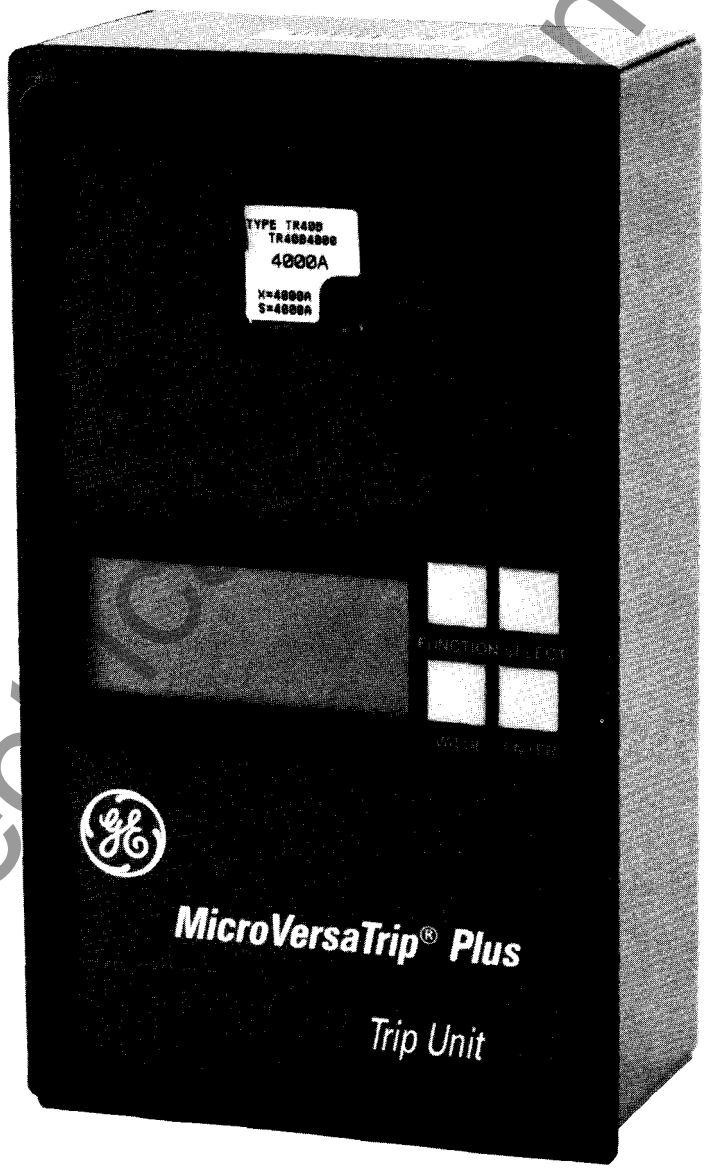
MicroVersaTrip® Plus and MicroVersaTrip® PM Trip Units

for Type AKR Low-Voltage Power Circuit Breakers
Power Break® Insulated-Case Circuit Breakers
R-Frame Molded-Case Circuit Breakers

User's Manual



GEH-5891A

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 exist 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 Electrical Distribution & Control assumes no obligation of notice to holders of this document with respect to changes subsequently made.

GE Electrical Distribution & Control makes no representation or warranty, expressed, implied, or statutory, with respect to, and assumes no responsibility for the accuracy, completeness, sufficiency, or usefulness of the information contained herein. No warrantees of merchantability or fitness for purpose shall apply.

The following are trademarks of GE Company:

MicroVersaTrip® Plus, MicroVersaTrip® PM, Power Break®, Spectra RMS™, Epic™.

Table of Contents

Chapter 1. Introduction

1-1 Read This First 1
1-2 Product Structure 1
1-3 Trip Unit Functions 2
1-4 Trip Unit Catalog Numbers 2
1-5 Rating Plugs 3
1-6 Equipment Interfaces 3
MicroVersaTrip Plus Trip Units 3
Neutral Current Sensors 4
MicroVersaTrip PM Trip Units 4
POWER LEADER Communication Network 4
Voltage Inputs 4
Power Requirements 5
1-7 Trip Unit Information 5
Trip Unit Label Information 5
Function Keys 5
Liquid Crystal Display 6
1-8 MicroVersaTrip Plus and MicroVersaTrip PM Accuracies 6

Chapter 2. Setup Mode

2-1 Overview 7
2-2 Operating Modes 7
2-3 Setup Mode Operation 8
Long-Time Pickup 13
Long-Time Delay 13
Short-Time Pickup 13
Short-Time Delay 14
Instantaneous Pickup 14
High-Range Instantaneous Overcurrent Protection 15
Ground-Fault Pickup 15
Ground-Fault Delay 16
Voltage-Unbalance Relay Pickup 16
Voltage-Unbalance Relay Delay 16
Current-Unbalance Relay Pickup 17
Current-Unbalance Relay Delay 17
Undervoltage Relay Pickup 17
Undervoltage Relay Delay 17
Overvoltage Relay Pickup 17
Overvoltage Relay Delay 18
Power-Reversal Relay Pickup 18
Power-Reversal Relay Delay 18
Rating Plug Current Setting 18

Potential Transformer Primary Voltage 19
Potential Transformer Connection 19
Communication Address 19

Chapter 3. Metering Mode

3-1 Overview 20
3-2 Metering Mode Operation 20
Current 22
Voltage 22
Energy 22
Real Power 22
Total Power 23
Frequency 23

Chapter 4. Status Mode

4-1 Overview 24
4-2 Status Mode Operation 24
Normal Status Display 24
Long-Time Overcurrent Pickup and Target Displays 24
Short-Time Overcurrent Target Display 24
Instantaneous Target Display 24
Ground-Fault Target Display 25
Protective-Relay Target Displays 25
Clearing the Target After Trip 25

Chapter 5. Maintenance and Trouble-Shooting

5-1 Trip Unit Removal and Replacement 26
POWER BREAK Insulated-Case Circuit Breakers 26
Type AKR Low-Voltage Power Circuit Breakers 26
5-2 Rating Plug Removal and Replacement 26
5-3 Trouble-Shooting Guide 26

List of Figures

1. Front view of MicroVersaTrip PM trip unit. 1
2. Rear view of MicroVersaTrip PM trip unit. 2
3. Function key placement on face of trip unit. 5
4. Liquid crystal display segments. 6
5. Operation of FUNCTION key, showing progression among trip unit operating modes. 8
6. Trip unit setup mode programming function flow. 9
7. Trip unit display for long-time pickup. 13
8. Time-current curve illustrating long-time pickup. 13
9. Trip unit display for long-time delay. 13
10. Time-current curve illustrating long-time delay. 13
11. Trip unit display for short-time pickup. 14
12. Time-current curve illustrating short-time pickup. 14
13. Trip unit display for short-time delay. 14
14. Time-current curve for short-time delay with I^2T OUT 14
15. Time-current curve for short-time delay with I^2T IN 14
16. Trip unit display for instantaneous pickup. 15
17. Instantaneous overcurrent protection set point. 15
18. Trip unit display for ground-fault pickup. 15
19. Time-current curve for ground-fault pickup. 15
20. Trip unit display for ground-fault delay. 16
21. Time-current curve for ground-fault delay with I^2T OUT 16
22. Time-current curve for ground-fault delay with I^2T IN 16
23. Trip unit display for voltage-unbalance relay pickup. 16
24. Trip unit display for voltage-unbalance relay delay. 17
25. Trip unit display for current-unbalance relay pickup. 17
26. Trip unit display for current-unbalance relay delay. 17
27. Trip unit display for undervoltage relay pickup. 17
28. Trip unit display for undervoltage relay delay. 17
29. Trip unit display for overvoltage relay pickup. 17
30. Trip unit display for overvoltage relay delay. 18
31. Trip unit display for power-reversal relay pickup. 18
32. Trip unit display for power-reversal relay delay. 18
33. Trip unit display for rating plug current set point. 18
34. Trip unit display for potential transformer primary voltage set point. 19
35. Trip unit display for potential transformer connection choice. 19
36. Trip unit display for setting communication address 19
37. Trip unit metering mode function flow. 20
38. Trip unit display for current metering. 22
39. Trip unit display for line-to-neutral voltages. 22

40. Trip unit display for line-to-line voltages. 22
41. Trip unit display for aggregate energy. 22
42. Trip unit display for real power with line-to-neutral connections. 22
43. Trip unit display for aggregate real power with line-to-line connections. 22
44. Trip unit display for total power with line-to-neutral connections. 23
45. Trip unit display for aggregate total power with line-to-line connections. 23
46. Trip unit display for frequency in each phase. 23
47. Trip unit display for normal status. 24
48. Trip unit status display for long-time overcurrent pickup. 24
49. Trip unit status display for long-time overcurrent trip. 24
50. Trip unit status display for short-time overcurrent trip. 24
51. Trip unit status display for ground-fault trip. 25
52. Trip unit status display for protective-relay trip. 25

List of Tables

1. Trip unit catalog number prefixes and corresponding current sensor ratings. 2
2. Trip unit catalog number suffixes for optional functions..... 3
3. MicroVersaTrip PM trip unit suffixes for communication, metering, and relaying..... 3
4. Rating plug catalog numbers. 4
5. Protective relay and metering accuracies and resolutions. 6
6. Abbreviations used in setup procedure descriptions..... 7
7. Actions of function keys in trip unit operating modes..... 8
8. Nominal delays for long-time delay bands. 13
9. Nominal delays for i2t out short-time delay bands. 14
10. Ground-fault pickup settings, as a function of sensor rating. 15
11. Nominal delays for ground-fault delay bands. 16
12. Trip unit rating plug options. 18
13. Trip unit display codes for protective relays. 25

1-1 Read This First

The MicroVersaTrip® Plus and MicroVersaTrip® PM trip units described in this publication are used on both Power Break® insulated-case and Type AKR low-voltage power circuit breakers.

Spectra RMS™ molded-case circuit breakers use different versions of MicroVersaTrip Plus and MicroVersaTrip PM trip units that are not interchangeable with the units described here. Refer to GEH-5934 for information on these trip units.

Testing of MicroVersaTrip Plus and MicroVersaTrip PM trip units may be performed with the trip unit installed in the circuit breaker, the rating plug installed in the trip unit, and the breaker carrying current. The test set catalog number is TVRMS. The test set plugs into the test socket of the rating plug.

Test set TVRMS may also be used for MicroVersaTrip RMS-9 and Epic™ MicroVersaTrip trip units. Refer to the Maintenance and Troubleshooting section for additional details.

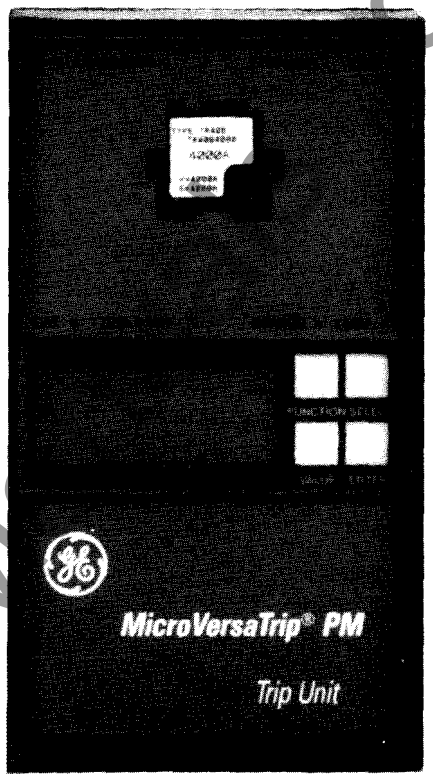


Figure 1. Front view of MicroVersaTrip PM trip unit.

1-2 Product Structure

MicroVersaTrip Plus and MicroVersaTrip PM trip units are removable. Figures 1 and 2 contain front and rear views of a MicroVersaTrip PM trip unit.

Figure 2 shows the 36-pin plug that connects either trip unit to the circuit breaker and equipment circuitry. This plug is called the trip unit disconnect.

CAUTION: Removal of a trip unit from its breaker must be performed with the breaker in the OPEN or TRIPPED position. Draw-out breakers should be racked out first.

CAUTION: Do not attempt to operate the breaker without its assigned trip unit. Installation of an incorrect trip unit may result in unsafe operation of the breaker.

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.

NOTE: Trip units as received may have settings that are undesirable for the specific application. Ensure that settings are appropriately adjusted before energizing.

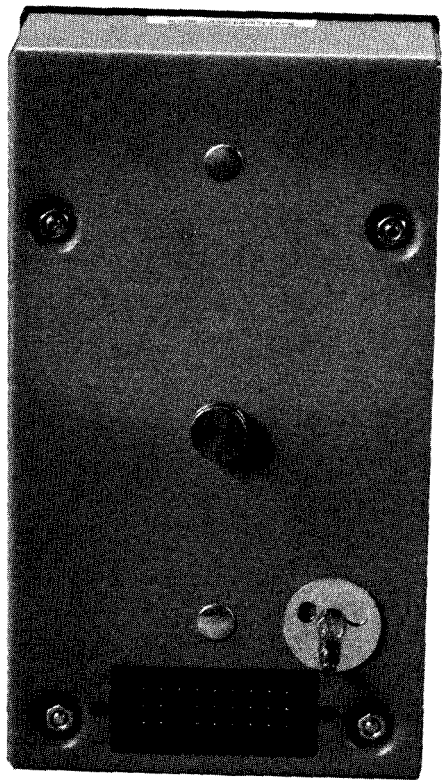


Figure 2. Rear view of MicroVersaTrip PM trip unit.

1-3 Trip Unit Functions

MicroVersaTrip Plus and MicroVersaTrip PM trip units have specific standard and optional functions. All trip units share a series of interchangeable rating plugs. The standard functions for both types of trip unit are as follows:

- Protection
  - Long-time protection
  - Instantaneous protection
- Status
  - Trip target
- Metering display
  - Phase current (selectable among phases)

The optional functions available on both types of trip unit are as follows:

- Adjustable protection
  - Switchable instantaneous and ground-fault protection (Type AKR only)
  - High-range (fixed) instantaneous overcurrent protection
  - Short-time protection, with or without I^2T
  - Ground-fault protection, with or without I^2T
  - Zone-selective interlock, with ground fault only or with both ground fault and short time

Additional optional functions available only with PM style trip units are as follows. PM style trip units require the presence of external control power.

- Configurations
  - Communication and metering
  - Communication and protective relaying
  - Communication, metering, and protective relaying
- Metering and protective-relaying functions
  - Voltage
  - Energy (kWh/MWh)
  - Real power (kW/MW)
  - Total power (kVA/MVA)
  - Frequency (Hz)
  - Protective relays (undervoltage, overvoltage, voltage unbalance, current unbalance, and power reversal)

1-4 Trip Unit Catalog Numbers

A simple catalog numbering system defines all of the standard and optional trip unit functions. The prefixes that determine the allowable current sensor ratings are listed in Table 1. One of these is present on all trip unit catalog numbers. Immediately following this prefix is the letter L, indicating long-time overcurrent protection.

	Current Sensor Ampere Ratings	
Prefix	**Power Break**	**AKR**
TT20	200, 400, 800, 1000, 1600, 2000	150, 400, 600, 800, 1600, 2000
TT32	2500, 3000	3200
TT40	4000	4000

Table 1. Trip unit catalog number prefixes and corresponding current sensor ratings.

Additional letters are appended to the catalog number to indicate installed protective functions, as in Table 2. These suffixes are valid for both Plus and PM style trip units. They are appended from left to right in the order given.

Suffix	Protective Function
S	Short-time overcurrent
I	Instantaneous overcurrent
H	Fixed high-range instantaneous
G	Ground fault
Z1 or Z2	Zone-selective interlock: Z1 – ground fault only Z2 – ground fault and short time
K	High-range instantaneous (AKR-30 S only)
X	Switchable instantaneous and ground fault (AKR only)

Table 2. Trip unit catalog number suffixes for optional functions.

MicroVersaTrip PM catalog numbers contain an additional one- or two-letter suffix to indicate the communication, metering, and relaying functions installed, as shown in Table 3. MicroVersaTrip Plus catalog numbers do not have this final suffix.

Suffix	Function
(none)	MicroVersaTrip Plus trip unit
PM	Metering, relaying, and communication
M	Metering and communication
P	Relaying and communication

Table 3. MicroVersaTrip PM trip unit suffixes for communication, metering, and relaying.

For example, a trip unit with catalog number TT32LSIG has the following functions:

TT32 – trip unit for sensor greater than 2000 and up to 3200 amperes.

L – long-time overcurrent protection

S – short-time overcurrent protection

I – standard instantaneous protection

G – ground-fault protection

(blank) – MicroVersaTrip Plus

1-5 Rating Plugs

Interchangeable rating plugs are used to establish or change the current rating of the breaker. Rating plugs for MicroVersaTrip Plus or MicroVersaTrip PM trip units in either Power Break or Type AKR breakers are interchangeable within the same sensor rating. Rating plugs for Power Break and Type AKR breakers can not be interchanged with Spectra RMS MicroVersaTrip Plus and MicroVersaTrip PM trip units.

A built-in rejection feature prevents the insertion of a rating plug with an incorrect sensor rating into a trip unit. Likewise, a Spectra RMS rating plug can not be inserted into a Power Break or Type AKR breaker.

Rating plug catalog numbers are listed in Table 4.

1-6 Equipment Interfaces

MicroVersaTrip Plus Trip Units

MicroVersaTrip Plus trip units do not usually require connections within the equipment, since all wiring is contained within the circuit breaker. The only two connections are for optional zone-selective interlock (Z1 and Z2), made by secondary disconnect, and the neutral sensor, which uses a special dedicated disconnect.

Zone-selective interlocking coordinates breakers, so that the downstream breaker is allowed the first opportunity to clear a disturbance. The two types of zone-selective interlocking available are Z1, which reacts only to ground faults, and Z2, which reacts to both ground faults and short-time overcurrent pickups.

Cat. No.	Sensor Rating, Amps	Plug Rating	Breaker Frames
TR1B60		60	
TR1B80		80	
TR1B100	150	100	AKR30S, AKR30H
TR1B125		125	
TR1B150		150	
TR2B100		100	
TR2B150	200	150	TP82, THP82
TR2B200		200	TC82, THC82
TR4B150		150	
TR4B200		200	
TR4B225	400	225	TP84, THP84
TR4B250		250	TC84, THC84
TR4B300		300	AKR30S, AKR30H
TR4B400		400	
TR8B300		300	
TR8B400		400	
TR8B450		450	TP88, THP88
TR8B500	800	500	TC88, THC88
TR8B600		600	AKR30S, AKR30H
TR8B700		700	AKR50S, AKR50H
TR8B800		800	
TR10B400		400	
TR10B600		600	TC2510, THC2510
TR10B800	1000	800	TP1610, THP1610
TR10B900		900	TP2510, THP2510
TR10B1000		1000	
TR16B600		600	
TR16B800		800	
TR16B1000		1000	TC1610, THC1610
TR16B1100	1600	1100	AKR50S, AKR50H
TR16B1200		1200	TP1616, THP1616
TR16B1600		1600	
TR20B750		750	
TR20B800		800	TC2020, THC2020
TR20B1000		1000	TC2520, THC2520
TR20B1200	2000	1200	TP2020, THP2020
TR20B1500		1500	TP2520, THP2520
TR20B1600		1600	AKRT50H
TR20B2000		2000	
TR25B1600		1600	
TR25B2000	2500	2000	TC2525, THC2525
TR25B2500		2500	TP2525, THP2525
TR30B2000		2000	
TR30B2500	3000	2500	TC3030, THC3030
TR30B3000		3000	TP3030, THP3030
TR32B1200		1200	
TR32B1600		1600	
TR32B2400	3200	2400	AKR75
TR32B3200		3200	
TR40B1600		1600	
TR40B2000		2000	
TR40B2500		2500	TC4040, THC4040
TR40B3000	4000	3000	TP4040, THP4040
TR40B3600		3600	
TR40B4000		4000	

Table 4. Rating plug catalog numbers.

Neutral Current Sensors

CAUTION: Neutral current sensors are required for three-phase, four-wire systems. When the trip unit is connected to a three-phase, three-wire system, the neutral sensor terminals 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.

MicroVersaTrip PM Trip Units

In addition to the inputs received by MicroVersaTrip Plus trip units, MicroVersaTrip PM trip units also receive inputs from external voltage conditioners, a 24 Vdc control power supply, and communication connections. External 24 Vdc control power is required for operation.

PM style trip units are also connected to an auxiliary switch within the breaker that senses the breaker position.

POWER LEADER Communication Network

The POWER LEADER Communication Network (commnet) transmits data and instructions between the trip unit and an external intelligent device. The external device may be the POWER LEADER system, the Epic system, or a POWER LEADER Monitor. Devices on commnet may be up to 1000 feet apart without signal repeaters, subject to certain constraints.

Commnet connections are made directly to wiring terminations on breaker frames. All commnet connections to the trip units are made through the 36-pin plug on the trip unit, which mates with a receptacle on the breaker frame. These additional connections are made to the equipment through the secondary disconnect of the breaker.

Voltage Inputs

Voltage inputs are sensed by conventional instrument potential transformers(PTs). PTs have 120 Vac secondaries and must always be used in threes; no open-delta connections are permitted. PT primaries are connected either line-to-line or line-to-neutral, as required.

PTs may be used for other monitoring functions, subject to reasonable burden limitations. Note that PTs must be connected in a specific sequence to ensure proper phase relations and power-flow sensing.

Each PT output feeds an individual voltage conditioner that scales the nominal voltage to approximately 1.76 Vac.

Power Requirements

A small amount of power is necessary to energize the liquid crystal display (LCD) during setup, for viewing breaker status, and for metering displays. MicroVersaTrip PM trip units require external 24 Vdc control power for operation. The four sources of such power are the following.

- *Flow of current* – Breaker current sensors provide sufficient power to energize the LCD when at least 20% of the sensor's ampere rating is flowing.
- *24 Vdc control power* – Breakers with MicroVersaTrip PM trip units are supplied with external 24 Vdc power that, whenever present, energizes the LCD. Some breaker models that are configured for MicroVersaTrip Plus trip units may be optionally equipped to accept an external 24 Vdc supply.
- *MicroVersaTrip Test Kit* – The MicroVersaTrip Test Kit, Cat No. TVRMS, contains a 24 Vdc power supply. The LCD is energized whenever the test kit jack is plugged into the test receptacle on the rating plug.
- *MicroVersaTrip battery pack* – The portable MicroVersaTrip battery pack contains a 24 Vdc power source and a jack. The LCD is energized when the jack is plugged into the rating plug test receptacle.

1-7 Trip Unit Information

Trip Unit Label Information

Following are descriptions of the various labels on the front of the trip unit, as shown in Figure 1.

- *Top left corner* – serial number of the unit, such as LBA000393.
- *Top right corner* – replacement trip unit order number, such as TT09N031, and date-of-manufacture code of the trip unit, such as E301=.
- *Top left of display* – catalog number of the trip unit, such as TT32LSPM.
- *Top right of display* – sensor rating of the trip unit, such as SENSOR = 1600A.
- *Below display* – indicates whether the unit is MicroVersaTrip Plus or MicroVersaTrip PM.

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

- *Top of unit* – another date code and a bar code, used for manufacturing only.
- *Rear of unit* – yellow caution label.

Function Keys

There are four function keys on the trip units, marked FUNCTION, SELECT, VALUE, and ENTER, as illustrated in Figure 3. All setup, status, and metering functions and displays are accessed through these keys. Control power is necessary to operate function keys. However, as each set point is entered, it is stored in the trip unit's nonvolatile memory, so subsequent loss of power does not lose or change any settings.

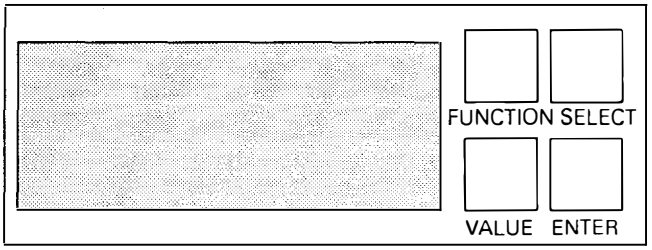


Figure 3. Function key placement on face of trip unit.

The functions of the four keys are

- FUNCTION – selects the mode of display.
- SELECT – chooses the next item for display.
- VALUE – selects the phase-to-phase display or allows changing of set points.
- ENTER – stores set points.

Chapter 2 describes the operation of these keys in detail.

Liquid Crystal Display

Figure 4 illustrates the LCD with all segments illuminated. The various segments are energized in response to conditions sensed by the trip unit.

1-8 MicroVersaTrip Plus and MicroVersaTrip PM Accuracies

The accuracy data in Table 5 represent the average expected performance of MicroVersaTrip Plus and MicroVersaTrip PM trip units, together with their associated current sensors, rating plugs, potential transformers, and voltage modules. These data are valid for setup, metering, and status mode displays. They include the effects of trip unit ambient-temperature variation from 0° C to 70° C.

All percentages are based on full-scale values. Full-scale current is *X*, the rating of the breaker's rating plug. Full-scale voltage is the potential transformer primary voltage rating. These data do not include the accuracy rating of any measuring instrument.

Refer to trip-time curves in GES-9865 (AKR), GES-9866 (Power Break and R-Frame), and GES-9863 (ground fault) for accuracies of overcurrent protection.

Value	Full-Scale Accuracy	Resolution
Current (A, kA)	± 2%	± 0.5 digit
Voltage (V)	± 1.5%	± 0.5 digit
Energy (kWh, MWh)	± 3.5%	± 0.5 digit
Real power (kW, MW)	± 3.5%	± 0.5 digit
Total power (kVA, MVA)	± 3.5%	± 0.5 digit
Frequency (Hz)	± 1 Hz	± 1 Hz
Time delay (sec)	± 1 sec	± 1 sec

Table 5. Protective relay and metering accuracies and resolutions.

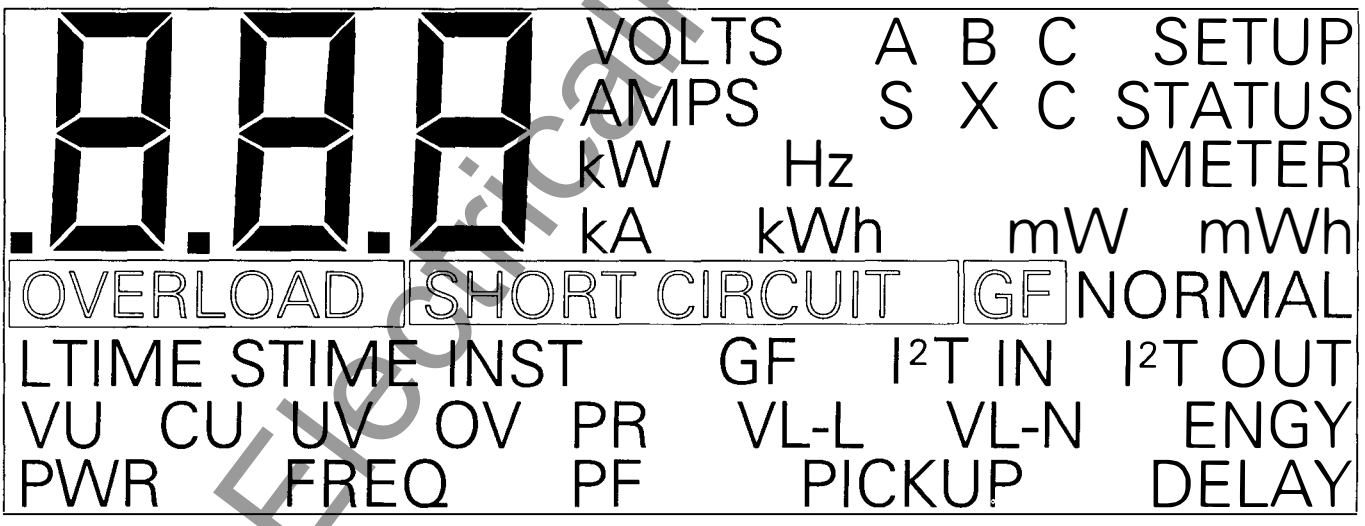


Figure 4. Liquid crystal display segments.

2-1 Overview

This chapter describes the operation of the four function keys, set point and time-delay adjustments, and their accuracies. The setup procedures should only be repeated if the trip unit or the protection characteristics are changed, requiring different set points and time delays.

These procedures apply to MicroVersaTrip Plus and MicroVersaTrip PM trip units. Setup programming must be performed with the rating plug installed.

For trip units set up through either the POWER LEADER system or the Epic MicroVersaTrip Field Programming Unit, refer to instructions published for those systems.

Table 6 contains a list of abbreviations used throughout the description of the setup procedures.

Abbr.	Description
X	Rating plug ampere rating.
S	Current sensor ampere rating.
C	Long–time (LT) setting in amperes. Multiply LT set point by rating plug amperes (*X*).
H	Short-time (ST) withstand rating of breaker in amperes.
Q	100% total power setting of power-reversal relay. Delta: $Q = 1.732 \times 100\%V \times X/1000$ kVA Wye: $Q = 3.0 \times 100\%V \times X/1000$ kVA
F	FUNCTION key on face of trip unit.
S	SELECT key on face of trip unit.
V	VALUE key on face of trip unit.
E	ENTER key on face of trip unit.

Table 6. Abbreviations used in setup procedure descriptions.

2-2 Operating Modes

MicroVersaTrip Plus and MicroVersaTrip PM trip units have three operating modes: Status, Metering, and Setup. The effects of each of the four function keys in each mode are listed in Table 7.

All the function keys, except for ENTER, automatically step the trip unit display to the next available option each time the key is pressed. Continued pressing of a key eventually loops the display back to the initial option for that function. This is illustrated in Figure 5 for the FUNCTION key, which shows that repeatedly pressing this key cycles the mode among Status, Metering, and Setup. Pressing the ENTER key more than once has no effect.

Depressing the VALUE key for about 5 seconds activates a fast scan that rapidly displays each of the available set points or time delays for some of the trip characteristics.

		Trip Unit Operating Mode		
Key	**Symbol**	**Setup**	**Metering**	**Status**
FUNCTION	F	Select one of three modes: Setup, Metering, Status		
SELECT	S	Select next programming display	Select next metering display	No effect
VALUE	V	Display next set-point or time-delay value	Display next phase value	No effect
ENTER	E	Store set-point or time-delay value into memory	No effect	No effect

Table 7. Actions of function keys in trip unit operating modes.

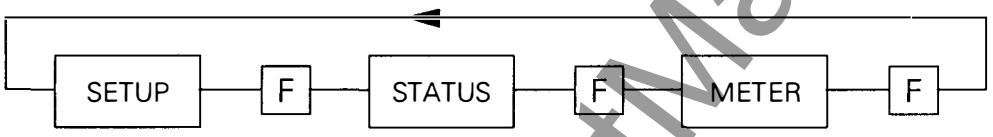


Figure 5. Operation of FUNCTION key, showing progression among trip unit operating modes.

2-3 Setup Mode Operation

The following instructions describe setup procedures for all available trip unit functions. These are illustrated in Figure 6. All trip units provide long-time overcurrent, long-time delay, and some form of instantaneous overcurrent protection when installed in Power Break circuit breakers. All other functions are optional.

If a specific set of trip unit functions, such as relaying or short-time overcurrent protection, has not been ordered, that function will not appear on the trip unit display. Ignore setup mode instructions for such functions.

The trip unit must be provided with control power during setup. This can come from a MicroVersaTrip Test Kit, a MicroVersaTrip battery pack, external 24 Vdc power supply, or energizing the breaker to at least 20% of its sensor load.

To begin the process, press the FUNCTION key until SETUP appears in the upper-right corner of the trip unit's LCD. Setup mode always begins with long-time pickup. After a choice has been made for this and each subsequent trip function, press SELECT to advance to the next function.

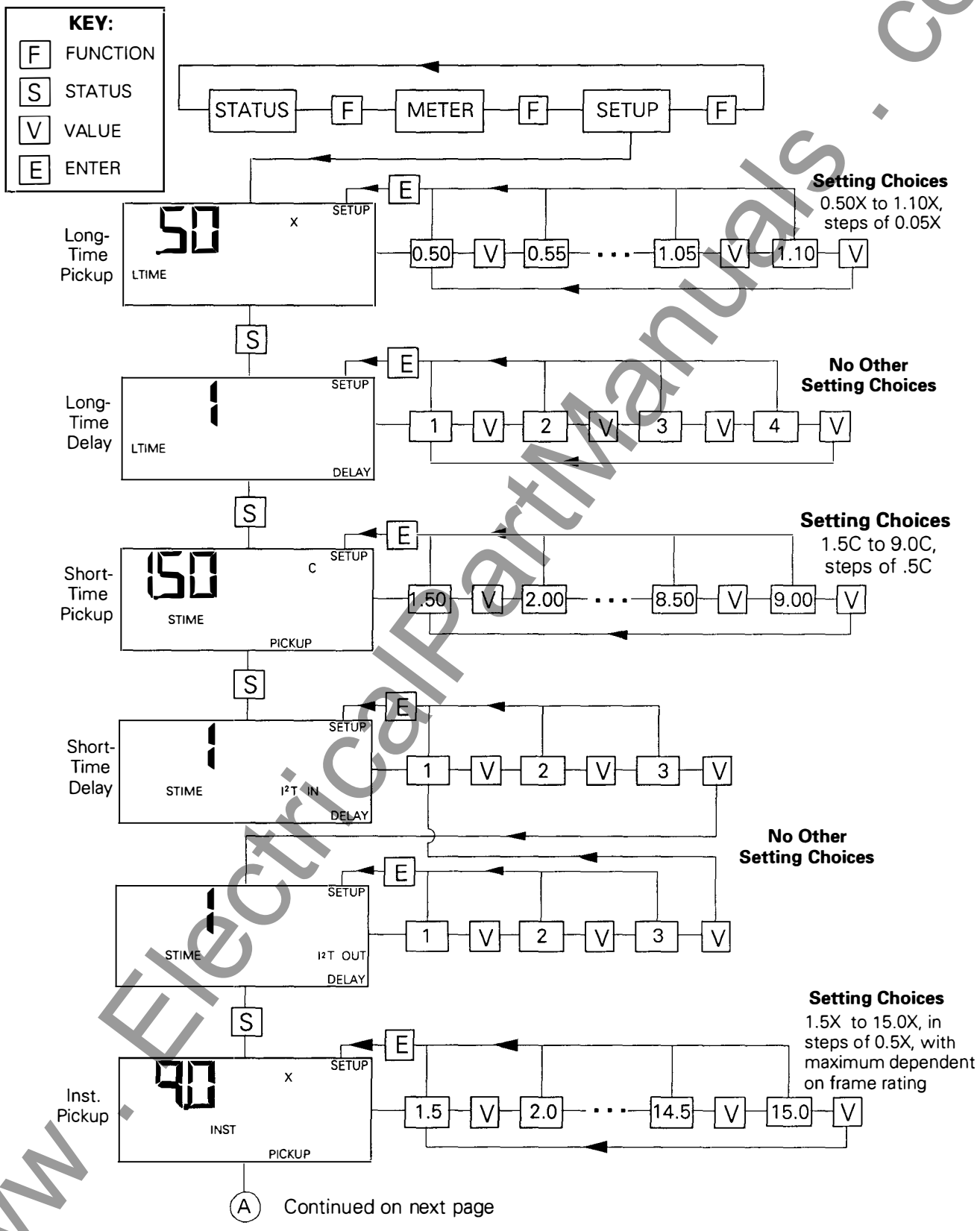


Figure 6. Trip unit setup mode programming function flow.

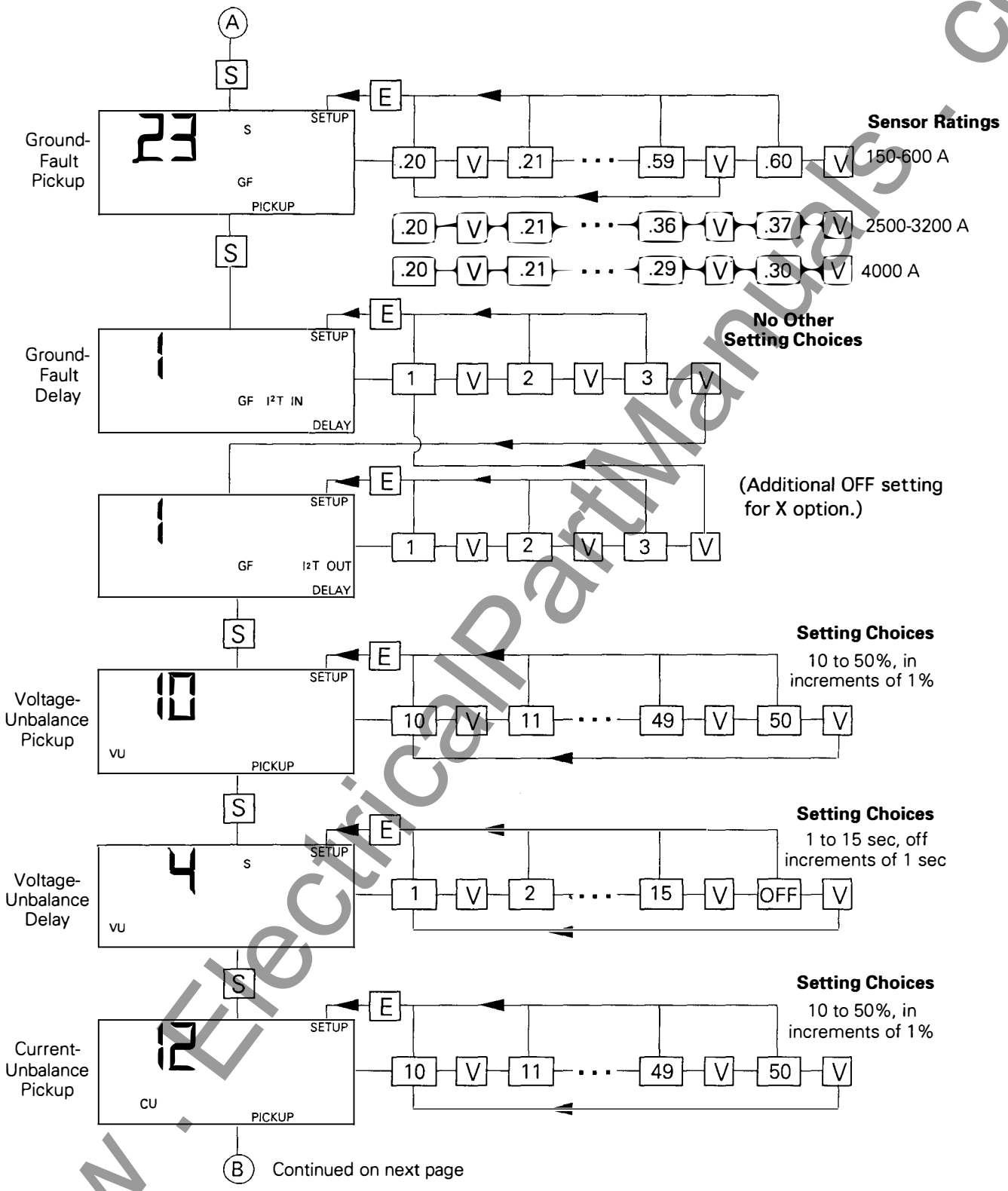


Figure 6. Trip unit setup mode programming function flow (continued).

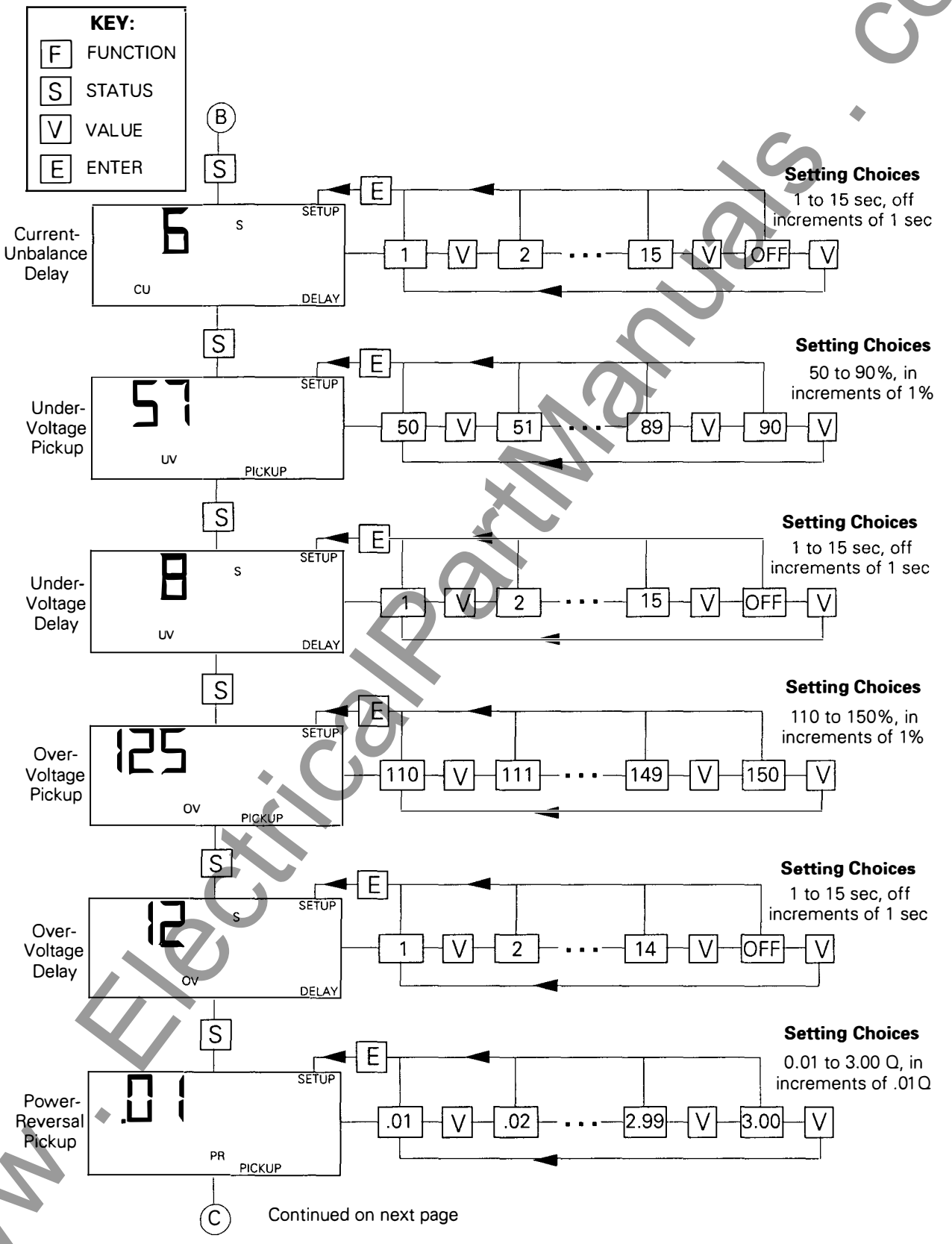


Figure 6. Trip unit setup mode programming function flow (continued).

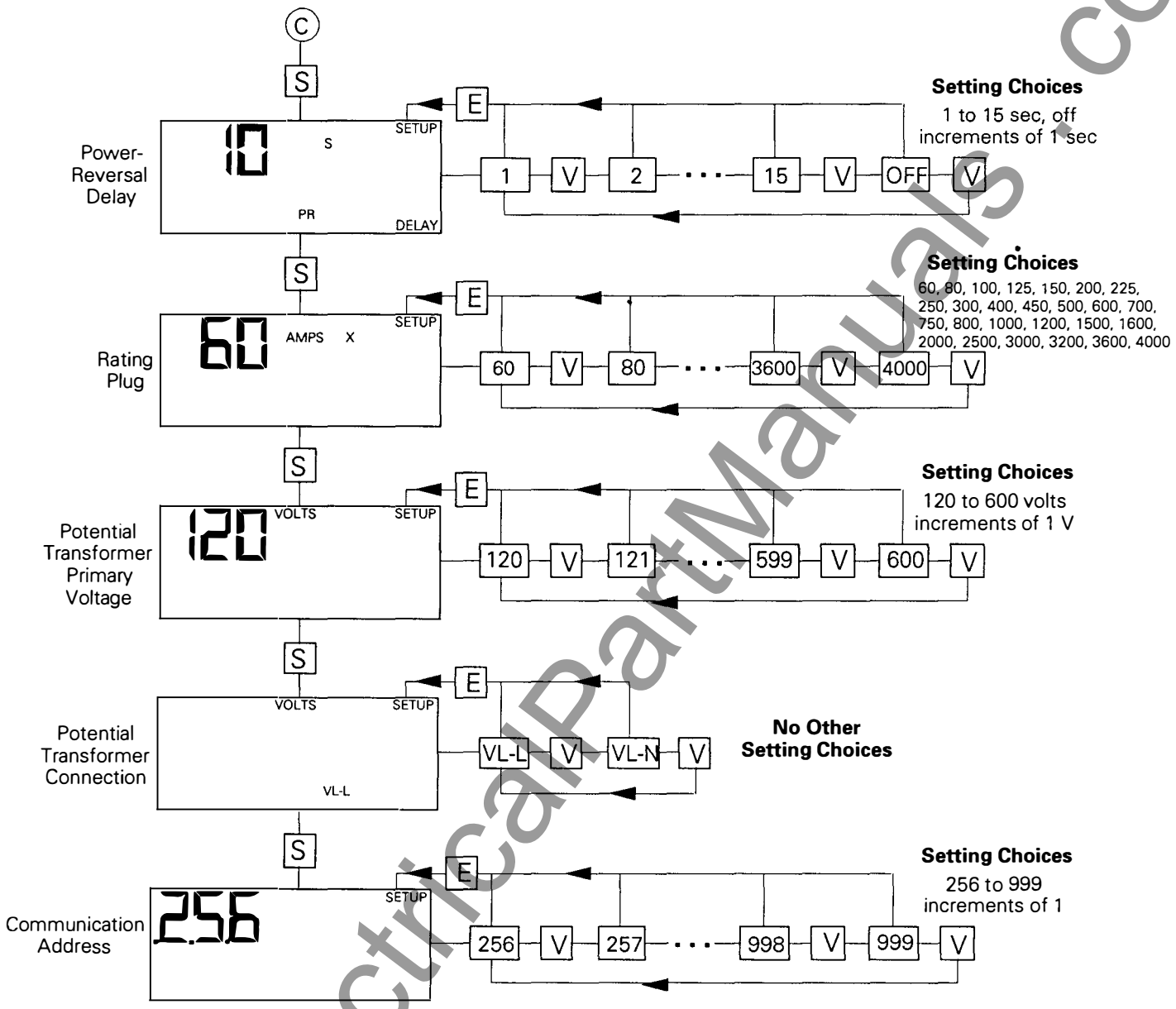


Figure 6. Trip unit setup mode programming function flow (continued).

Long-Time Pickup

The first setup-mode display is always the long-time pickup set point, as illustrated in Figure 7. This set point establishes the breaker's nominal ampere rating, *C*, as a fraction of *X*, the rating plug value. Press the VALUE key to scroll through the available choices. Press ENTER to store the desired set point.

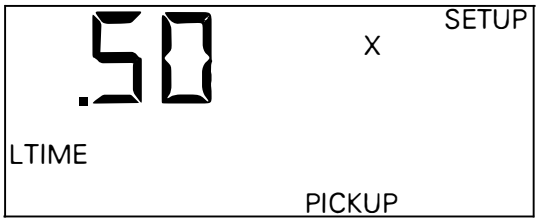


Figure 7. Trip unit display for long-time pickup.

The choices for Power Break circuit breakers are 0.50 to 1.00 times *X*, in steps of 0.05. The pickup value is defined for –0% to +20% of the set point.

The choices for Type AKR circuit breakers are 0.50 to 1.10 times *X*, in steps of 0.05. The pickup value is defined for –10% to +10% of the set point.

Figure 8 illustrates the long-time pickup settings.

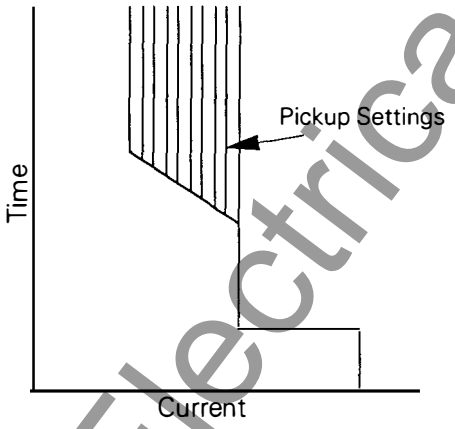


Figure 8. Time-current curve illustrating long-time pickup.

Long-Time Delay

The trip unit display for long-time delay is illustrated in Figure 9. This function allows normal momentary overloads without nuisance tripping. The nominal time delays at 600% of *C* are listed in Table 8. Figure 10 illustrates the effect of this delay on trip time. Press the VALUE key to cycle through the four choices of time-delay bands. Press ENTER to store the desired value.

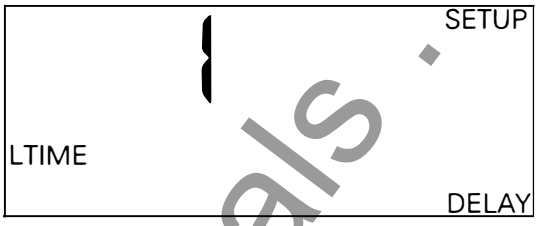


Figure 9. Trip unit display for long-time delay.

Band	Delay, sec
1	3
2	6
3	12
4	16

Table 8. Nominal delays for long-time delay bands.

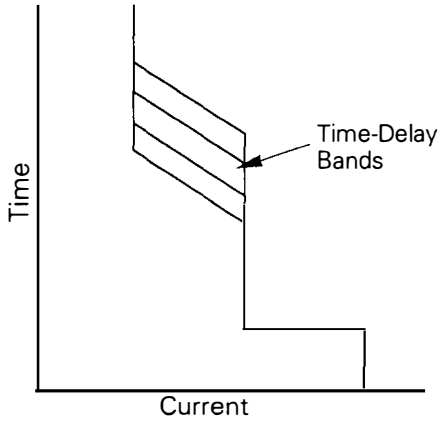


Figure 10. Time-current curve illustrating long-time delay.

Short-Time Pickup

The short-time pickup display is shown in Figure 11. This function, illustrated in Figure 12, establishes the current at which short-time trip is activated. There are 16 choices of pickup settings, from 1.5 to 9.0 times *C*, in steps of 0.5 *C*.

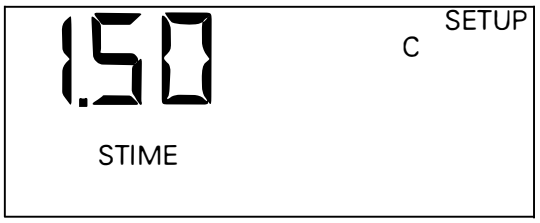


Figure 11. Trip unit display for short-time pickup.

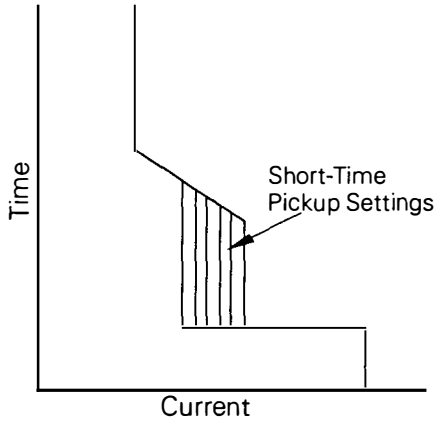


Figure 12. Time-current curve illustrating short-time pickup.

Short-Time Delay

The trip unit display for short-time delay is shown in Figure 13. This function delays the breaker trip on a short-time trip. The choices are listed in Table 9. 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 14, establishes a constant time delay. I^2T IN biases the delay with a constant slope, as shown in Figure 15.

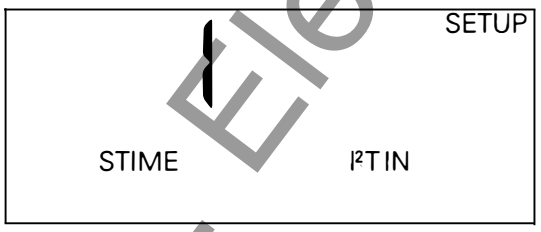


Figure 13. Trip unit display for short-time delay.

Band	Time Delays, sec
1	0.10
2	0.21
3	0.35

Table 9. Nominal delays for I^2T OUT short-time delay bands.

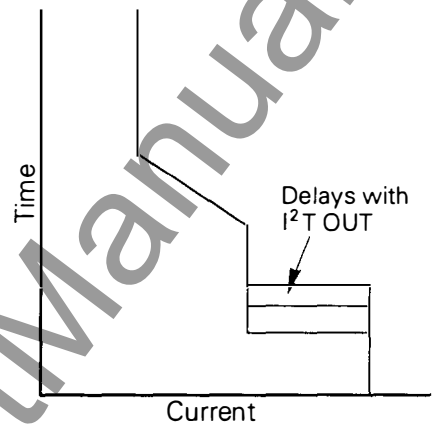


Figure 14. Time-current curve for short-time delay with I^2T OUT.

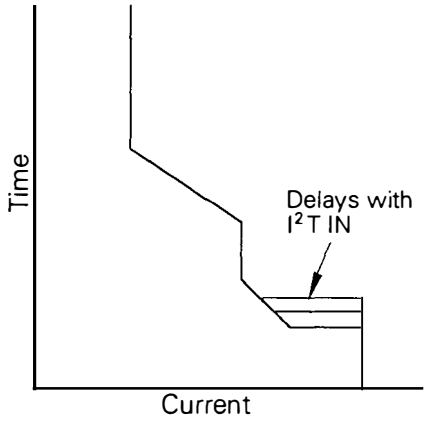


Figure 15. Time-current curve for short-time delay with I^2T IN

Instantaneous Pickup

Instantaneous overcurrent protection, with trip unit display shown in Figure 16, causes an immediate breaker trip when the chosen current level is reached. The pickup value may be set in the range of 1.5 to 15.0 times *X*, in steps of 0.5 *X*. Note the difference from short-time pickup, which is based on a multiple of *C*. The time-current characteristic is shown in Figure 17.

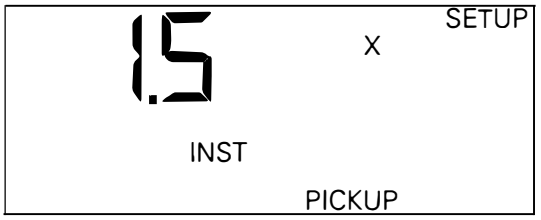


Figure 16. Trip unit display for instantaneous pickup.

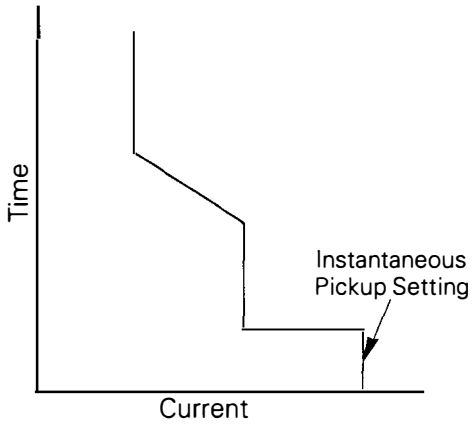


Figure 17. Instantaneous overcurrent protection set point.

If a 3000 A, 3200 A, or 4000 A sensor is installed in the breaker, instantaneous pickup is automatically limited to 13.0, 10.0, or 9.0 *X*, respectively.

> On trip units with the user-selectable switchable instantaneous overcurrent and ground-fault option, an additional value of OFF appears at the end of the listing of numerical values. Choose this setting to disable instantaneous protection.

High-Range Instantaneous Overcurrent Protection

High-range instantaneous overcurrent protection has a fixed trip setting equal to the breaker frame's short-time withstand rating, with pickup tolerance +0%, −20%. When this option is installed, skip programming of instantaneous pickup and go on to the next function by pressing SELECT.

Ground-Fault Pickup

The trip unit display for ground-fault pickup is shown in Figure 18. This function sets the pickup current for ground-fault protection. The available settings are listed in Table 10 as multiples of *S*, the current sensor rating, in steps of 0.01 *S*. The maximum value is limited to 1200 A. Figure 19 illustrates the time-current curve for ground-fault pickup.

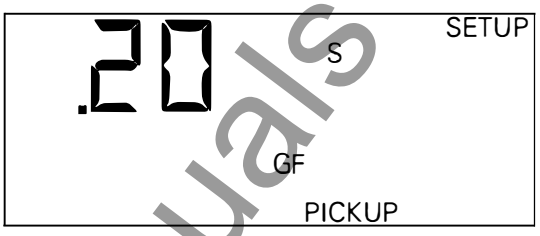


Figure 18. Trip unit display for ground-fault pickup.

Sensor, A	Set Points
150 - 2000	0.20 to 0.60
2500 - 3000	0.20 to 0.37
4000	0.20 to 0.30

Table 10. Ground-fault pickup settings, as a function of sensor rating.

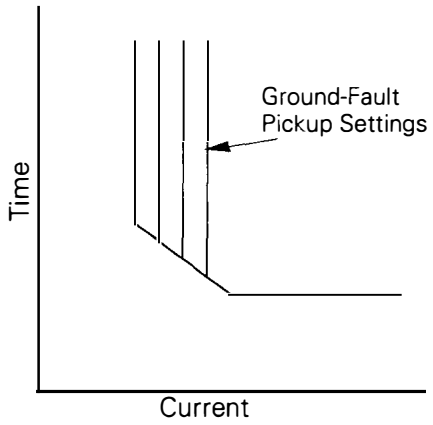


Figure 19. Time-current curve for ground-fault pickup.

Ground-Fault Delay

This function sets the delay before the breaker trips when the ground-fault pickup current has been detected. The trip unit display is shown in Figure 20. The choices are listed in Table 11. The delay for I^2T OUT is at the lower limit of each band. The delay for I^2T IN is at 200% of the pickup setting at the lower limit of the band.

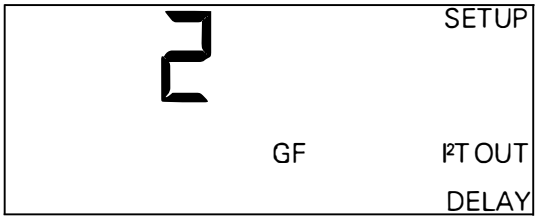


Figure 20. Trip unit display for ground-fault delay.

Band	Time Delay, sec
1	0.10
2	0.21
3	0.35

Table 11. Nominal delays for ground-fault delay bands.

The I^2T OUT function establishes a constant time delay, as shown in Figure 21. I^2T IN biases the delay with a constant slope, as shown in Figure 22.

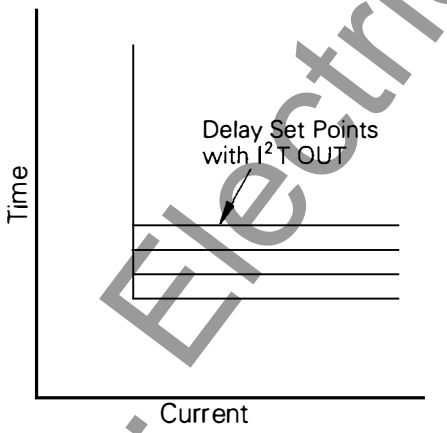


Figure 21. Time-current curve for ground-fault delay with I^2T OUT.

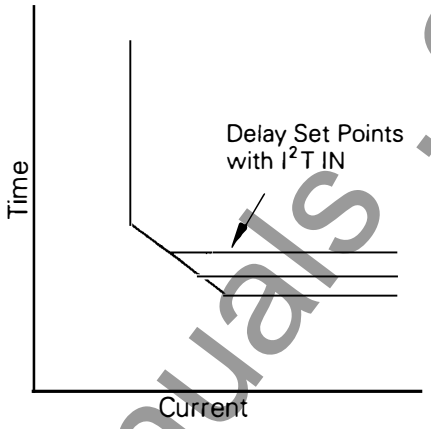


Figure 22. Time-current curve for ground-fault delay with I^2T IN.

With the X option (switchable ground fault), an OFF selection appears as an additional time-delay set point. Selecting OFF disables ground-fault protection.

Voltage-Unbalance Relay Pickup

This function compares the highest or lowest phase voltage with the voltages of the other two phases and initiates a trip if the difference exceeds the set point. The true rms voltage is computed for each phase. The range of set points is from 10 to 50%, with an increment of 1%. The trip unit display is shown in Figure 23.

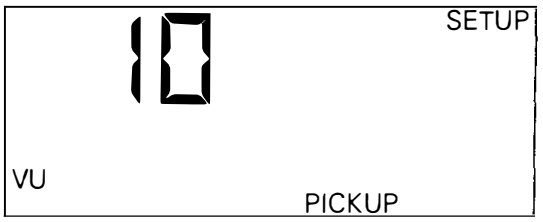


Figure 23. Trip unit display for voltage-unbalance relay pickup.

Voltage-Unbalance Relay Delay

This function sets the delay time before a voltage-unbalance trip occurs. The range of delays is 1 to 15 seconds, in steps of 1 second. Choosing OFF disables voltage-unbalance protection. The trip unit display is shown in Figure 24.

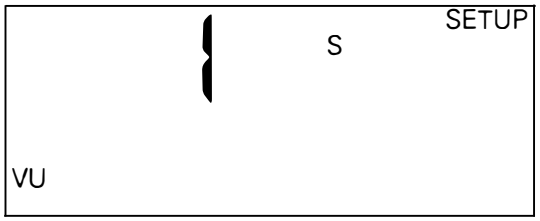


Figure 24. Trip unit display for voltage-unbalance relay delay.

Current-Unbalance Relay Pickup

This function compares the true RMS current in the highest or lowest phase with the other two phases and initiates a trip if the difference exceeds the set point. The range of set points is 10 to 50%, with an increment of 1%. The trip unit display is shown in Figure 25.

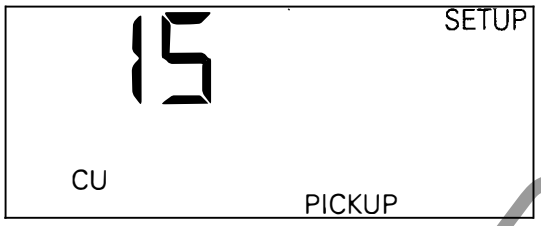


Figure 25. Trip unit display for current-unbalance relay pickup.

Current-Unbalance Relay Delay

This function sets the delay time before a current-unbalance trip occurs. The range of delays is 1 to 15 seconds, in steps of 1 second. Choosing OFF disables current-unbalance protection. The trip unit display is shown in Figure 26.

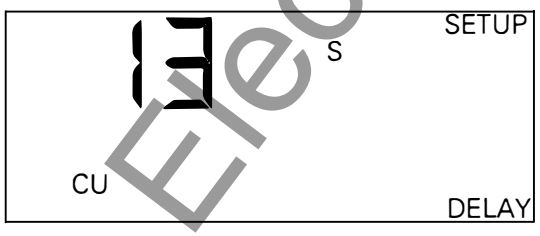


Figure 26. Trip unit display for current-unbalance relay delay.

Undervoltage Relay Pickup

This function measures the true rms voltage in all phases and initiates a trip if any phase voltage drops below the set point. The range of set points is 50 to 90% of the nominal voltage, with an increment of 1%. The trip unit display is shown in Figure 27.

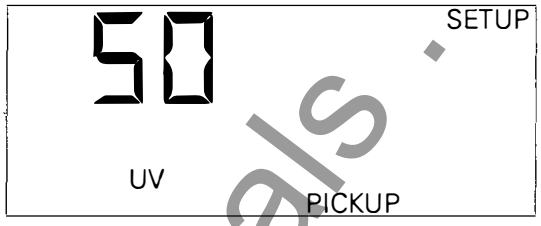


Figure 27. Trip unit display for undervoltage relay pickup.

Undervoltage Relay Delay

This function sets the delay time before an undervoltage trip occurs. The range of delays is 1 to 15 seconds, in steps of 1 second. Choosing OFF disables undervoltage protection. The trip unit display is shown in Figure 28.

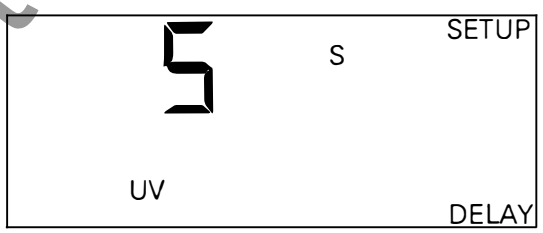


Figure 28. Trip unit display for undervoltage relay delay.

Overvoltage Relay Pickup

This function measures the true rms voltage in all phases and initiates a trip if any phase voltage exceeds the set point. The range of set points is 110 to 150% of the nominal voltage, with an increment of 1%. The trip unit display is shown in Figure 29.

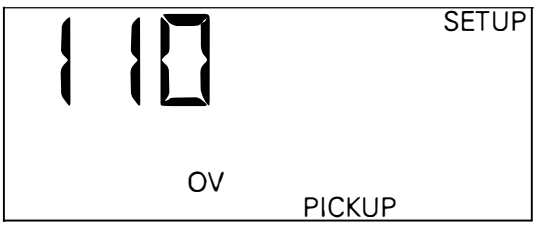


Figure 29. Trip unit display for overvoltage relay pickup.

Overvoltage Relay Delay

This function sets the delay time before an overvoltage trip occurs. The range of delays is 1 to 15 seconds, in steps of 1 second. Choosing OFF disables overvoltage protection. The trip unit display is shown in Figure 30.

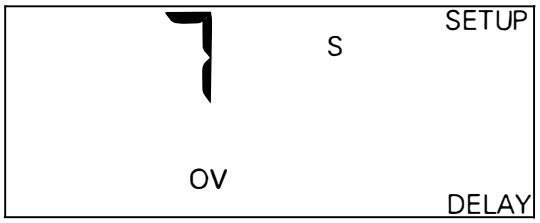


Figure 30. Trip unit display for overvoltage relay delay.

Power-Reversal Relay Pickup

This function measures the direction of power flow through the breaker and initiates a trip if a sufficient magnitude of reverse current is detected. The range of set points is 0.01 *Q* to 3.00 *Q*, in steps of 0.01. *Q* is the rating plug kVA and is calculated as shown in Table 6. Note that the PR indication on the trip unit display flashes when power direction is from load to line. The trip unit display is shown in Figure 31.

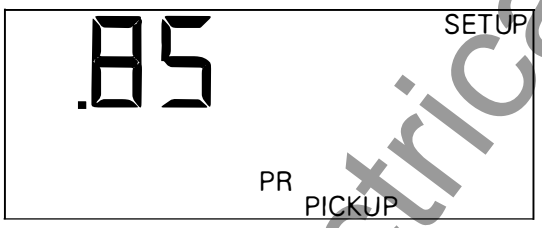


Figure 31. Trip unit display for power-reversal relay pickup.

Power-Reversal Relay Delay

This function sets the delay time before a power-reversal trip occurs. The range of delays is 1 to 15 seconds, in steps of 1 second. Choosing OFF disables power-reversal protection. The trip unit display is shown in Figure 32.

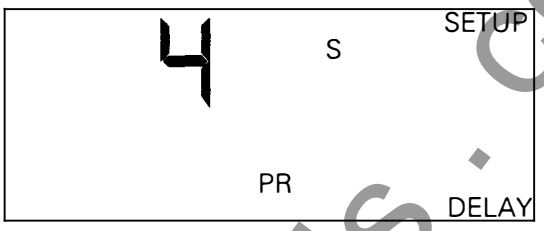


Figure 32. Trip unit display for power-reversal relay delay.

Rating Plug Current Setting

The trip unit display for rating plug setting is shown in Figure 33. Enter the current setting of the rating plug by scrolling through the list with VALUE and pressing ENTER when the correct value is reached. Table 12 lists the available rating plugs for the various trip units.

CAUTION: Incorrect storage of this set point will result in incorrect metering values. Even if this setting is entered remotely, it must be entered again locally.

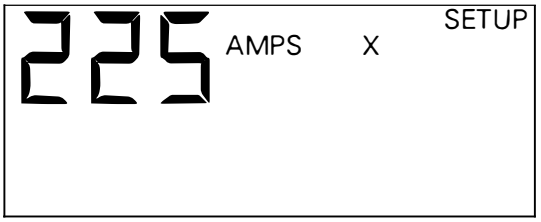


Figure 33. Trip unit display for rating plug current set point.

Cat. No.	Rating Plug Options, Amps
TT20	60, 80, 100, 125, 150, 200, 225, 250, 300, 400, 450, 500, 600, 700, 800, 1000, 1200, 1500, 1600, 2000
TT32	1200, 1600, 2000, 2400, 2500, 3000, 3200
TT40	1500, 1600, 2000, 3000, 4000

Table 12. Trip unit rating plug options.

Potential Transformer Primary Voltage

Enter the primary voltage rating of the potential transformer, as illustrated in Figure 34. The range of values is 120 to 600 volts, with an increment of 1 volt.

CAUTION: Incorrect storage of this set point will result in incorrect metering values. Even if this setting is entered remotely, it must be entered again locally.

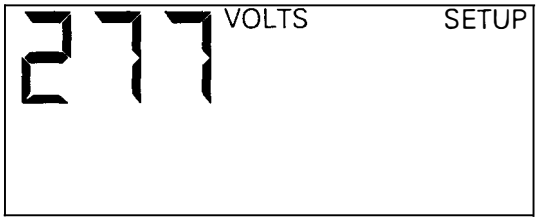


Figure 34. Trip unit display for potential transformer primary voltage set point.

Potential Transformer Connection

Note that this step applies only to MicroVersaTrip PM trip units.

Select the appropriate potential transformer connection, either line-to-line (VL-L) or line-to-neutral (VL-N), as illustrated in Figure 35.

CAUTION: Incorrect storage of this set point will result in incorrect metering values. Even if this setting is entered remotely, it must be entered again locally.

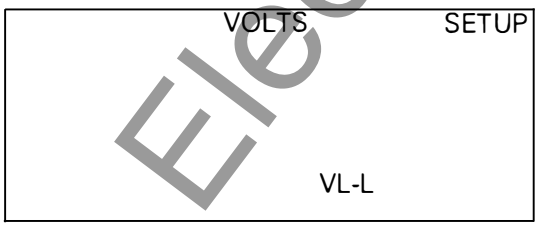


Figure 35. Trip unit display for potential transformer connection choice.

Communication Address

Note that this step applies only to MicroVersaTrip PM trip units connected to either POWER LEADER or Epic MicroVersaTrip systems.

With POWER LEADER systems the address is assigned at the breaker. The set point values are separated by decimal points to differentiate the addresses from other set points, as illustrated in Figure 36. The address options are from 256 to 999.

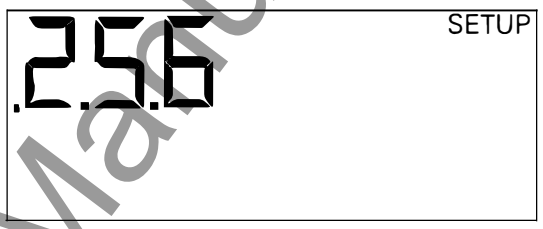


Figure 36. Trip unit display for setting communication address.

With Epic MicroVersaTrip systems, the Epic system's Field Programming Unit (FPU) calls for removal of the rating plug. This is not required for addressing a MicroVersaTrip PM trip unit. Simply press ENTER to identify the unit to the FPU. *The address shown on the FPU's display must not be changed at the breaker.*

3-1 Overview

The metering mode displays parameter values for that part of the electrical system controlled by the breaker's MicroVersaTrip Plus or MicroVersaTrip PM trip unit. Both currents and voltages are computed as true rms values. Displayed values are immune to high levels of harmonics. All metering displays are updated once each second. Accuracies and resolutions are described in Section 1-8 and Table 5.

All values except frequency are displayed to three significant figures. For example, phase currents might be displayed as 60.7 AMPS, 492 AMPS, or 1.22 kA.

The trip unit metering displays are appropriate to the actual configuration ordered. All MicroVersaTrip Plus and MicroVersaTrip PM trip units include current metering. Two configurations of the PM trip units (with PM and M suffixes in their catalog numbers) have the full complement of metering displays.

The trip unit must be provided with control power to display metered values. This can come from a MicroVersaTrip Test Kit, a MicroVersaTrip battery pack, an external 24 Vdc power supply, or energizing the breaker to at least 20% of its sensor load.

3-2 Metering Mode Operation

Metering mode is reached by pressing FUNCTION until METER appears in the upper-right corner of the display. Metering mode always begins with the phase currents. The sequence in which the metered values appear is illustrated in Figure 37.

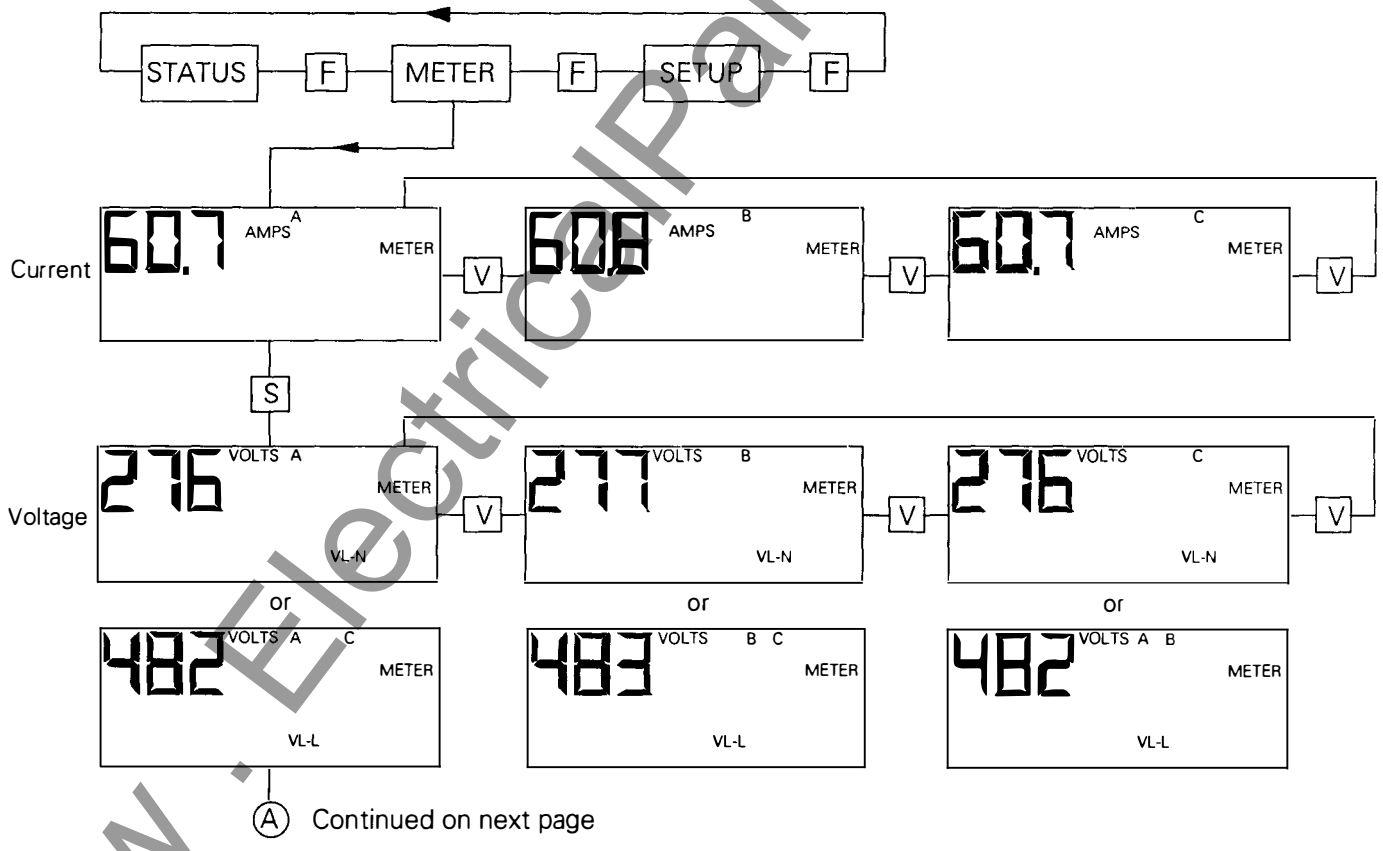


Figure 37. Trip unit metering mode function flow.

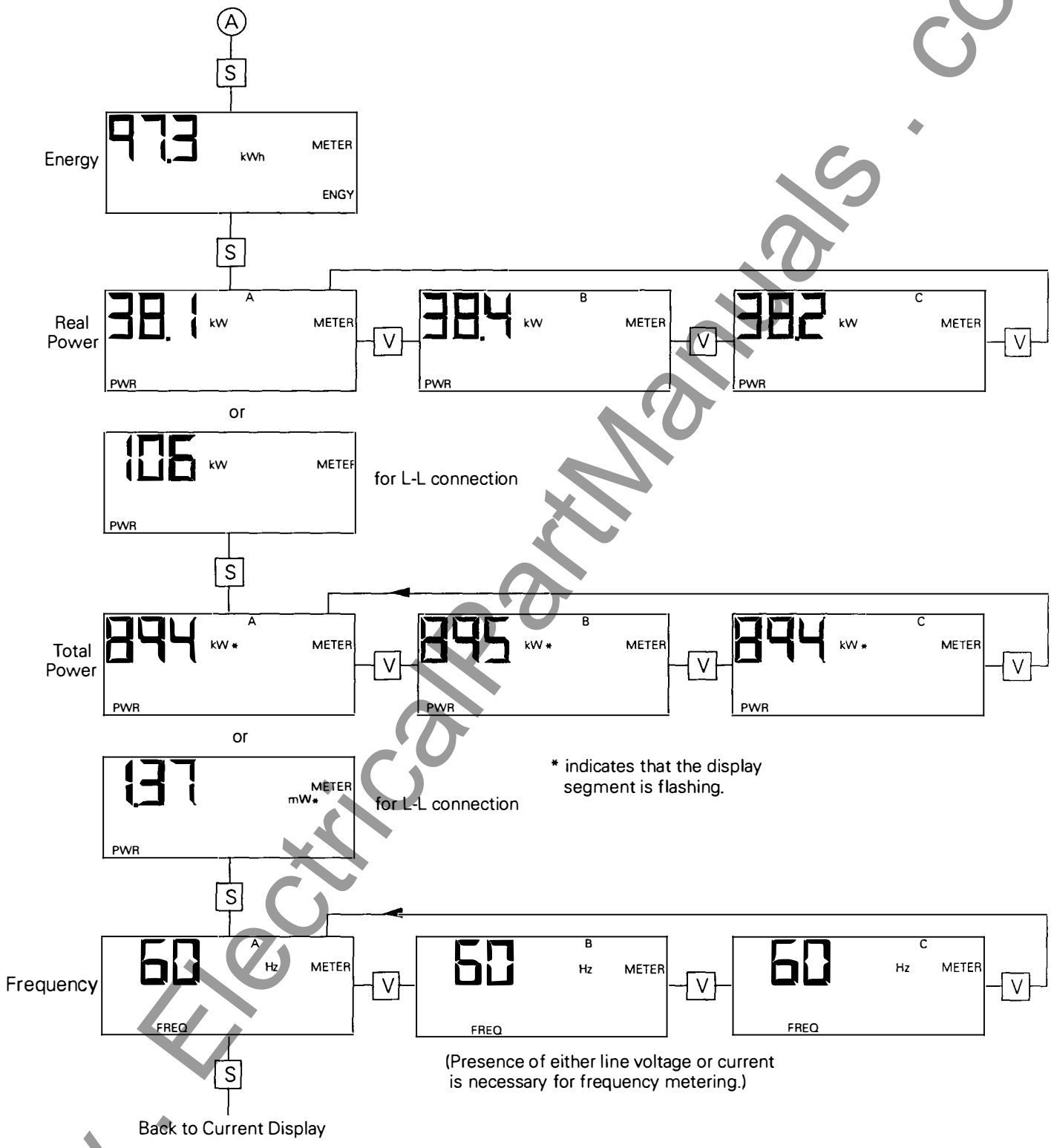


Figure 37. Trip unit metering mode function flow (continued).

Current

The initial metering display is phase A line current, as illustrated in Figure 38. Press VALUE to cycle among the three phases. Current is displayed from 0 to 999 amperes and from 1.00 to a maximum of 999 kA.

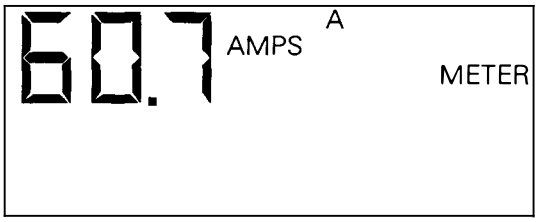


Figure 38. Trip unit display for current metering.

Voltage

The voltage displayed by this function depends on how the trip unit was configured during Setup. If the breaker was configured with line-to-neutral connections, the display shows individual phase voltages, as in Figure 39. If the breaker was configured with line-to-line connections, the display shows voltages between the phases, as in Figure 40.

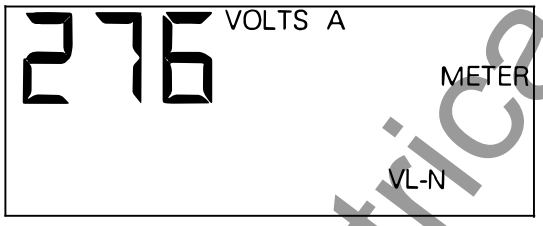


Figure 39. Trip unit display for line-to-neutral voltages.

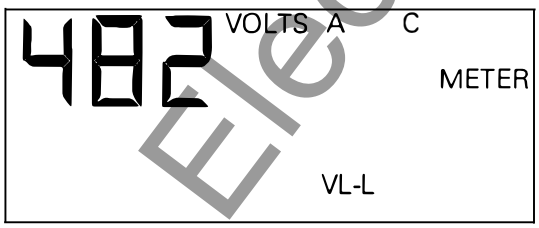


Figure 40. Trip unit display for line-to-line voltages.

Energy

This display, illustrated in Figure 41, shows the aggregate energy flow through the breaker. The value is displayed from 0 to 999 kWh, then automatically switches units to display 1.00 to 999 MWh. When 999 MWh is exceeded, the display switched back to 0 kWh. The largest negative energy value displayed is –99 MWh.

The value in the display can not be reset at the trip unit keypad. The VALUE key has no effect on the energy display.

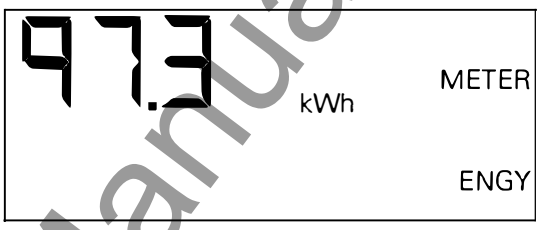


Figure 41. Trip unit display for aggregate energy.

Real Power

The value displayed for real power depends on how the breaker and trip unit were configured. For line-to-neutral connections, the power in each phase is displayed, as in Figure 42. For line-to-line connections, the aggregate power is displayed, as in Figure 43.

The value is shown from 0 to 999 kW or from 1.00 to 999 MW, as appropriate.

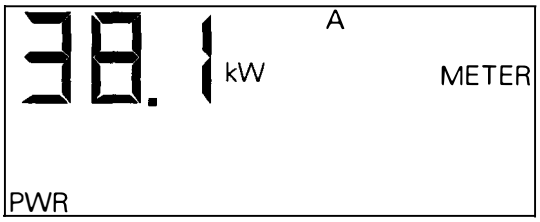


Figure 42. Trip unit display for real power with line-to-neutral connections.

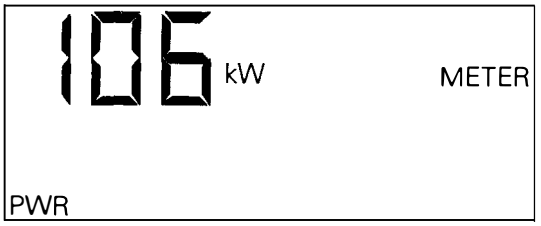


Figure 43. Trip unit display for aggregate real power with line-to-line connections.

Total Power

The value displayed for total power depends on how the breaker and trip unit were configured. For line-to-neutral connections, the total power in each phase is displayed, as in Figure 44. For line-to-line connections, the aggregate total power is displayed, as in Figure 45.

The value is shown from 0 to 999 kW or from 1.00 to 999 MW, as appropriate. The kW or mW segment flashes on the display to indicate that kVA or MVA is actually being measured. (This is indicated by * in the figures.)

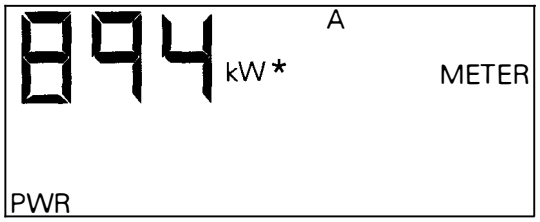


Figure 44. Trip unit display for total power with line-to-neutral connections.

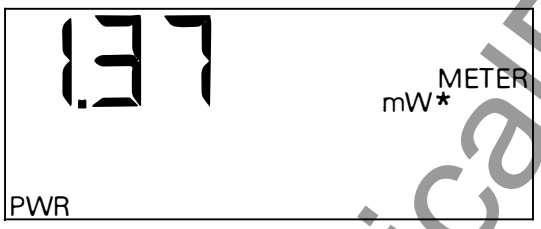


Figure 45. Trip unit display for aggregate total power with line-to-line connections.

Frequency

This display, illustrated in Figure 46, shows the frequency of the line current in each phase. Either line voltage or current must be present for this display to appear.

The frequency is calculated from the current and voltage signals. If both are present, the voltage frequency is displayed. If neither are present, this display does not appear.

The frequency is displayed in steps of 1 Hz.

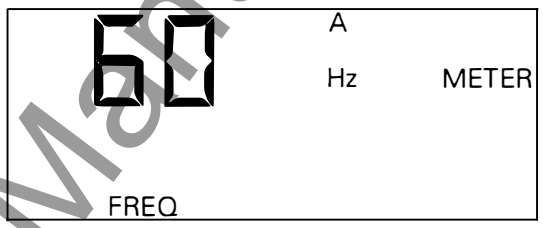


Figure 46. Trip unit display for frequency in each phase.

4-1 Overview

Status mode is the normal display mode for breaker information. The status display identifies an imminent overcurrent trip, then, afterward, target displays that indicate the reason for the trip.

Status displays reflect the options ordered with the trip unit. All MicroVersaTrip Plus and MicroVersaTrip PM trip units provide information on long-time overcurrent protection. Only PM style trip units can be equipped with protective relays and, consequently, display information about them.

The trip unit must be provided with control power to display status information. This can come from a MicroVersaTrip Test Kit, a MicroVersaTrip battery pack, an external 24 Vdc power supply, or energizing the breaker to at least 20% of its sensor load.

4-2 Status Mode Operation

This section describes each of the status displays and the sequences in which they appear.

Normal Status Display

When the breaker is closed and its circuit energized, the normal status display appears, as illustrated in Figure 47. This display indicates that the trip unit is not in long-time pickup.

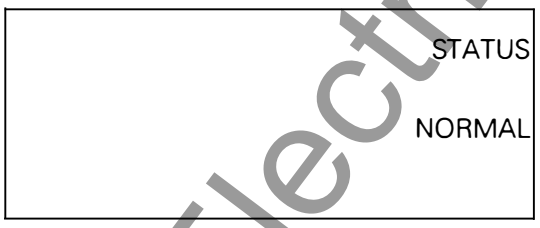


Figure 47. Trip unit display for normal status.

Long-Time Overcurrent Pickup and Target Displays

When the long-time overcurrent function has reached 95% of the trip unit's current rating, *C*, PICKUP begins to flash on the display, as illustrated in Figure 48. During the transition from 95% to 100% of the set point, the frequency of flashing increases. When the set point is reached, but before the time delay has expired, the flashing stops, indicating that trip is imminent.

Figure 48. Trip unit status display for long-time overcurrent pickup.

When the breaker trips for long-time overcurrent, the target display indicates OVERLOAD, as illustrated in Figure 49.

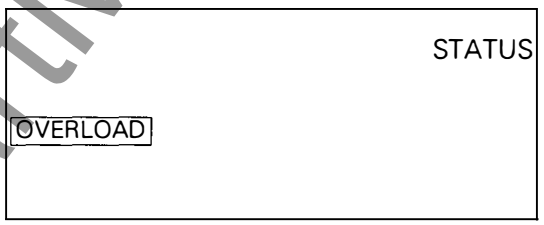


Figure 49. Trip unit status display for long-time overcurrent trip.

Short-Time Overcurrent Target Display

After a short-time trip, the status display appears as in Figure 50. The display does not flash.

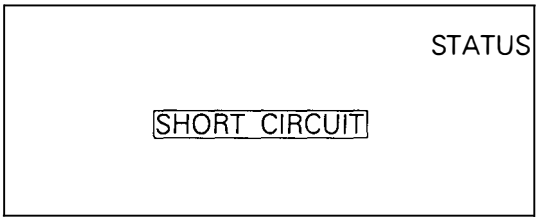


Figure 50. Trip unit status display for short-time overcurrent trip.

Instantaneous Target Display

The status display for an instantaneous trip is similar to that for a short-time trip, as in Figure 50, except that SHORT CIRCUIT flashes repeatedly.

Ground-Fault Target Display

When a ground-fault trip occurs, the display illustrated in Figure 51 appears.

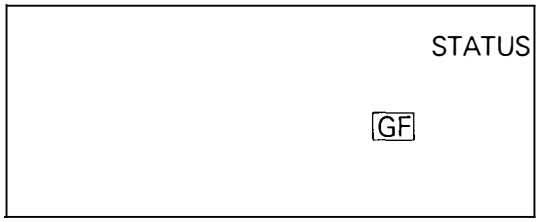


Figure 51. Trip unit status display for ground-fault trip.

Protective-Relay Target Displays

After a protective-relay trip, the display indicates OVERLOAD, which flashes repeatedly, with a two-letter code for the type of relay that initiated the trip. This is illustrated in Figure 52 for an overvoltage trip. The codes for the five protective relays are listed in Table 13.

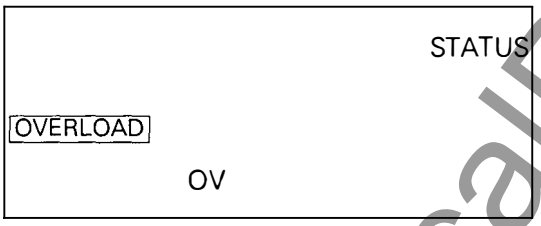


Figure 52. Trip unit status display for protective-relay trip.

Code	Protective Relay
VU	Voltage unbalance
CU	Current unbalance
UV	Undervoltage
OV	Overvoltage
PR	Power reversal

Table 13. Trip unit display codes for protective relays.

Clearing the Target After Trip

After any of the above abnormal-operation displays, the target must be acknowledged and cleared at the trip unit. If necessary, press FUNCTION until STATUS appears in the display. Press SELECT and VALUE simultaneously to acknowledge the trip and return the display to NORMAL status, as in Figure 47. If the target display is not cleared before the breaker is re-energized, it will continue to appear in all modes.

Rating plugs and MicroVersaTrip Plus and MicroVersaTrip PM trip units are factory tested and normally shipped installed in their breaker frame assemblies or as part of a conversion kit. There is no requirement for periodic maintenance of the trip units. *There are no user-serviceable components within the trip units.*

5-1 Trip Unit Removal and Replacement

Rejection plugs 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. Replacement of a trip unit always requires repeating the setup procedures, as described in Chapter 2.

POWER BREAK Insulated-Case Circuit Breakers

POWER BREAK circuit breakers are shipped from the factory with their trip units installed. Trip units can not be removed on site.

Type AKR Low-Voltage Power Circuit Breakers

Type AKR circuit breakers are shipped from the factory with their trip units installed. Removal is necessary only for replacement. Trip units are separately mounted on the breaker structure and are removed by moving the trip unit removal bracket. When a trip unit is replaced, the locking arm snaps back into place to indicate proper engagement.

WARNING: Always de-energize Type AKR circuit breakers before attempting to remove or replace the trip unit. Because of the exposed location of the trip unit, failure to observe this warning may result in equipment damage or personal injury, including death.

5-2 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.

Interchangeable rating plugs are removed with a Rating Plug Extractor, 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. Be sure to grab the tabs and not the front cover of the rating plug, or the plug may be damaged.

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.

If a replacement rating plug has a different rating than the plug that was removed, follow the appropriate setup procedure in Chapter 2 to enter the new rating.

Do not attempt to use a rating plug from a Spectra RMS breaker or a MicroVersaTrip RMS-9/MVT-4 function trip in a MicroVersaTrip Plus or MicroVersaTrip PM trip unit.

5-3 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 trip unit display is blank.	Line current is below 20% of *S* (MicroVersaTrip Plus).	At least 20% of the current sensor rating, *S*, must be flowing through the breaker to activate the display. If not, power the trip unit with the Test Kit or external battery pack.
	External 24 Vdc is absent (MicroVersaTrip PM).	Check that the control power supply is present and operational.
2. The trip unit display flashes.	Can occur on Plus style trip units when load current fluctuates near 20% of *S*.	Power the trip unit with the Test Kit or external battery pack.
3. The trip unit display flashes ERR.	The built-in self test has detected an error.	Replace the trip unit.
4. The trip indication target will not clear.	Trip unit is not in status mode.	Press FUNCTION until STATUS is displayed. Press SELECT and VALUE together to clear the target.
5. Unit does not communicate with the Monitor, POWER LEADER Distribution Software, or FPU.	Commnet wires are shorted or improperly connected.	Locate and repair the short or the incorrect connection.
	FPU version is lower than 2.0.	Update FPU to version 2.0 or higher.
	Trip unit address incorrect.	Check that address assigned to trip unit, as in Chapter 2, agrees with address at host.
6. Current readings are incorrect.	Rating plug value was defined incorrectly.	Read the *X* value from the rating plug name plate and enter this with the rating plug current set point procedure in Chapter 2. *Do not enter the sensor rating, S.*
7. Voltage readings are incorrect.	Potential transformer (PT) primary voltage was defined incorrectly.	Read the PT primary rating from the PT name plate and enter this value with the PT primary voltage procedure in Chapter 2.
	PT connection was defined incorrectly.	With the PT connection procedure in Chapter 2, enter VL-N for a wye-connected PT primary or VL-L for a delta-connected PT.
8. kW legend is flashing.	Total power metering.	Indicates that the total power is metered in kVA.
9. Overload target is flashing by itself.	Test Kit-initiated trip indication.	Clear target as indicated above (Symptom 4).

GE Electrical Distribution & Control

General Electric Company
41 Woodford Ave., Plainville, CT 06062

GEH-5891A 0493 PSB