GE
Digital Energy

Multilin™ 345

Transformer Protection System
Intuitive Transformer Protection

The Multilin 345 is a member of the Multilin 3 Series protective relay platform and has been designed for the protection, control and management of power transformers as primary or backup protection device. The 345 provides advanced transformer protection, control and monitoring in one economical draw-out or non draw-out design. The 345 contains a full range of self-contained protection and control elements as well as advanced communications, metering, monitoring and diagnostics.

Key Benefits

- Cost-effective proven and secure high-speed transformer protection
- Integrated transformer thermal monitoring for asset management maintenance optimization
- Improved transformer energization inhibiting
- Ground current supervised sensitive ground fault protection for detection of ground faults down to 5% of the winding
- Assignable CT inputs providing flexibility
- Seamless integration into most communication architectures
- Multiple communication networks including USB, Serial, Fiber or copper Ethernet supporting the most popular industry standard protocols
- Unique draw-out construction to reduce the use of test switches
- Small footprint easy on new installations or retrofits
- Simplified transformer and protection setup right from the main menu
- Draw out or non draw out options available

Applications

- Primary or backup protection of two winding power transformers
- Protection of reactors and autotransformers
- Applications requiring fast and secure communications
- Harsh environments requiring protection against corrosion and humidity

Protection and Control

- Dual slope, dual breakpoint differential protection
- Second harmonic inrush and fifth harmonic over-excitation inhibits
- Unrestrained differential
- Restricted Ground Fault (RGF)
- Thermal model
- Comprehensive overcurrent elements

Metering & Monitoring

- Comprehensive current metering
- Event Recorder: 256 events with 1ms time stamping
- 32 samples per cycle oscillography
- IRIG-B clock synchronization
- Security audit trail and password control

Communications

- Front USB and rear serial, Ethernet and Fiber ports
- Multiple Communication Protocols including IEC 61850, IEC 61850 GOOSE, MODBUS TCP/IP, MODBUS RTU, DNP 3.0, IEC60870-5-104, IEC60870-5-103

EnerVista™ Softwares

- Simplify setup and configuration
- Strong document archive and management system
- Simplify full featured monitoring and data recording
- Strong maintenance and troubleshooting tool
- Seamless integration toolkit

imagination at work

Overview

The 345 is a microprocessor-based system for primary and backup protection of small and medium size distribution transformers. The 345 offers advanced algorithms for automatic magnitude and phase compensations for more than twenty types of two winding transformers, fast and secure biased differential protection with dual slope, and dual breakpoint characteristic. The 345 is equipped with restricted ground fault elements to detect ground faults down to 5% of the transformer winding, basic thermal protection and a full set of phase, ground, neutral and negative sequence over-current protection. The two identical groups with protection elements aim to satisfy these applications, where an automatic change of the settings is required.

The 345 provides excellent accessibility and transparency with regard to the power system conditions and events, through its target messaging and the four lines of 20 characters display, the Transient and Event Recorders, and the powerful EnerVista PC program.

Easy to Use

Drawout Construction

The 345 offers a complete drawout feature eliminating the need for rewiring after testing has been concluded. The withdrawable feature also eradicates the need to disconnect communication cables, and helps retain communication status even after the relay has been withdrawn from its case.

Effortless Retrofit

The compact and withdrawable feature of the 345 relay minimizes mounting requirements, enables easy retrofit to existing cases, and allows multiple relays to be mounted side by side on a panel. The 345 also provides a pluggable RS485 & IRIG-B connection for easy trouble shooting.

Easy to Configure

Fast & Simple Configuration

Providing ease-of-use functionality, the 345 allows for transformer configuration in a simple one page setup screen. Therefore complete transformer protection setup can be completed in one easy step.

Advanced Communications

Easy integration into new or existing infrastructure

With several Ethernet and serial port options, and a variety of communication protocols, the 345 provides advanced and flexible communication selections for new and existing applications.

345 Relay Features

Easy to Configure - 1 simple step

Advanced & Flexible Communication Options

Easy to Use - Draw out case

Diagnostic Alarms

Enhanced Diagnostics

Preventative Maintenance

The 345 allows users to track relay exposure to extreme environmental conditions by monitoring and alarming at high or low temperatures. This data allows users to proactively schedule regular maintenance work and upgrade activities.

Failure Alarm

The 345 detects and alarms on communication port and IRIG-B failures. The 345 also enables users to analyze system performance via diagnostics information such as event records and oscillography. It issues detailed transformer health reports and alarms when thresholds are exceeded.

Cost Effective

Robust Design

The 345 is subjected to Accelerated Life Testing (ALT) to validate accurate relay functions under specified normal conditions. The device is further tested for durability through High Accelerated Life Testing (HALT), undergoing stress testing for extreme operating conditions.

Reduced Life Cycle Cost

The 345 is designed to reduce total installation and life cycle cost for transformer protection. The draw out construction of the device reduces downtime during maintenance and decreases extra wiring needed for relay testing and commissioning.

Multiple Options

Several options for protection and communications are provided to match basic to high end application requirements.

Protection & Control

The 345 transformer protection system is designed to protect and control small to medium size power transformers. Flexible and powerful, the 345 provides advanced transformer protection, control and monitoring in one economical draw-out design. The 345 contains a full range of self-contained protection and control elements as detailed in the Functional Block Diagram and in the Features table.

Percent Differential Protection

The Percent Differential protection is based on a proven algorithm that provides good sensitivity on detecting internal faults and better stability during through-fault conditions. The protection is characterized with the following key elements:

- Configurable dual slope, dual breakpoint differential/restraint characteristic
- Inrush inhibiting
- Overexcitation inhibits

Dual Slope, Dual Breakpoint Differential / Restraint Characterisitc

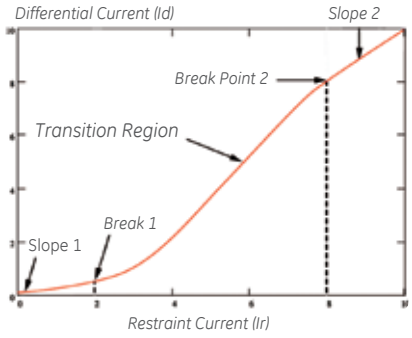
This characteristic defines the area of percent differential protection operation versus no-operation, constructed through the setting of the minimum pickup differential current, the settings of slope 1 and slope 2 connected by a cubic spline curve, as well as the settings of breakpoint 1 and breakpoint 2. The maximum winding current is used as a restraining signal for better through-fault stability under CT saturation conditions.

Inrush Inhibit

The 2nd harmonic inrush inhibit function is selectable in order to cover energization of different types of transformers, and can be set to either per-phase, 2-out-of-3, or average mode.

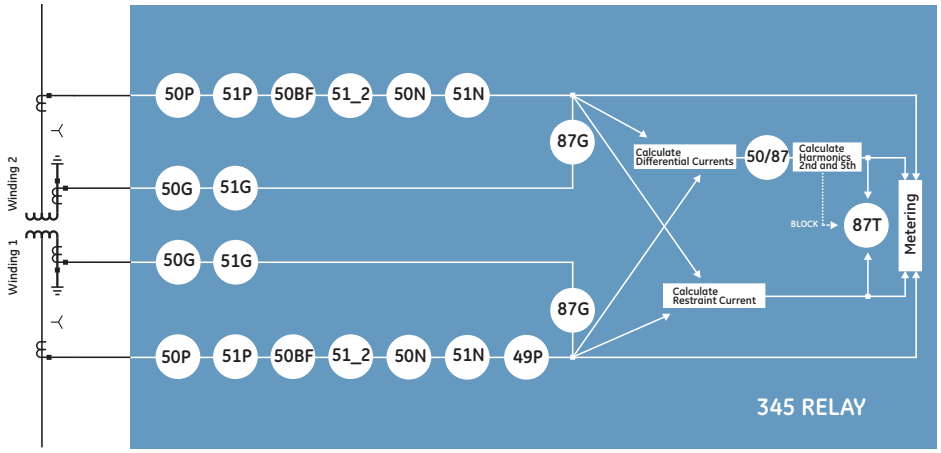
Overexcitation inhibit

An increase in transformer voltage, or decrease in system frequency may result in transformer overexcitation condition. In some cases the transformer overexcitation may result in undesirable operation of the percent differential element. Fifth harmonic inhibiting is integrated into the percent differential element to cater such overexcitation conditions.



The settings for the dual-slope, dual-breakpoint characteristic provides higher flexibility for shaping up the characteristic and achieve better sensitivity and security.

Functional Block Diagram



ANSI® Device Numbers & Functions

DEVICE NUMBER	FUNCTION
49	Thermal Model
50/87	Instantaneous Differential
50G	Ground/Sensitive Ground Instantaneous Overcurrent
50N	Neutral Instantaneous Overcurrent
50P	Phase Instantaneous Overcurrent
50BF	Breaker Failure
51_2	Negative Sequence Timed Overcurrent
51G	Ground/Sensitive Ground Timed Overcurrent
51N	Neutral Timed Overcurrent
51P	Phase Timed Overcurrent
87G	Restricted Ground Fault
87T	Percent Differential

Unrestrained differential

An unrestrained differential element is provided for fast tripping on heavy internal faults to limit further damage to the transformer and minimize the risk to the rest of the system.

Restricted Ground Fault (RGF)

The Restricted Ground Fault (RGF) elements extend the protection coverage to the neutral point of wye-connected windings where fault currents may be below the pickup of the main transformer differential element. The RGF elements use maximum phase winding currents as a restraining signal to provide stability during through fault conditions. Configurable ground current supervision is integrated into the element to add more stability during non-ground out of zone faults with CT saturation, resulting in excessive neutral current, that may be enough to cause RGF operation.

Thermal protection

The 345 relay provides basic thermal protection based on winding heating and cooling constants. The protection monitors the winding loading, and is settable to produce alarm or trip, based on the selected overloading criteria.

Overcurrent Elements

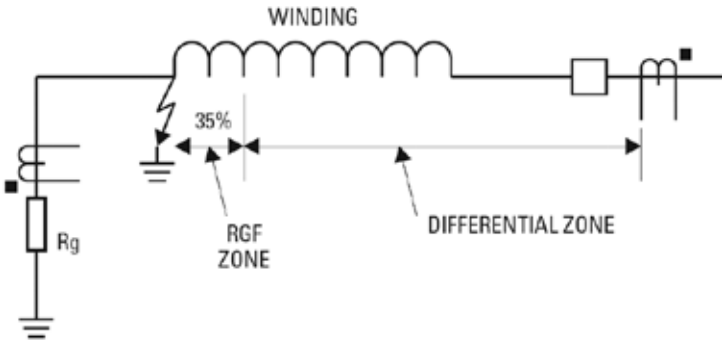
The 345 relay provides phase, neutral, ground and negative sequence over-current functions that are configurable with respect to either winding currents. They can run in parallel with the main differential protection, and can be set to provide either primary or backup transformer protection for all types of transformer faults.

When ordered with sensitive ground CTs, the 345 relay can be set to provide 10 times more sensitivity on detection of ground fault currents through the transformer winding neutrals grounded via current limiting resistor.

Inputs/Outputs

The 345 features the following inputs and outputs for monitoring and control of typical transformer applications:

- 10 contact Inputs with programmable thresholds
- 2 Form A output relays for breaker trip with coil monitoring
- 5 Form C output relays



Faults close to the neutral point of a wye-connected winding do not generate adequate fault current for differential element to pick up. Restricted Ground Fault protection provides sensitive ground fault detection for low-magnitude fault currents.

Advanced Automation

Logic Elements

The 345 relay has sixteen Logic Elements available for the user to build simple logic using the state of any programmed contact, virtual, or remote input, or an output operand from protection, or control elements.

The logic provides for assigning up to three triggering inputs in an "AND/OR" gate for the logic element operation and up to three blocking inputs in an "AND/OR" gate for defining the block signal. Pickup and dropout timers are available for delaying the logic element operation and reset respectively.

Virtual Inputs

Virtual inputs allow communication devices the ability to write digital commands to the 345 relay. These commands could be changing setting groups or blocking protection elements.

IEC61850

The 345 supports IEC 61850 Logical Nodes which allows for digital communications to DCS, SCADA and higher level control systems.

In addition, the 345 also supports IEC 61850 GOOSE communication, providing a means of sharing digital point state information between 345's or other IEC61850 compliant IED's.

- Eliminates the need for hardwiring contact inputs to contact outputs via communication messaging.
- Transmits information from one relay to the next in as fast as 8 ms.
- Enables sequence coordination with upstream and downstream devices.
- When Breaker Open operation malfunctions, GOOSE messaging sends a signal to the upstream breaker to trip and clear the fault.

Monitoring & Diagnostics

Event Recording

Events consist of a broad range of change of state occurrences, including pickups, trips, contact operations, alarms and self test status. The 345 stores up to 256 events time tagged to the nearest millisecond. This provides the information required to determine sequence of events which facilitates diagnosis of relay operation. Each event is individually maskable in order to avoid the generation of undesired events, and includes the values of currents and status of all the protection elements at the moment of the event.

Oscillography

The 345 captures current waveforms and digital channels at 32 samples per cycle. The oscillography record captures 8 individual analog channels allowing for detailed analysis. The oscillography is triggered either by internal signals or an external contact.

IRIG-B

IRIG-B is a standard time code format that allows time stamping of events to be synchronized among connected devices within 1 milliseconds. An IRIG-B input is provided in the 345 to allow time synchronization using a GPS clock over a wide area. The 345 IRIG-B supports both AM and DC time synchronization with an auto detect feature that removes the requirement for manual selection.

Metering

The 345 continuously measures and computes the following AC signals indicating the health of the protected transformer:

- Phase winding currents
- Winding ground current
- Winding neutral current
- Winding negative sequence current
- Differential and restraint currents per-phase
- Winding ground differential current
- Percent 2nd and 5th harmonics differential currents per phase
- Percent thermal capacity per-phase

The states of all digital inputs/outputs are provided through the actual values either from the summary pages or individually. This includes:

- States of contact inputs
- States of virtual inputs
- States of remote inputs
- States of relay outputs
- States of logic elements

Security

Security Audit Trail

The Security Audit Trail feature provides complete traceability of relay setting changes at any given time and is NERC CIP compliant. The 345 maintains a history of the last changes made to the 345 configuration, including modifications to settings and firmware upgrades. Security Setting Reports include the following information:

- If Password was required to change settings
- MAC address of user making setting changes
- Listing of modified changes
- Method of setting changes - Keypad, Front serial port, Ethernet, etc.

Password Control

With the implementation of the Password Security feature in the 345 relay, extra measures have been taken to ensure unauthorized changes are not made to the relay. When password security is enabled, changing of setpoints or issuing of commands will require passwords to be entered. Separate passwords are supported for remote and local operators, and separate access levels support changing of setpoints or sending commands.

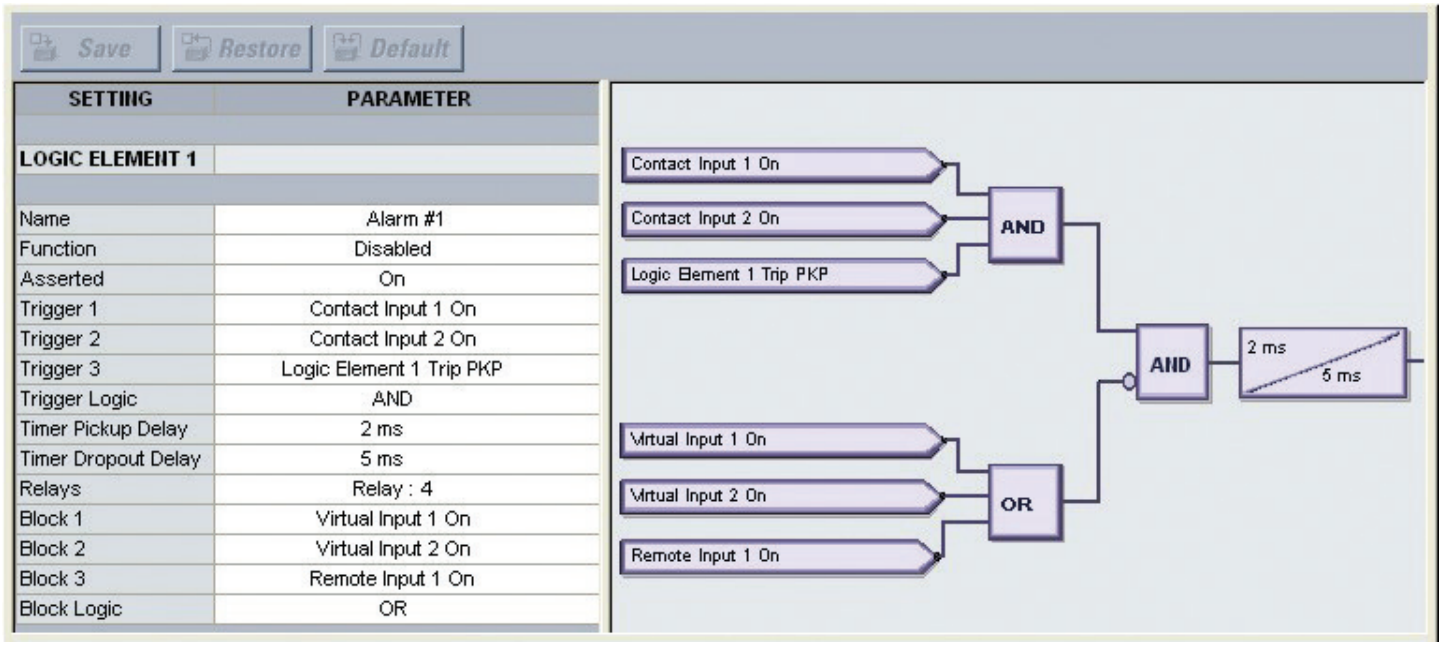
Advanced Communications

The 345 utilizes the most advanced communication technologies today making it the easiest and most flexible transformer protection relay to use and integrate into new and existing infrastructures. Multiple communication ports and protocols allow control and easy access to information from the 345.

The 345 supports the most popular industry standard protocols enabling easy, direct integration into electrical SCADA and HMI systems. Modbus RTU is provided as standard with a RS485 networking port.

The following optional protocols are available:

- IEC 61850
- IEC 61850 GOOSE
- DNP 3.0,
- Modbus RTU,
- Modbus TCP/IP,
- IEC 60870-5-104,
- IEC 60870-5-103



Eight logic elements available for simple logic for applications such as manual control, interlocking, and peer to peer tripping.

Easy to Use

Simplified Transformer Setting

Included with every 345 Transformer Protection System is the Multilin Simplified Transformer Setup. The Simplified Transformer Setup provides users with a quick and easy method to setup and start the transformer and process in applications that require fast commissioning.

The Simplified Transformer Setup will generate a complete 345 setting file based on the transformer nameplate and system information entered by the user. Once all the information is entered, the Simplified Transformer Setup will generate the settings file, as well as provide the documentation indicating which settings were enabled, along with an explanation of the specific parameters entered. The Simplified Transformer Setup will provide a detailed setting file in PDF format that can be saved or printed for future reference.

Enervista Software

The Enervista suite is an industry leading set of software programs that simplifies every aspect of using the 345 relay. The Enervista suite provides all the tools to monitor the status of the protected asset, maintain the relay, and integrate the information measured into DCS or SCADA monitoring systems. Convenient COMTRADE and sequence of event viewers are an integral part of the 345 set up software and are included to ensure proper protection and system operation.

Launchpad

Enervista Launchpad is a powerful software package that provides users with all of the set up and support tools needed for configuring and maintaining GE products. The setup software within Launchpad allows configuring devices in real time by communicating using serial, Ethernet or modem connections, or offline by creating setting files to be sent to devices at a later time.

Included in Launchpad is a document archiving and management system that ensures critical documentation is up-to-date and available when needed. Documents made available include:

- Manuals
- Application Notes
- Guideform Specifications
- Brochures
- Wiring Diagrams
- FAQs
- Service Bulletins

Viewpoint Monitoring

Viewpoint Monitoring is a simple to use and full featured monitoring and data recording software package for small systems. Viewpoint monitoring provides a complete HMI package with the following functionality:

- Plug and play device monitoring
- System single line monitoring and control
- Annunciator alarm screens
- Trending reports
- Automatic event retrieval
- Automatic waveform retrieval

Viewpoint Maintenance

Viewpoint Maintenance provides tools that will increase the security of the 345 Transformer Protection System. Viewpoint Maintenance will create reports on the operating status of the relay, and simplify the steps to troubleshoot protected transformers.

The tools available in Viewpoint Maintenance include:

- Settings Security Audit Trail
- Device Health Report
- Comprehensive Fault Diagnostics

EnerVista Integrator

EnerVista Integrator is a toolkit that allows seamless integration of Multilin devices into new or existing automation systems.

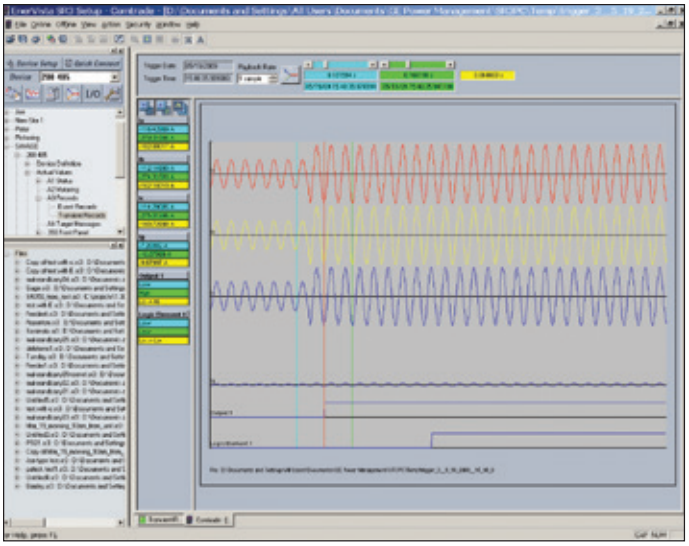
Included in the EnerVista Integrator is:

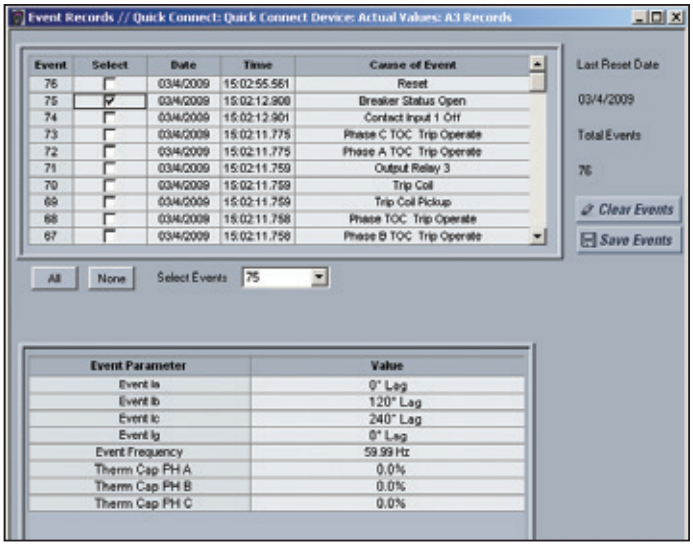
- OPC/DDE Server
- Multilin Devices
- Automatic Event Retrieval
- Automatic Waveform Retrieval

Trace any setting changes with security audit trail

Power System Troubleshooting

Analyze power system disturbances with transient fault recorder and event records





User Interface

IN SERVICE: This indicator will be on continuously lit if the relay is functioning normally and no major self-test errors have been detected.

TROUBLE: Trouble indicator LED will be AMBER if there is a problem with the relay or the relay is not configured.

TRIP: Indicates that the relay has tripped the transformer offline based on predefined programmed conditions.

ALARM: Indicates that the transformer is currently operating in an alarm condition and may proceed to a trip condition if not addressed.

MAINTENANCE: Environmental alarms such as ambient temperature alarm or coil monitor alarms.

The display messages are organized into Main Menus, 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 four Main Menu Headers.

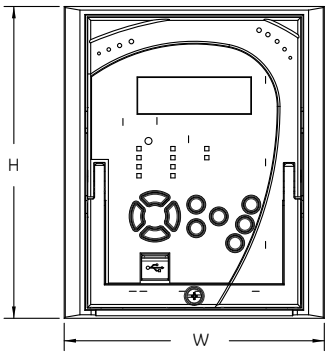
The ten button keypad allows users easy access to relay configuration and information.

USER INTERFACE OPTIONS: Draw out and non draw out options available

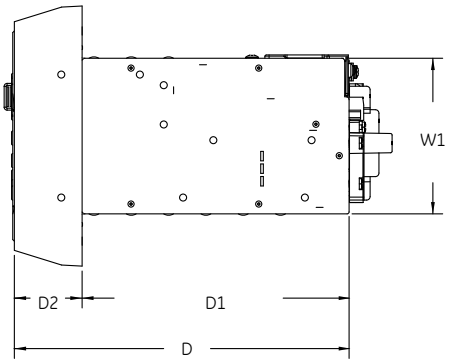
Dimensions

	DRAW-OUT DESIGN		NON DRAW-OUT DESIGN	
	in	mm	in	mm
H	7.93	201.5	7.98	202.7
W	6.62	168.2	6.23	158.2
D	9.62	244.2	9.35	237.5
W1	3.96	100.6	3.96	100.6
D1	7.89	200.4	7.88	200.2
D2	1.73	43.8	1.47	37.3
H1	6.82	173.2	6.82	173.2

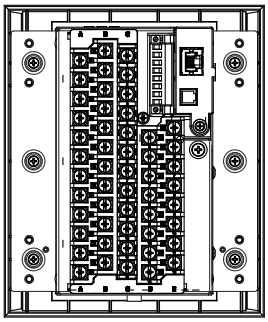
Front



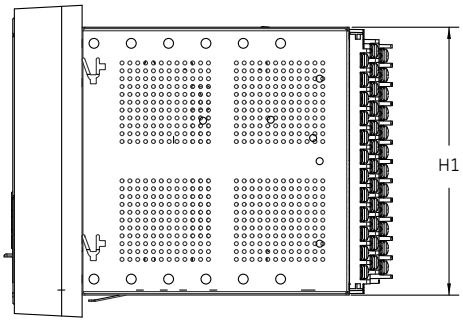
Top



Rear



Side



Technical Specifications

PASSWORD SECURITY

Master Reset Password:	8 to 10 alpha-numeric characters
Settings Password:	3 to 10 alpha-numeric characters for local or remote access
Control Password:	3 to 10 alpha-numeric characters for local or remote access

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

Ground Current:	Fundamental
Pickup Level:	0.04 to 20.00 x CT in steps of 0.01 x CT
Dropout Level:	97 to 99% of Pickup @ I > 1 x CT pickup - 0.02 x CT @ I > 1 x CT
Curve Shape:	ANSI Extremely/Very/Moderately/ Normally Inverse Definite Time (1 s base curve) IEC Curve A/B/C/Short IAC Extremely/Very/Inverse/Short
Curve Multiplier:	0.05 to 20.00 in steps of 0.01
Reset Time:	Instantaneous, Linear
Time Delay Accuracy:	±3% of expected inverse time or 1 cycle, whichever is greater
Level Accuracy:	per CT input

SENSITIVE GROUND TIMED OVERCURRENT (51SG)

Ground Current:	Fundamental
Pickup Level:	0.005 to 3.000 x CT in steps of 0.001 x CT
Dropout Level:	97 to 99% of Pickup @ I > 0.1 x CT pickup - 0.02 x CT @ I > 0.1 x CT
Curve Shape:	ANSI Extremely/Very/Moderately/ Normally Inverse Definite Time (1 s base curve) IEC Curve A/B/C/Short IAC Extremely/Very/Inverse/Short
Curve Multiplier:	0.5 to 20.0 in steps of 0.1
Reset Time:	Instantaneous, Linear
Time Delay Accuracy:	±3% of expected inverse time or 1 cycle, whichever is greater
Level Accuracy:	per CT input

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

Current:	Fundamental
Pickup Level	0.05 to 20.00 x CT in steps of 0.01 x CT
Dropout Level:	97 to 99% of Pickup I > 0.1 x CT Pickup - 0.02 x CT at I < 0.1 x CT
Time delay:	0.00 to 300.00 sec in steps of 0.01
Operate Time:	<30 ms @ 60Hz (I > 2.0 x PKP, No time delay) <35 ms @ 50Hz (I > 2.0 x PKP, No time delay)
Time Delay Accuracy:	0 to 1 cycle (time delay selected)
Level Accuracy:	per CT input

TRANSFORMER PERCENT DIFFERENTIAL PROTECTION (87T)

Differential/ Restraint Characteristic:	Dual Slope, Dual Breakpoint
Minimum Pickup Level:	0.05 to 1.00 x CT in steps of 0.01
Slope 1 Range:	15 to 100% in steps of 1%
Slope 2 Range:	50 to 100% in steps of 1%
Kneepoint 1:	0.50 to 4.00 x CT in steps of 0.01
Kneepoint 2:	1.00 to 10.00 x CT in steps of 0.01
2nd Harmonic Inhibit Level:	1.0 to 40.0% insteps of 0.1%
2nd Harmonic Inhibit Mode:	Per-phase, 2-out-of-three, Average
5th Harmonic Inhibit Level:	1.0 to 40.0% insteps of 0.1%
Dropout Level:	97 to 98% of Pickup
Operate Time:	< 20 ms (no harmonics inhibits selected) < 30 ms (harmonics inhibits selected)
Level Accuracy:	per current inputs

TRANSFORMER THERMAL PROTECTION (49)

Current:	Fundamental
Pickup Accuracy:	per current inputs
Timing Accuracy:	±3% of expected time, or 30 ms (whichever is greater) @ I > 1.5 x PKP

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 to 99% of Pickup @ I > 0.1 x CT Pickup - 0.002 x CT @ I < 0.1 x CT
Time delay:	0.00 to 300.00 sec in steps of 0.01
Operate Time:	<30 ms @ 60Hz (I > 2.0 x PKP, No time delay) <35 ms @ 50Hz (I > 2.0 x PKP, No time delay)
Time Delay Accuracy:	0 to 1 cycle (time delay selected)
Level Accuracy:	per CT input

TRANSFORMER INSTANTANEOUS DIFFERENTIAL PROTECTION (50/87)

Pickup Level:	3.00 to 20.00xCT in steps of 0.01xCT
Dropout Level:	97 to 98% of Pickup
Operate Time:	<30 ms
Level Accuracy:	per current inputs

RESTRICTED GROUND FAULT (87G)

Number of Elements:	2
Pickup Level:	0.02 to 20.00 xCT in steps of 0.01 0.002 to 2.000 xCT (with sensitive CTs)
GND Supervision Level:	0.02 to 20.00 xCT in steps of 0.01 0.002 to 2.000 xCT (with sensitive CTs)
Dropout Level:	97 to 98% of Pickup
Slope Range:	0 to 100% in steps of 1
Pickup Delay:	0.00 to 600.0 s in steps of 0.01
Operate Time:	< 30 ms @ 0 ms time delay
Level Accuracy:	per current inputs

Technical Specifications

PHASE & GROUND CURRENT INPUTS

CT Primary:	1 to 6000 A
Range:	0.02 to 20 × CT
Input type:	1 A or 5 A (must be specified with order P1G1 or P5G5) Configurable 1 A or 5 A (must be specified with order P0G0)
Nominal frequency:	50/60 Hz
Burden:	<0.1 VA at rated load
Accuracy:	±1% of reading at 1× CT ±3% of reading from 0.1 to 20 × CT ±20% of reading from 0.02 to 0.09 × CT
CT withstand:	1 second at 100 × rated current 2 seconds at 40 × rated current continuous at 3 × rated current

SENSITIVE GROUND CURRENT INPUT

CT Primary:	1 to 600 A
Range:	0.002 to 3 × CT
Input type:	1 A or 5 A (must be specified with order P1S1 or P5S5)
Nominal frequency:	50/60 Hz
Accuracy:	±1% of reading at 1× CT ±3% of reading from 0.01 to 3 × CT ±20% of reading from 0.002 to 0.009 × CT
CT withstand:	1 second at 100 × rated current 2 seconds at 40 × rated current continuous at 3 × rated current

TRANSIENT RECORDER

Buffer size:	3 s
No. of buffers:	1x192, 3x64, 6x32
No. of channels:	14
Sampling rate:	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; retained for 3 days

EVENT RECORDER

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

CLOCK

Setup:	Date and time (Daylight Savings Time)
IRIG-B:	Auto-detect (DC shift or Amplitude Modulated) Amplitude modulated: 1 to 10 V pk-pk DC shift: 1 to 10 V DC Input impedance: 40 kOhm ± 10% RTC Accuracy: ± 1 min / month at 25°C

LOGIC ELEMENTS

Number of logic elements:	16
Trigger source inputs per element:	3
Block inputs per element:	3
Supported operations:	AND, OR, NOT, Pickup / Dropout timers
Pickup timer:	0 to 6000 ms in steps of 1 ms
Dropout timer:	0 to 6000 ms in steps of 1 ms

BREAKER FAILURE (50BF)

Pickup Level:	0.05 to 20.00 × CT in steps of 0.01
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

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

CONTACT INPUTS

Inputs:	10
Selectable thresholds:	17, 33, 84, 166 VDC
Recognition time:	1/2 cycle
Continuous current draw:	2 mA (to be confirmed)
Debounce time:	1 to 64 ms, selectable, in steps of 1 ms
Type:	opto-isolated inputs
External switch:	wet contact
Maximum input voltage:	300 VDC

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 @ 250 VAC Pilot duty A300
Break (AC resistive):	277 VAC / 10 A

FORM-A VOLTAGE MONITOR

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

FORM-C RELAYS

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

TRIP SEAL-IN

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

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 POWER SUPPLY RANGES

Voltage withstand:	2 × highest nominal voltage for 10 ms
Power consumption:	15 W nominal, 20 W maximum 20 VA nominal, 28 VA maximum

ETHERNET (COPPER)

Modes:	10/100 MB (auto-detect)
Connector:	RJ-45
Protocol:	Modbus TCP/IP, DNP 3.0, IEC 60870-5-104, IEC 61850

ETHERNET (FIBER)

Fiber type:	100 MB Multi-mode
Wavelength:	1300 nm
Connector:	MTRJ
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
Protocol:	Modbus TCP/IP, DNP 3.0, IEC 60870-5-104, IEC 61850 GOOSE

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 ft)
Isolation:	2 kV

USB

Standard specification:	Compliant with USB 2.0
Connector:	115 kbps

TYPE TESTS

Dielectric voltage withstand:		2.3KV
Impulse voltage withstand:	EN60255-5	5KV
Damped Oscillatory:	IEC61000-4-18IEC60255-22-1	2.5KV CM, 1KV DM
Electrostatic Discharge:	EN61000-4-2/ IEC60255-22-2	Level 4
RF immunity:	EN61000-4-3/ IEC60255-22-3	Level 3
Fast Transient Disturbance:	EN61000-4-4/ IEC60255-22-4	Class A and B
Surge Immunity:	EN61000-4-5/ IEC60255-22-5	Level 3 & 4
Conducted RF Immunity:	EN61000-4-6/ IEC60255-22-6	Level 3
Power Frequency Immunity:	EN61000-4-7/ IEC60255-22-7	Class A & B
Voltage interruptionand Ripple DC:	IEC60255-11	15% ripple, 200ms interupts
Radiated & Conducted: Emissions	CISPR11 /CISPR22/ IEC60255-25	Class A
Sinusoidal Vibration:	IEC60255-21-1	Class 1
Shock & Bump:	IEC60255-21-2	Class 1
Siesmic:	IEC60255-21-3	Class 2
Power magnetic Immunity:	IEC61000-4-8	Level 5
Pulse Magnetic Immunity:	IEC61000-4-9	Level 4
Damped Magnetic Immunity:	IEC61000-4-10	Level 4
Voltage Dip & interruption:	IEC61000-4-11	0, 40, 70, 80% dips, 250/300 cycle interrupts
Damped Oscillatory:	IEC61000-4-12	2.5KV CM, 1KV DM
Conducted RF Immunity 0-150khz:	IEC61000-4-16	Level 4
Voltage Ripple:	IEC61000-4-17	15% ripple
Ingress Protection:	IEC60529	IP40 front , IP10 Back
Environmental (Cold):	IEC60068-2-1	-40C 16 hrs
Environmental (Dry heat):	IEC60068-2-2	85C 16hrs
Relative Humidity Cyclic:	IEC60068-2-30	6day variant 2
EFT:	IEEE²/ANSI C37.90.1	4KV, 2.5Khz
Damped Oscillatrory:	IEEE/ANSI C37.90.1	2.5KV,1Mhz
RF Immunity:	IEEE/ANSIC37.90.2	20V/m 80-1Ghz
ESD:	IEEE/ANSIC37.90.3 UL508	8KV CD/ 15KV AD e83849 NKCR
Safety:	UL C22.2-14 UL1053	e83849 NKCR7 e83849 NKCR

Technical Specifications

CERTIFICATION	
	Low voltage directive EN60255-5 / EN60255-27 / EN61010-1
CE:	EMC Directive EN60255-26/EN50263, EN61000-6-2, UL508
North America:	cULus UL1053, C22.2.No 14
ISO:	Manufactured under a registered quality program ISO9001

OPERATING ENVIRONMENT	
Ambient operating temperature:	-40°C to +60°C [-40°F to +140°F]
Ambient storage / shipping temperature:	-40°C to +85°C [-40°F to +185°F]
Humidity:	Operating up to 95% (non condensing) @ 55C (As per IEC60068-2-30 Variant 2, 6days)
Altitude:	2000m (max)
Pollution degree:	II
Overvoltage category:	III
Ingress Protection:	IP40 Front , IP10 back

DIMENSIONS	
Size:	Refer to Dimensions Chapter
Weight:	4.1 kg [9.0 lb]

Ordering

Multilin 345		**E**	******	******	******	**E**	*****	**N**	**N**	*** ***	*****	*****	**Description**
Base Unit	345												Base Unit
Language		E											English
Phase Currents			P1										1A three phase current inputs
			P5										5A three phase current inputs
345 Ground Currents*				G1									1A ground current input
				G5									5A ground current input
				S1									1A sensitive ground current input
				S5									5A sensitive ground current input
Power Supply					L								24 - 48 Vdc
					H								110 - 250 V dc/110 - 230 Vac
Faceplate						E							Standard faceplate (LCD, full menu, actual values and setpoints) with 10 Inputs, 7 Outputs (2 Form A, 5 Form C)
345 Current Protection							S						Standard configuration - 87T, 87T-50, 51P(1), 51G(1), 50P(1), 50G(1), 51N(1), 50N(1)
							E						Extended configuration - 87T, 87T-50, 51P(2), 51G(2), 50P(2), 50G(2), 51N(2), 50(2), 50BF(1), RGF(1), 49P
							M						Advanced configuration - 87T, 87T-50, 51P(2), 51G(2), 50P(2), 50G(2), 50BF(2), 49P, 51N(2), 50N(2), 51_2 (2), RGF(2)
Communications										SN			Standard :Front USB, Rear RS485 : Modbus RTU, DNP3.0, IEC60870-5-103
										1E			Standard + Ethernet (Copper & Fiber - MTRJ) MODBUS TCP/IP, DNP3.0, IEC 60870-5-104
										2E			Standard + Ethernet (Copper & Fiber - MTRJ) MODBUS TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850 GOOSE
										3E			Standard + Ethernet (Copper & Fiber - MTRJ) MODBUS TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850
Case Design											D		Draw-out design
											N		Non Draw-out design
Harsh Environment												N	None
												H	Harsh Environment Conformal Coating

Ordering Notes:

* 1) G1/G5 and S1/S5 must match corresponding P1/P5 - there cannot be 5A and 1A mixing

Accessories for the 345

- Multilink Ethernet Switch — ML2400-F-HI-HI-A2-A2-A6-G1
- Viewpoint Engineer — VPE-1
- Viewpoint Maintenance — VPM-1
- Viewpoint Monitoring IEC 61850 — VP-1-61850

Visit GEMultilin.com/345 to:

- View Guideform specifications
- Download the instruction manual
- Review applications notes and support documents
- Buy a 345 online
- View the 3 Series Family brochure

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