



G30

GENERATOR PROTECTION SYSTEM

Cost effective protection for small to medium generators, includes integrated unit transformer protection

KEY BENEFITS

- Integrated unit transformer protection reduces number of devices required
- Builds on proven G60 Generator protection platform and algorithms
- Increase the reliability of the protection & control system with dual power supply option
- Advanced automation capabilities
- Complete support of multiple breaker applications (eg. Ring Bus, Breaker-and-a-half) -
- Cost effective and flexible access to information - Multiple communication options and protocols
- Use high speed communications to reduce wiring and installation costs - Exchange inputs and outputs between relays to achieve relay-to-relay interaction
- Reduce installation space requirements through compact design - Multifunction device that integrates protection and control functions, programmable pushbuttons and status LEDs, and communication interfaces
- Maintenance cost savings and simplification - Modular construction, common hardware, reduced stock of spare parts, plug & play modules
- Application flexibility - Multiple I/O options, programmable logic (FlexLogic™), modularity, customize to specific requirements
- Reduce system event analyzing time and cost - Sequence of event reports, oscillography, datalogging, IRIG-B time synchronization
- Embedded IEC 61850 Protocol - No external protocol converters required

APPLICATIONS

- Small to medium Generators,
- Combined Generator and Transformer Protection
- G60 backup
- Stand-alone or component in automated substation control system

FEATURES

Protection and Control

- Unit Transformer protection
- Synchronism Check
- Restricted Ground Fault
- Split Phase protection
- Loss of excitation, Overexcitation
- Reverse and low forward power
- Generator unbalance
- Phase sequence reversal for pumped storage

Communications

- Networking options - Ethernet-fiber (optional redundancy), RS485, RS422, G.703, C37.94
- Multiple protocols - IEC 61850, DNP 3.0 Level 2, Modbus RTU, Modbus TCP/IP, IEC 60870-5-104, Ethernet Global Data (EGD)
- Direct I/O - Exchange of binary data between URs

Monitoring and Metering

- Metering - current, voltage, power, energy, frequency
- Oscillography - 64 samples/cycle, up to 64 records
- Event Recorder - 1024 time tagged events, with 0.5ms scan of digital inputs
- DataLogger - Up to 16 channels with user selectable sampling rate
- User Programmable Fault Reports

User Interface and Programming

- Front panel display and keypad for local direct access, with an RS232 port for local PC access
- User programmable local display, LEDs and pushbuttons
- Customize protection and control functions with FlexLogic™, FlexCurves™, and FlexElements™
- Includes EnerVista LaunchPad - Simple relay setup and programming
- Multi-language support - French, Chinese, Russian option

Protection and Control

The G30 Generator Protection System provides comprehensive generator protection for small to medium generators and for applications requiring in-zone transformer protection. The G30 includes advanced automation capabilities, extensive I/O options and configurations, and features that can minimize generator downtime.

The G30 builds on the wide market acceptance of the G60 and incorporates many of the same field proven protection and control algorithms. As part of the Universal Relay (UR) Family, the G30 provides superior protection and control that includes:

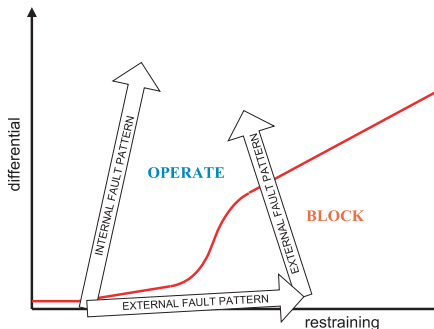
Transformer Differential

A transformer differential element is provided to allow for in-zone and unit transformer protection in one integrated generator protection relay.

Differential Protection

High speed Differential protection is provided for fast clearance of stator phase faults and advanced CT saturation detection algorithms are incorporated for increased security during heavy external fault/disturbances.

Dual-slope dual break-point operating characteristic with integrated magnetizing inrush and overexcitation inhibits. Maximum winding current is used as a restraining signal for better through fault stability under CT saturation conditions. This feature can also be used for unit transformer protection.



Percent differential restraint operating characteristics

Restricted Ground Fault (RGF)

RGF (also known as zero sequence differential) provides sensitive ground fault detection for low-magnitude fault currents. The G30 incorporates low-impedance RGF protection and uses novel algorithms to provide fast and sensitive protection while overcoming stability problems and CT saturation.

Split Phase Protection

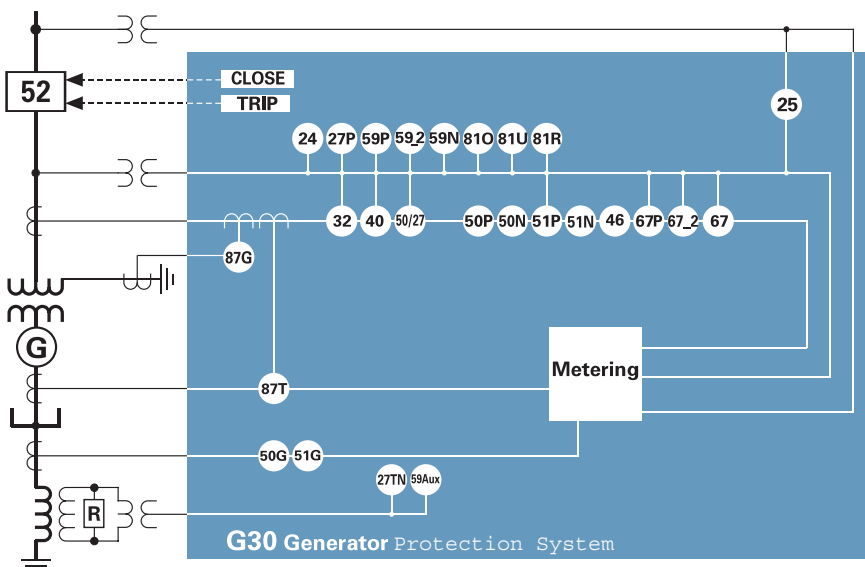
Split phase protection can be applied to detect inter-turn faults in cases where the generator is wound with two three-phase windings, each brought separately out of the machine and connected in parallel. This is a particularly popular winding design on hydro generators. The currents in the two windings are compared with any difference indicating an inter-turn fault. These faults cannot be detected by differential protection.

Loss of Excitation

Use the G30 for the detection of the loss of excitation of synchronous generators, and to automatically remove the generator from service. Loss of excitation can be damaging to the machine, and/or detrimental to the operation of the system. It is recommended that loss-of- excitation protection be considered for all synchronous generators. Protective relays are applied as backup protection for excitation systems, which in most cases include minimum-excitation limiters to prevent under-excitation. An offset mho characteristic was chosen to provide selectivity between loss of excitation and other normal or abnormal conditions that may exist on the system. The element provides two-stage impedance based protection and responds to the positive sequence voltage and current.

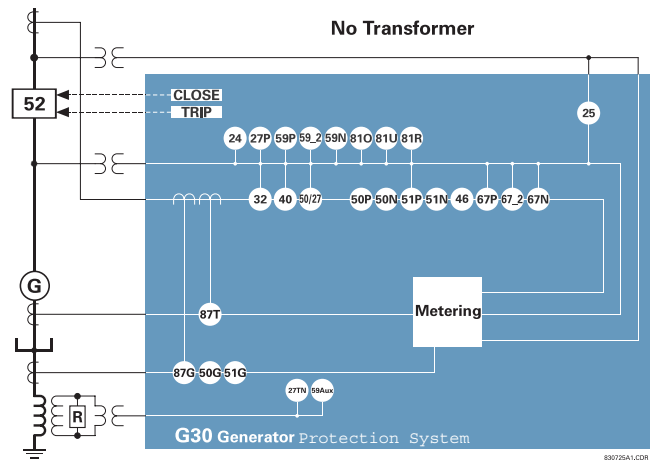
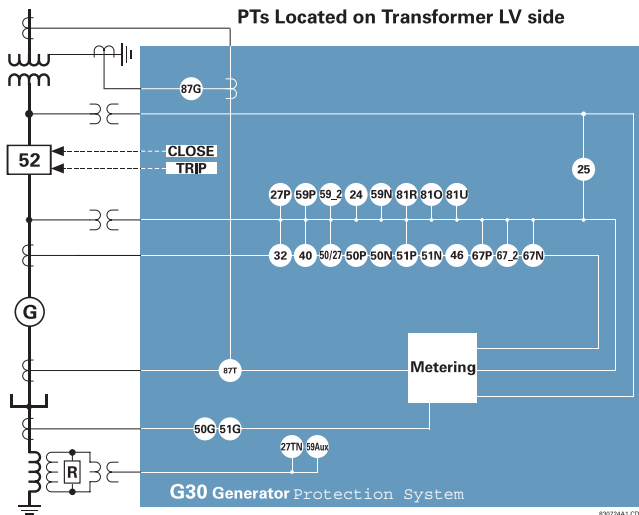
Functional Block Diagram

PTs Located on Transformer HV side



ANSI DEVICE NUMBERS AND FUNCTIONS

DEVICE NUMBER	FUNCTION
24	Volts Per Hertz
25	Synchrocheck
27P	Phase Undervoltage
27TN	Third Harmonic Neutral Undervoltage
27X	Auxiliary Undervoltage
32	Sensitive Directional Power
40	Loss of Excitation
46	Generator Unbalance
50G	Ground Instantaneous Overcurrent
50N	Neutral Instantaneous Overcurrent
50P	Phase Instantaneous Overcurrent
50SP	Split Phase Protection
50/27	Accidental Energization
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
87G	Restricted Ground Fault
87T	Transformer Differential



Sensitive Directional Power

The Directional Power element responds to three-phase active power and is designed for reverse power and low forward power applications for synchronous machines or interconnections involving co-generation. The relay measures the three-phase power from either full set of wye-connected VTs or full-set of delta-connected VTs.

Generator Unbalance

The negative sequence components of unbalance currents cause second harmonic currents to flow in the rotor that can lead to undetected overheating and consequently severe machine damage. The G30 meets ANSI standards to minimize risk of heat damage caused by unbalance in the generator.

Overcurrent Protection

IOC and TOC functions are available for phase, ground, and neutral. Time curves provided include three IEEE, four IEC, four GE IAC, I2t, definite time and four user-programmable curves. Phase TOC functions use voltage restraint.

Overexcitation Protection

Provided through a Volts/Hertz function with programmable inverse time characteristic.

Abnormal Voltage Frequency Protection

Over and underfrequency protection, and over and undervoltage protection are available.

Frequency Rate of Change Protection

Use the four frequency rate of change (df/dt) elements included in the G30 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.

Thermal protection via RTDs

Use the G30 to provide over-temperature protection, a unique feature not normally found on Generator Protection Relays. The G30 is designed to receive signals from any type of external Resistance Temperature Detectors (RTDs), and convert these signals into a digital format for use as required. Actions based on RTD over temperature, such as trips or alarms, are done in conjunction with the FlexElements™ feature. FlexElements™ operands are available to FlexLogic™ for further interlocking or to operate an output contact directly.

Minimize Downtime

The G30 incorporate many features that can minimize generator downtime. These include:

- Dual hot swappable power supplies
- Quick troubleshooting and repair with withdrawable modules
- Comprehensive self-test features
- Extensively tested to ANSI and IEC specifications

Synchronism Check

The synchrocheck elements are typically used at locations where the two parts of the system are interconnected through at least one other point in the system, which are to be joined by the closure of one or more circuit breakers. The G30 provides the required voltage source inputs, digital inputs and outputs, and elements to monitor differences in voltage magnitudes, phase angles, and frequencies to perform synchronism check across two breakers. Use the G30 to carry out full independent control over the associated breakers. When used in conjunction with an automated system, use the G30 to aid the restoration process as an independent check of the synchronizer.

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 URs for complete system protection, including the generator service unit, and balance of plant protection

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

Flexible CT/VT configurations allow for connection on the HV or LV side of the transformer. Also, to reduce costs, a single

Oscillography

Configure up to 64 oscillography channels to monitor any physical I/O point or internal digital and analog variables. The waveform traces and digital states provide a visual display of power system and operational data captured during specified triggered events. Sampling rates are up to 64 samples/cycle and 64 fault records can be stored on the unit.

Event Recorder

Capture the last 1024 events, with 0.5ms scan of digital inputs, to provide SOE recorder functionality. Consolidate the event records from multiple devices using EnerVista software tools and use the IRIG-B time synchronization feature to synchronize all events across a system of URs for even more accurate analysis and troubleshooting.

DataLogger

Profile operational data with up to 16 data logger channels with a user configurable sampling rate, ranging from 1 second to 1 hour. All data is stored in non-volatile memory so that information is retained even when power to the unit is lost. All recorded data can be easily retrieved via EnerVista for viewing and analysis.

Advanced Device Health Diagnostics

The new CT/VT DSP modules that are available (8L, 8M, 8N, 8R) have enhanced diagnostic capabilities that continually monitor the CT/VT input circuitry to validate the integrity of the of all signals. This extra degree of security ensures that protection and control algorithms are executed with accurately measured and processed power system information.

Along with this CT/VT input diagnostics, the Universal Relay (UR) platform also performs comprehensive device health diagnostic tests during startup and at runtime to test for proper operation of its own major functions and critical hardware. These diagnostic tests detect out-of-tolerance conditions that could impact product performance within the device, evaluate the criticality of this impact, and present the test status via SCADA, HMI and front panel LCD.

User Interface and Programming

The G30 front panel provides extensive local HMI capabilities. The local display is used for monitoring, status messages, fault diagnosis, and controller configuration. User configurable messages that combine text with live data, can be displayed when user defined conditions are met. A keypad is also provided for easy access and changes to relay settings.

Replace external indicator lights with the 48 user programmable LEDs to display key status information. An additional 14 pre-programmed LEDs and custom LED labeling are available.

An RS232 port for local PC access is provided on the front panel for convenient access to the relay through EnerVista LaunchPad. The Ethernet port allows for even easier access to the relay over the network.

User-Programmable Push Buttons

Perform manual control, operate breakers, or lock out functions, with the user-programmable pushbuttons. Replace external switches and bi-stable relays by using mechanically latching outputs controlled from the pushbuttons. The G30 can be ordered with 7 user programmable control pushbuttons (3 standard, 4 optional) and 12 large user-programmable push buttons (optional). The control action of each push button is fully programmable and its operation can be logged directly in the Sequence of Events recorder to enhance troubleshooting. The push buttons can be easily labeled for added clarity of functionality.

Multi-Language

The G30 supports multiple languages. French, Chinese, Russian language options are available on the local display, front panel, and EnerVista setup software, as well as the product instruction manual. Easily switch between English and an additional user selectable language on the local display.

FlexLogic™, FlexElements™, FlexCurves™

The G30 comes with powerful configuration and programming tools. These include:

- FlexLogic™: simplifies the programming and use of the G30 and enables powerful but flexible protection and control solutions
- FlexElements™: user-definable protection functions
- FlexCurves™: define additional custom curve shapes

Multiple Settings Groups

Six separate setting groups can be stored in the G30's non-volatile memory. An easy to use and fully programmable mechanism is provided to instantly switch the active settings. Multiple settings groups apply to all the protection elements.

Communications

The G30 supports a wide range of communication mediums and protocols compatible with new and existing communication infrastructures.

Networking options include Ethernet-Fiber, with optional redundancy, and RS485 interfaces. With the advent of high-speed relay-to-relay communication LANs, performing inter-device control signaling via remote I/O over the LAN can eliminate a great deal of inter-device control wiring. Protocols supported by the G30 include IEC61850, DNP 3.0, Modbus RTU, Modbus TCP/IP, and IEC60870-5-104. These protocols make it easy to connect to a utility automation system and are integrated into the G30, removing the need for external protocol converter devices.

Interoperability with Embedded IEC 61850 Protocol

IEC 61850 is the new international standard for information exchange and interoperability between intelligent devices within a substation. Use the G30 with IEC 61850 to lower the costs and simplify the engineering, commissioning, operating, and maintenance associated with substation protection and control applications. IEC 61850 is built on over 7 years of GE leadership in UCA 2.0 implementation.

IEC 61850 allows for the seamless connection of IEDs from multiple vendors. In addition to device interoperability, these protocols are designed to control the substation via a LAN instead of through discrete wiring to an RTU. Peer-to-peer communication over Ethernet enables distributed control with several IEDs and eliminates the need for an RTU to remote SCADA master. High-speed message transfer eliminates the need for large and costly hard-wired interconnection.

Direct I/O Messaging

This feature allows for the exchange of binary information (FlexLogic™ operands) between a number of UR IEDs over a dedicated fiber (single or multimode), RS422, G.703 or C37.94 interface. No switching equipment is required as the IEDs are connected directly in a ring or redundant (dual) ring configuration.

EnerVista™

The EnerVista™ Suite is an industry leading set of software programs that will simplify every aspect of using the G30 relay. Tools to instantly monitor the status of the Generator and view the magnitude of any power quantities measured by the G30 relay are available. Also, the ability to analyze the cause of any faults using the powerful COMTRADE and the Sequence of Event viewers in the EnerVista UR Setup program is included with each relay.

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 all GE Multilin products. Also included is a document archiving system that will ensure that all manuals, application notes, and other necessary documentation are always up-to-date and available when needed.

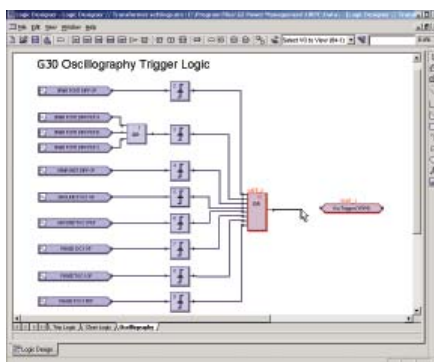
Viewpoint Monitoring

Viewpoint Monitoring is a software application that will provide Monitoring, Control, Trending, Alarming and Fault

Data Recording functionality needed for sub-station applications. This easy to use program can be configured to give complete visibility, control, and automated retrieving and archiving of all Event Records and Waveforms files from GE Multilin devices in minutes.

Viewpoint Engineer

Viewpoint Engineer is a set of tools that will reduce the amount of time required to program, test and commission UR relays. The Graphical FlexLogic™ Editor will improve efficiency in programming UR's by combining the creating of control diagrams, documenting of logic, and programming of relays into one easy step. The Real-Time FlexLogic™ Analyzer



Create your control and automation logic in our IEC1131 graphical logic editor

will then simply commissioning and troubleshooting by displaying the status of each part of the equations as they change state.

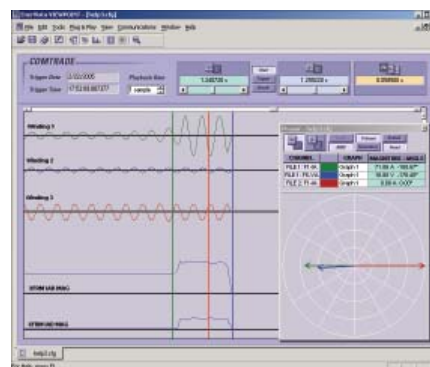
Viewpoint Maintenance

Viewpoint Maintenance is a set of tools designed specifically for individuals responsible for diagnosing faults, maintaining and troubleshooting GE Multilin devices after commissioning. With a single click of the mouse, this software provides users with a simplified report

that shows the cause of any power system faults or problems. This software will also enhance the security of the relay by providing reports that will document any changes have been made to the configuration of the devices.

EnerVista™ Integrator

EnerVista™ Integrator is the tool to use to send data that is measured by GE Multilin devices to new or existing HMI, SCADA, or DCS system. This software can greatly reduce the time required to integrate GE Multilin devices with the Energy Management or Plant Operations Systems. Also included is a tool that will detect any new Events or Waveform files created by all the relays and automatically save them into a permanent historical archive, which will give a station wide Sequence of Event record.



Automatically retrieves and archives all Waveforms and Event Records from GE Multilin devices

G30 Guideform Specifications

For an electronic version of the G30 guideform specifications, please visit: www.GEMultilin.com/specs, fax your request to 905-201-2098 or email to literature.multilin@ge.com.



