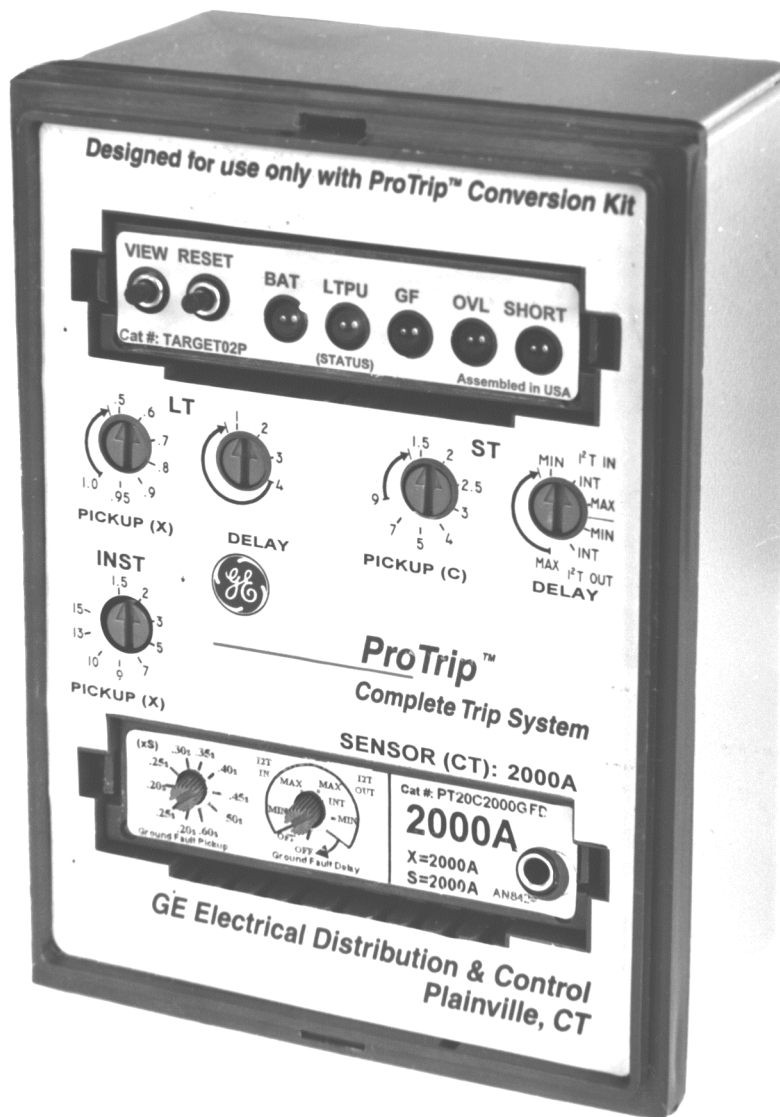


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ProTrip™ Trip Units

for Low-Voltage Power Circuit Breakers

User's Guide



Getting Started

Example

Code	Description	Function
PK### PIK## PD### PSL##	GE AK Breaker I-T-E® Breaker Westinghouse® Breaker Allis-Chalmers® Breaker	Breaker Family
D	ProTrip Trip Unit	
3	3-Wire	
F	Fixed Cts	
01 02 06 08 16 20 32 40	150 A 225 A 600 A 800 A 1600 A 2000 A 3200 A 4000 A	Installed CT
08	Long-Time , Short-Time, Instantaneous, Switchable Ground-Fault	
R	Replacement unit	Ordered as Replacement

- GE AK-50 circuit breaker
- ProTrip Trip Unit
- 3-wire breaker
- Fixed CT sensors
- 1600 A CT installed
- Long-time, short-time, instantaneous, and switchable ground-fault overcurrent protection
- Trip Unit was ordered as a replacement

DEH-40034

WARNINGS, CAUTIONS, AND NOTES AS USED IN THIS PUBLICATION

WARNINGS

Warning notices are used in this publication to emphasize that hazardous voltages, currents, or other conditions that could cause personal injury or death are present in this equipment or may be associated with its use.

Warning notices are also used for situations in which inattention or lack of equipment knowledge could cause either personal injury or damage to equipment.

CAUTIONS

Caution notices are used for situations in which equipment might be damaged if care is not taken.

NOTES

Notes call attention to information that is especially significant to understanding and operating the equipment.

This document is based on information available at the time of its publication. While efforts have been made to ensure accuracy, the information contained herein does not cover all details or variations in hardware and software, nor does it provide for every possible contingency in connection with installation, operation, and maintenance. Features may be described herein that are not present in all hardware and software systems. GE Industrial Systems assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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Chapter 1. Introduction

1-1 Applications.....	1
1-2 General	1
1-3 Trip Unit Functions	1
1-4 Trip Unit Catalog Numbers.....	2
1-5 Rating Plugs	3
Ground-Fault Protection	4
1-6 Equipment Interfaces.....	4
1-7 Trip Unit Information.....	4
Trip Unit Label Information	4
Selector Switches.....	4

Chapter 2. Trip Unit Setup

2-1 Overview	5
2-2 Long-Time Pickup	5
2-3 Long-Time Delay	5
2-4 Short-Time Pickup	6
2-5 Short-Time Delay	6
2-6 Instantaneous Pickup.....	6
2-7 Ground-Fault Pickup.....	7
2-8 Ground-Fault Delay.....	7
2-9 Defeatable Ground Fault	7

Chapter 3. Trip Unit Status

3-1 Target Module	8
3-2 Functions.....	8
Trip Targets.....	8
Long-Time Pickup Status.....	8
Battery Test	8
Health Monitor.....	8

Chapter 4. Maintenance and Trouble-Shooting

4-1 Trip Unit Removal and Replacement.....	9
4-2 Rating Plug Removal and Replacement	9
4-3 Target Module Removal and Replacement.....	9
Target Module Battery Replacement	10
4-4 High-Current Testing	10
4-4 Trouble-Shooting Guide.....	11

1. Front view of the ProTrip Trip Unit.	1
2. ProTrip rating plug.	3
3. Time-current curve illustrating long-time pickup.	5
4. Time-current curve illustrating long-time delay.	5
5. Time-current curves illustrating short-time pickup.	6
6. Time current curve illustrating short-time delay with I^2T OUT.	6
7. Time current curve illustrating short-time delay with I^2T IN.	6
8. Time-current curve illustrating instantaneous pickup.	6
9. Time-current curve illustrating ground-fault pickup.	7
10. Time-current curve illustrating ground-fault delay with I^2T OUT.	7
11. Time-current curve illustrating ground-fault delay with I^2T IN.	7
12. Target module.	8
13. Removing the interchangeable rating plug.	9
14. Removing the target module.	10

List of Tables

1. Breaker type referred to by the first character of the Trip Unit catalog number..... 2

2. Trip Unit type referred to by the sixth character of the Trip Unit catalog number 2

3. Wiring type referred to by the seventh character of the Trip Unit catalog number 2

4. Sensor type referred to by the eighth character of the Trip Unit catalog number 2

5. Installed CT, as indicated by the ninth and tenth characters of the Trip Unit catalog number 2

6. Trip unit functions, as indicated by the eleventh and twelfth characters of the Trip Unit catalog
number. 3

7. Catalog numbers for rating plugs..... 3

8. Summary of protective functions and setting values for each. 5

9. Nominal delays for the long-time delay bands..... 5

10. Settings available for ground-fault pickup according to breaker frame size. 7

1–4 Trip Unit Catalog Numbers

A simple catalog-numbering system defines all of the standard and optional Trip Unit functions. A catalog numbering key is found inside the front cover (but see Table 1 for the complete list of supported breakers). Each of the segments of the catalog number is described below.

The first five-character group indicates the breaker type for which the Trip Unit is configured, as listed in Table 1.

Characters	Breaker Type
	GE
PK115	AK-1-15
PKO15	AK-15
PK125	AK-1-25
PKO25	AK-25, AKU-25
PK150	AK-1-50
PKO50	AK-50, AKU-50, AKT-50, AKS-50, AKSU-50, AKST-50
PKO75	AK-75
PKO10	AK-100
PKW10	AKW10
	I-T-E®, ABB®
PIK22	K-225
PIK60	K-600, KDON-600
PIKC8	KC (800 A)
PIK80	K-800, KDON-800
PIK1B	K-1600 (black), KDON-1600 (black)
PIK16	K-1600 (red) KDON-1600 (red, rect. primary disconnects)
PIKN1	KDON-1600 (red, circ. primary disconnects)
	Westinghouse®, Cutler-Hammer®
PDB15	DB-15, DBL-15
PDB25	DB-25, DBL-25
PDA50	DA-50
PDB50	DB-50, DBL-50
PDA75	DA-75
PDB75	DB-75
PDA10	DA-100
PDB10	DB-100
	Allis/Chalmers®, Siemens/Allis®, Siemens
PSL6B	LA-600 (blue), LAF-600 (blue)
PSL6G	LA-600 (gold), LAF-600 (blue)
PSL1B	LA-1600 (blue), LAF-1600 (blue)
PSL1G	LA-1600 (gold), LAF-1600 (gold)

Table 1. Breaker type referred to by the first five characters of the Trip Unit catalog number.

The sixth character of the catalog number is always the letter *D*, indicating the Trip Unit type, as shown in Table 2.

Character	Trip Unit Type
D	ProTrip

Table 2. Trip Unit type referred to by the sixth character of the Trip Unit catalog number.

The seventh character of the catalog number indicates the wiring type of the breaker, as listed in Table 3.

Character	Wiring Type
3	3 Wire

Table 3. Wiring type referred to by the seventh character of the Trip Unit catalog number.

The eighth character of the catalog number indicates the sensor type, as listed in Table 4, and is always an *F*, for fixed CTs.

Character	Sensor Type
F	Fixed CTs

Table 4. Sensor type referred to by the eighth character of the Trip Unit catalog number.

The ninth and tenth characters of the catalog number indicate the CT that is installed in the circuit breaker, as listed in Table 5.

Characters	Installed CT
01	150 A
02	225 A
06	600 A
08	800 A
16	1600 A
20	2000 A
30	3000 A
32	3200 A
40	4000 A

Table 5. Installed CT, as indicated by the ninth and tenth characters of the Trip Unit catalog number.

The eleventh and twelfth characters of the catalog number indicate the trip functions provided by the Trip Unit, as listed in Table 6.

Characters	Protective Function
08	Long-time, short-time, instantaneous, and switchable ground fault

Table 6. Trip unit functions, as indicated by the eleventh and twelfth characters of the Trip Unit catalog number.

Finally, if the Trip Unit was ordered as a replacement, the letter *R* is appended to the catalog number.

For example, a Trip Unit with catalog number PK050P3F1608R has the following functions:

PK050 – Trip Unit for AK-50 circuit breaker with a frame rating of 1600 A

D – ProTrip Trip Unit

3 – 3-wire configuration

F – Fixed CT sensors

16 – 1600 A sensors

08 – Long-time, short-time, instantaneous, and switchable ground fault protection functions

R – Trip Unit was ordered as a replacement

1–5 Rating Plugs

Interchangeable rating plugs are used to establish or change the trip rating of the breaker. A built-in rejection feature prevents the insertion of a rating plug with an incorrect sensor rating into a Trip Unit. Rating plug catalog numbers are listed in Table 7. A rating plug is shown in Figure 2.

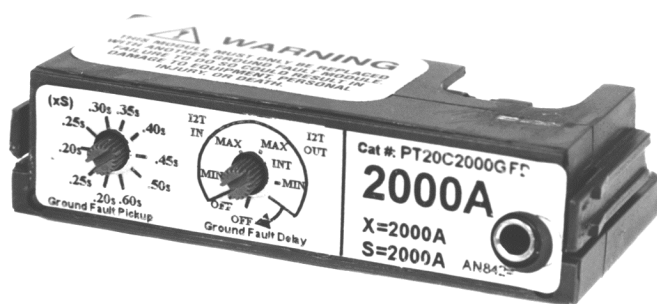


Figure 2. ProTrip rating plug.

CAUTION: Removal of the rating plug while the breaker is carrying current reduces the breaker's current-carrying capacity to approximately 25% of the current sensor rating. This may result in undesired tripping.

ATTENTION: Si le calibre est retiré alors que le disjoncteur est sous tension, le déclencheur se règle automatiquement à approximativement 25% du calibre du transformateur de courant. Ceci peut entraîner un déclenchement indésirable.

Cat. No.	Sensor Rating, A	Plug Rating, A
PT1C80GFD PT1C100 GFD PT1C125 GFD PT1C150 GFD	150	80 100 125 150
PT225C150 GFD PT225C225 GFD	225	150 225
PT4C200GFD PT4C225GFD PT4C250GFD PT4C300GFD PT4C400GFD	400	200 225 250 300 400
PT6C300GFD PT6C400GFD PT6C450GFD PT6C500GFD PT6C600GFD	600	300 400 450 500 600
PT8C400GFD PT8C450GFD PT8C500GFD PT8C600GFD PT8C700GFD PT8C800GFD	800	400 450 500 600 700 800
PT16C800GFD PT16C1000GFD PT16C1100GFD PT16C1200GFD PT16C1600GFD	1600	800 1000 1100 1200 1600
PT20C1000GFD PT20C1200GFD PT20C1500GFD PT20C1600GFD PT20C2000GFD	2000	1000 1200 1500 1600 2000
PT30C1200GFD PT30C1600GFD PT30C2000GFD PT30C2500GFD PT30C3000GFD	3000	1200 1600 2000 2500 3000
PT32C1200GFD PT32C1600GFD PT32C2400GFD PT32C3200GFD	3200	1200 1600 2400 3200
PT40C1600GFD PT40C2000GFD PT40C2500GFD PT40C3000GFD PT40C3600GFD PT40C4000GFD	4000	1600 2000 2500 3000 3600 4000

Table 7. Catalog numbers for rating plugs.

Ground-Fault Protection

Ground-fault protection with ProTrip Trip Units is provided in the rating plug. The pickup and delay settings available with the switches on the rating plug are described in Chapter 2, *Trip Unit Setup*.

1–6 Equipment Interfaces

ProTrip Trip Units do not usually require connections within the equipment, since all wiring is contained within the circuit breaker. The only connection is for the neutral sensor, which uses a special dedicated disconnect.

CAUTION: Neutral current sensors are required for single-phase, three-wire and three-phase, four-wire systems. When the Trip Unit is connected to a three-phase, three-wire system, the neutral sensor terminals of the breaker are left open. Do not short any neutral current sensor terminals in a three-phase, three-wire system, as this could result in damage to, or malfunction of, the electrical system.

ATTENTION: Un transformateur de courant de neutre est nécessaire pour les réseaux 3 phases + neutre. Si le neutre n'est pas distribué, les bornes de neutre du déclencheur doivent être laissées ouvertes. Ne pas les court-circuiter (ceci peut endommager le déclencheur et entraîner un mauvais fonctionnement du système électrique).

1–7 Trip Unit Information

Trip Unit Label Information

Following are descriptions of the various numbers on the front of the Trip Unit, as shown in Figure 1.

- *Top-left corner* – Serial number of the Trip Unit, such as RMS71234567.
- *Top-right corner* – Date of manufacture code, such as P1121=.
- *Right center above rating plug* – Catalog number of the Trip Unit, such as PK050D3F1608R.
- *Right center, below catalog number* – Current sensor rating in amperes.

There are two more labels on the Trip Unit that are not generally visible when it is plugged into a breaker.

- *Side of unit* – Bar code giving the catalog number of the Trip Unit.
- *Rear of unit* – Yellow caution label.

Selector Switches

The following selector switches are present on the front of the Trip Unit. See Chapter 2, *Setup Mode*, for a complete description of each function.

- Long-time pickup
- Long-time delay
- Short-time pickup
- Short-time delay
- Instantaneous pickup
- Ground-fault pickup (on the rating plug)
- Ground-fault delay (on the rating plug)

2–1 Overview

All of the Trip Unit protective functions are set with the rotary selector switches on the front of the unit. Table 8 contains a summary of the functions and the available settings.

Most of the selector switch scales (all but instantaneous pickup) have a heavy curved line, with an arrowhead on one end, connecting the low and high ends of the scale. When the switch points anywhere within this region, the highest value at the end of the line opposite the arrowhead is the active setting.

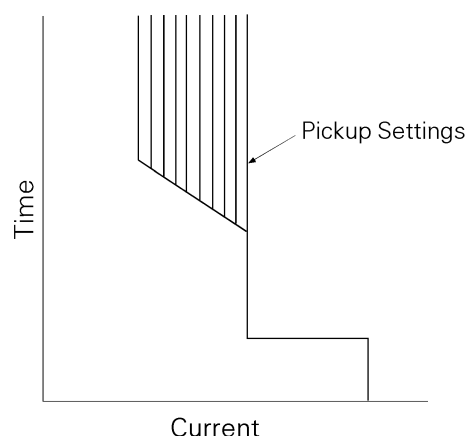


Figure 3. Time-current curve illustrating long-time pickup.

2–2 Long-Time Pickup

The long-time pickup set point establishes the breaker's nominal ampere rating, C , as a fraction of the rating plug current, X . The choices for C are .5, .6, .7, .8, .9, .95, 1.0, and 1.1 times X . Figure 3 illustrates the long-time pickup settings.

2–3 Long-Time Delay

The long-time delay function allows normal momentary overloads without nuisance tripping. The nominal time delays at the lower limits of the bands for 600% of the long-time current set point, C , for the four selectable bands are listed in Table 9. Figure 4 illustrates the effect of this delay on the trip time.

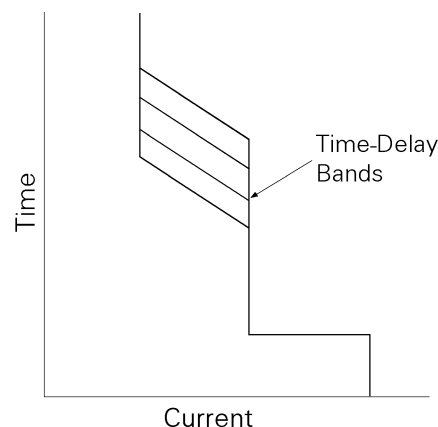


Figure 4. Time-current curve illustrating long-time delay.

Band	Delay, sec
1	2.4
2	4.9
3	9.8
4	20

Table 9. Nominal delays for the long-time delay bands.

Parameter	Pickup Settings	Delay Settings	Delay Curve
Long-Time Trip	.5, .6, .7, .8, .9, .95, 1.0, 1.1 multiple of Rating Plug Current (X)	2.4, 4.9, 9.8, 20 seconds (Bands 1, 2, 3, 4)	Fixed
Short-Time Trip	1.5, 2, 2.5, 3, 4, 5, 7, 9 multiple of Long-Time setting (C)	.10, .21, .35 second (Min, Int, Max)	I^2T In, I^2T Out
Instantaneous Trip	1.5, 2, 3, 5, 7, 9, 10 ¹ , 13 ¹ , 15 ¹ multiple of Rating Plug Current (X)	No delay	N/A
Ground-Fault Trip	.2, .25, .3, .35, .4, .45, .5, .6 multiple of Sensor rating (S) ²	.10, .21, .35 seconds (Min, Int, Max)	I^2T In, I^2T Out

¹ Maximum setting is limited by the frame size.

² Maximum setting is limited to 1200 A. Pickup settings are determined by the breaker frame size

Table 8. Summary of protective functions and setting values for each.

2–4 Short-Time Pickup

The short-time pickup function establishes the current at which short-time trip is activated. Short-time pickup is coupled with long-time pickup and the choices of pickup settings are 1.5, 2, 2.5, 3, 4, 5, 7, and 9 times the long-time setting. The time-current curves for short-time pickup is illustrated in Figure 5.

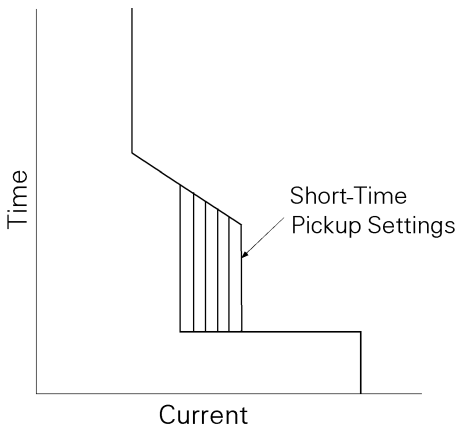


Figure 5. Time-current curves illustrating short-time pickup.

2–5 Short-Time Delay

This function delays the breaker trip when the short-time pickup function is activated. The switch settings MIN, INT, and MAX correspond to nominal time delays of .10, .21, and .35 second, respectively. The delay with I^2T IN is for a current of 600% of C at the lower limit of the band. The delay with I^2T OUT is for the lower limit of each band.

The I^2T OUT function, illustrated in Figure 6, establishes a constant time delay. I^2T IN biases the delay with a constant slope, as shown in Figure 7.

2–6 Instantaneous Pickup

Instantaneous overcurrent protection causes an immediate breaker trip when the chosen current setting is reached. The pickup current may be set to 1.5, 2, 3, 5, 7, and 9 times the rating plug current, X . Additional settings of 10, 13, and 15 times X are also available, depending on the breaker frame size.

Note the difference from short-time pickup, which is based on a multiple of the long-time pickup setting, C , while instantaneous pickup is based on the rating plug current, X . The time-current characteristic is illustrated in Figure 8.

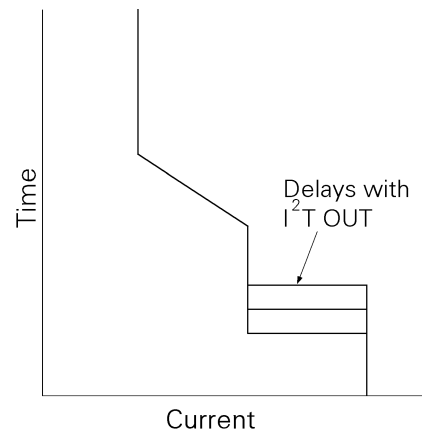


Figure 6. Time current curve illustrating short-time delay with I^2T OUT.

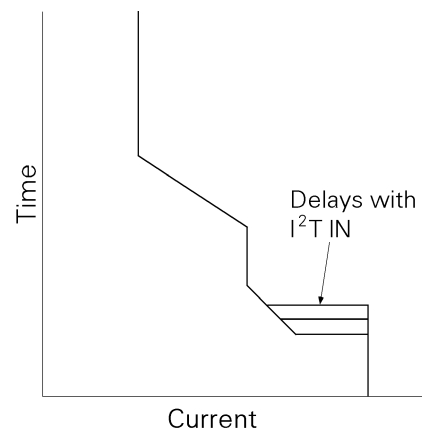


Figure 7. Time current curve illustrating short-time delay with I^2T IN.

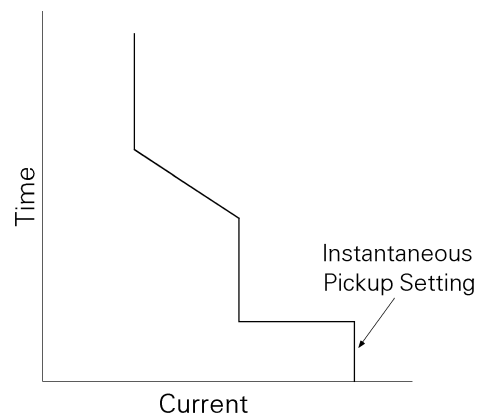


Figure 8. Time-current curve illustrating instantaneous pickup.

2-7 Ground-Fault Pickup

This function sets the pickup current for ground-fault protection. The available settings are listed in Table 10 as multiples of X, the current sensor rating. The maximum setting may be less than 0.6, depending on the breaker frame size. Figure 9 illustrates the time-current curve for ground-fault pickup.

Breaker Frame	Settings as Multiple of X
800–2000 A	.20, .25, .30, .35, .40, .45, .50, .60
3200 A	.20, .22, .24, .26, .28, .30, .34, .37
4000–5000 A	.20, .22, .24, .26, .28, .30

Table 10. Settings available for ground-fault pickup according to breaker frame size.

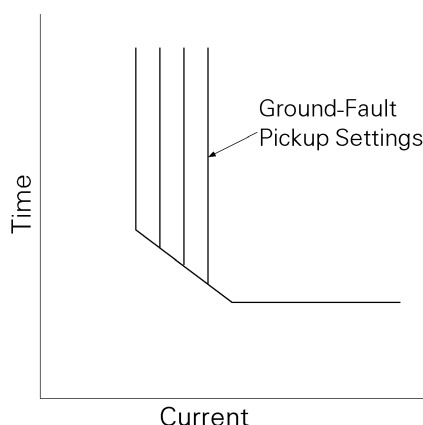


Figure 9. Time-current curve illustrating ground-fault pickup.

2-8 Ground-Fault Delay

This function sets the delay before the breaker trips when the ground-fault pickup current is detected. The switch settings MIN, INT, and MAX correspond to nominal time delays of .10, .21, and .35 second, respectively. The delay with I²T OUT is for the lower limit of each band. The delay with I²T IN is at 200% of the pickup setting at the lower limit of the band.

The I²T OUT function, illustrated in Figure 10, establishes a constant time delay. I²T IN biases the delay with a constant slope, as shown in Figure 11.

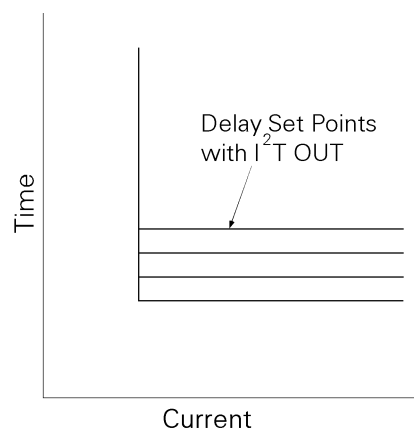


Figure 10. Time-current curve illustrating ground-fault delay with I²T OUT.

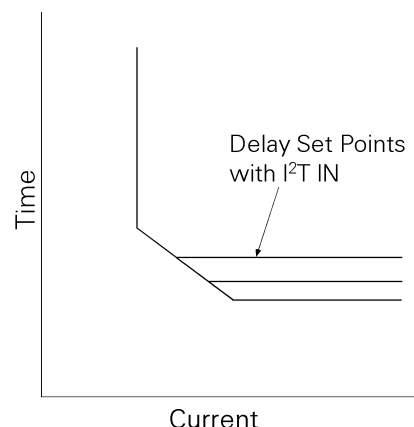


Figure 11. Time-current curve illustrating ground-fault delay with I²T IN.

2-9 Defeatable Ground Fault

All rating plugs have the additional setting OFF on the Pickup switch, which defeats ground-fault protection. These rating plugs are not UL listed.

3–1 Target Module

Trip Unit status information is provided by the target module, shown in Figure 12. This module indicates whether a breaker trip was caused by a short circuit, an overload, or a ground fault, as well as whether the Trip Unit is functioning properly. The catalog number of the target module is TARGET02P.

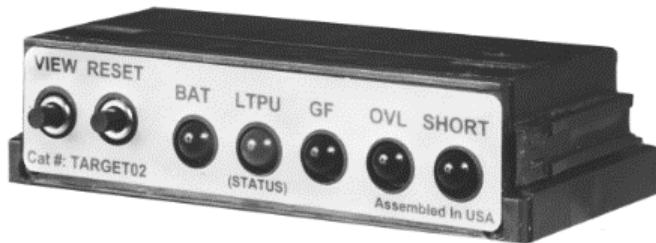


Figure 12. Target module.

3–2 Functions

The front of the target module contains two push buttons and either four or five LEDs. The following functions are provided by the target module.

Trip Targets

To determine the condition causing a breaker trip, press the **VIEW** button. One of the three target LEDs will light, as follows:

- SC – Short circuit (instantaneous or short-time trip)
- OVL – Overload (long-time trip)
- GF – Ground fault

The **RESET** button clears the trip target indication.

Long-Time Pickup Status

Whenever the circuit breaker is carrying at least 95% of the long-time pickup current (C), the **LTPU (STATUS)** LED begins to blink. Above 100% of the long-time pickup current, the LED is lit continuously, indicating an imminent overload trip.

Battery Test

If the breaker has not tripped or if the trip target has been cleared, pressing the **VIEW** button performs a battery test. The **BAT** LED will light if the batteries are okay. If the **BAT** LED is dim or does not light, replace the batteries as described in Chapter 4, *Maintenance and Trouble-Shooting*. Note that the only function of the Target Module batteries is to power the LEDs; they have no effect on Trip Unit

operation and are not required to store targets or for any protection functions.

Health Monitor

The Trip Unit can be tested for proper functioning if the Trip Unit is powered by one of the following sources:

- A Test Kit (catalog number TVRMS2) is plugged into the jack on the front of the rating plug.
- A Portable Battery Pack (catalog number TVPBP) is plugged into the jack on the front of the rating plug.
- The breaker is carrying a load current of at least 20% of its current sensor rating.
- External +24 Vdc control power is connected.

Press and hold the **VIEW** button for at least five seconds. If the Trip Unit is operating properly, the **LTPU** LED will blink slowly. Note that if the Trip Unit is not powered by one of the above sources, this test will not give a true indication of Trip Unit functioning.

4–1 Trip Unit Removal and Replacement

Rejection pins are installed on the rear of all Trip Units to prevent installation of an incorrect Trip Unit into a breaker. Do not use excessive force when installing a Trip Unit.

To install the Trip Unit, perform the following procedure:

1. Unscrew the brass knob in the center of the rear of the trip unit. Lineup the mounting bracket to engage the rejection posts. Screw the brass knob through the bracket and into the trip unit.
2. Plug the wiring harness into the trip unit and screw it to the bracket.
3. Attach the mounting bracket to the adapter plate, previously installed on the breaker.



Figure 13. Removing the interchangeable rating plug.

4–2 Rating Plug Removal and Replacement

CAUTION: Removal of the rating plug while the breaker is carrying current reduces the breaker's current-carrying capacity to approximately 25% of the current sensor rating.

ATTENTION: Si le calibre est retiré le disjoncteur et traversé par un courant, le niveau de protection s'ajuste à approximativement 25% du calibre du transformateur d'intensité.

Interchangeable rating plugs are removed with a rating plug removal tool, Catalog No. TRTOOL. (Suitable equivalents are commercially available as "integrated circuit (DIP) extractors.") Grasp the rating plug tabs with the extractor and pull the plug out as illustrated in Figure 13. Be sure to grab the tabs and not the front cover of the rating plug, or the plug may be damaged.

To install a rating plug, hold the plug between the thumb and forefinger, then push it into the Trip Unit. Proper engagement is verified by a click. Rejection features are provided on all rating plugs to prevent application mismatches. Never force a rating plug into place. Refer to Chapter 1 to find the appropriate rating plugs for each sensor rating and breaker frame.

Do not attempt to use a rating plug from a different type of Trip Unit in a ProTrip Trip Unit.

4–3 Target Module Removal and Replacement

The target module is removed with the rating plug removal tool, catalog number TRTOOL, also known as an integrated circuit (DIP) extractor. Grasp the tabs of the module with the tool, as shown in Figure 14. Be careful to hold the tabs and not the front cover, as the Target Module could be damaged otherwise. Gently pull the Target Module away from the Trip Unit. A gentle left-right motion assists the removal. Insure that the tabs are held securely until the Target Module is completely removed.

To install a target module, hold the module between the thumb and forefinger, then push it into the Trip Unit. Proper engagement is verified by a click.

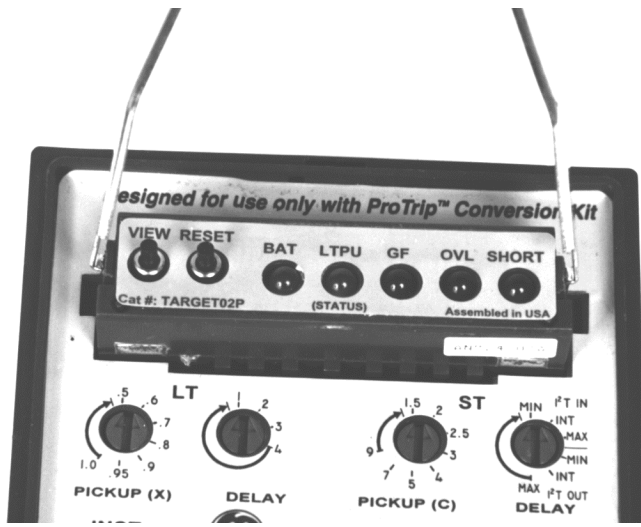


Figure 14. Removing the target module.

AVERTISSEMENT: La batterie peut exploser en cas de mauvaise utilisation. Ne pas la recharger, l'ouvrir ou la jeter dans un feu. Doit être gardé hors de portée des enfants. Une fois usée, la batterie doit être jeté rapidement.

4-4 High-Current Testing

The TVRMS2 Test Kit does *not* defeat ground fault on the ProTrip Trip Unit. If the breaker equipped with a ProTrip Trip Unit is undergoing high-current testing, then two poles must be connected in series to prevent ground fault operation.

Target Module Battery Replacement

To replace the two batteries in the Target Module, remove the module from the Trip Unit as described above. Slide the old batteries out from the battery compartment at the rear of the Target Module. It may help to carefully pry them out with a small screwdriver blade in the cutout on top of the module. Slide the new batteries into the battery compartment. Be careful not to short out the batteries during removal or installation. Recommended replacement batteries are Panasonic CR1616, Eveready E-CR1616BP, and Duracell DC1616B.

WARNING: Replace the batteries with Panasonic CR1616, Eveready E-CR1616BP, or Duracell DC1616B only. Use of a different battery may present risk of fire, explosion, or damage to equipment. Observe proper battery polarity when installing in the battery compartment.

AVERTISSEMENT: Remplacer la batterie avec uniquement des Panasonic CR1616, Eveready E-CR1616BP, ou Duracell DC1616B. L'utilisation d'autres batteries peut présenter un risque de feu, d'explosion ou d'endommagement du matériel. Respecter la polarité de la batterie en l'installant dans son logement.

WARNING: The batteries may explode if mistreated. Do not recharge, disassemble, or dispose of in fire. Keep the battery away from children and dispose of the used battery promptly.

4–4 Trouble-Shooting Guide

The following guide is provided for trouble-shooting and isolating common problems. It does not cover every possible condition. Contact the Customer Support Center at 800-843-3742 if the problem is not resolved by these procedures.

Symptom	Possible Cause	Corrective Action
1. The health monitor function of the target module does not operate.	Line current is below 20% of the breaker sensor rating.	At least 20% of the current sensor rating, X , must be flowing through the breaker to activate this function. If the load current is below this level, power the Trip Unit with the Test Kit or the Portable Battery Pack.
	The target module is not seated properly.	Verify that the target module is fully seated in its slot.
2. The trip indication target will not clear.	The target module batteries are low.	Replace the batteries in the target module.
3. The battery check (BAT) LED on the target module does not light.	The target module batteries are low.	Replace the batteries in the target module.
4. The circuit breaker trips at too low a current.	The rating plug is not fully seated.	Verify that the rating plug is fully seated in its slot.
	An incorrect rating plug is installed.	Check the current rating and catalog number of the rating plug.



GE Industrial Systems

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