

Instructions for Digitrip RMS 310 Trip Unit For Use with R-Frame Breakers

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The recommendations and information contained herein are based on Cutler-Hammer 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 Cutler-Hammer for further information or instructions.

1.0 GENERAL INFORMATION

1.1 Protection

The Digitrip RMS 310, illustrated in Figure 1, is an electronic trip unit that incorporates a microprocessor-based custom application specific integrated circuit design for use with R-Frame Molded Case Circuit Breakers.

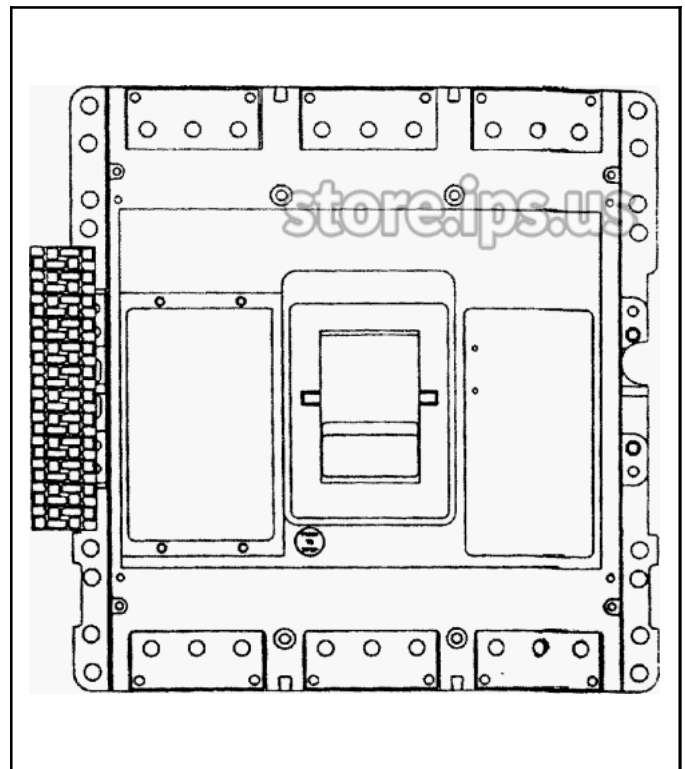


Fig. 1 Digitrip RMS 310 Trip Unit for use with R-Frame Circuit Breakers

The Digitrip RMS 310 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.



WARNING

DO NOT ATTEMPT TO INSTALL OR PERFORM MAINTENANCE ON EQUIPMENT WHILE IT IS ENERGIZED. DEATH, SEVERE PERSONAL INJURY, OR SUBSTANTIAL PROPERTY DAMAGE 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 CUTLER-HAMMER 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 Digitrip RMS 310 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.

Digitrip RMS 310 Trip Units are suitable for 50/60 Hz AC applications only.

The Digitrip RMS 310 Trip Unit is available in 4 different types. Each trip unit contains a fixed long delay time function (adjusted by changing the rating plug), and may be equipped with a maximum of two phase and two ground (time-current) adjustments to meet specific application requirements. The types of adjustments available for each model include the following, which are illustrated in Figures 3.1 through 3.4.

Adjustment	Type	Refer to Figure
1) Short Delay Pick-up	RESxxxxLS	3.1
2) Short Delay (Inst.) Pick-up/Short Delay Time	RESxxxxLSI	3.2
3) Short Delay Pick-up/ Ground Fault Pick-up/ Ground Fault Time	RESxxxxLSG	3.3
4) Short Delay (Inst.) Pick-up/Short Delay Time/Ground Fault Time	RESxxxxLSIG	3.4

1.2 Testing

Test points (Figs. 3.1 through 3.4) are provided for functional field testing of the trip unit when connected to a test kit (Catalog No. STK2).

2.0 UL LISTED DEVICES

The Digitrip RMS 310 Trip Unit is listed in accordance with Underwriters Laboratories, Inc. Standard UL 489, under file E7819 and satisfies the applicable requirements of the International Electrotechnical Commission (IEC) recommendations for molded case circuit breakers.

3.0 PRINCIPLE OF OPERATION

In open air at 40°C, an R-Frame circuit breaker with a Digitrip RMS 310 Trip Unit installed will carry continuously up to 1600,2000, or 2500 amperes without exceeding a 50°C rise at the terminals. The calibration of

the trip unit is insensitive to ambient temperatures over a range of -20° to +55°C. However, the trip unit contains thermal temperature protective circuitry that initiates a trip operation for self-protection if the internal ambient temperature at the printed circuit board (PCB) reaches approximately 100°C. This may occur for open-air temperatures above 40°C with circuit breaker currents near full load.

For ambient conditions above 40°C and where the maximum ampere rating plug has been installed, derating of the circuit breaker frame should be considered to avoid exceeding a safe terminal temperature operating range. Consult Cutler-Hammer for recommendations.

3.1 General

The Digitrip RMS 310 Trip Unit provides a tripping signal to the flux transfer shunt trip when current and time delay settings are exceeded. This is accomplished by employing the Cutler-Hammer custom designed integrated circuit *Sµre™* chip, which includes a microcomputer to perform its numeric and logic functions.

In the Digitrip RMS 310 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 currents from these sensors provide the correct input information for the protection functions, as well as tripping power, whenever the circuit breaker is carrying current. These current signals develop voltages across the appropriate calibrating resistors.

The microcomputer, in cyclic fashion, repeatedly scans the voltage values across each calibrating resistor and enters these values into memory. These data are used to calculate true RMS current values, which are then repeatedly compared with the protection function settings and other operating data stored in memory. The software program then determines whether to initiate protection functions, including tripping the breaker through the flux transfer shunt trip device in the circuit breaker.

A green status light indicates the operational status of the trip unit. If the load current through the circuit breaker exceeds approximately 20% of the maximum current rating of the trip unit, the status light will blink on and off once each second. A blinking status light is an indication of a properly functioning trip unit. If the status light is not blinking, the current through the breaker may be less than 20% of the maximum current rating of the trip unit

If the current exceeds 20% and the status light is not blinking, use the STK2 test kit to investigate. IF THE STATUS LIGHT IS ON STEADY, IT INDICATES A TRIP IS PENDING.

**CAUTION**

LACK OF ILLUMINATION OF THE STATUS LED DOES NOT INDICATE THE TERMINALS OF THE BREAKER ARE DE-ENERGIZED

3.2 Overload Trip: In accordance with standards requirements, the trip unit initiates a trip of the circuit breaker within two hours for an overload of 135 percent, and will trip in less time for higher overload currents.

A “Thermal Memory” effect prevents the breaker from being re-energized immediately after an overload trip. A “cooling off” period of up to 5 minutes is required, which allows time for cabling to cool off.

3.3 Short Delay/Instantaneous Trip: For short circuit conditions that exceed the short delay pick-up settings, the trip unit initiates a trip after a delay prescribed by the I^2t ramp function for trip units with catalog number suffixes LS and LSG. A flat response time delay action is provided by trip units with catalog number suffixes LSI and LSIG unless the instantaneous (I) setting is selected.

3.4 Ground Fault Protection: When selected, ground fault pickup and time delay settings shown in Table 1-2 allow selective ground fault coordination with other circuit protection devices.

An optional Automatic Trip Relay (ATR) may be furnished with the circuit breaker and is mounted underneath the trip unit as illustrated in Figure 4. The ATR provides a contact closure when a ground fault trip occurs. The connections required are shown in I.L. 29C714.

4.0 PROTECTION SETTINGS

4.1 General

Prior to placing any circuit breaker in operation, each trip unit protection setting must be set to the values specified by the engineer responsible for the installation. The available settings along with the effect of changing the settings are illustrated in Figures 2.1 to 2.4.

The installed rating plug establishes the maximum continuous current rating (I) of the circuit breaker. Short delay current settings are defined in multiples of I. Over-ride is set at 17,500A.

One to four time and pick-up adjustment settings are available depending on the particular trip unit purchased. An eight position rotary switch is provided for each setting. The rotary switch is adjusted using a small flatblade screwdriver. The selected setting for each adjustment will

appear in a small rectangular window in the trip unit above the switch.

4.2 Short Delay Pick-up Setting

Seven settings are available that range from 2 to 8 (I) as shown in Figure 2.1. This feature is included on all Digitrip RMS 310 Trip Units. Settings 7 and 8 are available on 2500A styles.

4.3 Short Delay Time Settings

For catalog numbers RES1600LS, RES2000LS, RES2500LS, RES1600LSG, RES2000LSG, and RES2500LSG, the short time delay is an I^2t ramp configuration with the actual time delay a function of the trip current involved.

For catalog numbers RES1600LSI, RES2000LSI, RES2500LSI, RES1600LSIG, RES2000LSIG, and RES2500LSIG,

Four settings (I, 0.1, 0.2, 0.3 second) are available (see Figure 2.2). The “I” setting gives a trip response with no intentional delay (Instantaneous).

4.4 Instantaneous Pickup Setting

For catalog numbers RES1600LSI, RES2000LSI, RES2500LSI, RES1600LSIG, RES2000LSIG, and RES2500LSIG, Instantaneous Pickup is achieved by setting Short Delay Time to “I” (Instantaneous.) Short Delay Pickup (see paragraph 4.2) then becomes Instantaneous Pickup.

4.5 Ground Fault Pick-up Setting

Eight settings lettered A through K (there is no setting marked “G”) are available (see Figure 2.3) and correspond to the fixed ampere values listed on the trip unit nameplate and in Table 1.2.

Note: These ampere values are always the same no matter what rating plug is installed in the circuit breaker.

Available on Catalog Nos. RES1600LSG, RES2000LSG, RES2500LSG, RES1600LSIG, RES2000LSIG, and RES2500LSIG.

4.6 Ground Fault Time Settings

The ground fault time delay is a flat response with four settings (I, 0.15, 0.3, 0.5 second) available (Figure 2-4). The I setting gives a trip response with no intentional delay (Instantaneous). This option is available on Catalog Nos. RES1600LSG, RES2000LSG, RES2500LSG, RES1600LSIG, RES2000LSIG, and RES2500LSIG.

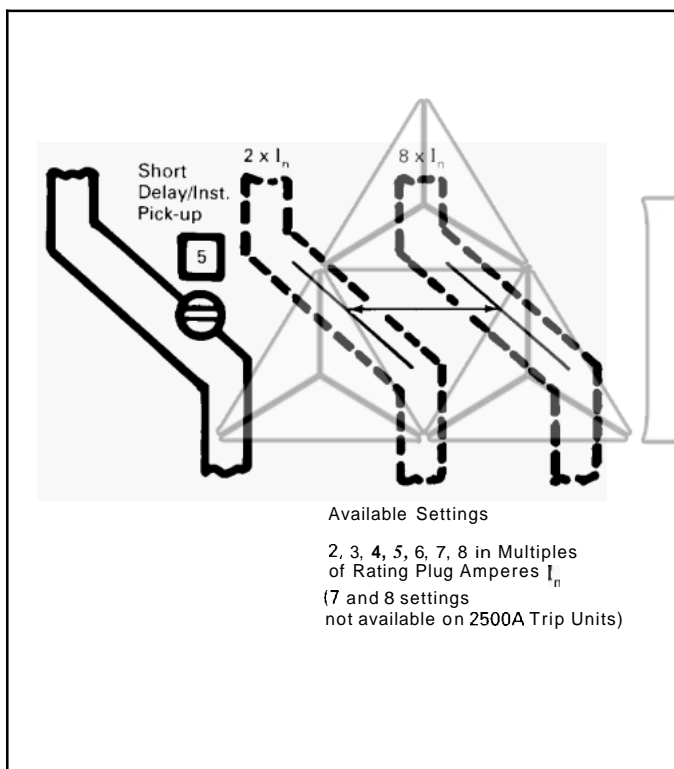


Fig. 2-1 Short Delay/Instantaneous Pick-Up Settings

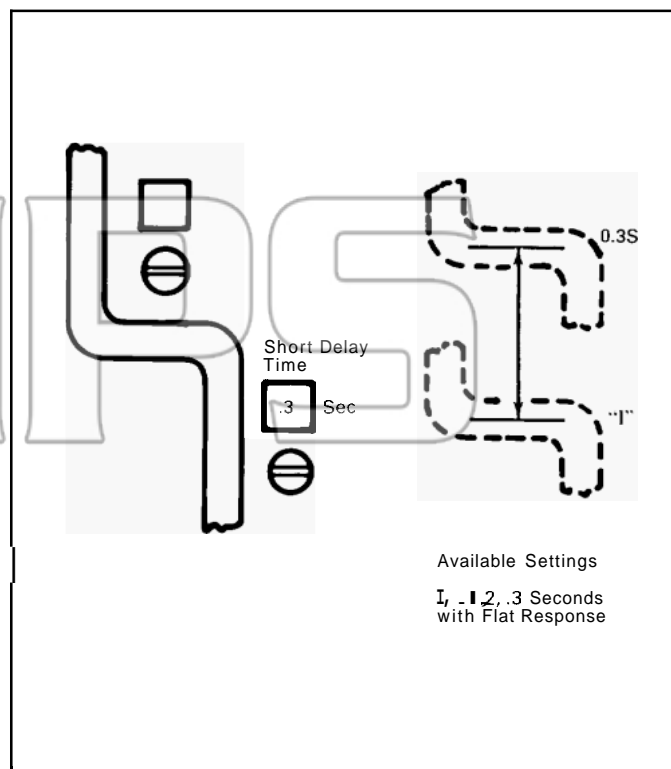


Fig. 2-2 Short Delay Time Settings

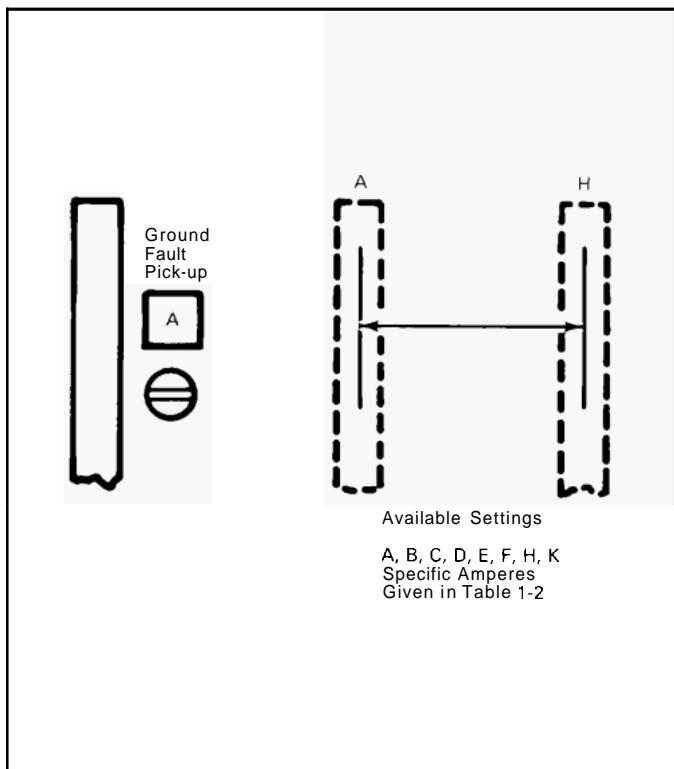


Fig. 2-3 Ground Fault Pick-Up Settings

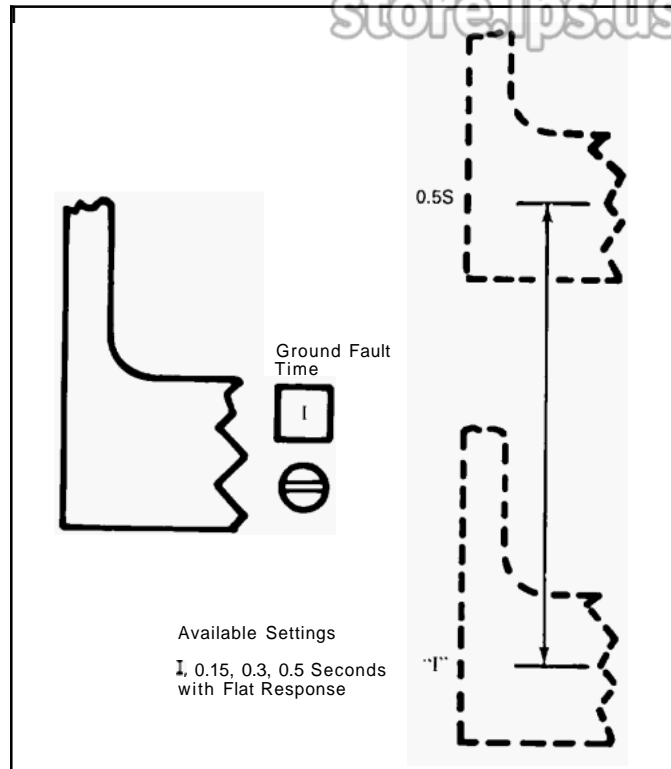


Fig. 2-4 Ground Fault Time Settings

5.0 TESTING

A test receptacle is built into each trip unit to allow use of the STK2 Test Kit. The Test Kit performs a test of the Long Delay, Short Delay and Ground Fault functions.

6.0 FRAME RATINGS AND RATING PLUGS

The **Frame Rating** of a circuit breaker is the maximum RMS current it can carry continuously. The maximum Short-circuit Current Ratings of the circuit breaker are usually related to the Frame Rating as well.

It is often desirable to be able to choose a current value (I_n), less than the full frame rating, to be the basis for the coordination of the circuit breaker's protection functions, without affecting its short-circuit current capability. For the Digitrip 310 Trip Unit this is implemented by changing the **Rating Plug**.

For Adjustable Rating Plugs, Table 1-2, the primary current carrying conductors used with the breaker must be sized to correspond with the maximum setting of the rating plug, in accordance with National Electric Code requirements.

The **Rating Plug** (See Fig. 5.2) fits into a special cavity to complete the trip unit.

The **Rating Plug** current rating, (I_n), is the basis for the trip unit current settings:

- 1) The long delay protection function of the trip unit is set at I_n .
- 2) The short delay pick-up setting is a multiple of I_n .
- 3) The ground pick-up setting is independent of I_n .

Rating Plugs for the Digitrip RMS 310 Trip Units are marked for and may be applied on both 50 and 60 Hz Systems.

Complete catalog descriptions of all available rating plugs are given in the applicable circuit breaker supplementary instruction leaflets (see Section 7.0).

7.0 REFERENCES

7.1 Digitrip RMS Trip Assemblies

I.L. 29C883	Instructions for Digitrip RMS 310 Trip Unit
I.L. 29-885	Instructions for Digitrip RMS 510 Trip Unit
I.L. 29-886	Instructions for Digitrip RMS 610 Trip Unit
I.L. 29-888	Instructions for Digitrip RMS 810 Trip Unit

7.2 R-Frame Molded Case Circuit Breakers

29-107	Frame Instruction Leaflet
29C713	Supplementary Instructions for R-Frame used with Digitrip RMS Trip Units
AD29-167R	Typical Time-Current Characteristic Curve for R-Frame Circuit Breakers
I.L. 29C714	Master Connections Diagram for R-Frame Circuit Breaker with Digitrip RMS Trip Units

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DANGER

BEFORE YOU FIT THE RATING PLUG INTO THE TRIP UNIT, BE SURE TO CHECK THAT THE BREAKER TYPE AND FRAME RATING, MATCH THOSE PRINTED ON THE RATING PLUG COVER.

INSTALLING A RATING PLUG THAT DOES NOT MATCH THE BREAKER TYPE AND FRAME RATING, CAN PRODUCE SERIOUS MISCOORDINATION AND/OR FAILURE OF THE PROTECTION SYSTEM.

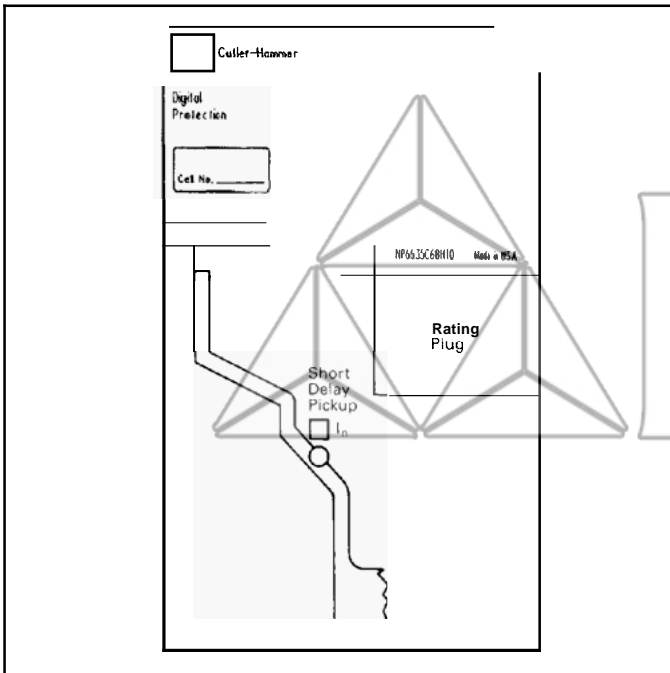


Fig. 3-1 Trip Unit Nameplate Catalog Nos. RES1600LS, RES2000LS, and RES2500LS

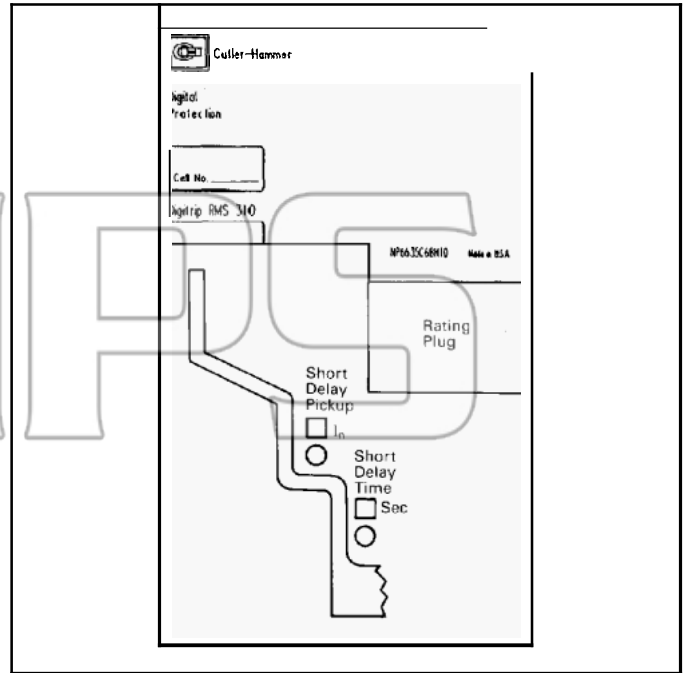


Fig. 3-2 Trip Unit Nameplate Catalog Nos. RES1600LSI, RES2000LSI, and RES2500LSI

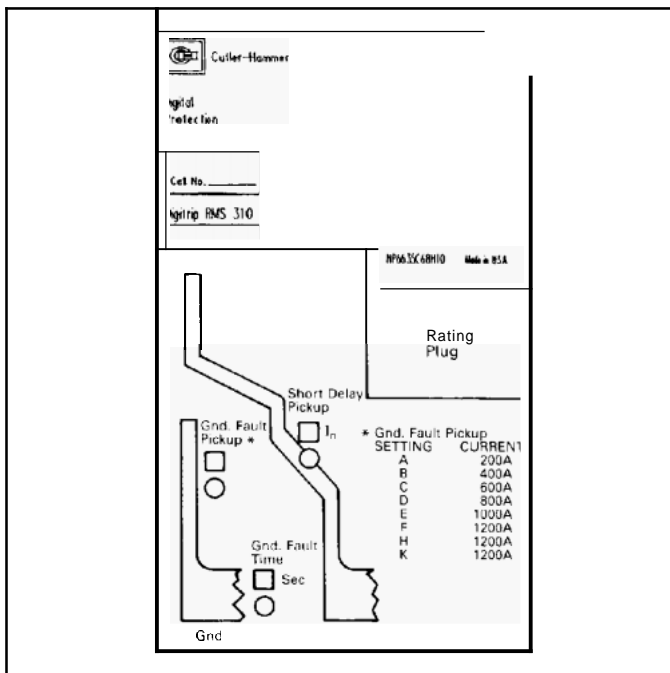


Fig. 3-3 Trip Unit Nameplate Catalog Nos. RES1600LSG, RES2000LSG, and RES2500LSG

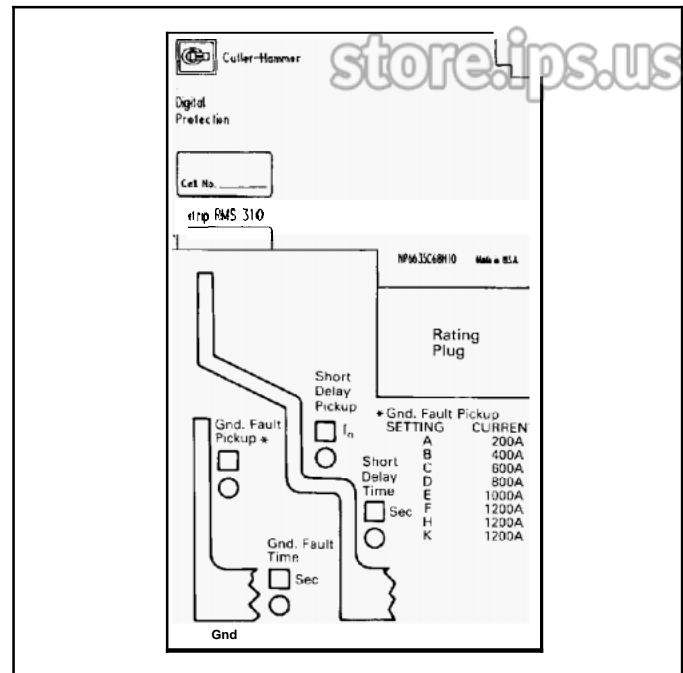


Fig. 3-4 Trip Unit Nameplate Catalog Nos. RES1600LSIG, RES2000LSIG, and RES2500LSIG

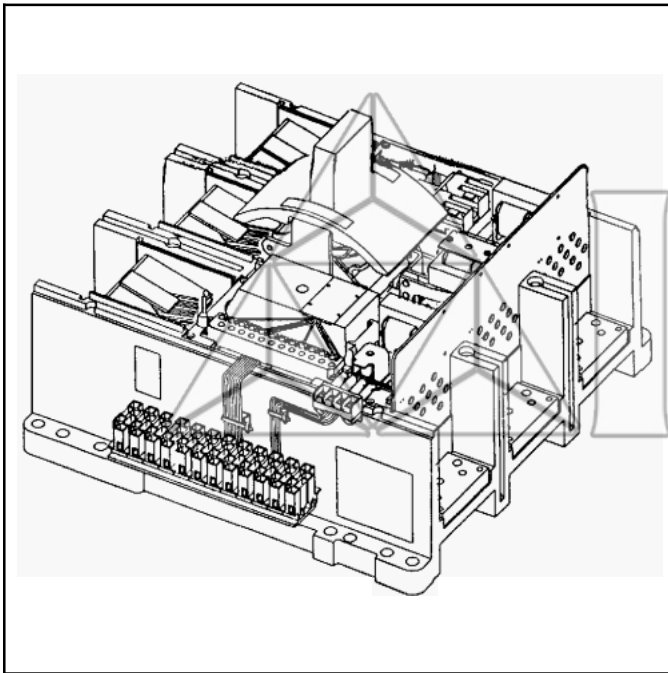


Fig. 4 Ground Fault Breaker with Cover Removed

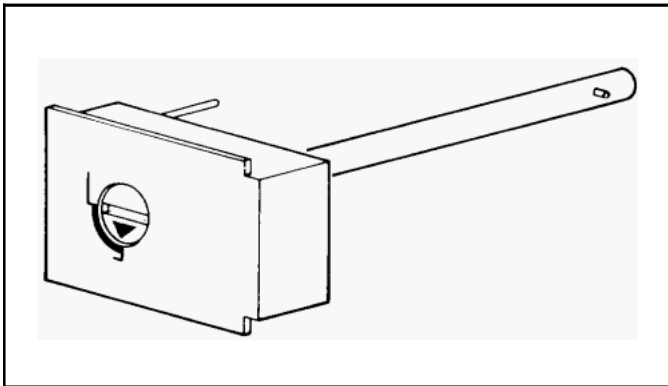


Fig. 5-2 Typical Rating Plug

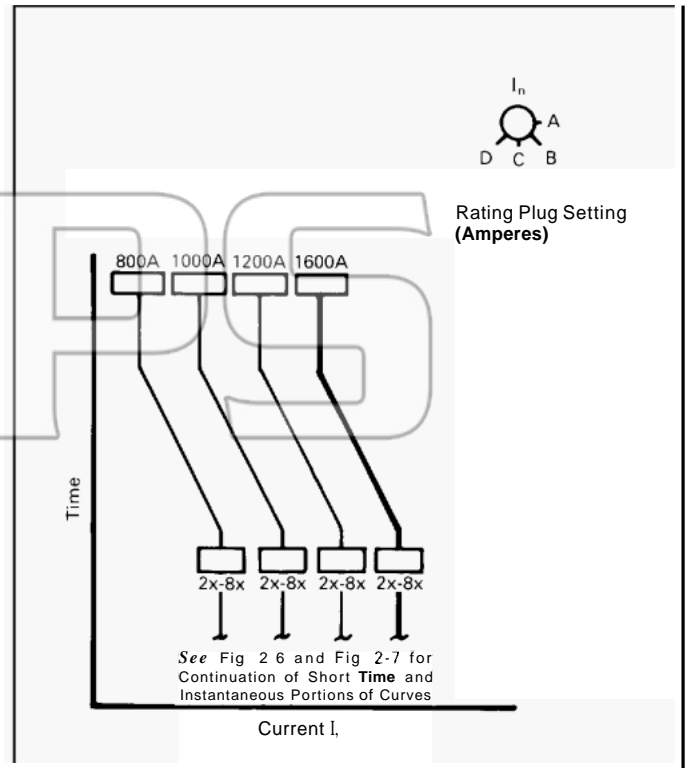


Fig. 5-1 Optional Adjustable Ampere Setting Rating Plug Used in the Digitrip RMS 310 Trip Unit

Table 1-1. Digitrip Rms 310 Trip Unit Types

Frame Rating	1600 amps 2000 amps 2500 amps	Digitrip RMS 310 Trip Unit Type Catalog Numbers			
		RES1600LS	RES1600LSI	RES1600LSG	RES1600LSIG
		RES2000LS	RES2000LSI	RES2000LSG	RES2000LSIG
		RES2500LS	RES2500LSI	RES2500LSG	RES2500LSIG
Trip Unit Functions: Long Delay	Fixed Ampere Rating ^① with Fixed Long Delay	x	x	x	x
	Adjustable Ampere Setting with Fixed Long Delay ^②	x	x	x	x
Short Delay	Adjustable Short Delay Pick-up with Short Delay Time I ² t Ramp	x		x	
	Adjustable Short Delay Time ^③ with Adjustable Short Delay Pick-up, or		x		x
	Adjustable Instantaneous Pick-up ^③		x		x
Instantaneous	Fixed Instantaneous (Override) ^④	x	x	x	x
Ground Fault	Adjustable Ground Fault Pick-up with Adjustable Ground Fault Time			x	x

- ① Fixed rating plugs available, see Table 1-2.
- ② Optional four-setting adjustable rating plugs available, see Table 1-2.
- ③ Using trip unit with adjustable short delay time (LSI, LSIG), instantaneous pick-up is achieved when the lowest time delay setting (I) is selected.
- ④ A nonadjustable override setting is set at the frame withstand rating.

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Table 1-2. Digitrip RMS 310 Trip Unit Trip Function and Rating Settings

Trip Function	Rating/Setting Description								
Ampere Rating Fixed at 100%	Fixed rating plugs available:								
	<table border="1"> <thead> <tr> <th>Trip Unit Ampere Rating</th> <th>Fixed Rating Plugs</th> </tr> </thead> <tbody> <tr> <td>1600A</td> <td>800A, 1000A, 1200A, 1250A^①, 1400A, 1500A^①, 1600A (I_n)</td> </tr> <tr> <td>2000A</td> <td>1000A, 1200A, 1250A^①, 1400A, 1600A, 2000A (I_n)</td> </tr> <tr> <td>2500A</td> <td>1200A, 1250A^①, 1600A, 2000A, 2500A (I_n)</td> </tr> </tbody> </table>	Trip Unit Ampere Rating	Fixed Rating Plugs	1600A	800A, 1000A, 1200A, 1250A ^① , 1400A, 1500A ^① , 1600A (I _n)	2000A	1000A, 1200A, 1250A ^① , 1400A, 1600A, 2000A (I _n)	2500A	1200A, 1250A ^① , 1600A, 2000A, 2500A (I _n)
	Trip Unit Ampere Rating	Fixed Rating Plugs							
	1600A	800A, 1000A, 1200A, 1250A ^① , 1400A, 1500A ^① , 1600A (I _n)							
2000A	1000A, 1200A, 1250A ^① , 1400A, 1600A, 2000A (I _n)								
2500A	1200A, 1250A ^① , 1600A, 2000A, 2500A (I _n)								
Adjustable Long Delay Pick-up	Adjustable rating plugs available:								
<table border="1"> <thead> <tr> <th>Trip Unit Ampere Rating</th> <th>Adjustable Rating Plugs</th> </tr> </thead> <tbody> <tr> <td>1600A</td> <td>800A, 1000A, 1200A, 1600A (I_n) 800A, 1000A, 1250A, 1600A^① (I_n)</td> </tr> <tr> <td>2000A</td> <td>1000A, 1200A, 1600A, 2000A (I_n) 1000A, 1250A, 1600A, 2000A^① (I_n)</td> </tr> <tr> <td>2500A</td> <td>1200A, 1600A, 2000A, 2500A (I_n) 1250A, 1600A, 2000A, 2500A^① (I_n)</td> </tr> </tbody> </table>	Trip Unit Ampere Rating	Adjustable Rating Plugs	1600A	800A, 1000A, 1200A, 1600A (I _n) 800A, 1000A, 1250A, 1600A ^① (I _n)	2000A	1000A, 1200A, 1600A, 2000A (I _n) 1000A, 1250A, 1600A, 2000A ^① (I _n)	2500A	1200A, 1600A, 2000A, 2500A (I _n) 1250A, 1600A, 2000A, 2500A ^① (I _n)	
Trip Unit Ampere Rating	Adjustable Rating Plugs								
1600A	800A, 1000A, 1200A, 1600A (I _n) 800A, 1000A, 1250A, 1600A ^① (I _n)								
2000A	1000A, 1200A, 1600A, 2000A (I _n) 1000A, 1250A, 1600A, 2000A ^① (I _n)								
2500A	1200A, 1600A, 2000A, 2500A (I _n) 1250A, 1600A, 2000A, 2500A ^① (I _n)								
Short Delay Pick-up (Adjustable)	In multiples of installed rating plug amperes (I _n) with marks at 2-3-4-5-6-7-8x ^③								
Short Delay Time (Fixed)	I ² t ramp configuration								
Short Delay Time (Adjustable)	Flat response with time delay settings at 0.1 sec, 0.2 sec, and 0.3 sec								
Instantaneous Pick-up ^②	In multiples of installed rating plug amperes (I _n) with marks at 2-3-4-5-6-7-8x ^③								
Ground Fault Pick-up (Adjustable)	Settings A=200A, B=400A, C=600A, D=800A, E=1000, F, H, K=1200A								
Ground Fault Time Delay	Settings at instantaneous (I), 0.15 sec, 0.3 sec, and 0.5 sec								

- ① Not UL Listed
- ② Occurs with short delay time adjustment set at I.
- ③ 7x and 8x settings not available for 2500A frame.

NOTES



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NOTES



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