Economical protection, monitoring and metering for generators

KEY BENEFITS

- Complete, secure protection of small to medium sized generators
- Easy to use generator protection system supported by and industry leading suite of software tools.
- Advanced protection and monitoring features including the use of RTDs for stator and bearing thermal protection and Analog Inputs for vibration monitoring
- Global acceptance as a member of the most renown protection relay product family in the market.
- Draw-out construction allowing for minimized downtime and easy removal/installation of the 489 during maintenance routines
- Large, user-friendly front panel interface allowing for real-time power monitoring and setpoint access with a display that is easily readable in direct sunlight
- Enhanced generator troubleshooting through the use of IRIG-B time synchronized event records, waveform capturing, and data loggers
- Simplified setpoint verification testing using built in waveform simulation functionality
- Cost effective access to information through industry standard communication hardware (RS232, RS485, 10BaseT Ethernet) and protocols (Modbus RTU, Modbus TCP/IP, DNP 3.0)
- Available for use in most extreme harsh locations with the available Harsh Chemical Environment Option

APPLICATIONS

- Synchronous or induction generators operating at 25Hz, 50Hz or 60Hz
- Primary or backup protection in cogeneration applications

FEATURES

Protection and Control

- Generator stator differential
- 100% stator ground
- Loss of excitation
- Distance backup
- Reverse power (anti-motoring)
- Overexcitation
- Ground directional overcurrent
- Inadvertent energization
- Breaker failure
- Stator and bearing thermal monitoring
- Stator and bearing vibration monitoring
- Negative sequence overcurrent

Communications

- Networking interfaces - RS232, RS485, 10Mbps copper Ethernet
- Multiple protocols - ModBus™ RTU, ModBus™ TCP/IP, DNP 3.0 Level 2

Monitoring and Metering

- Metering – current, voltage, power, Energy, frequency, power factor
- Demand – current, watts, vars, VA
- Temperature – 12 RTD inputs
- Vibration and Speed – 4 analog transducer inputs
- Event Recorder – 256 time tagged events
- Oscillography – 12 samples/ cycle up to 128 cycles in length
- Trending – 8 parameters with up to a 5 second sample rate

EnerVista™ Software

- State of the art software for configuration and commissioning Multilin products
- Document and software archiving toolset to ensure reference material and device utilities are up-to-date
- Ease to use real time monitoring, control, and data archiving software available
- EnerVista™ Integrator providing easy integration of data in the 489 into new or existing monitoring and control systems

Protection and Control

The 489 Generator Protection System provides comprehensive protection, metering, and monitoring of small to medium sized synchronous or induction generators operating at 25, 50 or 60 Hz. The 489 is ideally suited for primary or backup generator protection as well as for use in cogeneration applications. Protection features found in the 489 include:

Generator Stator Differential

The 489 utilizes high-speed dual slope differential protection for detecting and clearing of stator phase faults. Advanced CT saturation detection algorithms maintain immunity to saturation conditions that may be caused due to external disturbances through the use of a directional check that provides additional supervision and ensures the fault is internal to the generator before triggering it to trip.

100% Stator Ground

100% stator ground fault protection is provided through an overvoltage element and an adaptive voltage differential feature responding to the unbalance of the third harmonic at the machine terminals and at the neutral point. The 489 compares the machine neutral voltage and ground current to determine if ground directional faults are within or outside the generator.

Backup Phase Distance

Two separate phase distance elements provide time-delayed backup protection for generator faults that have not otherwise been cleared by the primary system and generator protections. The distance characteristic can compensate for a unit delta/wye power transformer that is located between the generator and the end of the zone of protection.

Sensitive Directional Power

The 489 provides low forward power and reverse power elements to prevent generator motoring that can cause damage the prime mover. Independent settings for power pickup levels and operational delays are available for both alarming and tripping of each element.

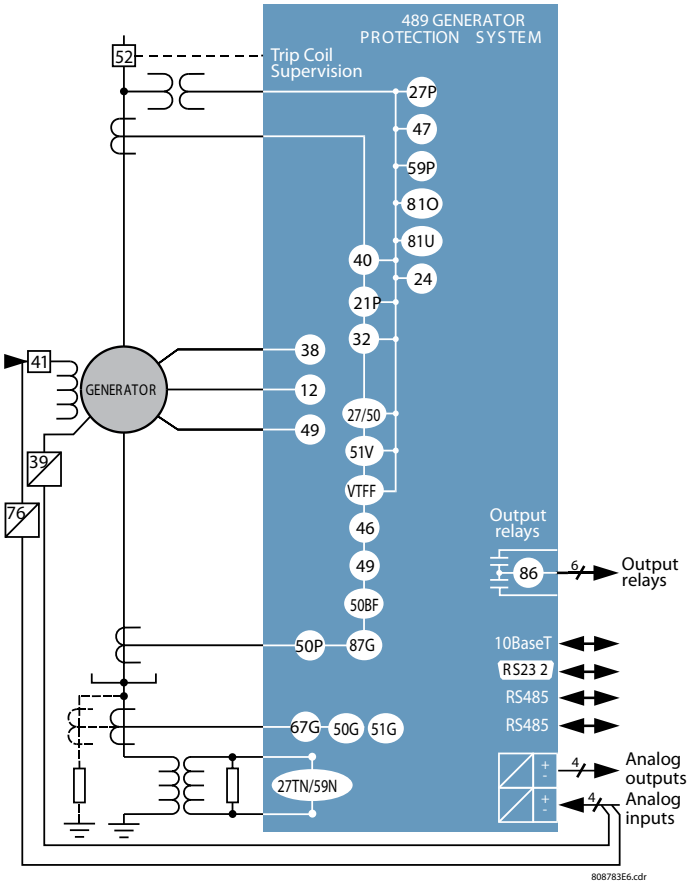
Breaker Failure

The embedded breaker failure function in the 489 allows for improved system dependability without the additional cost of providing an independent breaker failure relay. Upon detection of a breaker failure condition, the 489 can be configured to operate one of its 4 available digital outputs to signal upstream devices to quickly isolate the fault.

Loss of Excitation

Generator loss of excitation protection is provided through two negative offset mho characteristics as per IEEEC37.102 and has independent pickup delay setting for each characteristic. The loss of excitation element will be blocked from tripping if a VT fuse fail condition is detected or if the Voltage Supervision characteristic is

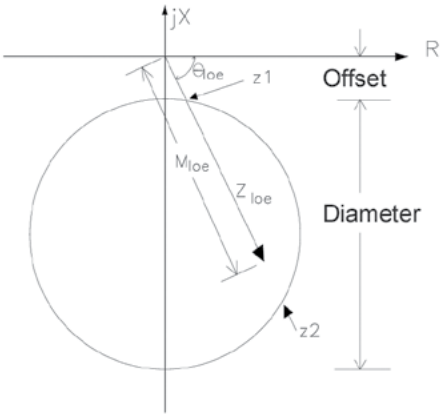
Functional Block Diagram



ANSI Device Numbers & Functions

Device Number	Function
12	Overspeed protection
21P	Phase distance
24	Volts/Hz
27P	Phase undervoltage
27/50	Accidental generator energization
27TN/59N	100% stator earth fault
32	Directional power
38	Bearing overtemperature (RTD)
39	Bearing vibration
40	Loss of excitation
46	Stator current unbalance
47	Phase reversal
49	Thermal overload
50BF	Breaker failure
50P	Phase instantaneous overcurrent
50G	Ground instantaneous overcurrent
51P	Phase time overcurrent
51G	Ground time overcurrent
51_2	Negative Sequence Time Overcurrent
51V	Voltage restrained time overcurrent
59P	Phase overvoltage
67G	Ground directional overcurrent
81O	Overfrequency
81U	Underfrequency
86	Lockout
87G	Generator differential
VTFF	VT fuse failure

enable and the voltage is measured to be above the user defined level.



A negative mho element can be used to detect a loss of excitation of the generator

Stator Thermal Protection

The 489 provides thermal modeling overload protection to prevent generator damage caused by generator overheating. The thermal model algorithms incorporate current unbalance biasing and RTD biasing which provides accurate modeling of the actual generator temperature. The 489 can be configured to trip the generator offline when the generator's thermal limits are reached, or close an Alarm contact that signals operations personnel to take appropriate actions.

Bearing Overtemperature

Twelve RTD inputs are provided that may be configured to monitor and protect against bearing overtemperature conditions. The 489 provides the option for using RTD voting which requires that two RTDs simultaneously indicate an overtemperature condition before it will trip the generator offline. RTD voting provides additional security against tripping of generators when an invalid overtemperature signal is received from a malfunctioning RTD.

Negative Sequence Overcurrent

Rotor thermal protection is provided through monitoring of negative sequence current, which is a significant contributor to rotor heating, to ensure it does not increase above the generator's capability limits. The 489 provides a negative sequence definite time overcurrent alarm element and a negative sequence timed overcurrent curve tripping element to ensure the generator stays within it's short time and continuous negative sequence current rated limits.

Abnormal Frequency Protection

Operation of generators at off-nominal frequencies can have extremely detrimental effects on both the generator itself and the associated prime mover, in particular with steam turbine generators operating below normal frequency. The 489 provides overfrequency and underfrequency elements needed to provide protection of generators from operation at off-nominal frequencies. The 489 has alarm level settings to alert operations of abnormal frequency conditions as well as multiple trip levels that have independent tripping delay settings for each magnitude of abnormal frequency detected.

Overcurrent Backup

Three voltage restrained overcurrent elements provide backup protection for system faults. The pickup level for the inverse time curves of the overcurrent elements are adjusted in conjunction with the measured phase-to-phase voltage. This feature is provided to protect against prolonged generator contribution to a fault on the system.

Monitoring and Metering

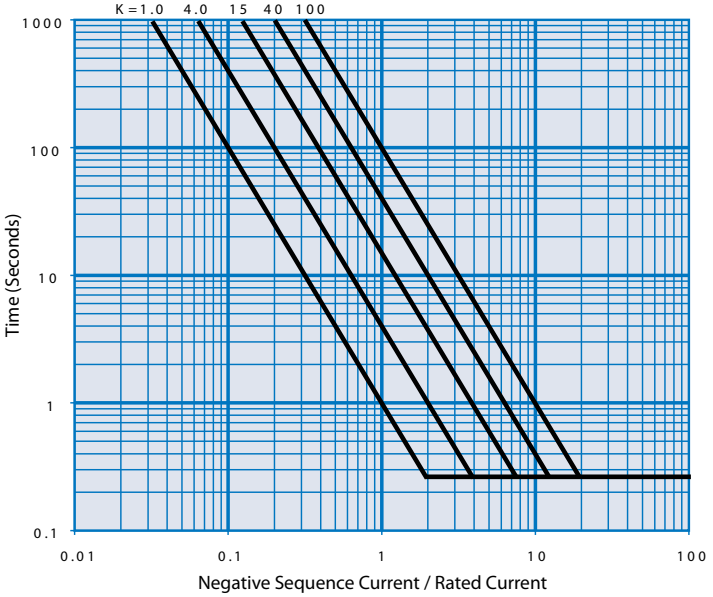
The 489 includes high accuracy metering and recording for all AC signals. Voltage, current, frequency, power, energy, and demand metering are built into the relay as a standard feature. Current and voltage parameters are available as total RMS magnitude, and as fundamental frequency magnitude and angle. Metered values can be read from the relay using one of the available communications ports or on the relay's front panel display.

Event Recording

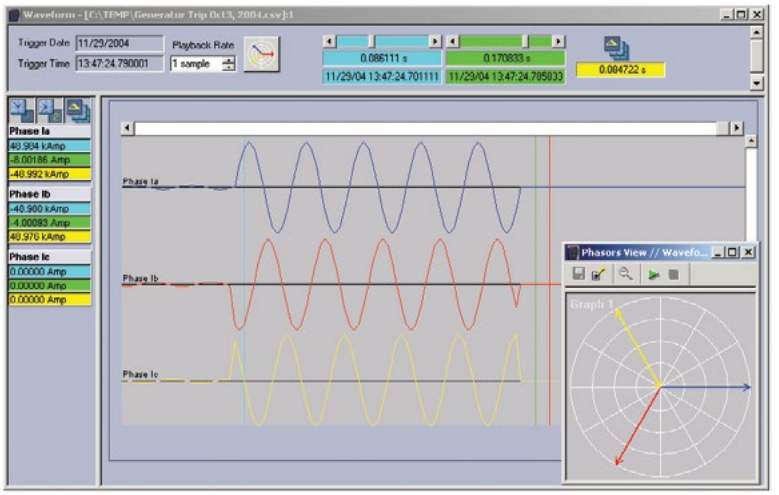
The 489 simplifies power generator troubleshooting by creating a sequence of events record that timestamps and logs events of internal relay operations and the operation of external devices connected to the relay's inputs. With each of the last 256 events the 489 stores, the relay will create a detailed event report that includes the time and date of the event, and the instantaneous value of all of the voltages, phase currents, and differential currents that were measured at the time the event occurred.

Oscillography

Postmortem analysis of generator faults can be performed using the waveform capture feature in the 489. The 489 samples the currents and voltages inputs at a rate of 12 times per cycle and can record records up to 128 cycles in length. The recorded waveforms can be retrieved and viewed using the EnerVista 489 Setup Software and allows users to examine the magnitudes and relationships of the measured signals at the time of the fault.



The negative sequence overcurrent element is adaptable to ensure negative sequence currents stay within the specific capability limits of a given generator



Analyze generator faults using waveforms that are captured at the time of generator faults or system instabilities

IRIG-B Time Synchronization

The 489 supports receiving an input from an IRIG-B time synchronization clock that will synchronize the 489 internal clock with other devices found in the substation or distributed across the power system. IRIG-B time synchronization will provide timestamping of events in the Event Record with 1ms accuracy thereby providing a means of accurately determining the sequence of operation of events that occurred across multiple devices in the power system.

Simulation Mode

The 489 has a built in simulation feature that allows for testing the functionality and relay response to programmed conditions without the need for external inputs. When placed in simulation mode the 489 suspends reading of the actual inputs and substitutes them with the simulated values. Pre-trip, fault, and post fault states can be simulated, with currents, voltages, system frequency, RTD temperatures, and analog inputs configurable for each state.

Automation

The 489 offers a multitude of different analog and digital inputs and outputs to allow the 489 to be seamlessly integrated into most generator automation schemes.

Outputs Relays

The 489 provides six output contacts for the purpose of controlling or signaling other devices and operations personnel. Protection elements can be configured to control the Trip contact, the Alarm contact, or the 3 Auxiliary contacts whenever the element operates. The status of each of these contact are also displayed on LEDs found on the relays front panel.

Digital Inputs

Eight digital inputs are available for monitoring the status of external contacts, tachometers, or control switches. With these inputs, the relay can identify the status of the associated breakers and receive commands from operational staff such as controlling the output relays, resetting the thermal limits, or triggering a waveform capture.

RTD Inputs

Twelve RTD inputs allow the 489 to monitor both the generator stator and bearing temperature. A built in voting feature adds additional security by ensuring that two RTDs monitoring the same device both detect the overtemperature condition before tripping the generator offline.

Analog Inputs

Four analog inputs are available for providing protection and monitoring of generator bearing vibration. The analog inputs are field programmable to measure transducer signals that operator over a range of 0 to 1 mA, 0 to 20 mA, or 4 to 20 mA.

Analog Outputs

Four analog outputs are available for signaling the value of measured analog quantities to external process control devices such as PLCs. The analog outputs can be ordered to operate over a 4 to 20mA range or a 0 to 1mA range and can be configured to signal a representation of most analog quantities measured by the 489 including currents, voltages, frequency, RTD temperature, power and demand.

Communications

The 489 provides advanced communications technologies for remote data and engineering access, making it easy and flexible to use and integrate into new or existing monitoring and control systems. Multiple communication ports are available including a front panel RS232 serial port for easy local computer access, two RS485 serial ports and a 10Mbps copper Ethernet port that provide direct integration in most communications architectures.

The 489 supports the most popular industry standard protocols enabling easy, direct integration into most DCS and SCADA systems. Protocols supported include:

- Modbus RTU
- Modbus TCP/IP
- DNP 3.0 Level 2

User Interfaces

Keypad and Display

The 489 has a keypad and 40 character display for local monitoring and relay configuration without the need for a computer. Up to 20 user-selected default messages can be displayed when the relay is protecting the generator. In the event of a trip, or an alarm, the display will automatically default to the proper message indicating the cause of the operation.

LED Indicators

The 489 front panel features 22 LED indicators that provide a quick indication of 489 status, generator status, and output relay status.

EnerVista™ Software

The EnerVista™ Suite is an industry-leading set of software programs that simplify every aspect of using the 489 relay. The EnerVista™ suite provides all the tools to monitor the status of your protected asset, maintain the relay and integrate information measured by the 489 into DCS or SCADA monitoring systems. Convenient COMTRADE and Sequence of Events viewers are an integral part of the 489 Setup software included with every relay to carry out post-mortem event analysis.

EnerVista™ Launchpad

EnerVista™ Launchpad is a powerful software package that provides users with all of the setup and support tools needed for configuring and maintaining Multilin 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

Features

489 FRONT

489 STATUS INDICATORS
- 489 status
- Generator status
- Output relays

NUMERIC KEYPAD
Numeric keys allow for simple entry of setpoint values. Control keys allow simple navigation through setpoint and actual value message structures. Help key provides context sensitive help messages

VALUE KEYS
Value Up, and Value Down keys to change setpoint values

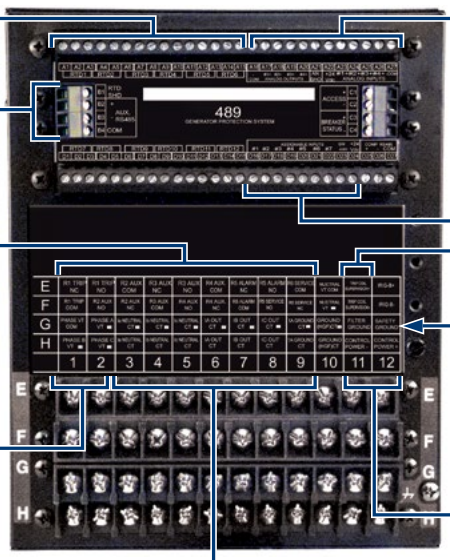
PROGRAM PORT INTERFACE
RS232 for connection to a computer, 9600 baud

LARGE DISPLAY
Forty character display for viewing setpoints and actual value messages. Diagnostic messages are displayed when there is a trip or alarm condition. Default messages are displayed after a period of inactivity.

CONTROL AND PROGRAMMING KEYS
Menu, Escape, Reset, Enter, Menu Up, and Menu Down keys for complete acess without a computer.

DRAWOUT HANDLE
With provision for a wire lead seal to prevent unauthorized removal

489 REAR



RTD INPUTS
Twelve RTD inputs are individually field programmable to measure platinum, nickel, or copper type RTDs.

RS485 COMMUNICATIONS
Two independent RS485 communication ports may be accessed simultaneously using ModbusRTU and DNP 3.0 protocol at baud rates up to 19200 bps.

OUTPUT RELAYS
Six, trip duty, form C output relays may be assigned to trip, alarm and control functions.

VT INPUTS
Four VT inputs provide wye or open delta system voltage sensing as well as neutral voltage sensing.

ANALOG SIGNALS
Four isolated 4-20 mA analog outputs may be used to replace costly transducers. They may be field programmed to reflect any measured parameter.
Four 0-1 or 4-20 mA analog inputs may be used to monitor any transducer signal. Possible applications include vibration and field current monitoring.

DIGITAL INPUTS
Access jumper input provides setpoint programming security. Breaker status input tells 489 if the generator is online or offline. Seven assignable digital inputs may be field programmed for a variety of functions including tachometer.

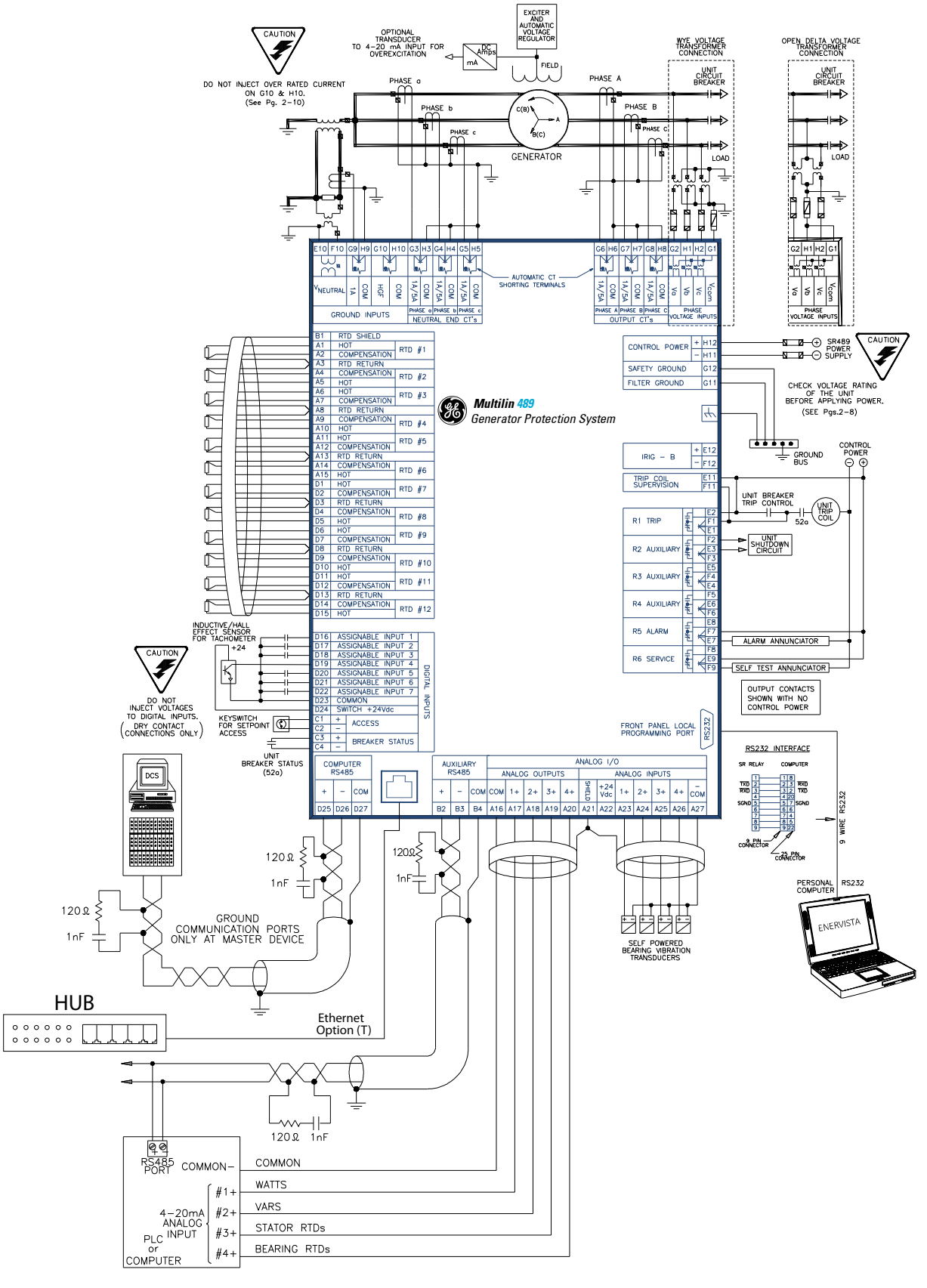
TRIP COIL SUPERVISION
Monitors the trip circuit for continuity when the generator is online and alarms if that continuity is broken.

GROUND
Separate safety and filter ground. All inputs meet C37.90 EMI, SWC, RFI interference immunity.

AC/DC CONTROL POWER
Universal power supply
90-300 VDC 70-265 VAC

CT INPUTS
Seven CT inputs provide three-phase output, three-phase neutral and ground current sensing.

Typical Wiring



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 & Play Device Monitoring
- System Single-Line Monitoring & Control
- Annunciator Alarm Screens
- Trending Reports
- Automatic Event Retrieval
- Automatic Waveform Retrieval

Viewpoint Maintenance

Viewpoint Maintenance provides tools that will create reports on the operating status of the relay, simplify the steps to download fault and event data, and reduce the work required for cyber-security compliance audits. Tools available in Viewpoint Maintenance include:

- Settings Security Audit Report
- Device Health Report
- Single Click Fault Data Retrieval

EnerVista™ Integrator

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

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

Technical Specifications

PROTECTION

OVERCURRENT ALARM

Pick-up Level:	0.10 to 1.50 x FLA in steps of 0.01 average phase current
Time Delay:	0.1 to 250.0 s in steps of 0.1
Pickup Accuracy:	as per Phase Current Inputs
Timing Accuracy:	±100 ms or ±0.5% of total time

OFFLINE OVERCURRENT

Pick-up Level:	0.05 to 1.00 x CT in steps of 0.01 of any one phase
Time Delay:	3 to 99 cycles in steps of 1
Pickup Accuracy:	as per Phase Current Inputs
Timing Accuracy:	+50ms at 50/60 Hz

INADVERTENT ENERGIZATION

Arming Signal:	undervoltage and/or offline from breaker status
Pick-up Level:	0.05 to 3.00 x CT in steps of 0.01 of any one phase
Time Delay:	no intentional delay
Pickup Accuracy:	as per Phase Current Inputs
Timing Accuracy:	+50 ms at 50/60 Hz

PHASE OVERCURRENT

Voltage Restraint:	Programmable fixed characteristic
Pick-up Level:	0.15 to 20.00 x CT in steps of 0.01 of any one phase
Curve Shapes:	ANSI, IEC, IAC, Flexcurve, Definite Time
Time Delay:	0.000 to 100.000 s in steps of 0.001
Pickup Accuracy:	as per Phase Current Inputs
Timing Accuracy:	+50 ms at 50/60 Hz or ±0.5% total time

NEGATIVE SEQUENCE OVERCURRENT

Pick-up Level:	3 to 100% FLA in steps of 1
Curve Shapes:	I^2t trip defined by k, definite time alarm
Time Delay:	0.1 to 100.0 s in steps of 0.1
Pickup Accuracy:	as per Phase Current Inputs
Timing Accuracy:	±100ms or ± 0.5% of total time

GROUND OVERCURRENT

Pick-up Level:	0.05 to 20.00 x CT in steps of 0.01
Curve Shapes:	ANSI, IEC, IAC, Flexcurve, Definite Time
Time Delay:	0.00 to 100.00 s in steps of 0.01
Pickup Accuracy:	as per Ground Current Input
Timing Accuracy:	+50 ms at 50/60 Hz or ±0.5% total time

PHASE DIFFERENTIAL

Pick-up Level:	0.05 to 1.00 x CT in steps of 0.01
Curve Shapes:	Dual Slope
Time Delay:	0 to 100 cycles in steps of 1
Pickup Accuracy:	as per Phase Current Inputs
Timing Accuracy:	+50 ms at 50/60 Hz or ±0.5% total time

GROUND DIRECTIONAL

Pick-up Level:	0.05 to 20.00 x CT in steps of 0.01
Time Delay:	0.1 to 120.0 s in steps of 0.1
Pickup Accuracy:	as per Phase Current Inputs
Timing Accuracy:	±100 ms or ±0.5% of total time

HIGH-SET PHASE OVERCURRENT

Pick-up Level:	0.15 to 20.00 x CT in steps of 0.01
Time Delay:	0.00 to 100.00 s in steps of 0.01
Pickup Accuracy:	as per Phase Current Inputs
Timing Accuracy:	±50 ms at 50/60 Hz or ±0.5% total time

UNDERVOLTAGE

Pick-up Level:	0.50 to 0.99 x rated V in steps of 0.01
Curve Shapes:	Inverse Time, definite time alarm 1
Time Delay:	0.2 to 120.0 s in steps of 0.1
Pickup Accuracy:	as per Voltage Inputs
Timing Accuracy:	±100 ms or ±0.5% of total time
Elements:	Trip and Alarm

PROTECTION

OVERVOLTAGE

Pick-up Level:	1.01 to 1.50 x rated V in steps of 0.01
Curve Shapes:	Inverse Time, definite time alarm
Time Delay:	0.2 to 120.0 s in steps of 0.1
Pickup Accuracy:	as per Voltage Inputs
Timing Accuracy:	±100 ms or ±0.5% of total time

VOLTS/HERTZ

Pick-up Level:	1.00 to 1.99 x nominal in steps of 0.01
Curve Shapes:	Inverse Time, definite time alarm
Time Delay:	0.1 to 120.0 s in steps of 0.1
Pickup Accuracy:	as per voltage inputs
Timing Accuracy:	±100 ms at ? 1.2 x Pickup ±300 ms at < 1.2 ´ Pickup

VOLTAGE PHASE REVERSAL

Configuration:	ABC or ACB phase rotation
Timing Accuracy:	200 to 400 ms

UNDERFREQUENCY

Required Voltage:	0.50 to 0.99 x rated voltage in Phase A
Block From Online:	0 to 5 sec. in steps of 1
Pickup Level:	20.00 to 60.00 in steps of 0.01
Curve Shapes:	1 level alarm, two level trip definite time
Time Delay:	0.1 to 5000.0 sec. in steps of 0.1
Pickup Accuracy:	±0.02 Hz
Timing Accuracy:	±100 ms or ±0.5% of total time

OVERFREQUENCY

Required Voltage:	0.50 to 0.99 x rated voltage in Phase A
Block From Online:	0 to 5 sec. in steps of 1
Pickup Level:	25.01 to 70.00 in steps of 0.01
Curve Shapes:	1 level alarm, 2 level trip definite time
Time Delay:	0.1 to 5000.0 s in steps of 0.1
Pickup Accuracy:	±0.02 Hz
Timing Accuracy:	±100 ms or ±0.5% of total time

NEUTRAL OVERVOLTAGE (FUNDAMENTAL)

Pick-up Level:	2.0 to 100.0 V secondary in steps of 0.01
Time Delay:	0.1 to 120.0 s in steps of 0.1
Pickup Accuracy:	as per Neutral Voltage Input
Timing Accuracy:	±100 ms or ±0.5% of total time

NEUTRAL UNDERVOLTAGE (3RD HARMONIC)

Blocking Signals:	Low power and low voltage if open delta
Pickup Level:	0.5 to 20.0 V secondary in steps of 0.01 if open delta VT; adaptive if wye VT
Time Delay:	5 to 120 s in steps of 1
Pickup Accuracy:	
at ≤ 20.0 V secondary:	as per Neutral Voltage Input
Timing Accuracy:	±3.0 s

LOSS OF EXCITATION (IMPEDANCE)

Pickup Level:	2.5 to 300.0 Ω secondary in steps of 0.1 with adjustable impedance offset
Time Delay:	0.1 to 10.0 s in steps of 0.1
Pickup Accuracy:	as per Voltage and Phase Current Inputs
Timing Accuracy:	±100 ms or ±0.5% of total time

DISTANCE (IMPEDANCE)

Pickup Levels:	0.1 to 500.0 Ω secondary in steps of 0.1 50 to 85° reach in steps of 1
Time Delay:	0.0 to 150.0 s in steps of 0.1
Pickup Accuracy:	as per Voltage and Phase Current Inputs
Timing Accuracy:	150 ms ±50 ms or ±0.5% of total time

PROTECTION

REACTIVE POWER

Block From Online:	0 to 5000 s in steps of 1
Pickup Level:	0.02 to 1.50 x rated Mvar (positive and negative)
Time Delay:	0.2 to 120.0 s in steps of 0.1
Pickup Accuracy:	see power metering
Timing Accuracy:	±100ms or ±0.5% of total time

REVERSE POWER

Block From Online:	0 to 5000 s in steps of 1
Pickup Level:	0.02 to 0.99 x rated MW
Time Delay:	0.2 to 120.0 s in steps of 0.1
Pickup Accuracy:	see power metering
Timing Accuracy:	±100 ms or ±0.5% of total time

LOW FORWARD POWER

Block From Online:	0 to 15000 s in steps of 1
Pickup Level:	0.02 to 0.99 x rated MW
Time Delay:	0.2 to 120.0 s in steps of 0.1
Pickup Accuracy:	see power metering
Timing Accuracy:	±100 ms or ±0.5% of total time

PULSE OUTPUT

Parameters:	+ kwh, +kvarh, -kvarh
Interval:	1 to 50000 in steps of 1
Pulse Width:	200 to 1000 ms in steps of 1 ms RTDS 1 TO 12
Pickup:	1 to 250°C in steps of 1
Pickup Hysteresis:	2°C
Time Delay:	3 sec.

OVERLOAD / STALL PROTECTION / THERMAL MODEL

Overload Curves:	15 Standard Overload Curves Custom Curve Voltage Dependent Custom Curve
Curve Biasing:	Phase Unbalance Hot/Cold Curve Ratio Stator RTD Online Cooling Rate Offline Cooling Rate Line Voltage
Overload Pickup:	1.01 to 1.25
Pickup Accuracy:	as per Phase Current Inputs
Timing Accuracy:	±100 ms or ±2% of total time

DIGITAL INPUT

GENERAL INPUT A TO G (DIGITAL INPUT)

Configurable:	Assignable Digital Inputs 1 to 7
Time Delay:	0.1 to 5000.0 s in steps of 0.1
Block From Online:	0 to 5000 s in steps of 1
Timing Accuracy:	±100 ms or ±0.5% of total time

SEQUENTIAL TRIP (DIGITAL INPUT)

Configurable:	Assignable to Digital Inputs 1 to 7
Pickup Level:	0.02 to 0.99 x rated MW in steps of 0.01 Low Forward Power / Reverse Power
Time Delay:	0.2 to 120.0 s in steps of 0.1
Pickup Accuracy:	see power metering
Timing Accuracy:	±100 ms or ±0.5% of total time

FIELD BREAKER DISCREPANCY (DIGITAL INPUT)

Configurable:	Assignable to Digital Inputs 1 to 7
Time Delay:	0.1 to 500.0 s in steps of 0.1
Timing Accuracy:	±100 ms or ±0.5% of total time

TACHOMETER (DIGITAL INPUT)

Configurable:	Assignable to Digital Inputs 4 to 7
RPM Measurement:	100 to 7200 RPM
Duty Cycle of Pulse:	>10%
Pickup Level:	101 to 175 x rated speed in steps
Time Delay:	1 to 250 s in steps of 1
Timing Accuracy:	±0.5 s or ±0.5% of total time

Technical Specifications (continued)

ANALOG INPUTS

PHASE CURRENT INPUTS

CT Primary: 10 to 50000 A
CT Secondary: 1 A or 5 A (must be specified with order)
Conversion Range: 0.02 to 20 x CT
Accuracy: at < 2 x CT: ±0.5% of 2 x CT
at > 2 x CT: ±1% of 20 x CT
Burden: Less than 0.2 VA at rated load
CT Withstand: 1 second at 80 times rated current
2 seconds at 40 times rated current
continuous at 3 times rated current

GROUND CURRENT INPUTS

CT Primary: 10 to 10000 A (1 A / 5 A CTs)
CT Secondary: 1 A / 5 A or 50:0.025 (HGF CTs)
Conversion Range: 0.02 to 20 x CT for 1 A / 5 A CTs 0.0 to 100 A pri. for 50:0.025 CTs(HGF)
50:0.025 CT Accuracy: ± 0.1 A at < 10 A
± 1.0 A at ³ 10 to 100 A
1A/5A CT Accuracy: at < 2 x CT: ±0.5% of 2 x CTat > 2 x CT: ±1% of 20 x CT

GROUND CT	INPUT	BURDEN	
		VA	Ω
1A/5A	1 A	0.024	0.024
	5 A	0.605	0.024
	20 A	9.809	0.024
50:0.025	0.025 A	0.057	90.7
HGF	0.1 A	0.634	90.7
	0.5 A	18.9	75.6

GROUND CT	WITHSTAND TIME		
CT	1 SEC	2 SEC.	CONTINUOUS
1A/5A	80 x CT	40 x CT	3 x CT
50:0.025 HGF	N/A	N/A	150 mA

PHASE VOLTAGE INPUTS

VT Ratio: 1.00 to 240.00:1 in steps of 0.01
VT Secondary: 200 V AC (full-scale)
Conversion Range: 0.02 to 1.00 x Full Scale
Accuracy: ±0.5% of Full Scale
Max. Continuous: 280 V AC
Burden: > 500 KΩ

NEUTRAL VOLTAGE INPUTS

VT Ratio: 1.00 to 240.00:1 in steps of 0.01
VT Secondary: 100 V AC (full-scale)
Conversion Range: 0.005 to 1.00 x Full Scale
Accuracy: ±0.5% of Full Scale
Max. Continuous: 280 V AC
Burden: > 500 KΩ

DIGITAL INPUTS

Inputs: 9 opto-isolated inputs
External Switch: dry contact < 400 Ω
489 Sensor Supply: +24 V DC at 20 mA maximum

ANALOG TRANSDUCER INPUTS

Current Inputs: 0 to 1 mA, 0 to 20mA or 4 to 20 mA (setpoint)
Input Impedance: 226 Ω ±10%
Conversion Range: 0 to 21 mA
Accuracy: ±1% of full scale
Type: passive
Analog In Supply: +24 V DC at 100 mA maximum
Sampling Interval 50 ms

INPUTS

RTD INPUTS

RTD (3 wire Types): 100 Ω Platinum
100 Ω Nickel, 120 Ω Nickel
10 Ω Copper
RTD Sensing Current: 5mA
Isolation: 36 Vpk (isolated with analog inputs and outputs)
Range: –50 to +250°C
Accuracy: ±2°C for Platinum and Nickel
±5°C for Copper
Lead Resistance: 25 Ω Max per lead for Pt and Ni type 3 Ω Max per lead for Cu type
No Sensor: >1000 Ω
Short/Low Alarm: < –50°C

TRIP COIL SUPERVISION

Applicable Voltage: 20 to 300 V DC / V AC
Trickle Current: 2 to 5 mA

OUTPUTS

ANALOG OUTPUTS

Type: Active
Range: 4 to 20 mA, 0 to 1 mA (must be specified with order)
Accuracy: ±1% of full scale
Maximum Load: 4 to 20 mA input: 1200,
0 to 1 mA input: 10 k
Isolation: 36 Vpk

OUTPUT RELAYS

Configuration: 6 Electromechanical Form C
Contact Material: Silver alloy
Operate Time: 10 ms
Max ratings for 100000 operations

VOLTAGE		M/C CONT.	M/C 0.2 SEC	BREAK	MAX LOAD
DC Resistive	30 VDC	10 A	30A	10 A	300 W
	125 VDC	10 A	30A	0.5 A	62.5 W
	250 VDC	10 A	30A	0.3 A	75 W
DC Inductive L/R= 40 ms	30 VDC	10 A	30A	5 A	150 W
	125 VDC	10 A	30A	0.25 A	31.3 W
	250 VDC	10 A	30A	0.15 A	37.5 W
AC Resistive	120 VAC	10 A	30A	10 A	2770 VA
	250 VAC	10 A	30A	10 A	2770 VA
AC Inductive P.F. = 0.4	120 VAC	10 A	30A	4 A	480 VA
	250 VAC	10 A	30A	3 A	750 VA

POWER SUPPLY

CONTROL POWER

Options: LO / HI
(must be specified with order)
LO Range: DC: 20 to 60 V DC
AC: 20 to 48 V AC at 48 to 62 Hz
Hi Range: DC: 90 to 300 V DC
AC: 70 to 265 V AC at 48 to 62 Hz
Power: 45 VA (max), 25 VA typical

AC ANALOG INPUTS FREQUENCY TRACKING

Frequency Tracking: Va for wye, Vab for open delta
6 V minimum, 10 Hz/sec.

COMMUNICATIONS

RS232 Port: 1, Front Panel, non-isolated
RS485 Ports: 2, Isolated together at 36 Vpk
Baud Rates: RS485: 300 - 19,200 Baud
RS232: 9600 Baud
Parity: None, Odd, Even
Ethernet: 10Mbbs Copper RJ45
Protocol: Modbus® RTU / Modbus® TCP/IP
DNP 3.0 Level 2

ENVIRONMENTAL

Temperature Range:
Operating: -40 °C to +60 °C
Ambient Storage: -40 °C to +85 °C
Ambient Shipping: -40 °C to +85 °C
Humidity: Operating up to 95% (non condensing) @ 55C
Altitude: Up to 2000 m
Pollution degree: 2

PRODUCT TESTS

Thermal Cycling: Operational test at ambient, reducing to –40°C and then increasing to 60°C
Dielectric Strength: 2.0 kV for 1 minute from relays, CTs, VTs, power supply to Safety Ground

TYPE TESTS

Dielectric voltage withstand: EN60255-5
Impulse voltage withstand: EN60255-5
Insulation resistance: EN60255-5
Damped Oscillatory: IEC 61000-4-18, IEC 60255-22-1
Electrostatic Discharge: EN61000-4-2, IEC 60255-22-2
RF immunity: EN61000-4-3, IEC 60255-22-3
Fast Transient Disturbance: EN61000-4-4, IEC 60255-22-4
Surge Immunity: EN61000-4-5, IEC 60255-22-5
Conducted RF Immunity: EN61000-4-6, IEC 60255-22-6
Radiated & Conducted Emissions: CISPR11, CISPR22, IEC 60255-25
Sinusoidal Vibration: IEC 60255-21-1
Power magnetic Immunity: IEC 61000-4-8
Voltage Dip & interruption: IEC 61000-4-11
Ingress Protection: IEC 60529
Environmental (Cold): IEC 60068-2-1
Environmental (Dry heat): IEC 60068-2-2
Relative Humidity Cyclic: IEC 60068-2-30
EFT: IEEE/ANSI C37.90.1
ESD: IEEE/ANSIC37.90.3

CERTIFICATION

ISO: Manufactured under an ISO9001 registered system.
CSA/UL: UL508, UL1053, C22.2.No 14
CE: Conforms to EN60255-5, EN50263

Please refer to Multilin 489 Generator Protection System Instruction Manual for complete technical specifications

Ordering

489	*	*	*	*	*	
Current Input Relays	P1					1 A phase CT secondaries
	P5					5 A phase CT secondaries
Power Supply Options		LO				DC: 24 – 60 V; AC: 20 – 48 V @ 48 – 62 Hz
		HI				DC: 90 – 300 V; AC: 70 – 265 V @ 48 – 62 Hz
Analogue Outputs			A1			0 – 1 mA analog outputs
			A20			4 – 20 mA analog outputs
Enhancements				E		Enhanced display, larger LCD, improved keypad
				T		Enhanced display, larger LCD, improved keypad plus 10BaseT Ethernet Port
Environmental Protection					H	Harsh (Chemical) Environment Conformal Coating

Accessories for the 489

- 489 Generator Protection Learning CD — TRCD-SR489-C-S-1
- Multilink Ethernet Switch — ML1600-HI-A1-A1
- Multinet — Multinet-FE
- Viewpoint Maintenance — VPM-1
- Viewpoint Monitoring — VP-1

Visit www.GEMultilin.com/489 to:

- View Guideform specifications
- Download the instruction manual
- Review applications notes and support documents
- Buy a 489 online
- View the 489 brochure