High-speed transmission line protection with three/single pole tripping

KEY BENEFITS

- High-speed cost effective five zone quad or mha, phase and ground distance protection
- Complete IEC 61850 Process Bus solution providing resource optimization and minimizing total P&c life cycle costs
- Reliable and secure protection on series compensated lines
- Superior phase selection algorithm ensures secure high speed single pole tripping
- Supports multiple standard pilot schemes for fast fault clearance within the protected zone
- Flexible programmable logic for building customized schemes
- Embedded IEC 61850 Protocol

APPLICATIONS

- Overhead lines including series compensated lines and underground cables of different voltage levels
- Single and dual-breaker circuits requiring single pole/three-pole autoreclosing and independent synchrocheck
- Circuits with in-zone power transformers and tapped transformer feeders
- Secure application with Capacitively-Coupled Voltage Transformers (CCVTs)
- Backup protection for generators, transformers and reactors

FEATURES

Protection and Control

- Phase Distance (five zones) with independent compensation settings for in-zone power transformers
- Ground distance (five zones) with independent self and mutual zero sequence compensation
- Reverse power, Out of Step tripping and power swing blocking
- Line pickup, thermal protection, under /over frequency
- Thermal overload, phase, neutral and negative sequence directional overcurrent; and broken conductor
- Over, Under and rate of change of Frequency, Synchronism check for dual breaker applications
- Four-shot dual breaker auto-recloser, broken conductor
- VT fuse failure detector, compensated over-voltage

EnerVista™ Software

- Graphical Logic Designer and Logic Monitor to simplify designing and testing procedures
- Document and software archiving toolset to ensure reference material and device utilities are up-to-date
- EnerVista™ Integrator providing easy integration of data in the D60 into new or existing monitoring and control systems

IEC 61850 Process Bus Interface

- Robust communications with up to 8 HardFiber Bricks
- Seamless integration with existing D60 functions
- Redundant architecture for dependability and security

Monitoring and Metering

- Synchronised measurement of voltage & current and sequence component phasors - 1 to 60 phasors/sec
- 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
- Setting Security Audit Trail for tracking changes to D60 configuration

Communications

- Networking interfaces – 100Mbit Fiber Optic Ethernet, RS485, RS232, RS422, G.703, C37.94
- Multiple Protocols - IEC 61850, 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 Direct Transfer Trip and pilot-Aided schemes
- Embedded Managed Ethernet Switch with 4 - 100 Mbit Fiber optic ports and 2 copper ports
Protection & Control

The D60 is a high-end, cost-effective distance protection relay intended for protecting transmission lines and cables providing reliable and secure operation even under the worst case power system conditions. Part of the Universal Relay family, the D60 comes with a variety of versatile features truly integrating protection, monitoring, metering, communication and control in one easy-to-use device. The Universal Relay family offers a high degree of modularity in its design and functionality providing superior performance in protection and control meeting the toughest requirements of the marketplace.

Distance Protection

The core of the D60 relay is the distance function providing high degree of sensitivity and selectivity for all types of faults. The distance function comes with five zones of phase distance and ground distance providing the user maximum flexibility to cater for different applications which include primary line protection and back-up protection for busbars generators, transformers and reactors. The relay can be applied to power systems with different earthing conditions, lines with in-zone transformers or tapped transformer feeders, and overhead lines with series compensation. Each zone element for the phase and ground distance can be independently set as Quad or Mho characteristics with the flexibility of designing different characteristic shapes to suit for different power system conditions.

The advanced comparator based distance elements provide utmost security, sensitivity and selectivity for different types of faults. Superior digital filtering techniques provide secure and optimum reach accuracy even under worst-case CVT transients. Secure directional discrimination is achieved by using positive sequence memory voltage polarization providing reliable directionality for worst-case close-in faults. The D60 employs a well-proven algorithm for phase selection which provides faster, secure and reliable faulted phase identification for single pole tripping and proper fault distance calculation for a variety of power system conditions. An additional voltage monitoring function provides extra security to the distance element, which can be used to block the distance elements under voltage source fuse failure conditions.

ANSI Device Numbers & Functions

<table>
<thead>
<tr>
<th>Device Number</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>21G</td>
<td>Ground Distance</td>
</tr>
<tr>
<td>21F</td>
<td>Phase Distance</td>
</tr>
<tr>
<td>25</td>
<td>Synchrophasor Check</td>
</tr>
<tr>
<td>27</td>
<td>Phase Undervoltage</td>
</tr>
<tr>
<td>27K</td>
<td>Auxiliary Undervoltage</td>
</tr>
<tr>
<td>32</td>
<td>Sensitive Reverse Power</td>
</tr>
<tr>
<td>49</td>
<td>Thermal Overload</td>
</tr>
<tr>
<td>50R</td>
<td>Breaker Failure</td>
</tr>
<tr>
<td>50S0</td>
<td>Current Disturbance Detector</td>
</tr>
<tr>
<td>50C</td>
<td>Ground Instantaneous Overcurrent</td>
</tr>
<tr>
<td>50N</td>
<td>Neutral Instantaneous Overcurrent</td>
</tr>
<tr>
<td>50P</td>
<td>Phase Instantaneous Overcurrent</td>
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<tr>
<td>50J</td>
<td>Negative Sequence Instantaneous Overcurrent</td>
</tr>
<tr>
<td>51C</td>
<td>Ground Time Overcurrent</td>
</tr>
<tr>
<td>51S</td>
<td>Neutral Time Overcurrent</td>
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<tr>
<td>51F</td>
<td>Phase Time Overcurrent</td>
</tr>
<tr>
<td>51J</td>
<td>Negative Sequence Time Overcurrent</td>
</tr>
<tr>
<td>52</td>
<td>AC-Circuit Breaker</td>
</tr>
<tr>
<td>53C</td>
<td>Compensated Overvoltage</td>
</tr>
<tr>
<td>59K</td>
<td>Neutral Overvoltage</td>
</tr>
<tr>
<td>59W</td>
<td>Auxiliary Overvoltage</td>
</tr>
<tr>
<td>59S</td>
<td>Negative Sequence Overvoltage</td>
</tr>
<tr>
<td>57N</td>
<td>Neutral Directional Overcurrent</td>
</tr>
<tr>
<td>57P</td>
<td>Phase Directional Overcurrent</td>
</tr>
<tr>
<td>57J</td>
<td>Negative Sequence Directional Overcurrent</td>
</tr>
<tr>
<td>68</td>
<td>Power Swing Blocking</td>
</tr>
<tr>
<td>78</td>
<td>Out-of-Step Tripping</td>
</tr>
<tr>
<td>79</td>
<td>Automatic Recloser</td>
</tr>
<tr>
<td>81U/O</td>
<td>Under/Over Frequency</td>
</tr>
<tr>
<td>8000</td>
<td>ROCOF</td>
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</tbody>
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The D60 is the single point for protection, control, metering, and monitoring in one integrated device that can be easily connected directly to HMI or SCADA monitoring and control systems.
Fault Locator
The integrated fault locator provides distance to fault in km or miles. Parallel line zero-sequence current compensation and load current compensation enables the D60 to provide improved accuracy for fault distance measurement.

Line Pickup (Switch-on-to Fault)
The Line Pickup feature uses a combination of undercurrent and undervoltage to identify a line that has been de-energized (line end open). Three instantaneous overcurrent elements are used to identify a previously de-energized line that has been closed on to a fault.

Power Swing Detection
Dynamic transients in the power system due to short-circuits, circuit switching, or load unbalance changes can travel across the power network as power swings characterized by fluctuating currents and voltages. This can result in unwanted tripping since distance elements can respond to these power swings as faults. The D60 power swing detection element provides both power swing blocking and out-of-step tripping functions. The element measures the positive sequence apparent impedance and traces its locus with respect to either a two or three step user selectable mho or quad operating characteristics.

Series Compensated Lines
D60 provides enhanced stability and security by employing an adaptive distance reach control to cope with the overreaching and sub-synchronous oscillations when applied to, or in the vicinity of series compensated lines. For directional integrity the relay uses memory voltage polarization and a multi-input comparator to deal with current inversion issues in series compensated lines.

Single-Pole Tripping
The D60 relay uses an advanced phase selection algorithm that provides fast and accurate fault type identification even under weak-infeed conditions. A convenient trip function is built-in to coordinate actions of the key elements of the single-pole tripping package.

Communication Aided (Pilot) Schemes
D60 supports different teleprotection functions for fast fault clearance for any faults within the protected line. The following types of pilot-aided schemes are available in the D60:

- Direct Under reach Transfer Trip (DUTT)
- Permissive Under reach Transfer Trip (PUTT)
- Permissive Overreach Transfer Trip (POTT)
- Hybrid Permissive Overreach Transfer Trip (HYB POTT) permissive echo and transient blocking logic incorporated
- Directional comparison blocking scheme
- Directional comparison unblocking scheme (DCUB)

Undervoltage & Overvoltage Protections
Long lines under lightly loaded conditions or no-load may experience voltages exceeding the rated insulation voltage level; use the D60’s phase overvoltage element to detect them and trip the line. A second compensated overvoltage element detects overvoltage caused by breakers opening at the remote end. The D60 also provides additional voltage functions including neutral overvoltage, negative sequence overvoltage and phase undervoltage.

Overcurrent Functions
The D60 provides thermal overload, time and instantaneous overcurrent elements for phase, neutral, ground, negative sequence, phase and neutral directional. All of them can run in parallel with distance elements or can be programmed to provide overcurrent protection under conditions when the distance element is blocked (Eg. VT Fuse failure)

Autorecloser
The D60 provides multi shot autoreclosing for single pole or three pole autoreclose on all types of faults with independently settable dead time for each shot. Autoreclosing also can be dynamically blocked by user programmable logic. Four different autoreclose modes are available enabling the users to select the reclosing mode to suit specific applications.
Synchronism Check
The D60 monitors voltage difference, phase angle difference and slip frequency to ensure proper breaker closure as per user defined settings. The D60 provides additional enhancements in synchronizing by checking dead source conditions for synchronism bypass under these conditions.

Multiple Breaker Configurations
The D60 supports dual-breaker busbar configurations such as breaker-and-a-half or ring bus arrangements, providing dual breaker auto reclose, dual synch-check elements, and dual independent Breaker Failure elements. The design provides secure operation during external faults with possible CT saturation.

Breaker Failure
The D60 is able to provide fully independent breaker failure protection for the breakers associated to the line when connected to a substation with a breaker-and-a-half or ring bus arrangement. The D60 provides the elements to perform two independent breaker failure functions.

IEC 61850 Process Bus
The IEC 61850 Process Bus module is designed to interface with the Multilin HardFiber System, allowing bi-directional IEC 61850 fiber optic communications. The HardFiber System is designed to integrate seamlessly with the existing Universal Relay applications, including protection functions, FlexLogic, metering and communications.

The 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 D60's by replacing traditional CT/VT inputs with IEC 61850 Process Bus module
- Does not introduce new Cyber Security concerns

Custom Programmable Logic Designer
FlexLogic™ allows customizing the D60 for custom protection, control and automation allowing users to build line protection schemes and applications for their equipment.

Visit the HardFiber System product page on the GE Digital Energy website for more details.

Advanced Automation
The D60 incorporates advanced automation features including powerful FlexLogic™ programmable logic, communication, and SCADA capabilities that far surpass what is found in the average line protection relay. The D60 integrates seamlessly with other UR relays for complete system protection, including the unit and auxiliary transformers, and Balance of Plant protection.

Scalable Hardware
The D60 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.

- Flexible, modular I/O covering a broad range of input signals and tripping schemes
- Types of digital outputs include trip-rated Form-A and Solid State Relay ISSRI mechanically latching, and Form-C outputs
- RTDs and DCmA inputs are available to monitor equipment parameters such as temperature & pressure
Monitoring and Metering

The D60 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 D60 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 rate and large amount of storage space available for data recording in the D60 can eliminate the need for installing costly standalone recording equipment.

Advanced Device Health Diagnostics

The D60 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

Communications

The D60 provides for secure remote data and engineering access, making it easy and flexible to use and integrate into new and existing infrastructures. 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.

The D60 supports the most popular industry standard protocols enabling easy, direct integration into monitoring and SCADA systems.

- IEC 61850
- DNP3.0
- Ethernet Global Data (EGD)
- IEC60870-5-104
- Modbus RTU, Modbus TCP/IP

Interoperability with Embedded IEC 61850

The D60 with integrated IEC 61850 can be used to lower costs associated with protection, control and automation. GE Energy’s leadership in IEC 61850 comes from thousands of installed devices and follows on Multilin’s extensive development experience with UCA 2.0.

- Replace expensive copper wiring between devices with direct transfer of data using GOOSE messaging
- Configure systems based on IEC 61850 and also monitor and troubleshoot them in real-time with EnerVista™ Viewpoint Engineer
- Integrate Multilin IEDs and generic IEC 61850-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 D50 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 and other special protection schemes.

- Communication with up to 16 UR relays in single or redundant rings rather than strictly limited to simplistic point-to-point configurations between two devices
- Connect to standard DS0 channel banks through standard RS422, G.703 or IEEE C37.94 interfaces or via direct fiber optic connections
- No external or handheld tester required to provide channel diagnostic information

Multi-Language

The D60 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 D60 relay. The EnerVista™ suite provides all the tools to monitor the status of the protected asset, maintain the relay, and integrate information measured by the D60 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 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
- FAQ’s
- 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

Power System Troubleshooting

The D60 contains many tools and reports that simplify and reduce the amount of time required for troubleshooting power system events.

Analyse transmission line faults using system voltage, current and appropriate pickup flags that are measured & recorded up to 64 samples/cycle.

Record the operation of the internal D60 elements and external connected devices with 1ms time-stamped accuracy to identify the Sequence of Operation of station devices during faults and disturbances.
• Annunciator Alarm Screens
• Trending Reports
• Automatic Event Retrieval
• Automatic Waveform Retrieval

Viewpoint Engineer

Viewpoint Engineer is a set of powerful tools that will allow the configuration and testing of 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 Multilin devices into new or existing automation systems. Included in EnerVista™ Integrator is:

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

User Interface

The D60 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: D60-HST7-HLU-H8U-HMK-PEC-UE6-UAS. 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

| Base Unit | D60 | H | F | M | P | U | W | ** | H | F | M | P | U | W | ** |
|-----------|-----|---|---|---|---|---|---|----|---|---|---|---|---|---|---|----|
| CPU       | E   | G | J | K | N | S |   |    | E | G | J | K | N | S |   |    |
| Software Options | 00 | 02 | 03 | 05 | 06 | 07 | 08 |    | 09 | A | B | C | H | J | M |  |
| Mount     | A   | B | C | H | J | M |  |    |   | A | B | C | H | J | M |  |  |
| User Interface | K | L | M | N | O | Q | T | U |   | V | W | X | Y | Z |   |   |  |
| Power Supply | H | I | J | K | L | M | N |   |    | H | I | J | K | L | M | N |   |
| CT/VT/DSP | BM | BL | BM |   |    |    |   |    |    | BM | BL | BM |   |    |    |    |    |
| IEC 61850 Process Bus | 8 | 8 |   | 8 | 8 |   | 8 |    |    | 8 | 8 |   | 8 | 8 |   | 8 | 8 |
| Digital I/O | 0A | 0B | 0C | 0D | 0E | 0F | 0G | 0H |    | 0I | 0J | 0K | 0L | 0M | 0N | 0O | 0P |
| Transducer I/O | 0Q | 0R | 0S | 0T | 0U | 0V | 0W | 0X | 0Y | 0Z |    |    |    |    |    |    |    |    |

### For Full Sized Horizontal Mount

- Breaker: & Haf
- IEC 61850
- Breaker and Haf + IEC 61850
- Phasor Measurement Unit (PMU)
- Breaker and Haf + Phasor Measurement Unit (PMU)
- Horizontal (19") rack - Standard
- Horizontal (19") rack - Harsh Chemical Environment Option
- Vertical (3/4 size) - Standard
- Vertical (3/4 size) - Harsh Chemical Environment Option
- Enhanced English Front Panel
- Enhanced English Front Panel with User-Programmable Pushbuttons
- Enhanced French Front Panel
- Enhanced Russian Front Panel
- Enhanced Chinese Front Panel
- Enhanced Chinese Front Panel with User-Programmable Pushbuttons

### Ordering Notes:
1. For vertical mounting order codes, please visit our online store
2. To view the latest options available for the D60, or to order the UR Classic Front Panel, please visit our online store for more details.

### Accessories for the D60
- UR Applications | Learning CD
- Multilink Ethernet Switch
- Viewpoint Engineer
- Viewpoint Maintenance
- Viewpoint Monitoring IEC 61850

### Visit www.GEMultilin.com/D60 to:
- View Guideform specifications
- Download the instruction manual
- Review applications Notes and support documents
- Buy a D60 online
- View the UR Family brochure