EntelliGuard® TU Trip Unit

Installation, Operation,
and Maintenance Manual for the UL
Versions of the EntelliGuard TU Trip Unit

Used in the following GE Circuit Breakers:

- EntelliGuard G
- WavePro
- AKR
- Power Break I
- Power Break II

Retain for Future Use.

DOCUMENT REVISION HISTORY			
REV	Page(s) Affected	Description of Revision	Date
-	All	Initial release.	08/04/08

HAZARD CATEGORIES

The following important highlighted information appears throughout this document to warn of potential hazards or to call attention to information that clarifies a procedure.

Carefully read all instructions and become familiar with the devices before trying to install, operate, service or maintain this equipment.

⚠ DANGER

Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Failure to comply with these instructions may result in product damage.

NOTICE

Indicates important information that must be remembered and aids in job performance

TRADEMARKS

The following are trademarks of GE Company:

EntelliGuard®

Power Break®

MicoVersaTrip®

ProTrip®

WARRANTY

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.

Contact your local sales office if further information is required concerning any aspect of EntelliGuard G, AKR, Power Break, Power Break II and WavePro circuit breaker operation or maintenance.

TABLE OF CONTENTS

TABLES

FIGURES

SECTION 1 – GENERAL INFORMATION

INTRODUCTION

The EntelliGuard TU Trip Unit is an electronic device that interfaces with a circuit breaker. It monitors the breaker phase currents, neutral current and/or voltage and trips the breaker in the event of an over-current or voltage related condition. It also provides protective relay functions, advanced metering, diagnostic features, and communications. The Trip Unit can be removed or replaced in the field by de-energizing and removing the cover of the circuit breaker.

The Trip Unit also connects with the circuit breaker flux shifter to provide the electromechanical tripping function. A user interface is provided on the front panel to allow adjustment of the Trip Unit's parameters.

ABBREVIATIONS AND ACRONYMS

The abbreviations and acronyms in Table 1 used throughout this manual. Slightly different abbreviations and acronyms are used for IEC trip units.

Table 1: Abbreviations and Acronyms

Item	Definition
I_{RMS}	True RMS current measurement through a phase
xI_{CT}	Multiples of current sensor rating (non-dimensional)
I_n	Rating plug ampere setting where I_n I_{CT}. This is the breaker nominal rated current (A)

PRODUCT DESCRIPTION

Appearance

The Trip Unit includes a graphical LCD. The front panel is similar to those shown in Figure 1 through Figure 3.

Figure 1: Front Panel View – Power Break II and WavePro Trip Units

Figure 2: Front Panel View – Power Break I and AKR Trip Units

Figure 3: Front Panel View – EntelliGuard G Trip Units

LCD ACCESS

The trip unit has five function keys as shown in Figure 4. Any key, when pressed, powers up the LCD.

All SETUP, STATUS, METER and EVENTS information is accessed through these five keys.

Figure 4: Trip Unit Keypad

- UP: Scroll up or increment value
- DOWN: Scroll down or decrement value
- RIGHT: Next function or next page
- LEFT: Previous function or previous page
- ENTER: Save or set in to memory

Electrical Requirements

None: Plug in installation. Done on un-energized units.

Equipment Interfaces

Power Break I, Power Break II, WavePro, AKR and EntelliGuard G Circuit Breakers.

Trip units, for the most part, do not require direct connections to the equipment. All wiring is intended to connect to the circuit breaker or cassette. Connections that are required for other equipment are the optional zone-selective interlock, input, and relay output made by the 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 fault or overload event. The types of available zone-selective interlocking are Z, which reacts to ground faults and short time pickups, and T, which reacts to ground faults, short-time and instantaneous pickups.

Input 1 can be programmed for reduced instantaneous or trip the breaker. Other inputs can be programmed to trip the breaker only.

Power Break I, Power Break II, WavePro and AKR Trip Units have one relay. EntelliGuard G Trip Units have two output relays. The relay output can be assigned to the following functions:

- GF Alarm
- Over-current trip (GF, INST, LT, ST)
- Reduced Instantaneous (RELT) Active
- Protective Relays
- Current Alarm 1
- Current Alarm 2
- Health status

The trip units must have the specific option (as an example protective relay must be enabled in order for protective function to actuate the relay) enabled in order to actuate the relay.

In addition to the inputs indicated above, Power Break I, Power Break II, WavePro, AKR , and EntelliGuard G Trip Units also receive inputs from external voltage conditioners, a +24 VDC control power supply, and communication connections. (Note: external +24 VDC control power is required for communication.)

All trip unit types have a connection to an auxiliary switch within the breaker that senses the breaker's position.

COMMUNICATIONS

External +24 VDC control power is required for communications.

Power Break I, Power Break II, WavePro, AKR, and EntelliGuard G Trip Units support Modbus communication protocol. In addition, EntelliGuard G Trip Units support Profibus communication.

Modbus and Profibus connections are made directly to wiring terminations on breaker frames. All Modbus/Profibus connections are made through the trip unit's back (Power Break I, Power Break II, WavePro and AKR Trip Units) and top (EntelliGuard G Trip Units) connectors, which mate with a receptacle on the breaker frame. These additional connections are made to the equipment through the secondary disconnects of the breaker.

Modbus

The Trip Units are fully compliant with Modbus Protocol. Full details of the Modbus protocol can be found in the Modbus Protocol Specification.

Two wire Modbus 485 are supported.

The link Host may operate at a 300, 600, 1200, 2400, 4800, 9600 or 19200-baud rate.

ProfiBus

This protocol is integral to EntelliGuard G Trip Units. ProfiBus DP over RS485 is supported.

OVER CURRENT PROTECTION FUNCTIONS

The Trip Unit provides the following over current protections:

- Long Time
- Short Time
- Instantaneous
- Reduce Let Through Energy Instantaneous (RELT)
- Ground Fault Internal Summation
- Ground Fault CT External Summation
- Override (HSIOC)
- Making Current Release (MCR)

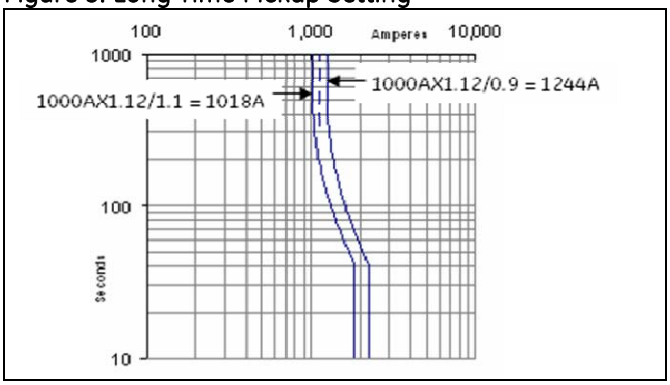
Long Time

Long Time Pickup

This setpoint establishes the breaker's nominal ampere rating, xLT, as a fraction of the rating plug value, xIn (xLT = LT multiplier x xIn).

The adjustment range for long time pickup settings is 0.50 to 1.00 times xIn in steps of 0.05. The pickup value tolerance band has a 10% tolerance. The band is drawn at 1/(1+10%) and 1/1-10%). The actual long time pickup is increased by 12% over the nominal so that 100% nominal current may be carried indefinitely. So a 1000 A setting is placed at 1120 A with the minimum pickup drawn (left side of band) is 1120 A/1.1, and the maximum pickup (right side of band) is drawn at 1120 A/0.9. Figure 5 shows the Long Time pickup setting.

Figure 5: Long Time Pickup Setting



Long Time Delay

The trip unit makes up to 44 different long time bands available. Not all circuit breakers have all bands available. There are 22 bands using a logarithmic type curve that resembles the thermal portion of a thermal magnetic circuit breaker. There are 22 bands that are a straight line that simulate a fuse curve. The Entelliguard circuit breaker is able to use all 44 bands. Power Break I, Power Break II, WavePro and AKR circuit breakers use the 19 lower thermal CB-type bands and the 22 fuse-type bands.

Short Time

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 from 1.5 to 12.0 times the Long Time setting, xLT, in steps of 0.5 xLT.

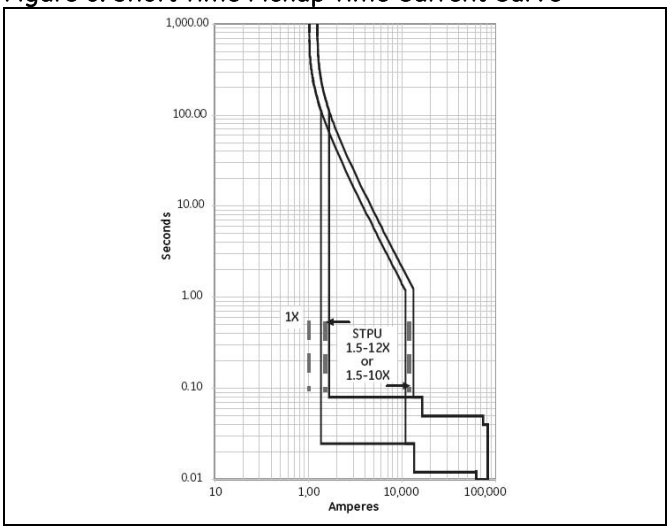
The maximum pickup depends on breaker type and frame as shown in Table 2 below:

Table 2. Short Time Breaker Type and Frame

Breaker	Available Settings
PowerBreak I, PowerBreak II, WavePro, AKR conversion kits	1.5 to 9, steps of 0.5
EntelliGuard G Frame 1 and 2	1.5 to 12, steps of 0.5
EntelliGuard G Frame 3	1.5 to 10, steps of 0.5

The Short Time Pickup value tolerance band is -9% to +11% of the set point based on a 10% current sensing accuracy with the pickup calculated with 1/(1±Tolerance). The time current curve of short time pickup is shown in Figure 6.

Figure 6: Short Time Pickup Time Current Curve



Short Time Delay

The Short Time Delay setting consists of both a slope setting and a fixed delay band setting. The slope and delay are independently selectable. The slope setting consists of three I^2T slopes (minimum (1), intermediate (2) and maximum (3)) and fixed delay. The fixed delay bands consist of 11 constant time bands. The width of the bands varies by circuit breaker and with frequency. See Table 3.

Table 3: Short Time Delay Slope Settings

Band	TDB Setting	Commit Time		EntelliGuard G	
		50 Hz	60 Hz	Clear Time 60 Hz	Clear Time 50 Hz
1	Min.	0.030	0.025	0.080	0.085
2	2nd	0.040	0.033	0.088	0.093
3	3rd	0.050	0.042	0.097	0.102
4	4th	0.060	0.058	0.113	0.118
5	5th	0.110	0.092	0.147	0.152
6	6th	0.130	0.117	0.172	0.177
7	7th	0.180	0.158	0.213	0.218
8	8th	0.210	0.183	0.238	0.243
9	9th	0.240	0.217	0.272	0.277
10	10th	0.280	0.350	0.405	0.410
11	Max.	0.340	0.417	0.472	0.477

Adjustable Selective Instantaneous Protection

Adjustable Selective Instantaneous over current protection causes an undelayed breaker trip when the chosen current level and proper waveform is reached.

The pickup value may be set in steps of 0.5 xIn from 2.0 xIn to 15 xIn and steps of 1 xIn from 15 xIn to a maximum of 30 xIn. Greater than 15xIn is available only in trips provided with the "Extended Range Instantaneous" option on ANSI EntelliGuard G circuit breakers.

The maximum possible setting depends on the trip unit instantaneous option provided, the circuit breaker's withstand capability and whether or not ST has been enabled.

Table 4: Maximum Instantaneous For Power Break I, Power Break II, WavePro and AKR Trip Units

Frame (A)	ANSI (X In)		UL (X In)	
	With ST	W/O ST	With ST	W/O ST
800	15	10	15	10
1,600	15	10	15	10
2,000	15	10	15	10
2,500	-	-	13	10
3,000	-	-	13	10
3,200	13	10	-	-
4000	9	9	9	9
5000	7	7	-	-

The Instantaneous pickup accuracy is 10%. On trip units with the user-selectable switchable instantaneous over current 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, and or GF protections.

Short Time and Instantaneous cannot be turned off simultaneously. Only ANSI circuit breakers may have the Instantaneous off option. Trips with GF off as an option are not UL listed.

When Instantaneous pickup is set above the maximum allowed for the CB without ST on, ST pickup is automatically switched on at a default delay is automatically switched on at a minimum delay setting.

Reduced Energy Let-Through Instantaneous Protection (RELT)

EntelliGuard G Trip Units provide a Reduced Let-Through Energy Instantaneous function (RELT) which may be enabled at the trip's key pad, via a 24 VDC/AC signal to INPUT 1 or via serial communications. The RELT function provides a faster instantaneous trip function that may be used in case faster and more sensitive protection is required temporarily.

The pickup value may be set in steps of 0.5 xIn from 1.5 xIn to 15xIn or the maximum allowed instantaneous pickup for the particular circuit breaker type, rating and size. The maximum setting depends on the trip unit catalog number, breaker type and frame, and whether or not ST is enabled. See Table 6.

Table 5: Maximum Instantaneous Thresholds For Power Break I, Power Break II, WavePro and AKR Trip Units

Breaker Frame Size (A)	Maximum Instantaneous Threshold with Short Time ($\times I_N$)	Maximum Instantaneous Threshold without Short Time ($\times I_N$)
800	Off, 1.5 to 15	Off, 1.5 to 10
1600	Off, 1.5 to 15	Off, 1.5 to 10
2000	Off, 1.5 to 15	Off, 1.5 to 10
3200	Off, 1.5 to 13	Off, 1.5 to 10
4000	Off, 1.5 to 9	Off, 1.5 to 9
5000	Off, 1.5 to 7	Off, 1.5 to 7

Ground Fault Protection

The Trip Unit provides two types of ground fault protection in addition to the GF alarm. These protections are independent. The GF alarm has the same pickup level, band choices and tolerances as GF.

The GF pickup value tolerance band is 15% the set point. The ground fault pickup settings are listed in Table 6 as multiples of xCT the current sensor rating, in steps of 0.01 xCT. The maximum value is limited to 1200.

Table 6: Ground Fault Pickup Settings

Protection Type	Sensor, I_{CT}	Ground Fault Pickup Threshold ($\times I_{CT}$)
GF SUM GF SUM ALARM GF CT GT CT ALARM	150–2000	0.20–0.60 (max of 1200 A) (increment of 0.01) with OFF as a selection when GF or GF Alarm Switchable is optioned.
GF/ALARM Pickup	2500-3200	0.20–0.37 (increment of 0.01) with OFF as a selection when GF or GF Alarm Switchable is optioned.
GF/ALARM Pickup	4000	0.20–0.30 (increment of 0.01 with OFF as a selection when GF or GF Alarm Switchable is optioned.
GF/ALARM Pickup	5000	0.20–0.24 (increment of 0.01) with OFF as a selection when GF or GF Alarm Switchable is optioned.
GF/ALARM Pickup	6000	0.2 (1200 A) with OFF as a selection when GF or GF Alarm Switchable is optioned.

Table 7 gives the sensor settings and ratings.

Table: 7: Sensor Settings and Ratings

Sensor	Max. X	Min.	A	Max.	A
400	0.60	80	A	240	A
600	0.60	120	A	360	A
800	0.60	160	A	480	A
1200	0.60	240	A	720	A
1600	0.60	320	A	960	A
2000	0.60	400	A	1,200	A
2500	0.48	500	A	1,200	A
3000	0.40	600	A	1,200	A
3200	0.37	640	A	1,184	A
4000	0.30	800	A	1,200	A
5000	0.24	1,000	A	1,200	A
6000	0.20	1,200	A	1,200	A

Notes:

- Continuously adjusted in 0.01 increments.
- Minimum X is 0.2 for all sensors.

Ground-Fault Delay

This function sets the delay before the breaker trips when the ground-fault pickup current has been detected.

The Ground Fault Delay setting consists of a selection between two I^2T slopes:, an optional steeper fuse slope, and fixed delay only. One of fourteen fixed time bands is also selected. The fixed delay bands are listed in Table 8.

Table 8: Ground Fault Time Delay Bands, 50 Hz and 60 Hz

Time Band	EntelliGuard G UL Commit Time (S)		PB I, PB II, WavePro, AKR Commit Time (S)	
	60 Hz	50Hz	60 Hz	50Hz
1	0.042	0.050	-	-
2	0.058	0.060	0.058	0.060
3	0.092	0.110	0.092	0.110
4	0.117	0.130	0.117	0.130
5	0.158	0.180	0.158	0.180
6	0.183	0.210	0.183	0.210
7	0.217	0.240	0.217	0.240
8	0.350	0.280	0.350	0.280
9	0.417	0.340	0.417	0.340
10	0.517	0.390	0.517	0.390
11	0.617	0.540	0.617	0.540
12	0.717	0.640	0.717	0.640
13	0.817	0.740	0.817	0.740
14	0.917	0.840	0.917	0.840

Notes:

- Power Breaker I, Power Breaker II, WavePro and AKR time band width is 60 msec.
- EntelliGuard G 60 Hz time band width is 0.055 sec.
- EntelliGuard G 50 Hz time band width is 0.060 sec.

PROTECTIVE RELAY

The protection relay can be set to either cause a trip or an alarm. If the PR Enable on the LCD is set to ON, a trip will be generated, if set to NO an alarm will be generated.

Voltage Unbalance Relay

This function compares the highest or lowest phase voltage with the average of all three phases and initiates a trip if the difference exceeds the set point.

Table 9: Voltage Unbalance Settings

Item	Option
Voltage unbalance pickup	Adjustable from 10% to 50% in increments of 1%.
Voltage unbalance delay setting	Adjustable from 1 sec to 15 sec in increments of 1 sec. Setting this value to zero (0) disables this function.

Current Unbalance Relay

This function compares the current in the highest or lowest phase with the average of all three phases and initiates a trip if the difference exceeds the set point.

Table 10: Current Unbalance Settings

Item	Option
Current unbalance pickup	Adjustable from 10% to 50% in increments of 1%.
Current unbalance delay setting	Adjustable from 1 sec to 15 sec in increments of 1 sec. Setting this value to zero (0) disables this function.

Under Voltage Relay

This function measures the voltage in all phases and initiates a trip if any phase voltage drops below the set point.

Under Voltage Relay Zero-Volt Trip Enable

This function determines if the relay trips when all three-phase voltages drop to zero volts. See Table 11.

Table 11: Under Voltage Settings

Item	Option
Under voltage pickup	Adjustable from 50% to 90% in increments of 1%.
Under voltage delay setting:	Adjustable from 1 sec to 15 sec in increments of 1 sec. Setting this value to zero (0) disables this function.

Over Voltage Relay

This function measures the voltage in all phases and initiates a trip if any phase voltage exceeds the set point. See Table 12.

Table 12: Over Voltage Settings

Item	Option
Over voltage pickup	Adjustable from 110% to 150% in increments of 1%.
Over voltage delay	Adjustable from 1 sec to 15 sec in increments of 1 sec. Setting this value to zero (0) disables this function.

Power-Reversal Relay

This function measures the direction of power flow through the breaker and initiates a trip if a sufficient magnitude of reverse power is detected.

Table 13: Power Reversal Settings

Item	Option
Power reversal pickup	Adjustable from 10 kW to 990 kW in increments of 10 kW.
Power reversal delay	Adjustable from 1 sec to 15 sec in increments of 1 sec. Setting this value to zero (0) will disable this function.

Power Direction Setup

This function selects the normal power flow direction for the breaker, either from line to load or from load to line. This direction setup also affects the sign of the normal power metering displays.

Potential Transformer Primary Voltage

Enter the primary voltage rating of the potential transformer. The range of values is 120 V to 600 V, with an increment of 1 V.

NOTICE
Incorrect set point will result in incorrect metering values.

Potential Transformer Connection

Select the appropriate potential transformer connection, either line-to-line (Ph-Ph) or line-to-neutral (Ph-N).

Power Demand Intervals

This function sets the power demand interval, which can be in the range of 5 min to 60 min, in steps of 5 min. This setpoint specifies the time interval for power demand averaging.

Communication Address

The address options are from 1 to 254, in steps of 1 for Modbus and Profibus communication protocols.

Bell Alarm-Alarm Only/Bell Alarm with Lock-out Accessory Configuration Setup (applies to Power Break II and WavePro Trip Units only)

This defines the types of signals (protection trip, Shunt trip, Shunt Trip with Lockout, or Under Voltage Release trip) that activate the Bell Alarm-Alarm Only and Bell Alarm with Lockout accessories on the Power Break II breaker only. The customer may enable or disable a different path to activate these accessories from the different types of trip signals.

The following settings can be set on the LCD or through communication:

- Disabled
- Shunt Trip
- UVR Trip
- Over Current Trip
- Protective Relay Trip
- Shunt, UVR
- Shunt, Over Current
- Shunt, Protective Relay
- UVR, Over Current
- UVR, Protective Relay
- Over Current, Protective Relay
- Shunt Trip, UVR, Over Current
- Shunt, UVR, Protective Relay
- Shunt, Over Current, Protective Relay
- UVR, Over Current, Protective Relay
- Shunt, UVR, Over Current, Protective Relay

Settings Description

The following are descriptions of the effects of each accessory switch when it is enabled:

If Bell Alarm or Bell Alarm with Lockout is set to Shunt Trip, a fault generated by a Shunt Trip will cause the Bell Alarm contacts to change state.

If Bell Alarm with Lock-out is set to over current trip, a fault generated by LT, ST, GF, and/or Instantaneous will cause the Bell Alarm contacts to change state.

Input

Inputs can be assigned to two main functionalities:

- Reduced Energy Let-Through (RELT)
- Trip the breaker

Table 14 shows the assignment for the inputs.

Table 14: Input Assignments

Input	Input 1 Assignment	Summary Description
1	OFF	No action taken.
	TRIP	Causes a breaker to trip.
	RELT	Causes unit to use the RELT setpoint as long as input is active. Note: RELT must be set to REMOTE.
2	OFF	No action taken.
	TRIP	Causes a breaker to trip.

Output

The number of outputs available varies by breaker. These outputs are relay contact outputs to secondary disconnect. Each output can be configured per Table 15.

Table 15: Output Configuration

Function	Summary Description
GF alarm	Turns on when GF alarm is activated.
Over-current trip (GF, INST, LT, ST)	Over-voltage trip turns ON the relay.
Reduced-Energy Let-Through	Output relay contact closes when the RELT pickup is enabled.
Protective relays	When protective relay trips the relay contact closes.
Current alarm 1	Exceeding current alarm pick-up turns closes the relay contact.
Current alarm 2	Exceeding current alarm pick-up turns closes the relay contact.
*Health status	Relay contact will be closed or opened depending of the Health contact setting.

Note:
The health relay can be set to either normally open (NO) or normally close (NC) via communication. The contacts are rated for 30 VDC/25 VAC MAX, 1 A.

Current Alarm

The trip unit provides two types of current alarms: Current Alarm 1 and Current Alarm 2.

The Current Alarm's ON/OFF pickup settings are 0.5 to 1.0 xIn in steps of 0.05.

The trip unit does not allow the current alarm OFF setpoint to be set above the ON threshold.

If the highest measured phase current goes above Current Alarm 1 or Current Alarm 2 ON setpoint, and then remains above the setpoint for more than 60 sec, the output will close if assigned to either of these alarms. If the current falls below the Current Alarm 1 or Current Alarm 2 for more than 60 sec, the output, if assigned to Current Alarm, will open.

ZONE SELECT INTERLOCK

The Zone Select Interlock (ZSI) function operates with a group of series-connected breakers. The ZSI is achieved with the use of the TIM module or an equivalent GE qualified and recommended device.

ZSI Option

Per the trip unit catalog number there are two types of zone-selective interlocking options:

- Z: reacts to ground faults and short time pickups.
- T: reacts to ground faults, short time and instantaneous pickups. (Requires 24 VDC external power be provided to the trip unit.)

The upstream breaker uses the ST ZSI and/or GF ZSI delay bands and slope, and/or transition to a delay Instantaneous if it receives a downstream ZSI signal.

The desired ZSI (ST and-or GF and-or Inst) must be selected in order for the downstream breaker to issue a ZSI signal, and the upstream breaker to act upon this signal.

The ST ZSI Delay Bands are independent and have the same bands available. Slope settings may also be interlocked.

The GF ZSI Delay Bands are independent and have the same bands available. Slope settings may also be interlocked.

High Set Instantaneous Protection (HSIOC)

HSIOC is also Known as Override Pickup. Some of the trip units on EntelliGuard G circuit breakers may be provided with an override instantaneous trip.

Whether such a trip is provided or not depends on the circuit breaker within which the trip is installed. If the circuit breaker's withstand (Icw) is equal to the short circuit rating then the trip will not have an override pickup. If the withstand rating is lower than the short circuit rating then the trip will enable override protection of the circuit breaker.

In UL 489 circuit breakers the HSIOC setting is nominally at 107%of the Icw for the circuit breaker. Taking tolerance into account, the override's minimum trip is at 100% of the circuit breaker's Icw.

In UL 1066 (ANSI) circuit breakers the HSIOC setting is also at 107% Icw if the adjustable selective instantaneous is ON. If the adjustable selective instantaneous is OFF then the HSIOC nominal pick up is at 98% of the circuit breaker's Icw and, considering tolerance, the minimum pickup is at 91% of the circuit breaker's Icw.

Power Break I, WavePro and AKR circuit breakers do not employ an override function. PowerBreak II circuit breakers use a mechanical override function.

Making Current Release (MCR)

Every EntelliGuard TU or EntelliGuard TU circuit breaker uses a making current release. The making current release varies per circuit breaker Envelope and is related to the circuit breaker's close and latch rating.

The MCR pickup is activated at the time the circuit breaker closes and for six cycles thereafter. When the six cycles are over, the threshold changes to the HSIOC pickup setting.

POWER REQUIREMENTS

⚠ WARNING

IMPROPER INSTALLATION, OPERATION AND MAINTENANCE

Ensure only qualified personnel install, operate, service and maintain all electrical equipment.

Failure to comply with these instructions could result in death or serious injury.

A small amount of power is necessary to energize the liquid crystal display (LCD) during setup, for viewing breaker status and for metering displays.

Power Break I, Power Break II, WavePro, AKR and EntelliGuard G Trip Units require external +24 VDC control power for communication

The power sources are:

- Current flow: 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
- Internal battery power: Powers the unit temporarily when any keypad key is pressed. Battery power automatically turns off 20 sec after the last keypad press. The battery power supply is disabled when any current is sensed through the current sensors.

METERING FUNCTIONS

Table 16 shows the metering data provided by the trip unit:

Table 16: Metering Data

Parameter	Phase	Unit
Current	Phase A,B,C, neutral	A
Voltage	Phase L1, L2, L3 (Note 1)	V
Real Power	Phase L1, L2, L3 and total	kW
Reactive Power	Phase L1, L2, L3 and total	kVAR
Apparent Power	Phase L1, L2, L3 and total	kVA
Peak Power Demand	Total	Auto-ranging from 0.00 kWH to 999 mW
Energy	Phase A, B, C and total	Auto-ranging from 0.00 kWH to 999 mWH
Frequency	-	Hz
Power Factor	-	%

Notes:

- Potential transformers must be connected similar to source (Wye or Delta). For Wye construction V=L-N and for Delta construction V=L-L.
- Energy reset is supported from setup software and over communications.

SECTION 2 LIFTING, MOUNTING AND INSTALLATION

⚠ DANGER

ELECTROCUTION

- Ensure the circuit breaker has been tripped, indicating OFF and that applicable lock-out/tag-out requirements are met and followed.
- Ensure the main springs are fully discharged.
- Do not touch the circuit breaker's isolating contacts during lifting.

Failure to comply with these instructions will result in death or serious injury.

⚠ WARNING

IMPROPER INSTALLATION, OPERATION, SERVICE AND MAINTENANCE

- Ensure only qualified personnel install, operate, service and maintain all electrical equipment.
- Do not perform any maintenance, including breaker charging, closing, tripping, or any other function that could cause significant movement of circuit breaker while it is on the draw-out extension rails.
- Ensure circuit breaker is always left in the CONNECTED, TEST or DISCONNECTED position to avoid mispositioning of the breaker and flashback.

Failure to comply with these instructions could result in death or serious injury.

⚠ WARNING

FALLING OBJECT

- Ensure lifting equipment has capability for device being lifted.
- Wear hard hat, gloves and safety shoes.

Failure to comply with these instructions could result in death or serious injury.

CAUTION

PRODUCT DAMAGE

- Ensure circuit breaker and its accessories are always used within their designated ratings.
- Ensure the correct trip unit is paired with the correct circuit breaker.
- Do not use excessive force when installing a trip unit.
- Do not allow circuit breaker to hit a hard surface while handling.
- Do not drag or slide circuit breaker across a hard or rough surface.

Failure to comply with these instructions may result in product damage.

TRIP UNIT REMOVAL AND REPLACEMENT

Power Break I, Power Break II, WavePro and AKR Trip Units have rejection pins, installed on the rear of these trip units, to prevent installation of an incorrect trip unit into a breaker.

Replacement of a trip unit always requires repeating the setup procedures

Power Break I and Power Break II Insulated Case Circuit Breakers

The trip unit procedures for Power Break I and Power Break II circuit breakers are very similar and are outlined below. The EntelliGuard TU trip unit for a Power Break I is different than that for a Power Break II (see Section 1). Ensure the correct trip unit is used.

Trip Unit Removal

1. Loosen the four #8-32 screws on the circuit breaker trim-plate assembly and remove the trim plate.
2. Loosen the four #10-32 screws at the corner of the breaker cover. Remove the cover from the breaker face.
3. Pull the trip unit locking lever to the right, then hold the trip unit near the battery cover and lift it straight out of the circuit breaker.

Trip Unit Reinstallation

1. Pull the trip unit locking lever to the right. While holding the lever, carefully align the connector on the rear of the trip unit with the connector in the breaker. Press down on the trip unit while holding it near the battery cover. When the trip unit is fully seated, slide the locking lever back to the left.
2. Reinstall the breaker top cover and tighten the four #10-32 screws to 32 in-lb.
3. Replace the trim plate and tighten the four #8-32 screws to 20 in-lb.

WavePro Circuit Breakers

Removal

1. Open the circuit breaker and remove it from the cubicle or substructure. Place it on a suitable work surface.
2. For 800 A, 1600 A and 2000 A frame circuit breakers, insert the racking handle (catalog number 568B731G1) and move the racking mechanism to the TEST position, as shown on the draw-out position indicator.
3. Depress the OPEN button to close the racking door.
4. Remove the wire forms and remove the trim plate from the breaker.

5. Remove the six ¼ hex head screws, securing the escutcheon to the breaker (three at top and three at bottom). Pull the manual-charging handle out part way, and then slide off the escutcheon.
6. Pull out the locking side on the right of the trip unit mounting plate, and then pull the trip unit out carefully disengaging the pins on the rear connector.
7. Pull out the locking side on the right of the trip unit mounting plate, and then pull the trip unit out carefully disengaging the pins on the rear connector.

Reinstallation

1. Pull out the locking side on the right of the trip unit mounting plate. Push the trip unit into place, carefully, engaging the 50 pin connector and lining up the rejection posts on the rear of the trip unit with the holes in the mounting plate. Push the locking slide to the left.
2. Ensure the breaker racking mechanism is still in the TEST position. Pull the manual charging handle out partway, and then slide the handle through the slot in the escutcheon and move escutcheon into place. Insert the six mounting screws and tighten to 14-20 in-lb.
3. Replace the trim plate around the escutcheon by re-hooking the wire forms into the sides.
4. Insert the racking handle and return the racking mechanism to the DISC position, as shown by the draw-out position indicator.
5. Reinstall the circuit breaker into its cubical or substructure.

AKR (225 A to 5000 A Frames) Circuit Breakers

1. Open the circuit breaker by pressing the red TRIP button on the front of the breaker escutcheon.
2. Disconnect any secondary wire harnesses between the breaker and the switchgear.
3. On draw-out breakers, rack the breaker all the way out to the DISCONNECT position.
4. Follow the instructions on the label attached to the PROGRAMMER RELEASE LEVER to remove the trip unit. There are three types of mounting plates:
   - Type 1: Push in the lever to release the trip unit.
   - Type 2: Pull out the lever to release the trip unit as shown in Figure 7.
   - Type 3: Push down on the lever.

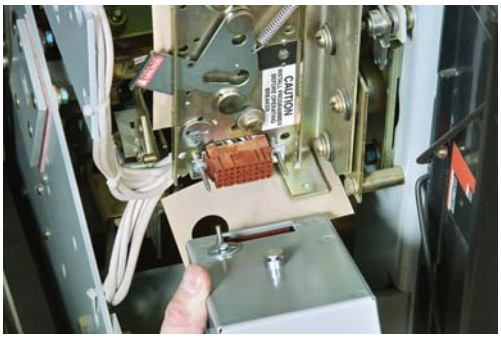
Figure 7: Removing the Old Trip Unit

5. If the breaker is equipped with a MicroVersaTrip® 9 trip unit, the 36-pin trip unit connector must be removed and remounted on the adapter bracket provided. Slide the connector out of the mounting plate and install it on the adapter bracket, as shown in Figure 8.

Figure 8: AKR Circuit Breaker without Trip Unit

6. Align the connectors and rejection pin and connect the EntelliGuard TU to the circuit breaker, as shown in Figure 9.

Figure 9: Installing the New Trip Unit



EntelliGuard G Circuit Breaker Installation

Trip Unit Removal (See Figures 10 through 13)

1. Loosen the six screws on the breaker fascia assembly and remove the fascia.
2. Depress the trip unit locking lever on the left side of the trip unit, then hold the trip unit near the bottom and lift it straight out of the mounting base.

Figure 10. Trip Unit Removal Sequence, Step A

Figure 11. Trip Unit Removal Sequence, Step B

Figure 12. Trip Unit Removal Sequence, Step C

Figure 13. Trip Unit Removal Sequence, Step D

Trip Unit Reinstallation

1. Depress the trip unit locking lever on the left side of the trip unit. While depressing the lever, carefully align the connector on the rear of the trip unit with the connector in the mounting base on the breaker. Press down on the trip unit while holding it near the bottom.
2. When the trip unit is fully seated, stop depressing the trip-unit-locking lever and allow the lever to come up and lock the trip unit to the mounting base.
3. Reinstall the breaker fascia and ensure that the Trip unit is centered in the fascia window before tightening the fascia fixing screws.

SECTION 3 – OPERATION

⚠ WARNING

IMPROPER INSTALLATION, OPERATION AND MAINTENANCE

Ensure only qualified personnel install, operate, service and maintain all electrical equipment.

Failure to comply with these instructions could result in death or serious injury.

⚠ WARNING

PERSONAL INJURY

- Avoid risk of injury from moving parts while handling the circuit breaker.
- If advisable, use a cable/busbar lockable grounding device (optional accessory) to provide additional safety during system maintenance.

Failure to comply with these instructions could result in death or serious injury.

CAUTION

PRODUCT DAMAGE

- Ensure circuit breaker and its accessories are always used within their designated ratings.
- Use the specially designed circuit breaker handling truck (optional accessory) when removing the circuit breaker from its cassette.

Failure to comply with these instructions may result in product damage.

NOTICE

- Each charging action provides sufficient charge for an Open-Close-Open Operation without requiring additional charging.
- The mechanism works properly only when the circuit breaker is mounted on a horizontal plane with bottom mounting or on vertical plane with front mounting.

CIRCUIT BREAKER OPENING

NOTICE

Tripping under fault conditions will be automatic depending on the protective device installed and its settings.

WAVEFORM CAPTURE

A total of eight cycles are captured:

- Four pre-trigger.
- Four post-trigger.

24 V external power is required for this feature.

When waveform capture is executed, the following channels will be captured simultaneously: Phase A current, Phase B Current, Phase C Current, Phase L1 voltage, Phase L2 voltage, Phase L3 voltage. See Table 17.

Table 17: Trigger Waveform Capture Events

Event	Waveform Capture Setpoint
Manual trigger over communications	ON, OFF
Over current (GF, ST, LT, Inst)	ON, OFF
Protective relays	ON, OFF
Current alarm 1	ON, OFF
Current alarm 2	ON, OFF

EVENT LOGGING

The trip unit keeps a log of the last 10 events:

- Over current trips
- Protective relay trips
- Shunt trip (PBII and Global EntelliGuard G Trip Units Only)
- Under voltage Release trip (PBII and Global EntelliGuard G Trip Units Only)
- BIM Trip Unit Mismatch - Breaker Interface Module

The following information is stored with each event:

- RMS currents
- Phase
- Type of trip
- Trip counter
- Time and date stamps

Trips are logged under self power without time stamp. Events with time stamps are only logged when 24 V control power is available.

All setup, status and metering information is accessed through five keys whose functions are:

- Up: Scroll up or increment value
- Down: Scroll down or decrement value
- Right: Next function or next page
- Left: Previous function or previous page
- Enter: Save or setting in to memory

LED STATUS INDICATOR

Table 18 shows the operation of the green LED located on the front of the trip unit.

Table 18: LED Operation

Power Break I and AKR Trip Units Status	LED Status
Normal	ON-OFF-ON-OFF (OFF for 2 sec)
Error	ON-OFF-ON-OFF-ON-OFF (OFF for 2 sec)
Trip	ON-OFF (OFF for 2 sec)
Pickup	ON-OFF-ON-OFF-ON-OFF-ON-OFF (continuous)

OPERATING MODES

Power Break I, Power Break II, WavePro, AKR and EntelliGuard G Trip Units have four operating modes: Setup, Meter, Status and Events as shown in Figure 14. (See Appendix 2 for Operating Modes and Functions Specifics.)

Figure 14. Operating Modes and Functions Overview

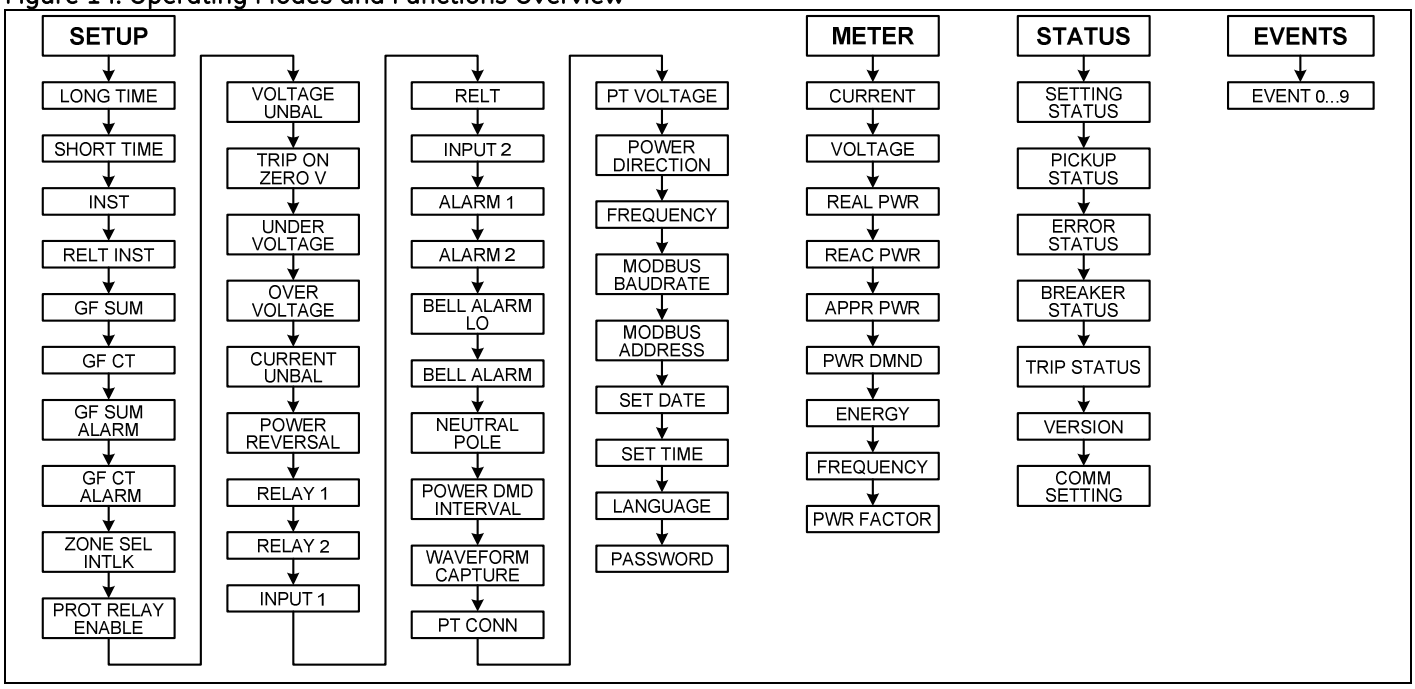
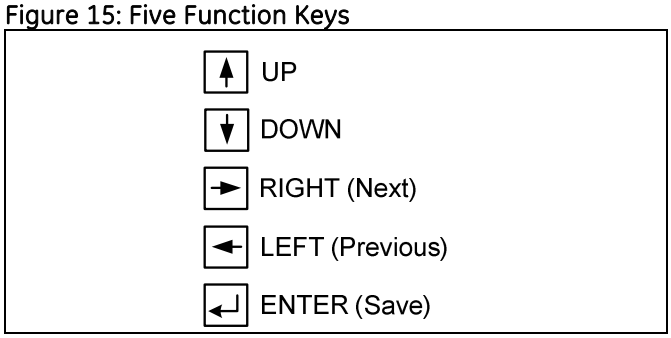


Figure 15 shows the five functions keys:

- UP: Scroll up or increment value
- DOWN: Scroll down or decrement value
- RIGHT: Next function or next page
- LEFT: Previous function or previous page
- ENTER: Save or set in to memory

Figure 15: Five Function Keys



SETUP MODE

SETUP Mode programming must be performed with the rating plug installed.

These procedures apply to all trip units.

SETUP procedures should only be repeated if the trip unit or the protection characteristics are changed, requiring different set points and time-delays.

All trip units provide long time over current protection, long time delay, and some form of instantaneous over current protection when installed in circuit breakers. All other functions are optional.

If a specific set of trip unit functions, such as relaying or short time over-current 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. Power can come from internal battery power, from an external +24 VDC power supply, or by energizing the breaker to at least 20% of its sensor load.

- Press UP or DOWN until the SETUP mode is selected.
- Press RIGHT or LEFT to access the functions in the SETUP mode.
- Press ENTER to save desired values.
- Press RIGHT to advance to the next function.

Entering Setpoints into Memory

1. Press UP or DOWN to select SETUP.
2. Press LEFT to select the desired protection to change.
3. Press UP or DOWN to change values. The values will start flashing.
4. Press ENTER to store the value into the memory. The displayed value stops flashing and the save icon appears on the top of the LCD. This indicates that the value has been stored in memory and is active.
5. Confirm settings on the trip unit after making changes by exiting and re-entering SETUP mode and rechecking each changed setting.

Long Time Pickup

The first SETUP mode display is always the Long Time Pickup setpoint. This setpoint establishes the breaker's nominal ampere rating, xLT, as a fraction of the rating plug value, xIn (xLT = LT multiplier x xIn).

The Long Time Pickup settings are 0.50 to 1.00 times xIn in steps of 0.05. The pickup value tolerance band is -10% to +10% of the set point. An additional accuracy degradation of ±5% is allowed for waveforms with significant harmonic distortion.

Long Time Delay

The EntelliGuard trip unit offers up to 44 long time delay bands. Twenty-two have steep fuse-like shape and 22 have a logarithmic curve to a straight I^2T slope shape. This second shape is similar to that of the thermal element of a thermal magnetic circuit breaker.

EntelliGuard G circuit breakers use all 44 bands. WavePro, AKR and both PowerBreak devices use the lower 19 of the curved thermal-type bands. To see the bands and the range of settings, see the TCCs in the Application Guide available at wwwgeelectrical.com/industrial.

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 from 1.5 to 12.0 times the long time setting, xLT, in steps of 0.5 xLT.

The ST pickup value tolerance band is -10% to +10% of the set point. An additional accuracy degradation of ±5% shall be allowed for waveforms with significant harmonic distortion

Short Time Delay

The Short Time Delay function consists of both a slope setting and a fixed delay band setting. The slope and delay are independently selectable. The slope setting consists of three I^2T slopes (1, 2, 3) and fixed delay. The fixed delay bands consist of 15 constant time bands

Reduced Instantaneous Let-Through Instantaneous Protection (RELT)

The EntelliGuard TU Trip Unit provides a second user settable and user-selectable instantaneous protection algorithm. This protection is referred to as the RELT pickup.

This protection enables an instantaneous protection mode that may be set separately from the “Adjustable Selective Instantaneous” and is a bit faster. The RELT instantaneous pickup may be set by the user to a value from 1.5X trip rating plug up to 15X trip rating plug in some circuit breakers.

The user may also enable the function “ON” or “OFF” at the HMI, as well as set it to remote. In the “remote” mode the trip unit is able to receive a command via serial communication (Modbus or Profibus) or a hardwired 24 V AC or DC signal to enable the RELT protection on. If the RELT protection is ON via any of the three ways it must be turned off that same way.

When the trip unit receives a RELT on signal the RELT instantaneous setting is enabled. If the RELT pick up setting is lower than the adjustable selective instantaneous setting the RELT setting will take precedence.

Ground Fault Protection

The EntelliGuard TU Trip Unit can provide ground fault protection in two different ways:

- via an internal summation scheme that adds up the three phase current phasors, and if provided also the neutral current phasor.
- Via an external zero sequence current signal from a CT or a residual sum using iron core CTs.

Internal Residual Summation

The EntelliGuard trip unit uses internal air core sensors for current sensing and the signals are residually summed using advanced digital electronics. A neutral sensor may be located remotely and connected to the trip unit. The connection is limited to 10 m (33 ft).

Due to the air core sensor's ability to handle a wide range of primary currents without distortion, ground fault sensing is accurate for a wide range of phase and current inputs.

External Sensed Zero Sequence Input

The EntelliGuard trip unit can accept input from an externally calculated ground fault current. The ground fault current may be derived using a single zero sequence CT or multiple phase CTs.

External CE marked zero sequence or ground return CTs are available for IEC applications, but are not UL Listed. Phase CTs used for a summation connection are UL Listed. Applications for this capability include sensing at the ground return connection for a transformer or generator as well as application in multiple source grounded systems.

Ground Fault Pickup Settings

All UL 489 and UL 1066 circuit breakers are limited to a maximum nominal pick up setting of 1200 A per the National Electrical Code or 60% of the sensor size, whichever is lower. The minimum setting is 20% of sensor size.

Ground Fault Time Delay Bands

Ground fault time delay bands used in the EntelliGuard G circuit breakers range from 42 msec to 942 msec. In Power Break I, Power Break II, WavePro and AKR circuit breakers, the minimum GF time delay band is 58 msec and the maximum is 417 msec. See Table 19.

Table 19: Ground Fault Time Delay

Sensor	Minimum	Maximum
400	0.2	0.60
600	0.2	0.60
800	0.2	0.60
1200	0.2	0.60
1600	0.2	0.60
2000	0.2	0.60
2500	0.2	0.48
3000	0.2	0.40
3200	0.2	0.37
4000	0.2	0.30
5000	0.2	0.24
6000	0.2	0.20

Notes:

- Continuously adjusted in 0.01 increments.
- Connected in a residual summation scheme.

The available minimum settings per circuit breaker type are shown in Table 21. The maximum time delay band setting for all circuit breakers is 0.940 sec with a 1 sec clear. See Table 20.

Table 20: Minimum Pickup and Clear Time

Characteristic	Power Break I Power Break II, WavePro, AKR	EntelliGuard G
Minimum Pickup	0.058 sec	0.042 sec
Minimum Clear	-	0.097 sec
Maximum Pickup	0.417 sec	0.940 sec
Maximum Clear	-	1.000 sec

The ground fault function may be shaped as a definite time function (pickup and delay), an I^2T slope an I^4T slope or a distinct double slope function designed to optimize coordination. The I^4T slope provides easier selectivity with downstream fuses. The double knee GF curve facilitates selectivity with downstream devices.

SECTION 4 – BATTERY

GENERAL BATTERY INFORMATION

The trip unit has a front pane-mounted battery. When the battery is present, the user scan view data on the LCD and read or program the trip unit via the keypads. The battery allows the user to display data, change set points and provide thermal memory.

The battery does not allow normal trip unit operation; i.e. over current protection, alarms, relays, etc., are not functional when the trip unit is powered from the battery.

The trip unit will automatically shut off after 20 sec when battery powered to maximize battery life.

BATTERY FUNCTION

Pressing any key on the face of the trip unit powers the unit from its internal battery. Battery power is maintained for 20 sec after the last key is pressed.

This self-powered mode allows setting up the trip unit or viewing trip targets when the breaker is de-energized and external control power is unavailable.

All normal setup, meter, and status functions can be performed with battery power.

NOTICE

For temperatures above 40° C, any key may have to be held down for up to 5 sec for the trip unit to be powered.

BATTERY REPLACEMENT

⚠ WARNING

IMPROPER REPLACEMENT

- Replace the battery with 3.6 V ½ AA lithium battery only.
- Wear hard hat, gloves and safety shoes when replacing the battery.

Failure to comply with these instructions could result in death or serious injury.

⚠ WARNING

IMPROPER DISPOSAL

- Ensure battery is properly disposed of according to all applicable regulations.

Failure to comply with these instructions could result in death or serious injury.

Replace the battery if it does not power up the trip unit when any key is pressed.

Lift the battery cover on the front of the trip unit to expose the 3.6 V ½ AA lithium cell. A suitable replacement is TADIRAN part number TLL-5902/S or SANYO part number CR14250SEwhich are commonly available from most electrical stores or industrial distributors.

SECTION 5– MAINTENANCE AND TROUBLESHOOTING

⚠ DANGER

ELECTROCUTION

Ensure the circuit breaker has been tripped, indicating OFF, and the main springs are fully discharged when performing circuit breaker maintenance.

Failure to comply with these instructions could result in death or serious injury.

⚠ WARNING

IMPROPER INSTALLATION, OPERATION AND MAINTENANCE

Ensure only qualified personnel install, operate, service and maintain all electrical equipment.

Failure to comply with these instructions could result in death or serious injury.

⚠ WARNING

PERSONAL INJURY

- Avoid risk of injury from moving parts while handling the circuit breaker.
- If advisable, use a cable/busbar lockable grounding device (optional accessory) to provide additional safety during system maintenance.

Failure to comply with these instructions could result in death or serious injury.

MAINTENANCE

Rating Plug Removal and Replacement

NOTICE

Removal of the rating plug while the breaker is carrying current reduces the breaker's current-carrying capacity to approximately 40% 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 as shown in Figure 16.

Be sure to grab the tabs and not the front cover of the rating plug, or the plug may be damaged.

Figure 16: Rating Plug Removal

TROUBLESHOOTING

Table 21 provides procedures for troubleshooting and isolating common problems. It does not cover every possible condition.

Contact Post Sales Service at 1-888-GE-Resolve or 1-888-437-3765 if these procedures doe not resolve the problem.

Table 21: Troubleshooting Guide

The trip unit display is blank.	External +24 VDC is absent. The load current fluctuates near 20% of the breaker sensor rating.	At least 20% of the current sensor rating, (xCT) must be flowing through the breaker to activate the display. If not, power the trip unit with the internal battery. The battery power supply is disabled when any current is sensed through the current sensors. Check that the control power supply is present and operational.
The trip unit display E02.	BIM error.	No communication with the BIM Check the BIM harness. Mismatch trip unit / BIM option
The trip unit display E03.	Memory failure.	Return the unit to GE.
The trip unit display E06.	Internal failure.	Return the unit to GE.
The trip unit display E08.	Invalid rating plug.	Check the rating plug. The rating plug value shall not exceed and be below 40% of the breaker sensor. Ensure the rating plug is properly sited.
Unit does not communicate with the Master.	The communication wires are shorted or improperly connected. Incorrect baud rate. Incorrect address.	Locate and repair the short or the incorrect connection. Check that the baud rate assigned to the trip unit, agrees with the baud rate at the host. Check that the address assigned to the trip unit, agrees with the address at the host.
Current readings are incorrect.	Incorrect rating plug value.	Check the rating plug label.
Voltage readings are incorrect.	The potential transformer (PT) primary voltage was defined incorrectly. The PT connection was defined incorrectly.	Read the PT primary rating from the PT name plate and set trip unit PT to this value. Set the trip unit phase to phase PH-PH or phase to neutral PH-N according to the system.
The display is blank or the Low Battery symbol appears when the BATTERY key is pressed. Line current is below 20% of the breaker sensor rating.	The battery is discharged. The battery was stored too long with no power applied to the trip unit.	Replace the battery. Power the trip unit with external power or by energizing the breaker for several days to freshen the battery.

APPENDIX 1: COMMUNICATIONS PARAMETERS

Table 22: Communications Parameters – Modbus Function 2

Register	Variable	Value	Read/Write
5	Relay 1 Status	0 – OFF, 1 – ON	Read
6	Relay 2 Status	0 – OFF, 1 – ON	Read
7	Relay 3 Status	0 – OFF, 1 – ON	Read
8	Relay 4 Status	0 – OFF, 1 – ON	Read
9	Input 1 Status	0 – OFF, 1 – ON	Read
10	Input 2 Status	0 – OFF, 1 – ON	Read
11	Input 3 Status	0 – OFF, 1 – ON	Read
12	Input 4 Status	0 – OFF, 1 – ON	Read
27	Breaker position	0 – OFF, 1 – ON	Read
34	Cassette Indication	0 – OFF, 1 – ON	Read
35	Draw Out	0 – OFF, 1 – ON	Read
44	Remote Close	0 – OFF, 1 – ON	Read
61	GF Sum Alarm Status	0 – Normal, 1 – Alarm	Read
62	GF CT Alarm Status	0 – Normal, 1 – Alarm	Read

Table 23: Communications Parameters – Modbus Function 3

Register	Variable	Value	Read/Write
2	GF Protection Sun Enable	0–Disable, 1–Enable	Read
5	No. of Poles	0–3 Pole, 1–4 Pole	Read
6	Protective Relays Enable	0–Disable, 1–Enable	Read
7	Full Metering Enable	0–Disable, 1–Enable	Read
8	Neutral Position	0–Disable, 1–Enable	Read
10	Long Time Protection Enable	0–Disable, 1–Enable	Read
18	Agency Standard	0–UL, 1–IEC, 2–ANSI	Read
20	GTU Model Type	0– GTU C, 1–GTU D, 4–GTU ACB	Read
22	Current Sensor Rating	1–150 A, 2–200 A, 3–225 A, 4–400 A, 5–600 A, 6–800 A, 7–1000 A, 8–1200 A, 9–1600 A, 10–2000 A, 11–2500 A, 12–3000 A, 13–3200 A, 14–4000 A, 15–5000 A, 16–6000 A, 17–630 A, 18–1250 A, 19–6400 A, 20–Universal spare	Read
24	Ground Fault Sum Alarm Enable	0–Disable, 1–Enable	Read
25	Ground Fault CT Alarm Enable	0–Disable, 1–Enable	Read
31	Current Alarm Enable	0–Disable, 1–Enable	Read
35	ZSI Enable	0–Disable, 1–GT-ST (Z), 2–GR-ST-Inst (T)	Read
79	ST Switchable	0–Disable, 1–Enable	Read
81	Instantaneous	0–Disable, 1–15X Switchable, 2–15X Non-Switchable, 3–30X Switchable, 4–30X Non-Switchable	Read
82	LT Switchable	0–Disable, 1–Enable	Read
84	Fuse Protection	0–Disable, 1–Enable	Read
86	GF Protection CT Enable	0–Disable, 1–Enable	Read
95	GF CT Switchable	0–Disable, 1–Enable	Read
98	Breaker Serial Number – Low 16 bit	-	Read
99	Breaker Serial Number – High 16 bits	-	Read
107	Reduce Instantaneous	0–Disable, 1–Enable	Read
206	Neutral Pole Rating	0–50%, 1–63%, 2–100%	Read/Write
207	ZSI Combination	0, 1–GF, 4–Instantaneous, 5–GF and Inst	Read/Write

Register	Variable	Value	Read/Write
		2–GF&ST 6–ST and Inst 3–ST 7–GF, ST and Inst	
208	PT Primary Voltage	120–600	Read/Write
209	PT Connection	0–Ph-N, 1–Ph-Ph	Read/Write
210	Password Protection	0 to 20, 16–Lock, 19–Unlock	Read/Write
211	Modbus Slave Address	8 bit value	Read/Write
212	Profibus Slave Address	8 bit value	Read/Write
213	Communication Setting	0–300-8N1 7–300-8O1 14–300-8E1 1–600-8N1 8–600-8O1 15–600-8E1 2–1200-8N1 9–1200-8O1 16–1200-8E1 3–400-8N1 10–2400-8O1 17–2400-8E1 4–4800-8N1 11–4800-8O1 18–4800-8E1 5–9600-8N1 12–9600-8O1 19–9600-8E1 6–19200-8N1 13–19200-8O1	Read/Write
215	Long Time Trip Pickup	1–0.5 2–0.55 … 10–9.5 11–1.0	Read/Write
216	Long Time Trip Delay	0–Off 1–C Min … 24–F 2 44–F Max	Read/Write
217	Long Time Cooling Constant	0–No Cooling, 1–12 Minute Cooling	Read/Write
219	Protective Relay Trip Enable	0–Disable, 1–Enable	Read/Write
220	Frequency	0–50 Hz, 1–60 Hz, 1–400 Hz	Read/Write
222	Short Time Trip Pickup	1–1.5 2–2.0 …	Read/Write
223	Short Time Trip Delay	0–Off 1–Band1 2–Band2 … 16–Band 16 17–Band 17	Read/Write
224	Short Time Slope	0–No Slope 1 2 3	Read/Write
225	Instantaneous Trip Pickup	0–Off (For switchable Inst Only) 2–2 … 43–29 44–30	Read/Write
226	Reduced Instantaneous Trip Pickup	1–1.5 2–2 … 27–14.5 28–15	Read/Write
227	GF CT Trip Pickup	11–0.2 2–0.11 …	Read/Write

Register	Variable	Value	Read/Write
		50–0.59 51–0.6	
228	GF CT Trip Delay	0–Off 1–Band1 2–Band2 … 12–Band12 13–Band13 14–Band14	Read/Write
229	GF CT Trip Slope	0–0 1–I2T Slope 2–I2T Slope 3–Fuse Slope	Read/Write
230	GF CT Alarm Pickup	11–0.2 2-0.11 … 50–.59 51–0.6	Read/Write
231	GF CT Alarm Delay	0–Off 1–Band1 2–Band2 … 13–Band13 14–Band14	Read/Write
232	GF CT Alarm K Value	0–0 1–I2T Slope 2–I2T Slope 3–Fuse Slope	Read/Write
233	GF Sum Trip Pickup	11–0.2 2–0.11 … 50–0.59 51–0.6	Read/Write
234	GF Sum Trip Delay	0–Off 1–Band1 … 13–Band13 14–Band14	Read/Write
235	GF Sum K Value	0–0 1–I2T Slope 2–I2T Slope 3–Fuse Slope	Read/Write
236	GF Sum Alarm Pickup	11–0.2 2–0.11 … 50–0.59 51–0.6	Read/Write
237	GF Sum Alarm Delay	0–Off 1–Band1 2–Band2 … 12–Band12 13–Band13	Read/Write

Register	Variable	Value	Read/Write
		14–Band14	
238	GF Sum Alarm K Value	0–0 1–I^2T Slope 2–I^2T Slope 3–Fuse Slope	Read/Write
258	Over Voltage Pickup	1–110 2–111 3–112 … 39–148 40–149 41–150	Read/Write
259	Over Voltage Delay	0–Off 1–1 2–2 … 13–13 14–14 15-15	Read/Write
260	Under Voltage Pickup	1–50 2–51 3–52 39–88 40–89 41–90	Read/Write
261	Under Voltage Delay	0–Off 1–1 2–2 … 13–13 14–14 15–15	Read/Write
262	Under Voltage Zero–Volt Trip Enable	0–Disable, 1–Enable	Read/Write
263	Voltage Unbalance Pickup	8–17 9–18 39–48 40–49 41–50	Read/Write
264	Voltage Unbalance Delay	0–Off 1–1 2–2 3–3 13–13 14–14 15–15	Read/Write
265	Current Unbalance Pickup	1–10 2–11 … 39–48 40–49 41–50	Read/Write
266	Current Unbalance Delay	0–Off 1–1	Read/Write

Register	Variable	Value	Read/Write
		2–2 … 13–13 14–14 15–15	
267	Power Reversal Pickup	1–10 2–20 … 97–970 98–980 99–990	Read/Write
268	Power Reversal Delay	0–Off 1–1 2–2 … 13–13 14–14 15–15	Read/Write
269	Power Direction Setting	0–Line to Load 1–Load to Line	Read/Write
270	Power Demand Interval	1–5 2–10 … 5–15 12–60	Read/Write
271	Relay 1 (Output 1) Function	1–Group 1 5–Group 5 2–Group 2 6–Group 6 3–Group 3 7–Group 7 4–Group 4	Read/Write
272	Relay 2 (Output 2) Function	1–Group 1 5–Group 5 2–Group 2 6–Group 6 3–Group 3 7–Group 7 4–Group 4	Read/Write
273	Relay 3 (Output 3) Function	1–Group 1 5–Group 5 2–Group 2 6–Group 6 3–Group 3 7–Group 7 4–Group 4	Read/Write
274	Relay 4 (Output 4) Function	1–Group 1 5–Group 5 2–Group 2 6–Group 6 3–Group 3 7–Group 7 4–Group 4	Read/Write
275	Input 1 Function	0–None, 1–Trip Breaker, 2–Reduce Instantaneous	Read/Write
276	Input 2 Function	0–None, 1–Trip Breaker	Read/Write
277	Input 3 Function	0–None, 1–Trip Breaker	Read/Write
278	Input 4 Function	0–None, 1–Trip Breaker	Read/Write
285	Waveform Capture	0–Disable 4–Current Alarm 1 1–Manual 5–Current Alarm 2 2–Over Current 6–All 3–Protection Relays	Read/Write
286	Language	0–English, 1–French, 2–Spanish, 3–German, 4–Chinese	Read/Write
287	Time Sync Year	8 bit	Read/Write
288	Time Sync Month	8 bit	Read/Write
289	Time Sync Date	8 bit	Read/Write

Register	Variable	Value	Read/Write
290	Time Sync Day	8 bit	Read/Write
291	Time Sync Hour	8 bit	Read/Write
292	Time Sync Minute	8 bit	Read/Write
293	Time Sync Second	8 bit	Read/Write
294	Health status output type	0–NO, 1–NC	Read/Write
296	Current Alarm 1 Pickup On	1–0.5 2–0.55 3–0.60 … 10–0.95 11–1.00	Read/Write
297	Current Alarm 1 Pickup Off	1–0.5 2–0.55 3–0.60 … 10–0.95 11–1.00	Read/Write
298	Current Alarm 2 Pickup On	1–0.5 2–0.55 3–0.60 … 10–0.95 11–1.00	Read/Write
299	Current Alarm 2 Pickup Off	1–0.5 2–0.55 3–0.60 … 10–0.95 11–1.00	Read/Write
300	Bell Alarm (Bell Alarm 1)	0–Disabled 1–Shunt Trip 2–UVR Trip 3–Over Current Trip 4–Protective Relay Trip 5–Shunt, UVR 6–Shunt, Over Current 7–Shunt, Protective Relay 8–UVR, Over Current 9–UVR, Protective Relay 10–Over Current, Protective Relay 11–Shunt Trip, UVR, Over Current 12–Shunt, UVR, Protective Relay 13–Shunt, Over Current, Protective Relay 14–UVR, Over Current, Protective Relay 15–Shunt, UVR, Over Current, Protective Relay	Read/Write
301	Bell Alarm with lockout (Bell Alarm 2)	0–Disabled 1–Shunt Trip 2–UVR Trip 3–Over Current Trip 4–Protective Relay Trip 5–Shunt, UVR 6–Shunt, Over Current 7–Shunt, Protective Relay	Read/Write

Register	Variable	Value	Read/Write
		8–UVR, Over Current 9–UVR, Protective Relay 10–Over Current, Protective Relay 11–Shunt Trip, UVR, Over Current 12–Shunt, UVR, Protective Relay 13–Shunt, Over Current, Protective Relay 14–UVR, Over Current, Protective Relay 15–Shunt, UVR, Over Current, Protective Relay	
302	ZSI Short Time Delay Band	1–Band1 2–Band2 … 16–Band 16 17–Band 17	Read/Write
303	ZSI Short Time Slope	0–No slope 1 2 3	Read/Write
304	ZSI GF Trip Delay	1–Band1 2–Band2 … 16–Band 16 17–Band 17	Read/Write
305	ZSI GF Trip Slope	0–no slope 1 2 3	Read/Write
306	ZSI GF Trip Slope	1–CLOSE. 0–OPEN	Read/Write
307	Waveform Trigger Source–Manual	0–Disable, 1–Enable	Read/Write
308	Waveform Trigger Source– Over Current	0–Disable, 1–Enable	Read/Write
309	Waveform Trigger Source–Protection Relays	0–Disable, 1–Enable	Read/Write
310	Waveform Trigger Source–Current Alarm 1	1–Disable, 0–Enable	Read/Write
311	Waveform Trigger Source–Current Alarm 2	1–Disable, 0–Enable	Read/Write
312	Reduced Instantaneous Let–Through (RELT)	0–OFF, 1–ON, 2–REMOTE	Read/Write

Table 24: Communication Parameters – Modbus Function 4

Register	Variable	Value	Read/Write
16	GTU Rev	8 bit	Read
17	Software Rev	8 bit	Read
18	Voltage Phase A	16 bit	Read
19	Voltage Phase B	16 bit	Read
20	Voltage Phase C	16 bit	Read
21	Current Phase A(LO 16 bits)	32 bit	Read
22	Current Phase A(HI 16 bits)	–	Read
23	Current Phase B(LO 16 bits)	32 bit	Read
24	Current Phase B(HI 16 bits)	–	Read
25	Current Phase C(LO 16 bits)	32 bit	Read

Register	Variable	Value	Read/Write
26	Current Phase C(HI 16 bits)	–	Read
27	Current Phase N(LO 16 bits)	32 bit	Read
28	Current Phase N(HI 16 bits)	–	Read
29	Rating Plug Value	–	Read
31	Energy Total (0-15 bits)	16 bit	Read
32	Energy Total (16-31 bits)	16 bit	Read
33	Energy Total (32-47 bits)	16 bit	Read
34	Energy Total (48-63 bits)	16 bit	Read
35	Energy Rollover Count	16 bit	Read
36	Power Factor Phase A	16 bit	Read
37	Power Factor Phase B	16 bit	Read
38	Power Factor Phase C	16 bit	Read
39	Power Factor Total	16 bit	Read
40	Real Power Phase A–Lo 16 bits	32 bit	Read
41	Real Power Phase A–Hi 16 bits	–	Read
42	Real Power Phase B–Lo 16 bits	32 bit	Read
43	Real Power Phase B–Hi 16 bits	–	Read
44	Real Power Phase C–Lo 16 bits	32 bit	Read
45	Real Power Phase C–Hi 16 bits	–	Read
46	Real Power Phase Total–Lo 16 bits	32 bit	Read
47	Real Power Phase Total–Hi 16 bits	–	Read
48	Reactive Power Phase A–Lo 16 bits	32 bit	Read
49	Reactive PowerPhase A–Hi 16 bits	–	Read
50	Reactive PowerPhase B–Lo 16 bits	32 bit	Read
51	Reactive PowerPhase B–Hi 16 bits	–	Read
52	Reactive PowerPhase C–Lo 16 bits	32 bit	Read
53	Reactive PowerPhase C–Hi 16 bits	–	Read
54	Reactive PowerPhase Total–Lo 16 bits	32 bit	Read
55	Reactive PowerPhase Total–Hi 16 bits	–	Read
56	Power Apparent Phase A–Lo 16 bits	32 bit	Read
57	Power Apparent Phase A–Hi 16 bits	–	Read
58	Power Apparent Phase B–Lo 16 bits	32 bit	Read
59	Power Apparent Phase B–Hi 16 bits	–	Read
60	Power Apparent Phase C - Lo 16 bits	32 bit	Read
61	Power Apparent Phase C - Hi 16 bits	-	Read
62	Power Apparent Phase Total - Lo 16 bits	32 bit	Read
63	Power Apparent Phase Total - Hi 16 bits	-	Read
64	Power Demand Total - Hi 16 bits	32 bit	Read
65	Power Demand Total - Hi 16 bits	-	Read
66	Frequency Measured	16 bit	Read
67	Event 1	8 bit	Read
68	Year	8 bit	Read
69	Month	8 bit	Read
70	Date	8 bit	Read
71	Hour	8 bit	Read
72	Minute	8 bit	Read
73	Second	8 bit	Read
74	Phase	8 bit	Read
75	Event Specific 1	16 bit	Read
76	Event Specific 2	16 bit	Read
77	Event 2	8 bit	Read
78	Year	8 bit	Read

Register	Variable	Value	Read/Write
79	Month	8 bit	Read
80	Date	8 bit	Read
81	Hour	8 bit	Read
82	Minute	8 bit	Read
83	Second	8 bit	Read
84	Phase	8 bit	Read
85	Event Specific 1	16 bit	Read
86	Event Specific 2	16 bit	Read
87	Event 3	8 bit	Read
88	Year	8 bit	Read
89	Month	8 bit	Read
90	Date	8 bit	Read
91	Hour	8 bit	Read
92	Minute	8 bit	Read
93	Second	8 bit	Read
94	Phase	8 bit	Read
95	Event Specific 1	16 bit	Read
96	Event Specific 2	16 bit	Read
97	Event 4	8 bit	Read
98	Year	8 bit	Read
99	Month	8 bit	Read
100	Date	8 bit	Read
101	Hour	8 bit	Read
102	Minute	8 bit	Read
103	Second	8 bit	Read
104	Phase	8 bit	Read
105	Event Specific 1	16 bit	Read
106	Event Specific 2	16 bit	Read
107	Event 5	8 bit	Read
108	Year	8 bit	Read
109	Month	8 bit	Read
110	Date	8 bit	Read
111	Hour	8 bit	Read
112	Minute	8 bit	Read
113	Second	8 bit	Read
114	Phase	8 bit	Read
115	Event Specific 1	16 bit	Read
116	Event Specific 2	16 bit	Read
117	Event 6	8 bit	Read
118	Year	8 bit	Read
119	Month	8 bit	Read
120	Date	8 bit	Read
121	Hour	8 bit	Read
122	Minute	8 bit	Read
123	Second	8 bit	Read
124	Phase	8 bit	Read
125	Event Specific 1	16 bit	Read
126	Event Specific 2	16 bit	Read
127	Event 7	8 bit	Read
128	Year	8 bit	Read
129	Month	8 bit	Read
130	Date	8 bit	Read

Register	Variable	Value	Read/Write
131	Hour	8 bit	Read
132	Minute	8 bit	Read
133	Second	8 bit	Read
134	Phase	8 bit	Read
135	Event Specific 1	16 bit	Read
136	Event Specific 2	16 bit	Read
137	Event 8	8 bit	Read
138	Year	8 bit	Read
139	Month	8 bit	Read
140	Date	8 bit	Read
141	Hour	8 bit	Read
142	Minute	8 bit	Read
143	Second	8 bit	Read
144	Phase	8 bit	Read
145	Event Specific 1	16 bit	Read
146	Event Specific 2	16 bit	Read
147	Event 9	8 bit	Read
148	Year	8 bit	Read
150	Date	8 bit	Read
151	Hour	8 bit	Read
152	Minute	8 bit	Read
153	Second	8 bit	Read
154	Phase	8 bit	Read
155	Event Specific 1	16 bit	Read
156	Event Specific 2	16 bit	Read
157	Event 10	8 bit	Read
158	Year	8 bit	Read
159	Month	8 bit	Read
160	Date	8 bit	Read
161	Hour	8 bit	Read
162	Minute	8 bit	Read
163	Second	8 bit	Read
164	Phase	8 bit	Read
165	Event Specific 1	16 bit	Read
166	Event Specific 2	16 bit	Read
167	Long Time Trip Count	8 bit	Read
168	Short Time Trip Count	8 bit	Read
169	Instantaneous Trip Count	8 bit	Read
170	Ground Fault Sum Trip Count	8 bit	Read
179	Shunt 1 Trip Count	8 bit	Read
180	Shunt 2 Trip Count	8 bit	Read
196	Software Rev	8 bit	Read
227	Breaker Position	1–CLOSE, 0–OPEN	Read
228	Error Code Log	-	Read
229	Error Code Log	-	Read
230	Error Code Log	-	Read
231	Error Code Log	-	Read
232	Error Code Log	-	Read
233	Error Code Log	-	Read
234	Error Code Log	-	Read
235	Error Code Log	-	Read
236	Error Code Log	-	Read

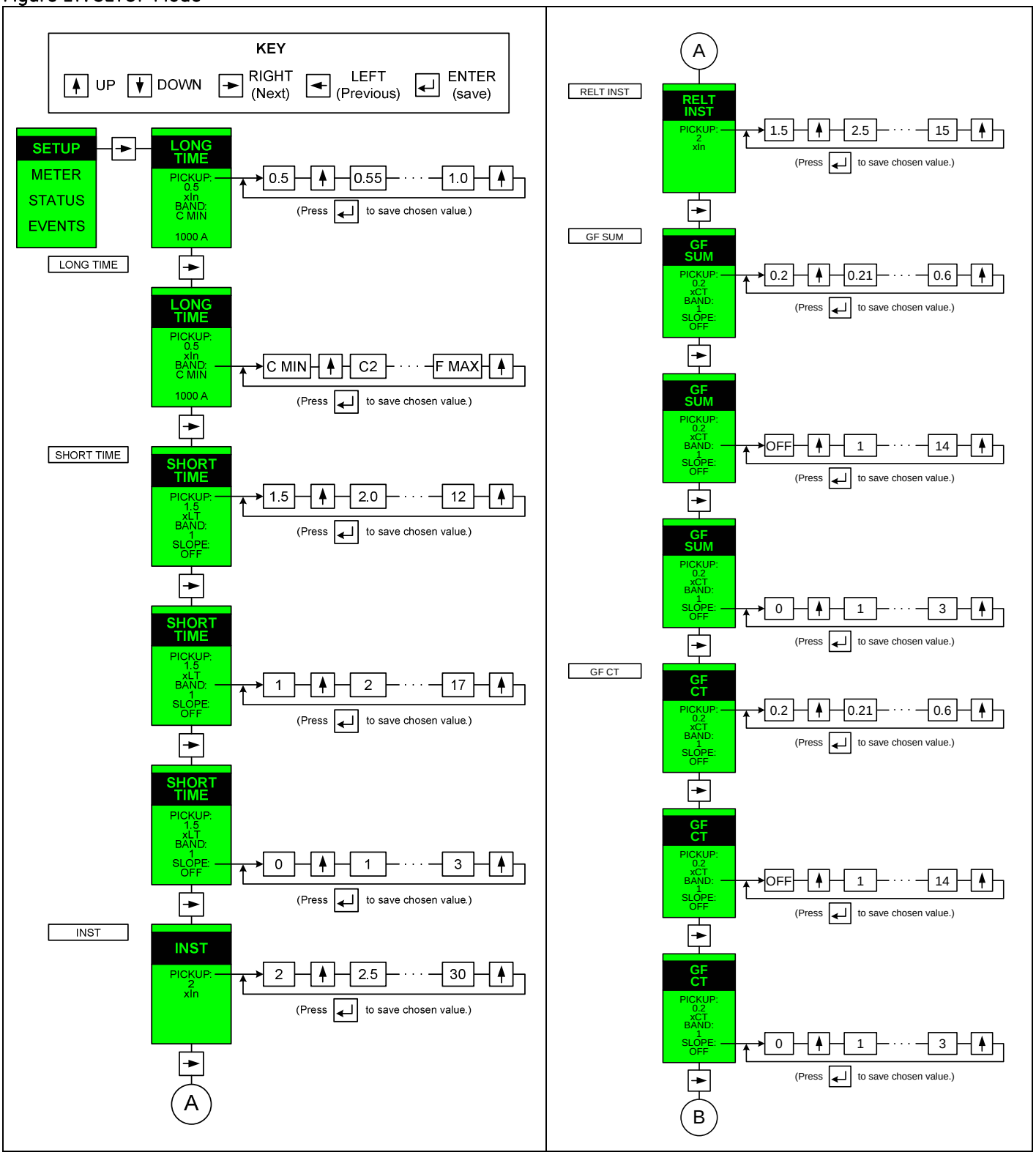
Register	Variable	Value	Read/Write
237	Error Code Log	–	Read
238	Error Counter	1 to 10	Read
239	Long Time pickup State	0–Not in Pickup, 1–Near Pickup, 2–In Pickup	Read

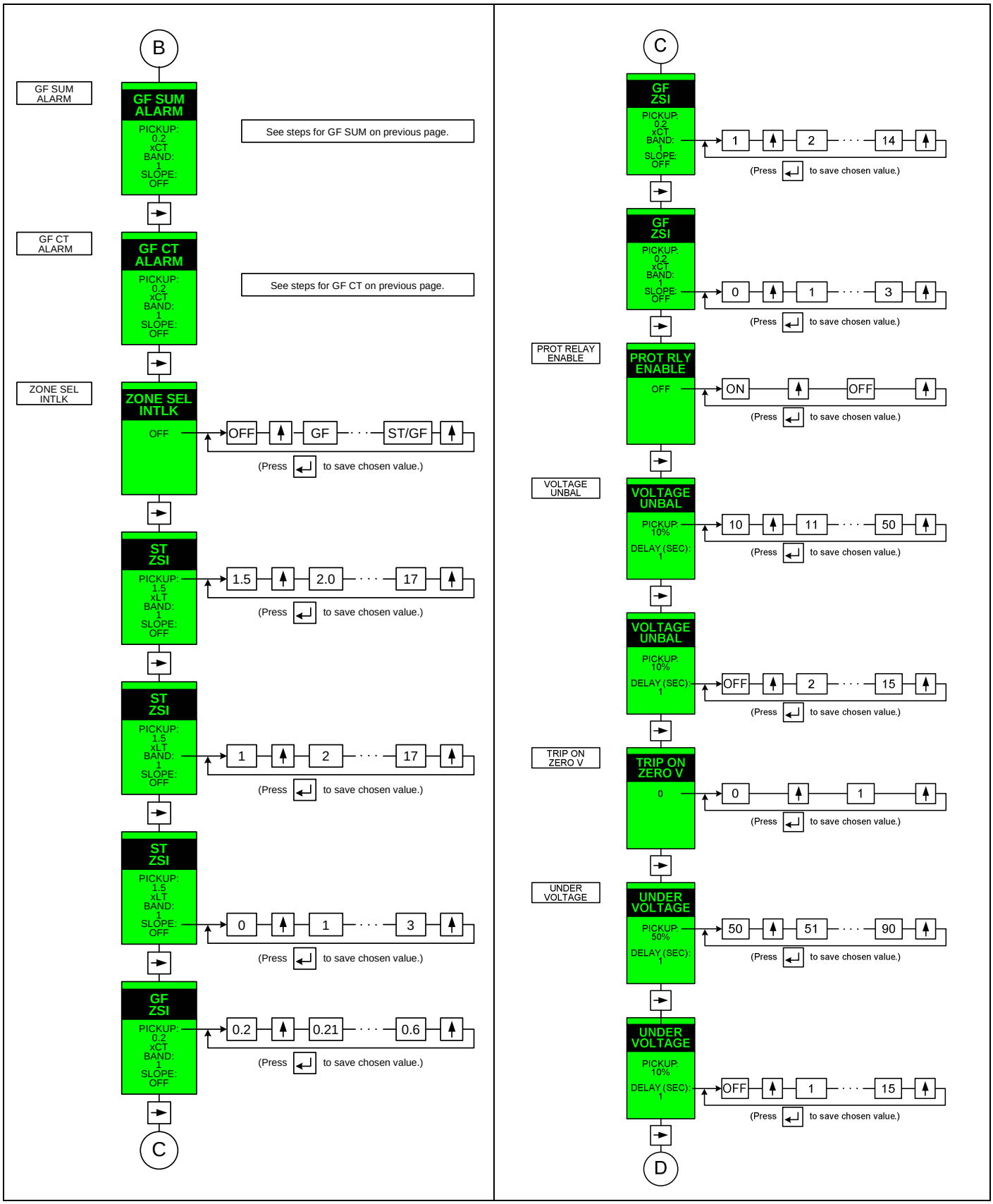
Table 25: Communication Parameters – Modbus Function 5

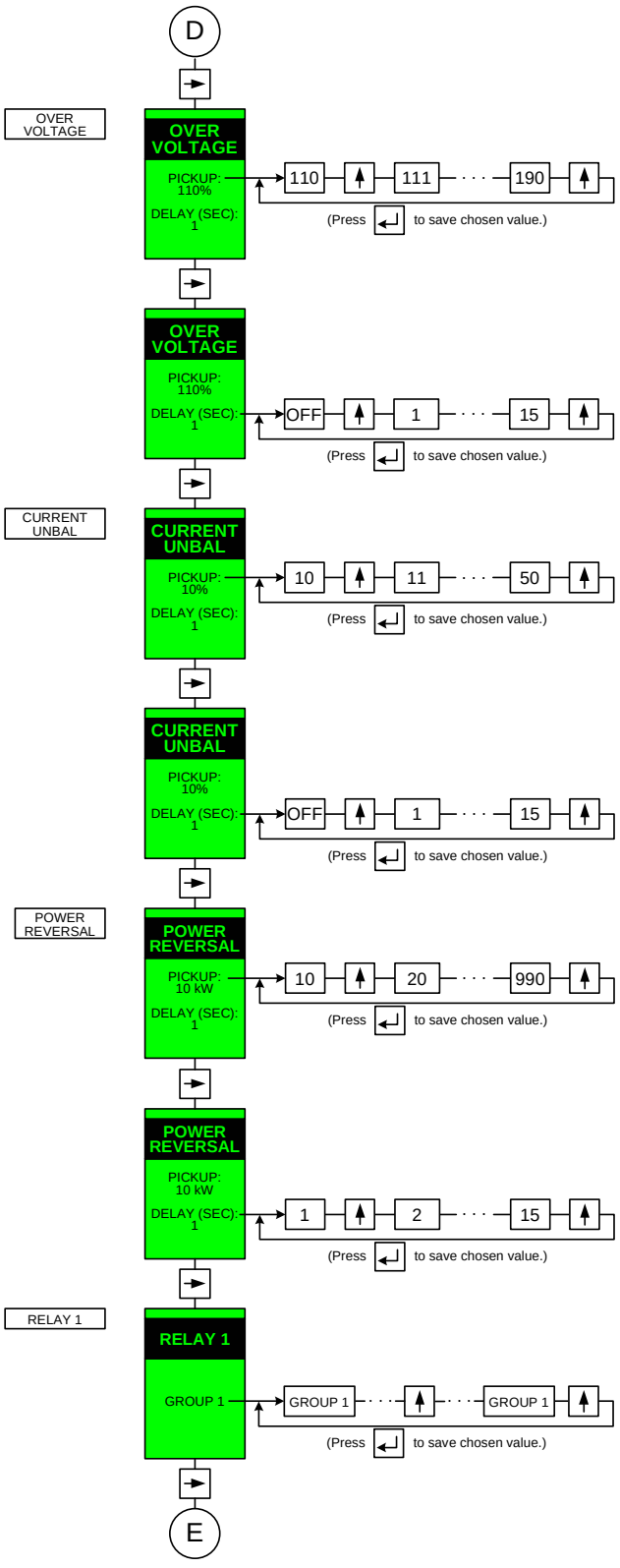
Register	Parameter	Values
102	Save Public Default Data	–
103	Save Real Time Clock Registers	–
104	Read Real Time Clock Registers	–
105	Save EPROM Data	–
107	Upload to BIM	–
108	Trip Breaker	0–Reset, 1–Trip
109	Reduced Instantaneous	0–Off, 1–ON
111	Fan State	0–Off, 1–ON
112	Relay 1 State	0–Off, 1–ON
113	Relay 2 State	0–Off, 1–ON
114	Relay 3 State	0–Off, 1–ON
116	Clear All Events	–
117	Clear EEPROM	–
118	Clear Energy Total	–
119	Clear All Trip Counters	–
143	Trigger Waveform Capture	–
144	Clear Waveform Capture Data Buffer	–

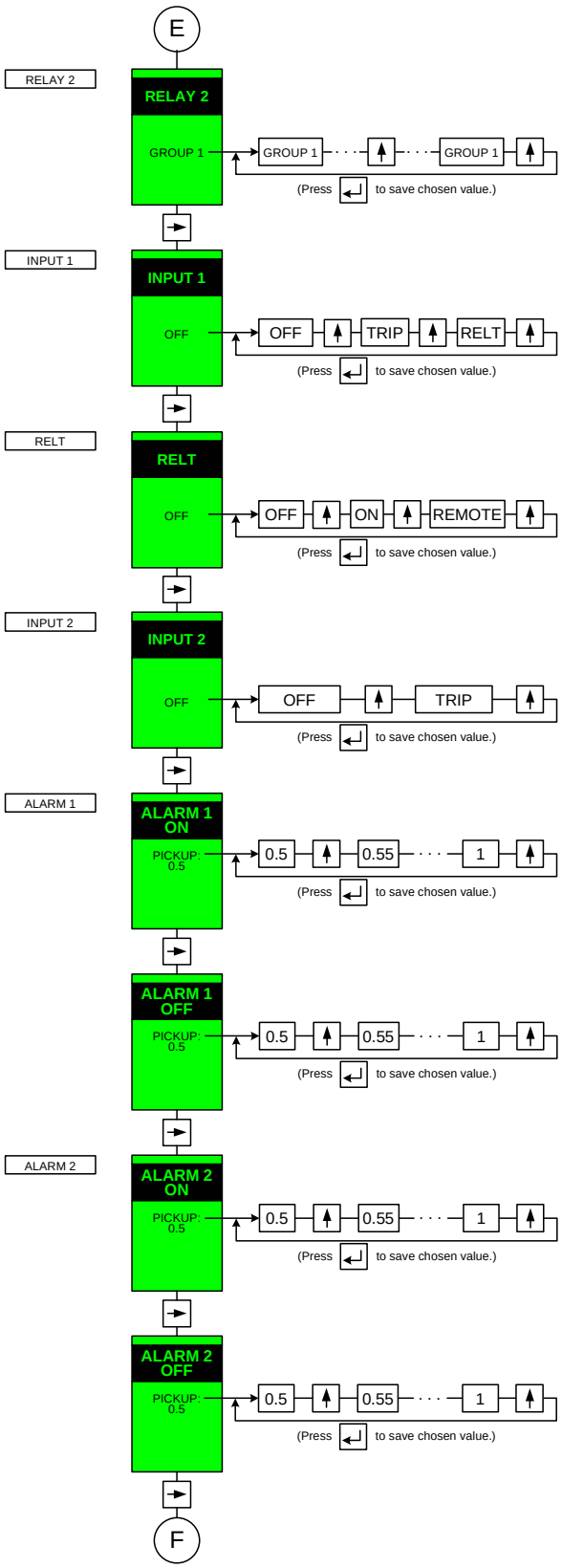
APPENDIX 2: OPERATING MODES AND FUNCTIONS SPECIFICS

Figure 17: SETUP Mode






D
OVER VOLTAGE
OVER VOLTAGE
PICKUP: 110%
DELAY (SEC): 1
110
111
190
(Press to save chosen value.)
OVER VOLTAGE
PICKUP: 110%
DELAY (SEC): 1
OFF
1
15
(Press to save chosen value.)
CURRENT UNBAL
CURRENT UNBAL
PICKUP: 10%
DELAY (SEC): 1
10
11
50
(Press to save chosen value.)
CURRENT UNBAL
PICKUP: 10%
DELAY (SEC): 1
OFF
1
15
(Press to save chosen value.)
POWER REVERSAL
POWER REVERSAL
PICKUP: 10 kW
DELAY (SEC): 1
10
20
990
(Press to save chosen value.)
POWER REVERSAL
PICKUP: 10 kW
DELAY (SEC): 1
1
2
15
(Press to save chosen value.)
RELAY 1
RELAY 1
GROUP 1
GROUP 1
GROUP 1
(Press to save chosen value.)
E


E
RELAY 2
RELAY 2
GROUP 1
GROUP 1
GROUP 1
(Press to save chosen value.)
INPUT 1
INPUT 1
OFF
OFF
TRIP
RELT
(Press to save chosen value.)
RELT
RELT
OFF
OFF
ON
REMOTE
(Press to save chosen value.)
INPUT 2
INPUT 2
OFF
OFF
TRIP
(Press to save chosen value.)
ALARM 1
ALARM 1 ON
PICKUP: 0.5
0.5
0.55
1
(Press to save chosen value.)
ALARM 1 OFF
PICKUP: 0.5
0.5
0.55
1
(Press to save chosen value.)
ALARM 2
ALARM 2 ON
PICKUP: 0.5
0.5
0.55
1
(Press to save chosen value.)
ALARM 2 OFF
PICKUP: 0.5
0.5
0.55
1
(Press to save chosen value.)
F

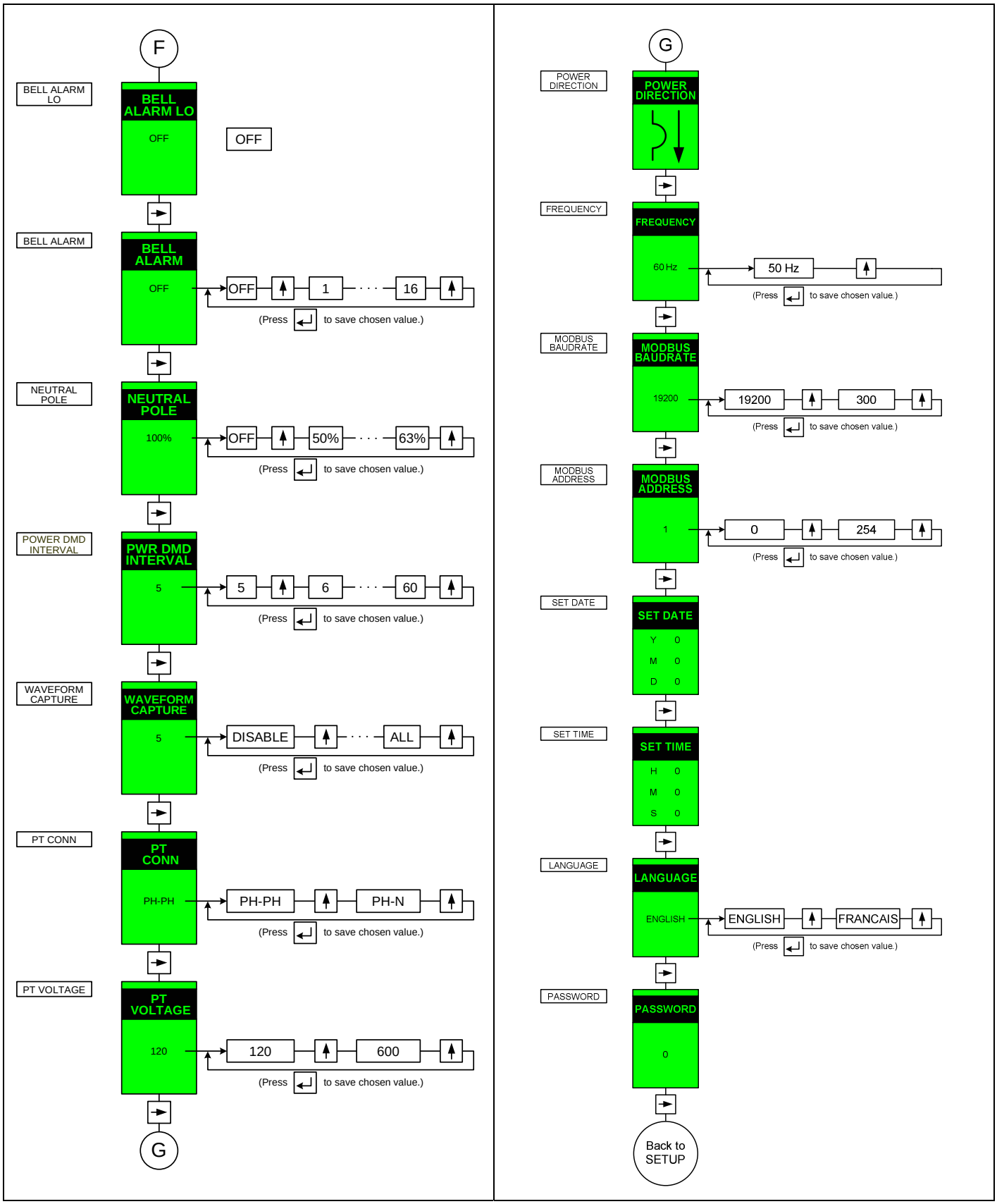


Figure 18: METER Mode (Wye and Delta Systems)

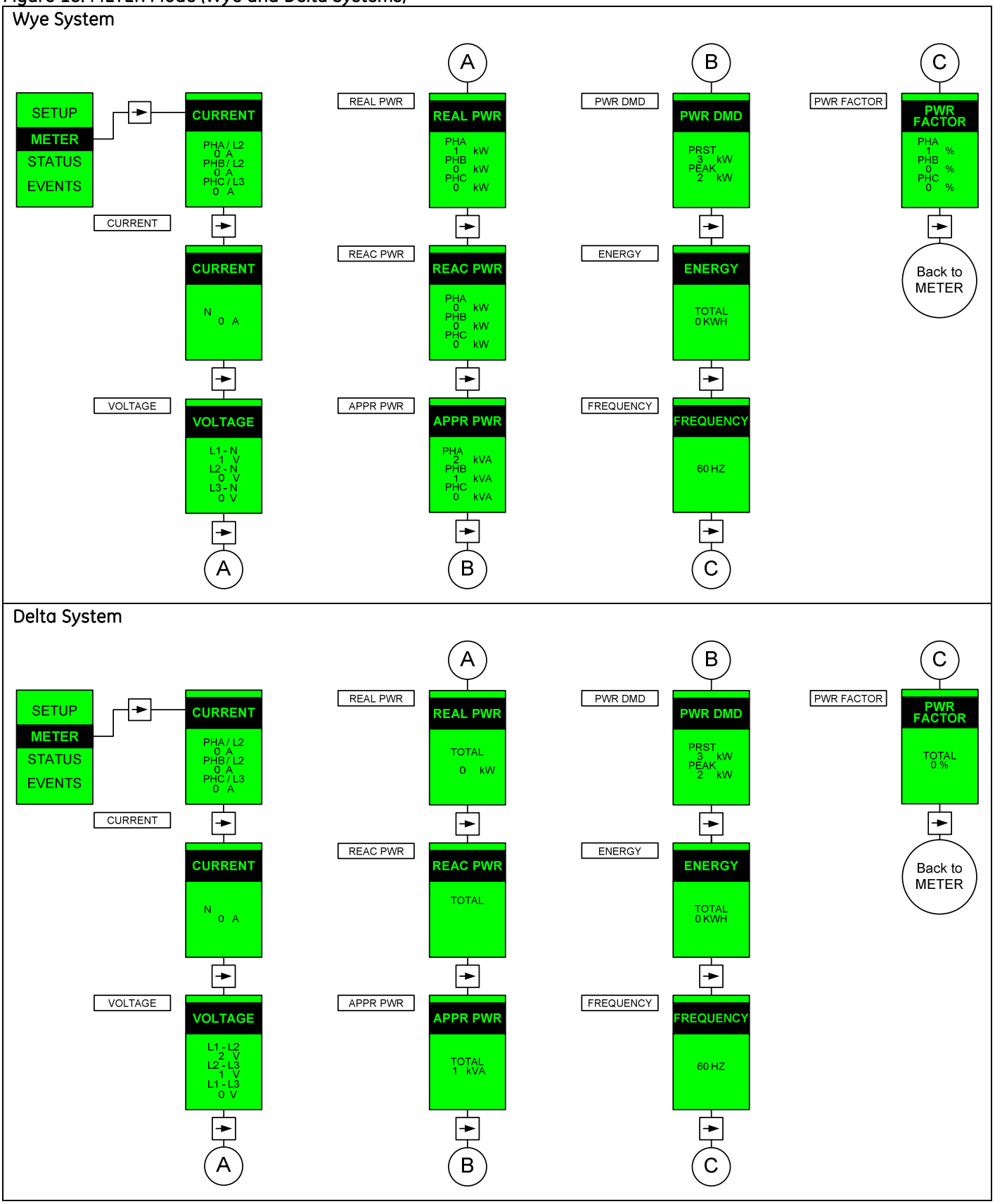


Figure 19: STATUS Mode

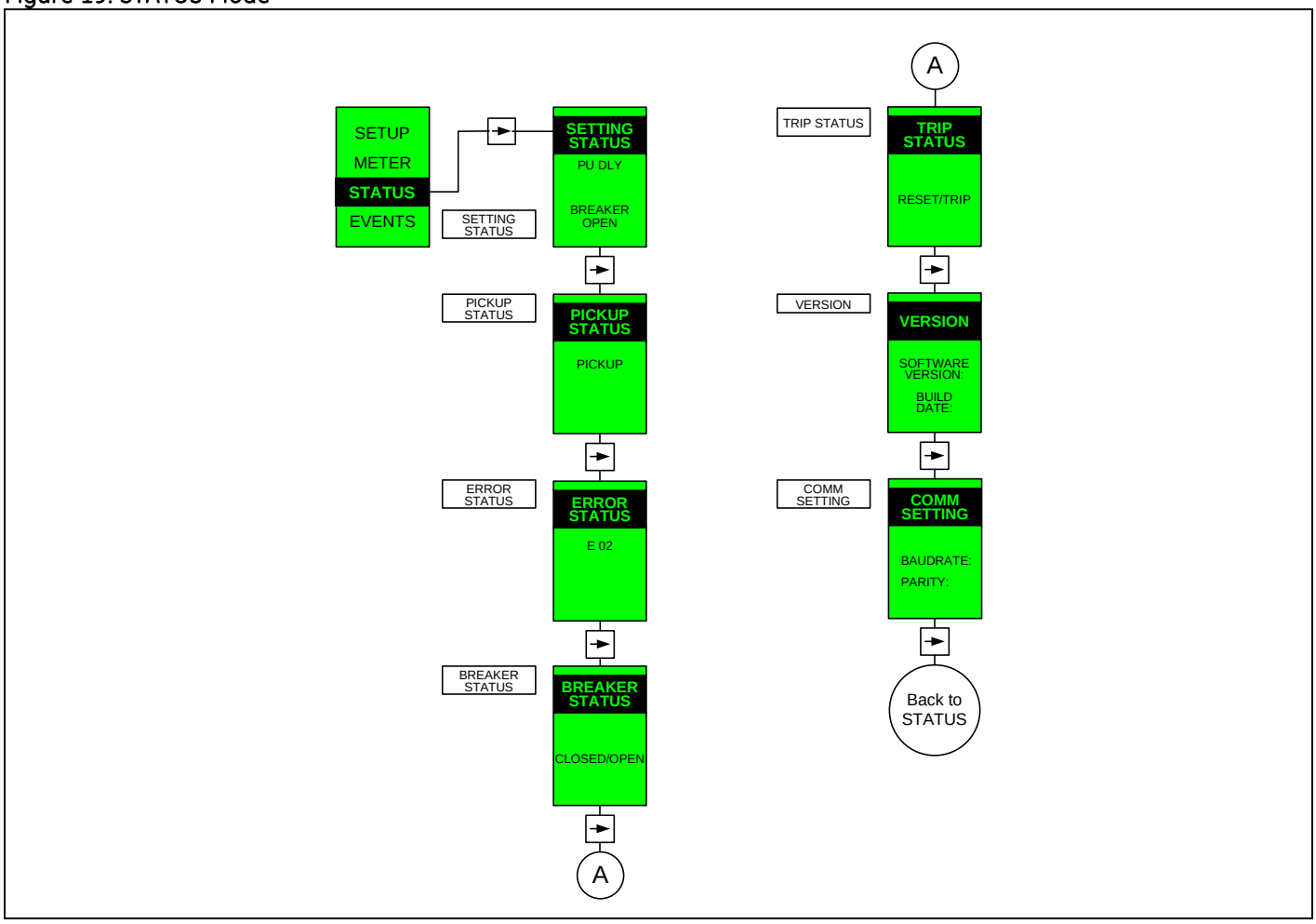
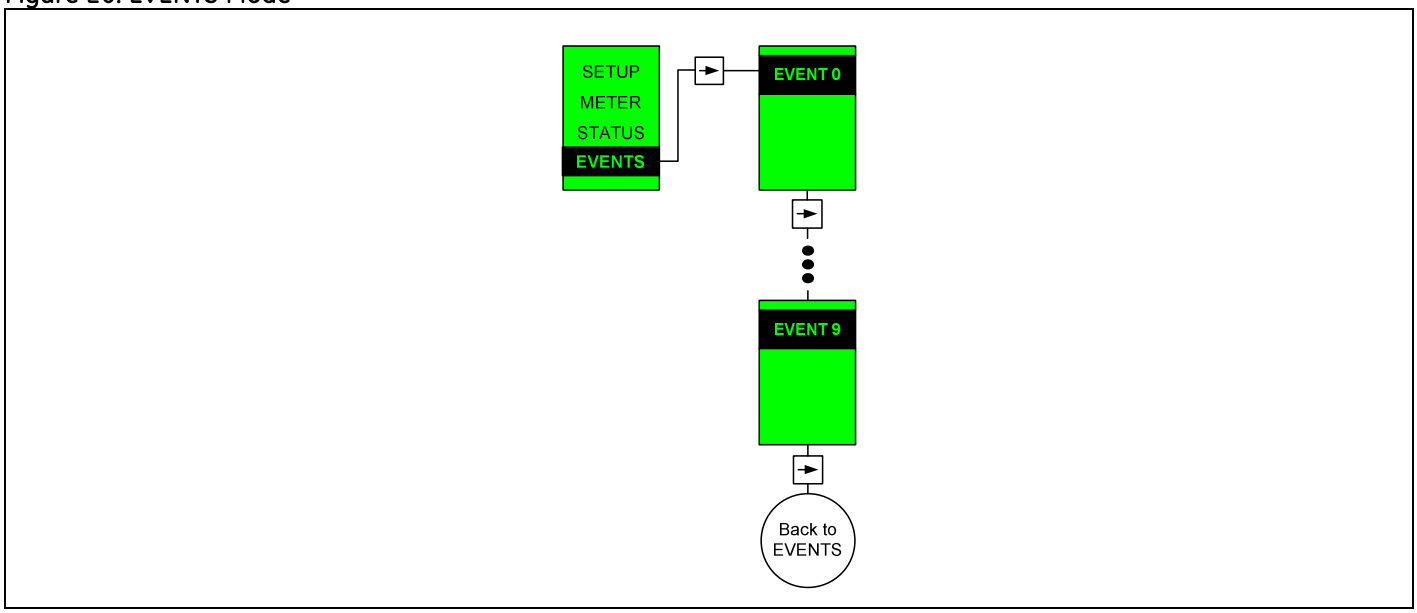


Figure 20: EVENTS Mode



GE
41 Woodford Avenue
Plainville, CT 06062

www.geelectrical.com

DEH-4567 (08/08)

imagination at work