



G30

GENERATOR PROTECTION SYSTEM

Small to medium generators & combined generators and transformer protection

KEY BENEFITS

- Complete protection for small to medium sized generators
- Complete IEC 61850 Process Bus solution providing resource optimization and minimizing total P&C life cycle costs
- Combined generator and transformer protection
- Advanced automation capabilities for providing customized protection and control solutions
- Robust network security enabling Critical Infrastructure Protection through user command logging, and dual permission access control
- Application flexibility with multiple I/O options and programmable logic (FlexLogic™)
- High-end fault and disturbance recording eliminating the need for redundant recording devices
- Ambient temperature monitoring with alarming when outside temperature exceeds upper thresholds
- High-speed peer-to-peer communications allowing reduction of relay to relay wiring and associated installation costs
- Embedded IEC61850 Protocol

APPLICATIONS

- Small to medium sized generators typically driven by steam, gas or hydraulic turbines
- Pumped Storage Generators
- Combined Generator and Transformer in the zone of protection
- Distributed Generator (DG) interconnect protection per IEEE 1547

FEATURES

Protection and Control

- Overall unit differential including transformer
- Restricted ground fault
- Split phase protection
- Loss of excitation, overexcitation
- Third harmonic neutral undervoltage
- Generator unbalance
- Reverse and low forward power
- Accidental energization
- Synchronism check
- Phase sequence reversal for pumped storage

Communications

- Networking interfaces – 100Mbit Fiber Optic Ethernet, RS485, RS232, RS422, G.703, C37.94
- Multiple Protocols – IEC61850, DNP 3.0 Level 2, Modbus RTU, Modbus TCP/IP, IEC60870-5-104, Ethernet Global Data (EGD)
- Direct I/O – secure, high-speed exchange of data between URs for transformer tripping applications
- Embedded Managed Ethernet Switch with 4 - 100 Mbit Fiber optic ports and 2 copper ports

IEC 61850 Process Bus Interface

- Robust communications with up to 8 HardFiber Bricks
- Seamless integration with existing G30 functions
- Redundant architecture for dependability and security

Monitoring and Metering

- Metering – current, voltage, power, energy, frequency
- Oscillography – analog and digital parameters at 64 samples/cycle
- Event Recorder – 1024 time tagged events with 0.5ms scan of digital inputs
- Data Logger – 16 channels with sampling rate up to 1 sample / cycle
- Setting Security Audit Trail for tracking changes to G30 configuration

EnerVista™ Software

- Graphical Logic Designer and Logic Monitor to simplify designing and testing procedures
- EnerVista™ Integrator providing easy integration of data in the G30 into new or existing monitoring and control systems



Digital Energy
Multilin

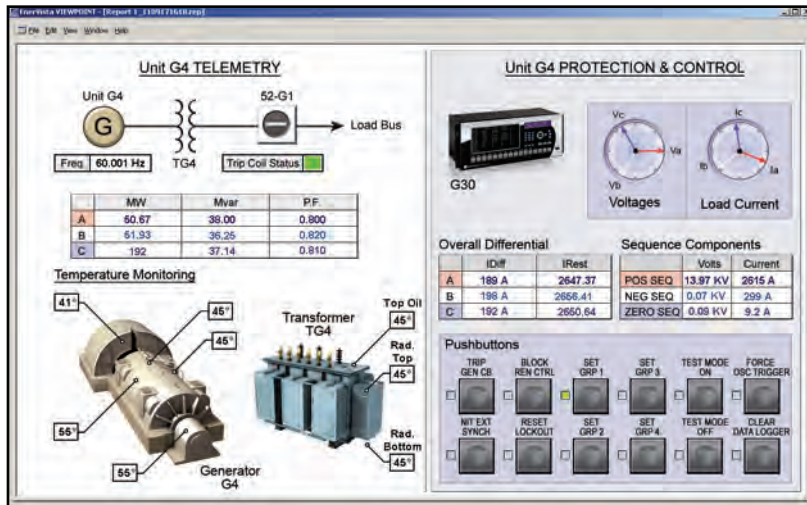
Protection and Control

The G30 Generator protection system provides comprehensive protection for small to medium sized steam, hydraulic and combustion-turbine generators as well as applications that have both the generator and transformer in the same zone of protection. The G30 is ideal for protecting single and multi-pole generators with single or split phase windings configuration of generators. The G30 includes advanced automation and communication capabilities, extensive I/O options, and powerful fault recording features that can simplify fault and disturbance troubleshooting and minimize generator downtime. As part of the UR family, the G30 provides superior protection and control that includes:

Generator/Transformer Differential

High-speed percent differential protection is provided for detecting and clearing both generator stator and transformer winding faults that occur in the zone of protection of a single generator. The differential protection element has built-in phase compensation and magnitude compensation characteristics that allow for dealing with the inherent offset that occurs with CTs located on different windings of the transformer. These compensation characteristics eliminate the need for installing additional interposing CTs to

G30 - Protection, Metering, Monitoring and Control



The G30 is the single point for protection, control, metering, and monitoring in one integrated device that can easily be connected directly into HMI or SCADA monitoring and control systems like Viewpoint Monitoring as shown.

account for the difference in parameters measured by the relay.

2nd Harmonic Inrush Inhibit

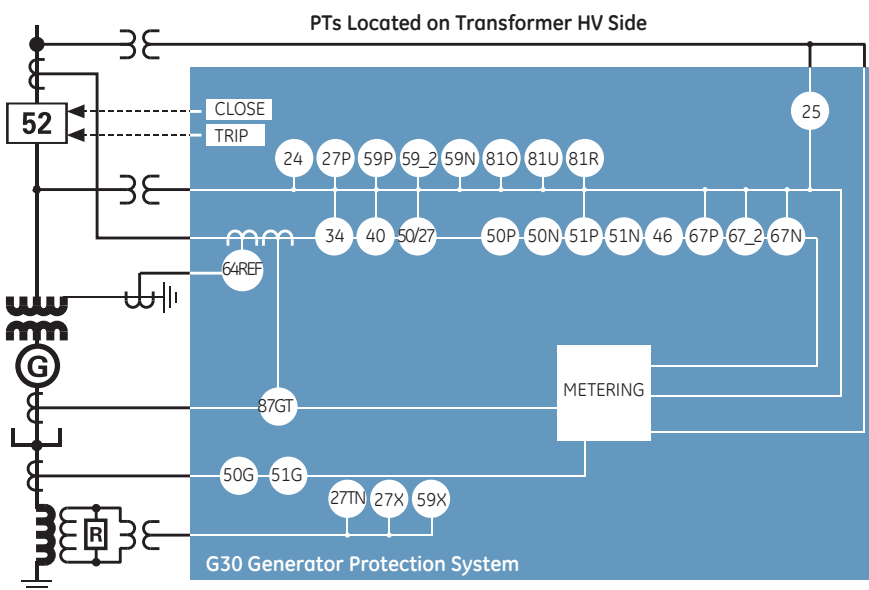
The G30 utilizes a 2nd Harmonic Inrush Inhibit function to block the G30 from tripping under transformer inrush conditions that can otherwise cause the differential element to maloperate. This element can be configured to include energization of different types of transformers by using either a traditional or adaptive mode of 2nd Harmonic restraint.

The adaptive 2nd harmonic restraint maintains protection dependability and speed on internal faults while ensuring security during inrush conditions even with weak second harmonics.

Overexcitation Inhibit

An increase in transformer voltage or decrease in system frequency may result in overexcitation of the transformer. It is often desirable to prevent operation of the percent differential element in these cases therefore a fifth harmonic inhibit is

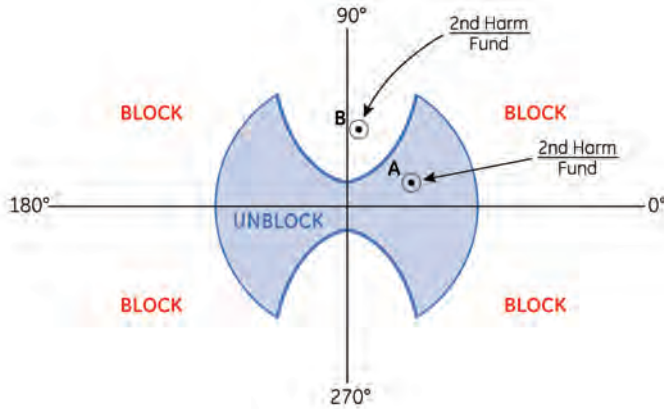
Functional Block Diagram



ANSI Device Numbers & Functions

Device Number	Function
24	Volts Per Hertz
25	Synchronism Check
27P	Phase Undervoltage
27TN	Third Harmonic Neutral Undervoltage
27X	Auxiliary Undervoltage
27/50	Accidental Energization
32	Directional Power
40	Loss of Excitation
46	Stator Current Unbalance
50G	Ground Instantaneous Overcurrent
50N	Neutral Instantaneous Overcurrent
50P	Phase Instantaneous Overcurrent
50SP	Split Phase Instantaneous Overcurrent
51G	Ground Time Overcurrent
51P	Phase Time Overcurrent
59N	Neutral Overvoltage
59P	Phase Overvoltage
59X	Auxiliary Overvoltage
59_2	Negative Sequence Overvoltage
67_2	Negative Sequence Directional Overcurrent
67N	Neutral Directional Overcurrent
67P	Phase Directional Overcurrent
81O	Overfrequency
81R	Rate of Change of Frequency
81U	Underfrequency
87GT	Generator/Transformer Differential
87RGF	Restricted Ground Fault

2nd Harmonic Blocking Characteristic



The Adaptive 2nd Harmonic Inhibit function will stop blocking the differential element as soon as the 2nd harmonic level drops below the pickup level if the angle of the 2nd Harmonic to Fundamental ratio is close to 0° or 180° (Point A). If the angle of the 2nd Harmonic to Fundamental ratio is close to 90° or 270°, this is an indication that the transformer is in an inrush condition even if the magnitude drops below the pickup level, the Adaptive 2nd Harmonic Inhibit function will continue to block the differential element for an extended period of time (Point B).

integrated into percent differential function to protect for overexcitation conditions resulting from an increased V/Hz ratio. The overexcitation inhibit works on a per-phase basis and is user definable.

Split Phase Protection

Split phase protection is provided for sensitive detection for inter-turn faults and can be run in conjunction with the primary stator differential protection. Independent settings are provided on a per-phase basis and a single-slope bias characteristic is used to allow operation on machines with a section of winding bypassed.

Restricted Ground Fault (RGF)

Restricted Ground Fault protection (also known as zero sequence differential) extends protection coverage to the neutral point of the stator winding, where fault currents may be below the pickup of the main stator differential element. The low-impedance RGF protection provided by the G30 uses an optimized adaptive restraint signal that provides security for external fault conditions that may cause CT saturation while still maintaining sensitivity for internal faults.

Sensitive Directional Power

Two separate directional power elements are provided to detect reverse and low forward power conditions that is often needed for ensuring power only flows in one direction through the breaker. Each element responds to either reverse or low forward power flow and can be used to provide independent alarm and trip settings.

Loss of Excitation

Generator loss of excitation protection is provided via two negative offset mho characteristics as per IEEE C37.102. Independent pickup time delay settings and blocking input provide security for blown VT fuses and power swing conditions.

Frequency Rate of Change

The four available frequency rate of change (df/dt) elements can be used to provide protection against system disturbances through load shedding and to provide anti-islanding protection. These elements monitor the speed by which the frequency changes in any direction, through voltage, current, and frequency supervision.

Pump Storage Generator

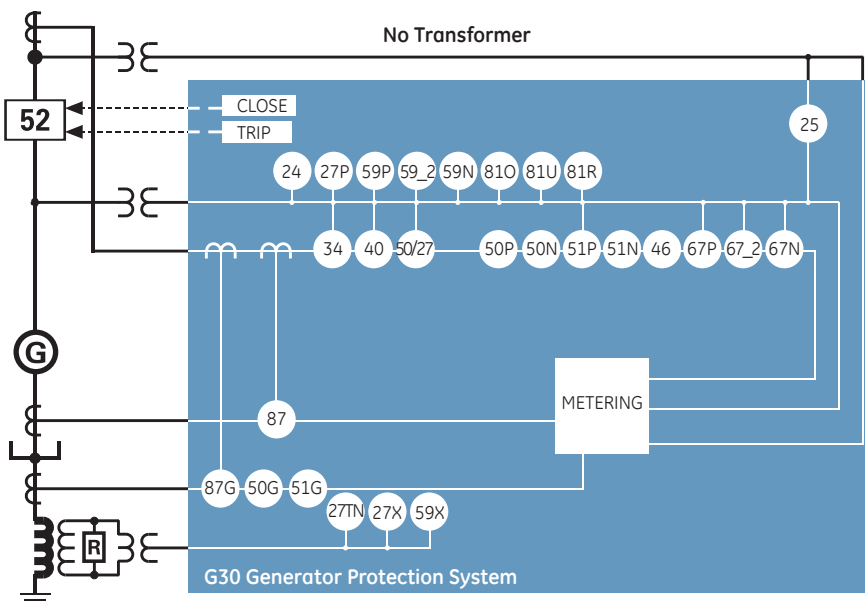
The G30 can be used for protecting generators that are also run as pump storage motors without the need for switching the CT secondary circuitry. The G30 is able to automatically compensate for the phase reversal that occurs when the generator is being run as a motor.

Synchronism Check

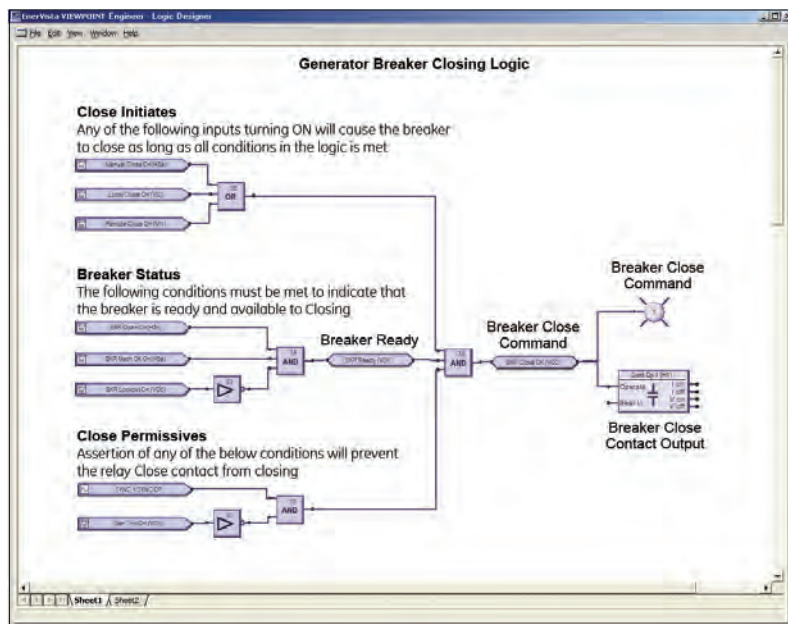
The G30 provides elements to monitor differences in voltage magnitudes, phase angles, and frequencies to perform synchronism check across up to two breakers. The G30 can be used in conjunction with an external synchronizer as an independent check of the synchronizer prior to closing the generator breaker.

IEC 61850 Process Bus

The IEC 61850 Process Bus module is designed to interface with the GE Multilin HardFiber System, allowing bi-directional IEC 61850 fiber optic communications. The HardFiber System is designed to integrate seamlessly with the existing Universal Relay



FlexLogic™ Designer



Flexlogic allows for customizing the G30 to operate and control the breakers and other auxiliary devices needed to fit most generator protection schemes and applications.

applications, including protection functions, FlexLogic, metering and communications.

The GE Multilin HardFiber System offers the following benefits:

- Communicates using open standard IEC 61850 messaging
- Drastically reduces P&C design, installation and testing labor by eliminating individual copper terminations
- Integrates with existing G30's by replacing traditional CT/VT inputs with IEC 61850 Process Bus module
- Does not introduce new Cyber Security concerns

Visit the HardFiber System product page on the GE Multilin web site for more details.

Advanced Automation

The G30 incorporates advanced automation features including powerful FlexLogic™ programmable logic, communication, and SCADA capabilities that far surpass what is found in the average generator relay. The G30 integrates seamlessly with other UR relays for complete system protection, including the unit and auxiliary transformers, and Balance of Plant protection.

FlexLogic™

FlexLogic™ is the powerful UR platform programming logic engine that provides the ability of creating customized protection and control schemes thereby minimizing the need, and the associated costs, of auxiliary components and wiring.

Using FlexLogic™, the G30 can be programmed to provide required tripping logic along with custom scheme logic for generator breaker control (including interlocking with external synchronizers), transfer tripping schemes for remote breakers and dynamic setting group changes.

Scalable Hardware

The G30 is available with a multitude of I/O configurations to suit the most demanding application needs. The expandable modular design allows for easy configuration and future upgrades.

- Multiple CT/VT configurations allow for implementation of many differential schemes, including concurrent split-phase and differential protection
- Up to 80 digital inputs and up to 56 digital outputs are available

- Types of digital outputs include trip-rated Form-A and Solid State Relay (SSR) mechanically latching, and Form-C outputs
- RTDs and DCmA inputs are available to monitor equipment parameters such as temperature & pressure

Monitoring and Metering

The G30 includes high accuracy metering and recording for all AC signals. Voltage, current, and power 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.

Fault and Disturbance Recording

The advanced disturbance and event recording features within the G30 can significantly reduce the time needed for postmortem analysis of power system events and creation of regulatory reports. Recording functions include:

- Sequence of Event (SOE)
 - 1024 time stamped events
- Oscillography,
 - 64 digital & up to 40 Analog channels
- Data Logger, disturbance recording
 - 16 channels up to 1 sample / cycle / channel
- Fault Reports
 - Powerful summary report of pre-fault and fault values

The very high sampling rates and large amounts of storage space available for data recording in the G30 can eliminate the need for installing costly standalone recording equipment.

Advanced Device Health Diagnostics

The G30 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 security and availability of protection, and present

device status via SCADA communications and front panel display. Providing continuous monitoring and early detection of possible issues helps improve system uptime.

- Comprehensive device health diagnostic performed during startup
- Monitors the CT/VT input circuitry to validate the integrity of all signals
- Input, outputs, trip circuits and analog channels are continuously monitored for accuracy and performance

Communications

The G30 provides advanced communications technologies for remote data and engineering access, making it the easiest and most flexible generator protection relay to use and integrate into new and existing infrastructures. Direct support for fiber optic Ethernet provides high-bandwidth communications allowing for low-latency controls and high-speed file transfers of relay fault and event record information. The available redundant Ethernet option and the embedded managed Ethernet switch provide the means of creating fault tolerant communication architectures in an easy, cost-effective manner without

the need for intermediary communication hardware.

The G30 supports the most popular industry standard protocols enabling easy, direct integration into DCS and SCADA systems.

- IEC61850
- DNP 3.0
- Ethernet Global Data (EGD)
- IEC60870-5-104
- Modbus RTU, Modbus TCP/IP

Interoperability with Embedded IEC61850

Use the G30 with integrated IEC61850 to lower costs associated with substation protection, control and automation. GE Multilin's leadership in IEC61850 comes from thousands of installed devices and follows on seven years of development experience with UCA 2.0.

- Replace expensive copper wiring between devices with direct transfer of data using GOOSE messaging
- Configure systems based on IEC61850 and also monitor and troubleshoot them in real-time with EnerVista Viewpoint Engineer

- Integrate GE Multilin IEDs and generic IEC61850 compliant devices seamlessly in EnerVista Viewpoint Monitoring

Direct I/O Messaging

Direct I/O allows for sharing of high-speed digital information between multiple UR relays via direct back-to-back connections or multiplexed through a standard DS0 multiplexer channel bank. Regardless of the connection method, Direct I/O provides continuous real-time channel monitoring that supplies diagnostics information on channel health.

Direct I/O provides superior relay-to-relay communications that can be used in advanced interlocking, generation rejection and other special protection schemes.

- Communication with up to 16 UR relays in single or redundant rings rather than simplistic point-to-point configurations
- Connect to standard DS0 channel banks through standard RS422, G.703 or IEEE C37.94 interfaces or via direct fiber optic connections
- Built-in continuous loop and channel monitoring provides real-time diagnostics of your communication channels – no external or handheld tester required

Power System Troubleshooting



The G30 contains many tools and reports that simplify and reduce the amount of time required for troubleshooting power system events.

Multi-Language

The G30 supports English, French, Russian, and Chinese languages on the front panel, EnerVista setup software, and product manual. Easily switch between English and an additional language on the local displays without uploading new firmware.

EnerVista™ Software

The EnerVista™ Suite is an industry-leading set of software programs that simplifies every aspect of using the G30 relay. The EnerVista suite provides all the tools to monitor the status of your generator, maintain your relay, and integrate information measured by the G30 into DCS or SCADA monitoring systems. Convenient COMTRADE and Sequence of Events viewers are an integral part of the UR Setup software included with every UR relay, to carry out postmortem event analysis to ensure proper protection system operation.

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 GE 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

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 Engineer

Viewpoint Engineer is a set of powerful tools that will allow you to configure and test UR relays at a system level in an easy-to-use graphical drag-and-drop environment. Viewpoint Engineer provides the following configuration and commissioning utilities:

- Graphical Logic Designer
- Graphical System Designer
- Graphical Logic Monitor
- Graphical System Monitor

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 GE Multilin devices into new or existing automation systems. Included in EnerVista™ Integrator is:

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

Providing Traceability and Regulatory Audit Tracking

SECURITY/CHANGE HISTORY REPORT

Generated at: Sep 09 2006 14:30:40

Device Summary

Device Name:	GEN/TRANSFORMER
Device Type:	UR G30
Order Code:	G30-K01-HPH-F8L-H6A-M8N-H6B
Firmware Version:	5.20
Serial Number:	MAC05867834227
IP Address:	3.94.24.172

Setting Changes History

Event	Date of Change	# of Changes	Password Entered	Method of Change	Changed by Whom (MAC address)	Filename Uploaded	Status	Firm. Version
16	09/22/2006, 3:26 PM	3	Yes	Ethernet	00A0953B9A02		In Service	5.20
15	09/21/2006, 11:15 AM	24	Yes	Ethernet	00A0953B9A02	Gen-B-Rev3.urs	In Service	5.20
14	09/21/2006, 9:26 AM	6	Yes	Ethernet	00A0953B9A02		Out of Service	5.20
13	07/16/2006, 4:02 PM	4	Yes	Keypad			In Service	5.20
12	07/16/2006, 10:51 AM	12	Yes	Front Port	00A098B123AC		In Service	5.20
11	07/15/2006, 12:33 PM	2	No	Front Port	00A098B123AC		In Service	5.20
10	12/06/2005, 1:41 PM	3	No	Ethernet	00A098B123AC		In Service	5.20
9	12/05/2005, 9:46 AM	46	No	Ethernet	00A098B123AC	Gen-B-Rev2.urs	In Service	5.20
8	12/23/2005, 4:22 PM	3	No	Ethernet	00A098B123AC		Out of Service	5.20
7	12/23/2005, 11:53 AM	8	No	Keypad			Out of Service	5.20

Setting Changes Detail History

Event	Date of Change	Old Value	New Value	Item	Modbus Address
16	09/09/05 02:18 PM	Disabled	Enabled	Thermal Model Events	0x6620
16	09/09/05 01:10 PM	Disabled	Enabled	Thermal Model Function	0x6620
16	09/09/05 12:45 PM	Disabled	Enabled	Acceleration Events	0x6900
16	09/09/05 12:10 PM	10.00s	9.00s	Acceleration Time	0x6900
16	09/09/05 11:05 AM	Disabled	Enabled	Acceleration Function	0x6900

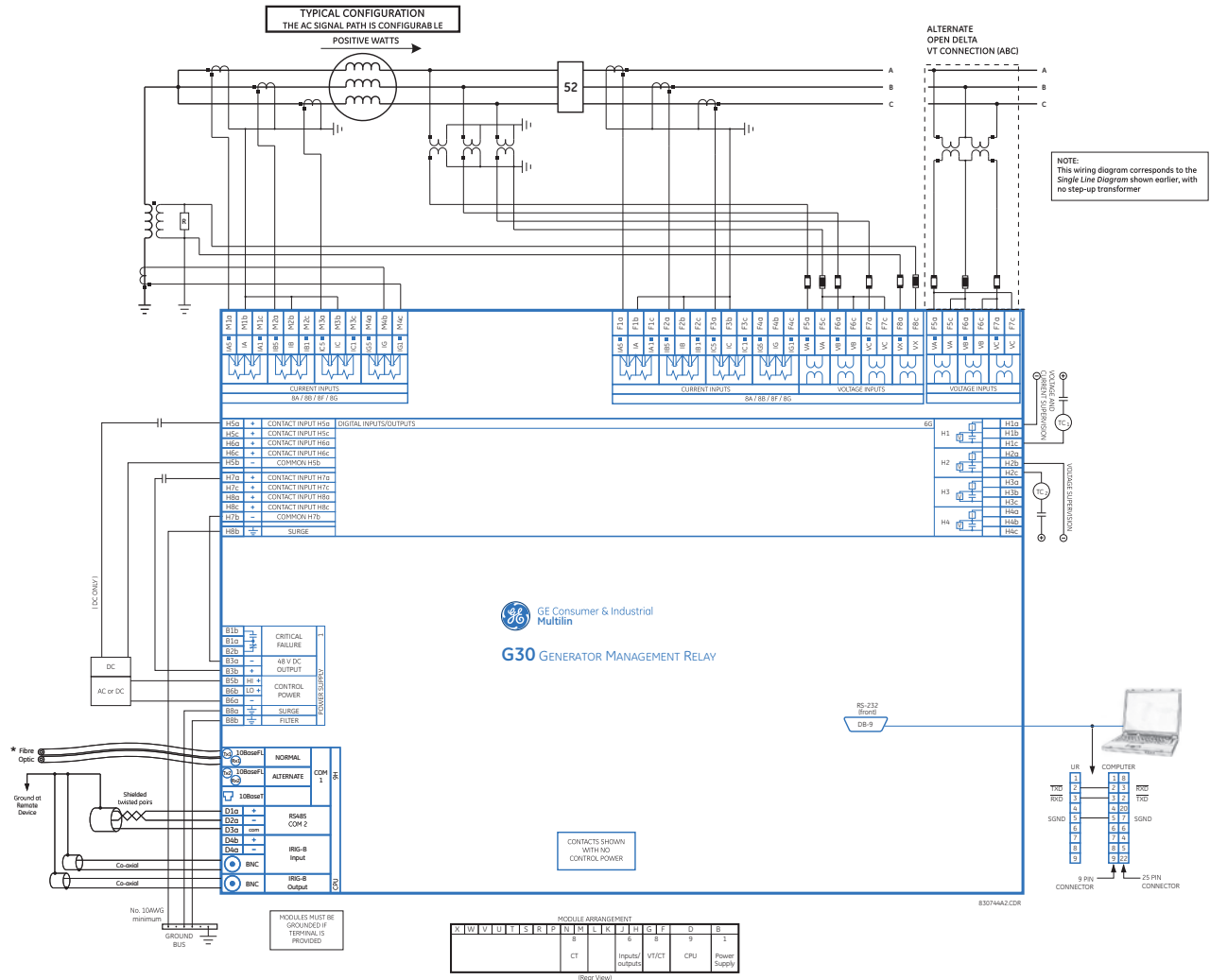
The G30 tracks and records information about configuration changes that have been made to the relay thereby providing a method of auditing system security and engineering processes

User Interface

The G30 front panel provides extensive local HMI capabilities. The local display is used for monitoring, status messaging, fault diagnosis, and device configuration. User configurable messages that combine text with live data, can be displayed when user-defined conditions are met.



Typical Wiring



This diagram is based on the following order code:
G60-H00-HCH-F8F-H6G-M8H-PXX-UXX-WXX
This diagram provides an example of how the device is wired, not specifically how to wire the device. Please refer to the Instruction Manual for additional details on wiring based on various configurations.

Ordering

G30 - * 00 - H * - F ** - H ** - M ** - P ** - U ** - W/X **										For Full Sized Horizontal Mount
Base Unit	G30	E G H J K N S								Base Unit
CPU										RS485 + RS485 (IEC61850 option not available) RS485 + Multi-mode ST 10BaseF RS485 + Multi-mode ST Redundant 10BaseF RS485 + Multi-mode ST 100BaseFX RS485 + Multi-mode ST Redundant 100BaseFX RS485 + 10/100 BaseT RS485 + 6 port, 100 Mbps, Managed Ethernet Switch
Software Options		00 01 03 04								No Software Options Ethernet Global Data (EGD) IEC61850 Ethernet Global Data (EGD) + IEC61850
Mount / Coating			H A V B							Horizontal (19" rack) - Standard Horizontal (19" rack) - Harsh Environment Coating Vertical (3/4 size) - Standard Vertical (3/4 size) - Harsh Environment Coating
User Interface				K L M N O T U V F						Enhanced English Front Panel Enhanced English Front Panel with User-Programmable Pushbuttons Enhanced French Front Panel Enhanced French Front Panel with User-Programmable Pushbuttons Enhanced Russian Front Panel Enhanced Russian Front Panel with User-Programmable Pushbuttons Enhanced Chinese Front Panel Enhanced Chinese Front Panel with User-Programmable Pushbuttons Vertical Front Panel with English display
Power Supply					H H L				RH	125 / 250 V AC/DC 125/250 V AC/DC with redundant 125/250 V AC/DC 24 - 48 V (DC only)
CT/VT DSP						8L 8M 8N 8R		8L 8M 8N 8R		Standard 4CT/4VT w/ enhanced diagnostics Sensitive Ground 4CT/4VT w/ enhanced diagnostics Standard 8CT w/ enhanced diagnostics Sensitive Ground 2CT/6VT w/ enhanced diagnostics
IEC 61850 Process Bus							81			8 Port IEC 61850 Process Bus Module
Digital I/O						XX 4A 4C 4D 4L 4L 67 6C 6D 6E 6F 6K 6L 6M 6N 6P 6R 6S 6T 6U 6V	XX 4A 4C 4C 4D 4L 4L 67 6C 6D 6E 6F 6K 6L 6M 6N 6P 6R 6S 6T 6U 6V	XX 4A 4C 4C 4D 4L 4L 67 6C 6D 6E 6F 6K 6L 6M 6N 6P 6R 6S 6T 6U 6V	No Module 4 Solid State (No Monitoring) MOSFET Outputs 4 Solid State (Current w/opt Voltage) MOSFET Outputs 16 Digital Inputs with Auto-Burnish 14 Form-A (No Monitoring) Latchable Outputs 8 Form-A (No Monitoring) Outputs 8 Form-C Outputs 16 Digital Inputs 4 Form-C Outputs, 8 Digital Inputs 8 Fast Form-C Outputs 4 Form-C & 4 Fast Form-C Outputs 2 Form-A (Current w/ opt Voltage) & 2 Form-C Outputs, 8 Digital Inputs 2 Form-A (Current w/ opt Voltage) & 4 Form-C Outputs, 4 Digital Inputs 4 Form-A (Current w/ opt Voltage) Outputs, 8 Digital Inputs 6 Form-A (Current w/ opt Voltage) Outputs, 4 Digital Inputs 2 Form-A (No Monitoring) & 2 Form-C Outputs, 8 Digital Inputs 2 Form-A (No Monitoring) & 4 Form-C Outputs, 4 Digital Inputs 4 Form-A (No Monitoring) Outputs, 8 Digital Inputs 6 Form-A (No Monitoring) Outputs, 4 Digital Inputs 2 Form-A (Cur w/ opt Volt) 1 Form-C Output, 2 Latching Outputs, 8 Digital Inputs	
Transducer I/O						5C 5E 5F	5C 5E 5F	5C 5E 5F	5C 5E 5F	5C 5E 5F 7A 7B 7C 7H 7I 7J 7R 7S 7T 7W 76 77 2A 2B 2S 2T
Inter-Relay Communications										8 RTD Inputs 4 dcmA Inputs, 4 RTD Inputs 8 dcmA Inputs 820 nm, multi-mode, LED, 1 Channel 1300 nm, multi-mode, LED, 1 Channel 1300 nm, single-mode, ELED, 1 Channel 820 nm, multi-mode, LED, 2 Channels 1300 nm, multi-mode, LED, 2 Channels 1300 nm, single-mode, ELED, 2 Channels G.703, 1 Channels G.703, 2 Channels RS422, 1 Channels RS422, 2 Channels IEEE C37.94, 820 nm, multimode, LED, 1 Channel IEEE C37.94, 820 nm, multimode, LED, 2 Channel C37.94SM, 1300nm Singlemode, ELED, 1 Channel Single mode C37.94SM, 1300nm Singlemode, ELED, 2 Channel Single 6 port, 100 Mbps, Managed Ethernet Switch, HI (125/250V AC/DC) 6 port, 100 Mbps, Managed Ethernet Switch, LO (24-48 Vdc)ttt

Accessories for the G30

- UR Applications I Learning CD TRCD-URA1-C-S-1
- Multilink Ethernet Switch ML2400-F-HI-HI-A2-A2-A6-G1
- Viewpoint Engineer VPE-1
- Viewpoint Maintenance VPM-1
- Viewpoint Monitoring IEC61850 VP-1-61850

Visit www.GEMultilin.com/G30 to:

- View Guideform specifications
- Download the instruction manual
- Review applications Notes and support documents
- Buy a G30 online
- View the UR Family brochure

Ordering Note: To view the latest options available for the G30, or to order the UR Classic Front Panel, please visit our online store for more details.