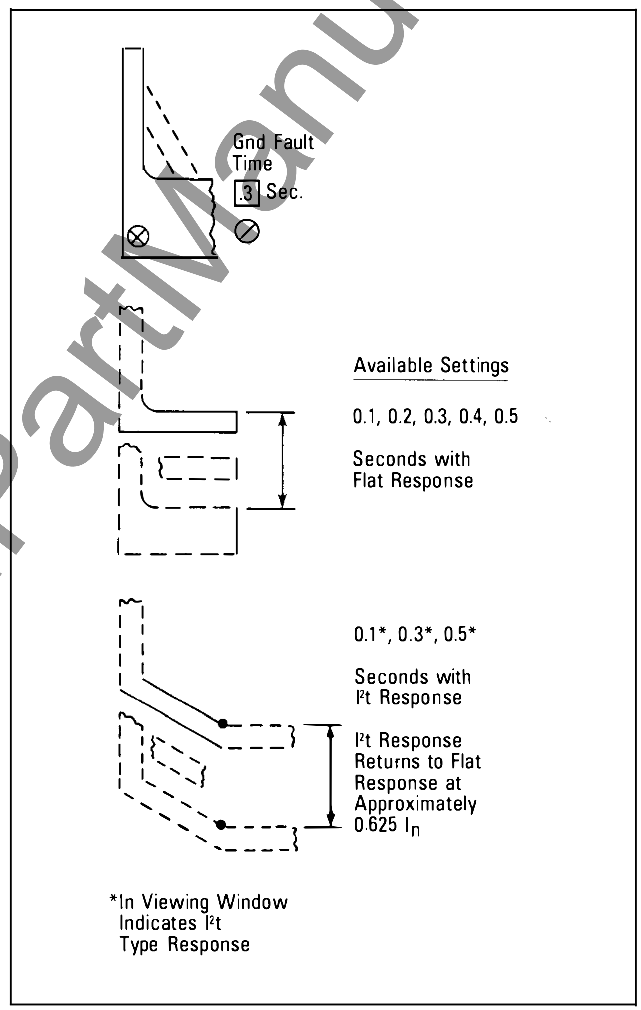


Fig. 6.7 *Ground Fault Time Delay Settings*

6.0 Back-up Battery

6.1 General

As indicated in Figs. 3 and 5, a back-up battery is provided to maintain the mode of trip LED indication in the Digitrip RMS 600 Trip Unit when external control power to the Power/Relay module is not available. The back-up battery is located in the rating plug along with a battery check pushbutton and green battery check LED.

6.2 Battery Check

The battery is a long life, lithium photo type unit. The ready status of the battery can be checked at any time by depressing the battery check pushbutton and observing the "On" condition of the battery check LED as shown in Fig. 5.1. If the battery check LED does not turn "On", replace the battery.

6.3 Battery Replacement

Should the battery require replacement, it can be easily replaced from the front of the trip unit by lowering the hinged cover of the rating plug as shown in Fig. 5.2. The battery can then be removed by pulling the battery tab as shown in Fig. 5.3.

> **Note:** The battery can be replaced at any time with the circuit breaker in service without affecting the operation of the circuit breaker and its protection function.

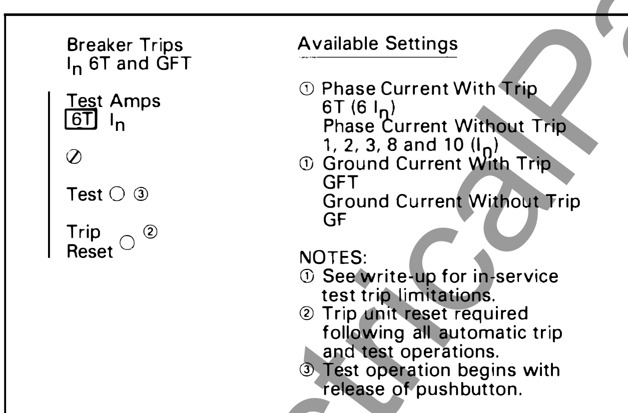


Fig. 7 *Integral Test Panel*

The replacement battery should be the same type or equivalent. Acceptable 3.0 volt lithium batteries may be obtained from the following companies under their type designation indicated:

Company	Model
Varta Batteries, Inc. 150 Clarbrook Road Elmsford, N.Y. 10523	CR 1/3N
Duracell South Broadway Tangtown, N.Y. 10591 (914) 591-7000	DL 1/3N
Union Carbide Corp. Battery Products Div. Eveready 39 Old Ridgebury Road Danbury, CT 06817-0001 (203) 794-7548	2L-76BP

Note: Care should be exercised when replacing a battery to insure that the correct polarities are observed. Polarity markings are shown on the rating plug when the hinged cover is open as indicated in Figs. 5.2 and 5.3.

7.0 Auxiliary Power Module

The Auxiliary Power Module (Catalog No. PRTAAPM), illustrated in Fig. 8, is an encapsulated power supply that requires a 120 Vac input at either 50 or 60 Hz. It provides an output of 32 Vdc (nominal 40 Vdc open circuit) which can be used for testing a Digitrip RMS 600 Trip Unit.

When drawout construction is provided, any circuit breaker equipped with a Digitrip RMS 600 Trip Unit can be conveniently set and tested while the circuit breaker is out of its cell or in its cell in the "Disconnect" or "Withdrawn" positions using the Auxiliary Power Module.

The Auxiliary Power Module is equipped with a unique plug-in connector suitable only for plugging into the keyed receptacle of a Digitrip RMS Trip Unit. This prohibits the possible use of an incorrect, but similar, type power module. The location of the keyed receptacle for the Auxiliary Power Module is shown in Fig. 1.

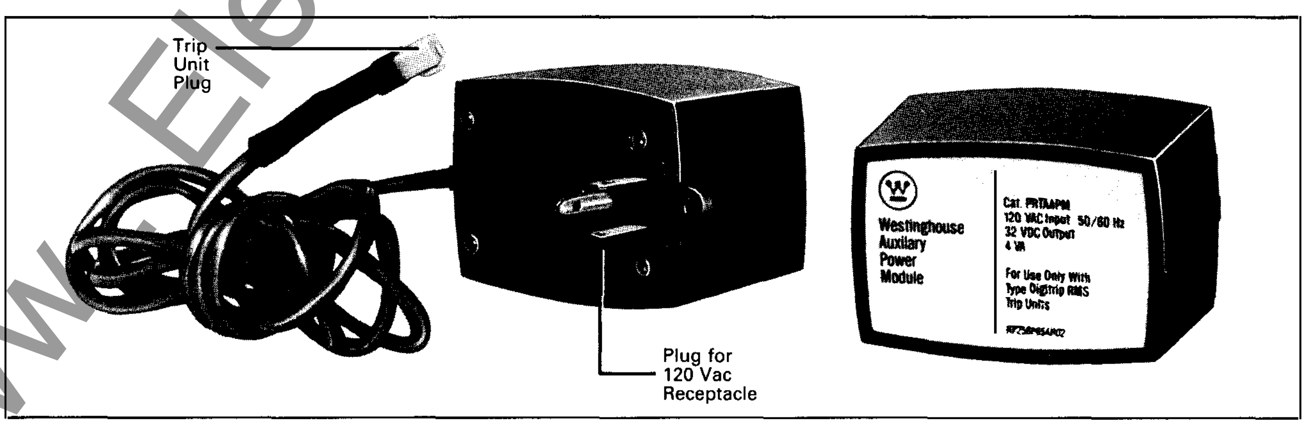


Fig. 8 *Auxiliary Power Module*

8.0 Rating Plug

The rating plugs, as illustrated in Figs. 1 and 5, are used to establish the continuous ampere rating of the related circuit breaker. All pick-up settings of the protection functions of the trip unit, i.e., long delay, short delay, and instantaneous and groundfault are selected as a multiple of the rating plug ampere rating (I_n).

Different types and ratings are available to match the desired ampere rating and type of circuit breaker into which the trip unit is to be installed. Also, since the rating plugs are frequency sensitive, specific types are available for 50 or 60 Hz system applications.

Complete catalog descriptions of all available rating plugs are given in the applicable circuit breaker supplementary instruction leaflets. References to these documents are given in Sections 9.1 and 9.2.

9.0 References

9.1 Type DS Low Voltage Ac Power Circuit Breakers

I.B. 33-790-1F	Instructions for Low-Voltage Power Circuit Breakers Types DS and DSL
I.B. 33-790-1F Supplement No. 1	Section 8A Supplement Circuit Breaker Automatic Tripping System When Using Digitrip RMS Trip Assembly
SC-4280-87	Typical Time-Current Characteristic Curve (LI) for Type DS Circuit Breakers
SC-4281-87	Typical Time-Current Characteristic Curve (LS) for Type DS Circuit Breakers
SC-4279-87	Typical Time-Current Characteristic Curve (G) for Type DS Circuit Breakers
508B508	Connection Diagram for Type DS Circuit Breakers

9.2 Type SPB Systems Pow-R Breakers

I.L. 29-801	Instruction for the Systems Pow-R Breaker and Drawout Mechanism
I.L. 29-855	Supplementary Instructions for the Systems Pow-R Breaker used with the Digitrip RMS Trip Assembly
SC-4283-87	Typical Time-Current Characteristic Curve (LI) for Type SPB Systems Pow-R Breaker
SC-4284-87	Typical Time-Current Characteristic Curve (LS) for Type SPB Systems Pow-R Breaker
SC-4282-87	Typical Time-Current Characteristic Curve (G) for Type SPB Systems Pow-R Breaker
I.S. 15545	SPB Master Connection Diagram using Digitrip RMS Trip Assemblies

9.3 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

9.4 Series C R-Frame Molded Case Circuit Breakers

29-106	Framebook
29C107	Frame Instruction Leaflet
29-707	Supplement Instructions for Series C R-Frame used with Digitrip RMS Trip Assembly
SC-4582-89	Typical Time-Current Characteristic Curve (LI) for Type RD Circuit Breakers
SC-4583-89	Typical Time-Current Characteristic Curve (LS) for Type RD Circuit Breakers
SC-4584-89	Typical Time-Current Characteristic Curve (G) for Type RD Circuit Breakers
I.L. 29C709	Master Connection Diagram for Series C R-Frame Circuit Breaker with Digitrip RMS

Westinghouse Electric Corporation
Distribution and Control Business Unit
Electrical Components Division
Pittsburgh, PA 15220

Style No. 6615C97H01

Instructions for Digitrip RMS 600 Trip Unit

I.L. 29-852-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.

1.0 General Description

1.1 Protection

The Digitrip RMS 600 Trip Unit, illustrated in Fig. 1, is a microprocessor based type trip unit suitable for use in type SPB Systems Pow-R circuit breakers and types DS and DSL low voltage AC power circuit breakers and Series C® R-Frame molded case circuit breaker.

The trip unit provides true RMS current sensing for proper correlation with thermal characteristics of conductors and equipment. Interchangeable rating plugs are provided to establish the continuous current rating of each circuit breaker.

The Digitrip RMS 600 Trip Unit is completely self-contained and when the circuit breaker is closed, requires no external control power to operate its **protection systems**. It operates from current signal levels and control power derived through current sensors integrally mounted in the circuit breaker.

The Digitrip RMS 600 Trip Unit is available in six optional protection models. Each trip unit may be equipped with a maximum of five phase and two ground (time-current) adjustments to meet specific application requirements. These protection models include the following types which are further illustrated in the nameplate examples shown in Fig. 2.

Figure	Type Protection	Identifier
2.1	Long Time/Instantaneous	(LI)
2.2	Long Time/Short Time	(LS)
2.3	Long Time/Short Time/Instantaneous	(LSI)
2.4	Long Time/Instantaneous/Ground	(LIG)
2.5	Long Time/Short Time/Ground	(LSG)
2.6	Long Time/Short Time/Instantaneous/Ground	(LSIG)

1.2 Information/General

In addition to the protection function, the Digitrip RMS 600 Trip Unit is equipped with a four-digit, alpha-numeric readout display, three phase and one ground (when supplied) current pointer green LEDs along with a stepping pushbutton as illustrated in Figs. 1 and 2. A Power/Relay module is included to provide control power for operating the readout display and internally mounted signal relays. The signal relays provide contacts for three remote mode of trip indicators (long delay, short circuit, ground fault) and a High-Load remote alarm.

Red LED indicators are provided on the face of the trip unit to indicate the mode of an automatic trip operation as well as a High-Load alarm.

Green LED indicators are provided to indicate the operational status of the trip unit and the status of the back-up battery mounted in the rating plug.

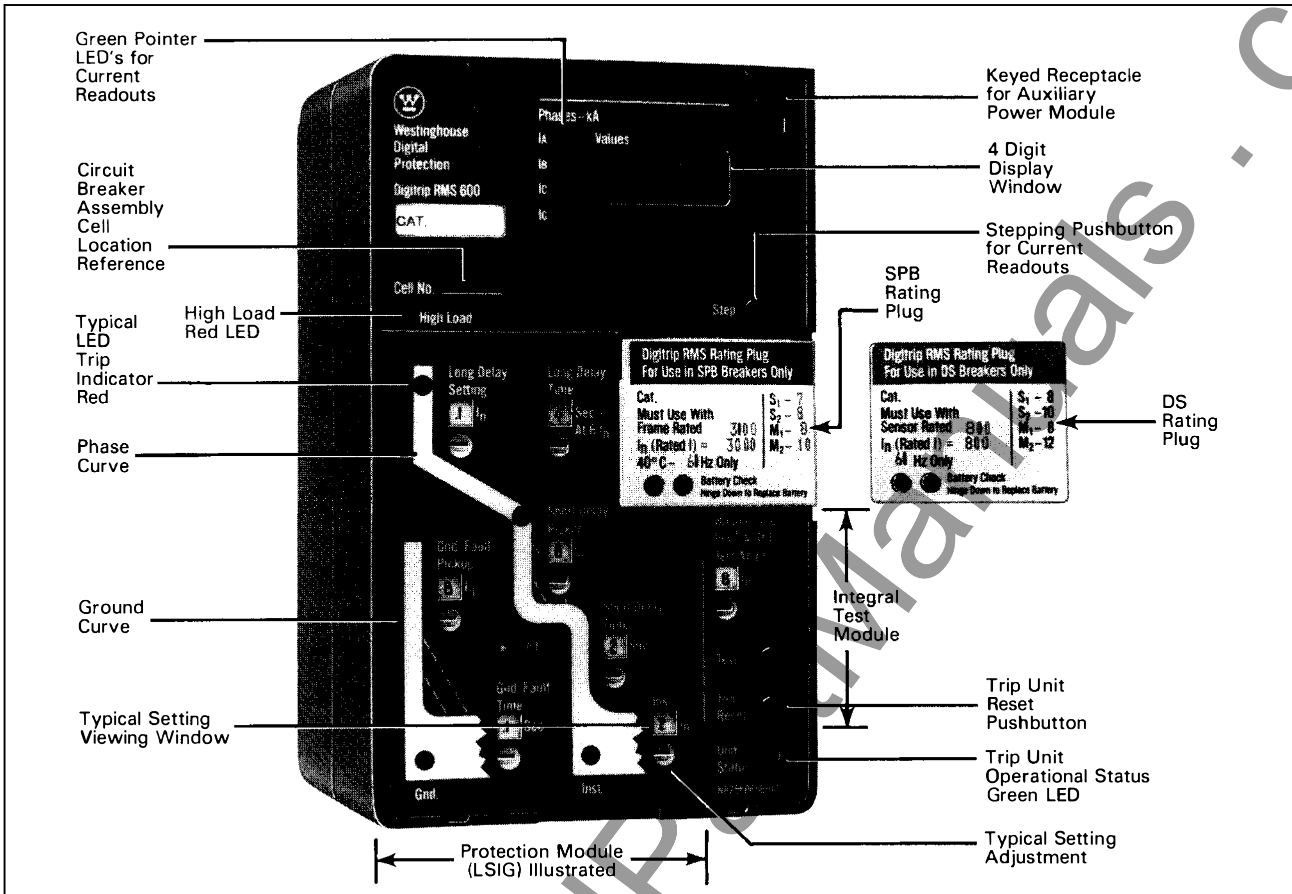

Fig. 1 *Typical Digitrip RMS 600 Trip Unit with Rating Plug Installed*

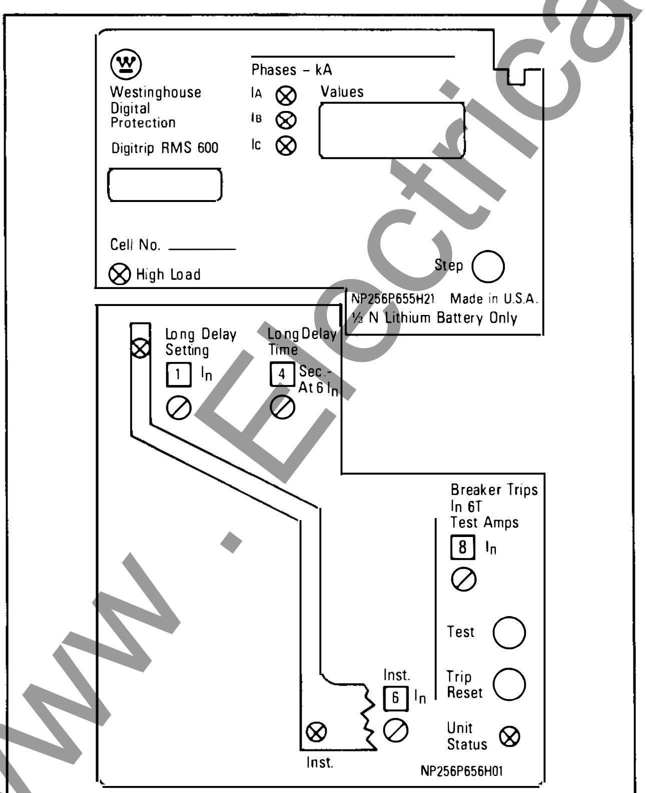

Fig. 2.1 *Long Time/Instantaneous Protection (LI) Nameplate*

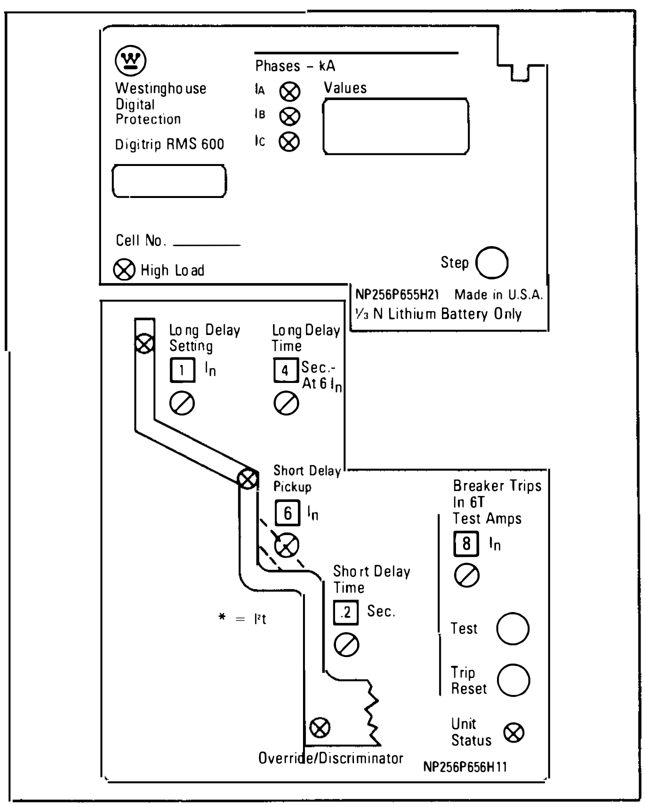

Fig. 2.2 *Long Time/Short Time Protection (LS) Nameplate*

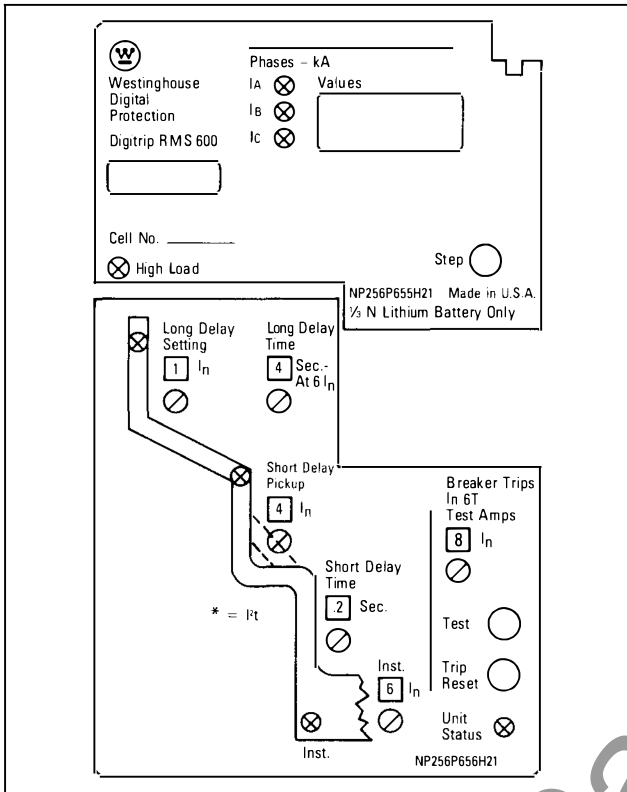

Fig. 2.3 *Long Time/Short Time/Instantaneous Protection (LSI) Nameplate*

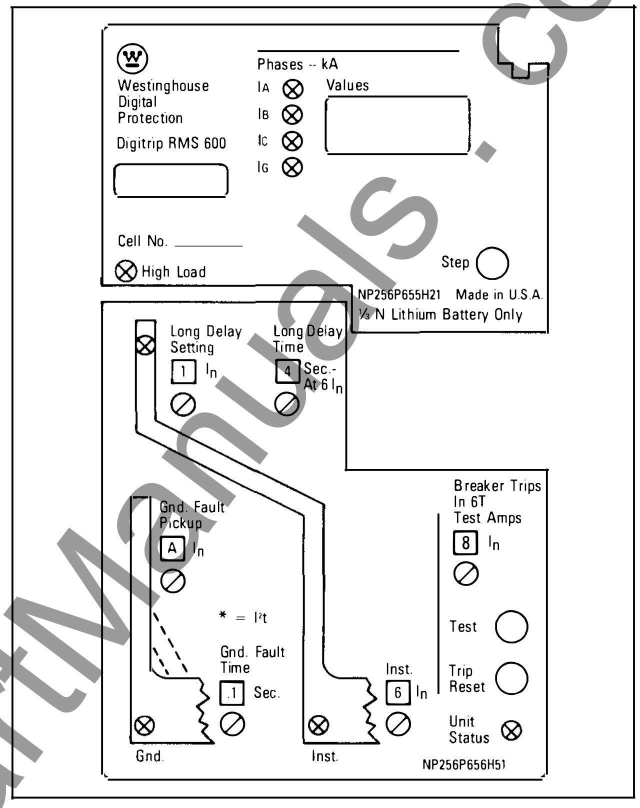

Fig. 2.4 *Long Time/Instantaneous/Ground Protection (LIG) Nameplate*

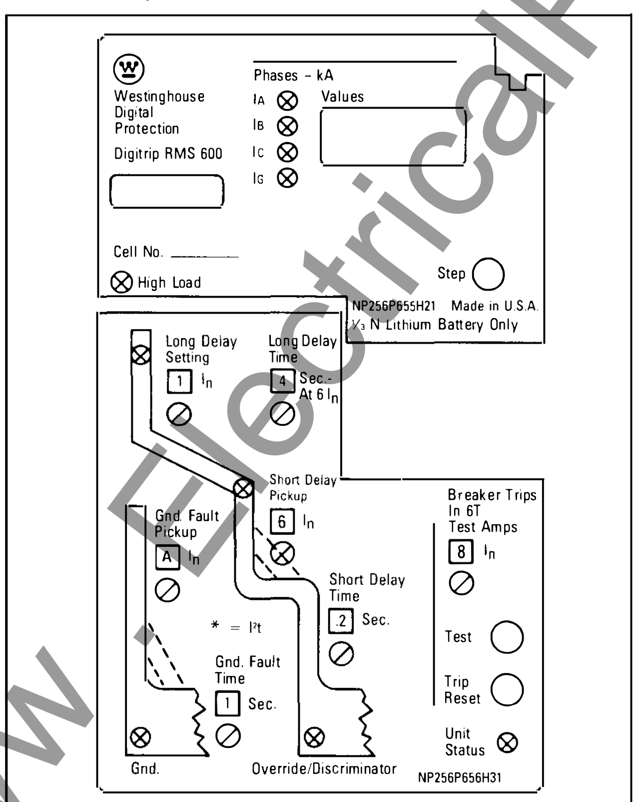

Fig. 2.5 *Long Time/Short Time/Ground Protection (LSG) Nameplate*

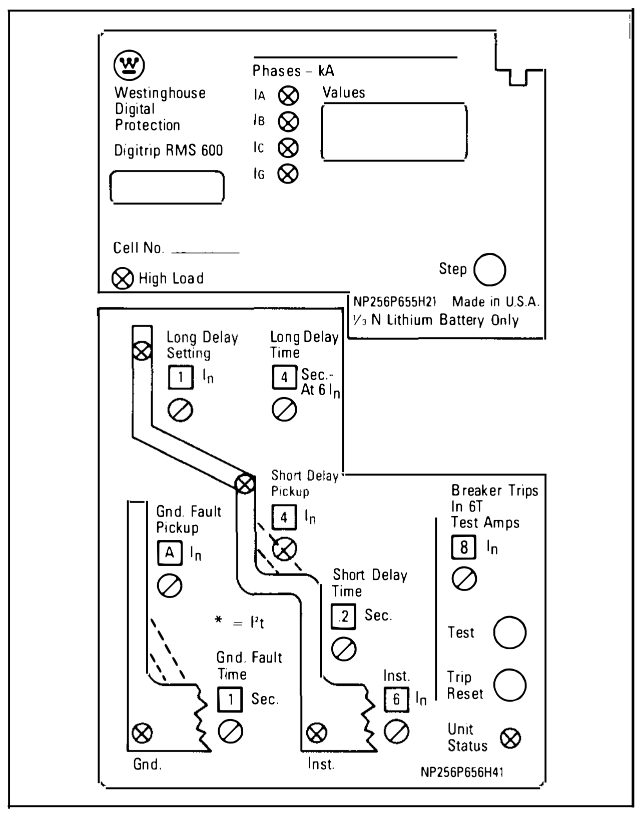

Fig. 2.6 *Long Time/Short Time/Instantaneous/Ground Protection (LSIG) Nameplate*

A red colored LED, as shown in Fig. 1, indicates that the load current through the circuit breaker has reached 85% of the preset value of the Long Delay Setting. The High-Load LED will turn "On" and the High-Load relay, located internally in the Power/Relay module shown in Fig. 4, will pick-up after an approximate 40 second delay. This delay allows the alarm to ride-through a momentary high-load condition thus avoiding nuisance alarms.

3.6 Readout Display

The four-digit alpha-numeric readout display window, illustrated in Figs. 1 and 2, serves two basic purposes: instrumentation and mode of trip or trouble indication.

Instrumentation

During normal service conditions, with the circuit breaker closed, it serves an ammeter instrumentation function. It displays the individual phase currents (I_A, I_B, I_C) and ground current (I_G) provided integral ground fault protection is included in the trip unit. Current values are displayed in kA. The actual current value being displayed is indicated by the marked LED that is turned "On". A stepping pushbutton is provided to step among the different currents.

Mode of Trip and Trouble Indication

Following an automatic circuit breaker trip operation and with control power available to the Power/Relay module, the Readout Display indicates the mode of trip using coded messages such as, INST (Instantaneous Trip), SDT (Short Delay Trip), LTD (Long Delay Trip) and GNDT (Ground Fault Trip). The coded message will lock-in position until the Stepping Pushbutton is depressed. Afterwards, the Display will indicate the value of current (in kA) at the time of the trip initiation by the protection function involved.

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. Following an automatic trip operation of the circuit breaker, it will maintain the cause of the trip history and the mode of trip LEDs as long as the external control power supply is available. Each signal relay contact is rated 120 V., 50/60 Hz, 1.0 A.

3.6.1 Readout Display Messages

The Readout Display provides ammeter instrumentation under normal service conditions of the circuit breaker and alpha-numeric coded messages after an automatic trip. To properly understand the actions of the trip unit, each coded message must be understood as well as any required follow-up operational action. Messages can be divided into two categories: Normal service and after trip or trouble conditions.

3.6.1.1 Normal Service

Normal service messages are those that serve the ammeter instrumentation function. In Fig. 1, four green colored LEDs serve a pointer function, i.e., phase A current (I_A), phase B current (I_B), phase C current (I_C) and ground current (I_G). The ground current LED will be included only if integral ground fault protection is included as an integral part of the trip unit protections functions.

Each LED, when turned "On", will indicate the current being displayed in the four-digit display window. The current displayed in the window will remain in view until a change is implemented. A step pushbutton is provided to step among the available currents.

3.6.1.2 After Trip or Trouble

For the after trip and trouble conditions, one of the following coded messages will appear in the display window:

Message	Condition	Action/Comment
LDPU	Overload in Progress	Indication is warning signal. Trip will occur if condition persists.
LDT	Overload Trip	Trip action initiated as result of an overload. Clear overload, reset trip unit and reclose breaker as required.
SDT	Short Delay Trip	Trip action initiated as result of fault exceeding trip setting. Examine breaker to insure reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been corrected.
INST	① Instantaneous Trip	Trip action initiated as result of fault exceeding trip setting. Examine breaker to insure reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been corrected.
GNDT	Ground Fault Trip	Trip action initiated as result of ground fault exceeding trip setting. Examine breaker to insure reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been corrected.
DISC	① Making Current Release (Discriminator) Trip	Trip action initiated by Discriminator – most likely on initial breaker closing action. Examine breaker to insure that reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been cleared.
ORID	②③ Override Trip	Trip action initiated by override circuit indicative of a high level fault. Examine breaker to insure that reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been cleared.

Message	Condition	Action/Comment
TEST	Test in Progress	This message will appear when the integral test pushbutton is depressed and will disappear when the test pushbutton is released (indicating test has started). The test message only appears when a complete breaker trip test is selected, i.e., 6T or GFT (see Fig. 7)
PLUG	Rating Plug Problem	This message will appear should there be a missing, improperly installed or defective rating plug.
RAM	Data Memory Problem	This message will appear in response to a data memory test failure. Depress trip unit Trip Reset to reconfirm message. If message reappears, replace trip unit.
ROM	Program Memory Problem	This message will appear in response to a program memory test failure. Depress trip unit Trip Reset to reconfirm message. If message reappears, replace trip unit.

Notes:

① All values of current displayed were present prior to initiation of the trip signal. In the case of a high-level fault condition where fast tripping is desirable, the trip unit will operate before a complete RMS current value can be calculated. For this reason, the displayed value may be less than the actual RMS fault current.

② In the case of very high fault levels outside the range of normal current sensor accuracy ranges, the message "ORNG" (indicating over range) will appear at each phase readout position when the trip message "ORID" (indicating override) is interrogated by the stepping pushbutton.

③ The override value in the trip unit is set to operate at approximately 100 X the frame/sensor ampere rating For circuit breakers having lower withstand ratings, other details are provided in the breaker to insure proper applications within the breaker withstand rating.

3.6.1.3 Analyzing "After Trip" Coded Messages

As indicated in Section 3.6, as long as control power is available to the Power/Relay Module, coded messages will lock-in position on the Readout Display until the stepping pushbutton is depressed. Likewise, the individual values of phase and ground current, if any, at the time the automatic trip was initiated will also lock-in position and remain until the trip unit is reset by depressing the reset pushbutton. The manner that these coded messages operate can best be understood by referring to the following examples:

Given A 1600 amp circuit breaker with a 1000 amp rating plug installed.

3.6.1.3.1 Case 1 – Overload Trip Operation

Assume a prolonged overload condition which results in an automatic breaker trip operation. The following will occur:

1. The Long Delay Trip LED will turn "On" (see Fig. 1)
2. The coded message LDT will appear in the Display Window (see Fig. 1)
3. The Long Delay Relay in the Power/Relay Module (see Figs. 3 and 4) will operate to transmit a remote Long Delay alarm signal.

Operator Actions

1. Observe the mode of trip LED and coded alpha-numeric message in the Display Window.
2. Depress Stepping Pushbutton twice (see Fig. 1). This action will clear the coded cause of trip message in the Display Window.
3. View value of phase current in Display Window (see Fig. 1) e.g., 1.50 (in kA).

   Note: The phase current shown will be that referenced by the Pointer LED (see Fig. 1) that is turned "On," assume "I_A". (It may not be the faulted phase).

4. Depress the Stepping Pushbutton to move from LED "I_A" to LED "I_B" to LED "I_C". At each position, the related value of phase current (in kA) at the time of the trip operation will appear in the Display Window.
5. Reset the trip unit by depressing the "Trip Reset" pushbutton (see Fig. 1). All coded messages and current values in the display window, the cause of trip LED and the signal relay in the Power/Relay module will turn "Off".

Notice

On trip operations initiated by the long delay trip (LDT) function it is essential that any cause of overload trip be corrected prior to reclosing the circuit breaker. Should it not be corrected and the circuit breaker be reclosed too soon, then because of the inherent Long Time Memory Function, the Long Delay trip time will operate faster than the related time-current curve indicates.

The amount of time required to clear the memory circuit is a factor of the Long Delay time setting (see Fig. 6.2). The longer the delay setting, the longer the time required to reset the memory. Total memory clearing time could vary from one to twelve (12) minutes depending upon the time delay setting selected.

The memory function, as in any conventional thermal type (bimetal) circuit breaker, serves a useful function by allowing the load conductors to cool down.

6. After correcting the cause of the overload trip (LDT) and allowing for the memory circuit to reset, reclose the circuit breaker as required following established operating procedures.

Note: During the overload condition, prior to the automatic trip operation, the following trip unit indications would have been visible:

1. The "High-Load" LED (Fig.1) would have been turned "On" if the overload condition had existed for 40 seconds or longer.
2. The "High-Load" relay in the Power/Relay Module (see Figs. 3 and 4) would have picked-up (after a 40 second delay,) to close a contact for a remote High-Load alarm.
3. The Long Delay LED (Fig.1) would have been flashing "On" and "Off".
4. The coded message LDPU would have been flashing in the Display Window.

3.6.1.3.2 Case 2 – Instantaneous Trip Operation

Assume a high-level fault above the instantaneous trip setting – Assume 8 x I_n – (see Fig. 1). Following the trip operation, the following will occur:

1. The Instantaneous Trip LED will turn "On" (see Fig. 1).
2. The coded message INST will appear in the Display Window (see Fig. 1).
3. The Short Circuit Relay in the Power/Relay Module (see Figs. 3 and 4) will operate to close a contact for a remote Short Circuit Alarm.

Operator Actions

1. Observe the mode of trip LED and coded message in the Display Window.
2. Depress Stepping Pushbutton (see Fig. 1). This action will clear the coded cause of trip message in the Display Window.

Fig. 4 *Power/Relay Module.*

3. View value of phase current in Display Window (see Fig. 1) e.g., 12.0 (in kA).

   Note: The phase current shown will be that referenced by the Pointer LED (see Fig. 1) that is turned "On" (It may not be the faulted phase), assume "I_A".

4. Depress the Stepping Pushbutton to move from LED "I_A" to LED "I_B" to LED "I_C". At each position, the related value of phase current (in kA) at the time of the trip operation will appear in the Display Window.

   Note: Should the level of fault current be very high, then, the coded message ORID could appear in the Display Window. When the step pushbutton is depressed, the coded message ORNG rather than a numerical current value would appear. This would be indicative of a very high fault level outside the range of normal current sensor accuracy ranges.

5. Reset the trip unit by depressing the "Trip Reset" pushbutton (see Fig. 1). All coded messages and/or current values in the display window, the cause of trip LED and the signal relay in the Power/Relay module will turn "Off".
6. Following any corrective actions in the system and inspections of the circuit breaker and related equipment, reclose the circuit breaker as required.

3.6.1.3.3 Other Cases

Similar type indications will occur and similar operator actions will be required as described in the above two cases following an automatic trip operation initiated by any other of the Protection Functions, including Short delay and ground fault.

3.7 Test Provisions

An integral test panel including a test selector switch and test and reset pushbuttons is provided to test the circuit breaker in either a TRIP or NO-TRIP test mode under qualified conditions. See Section 5.

For bench testing of the trip unit alone or of the trip unit while it is installed in the circuit breaker, an optional Auxiliary Power module (Catalog No. PRTAAPM) as shown in Fig. 7 is available. This Auxiliary Power module, which operates from a separate 120Vac, supply, may also be used when a drawout type circuit breaker is in any of its four cell positions, i.e., "Connected", "Test", "Disconnected" and "Withdrawn" (or "Removed").

4.0 Protection Settings

4.1 General

Prior to placing any circuit breaker in operation, all available protection settings should be set using values as recommended by the specifying engineer responsible for the installation. The number of settings that must be made will be a factor of the protection model supplied as illustrated in Figs. 2.1 through 2.6. Each setting is made with an eight position rotary switch using a small screwdriver. The selected setting for each adjustment will appear in the small rectangular opening as illustrated in Fig. 1.

The installed rating plug establishes the maximum continuous current rating of the circuit breaker. All current pick-up settings in the protection module are defined in per unit multiples of the ampere rating (I_n) of the installed rating plug.

To illustrate the portion of the protection curve being adjusted, simulated Time-Current curves are pictured on the face of the trip unit. The particular setting to be adjusted is located in close proximity to its portion of the simulated Time-Current curve. Should an automatic trip occur as a result of a fault current exceeding the preselected value in this portion of the Time-Current curve, the red LED shown in this segment of the simulated Time-Current curve will turn "On".

The available settings, along with the illustrated effect of changing the settings, are given in Figs. 6.1 through 6.7.

4.2 Long Delay Settings

Eight (8) available settings, as indicated in Fig. 6.1, range from 0.5 to 1.0 (I_n). Each setting is expressed as a multiple of the maximum ampere rating (I_n) of the installed rating plug.

4.3 Long Delay Time Settings

Eight (8) available settings, as illustrated in Fig. 6.2, range from 2 to 24 seconds. These settings represent total clearing times at a current value equal to six (6) times the installed rating plug ampere rating (I_n).

4.4 Short Delay Pick-up Settings

As illustrated in Fig. 6.3, eight (8) available settings range from 2 to 6 (I_n) with two variable settings of S1 and S2. These variable settings depend upon the type of circuit breaker in which the trip unit is installed. Specific information on these settings is given in the supplemental instruction leaflet referenced in Sections 9.1 and 9.2 that is supplied with the circuit breaker. Specific information is also shown on the rating plug and on the applicable Time-Current curve.

4.5 Short Delay Time Settings

As illustrated in Fig. 6.4, two different curve configurations are possible, i.e., flat or I^2t response. The configuration selected will be a factor of the type of selective coordination being developed. The I^2t response will provide a longer time delay in the low-end of the short delay pick-up range than will the flat response setting.

Five flat (0.1, 0.2, 0.3, 0.4, 0.5 sec.) and three I^2t (0.1, 0.3, 0.5 sec.) response time delay settings are provided. The I^2t response settings are identified by the suffix asterisk (*) that appears in the setting viewing window. The I^2t response is applicable only up to eight (8) times the ampere rating of the installed rating plug (I_n). After this value is exceeded, the I^2t response configuration reverts to a flat response.

4.6 Instantaneous Pick-up Settings

As illustrated in Fig. 6.5, eight (8) available settings range from 2 to 6 (I_n) with two variable settings M1 and M2. These variable settings depend upon the type of circuit breaker in which the trip unit is installed. Specific information on these settings is given in the supplemental instruction leaflet referenced in Sections 9.1 and 9.2 that is supplied with the circuit breaker. Specific information is also shown on the rating plug and on the applicable Time-Current curve.

4.7 Ground Fault Current Pick-up Settings

As illustrated in Fig. 6.6, eight (8) available settings are given in alphabetical notations from A to K (there is no "G" notation). Specific setting values are a function of the installed rating plug. In general, the pick-up settings range from 0.25 to 1.0 times the ampere rating (I_n) of the installed rating plug up to a maximum pick-up value of 1200A.

Specific current pick-up values are tabulated in Table 1 and on the ground fault Time-Current curve of the applicable circuit breaker. Under primary injection test conditions conducted with the breaker outside of its cell and the external Auxiliary Power module shown in Fig. 8 is used, the tabulated values should be in effect.

The tabulated values shown in Table 1 are based on the use of a residual current sensing scheme with the same rated current sensor for all phase and neutral conductors. Refer to the applicable supplemental circuit breaker instruction leaflet shown in Sections 9.1 and 9.2 for values applicable to alternate sensing schemes.

Table 1 – Ground Fault Current Pickup Settings

INSTALLED RATING PLUG AMPERES (I_n)③	PICKUP SETTINGS GROUND FAULT CURRENTS (AMPERES)①							
	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
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

① Tolerances on pickup levels are ±10% of values shown in chart.

② Ground fault pickup levels shown are nominal values when tested with external control power present. This could be with the Power/Relay Module energized or with the auxiliary power module energized. Without external control power, the pick-up level may be as high as the value shown for the "E" setting of that particular plug.

③ Refer to Type DS, Type SPB or Type Series C R-Frame supplemental instruction leaflets given in Section 9 for list of available rating plugs with each type circuit breaker.

4.8 Ground Fault Time Delay Settings

As illustrated in Fig. 6.7, two different curve configurations are possible, i.e., flat or I^2t response. The configuration selected will be a factor of the type of selective coordination being developed. The I^2t response will provide a longer time delay in the low-end of the ground fault pick-up range than will the flat response setting.

Five flat (0.1, 0.2, 0.3, 0.4, 0.5, sec) and three I^2t (0.1, 0.3, 0.5 sec) response time delay settings are provided. The I^2t response settings are identified by the suffix asterisk (*) that appears in the setting viewing window. The I^2t response is applicable only up to 0.625 times the ampere rating of the installed rating plug (I_n). Beyond this value, the I^2t response configuration reverts to a flat response.

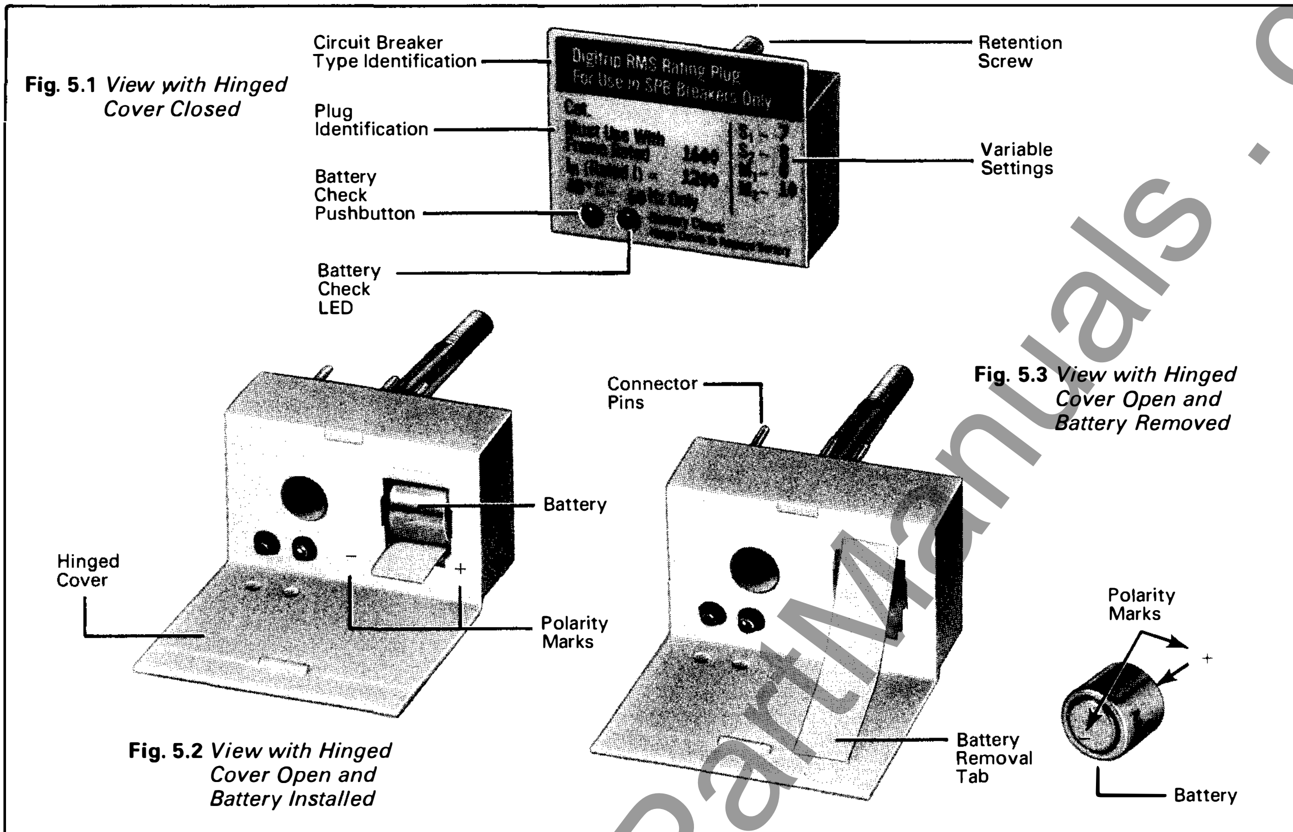

Fig. 5.1 *View with Hinged Cover Closed*

Fig. 5.2 *View with Hinged Cover Open and Battery Installed*

Fig. 5.3 *View with Hinged Cover Open and Battery Removed*

Fig. 5 *Typical Rating Plug*

5.0 Integral Test Panel – Test Procedure

5.1 General

As illustrated in Figs. 1 and 7, an integral test panel is provided to test the Digitrip RMS 600 Trip Unit.

Adequate no-trip settings are provided to insure that the trip unit is operational without tripping the circuit breaker.

CAUTION

THE TRIPPING OF A CIRCUIT BREAKER UNDER "TEST CONDITIONS" WHILE IT IS IN SERVICE AND CARRYING LOAD CURRENT, WHETHER DONE BY INTEGRAL OR EXTERNAL TEST MEANS, IS NOT RECOMMENDED.

ANY SUCH TRIPPING OPERATION WILL CAUSE DISRUPTION OF SERVICE AND POSSIBLE PERSONAL INJURY RESULTING FROM UNNECESSARY SWITCHING OF CONNECTED EQUIPMENT.

Testing of a circuit breaker that results in the tripping of the circuit breaker should be done only with the circuit breaker in the "Test" or "Disconnected" cell positions or while the circuit breaker is on a test bench.

To preserve the primary protection function of the trip unit, all in-service testing under "Trip" or "No-Trip" conditions must be done at load current values no greater than 40% of the plug rating (I_n). Any attempt to conduct in-service testing above this value will be ***automatically aborted** by the trip unit.

Since the Digitrip RMS 600 Trip Unit requires external control power to operate the Power/Relay Module, any in-service testing elected to be done may be conducted without the insertion of the Auxiliary Power Module.

5.2 When to Test

Tests can be conducted with the breaker in the "connected" cell position while carrying load current. However, as stated in the caution note in Section 5.1, good practice will limit circuit breaker in-service "trip tests", where required, to maintenance periods during times of minimum load conditions. Testing, prior to start-up can best be accomplished with the breaker out of its cell or in the "Test", "Disconnect" or "Withdrawn" (or "Removed") cell positions.

Note: Since time-current settings are based on desired system coordination and protection schemes, the protection settings selected and preset under Section 4.0 above should not be altered during or as a part of any routine test sequence.

5.3 Test Provision

As indicated in Fig. 7, six different test settings (1, 2, 3, 6T, 8 and 10 x I_n) are available for testing the phase elements of the trip unit and two (GF, GFT) are provided for testing the ground elements. One setting under each test mode (6T and GFT) will initiate a tripping action of the circuit breaker.

*No abort signal will occur for tests conducted unless the circuit breaker is carrying load current.

With appropriate preset selections of the phase protection settings, an ample range of settings under the "No Trip" condition are available to test the long time, short time and instantaneous trip settings without tripping the circuit breaker.

In the "GF" test position, the amount of test current is adequate to prove the operating condition of the trip unit without tripping the circuit breaker. This is not to be construed as a calibration test. The value of the simulated test current is 1.0 per unit of the rating plug value.

5.4 Mode of Conducting Tests

5.4.1 Control Power

Should the circuit breaker be in the "Disconnected" cell position or withdrawn from its cell entirely, install the Auxiliary Power module (Catalog No. PRTAAPM) to insure control power is available for testing. Should the circuit breaker be in the "Connected" or "Test" position and have control power available to the "Power/Relay" Module, then the Auxiliary Power Module is not required.

5.4.2 By Not Tripping the Breaker

1. Should the circuit breaker be in the cell "Connected" position and carrying load current, make sure that the circuit breaker is carrying no more than 40% of the plug ampere rating.

2. Place the test selector switch in one of the six "No Trip" test settings, i.e., 1, 2, 3, 8, 10, or GF.

3. Depress the "Test" pushbutton and release it – the test is initiated when the pushbutton is released.

4. Should any of the various protection settings be less than the selected "No Trip" test value, then the LED related to that function will turn "On" signifying successful completion of the test action and the time delay value (in seconds) that would have been allowed before initiating the trip will appear in the display window. Operation of the stepping pushbutton between the pointer LED's will not change the time value indicated in the Display Window. **Current** values will not be displayed following "No Trip" tests.

   Note: When a "No Trip" test is in progress the "Display Window" will show the time clock as it counts. The maximum time value that the clock will display is 99.9 seconds. This means for a trip time in excess of 99.9 seconds, the value in the display window will "Roll-Over", i.e., an actual trip time of 125 sec wound read 25.1 (99.9 plus 25.1) sec.

5. Reset the trip unit by depressing and releasing the "Trip Reset" pushbutton provided. All LEDs turned on by the "No Trip" test action should turn "Off". The time delay value in the Display Window will disappear.

Should an actual overload or fault condition occur during an in-service, "No Trip Test" sequence, the protection function will override the test function, and the circuit breaker will trip automatically as pre-programmed with the various Time-Current settings.

Note: The "Trip Reset" pushbutton may be depressed at any time. However, should a test initiated via the integral test panel be in progress, it would be aborted. A test initiated via the integral test panel may be aborted at any time by depressing the "trip reset" pushbutton.

5.4.3 By Tripping the Breaker

1. Make sure that the circuit breaker is carrying no more than 40% of the plug rating (I_n).

2. Place the test selector switch in one of the two "Trip" test settings, i.e., 6T or GFT.

3. Depress the "Test" pushbutton and release it – the test is initiated when the pushbutton is released. With the "Test" pushbutton depressed, the coded message "Test" will appear in the Test Window. When the pushbutton is released, the display window will show the time clock counting.

4. Should any of the various protection settings be less than the selected "Trip" test value, the circuit breaker will trip and the LED related to that function will turn on following the test action and a coded message will appear in the display window.

5. Depress the Step Pushbutton (twice for a LDT Test). The coded message will disappear and if the pointer LED is on I_A for "6T" or I_G for "GFT" the value of test current (in kA) that initiated the trip action will be displayed. If the pointer LED is on other than I_A for "6T" or I_G for "GFT", depress the Step Pushbutton until the position of the pointer LED is in the appropriate position.

   Trip Time values will not be displayed in the "Trip" test positions.

6. Reset the trip unit by depressing and releasing the "Trip Reset" pushbutton. All LEDs turned on resulting from the "Trip" test action should turn off. The value of trip current in the Display Window will disappear. If the pointer LED is not on I_A, it will return to I_A.

7. Reset and reclose the circuit breaker per established operating procedures.

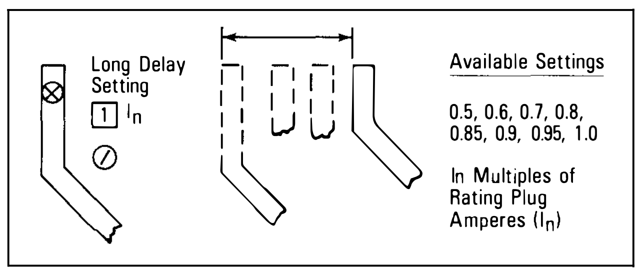

Fig. 6.1 *Long Delay Ampere Pickup Settings*

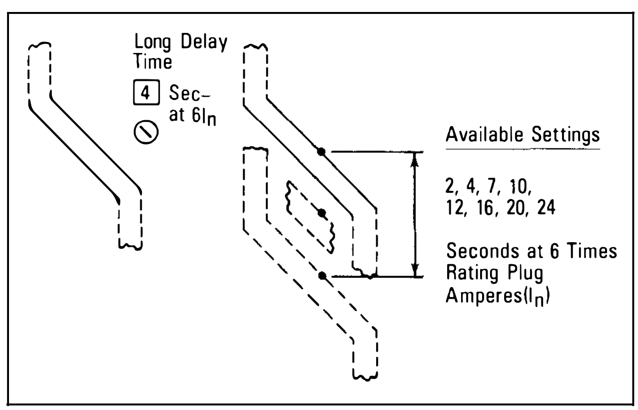

Fig. 6.2 *Long Delay Time Settings*

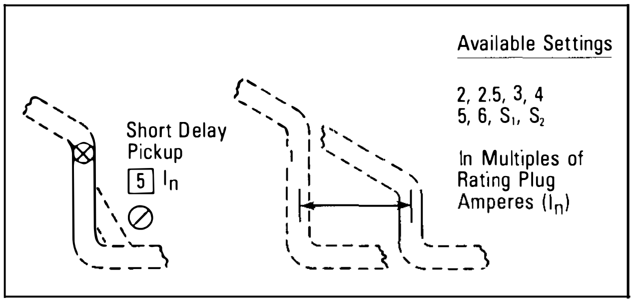

Fig. 6.3 *Short Delay Current Pickup Settings*

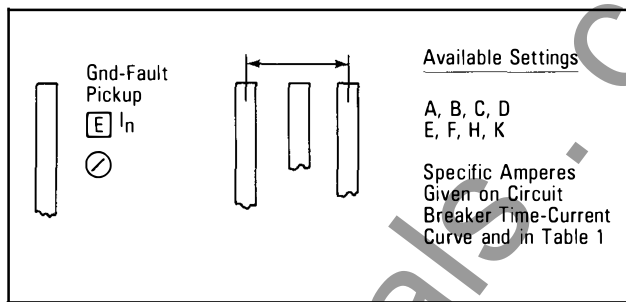

Fig. 6.6 *Ground Fault Current Pickup Settings*

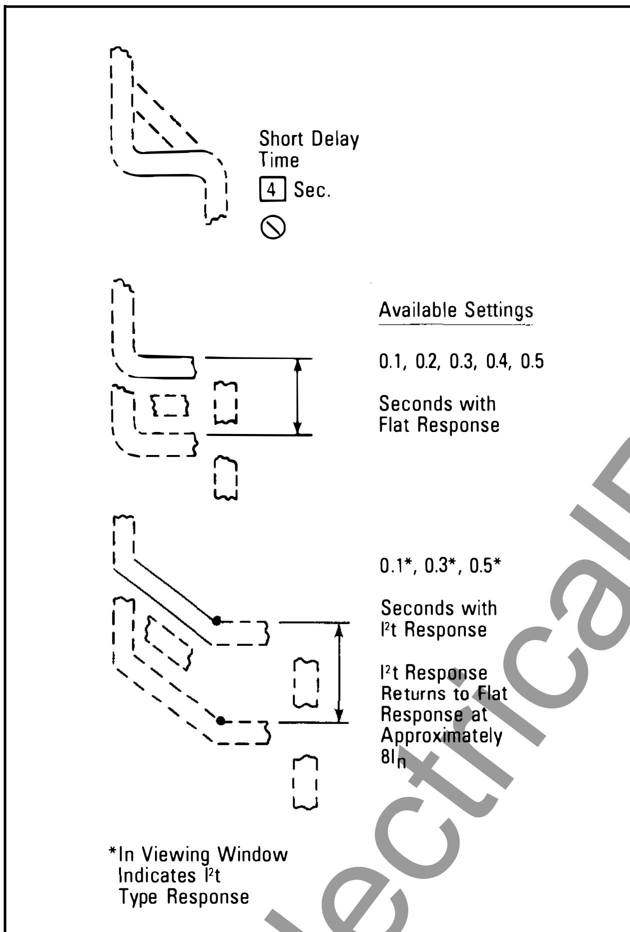

Fig. 6.4 *Short Delay Time Settings*

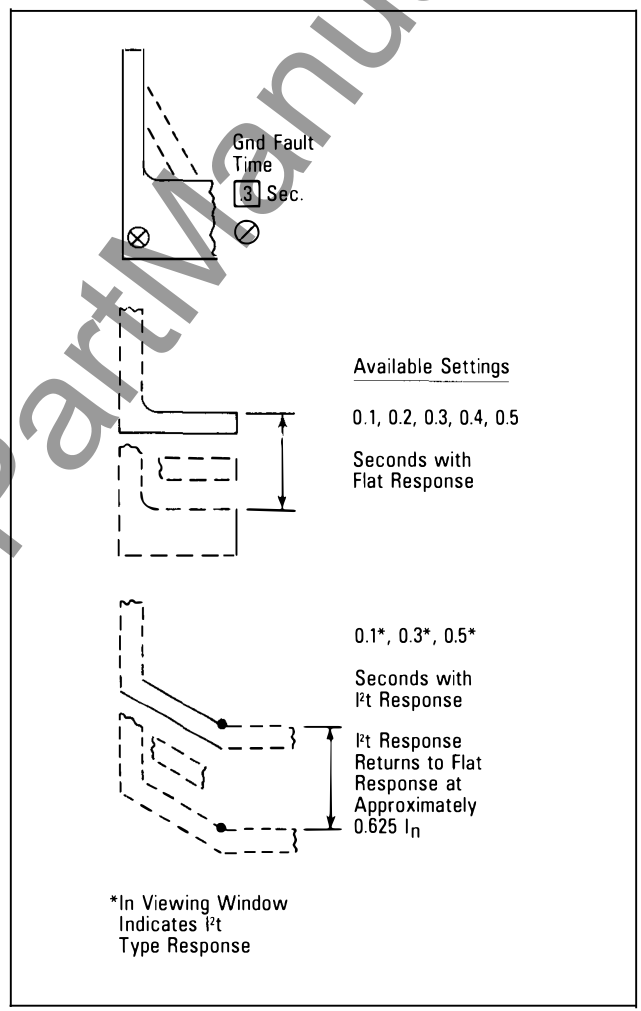

Fig. 6.7 *Ground Fault Time Delay Settings*

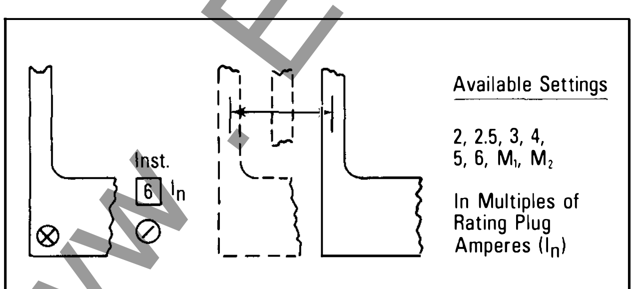

Fig. 6.5 *Instantaneous Current Pickup Settings*

6.0 Back-up Battery

6.1 General

As indicated in Figs. 3 and 5, a back-up battery is provided to maintain the mode of trip LED indication in the Digitrip RMS 600 Trip Unit when external control power to the Power/Relay module is not available. The back-up battery is located in the rating plug along with a battery check pushbutton and green battery check LED.

6.2 Battery Check

The battery is a long life, lithium photo type unit. The ready status of the battery can be checked at any time by depressing the battery check pushbutton and observing the "On" condition of the battery check LED as shown in Fig. 5.1. If the battery check LED does not turn "On", replace the battery.

6.3 Battery Replacement

Should the battery require replacement, it can be easily replaced from the front of the trip unit by lowering the hinged cover of the rating plug as shown in Fig. 5.2. The battery can then be removed by pulling the battery tab as shown in Fig. 5.3.

> **Note:** The battery can be replaced at any time with the circuit breaker in service without affecting the operation of the circuit breaker and its protection function.

Breaker Trips
I_n 6T and GFT

Test Amps
[6T] I_n

⊘

Test ○ ③

Trip Reset ○ ②

Available Settings

① Phase Current With Trip
6T (6 I_n)
Phase Current Without Trip
1, 2, 3, 8 and 10 (I_n)
① Ground Current With Trip
GFT
Ground Current Without Trip
GF

NOTES:
① See write-up for in-service test trip limitations.
② Trip unit reset required following all automatic trip and test operations.
③ Test operation begins with release of pushbutton.

Fig. 7 *Integral Test Panel*

The replacement battery should be the same type or equivalent. Acceptable 3.0 volt lithium batteries may be obtained from the following companies under their type designation indicated:

Company	Model
Varta Batteries, Inc. 150 Clarbrook Road Elmsford, N.Y. 10523	CR 1/3N
Duracell South Broadway Tangtown, N.Y. 10591 (914) 591-7000	DL 1/3N
Union Carbide Corp. Battery Products Div. Eveready 39 Old Ridgebury Road Danbury, CT 06817-0001 (203) 794-7548	2L-76BP

Note: Care should be exercised when replacing a battery to insure that the correct polarities are observed. Polarity markings are shown on the rating plug when the hinged cover is open as indicated in Figs. 5.2 and 5.3.

7.0 Auxiliary Power Module

The Auxiliary Power Module (Catalog No. PRTAAPM), illustrated in Fig. 8, is an encapsulated power supply that requires a 120 Vac input at either 50 or 60 Hz. It provides an output of 32 Vdc (nominal 40 Vdc open circuit) which can be used for testing a Digitrip RMS 600 Trip Unit.

When drawout construction is provided, any circuit breaker equipped with a Digitrip RMS 600 Trip Unit can be conveniently set and tested while the circuit breaker is out of its cell or in its cell in the "Disconnect" or "Withdrawn" positions using the Auxiliary Power Module.

The Auxiliary Power Module is equipped with a unique plug-in connector suitable only for plugging into the keyed receptacle of a Digitrip RMS Trip Unit. This prohibits the possible use of an incorrect, but similar, type power module. The location of the keyed receptacle for the Auxiliary Power Module is shown in Fig. 1.

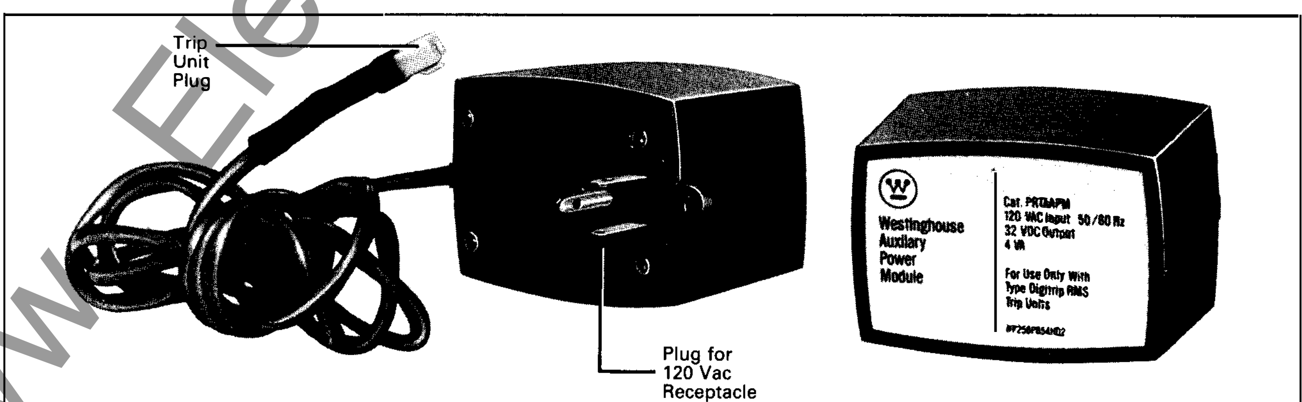

Fig. 8 *Auxiliary Power Module*

8.0 Rating Plug

The rating plugs, as illustrated in Figs. 1 and 5, are used to establish the continuous ampere rating of the related circuit breaker. All pick-up settings of the protection functions of the trip unit, i.e., long delay, short delay, and instantaneous and ground fault are selected as a multiple of the rating plug ampere rating (I_n).

Different types and ratings are available to match the desired ampere rating and type of circuit breaker into which the trip unit is to be installed. Also, since the rating plugs are frequency sensitive, specific types are available for 50 or 60 Hz system applications.

Complete catalog descriptions of all available rating plugs are given in the applicable circuit breaker supplementary instruction leaflets. References to these documents are given in Sections 9.1 and 9.2.

9.0 References

9.1 Type DS Low Voltage Ac Power Circuit Breakers

I.B. 33-790-1F	Instructions for Low-Voltage Power Circuit Breakers Types DS and DSL
I.B. 33-790-1F Supplement No. 1	Section 8A Supplement Circuit Breaker Automatic Tripping System When Using Digitrip RMS Trip Assembly
SC-4280-87	Typical Time-Current Characteristic Curve (LI) for Type DS Circuit Breakers
SC-4281-87	Typical Time-Current Characteristic Curve (LS) for Type DS Circuit Breakers
SC-4279-87	Typical Time-Current Characteristic Curve (G) for Type DS Circuit Breakers
508B508	Connection Diagram for Type DS Circuit Breakers

9.2 Type SPB Systems Pow-R Breakers

I.L. 29-801	Instruction for the Systems Pow-R Breaker and Drawout Mechanism
I.L. 29-855	Supplementary Instructions for the Systems Pow-R Breaker used with the Digitrip RMS Trip Assembly
SC-4283-87	Typical Time-Current Characteristic Curve (LI) for Type SPB Systems Pow-R Breaker
SC-4284-87	Typical Time-Current Characteristic Curve (LS) for Type SPB Systems Pow-R Breaker
SC-4282-87	Typical Time-Current Characteristic Curve (G) for Type SPB Systems Pow-R Breaker
I.S. 15545	SPB Master Connection Diagram using Digitrip RMS Trip Assemblies

9.3 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

9.4 Series C R-Frame Molded Case Circuit Breakers

29-106	Framebook
29C107	Frame Instruction Leaflet
29-707	Supplement Instructions for Series C R-Frame used with Digitrip RMS Trip Assembly
SC-4582-89	Typical Time-Current Characteristic Curve (LI) for Type RD Circuit Breakers
SC-4583-89	Typical Time-Current Characteristic Curve (LS) for Type RD Circuit Breakers
SC-4584-89	Typical Time-Current Characteristic Curve (G) for Type RD Circuit Breakers
I.L. 29C709	Master Connection Diagram for Series C R-Frame Circuit Breaker with Digitrip RMS

Westinghouse Electric Corporation
Distribution and Control Business Unit
Electrical Components Division
Pittsburgh, PA 15220

Style No. 6615C97H01

Instructions for Digitrip RMS 600 Trip Unit

I.L. 29-852-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.

1.0 General Description

1.1 Protection

The Digitrip RMS 600 Trip Unit, illustrated in Fig. 1, is a microprocessor based type trip unit suitable for use in type SPB Systems Pow-R circuit breakers and types DS and DSL low voltage AC power circuit breakers and Series C® R-Frame molded case circuit breaker.

The trip unit provides true RMS current sensing for proper correlation with thermal characteristics of conductors and equipment. Interchangeable rating plugs are provided to establish the continuous current rating of each circuit breaker.

The Digitrip RMS 600 Trip Unit is completely self-contained and when the circuit breaker is closed, requires no external control power to operate its **protection systems**. It operates from current signal levels and control power derived through current sensors integrally mounted in the circuit breaker.

The Digitrip RMS 600 Trip Unit is available in six optional protection models. Each trip unit may be equipped with a maximum of five phase and two ground (time-current) adjustments to meet specific application requirements. These protection models include the following types which are further illustrated in the nameplate examples shown in Fig. 2.

Figure	Type Protection	Identifier
2.1	Long Time/Instantaneous	(LI)
2.2	Long Time/Short Time	(LS)
2.3	Long Time/Short Time/Instantaneous	(LSI)
2.4	Long Time/Instantaneous/Ground	(LIG)
2.5	Long Time/Short Time/Ground	(LSG)
2.6	Long Time/Short Time/Instantaneous/ Ground	(LSIG)

1.2 Information/General

In addition to the protection function, the Digitrip RMS 600 Trip Unit is equipped with a four-digit, alpha-numeric readout display, three phase and one ground (when supplied) current pointer green LEDs along with a stepping pushbutton as illustrated in Figs. 1 and 2. A Power/Relay module is included to provide control power for operating the readout display and internally mounted signal relays. The signal relays provide contacts for three remote mode of trip indicators (long delay, short circuit, ground fault) and a High-Load remote alarm.

Red LED indicators are provided on the face of the trip unit to indicate the mode of an automatic trip operation as well as a High-Load alarm.

Green LED indicators are provided to indicate the operational status of the trip unit and the status of the back-up battery mounted in the rating plug.

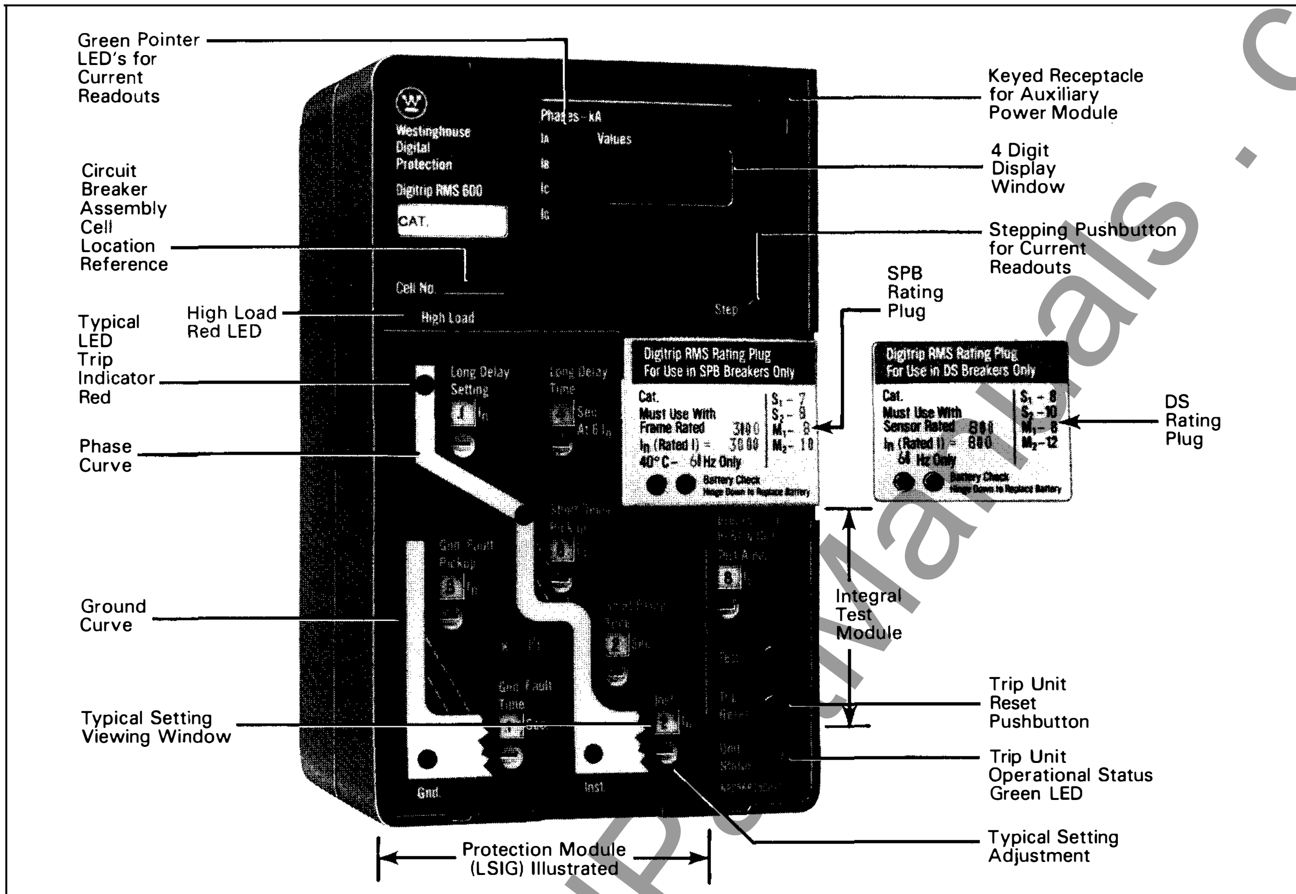


Fig. 1 *Typical Digitrip RMS 600 Trip Unit with Rating Plug Installed*

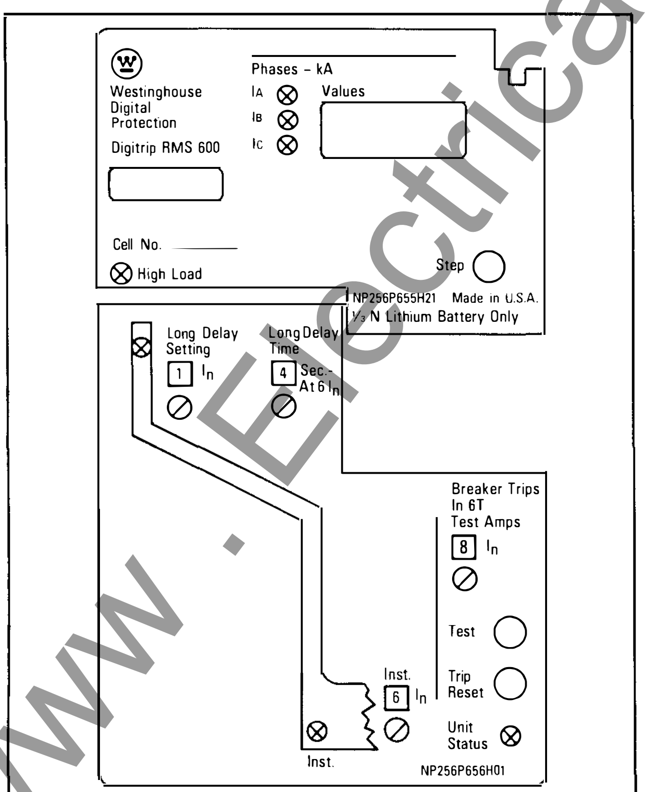


Fig. 2.1 *Long Time/Instantaneous Protection (LI) Nameplate*

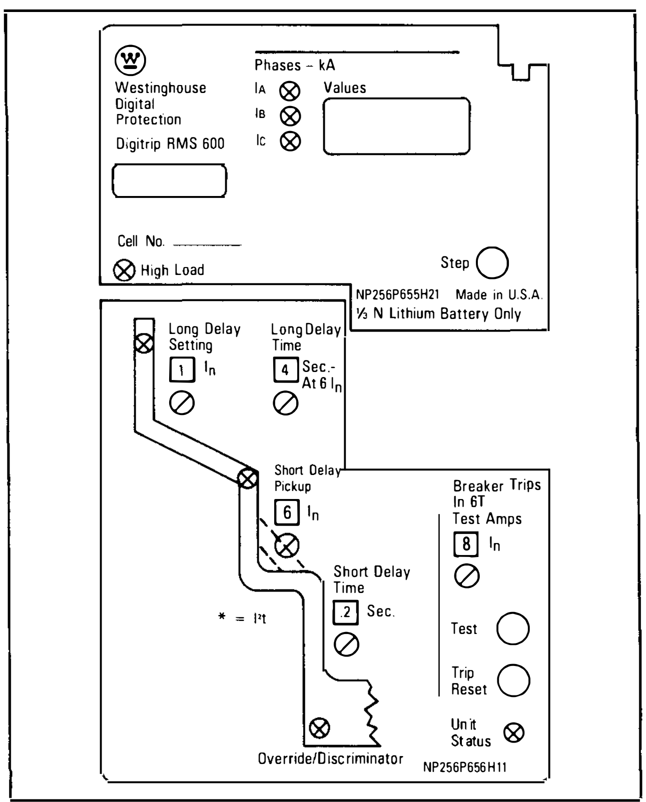


Fig. 2.2 *Long Time/Short Time Protection (LS) Nameplate*

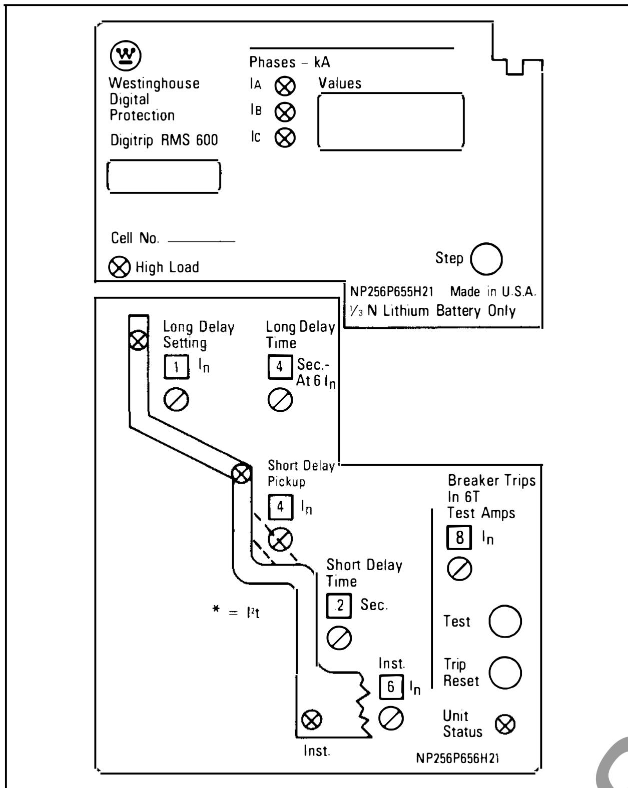


Fig. 2.3 *Long Time/Short Time/Instantaneous Protection (LSI) Nameplate*

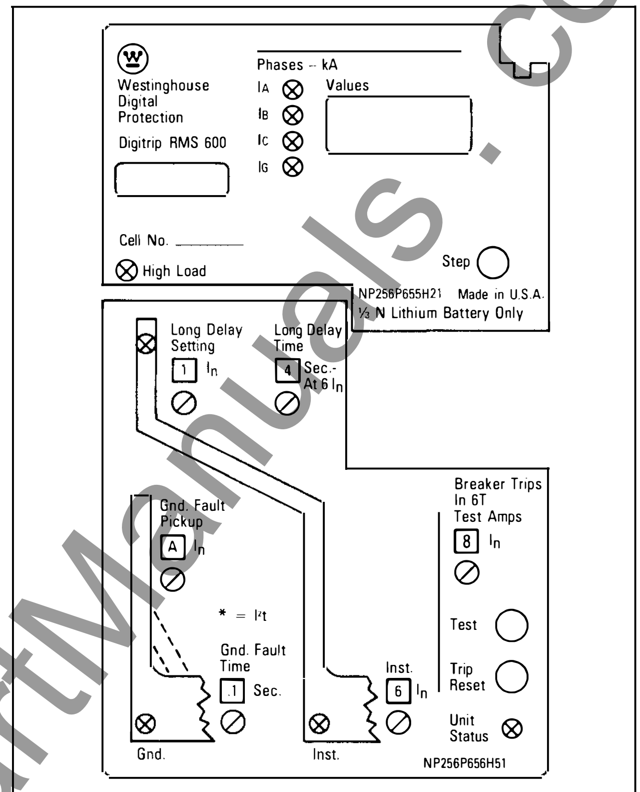


Fig. 2.4 *Long Time/Instantaneous/Ground Protection (LIG) Nameplate*

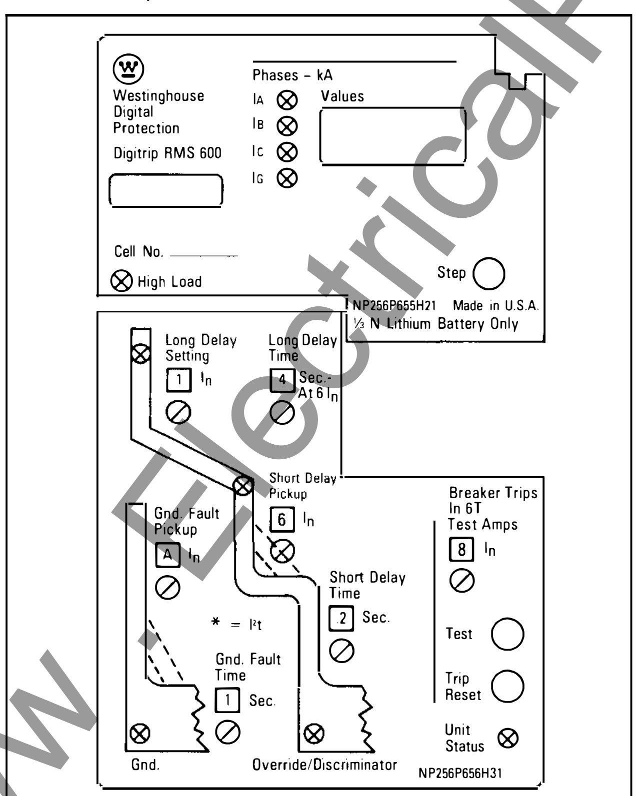


Fig. 2.5 *Long Time/Short Time/Ground Protection (LSG) Nameplate*

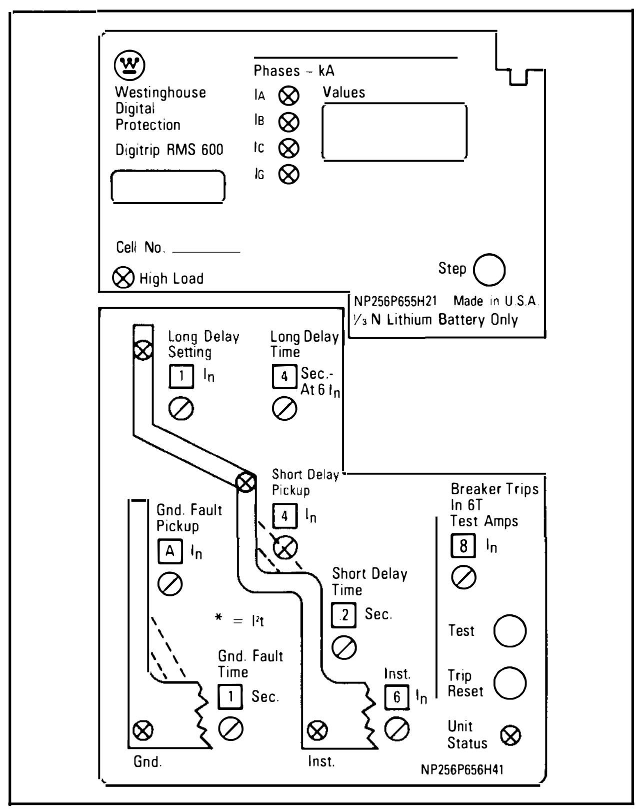


Fig. 2.6 *Long Time/Short Time/Instantaneous/Ground Protection (LSIG) Nameplate*

The back-up battery is provided to maintain the mode of trip LED indicators following an automatic trip operation and simultaneous loss of control power to the Power/Relay module. It does not provide control power for the microprocessor.

1.3 Testing

Integral test provisions with selectable "Trip" and "No Trip" test positions are provided. For phase testing, five "No Trip" test settings and one "Trip" test setting are provided. For ground fault testing, one "No Trip" and one "Trip" setting are provided. Test and Trip Reset pushbuttons are provided.

2.0 UL Listed Devices

Digitrip RMS 600 Trip Units are listed by the Underwriters Laboratories, Inc. for use in types SPB, DS and DSL and Series C R-Frame circuit breakers under U.L. File E7819.

3.0 Principle of Operation

3.1 General

The Digitrip RMS 600 Trip Unit provides three basic functions: Protection, Information and Testing. A typical trip unit and rating plug are illustrated in Fig. 1. Individual product instruction leaflets referenced in Sections 9.1 and 9.2 illustrate typical Digitrip RMS Trip Units installed in specific breakers.

The trip unit uses the INTEL MCS-51 family of microcomputers to perform its numeric and logic functions. The principle of operation can best be described by referring to the block diagram shown in Fig. 3.

In the Digitrip RMS 600 Trip Unit all required sensing and tripping power to operate its **protection function** is derived from the current sensors in the circuit breaker. The secondary current signals from these sensors provide the correct magnitude of current for protection functions as well as tripping power during normal circuit breaker operating periods. Using these current signals in the protection function, analog voltages are developed across various calibrating resistors including:

1) Phase current
2) Ground fault current (when supplied)
3) Rating plug

The resulting analog voltages are multiplexed into an analog-to-digital converter and the output data fed into the microcomputer chip along the data bus.

The microcomputer, in cyclic fashion, repeatedly scans the resultant voltage values across each calibrating resistor and enters these values into its RAM or Read/Write Memory. This data, which is used to calculate true RMS current values, is repeatedly compared with the pre-set protection function pick-up settings and other operating data stored in the ROM or Read Only Memory. The microcomputer software program is then used, in decision tree fashion, to initiate protection functions including tripping actions through the low energy flux transfer trip coil in the circuit breaker.

3.2 Making Current Release (Discriminator)

When the Digitrip RMS 600 Trip Unit is not equipped with an adjustable instantaneous protection setting, i.e., types LS or LSG, a making current release (or discriminator) circuit is provided. This circuit will prevent the circuit breaker from being

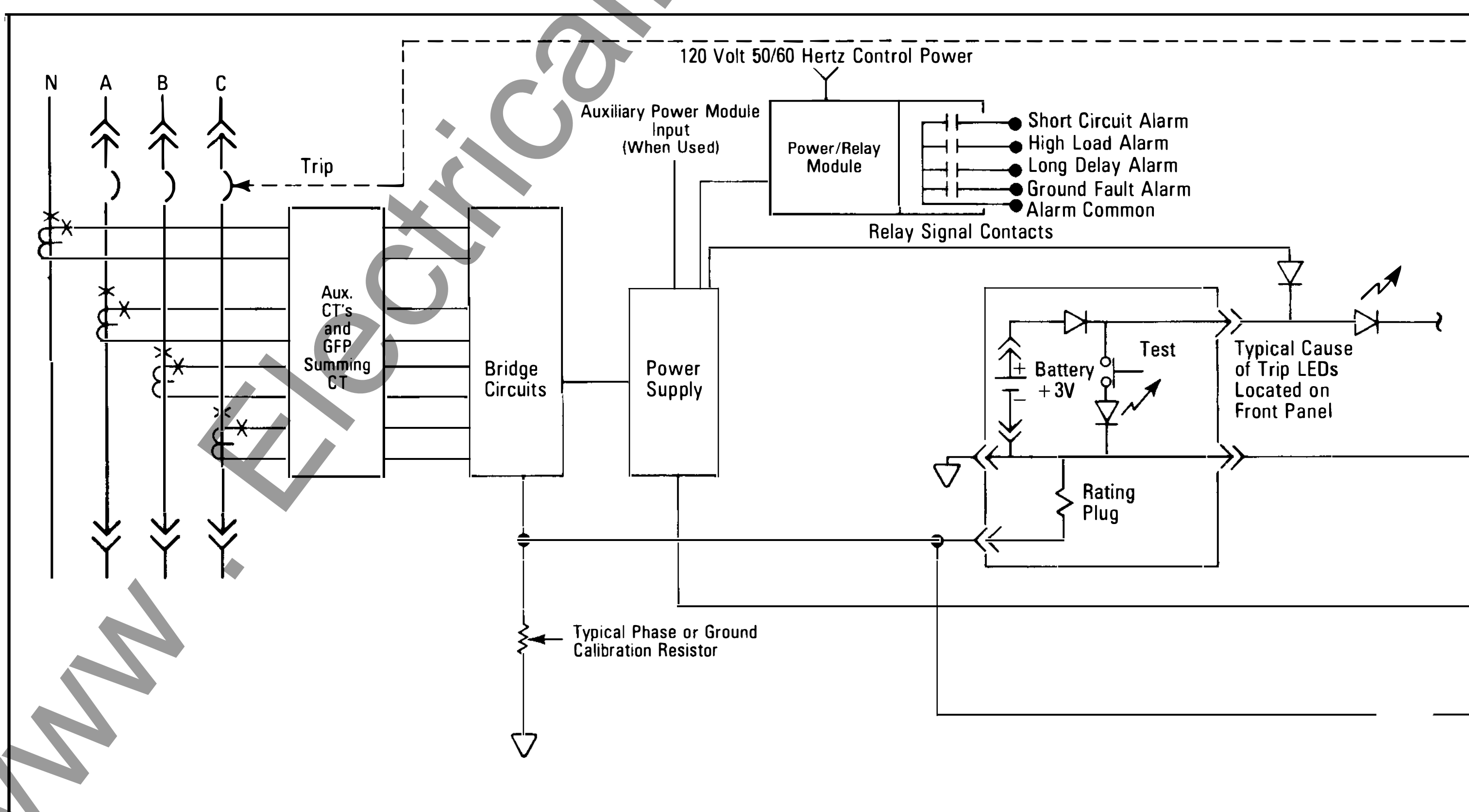


Fig. 3 *Digitrip RMS 600 Block Diagram with Breaker Interface*

closed and latched-in on a faulted circuit. The non-adjustable release is pre-set at eleven (11) times the installed rating plug ampere rating (I_n).

The making current release is armed only for the first ten (10) cycles following an initial circuit breaker closing operation provided the load current exceeds approximately 10% of the circuit breaker frame or sensor rating. Should the load current through the circuit breaker drop to a value less than this, the release will re-arm. The release, once armed, will remain armed until approximately 10% load current passes through the breaker for 10 cycles. Any trip operation initiated by the making current release will trip the circuit breaker instantaneously.

3.3 Instantaneous Override

In addition, when the Digitrip RMS 600 Trip Unit is not equipped with an adjustable instantaneous setting, i.e., types LS or LSG, a high-set non-adjustable instantaneous override trip circuit is provided. This high level tripping action is preset to a specific value that reflects the short time withstand rating of the circuit breaker in which the trip unit is installed. Specific values vary between circuit breaker types and ratings. For specific information, refer to the supplementary leaflets and/or Time-Current curves referenced in Sections 9.1 and 9.2.

3.4 Zone Interlocking

As indicated in the block diagram in Fig. 3, zone interlock signals are provided. For Digitrip RMS 600 Trip Units equipped with either ground fault or short time protection functions or both, separate zone interlocking circuits are provided. When utilized, these input/output signals must be connected in the ultimate equipment assembly in line with details provided with the specific circuit breaker connection diagrams supplied with the circuit breaker and referenced in Sections 9.1 and 9.2. Similarly, if the zone interlocking function is chosen not to be used, defeater connections on each circuit must be added as illustrated in the same referenced diagrams.

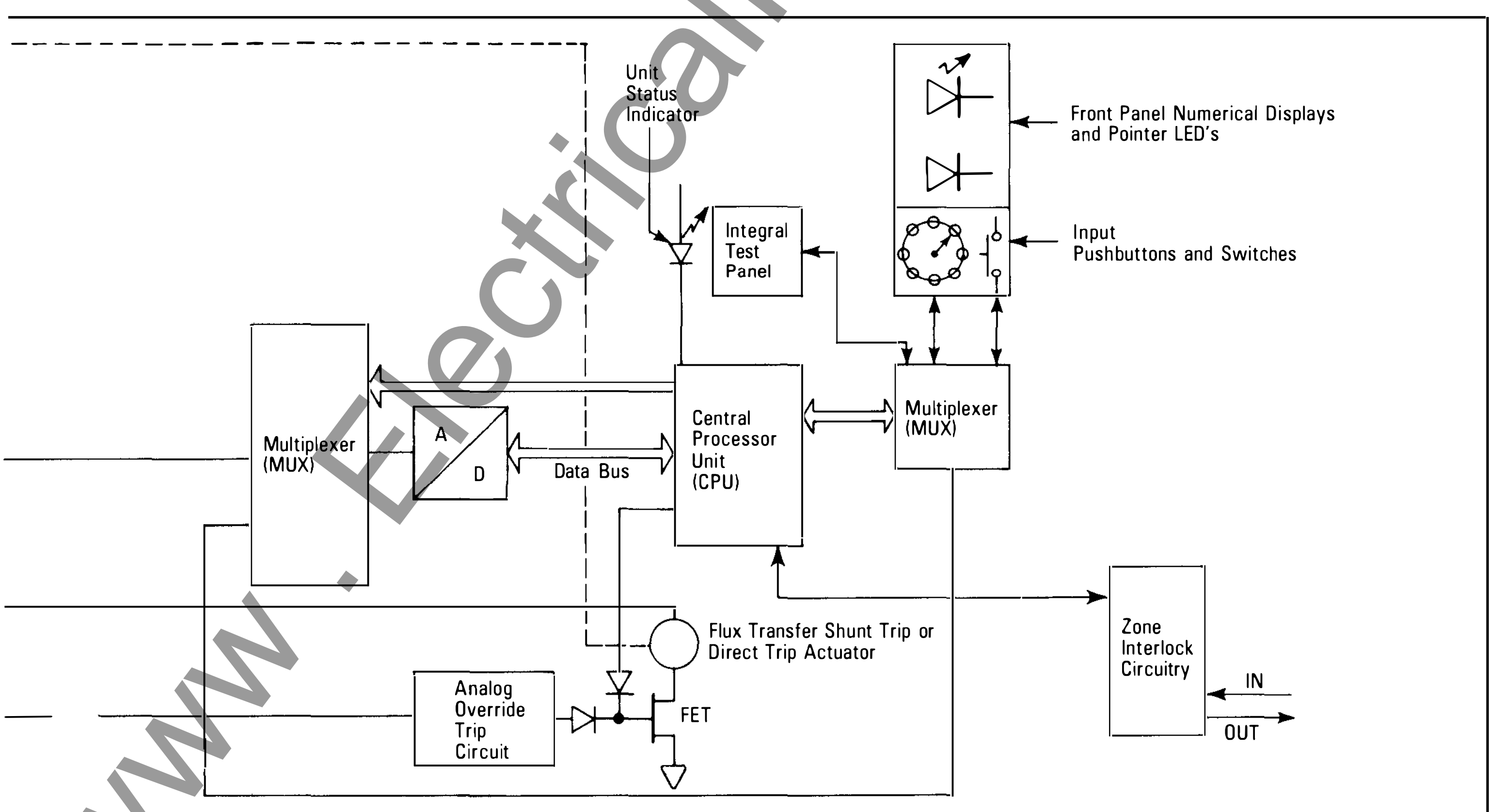
3.5 Trip and Operation Indicators

Red colored LEDs, as shown in Figs. 1 and 2, also indicate on the face of the trip unit the mode of trip of any automatic trip operation. As indicated in Fig. 2, each LED is strategically located in the related segment of the Time-Current curve depicted on the face of the trip unit. The mode of trip is identified by the segment of the Time-Current curve in which the LED is turned "On".

External control power is required to operate the Power/Relay module. The power/relay module maintains the mode of trip LED indicators in their "On" position following an automatic trip operation as long as the control power is available. With a loss of control power following an automatic trip operation, a back-up battery as illustrated in Figs. 3 and 5 is provided to perform this function.

A green colored battery check, LED and test pushbutton, as shown in Figs. 1 and 5, are provided to check the status of the battery.

A green colored LED, as shown in Fig. 1, indicates the operational status of the trip unit. With external control power available at the Power/Relay module (or via the external Auxiliary Power module during bench testing operations), the green LED will flash "On" and "Off" once each second. A flashing green LED is an indication of a properly operating trip unit.



A red colored LED, as shown in Fig. 1, indicates that the load current through the circuit breaker has reached 85% of the preset value of the Long Delay Setting. The High-Load LED will turn "On" and the High-Load relay, located internally in the Power/Relay module shown in Fig. 4, will pick-up after an approximate 40 second delay. This delay allows the alarm to ride-through a momentary high-load condition thus avoiding nuisance alarms.

3.6 Readout Display

The four-digit alpha-numeric readout display window, illustrated in Figs. 1 and 2, serves two basic purposes: instrumentation and mode of trip or trouble indication.

Instrumentation

During normal service conditions, with the circuit breaker closed, it serves an ammeter instrumentation function. It displays the individual phase currents (I_A, I_B, I_C) and ground current (I_G) provided integral ground fault protection is included in the trip unit. Current values are displayed in kA. The actual current value being displayed is indicated by the marked LED that is turned "On". A stepping pushbutton is provided to step among the different currents.

Mode of Trip and Trouble Indication

Following an automatic circuit breaker trip operation and with control power available to the Power/Relay module, the Readout Display indicates the mode of trip using coded messages such as, INST (Instantaneous Trip), SDT (Short Delay Trip), LTD (Long Delay Trip) and GNDT (Ground Fault Trip). The coded message will lock-in position until the Stepping Pushbutton is depressed. Afterwards, the Display will indicate the value of current (in kA) at the time of the trip initiation by the protection function involved.

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. Following an automatic trip operation of the circuit breaker, it will maintain the cause of the trip history and the mode of trip LEDs as long as the external control power supply is available. Each signal relay contact is rated 120 V., 50/60 Hz, 1.0 A.

3.6.1 Readout Display Messages

The Readout Display provides ammeter instrumentation under normal service conditions of the circuit breaker and alphanumeric coded messages after an automatic trip. To properly understand the actions of the trip unit, each coded message must be understood as well as any required follow-up operational action. Messages can be divided into two categories: Normal service and after trip or trouble conditions.

3.6.1.1 Normal Service

Normal service messages are those that serve the ammeter instrumentation function. In Fig. 1, four green colored LEDs serve a pointer function, i.e., phase A current (I_A), phase B current (I_B), phase C current (I_C) and ground current (I_G). The ground current LED will be included only if integral ground fault protection is included as an integral part of the trip unit protections functions.

Each LED, when turned "On", will indicate the current being displayed in the four-digit display window. The current displayed in the window will remain in view until a change is implemented. A step pushbutton is provided to step among the available currents.

3.6.1.2 After Trip or Trouble

For the after trip and trouble conditions, one of the following coded messages will appear in the display window:

Message	Condition	Action/Comment
LDPU	Overload in Progress	Indication is warning signal. Trip will occur if condition persists.
LDT	Overload Trip	Trip action initiated as result of an overload. Clear overload, reset trip unit and reclose breaker as required.
SDT	Short Delay Trip	Trip action initiated as result of fault exceeding trip setting. Examine breaker to insure reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been corrected.
INST	①Instantaneous Trip	Trip action initiated as result of fault exceeding trip setting. Examine breaker to insure reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been corrected.
GNDT	Ground Fault Trip	Trip action initiated as result of ground fault exceeding trip setting. Examine breaker to insure reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been corrected.
DISC	①Making Current Release (Discriminator) Trip	Trip action initiated by Discriminator – most likely on initial breaker closing action. Examine breaker to insure that reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been cleared.
ORID	②③Override Trip	Trip action initiated by override circuit indicative of a high level fault. Examine breaker to insure that reclosing action is appropriate. Reset trip unit and reclose breaker only after reason for trip has been cleared.

Message	Condition	Action/Comment
TEST	Test in Progress	This message will appear when the integral test pushbutton is depressed and will disappear when the test pushbutton is released (indicating test has started). The test message only appears when a complete breaker trip test is selected, i.e., 6T or GFT (see Fig. 7)
PLUG	Rating Plug Problem	This message will appear should there be a missing, improperly installed or defective rating plug.
RAM	Data Memory Problem	This message will appear in response to a data memory test failure. Depress trip unit Trip Reset to reconfirm message. If message reappears, replace trip unit.
ROM	Program Memory Problem	This message will appear in response to a program memory test failure. Depress trip unit Trip Reset to reconfirm message. If message reappears, replace trip unit.

Notes:

① All values of current displayed were present prior to initiation of the trip signal. In the case of a high-level fault condition where fast tripping is desirable, the trip unit will operate before a complete RMS current value can be calculated. For this reason, the displayed value may be less than the actual RMS fault current.

② In the case of very high fault levels outside the range of normal current sensor accuracy ranges, the message "ORNG" (indicating over range) will appear at each phase readout position when the trip message "ORID" (indicating override) is interrogated by the stepping pushbutton.

③ The override value in the trip unit is set to operate at approximately 100 X the frame/sensor ampere rating For circuit breakers having lower withstand ratings, other details are provided in the breaker to insure proper applications within the breaker withstand rating.

3.6.1.3 Analyzing "After Trip" Coded Messages

As indicated in Section 3.6, as long as control power is available to the Power/Relay Module, coded messages will lock-in position on the Readout Display until the stepping pushbutton is depressed. Likewise, the individual values of phase and ground current, if any, at the time the automatic trip was initiated will also lock-in position and remain until the trip unit is reset by depressing the reset pushbutton. The manner that these coded messages operate can best be understood by referring to the following examples:

Given A 1600 amp circuit breaker with a 1000 amp rating plug installed.

3.6.1.3.1 Case 1 – Overload Trip Operation

Assume a prolonged overload condition which results in an automatic breaker trip operation. The following will occur:

1. The Long Delay Trip LED will turn "On" (see Fig. 1)
2. The coded message LDT will appear in the Display Window (see Fig. 1)
3. The Long Delay Relay in the Power/Relay Module (see Figs. 3 and 4) will operate to transmit a remote Long Delay alarm signal.

Operator Actions

1. Observe the mode of trip LED and coded alpha-numeric message in the Display Window.
2. Depress Stepping Pushbutton twice (see Fig. 1). This action will clear the coded cause of trip message in the Display Window.
3. View value of phase current in Display Window (see Fig. 1) e.g., 1.50 (in kA).

   Note: The phase current shown will be that referenced by the Pointer LED (see Fig. 1) that is turned "On," assume "I_A". (It may not be the faulted phase).

4. Depress the Stepping Pushbutton to move from LED "I_A" to LED "I_B" to LED "I_C". At each position, the related value of phase current (in kA) at the time of the trip operation will appear in the Display Window.
5. Reset the trip unit by depressing the "Trip Reset" pushbutton (see Fig. 1). All coded messages and current values in the display window, the cause of trip LED and the signal relay in the Power/Relay module will turn "Off".

Notice

On trip operations initiated by the long delay trip (LDT) function it is essential that any cause of overload trip be corrected prior to reclosing the circuit breaker. Should it not be corrected and the circuit breaker be reclosed too soon, then because of the inherent Long Time Memory Function, the Long Delay trip time will operate faster than the related time-current curve indicates.

The amount of time required to clear the memory circuit is a factor of the Long Delay time setting (see Fig. 6.2). The longer the delay setting, the longer the time required to reset the memory. Total memory clearing time could vary from one to twelve (12) minutes depending upon the time delay setting selected.

The memory function, as in any conventional thermal type (bi-metal) circuit breaker, serves a useful function by allowing the load conductors to cool down.

6. After correcting the cause of the overload trip (LDT) and allowing for the memory circuit to reset, reclose the circuit breaker as required following established operating procedures.

Note: During the overload condition, prior to the automatic trip operation, the following trip unit indications would have been visible:

1. The "High-Load" LED (Fig.1) would have been turned "On" if the overload condition had existed for 40 seconds or longer.
2. The "High-Load" relay in the Power/Relay Module (see Figs. 3 and 4) would have picked-up (after a 40 second delay,) to close a contact for a remote High-Load alarm.
3. The Long Delay LED (Fig.1) would have been flashing "On" and "Off".
4. The coded message LDPU would have been flashing in the Display Window.

3.6.1.3.2 Case 2 – Instantaneous Trip Operation

Assume a high-level fault above the instantaneous trip setting – Assume 8 x I_n – (see Fig. 1). Following the trip operation, the following will occur:

1. The Instantaneous Trip LED will turn "On" (see Fig. 1).
2. The coded message INST will appear in the Display Window (see Fig. 1).
3. The Short Circuit Relay in the Power/Relay Module (see Figs. 3 and 4) will operate to close a contact for a remote Short Circuit Alarm.

Operator Actions

1. Observe the mode of trip LED and coded message in the Display Window.
2. Depress Stepping Pushbutton (see Fig. 1). This action will clear the coded cause of trip message in the Display Window.

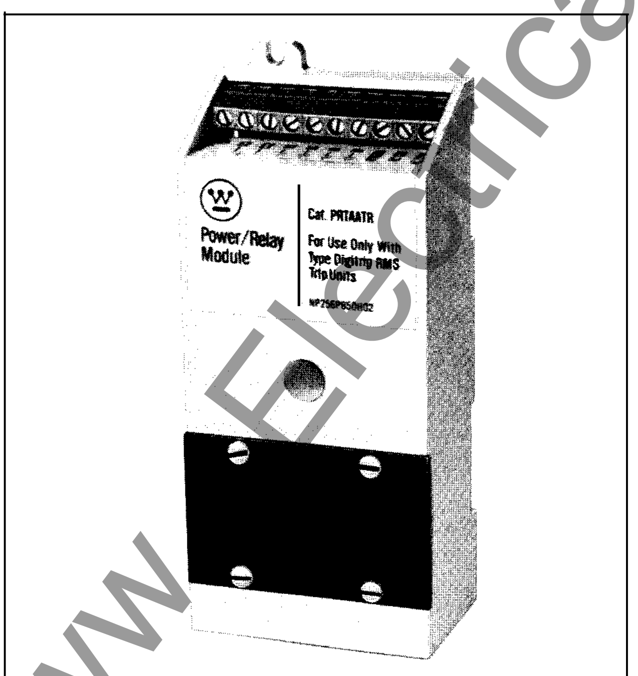


Fig. 4 *Power/Relay Module.*

3. View value of phase current in Display Window (see Fig. 1) e.g., 12.0 (in kA).

   Note: The phase current shown will be that referenced by the Pointer LED (see Fig. 1) that is turned "On" (It may not be the faulted phase), assume "I_A".

4. Depress the Stepping Pushbutton to move from LED "I_A" to LED "I_B" to LED "I_C". At each position, the related value of phase current (in kA) at the time of the trip operation will appear in the Display Window.

   Note: Should the level of fault current be very high, then, the coded message ORID could appear in the Display Window. When the step pushbutton is depressed, the coded message ORNG rather than a numerical current value would appear. This would be indicative of a very high fault level outside the range of normal current sensor accuracy ranges.

5. Reset the trip unit by depressing the "Trip Reset" pushbutton (see Fig. 1). All coded messages and/or current values in the display window, the cause of trip LED and the signal relay in the Power/Relay module will turn "Off".
6. Following any corrective actions in the system and inspections of the circuit breaker and related equipment, reclose the circuit breaker as required.

3.6.1.3.3 Other Cases

Similar type indications will occur and similar operator actions will be required as described in the above two cases following an automatic trip operation initiated by any other of the Protection Functions, including Short delay and ground fault.

3.7 Test Provisions

An integral test panel including a test selector switch and test and reset pushbuttons is provided to test the circuit breaker in either a TRIP or NO-TRIP test mode under qualified conditions. See Section 5.

For bench testing of the trip unit alone or of the trip unit while it is installed in the circuit breaker, an optional Auxiliary Power module (Catalog No. PRTAAPM) as shown in Fig. 7 is available. This Auxiliary Power module, which operates from a separate 120Vac, supply, may also be used when a drawout type circuit breaker is in any of its four cell positions, i.e., "Connected", "Test", "Disconnected" and "Withdrawn" (or "Removed").

4.0 Protection Settings

4.1 General

Prior to placing any circuit breaker in operation, all available protection settings should be set using values as recommended by the specifying engineer responsible for the installation. The number of settings that must be made will be a factor of the protection model supplied as illustrated in Figs. 2.1 through 2.6. Each setting is made with an eight position rotary switch using a small screwdriver. The selected setting for each adjustment will appear in the small rectangular opening as illustrated in Fig. 1.

The installed rating plug establishes the maximum continuous current rating of the circuit breaker. All current pick-up settings in the protection module are defined in per unit multiples of the ampere rating (I_n) of the installed rating plug.

To illustrate the portion of the protection curve being adjusted, simulated Time-Current curves are pictured on the face of the trip unit. The particular setting to be adjusted is located in close proximity to its portion of the simulated Time-Current curve. Should an automatic trip occur as a result of a fault current exceeding the preselected value in this portion of the Time-Current curve, the red LED shown in this segment of the simulated Time-Current curve will turn "On".

The available settings, along with the illustrated effect of changing the settings, are given in Figs. 6.1 through 6.7.

4.2 Long Delay Settings

Eight (8) available settings, as indicated in Fig. 6.1, range from 0.5 to 1.0 (I_n). Each setting is expressed as a multiple of the maximum ampere rating (I_n) of the installed rating plug.

4.3 Long Delay Time Settings

Eight (8) available settings, as illustrated in Fig. 6.2, range from 2 to 24 seconds. These settings represent total clearing times at a current value equal to six (6) times the installed rating plug ampere rating (I_n).

4.4 Short Delay Pick-up Settings

As illustrated in Fig. 6.3, eight (8) available settings range from 2 to 6 (I_n) with two variable settings of S1 and S2. These variable settings depend upon the type of circuit breaker in which the trip unit is installed. Specific information on these settings is given in the supplemental instruction leaflet referenced in Sections 9.1 and 9.2 that is supplied with the circuit breaker. Specific information is also shown on the rating plug and on the applicable Time-Current curve.

4.5 Short Delay Time Settings

As illustrated in Fig. 6.4, two different curve configurations are possible, i.e., flat or I^2t response. The configuration selected will be a factor of the type of selective coordination being developed. The I^2t response will provide a longer time delay in the low-end of the short delay pick-up range than will the flat response setting.

Five flat (0.1, 0.2, 0.3, 0.4, 0.5 sec.) and three I^2t (0.1, 0.3, 0.5 sec.) response time delay settings are provided. The I^2t response settings are identified by the suffix asterisk (*) that appears in the setting viewing window. The I^2t response is applicable only up to eight (8) times the ampere rating of the installed rating plug (I_n). After this value is exceeded, the I^2t response configuration reverts to a flat response.

4.6 Instantaneous Pick-up Settings

As illustrated in Fig. 6.5, eight (8) available settings range from 2 to 6 (I_n) with two variable settings M1 and M2. These variable settings depend upon the type of circuit breaker in which the trip unit is installed. Specific information on these settings is given in the supplemental instruction leaflet referenced in Sections 9.1 and 9.2 that is supplied with the circuit breaker. Specific information is also shown on the rating plug and on the applicable Time-Current curve.

4.7 Ground Fault Current Pick-up Settings

As illustrated in Fig. 6.6, eight (8) available settings are given in alphabetical notations from A to K (there is no "G" notation). Specific setting values are a function of the installed rating plug. In general, the pick-up settings range from 0.25 to 1.0 times the ampere rating (I_n) of the installed rating plug up to a maximum pick-up value of 1200A.

Specific current pick-up values are tabulated in Table 1 and on the ground fault Time-Current curve of the applicable circuit breaker. Under primary injection test conditions conducted with the breaker outside of its cell and the external Auxiliary Power module shown in Fig. 8 is used, the tabulated values should be in effect.

The tabulated values shown in Table 1 are based on the use of a residual current sensing scheme with the same rated current sensor for all phase and neutral conductors. Refer to the applicable supplemental circuit breaker instruction leaflet shown in Sections 9.1 and 9.2 for values applicable to alternate sensing schemes.

Table 1 – Ground Fault Current Pickup Settings

INSTALLED RATING PLUG AMPERES (I_n)③	PICKUP SETTINGS GROUND FAULT CURRENTS (AMPERES)①							
	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
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

① Tolerances on pickup levels are ±10% of values shown in chart.
② Ground fault pickup levels shown are nominal values when tested with external control power present. This could be with the Power/Relay Module energized or with the auxiliary power module energized. Without external control power, the pick-up level may be as high as the value shown for the "E" setting of that particular plug.
③ Refer to Type DS, Type SPB or Type Series C R-Frame supplemental instruction leaflets given in Section 9 for list of available rating plugs with each type circuit breaker.

4.8 Ground Fault Time Delay Settings

As illustrated in Fig. 6.7, two different curve configurations are possible, i.e., flat or I^2t response. The configuration selected will be a factor of the type of selective coordination being developed. The I^2t response will provide a longer time delay in the low-end of the ground fault pick-up range than will the flat response setting.

Five flat (0.1, 0.2, 0.3, 0.4, 0.5, sec) and three I^2t (0.1, 0.3, 0.5 sec) response time delay settings are provided. The I^2t response settings are identified by the suffix asterisk (*) that appears in the setting viewing window. The I^2t response is applicable only up to 0.625 times the ampere rating of the installed rating plug (I_n). Beyond this value, the I^2t response configuration reverts to a flat response.

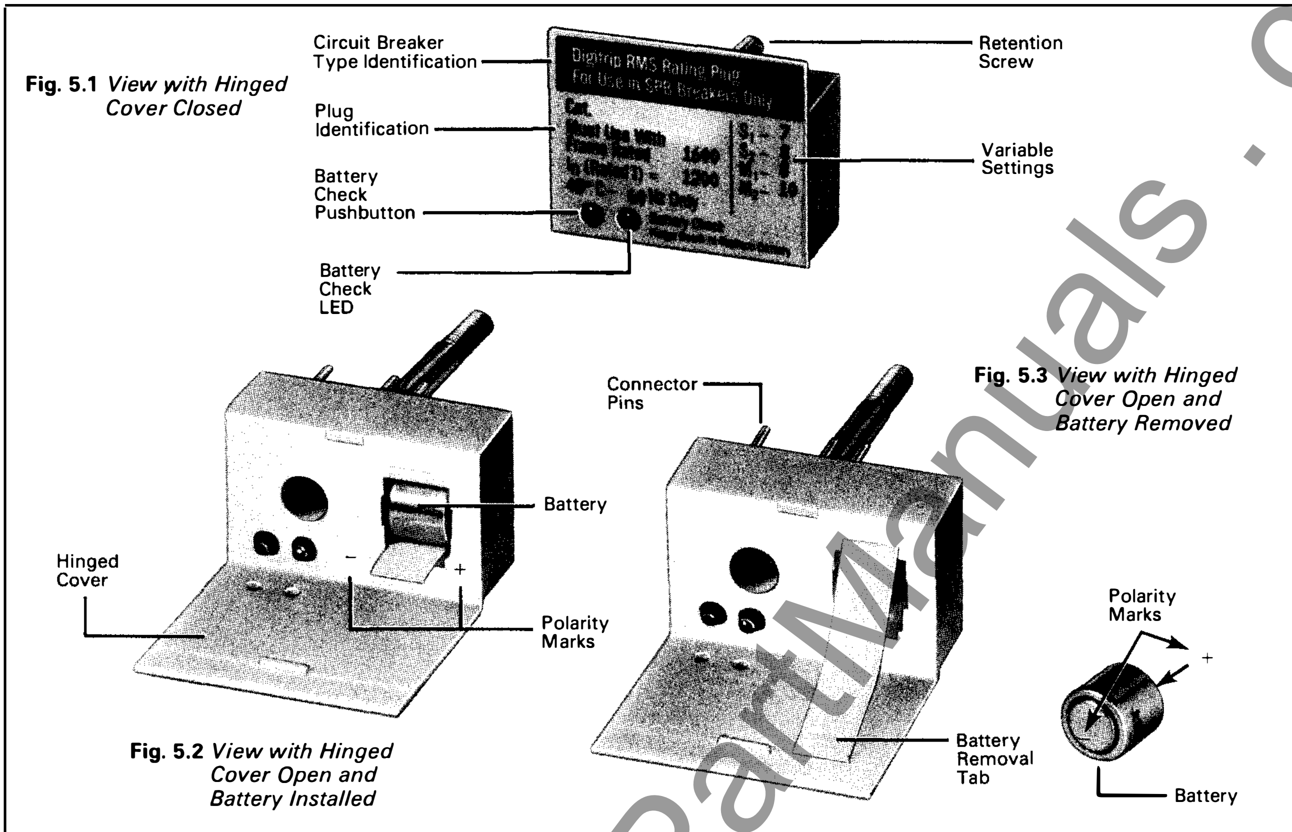


Fig. 5.1 *View with Hinged Cover Closed*

Fig. 5.2 *View with Hinged Cover Open and Battery Installed*

Fig. 5.3 *View with Hinged Cover Open and Battery Removed*

Fig. 5 *Typical Rating Plug*

5.0 Integral Test Panel – Test Procedure

5.1 General

As illustrated in Figs. 1 and 7, an integral test panel is provided to test the Digitrip RMS 600 Trip Unit.

Adequate no-trip settings are provided to insure that the trip unit is operational without tripping the circuit breaker.

CAUTION

THE TRIPPING OF A CIRCUIT BREAKER UNDER "TEST CONDITIONS" WHILE IT IS IN SERVICE AND CARRYING LOAD CURRENT, WHETHER DONE BY INTEGRAL OR EXTERNAL TEST MEANS, IS NOT RECOMMENDED.

ANY SUCH TRIPPING OPERATION WILL CAUSE DISRUPTION OF SERVICE AND POSSIBLE PERSONAL INJURY RESULTING FROM UNNECESSARY SWITCHING OF CONNECTED EQUIPMENT.

Testing of a circuit breaker that results in the tripping of the circuit breaker should be done only with the circuit breaker in the "Test" or "Disconnected" cell positions or while the circuit breaker is on a test bench.

To preserve the primary protection function of the trip unit, all in-service testing under "Trip" or "No-Trip" conditions must be done at load current values no greater than 40% of the plug rating (I_n). Any attempt to conduct in-service testing above this value will be ***automatically aborted** by the trip unit.

Since the Digitrip RMS 600 Trip Unit requires external control power to operate the Power/Relay Module, any in-service testing elected to be done may be conducted without the insertion of the Auxiliary Power Module.

5.2 When to Test

Tests can be conducted with the breaker in the "connected" cell position while carrying load current. However, as stated in the caution note in Section 5.1, good practice will limit circuit breaker in-service "trip tests", where required, to maintenance periods during times of minimum load conditions. Testing, prior to start-up can best be accomplished with the breaker out of its cell or in the "Test", "Disconnect" or "Withdrawn" (or "Removed") cell positions.

Note: Since time-current settings are based on desired system coordination and protection schemes, the protection settings selected and preset under Section 4.0 above should not be altered during or as a part of any routine test sequence.

5.3 Test Provision

As indicated in Fig. 7, six different test settings (1, 2, 3, 6T, 8 and 10 x I_n) are available for testing the phase elements of the trip unit and two (GF, GFT) are provided for testing the ground elements. One setting under each test mode (6T and GFT) will initiate a tripping action of the circuit breaker.

*No abort signal will occur for tests conducted unless the circuit breaker is carrying load current.

With appropriate preset selections of the phase protection settings, an ample range of settings under the "No Trip" condition are available to test the long time, short time and instantaneous trip settings without tripping the circuit breaker.

In the "GF" test position, the amount of test current is adequate to prove the operating condition of the trip unit without tripping the circuit breaker. This is not to be construed as a calibration test. The value of the simulated test current is 1.0 per unit of the rating plug value.

5.4 Mode of Conducting Tests

5.4.1 Control Power

Should the circuit breaker be in the "Disconnected" cell position or withdrawn from its cell entirely, install the Auxiliary Power module (Catalog No. PRTAAPM) to insure control power is available for testing. Should the circuit breaker be in the "Connected" or "Test" position and have control power available to the "Power/Relay" Module, then the Auxiliary Power Module is not required.

5.4.2 By Not Tripping the Breaker

1. Should the circuit breaker be in the cell "Connected" position and carrying load current, make sure that the circuit breaker is carrying no more than 40% of the plug ampere rating.

2. Place the test selector switch in one of the six "No Trip" test settings, i.e., 1, 2, 3, 8, 10, or GF.

3. Depress the "Test" pushbutton and release it – the test is initiated when the pushbutton is released.

4. Should any of the various protection settings be less than the selected "No Trip" test value, then the LED related to that function will turn "On" signifying successful completion of the test action and the time delay value (in seconds) that would have been allowed before initiating the trip will appear in the display window. Operation of the stepping pushbutton between the pointer LED's will not change the time value indicated in the Display Window. **Current** values will not be displayed following "No Trip" tests.

   Note: When a "No Trip" test is in progress the "Display Window" will show the time clock as it counts. The maximum time value that the clock will display is 99.9 seconds. This means for a trip time in excess of 99.9 seconds, the value in the display window will "Roll-Over", i.e., an actual trip time of 125 sec wound read 25.1 (99.9 plus 25.1) sec.

5. Reset the trip unit by depressing and releasing the "Trip Reset" pushbutton provided. All LEDs turned on by the "No Trip" test action should turn "Off". The time delay value in the Display Window will disappear.

Should an actual overload or fault condition occur during an in-service, "No Trip Test" sequence, the protection function will override the test function, and the circuit breaker will trip automatically as pre-programmed with the various Time-Current settings.

Note: The "Trip Reset" pushbutton may be depressed at any time. However, should a test initiated via the integral test panel be in progress, it would be aborted. A test initiated via the integral test panel may be aborted at any time by depressing the "trip reset" pushbutton.

5.4.3 By Tripping the Breaker

1. Make sure that the circuit breaker is carrying no more than 40% of the plug rating (I_n).

2. Place the test selector switch in one of the two "Trip" test settings, i.e., 6T or GFT.

3. Depress the "Test" pushbutton and release it – the test is initiated when the pushbutton is released. With the "Test" pushbutton depressed, the coded message "Test" will appear in the Test Window. When the pushbutton is released, the display window will show the time clock counting.

4. Should any of the various protection settings be less than the selected "Trip" test value, the circuit breaker will trip and the LED related to that function will turn on following the test action and a coded message will appear in the display window.

5. Depress the Step Pushbutton (twice for a LDT Test). The coded message will disappear and if the pointer LED is on I_A for "6T" or I_G for "GFT" the value of test current (in kA) that initiated the trip action will be displayed. If the pointer LED is on other than I_A for "6T" or I_G for "GFT", depress the Step Pushbutton until the position of the pointer LED is in the appropriate position.

   Trip Time values will not be displayed in the "Trip" test positions.

6. Reset the trip unit by depressing and releasing the "Trip Reset" pushbutton. All LEDs turned on resulting from the "Trip" test action should turn off. The value of trip current in the Display Window will disappear. If the pointer LED is not on I_A, it will return to I_A.

7. Reset and reclose the circuit breaker per established operating procedures.

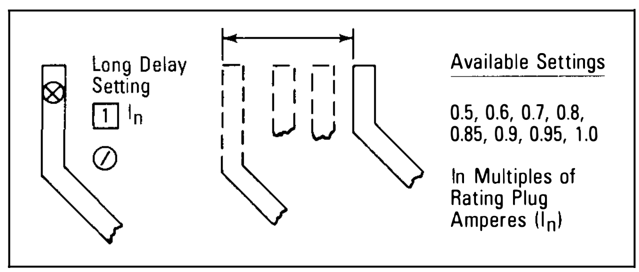


Fig. 6.1 *Long Delay Ampere Pickup Settings*

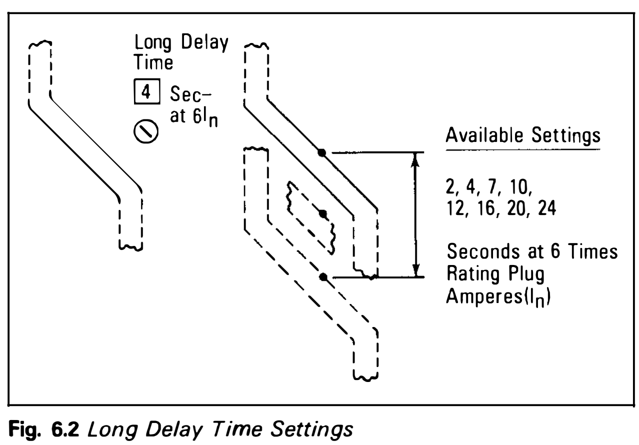


Fig. 6.2 *Long Delay Time Settings*

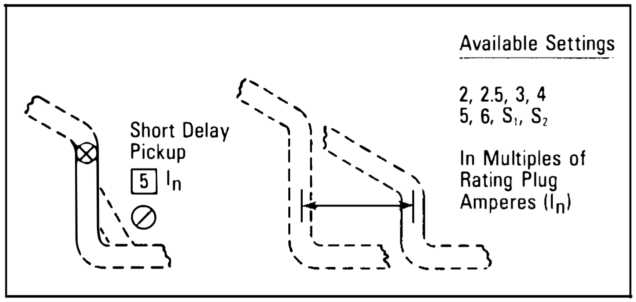


Fig. 6.3 *Short Delay Current Pickup Settings*

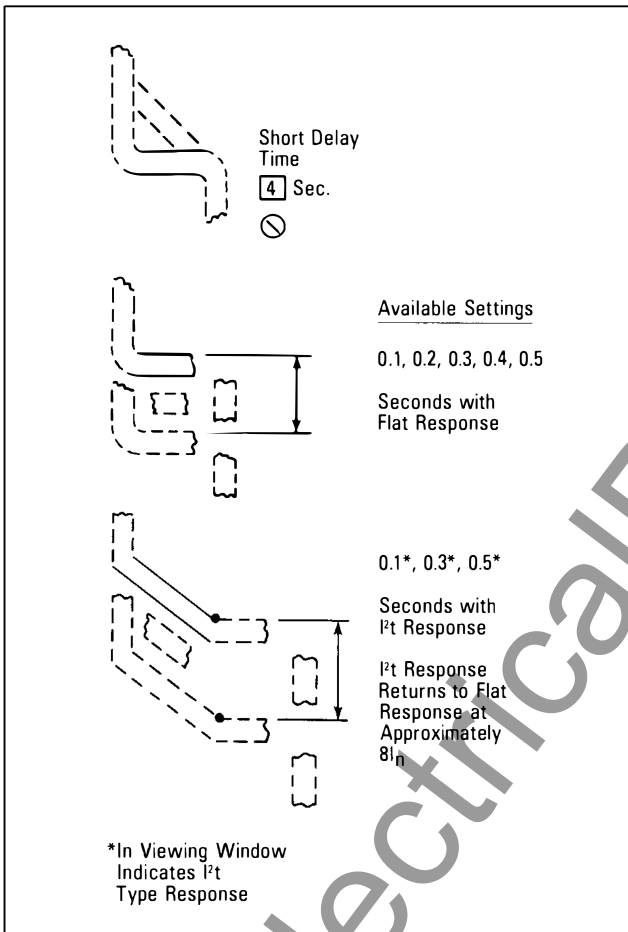


Fig. 6.4 *Short Delay Time Settings*

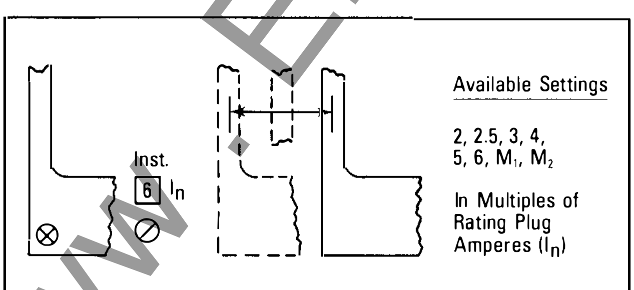


Fig. 6.5 *Instantaneous Current Pickup Settings*

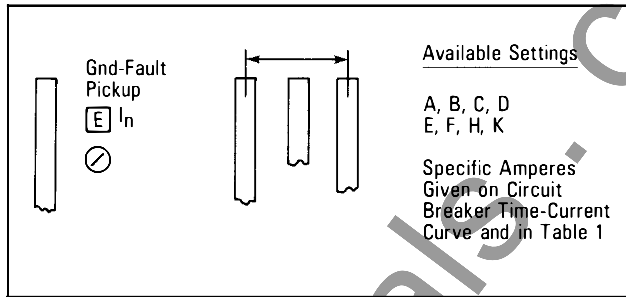


Fig. 6.6 *Ground Fault Current Pickup Settings*

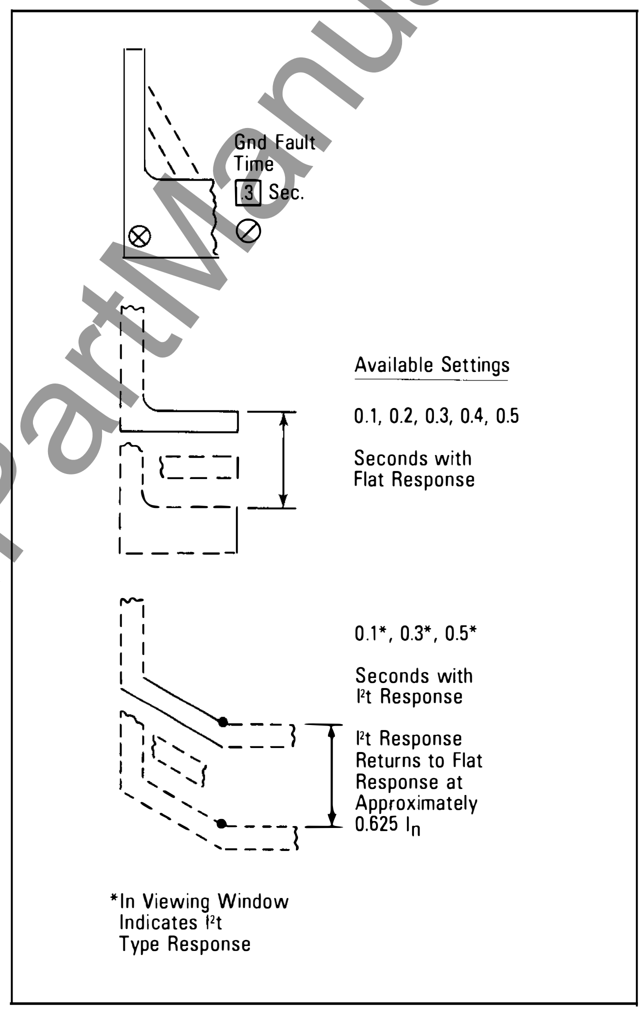


Fig. 6.7 *Ground Fault Time Delay Settings*

6.0 Back-up Battery

6.1 General

As indicated in Figs. 3 and 5, a back-up battery is provided to maintain the mode of trip LED indication in the Digitrip RMS 600 Trip Unit when external control power to the Power/Relay module is not available. The back-up battery is located in the rating plug along with a battery check pushbutton and green battery check LED.

6.2 Battery Check

The battery is a long life, lithium photo type unit. The ready status of the battery can be checked at any time by depressing the battery check pushbutton and observing the "On" condition of the battery check LED as shown in Fig. 5.1. If the battery check LED does not turn "On", replace the battery.

6.3 Battery Replacement

Should the battery require replacement, it can be easily replaced from the front of the trip unit by lowering the hinged cover of the rating plug as shown in Fig. 5.2. The battery can then be removed by pulling the battery tab as shown in Fig. 5.3.

> **Note:** The battery can be replaced at any time with the circuit breaker in service without affecting the operation of the circuit breaker and its protection function.

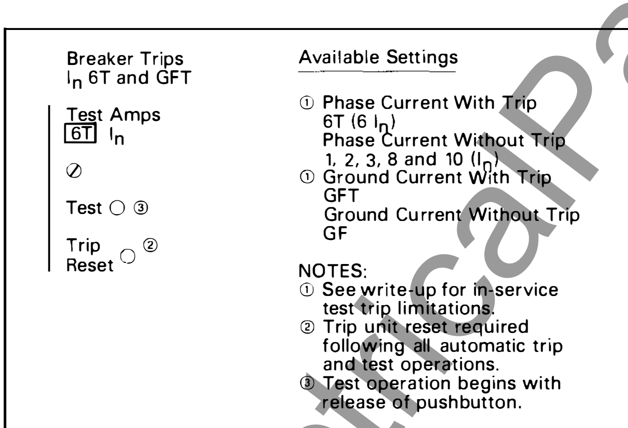


Fig. 7 *Integral Test Panel*

The replacement battery should be the same type or equivalent. Acceptable 3.0 volt lithium batteries may be obtained from the following companies under their type designation indicated:

Company	Model
Varta Batteries, Inc. 150 Clarbrook Road Elmsford, N.Y. 10523	CR 1/3N
Duracell South Broadway Tangtown, N.Y. 10591 (914) 591-7000	DL 1/3N
Union Carbide Corp. Battery Products Div. Eveready 39 Old Ridgebury Road Danbury, CT 06817-0001 (203) 794-7548	2L-76BP

Note: Care should be exercised when replacing a battery to insure that the correct polarities are observed. Polarity markings are shown on the rating plug when the hinged cover is open as indicated in Figs. 5.2 and 5.3.

7.0 Auxiliary Power Module

The Auxiliary Power Module (Catalog No. PRTAAPM), illustrated in Fig. 8, is an encapsulated power supply that requires a 120 Vac input at either 50 or 60 Hz. It provides an output of 32 Vdc (nominal 40 Vdc open circuit) which can be used for testing a Digitrip RMS 600 Trip Unit.

When drawout construction is provided, any circuit breaker equipped with a Digitrip RMS 600 Trip Unit can be conveniently set and tested while the circuit breaker is out of its cell or in its cell in the "Disconnect" or "Withdrawn" positions using the Auxiliary Power Module.

The Auxiliary Power Module is equipped with a unique plug-in connector suitable only for plugging into the keyed receptacle of a Digitrip RMS Trip Unit. This prohibits the possible use of an incorrect, but similar, type power module. The location of the keyed receptacle for the Auxiliary Power Module is shown in Fig. 1.

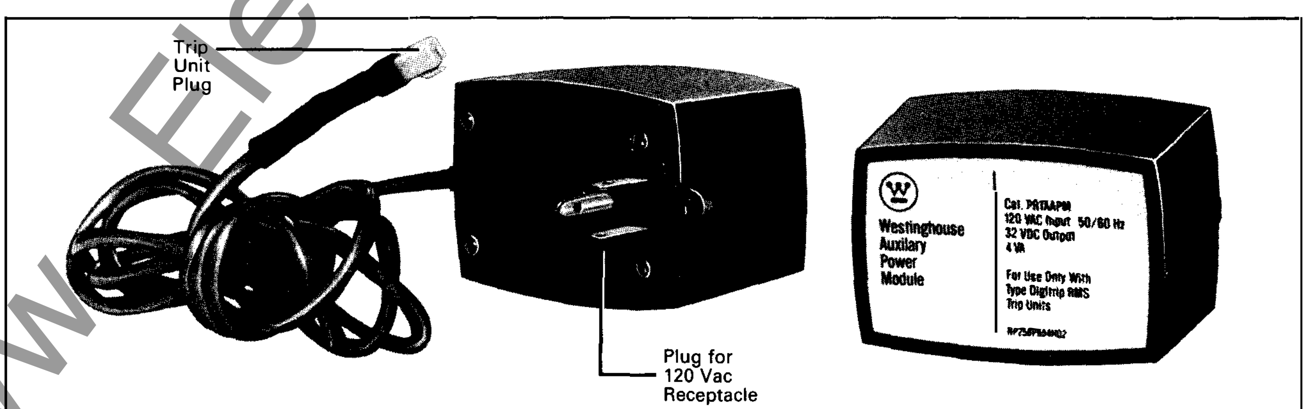


Fig. 8 *Auxiliary Power Module*

8.0 Rating Plug

The rating plugs, as illustrated in Figs. 1 and 5, are used to establish the continuous ampere rating of the related circuit breaker. All pick-up settings of the protection functions of the trip unit, i.e., long delay, short delay, and instantaneous and ground fault are selected as a multiple of the rating plug ampere rating (I_n).

Different types and ratings are available to match the desired ampere rating and type of circuit breaker into which the trip unit is to be installed. Also, since the rating plugs are frequency sensitive, specific types are available for 50 or 60 Hz system applications.

Complete catalog descriptions of all available rating plugs are given in the applicable circuit breaker supplementary instruction leaflets. References to these documents are given in Sections 9.1 and 9.2.

9.0 References

9.1 Type DS Low Voltage Ac Power Circuit Breakers

I.B. 33-790-1F	Instructions for Low-Voltage Power Circuit Breakers Types DS and DSL
I.B. 33-790-1F Supplement No. 1	Section 8A Supplement Circuit Breaker Automatic Tripping System When Using Digitrip RMS Trip Assembly
SC-4280-87	Typical Time-Current Characteristic Curve (LI) for Type DS Circuit Breakers
SC-4281-87	Typical Time-Current Characteristic Curve (LS) for Type DS Circuit Breakers
SC-4279-87	Typical Time-Current Characteristic Curve (G) for Type DS Circuit Breakers
508B508	Connection Diagram for Type DS Circuit Breakers

9.2 Type SPB Systems Pow-R Breakers

I.L. 29-801	Instruction for the Systems Pow-R Breaker and Drawout Mechanism
I.L. 29-855	Supplementary Instructions for the Systems Pow-R Breaker used with the Digitrip RMS Trip Assembly
SC-4283-87	Typical Time-Current Characteristic Curve (LI) for Type SPB Systems Pow-R Breaker
SC-4284-87	Typical Time-Current Characteristic Curve (LS) for Type SPB Systems Pow-R Breaker
SC-4282-87	Typical Time-Current Characteristic Curve (G) for Type SPB Systems Pow-R Breaker
I.S. 15545	SPB Master Connection Diagram using Digitrip RMS Trip Assemblies

9.3 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

9.4 Series C R-Frame Molded Case Circuit Breakers

29-106	Framebook
29C107	Frame Instruction Leaflet
29-707	Supplement Instructions for Series C R-Frame used with Digitrip RMS Trip Assembly
SC-4582-89	Typical Time-Current Characteristic Curve (LI) for Type RD Circuit Breakers
SC-4583-89	Typical Time-Current Characteristic Curve (LS) for Type RD Circuit Breakers
SC-4584-89	Typical Time-Current Characteristic Curve (G) for Type RD Circuit Breakers
I.L. 29C709	Master Connection Diagram for Series C R-Frame Circuit Breaker with Digitrip RMS

Westinghouse Electric Corporation
Distribution and Control Business Unit
Electrical Components Division
Pittsburgh, PA 15220

Style No. 6615C97H01