GE

Digital Energy

Multilin 339

Motor Protection System

The Multilin™ 339 is a member of the Multilin 3 Series protective relay platform and has been designed for the protection, control and management of medium voltage motors in industrial applications. The Multilin 339 delivers unparalleled protection, control, diagnostics and communications in an industry leading draw-out construction. Providing simplified setup configuration through the use of the Motor Settings Auto-Configurator, advanced graphical diagnostics with the Motor Health Report and support for multiple communication protocols including IEC® 61850, the 339 Motor Protection System provides comprehensive motor protection for most small and medium sized motors.

Key Benefits

- Cost-effective and flexible protection and control device for motors
- Enhanced Thermal Model including RTD and current unbalance biasing
- Time stamped event reports, waveform capture, motor start and motor trending
- Security Audit Trail capturing setting and command changes
- Draw-out construction eliminates the need for test switches
- Reduced wiring with support for remote RTD's using the RMIO module
- Optional internal RTD board supporting 3 programmable RTDs
- Simplified Motor Setup screen reduces setup and configuration time
- Customized motor overload curve Flex curves
- Detailed Motor Health Report with critical data
- Draw-out or non draw-out options available
- Multiple communication networks supporting the most popular industry standard protocols

Applications

- Small to medium sized medium voltage motors
- Protection of pumps, conveyors, fans, compressors, etc.
- Applications requiring fast and secure communications
- Harsh environments requiring protection against corrosive chemicals and humid environments

imagination at work

Protection & Control

- Thermal model biased with RTD and negative sequence current feedback
- Phase and ground overcurrent
- Start supervision and inhibit
- Mechanical jam
- Current unbalance
- Over/under voltage and phase reversal
- Breaker failure/welded contactor

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

Metering & Monitoring

- Current and voltage metering
- RTD temperature
- Power, energy and frequency metering
- Event Recorder: 256 events with 1ms time stamping
- Oscillography with 32 samples per cycle and digital states
- IRIG-B clock synchronization
- Motor health diagnostics

EnerVista Software

- Simplify setup and configuration
- Strong document archive and management system
- Simplify full featured monitoring

Overview

The Multilin 339 relay is a member of the 3 Series family of Multilin relays. This motor protective device is used to perform primary motor protection of medium voltage motor applications.

The basic protection functions of this relay include motor thermal model, time-delayed and instantaneous overcurrent, ground overcurrent and sensitive ground overcurrent protection. Additional control features such as logic control are available for applications that require additional motor control functionality.

The robust 339 streamlines user work flow processes and simplifies engineering tasks such as configuration, wiring, testing, commissioning, and maintenance. This cost-effective relay also offers enhanced features such as diagnostics, preventative maintenance, motor health reports and advanced security features.

Easy to Use

Draw-out Construction

The 339 offers a complete draw-out feature eliminating the need for rewiring after testing has been concluded. The withdrawable feature also eradicates the need to disconnect communication cables, e.g. fiber, copper, RJ45, etc and helps retain communication status even after a relay has been withdrawn from its case.

Effortless Retrofit

The compact and withdrawable feature of the 339 relay minimizes mounting requirements, enables easy retrofit to existing cases, and allows multiple relays to be mounted side by side on a panel. The 339 also provides a pluggable RS485 & IRIG-B connection for easy trouble shooting.

Easy to Configure

Fast & Simple Configuration

Providing ease-of-use functionality, the 339 allows for motor configuration in a simple one page setup screen. Therefore complete motor 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 339 provides advanced and flexible communication selections for new and existing applications.

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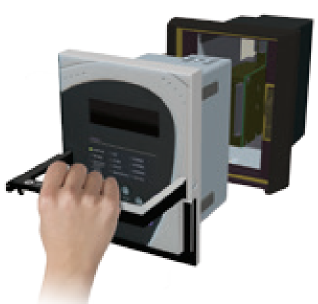
339 Relay Features

Easy to Configure - 1 Simple step

Easy to Use - Draw-out Case



Advanced & Flexible Communication Options

Diagnostic Alarms

Enhanced Diagnostics

Preventative Maintenance

The 339 allows user 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 339 detects and alarms on communication port and IRIG-B failures. The 339 also enables users to analyze system performance via diagnostics information such as event records, oscillography, etc. It issues detailed motor health reports and alarms when thresholds are exceeded.

Cost Effective

Robust Design

The 339 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 339 is designed to reduce total installation and life cycle cost for motor 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 339 motor protection system is designed to protect and manage small to medium sized AC motors and driven equipment. Flexible and powerful, the 339 provides advanced motor protection, control and monitoring in one integrated, economical draw-out design. The 339 contains a full range of self contained protection and control elements as detailed in the Functional Block Diagram and Features table.

Motor Thermal Model

To provide optimal protection and maximum runtime, the 339 Motor Protection System employs GE's Industry leading advanced Thermal Model, consisting of six key elements:

- Overload Curves
- Unbalance Biasing
- Hot/Cold Safe Stall Ratio
- Motor Cooling Time Constants
- Thermal Inhibit and Emergency Restart
- RTD Biasing

FlexCurves

A smooth custom overload curve is created using FlexCurves™. These curves can be used to protect motors with different rotor damage and stator damage curves, allowing total motor design capacity with complete protection.

Over/Under Voltage Protection

Overvoltage/Undervoltage protection features can cause a trip or generate an alarm when the voltage exceeds a specified voltage setting for a specified time.

Frequency Protection

The 339 offers overfrequency and underfrequency protection elements that provide the ability to detect when the motor is operating at off-nominal frequencies which can cause damage to the process. In such cases, the protection elements can trip the motor off-line or can be used to signal to upstream protection and control devices to implement load-shedding schemes.

Unbalance (Negative Sequence) Biasing

Negative sequence current, which causes additional rotor heating, is not accounted for in the thermal limit curves provided by the manufacturer. The 339 measures current unbalance as a ratio of negative to positive sequence current. The thermal model is then biased to reflect the additional rotor heating.

RTD Biasing

The Thermal Model relies solely on measured current to determine motor heating, assuming an ambient temperature of 40°C and normal motor cooling. The actual motor temperature will increase due to abnormally high ambient temperatures or if the motor cooling systems have failed.

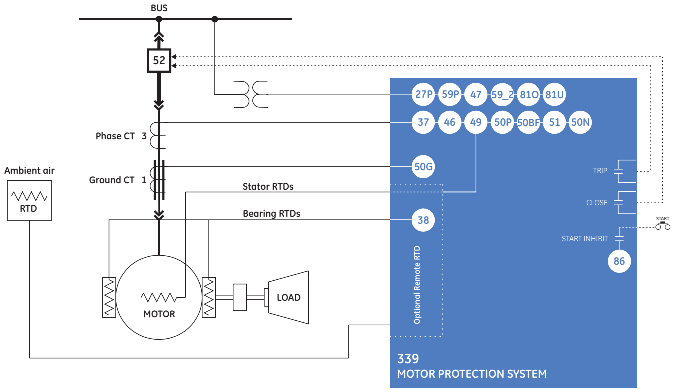
RTD Biasing enhances the motor thermal model by calculating the thermal capacity used based on available Stator RTD temperatures.

RTD Biasing does not replace the Thermal Capacity Used (TCU) calculated using the motor current. It provides a second and independent measure of thermal capacity used. Based on a programmable curve, the 339 will calculate the TCU at any given temperature. This TCU is then compared to that of the thermal model, and the larger of the two will be used.

Hot / Cold Safe Stall Ratio

The ratio defines the steady state level of thermal capacity used (TCU) by the motor. This level corresponds to normal operating temperature of a fully loaded motor and will be adjusted proportionally if the motor load is lower than rated.

Functional Block Diagram



ANSI® Device Numbers & Functions

DEVICE NUMBER	FUNCTION
27P	Phase UV
37	Undercurrent, Underpower
38	Bearing RTD, Stator/Ambient/ Other, RTD Trouble Alarm
46	Current Unbalance
47	Voltage Phase Reversal
48	Acceleration Time
49	Thermal Protection/Stall Protection
50BF	Breaker Failure / Welded Contactor
50G	Ground Fault
50P	Short Circuit

DEVICE NUMBER	FUNCTION
51P	Mechanical Jam
50N	Neutral Instantaneous Overcurrent
59_2	Negative Sequence OV
59P	Phase OV
66	Starts per Hour & Time Between Starts, Restart Block, Thermal Inhibit
81O	Overfrequency
81U	Underfrequency
86	Lockout
VTFF	VT Fuse Failure

Motor Cool Time Constants

The 339 has a true exponential cooldown characteristic which mimics actual motor cooling rates, providing that motor cooling time constants are available for both the stopped and running states. When ordered with RTD's the stopped and running cool time constants will be calculated by the 339 based on the cooling rate of the hottest RTD, the hot/cold stall ratio, the ambient temperature, the measured motor load and the programmed service factor or overload pickup.

Start Inhibit

The Start Inhibit function prevents starting of a motor when insufficient thermal capacity is available or a motor start supervision function dictates inhibit.

Motor Start Supervision

Motor Start Supervision consists of the following features: Time-Between-Starts, Starts-per-hour, Restart Time.

These elements guard the motor against excessive starting duty, which is normally defined by the motor manufacturer in addition to the thermal damage curves.

Undercurrent

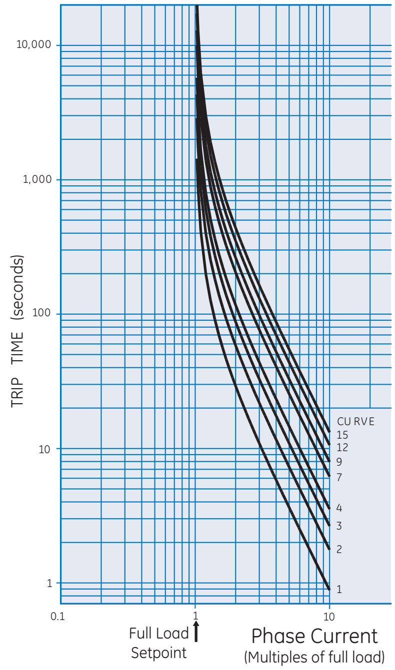
The undercurrent function is used to detect a decrease in motor current caused by a decrease in motor load. This is especially useful for indication of conditions such as: loss of suction for pumps, loss of airflow for fans, or a broken belt for conveyors. A separate undercurrent alarm may be set to provide early warning.

Mechanical Jam

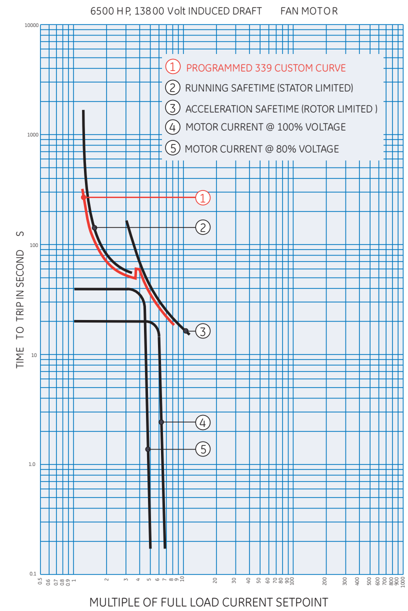
During overload conditions, quick motor shutdown can reduce damage to gears, bearings and other mechanical parts associated with the drive combination.

Ground Overcurrent

For zero sequence ground overcurrent protection, all three of the motor conductors must pass through a separate ground CT. CTs may be selected to detect either high-impedance zero sequence ground or residual ground currents. The ground fault trip can be instantaneous or programmed for a time delay.



15 Standard Curves available in the 339.



Typical Flexcurve

RTD Protection

The 339 provides programmable RTD inputs via the remote RMIO that are used for monitoring the Stator, Bearing and Ambient temperatures. Each RTD input has 2 operational levels: alarm and trip. The 339 supports RTD trip voting and provides open and short RTD monitoring.

The remote RMIO RTD module is used with the 339 in cases where RTD monitoring is required.

Inputs/Outputs

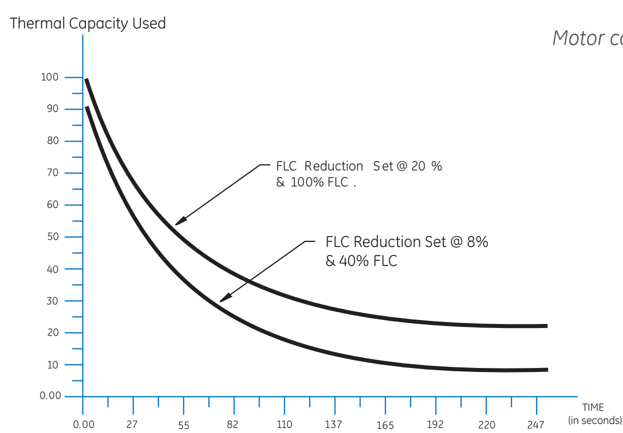
The 339 features the following inputs and outputs for monitoring and control of typical motor applications:

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

Advanced Automation

Logic Elements

The 339 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.



Motor cooling curves

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 339 relay. These commands could be starting or stopping the motor, changing setting groups or blocking protection elements.

IEC 61850

The 339 supports IEC 61850 Logical Nodes which allows for digital communications to DCS, SCADA and higher level control systems.

In addition, the 339 also supports IEC 61850 GOOSE communication, providing a means of sharing digital point state information between 339's or other IEC 61850 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 339 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. Event types are individually maskable in order to avoid the generation of undesired events, and includes metered values and status of all the protection elements at the moment of the event.

Oscillography

The 339 captures current and voltage waveforms and digital channels at 32 samples per cycle. The oscillography record captures 8 individual channels allowing for detailed analysis. The oscillography is triggered either by internal signals or an external contact.

Statistical Data

The 339 records the following statistical data in order to assist in diagnosing common motor faults, as well as assisting in planning preventative maintenance.

- Total running hours
- Number of motor starts
- Total number of motor trips

Pre-Trip Alarms

The 339 can trigger an alarm prior to a trip caused by the following conditions:

- Thermal Overload
- Ground Fault
- Unbalance
- Undercurrent
- RTD over temperature
- Broken RTD sensor
- Internal self-test

Advanced Device Health Diagnostics

The 339 performs comprehensive device health diagnostic tests during startup and continuously at runtime to test its own 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.

IRIG-B

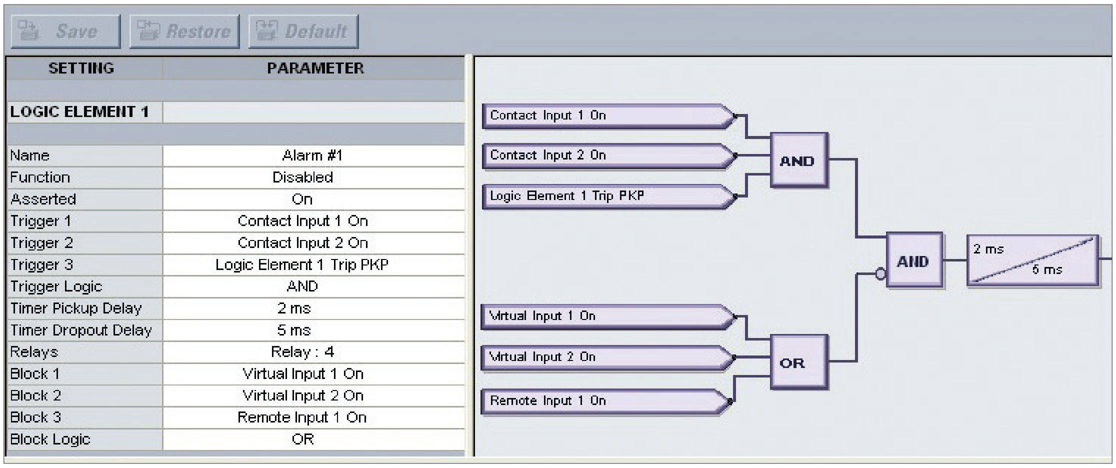
IRIG-B is a standard time code format that allows time stamping of events to be synchronized among connected devices within 1 milliseconds. An IRIG-B input is provided in the 339 to allow time synchronization using a GPS clock over a wide area. The 339 IRIG-B supports both AM and DC time synchronization with an auto detect feature that removes the requirement for manual selection.

Motor Health Report

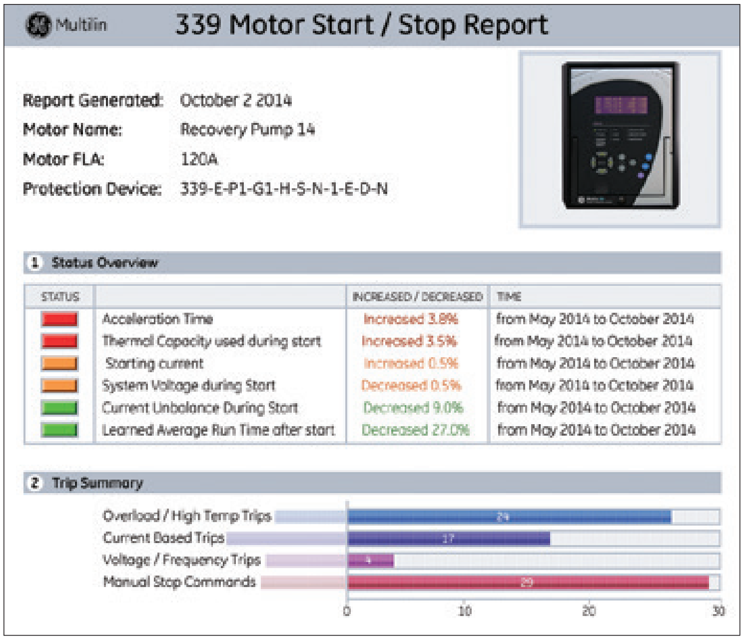
The Multilin 339 relay provides motor diagnostic information in a legible easy to use format that enables the user to make informed decisions on the health of their motor.

Based on the graphical representation and trended values of the motor data gathered by the 339, this enables users to quickly identify process and motor issues prior to a process failure.

The 339 Motor Health Report provides a summary page detailing information on related motor performance.



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



Multilin **339 Motor Start / Stop Report**

Report Generated: October 2 2014
Motor Name: Recovery Pump 14
Motor FLA: 120A
Protection Device: 339-E-P1-G1-H-S-N-1-E-D-N

1 Status Overview

STATUS		INCREASED / DECREASED	TIME
	Acceleration Time	Increased 3.8%	from May 2014 to October 2014
	Thermal Capacity used during start	Increased 3.5%	from May 2014 to October 2014
	Starting current	Increased 0.5%	from May 2014 to October 2014
	System Voltage during Start	Decreased 0.5%	from May 2014 to October 2014
	Current Unbalance During Start	Decreased 9.0%	from May 2014 to October 2014
	Learned Average Run Time after start	Decreased 27.0%	from May 2014 to October 2014

2 Trip Summary

The Motor Heath Report allows you to easily "see" how your motor is doing:

- *Start/stop history*
- *Comprehensive trip details*
- *Learned acceleration time and starting current*
- *Many other motor health details*

The following information is detailed in the 339 Motor Health Report:

- Motor Acceleration Time
- Starting Current
- Thermal capacity used during starting
- Average Motor Load
- Average Phase currents
- Current unbalance
- Ground current
- Motor load current as a % of full load
- Motor thermal capacity used
- Stator/Bearing/Ambient RTD temperature

Metering

Actual Values

The 339 provides users with the following metering information in order to accurately monitor the operating conditions of the motor:

- Current: Ia, Ib, Ic, In, Ig, Isg
- Phase-to-phase and phase-to-ground voltages: Van, Vbn, Vcn, Vab, Vbc, Vca
- Active power (3-phase) kW
- Reactive power (3-phase) kVAR
- Frequency
- Current Unbalance

Security

Security Audit Trail

In accordance with NERC® CIP security reporting requirements and to provide complete traceability, the 339 maintains a history of the last 10 changes made to the 339 configuration, including modifications to settings and firmware upgrades. In addition, the Security Audit Trail records the last ten commands sent to the relay through communications or from the front panel.

Security Setting Report includes 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 339 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 339 utilizes the most advanced communication technologies today making it the easiest and most flexible motor 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 339. All communication ports are capable of communicating simultaneously.

The 339 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

Easy to Use

Simplified Motor Setting

Included with every 339 Motor Protection System is the Multilin Simplified Motor Setup. The Simplified Motor Setup provides users with a quick and easy method to setup and start the motor and process in applications that require fast commissioning.

The Simplified Motor Setup will generate a complete 339 setting file based on the motor nameplate and system information entered by the user. Once all the information is entered, the Simplified Motor 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 Motor 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 339 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 339 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
- SService 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 339 Motor Protection System. Viewpoint Maintenance will create reports on the operating status of the relay, and simplify the steps to troubleshoot protected motors.

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 Retrievel


SECURITY/CHANGE HISTORY REPORT

Generated at: September 15 2010 16:56:05

Device Summary

Device Name:	339
Device Type:	SR 339
Order Code:	339-CP5G5HESNP2EDH
Firmware Version:	1.30
Serial Number:	BL0A09000564
Communication:	COM 3, 115200

Setting Changes History

Session#	Date of Change	Method of Change	# Of Changes	Password Entered	Changes by Whom IP /Mac	Event Type	Filename	Status	Firm. Version
1	09/15/2010 07:09:05 PM	USB	25	Yes	0:0:0:0	Setpoint Change		Relay Not Ready	130
2	09/15/2010 07:13:32 PM	USB	2	Yes	3:13:81:141	Setpoint Change		Relay Ready	130

Setting Changes Detail History

Session#	Date Of Change	Old Value	New Value	Data Item	Modbus Address
1	09/15/2010 07:09:05 PM	0	1	Relay Status	0X39e
1	09/15/2010 07:09:13 PM	120	240	Bus VT Secondary	0X118
1	09/15/2010 07:09:20 PM	0	1	Supply Frequency	0X11b
1	09/15/2010 07:09:35 PM	100	1500	CT Primary	0X10a
1	09/15/2010 07:09:48 PM	0	448	Low Speed Switch	0X57e
1	09/15/2010 07:09:53 PM	0	1	Enable Two Speed Motor	0X136
1	09/15/2010 07:10:07 PM	0	1	Thermal Overload Function	0X2b9
1	09/15/2010 07:10:07 PM	0	1	Thermal Alarm Function	0X2bc
1	09/15/2010 07:10:18 PM	0	1	Short Circuit Function	0X3b3
1	09/15/2010 07:10:36 PM	0	1	Mechanical Jam Function	0X2cd

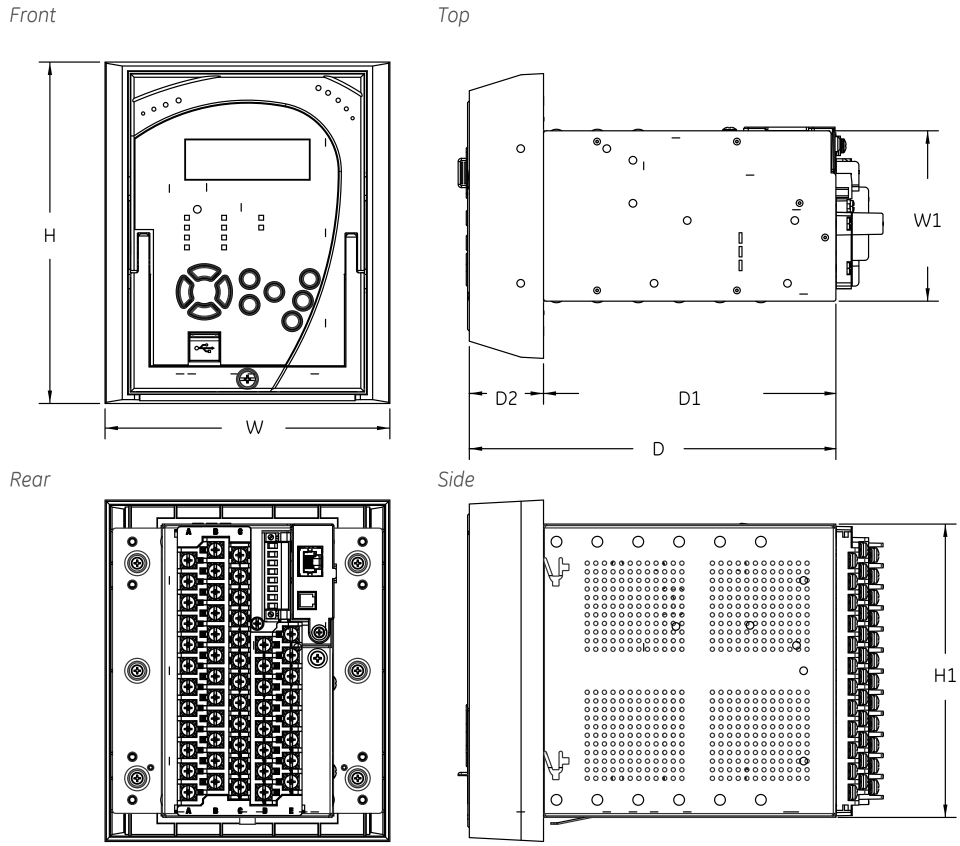
GE Multilin

EnerVista VIEWPOINT maintenance

Trace any setting changes with security audit trail

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



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 if relay is not programmed.

LOCKOUT: Lockout initiates when a lockout trip is active.

RUNNING: Indicates that the motor is running in normal operation

STOPPED: Indicates that the motor is stopped

STARTING: Indicates that the motor is in the starting process

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

ALARM: Indicates that the motor 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, coil monitor or trip counter.

The display messages are organized into Main Menus, Pages, and Sub-pages.

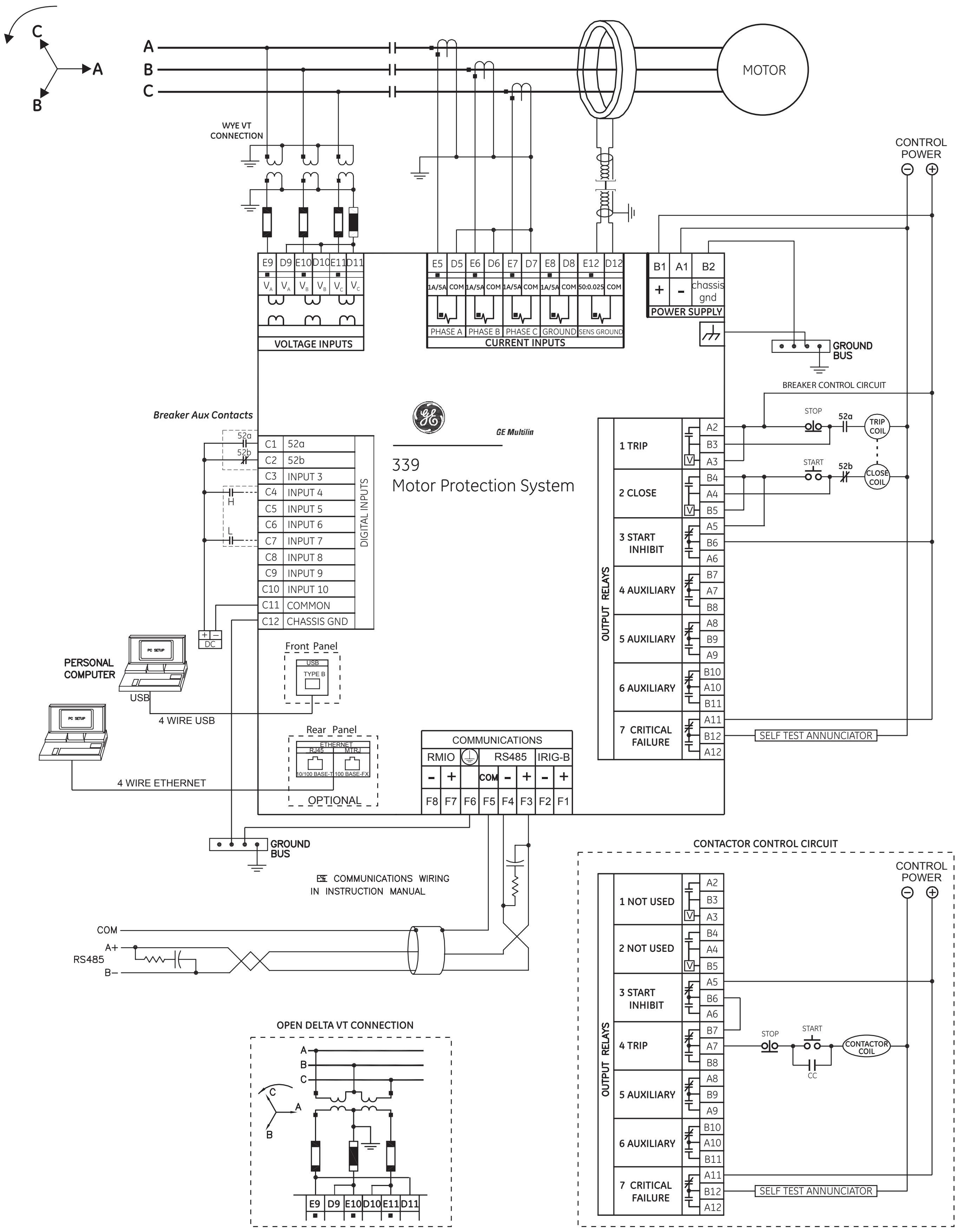
There are four main menus labeled Actual Values, Quick Setup, Setpoints, and Maintenance. Pressing the MENU key followed by the MESSAGE key scrolls through the four Main Menu Headers.

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

USER INTERFACE OPTIONS:

Draw out and non draw out options available

Wiring Diagram



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
Pickup delay	0 to 30000 min. in steps of 1

NEUTRAL INSTANTANEOUS OVERCURRENT (50N)

Pickup Level:	0.05 to 20 x CT in steps of 0.01 x CT
Dropout Level:	96 to 99% of Pickup @ I > 1 x CT Pickup - 0.02 x CT @ I <1 x CT
Time Delay:	0.00 to 300.00 sec in steps of 0.01
Operate Time:	<30 ms @ 60Hz (I > 2.0 x PKP), 0 ms time delay <35 ms @ 50Hz (I > 2.0 x PKP), 0 ms time delay
Timer Accuracy:	0 to 1 cycle
Level Accuracy:	per CT input
Elements:	Trip or Alarm

NEUTRAL DIRECTIONAL OVERCURRENT (67N)

Directionality:	0.005 to 3 x CT in steps of 0.001 x T
Polarizing:	Voltage, Current, Dual Voltage can be: - Calculated from VT phases (VTs must be connected in "Wye") - Measured by Vaux input (3V0 provided by an external open delta connection)
Polarizing Voltage:	$-V_0$
Polarizing Current:	I_G
MTA:	From 0° to 359° in steps of 1°
Angle Accuracy:	±2°
Operation Delay:	20 to 30 ms

UNDERCURRENT

Pickup Level:	0.1 to 0.95 x FLA in steps of 0.01 x FLA
Dropout Level:	101 to 104% of Pickup
Time Delay:	1.00 to 60.00 s in steps of 0.01 s
Block from Start:	0 to 600 s in steps of 1 s
Pickup Accuracy:	as per phase current inputs
Timing Accuracy:	±0.5 s or ± 0.5% of total time
Level Accuracy:	per CT input
Elements:	Trip or Alarm

CURRENT UNBALANCE

Unbalance Pickup Level:	4 to 40% in steps of 1%
Unbalance Time Delay:	1.00 to 60.00 s in steps of 0.01 s
Single Phasing Pickup Level:	unbalance level > 40% or when Iavg ≥25%FLA and current in any phase is less than the cutoff current
Single Phasing Time Delay:	2 sec
Dropout Level:	96 to 99% of pickup
Pickup Accuracy:	±2%
Timing Accuracy:	±0.5 s or ± 0.5% of total time
Unbalance Elements:	Trip and Alarm
Single Phasing Elements:	Trip

RTD

Pickup:	1 to 250°C in steps of 1°C
Pickup Hysteresis:	2°C
Time Delay:	3 sec
Elements:	Trip and Alarm

RTD TROUBLE ALARM

RTD Trouble Alarm:	<-50°C or >250°C

LOAD INCREASE ALARM

Pickup Level:	50 to 150%FLA in steps of 1%FLA
Dropout Level:	96 to 99% of Pickup
Alarm Time Delay:	1.00 to 60.00 s in steps of 0.01 s
Pickup Accuracy:	as per phase current inputs
Timing Accuracy:	±0.5 s or ±0.5% of total time

SHORT CIRCUIT

Pickup Level:	1.00 to 20.00 x CT in steps of 0.01 x CT
Dropout Level:	96 to 99% of Pickup @ I > 1 x CT Pickup - 0.02 x CT @ I < 1 x CT
Alarm Time Delay:	0.00 to 60.00 s in steps of 0.01 s
Pickup Accuracy:	as per phase current inputs
Operate Time:	<30 ms @ 60Hz (I > 2.0 x PKP), 0 ms time delay <35 ms @ 50Hz (I > 2.0 x PKP), 0 ms time delay
Timing Accuracy:	0 to 1 cycle
Elements:	Trip or Alarm

MECHANICAL JAM TRIP

Pickup Level:	1.01 to 4.50 x FLA in steps of 0.01 x FLA, blocked from start
Dropout Level:	96 to 99% of Pickup
Trip Time Delay:	0.10 to 30.00 s in steps of 0.01 s
Pickup Accuracy:	as per phase current inputs
Operate Time:	<30 ms @ 60Hz (I > 2.0 x PKP), 0 ms time delay <35 ms @ 50Hz (I > 2.0 x PKP), 0 ms time delay
Timing Accuracy:	±0.5 s or ±0.5% of total time

GROUND FAULT

Pickup Level:	0.03 to 1.00 x CT in steps of 0.01 x CT 0.50 to 15.00 A in steps of 0.01 A (CBCT)
Dropout Level:	Pickup - 0.02 x CT 96 to 99% of Pickup (CBCT)
Alarm Time Delay on Run:	0.00 to 60.00 s in steps of 0.01 s
Alarm Time Delay on Start:	0.00 to 60.00 s in steps of 0.01 s
Trip Time Delay on Run:	0.00 to 5.00 s in steps of 0.01 s
Trip Time Delay on Start:	0.00 to 10.00 s in steps of 0.01 s
Pickup Accuracy:	as per ground current inputs
Operate Time:	<30 ms @ 60Hz (I > 2.0 x PKP), 0 ms time delay <35 ms @ 50Hz (I > 2.0 x PKP), 0 ms time delay
Timing Accuracy:	0 to 1 cycle
Elements:	Trip and Alarm

PHASE/AUXILIARY UNDERVOLTAGE

Pickup Level:	1 to 100% Hz MNR 1%
Dropout Level:	101% to 104% of Pickup
Time Delay:	1.0 to 60.0 s in steps of 0.1
Pickup Accuracy:	as per power monitoring specification
Timing Accuracy:	±0.5 s or ±0.5% of total time
Elements:	Trip and Alarm

THERMAL PROTECTION (49)

Locked Rotor Current:	2.0 to 11.0 x FLA in steps of 0.1 x FLA
Safe Stall Time:	1.0 to 600.0 s in steps of 0.1 s
Curve Multiplier:	1 to 15 in steps of 1
Pickup Level:	1.01 to 1.25 x FLA in steps of 0.01 x FLA
Curve Biasing:	Phase unbalance Hot/cold biasing Stator RTD biasing Exponential Running and Stopped Cooling Rates
TCU Update Rate:	3 cycles
Pickup Accuracy:	per phase current inputs
Timing Accuracy:	± 200 ms or ±2% of total time
Elements:	Trip and Alarm

PHASE/AUXILIARY UNDERVOLTAGE (27P/27X)

Minimum Voltage:	Programmable from 0.00 to 1.25 x VT in steps of 0.01
Pickup Level:	0.00 to 1.25 x VT in steps of 0.01
Dropout Level:	101 to 104% of pickup
Curve:	Definite Time, Inverse Time
Time Delay:	0.1 to 600.0 s in steps of 0.1
Operate Time:	Time delay ±30 ms @ 60 Hz (V < 0.85 x PKP) Time delay ±40 ms @ 50 Hz (V < 0.85 x PKP)
Time Delay Accuracy:	±3% of expected time, or 1 cycle, whichever is greater
Level Accuracy:	Per voltage input

NEGATIVE SEQUENCE/PHASE OVERVOLTAGE (59P/59_2)

Pickup Level:	0.00 to 1.25 x VT in steps of 0.01
Dropout Level:	96 to 99% of pickup
Time Delay:	0.1 to 600.0 s in steps of 0.1
Operate Time:	Time delay ±30 ms @ 60 Hz (V < 0.85 x PKP)
Timing Accuracy:	±0.5 s or ±0.3% of total time
Level Accuracy:	Per voltage input

PHASE REVERSAL (47)

Configuration:	ABC or ACB phase rotation
Time Delay:	100 ms
Timing Accuracy:	±0.5 s
Elements:	Trip or Alarm

UNDERFREQUENCY (81U)

Minimum Voltage:	0.00 to 1.25 x VT in steps of 0.01
Pickup Level:	40.00 to 70.00 Hz in steps of 0.01
Dropout Level:	Pickup +0.03 Hz
Time Delay:	0.1 to 600.0 s in steps of 0.1
Timing Accuracy:	±0.5 s or ±0.5% of total time
Level Accuracy:	±0.01 Hz
Elements	Trip and Alarm

OVERFREQUENCY (81O)

Minimum Voltage:	0.3xVT
Pickup Level:	40.00 to 70.00 Hz in steps of 0.01
Dropout Level:	Pickup -0.03 Hz
Time Delay:	0.1 to 600.0 s in steps of 0.1
Timing Accuracy:	±0.5 s or ±0.5% of total time
Level Accuracy:	±0.01 Hz
Elements	Trip and Alarm

ACCELERATION TIME TRIP

Pickup Level:	Motor start condition
Dropout Level:	Motor run, trip, or stop condition
Timers for single-speed:	Stopped to running
Timers for two-speed:	Stopped to high speed, stopped to low speed, low to high speed
Time Delay:	1.0 to 250.0 s in steps of 0.1
Timing Accuracy:	±200 ms or ±1% of total time

MOTOR DATA LOGGER

Length:	6 buffers, containing a total of 30 seconds of motor starting data
Trigger:	Motor start status
Trigger Position:	1-second pre-trigger duration
Logging Rate:	1 sample/200 ms

FUSE FAIL

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

DATA LOGGER

Number of Channels:	10
Parameters:	Any available analog actual value
Sampling Rate:	1 cycle, 1 second, 1 minute, 1 hour
Trigger Source:	All logic elements, Logic operand: Any Trip PKP/OP/DPO, Any Alarm PKP/OP/DPO
Mode:	Continuous or triggered

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

EVENT RECORDER

Number of events:	256
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, motor load, current unbalance
Data Storage:	Non-volatile memory

LEARNED DATA RECORDER

Number of events:	250
Header:	Date, number of records
Content:	learned acceleration time , learned starting current, learned starting capacity, last starting current, last starting capacity, last acceleration time , average motor load learned, average run time after start (days), average run time after start (minutes)
Data Storage:	Non-volatile memory

CLOCK

Setup:	Date and time Daylight Saving Time RTC Accuracy: ± 1 min / month at 25°C
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%

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 CONTROL

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

START INHIBIT

Thermal Start Inhibit:	Thermal Inhibit Margin: 0 to 25 % in steps of 1%
Starts per Hour Inhibit:	Maximum: 1 to 5 starts in steps of 1
Time Between Starts Inhibit:	Time Between Starts: 1 to 3600 s in steps of 1 s
Restart Inhibit:	Restart Inhibit Delay: 1 to 50000 s in steps of 1 s

Technical Specifications

BREAKER FAILURE/WELDED CONTACTOR	
Current Supervision:	Phase Current
Current Supervision Pickup:	0.05 to 20.00 × CT in steps of 0.01 × CT
Time Delay 1:	0.03 to 1.00 s in steps of 0.01 s
Time Delay 2:	0.00 to 1.00 s in steps of 0.01 s
Current Supervision Dropout:	1 to 64 ms, selectable, in steps of 1 ms
Current Supervision Accuracy:	97 to 98% of pickup
Timing Accuracy:	0 to 1 cycle (Timer 1, Timer 2)

BREAKER TRIP COUNTER	
Trip Counter Limit (Pickup):	1 to 10000 in steps of 1

EMERGENCY RESTART	
Function:	Defeats all motor start inhibit features, resets all trips and alarms, and discharges the thermal capacity to zero so that a hot motor can be restarted in the event of an emergency
Operation:	Contact Input 1 to 10, Virtual Input 1 to 32, Logic Element 1 to 16, Remote Input 1 to 32

LOCKOUT RESET	
Function:	Reset any lockout trips when this feature is configured
Operation:	Contact Input 1 to 10, Virtual Input 1 to 32, Logic Element 1 to 16, Remote Input 1 to 32

RESET	
Function:	Resets any alarms and non-lockout trips when LOCKOUT RESET is configured, or resets any alarms and trips (lockout and non-lockout trips) when LOCKOUT RESET is not configured.
Operation:	Contact Input 1 to 10, Virtual Input 1 to 32, Logic Element 1 to 16, Remote Input 1 to 32

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 mins
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
Debounce time:	1 to 64 ms, selectable, in steps of 1 ms
Continuous current draw:	2 mA
Type:	opto-isolated inputs
External switch:	wet contact
Maximum input voltage:	300 VDC

CBCT INPUT (50:0.025)	
Range:	0.5 to 15.0 A
Nominal frequency:	50 or 60 Hz
Accuracy (CBCT):	±0.1 A (0.5 to 3.99 A) ±0.2 A (4.0 A to 15 A)

PHASE VOLTAGE INPUTS	
Source VT:	100 to 20000 V
VT secondary range:	50 to 240 V
VT ratio:	1 to 300 in steps of 1
Nominal frequency:	50/60 Hz
Accuracy:	±1.0% throughout range
Voltage withstand:	260 VAC continuous

PHASE & GROUND CURRENT INPUTS	
CT Primary:	30 to 1500 A
Range:	0.05 to 20 × CT
Input type:	1 A or 5 A (must be specified with order)
Nominal frequency:	50/60 Hz
Burden:	<0.1 VA at rated load
Accuracy:	±1% of reading at 1× CT ±3% of reading from 0.2 to 20 × CT ±20% of reading from 0.02 to 0.19 × CT
CT withstand:	1 second at 100 × rated current 2 seconds at 40 × rated current continuous at 3 × rated current

FREQUENCY	
Accuracy:	±0.05 Hz
Resolution:	0.01 Hz
Range:	40.00 to 70.00 Hz

RTD INPUTS	
RTD Type:	100 Ohm platinum (DIN.43760)
RTD Sensing Current:	5 mA
Isolation:	2 kV from base unit
Distance:	250 m maximum
Range:	-50 to +250°C
Accuracy:	±2°C
Lead Resistance:	25 Ohm max per lead

FORM-A VOLTAGE MONITOR	
Applicable voltage:	20 to 250 VDC
Trickle current:	1 to 2.5 mA

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

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

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

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

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

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

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

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

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

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

CERTIFICATION	
CE:	Low voltage directive EN60255-5 / EN60255-27 / EN61010-1 EMC Directive EN60255-26/EN50263, EN61000-6-2, UL508
ISO:	Manufactured under a registered quality program ISO9001

METERING SPECIFICATIONS			
Parameter	**Accuracy**	**Resolution**	**Range**
3-Phase Real Power (kW)	±1% of full scale	0.1 kW	±100000.0 kW
3-Phase Reactive Power (kvar)	±1% of full scale	0.1 kvar	±100000.0 kvar
3-Phase Apparent Power (kVA)	±1% of full scale	0.1 kVA	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

Technical Specifications

TYPE TESTS		
Dielectric voltage withstand:		2.3KV
Impulse voltage withstand:	EN60255-5	5KV
Damped Oscillatory:	IEC 61000-4-18/ IEC 60255-22-1	2.5KV CM, 1KV DM
Electrostatic Discharge:	EN61000-4-2/ IEC 60255-22-2	Level 4
RF immunity:	EN61000-4-3/ IEC 60255-22-3	Level 3
Fast Transient Disturbance:	IEEE® C37.90.1	4KV CM & DM
Surge Immunity:	EN61000-4-5/ IEC 60255-22-5	Level 3 & 4
Conducted RF Immunity:	EN61000-4-6/ IEC 60255-22-6	Level 3
Power Frequency Magnetic Field Immunity:	IEC 61000-4-8	Level 4

Radiated & Conducted Emissions:	CISPR11 / CISPR22/ IEC 60255-25	Class A
Sinusoidal Vibration:	IEC 60255-21-1	Class 1
Shock & Bump:	IEC 60255-21-2	Class 1
Voltage Dip & interruption:	IEC 61000-4-11	0, 40, 70, 80% dips, 250/ 300 cycle interrupts
Ingress Protection:	IEC 60529	IP40 front , IP10 Back
Environmental (Cold):	IEC 60068-2-1	-40C 16 hrs
Environmental (Dry heat):	IEC 60068-2-2	85C 16hrs
Relative Humidity Cyclic:	IEC 60068-2-30	6day variant 2
Fast Transient Disturbance:	IEEE C37.90.1	4KV CM & DM
SWC Damped Oscillatrory:	IEEE C37.90.1	2.5KV CM & DM
Electrostatic Discharge:	IEEE C37.90.3	8KV CD, 15KV AD

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 IEC 60068-2-30 Variant 2, 6days)
Pollution degree:	II
Overvoltage category:	III
Ingress Protection:	IP40 Front , IP10 back

Ordering

	339	E	**	**	**	*	S	N	*	* *	*	*	Description
Base Unit	339												Base Unit
Language		E											English
Phase Currents*			P1										1A three phase current inputs
			P5										5A three phase current inputs
339 Ground Currents*				G1									1A ground current input
				G5									5A ground current input
Power Supply					L								24 - 48 Vdc
					H								110 - 250 V dc/110 - 230 Vac
Input/Output*						E							10 Inputs, 7 Outputs (2 Form A, 5 Form C)
						R							10 Contact Inputs, 4 Outputs (1 Form A, 3 FormC), 3 100 Ohm Platinum RTD Inputs
339 Current Protection							S						Standard Configuration – 14, 37, 46, 48, 49, 50P(1), 50G(1), 50M, 50L, 66, 86, 50BF(1), 50N(1), 51G(1)
339 Other Options									N				No Selection
									M				Voltage Metering
									P				Voltage Protection - 27P(2), 47(1), VTFF(1), 59P(2), 81O(2), 81U(2) , 59_2(1)
Communications										S N			Standard :Front USB, Rear RS485 : Modbus RTU, DNP3.0, IEC 60870-5-103
										1 E			Standard + Ethernet (Copper & Fiber - MTRJ) Modbus TCP/IP, DNP3.0, IEC 60870-5-104
										2 E			Standard + Ethernet (Copper & Fiber - MTRJ) Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850 GOOSE
										3 E			Standard + Ethernet (Copper & Fiber - MTRJ) Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850
Case Design											D		Draw-out
											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
2. Input/Output “R” option is available on draw-out version only

Accessories for the 339

- SR3 Depth Reducing Collar Kit – 1.375 18L0-0075
- SR3 Depth Reducing Collar Kit – 3.00 18L0-0076

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