



GE VERNOVA

350

Feeder Protection System

Feeder protection and control



Quick Start Guide

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GE VERNOVA 350 Feeder Protection System QuickStart Guide for revision 2.5x.

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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.

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

NOTICE

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.gevernova.com/grid-solutions/multilin/warranty>. 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 VERNOVA 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 VERNOVA service department. Use the detailed return procedure outlined at

<https://www.gevernova.com/grid-solutions/return-procedures>

The current warranty and return information are outlined at

<https://www.gevernova.com/grid-solutions/multilin/warranty>



GENERAL SAFETY PRECAUTIONS - 350

- 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:

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Website: <https://www.gevernova.com/grid-solutions/automation/protection-control-metering>

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350 Feeder Protection System

Chapter 1: Introduction

Overview

The 350 is a microprocessor-based relay for primary and backup over-current protection of medium and low voltage distribution feeders. The relay is also suitable for providing over-current and backup protection for small and medium size motors, transformers, generators, and distribution bus-bars. The small footprint and the withdrawable option make the 350 relay ideal for panel mounting on either new or retrofit installations. The combination of proven hardware, a variety of protection and control features, and communications, makes the relay ideal for total feeder protection and control. Equipped with serial (RS485), USB, and Ethernet ports with the possibility of adding redundancy (IEC62439, PRP and HSR), and a wide selection of protocols such as Modbus, DNP3.0, IEC 60870-5-103, 60870-5-104, IEC61850 GOOSE, OPC-UA, the 350 relay is the best-in-class for MCCs and PCCs, SCADA and inter-relay communications. The 350 relay provides excellent transparency with respect to power system conditions and events, through its four-line 20-character display, as well as the EnerVista 3 Series Setup program. Conveniently located LEDs provide indication of relay operation, alarm, and pickup, as well as breaker, and relay status.

The 350 relay provides the following key benefits:

- Withdrawable small footprint – saves on rewiring and space. (non-draw out version is also available)
- Multiple protection groups with the added flexibility of switching through a wide selection of overcurrent protection and control features.
- Fast setup (Quick Setup) menu for power-system setup and a simple overcurrent protection configuration.
- Large four-line LCD display, LEDs, and an easy-to-navigate keypad.
- Multiple communication protocols for simultaneous access when integrated into monitoring and control systems.

Description of the 350 Feeder 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.

Frequency

Frequency measurement is accomplished by measuring the time between zero crossings of the Bus VT phase A voltage. The signals are passed through a low pass filter to prevent false zero crossings. Sampling is synchronized to the V_a -x voltage zero crossing which results in better co-ordination for multiple 350 relays on the same bus.

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.

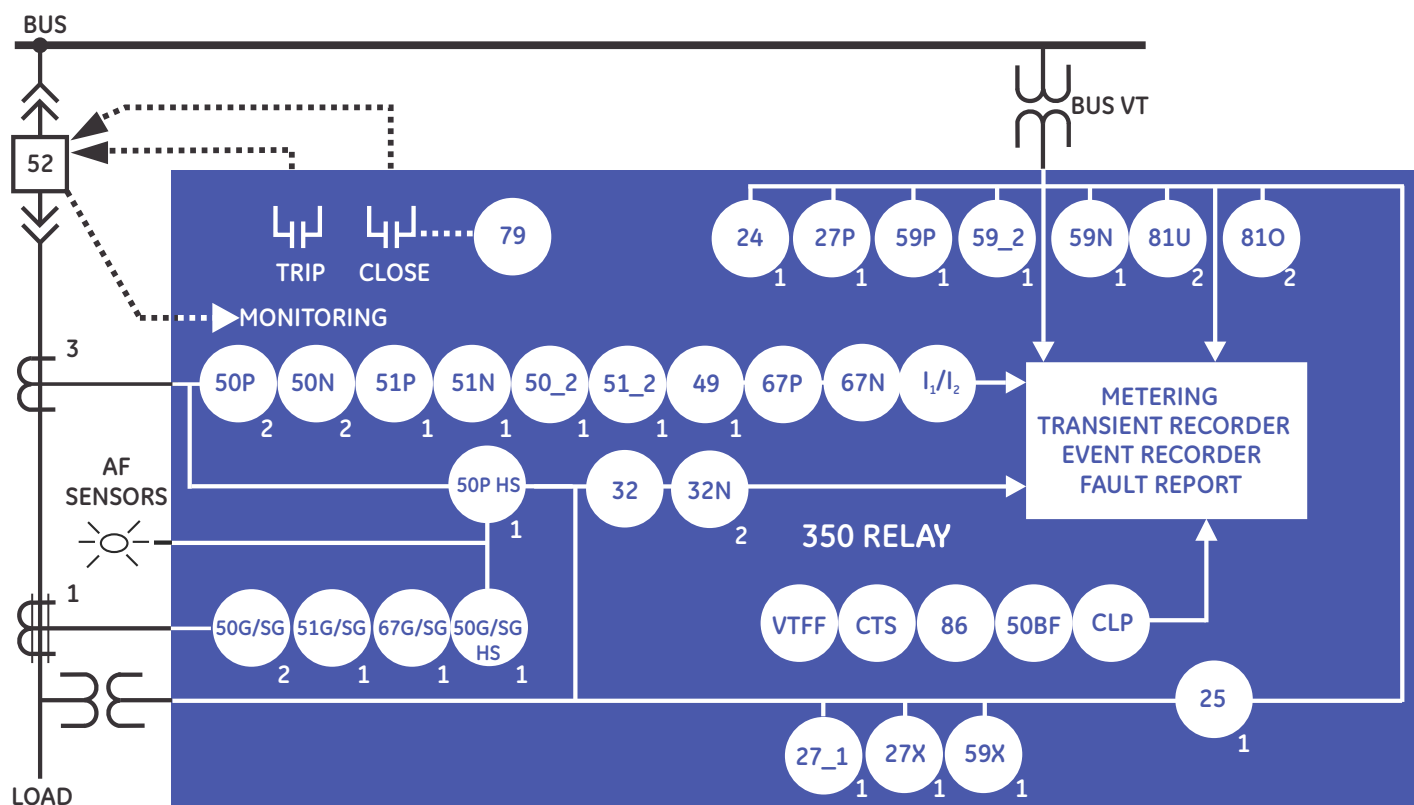
Protection Elements

Protection elements are processed up to four times every cycle to determine if a pickup has occurred or a timer has expired. The protection elements use RMS current/voltage, based on the magnitude of the phasor. Hence, protection is impervious to both harmonics and DC transients.

Arc Flash protection elements are processed up to 8 times every cycle.



NOTE



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Figure 1-1: Functional block diagram

Table 1-1: ANSI device numbers and functions

ANSI Code	61850 Logical Node	Description
24	PVPH	Volts per Hertz
25	RSYN1	Synchrocheck
27_1	psseqPTUV1	Positive Sequence Undervoltage
27P	phsPTUV1, phsPTUV2, phsPTUV3, phsPTUV4	Phase Undervoltage
27X	auxPTUV1	Auxiliary Undervoltage
32	PDOP1, PDOP2	Directional Power
32N	ndPDOP	Wattmetric Ground Fault
I1/I2 (46BC)	-	Broken Conductor
49	PTTR1	Thermal Overload
50_2	ngseqPIOC1	Negative Sequence Overcurrent
50BF	RBRF1	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	Negative Sequence Time Overcurrent
51G/SG	gndPTOC1/hsePTOC1	Ground/Sensitive Ground Time Overcurrent
51N	ndPTOC1	Neutral Time Overcurrent
51P	phsPTOC1	Phase Time Overcurrent

ANSI Code	61850 Logical Node	Description
59_2	ngseqPTOV1, ngseqPTOV2	Negative Sequence Overvoltage
59N	ndPTOV1, nfPTOV2, ndPTOV3, ndPTOV4	Neutral Overvoltage
59P	phsPTOV1, phsPTOV2, phsPTOV3, phsPTOV4	Phase Overvoltage
59X	auxPTOV1	Auxiliary Overvoltage
60CTS	-	CT Supervision
67G/SG	gndRDIR1/hseRDIR1	Ground/Sensitive Ground Directional Element
67N	ndRDIR1	Neutral Directional Element
67P	phsRDIR1	Phase Directional Element
79	RREC1	Autoreclose
81O	PTOF1, PTOF2, PTOF3, PTOF4	Overfrequency
81U	PTUF2, PTUF2, PTUF3, PTUF4	Underfrequency
86	-	Lockout
CLP	-	Cold Load Pickup
VTFF (60VTS)	-	Voltage Fuse Failure
-	MMXU1	Voltage, Energy, Power Metering

Table 1-2: Other device functions

Description
2nd Harmonic Blocking
Arc Flash Detector
Ambient Temperature
Breaker Control
Breaker Health
Breaker Maintenance
CT Failure Detection
Data Logger
Demand (in metering)
Digital Counters
DNP 3.0 Communications
Event Recorder
Fault Report
Flexcurves
HSR Communications
IEC 60870-5-103 Communications
IEC 60870-5-104 Communications
IEC 61850 Communications
IEC 61850 GOOSE Communications
Lockout (86)
Logic Elements
Metering: current, voltage, power, PF, energy, frequency, 2nd harmonics
Modbus User Map
Modbus RTU Communications
Modbus TCP Communications
Non-volatile Latches

Description
OPC-UA Communications
Output Relays
PRP Communications
Relay Maintenance
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)

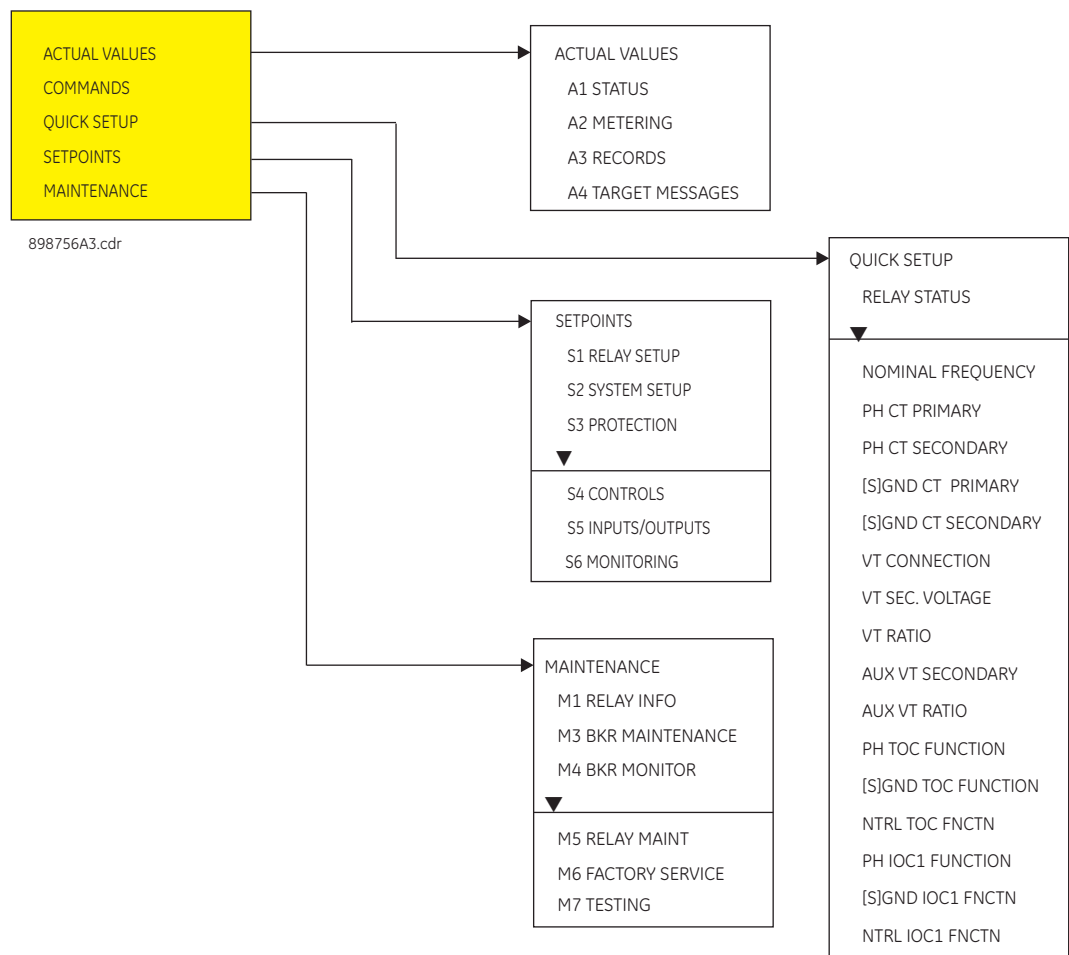


Figure 1-2: Main Menu structure

350 order codes

The information to specify a 350 relay is provided in the following order code figure.



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

Arc Flash System

The 350 protection relay with Input/Output option “A” supports up to 4 Arc Flash sensors, which are ordered separately so that the connected sensor fiber lengths can be customized.

AFC - * *		
AF System Component	E	Sensor Fiber Extension (black sensor fiber with two single bulkhead connectors, used with loop sensors)
	L	Loop Sensor with transparent sensor fiber
	P	Point Sensor with black sensor fiber
Sensor Fiber Length	XX	Sensor fiber length: 01 to 35 meters for Point Sensors and Extensions 01 to 70 meters for Loop Sensors

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NOTICE

The total sensor fiber length connected to each loop sensor must not exceed 70 meters of single sensor fiber. Black sensor fiber is duplex, and must be doubled in calculations.

For example, a loop sensor with a 25 meter transparent sensor fiber plus a sensor fiber extension of 10 meters would have a total of $2 \times 10\text{m} + 25\text{m} = 45\text{m}$ of single sensor fiber.

NOTICE

The total sensor fiber length connected to each point sensor must not exceed 35 meters of black (duplex) cable.



Generally each loop sensor is used with a sensor fiber extension, in order to minimize exposure to ambient light when running the sensor fiber between cabinets. A duplex sensor fiber extension connects the relay to the loop sensor, and can be gently pulled apart to connect to the loop sensor connectors if they are not adjacent. Consider your installation needs carefully when ordering sensor and extension lengths.

Empty chassis

The 350 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.



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.

350 – CH – * * * * *						
Phase Currents	P1					1 A 3-phase current inputs
	P5					5 A 3-phase current inputs
Ground Currents ^a	G1					1 A ground current input
	G5					5 A ground current input
	S1					1 A sensitive ground current input
	S5					5 A sensitive ground current input
Other Options	N					No selection
	D					Neutral and Ground Directional Overcurrent Protection: 67N(1), 67G/SG(1), 60CTS
	M					Voltage, Power, and Energy Metering, 60CTS
	R					Phase, Neutral, and Ground Directional Overcurrent Protection: 67P(1), 67N(1), 67G/SG(1), 32N(2), VTFF + Voltage, Power, and Energy Metering, 60CTS
	P					Extended Protection: 27P(2), 27X(1), 27P_1 (1), 59P(2), 59N(1), 59X(1), 59_2(1), 81O(2), 81U(2), 67P(1), 67N(1), 67G/SG(1), VTFF(1), 25(1), 60CTS, Voltage, Power, and Energy Metering
	W					Advanced Protection: Extended + 32(2)
Communications ^b	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
	3	E				Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850
	4	E				Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850, OPC-UA
	5	E				Standard + Ethernet (Dual Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850, OPC-UA, PRP, HSR, 1588, PTP
	6	E				Standard + Ethernet (Dual Copper RJ45), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850, OPC-UA, PRP, HSR, 1588, PTP
Harsh Environment	N					None
	H					Harsh Environment Conformal Coating

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

b. Communications option "4E" allows the selection of either IEC 61850 or OPC-UA; both cannot be used at the same time.

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Figure 1-4: 350 chassis order codes

Other accessories

- 1819-0103 350 Retrofit Kit for 735
- 1819-0102 350 Retrofit Kit for IAC Relay
- 1819-0101 350 Retrofit Kit for MDP Relay
- 1819-0100 350 Retrofit Kit for S1/S2 Cut-Out
- 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'



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, with the exception of Arc Flash SSR loads.

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

BROKEN CONDUCTOR (I1/I2 OR 46BC)

Minimum operating positive current: 0.05 to 1.00 x CT in steps of 0.01 x CT
Maximum operating positive current: 0.05 to 5.00 x CT in steps of 0.01 x CT
Pickup level: 20.0% to 100.0% in steps of 0.1%
Dropout level: 97% to 98% of the pickup level
Pickup time delay: 0.000 to 65.535 s in steps of 0.001 s
Timer accuracy: $\pm 3\%$ of delay setting or $\pm \frac{3}{4}$ cycle (whichever is greater) from pickup to operate
Operate time: <30 ms at 60 Hz

WATTMETRIC GROUND FAULT (32N)

Measured power: zero sequence
Number of elements: 1
Characteristic angle: 0° to 359° in steps of 1°
Pickup threshold: 0.001 to 1.200 pu in steps of 0.001 pu
Pickup level accuracy: $\pm 2\%$ or ± 0.03 pu, whichever is greater
Hysteresis: 3% or 0.001 pu, whichever is greater
Pickup delay: Definite Time (0.00 to 600.0 s in steps of 0.1 s), Inverse Time, or Flexcurve
Inverse time multiplier: 0.01 to 2.00 in steps of 0.01
Curve timing accuracy: $\pm 3.5\%$ of operate time or $\pm \frac{1}{4}$ cycle (whichever is greater) from pickup to operate
Operate time: <30 ms at 60 Hz

DIRECTIONAL POWER (32)

Measured power:	3-phase
Characteristic angle:	0° to 359° in steps of 1°
Power pickup range:	-1.200 to 1.200 x Rated Power in steps of 0.001
Pickup level accuracy:	2.5% or 0.01 pu, whichever is greater
Hysteresis:	2% or 0.001 x Rated Power, whichever is greater
Pickup time delay:	0.0 to 600.0 s in steps of 0.1 s
Operate time:	< 55 ms at 1.1 x pickup at 60 Hz < 65 ms at 1.1 x pickup at 50 Hz
Timer accuracy:	± 3% of delay setting or ± ¼ cycle (whichever is greater) from pickup to operate

VOLTS PER HERTZ (24)

Inputs:	Van (Wye VTs), Vab (Delta VTs)
Pickup Level:	0.80 to 4.00 x V/Hz in steps of 0.01 x V/Hz
Dropout Level:	97% to 98% of pickup
Level Accuracy:	± 0.02 x V/Hz or 2% of set value, whichever is greater
Time Curves:	Definite Time, Inverse A/B/C, FlexCurves A/B
TD Multiplier:	0.00 to 600.00 s in steps of 0.01 s
Reset Delay:	0.00 to 600.00 s in steps of 0.01 s
Time Accuracy:	± 3% of operate time of ±15 cycles (whichever is greater) for values greater than 1.1 x pickup

PHASE/NEUTRAL/GROUND/NEGATIVE SEQUENCE TIME 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 @ $I > 1 \times CT$ Pickup - 0.02 x CT @ $I < 1 \times CT$
Curve Shape:	ANSI Extremely/Very/Moderately/Normally Inverse Definite Time (0.1 s base curve) IEC Curve A/B/C and Short Inverse IAC Extreme/Very/-/Short Inverse User Curve, FlexCurve™ A/B (programmable curves)
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 1.5 cycle, whichever is greater, from pickup to operate
Level Accuracy:	per CT input

SENSITIVE GROUND TIME OVERCURRENT (51SG)

Pickup Level:	0.005 to 3.000 x CT in steps of 0.001 x CT
Dropout Level:	97% of Pickup @ $I > 0.1 \times CT$ Pickup - 0.002 x CT @ $I < 0.1 \times CT$
Curve Shape:	ANSI Extremely/Very/Moderately/Normally Inverse Definite Time (0.1 s base curve) IEC Curve A/B/C/Short Inverse IAC Extreme/Very/-/Short Inverse User Curve, FlexCurve™ A/B
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

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 @ $I > 1 \times CT$ Pickup - 0.02 x CT @ $I < 1 \times CT$
Time Delay:	0.00 to 300.00 sec in steps of 0.01
Operate Time:	<30 ms @ 60Hz ($I > 2.0 \times PKP$, No time delay) <35 ms @ 50Hz ($I > 2.0 \times PKP$, 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 @ $I > 0.1 \times CT$ Pickup - 0.002 x CT @ $I < 0.1 \times CT$
Time Delay:	0.00 to 300.00 sec in steps of 0.01
Operate Time:	<30 ms @ 60Hz ($I > 2.0 \times PKP$, No time delay) <35 ms @ 50Hz ($I > 2.0 \times PKP$, No time delay)
Time Delay Accuracy:	1% or 1 cycle, whichever is greater (Time Delay selected)
Level Accuracy:	per CT input

PHASE DIRECTIONAL (67P)

Directionality:	Co-existing forward and reverse
Operating:	Phase Current (I_a , I_b , I_c)
Polarizing Voltage:	Quadrature Voltage (ABC phase sequence: V_{bc} , V_{ca} , V_{ab}) (CBA phase sequence: V_{cb} , V_{ac} , V_{ba})
Polarizing voltage threshold:	0.05 to 1.25 x V_T in steps of 0.01
MTA (Maximum Torque Angle):	From 0° to 359° in steps of 1°
Angle Accuracy:	±4°
Operational Delay:	20 to 30 ms



NOTE

The selection of the “P” or “R” option from “350 OTHER OPTIONS” in the order code table, will enable the Phase directional element. The polarizing voltage used for this element is the line voltage.

GROUND DIRECTIONAL (67G)

Directionality:	Co-existing forward and reverse
Operating:	Ground Current (I_g)
Polarizing Voltage:	- V_0 calculated using phase voltages (V_T s must be connected in “Wye”) - $3V_0$ measured from V_{aux} input. ($3V_0$ provided by an external open delta connection).
MTA (Maximum Torque Angle):	From 0° to 359° in steps of 1°
Angle Accuracy:	±4°
Operational Delay:	20 to 30 ms



NOTE

The selection of the “D” option from “350 OTHER OPTIONS” in the Order Code table, will enable the Ground Directional element with voltage polarizing $3V_0$ measured from the V_{aux} voltage input.



NOTE

The selection of the “P”, “R”, or “W” option from “350 OTHER OPTIONS” in the order code table, will enable the Ground directional element. The polarizing voltage used for this element is the computed V_0 from the measured phase voltage inputs.

NEUTRAL DIRECTIONAL (67N)

Directionality:	Forward and reverse
Polarizing:	Voltage, Current, Dual
Polarizing Voltage:	- V_0 calculated using phase voltages (VTs must be connected in "Wye") - $3V_0$ measured from V_{aux} input ($3V_0$ provided by an external broken delta connection).
Polarizing Current:	I_G
MTA:	From 0° to 359° in steps of 1°
Angle Accuracy:	$\pm 4^\circ$
Operational Delay:	20 to 30 ms



The selection of the “D” option from “350 OTHER OPTIONS” in the Order Code table, will enable the Neutral Directional element with voltage polarizing $3V_0$ measured from the V_{aux} voltage input.

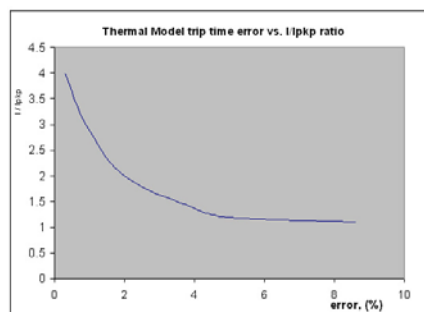
The selection of “P”, “R”, or “W” option from “350 OTHER OPTIONS” in the Order Code table, will enable the Neutral Directional elements with voltage polarizing V_0 computed from the measured phase voltage inputs.

The ground polarizing current, I_G , is available for selection in both cases.

THERMAL OVERLOAD (49)

Current:..... RMS current - max (Ia, Ib, Ic)
Pickup Accuracy:..... per current inputs
Timing Accuracy:..... See graph below

Figure 1-5:



The graph shows the trip time error with respect to the ratio of cable load and thermal model pickup setting. With a smaller I/lpkp ratio, the time error tends to be higher, as accumulated through the logarithmic formula, the measurement error, and the time of measurement. For higher I/lpkp ratios, the time to trip is substantially more accurate. Each point on the graph represents a trip time error, with the I/lpkp ratio kept constant during the test.

PHASE/AUXILIARY/POSITIVE SEQUENCE UNDERVOLTAGE (27P, 27X, 27_1)

Minimum Voltage:.....	Programmable from 0.00 to 1.25 × VT in steps of 0.01
Pickup Level:.....	0.00 to 1.25 × VT in steps of 0.01
Dropout Level:	102% of pickup (pickup > 0.1 × VT) Pickup + 0.02 × VT (pickup < 0.1 × VT)
Curve:	Definite Time, Inverse Time
Time Delay:.....	0.00 to 600.00 s in steps of 0.01
Operate Time:.....	Time delay ±30 ms @ 60 Hz (V < 0.85 × PKP) Time delay ±40 ms @ 50 Hz (V < 0.85 × PKP)
Time Delay Accuracy:	at V < 0.85 PKP: ±3% of expected time, or 1 cycle, whichever is greater
Level Accuracy:.....	Per voltage input

PHASE/AUXILIARY/NEUTRAL/NEGATIVE SEQUENCE OVERVOLTAGE (59P, 59X, 59N, 59_2)

Pickup Level:	0.00 to 1.25 x VT in steps of 0.01
Dropout Level:	98% of pickup (pickup > 0.1 x VT) Pickup - 0.02 x VT (pickup < 0.1 x VT)
Time Delay:	0.00 to 600.00 s in steps of 0.01
Operate Time:	Time delay ± 35 ms @ 60Hz ($V > 1.1 \times PKP$) Time delay ± 40 ms @ 50Hz ($V > 1.1 \times PKP$)
Time Delay Accuracy:	$\pm 3\%$ of expected time, or 1 cycle, whichever is greater
Level Accuracy:	Per voltage input

UNDERFREQUENCY (81U)

Minimum Voltage:	0.00 to 1.25 x VT in steps of 0.01
Voltage DPO:	6% of minimum voltage setting
Pickup Level:	40.00 to 70.00 Hz in steps of 0.01
Dropout Level:	Pickup + 0.05 Hz
Time Delay:	0.10 to 600.0 s in steps of 0.01
Time Delay Accuracy:	0 to 6 cycles (Time Delay selected)
Operate Time:	Typically 10 cycles @ 0.1Hz/s change
Level Accuracy:	± 0.03 Hz

OVERFREQUENCY (81O)

Minimum Voltage:	0.3 x VT
Pickup Level:	40.00 to 70.00 Hz in steps of 0.01
Dropout Level:	Pickup - 0.05 Hz
Time Delay:	0.1 to 600.0 s in steps of 0.01
Time Delay Accuracy:	0 to 6 cycles (Time Delay selected)
Operate Time:	Typically 10 cycles @ 0.1Hz/s change
Level Accuracy:	± 0.03 Hz

ARC FLASH HS PHASE/GROUND INSTANTANEOUS OVERCURRENT HS 50P/50G

Current:	RMS Magnitude (special high speed algorithm)
Pickup Level:	0.050 to 30.000 x CT in steps of 0.001 x CT
Dropout Level:	97 to 98% of Pickup
Level Accuracy:	For 0.1 to 0.2 x CT: $\pm 0.2\%$ of reading or 1.5% of rated current, whichever is greater For > 0.2 x CT: $\pm 5\%$ of reading
Operate Time:	4 ms at >6 x Pickup at 60 Hz 5 ms at >6 x Pickup at 50 Hz 4-8 ms at > (3-6) x Pickup at 60 Hz 4-10 ms at > (3-6) x Pickup at 50 Hz



NOTE

The operate times listed require that SSR output relays (Aux 5 and 6) be used for Arc Flash detection.

ARC FLASH SENSOR/FIBER

Number of Sensors:	4
Detection Radius:	180 degree
Maximum Duplex Fiber Length (Point Sensor):	35 m
Maximum Single Fiber Length (Loop Sensor):	70 m
Fiber Size:	1.0 mm core diameter 2.2 mm total diameter (single) 4.4 mm total diameter (duplex)
Mode:	Multi-mode
Connector:	Small Media Interface (SMI)
Fiber Type:	Plastic Optical Fiber
Bend Radius:	35 mm minimum
Product Type:	Class 1 Laser product

Metering

PARAMETER	ACCURACY (full scale for CT Input is 3 x CT)	RESOLUTION	RANGE
3-Phase Real Power (MW or kW)	±1% of full scale	0.1 MW	± 100000.0 kW
3-Phase Reactive Power (Mvar or kvar)	±1% of full scale	0.1 Mvar	± 100000.0 kvar
3-Phase Apparent Power (MVA or kVA)	±1% of full scale	0.1 MVA	± 100000.0 kVA
3-Phase Positive Watthour (MWh)	±1% of full scale	±0.001 MWh	50000.0 MWh
3-Phase Negative Watthour (MWh)	±1% of full scale	±0.001 MWh	50000.0 MWh
3-Phase Positive Varhour (Mvarh)	±1% of full scale	±0.001 Mvarh	50000.0 Mvarh
3-Phase Negative Varhour (Mvarh)	±1% of full scale	±0.001 Mvarh	50000.0 Mvarh
Power Factor	±0.05	0.01	-0.99 to 1.00
Frequency	±0.05 Hz	0.01 Hz	40.00 to 70.00 Hz



NOTE

Negative values (-) represent lead and positive values (+) represent lag.

CURRENTS

Parameters: Phase A, Phase B, Phase C, Neutral, Ground, Sensitive Ground, Positive Sequence, Negative Sequence, Zero Sequence, and 2nd Harmonic

Accuracy: See the Inputs section in Chapter 1: Specifications

VOLTAGES

Parameters: Wye VTs: AN, BN, CN, Negative Sequence, Zero Sequence and Auxiliary
Delta VTs: AB, BC, CA, Negative Sequence, Zero Sequence and Auxiliary

Accuracy: See the Inputs section in Chapter 1: Specifications

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, Ic, 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, per-phase voltage (VTs connected in "Wye"), or phase-phase voltages (VTs connected in "Delta"), system frequency, power, power factor, thermal capacity
Data Storage:	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 $\pm$ 10% IRIG formats accepted: B001, B002, B003, B004
Accuracy with IRIG-B:	$\pm$ 1 ms
Accuracy without IRIG-B:	$\pm$ 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 CONTROL

Operation:	Asserted Contact Input, Logic Element, Virtual Input, Manual Command
Function:	Opens / closes the feeder breaker

AUTORECLOSE (79)

Reclose attempts:	Up to 4 shots
Time Delay Accuracy:	0 to 3 cycles (AR Dead Time selected)
Elements:	Inputs, Outputs, Breaker Status (52 status)

SYNCHROCHECK (25)

Maximum frequency difference:	0.05 to 5.00 Hz in steps of 0.01 Hz
Maximum Angle difference:	2° to 80° in steps of 1°
Maximum Voltage difference:	10 to 10000 V in steps of 1 V
Dead Bus and Dead Line level:	0.00 to 1.25 x VT in steps of 0.01 x VT
Live Bus and Live Line level:	0.03 to 1.25 x VT in steps of 0.01 x VT

SECOND HARMONIC INHIBIT

Operating Parameter:	Current 2nd harmonic per phase or average
Pickup Level:	0.1% to 40.0% in steps of 0.1
Minimum Current:	0.03 to 3.00 x CT in steps of 0.01 x CT
Time Delay:	0.00 to 600.00 s in steps of 0.01 s
Time Delay Accuracy:	$\pm$ 3% of expected time or 2 cycles, whichever is greater
Level Accuracy:	$\pm$ 2% or $\pm$ 10mA (whichever is greater)

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

CT FAILURE

Inputs:	Neutral Current IN, Neutral Current VN (from three-phase VTs) Ground Current Ig
Time Delay:	0.00 to 60.00 s in steps of 0.01 s
3IO level accuracy:	per CT inputs
3VO level accuracy:	per VT inputs
GND current level accuracy:	see the specifications for phase and ground current inputs
Operate Time:	30 ms at 60 Hz 35 ms at 50 Hz

BREAKER TRIP COUNTER

Trip Counter Limit (Pickup):	1 to 10000 in steps of 1
------------------------------	--------------------------

LOCKOUT

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

COLD LOAD PICKUP BLOCKING

Operation:	Automatically (current level), or by command (asserted input)
Function:	Block IOC functions, raise TOC pickup, for selected period of time
Time Delay Accuracy:	0 to 1 cycle (block Time) ±50 ms (outage time ≤5 min) ±1 s (outage time > 5 min)

FUSE FAIL (VTFF)

Time Delay:	1 s
Timing Accuracy:	±0.5 s
Elements:	Trip or Alarm

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: $\pm 3\%$ of delay setting or ± 1 cycle (whichever is greater) from pickup to operate

DEMAND

Measured Values: Phase A/B/C present and maximum current, three-phase present and maximum real/reactive/apparent power

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

Real Power Pickup Level: 0.1 to 300000.0 in steps of 0.1 kW

Reactive Power Pickup Level: 0.1 to 300000.0 in steps of 0.1 kVar

Apparent Power Pickup Level: 0.1 to 300000.0 in steps of 0.1 kVA

Dropout Level: 96-98% of Pickup level

Level Accuracy: $\pm 2\%$ (current demand only)

Inputs

CONTACT INPUTS

Inputs: 10

Selectable thresholds: 17, 33, 84, 166 VDC
 $\pm 10\%$

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

PHASE & GROUND CURRENT INPUTS

CT Primary: 1 to 6000 A

Range: 0.02 to $20 \times$ CT

Input type: 1 A, 5 A, or 1/5 A (must be specified with order)

Nominal frequency: 50/60 Hz

Burden: <0.1 VA at rated load

Accuracy at nominal frequency: 3%
 ± 10 mA or $\pm 20\%$ of reading from 0.02 to $0.19 \times$ 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 $40 \times$ rated current
continuous at $3 \times$ rated current

SENSITIVE GROUND CURRENT INPUT

CT Primary:	1 to 600 A
Range:	0.002 to $3 \times \text{CT}$
Input type:	1 A, 5 A, or 1/5 A (must be specified with order)
Nominal frequency:	50/60 Hz
Burden:	<0.1 VA at rated load
Accuracy at nominal frequency:	3%
	$\pm 10 \text{ mA}$ or $\pm 20\%$ of reading from 0.02 to $0.19 \times \text{CT}$, 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 $40 \times$ rated current
	continuous at $3 \times$ rated current

PHASE/AUX VOLTAGE INPUTS

Source VT:	0.15 to 550 kV / 50 to 220 V
VT secondary range:	50 to 240 V
VT ratio:	1.0 to 5000.0 in steps of 0.1
Nominal frequency:	50/60 Hz
Relay burden:	<0.25 VA at 120 V
Accuracy at nominal frequency:	$\pm 1.0\%$ throughout range
Voltage withstand:	260 VAC continuous

Outputs

ARC FLASH OPTION**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

Ratings per UL Certification:

Break (AC resistive):	250 VAC / 10 A GEN USE
Continuous Current:	10 A

FORM-A VOLTAGE MONITOR

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

FORM-C RELAYS

Configuration:	3 (three) 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

Ratings per UL Certification:

Break (AC resistive):	250 VAC / 10 A GEN USE
Continuous Current:	10 A

SOLID STATE CONTACT

Configuration:	2 MOSFET
Operate time:	60 μ s
Continuous current:	6 A
Make and carry for 1 s:	10 A
Break (DC resistive):	300 V / 6 A
Break (DC inductive L/R=40ms):	300 V / 6 A

Ratings per UL Certification:

Break:	24 VDC, 1 A Pilot Duty
	48 VDC, 0.5 A Pilot Duty
	125 VDC, 0.3 A Pilot Duty
	250 VDC, 0.2 A Pilot Duty
Continuous Current:	6 A

TRIP / CLOSE SEAL-IN

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

NON-ARC FLASH OPTION**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

Ratings per UL Certification:

Break (AC resistive):	250 VAC / 10 A GEN USE
Continuous Current:	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 @ 240 VAC Pilot duty A300

Break (AC resistive): 250 VAC / 10 A

Ratings per UL Certification:

Break (AC resistive): 250 VAC / 10 A GEN USE

Continuous Current: 10 A

TRIP / CLOSE SEAL-IN

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

Relay 2 close 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, OPC-UA

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, OPC-UA, PRP, HSR
 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
 Maximum number of TCP/IP sessions: 3
 Product type: Class 1 Laser product

USB

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

OPC-UA (OLE FOR PROCESS CONTROL - UNIFIED ARCHITECTURE)

DA Server: Transmission of real-time data to Clients
 A&E Server: Transmission of Event information to Clients. Acknowledge
 and confirmation permitted from Client side

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

TEST	REFERENCE STANDARD	TEST LEVEL
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

350 Feeder Protection System

Chapter 2: Installation

Mechanical installation

This section describes the mechanical installation of the 350 system, including dimensions for mounting and information on module withdrawal and insertion.

This equipment is **Suitable for mounting on the flat surface of a Type 1 Enclosure**

Dimensions

The dimensions of the 350 are on the following pages. Additional dimensions for mounting and panel cutouts are shown in the following sections.

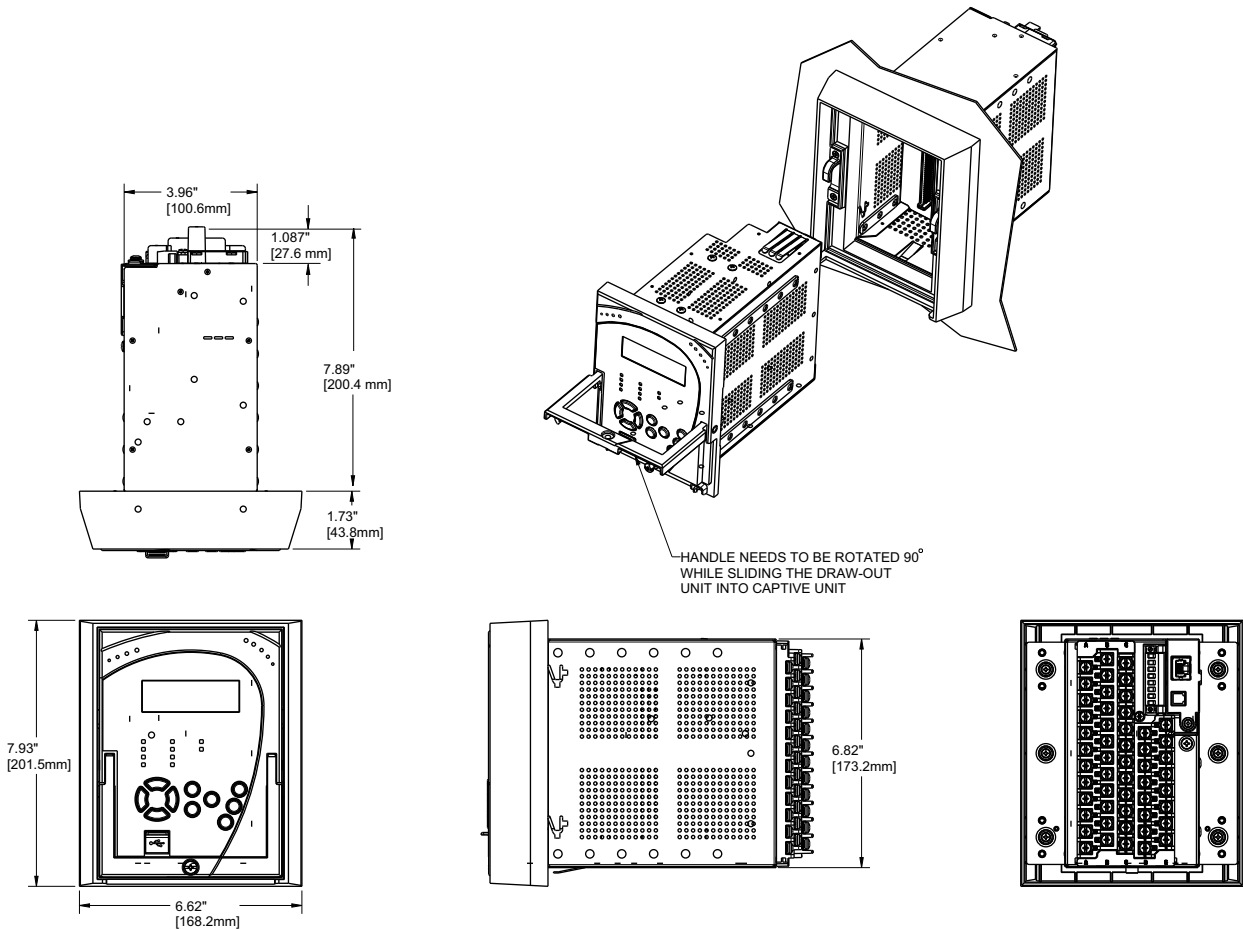


Figure 2-1: 350 dimensions - Drawout unit

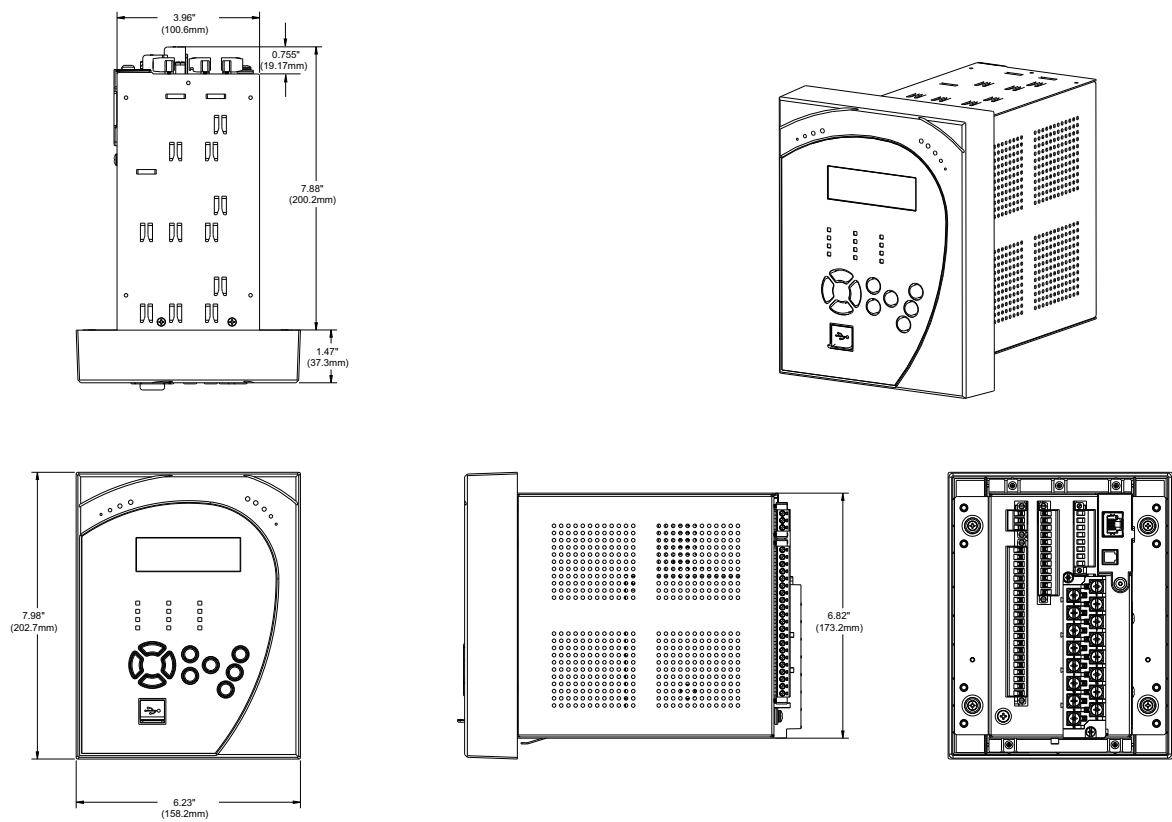


Figure 2-2: 350 dimensions - Non-drawout unit

Product identification

The product identification label is located on the side panel of the 350 . This label indicates the product model, serial number, and date of manufacture.



Figure 2-3: 350 Product labels



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.

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.

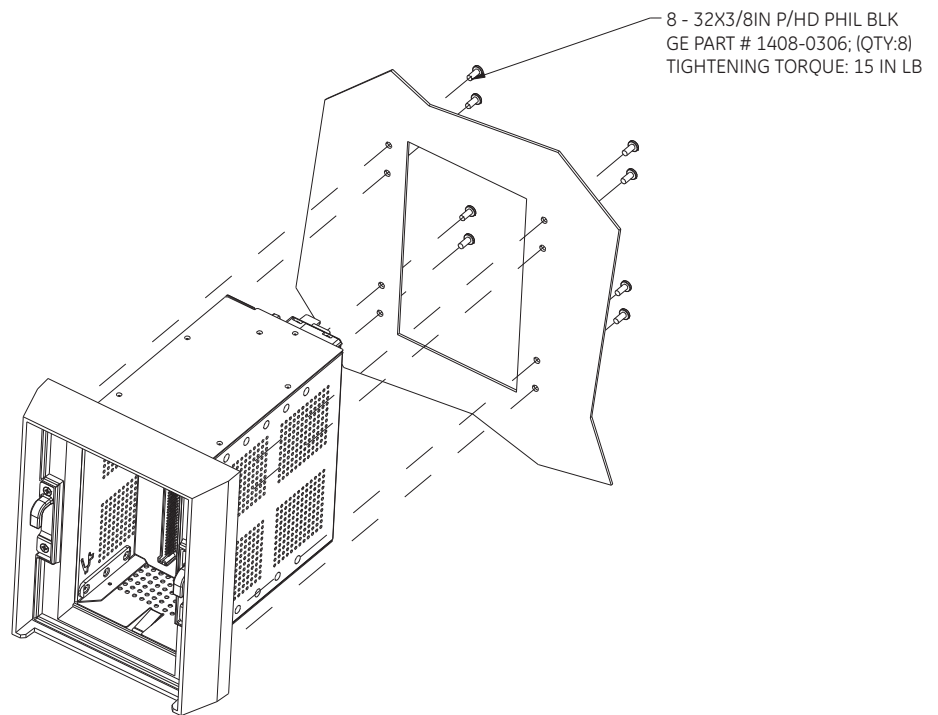


Figure 2-4: Standard panel mounting - Drawout

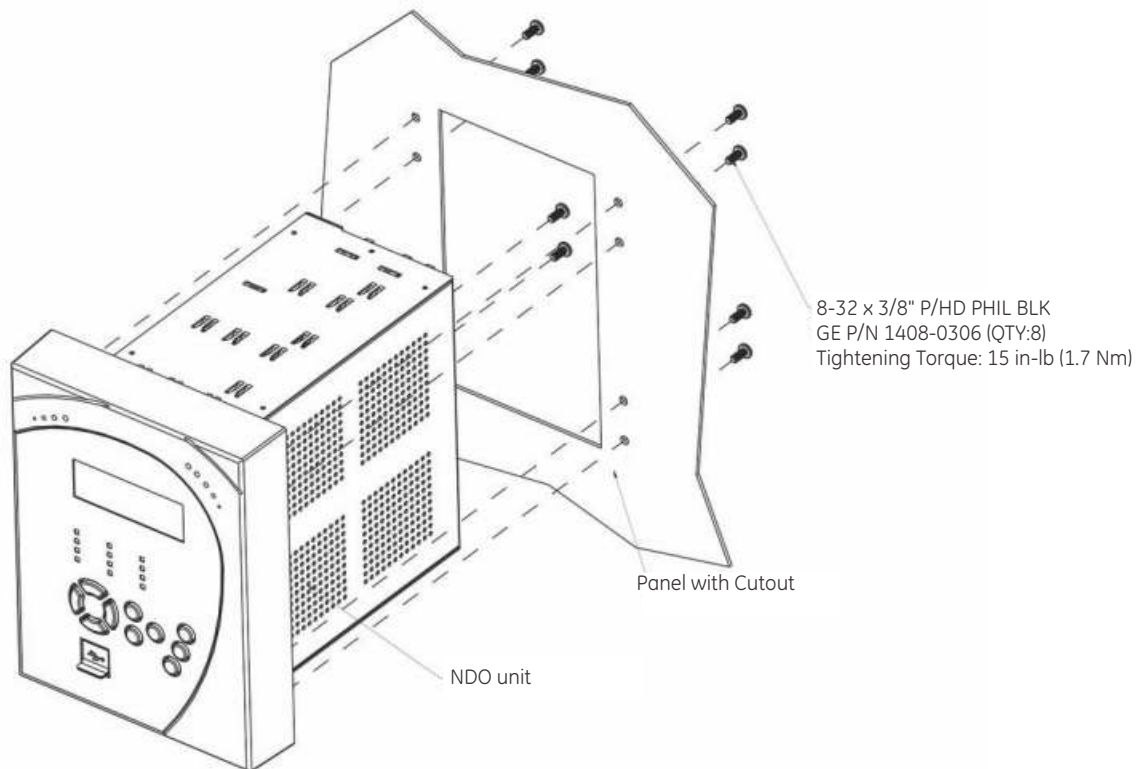


Figure 2-5: Standard Panel mounting - Non-drawout

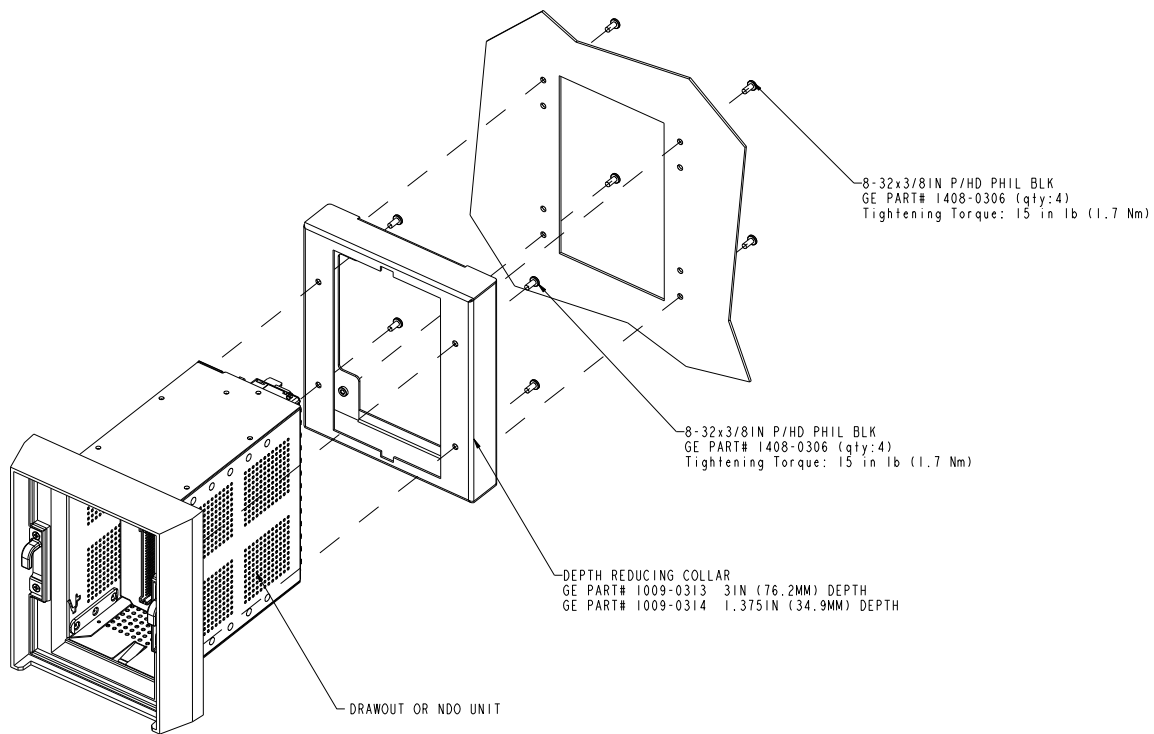


Figure 2-6: Depth Reducing collar (optional)

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.

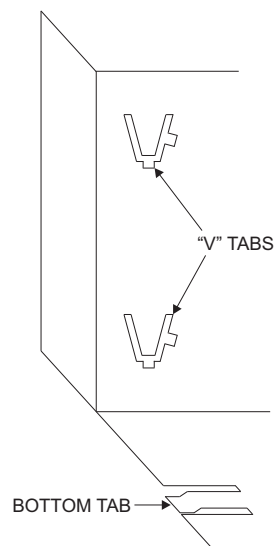


Figure 2-7: Mounting tabs (optional)

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.

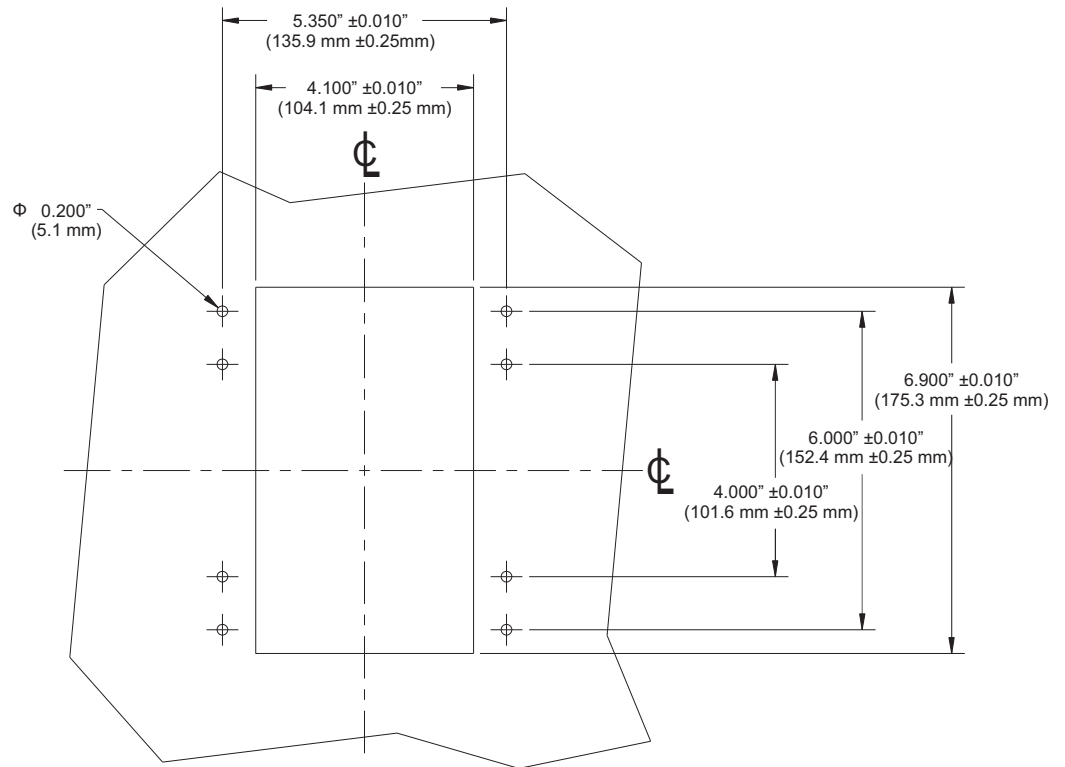


Figure 2-8: Panel cutout dimensions

Mounting using the S1/S2/MDP/IAC or SR735 adapter plate

Retrofit Kit	Kit Part Number	Adapter Plate	Washer Lock (8)	Machine Screws (8)	Flat Washers (4)	Screws with ext. Lock Washers (4)
350 Retrofit Kit for 735	1819-0103	1463-0012	1430-0003	1408-0015	1430-0039	1410-0112
350 Retrofit Kit for IAC Relay	1819-0102	1463-0011	1430-0003	1408-0015	1430-0039	1410-0112
350 Retrofit Kit for MDP Relay	1819-0101	1463-0011	1430-0003	1408-0015	1430-0039	1410-0112
350 Retrofit Kit for S1/S2 Cut-Out	1819-0100	1463-0011	1430-0003	1408-0015	1430-0039	1410-0112



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.

The adaptor plate for mounting the 350 directly over the existing S1/S2/MDP/IAC or SR735 mounting plate, is shown below:

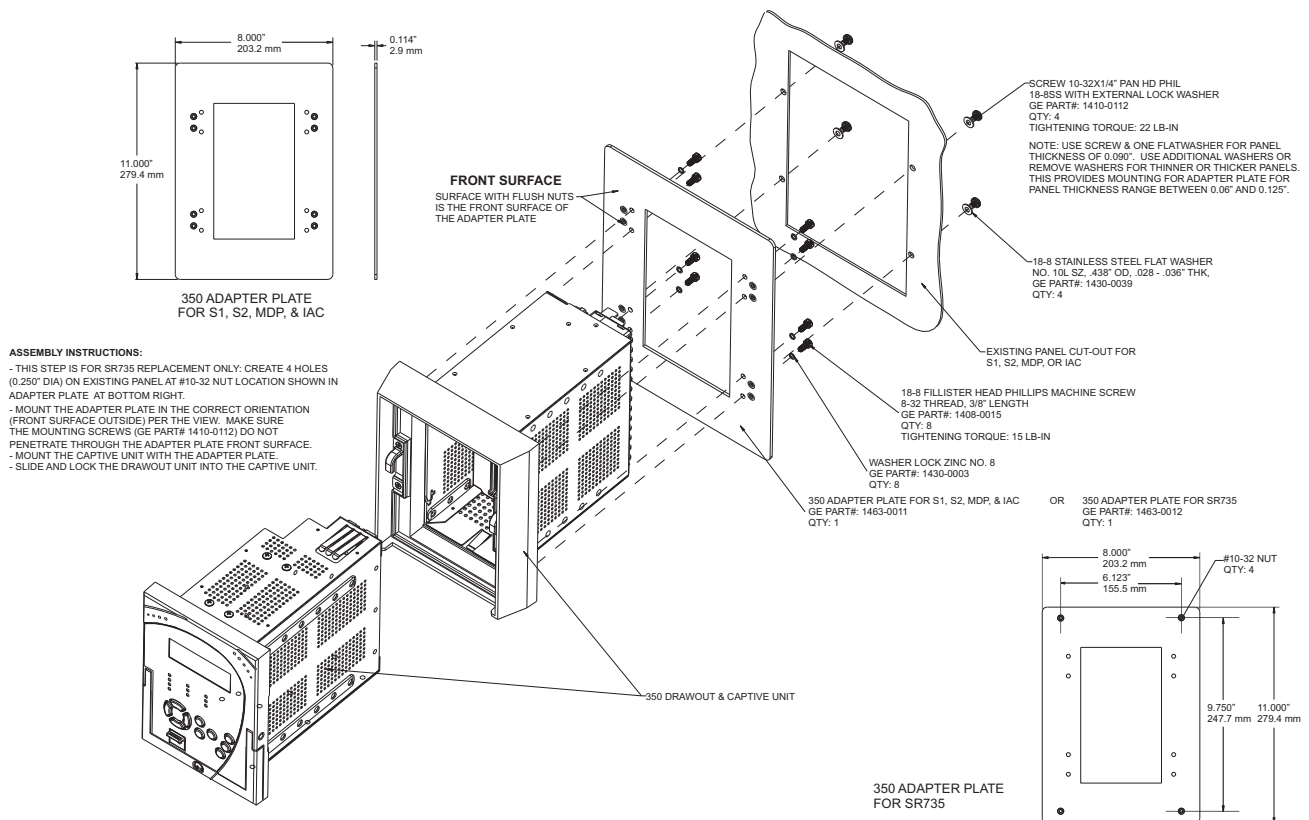


Figure 2-9: Adaptor Plate mounting - Drawout case

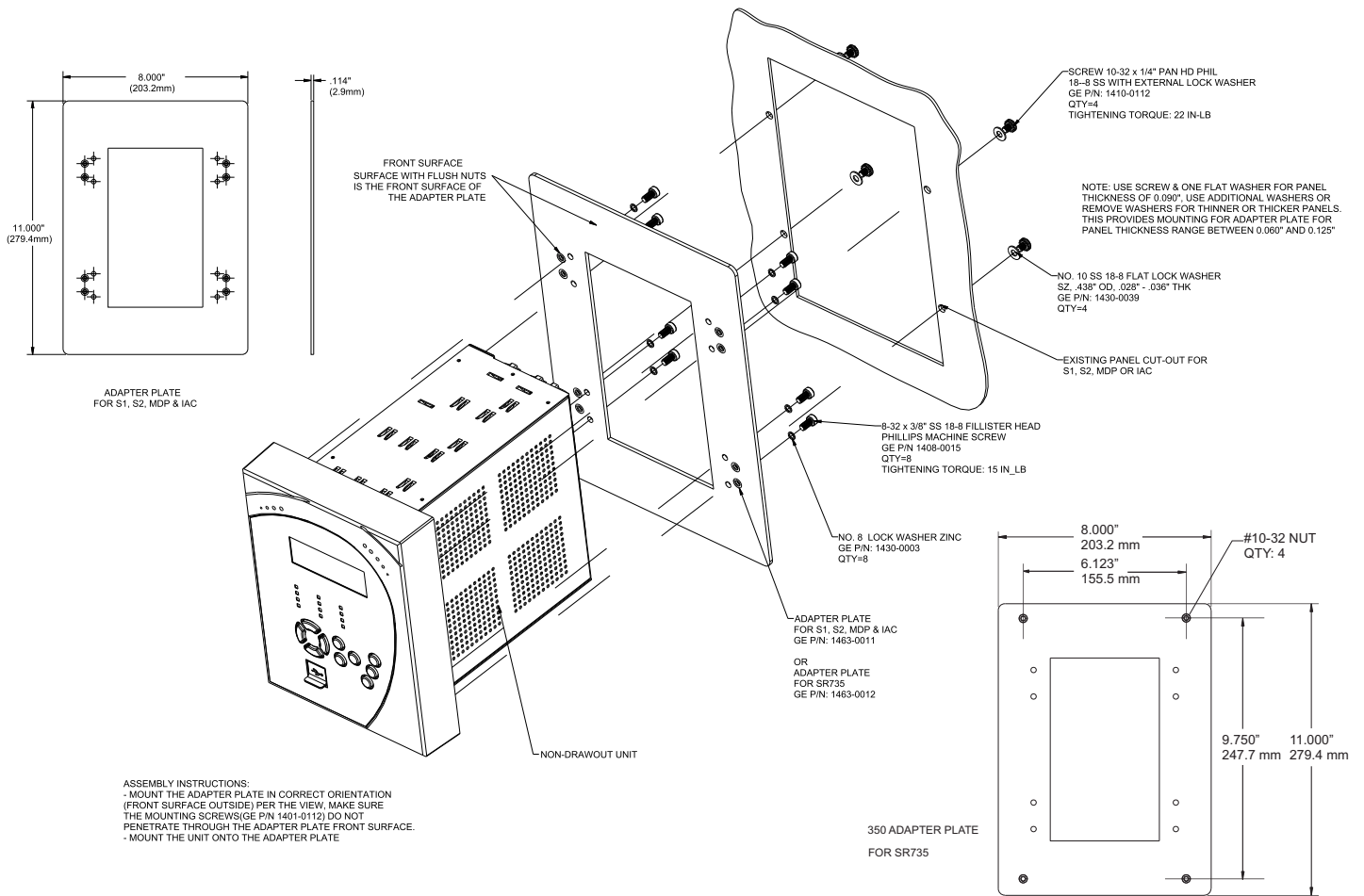


Figure 2-10: Non-drawout - Adapter plate mounting

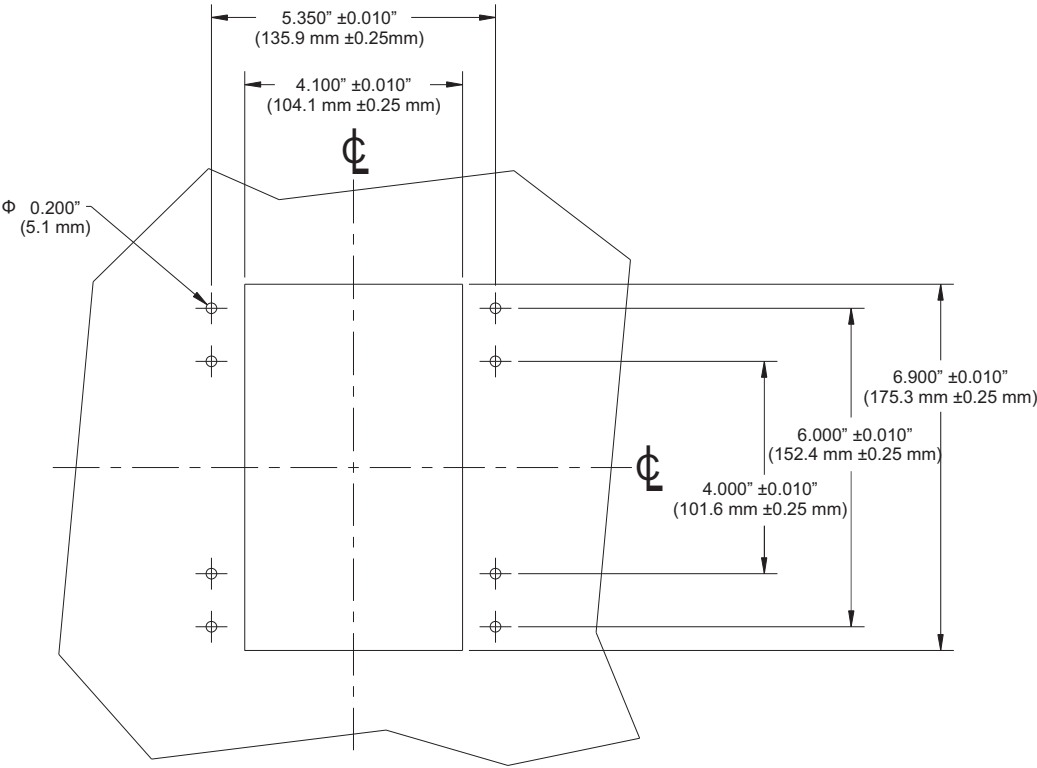


Figure 2-11: Panel cutout dimensions

Drawout unit withdrawal and insertion

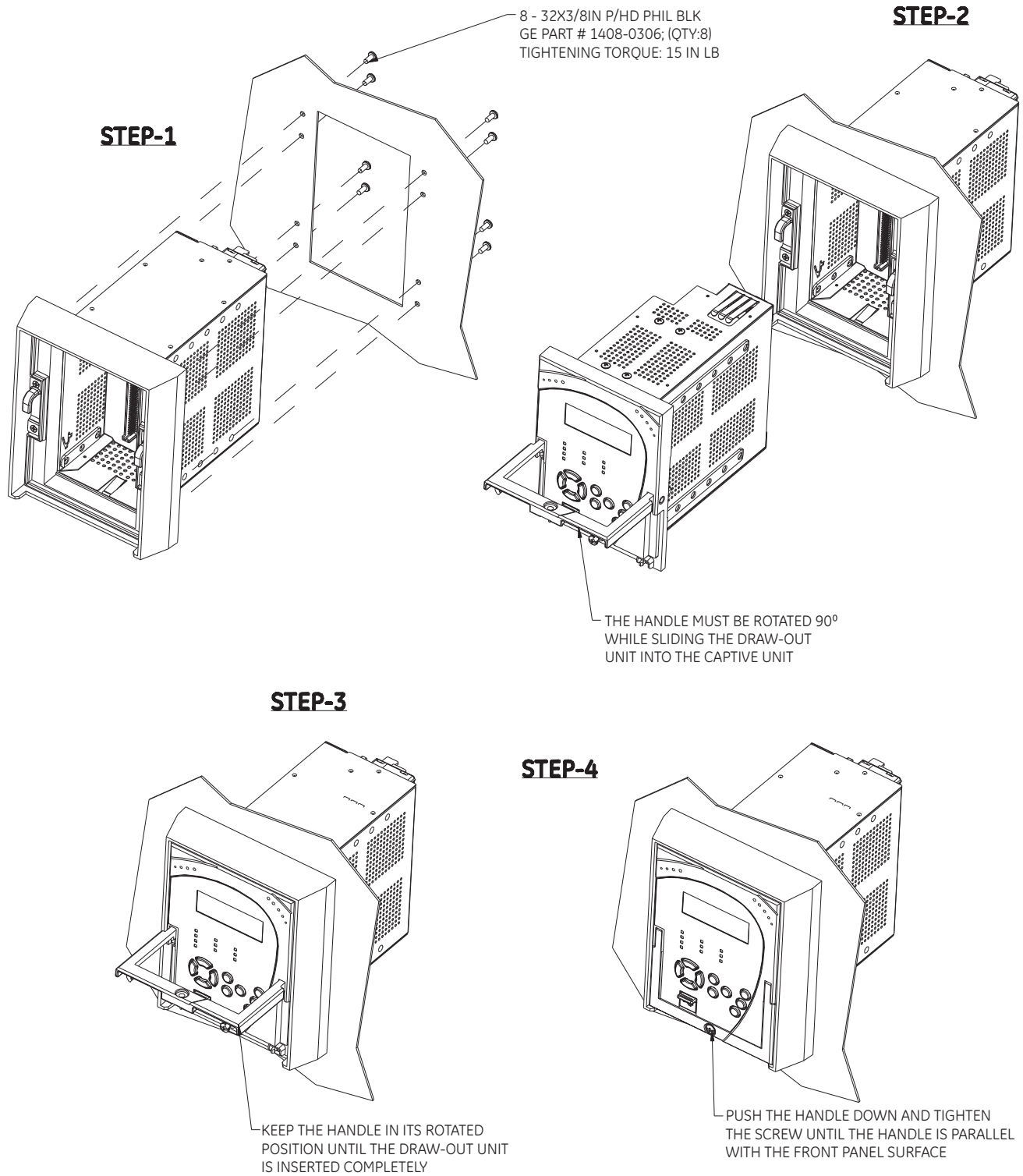


Figure 2-12: Unit withdrawal and insertion diagram

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:

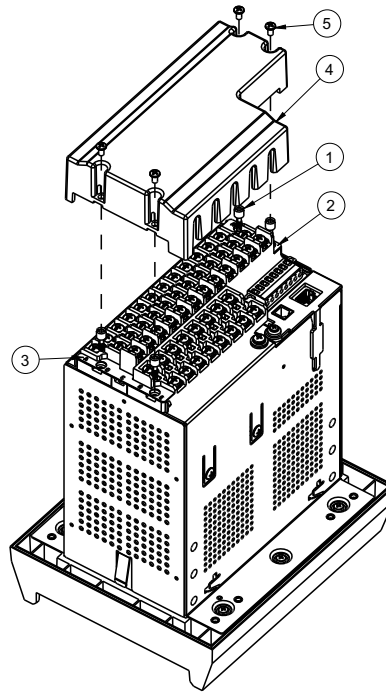


Figure 2-13: IP20 Cover mounting - Drawout unit only

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.



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.

Arc flash sensors

Arc flash sensors house the fiber optics that are used to detect the arc flash. Mounting details depend on the sensor type (point or loop).

For detailed installation, testing and maintenance guidance for Arc Flash sensors, see GET-20057 *3 Series Arc Flash Application Note*.

CAUTION

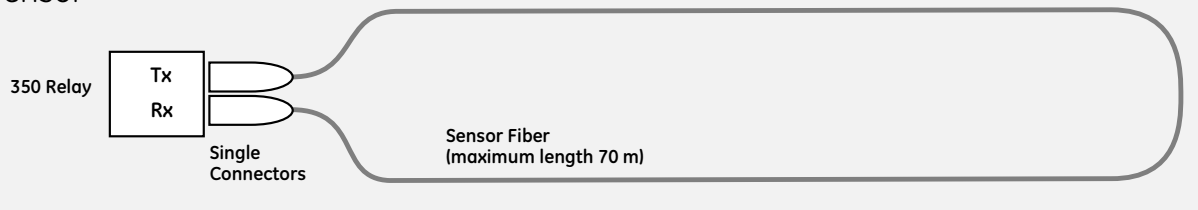
If the relay is used in the computation for reducing the Hazard Reduction Category code, operands for sensor failures must be assigned to an auxiliary output relay which must be connected into the control logic of the breaker equipment to ensure safe operations when the output relay is asserted. In the event of this assertion, the Hazard Reduction Category code cannot be maintained unless backup protection is continuing to maintain it.

CAUTION

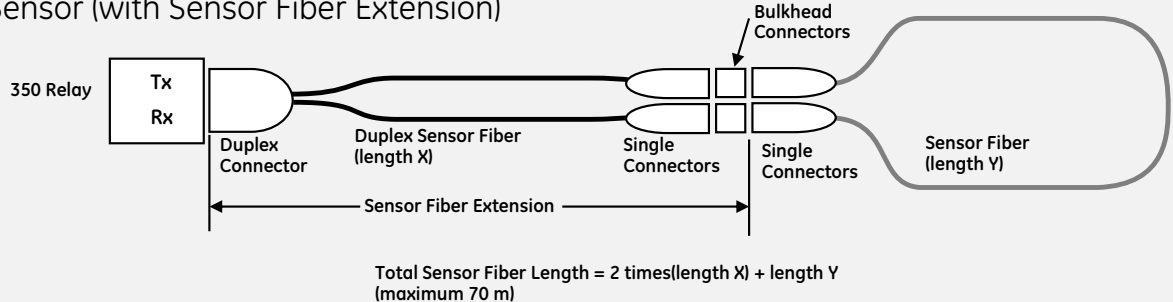
This product uses optical electronic devices (line or point sensors) to sense arc flash fault conditions. It is recommended to follow proper housekeeping measures & establish a regularly scheduled preventive maintenance routine to ensure proper device operation. For maintenance recommendations, see GET-20057 *3 Series Arc Flash Application Note*

Arc flash sensors are available in two different configurations, point and loop. Loop sensors can be used with a black-coated sensor fiber extension to connect the ends of the loop sensor to the 350 relay through panels up to 51 mm (2 inches) thick.

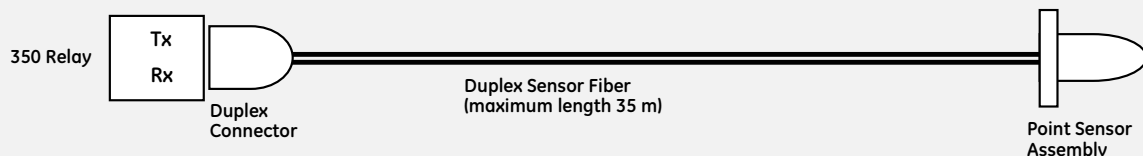
Loop Sensor



Loop Sensor (with Sensor Fiber Extension)



Point Sensor



Arc flash sensors of either type can be connected to any of the four arc flash ports on the back of the 350 relay, as shown.

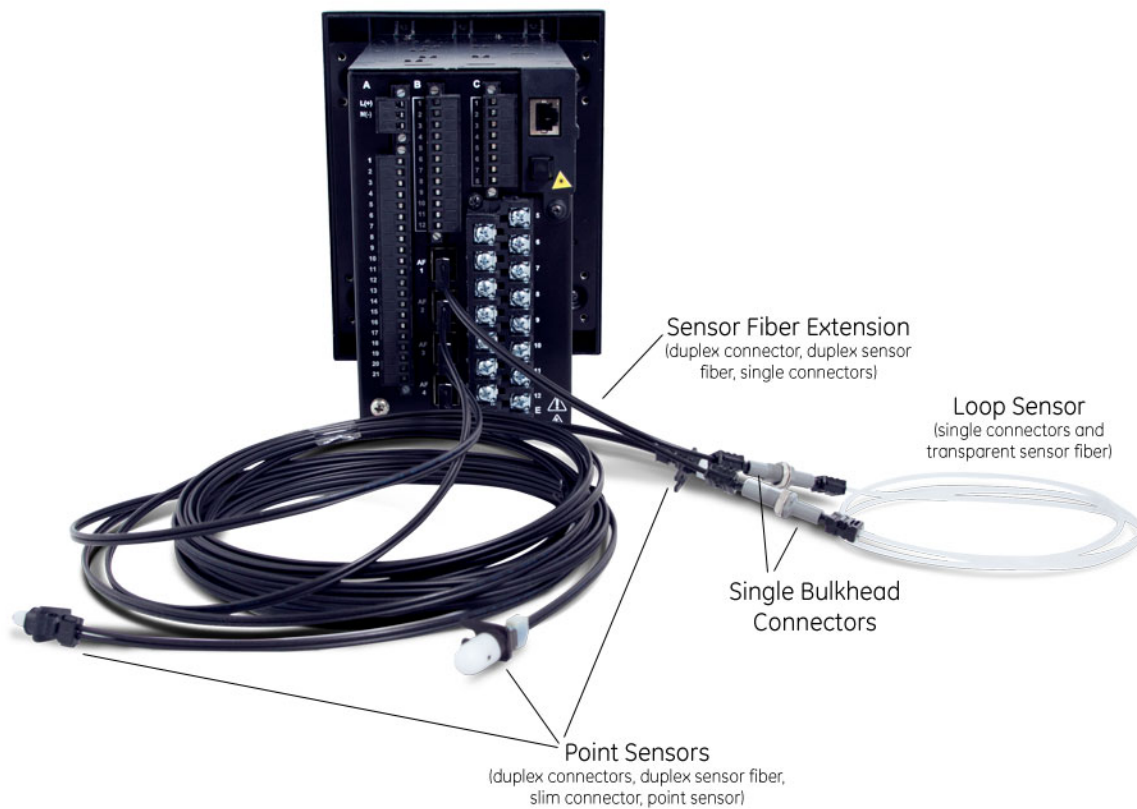


Figure 2-14: Arc flash sensors connected to a 350 relay

Sensor fiber handling & storage

CAUTION

Arc Flash sensor fiber is pressure sensitive and must be handled carefully to avoid damage. Read the following guidelines fully before proceeding.

Care must be taken when handling the Arc Flash sensor fiber, which can be damaged if twisted, bent, or clamped tightly during installation.

- Do not bend sensor fiber sharply, or with a radius of less than 35 mm (1.3 inches). Sharp bends can damage the fiber. Do not pull or tug loops of sensor fiber, as sharp bends may result.
- Do not clamp sensor fiber tightly during installation. Sensor fiber should be held in place loosely for the best long-term performance. Avoid over-tightening ties which may deform or break the sensor fiber.
- Do not pull or tug sensor fiber with force, as this may cause internal damage or separate the fiber from the cable connector.
- Do not twist the sensor fiber, as twisting can damage the fiber resulting in substandard performance.
- Do not attach sensor fiber directly to the bus or other live conductors.
- Avoid surface temperatures above 70 °C or 158 °F to prolong the life of the fiber.
- Secure all sensor fibers (loosely but securely) away from any moving parts.

Point sensor installation



Figure 2-15: Arc flash point sensor without sensor fiber connected

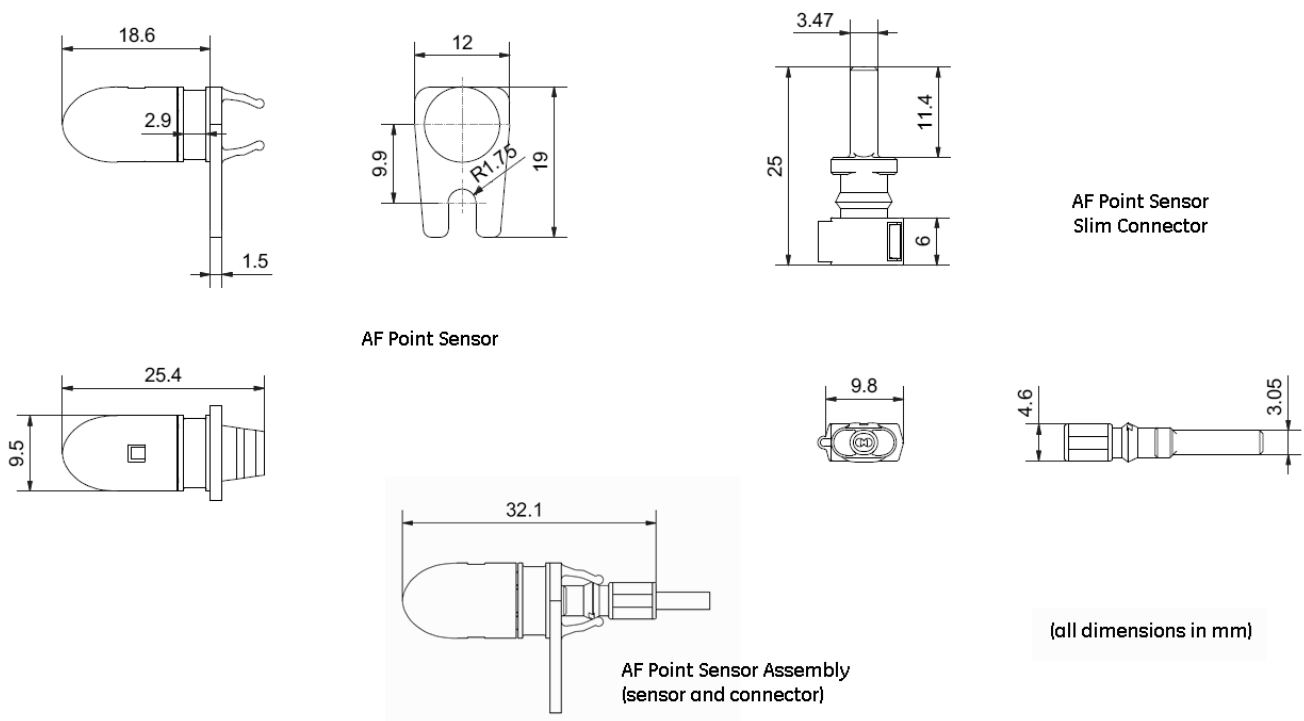
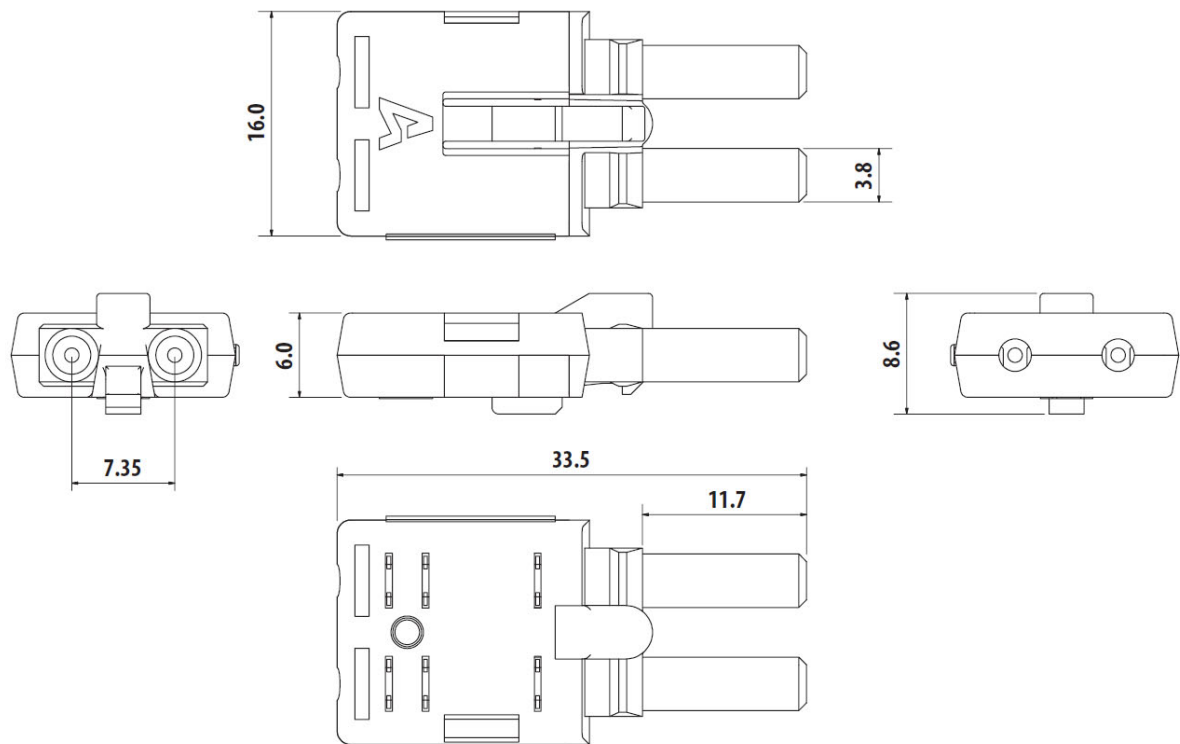


Figure 2-16: Point sensor and slim connector dimensions



Note: Dimensions are in mm

Figure 2-17: Duplex connector dimensions (point sensor, and sensor fiber extension for loop sensor)

The point sensor fiber includes a duplex connector to connect to the back of the 350 relay on one end, and a compressed slim connector that connects to the sensor itself on the other end.

Before installing the AF sensor units, ensure that all other drilling and installation is complete to minimize possible damage to the sensitive unit and connected sensor fiber cable. Choose a location for the sensor clear of any obstructions that could shield the sensor from arc flash light.

NOTICE

Review the sensor fiber handling guidelines above.

Sensor fiber should be held in place loosely for the best long-term performance. Avoid over-tightening ties which may deform or break the sensor fiber.

General installation:

1. Choose a location for the point sensor.

Arc flash point sensors should be installed clear of any obstructions that could shield the sensor from arc flash light, and less than 2m (6ft 6") from any potential arc flash source.

The sensor head should be pointed towards the most likely source of arc flash.

For further guidance selecting point sensor locations, see GET-20057 *3 Series Arc Flash Application Note*.

2. Remove the slim connector from the point sensor assembly.

3. Carefully route the duplex sensor fiber from the point sensor location to the back of the relay unit, minimizing loops and curves for the strongest possible signal. Ensure all sensor fiber handling precautions are followed.

The slim connector fits through holes with a diameter of 11 mm or greater, and can be threaded through holes drilled in any panels between the relay and arc flash detection location.



Install protective grommets when routing sensor fiber through metal walls.

4. Mount the point sensor using either a cable tie mount or through-hole mount, as detailed below.
5. Reconnect the slim connector to the point sensor.

Arc flash point sensors can be installed in one of two ways, using a cable tie mount or a through-hole mount.

Cable tie mount:

- Requires a 2.5-mm-wide cable tie.
- Mount the sensor on a stick or similar using the cable tie, as shown in the following figure.



Figure 2-18: AF point sensor, cable tie mount

Through-hole mount

- Requires a standard or self-tapping M3 screw, and optionally an M3 washer.
- Mount the sensor through a 10 mm hole made in the surface of any mechanical structure inside the switchgear or on the surface of one side of the switchgear itself, as shown in the following figure.

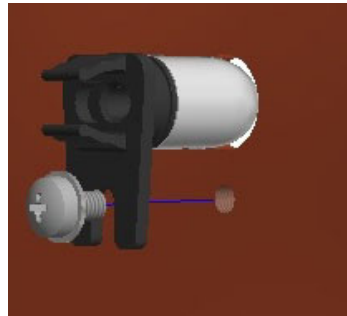


Figure 2-19: AF point sensor, through-hole mount



Figure 2-20: AF point sensors connected to 350 relay

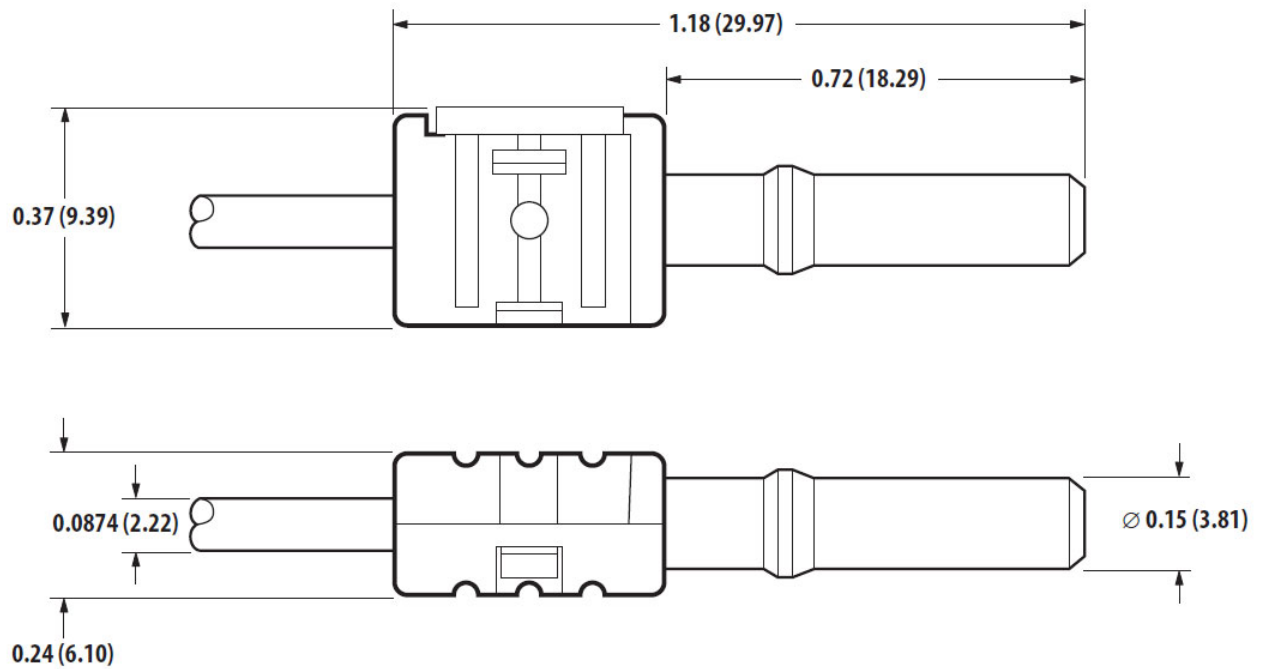
Make sure there is no dirt or dust inside the point sensor or on the surface because it reduces the capturing efficiency of the device, increases its transmission loss, or both. If the point sensor is covered with dust, clean it by blowing or wiping the dust off the point sensor.

NOTICE

The material of the point sensor is not affected by water-based cleaning agents, dish soap, or organic solvents with an alcohol (ethanol) base. Do not use solvents or solvent mixtures that contain acids because they can attack or dissolve the optical plastic material.

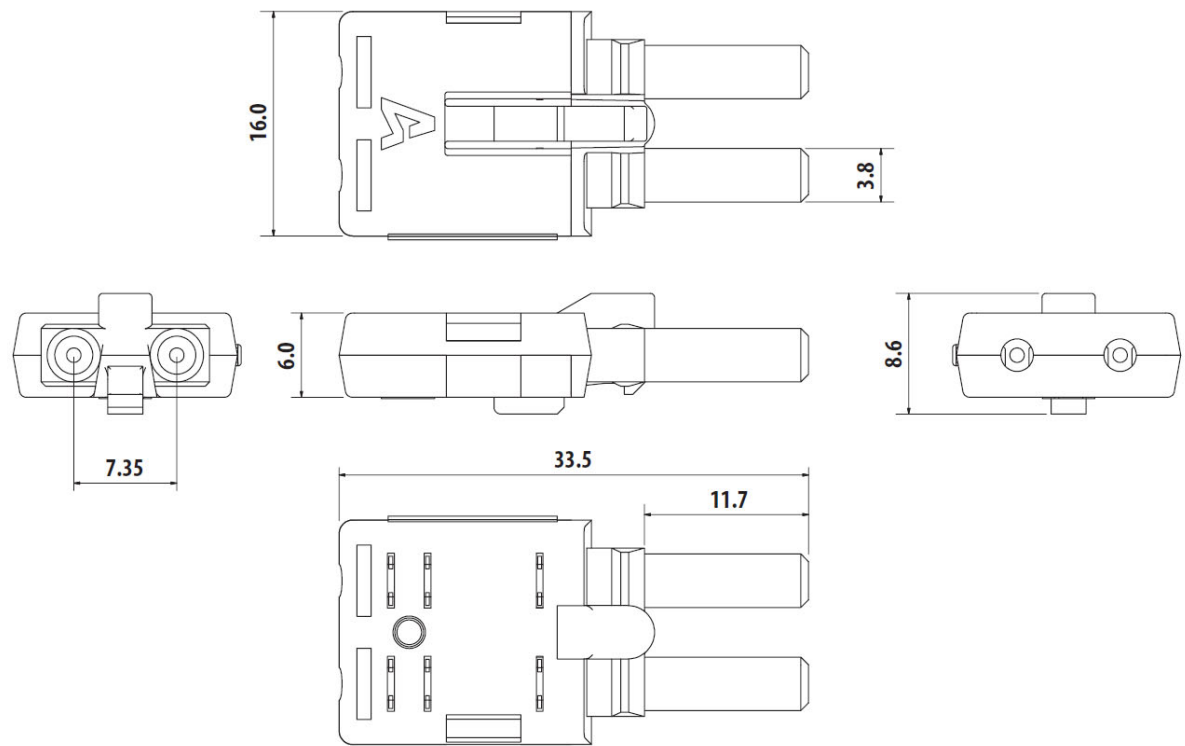
Loop sensor installation

The loop sensor transparent sensor fiber has a single connector on either end. The sensor fiber extension has a duplex connector on one end, two single connectors on the other end, and comes with two single bulkhead connectors. Both come in custom lengths, which can be ordered to fit your installation.



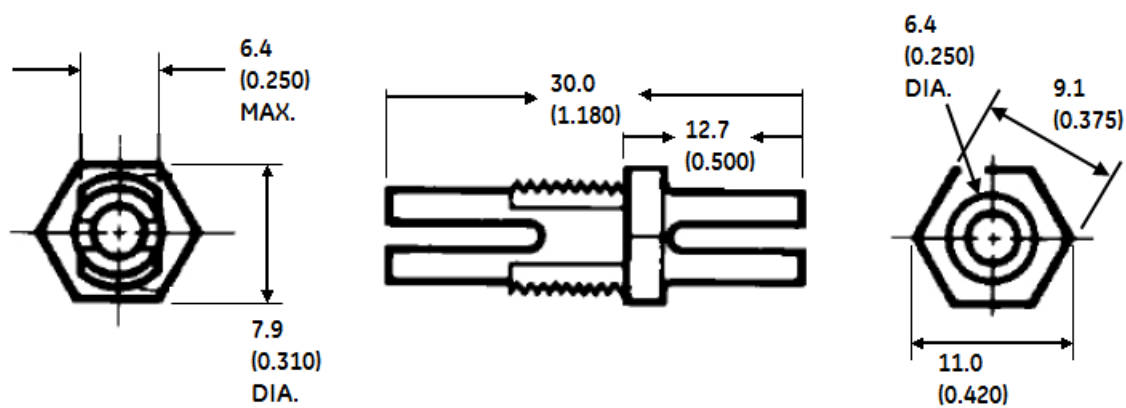
All dimensions are in inches and (millimeters).

Figure 2-21: Single connector dimensions (loop sensor, and sensor fiber extension for loop sensor)



Note: Dimensions are in mm

Figure 2-22: Duplex connector dimensions (point sensor, and sensor fiber extension for loop sensor)



Note: All dimensions in mm (inches)

Figure 2-23: Single bulkhead connector dimensions

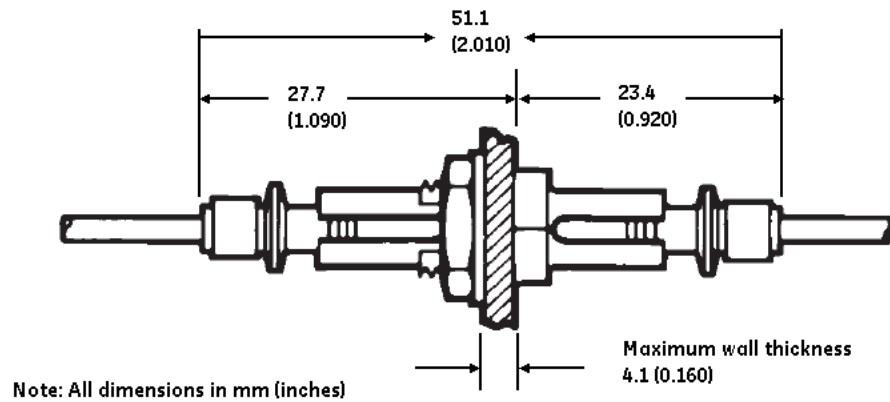


Figure 2-24: Single bulkhead connector with single connectors and sensor fiber

Before installing the AF sensor units, ensure that all other drilling and installation is complete to minimize possible damage to the sensitive unit and connected sensor fiber cable.

NOTICE

Review the sensor fiber handling guidelines above.

Sensor fiber should be held in place loosely for the best long-term performance. Avoid over-tightening ties which may deform or break the sensor fiber.

NOTICE

The loop sensor fiber can be connected directly to the 350 relay without a sensor fiber extension, however, care must be taken to ensure correct alignment of the loop sensor single connectors into the 350 light sensor input.

Installing the loop sensor fiber without an extension:

1. Plan the path of the loop sensor fiber, looping through the chamber or chambers requiring arc flash detection. See GET-20057 *3 Series Arc Flash Application Note* for detailed examples of loop sensor installation.
2. Ensure that both ends of the loop remain close together and can reach the 350 relay light sensor inputs.
3. Install the loop sensor carefully, following all sensor fiber handling guidelines.
4. Plug the single connectors into the back of the 350 relay, ensuring correct alignment as shown.

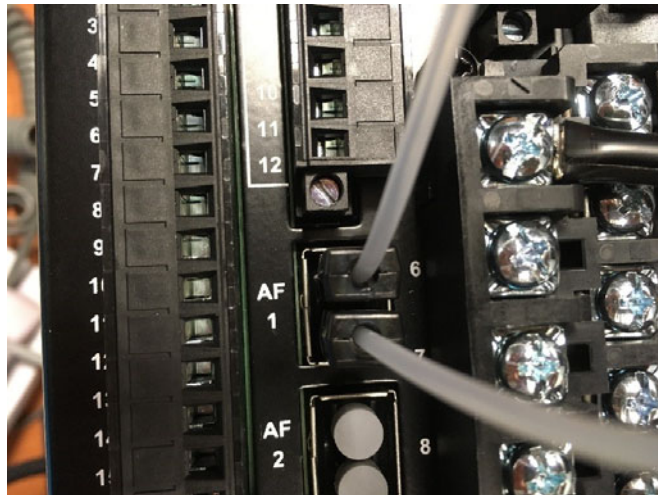


Figure 2-25: Loop sensor fiber direct to relay - correct installation

Installing the loop sensor fiber with a sensor fiber extension:

1. Plan the path of the loop sensor fiber, looping through the chamber or chambers requiring arc flash detection. See GET-20057 *3 Series Arc Flash Application Note* for detailed examples of loop sensor installation.
2. Ensure that both ends of the loop remain close enough together to be reached by the sensor fiber extension. If needed, gently pull apart the duplex sensor fiber extension from the end with two single connectors, being careful not to bend the fiber with a radius of less than 35 mm (1.3 inches).
3. Ensure that the sensor fiber extension is long enough to reach the 350 relay from the bulkhead connector location.
4. Mount the bulkhead connector on the side of the chamber, following the drill hole dimensions provided. Note that the single bulkhead connector uses washers 11.0 mm (0.420 in) wide, so the drill holes must be spaced accordingly if the loop sensor path begins and ends in the same place.

Note: All dimensions in mm (inches)

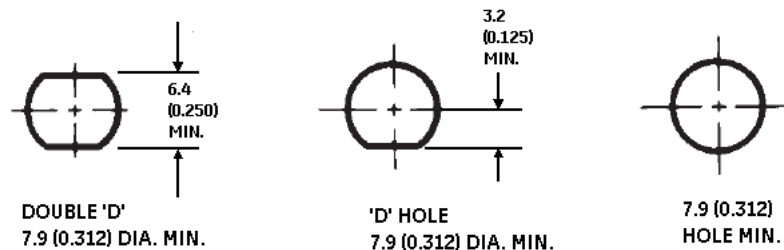


Figure 2-26: Bulkhead connector cutout

5. Install the loop sensor carefully, following all sensor fiber handling guidelines.
6. Plug the ends of the loop sensor into the bulkhead connectors.
7. Plug the single connectors on the sensor fiber extension into the other sides of the bulkhead connectors, and the duplex connector into the back of the 350 relay.

Electrical installation

This section describes the electrical installation of the 350 system, including typical wiring diagrams and terminal identification.

Typical wiring diagrams

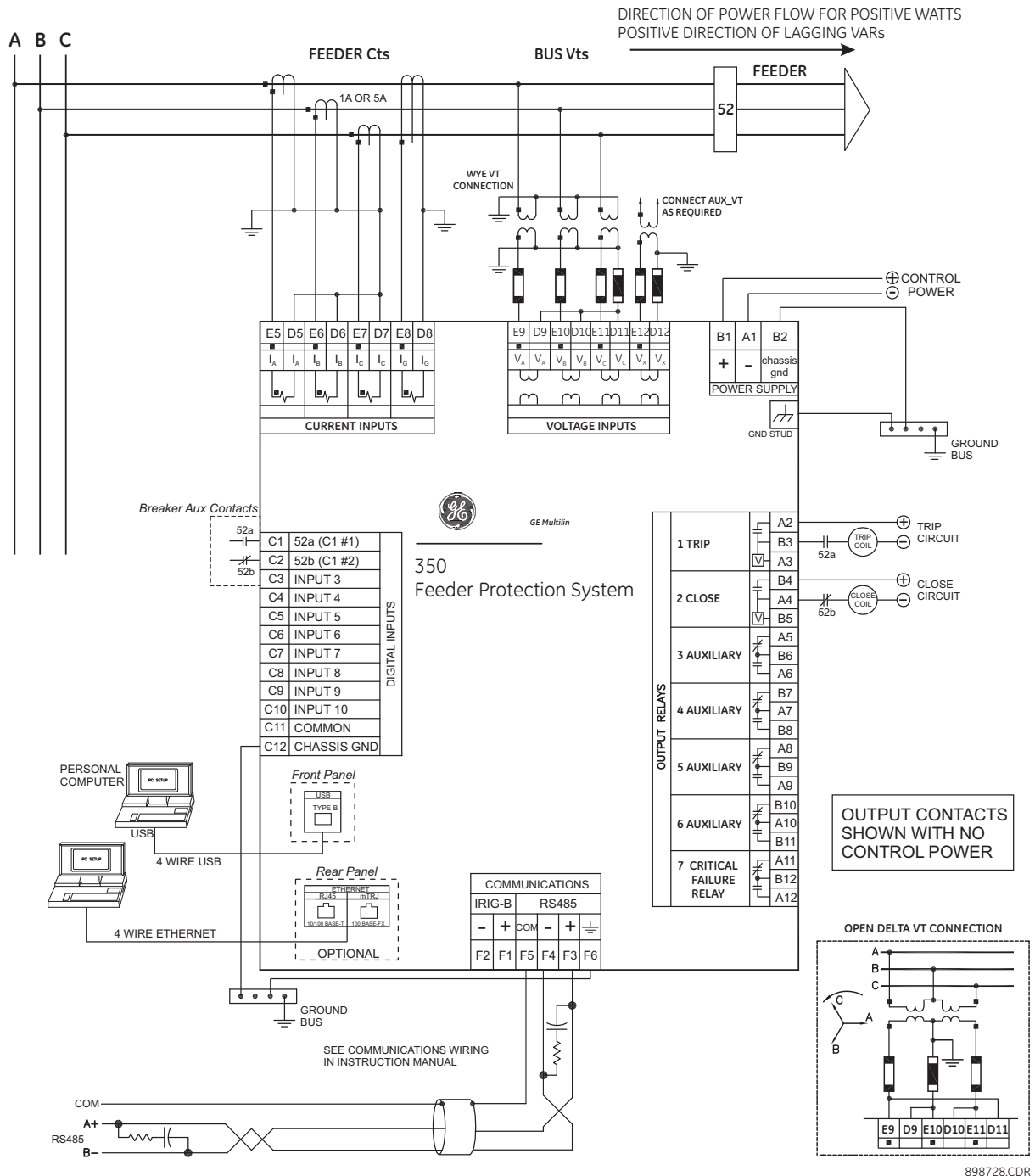


Figure 2-27: Typical wiring diagram - Drawout

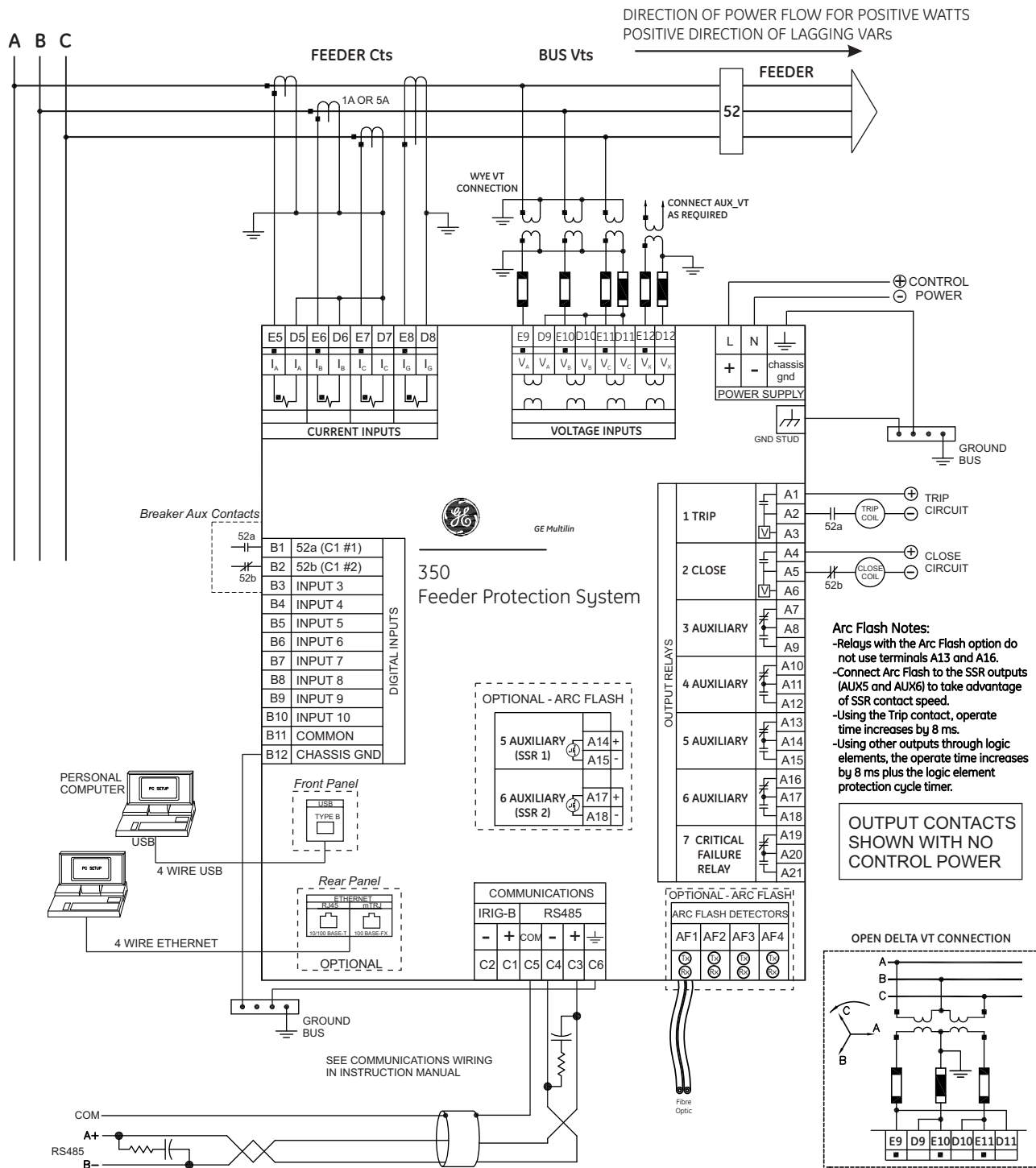


Figure 2-28: Typical wiring diagram - Non-drawout

350 Terminal identification



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.

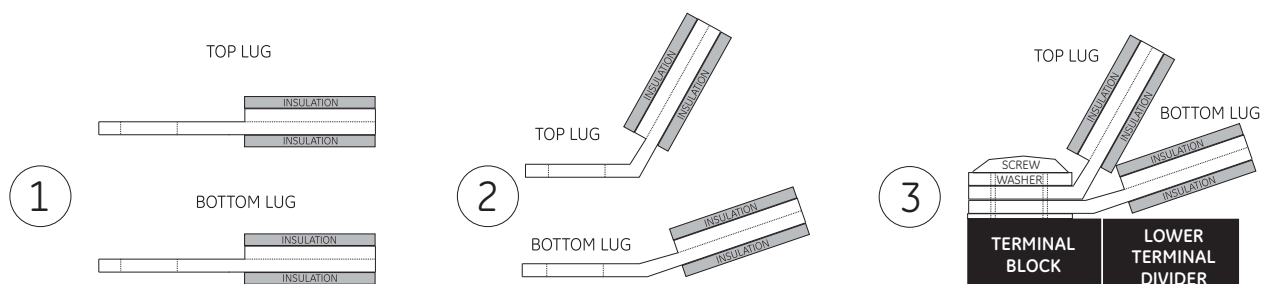


Figure 2-29: Orient the Lugs correctly...



Figure 2-30: CORRECT INSTALLATION METHOD

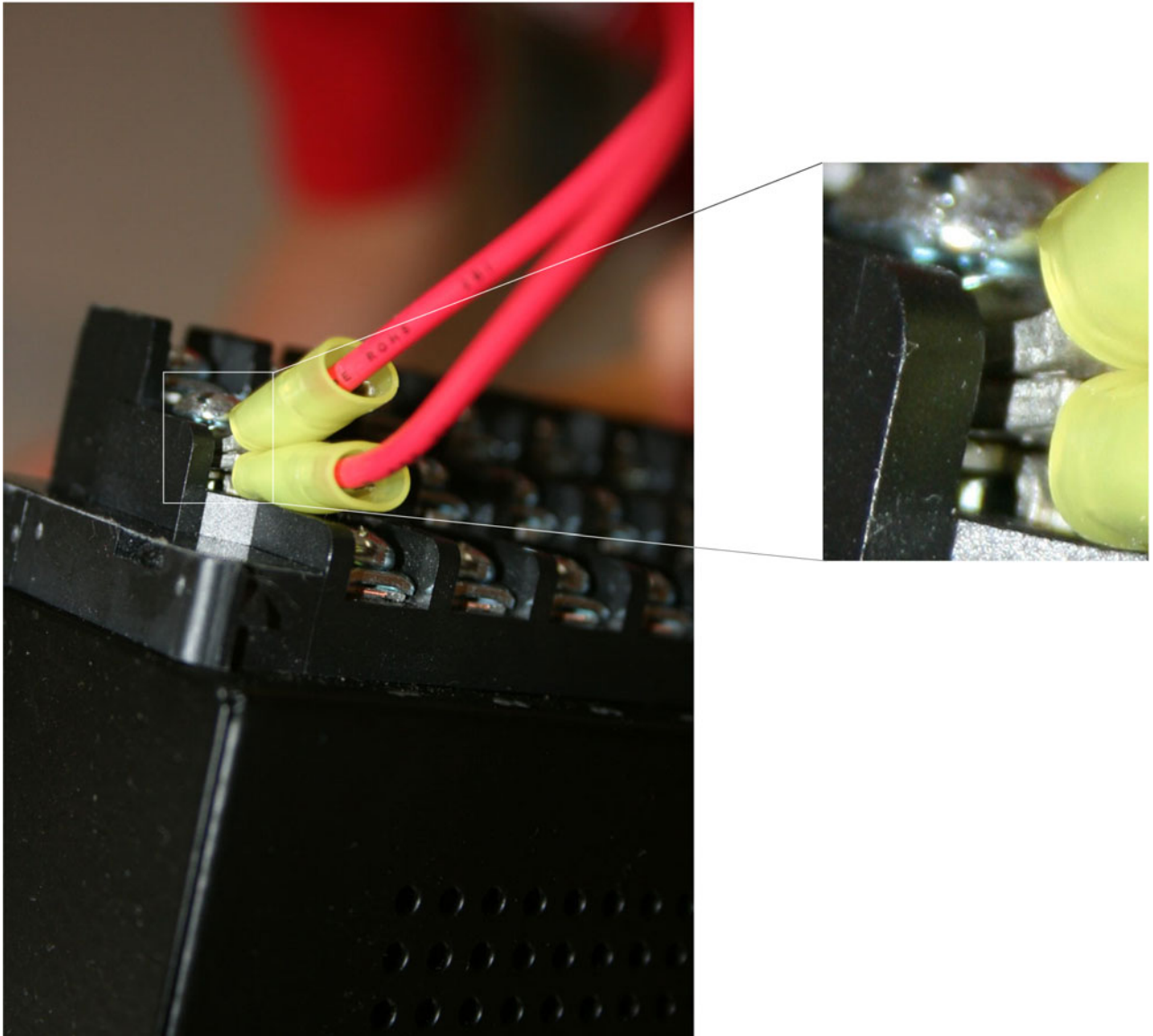


Figure 2-31: INCORRECT INSTALLATION METHOD (lower lug reversed)

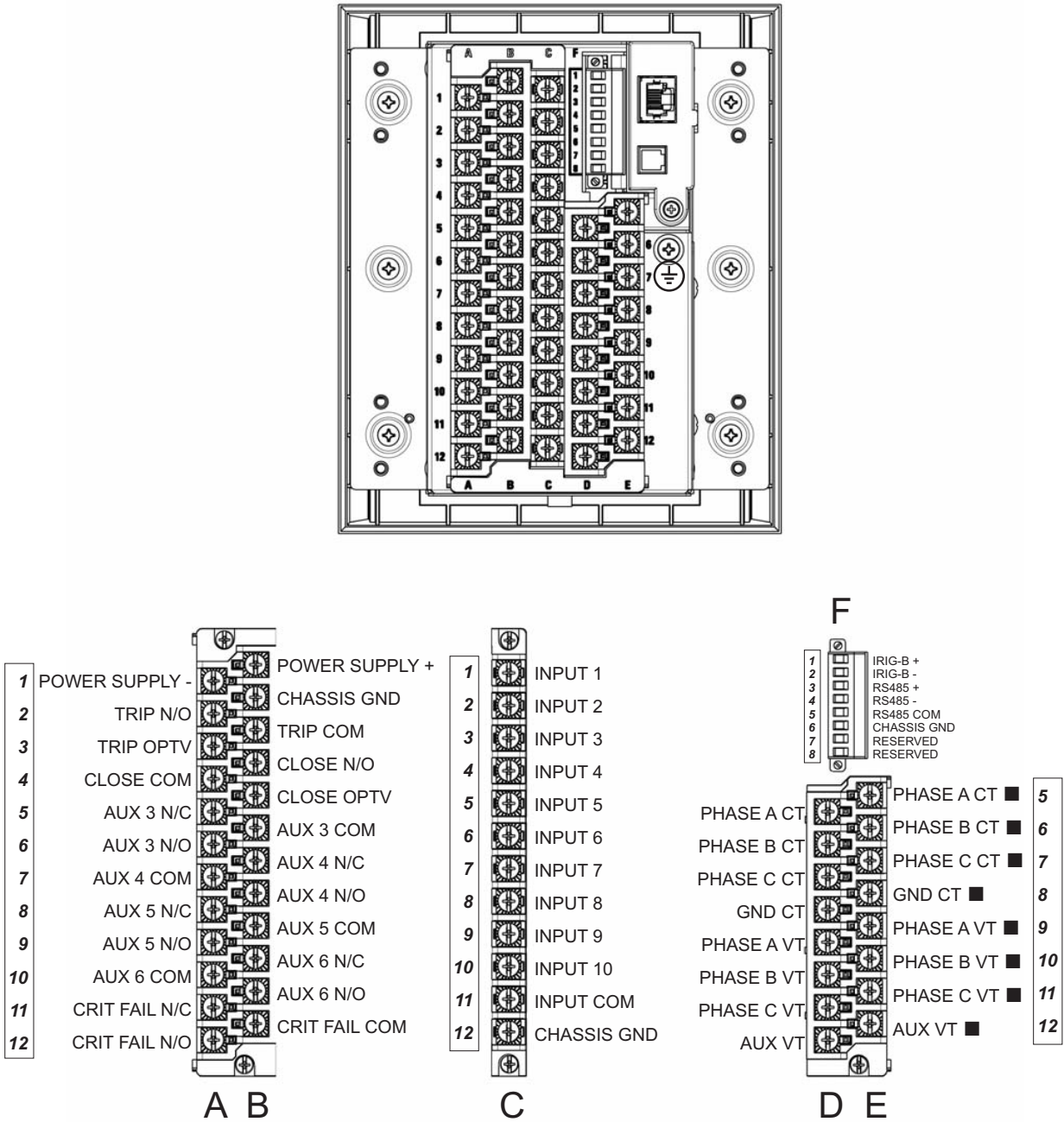


Figure 2-32: 350 Terminal Identification - standard(drawout)

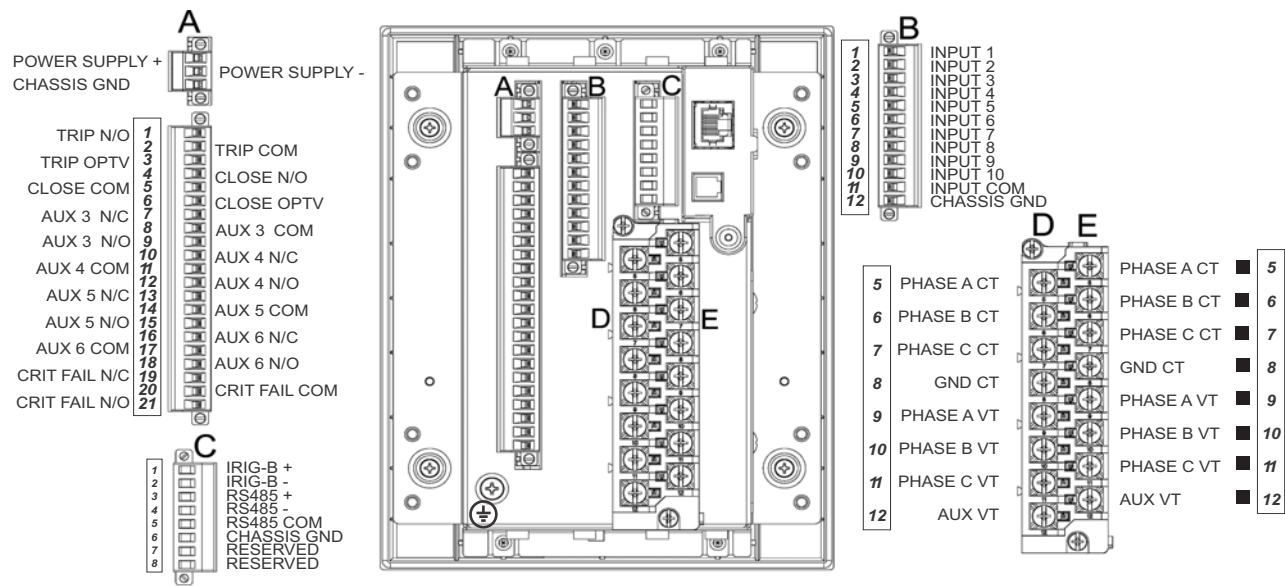


Figure 2-33: 350 Terminal Identification - Non-drawout

Wire range

Use the following guidelines 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 mm² to 0.3 mm²): Single wire termination with/without 9.53 mm (0.375") maximum diameter ring terminals (#8).
- 14 AWG to 22 AWG (2.1 mm² to 0.3 mm²): Multiple wire termination with matching wire sizes and stranding. Two wires maximum per circuit.
- 14 AWG to 22 AWG (2.1 mm² to 0.3 mm²): Multiple wire termination with 9.53 mm (0.375") maximum diameter ring terminals (#8). Two ring terminals maximum per circuit.
- Suggested wiring screw tightening torque, tighten to 12 in-lb (1.35 N-m).
- Minimum suggested temperature rating for the conductors is 75C.

Use the following guidelines when selecting wires to connect to terminal strip F (Drawout case design), and terminal strips A,B,C (Non-drawout case design):

- 12 AWG to 24 AWG (3.3 mm² to 0.2 mm²)
- Suggested wiring screw tightening torque: 4.5 in-lbs (0.5 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.

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. When the connections adhere to this drawing, the arrow shows the direction of power flow for positive watts and the positive direction of lagging vars. The phase sequence is user programmable for either ABC or ACB rotation.

Current inputs

The 350 relay has four (4) 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 $20 \times$ 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

One dedicated ground input is referred to throughout this manual as the **Ground Current** or **Sensitive Ground Current** input. 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 input (Terminals D8 and E8) is used in conjunction with a Zero Sequence CT as source, or in the neutral of wye-connected source CTs. The ground current input can be used to polarize the neutral directional element. 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) the sensitive ground current input is intended for use either 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 specifications.

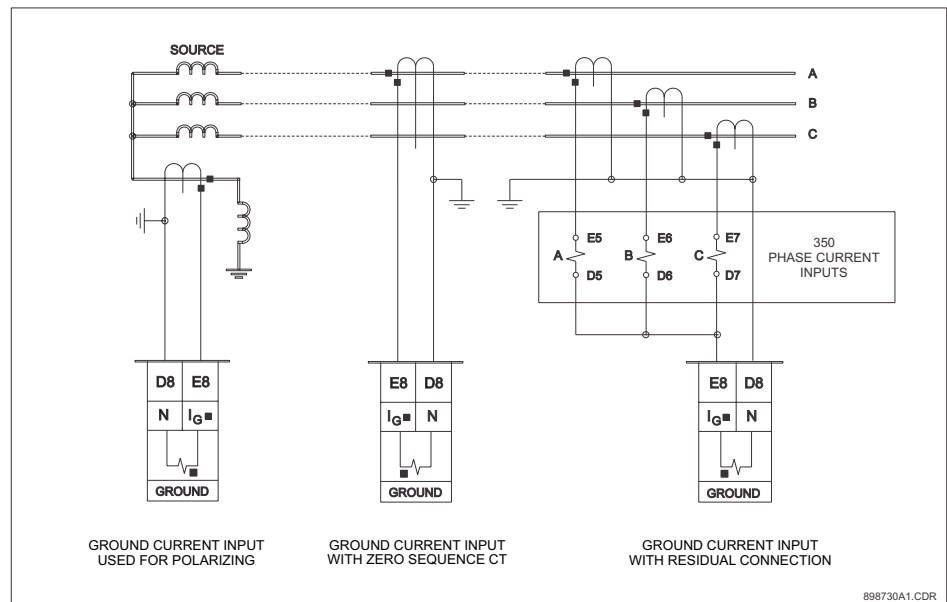


Figure 2-34: Ground/Sensitive Ground wiring

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.

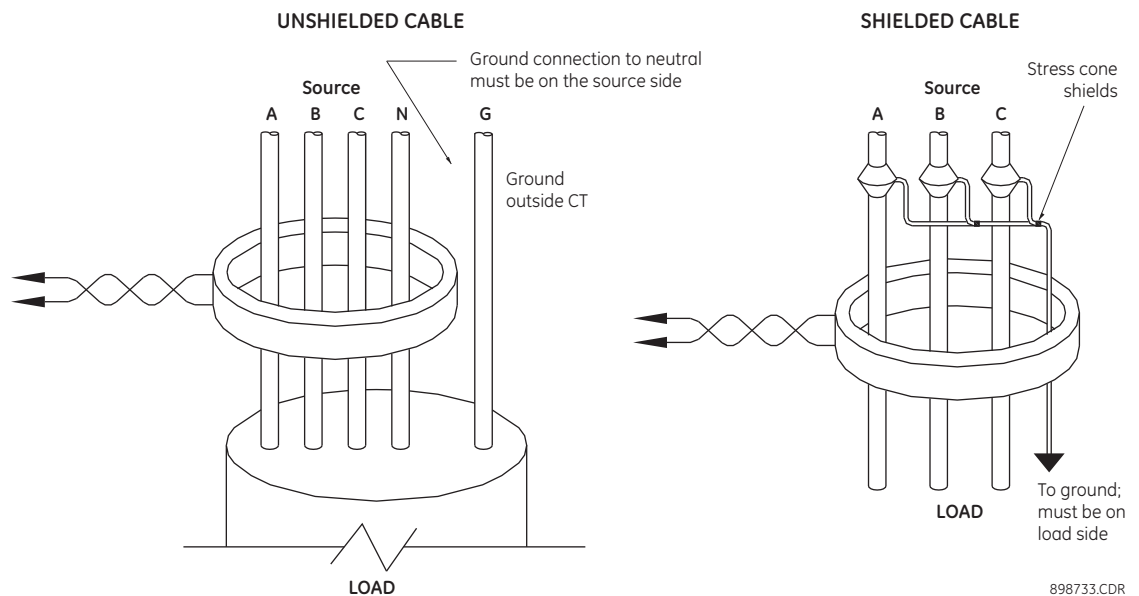


Figure 2-35: Zero sequence core balance (CT) installation

Voltage inputs

The 350 relay has four channels for AC voltage inputs, each with an isolating transformer. Voltage transformers up to a maximum 5000:1 ratio may be used. The nominal secondary voltage must be in the 50 to 240 V range. The three phase inputs are designated as the “bus voltage”. The Bus VT connections most commonly used, wye and delta (or open delta), are shown in the typical wiring diagram.



If Delta VTs are used, the zero sequence voltage (V0) and neutral/sensitive ground polarizing voltage (–V0) will be zero. Also, with the Delta VT connection, the phase-neutral voltage cannot be measured and will not be displayed.



The 350 relay can be applied to both metering and protection feeders with up to 550 kV phase-to-phase voltage. Please ensure that the selected VT ratio and VT secondary do not result in a primary voltage exceeding 550 kV.

The single phase input is designated as the “Aux VT Input”. The Aux VT input channel can be connected for either phase-neutral voltage V_{an} , V_{bn} , V_{cn} , or for phase-phase voltage V_{ab} , V_{bc} , V_{ca} as shown below.

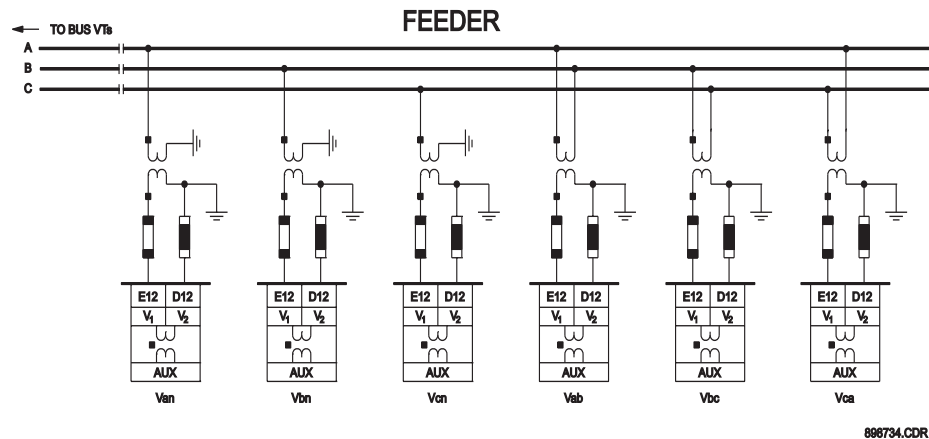


Figure 2-36: Auxiliary VT connections

Control power



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))



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.



Isolate power prior to servicing.



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

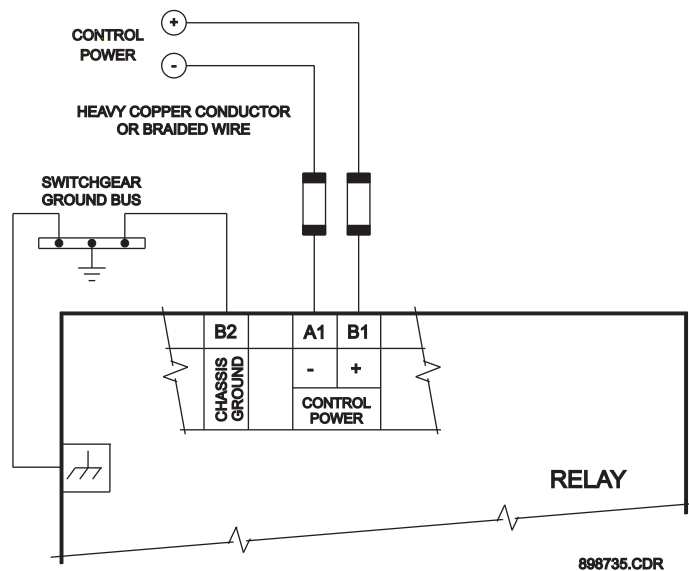


Figure 2-37: Control power connection

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).



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.

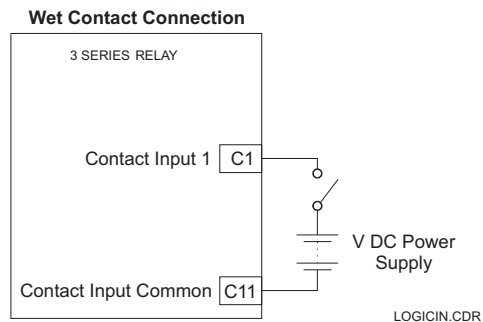


Figure 2-38: Wet contact connections

Trip and Close output relays

The 350 relay is equipped with seven electromechanical output relays: two special relays designed for Breaker trip and close (Relay 1 “Trip”, Relay 2 “Close”), 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 Trip and Close output relays is designed to be controlled by the state of the circuit breaker as monitored by a 52a or 52b contact.

- The Trip and Close 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. The Close Relay is de-energized after 200 ms.
- If a delay is programmed for the Trip or Close 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. Close Relay remains operational until 52a indicates a closed breaker.
Yes	No	Trip Relay remains operational until 52a indicates an open breaker. Close Relay remains operational until 52a indicates a closed breaker.
No	Yes	Trip Relay remains operational until 52b indicates an open breaker. Close Relay remains operational until 52b indicates a closed 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. Close Relay operates for 200 ms.

Breaker monitoring (Trip and Close coil monitoring) is performed by a built-in voltage monitor on Form A output relays: #1 Trip, and #2 Close. 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 Trip coil monitoring, or/and B4, and B5 for Close 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 (Close) coil is effectively normal. If the Trip (Close) coil circuit gets disconnected, or if in general a high resistance is detected in the circuitry, a Trip (Close) 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 (close) coil to the relay’s trip output #1 terminals (output #2 Close coil monitoring) for both no voltage monitoring and voltage monitoring of the trip (close) 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.



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

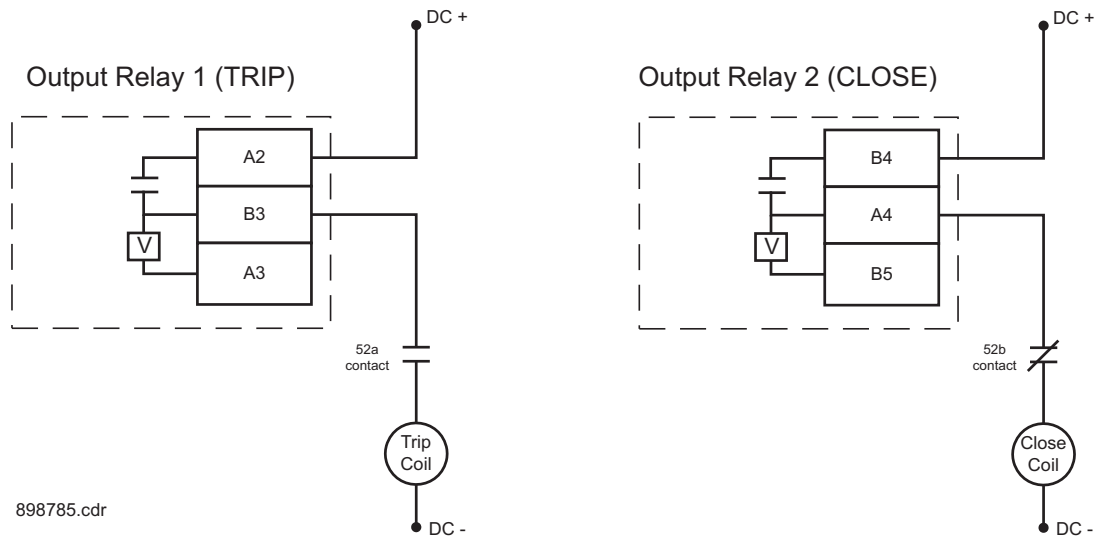


Figure 2-39: Trip and Close circuits with no voltage monitoring



All AUX contacts are shown when the breaker is open.

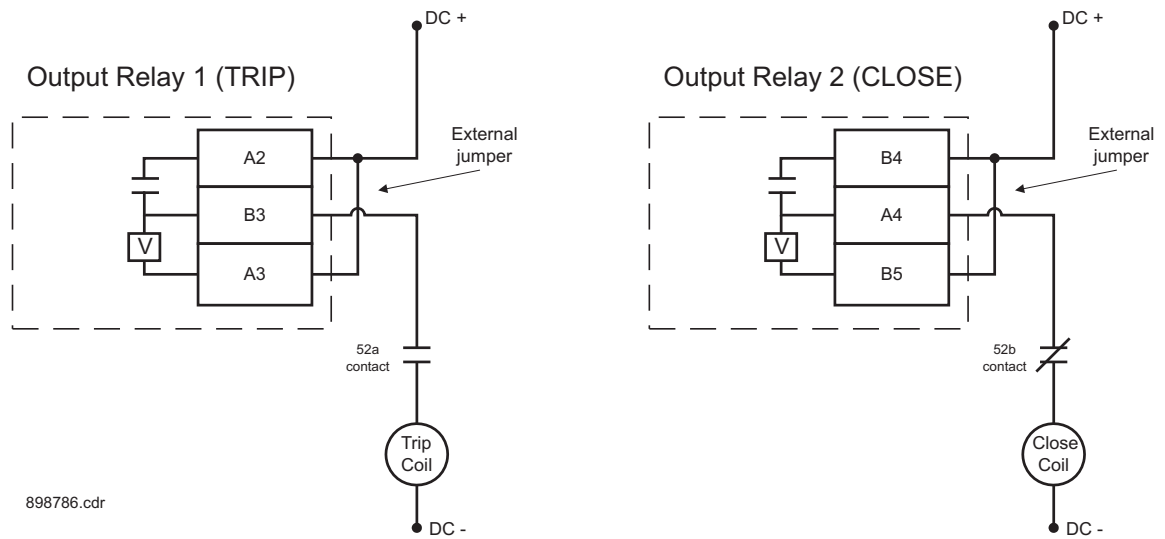


Figure 2-40: Trip and close circuits with voltage monitoring

Serial communications

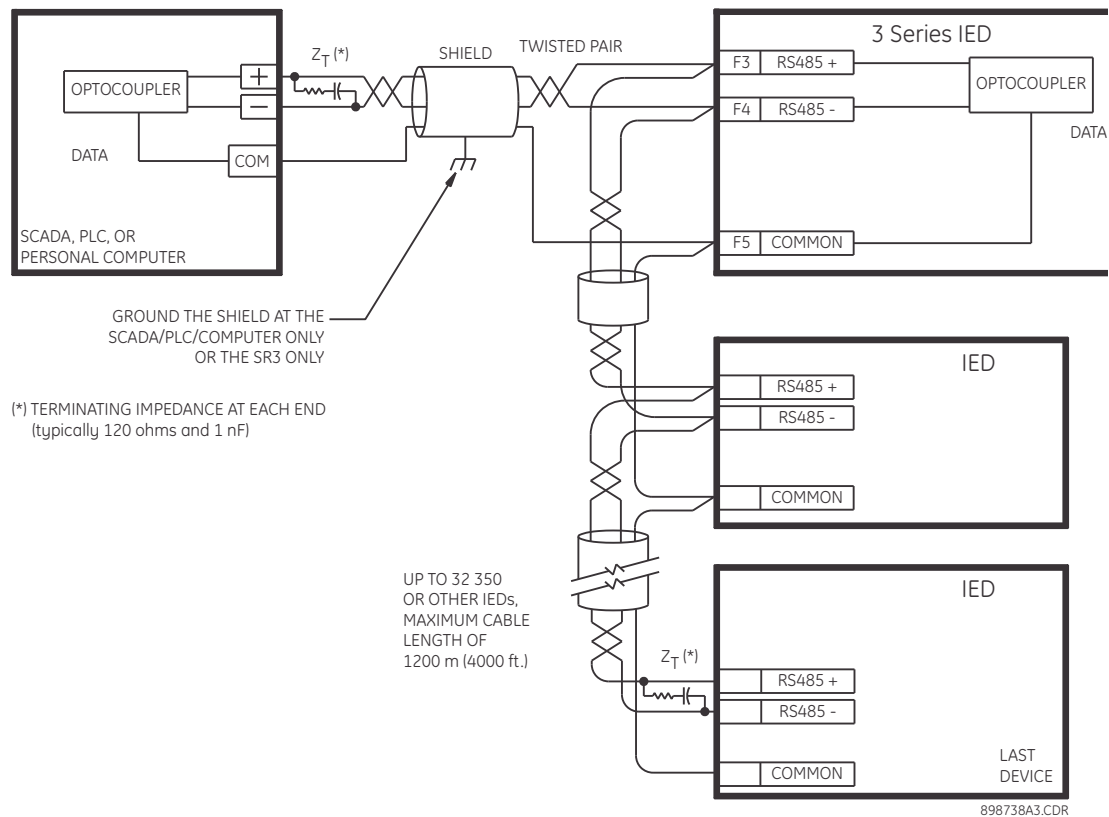


Figure 2-41: RS485 wiring diagram

One two-wire RS485 port is provided. Up to 32 350 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.

NOTICE

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 350. 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 350 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 $\frac{1}{4}$

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 350 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.

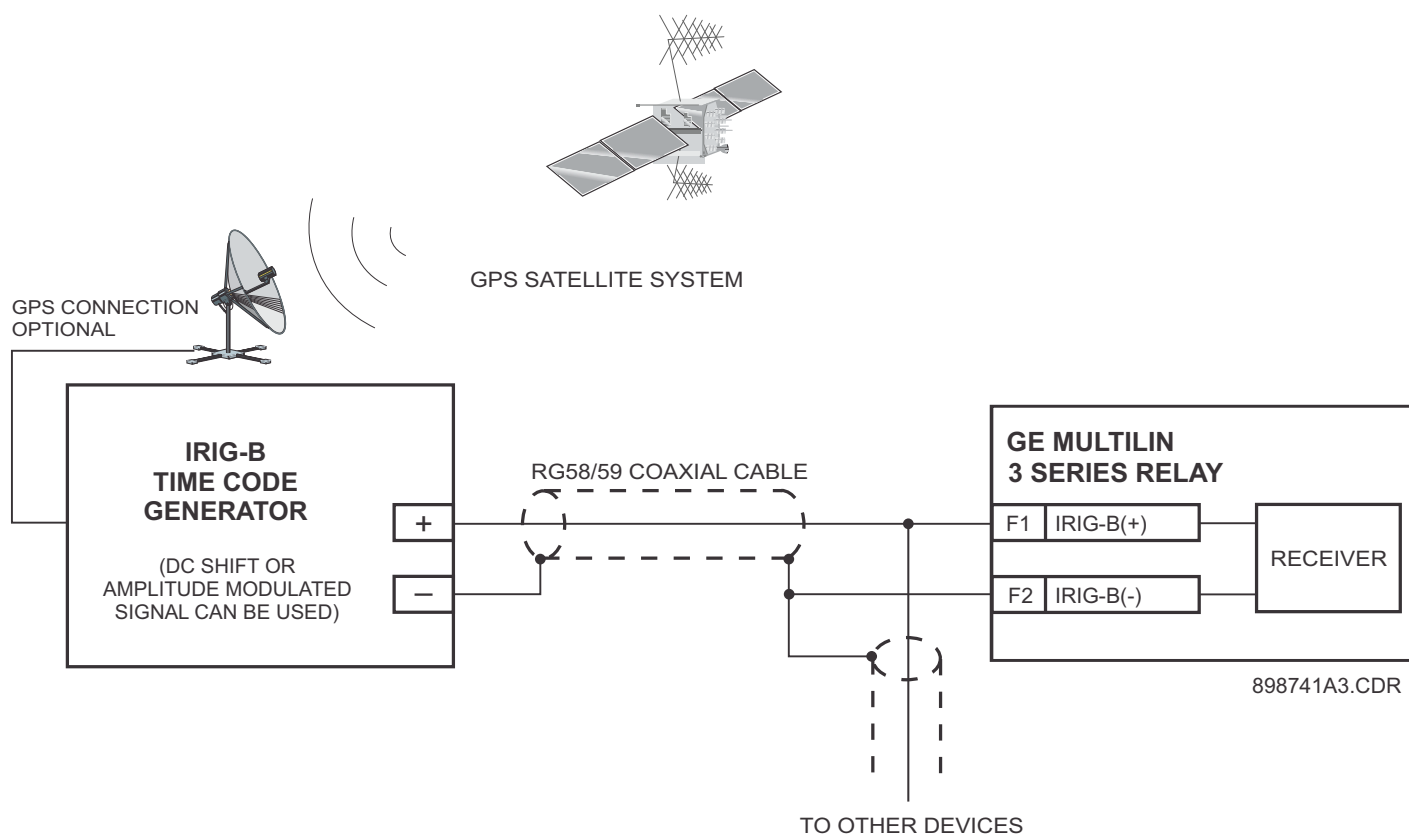


Figure 2-42: IRIG-B connection

350 Feeder Protection System

Chapter 3: Interfaces

There are two methods of interfacing with the 350 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 350 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

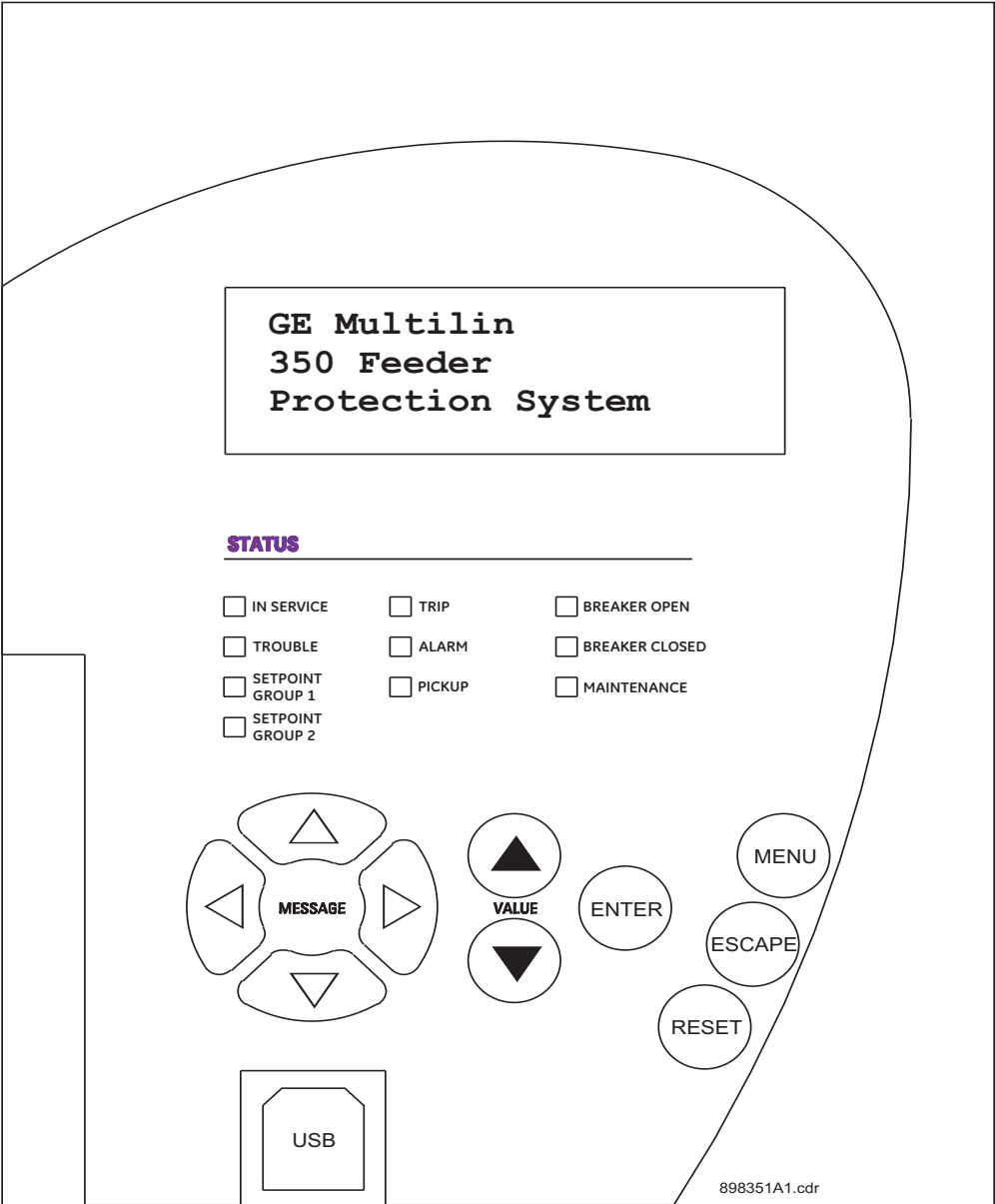


Figure 3-1: 350 Feeder Protection System Front Panel - Non-programmable LEDs

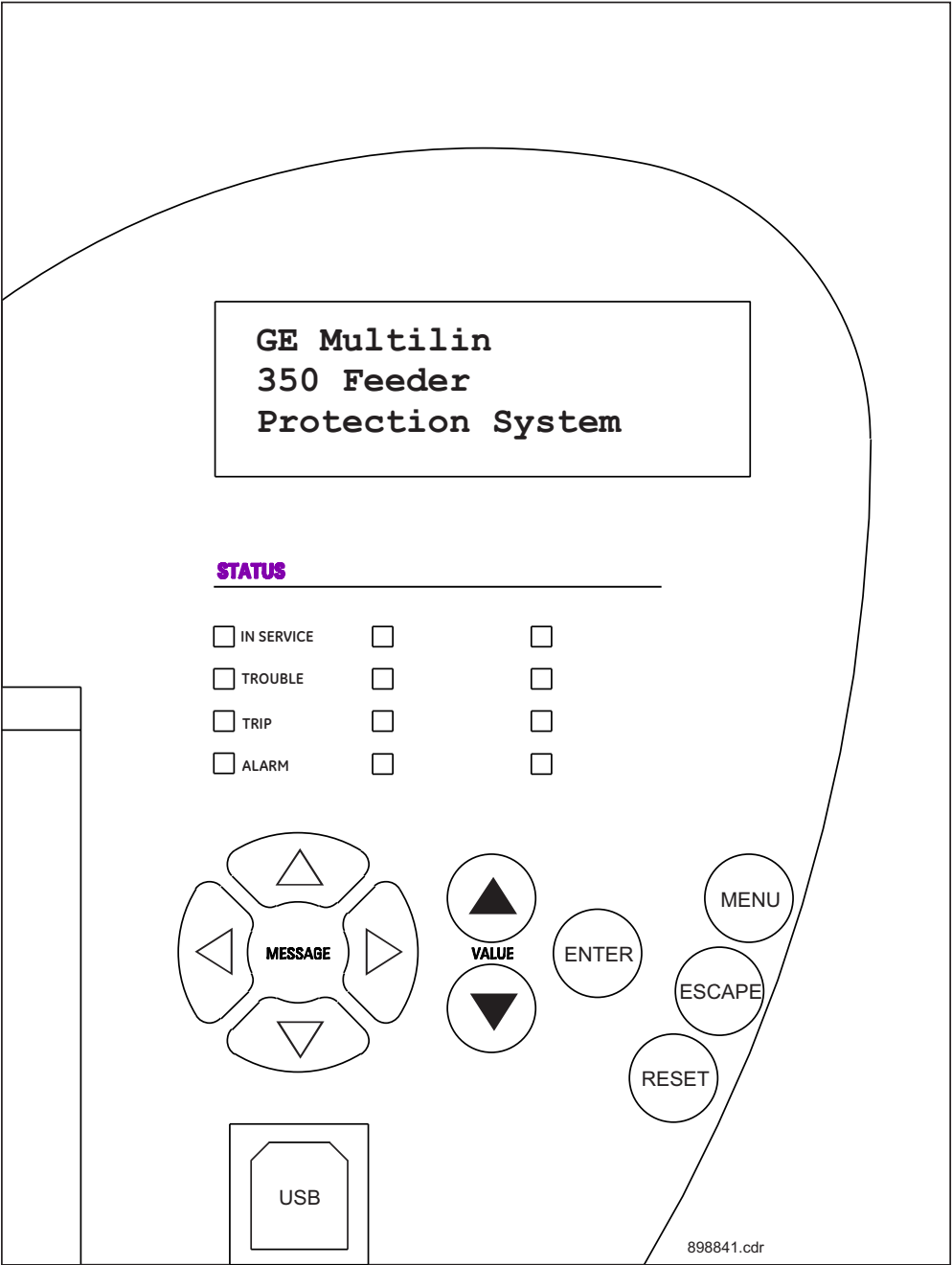


Figure 3-2: 350 Feeder Protection System Front Panel - Programmable LEDs

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 350 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:

ACTUAL VALUES
COMMANDS
QUICK SETUP
SETPOINTS
MAINTENANCE

Figure 3-3: The five Main Menu headers

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.

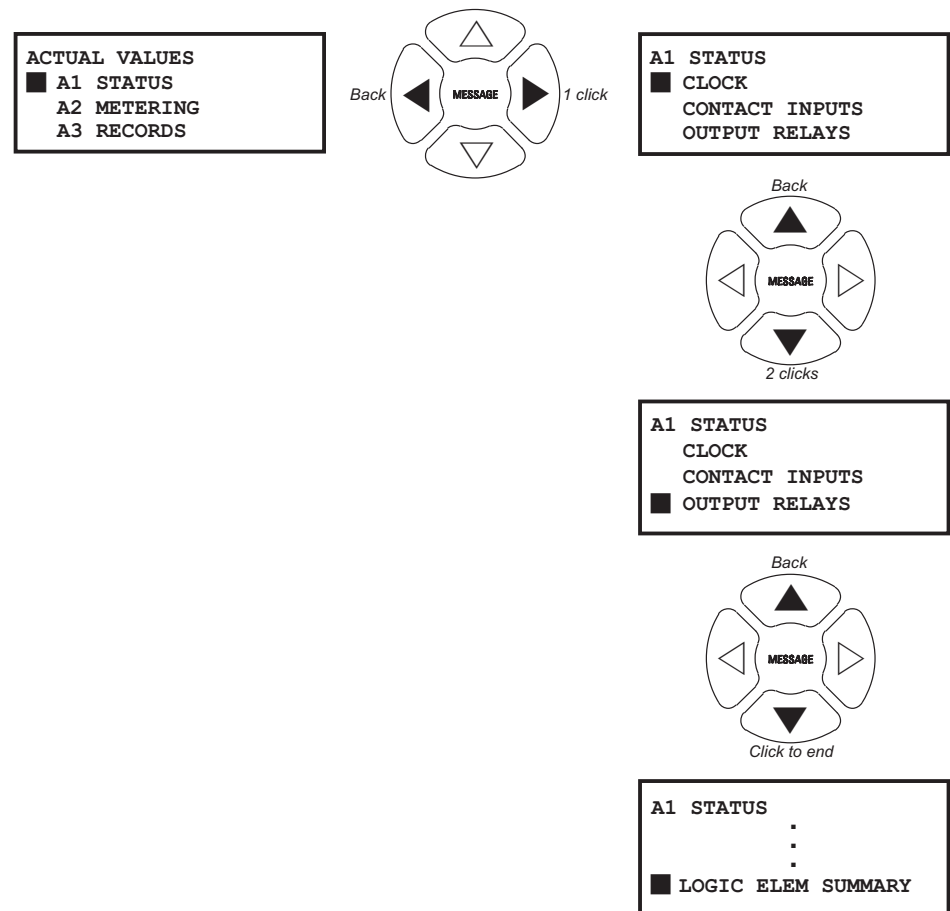


Figure 3-4: Typical paging operation from Main Menu selection

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**

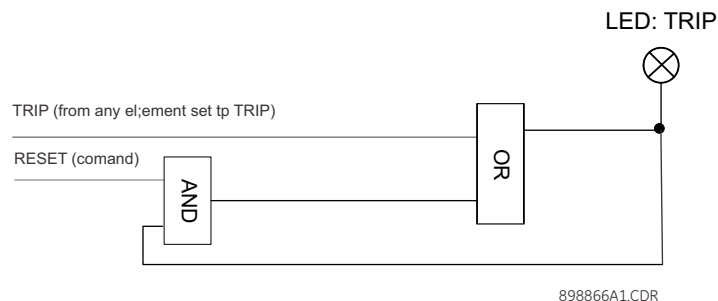
This LED will turn “ON”, when the relay is in the not programmed (Not Ready) state under **S1 RELAY SETUP > INSTALLATION > RELAY STATUS**, or upon detection of a major self-test error. The relay will turn back to “IN-SERVICE” if no major self-test error is present.

- **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.

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

When the breaker is open, this indicator will be on continuously.

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

When the breaker is closed, this indicator will be on continuously.

- **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.



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

LED status indicators - Front panel with programmable LEDs

- **IN SERVICE: Green**

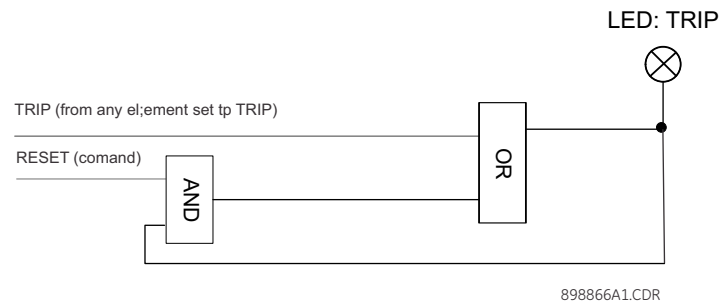
This LED will be continuously “ON”, when the relay is set to “Ready” under **S1 RELAY SETUP > INSTALLATION > RELAY STATUS**, and no major self-test errors have been detected.

- **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**



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:

```

A4 TARGET MESSAGES
Cause <function>
State: Operate
▼ Phase:
  
```

Figure 3-5: Typical target message

Example of a Phase IOC1 operation - phase A:

Phase IOC1 function: Trip

```

A4 TARGET MESSAGES
Ph IOC1 Trip
State: Operate
▼ Phase:A
  
```

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.

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.

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

Figure 3-6: Typical Self-test warning

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 PRODUCT 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 350 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
MAINTENANCE ALERT: High Ethernet Traffic	No		Every 5 seconds*	

Self-test Error Message	Latched Target Message?	Description of Problem	How Often the Test is Performed	What to do
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.

* 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.

```
S3 PHASE IOC
BLOCK 1
Logic Element 8
<SETPOINT STORED>
```

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.

AR IN PROGRESS

This flash message appears when the Autoreclosure is in progress performing the configured sequence.

Software setup

Quick setup - Software interface

Quick Setup SR350 Relay(Device Offline)

Quick Setup

Relay Status: Nominal Frequency:

Current Sensing

Phase CT Primary: A
 Phase CT Secondary:
 Sens. Ground CT Type:
 Sens. Ground CT Primary: A

Voltage Sensing

VT Connection:
 VT Secondary: V
 VT Ratio: : 1
 Aux VT Secondary: V
 Aux VT Ratio: : 1

Protection Elements

Phase TOC: Disabled	Sens. Ground TOC: Disabled	Neutral TOC: Disabled
Pickup: 0.00 x CT	Pickup: 0.000 x CT	Pickup: 0.00 x CT
Curve: Extremely Inverse	Curve: Extremely Inverse	Curve: Extremely Inverse
TDM: 0.00	TDM: 0.00	TDM: 0.00
Phase IOC 1: Disabled	Sens. Ground IOC 1: Disabled	Neutral IOC 1: Disabled
Pickup: 0.00 x CT	Pickup: 0.000 x CT	Pickup: 0.00 x CT

- **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 350 firmware

The EnerVista 3 Series Setup software allows immediate access to all 350 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 350 connected to the computer. In this case, settings may be saved to a file for future use. If a 350 is connected to a PC and communications are enabled, the 350 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 the GE Multilin website at <http://www.gegridsolutions.com/multilin>

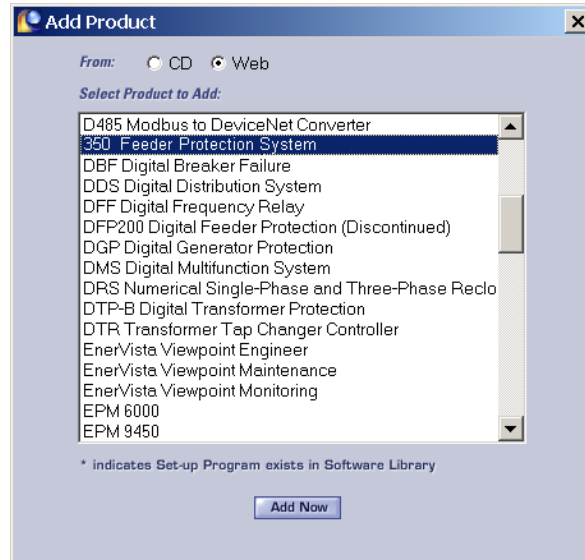
Installing the EnerVista 3 Series Setup software

After ensuring the minimum requirements indicated earlier, use the following procedure to install the EnerVista 3 Series Setup software from the GE Multilin website using EnerVista Launchpad. The no-charge EnerVista Launchpad software provides easy installation of Multilin software, notification of new software and document releases, and manages configuration files for different Multilin devices.

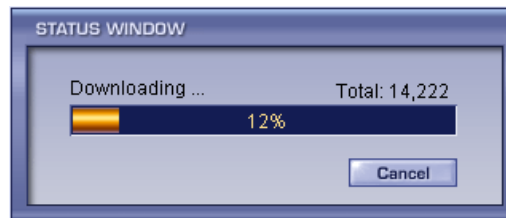
1. Navigate to: <http://www.gegridsolutions.com/multilin/enervista/launchpad>.
2. Click **Software** on the left menu and download the latest EnerVista Launchpad package.
3. Double-click the downloaded file to start the installation.
4. When installation is complete, start the EnerVista Launchpad application.
5. Click the **IED Setup** section of the LaunchPad toolbar.



6. In the EnerVista Launchpad window, click the **Add Product** button and select the 350 Feeder Protection System as shown below. Select the Web option to ensure the most recent software release, then click the **Add Now** button to list software items for the 350 .



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

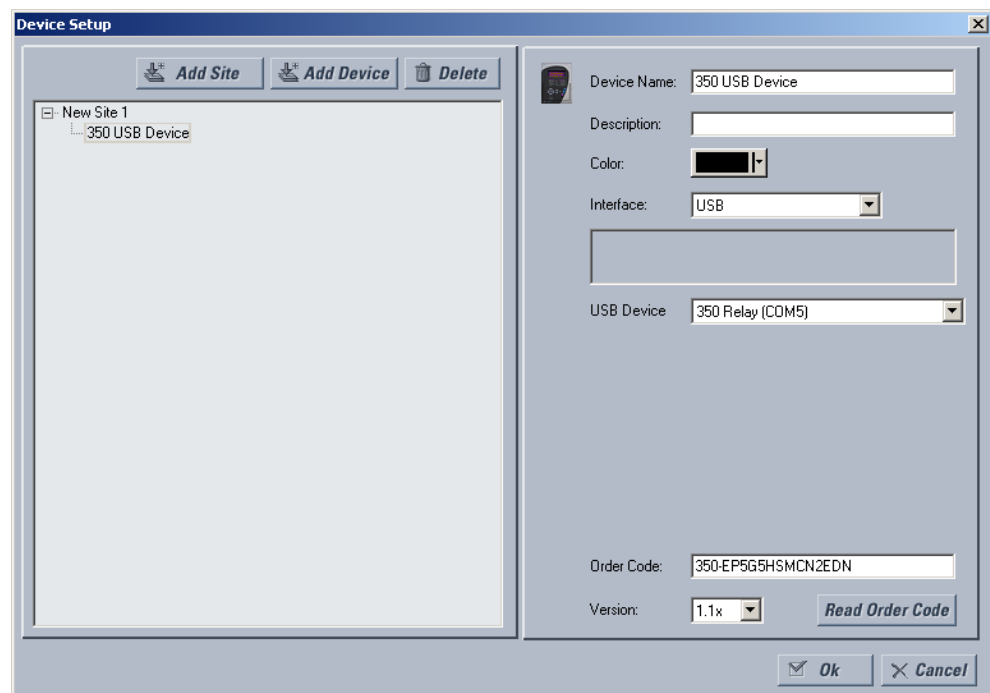


8. Select the complete path, including the new directory name, where the EnerVista 3 Series Setup software will be installed.
9. Click on **Next** to begin the installation. The files will be installed in the directory indicated, the USB driver will be loaded into the computer, and the installation program will automatically create icons and add EnerVista 3 Series Setup software to the Windows start menu.
10. The 350 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 350 Relay using the USB port:

11. Plug the USB cable into the USB port on the 350 Relay then into the USB port on your computer.
12. Launch EnerVista 3 Series Setup from LaunchPad.
13. In **EnerVista > Device Setup**:



14. Select **USB** as the Interface type.
15. Select **350 Relay** as the USB device.

Upgrading the software

The latest EnerVista software and firmware can be downloaded from:

<https://www.gegridsolutions.com/>

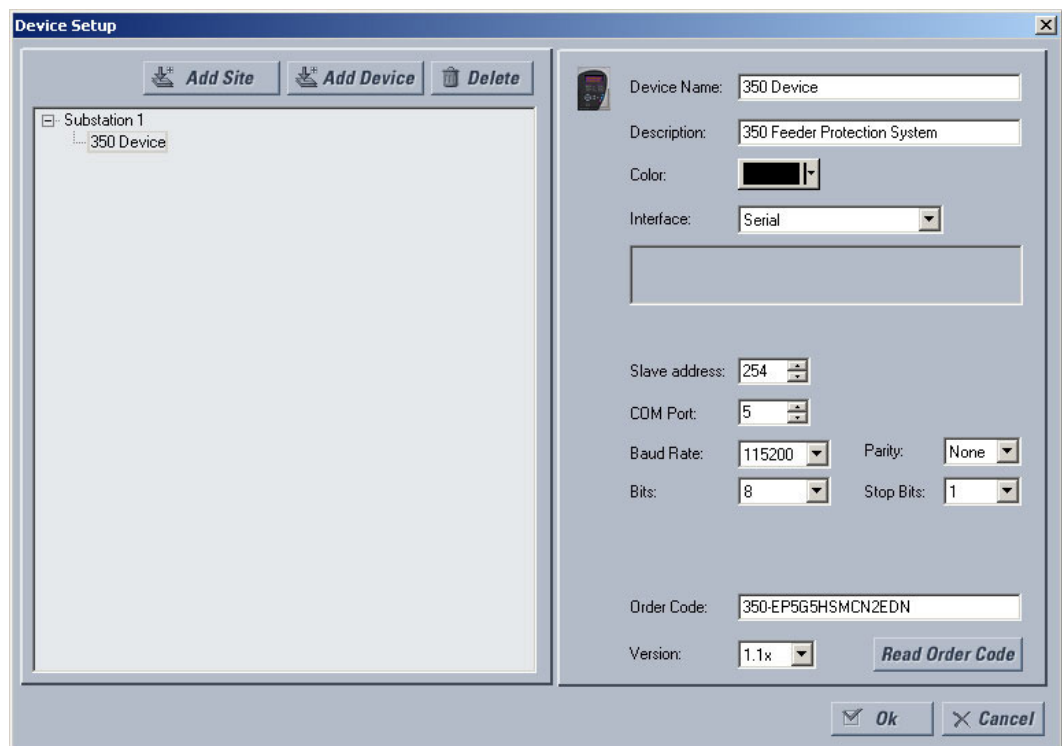
After upgrading, check the version number under **Help > About**. If the new version does not display, try uninstalling the software and reinstalling the new versions.

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 350 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 350 Site Device has now been configured for USB communications. Proceed to *Connecting to the Relay* below, to begin communications.

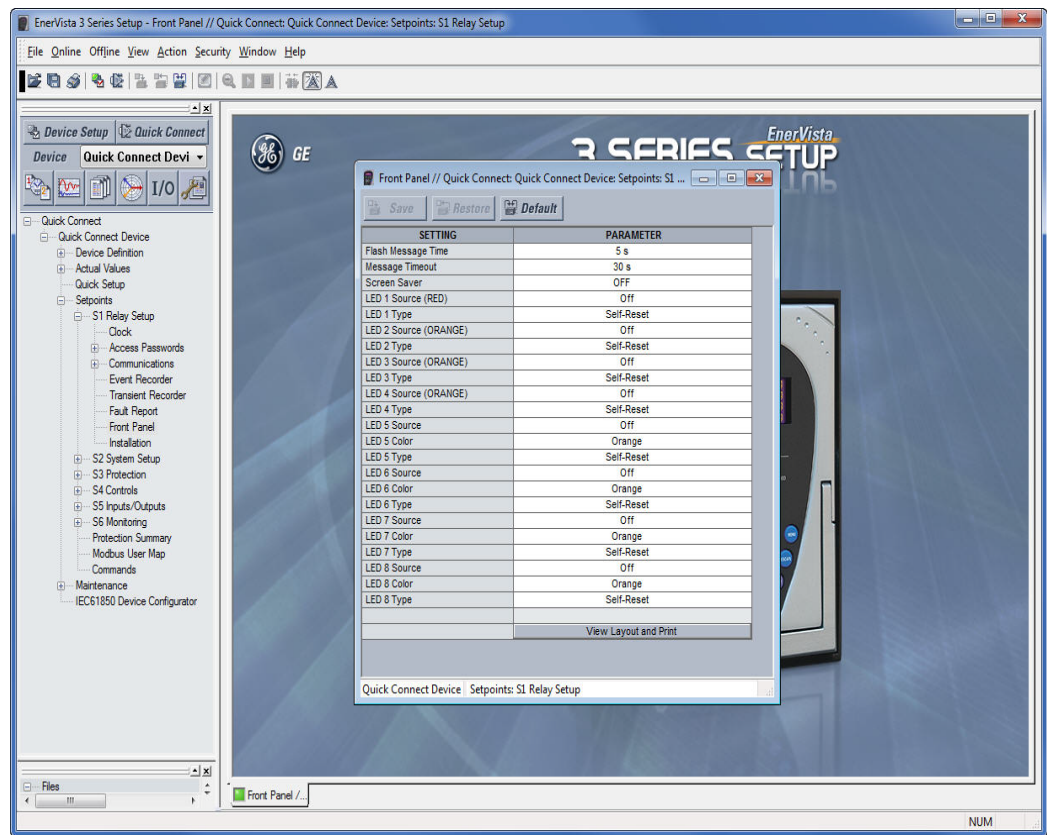
Using the Quick Connect feature

The **Quick Connect** button can be used to establish a fast connection through the front panel USB port of a 350 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 350 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 350 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.

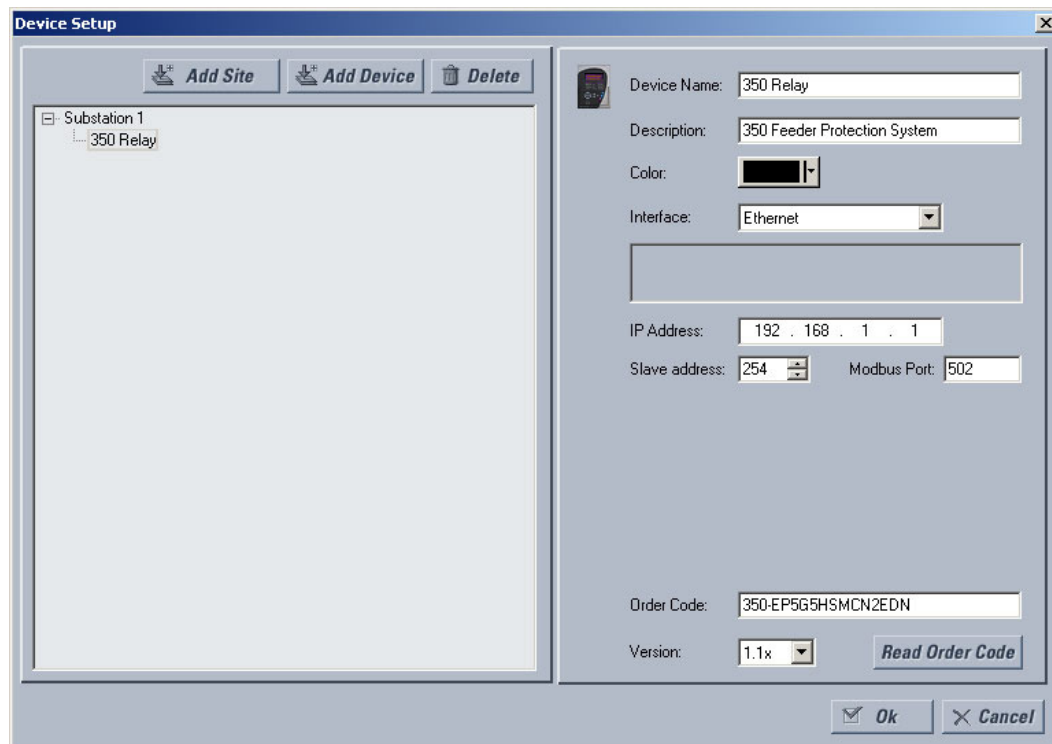
Configuring Ethernet communications



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

350 supports a maximum of 3 TCP/IP sessions.

1. Install and start the latest version of the EnerVista 3 Series Setup Setup software. 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.



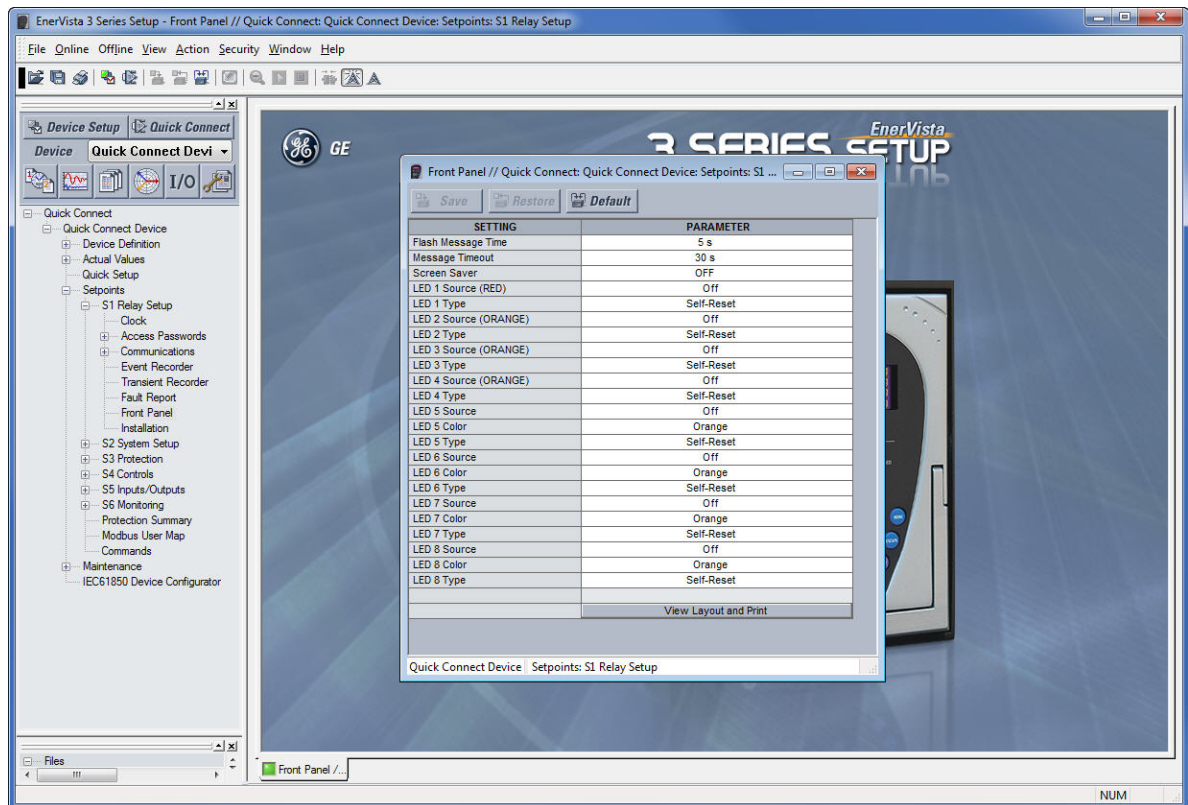
8. Enter the IP address, slave address, and Modbus port values assigned to the 350 relay (from the S1 RELAY SETUP > COMMUNICATIONS > ETHERNET menu).
9. Click the **Read Order Code** button to connect to the 350 and upload the order code. If a communications error occurs, ensure that the Ethernet communication 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 350 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

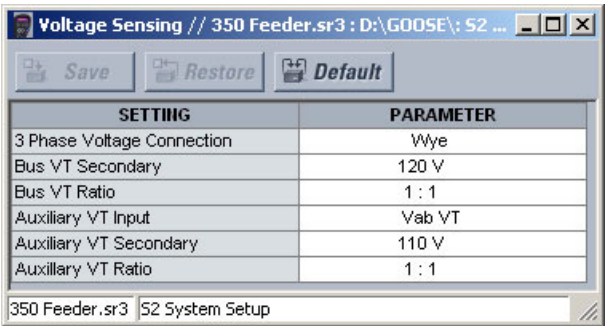
Engaging a device

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.

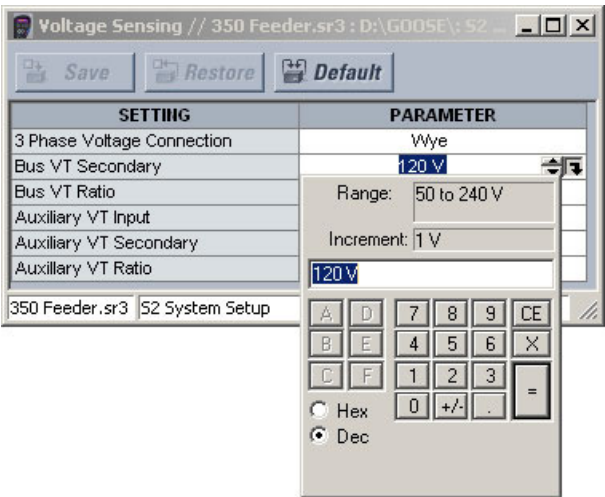
Entering setpoints

The System Setup page will be used as an example to illustrate the entering of setpoints. In this example, we will be changing the voltage sensing setpoints.

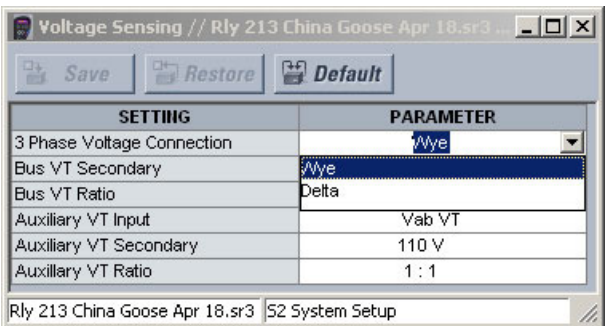
1. Establish communications with the relay.
2. Select the **Setpoint > System Setup > Voltage Sensing** menu item.
3. Select the Bus VT Secondary setpoint by clicking anywhere in the parameter box. This will display three arrows: two to increment/decrement the value and another to launch the numerical 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. **3-Phase voltage connection** below), clicking anywhere within the setpoint value box displays a drop-down selection menu arrow. Select the desired value from this list.

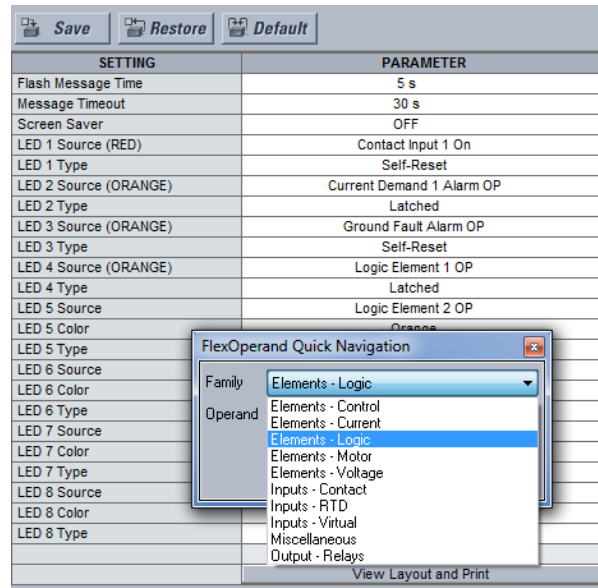


6. For setpoints requiring an alphanumeric text string (e.g. "relay name"), the value may be entered directly within the setpoint value box.
7. In the **Setpoint > System Setup > Voltage Sensing** dialog box, click on **Save** to save the values into the 350 . Click **YES** to accept any changes and 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.

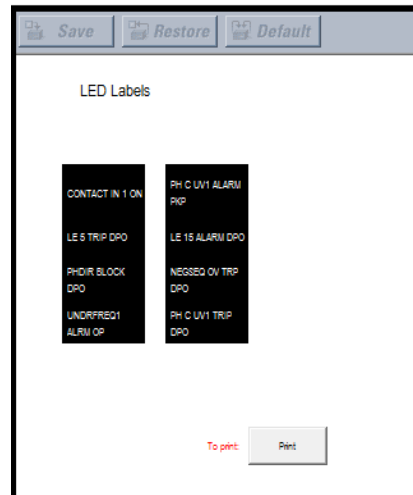
1. Establish communications with the relay.
2. Select the **Setpoint > S1 Relay Setup > Front Panel** menu item.
3. Select an LED Source setpoint by clicking anywhere in the parameter box beside an LED Source label. This opens a Quick Navigation window.



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.

 Save	 Restore	 Default
SETTING	PARAMETER	
Flash Message Time	5 s	
Message Timeout	30 s	
Screen Saver	OFF	
LED 1 Source (RED)	Contact Input 1 On	
LED 1 Type	Self-Reset	
LED 2 Source (ORANGE)	Current Demand 1 Alarm OP	
LED 2 Type	Latched	
LED 3 Source (ORANGE)	Ground Fault Alarm OP	
LED 3 Type	Self-Reset	
LED 4 Source (ORANGE)	Logic Element 1 OP	
LED 4 Type	Latched	
LED 5 Source	Logic Element 2 OP	
LED 5 Color	Orange	
LED 5 Type	Latched	
LED 6 Source	Emergency Restart	
LED 6 Color	Red	
LED 6 Type	Self-Reset	
LED 7 Source	Off	
LED 7 Color	Orange	
LED 7 Type	Self-Reset	
LED 8 Source	Off	
LED 8 Color	Orange	
LED 8 Type	Self-Reset	
View Layout and Print		

6. In the **Setpoint > S1 Relay Setup > Front Panel** dialog box, click **Save** to save the values into the 350 . 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 350 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.

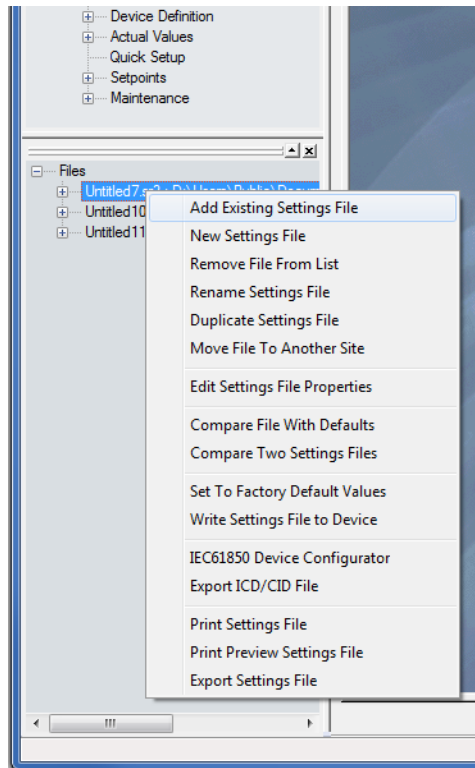
The setpoint files in the EnerVista 3 Series Setup window are accessed in the Files Window. Use the following procedure to download and save setpoint files to a local PC.

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.



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>.



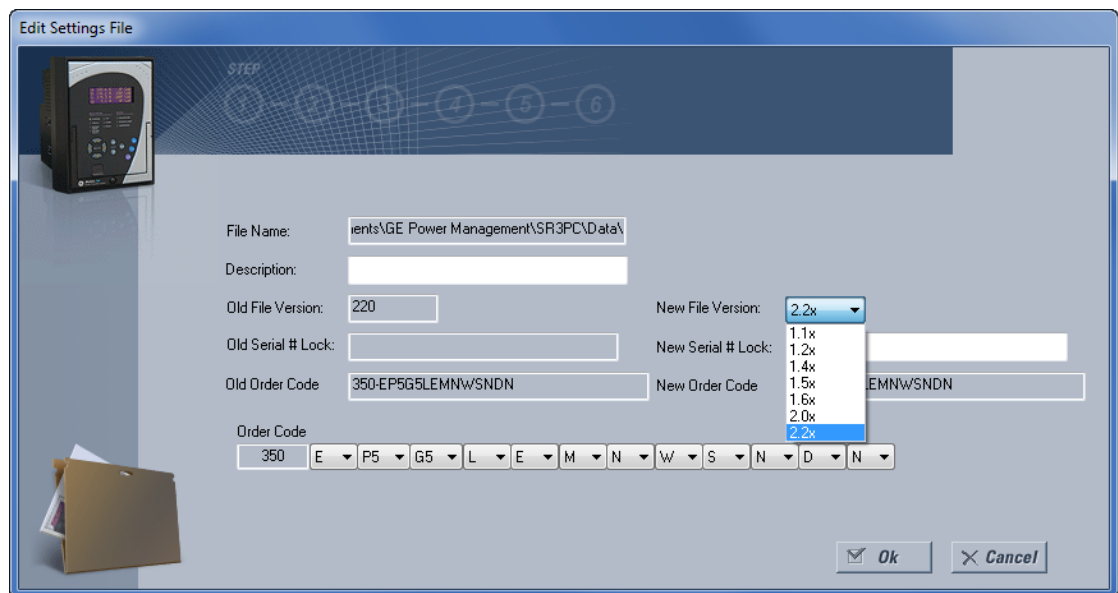
Refer to the *3 Series Retrofit Instruction Manual* for instructions on converting existing Multilin MIF II or MIV II setpoint files.

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 350 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 350 firmware has been upgraded. This is illustrated in the following procedure:

1. Establish communications with the 350 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 panel, 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 SR350_V140.sfd (Firmware Revision 1.40) and the current setpoint file revision is 1.20, change the setpoint file revision to "1.4x".



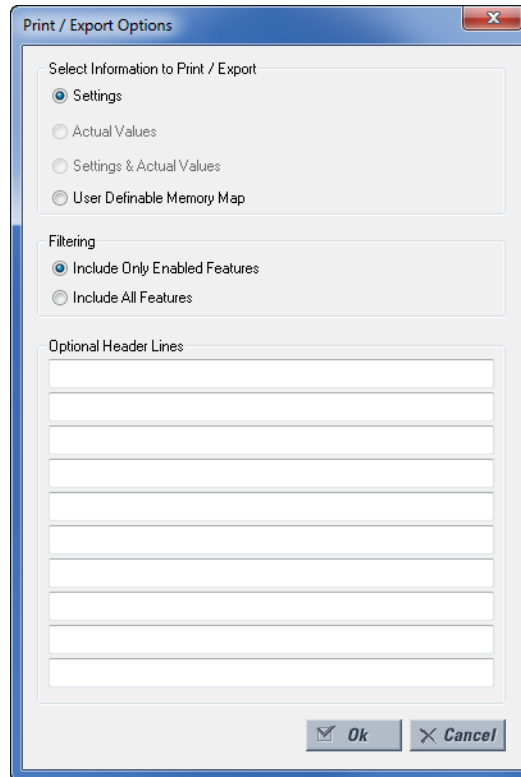
Discontinued order codes may be included to maintain back-compatibility of setpoint files. For current order codes, refer to the GE Multilin website at <http://www.gegridsolutions.com/multilin>.

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 350.

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 350 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 350 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

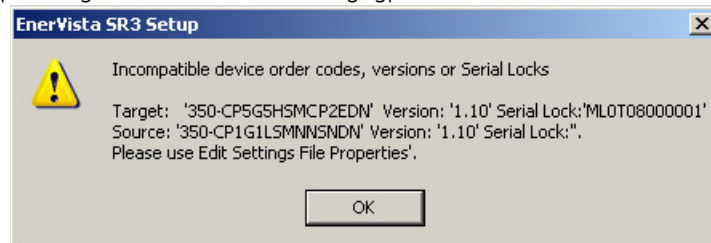
Loading setpoints from a file



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 before uninstalling the EnerVista software or 350 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 350 firmware, follow the procedures listed in this section. Upon successful completion of this procedure, the 350 will have new firmware installed with the factory default setpoints. The latest firmware files are available from the GE Multilin website at <http://www.GEgrid solutions.com/multilin>.



NOTE

EnerVista 3 Series Setup software prevents incompatible firmware from being loaded into a 350 relay.



NOTE

Before upgrading firmware, it is very important to save the current 350 settings to a file on your PC. After the firmware has been upgraded, it will be necessary to load this file back into the 350. Refer to *Downloading and Saving Setpoints Files* for details on saving relay setpoints to a file.

Loading new relay firmware

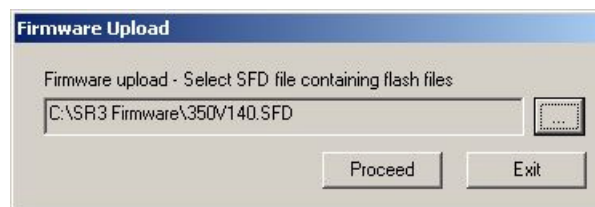
Loading new firmware into the 350 flash memory is accomplished as follows:

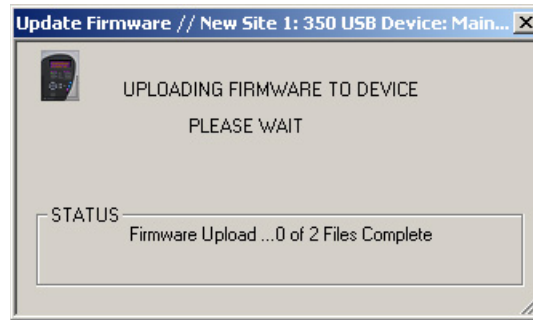
1. Connect the relay to the local PC and save the setpoints to a file as shown in *Downloading and Saving Setpoints Files*.
2. Select the **Maintenance > Update Firmware** menu item.
3. The EnerVista 3 Series Setup software will request the new firmware file. Locate the folder that contains the firmware files to load into the 350. The firmware filename has the following format:

SR350_200.SFD

↑
Firmware Rev #

4. EnerVista 3 Series Setup software now prepares the 350 to receive the new firmware file. The 350 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 350, 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 350 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 350 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.

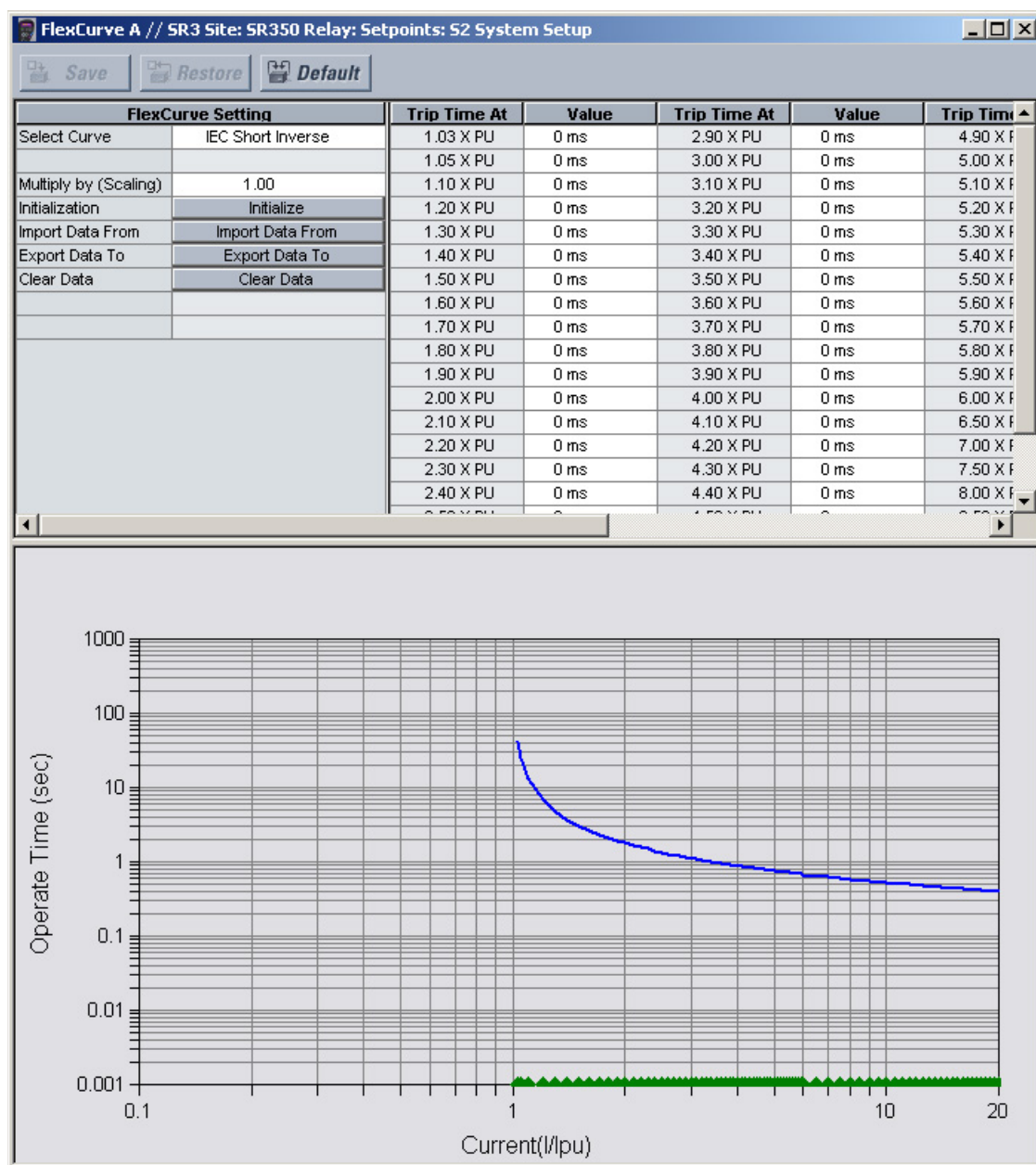
Modbus addresses assigned to firmware modules, features, settings, and corresponding data items (i.e. default values, min/max values, data type, and item size) may change slightly from version to version of firmware.

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

Advanced EnerVista 3 Series Setup features

Flexcurve editor

The FlexCurve Editor is designed to allow the user to graphically view and edit the FlexCurve. The Flexcurve Editor screen is shown below:



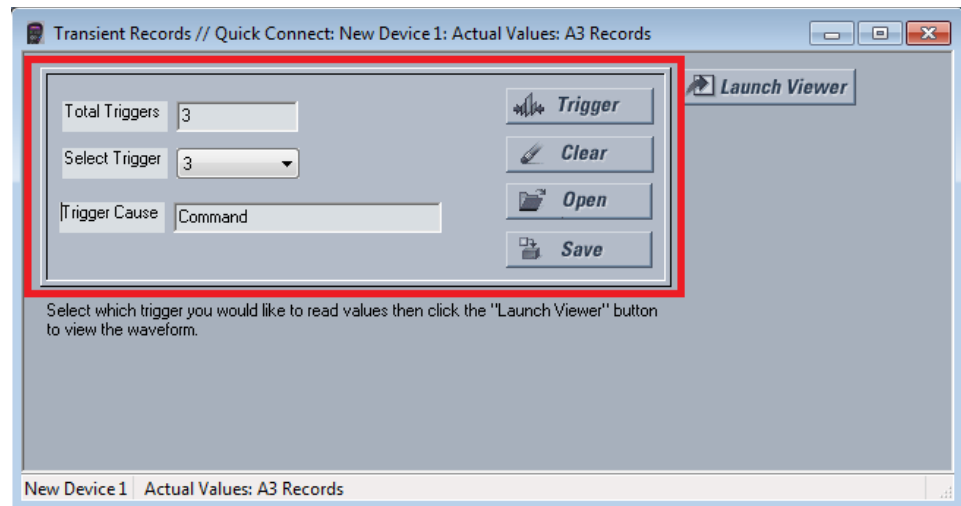
- The Operate Curves are displayed, and can be edited by dragging the tips of the curves
- A Base curve can be plotted for reference, to customize the operating curve. The Blue curve in the picture is a reference curve.
- The Trip Times in the tables and curves work interactively i.e., changing the table value will affect the curve shape and vice versa.
- Configured Trip Times can be saved.

- Configured Trip Times can be exported to a CSV file
- Trip Times can be loaded from a CSV File
- The screen above shows an example of the model followed by 350 for viewing Flexcurves. Select **Initialize** to copy the trip times from the selected curve to the FlexCurve.

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.



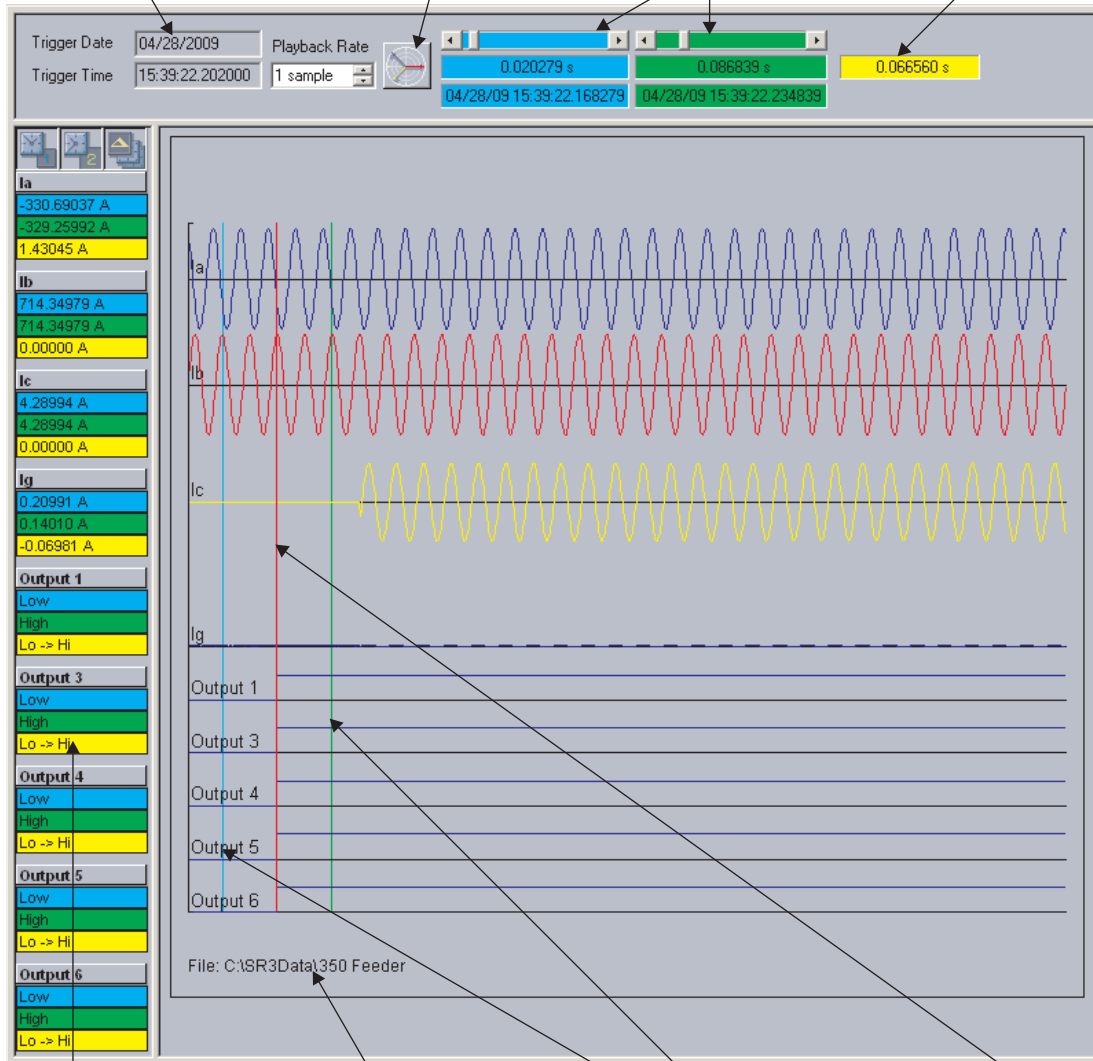
- Click on **Trigger Waveform** to trigger a waveform capture. Waveform file numbering starts with the number zero in the 350, so that the maximum trigger number will always be one less than the total number of triggers available.
- Click on the **Save to File** button to save the selected waveform to 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.

TRIGGER TIME & DATE
Displays the time and date of the Trigger.

VECTOR DISPLAY SELECT
Click here to open a new graph to display vectors.

CURSOR LINE POSITION
Indicates the cursor line position in time with respect to the beginning of the buffer.

DELTA
Indicates time difference between the two cursor lines.



Display graph values at the corresponding cursor line. Cursor lines are identified by their colors.

FILE NAME
Indicates the file name and complete path (if saved).

CURSOR LINES
To move lines, locate the mouse pointer over the cursor line, then click and drag the cursor to the new position.

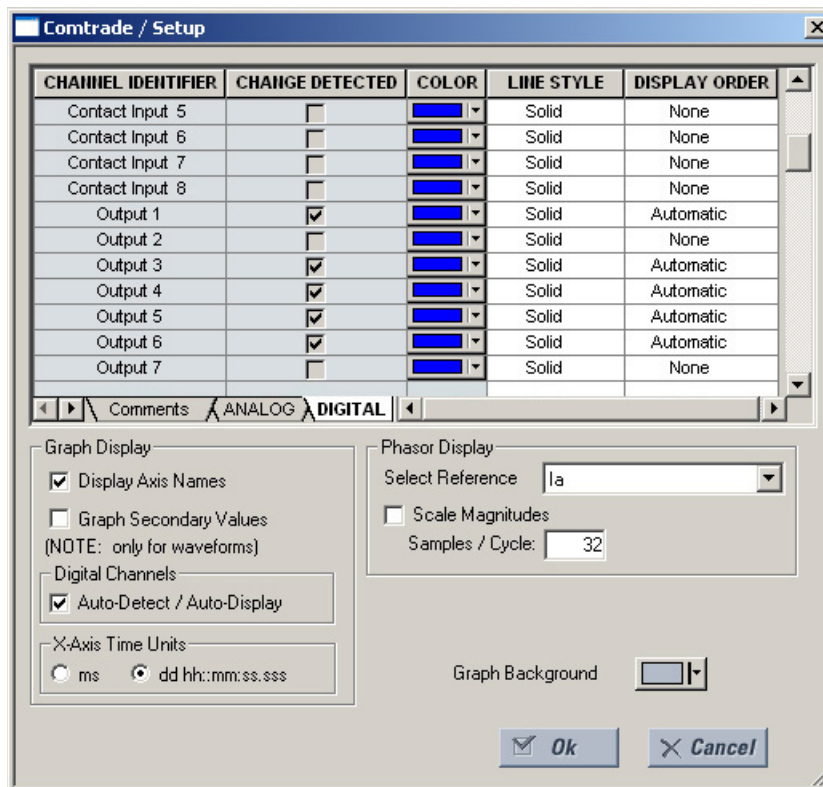
TRIGGER LINE
Indicates the point in time for the trigger.

- 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.



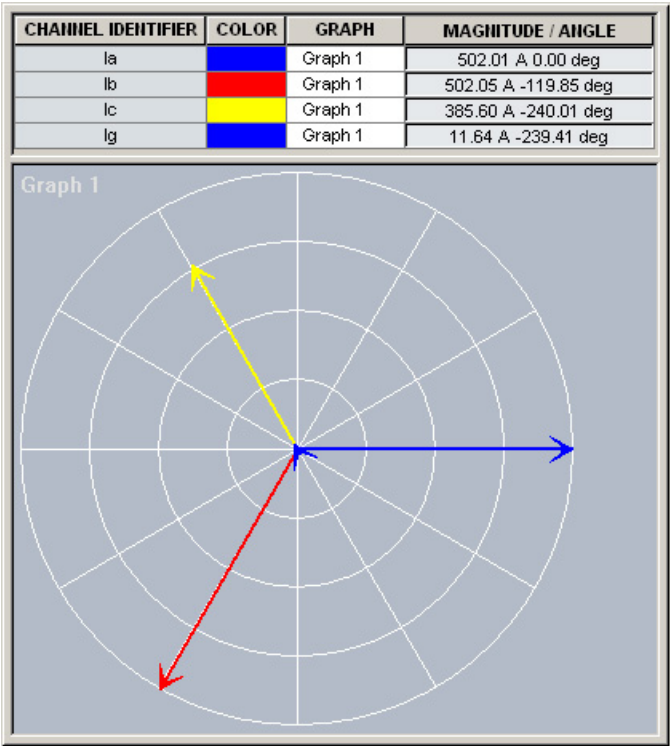
Preference Button

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:

Elements to Show

[Click Status to View Settings Information](#)

GROUPED ELEMENTS	OUTPUT RELAYS						OUTPUT RELAYS					
	R3	R4	R5	R6	GROUP 1		R3	R4	R5	R6	GROUP 2	
Phase TOC (51P)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Phase IOC 1 (50P)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Phase IOC 2 (50P)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Phase Directional OC (67P)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Ground TOC (51G)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Ground IOC 1 (50G)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Ground IOC 2 (50G)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Ground Directional OC (67G)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Neutral TOC (51N)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Neutral IOC 1 (50N)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Neutral IOC 2 (50N)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Neutral Directional OC (67N)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Negative Sequence IOC (46 (50_2))	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Negative Sequence TOC (46 (51_2))	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Phase UV 1 (27P)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Phase UV 2 (27P)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Phase OV 1 (59P)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Phase OV 2 (59P)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Neutral OV 1 (59N)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Negative Sequence OV 1 (59_2)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Auxiliary UV (27X)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Auxiliary OV (59X)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Under-frequency 1 (81U)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Under-frequency 2 (81U)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Over-frequency 1 (81O)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Over-frequency 2 (81O)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Thermal Overload (49)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Directional Power 1 (32)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Directional Power 2 (32)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Positive Seq UV 1 (27P_1)	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
Broken Conductor (I2/I1 (46BC))	☐	☐	☐	☐	Disabled		☐	☐	☐	☐	Disabled	
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							
Cold Load Pickup (50CLP)	☐	☐	☐	☐	Disabled							
Breaker Fail (50BF)	☐	☐	☐	☐	Disabled							
AR Ready (79)	☐	☐	☐	☐	Disabled							
AR In Progress (79)	☐	☐	☐	☐	Disabled							
AR N/Ready (79)	☐	☐	☐	☐	Disabled							
Synchrocheck (25)	☐	☐	☐	☐	Disabled							
2nd Harmonic Inhibit	☐	☐	☐	☐	Disabled							
CT Failure (60CTS)	☐	☐	☐	☐	Disabled							
Arc Flash (AFD)	☐	☐	☐	☐	Disabled							
VT Fuse Failure (VTFF)	☐	☐	☐	☐	Disabled							
Lockout (86)	☐	☐	☐	☐	Disabled							
MAINTENANCE	R3	R4	R5	R6	STATUS							
Breaker Trip Counter	☐	☐	☐	☐	Disabled							
Trip Coil (74(TCS))	☐	☐	☐	☐	Disabled							
Close Coil (74(CCS))	☐	☐	☐	☐	Disabled							
Ambient Temperature	☐	☐	☐	☐	Disabled							
Breaker Health	☐	☐	☐	☐	Disabled							

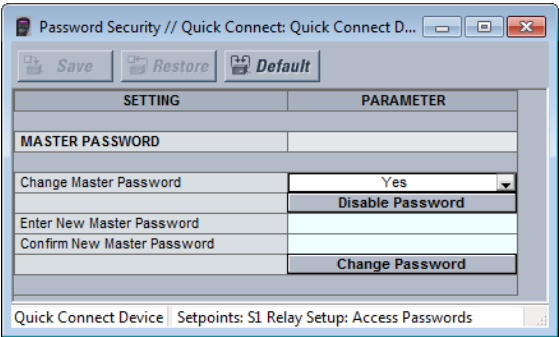
Password security

Password security is an optional feature of the 350 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. 350 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**.



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.

SETTING	PARAMETER
MASTER PASSWORD	
Change Master Password	No
Change User Passwords	Yes
O/W Local SP Pwd	Yes
LOCAL PASSWORDS	
Overwrite Local Setting Password	Yes
Enter New Local Setting Password	
Confirm New Local Setting Password	
Change Password	
Overwrite Local Control Password	Yes
Enter New Local Control Password	
Confirm New Local Control Password	
Change Password	

Quick Connect Device | Setpoints: S1 Relay Setup: Access Passwords

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.

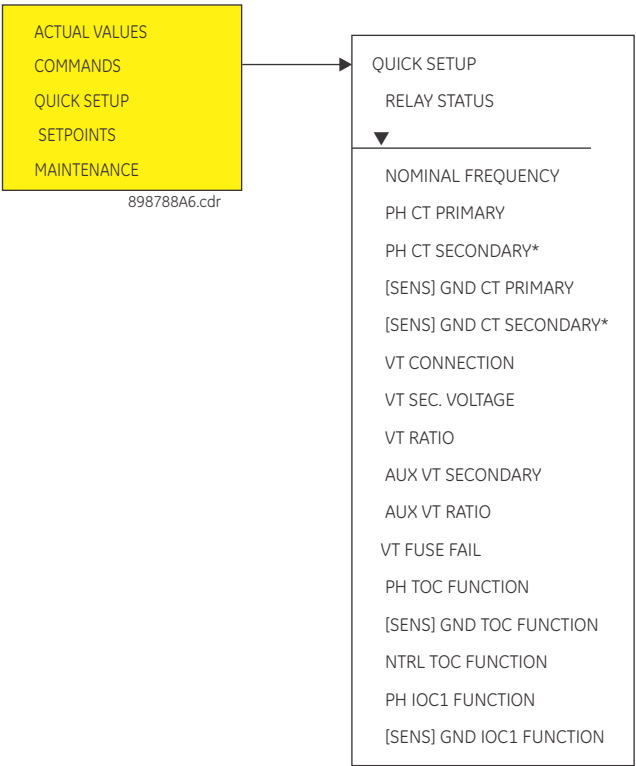
350 Feeder Protection System

Chapter 4: Quick setup - Front control panel

The “Quick Setup” utility is part of the 350 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.



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



* Present only for universal CT

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 >

PH CT PRIMARY

Range: 1 A to 6000 A in steps of 1

Default: 500 A

GND CT PRIMARY

Range: 1 A to 6000 A in steps of 1

Default: 50 A

VT CONNECTION

Range: Wye, Delta

Default: Wye

VT SEC VOLTAGE

Range: 50 V to 240 V in steps of 1

Default: 120 V

VT RATIO

Range: 1.0:1 to 5000.0:1 in steps of 0.1

Default: 1:1

AUX VT SECONDARY

Range: 50 V to 240 V in steps of 1

Default: 110 V

AUX VT RATIO

Range: 1.0:1 to 5000.0:1 in steps of 0.1

Default: 1:1

VT FUSE FAIL

Range: Trip, Disabled, Alarm

Default: Disabled

PH TOC FUNCTION

Range: Trip, Disabled, Latched Alarm, Alarm

Default: Trip

↳

PH TOC PICKUP

Range: 0.05 to 20.00 x CT

Default: 1.00 x CT

PH TOC CURVE

Range: ANSI Extremely/Very/Moderately/Normally Inverse, Definite Time, IEC Curve A/B/C and Short, IAC Extreme/Very/Inverse/Short, User Curve, FlexCurve™ A/B (programmable curves)

Default: Extremely Inverse

PH TOC TDM

Range: 0.05 to 50.00

Default: 1.00

GND TOC FUNCTION*Range: Disabled, Trip, Latched Alarm, Alarm**Default: Disabled*

↳

GND TOC PICKUP*Range: 0.05 to 20.00 x CT**Default: 1.00 x CT***GND TOC CURVE***Range: ANSI Extremely/Very/Moderately/Normally Inverse; Definite Time; IEC Curve A/B/C /Short Inverse; IAC Extreme/Very/Inverse/Short Inverse; User Curve, FlexCurve™ A/B (programmable curves)**Default: Extremely Inverse***GND TOC TDM***Range: 0.05 to 50.00**Default: 1.00***SENS GND TOC FUNCTION [WHEN SPECIFICALLY ORDERED]***Range: Disabled, Trip, Latched Alarm, Alarm**Default: Disabled*

↳

SENS GND TOC PICKUP*Range: 0.005 to 3.000 x CT**Default: 1.000 x CT***SENS GND TOC CURVE***Range: ANSI Extremely/Very/Moderately/Normally Inverse; Definite Time; IEC Curve A/B/C /Short Inverse; IAC Extreme/Very/Inverse/Short Inverse; User Curve, FlexCurve™ A/B (programmable curves)**Default: Extremely Inverse***SENS GND TOC TDM***Range: 0.05 to 50.00**Default: 1.0***NTRL TOC FUNCTION***Range: Disabled, Trip, Latched Alarm, Alarm**Default: Disabled*

↳

NTRL TOC PICKUP*Range: 0.05 to 20.00 x CT**Default: 1.00 x CT***NTRL TOC CURVE***Range: ANSI Extremely/Very/Moderately/Normally Inverse, Definite Time, IEC Curve A/B/C and Short, IAC Extreme/Very/Inverse/Short, User Curve, FlexCurve™ A/B (programmable curves)**Default: Extremely Inverse***NTRL TOC TDM***Range: 0.05 to 50.00**Default: 1.00*

PH IOC1 FUNCTION

Range: Disabled, Trip, Latched Alarm, Alarm

Default: Disabled

↳

PH IOC1 PICKUP

Range: 0.05 to 20.00 x CT

Default: 1.00 x CT

GND IOC1 FUNCTION

Range: Disabled, Trip, Latched Alarm, Alarm

Default: Disabled

↳

GND IOC1 PICKUP

Range: 0.05 to 20.00 x CT

Default: 1.00 x CT

SENS GND IOC1 FUNCTION [WHEN SPECIFICALLY ORDERED]

Range: Disabled, Trip, Latched Alarm, Alarm

Default: Disabled

↳

SENS GND IOC1 PICKUP

Range: 0.005 to 3.000 x CT

Default: 1.000 x CT

NTRL IOC1 FUNCTION

Range: Disabled, Trip, Latched Alarm, Alarm

Default: Disabled

↳

NTRL IOC1 PICKUP

Range: 0.05 to 20.00 x CT

Default: 1.00 x CT



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.

350 Feeder Protection System

Chapter 5: Maintenance

General maintenance

The 350 requires minimal maintenance. As a microprocessor-based relay, its characteristics do not change over time. The expected service life of a 350 is 20 years when the environment and electrical conditions are within stated specifications.

While the 350 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.