GE
Grid Solutions

345
Transformer Protection System

Transformer protection and control

Quick Start Guide

345 revision: 2.3x

Manual P/N: 1601-9100-AB

GE publication code: GEK-113569K

WORLDWIDE 10 YEAR WARRANTY

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GE Multilin 345 Transformer Protection System QuickStart Guide for revision 2.3x.

345 Transformer Protection System, EnerVista, EnerVista Launchpad, and EnerVista 3 Series Setup are registered trademarks of GE Multilin Inc.

Part number: 1601-9100-AB (September 2017)

Storage

Store the unit indoors in a cool, dry place. If possible, store in the original packaging. Follow the storage temperature range outlined in the Specifications.

NOTICE

To avoid deterioration of electrolytic capacitors, power up units that are stored in a de-energized state once per year, for one hour continuously.

Warranty

For products shipped as of 1 October 2013, GE warrants most of its GE manufactured products for 10 years. For warranty details including any limitations and disclaimers, see our Terms and Conditions at https://www.gegridsolutions.com/multilin/warranty.htm

For products shipped before 1 October 2013, the standard 24-month warranty applies.

Repairs

The firmware and software can be upgraded without return of the device to the factory.

For issues not solved by troubleshooting, the process to return the device to the factory for repair is as follows:

- Contact a GE Grid Solutions Technical Support Center. Contact information is found in the first chapter.
- Obtain a Return Materials Authorization (RMA) number from the Technical Support Center.
- Verify that the RMA and Commercial Invoice received have the correct information.
- Tightly pack the unit in a box with bubble wrap, foam material, or styrofoam inserts or packaging peanuts to cushion the item(s). You may also use double boxing whereby you place the box in a larger box that contains at least 5 cm of cushioning material.
- Ship the unit by courier or freight forwarder, along with the Commercial Invoice and RMA, to the factory.

  Customers are responsible for shipping costs to the factory, regardless of whether the unit is under warranty.
- Fax a copy of the shipping information to the GE Grid Solutions service department.

Use the detailed return procedure outlined at

https://www.gegridsolutions.com/multilin/support/ret_proc.htm

The current warranty and return information are outlined at

https://www.gegridsolutions.com/multilin/warranty.htm

⚠CAUTION

GENERAL SAFETY PRECAUTIONS - 345

- Failure to observe and follow the instructions provided in the equipment manual(s) could cause irreversible damage to the equipment and could lead to property damage, personal injury and/or death.
- Before attempting to use the equipment, it is important that all danger and caution indicators are reviewed.
- If the equipment is used in a manner not specified by the manufacturer or functions abnormally, proceed with caution. Otherwise, the protection provided by the equipment may be impaired and can result in Impaired operation and injury.
- Caution: Hazardous voltages can cause shock, burns or death.
- Installation/service personnel must be familiar with general device test practices, electrical awareness and safety precautions must be followed.
- Before performing visual inspections, tests, or periodic maintenance on this device or associated circuits, isolate or disconnect all hazardous live circuits and sources of electric power.
- Failure to shut equipment off prior to removing the power connections could expose you to dangerous voltages causing injury or death.
- All recommended equipment that should be grounded and must have a reliable and un-compromised grounding path for safety purposes, protection against electromagnetic interference and proper device operation.
- Equipment grounds should be bonded together and connected to the facility's main ground system for primary power.
- Keep all ground leads as short as possible.
- At all times, equipment ground terminal must be grounded during device operation and service.
- In addition to the safety precautions mentioned all electrical connections made must respect the applicable local jurisdiction electrical code.
- Before working on CTs, they must be short-circuited.
- LED transmitters are classified as IEC 60825-1 Accessible Emission Limit (AEL) Class 1M. Class 1M devices are considered safe to the unaided eye. Do not view directly with optical instruments.

This product cannot be disposed of as unsorted municipal waste in the European Union. For proper recycling return this product to your supplier or a designated collection point. For more information go to www.recyclethis.info.

Safety words and definitions

The following symbols used in this document indicate the following conditions

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

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

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Indicates practices not related to personal injury.

For further assistance

For product support, contact the information and call center as follows:

GE Grid Solutions
650 Markland Street
Markham, Ontario
Canada L6C 0M1
Worldwide telephone: +1 905 927 7070
Europe/Middle East/Africa telephone: +34 94 485 88 54
North America toll-free: 1 800 547 8629
Fax: +1 905 927 5098
Worldwide e-mail: multilin.tech@ge.com
Europe e-mail: multilin.tech.euro@ge.com
Website: http://www.gegridsolutions.com/multilin

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345 Transformer Protection System

Chapter 1: Introduction

Overview

The 345 is a microprocessor-based relay for primary and backup protection of small to medium size distribution transformers. The relay provides advanced algorithms for automatic magnitude and phase compensation for more than twenty types of two-winding transformers, good sensitivity for the detection of winding ground faults, and the flexibility to set any of the phase, ground, neutral and negative sequence currents over-current elements. The 345 relay has a small footprint and is withdrawable for easy mounting into either new or retrofit installations. The combination of proven hardware, advanced features, and communications, makes the relay superior for total transformer metering, monitoring, protection and control. Equipped with serial (RS485), USB, and Ethernet ports, as well as a wide selection of protocols such as Modbus, DNP3.0, IEC60870-5-103, 60870-5-104, IEC 61850 GOOSE, the 345 relay is the best-in-class for either MCCs, SCADA or inter-relay communications. The 345 provides excellent accessibility and transparency with regard to power system conditions and events, through both its four-line 20 character display, and the EnerVista SR3 Setup program. Conveniently located LEDs indicate the relay status, pickup, operation, and alarm events, as well as the status of each winding breaker.

The 345 relay provides the following key benefits:

- Withdrawable small footprint – saves on rewiring and space.
- Multiple protection groups with the flexibility to switch through a wide selection of main and backup transformer protections and controls.
- Fast setup (Quick Setup) menu for power system configuration and protection.
- Large four-line LCD display, LEDs, and keypad
- Multiple communication protocols and simultaneous access with easy integration into monitoring and control systems.

Description of the 345 Transformer Protection System

CPU

Relay functions are controlled by two processors: a Freescale MPC5554 32-bit microprocessor measures all analog signals and digital inputs and controls all output relays; a Freescale MPC520B 32-bit microprocessor controls all the Ethernet communication protocols.

Analog Input and Waveform Capture

Magnetic transformers are used to scale-down the incoming analog signals from the source instrument transformers. The analog signals are then passed through a 960 Hz low pass anti-aliasing filter. All signals are then simultaneously captured by sample and hold buffers to ensure there are no phase shifts. The signals are converted to digital values by a 12-bit A/D converter before finally being passed on to the CPU for analysis.

Both current and voltage are sampled thirty-two times per power frequency cycle. These 'raw' samples are scaled in software, then placed into the waveform capture buffer, thus emulating a fault recorder. The waveforms can be retrieved from the relay via the EnerVista 3 Series Setup software for display and diagnostics.

Phasors, Transients, and Harmonics

Current waveforms are processed four times every cycle with a DC Offset Filter and a Discrete Fourier Transform (DFT). The resulting phasors have fault current transients and all harmonics removed. This results in an overcurrent relay that is extremely secure and reliable; one that will not overreach.

Processing of AC Current Inputs

The DC Offset Filter is an infinite impulse response (IIR) digital filter, which removes the DC component from the asymmetrical current present at the moment a fault occurs. This is done for all current signals used for overcurrent protection; voltage signals bypass the DC Offset Filter. This filter ensures no overreach of the overcurrent protection.

The Discrete Fourier Transform (DFT) uses exactly one sample cycle to calculate a phasor quantity which represents the signal at the fundamental frequency; all harmonic components are removed. All subsequent calculations (e.g. RMS, power, etc.) are based upon the current and voltage phasors, such that the resulting values have no harmonic components.

Protection Elements

The protection elements are processed four times per power cycle. The protection elements use RMS current, based on the magnitude of the phasor. Hence, protection is impervious to both harmonics and DC transients.

Figure 1-1: Functional block diagram

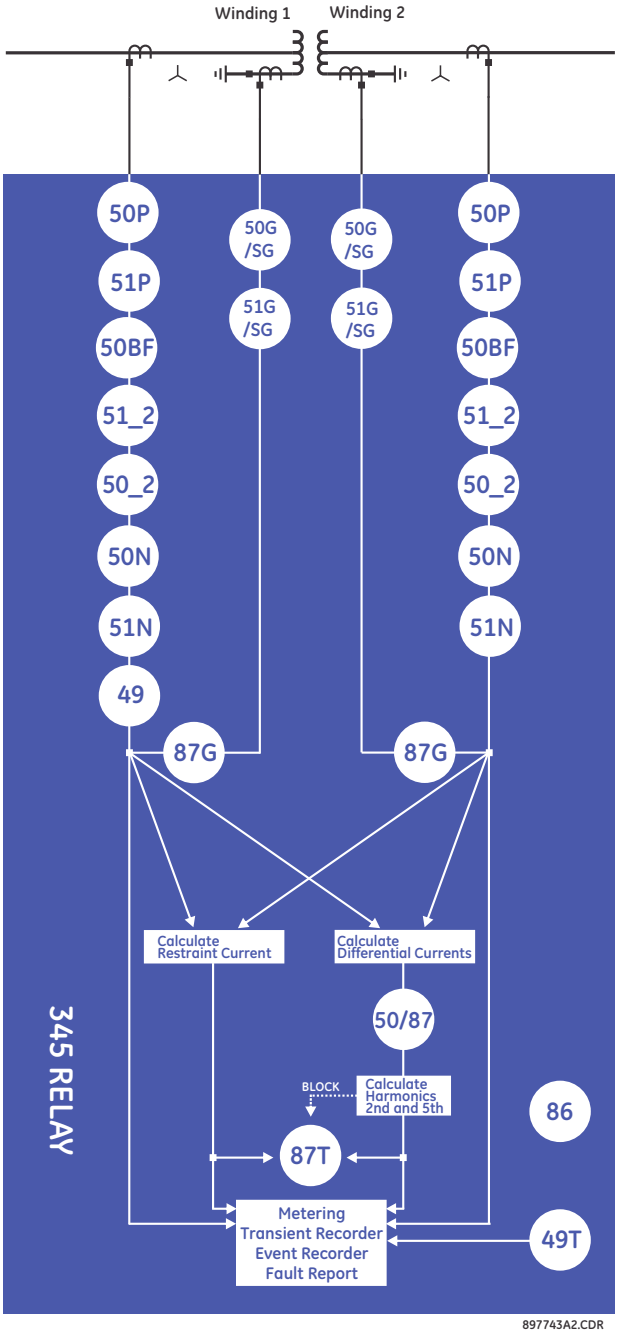


Table 1-1: ANSI device numbers and functions

ANSI Code	61850 Logical Node	Description
49	PTTR1	Thermal Overload
49T	rtdGGIO6	Temperature Monitoring
50/87	insPDIF1	Instantaneous Differential
50_2	ngseqPIOC1, ngseqPIOC2	Negative Sequence Instantaneous Overcurrent
50BF	RBRF1, RBRF2	Breaker Failure
50G/SG	gndPIOC1, gndPIOC2/ hsePIOC1, hsePIOC2	Ground/Sensitive Ground Instantaneous Overcurrent
50N	ndPIOC1, ndPIOC2	Neutral Instantaneous Overcurrent
50P	phsPIOC1, phsPIOC2	Phase Instantaneous Overcurrent
51_2	ngseqPTOC1, ngseqPTOC2	Negative Sequence Timed Overcurrent
51G/SG	gndPTOC1, gndPTOC2/ hsePTOC1, hsePTOC2	Ground/Sensitive Ground Timed Overcurrent
51N	ndPTOC1, ndPTOC2	Neutral Timed Overcurrent
51P	phsPTOC1, phsPTOC2	Phase Timed Overcurrent
86	-	Lockout
87G (RGF)[1]	rgfPDIF1, rgfPDIF2	Restricted Ground Fault
87T	pcntPDIF1	Percent Differential

1.Restricted Ground Fault is sometimes coded as “87G”, "REF", "87RGF", "87N", "64R", "64REF", etc.

Table 1-2: Other device functions

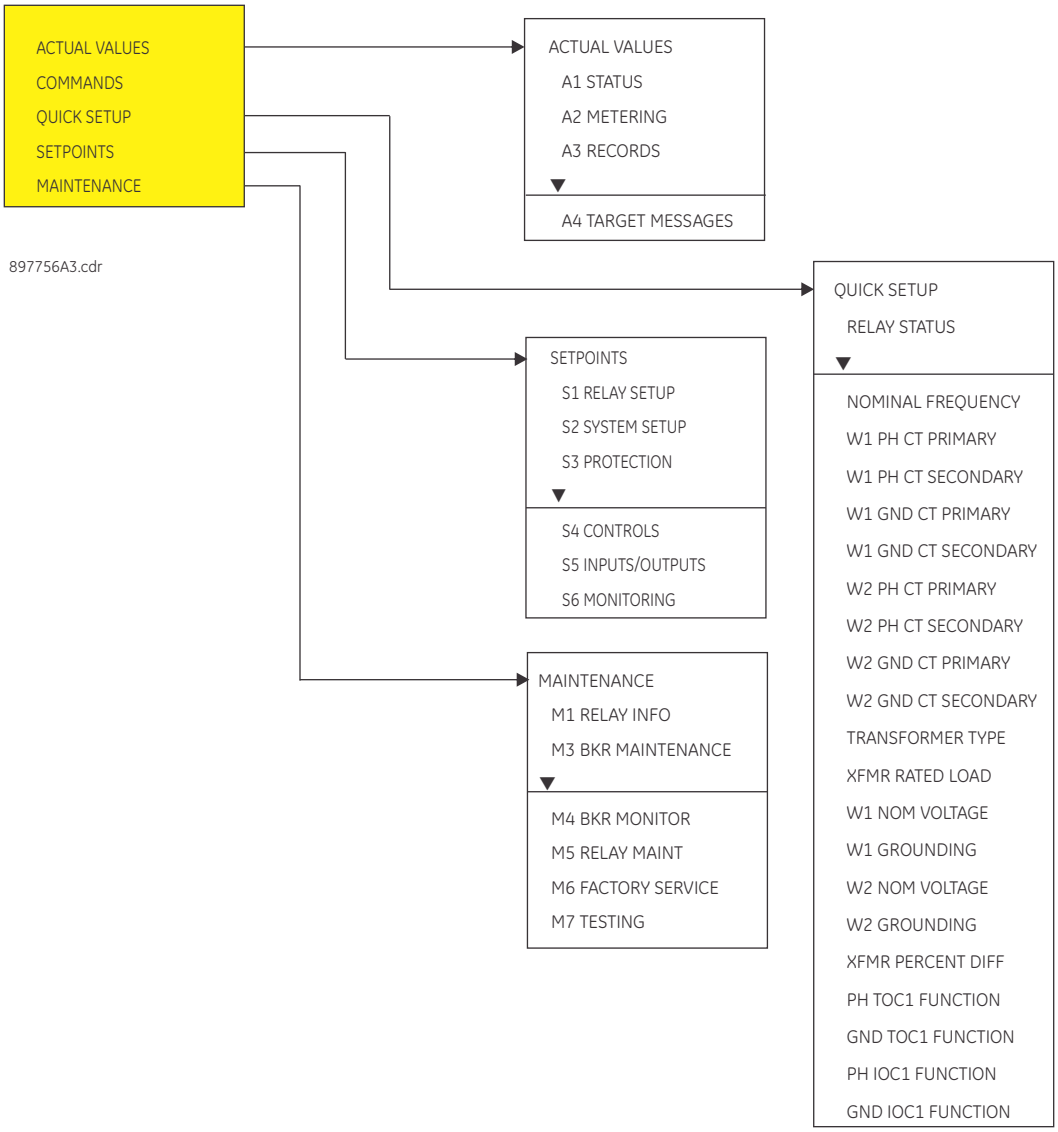
Description
2nd Harmonic Blocking
Ambient Temperature
Breaker Control
Breaker Maintenance
CT Failure Detection
Demand (in metering)
Digital Counters
DNP 3.0 Communications
Event Recorder
Fault Report
IEC 60870-5-103 Communications
IEC 60870-5-104 Communications
IEC 61850 Communications
IEC 61850 GOOSE Communications
Lockout (86)
Logic Elements
Metering: current, frequency, harmonics
Modbus User Map
Modbus RTU Communications
Modbus TCP Communications
Non-volatile Latches
Output Relays
Relay Maintenance

Description
Remote Inputs (32)
Setpoint Groups (2)
Test Mode
Transient Recorder (Oscillography)
Trip and Close Coil Monitoring
User Curves
User-programmable LEDs
Virtual Inputs (32)
Virtual Outputs (32)

The 345 relay has two identical setpoint groups, with the same set of protection elements. By default setpoint group 1 will be active. Setpoint group 2 can be activated by programming the conditions under S4 Control/Change Setpoint Group menu.

Depending on the relay order code, the type and number of protection elements per setpoint group changes. The full set of protection elements will be available in the setpoint group, if the "Advanced configuration (letter M) is selected in the order code. This includes one Transformer Percent Differential element, one Instantaneous Differential element, two Restricted Ground Fault elements, one Thermal Model, two Breaker Failure elements, two of each Phase-, Ground-, and Neutral Instantaneous Overcurrent elements, two of each Phase-, Ground-, Neutral Timed Overcurrent elements, and two Negative Sequence Timed Overcurrent elements. Some of the protection elements are common for the transformer protection: Percent and Instantaneous differential elements, Thermal Model, and others are generic with programmable AC inputs from either winding currents: the Restricted Ground Fault 1(2), the Phase-, Ground-, and Neutral IOC1(2), the Phase, Ground, and Neutral TOC1(2), and the Negative Sequence TOC1(2) elements.

Figure 1-2: Main menu


ACTUAL VALUES
COMMANDS
QUICK SETUP
SETPOINTS
MAINTENANCE
897756A3.cdr
ACTUAL VALUES
A1 STATUS
A2 METERING
A3 RECORDS
A4 TARGET MESSAGES
QUICK SETUP
RELAY STATUS
NOMINAL FREQUENCY
W1 PH CT PRIMARY
W1 PH CT SECONDARY
W1 GND CT PRIMARY
W1 GND CT SECONDARY
W2 PH CT PRIMARY
W2 PH CT SECONDARY
W2 GND CT PRIMARY
W2 GND CT SECONDARY
TRANSFORMER TYPE
XFMR RATED LOAD
W1 NOM VOLTAGE
W1 GROUNDING
W2 NOM VOLTAGE
W2 GROUNDING
XFMR PERCENT DIFF
PH TOC1 FUNCTION
GND TOC1 FUNCTION
PH IOC1 FUNCTION
GND IOC1 FUNCTION
SETPOINTS
S1 RELAY SETUP
S2 SYSTEM SETUP
S3 PROTECTION
S4 CONTROLS
S5 INPUTS/OUTPUTS
S6 MONITORING
MAINTENANCE
M1 RELAY INFO
M3 BKR MAINTENANCE
M4 BKR MONITOR
M5 RELAY MAINT
M6 FACTORY SERVICE
M7 TESTING

345 order codes

The information to specify a 345 relay is provided in the following Order Code figure.

Figure 1-3: Order Codes

	345	–	*	*	*	*	E	*	N	N	*	*	*	*	
Interface	**345**		|	|	|	|		|			|	|	|	|	345 Transformer Protection Relay
User Interface			**E**	|	|	|		|			|	|	|	|	English without programmable LEDs
			L	|	|	|		|			|	|	|	|	English with programmable LEDs
Phase Currents[a]				**P0**	|	|		|			|	|	|	|	1 A and 5 A configurable phase current inputs
				P1	|	|		|			|	|	|	|	1 A 3-phase CTs (Winding 1 - 1 A, Winding 2 - 1 A)
				P5	|	|		|			|	|	|	|	5 A 3-phase CTs (Winding 1 - 5 A, Winding 2 - 5 A)
Ground Currents[b]					**G0**	|		|			|	|	|	|	1 A and 5 A configurable ground current input
					G1	|		|			|	|	|	|	1 A standard ground CTs (Winding 1 - 1 A, Winding 2 - 1 A)
					G5	|		|			|	|	|	|	5 A standard ground CTs (Winding 1 - 5 A, Winding 2 - 5 A)
					S0	|		|			|	|	|	|	1 A and 5 A configurable sensitive ground current input
					S1	|		|			|	|	|	|	1 A sensitive ground CTs (Winding 1 - 1 A, Winding 2 - 1 A)
					S5	|		|			|	|	|	|	5 A sensitive ground CTs (Winding 1 - 5 A, Winding 2 - 5 A)
Power Supply						**L**		|			|	|	|	|	24 to 48 V DC
						H		|			|	|	|	|	110 to 250 V DC/110 to 230 V AC
Current Protection[c]								**S**			|	|	|	|	Standard: 87T, 87T-50, 51P(1), 51N(1), 51G(1), 50P(1), 50G(1), 50N(1), 49P, 46 (51_2/50_2), 86
								M			|	|	|	|	Advanced: 87T, 87T-50, 51P(2), 51N(2), 51G(2), 50P(2), 50G(2), 50N(2), 49P, 46 (51_2/50_2)(2), 86, 50BF(2), 87G/RGF(2)
Communications											**S**	**N**	|	|	Standard: Front USB, Rear RS485: Modbus RTU, DNP3.0, IEC60870-5-103
											1	**E**	|	|	Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104
											2	**E**	|	|	Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850 GOOSE
											3	**E**	|	|	Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850
Case Design													**D**	|	Protection Relay with drawout design
													N	|	Protection Relay with non-drawout design
													X	|	Protection Relay (drawout design) with no chassis
Harsh Environment														**N**	None
														H	Harsh Environment Conformal Coating

a Phase current option "P0" and Ground current option "G0" is only available on the non-drawout version (Case Design option "N")

b Ground current options "G0/G1/G5" and "S0/S1/S5" must match the corresponding "P0/P1/P5" Phase currents The selected phase and ground CTs apply to both windings.

c Current protection option "E" has been discontinued.

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NOTE

Features related to each order number are subject to change without notice.

Empty chassis

The 345 protection relay chassis used with a drawout relay is available separately, for use as a partial replacement or in test environments. Many features are supported by the cards and ports within the chassis, as is reflected in the chassis order code.

NOTE

The chassis order code and drawout relay order code must match exactly.

NOTICE

A drawout relay cannot be used in a chassis with different order code options.

Figure 1-4: 350 chassis order codes

345 – CH – * * * N N * * *		
Phase Currents	**P1**	1 A 3-phase CTs (Winding 1 - 1 A, Winding 2 - 1 A)
	P5	5 A 3-phase CTs (Winding 1 - 5 A, Winding 2 - 5 A)
Ground Currents[a]	**G1**	1 A standard ground CTs (Winding 1 - 1 A, Winding 2 - 1 A)
	G5	5 A standard ground CTs (Winding 1 - 5 A, Winding 2 - 5 A)
	S1	1 A sensitive ground CTs (Winding 1 - 1 A, Winding 2 - 1 A)
	S5	5 A sensitive ground CTs (Winding 1 - 5 A, Winding 2 - 5 A)
Communications	**S N**	Standard: Front USB, Rear RS485: Modbus RTU, DNP3.0, IEC60870-5-103
	1 E	Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104
	2 E	Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850 GOOSE
	3 E	Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850
Harsh Environment	**N**	None
	H	Harsh Environment Conformal Coating

a Ground current options "G1/G5" must match the corresponding "P1/P5" Phase currents

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Remote Module I/O

The remote RTD Module provides additional protection by monitoring the temperature of key components in the equipment.

RMIO – * G G * *		
Power Supply	**L**	24 - 48 V DC
	H	110 - 250 V DC / 110 - 230 V AC
I/O Module 1	**G**	Remote Module I/O (3 - 100 Ohm Platinum RTDs)
I/O Module 2	**G**	Remote Module I/O (3 - 100 Ohm Platinum RTDs)
I/O Module 3	**G**	Remote Module I/O (3 - 100 Ohm Platinum RTDs)
	X	None
I/O Module 4	**G**	Remote Module I/O (3 - 100 Ohm Platinum RTDs)
	X	None

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Accessories

- 18L0-0075 3 Series Depth reducing collar - 1.375"
- 18L0-0076 3 Series Depth reducing collar - 3.00"
- 18L0-0080 3 Series IP20 Kit
- 3S-NDO-STCONKIT 3 Series NDO straight terminal block kit
- 0804-0458 USB A-B configuration cable - 6'

NOTE

Refer to the *3 Series Retrofit Instruction Manual* for the retrofit of Multilin MI, MII, MLJ, and TOV relays.

Specifications

NOTE

Specifications are subject to change without notice.

NOTE

All accuracies defined below are at nominal frequency (50Hz or 60Hz) unless otherwise stated.

NOTE

To obtain the element operating time delay, i.e. from fault injection until operation, add the operate time to the curve time.

To obtain the total element operating time, i.e. from the presence of a trip condition to initiation of a trip, add 8 ms output relay time to the operate times listed below.

Password security

PASSWORD SECURITY

Master Password: ..... 8 to 10 alpha-numeric characters

Settings Password: ..... 3 to 10 alpha-numeric characters for local and remote access

Control Password: ..... 3 to 10 alpha-numeric characters for local and remote access

Protection

PHASE/NEUTRAL/GROUND/NEGATIVE SEQUENCE TIMED OVERCURRENT (51P/51N/51G/51_2)

Pickup Level: ..... 0.05 to 20.00 x CT in steps of 0.01 x CT

Dropout Level: ..... 97% of Pickup @ I > 1 x CT
Pickup - 0.02 x CT @ I < 1 x CT

Curve Shape: ..... ANSI Extremely/Very/Moderately/Normally Inverse
Definite Time (0.1 s base curve)
IEC Curve A/B/C and Short Inverse
IAC Extremely/Very/-/Short Inverse

Curve Multiplier: ..... 0.05 to 50.00 in steps of 0.01

Reset Time: ..... Instantaneous, Linear

Curve Timing Accuracy: ..... ±3% of expected inverse time or 1 cycle, whichever is greater, from pickup to operate

Level Accuracy: ..... per CT input

SENSITIVE GROUND TIMED OVERCURRENT (51SG)

Pickup Level: ..... 0.005 to 3.000 x CT in steps of 0.001 x CT
Dropout Level: ..... 97% of Pickup @ I > 0.1 x CT
Pickup - 0.002 x CT @ I < 0.1 x CT
Curve Shape: ..... ANSI Extremely/Very/Moderately/Normally Inverse
Definite Time
IEC Curve A/B/C/Short
IAC Extremely/Very/-/Short Inverse
Curve Multiplier: ..... 0.05 to 50.00 in steps of 0.1
Reset Time: ..... Instantaneous, Linear
Curve Timing Accuracy: ..... ±3% of expected inverse time or 1 cycle, whichever is greater, from pickup to operate
Level Accuracy: ..... per CT input

PHASE/NEUTRAL/GROUND/NEGATIVE SEQUENCE INSTANTANEOUS OVERCURRENT (50P/50N/50G/50_2)

Pickup Level: ..... 0.05 to 20.00 x CT in steps of 0.01 x CT
Dropout Level: ..... 97% of Pickup @ I > 1 x CT
Pickup - 0.02 x CT @ I <1 x CT
Time Delay: ..... 0.00 to 300.00 sec in steps of 0.01
Operate Time: ..... <30 ms @ 60Hz (I > 2.0 x PKP, No time delay)
<35 ms @ 50Hz (I > 2.0 x PKP, No time delay)
Time Delay Accuracy: ..... 1% or 1 cycle, whichever is greater (Time Delay selected)
Level Accuracy: ..... per CT input

SENSITIVE GROUND INSTANTANEOUS OVERCURRENT (50SG)

Pickup Level (Gnd IOC): ..... 0.005 to 3.000 x CT in steps of 0.001 x CT
Dropout Level: ..... 97% of Pickup @ I > 0.1 x CT
Pickup - 0.002 x CT @ I < 0.1 x CT
Time Delay: ..... 0.00 to 300.00 sec in steps of 0.01
Operate Time: ..... <30 ms @ 60Hz (I > 2.0 x PKP, No time delay)
<35 ms @ 50Hz (I > 2.0 x PKP, No time delay)
Time Delay Accuracy: ..... 1% or 1 cycle, whichever is greater (Time Delay selected)
Level Accuracy: ..... per CT input

TRANSFORMER THERMAL PROTECTION (49)

Current: ..... RMS current - max (Ia, Ib, Ic)
Pickup Accuracy: ..... per current inputs
Timing Accuracy: ..... ±3% of expected time, or 30 ms (whichever is greater) @ I > 1.5 x PKP

TRANSFORMER PERCENT DIFFERENTIAL PROTECTION (87T)

Differential/Restraint Characteristic: ..... Dual Slope, Dual Breakpoint
Minimum Pickup Level: ..... 0.05 to 1.00 x CT in steps of 0.01
Slope 1 Range: ..... 15 to 100% in steps of 1%
Slope 2 Range: ..... 50 to 100% in steps of 1%
Kneepoint 1: ..... 0.50 to 4.00 x CT in steps of 0.01
Kneepoint 2: ..... 1.00 to 10.00 x CT in steps of 0.01
2nd Harmonic Inhibit Level: ..... 1.0 to 40.0% insteps of 0.1%
2nd Harmonic Inhibit Mode: ..... Per-phase, 2-out-of-3, Average, 1-out-of-3
5th Harmonic Inhibit Level: ..... 1.0 to 40.0% insteps of 0.1%
Dropout Level: ..... 95% of Pickup
Operate Time: ..... < 20 ms (no harmonics inhibits selected)
< 30 ms (harmonics inhibits selected)
Level Accuracy: ..... per current inputs

TRANSFORMER INSTANTANEOUS DIFFERENTIAL PROTECTION (50/87)

Pickup Level: ..... 3.00 to 20.00xCT in steps of 0.01xCT
Dropout Level: ..... 95% of Pickup
Operate Time: ..... <30 ms
Level Accuracy: ..... per current inputs

RESTRICTED GROUND FAULT

Number of Elements: 2
Pickup Level: 0.02 to 20.00 xCT in steps of 0.01
0.002 to 2.000 xCT (with sensitive CTs)
GND Supervision Level: 0.02 to 20.00 xCT in steps of 0.01
0.002 to 2.000 xCT (with sensitive CTs)
Dropout Level: 97% of Pickup
Slope Range: 0 to 100% in steps of 1
Pickup Delay: 0.00 to 600.0 s in steps of 0.01
Operate Time: < 30 ms @ 0 ms time delay
Level Accuracy: per current inputs

Metering

PHASE & GROUND CURRENT INPUTS

CT Primary: 1 to 6000 A
Range: 0.02 to 20 × CT
Input type: 1 A or 5 A (must be specified with order P1G1 or P5G5)
Configurable 1 A or 5 A (must be specified with order P0G0)
Nominal frequency: 50/60 Hz
Burden: <0.1 VA at rated load
Accuracy at nominal frequency: 3%
±10 mA or ±20% of reading from 0.02 to 0.19 × CT, whichever is greater
CT withstand: 1 second at 100 A (1 A option)
1 second at 400 A (5 A or universal CT option)
2 seconds at 40 × rated current
continuous at 3 × rated current

SENSITIVE GROUND CURRENT INPUT

CT Primary: 1 to 600 A
Range: 0.002 to 3 × CT
Input type: 1 A or 5 A (must be specified with order P1S1 or P5S5)
Configurable 1 A or 5 A (must be specified with order P0S0)
Nominal frequency: 50/60 Hz
Burden: <0.1 VA at rated load
Accuracy at nominal frequency: 3%
±10 mA or ±20% of reading from 0.02 to 0.19 × CT, whichever is greater
CT withstand: 1 second at 100 A (1 A option)
1 second at 400 A (5 A or universal CT option)
2 seconds at 40 × rated current
continuous at 3 × rated current

Data capture

TRANSIENT RECORDER

Buffer size: 3 s
No. of buffers: 1, 3, 6
No. of channels: 14
Sampling rate: 4, 8, 16, or 32 samples per cycle
Triggers: Manual Command
Contact Input
Virtual Input
Logic Element
Element Pickup/Trip/Dropout/Alarm
Data: AC input channels
Contact input state
Contact output state
Virtual input state
Logic element state
Data storage: RAM - battery backed-up

FAULT RECORDER

Number of records: 1
Content: Date and Time, first cause of fault, phases,
Currents: Ia, Ib, Ib, Ig/Isg, In - magnitudes and angles
Voltages: Van, Vbn, Vcn, Vab, Vbc, Vca, Vaux - magnitudes and angles
System frequency

EVENT RECORDER

Number of events: 256
Header: relay name, order code, firmware revision
Content: event number, date of event, cause of event,per-phase current, ground current, sensitive ground current, neutral current, ground differential current, negative sequence current, restraint current, per-phase differential current, per-phase differential second harmonic current, thermal capacity
Data Storage: RAM - battery backed up; retained for 3 days

CLOCK

Setup: Date and time
Daylight Saving Time
IRIG-B: Auto-detect (DC shift or Amplitude Modulated)
Amplitude modulated: 1 to 10 V pk-pk
DC shift: 1 to 10 V DC
Input impedance: 40 kOhm ± 10%
Accuracy with IRIG-B: ± 1 ms
Accuracy without IRIG-B: ± 1 min / month

Control

LOGIC ELEMENTS

Number of logic elements: 16
Trigger source inputs per element: 2 to 8
Block inputs per element: 2 to 4
Supported operations: AND, OR, NOR, NAND, XOR, XNOR, Pickup / Dropout timers
Pickup timer: 0 to 60000 ms in steps of 1 ms
Dropout timer: 0 to 60000 ms in steps of 1 ms

BREAKER FAILURE (50BF)

Pickup Level: ..... 0.05 to 20.00 x CT in steps of 0.01 x CT
Dropout Level: ..... 97 to 98% of pickup
Timer 1 Delay: ..... 0.03 to 1.00 s in steps of 0.01 s
Timer 2 Delay: ..... 0.00 to 1.00 s in steps of 0.01 s
Time Delay Accuracy: ..... 0 to 1 cycle (Timer 1, Timer 2)
Level Accuracy: ..... per CT input
Reset Time: ..... <14 ms typical at 2 x pickup at 60 Hz
<16 ms typical at 2 x pickup at 50 Hz

LOCKOUT

Function: ..... Latch Trip command to Relay 1 TRIP
Block Close to Relay 2 CLOSE
Operation: ..... Any protection element

AMBIENT TEMPERATURE

High Temperature Pickup: ..... 20°C to 80°C in steps of 1°C
Low Temperature Pickup: ..... -40°C to 20°C in steps of 1°C
Time Delay: ..... 1 to 60 min in steps of 1 min
Temperature Dropout: ..... Configurable 90 to 98% of pickup
Temperature Accuracy: ..... ±10°C
Timing Accuracy: ..... ±1 second

Monitoring

BREAKER HEALTH

Timer Accuracy: ± 3% of delay setting or ± 1 cycle (whichever is greater) from pickup to operate

DEMAND

Measured Values: Phase A/B/C present and maximum current

Measurement Type: Thermal Exponential, 90% response time (programmed): 5, 10, 15, 20, 30 minutes
Block Interval / Rolling Demand, time interval (programmed): 5, 10, 15, 20, 30 minutes

Current Pickup Level: 10 to 10000 in steps of 1 A

Dropout Level: 96-98% of Pickup level

Level Accuracy: ± 2%

RTD (49T)

Pickup: 1 to 250°C in steps of 1°C

Pickup Hysteresis: 2°C

Time Delay: 3 sec

Elements: Trip and Alarm

RTD TROUBLE ALARM(49T)

RTD Trouble Alarm: <-50°C or >250°C

Inputs

CONTACT INPUTS

Inputs: 10

Selectable thresholds: 17, 33, 84, 166 VDC ±10%

Recognition time: 1/2 cycle

Debounce time: 1 to 64 ms, selectable, in steps of 1 ms

Maximum input voltage & continuous current draw: 300 VDC, 2 mA, connected to Class 2 source

Type: opto-isolated inputs

External switch: wet contact

RTD INPUTS

RTD Type: 100 Ohm platinum (DIN.43760)

RTD Sensing Current: 5 mA

Isolation: 2 kV from base unit (RMIO only)

Distance: 250 m maximum

Range: -50 to +250°C

Accuracy: ±3°C

Lead Resistance: 25 Ohm max per lead

RTD Trouble Alarm: <-50 or >250°C

RTD Inputs Available: 12 maximum with the RMIO option connected

Outputs

FORM-A RELAYS

Configuration: 2 (two) electromechanical
Contact material: silver-alloy
Operate time: <8 ms
Continuous current: 10 A
Make and carry for 0.2s: 30 A per ANSI C37.90
Break (DC inductive, L/R=40 ms): 24 V / 1 A
48 V / 0.5 A
125 V / 0.3 A
250 V / 0.2 A
Break (DC resistive): 24 V / 10 A
48 V / 6 A
125 V / 0.5 A
250 V / 0.3 A
Break (AC inductive): 720 VA @ 240 VAC Pilot duty A300
Break (AC resistive): 250 VAC / 10 A

FORM-A VOLTAGE MONITOR

Applicable voltage: 20 to 250 VDC
Trickle current: 1 to 2.5 mA

FORM-C RELAYS

Configuration: 5 (five) electromechanical
Contact material: silver-alloy
Operate time: <8 ms
Continuous current: 10 A
Make and carry for 0.2s: 30 A per ANSI C37.90
Break (DC inductive, L/R=40 ms): 24 V / 1 A
48 V / 0.5 A
125 V / 0.3 A
250 V / 0.2 A
Break (DC resistive): 24 V / 10 A
48 V / 6 A
125 V / 0.5 A
250 V / 0.3 A
Break (AC inductive): 720 VA @ 250 VAC Pilot duty A300
Break (AC resistive): 277 VAC / 10 A

TRIP SEAL-IN

Relay 1 trip seal-in: 0.00 to 9.99 s in steps of 0.01
Relay 2 trip seal-in: 0.00 to 9.99 s in steps of 0.01

Power supply

HIGH RANGE POWER SUPPLY

Nominal: 120 to 240 VAC
125 to 250 VDC
Range: 60 to 300 VAC (50 and 60 Hz)
84 to 250 VDC
Ride-through time: 35 ms

LOW RANGE POWER SUPPLY

Nominal: 24 to 48 VDC
Range: 20 to 60 VDC

ALL RANGES

Voltage withstand: ..... 2 × highest nominal voltage for 10 ms
Power consumption: ..... 15 W nominal, 20 W maximum
20 VA nominal, 40 VA maximum
Fuse rating: ..... 5A fuse; time lag, slow blow, 350V 4.5 O.D. X 14.5mm

Communications

SERIAL

RS485 port: ..... Opto-coupled
Baud rates: ..... up to 115 kbps
Response time: ..... 1 ms typical
Parity: ..... None, Odd, Even
Protocol: ..... Modbus RTU, DNP 3.0, IEC 60870-5-103
Maximum distance: ..... 1200 m (4000 feet)
Isolation: ..... 2 kV

ETHERNET (COPPER)

Modes: ..... 10/100 MB (auto-detect)
Connector: RJ-45
Protocol: ..... Modbus TCP, DNP3.0, IEC 60870-5-104, IEC 61850 GOOSE, IEC 61850

ETHERNET (FIBER)

Fiber type: ..... 100 MB Multi-mode
Wavelength: ..... 1300 nm
Connector: ..... MTRJ
Protocol: ..... Modbus TCP, DNP3.0, IEC 60870-5-104, IEC 61850 GOOSE, IEC 61850
Transmit power: ..... -20 dBm
Receiver sensitivity: ..... -31 dBm
Power budget: ..... 9 dB
Maximum input power: ..... -11.8 dBm
Typical distance: ..... 2 km (1.25 miles)
Duplex: ..... half/full
Product type: ..... Class 1 Laser product

USB

Standard specification: ..... Compliant with USB 2.0
Data transfer rate: ..... 115 kbps

Testing and certification

TYPE TESTS

TEST	REFERENCE STANDARD	TEST LEVEL
Dielectric voltage withstand		
(high voltage power supply*)	60255-27	2200 VAC for one second
(low voltage power supply*)	60255-27	550 VAC for one second
* Test level is based on basic insulation principle (Power supply I/P terminals tested to Chassis ground).		
Impulse voltage withstand	EN60255-27	5 kV
Damped Oscillatory	IEC 60255-26 / IEC61000-4-18	2.5 kV CM, 1 kV DM
Electrostatic Discharge	IEC 60255-26 / IEC 61000-4-2	15 kV / 8 kV
RF immunity	IEC 60255-26 / IEC 61000-4-3	80 MHz - 1 GHz, 1.4 GHz - 2.7 GHz, 10 V/m
Fast Transient Disturbance	IEC 60255-26 / IEC 61000-4-4	2 kV / 4 kV
Surge Immunity	IEC 60255-26 / IEC 61000-4-5	0.5, 1 & 2 kV
Conducted RF Immunity	IEC 60255-26 / IEC 61000-4-6	150 kHz - 80 MHz, 26 MHz - 68MHz, 10V/m
Voltage interruption and Ripple DC	IEC 60255-26 / IEC 60255-4-11	15% ripple, 200ms interrupts
Radiated & Conducted Emissions	CISPR11 / CISPR22/ IEC 60255-26: Section 7.1.2 & 7.1.3	Class A
Sinusoidal Vibration	IEC 60255-21-1	Class 1
Shock & Bump	IEC 60255-21-2	Class 1
Seismic	IEC 60255-21-3	Class 2
Power magnetic Immunity	IEC 60255-26 / IEC 61000-4-8	1000 A/m, 100 A/m, 30A/m 300 A/m
Voltage Dip & interruption	IEC 60255-26 / IEC 61000-4-11	0, 40, 70, 80% dips, 250/ 300 cycle interrupts
Power frequency	IEC 60255-26 / IEC 61000-4-16	Level 4
Voltage Ripple	IEC 60255-26 / IEC 61000-4-17	15% ripple
Ingress Protection	IEC 60529	IP54 front
Environmental (Cold)	IEC 60068-2-1	-40°C 16 hrs
Environmental (Dry heat)	IEC 60068-2-2	85°C 16hrs
Relative Humidity Cyclic	IEC 60068-2-30	6 day variant 2
EFT	IEEE / ANSI C37.90.1	4KV, 2.5Khz
Damped Oscillatory	IEEE / ANSI C37.90.1	2.5KV, 1Mhz
RF Immunity	IEEE / ANSI C37.90.2	35V/m (max field), (80 MHz-1 GHz with 1 KHz sine and 80% AM modulation)
ESD	IEEE / ANSI C37.90.3	8KV CD/ 15KV AD
	UL 508	e83849 NKCR
Safety	UL C22.2-14	e83849 NKCR7
	UL 1053	e83849 NKCR

APPROVALS

	Applicable Council Directive	According to:
	Low voltage directive	2014/35/EU
CE compliance	EMC Directive	2014/30/EU
		UL 508
North America	cULus	UL 1053
		C22.2. No 14
EAC	Machines and Equipment	TR CU 010/2011
Lloyd's Register	Rules and Regulations for the Classifications of Ships	Marine Applications: ENV2, ENV3
IEC 61850	IEC 61850 Certificate Level B	IEC 61850-10
ISO	Manufactured under a registered quality program	ISO9001

EAC

The EAC Technical Regulations (TR) for Machines and Equipment apply to the Customs Union (CU) of the Russian Federation, Belarus, and Kazakhstan.

Item	Description
Country of origin	Spain or Canada; see label on the unit
Date of manufacture	See label on the side of the unit
Declaration of Conformity and/or Certificate of Conformity	Available upon request

Physical

DIMENSIONS

Refer to Chapter 2 for details

NON-DRAWOUT UNIT

Height: ..... 7.98" (202.7 mm)
Width: ..... 6.23" (158.2 mm)
Length: ..... 9.35" (237.5 mm)

DRAWOUT UNIT

Height: ..... 7.93" (201.51 mm)
Width: ..... 6.62" (138.2 mm)
Length: ..... 9.62" (244.2 mm)

WEIGHT

NON-DRAWOUT UNIT

Weight (net): ..... 2.9 kg (6.4 lbs)
Weight (gross): ..... 4.0 kg (8.6 lbs)

DRAWOUT UNIT

Weight (net): ..... 3.9 kg (8.6 lbs)
Weight (gross): ..... 5.0 kg (11.0 lbs)

Environmental

OPERATING ENVIRONMENT	
Ambient temperatures:	
Storage/Shipping:	-40°C to 85°C
Operating:	-40°C to 60°C
Humidity:	Operating up to 95% (non condensing) @ 55°C (As per IEC60068-2-30 Variant 2, 6 days)
Altitude:	2000 m (max)
Pollution Degree:	II
Overvoltage Category:	III
Ingress Protection:	IP54 Front, IP20 cover (optional)
Noise:	0 dB

GE
Grid Solutions

345 Transformer Protection System

Chapter 2: Installation

Mechanical installation

This section describes the mechanical installation of the 345 system, including dimensions for mounting and information on module withdrawal and insertion.

Dimensions

The dimensions of the 345 are on the following pages. Additional dimensions for mounting and panel cutouts are shown in the following sections.

Figure 2-1: 345 dimensions - Drawout unit

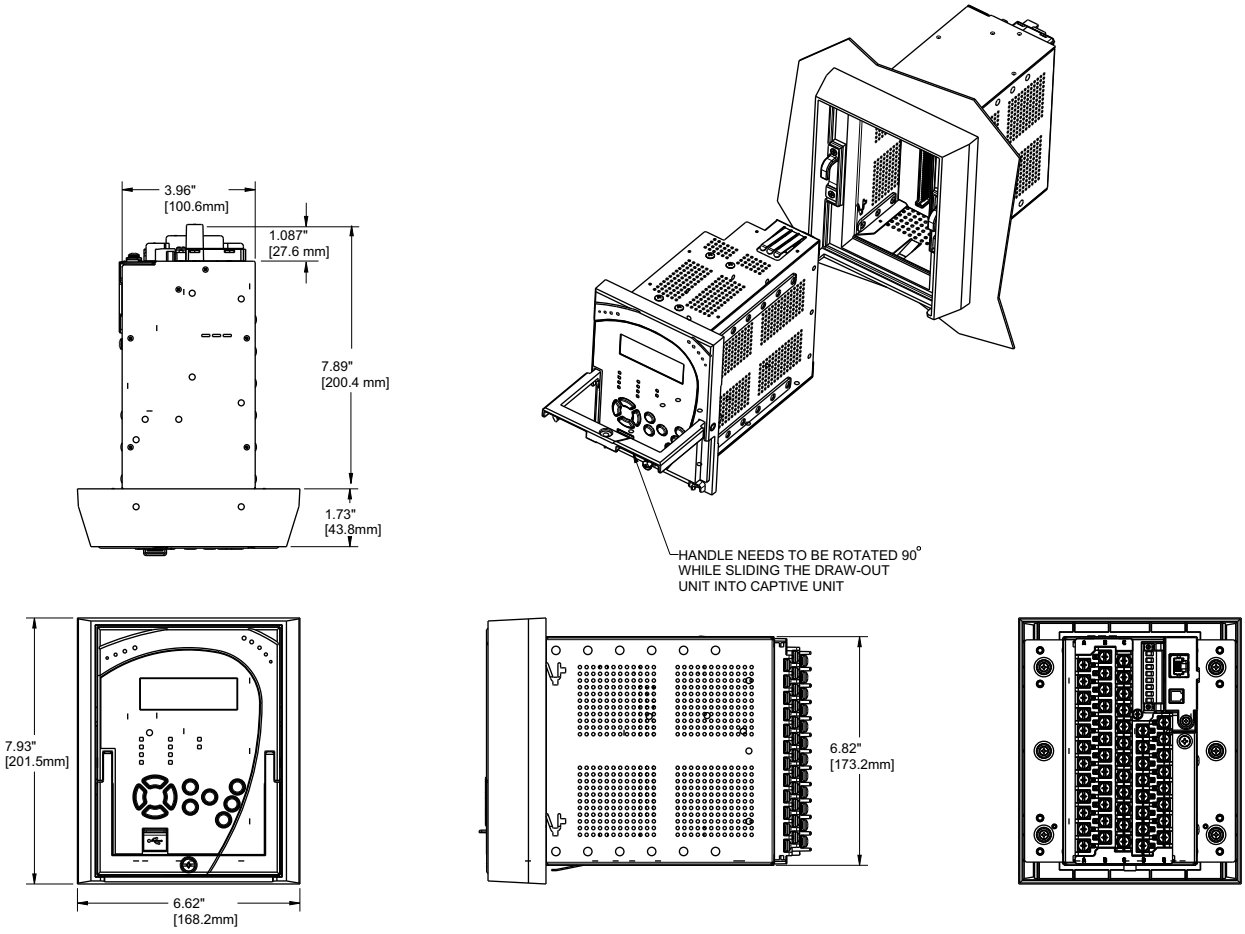
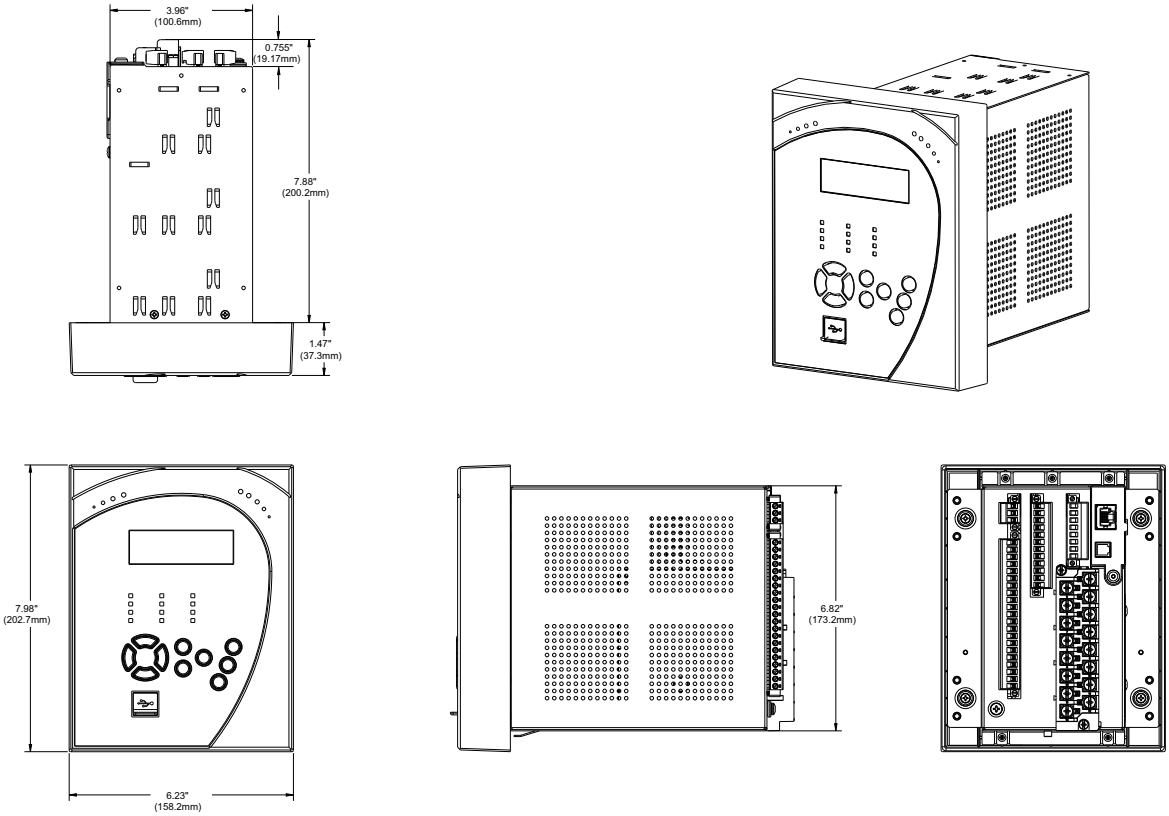


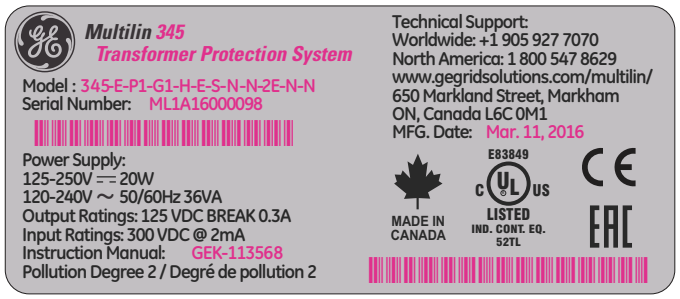
Figure 2-2: 345 dimensions - Non-drawout unit



Product identification

The product identification label is located on the side panel of the 345 . This label indicates the product model, serial number, and date of manufacture.

Figure 2-3: 345 Product label



NOTE

The pink color text (i.e. Model, Serial Number, Instruction Manual, MFG Date) is for reference only. The text can vary.

Mounting

Standard panel mount

The standard panel mount and cutout dimensions are illustrated below.

⚠CAUTION

To avoid the potential for personal injury due to fire hazards, ensure the unit is mounted in a safe location and/or within an appropriate enclosure.

Figure 2-4: Standard panel mounting - Drawout

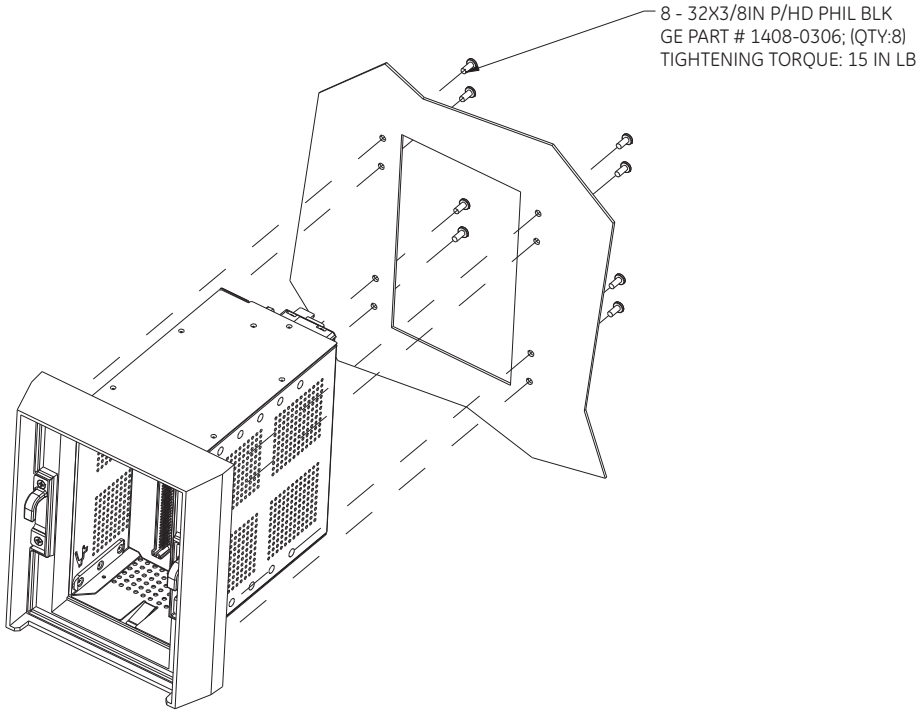


Figure 2-5: Standard Panel mounting - Non-drawout

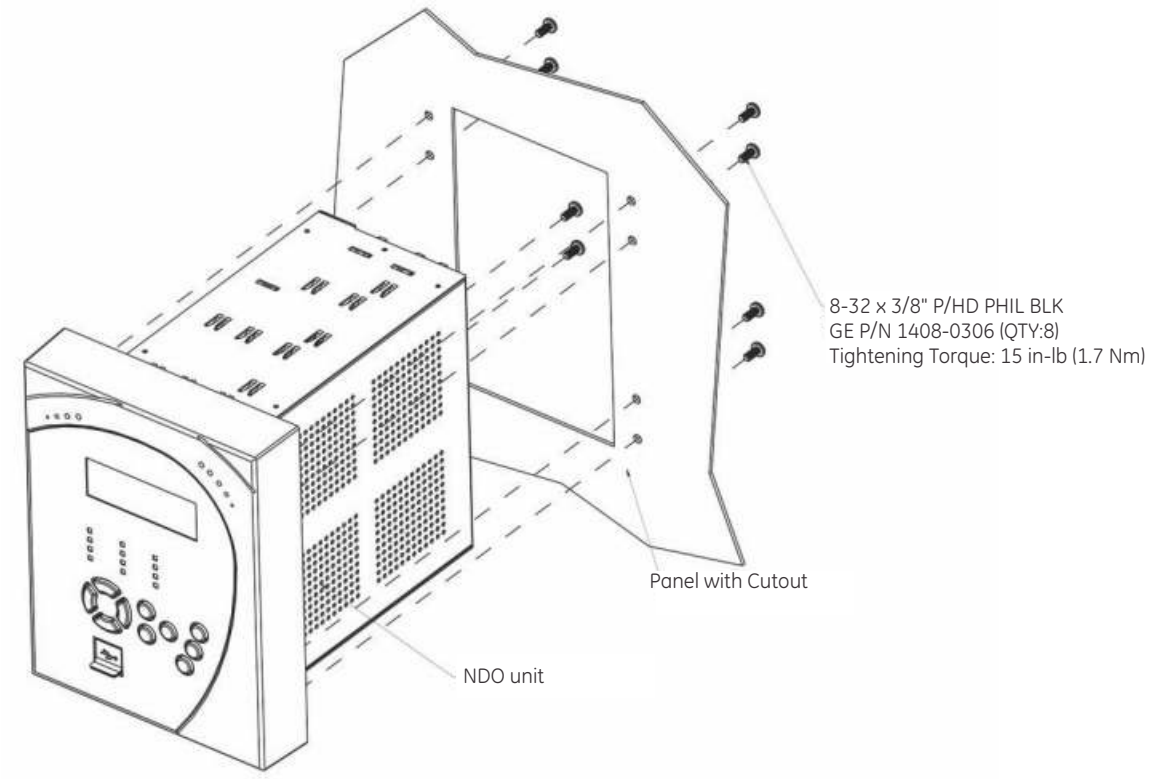
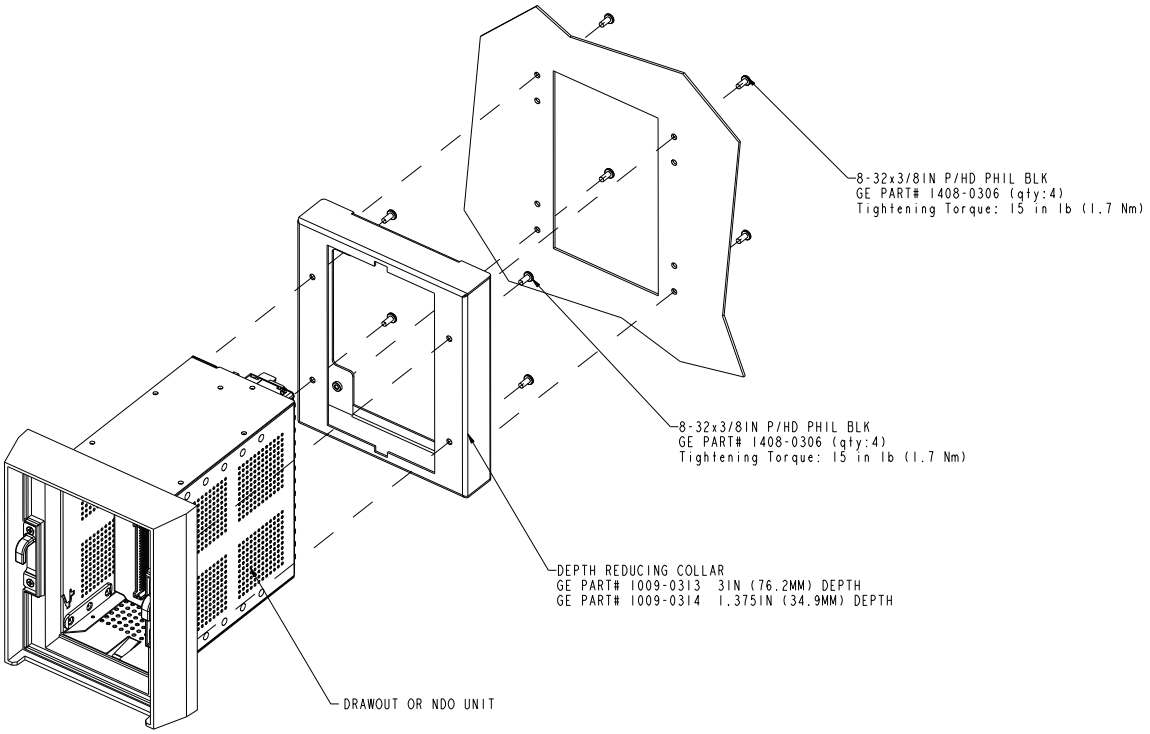


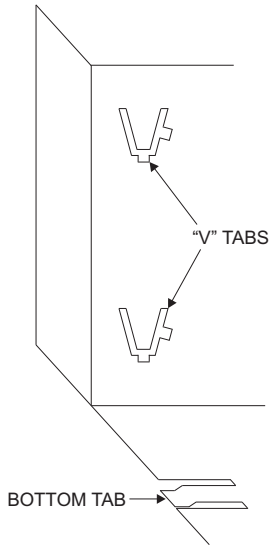
Figure 2-6: Depth Reducing collar (optional)



Panel mounting with depth reducing collar:

1. Mount the collar of required depth (1.375" or 3") to the unit (captive or non-drawout) using 4 screws (see above).
2. Mount the combination of unit and collar to the panel using 4 screws as shown above.

Figure 2-7: Mounting tabs (optional)



1. From the front of the panel, slide the empty case into the cutout until the bottom tab clicks into place (see above).
2. From the rear of the panel screw the case into the panel at the 8 screw positions shown above.
3. If added security is required, bend the retaining "V"tabs outward, to about 90°. These tabs are located on the sides of the case and appear as shown above.

The relay can now be inserted and can be panel wired.

Figure 2-8: Panel cutout dimensions

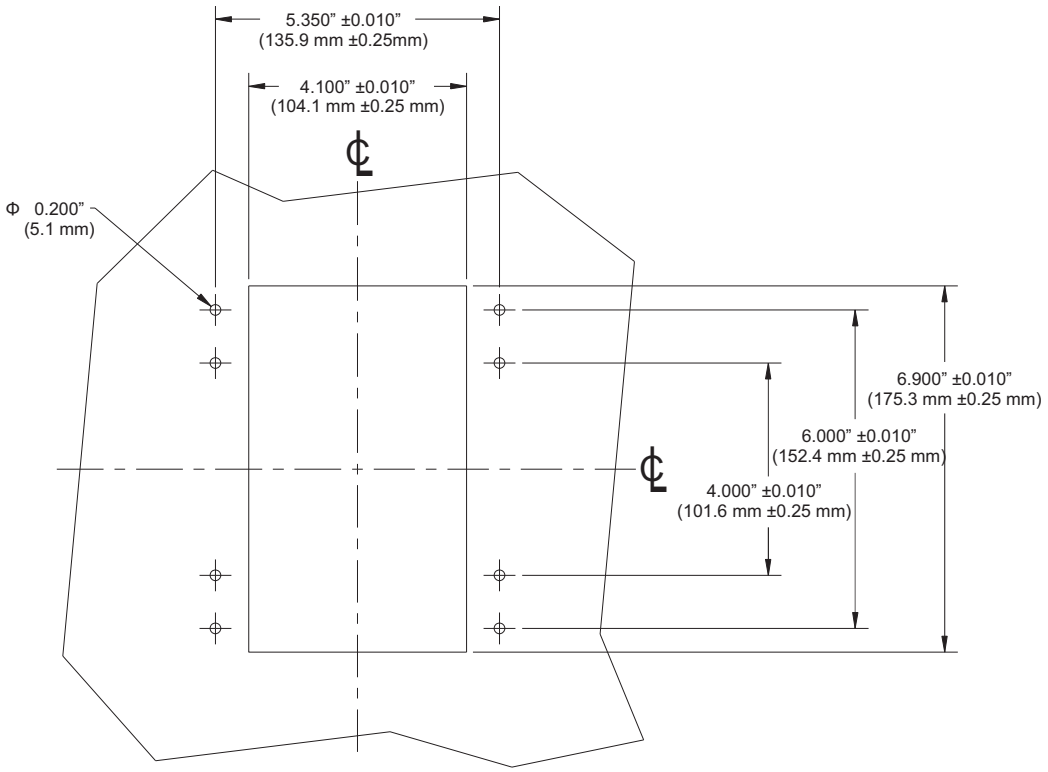


Figure 2-9: RMIO - DIN rail mounting - Base & Expansion units

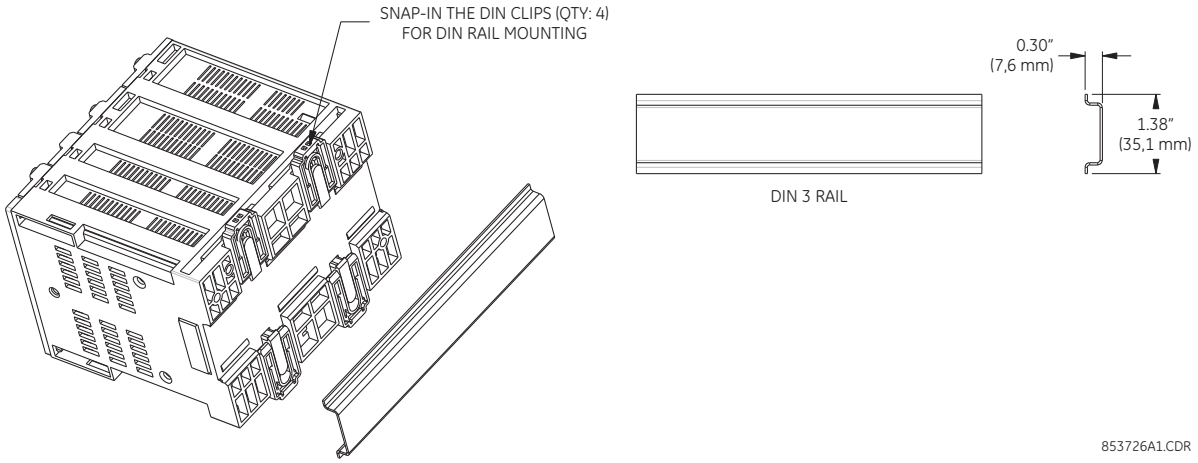


Figure 2-10: RMIO - Base Unit screw mounting

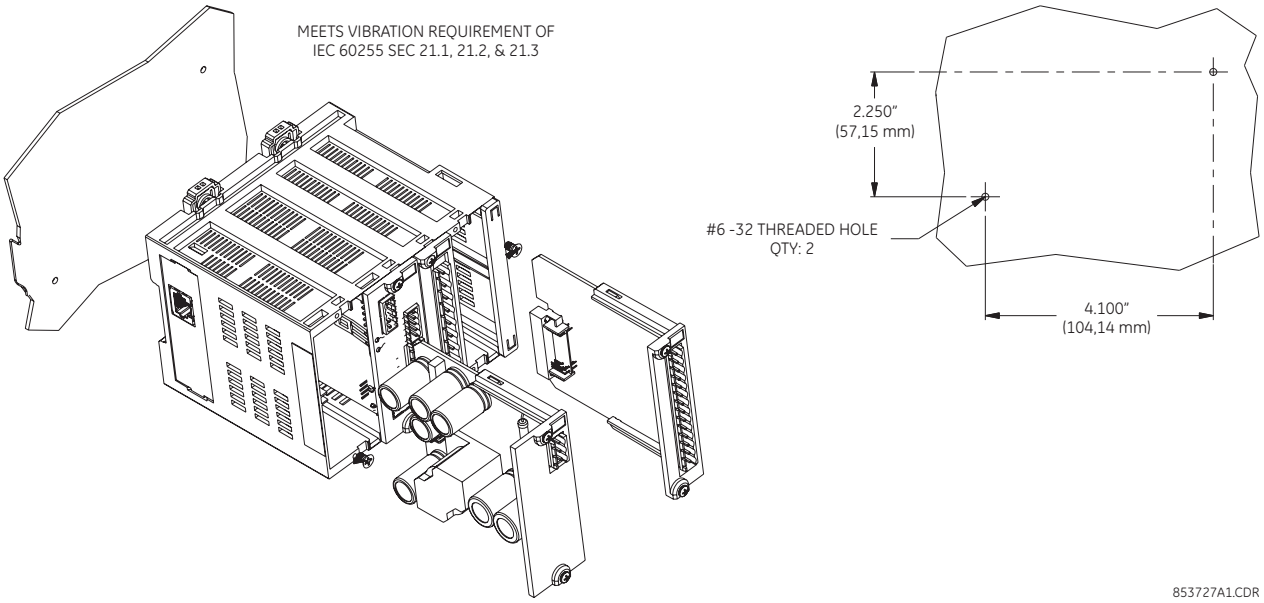
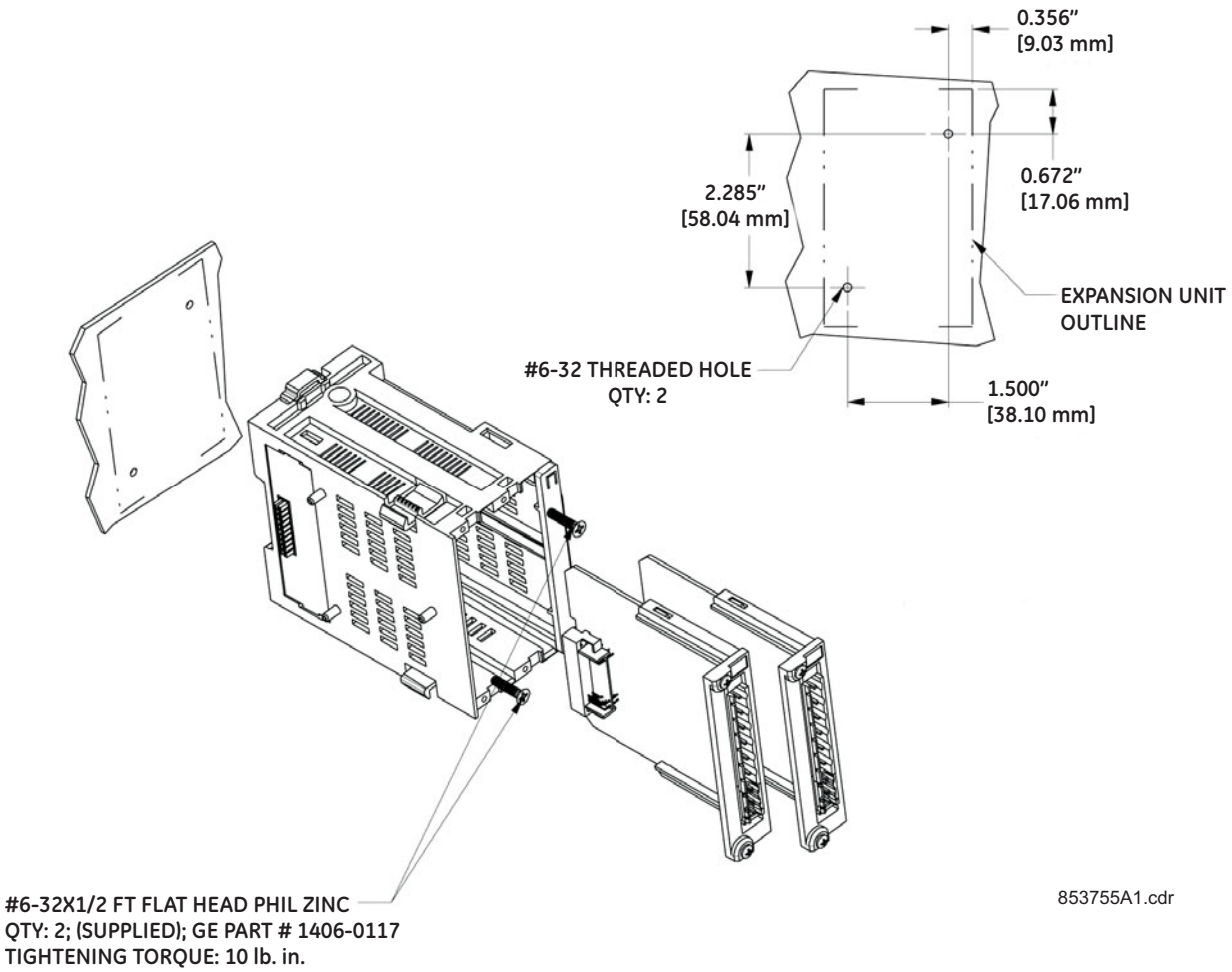
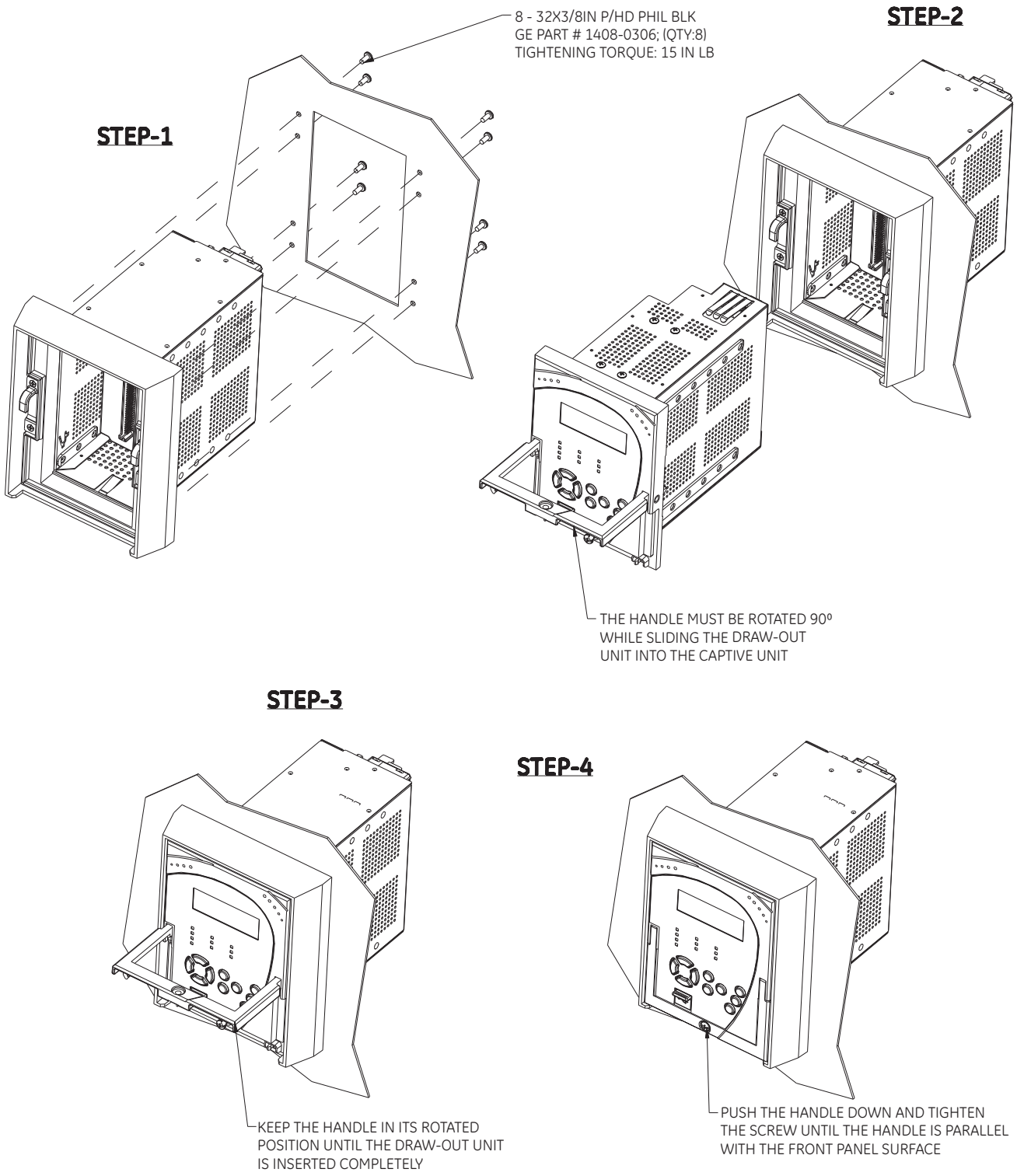


Figure 2-11: RMIO - Expansion Unit screw mounting



Drawout unit withdrawal and insertion

Figure 2-12: Unit withdrawal and insertion diagram



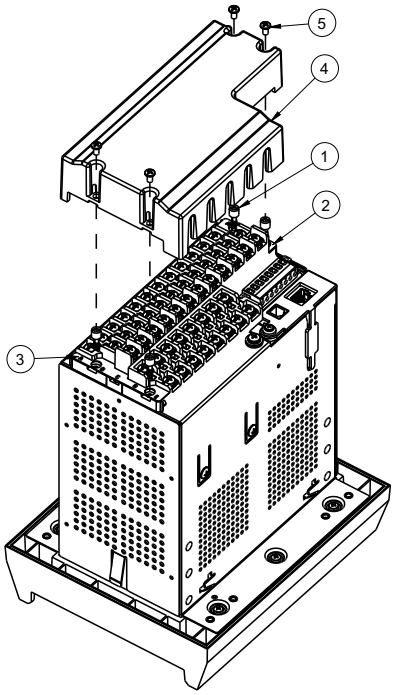
IP20 Cover (optional)

The IP20 cover minimizes potential dangers to users by preventing finger contact with electrical connections at the back of the 3 Series drawout units.

Attaching the cover

The steps for attaching the IP20 cover (optional) to the drawout unit are as follows:

Figure 2-13: IP20 Cover mounting - Drawout unit only



1. Place 4 custom standoffs (item#1) using the suggested tightening torque of 8lb-in in the following order:

   A. Remove the 2 mounting screws near letters A and C, of label ABC (item#2), and mount 2 standoffs.

   B. Remove the 2 mounting screws near the letters B and E, of label ABCDE (item#3), and mount 2 standoffs.

2. Place the IP20 cover (item#4) and secure it with 4 screws (item#5) using the suggested tightening torque of 8lb-in.

NOTE

Make sure the device terminals are wired before placing the cover. Use the 5 slots located on each side of the cover to guide the wires outside of the cover.

Retrofit kit for IP20

Before attaching the cover, remove the old labels from the device (see item#2 and item#3) and replace them with the new labels from the retrofit kit. Attach the cover as described in the previous section.

Electrical installation

This section describes the electrical installation of the 345 system, including typical wiring diagrams and terminal identification.

Typical Wiring Diagrams

Figure 2-14: Typical wiring diagram – Drawout

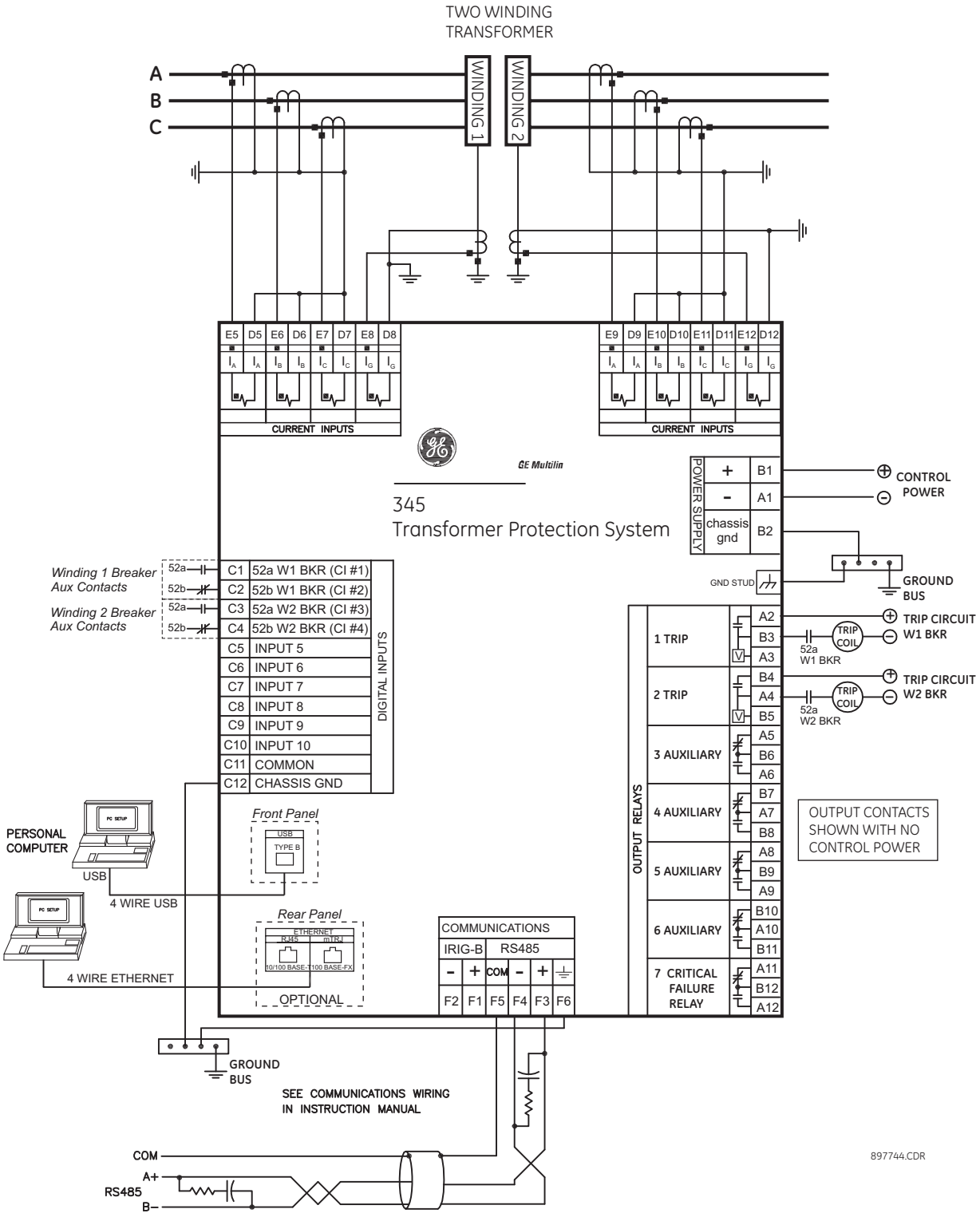
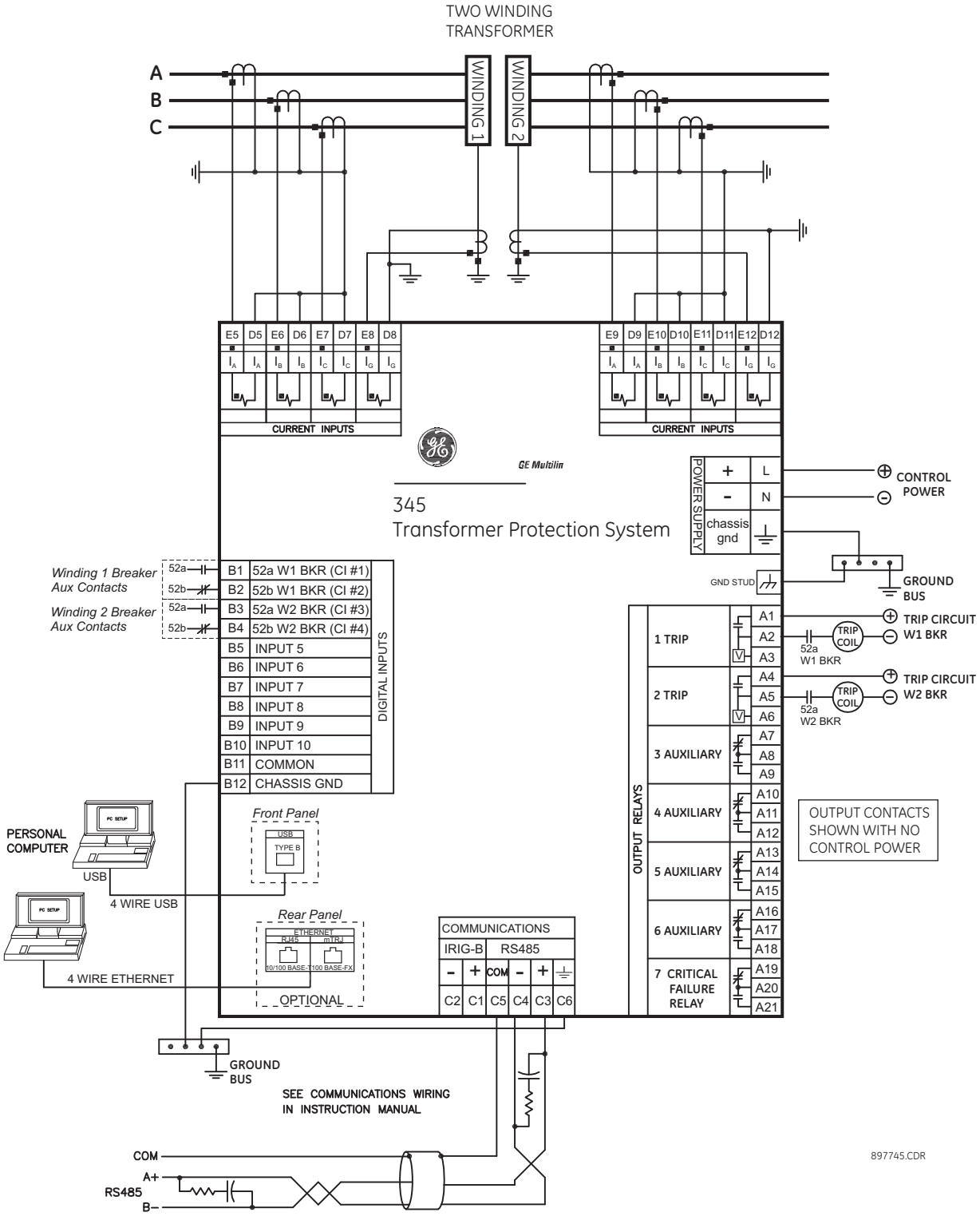


Figure 2-15: Typical wiring diagram - Non-drawout



345 Terminal identification

NOTE

When installing two lugs on one terminal, both lugs should be "right side up" as shown in the picture below. This is to ensure the adjacent lower terminal block does not interfere with the lug body.

Figure 2-16: Orient the lugs correctly...

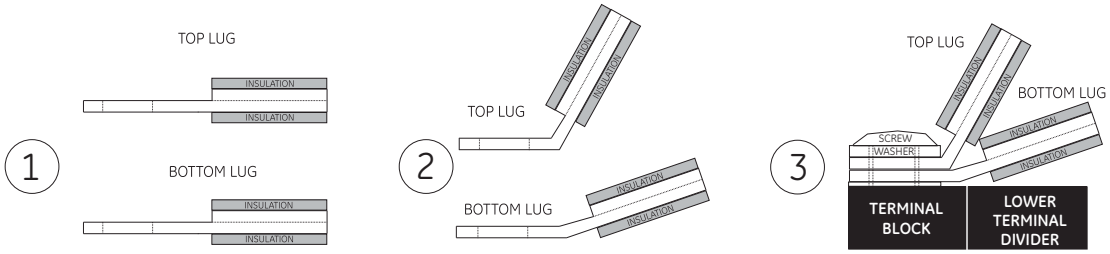


Figure 2-17: CORRECT INSTALLATION METHOD

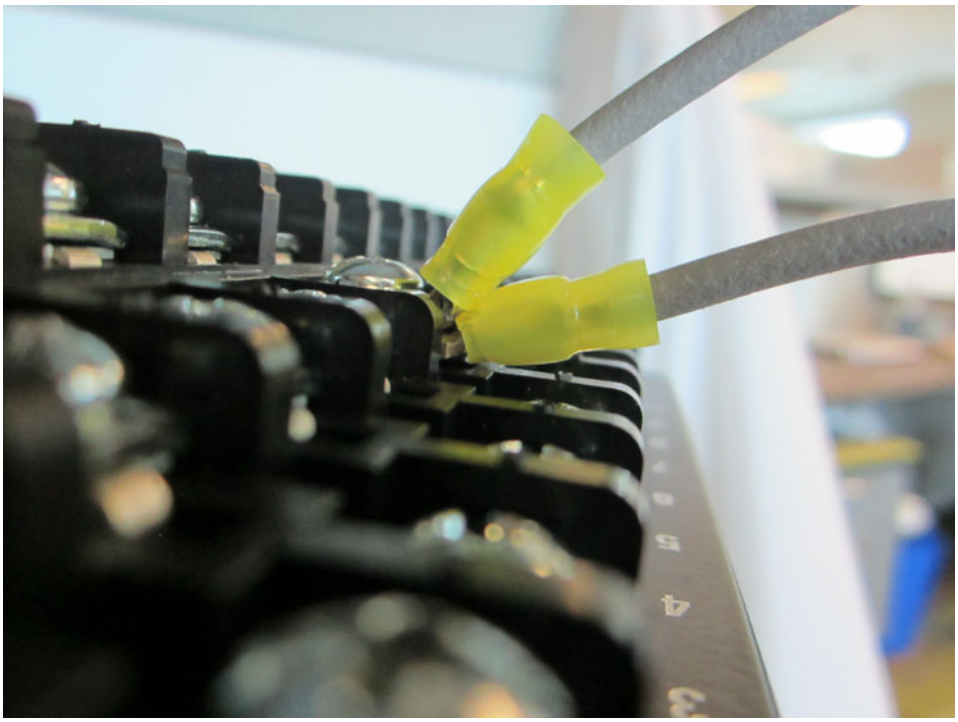


Figure 2-18: INCORRECT INSTALLATION METHOD (lower lug reversed)

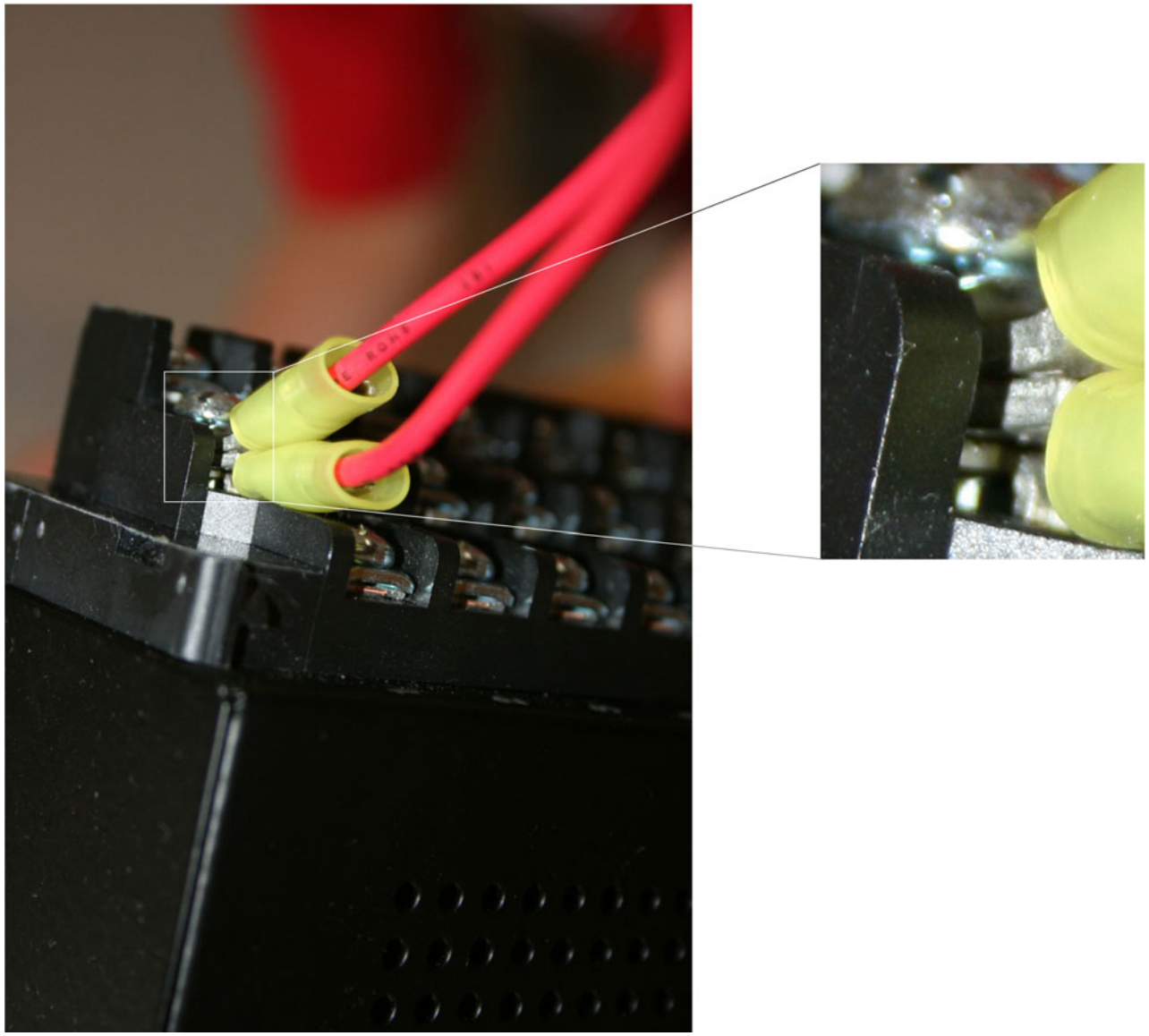
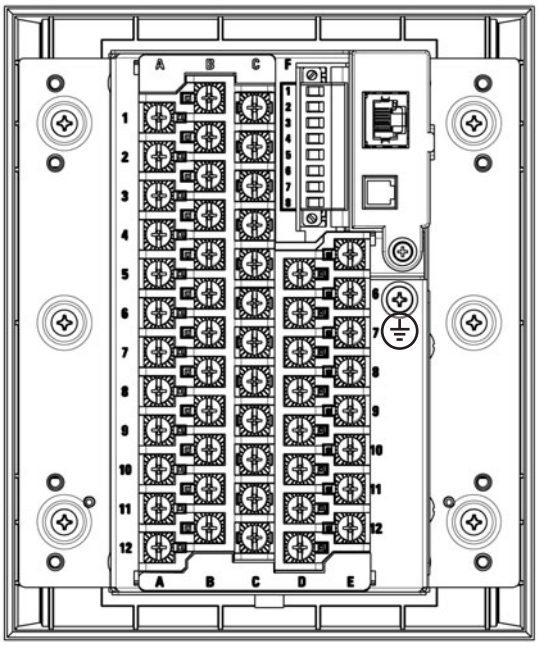


Figure 2-19: Terminal Identification - Drawout



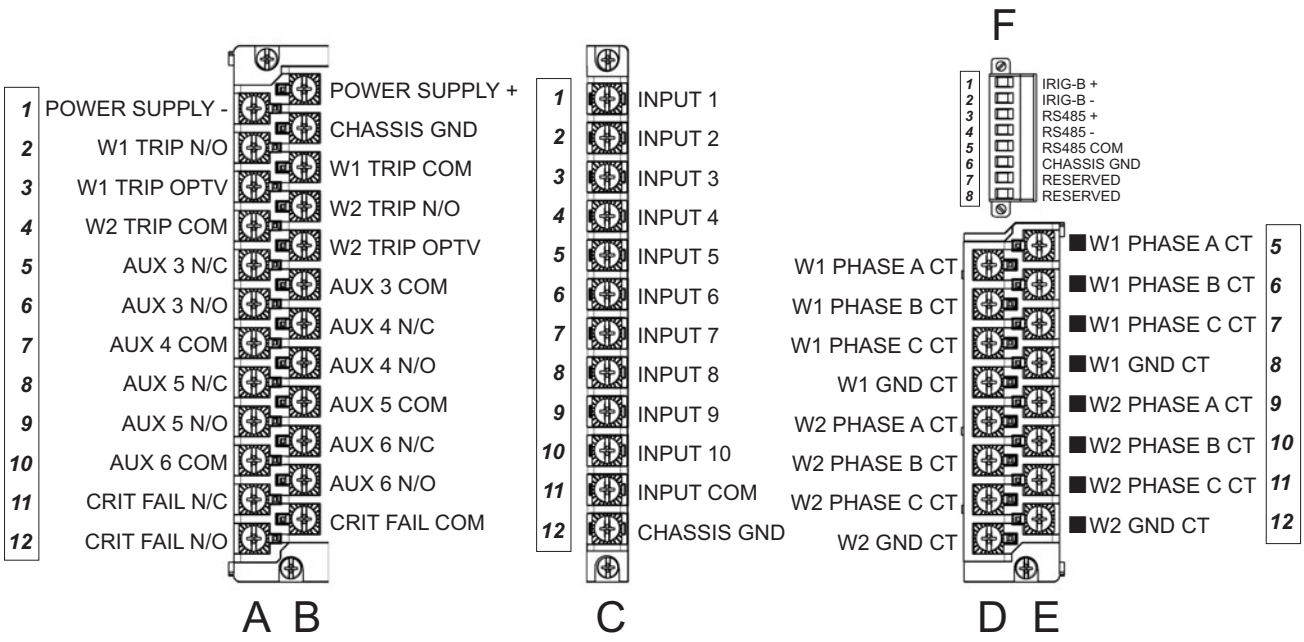
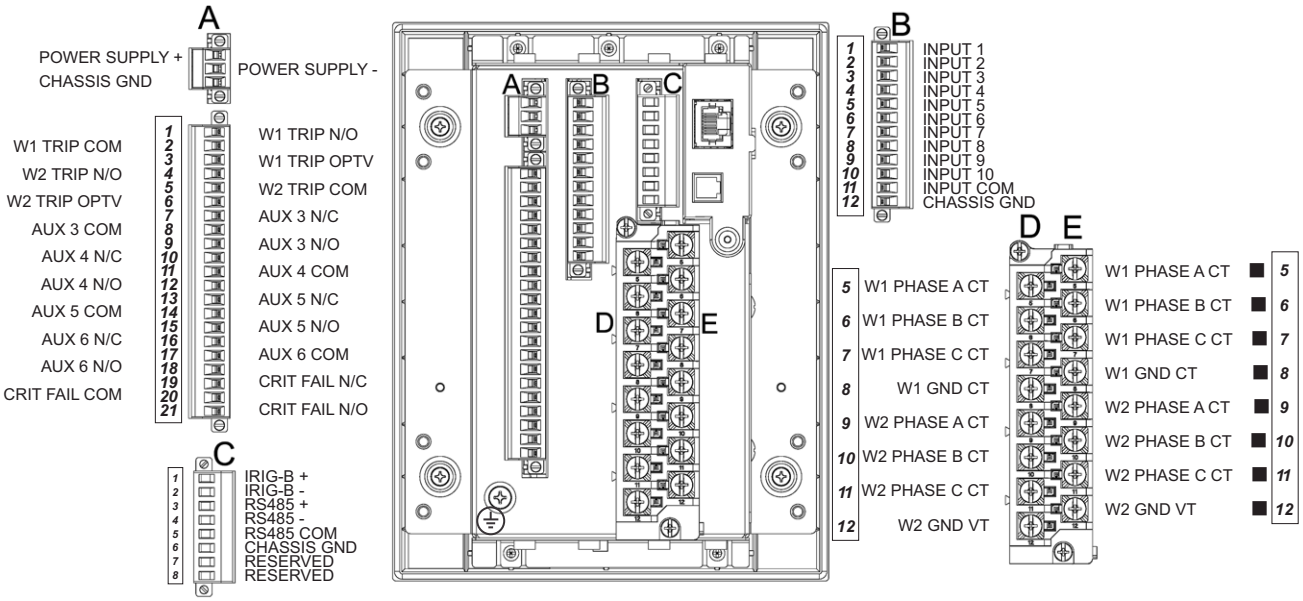


Figure 2-20: Terminal Identification - Non-drawout



Wire range

Use the following guideline when selecting wires or lugs to connect to terminal blocks A,B,C,D,E (Drawout case design), and terminal blocks D,E (Non-drawout case design):

- 12 AWG to 22 AWG (3.3 mm^2 to 0.3 mm^2): Single wire termination with/without 9.53 mm (0.375") maximum diameter ring terminals.
- 14 AWG to 22 AWG (2.1 mm^2 to 0.3 mm^2): Multiple wire termination with matching wire sizes and stranding. Two wires maximum per circuit.
- 14 AWG to 22 AWG (2.1 mm^2 to 0.3 mm^2): Multiple wire termination with 9.53 mm (0.375") maximum diameter ring terminals. Two ring terminals maximum per circuit.
- Suggested wiring screw tightening torque, tighten to 12 in-lb (1.35 N-m).
- The uncovered communications cable shield connected to the common terminal should not exceed 1" (2.5 cm) for proper EMC shielding of the communications cable.

RMIO module installation

Although the RMIO is internally shielded to minimize noise pickup and interference, it should be mounted away from high current conductors or sources of strong magnetic fields.

Figure 2-21: RMIO unit showing 2 IO_G modules

Figure 2-22: RMIO terminal identification with 4 IO_G modules

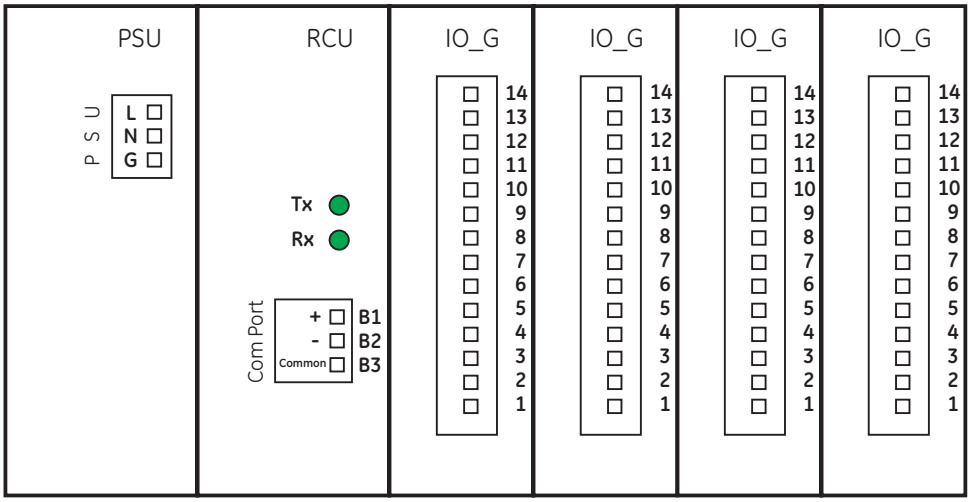
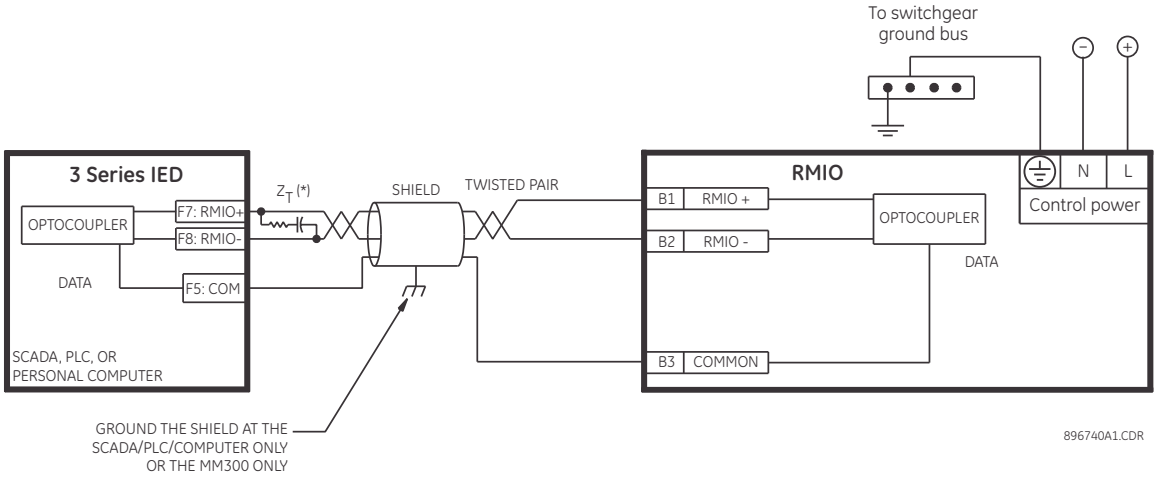


Figure 2-23: RMIO wiring diagram



(*) TERMINATING IMPEDANCE AT EACH END
(typically 120 ohms and 1 nF)

NOTE

F5, F7, and F8 refer to terminals shown on the above 345 Terminal Identification diagrams.

Phase sequence and transformer polarity

For correct operation of the relay features, the user must follow the instrument transformer polarities, shown in the Typical Wiring Diagram. Note the solid square markings shown with all instrument transformer connections. The phase sequence is user programmable for either ABC or ACB rotation.

Current inputs

The 345 relay has eight (8) channels for AC current inputs, each with an isolating transformer. There are no internal ground connections on the current inputs. Current transformers with 1 to 6000 A primaries may be used.

CAUTION

Verify that the relay's nominal input current of 1 A or 5 A matches the secondary rating of the connected CTs. Unmatched CTs may result in equipment damage or inadequate protection.

CAUTION

IMPORTANT: The phase and ground current inputs will correctly measure up to 20 times the current input's nominal rating. Time overcurrent curves become horizontal lines for currents above the 20 × CT rating. This becomes apparent if the pickup level is set above the nominal CT rating.

CAUTION

Before working on CTs, they MUST be short circuited.

Ground and sensitive ground CT inputs

Two ground inputs - one per winding - are referred to throughout this manual as the **Ground Current** or **Sensitive Ground Current** inputs. Before making ground connections, consider that the relay automatically calculates the neutral (residual) current from the sum of the three phase current phasors. The following figures show three possible ground connections (or three possible sensitive ground connections).

The ground inputs (Terminals D8 and E8 for W1, and D12 and E12 for W2) are used in conjunction with a Zero Sequence CT as source, or in the neutral of wye-connected source CTs. When using the residual connection set the GROUND CT PRIMARY setpoint to a value equal to the PHASE CT PRIMARY setpoint.

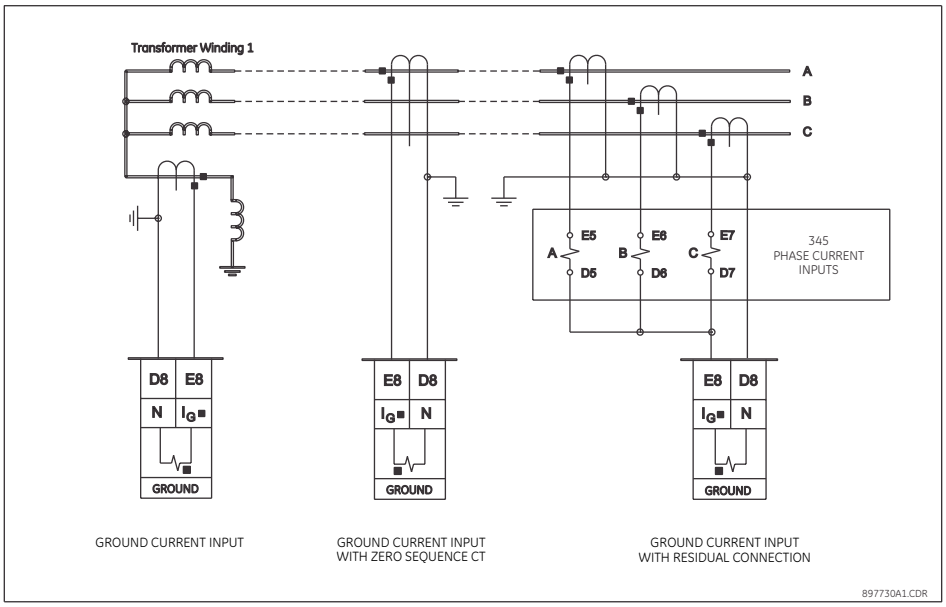
In cases where the relay is equipped with sensitive ground CT (terminals D8 and E8 for W1, and D12 and E12 for W2) the sensitive ground current input is intended for use with a CT in a source neutral of a high-impedance grounded system, or on ungrounded systems. On ungrounded systems it is connected residually with the phase current inputs. In this case, the SENSTV GND CT PRIMARY setpoint should be programmed to a value equal to the PHASE CT PRIMARY setpoint. The sensitive ground current input can be connected to a Zero Sequence CT for increased sensitivity and accuracy when physically possible in the system.

NOTE

The Sensitive Ground input must only be used on systems where the maximum ground current does not exceed current input specification.

The ground CT wiring in the figure below, shows 3 possible ways for wiring the Winding 1 ground CT (terminals D8, E8). The Winding 2 ground CT wiring (terminals D12, E12) is similar.

Figure 2-24: Ground/Sensitive Ground wiring

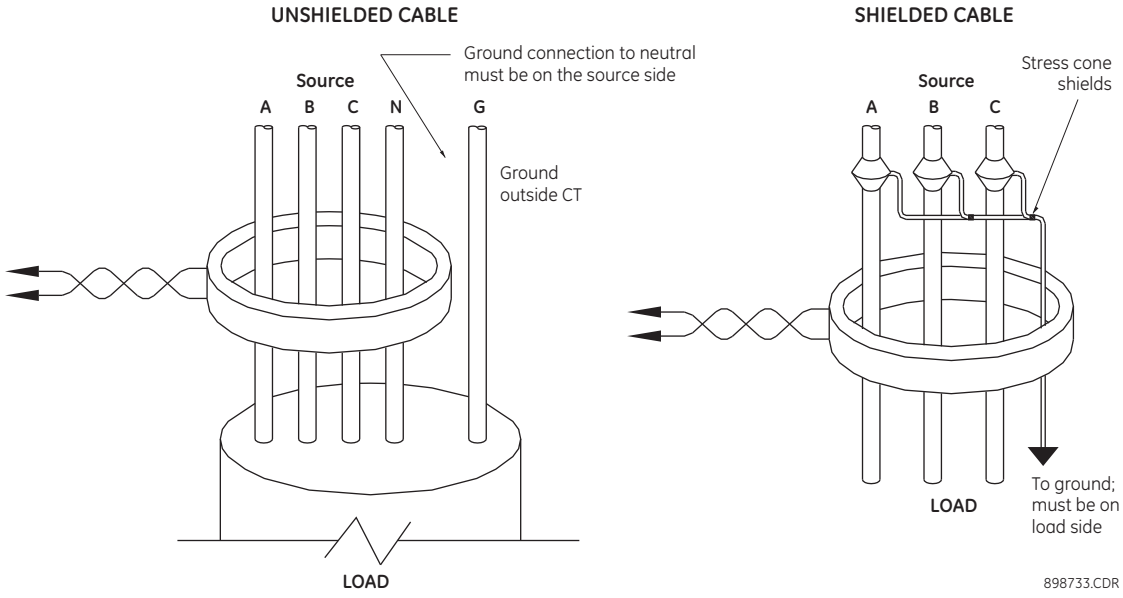


For Winding 2 ground CT, use relay terminals D12-E12 in the same wiring configuration as shown above for Winding 1.

Zero sequence CT installation

The various CT connections and the exact placement of a Zero Sequence CT, for ground fault current detection, are shown in the figure below. Twisted pair cabling on the Zero Sequence CT is recommended.

Figure 2-25: Zero sequence core balance (CT) installation



Control power

⚠CAUTION

Control power supplied to the relay must match the installed power supply range. If the applied voltage does not match, damage to the unit may occur. All grounds MUST be connected for safe, normal operation regardless of control power supply type.

The label found on the relay specifies its order code or model number. The installed power supply's operating range will be one of the following:

LO: 24 to 48 V DC (Range: 20 to 60 V DC)

HI: 125 to 250 V DC/120 to 240 V AC (Range: 84 to 250 V DC/60 to 300 V AC (50 and 60 Hz))

⚠CAUTION

The relay should be connected directly to the ground bus, using the shortest practical path. A tinned copper, braided, shielding and bonding cable should be used. As a minimum, 96 strands of number 34 AWG should be used. Belden catalog number 8660 is suitable.

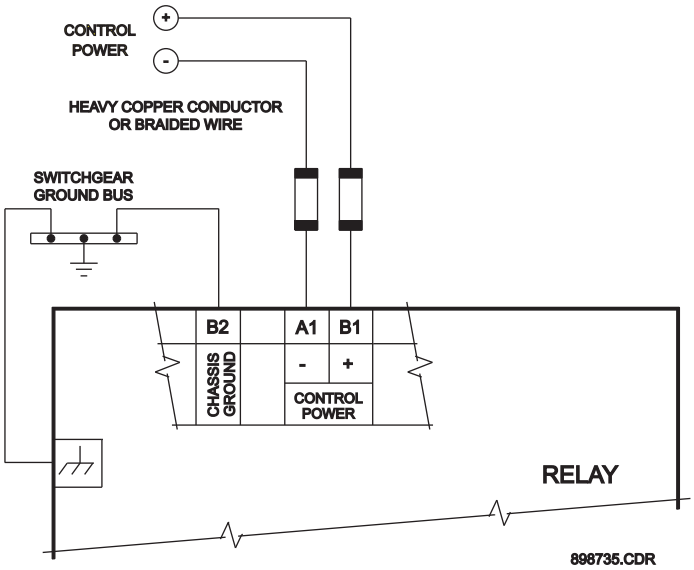
⚠CAUTION

Isolate power prior to servicing.

NOTE

An external switch, circuit breaker, or other protective device **must** be connected near to the equipment.

Figure 2-26: Control power connection



Contact inputs

External contacts can be connected to the relay's ten (10) digital inputs. These contacts are wet only.

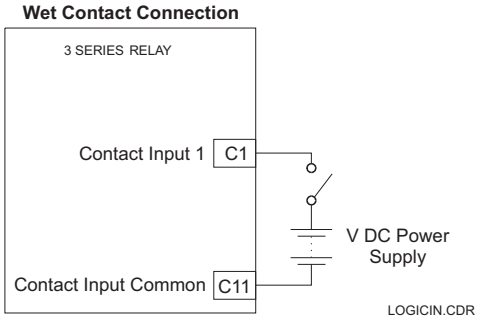
The inputs can be programmed to different thresholds depending on the DC voltage (17, 33, 84, 166).

CAUTION

Ensure correct polarity on contact input connections and do not connect any contact input circuits to ground or else relay hardware may be damaged.

A wet contact has one side connected to the positive terminal of an external DC power supply. The other side of this contact is connected to the required contact input terminal. In addition, the negative side of the external source must be connected to the relay's DC negative rail at Terminal C11. The maximum external source voltage for this arrangement is 300 V DC.

Figure 2-27: Wet contact connections



Trip1 and Trip2 output relays

The 345 relay is equipped with seven electromechanical relays: two special relays designed for Winding 1 Breaker trip and Winding 2 Breaker trip, four general purpose relays (Auxiliary Relays 3 to 6), and a Critical Failure relay. The special purpose relays have fixed operating characteristics and the general purpose relays can be configured by the user.

Operation of the two Trip output relays is designed to be controlled by the state of the circuit breaker as monitored by a 52a or 52b contact.

- The Trip relays reset after the breaker is detected in a state corresponding to the command. When a relay feature sends a command to one of these special relays, it will remain operational until the requested change of breaker state is confirmed by a breaker auxiliary contact and the initiating condition has reset.
- If the initiating feature resets, but the breaker does not change state, the output relay will be reset after a default interval of 2 seconds.
- If neither of the breaker auxiliary contacts, 52a nor 52b, is programmed to a contact input, the Trip Relay is de-energized after either the delay programmed in the Breaker Failure feature, or a default interval of 100 ms after the initiating input resets.
- If a delay is programmed for the Trip contact seal-in time, then this delay is added to the reset time. Note that the default setting for the seal-in time is 40 ms.

52a Contact Configured	52b Contact Configured	Relay Operation
Yes	Yes	Trip Relay remains operational until 52b indicates an open breaker.
Yes	No	Trip Relay remains operational until 52a indicates an open breaker.
No	Yes	Trip Relay remains operational until 52b indicates an open breaker.
No	No	Trip Relay operates until either the Breaker Failure delay expires (if the Breaker Failure element is enabled), or 100 ms after the feature causing the trip resets.

Breaker monitoring (Trip coil monitoring) is performed by a built-in voltage monitor on Form A output relays: #1 Trip, and #2 Trip. The voltage monitor is connected across each of the two Form A contacts, and the relay effectively detects healthy current through the circuit. In order to do this, an external jumper must be connected between terminals A2 and A3 for #1 Trip coil monitoring, or/and B4, and B5 for #2 Trip coil monitoring.

As long as the current through the Voltage Monitor is above the threshold of the trickle currents (see Technical Specification for Form A output relays), the circuit integrity for the Trip coil is effectively normal. If the Trip coil circuit gets disconnected, or if in general a high resistance is detected in the circuitry, a Trip alarm will be set and the "ALARM" and "MAINTENANCE" LEDs will be on.

Example 1: The figures below show the two different connections of the breaker Trip coil to the relay's trip output #1 terminals (output #2 Trip coil monitoring) for both no voltage monitoring and voltage monitoring of the trip circuit integrity.

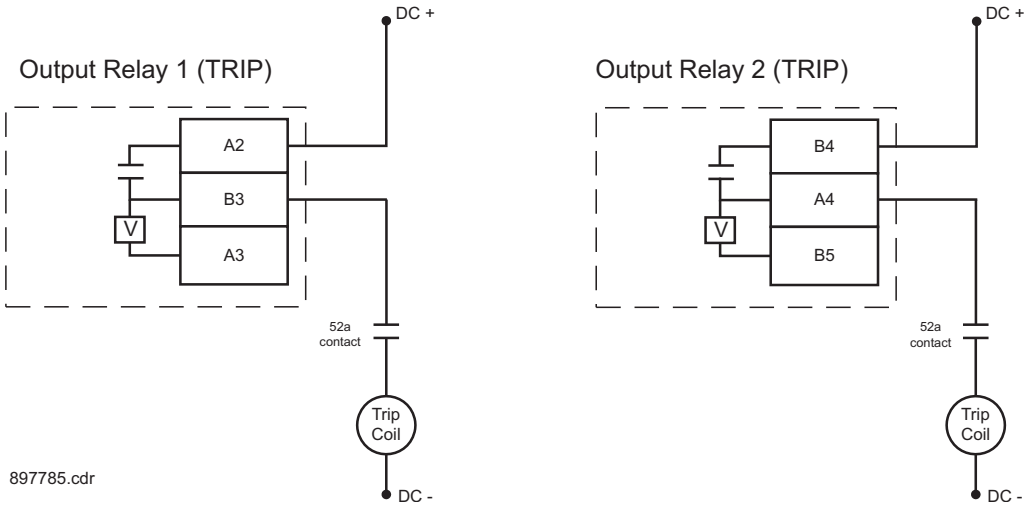

NOTE

To monitor the Trip coil circuit integrity, use the relay terminals A2 and B3 to connect the Trip coil, and provide a jumper between terminals A2 (optional voltage) and A3.


NOTE

To monitor the Trip coil circuit integrity, use the relay terminals B4 and A4 to connect the Trip coil, and provide a jumper between terminals B4 (optional voltage) and B5.

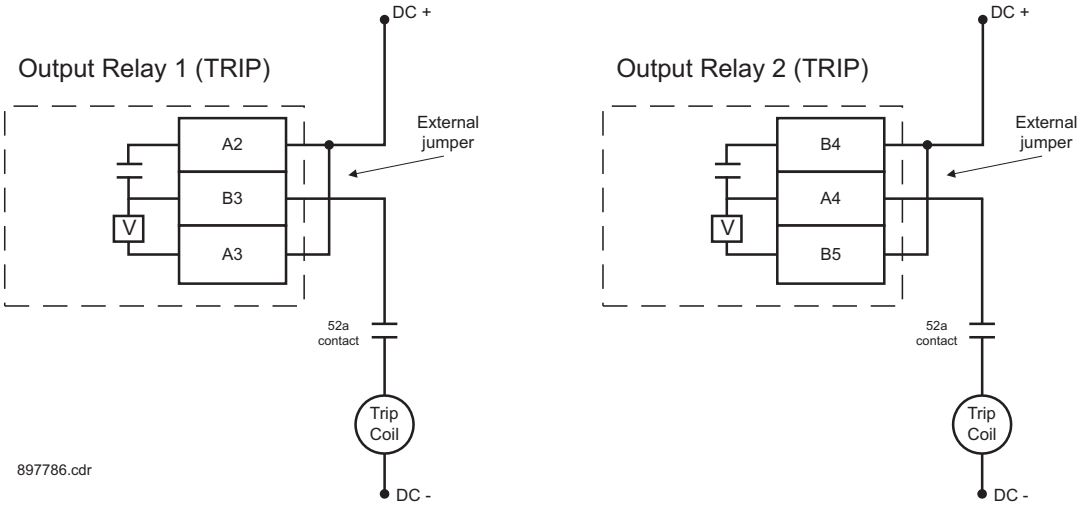
Figure 2-28: Relay #1 Trip and Relay #2 Trip circuits with no voltage monitoring



NOTE

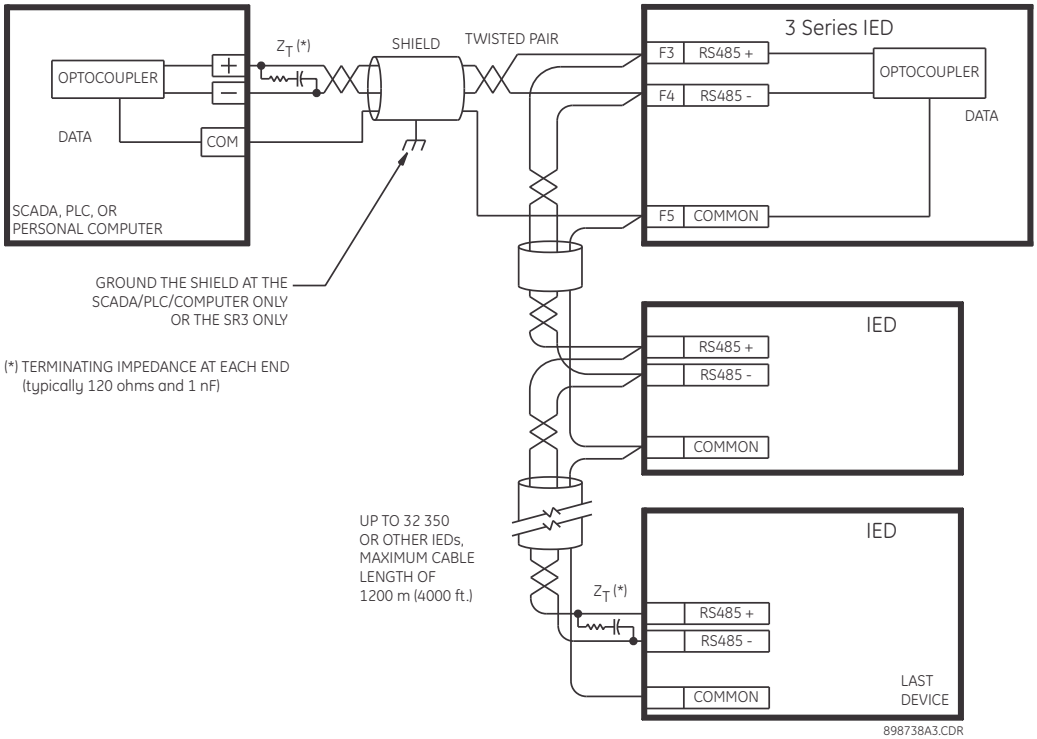
All AUX contacts are shown when the breaker is open.

Figure 2-29: Relay #1 Trip and Relay #2 Trip circuits with voltage monitoring



Serial communications

Figure 2-30: RS485 wiring diagram



One two-wire RS485 port is provided. Up to 32 345 IEDs can be daisy-chained together on a communication channel without exceeding the driver capability. For larger systems, additional serial channels must be added. Commercially available repeaters can also be used to add more than 32 relays on a single channel. Suitable cable should have a characteristic impedance of 120 ohms (for example, Belden #9841) and total wire length should not exceed 1200 meters (4000 ft.). Commercially available repeaters will allow for transmission distances greater than 1200 meters.

Voltage differences between remote ends of the communication link are not uncommon. For this reason, surge protection devices are internally installed across all RS485 terminals. Internally, an isolated power supply with an optocoupled data interface is used to prevent noise coupling.

CAUTION

To ensure that all devices in a daisy-chain are at the same potential, it is imperative that the common terminals of each RS485 port are tied together and grounded only once, at the master or at the 345 . Failure to do so may result in intermittent or failed communications.

The source computer/PLC/SCADA system should have similar transient protection devices installed, either internally or externally. Ground the shield at one point only, as shown in the figure above, to avoid ground loops.

Correct polarity is also essential. The 345 IEDs must be wired with all the positive (+) terminals connected together and all the negative (–) terminals connected together. Each relay must be daisy-chained to the next one. Avoid star or stub connected configurations. The last device at each end of the daisy-chain should be terminated with a 120 ohm ¼ watt resistor in series with a 1 nF capacitor across the positive and negative terminals. Observing these guidelines will ensure a reliable communication system immune to system transients.

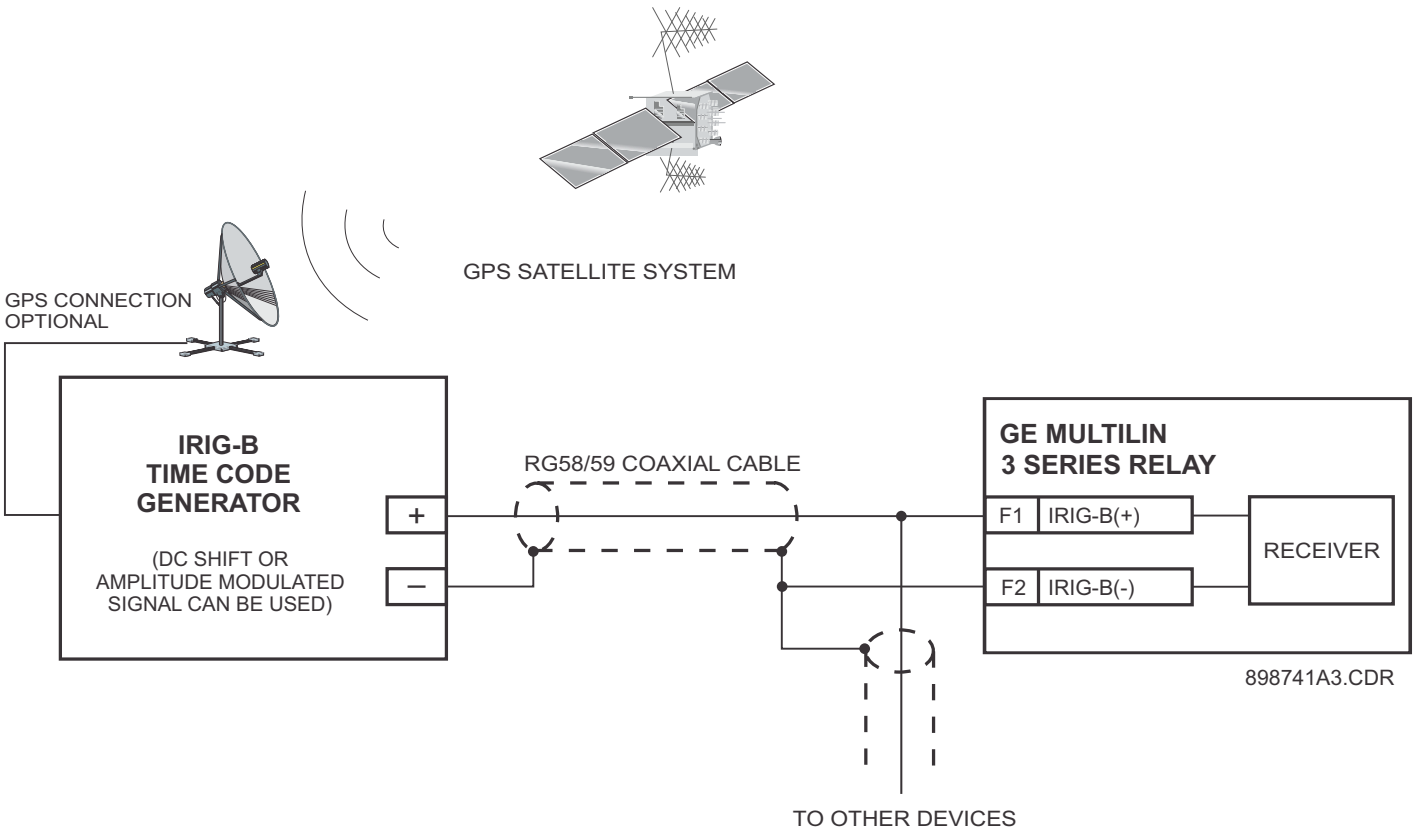
The uncovered communications cable shield connected to the common terminal should not exceed 1" (2.5 cm) for proper EMC shielding of the communications cable.

IRIG-B

IRIG-B is a standard time code format that allows time stamping of events to be synchronized among connected devices within 1 millisecond. The IRIG time code formats are serial, width-modulated codes which can be either DC level shift or amplitude modulated (AM) form. The type of form is auto-detected by the 345 relay. Third party equipment is available for generating the IRIG-B signal; this equipment may use a GPS satellite system to obtain the time reference so that devices at different geographic locations can also be synchronized.

The uncovered communications cable shield connected to the common terminal should not exceed 1" (2.5 cm) for proper EMC shielding of the communications cable.

Figure 2-31: IRIG-B connection



GE
Grid Solutions

345 Transformer Protection System

Chapter 3: Interfaces

There are two methods of interfacing with the 345 Feeder Protection System.

- Interfacing via the relay keypad and display.
- Interfacing via the EnerVista 3 Series Setup software.

This section provides an overview of the interfacing methods available with the 345 using the relay control panels and EnerVista 3 Series Setup software. For additional details on interface parameters (for example, settings, actual values, etc.), refer to the individual chapters.

Front control panel interface

Figure 3-1: Transformer Protection System Front Panel

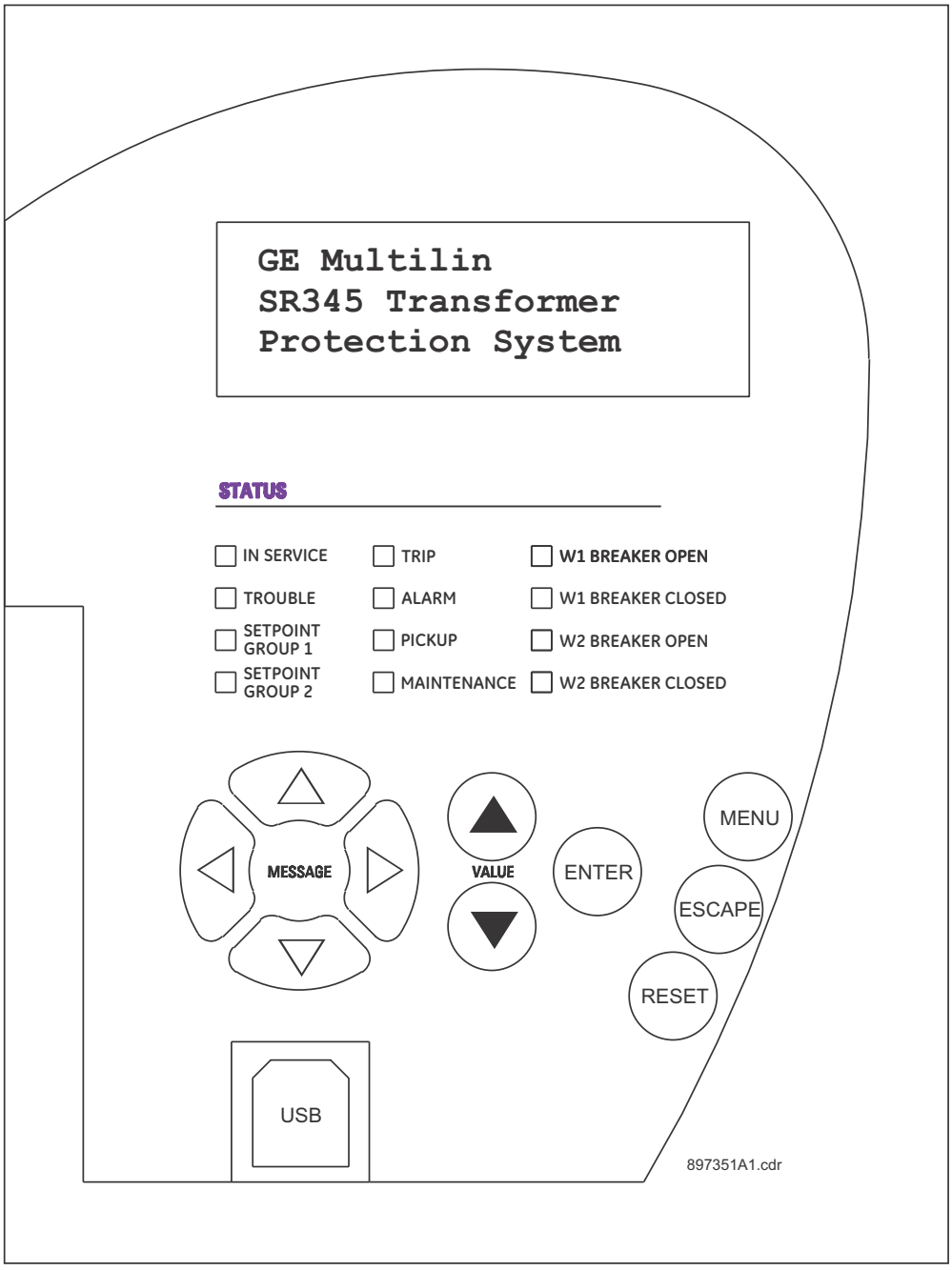
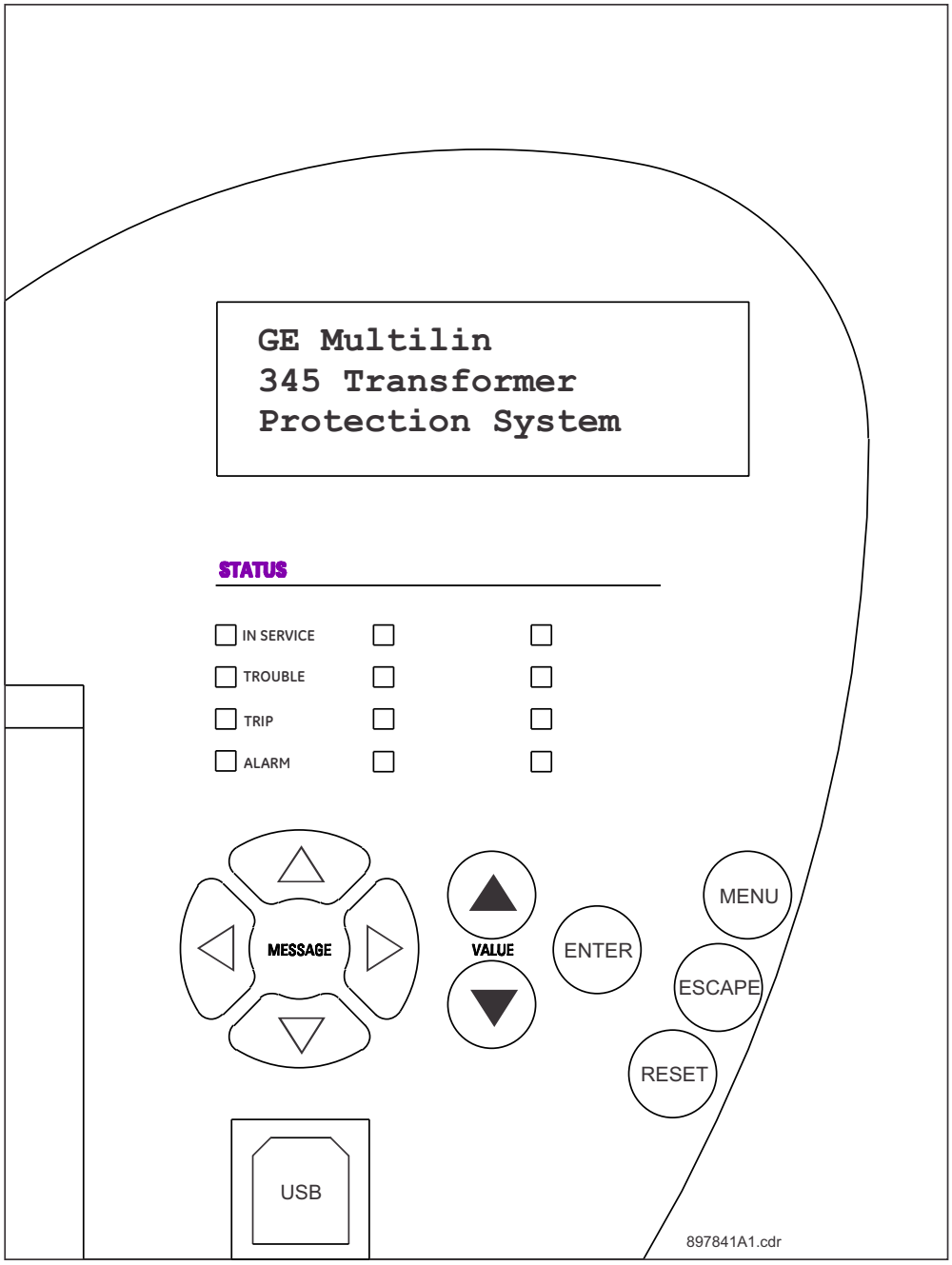


Figure 3-2: 345 Feeder Protection System Front Panel - Programmable LEDs



Description

The relay front panel provides an interface with a liquid crystal display, LED status indicators, control keys, and a USB program port. The display and status indicators show the relay information automatically. The control keys are used to select the appropriate message for entering setpoints or displaying measured values. The USB program port is also provided for connection with a computer running the EnerVista 3 Series Setup software.

Display

The 80-character liquid crystal display (LCD) allows visibility under varied lighting conditions. When the keypad and display are not being used, system information is displayed after a user-defined period of inactivity. Pressing the Menu key during the display of default message returns the display to the last message shown before the default message appeared. Any trip, alarm, or pickup is displayed immediately, automatically overriding the default message.

Working with the Keypad

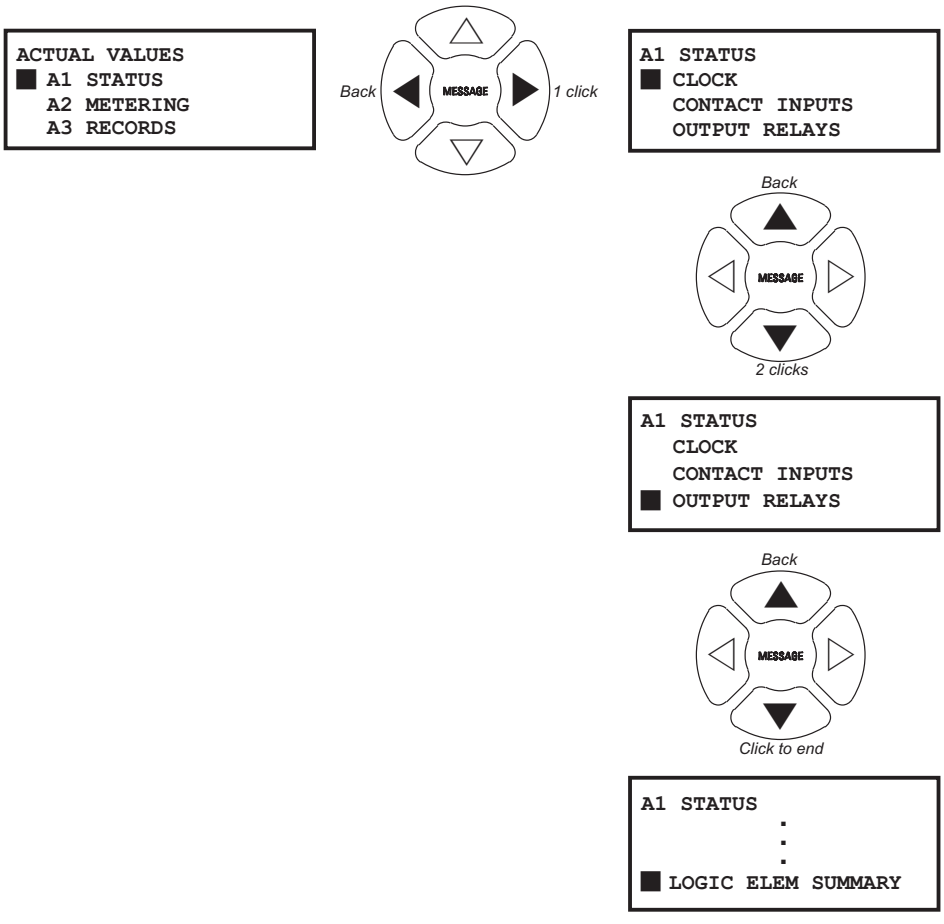
The 345 display messages are organized into a Main Menu, pages, and sub-pages. There are four main menus labeled Actual Values, Quick Setup, Setpoints, and Maintenance. Pressing the MENU key followed by the MESSAGE key scrolls through the five Main Menu headers, which appear in sequence as follows:

Figure 3-3: The five Main Menu headers

```
ACTUAL VALUES
COMMANDS
QUICK SETUP
SETPOINTS
MAINTENANCE
```

Pressing the **MESSAGE ►** key or the **ENTER** key from these Main Menu pages will display the corresponding menu Page. Use the MESSAGE ▲ and MESSAGE ▼ keys to scroll through the Page headers.

Figure 3-4: Typical paging operation from Main Menu selection



When the display shows **SETPOINTS**, pressing the **MESSAGE** ► key or the **ENTER** key will display the page headers of programmable parameters (referred to as setpoints in the manual). When the display shows **ACTUAL VALUES**, pressing the **MESSAGE** ► key or the **ENTER** key displays the page headers of measured parameters (referred to as actual values in the manual).

Each page is broken down further into logical sub-pages of messages. The **MESSAGE** ▲ and **MESSAGE** ▼ keys are used to navigate through the sub-pages. A summary of the setpoints and actual values pages can be found in the Chapters : Setpoints and Actual Values, respectively.

The **ENTER** key is dual purpose. It is used to enter the sub-pages and to store altered setpoint values into memory to complete the change. The **MESSAGE** ► key can also be used to enter sub-pages but not to store altered setpoints.

The **ESCAPE** key is also dual purpose. It is used to exit the sub-pages and to cancel a setpoint change. The **MESSAGE** ◄ key can also be used to exit sub-pages and to cancel setpoint changes.

The **VALUE** keys are used to scroll through the possible choices of an enumerated setpoint. They also decrement and increment numerical setpoints.

The **RESET** key resets any latched conditions that are not currently active. This includes resetting latched output relays, latched Trip LEDs, breaker operation failure, and trip / close coil failures. The Autoreclose Scheme is also reset with the shot counter being returned to zero and the lockout condition being cleared.

The **MESSAGE** ▲ and **MESSAGE** ▼ keys scroll through any active conditions in the relay. Diagnostic messages are displayed indicating the state of protection and monitoring elements that are picked up, operating, or latched.

LED status indicators - Front panel with non-programmable LEDs

- **IN SERVICE: Green**

  This LED will be continuously “ON”, when the relay is set to “Ready” under **S1 RELAY SETUP > INSTALLATION > RELAY STATUS**, and no major self-test errors have been detected.

- **TROUBLE: Orange**

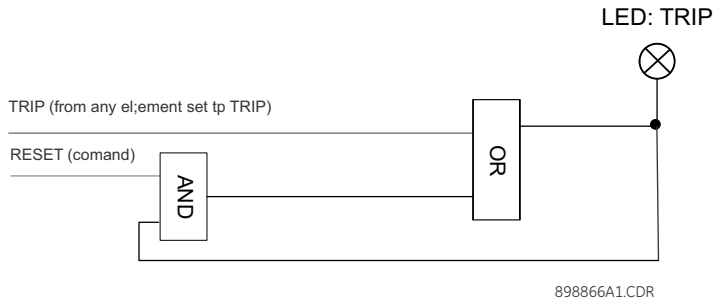
  This LED will turn “ON”, when the relay is in the not programmed (Not Ready) state under **S1 RELAY SETUP > INSTALLATION > RELAY STATUS**, or upon detection of a major self-test error. The relay will turn back to “IN-SERVICE” if no major self-test error is present.

- **SETPOINT GROUP 1, 2: Green**

  These LEDs indicate the group of active protection elements. If setpoint group 1 is lit green, only the protection elements under group 1 will be active. The protection elements from group 2 will be inactive. The settings for each protection element can be edited and displayed regardless of the active group.

- **TRIP: Red**

  This indicator turns on when the relay detects a fault and sends a trip command to the trip output relay. The LED will reset by initiating a reset command from either the RESET pushbutton Breaker Control, or communications; in all cases after the fault condition has cleared.



- **ALARM: Orange**

  This LED will flash upon detection of an alarm condition, with element functions selected as “alarm”. The LED will automatically turn off if the alarm condition clears. The LED will remain steady “ON”, if the function of the operated protection was selected as "latched alarm".

- **PICKUP: Orange**

  This indicator will light ON upon pickup condition generated by any of the relay features. The indicator will turn off if no pickup condition is detected.

- **MAINTENANCE: Orange**

  This LED may indicate both breaker or relay maintenance depending on the programmed maintenance elements. The LED will turn on upon operation of a maintenance element.

- **W1 BREAKER OPEN: Red/Green/Orange/Off – programmable color, default Green**

  This LED is lit when the winding 1 breaker is detected open.

- **W1 BREAKER CLOSED: Red/Green/Orange/Off – programmable color, default Green**

  This LED is lit when the winding 1 breaker is detected closed.

- **W2 BREAKER OPEN: Red/Green/Orange/Off – programmable color, default Green**

  This LED is lit when the winding 2 breaker is detected open.

- **W2 BREAKER CLOSED: Red/Green/Orange/Off – programmable color, default Green**

  This LED is lit when the winding 2 breaker is detected closed.

NOTE

Refer to M7 Testing for information on testing LED status indicators.

LED status indicators - Front panel with programmable LEDs

- **IN SERVICE: Green**

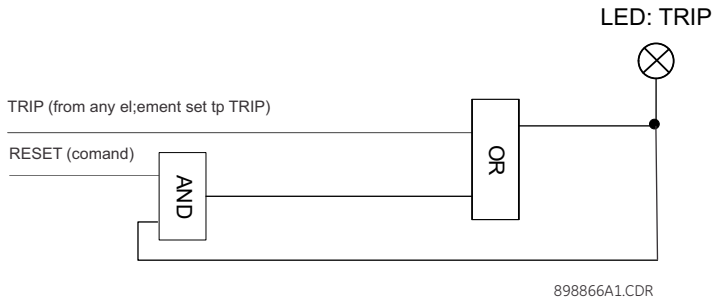
  This LED will be continuously "ON", when the relay is set to "Ready" under **S1 RELAY SETUP > INSTALLATION > RELAY STATUS**, and no major self-test errors have been detected.

- **TROUBLE: Orange**

  This LED will turn "ON", when the relay is not programmed (Not Ready) state under **S1 RELAY SETUP > INSTALLATION > RELAY STATUS**, or upon detection of a major self-test error. The relay will turn back to "IN-SERVICE" if no major self-test error is present.

- **TRIP: Red**

  This indicator turns on when the relay detects a fault and sends a trip command to the trip output relay. The LED will reset by initiating a reset command from either the RESET pushbutton Breaker Control, or communications; in all cases after the fault condition has cleared.



- **ALARM: Orange**

  This LED will flash upon detection of an alarm condition, with element functions selected as "alarm". The LED will automatically turn off if the alarm condition clears. The LED will remain steady "ON", if the function of the operated protection was selected as "latched alarm".

- **LED 1: Red - programmable source signal and type**
- **LED 2: Orange - programmable source signal and type**
- **LED 3: Orange - programmable source signal and type**
- **LED 4: Orange - programmable source signal and type**
- **LED 5: Red/Orange/Green/Off - programmable source signal, type, and color**
- **LED 6: Red/Orange/Green/Off - programmable source signal, type, and color**
- **LED 7: Red/Orange/Green/Off - programmable source signal, type, and color**
- **LED 8: Red/Orange/Green/Off - programmable source signal, type, and color**

NOTE

Refer to M7 Testing for information on testing LED status indicators.

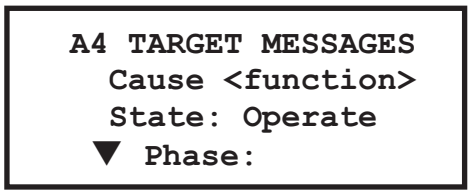
Relay messages

Target messages

Target messages are automatically displayed for any active condition on the relay such as pickups, trips, or alarms.

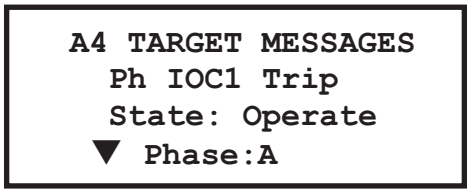
The relay displays the most recent event first, and after 5 seconds will start rolling up the other target messages until the conditions clear and/or the RESET command is initiated. The Target Messages can be reviewed by pressing either the MESSAGE UP or MESSAGE DOWN key. If a RESET command is not performed but any of the other faceplate pushbuttons is pressed, the display will not show the target messages unless the user navigates to **ACTUAL VALUES > A4 TARGET MESSAGES**, where they can be reviewed. If the target messages have not been cleared before the user presses a pushbutton different from "RESET", they will reappear on the screen after the time specified under the **SETPOINTS > S1 RELAY SETUP > FRONT PANEL > MESSAGE TIMEOUT** setting, that will start timing out from the last pressed pushbutton. The following shows the format of a typical Target Message:

Figure 3-5: Typical target message



Example of a Phase IOC1 operation - phase A:

Phase IOC1 function: Trip



Cause <Function>

The first line contains information of the cause of operation (the name of the operated element), and the element function.

State: Operate

This line from the display shows the state of the element: Pickup, Operated, Alarm.

Phase: A

The last line from the display shows the phase that picked up or operated.

Self-test errors

The relay performs self diagnostics at initialization (after power up), and continuously as a background task to ensure that the hardware and software are functioning correctly. There are two types of self-test warnings indicating either a minor or major problem. Minor problems indicate a problem with the relay that does not compromise protection of the power system. Major errors indicate a problem with the relay which takes it out of service.

⚠CAUTION

Self-Test Warnings may indicate a serious problem with the relay hardware!

Upon detection of a **minor** problem, the relay will:

- Turn on the "TROUBLE" LED at the same time as the "IN SERVICE" LED is on.
- Display the error on the relay display.
- Record the minor self-test error in the Event Recorder.

Upon detection of a **major** problem, the relay will:

- De-energize critical failure relay (Output Relay 7).
- Inhibit operation of all other output relays (1 to 6).
- Turn off the "IN SERVICE" LED; turn on the "TROUBLE" LED.
- Flash the "ALARM" LED.
- Display the cause of major self-test failure.
- Record the major self-test failure in the Event Recorder.

Figure 3-6: Typical Self-test warning

```
A4 TARGET MESSAGES
  UNIT FAILURE:
  Contact Factory:
  Error code:1
```

Table 3-1: Minor Self-test Errors

Self-test Error Message	Latched Target Message?	Description of Problem	How Often the Test is Performed	What to do
MAINTENANCE ALERT: IRIG-B Failure	No	A bad IRIG-B input signal has been detected.	Every 5 seconds*	Ensure IRIG-B cable is connected, check cable functionality (i.e. physical damage or perform continuity test), ensure IRIG-B receiver is functioning, and check input signal level (it may be less than specification). If none of these apply, contact the factory.
MAINTENANCE ALERT: Clock Not Set	No	Clock time is the same as the default time.	Every 5 seconds*	Set the date and time in S1 RELAY SETUP.
MAINTENANCE ALERT: Comm Alert 1, 2, or 3	No	Communication error between CPU and Comms board.	Every 5 seconds*	If alert doesn't self-reset, then contact factory. Otherwise monitor recurrences as errors are detected and self-reset.
MAINTENANCE ALERT : Ethernet Link Fail	No	Communication error between 345 and Network.	Detected Instantaneously	Check Ethernet cable and Ethernet connection. Check health of the network. Check status of external routers and switches. Check that IP settings are not 0.0.0.0

Self-test Error Message	Latched Target Message?	Description of Problem	How Often the Test is Performed	What to do
MAINTENANCE ALERT: High Ethernet Traffic	No		Every 5 seconds*	
MAINTENANCE ALERT: High Ambient Temperature	No	The ambient temperature is above 80°C.	Every 1 hour	Increase ventilation to the surroundings.
MAINTENANCE ALERT: Daughter Error	No	The rear Communications daughter board type does not match the order code.	Every 5 seconds*	Replace the rear communications daughter board with the correct board.
MAINTENANCE ALERT: Comms Serial Invalid	No	The internal communications board does not match the order code.	Every 5 seconds*	Contact factory.
MAINTENANCE ALERT: RMIO Mismatch	No	RMIO Module is not validated; communications with the RMIO module are lost or interrupted.	Every 5 seconds*	Validate the RMIO Module; check CANBUS communication.

* Failure is logged after the detection of 5 consecutive failures - that is after 25 seconds

Table 3-2: Major Self-test Errors

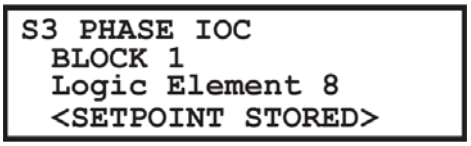
Self-test Error Message	Latched Target Message?	Description of Problem	How Often the Test is Performed	What to do
UNIT FAILURE: Contact Factory (XXXX)	Yes	This warning is caused by a unit hardware failure. Failure code (XXXX) is shown.	Every 5 seconds*	Contact the factory and provide the failure code.
RELAY NOT READY: Check Settings	No	PRODUCT SETUP INSTALLATION setting indicates that relay is not in a programmed state.	On power up and whenever the PRODUCT SETUP INSTALLATION setting is altered.	Program all required settings then set the PRODUCT SETUP INSTALLATION setting to "Programmed".

* Failure is logged after the detection of 5 consecutive failures - that is after 25 seconds

Flash messages

Flash messages are warning, error, or general information messages displayed in response to pressing certain keys. The factory default flash message time is 4 seconds.

Figure 3-7: Typical Flash message



SETPOINT STORED

This flash message is displayed in response to the **ENTER** key while on any setpoint message (see example above). The edited value was stored as entered.

COMMAND EXECUTED

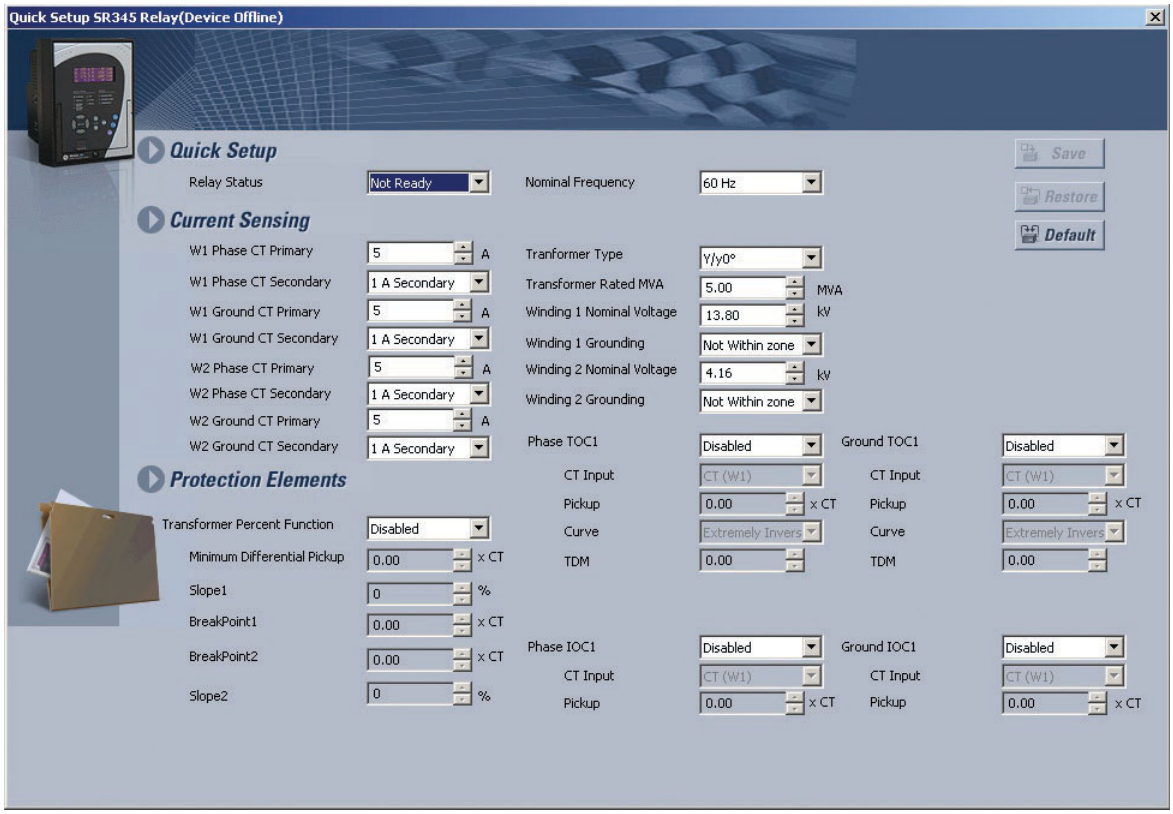
This flash message is displayed in response to executing a command: ON, OFF, YES, NO, etc.

INVALID PASSWORD

This flash message appears upon an attempt to enter an incorrect password, as part of password security.

Software setup

Quick setup - Software interface



- **The Quick Setup** window allows you to configure important settings from different screens in the relay by adding them to a common window.
- **Quick Setup** window options are available for a single device or a file.
- **The Quick Setup** Window option is accessed from the "Tree" which launches on clicking.

EnerVista 3 Series Setup Software

Although settings can be entered manually using the control panel keys, a PC can be used to download setpoints through the communications port. The EnerVista 3 Series Setup software is available from GE Multilin to make this as convenient as possible. With EnerVista 3 Series Setup running, it is possible to:

- Program and modify settings
- Load and save setting files to and from a disk
- Read actual values
- Monitor status
- Read pre-trip data and event records
- Get help on any topic

- Upgrade the 345 firmware

The EnerVista 3 Series Setup software allows immediate access to all 345 features with easy to use pull down menus in the familiar Windows environment. This section provides the necessary information to install EnerVista 3 Series Setup , upgrade the relay firmware, and write and edit setting files.

The EnerVista 3 Series Setup software can run without a 345 connected to the computer. In this case, settings may be saved to a file for future use. If a 345 is connected to a PC and communications are enabled, the 345 can be programmed from the setting screens. In addition, measured values, status and trip messages can be displayed with the actual value screens.

Hardware and software requirements

The following requirements must be met for the EnerVista 3 Series Setup software.

- Pentium 4 (Core Duo recommended)
- Windows XP with Service Pack 2 (Service Pack 3 recommended) , Windows 7 (32-bit or 64-bit), Windows 8.1 (32-bit or 64-bit), Windows 10 (32-bit or 64-bit)
- 1 GB of RAM (2 GB recommended)
- 500 MB free hard drive space (1 GB recommended)
- 1024 x 768 display (1280 x 800 recommended)

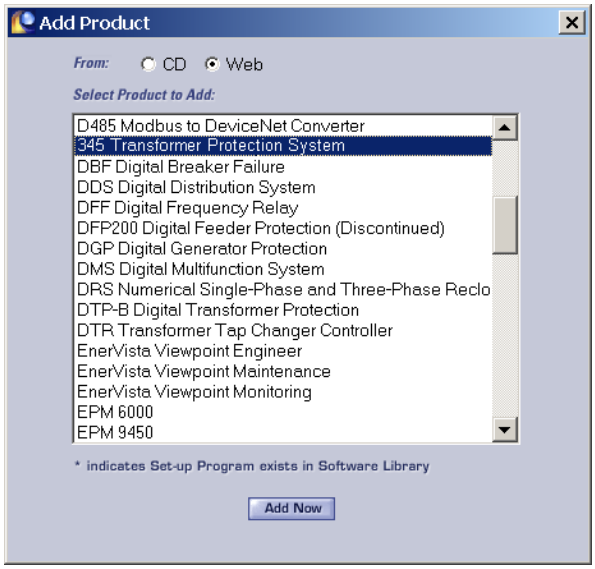
The EnerVista 3 Series Setup software can be installed from either the GE EnerVista CD or the GE Multilin website at http://www.gegridsolutions.com/multilin

Installing the EnerVista 3 Series Setup software

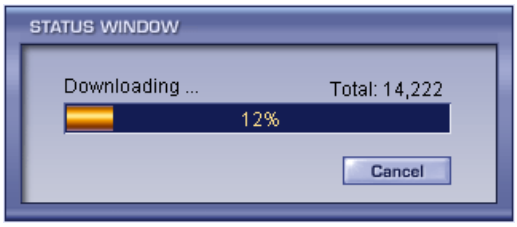
After ensuring the minimum requirements indicated earlier, use the following procedure to install the EnerVista 3 Series Setup software from the enclosed GE EnerVista CD.

1. Insert the GE EnerVista CD into your CD-ROM drive.
2. Click the **Install Now** button and follow the installation instructions to install the no-charge EnerVista software on the local PC.
3. When installation is complete, start the EnerVista Launchpad application.
4. Click the **IED Setup** section of the LaunchPad toolbar.

5. In the EnerVista Launchpad window, click the **Add Product** button and select the 345 Feeder Protection System as shown below. Select the Web option to ensure the most recent software release, or select CD if you do not have a web connection, then click the **Add Now** button to list software items for the 345 .



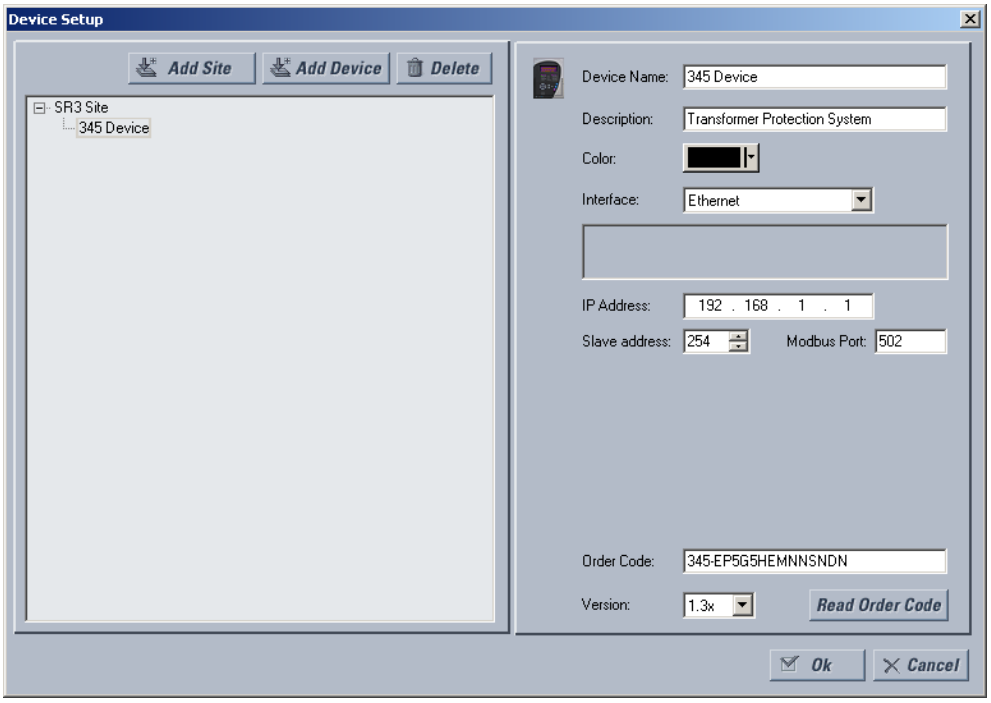
6. EnerVista Launchpad will obtain the latest installation software from the Web or CD and automatically start the installation process. A status window with a progress bar will be shown during the downloading process.



7. Select the complete path, including the new directory name, where the EnerVista 3 Series Setup software will be installed.
8. Click on **Next** to begin the installation. The files will be installed in the directory indicated, the USB driver will be loaded into the computer, and the installation program will automatically create icons and add EnerVista 3 Series Setup software to the Windows start menu.
9. The 345 device will be added to the list of installed IEDs in the EnerVista Launchpad window, as shown below.

If you are going to communicate from your computer to the 345 Relay using the USB port:

10. Plug the USB cable into the USB port on the 345 Relay then into the USB port on your computer.
11. Launch EnerVista 3 Series Setup from LaunchPad.
12. In **EnerVista > Device Setup**:



13. Select **USB** as the Interface type.
14. Select **345 Relay** as the USB device.

Upgrading the software

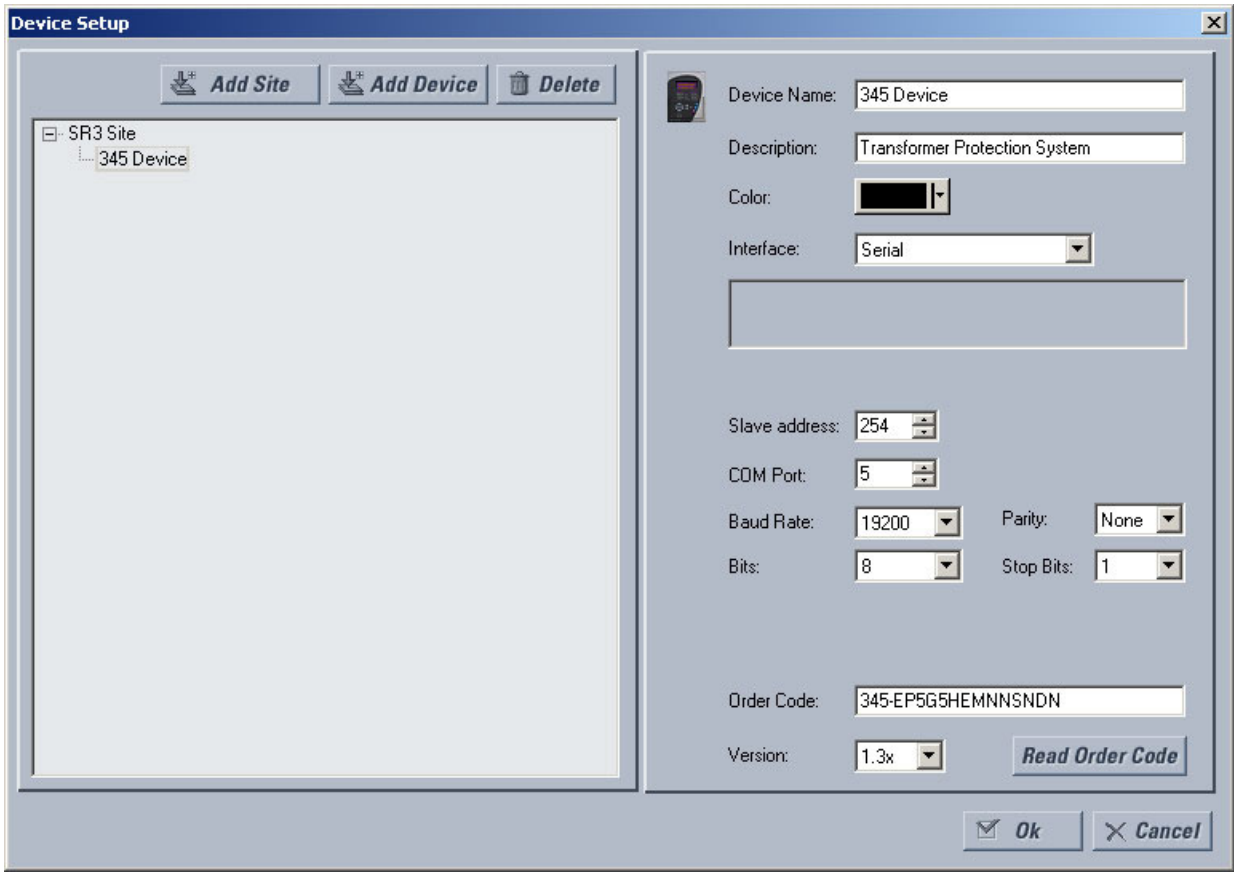
The latest EnerVista software and firmware can be downloaded from:
https://www.gegridsolutions.com/
After upgrading, check the version number under **Help > About**. If the new version does not display, try uninstalling the software and reinstalling the new versions.

Connecting EnerVista 3 Series Setup to the relay

Configuring serial communications

Before starting, verify that the cable is properly connected to either the USB port on the front panel of the device (for USB communications) or to the RS485 terminals on the back of the device (for RS485 communications). This example demonstrates an USB connection. For RS485 communications, the GE Multilin F485 converter will be required. Refer to the F485 manual for additional details. To configure the relay for Ethernet communications, see *Configuring Ethernet Communications* below.

1. Install and start the latest version of the EnerVista 3 Series Setup software (available from the GE Multilin web site). See the previous section for the installation procedure.
2. Click on the **Device Setup** button to open the Device Setup window and click the **Add Site** button to define a new site.
3. Enter the desired site name in the "Site Name" field. If desired, a short description of the site can also be entered. In this example, we will use “Substation 1” as the site name.
4. The new site will appear in the upper-left list in the EnerVista 3 Series Setup window.
5. Click the **Add Device** button to define the new device.
6. Enter the desired name in the "Device Name" field and a description (optional) of the device.
7. Select “Serial” from the Interface drop-down list.

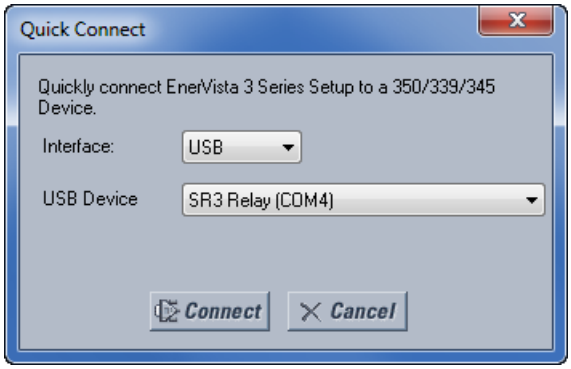


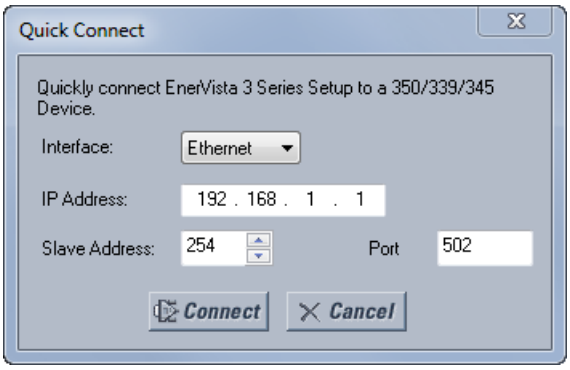
8. Click the **Read Order Code** button to connect to the 345 device and upload the order code.
9. Click **OK** when the relay order code has been received. The new device will be added to the Site List window (or Online window) located in the top left corner of the main EnerVista 3 Series Setup window.

The 345 Site Device has now been configured for USB communications. Proceed to *Connecting to the Relay* below, to begin communications.

Using the Quick Connect feature

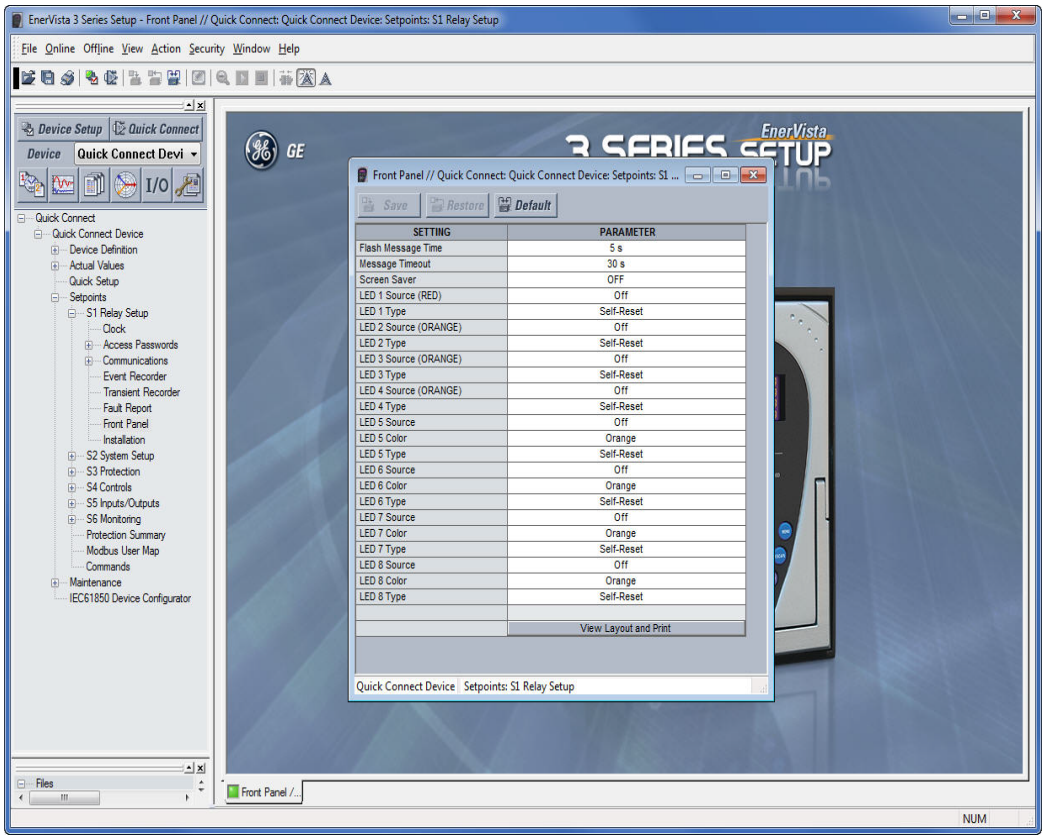
The **Quick Connect** button can be used to establish a fast connection through the front panel USB port of a 345 relay, or through the Ethernet port. The following window will appear when the **QuickConnect** button is pressed:





As indicated by the window, the "Quick Connect" feature can quickly connect the EnerVista 3 Series Setup software to a 345 front port if the USB is selected in the interface drop-down list. Select "SR3 Relay" and press the **Connect** button. Ethernet can also be used as the interface for Quick Connect as shown above.

When connected, a new Site called "Quick Connect" will appear in the Site List window.



The 345 Site Device has now been configured via the Quick Connect feature for either USB or Ethernet communications. Proceed to *Connecting to the Relay* below, to begin communications.

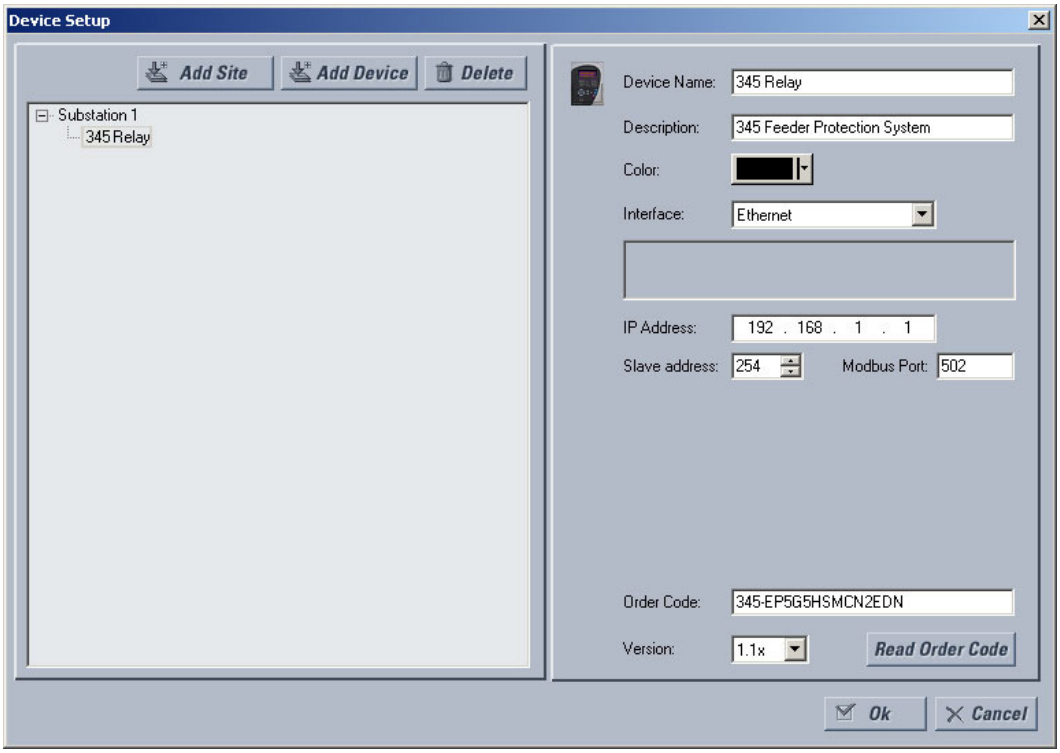
Configuring Ethernet communications

Before starting, verify that the Ethernet cable is properly connected to the RJ-45 Ethernet port.

NOTE

345 supports a maximum of 3 TCP/IP sessions.

1. Install and start the latest version of the EnerVista 3 Series Setup Setup software (available from the GE EnerVista CD). See the previous section for the installation procedure.
2. Click on the **Device Setup** button to open the Device Setup window and click the **Add Site** button to define a new site.
3. Enter the desired site name in the "Site Name" field. If desired, a short description of the site can also be entered. In this example, we will use “Substation 1” as the site name.
4. The new site will appear in the upper-left list.
5. Click the **Add Device** button to define the new device.
6. Enter the desired name in the "Device Name" field, and a description (optional).
7. Select “Ethernet” from the Interface drop-down list. This will display a number of interface parameters that must be entered for proper Ethernet functionality.



8. Enter the IP address, slave address, and Modbus port values assigned to the 345 relay (from the S1 RELAY SETUP > COMMUNICATIONS > ETHERNET menu).
9. Click the **Read Order Code** button to connect to the 345 and upload the order code. If a communications error occurs, ensure that the Ethernet communication values correspond to the relay setting values.
10. Click **OK** when the relay order code has been received. The new device will be added to the Site List window (or Online window) located in the top left corner of the main EnerVista 3 Series Setup window.

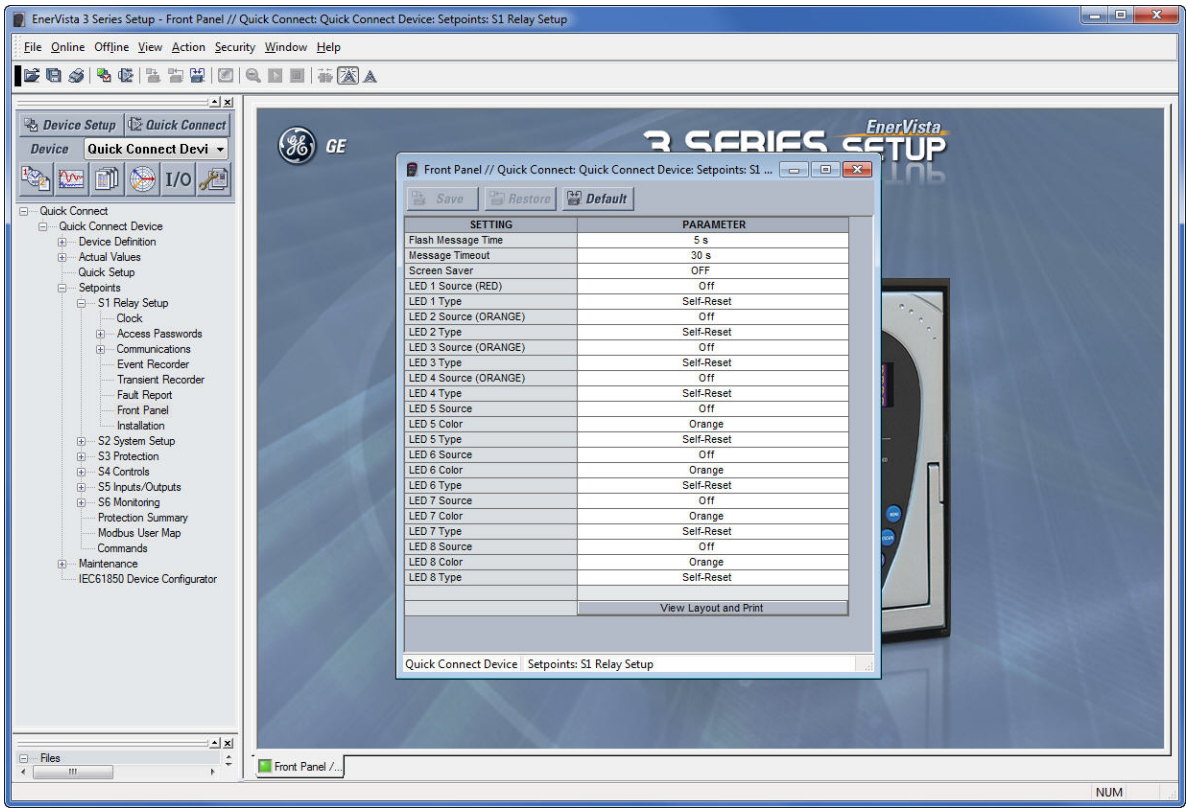
The 345 Site Device has now been configured for Ethernet communications. Proceed to the following section to begin communications.

Connecting to the relay

Now that the communications parameters have been properly configured, the user can easily communicate with the relay.

1. Expand the Site list by double clicking on the site name or clicking on the «+» box to list the available devices for the given site.
2. Desired device trees can be expanded by clicking the «+» box. The following list of headers is shown for each device:

   Device Definition
   Actual Values
   Quick Setup
   Setpoints
   Maintenance.
3. Expand the SETTINGS > RELAY SETUP list item and double click on **Front Panel** to open the Front Panel settings window as shown:



4. The Front Panel settings window opens with a corresponding status indicator on the lower left of the EnerVista 3 Series Setup window.
5. If the status indicator is red, verify that the serial, USB, or Ethernet cable is properly connected to the relay, and that the relay has been properly configured for communications (steps described earlier).

The Front Panel settings can now be edited, printed, or changed. Other setpoint and command windows can be displayed and edited in a similar manner. "Actual Values" windows are also available for display. These windows can be arranged, and resized at will.

Working with setpoints and setpoint files

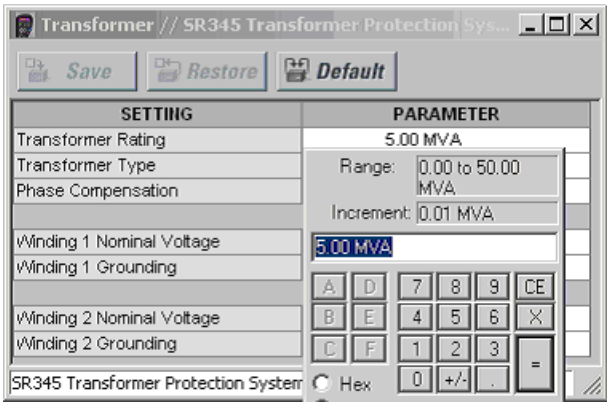
Engaging a device

The EnerVista 3 Series Setup software may be used in on-line mode (relay connected) to directly communicate with a relay. Communicating relays are organized and grouped by communication interfaces and into sites. Sites may contain any number of relays selected from the product series.

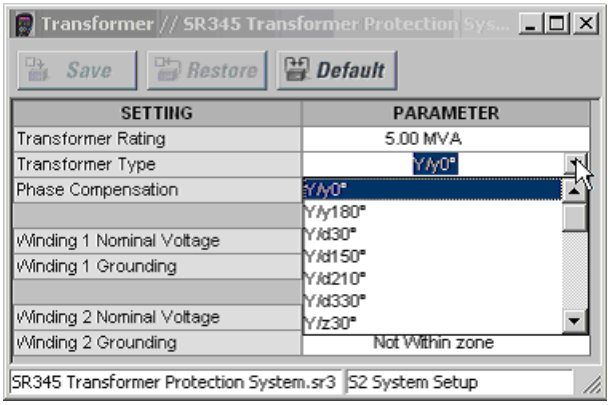
Entering setpoints

The System Setup page will be used as an example to illustrate the entering of setpoints. Inthis example, we will be changing the power system setpoints.

1. Establish communications with the relay.
2. Select the **Setpoint > System Setup > Transformer** menu item.
3. Select the **Transformer Rating** setpoint by clicking anywhere in the parameter box. This will display three arrows: two to increment/decrement the value, and another to launch the numerical keypad.
4. Clicking the arrow at the end of the box displays a numerical keypad interface that allows the user to enter a value within the setpoint range displayed near the top of the keypad: Click **=** to exit from the keypad and keep the new value. Click on **X** to exit from the keypad and retain the old value.



5. For setpoints requiring non-numerical pre-set values (e.g. Transformer type below), clicking anywhere within the setpoint value box displays a dropdown selection menu arrow. Select the desired value from this list.

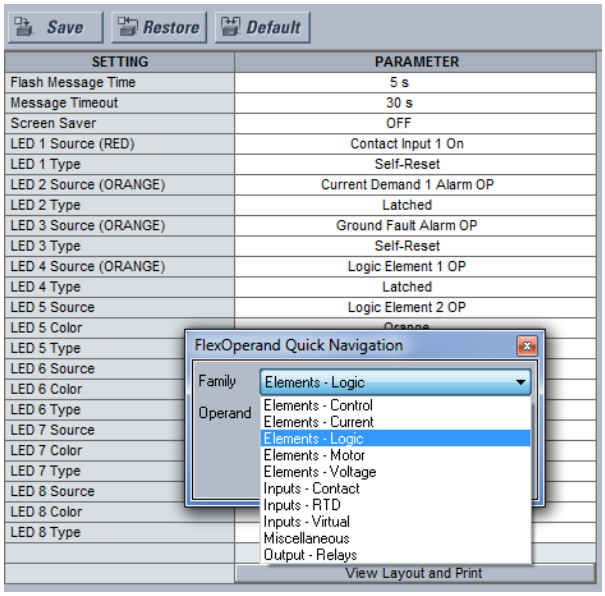


6. For setpoints requiring an alphanumeric text string (e.g. "relay name"), the value may be entered directly within the setpoint value box.
7. In the **Setpoint > System Setup > Transformer** dialog box, click on **Save** to save the values into the 345 . Click **YES** to accept any changes and exit the window. Click **Restore** to retain previous values. Click **Default** to restore Default values.

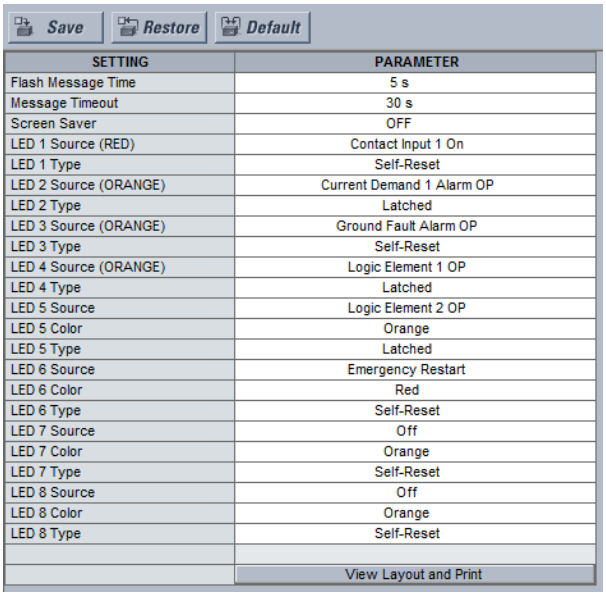
Setting programmable LEDs

Front panels with programmable LEDs have eight LEDs that are off by default, and must be set to a source signal and type. Four of these LEDs can also be set to different colors.

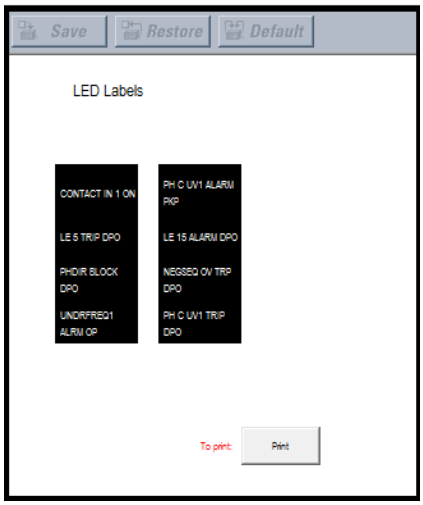
1. Establish communications with the relay.
2. Select the **Setpoint > S1 Relay Setup > Front Panel** menu item.
3. Select an LED Source setpoint by clicking anywhere in the parameter box beside an LED Source label. This opens a Quick Navigation window.



4. Select a Type for the LED (Latched or Self-Reset), and a Color if applicable.
5. Repeat this process for all programmable LED Source, Type, and Color parameters.



6. In the **Setpoint > S1 Relay Setup > Front Panel** dialog box, click **Save** to save the values into the 345 . Click **YES** to accept any changes. Click **Restore** to retain previous values. Click **Default** to restore Default values (all LEDs Off and colors Orange).
7. Click **View Layout and Print** to create a printable label for the front panel showing the programmable LED settings. Edit LED names manually by clicking the LED label and entering up to 20 characters. (Manual edits can be printed, but are not saved.)



8. Click **Print** to print a copy of the customized front panel label.

File support

Opening any EnerVista 3 Series Setup file will automatically launch the application or provide focus to the already opened application. If the file is a settings file (has a 'SR3' extension) which had been removed from the Settings List tree menu, it will be added back to the Settings List tree.

New files will be automatically added to the tree.

Using setpoint files

The EnerVista 3 Series Setup software interface supports three ways of handling changes to relay settings:

- In off-line mode (relay disconnected) to create or edit relay settings files for later download to communicating relays.
- Directly modifying relay settings while connected to a communicating relay, then saving the settings when complete.
- Creating/editing settings files while connected to a communicating relay, then saving them to the relay when complete.

Settings files are organized on the basis of file names assigned by the user. A settings file contains data pertaining to the following types of relay settings:

- Device Definition
- Relay Setup
- System Setup
- Protection
- Control
- Inputs/Outputs

Factory default values are supplied and can be restored after any changes.

The EnerVista 3 Series Setup displays relay setpoints with the same hierarchy as the front panel display.

Downloading and saving setpoint files

Back up a copy of the in-service settings for each commissioned 345 unit, so as to revert to the commissioned settings after inadvertent, unauthorized, or temporary setting changes are made, after the settings default due to firmware upgrade, or when the unit has to be replaced. This section describes how to backup settings to a file and how to use that file to restore settings to the original relay or to a replacement relay

Setpoints must be saved to a file on the local PC before performing any firmware upgrades. Saving setpoints is also highly recommended before making any setpoint changes or creating new setpoint files.

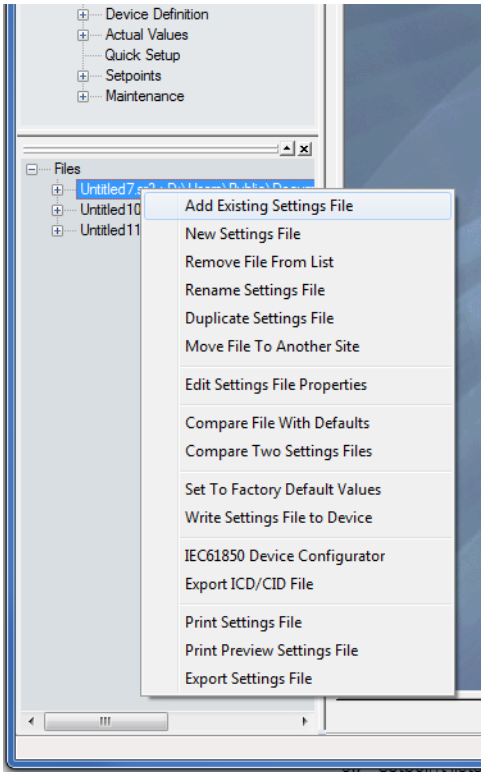
The setpoint files in the EnerVista 3 Series Setup window are accessed in the Files Window. Use the following procedure to download and save setpoint files to a local PC.

1. Ensure that the site and corresponding device(s) have been properly defined and configured as shown in *Connecting EnerVista 3 Series Setup to the Relay*, above.
2. Select the desired device from the site list.
3. Select the **Online > Read Device Settings** from Device menu item, or right-click on the device and select **Read Device Settings** to obtain settings information from the device.
4. After a few seconds of data retrieval, the software will request the name and destination path of the setpoint file. The corresponding file extension will be automatically assigned. Press **Receive** to complete the process. A new entry will be added to the tree, in the File pane, showing path and file name for the setpoint file.

Adding setpoint files to the environment

The EnerVista 3 Series Setup software provides the capability to review and manage a large group of setpoint files. Use the following procedure to add an existing file to the list.

1. In the files pane, right-click on **Files** and select the **Add Existing Setting File** item as shown:

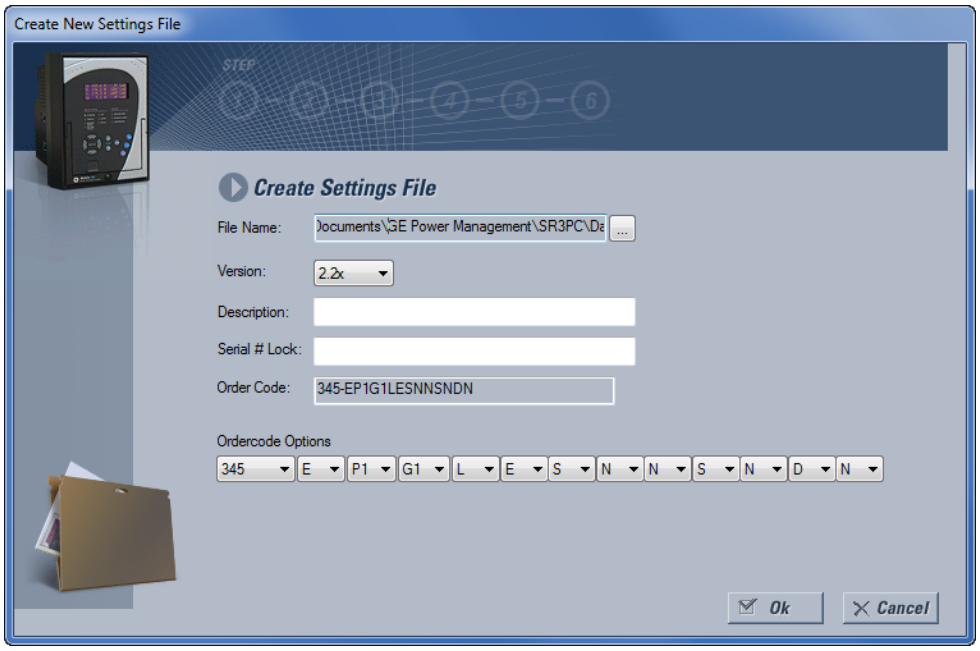


2. The Open dialog box will appear, prompting the user to select a previously saved setpoint file. As for any other MS Windows® application, browse for the file to be added then click **Open**. The new file and complete path will be added to the file list.

Creating a new setpoint file

The EnerVista 3 Series Setup software allows the user to create new setpoint files independent of a connected device. These can be uploaded to a relay at a later date. The following procedure illustrates how to create new setpoint files.

1. In the File pane, right click on **File** and select the **New Settings File** item. The following box will appear, allowing for the configuration of the setpoint file for the correct firmware version. It is important to define the correct firmware version to ensure that setpoints not available in a particular version are not downloaded into the relay.



NOTE

Discontinued order codes may be included to maintain back-compatibility of setpoint files. For current order codes, refer to the GE Multilin website at http://www.gegridsolutions.com/multilin.

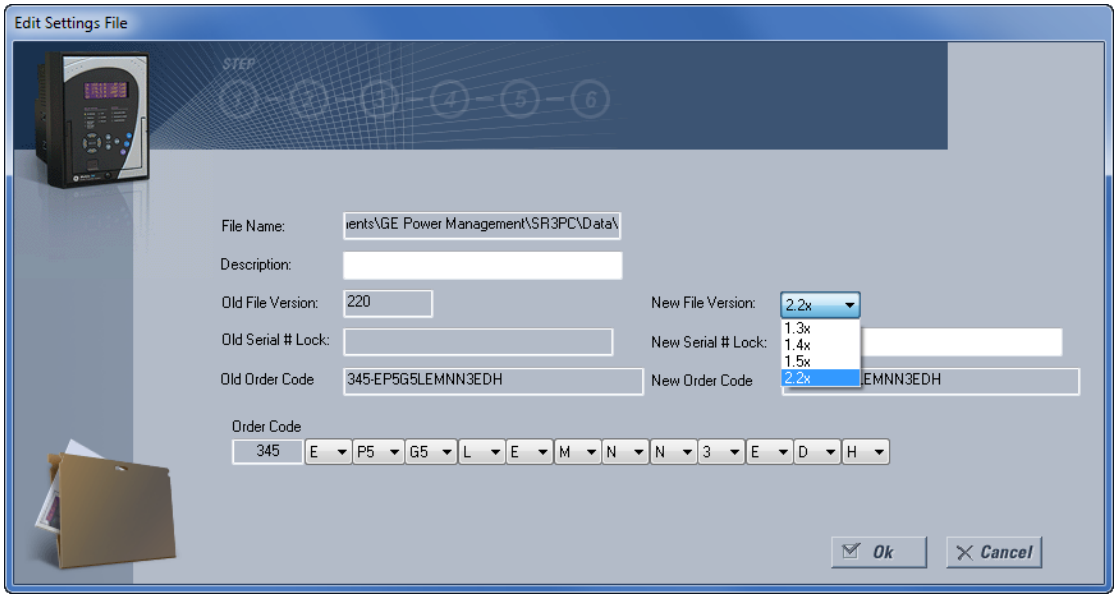
2. Select the Firmware Version, and Order Code options for the new setpoint file.
3. For future reference, enter some useful information in the **Description** box to facilitate the identification of the device and the purpose of the file.
4. To select a file name and path for the new file, click the button beside the File Name box.
5. Select the file name and path to store the file, or select any displayed file name to replace an existing file. All 345 setpoint files should have the extension 'SR3' (for example, 'feeder1.SR3').
6. Click **OK** to complete the process. Once this step is completed, the new file, with a complete path, will be added to the EnerVista 3 Series Setup software environment.

Upgrading setpoint files to a new revision

It is often necessary to upgrade the revision for a previously saved setpoint file after the 345 firmware has been upgraded. This is illustrated in the following procedure:

1. Establish communications with the 345 relay.
2. Select the **Maintenance > M1 Relay Info** menu item and record the Firmware Revision.
3. Load the setpoint file to be upgraded into the EnerVista 3 Series Setup environment as described in the section, *Adding Setpoints Files to the Environment*.
4. In the File pane, select the saved setpoint file.

5. From the main window menu bar, select the **Offline > Edit Settings File Properties** menu item and note the File Version of the setpoint file. If this version is different from the Firmware Revision noted in step 2, select a New File Version that matches the Firmware Revision from the pull-down menu.
6. For example, if the firmware revision is L0L01MA140.000 (Firmware Revision 1.40) and the current setpoint file revision is 1.20, change the setpoint file revision to "1.4x".



NOTE

Discontinued order codes may be included to maintain back-compatibility of setpoint files. For current order codes, refer to the GE Multilin website at http://www.gegridsolutions.com/multilin.

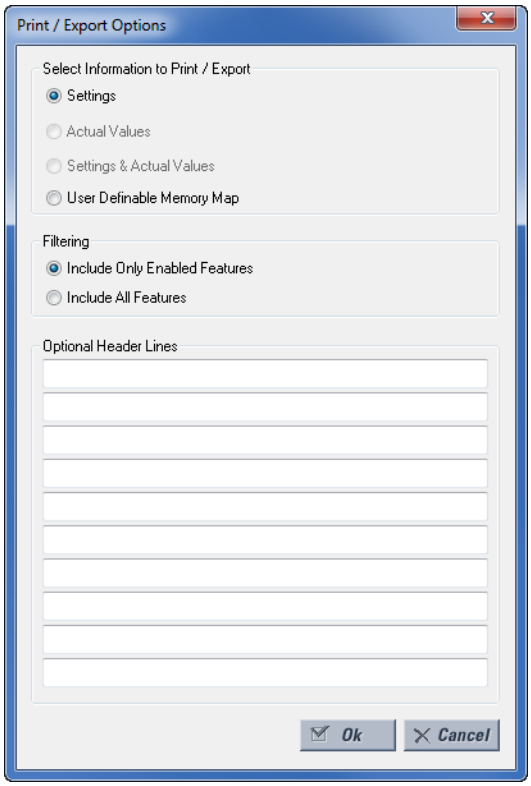
7. Enter any special comments about the setpoint file in the "Description" field.
8. Select the desired firmware version from the "New File Version" field.
9. When complete, click **OK** to convert the setpoint file to the desired revision. See *Loading Setpoints from a File* below, for instructions on loading this setpoint file into the 345 .

Printing setpoints and actual values

The EnerVista 3 Series Setup software allows the user to print partial or complete lists of setpoints and actual values. Use the following procedure to print a list of setpoints:

1. Select a previously saved setpoints file in the File pane or establish communications with a 345 device.
2. From the main window, select the **Offline > Export Settings File** menu item.

3. The Print/Export Options dialog box will appear. Select **Settings** in the upper section and select either **Include All Features** (for a complete list) or **Include Only Enabled Features** (for a list of only those features which are currently used) in the filtering section and click **OK**.



4. The process for **Offline > Print Preview Settings File** is identical to the steps above.
5. Setpoint lists can be printed in the same manner by right clicking on the desired file (in the file list) or device (in the device list) and selecting the **Print Device Information** or **Print Settings File** options.

Printing actual values from a connected device

A complete list of actual values can also be printed from a connected device with the following procedure:

1. Establish communications with the desired 345 device.
2. From the main window, select the **Online > Print Device Information** menu item
3. The Print/Export Options dialog box will appear. Select **Actual Values** in the upper section and select either **Include All Features** (for a complete list) or **Include Only Enabled Features** (for a list of only those features which are currently used) in the filtering section and click **OK**.

Actual values lists can be printed in the same manner by right clicking on the desired device (in the device list) and selecting the **Print Device Information** option

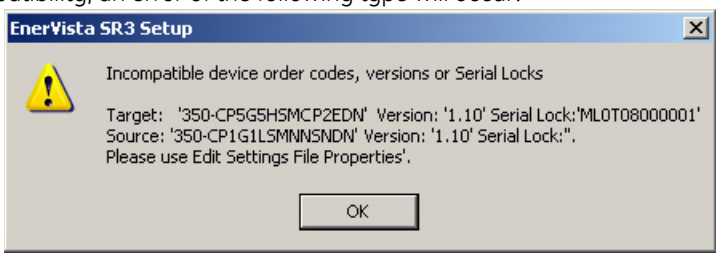
Loading setpoints from a file

CAUTION

An error message will occur when attempting to download a setpoint file with a revision number that does not match the relay firmware. If the firmware has been upgraded since saving the setpoint file, see for instructions on changing the revision number of a setpoint file.

The following procedure illustrates how to load setpoints from a file. Before loading a setpoints file, it must first be added to the EnerVista 3 Series Setup environment as described in the section, *Adding Setpoints Files to the Environment*.

1. Select the previously saved setpoints file from the File pane of the EnerVista 3 Series Setup software main window.
2. Select the **Offline > Edit Settings File Properties** menu item and verify that the corresponding file is fully compatible with the hardware and firmware version of the target relay. If the versions are not identical, see *Upgrading Setpoint Files to a New Revision* for details on changing the setpoints file version.
3. Right-click on the selected file and select the **Write Settings File to Device** item.
4. Select the target relay from the list of devices shown and click **Send**. If there is an incompatibility, an error of the following type will occur:



If there are no incompatibilities between the target device and the settings file, the data will be transferred to the relay. An indication of the percentage completed will be shown in the bottom of the main window.

Uninstalling files and clearing data

The unit can be decommissioned by turning off the power to the unit and disconnecting the wires to it. Files can be cleared after uninstalling the EnerVista software or 345 device, for example to comply with data security regulations. On the computer, settings files can be identified by the .sr3 extension.

To clear the current settings file do the following:

1. Create a default settings file.
2. Write the default settings file to the relay.
3. Delete all other files with the .sr3 extension.
4. Delete any other data files , which can be in standard formats, such as COMTRADE or .csv.

You cannot directly erase the flash memory, but all records and settings in that memory can be deleted. Do this using these commands:

ACTUAL VALUES > RECORDS

- **EVENTS RECORDS > CLEAR**
- **TRANSIENT RECORDS > CLEAR**

Upgrading relay firmware

To upgrade the 345 firmware, follow the procedures listed in this section. Upon successful completion of this procedure, the 345 will have new firmware installed with the factory default setpoints.The latest firmware files are available from the GE Multilin website at http://www.GEgridsolutions.com/multilin.

NOTE

EnerVista 3 Series Setup software prevents incompatible firmware from being loaded into a 345 relay.

NOTE

Before upgrading firmware, it is very important to save the current 345 settings to a file on your PC. After the firmware has been upgraded, it will be necessary to load this file back into the 345 . Refer to *Downloading and Saving Setpoints Files* for details on saving relay setpoints to a file.

Loading new relay firmware

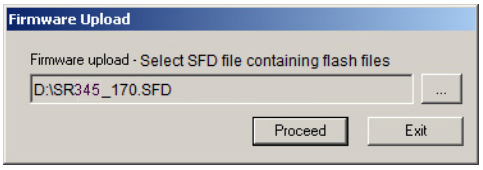
Loading new firmware into the 345 flash memory is accomplished as follows:

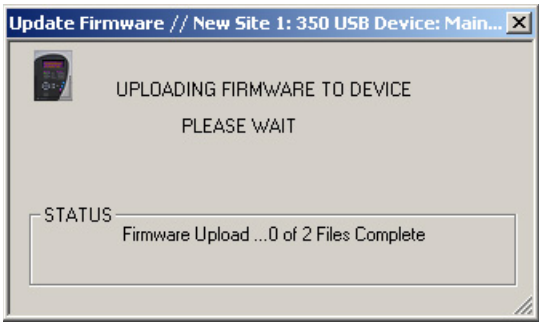
1. Connect the relay to the local PC and save the setpoints to a file as shown in *Downloading and Saving Setpoints Files*.
2. Select the **Maintenance > Update Firmware** menu item.
3. The EnerVista 3 Series Setup software will request the new firmware file. Locate the folder that contains the firmware files to load into the 345 . The firmware filename has the following format:

SR345_150.SFD

Firmware Rev #

4. EnerVista 3 Series Setup software now prepares the 345 to receive the new firmware file. The 345 front panel will momentarily display "BOOT PROGRAM Waiting for Message," indicating that it is in upload mode.
5. While the file is being loaded into the 345 , a status box appears showing how much of the new firmware file has been transferred and the upgrade status. The entire transfer process takes approximately 10 minutes.





6. The EnerVista 3 Series Setup software will notify the user when the 345 has finished loading the file. Carefully read any displayed messages and click **OK** to return the main screen. **Cycling power to the relay is recommended after a firmware upgrade.**

After successfully updating the 345 firmware, the relay will not be in service and will require setpoint programming. To communicate with the relay, the communication settings may have to be manually reprogrammed.

When communications is established, the saved setpoints must be reloaded back into the relay. See *Loading Setpoints from a File* for details.

Modbus addresses assigned to firmware modules, features, settings, and corresponding data items (i.e. default values, min/max values, data type, and item size) may change slightly from version to version of firmware.

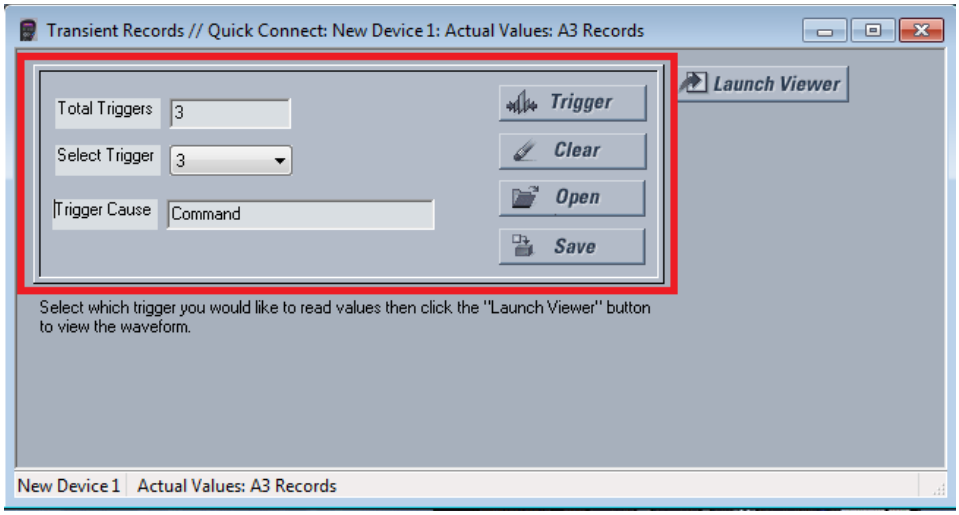
The addresses are rearranged when new features are added or existing features are enhanced or modified.

Advanced EnerVista 3 Series Setup features

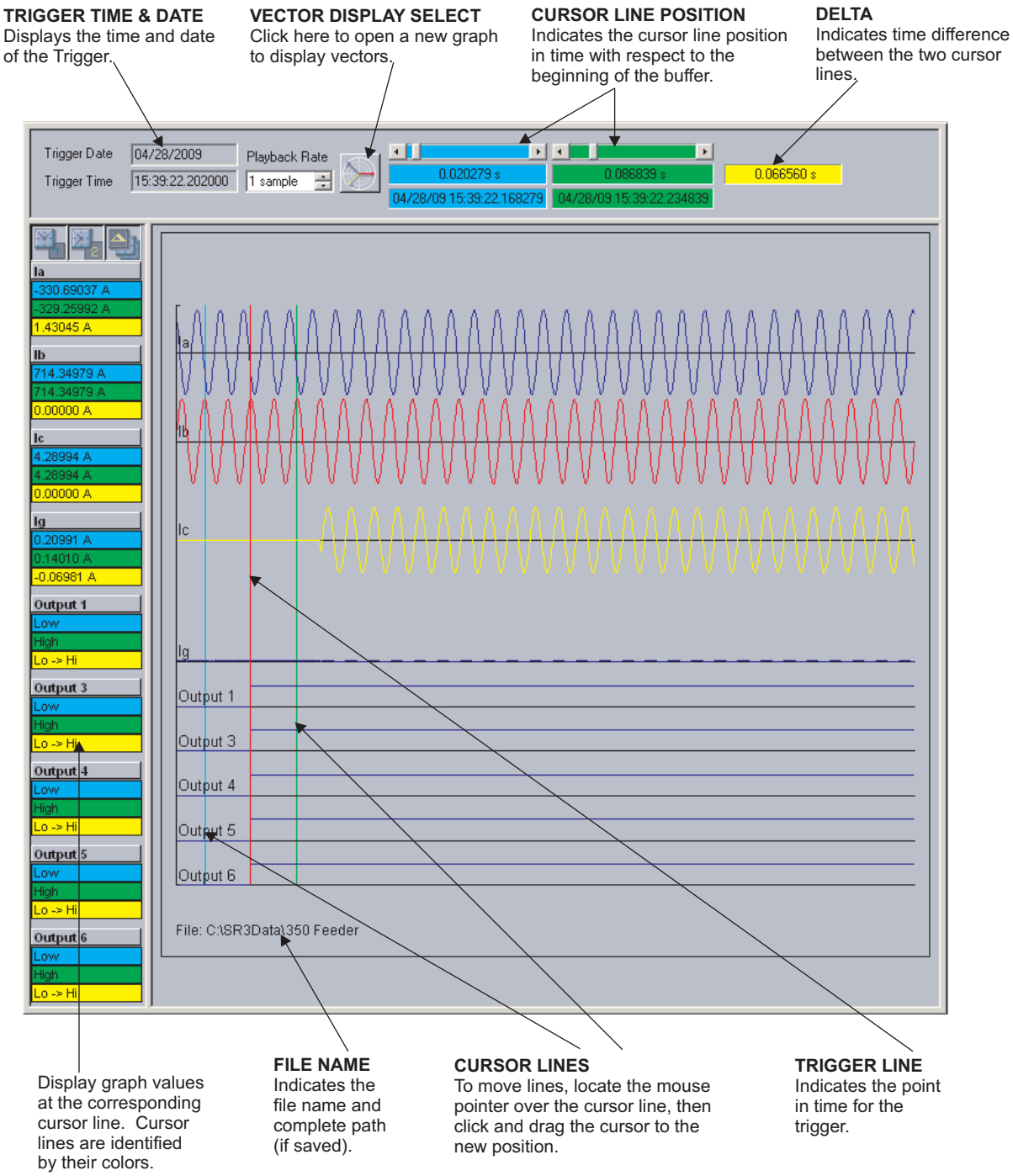
Transient recorder (Waveform capture)

The EnerVista 3 Series Setup software can be used to capture waveforms (or view trace memory) from the relay at the instance of a pickup, trip, alarm, or other condition.

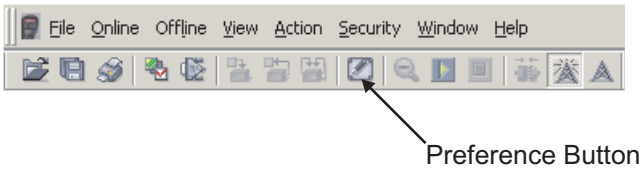
- With EnerVista 3 Series Setup software running and communications established, select the **Actual Values > A3 Records > Transient Records** menu item to open the Transient Recorder Viewer window.



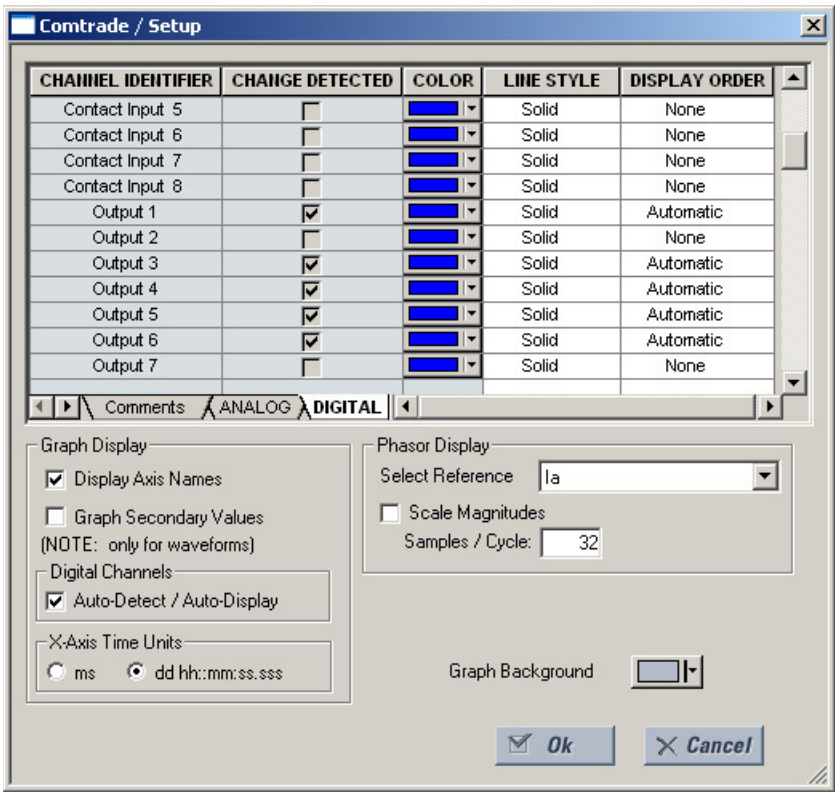
- Click on **Trigger Waveform** to trigger a waveform capture. Waveform file numbering starts with the number zero in the 345 , so that the maximum trigger number will always be one less than the total number of triggers available.
- Click on the **Save to File** button to save the selected waveform to the local PC. A new window will appear, requesting the file name and path. One file is saved as a COMTRADE file, with the extension "CFG." The other file is a "DAT" file, required by the COMTRADE file for proper display of waveforms.
- To view a previously saved COMTRADE file, click the **Open** button and select the corresponding COMTRADE file.
- To view the captured waveforms, click on the **Launch Viewer** button. A detailed Waveform Capture window will appear as shown below.



- The red vertical line indicates the trigger point.
- The date and time of the trigger are displayed at the top left corner of the window. To match the captured waveform with the event that triggered it, make note of the time and date shown in the graph, then find the event that matches the same time in the event recorder. The event record will provide additional information on the cause and system conditions at the time of the event.
- From the window main menu bar, press the **Preference** button to open the COMTRADE Setup page, in order to change the graph attributes.

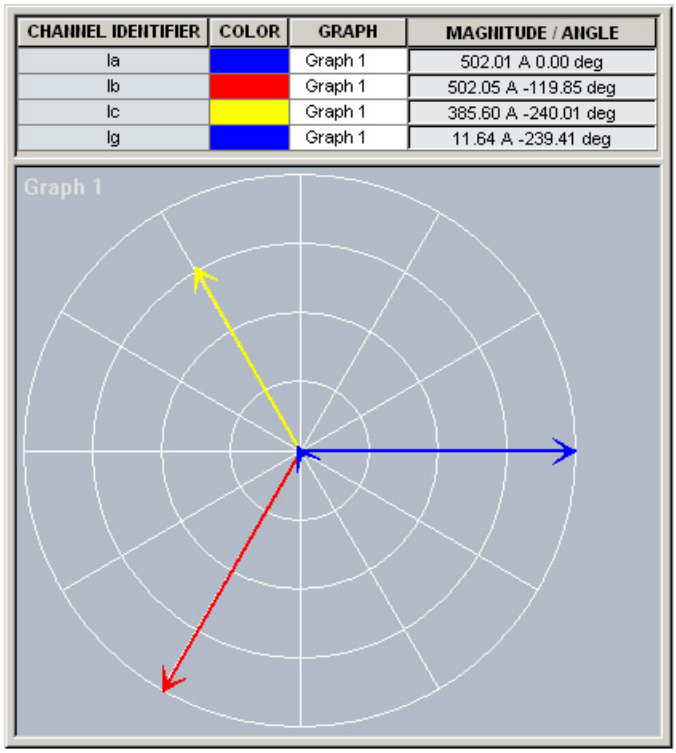


The following window will appear:



Change the color of each graph as desired, and select other options as required, by checking the appropriate boxes. Click **OK** to store these graph attributes, and to close the window. The Waveform Capture window will reappear based on the selected graph attributes.

To view a vector graph of the quantities contained in the waveform capture, press the **Vector Display** button to display the following window:



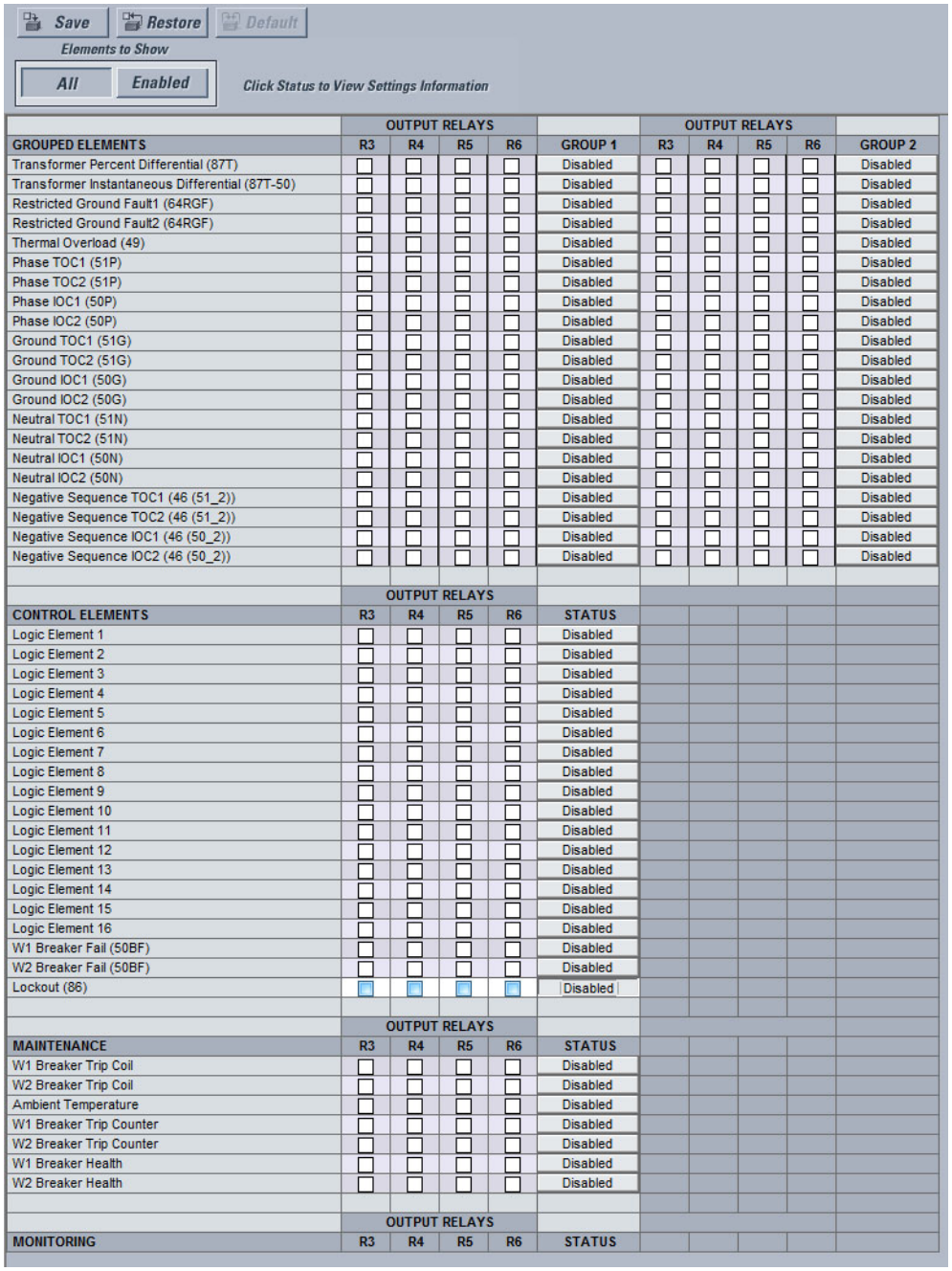
Protection summary

Protection Summary is a single screen which holds the summarized information of different settings from Grouped Elements, Control Elements and Maintenance screens.

Protection Summary Screen allows the user to:

- view the output relay assignments for the elements
- modify the output relay assignments for the elements
- view the enable/disable status of Control Elements
- navigate to the respected Protection Element screen on a button click.

An example of the Protection Summary screen follows:



	OUTPUT RELAYS					OUTPUT RELAYS				
GROUPED ELEMENTS	R3	R4	R5	R6	GROUP 1	R3	R4	R5	R6	GROUP 2
Transformer Percent Differential (87T)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Transformer Instantaneous Differential (87T-50)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Restricted Ground Fault1 (64RGF)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Restricted Ground Fault2 (64RGF)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Thermal Overload (49)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Phase TOC1 (51P)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Phase TOC2 (51P)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Phase IOC1 (50P)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Phase IOC2 (50P)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Ground TOC1 (51G)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Ground TOC2 (51G)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Ground IOC1 (50G)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Ground IOC2 (50G)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Neutral TOC1 (51N)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Neutral TOC2 (51N)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Neutral IOC1 (50N)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Neutral IOC2 (50N)	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Negative Sequence TOC1 (46 (51_2))	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Negative Sequence TOC2 (46 (51_2))	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Negative Sequence IOC1 (46 (50_2))	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled
Negative Sequence IOC2 (46 (50_2))	☐	☐	☐	☐	Disabled	☐	☐	☐	☐	Disabled

	OUTPUT RELAYS				
CONTROL ELEMENTS	R3	R4	R5	R6	STATUS
Logic Element 1	☐	☐	☐	☐	Disabled
Logic Element 2	☐	☐	☐	☐	Disabled
Logic Element 3	☐	☐	☐	☐	Disabled
Logic Element 4	☐	☐	☐	☐	Disabled
Logic Element 5	☐	☐	☐	☐	Disabled
Logic Element 6	☐	☐	☐	☐	Disabled
Logic Element 7	☐	☐	☐	☐	Disabled
Logic Element 8	☐	☐	☐	☐	Disabled
Logic Element 9	☐	☐	☐	☐	Disabled
Logic Element 10	☐	☐	☐	☐	Disabled
Logic Element 11	☐	☐	☐	☐	Disabled
Logic Element 12	☐	☐	☐	☐	Disabled
Logic Element 13	☐	☐	☐	☐	Disabled
Logic Element 14	☐	☐	☐	☐	Disabled
Logic Element 15	☐	☐	☐	☐	Disabled
Logic Element 16	☐	☐	☐	☐	Disabled
W1 Breaker Fail (50BF)	☐	☐	☐	☐	Disabled
W2 Breaker Fail (50BF)	☐	☐	☐	☐	Disabled
Lockout (86)	☐	☐	☐	☐	Disabled

	OUTPUT RELAYS				
MAINTENANCE	R3	R4	R5	R6	STATUS
W1 Breaker Trip Coil	☐	☐	☐	☐	Disabled
W2 Breaker Trip Coil	☐	☐	☐	☐	Disabled
Ambient Temperature	☐	☐	☐	☐	Disabled
W1 Breaker Trip Counter	☐	☐	☐	☐	Disabled
W2 Breaker Trip Counter	☐	☐	☐	☐	Disabled
W1 Breaker Health	☐	☐	☐	☐	Disabled
W2 Breaker Health	☐	☐	☐	☐	Disabled

	OUTPUT RELAYS				
MONITORING	R3	R4	R5	R6	STATUS

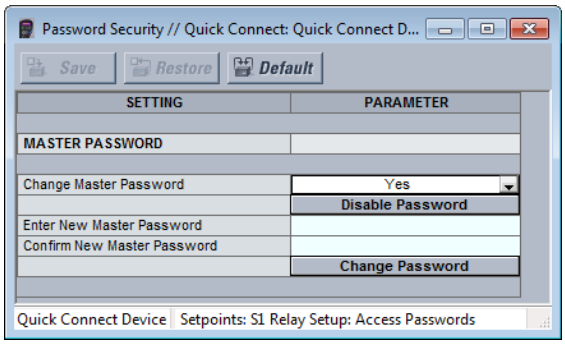
Password security

Password security is an optional feature of the 345 which can be setup using the EnerVista 3 Series Setup software. The password system has been designed to facilitate a hierarchy for centralized management. This is accomplished through a Master level access password which can be used for resetting lower level access passwords and higher level privileged operations. In cases where operational security is required as well as a central administrative authority then the use of the password system is highly encouraged. The feature robustness of this system requires it to be managed exclusively through the EnerVista 3 Series Setup software. This section describes how to perform the initial setup. For more details on the password security feature, refer to *Chapter 6 - Password Security*.

1. 345 devices shipped from the factory are initially set with security disabled. If the password security feature is to be used, the user must first change the Master Password from the initial Null setting, this can only be done over communications, not from the front panel keypad. The new Master Password must be 8 to 10 characters in length, and must have minimum 2 letters and 2 numbers. The letters are case sensitive. Set **Change Master Password** to Yes to enable password security. After entering a valid Master Password, enter the new Master Password again to confirm, then select **Change Password**.

NOTE

To disable password security, Set **Change Master Password** to Yes and then click **Disable Password**.

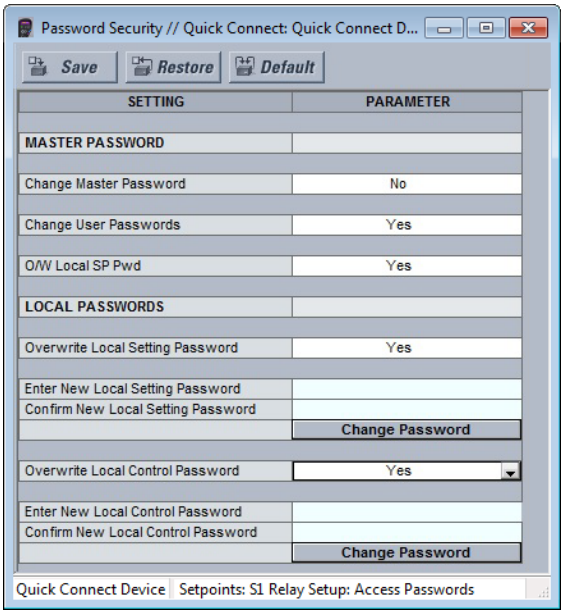


2. Now that the Master Password has been programmed, enter it again to log in to the Master Access level. The Master Level permits setup of the Remote and Local Passwords. If the Master Password has been lost, contact the factory.

3. With Master Level access, the user may disable password security altogether, or change the Master Password.
4. The Master Access level allows programming of the Remote Setpoint and Remote Control passwords. These passwords are initially set to a Null value, and can only be set or changed from a remote user over RS485 or Ethernet communications. Remote Passwords must be 3 to 10 characters in length.

REMOTE PASSWORDS	
Change Remote Setting Password	Yes
Enter New Remote Setting Password	
Confirm New Remote Setting Password	
	Change Password
Change Remote Control Password	Yes
Enter New Remote Control Password	
Confirm New Remote Control Password	
	Change Password

5. Initial setup of the Local Setpoint and Local Control passwords requires the Master Access level. If Overwrite Local Passwords is set to YES, Local passwords can be changed remotely only (over RS485 or Ethernet). If Overwrite Local Passwords is set to NO, Local passwords can be changed locally only (over USB or keypad). If changing Local Passwords is permitted locally, the keypad user can only change the Local Passwords if they have been changed from the initial NULL value to a valid one. Local Passwords must be 3 to 10 characters in length.



6. If any Remote password has never been set, that level will not be attainable except when logged in as the Master Level. The same logic applies to the Local passwords.
7. When passwords have been set, the user will be prompted to enter the appropriate password depending on the interface being used (remote or local), and the nature of the change being made (setpoint or control). If the correct password is entered, the user is now logged into that access level over that interface only. The access level turns off after a period of 5 minutes of inactivity, if control power is cycled, or if the user enters an incorrect password.

345 Transformer Protection System

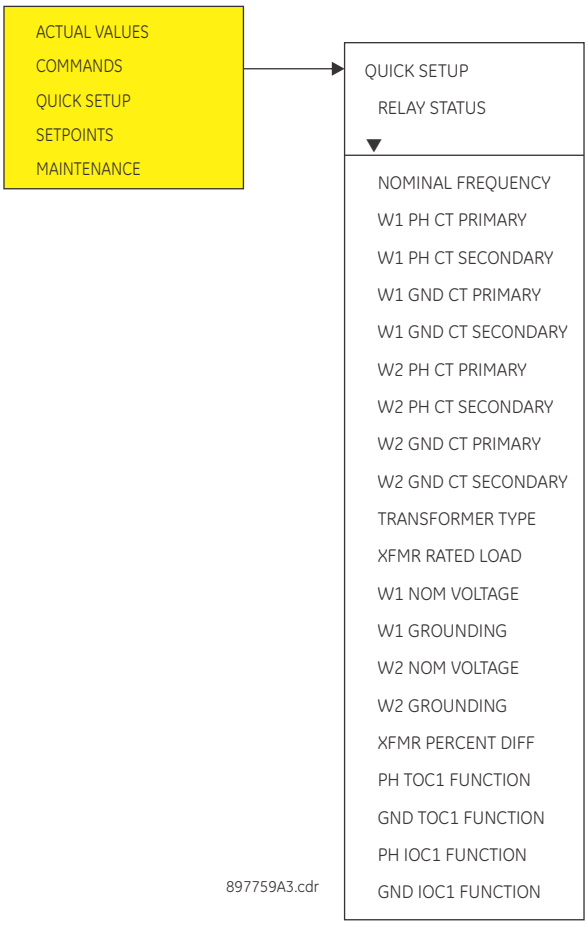
Chapter 4: Quick setup - Front control panel

The “Quick Setup” utility is part of the 345 relay main menu, and can be used for quick and easy programming. Power system parameters, and settings for some simple over-current elements can be easily set.

NOTE

Ensure the relay is in "Relay Ready" state before using Quick Setup.

Figure 4-1: Quick Setup menu



Quick Setup settings

The setpoints below can be programmed under the "Quick Setup" menu.

Note that monitoring of Breaker Status via 52a, 52b, or both of these contacts,, should be programmed under **SETPOINTS > S2 SYSTEM SETUP > BREAKER**.

PATH: **QUICK SETUP >**

RELAY STATUS
Range: Not Ready, Ready
Default: Not Ready

NOMINAL FREQUENCY
Range: 60 Hz, 50 Hz
Default: 60 Hz

W1 PH CT PRIMARY
Range: 1 A to 6000 A in steps of 1
Default: 5 A

W1 GND/SGND CT PRIMARY
Range: 1 A to 6000/600 A in steps of 1
Default: 5 A

W2 PH CT PRIMARY
Range: 1 A to 6000 A in steps of 1
Default: 5 A

W2 GND/SGND CT PRIMARY
Range: 1 A to 6000/600 A in steps of 1
Default: 5 A

TRANSFORMER TYPE
Range: Refer to above "Transformer Types" table
Default: Y/y0

XFMR RATED LOAD
Range: 0.00 to 200.00 MVA in steps of 0.01 MVA
Default: 5.0 MVA

W1 NOM VOLTAGE
Range: 0.01 to 250.00 kV in steps of 0.01 kV
Default: 13.8 kV

W1 GROUNDING
Range: Not Within Zone, Within Zone
Default: Not Within Zone

W2 NOM VOLTAGE
Range: 0.01 to 250.00 kV in steps of 0.01 kV
Default: 4.16 kV

W2 GROUNDING
Range: Not Within Zone, Within Zone
Default: Not Within Zone

XFMR PERCENT DIFF
Range: Disabled, Trip, Latched Alarm, Alarm
Default: Disabled

↳

PCNT DIFF FUNCTION
Range: Disabled, Trip, Latched Alarm, Alarm
Default: Disabled

MINIMUM PICKUP
Range: 0.05 to 1.00 x CT in steps of 0.01 x CT
Default: 0.10 x CT

SLOPE 1
Range: 15 to 100% in steps of 1%
Default: 30%

BREAKPOINT 1
Range: 0.50 to 4.00 x CT in steps of 0.01 x CT
Default: 1.50 x CT

BREAKPOINT 2
Range: 1.00 to 10.00 x CT in steps of 0.01 x CT
Default: 1.50 x CT

SLOPE 2
Range: 50 to 100% in steps of 1%
Default: 95%

PH TOC1 FUNCTION
Range: Disabled, Trip, Latched Alarm, Alarm
Default: Disabled
↳

PHASE CT INPUT
Range: CT(W1), CT(W2)
Default: CT(W1)

PH TOC1 PICKUP
Range: 0.05 to 20.00 x CT in steps of 0.01 x CT
Default: 1.00 x CT

PH TOC1 CURVE
Range: ANSI Extremely/Very/Moderately/Normally Inverse, Definite Time, IEC Curve A/B/C and Short Inverse, IAC Extremely/Very/Inverse/ Short
Default: Ext. Inverse

PH TOC1 TDM
Range: 0.05 to 50.00 in steps of 0.01
Default: 1.00

RLY1 TRIP W1 BKR
Range: Do Not Operate, Operate
Default: Do not operate

RLY2 TRIP W2 BKR
Range: Do Not Operate, Operate
Default: Do not operate

GND TOC1 FUNCTION
Range: Disabled, Trip, Latched Alarm, Alarm
Default: Disabled
↳

GND CT INPUT
Range: CT(W1), CT(W2)
Default: CT(W1)

GND TOC1 PICKUP
Range: 0.05 to 20.00 x CT in steps of 0.01 x CT
Default: 1.00 x CT

GND TOC1 CURVE
Range: ANSI Extremely/Very/Moderately/Normally Inverse, Definite Time, IEC Curve A/B/C and Short Inverse, IAC Extremely/Very/Inverse/ Short
Default: Ext. Inverse

GND TOC1 TDM
Range: 0.05 to 50.00 in steps of 0.01
Default: 1.00

RLY1 TRIP W1 BKR
Range: Do not operate, Operate
Default: Do not operate

RLY2 TRIP W2 BKR
Range: Do not operate, Operate
Default: Do not operate

PH IOC1 FUNCTION
Range: Disabled, Trip, Latched Alarm, Alarm
Default: Disabled

↳

PH CT INPUT
Range: CT(W1), CT(W2)
Default: CT(W1)

PH IOC1 PICKUP
Range: 0.05 to 20.00 x CT in steps of 0.01 x CT
Default: 1.00 x CT

RLY1 TRIP W1 BKR
Range: Do not operate, Operate
Default: Do not operate

RLY2 TRIP W2 BKR
Range: Do not operate, Operate
Default: Do not operate

GND IOC FUNCTION
Range: Disabled, Trip, Latched Alarm, Alarm
Default: Disabled

↳

GND CT INPUT
Range: CT(W1), CT(W2)
Default: CT(W1)

GND IOC1 PICKUP
Range: 0.05 to 20.00 x CT in steps of 0.01 x CT
Default: 1.00 x CT

RLY1 TRIP W1 BKR

Range: Do not operate, Operate
Default: Do not operate

RLY2 TRIP W2 BKR

Range: Do not operate, Operate
Default: Do not operate

NOTE

The settings changed using the Quick Setup menu, are available for review and modification by navigating through **S1 RELAY SETUP**, **S2 SYSTEM SETUP** and **S3 PROTECTION** in the **SETPOINTS** main menu.

GE
Grid Solutions

345 Transformer Protection System

Chapter 5: Maintenance

General maintenance

The 345 requires minimal maintenance. As a microprocessor-based relay, its characteristics do not change over time. The expected service life of a 345 is 20 years when the environment and electrical conditions are within stated specifications.

While the 345 performs continual self-tests, it is recommended that maintenance be scheduled with other system maintenance. This maintenance can involve in-service, out-of-service, or unscheduled maintenance.

In-service maintenance

1. Visual verification of the analog values integrity, such as voltage and current (in comparison to other devices on the corresponding system).
2. Visual verification of active alarms, relay display messages, and LED indications.
3. Visual inspection for any damage, corrosion, dust, or loose wires.
4. Event recorder file download with further events analysis.

Out-of-service maintenance

1. Check wiring connections for firmness.
2. Analog values (currents, voltages, RTDs, analog inputs) injection test and metering accuracy verification. Calibrated test equipment is required.
3. Protection elements setting verification (analog values injection or visual verification of setting file entries against relay settings schedule).
4. Contact inputs and outputs verification. This test can be conducted by direct change of state forcing or as part of the system functional testing.
5. Visual inspection for any damage, corrosion, or dust.
6. Event recorder file download with further events analysis.

NOTICE

To avoid deterioration of electrolytic capacitors, power up units that are stored in a de-energized state once per year, for one hour continuously.

Unscheduled maintenance (system interruption)

- View the event recorder and oscillography for correct operation of inputs, outputs, and elements.