

Multilin™ L30

LINE CURRENT DIFFERENTIAL SYSTEM

Cost-Effective Current Differential System for Lines and Cables



KEY BENEFITS

- Proven current differential protection ensures secure high-speed tripping
- Increased sensitivity through dynamic charging current compensation and communication channel asymmetry compensation
- Adaptive restraint characteristic provides excellent security against measurement errors including CT saturation
- In-zone power transformer functionality enables savings on CTs and protection device requirements
- Phasor Measurement Unit (synchrophasor) according to IEEE® C37.118 (2011) and IEC® 61850-90-5 support
- Three independent fiber or copper Ethernet ports for simultaneous/dedicated network connections with advanced 1 microsecond time synchronization via LAN with IEEE 1588 support
- Complete IEC 61850 Process Bus solution provides resource optimization and minimizes total P&C life cycle costs
- Increase network availability by reducing failover time to zero through IEC 62439-3 “PRP” support
- CyberSentry™ provides high-end cyber security aligned to industry standards and services (NERC® CIP, AAA, Radius, RBAC, Syslog)
- Advanced fault and disturbance recording, including internal relay operating signals, eliminating the need for external recording devices

APPLICATIONS

- Overhead lines and underground cables of different voltage levels
- Circuits with tapped transformer feeders
- Suitable for three-terminal line configurations, with channel redundancy and direct transfer tripping (DTT)
- Wide area system monitoring and control and using integrated protection and synchrophasor measurement
- Applications requiring three-pole autoreclosing and independent synchrocheck supervision

FEATURES

Protection and Control

- Line current differential with adaptive restraint and in-zone transformer
- Stub bus protection
- Breaker failure and three-pole autoreclose
- Underfrequency protection
- Phase, ground, neutral and negative sequence time and instantaneous overcurrent
- Phase and negative sequence directional overcurrent, neutral directional with dual polarity criteria, broken conductor and thermal overload
- Phase over/under voltage, negative sequence overvoltage and four independent synchronism check elements

Communications

- Networking interfaces: up to three Ethernet ports 100Mb fiber or copper, RS485, RS232, RS422, G.703, C37.94
- Multiple protocols: IEC 61850, DNP 3.0 and Modbus® serial/TCP, IEEE 1588, IEC 60870-5-104 and 103, PRP, SNTP, HTTP, TFTP
- Direct I/O: secure, high-speed exchange of data between L30s for DTT applications
- Embedded managed Ethernet switch with four 100 Mbit fiber optic ports and 2 copper ports

IEC 61850 Process Bus Interface

- Robust communications with up to 8 HardFiber Bricks
- Redundant architecture for dependability and security

Monitoring and Metering

- Real-time monitoring of remote, local and differential per-phase currents
- Advanced recording capabilities deliver a 1024 event recorder, configurable and extended waveform capture and data logger
- P & M class synchrophasors of voltage, current and sequence components: reporting rate 1 to 120 frames/sec

EnerVista™ Software

- Graphical Logic Designer and Logic Monitor to simplify designing and testing procedures via EnerVista UR Engineer
- Service and update notification toolset ensures device documents and software are up-to-date via EnerVista Launchpad



Protection and Control

The L30 is a cost-effective line current differential protection relay intended for sub-transmission and medium voltage lines and cables, providing reliable and secure operation even under the worst-case power system conditions. The L30 provides secure high-speed fault detection and clearance suitable for three-pole tripping applications. Part of the Universal Relay (UR) family, the L30 comes with a variety of versatile features truly integrating protection, monitoring, metering, communication and control in one easy-to-use device. The UR family offers a high degree of modularity in its design and functionality, providing superior performance in protection and control, while meeting the toughest requirements of the marketplace.

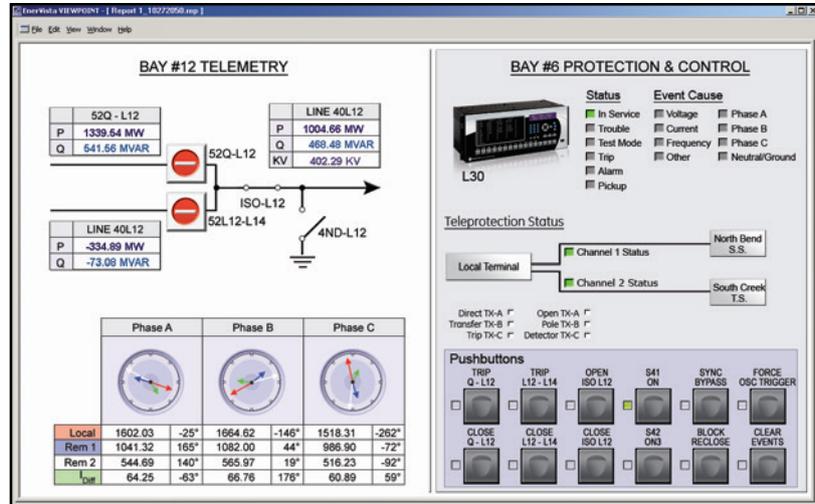
Current Differential Protection

The L30 current differential protection relay uses superior and patented algorithms to address the challenges of bandwidth, security, dependability and sensitivity in current differential relaying.

Bandwidth requirements are effectively addressed by means of a patented new data consolidation technique called "phaselets". This permits application within a communications bandwidth of 64 Kbps, and can detect faults within a half cycle plus channel delay.

The L30 innovative dual slope adaptive restraint characteristic, based on estimates

L30 - Protection, Metering, Monitoring and Control



The L30 is the single point for protection, control, metering, and monitoring in one integrated device that can easily be connected directly into DCS or SCADA monitoring and control systems like Viewpoint Monitoring as shown.

of measurement errors, allows the relay to be secure on severe external faults while maintaining sensitivity for internal faults. The estimate of errors in the input currents permits more sensitive settings than those used in the traditional percent differential schemes. The line differential element also has 2nd harmonic inrush-current inhibit for in-zone power transformer protection. This functionality enables the L30 to protect 2 or 3-terminal lines that have a power transformer in between ends.

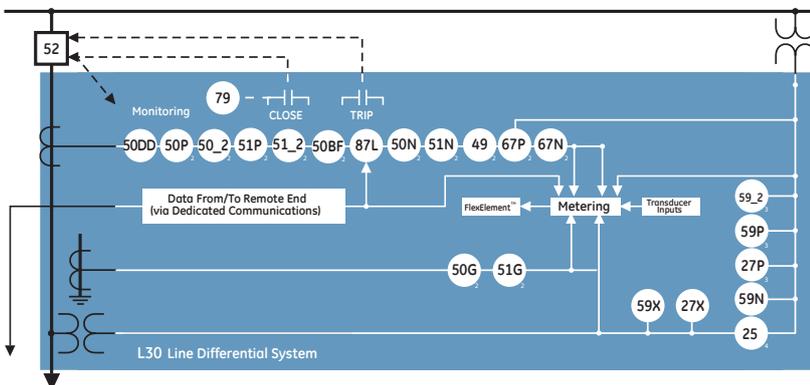
The L30 approach to clock synchronization relies upon precise distributed

synchronization. Clocks are phase synchronized to each other and frequency synchronized to the power system frequency. Each relay compares its clock to the phase of the other clocks and makes appropriate adjustments. This allows for greater transient ride-through for power system and communications disturbances. Enhanced additional security is provided by a sensitive current disturbance detector, which can be used to supervise the current differential element.

Charging Current Compensation

For long lines and especially for underground cables, the charging current

Functional Block Diagram



ANSI Device Numbers & Functions

Device Number	Function
25	Synchronism Check
27P	Phase Undervoltage
27X	Auxiliary Undervoltage
49	Thermal Overload
50BF	Breaker Failure
50DD	Current Disturbance Detector
50G	Ground Instantaneous Overcurrent
59_2	Negative Sequence Overvoltage
50P	Phase Instantaneous Overcurrent
50_2	Negative Sequence Instantaneous Overcurrent
51G	Ground Time Overcurrent
51N	Neutral Time Overcurrent
51P	Phase Time Overcurrent
51_2	Negative Sequence Time Overcurrent
52	AC Circuit Breaker
59_2	Negative Sequence Overvoltage
59P	Phase Overvoltage
59X	Auxiliary Overvoltage
67N	Neutral Directional
67P	Phase Directional
79	Automatic Recloser
81U	Underfrequency
87L	Segregated Line Current Differential
87LG	Line Ground Current Differential

may be large and result in excessively high pickup settings. The L30 can dynamically compensate the charging current, thus increasing its sensitivity to the fault current on long transmission lines.

Enhanced Monitoring Features

The L30 uses advanced error detection and supervising functions to secure the L30 against maloperation due to erroneous data. High bit error rates are addressed by means of computing a 32-bit CRC checksum, effectively addressing the concerns of multiple bit errors due to high channel noise. On multiplexed channels, channel asymmetry may be expected due to path switching causing spurious differential currents, which can endanger the security of the differential system. By using GPS time synchronization, up to 10ms of channel asymmetry can be compensated. Extra security has been implemented in the L30 to ensure proper operation in the event of IRIG-B signal failure.

Integrated channel monitoring provides real-time diagnostic data on the health of the L30. Communications channel deterioration or failure will activate an alarm, and can be used to enable backup protection. Channel propagation delay is monitored and adjusted according to variations in communication paths.

Communication Topologies

Relays can communicate through direct fiber, RS422, G.703, and IEEE C37.94 interfaces at 64Kbps, with extensive channel monitoring and diagnostics. In a current differential scheme, the L30s exchange data via the communication link, acting either as master collecting data, making calculations and making all relevant trip and restraint decisions, or as slave only, transmitting current data to the one acting as master. For two-terminal applications, use the redundant communications capability of the L30 for optimal reliability of the current differential line protection. For this scheme, data is continuously transmitted over both channels, so if a failure occurs, the L30 will continue to provide current differential protection.

For three-terminal applications, advanced inter-relay communication features

eliminate the need for redundant communication channels due to the ability of the L30 to automatically switch between master and slave mode, maintaining a dependable system even with a failure of one of the communication channels.

Overvoltage and Undervoltage Protection

Long lines under lightly loaded or no-load conditions may experience voltages exceeding rated per unit voltage level of the line. Use the three phase overvoltage elements of the L30 to initiate a local trip as well as a remote trip using DTT.

Overcurrent Functions

The L30 provides thermal overload, and time and instantaneous overcurrent elements for phase, neutral, ground, negative sequence, phase and neutral directional. The neutral directional overcurrent element supports enhanced dual polarization modes which can be configured to prioritize on voltage or current polarization. Any of them can run in parallel with primary differential protection or can be programmed to run when the differential element is not available.

Direct Transfer Trip (DTT)

Use the DTT feature of L30 to trip remote breakers. Both single and three-pole DTTs are supported. Up to eight signals can be sent over pilot communications channels, selectable through user-configurable logic.

Autoreclosing

The L30 provides multi-shot autoreclosing for three-pole applications with independently programmable dead time for each shot. Autoreclose can be dynamically blocked by user-programmable logic.

Synchronism Check

The L30 provides four synchrocheck elements that monitor voltage difference, phase angle difference and slip frequency to ensure proper breaker closure as per user requirements. The L30 provides additional enhancements in synchronizing, by checking dead source conditions for synchronism bypass under these conditions.

Breaker Failure

The L30 provides two fully independent breaker failure protection elements.

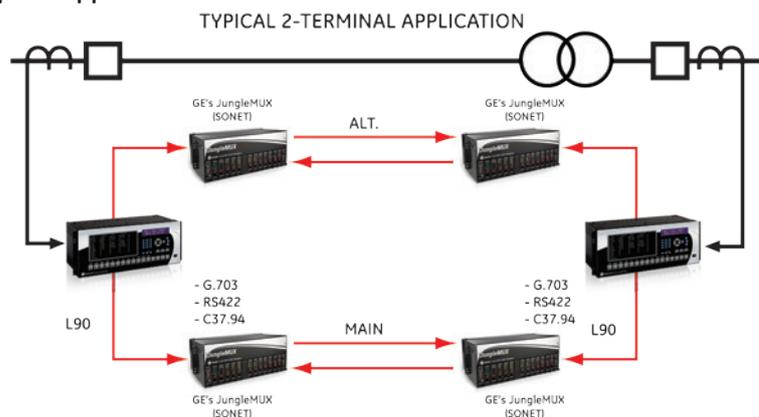
IEC 61850 Process Bus

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 existing UR applications, including protection functions, FlexLogic™, metering and communications.

The GE Multilin HardFiber System offers the following benefits:

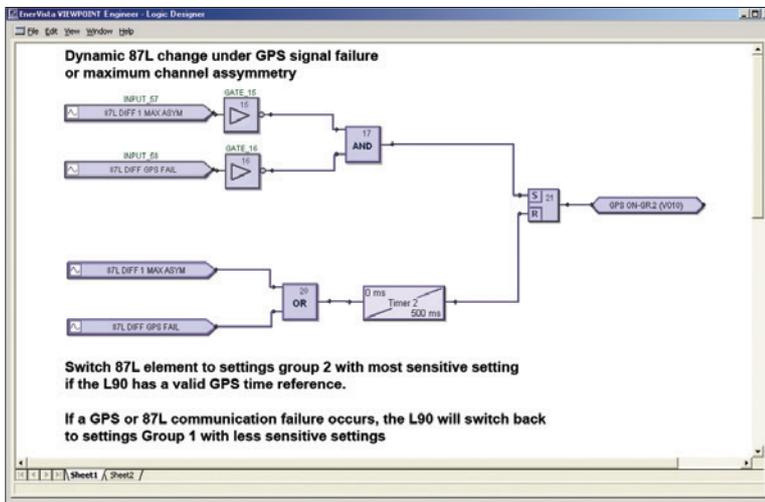
- Communicates using open standard

Typical Applications



Typical two-terminal application of L30. L30 supports a variety of media cards for signaling between L30's including direct multimode or singlemode fiber, RS422, G.703 and IEEE C37.94.

FlexLogic Designer



FlexLogic allows for the customization of the L30 to operate and control the breakers and other auxiliary devices needed to fit most line protection schemes and applications.

IEC 61850 messaging

- Drastically reduces P&C design, installation and testing labor by eliminating individual copper terminations
- Integrates with existing L30's by replacing traditional CT/VT inputs with the 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 L30 incorporates advanced automation features including powerful FlexLogic programmable logic, communication, and SCADA capabilities that far surpass what is found in the average line relay. The L30 integrates seamlessly with other UR relays for complete system protection.

FlexLogic

FlexLogic is the powerful UR-platform programming logic engine that provides the ability to create customized protection and control schemes, minimizing the need and associated costs of, auxiliary components and wiring. Using FlexLogic, the L30 can be programmed to provide the required tripping logic along with custom scheme logic for line breaker control and interlocking

and dynamic setting group changes.

Scalable Hardware

The L30 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
- Mechanically latching outputs can be used to develop secure interlocking applications and replace electromechanical lockout relays

Monitoring and Metering

The L30 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 L30 can significantly reduce the time needed for postmortem analysis of power system events and the creation of regulatory reports. Recording functions include:

- Sequence of Event (SOE)
 - 1024 time stamped events
- Oscillography
 - 64 digital & up to 40 analog channels
 - Events with up to 45s length
- Data Logger and 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 L30 can eliminate the need for installing costly stand-alone recording equipment.

Advanced Device Health Diagnostics

The L30 performs comprehensive device health diagnostic tests at startup and continuously during run-time 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 help improve system uptime.

- Comprehensive device health diagnostic performed at startup
- Monitors the CT/VT input circuitry to validate the integrity of all signals

Cyber Security – CyberSentry UR

CyberSentry UR enabled UR devices deliver full cyber security features that help customers to comply with NERC CIP and NIST® IR 7628 cyber security requirements. This software option delivers the following core features:

AAA Server Support (Radius/LDAP)

Enables integration with centrally managed authentication and accounting of all user activities and uses modern industry best practices and standards that meet and exceed NERC CIP requirements for authentication and password management.

Role Based Access Control (RBAC)

Efficiently administrate users and roles within UR devices. The new and advanced access functions allow users to configure up to five roles for up to eight configurable users with independent passwords. The standard "Remote Authentication Dial In User Service" (Radius) is used for authentication.

Event Recorder (Syslog for SEM)

Capture all cyber security related events within a SOE element (login, logout, invalid password attempts, remote/local access, user in session, settings change, FW update, etc), and then serve and classify data by security level using standard Syslog data format. This will enable integration with established SEM (Security Event Management) systems.

Communications

The L30 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 three independent Ethernet ports, redundant Ethernet option and the embedded managed Ethernet switch provide the means to create fault tolerant communication architectures in an easy, cost-effective manner. The L30 supports the most popular industry standard protocols enabling easy, direct integration into monitoring and SCADA systems.

- IEC 61850 with 61850-90-5 support
- DNP 3.0
- IEC 60870-5-103 and IEC 60870-5-104
- IEEE 1588 for time synchronization
- Modbus RTU, Modbus TCP/IP
- PRP as per IEC 62439-3

Interoperability with Embedded IEC 61850

The L30 with integrated IEC 61850 can be used to lower costs associated with line protection, control and automation. GE Digital Energy's leadership in IEC 61850 comes from thousands of installed devices and follows on extensive development experience with UCA 2.0.

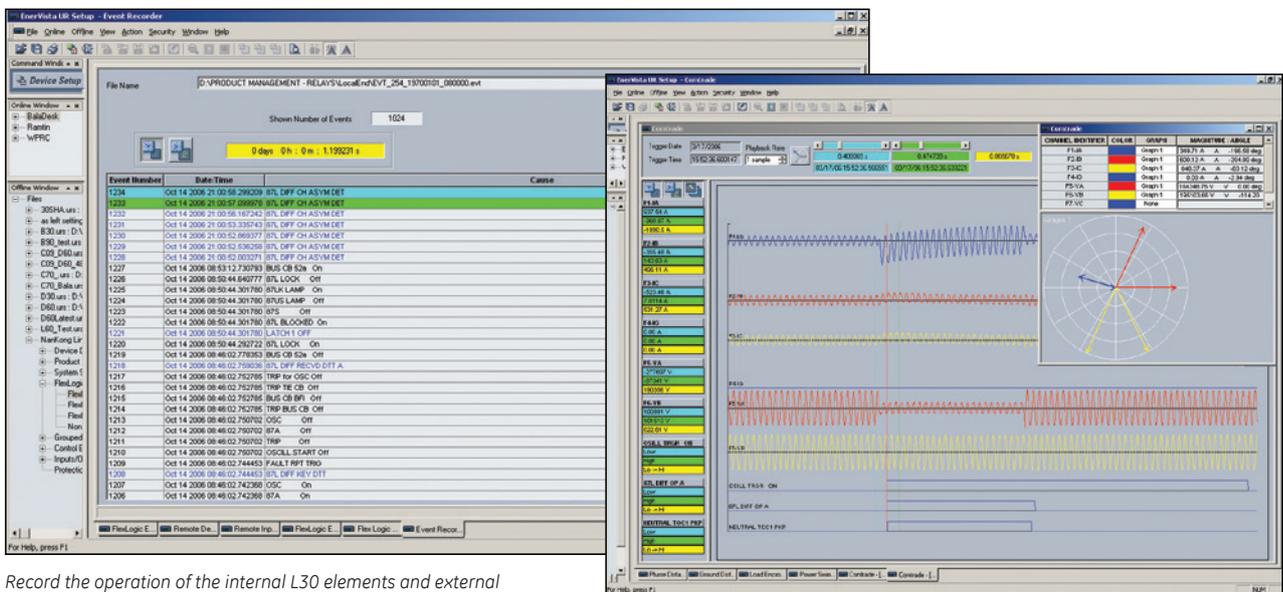
- Replace expensive copper wiring between devices with direct transfer of data using GOOSE messaging
- Configure GE systems based on IEC 61850 and also monitor and troubleshoot them in real-time with EnerVista Viewpoint Engineer
- Multicast IEEE C37.118 synchrophasor data between PMU and PDC devices using IEC 61850-90-5

LAN Redundancy

Substation LAN redundancy has been traditionally accomplished by reconfiguring the active network topology in case of failure. Regardless of the type of LAN architecture (tree, mesh, etc), reconfiguring the active LAN requires time to switchover, during which the LAN is unavailable. UR devices deliver redundancy as specified by PRP-IEC 62439-3, which eliminates the dependency on LAN reconfiguration and the associated switchover time. The UR becomes a dual attached node that transmits data packets over both main and redundant networks simultaneously, so in case of failure, one of the data packets will reach the receiving device with no time delay.

Power System Troubleshooting

The L30 contains many tools and reports that simplify and reduce the amount of time required for troubleshooting power system events.



Record the operation of the internal L30 elements and external connected devices with 1ms time-stamped accuracy to identify the Sequence of Operation of station devices during line faults and disturbances.

Analyze line faults using both analog and digital power system quantities that are measured and recorded up to a rate of 64 samples per cycle.

Multi-Language

UR devices support multiple languages: English, French, Russian, Chinese, Turkish and German. These language options are available on the front panel, in the EnerVista setup software, and in the product manuals. 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 L30 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 L30 into DCS or SCADA monitoring systems. Convenient COMTRADE and SOE viewers are an integral part of the UR setup software included with every UR relay, to carry out postmortem event analysis and 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 for the configuration of 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
- Annunciator Alarm Screens
- Trending Reports
- Automatic Event Retrieval
- Automatic Waveform Retrieval

Viewpoint UR Engineer

Viewpoint UR Engineer is a set of powerful tools that allows the configuration and testing of GE relays at a system level in an easy-to-use graphical drag-and-drop environment. Viewpoint UR 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

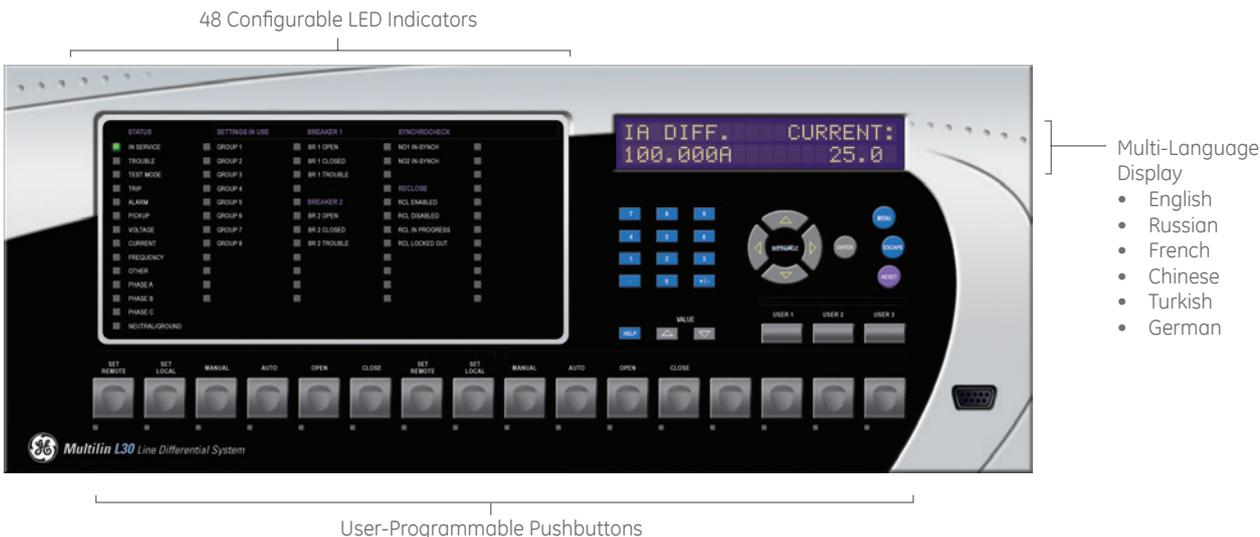
EnerVista Integrator

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

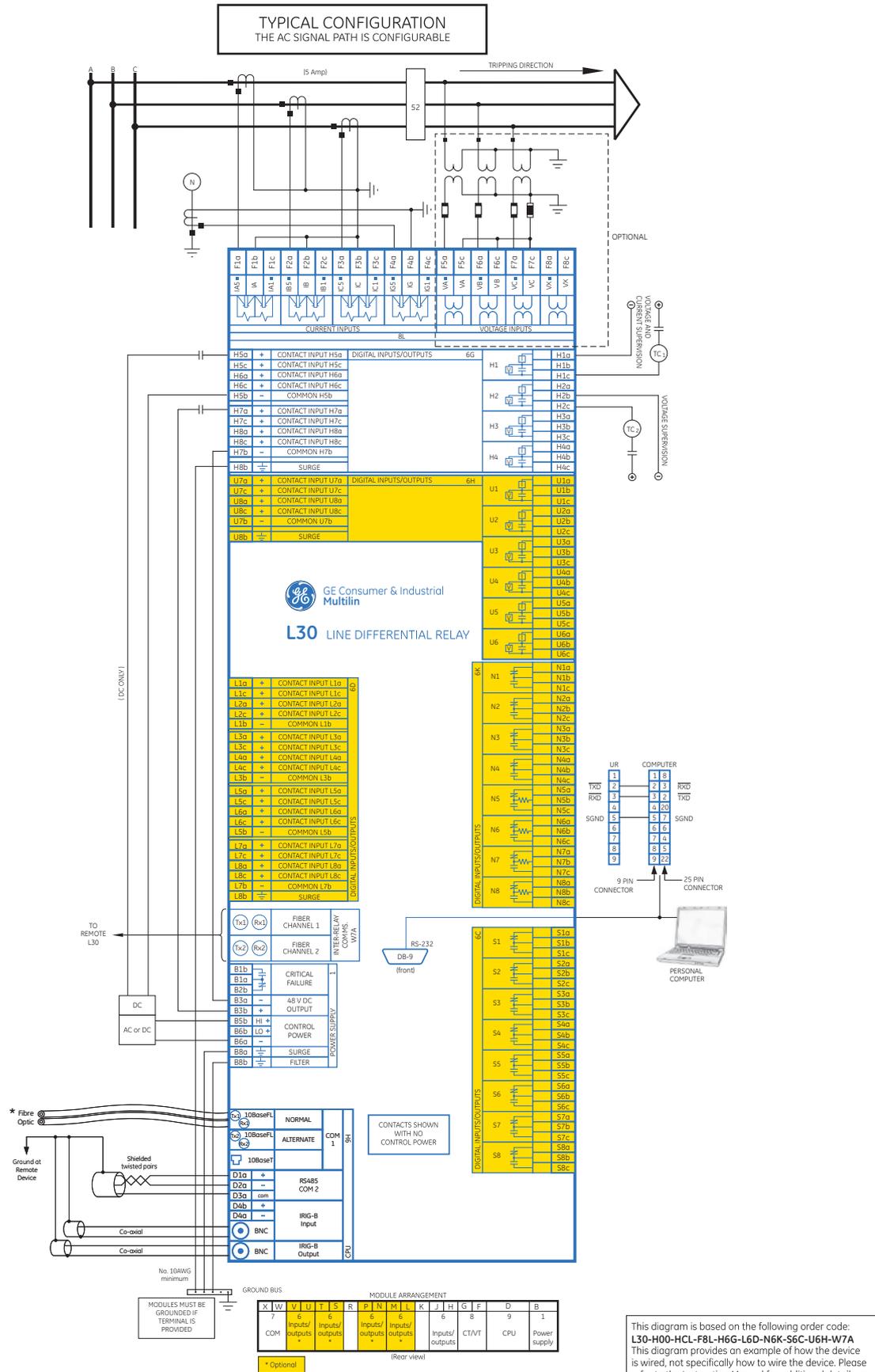
- OPC/DDE Server
- GE Multilin Drivers
- Automatic Event Retrieval
- Automatic Waveform Retrieval

User Interface

The L30 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:
L30-H00-HCL-F8L-H6G-L6D-N6K-S6C-U6H-W7A
 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.

