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

- Secure high-speed protection with improved energization inhibiting
- Field-proven algorithms and reliable protection to avoid unwanted trips or under-protection
- Integrated transformer thermal monitoring for asset management maintenance optimization
- Ground current supervised sensitive ground fault protection for detection of ground faults down to 5% of the winding
- Ease of use and flexibility with one-step setup, universal CT inputs and assignable CT inputs
- Flexible communications with multiple ports and protocols allowing seamless integration
- Powerful Security and hierarchical password control for centralized management
- Drawout design simplifies testing, commissioning and maintenance, thereby increasing process uptime
- Application flexibility with the use of programmable logic elements
- Switchgear diagnostics and easy troubleshooting by trip/close circuit supervision and LED and Digital Output Test Mode
- Environmental monitoring system to monitor operating conditions and plan preventative maintenance
- Robust design exceeding industry standards, with Automotive Grade components and advanced testing procedures such as accelerated life cycle testing
- Draw out or non draw out options available
- Simplified migration of legacy MII Family relays to the 3 Series platform
- Intuitive configuration software and user-friendly logic configuration tool

Applications

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

Protection and Control

- Dual slope with unique dual breakpoint differential protection with Unrestrained differential
- Second harmonic inrush and fifth harmonic over-excitation inhibits
- Thermal Overload and restricted Ground Fault (RGF/87G)
- Comprehensive overcurrent elements
- Breaker failure and lockout functions

Metering & Monitoring

- Comprehensive metering
- Event Recorder: 256 events (1ms time stamping)
- Programmable oscillography up to 32 samples per cycle and, digital states and Fault Report
- Relay health diagnostics and Breaker monitoring
- Security and password control
- SNTP or IRIG-B time synchronization

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, IEC 60870-5-104, IEC 60870-5-103 and OPC-UA (IEC 62541)

EnerVista™ Software

- Simplified setup and configuration
- Strong document management system
- Full featured monitoring and data recording
- Maintenance and troubleshooting tool
- Seamless integration toolkit
- Setting conversion tool for MII Family to 3 Series
Overview
The 345 is a microprocessor-based system for primary or backup protection of two winding power transformers. The 345 also provides a very cost-effective differential solution for distribution transformers as well as backup protection for primary substations. 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 & Non-Drawout Construction
The 345 is offered in both a drawout or a non-drawout construction. In the drawout case design the 345 simplifies installation and improves site safety as the need to open switchgear doors or rewire the device after testing is eliminated. As communication cables remain connected to the chassis, even when the relay is withdrawn, communications status is retained.

Application Flexibility & Ease of Wiring
Available universal CT inputs along with a software-configurable input range (1A and/or 5A) helps to standardize the design and reduce the number of order codes. There is also no need to change the entire relay in case of a design change or future switchgear modifications.

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 Use

Easy to Use - Drawout Case

Effortless Retrofit

Effortless Retrofit

Diagnostic Alarms

Fast & Simple Configuration
With quick setup screens the 345 requires minimal configuration for standard transformer protection applications. Utilizing the powerful EnerVista 3 Series setup software, device configuration 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 protocols, the 345 provides advanced and flexible communication selections for new and existing energy management, SCADA and DCS systems.

345 Relay Features

Easy to Configure- 1 Simple Step

Advanced & Flexible Communication Options

Easy to Use - Drawout Case

Diagnostic Alarms

Easy to Configure- 1 Simple Step

Non-drawout case design

Drawout case design
Enhanced Diagnostics
Preventative Maintenance
The 345 allows users to track relay exposure to extreme environmental conditions by monitoring and alarming at high ambient temperatures. This data allows proactive scheduling of regular maintenance work and upgrade activities. The diagnostics data enables the user to understand degradation of electronics due to extreme conditions.

Switchgear Diagnostics
Trip/Close Circuit Monitoring provides constant monitoring of the health of the control circuit. Breaker Health feature provides valuable information about the breaker like tripping, closing and the spring charging time or trip counter, incomplete charging which is of big assistance for proactive maintenance.

Cost Effective
Robust Design and Reduced Life Cycle Cost
The 345 is subjected to Accelerated Life Testing (ALT) to validate accurate relay function under specified normal conditions. The device is further tested for durability through Highly Accelerated Life Testing (HALT) where it undergoes extreme operating conditions.

The robust 345 design along with drawout construction ensures long term operation and reduces the total installation, maintenance and life cycle cost of the protection system, thereby reducing downtime and associated costs.

Fit-for-Purpose Options
Severals options for protection, control and communications are provided to match basic to high end application requirements.

The variety of order code selections satisfies the need for various applications from single function Current or Voltage protection to multi-function including Power and Directional elements.

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 (87T)
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
- Unique Dual Slope-Dual Breakpoint differential and Restraint characteristic

Functional Block Diagram

ANSI® Device Numbers & Functions

<table>
<thead>
<tr>
<th>ANSI CODE</th>
<th>61850 LOGICAL NODE</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>49</td>
<td>PTTR</td>
<td>Thermal Overload</td>
</tr>
<tr>
<td>50/87</td>
<td>insPDIF</td>
<td>Instantaneous Differential</td>
</tr>
<tr>
<td>50_2</td>
<td>ngseqPIOC</td>
<td>Negative Sequence Instantaneous Overcurrent</td>
</tr>
<tr>
<td>50BF</td>
<td>RBF</td>
<td>Breaker Failure</td>
</tr>
<tr>
<td>50G/51G</td>
<td>gndPIOC/hsPIOC</td>
<td>Ground/Sensitive Ground Instantaneous Overcurrent</td>
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<tbody>
<tr>
<td>50N</td>
<td>ndPIOC</td>
<td>Neutral Instantaneous Overcurrent</td>
</tr>
<tr>
<td>50P</td>
<td>phsPIOC</td>
<td>Phase Instantaneous Overcurrent</td>
</tr>
<tr>
<td>51_2</td>
<td>ngseqPTOC</td>
<td>Negative Sequence Timed Overcurrent</td>
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<tr>
<td>51G/5G</td>
<td>gndPTOC/hsPTOC</td>
<td>Ground/Sensitive Ground Timed Overcurrent</td>
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<td>Phase Timed Overcurrent</td>
</tr>
<tr>
<td>86</td>
<td>-</td>
<td>Lockout</td>
</tr>
<tr>
<td>87G</td>
<td>rgfPDIF</td>
<td>Restricted Ground Fault</td>
</tr>
<tr>
<td>87T</td>
<td>pcnPDIF</td>
<td>Percent Differential</td>
</tr>
</tbody>
</table>
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 “cubic spline” curve characteristics enables the relay to perform accurately for restraint current in range between the two slope breakpoints.

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.

Unrestrained differential (50/87)
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/87G)
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 Overload (49)
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 (50P/NG/SG/2, 51P/NG/SG/2)
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 outputs for breaker trip and close with coil monitoring and 5 Form C output relays

Automation and Integration
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 the output operand of any protection or control element.

Use the logic element feature to assign up to eight triggering inputs in an “AND/OR/NOR/NAND/XOR/XNOR” gate for the logic element operation, and up to four blocking inputs in an “AND/OR/NOR/NAND/XOR/XNOR” gate for defining the block signal. Pickup and dropout timers are available for delaying the operation and reset.

Virtual Inputs
Virtual inputs allow communication devices the ability to write digital commands to the 345 relay. These commands can include open/close the breaker, changing setting groups, or blocking any of the protection elements.

IEC61850
The 345 supports IEC 61850 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 several 345 relays or other IEC 61850 compliant IEDs.

- Eliminates the need for hardwiring contact inputs to contact outputs via communication messaging.
- Handles information exchange between devices as fast as 8 ms, depending on the architecture.
- Enables sequence coordination with upstream and downstream devices.
• If a Breaker Open operation malfunctions, GOOSE messaging sends a signal to the upstream breaker to trip and clear the fault.

**Metering, Monitoring and 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 relay stores up to 256 events, time tagged to the nearest millisecond. This provides the information required to determine sequence of events, facilitating the diagnosis of relay operation. Event types are individually maskable in order to avoid generating undesired events, and include the metered values at the moment of the event.

**Oscillography / Transient Fault Recorder**
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.

**Trip/Close Coil Monitoring**
The 345 can be used to monitor the integrity of both the breaker trip and closing coils and circuits. The supervision inputs monitor both the auxiliary voltage levels, while the outputs monitor the continuity of the trip and/or closing circuits, by applying a small current through the circuits.

**Advanced Device Health Diagnostics**
The 345 performs comprehensive device health diagnostic tests during startup and continuously at runtime to test major functions and critical hardware. These diagnostic tests monitor for conditions that could impact system reliability. Device status is communicated via SCADA communications and the front panel display. This continuous monitoring and early detection of possible issues helps improve system availability by employing predictive maintenance.

**Temperature Monitoring**
The 345 continually monitors ambient temperature around the relay and alarms when the device is exposed to extreme temperatures and undesirable conditions such as air-conditioning unit or station heater failures. The EnerVista Viewpoint maintenance tool allows users to review and analyze the time period a 345 relay is exposed to certain temperature ranges.

**Logic Designer**

![Logic Designer Diagram]

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

**IRIG-B**
The 345 captures current and voltage waveforms and digital channels at up to 32 samples per cycle (user-selectable). Multiple records can be stored in the relay at any given time with a maximum length of 192 cycles. Oscillography is triggered either by internal signals or an external contact.

**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
- Current demand

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**

**Password Control**
The password system has been designed to facilitate a hierarchy for centralized management. 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

These protocols make it easy to connect to a Utility or Industrial automation system, eliminating the need for external protocol converter devices.

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 setup software and are included to ensure proper protection and system operation.

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.

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

### Power System Troubleshooting

Analyze power system disturbances with transient fault recorder and event records.

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, information and control commands.

**INSTALLATION OPTIONS** Draw out and non draw out options available.

---

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**INSTALLATION OPTIONS** Draw out and non draw out options available.
Dimensions

<table>
<thead>
<tr>
<th></th>
<th>DRAWOUT</th>
<th>NON-DRAWOUT</th>
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<tbody>
<tr>
<td>H</td>
<td>7.93</td>
<td>7.98</td>
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<tr>
<td>W</td>
<td>6.62</td>
<td>6.23</td>
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<tr>
<td>D</td>
<td>9.62</td>
<td>9.35</td>
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<td>3.96</td>
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<tr>
<td>D1</td>
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<td>H1</td>
<td>6.82</td>
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</tr>
</tbody>
</table>

Mounting

3 Series Depth Reducing Collar
Typical Wiring Diagram

TWO WINDING TRANSFORMER

A
B
C

Winding 1 Breaker Aux Contacts
Winding 2 Breaker Aux Contacts

C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12
E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12

Input 5
Input 6
Input 7
Input 8
Input 9
Input 10
Common
Chassis GND

52a W1 BKR (CI #1)
52b W1 BKR (CI #2)
52c W2 BKR (CI #3)
52d W2 BKR (CI #4)

COMMUNICATIONS
IRIG-B RS485

OPTIONAL

PERSONAL COMPUTER
USB
4 WIRE USB
4 WIRE ETHERNET

CONTROL POWER
GROUND BUS
TRIP CIRCUIT W1 BKR
TRIP CIRCUIT W2 BKR

OUTPUT CONTACTS SHOWN WITH NO CONTROL POWER

TRIP COIL W1 BKR
TRIP COIL W2 BKR

OUTPUT CONTACTS
1 TRIP
2 TRIP
3 AUXILIARY
4 AUXILIARY
5 AUXILIARY
6 AUXILIARY
7 CRITICAL FAILURE RELAY

A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12
B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12

SEE COMMUNICATIONS WIRING IN INSTRUCTION MANUAL

GE Grid Solutions
**Transformer Protection System**

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

**Transformer Protection System**
- GEGridSolutions.com

### Technical Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>Password Security</strong></td>
<td>Master Reset: 8 to 10 alpha-numeric characters&lt;br&gt;Master Password: 3 to 10 alpha-numeric characters for local or remote access&lt;br&gt;Control Password: 3 to 10 alpha-numeric characters for local or remote access</td>
</tr>
<tr>
<td><strong>Phase/Neutral/Ground/Overshoot Sequence Time Overcurrent</strong> (1P15/1P13/1P12)</td>
<td>Pickup Level: 0.02 to 20.00 AC in steps of 0.01&lt;br&gt;Dropout Level: 97 to 98% of pickup&lt;br&gt;Curve Shape: ANSI Extremely/Very/Normal/Normally Normal&lt;br&gt;Time Delay: 0.00 to 20.00 in steps of 0.01&lt;br&gt;Operate Time: 20 to 250 ms in steps of 0.01&lt;br&gt;Logic Element State: per CT input</td>
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<td><strong>Sensitive Ground Time Overcurrent</strong> (1G15)</td>
<td>Pickup Level: 0.02 to 3.00 AC in steps of 0.01&lt;br&gt;Dropout Level: 0.05 to 3.000 xCT in steps of 0.01&lt;br&gt;Curve Multiplier: 0.05 to 20.00 xCT in steps of 0.01&lt;br&gt;Curve Shape: ANSI Extremely/Very/Inverse/Short&lt;br&gt;Time Delay: 0.00 to 1 cycle (time delay selected)&lt;br&gt;Logic Element State: per CT input</td>
</tr>
<tr>
<td><strong>Transformer Percent Differential Protection (B71)</strong></td>
<td>Differential/Restrain Characteristic: Dual Slope, Dual Breakpoint&lt;br&gt;Minimum Pickup Level: 0.02 to 1.00 xCT in steps of 0.01&lt;br&gt;Slope 1 Range: 10 to 100% in steps of 1&lt;br&gt;Knee Point 1: 0.05 to 0.40 xCT in steps of 0.01&lt;br&gt;2X Harmonic Inhibit Level: 1.0 to 4.00% of CT&lt;br&gt;4X Harmonic Inhibit Level: 0.02 to 0.40% of CT&lt;br&gt;9X Harmonic Inhibit Level: 0.01 to 0.40% of CT&lt;br&gt;Dropout Level: 97 to 98% of pickup&lt;br&gt;Operate Time: 20 to 200 ms in steps of 0.01&lt;br&gt;Logic Element State: per CT input</td>
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<tr>
<td><strong>Sensitive Ground Instantaneous Overcurrent (1G05)</strong></td>
<td>Pickup Level (GND): 0.005 to 3.000 xCT in steps of 0.001 xCT&lt;br&gt;Dropout Level: 97 to 98% of pickup&lt;br&gt;Curve Multiplier: 0.005 to 20.00 xCT/0.005 to 20.00 xCT&lt;br&gt;Curve Shape: ANSI Extremely/Very/Inverse/Normal&lt;br&gt;Time Delay: 0.00 to 3000.00 sec in steps of 0.01&lt;br&gt;Operate Time: 20 to 2000 ms in steps of 0.01&lt;br&gt;Logic Element State: per CT input</td>
</tr>
<tr>
<td><strong>Fault Recorder</strong></td>
<td>Number of records: 50&lt;br&gt;Recall: Data and time, first cause of fault, phases, currents: Ia, Ib, Ic, Ig, Isg in magnitudes and angles&lt;br&gt;Event Storage: RAM battery-backed-up&lt;br&gt;Time Delay: 0 to 1 cycle (time delay selected)</td>
</tr>
<tr>
<td><strong>Restricted Ground Fault (B70)</strong></td>
<td>Number of elements: 2&lt;br&gt;Level Function: 0.02 to 20.00 AC in steps of 0.01&lt;br&gt;Dropout Level: 97 to 98% of pickup&lt;br&gt;Curve Multiplier: 0.02 to 20.00 xCT (with sensitive CTs)&lt;br&gt;Time Delay: 0.00 to 20.00 ms in steps of 0.01&lt;br&gt;Logic Element State: per current inputs</td>
</tr>
<tr>
<td><strong>Logic Elements</strong></td>
<td>Number of logic elements: 16&lt;br&gt;Trigger source inputs: 2 to 8&lt;br&gt;Block inputs per element: 2 to 4&lt;br&gt;Supported operations: AND, OR, NOR, NAND, XOR, XNOR&lt;br&gt;Pickup / Dropout timers: 0 to 60000 ms in steps of 1 ms&lt;br&gt;Input impedance: 40 kOhm + 10%&lt;br&gt;Accuracy without IRIG-B: ± 1 ms&lt;br&gt; Accuracy with IRIG-B: ± 1 min / month</td>
</tr>
<tr>
<td><strong>Breaker Failure (10BF)</strong></td>
<td>Pickup Level: 0.02 to 20.00 xCT in steps of 0.01 xCT&lt;br&gt;Dropout Level: 98 to 99.8% of pickup&lt;br&gt;Timer 1 Delay: 0.03 to 1.000 s in steps of 0.01 s&lt;br&gt;Timer 2 Delay: 0.00 to 1.000 s in steps of 0.01 s&lt;br&gt;Accuracy: ± 3% of delay setting or ± 1 cycle (whichever is greater) from pickup to operate&lt;br&gt;Accuracy: ± 3% of delay setting or ± 1 cycle (whichever is greater) from pickup to operate&lt;br&gt;</td>
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Technical Specifications

**FORM-C RELAYS**
- **Configuration:** 5 (five) electromechanical
- **Contact material:** silver-alloy
- **Operate time:** <8 ms
- **Continuous current:** 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:**
  - 48 V / 1 A
  - 125 V / 0.5 A
  - 250 V / 0.3 A
- **Break AC inductive:** 720 VA @ 50 VAC, Pilot duty A100
- **Break AC resistive:** 277 VAC / 10 A

**RELAY**
- 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 250 VAC
- **Range:** 60 to 300 VAC [50 and 60 Hz]
- **Ride-through time:** 5 ms

**ALL-PURPOSE POWER SUPPLY RANGES**
- **Voltage withstand:** 1000 V AC, 900 V DC (required for 10 ms)
- **Power:** 15 W nominal, 20 W maximum
- **Consumption:**
  - 5A fuse, time lag, slow blow, 350V 4.5 O.D.
- **Fuses:**
  - 5A fuse, time lag, slow blow, 350V 4.5 O.D.

**ENVIRONMENTAL COPPER**
- **Modes:** 10/100 Mbit autosensing
- **Connector:** RJ-45
- **Protocols:**
  - Modbus TCP
  - DNP3.0, IEC 60870-5-104
  - IEC 61850 GOOSE, IEC 61850-11

**ETHERNET TO SPI**
- **Type:** 100 MHz Multi-mode
- **Wave length:** 1300 nm
- **Connector:** MTU
- **Transmit power:** -20 dBm
- **Receiver sensitivity:** -31 dBm
- **Power budget:** 9 dBm
- **Maximum input:** -113 dBm
- **Power:**
  - Typical distance: 2 km (1.25 miles)
  - Duplex: half/duplex
  - Protocol: Modbus TCP, DNP3.0, IEC 60870-5-104, IEC 61850 GOOSE, IEC 61850

**SPECIAL**
- **RS485 port:** Opto-coupled
- **Baud rate:** Up to 115 kbps
- **Power:**
  - 1200 m (4000 ft)
  - ISO-7: 2.2 V

**ISO 9001**
- **Certification:** Application council directive according to Low-voltage directive 2014/35/EU
- **CE:**
  - EN61850 GOOSE, IEC 61850-11
- **North America:**
  - UL C22.2 No 14
- **EAC:**
  - Machines and Equipment, TR CU 010/2011
  - ISO: Manufactured under a registered quality program ISO9001
  - Lloyd's Register Rules and regulations for the classification of ships
- **Marine applications:** ENV2, ENW3

**ELECTRICAL**
- **Voltage:**
  - 84 to 250 VDC
  - 125 to 250 VDC
  - 120 to 240 VAC
- **Ripple:**
  - 550 VAC for one second
  - 550 VAC for one second
- **Impulse voltage withstand:**
  - EN60255-4-5: 2.5kV CM, 3kV DM
  - EN60255-4-2: Level 4
  - EN60255-4-2: Level 4
- **Discharge:**
  - CLASS A & B
  - CLASS A & B

**EMC**
- **Immunity:**
  - Conducted RF: EN61000-4-5
  - Radiated & Conducted:EN61000-4-5
  - Modulation: EN61000-4-5
  - Disturbance: EN61000-4-5
  - Surge Immunity: EN61000-4-5
  - Voltage Dip & Interruption: EN61000-4-5
  - Voltage Ripple: EN61000-4-5
  - Ingress Protection: EN61000-4-5
  - Shock & Bump: IEC60255-5 5KV
  - ESD: IEC60255-5 5KV
  - Lightning: EN60255-5 5KV

**ENVIRONMENTAL**
- **Temperature:**
  - Operating up to 95% (non condensing)
  - Storage up to 95% (non condensing)
  - Temperature:**
  - Operating up to 95% (non condensing)
  - Storage up to 95% (non condensing)

**WEIGHT**
- **Net:** 2.9 kg (6.4 lbs)
- **Gross:** 4.0 kg (8.6 lbs)
- **DRAWDOWN UNIT**
- **Net:** 3.9 kg (8.6 lbs)
- **Gross:** 5.0 kg (11.0 lbs)
### Multilin 345

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<td><strong>Phase Currents</strong></td>
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<td>1A standard ground CTs (Winding 1 - 1A, Winding 2 - 1A)</td>
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<td>110 - 230 V dc/110 - 230 Vac</td>
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<td><strong>Faceplate</strong></td>
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<td>Standard faceplate (LCD, full menu, actual values and setpoints) with 10 Inputs, 7 Outputs (2 Form A, 5 Form C)</td>
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<td><strong>345 Current Protection</strong></td>
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<td>Standard: 87T, 87T-50, S1P(1), S1G(1), S0P(1), S0G(1), 50P(1), 50G(1), 46P(1), 46S1(2), 50S1(2), 86</td>
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<td>Advanced: 87T, 87T-50, S1P(1), S1G(1), S0P(1), S0G(1), 50P(1), 50G(1), 46P(1), 46S1(2), 50S1(2), 50P(2), 50G(2), 86, 50BF(2), 87G/RGF(2)</td>
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<td>Standard: Front USB, Rear RS485 Modbus RTU, DNP3.0, IEC60870-5-103</td>
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<td>Standard + Ethernet (Cooper &amp; Fiber - MTRJ) MODBUS TCP/IP, DNP3.0, IEC 60870-5-104</td>
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<td><strong>Case Design</strong></td>
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<td>Harsh Environment Conformal Coating</td>
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### Ordering Notes:
1. The Language option “L” is only available with the drawout Case Design (option D).
2. Phase current option “P0” and Ground current option “G0” is only available on the non-drawout version (Case Design option “N”).
3. Ground current options “G0” / “G1” / “G5” and “S0” / “S1” / “S5” must match the corresponding “P0” / “P1” / “P5” Phase currents. The selected phase and ground CTs apply to both windings.
4. Current protection option “E” has been discontinued.

### Related Products / Accessories
- SR3 Depth reducing collar - 1.375” 18L0-0076
- SR3 Depth reducing collar - 3.00” 18L0-0075
- SR3 IP20 Kit 18L0-0080

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