Multilin™
L90
LINE CURRENT DIFFERENTIAL SYSTEM

Line Protection System with Segregated Line Current Differential and Complete Distance Protection

KEY BENEFITS

- Phase segregated differential protection ensures secure high-speed single-pole tripping
- High-speed cost-effective five zones quad or mho, phase and ground distance protection with multiple standard and customizable pilot schemes support
- Reliable and secure protection on lines equipped with series compensation
- In-zone power transformer enables savings on CTs and protection device requirements
- Increased sensitivity through dynamic charging current compensation and communication channel asymmetry compensation

- 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 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 including series compensated 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, using integrated protection and synchrophasor measurement
- Single and dual-breaker circuits requiring single/three-pole autoreclosing and independent synchrocheck supervision
- Secure application with Capacitively-Coupled Voltage Transformers (CCVTs)

FEATURES

Protection and Control

- Phase segregated line current differential with adaptive restraint, ground differential, in-zone transformer and stub bus protection
- 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
- Line pickup, reverse power, out-of-step tripping and power swing blocking
- 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

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 L90s for DTT applications

IEC 61850 Process Bus Interface

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

Monitoring and Metering

- Multi-ended fault location consistently providing 2% accuracy
- 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 that ensures device documents and software are up-to-date via EnerVista Launchpad
- EnerVista Integrator providing easy integration of data in the L90 into new or existing monitoring and control systems

imagination at work

Protection and Control

The L90 is a high-end cost-effective line current differential protection relay intended for transmission lines and cables of different voltages levels, providing reliable and secure operation even under the worst case power system conditions. The L90 provides high-speed phase-segregated fault clearance, suitable for single and three-pole tripping applications. Part of the Universal Relay (UR) family, the L90 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.

Segregated Current Differential Protection

The L90 is a phase-segregated current differential protection relay, which 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,

L90 - Protection, Metering, Monitoring and Control
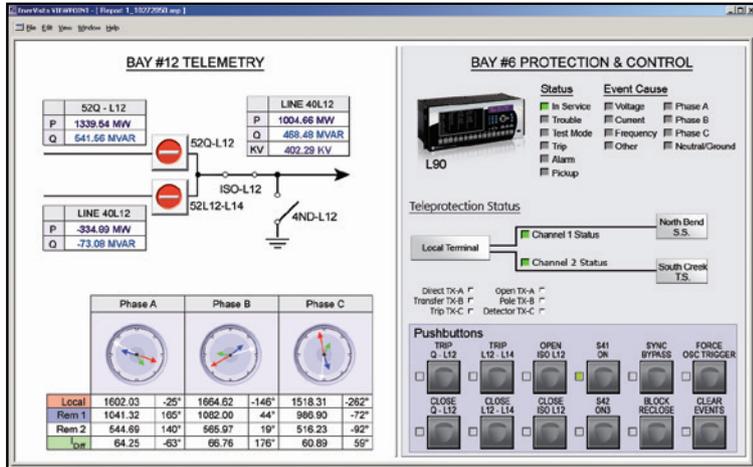
The L90 is the single point for protection, control, metering, and monitoring in one integrated device that can easily be connected directly into DCS or SCADA monitoring and control systems like Viewpoint Monitoring as shown.

and can detect faults within a half-cycle plus channel delay.

The L90 innovative dual-slope-adaptive-restraint characteristic, based on estimates 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 L90 approach to clock synchronization relies upon precise and 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,

Functional Block Diagram
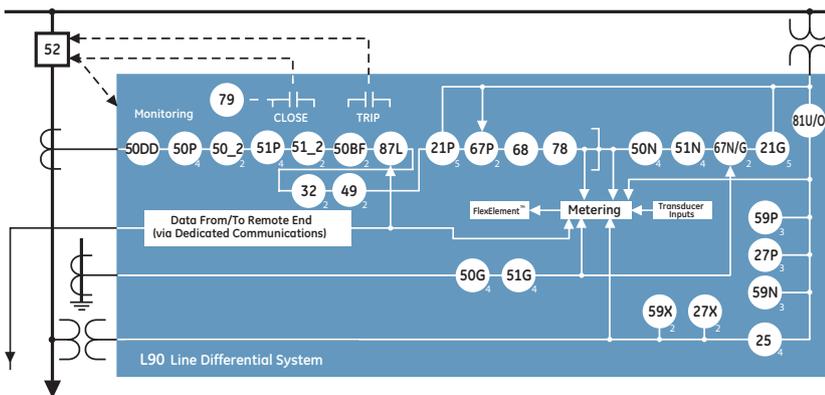
ANSI Device Numbers & Functions

Device Number	Function
21G	Ground Distance
21P	Phase Distance
25	Synchronism Check
27P	Phase Undervoltage
27X	Auxiliary Undervoltage
32	Sensitive Reverse Power
49	Thermal Overload
50BF	Breaker Failure
50DD	Current Disturbance Detector
50G	Ground Instantaneous Overcurrent
50N	Neutral Instantaneous Overcurrent
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
59N	Neutral Overvoltage
59P	Phase Overvoltage
59X	Auxiliary Overvoltage
67_2	Negative Sequence Directional Overcurrent
67N	Neutral Directional Overcurrent
67P	Phase Directional Overcurrent
68	Power Swing Blocking
78	Out-of-Step Tripping
79	Automatic Recloser
81U/O	Under/Over Frequency, df/dt
87L	Segregated Line Current Differential
81ROCOF	Rate of Change of Frequency
87LG	Ground Line Current Differential

which can be used to supervise the current differential element.

Ground Differential "87G"

The ground differential function "87G" protects against low-current single line-to-ground faults. It has a single slope characteristic and uses the vectorial sum of all in-zone phase currents to calculate the neutral differential current, with the maximum value of phase current being used as restraint. This function, together with the phase differential, delivers enhanced sensibility and selectivity to the protection scheme.

Charging Current Compensation

For long transmission lines and underground cables, the charging current may be large and result in excessively high pickup settings. The L90 can dynamically compensate the charging current, thus increasing its sensitivity to the fault current on long transmission lines.

Enhanced Monitoring Features

The L90 uses advanced error detection and supervising functions to secure itself against misoperation due to erroneous data. High bit errors 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 L90 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 L90. 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 64/128Kbps, with extensive channel monitoring and diagnostics. In a current differential scheme, the L90s 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 L90 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 L90 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 L90 to automatically switch between master and slave mode, maintaining a dependable system even with a failure of one of the communication channels.

Distance Protection

The L90 shares the core of the D60 relay, which is the distance function, and provides a high degree of sensitivity and selectivity for all types of faults.

The distance function in the L90 comes with five zones of phase distance and ground distance, providing the user maximum flexibility to cater to different applications, which include primary line protection and backup protection for busbars, generators, transformers and reactors. The L90 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 different power system conditions. The advanced comparator-based distance elements provide the utmost security, sensitivity and selectivity for different types of faults. Superior digital filtering techniques provide secure and optimum reach accuracy even under worst-case CCVT transients. Secure directional discrimination is achieved by using positive sequence memory voltage polarization, providing reliable directionality for worst-case close-in faults. Dual distance algorithms deliver exceptional security and speed performance to ensure average operating times of 1.5 cycles for 75% line reach and SIR 30, and <2.5 cycles for 90% line reach and SIR 60.

Typical Applications
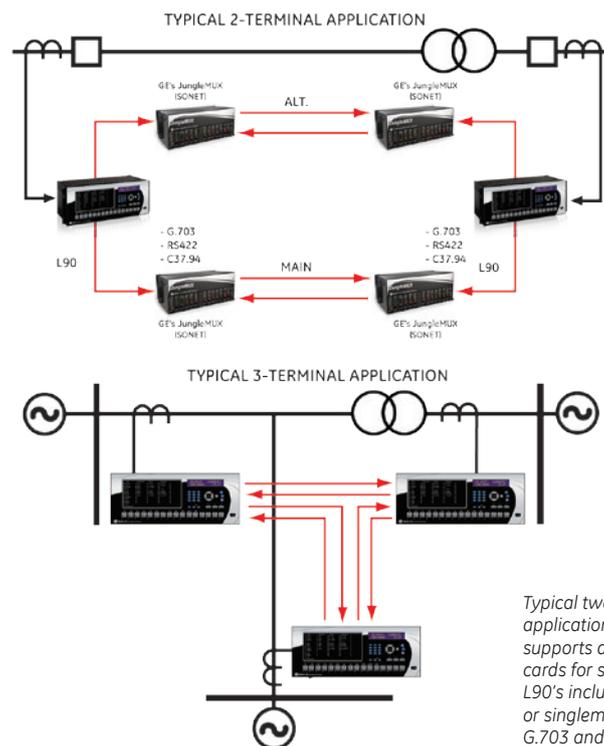
Typical two and three-terminal applications of L90. L90 supports a variety of media cards for signaling between L90's including direct multimode or singlemode fiber, RS422, G.703 and IEEE C37.94.

The L90 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.

In-Zone Transformer Compensation

Phase distance protection in the L90 can be used to detect faults through different types of three-phase wye/delta transformers, allowing application of the L90 for backup protection on generators. VTs and CTs can be installed independently of each other on either side of the power transformer. The relay automatically compensates for transformer connections, to guarantee accurate reach for any type of fault.

Load Encroachment

The load encroachment feature offers discrimination between line loading conditions and fault conditions, especially for long lines under heavy loads by supervising the distance elements or any overcurrent element. This prevents unwanted tripping under heavy line load conditions and enables optimum operation of the line while meeting regulatory requirements for line loading.

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 L90 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 characteristic. Negative sequence current supervisors provide extended selectivity for detecting evolving faults that may appear as a power swing event (faults with slow moving impedance locus).

Series Compensated Lines

The L90 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 L90 relay uses a state-of-the-art dual phase selection algorithm that provides fast and accurate fault type identification even under weak infeed conditions.

Direct Transfer Trip (DTT)

Use the DTT feature of L90 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.

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 L90 to initiate a local trip as well as a remote trip using DTT.

Overcurrent Functions

The L90 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.

Communication Aided (Pilot) Schemes

L90 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 L90:

- Direct Underreach Transfer Trip (DUTT)
- Permissive Underreach Transfer Trip for Distance and Current (PUTT)
- Two Permissive Overreach Transfer Trip (POTT)
- Hybrid Permissive Overreach Transfer Trip (HYB POTT), permissive echo and transient blocking logic incorporated
- Directional Comparison Blocking Scheme (DCB)
- Directional Comparison Unblocking Scheme (DCUB)
- Customizable version of the POTT and DCB schemes (POTT1 and DCB1)

Autoreclosing

The L90 provides multi-shot autoreclosing (up to 4 shots) for single or three-pole autoreclose on all types of faults with independent settings for each shot. Any of the autoreclose elements can be dynamically blocked or unblocked by other elements or user logic. This way they can be coordinated with the L90 protection setting groups. Four different autoreclose operation modes are available, enabling users to select the autoreclosing mode to suit specific applications.

Synchronism Check

The L90 provides four synchrocheck elements that monitor voltage difference, phase angle difference and slip frequency, to ensure proper breaker closure as per user requirements. Any of the four synchrocheck elements can be dynamically blocked or unblocked by other elements or user logic. The L90 also provides additional enhancements in synchronizing by allowing synchrocheck verification between local and remote line terminal voltages.

Breaker Failure

The L90 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 L90 provides the required elements to perform two independent breaker failure functions.

Multiple Breaker Configurations

The L90 supports multi-breaker busbar configurations, such as breaker-and-a-half

or ring bus arrangements, providing dual breaker autoreclose dual synchrocheck elements, and dual independent breaker failure elements. The design provides secure operation during external faults with possible CT saturation.

Special Applications - Distributed Busbar

Use the L90's capability of supporting up to 4 directly connected CTs for applications where the use of conventional bus differential relaying is not practical or economically feasible. The L90 can be used to protect both line and buses by measuring currents from the feeder CTs as shown. The L90 provides primary protection for both the buses and the circuit connecting them.

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

HardFiber System 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 L90's by replacing traditional CT/VT inputs with the IEC 61850 Process Bus module

- Does not introduce new cyber security concerns

Advanced Automation

The L90 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 L90 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 L90 can provide required tripping and custom scheme logic for line breaker control and interlocking and dynamic setting group changes.

Scalable Hardware

The L90 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 L90 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 L90 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
  - 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
- Multi-Ended Fault Location
  - Calculation of fault location on two or three-terminal lines with 2% accuracy

The very high sampling rate and large amount of storage space available for data recording in the L90 can eliminate the need for installing costly stand-alone recording equipment.

Advanced Device Health Diagnostics

The L90 performs comprehensive device health diagnostic tests at startup and
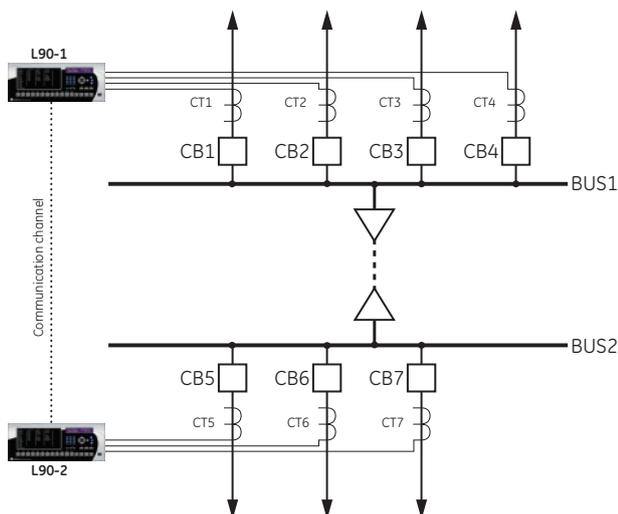
Example of Distributed Bus Differential Protection Application.
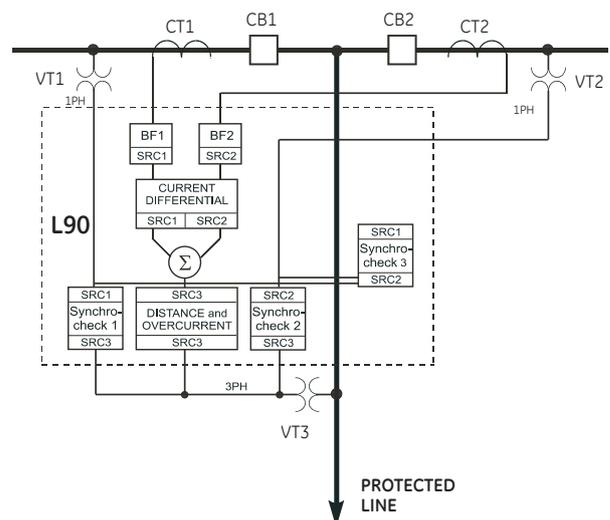
L90 Breaker-and-a-Half Application Example.

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 the 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 L90 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 to create fault tolerant communication architectures in an easy, cost-effective manner.

The L90 supports the most popular industry standard protocols enabling easy, direct integration into monitoring and SCADA systems.

- IEC 61850
- 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 L90 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.

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 L90 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 L90 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 Multilin products. The setup software within Launchpad allows for the configuration of devices in real-time by communicating via 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 & Brochures
- Application Notes
- Guideform Specifications
- 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 will allow 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 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 L90 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

TYPICAL CONFIGURATION
THE AC SIGNAL PATH IS CONFIGURABLE
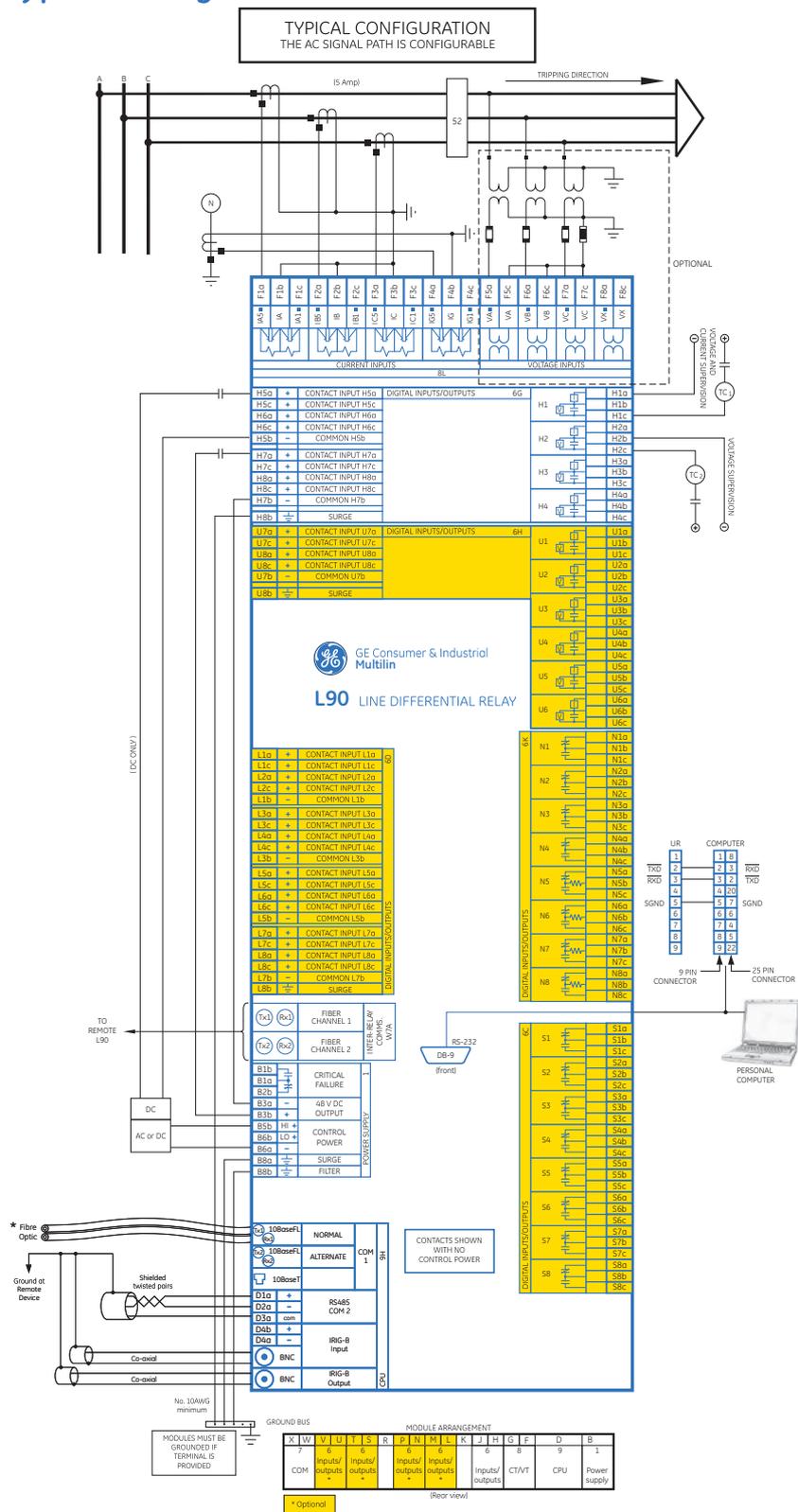
This diagram is based on the following order code:
L90-H00-HCL-F8F-H6G-L6D-N6K-S6C-U6H-W7A
This diagram provides an example of how the device is wired, not specifically how to wire the device. Please refer to the Instruction Manual for additional details on wiring based on various configurations.

Ordering

Transmission Line Protection

		L90 -	* 00 -	H *	* - F **-	H ** -	L **-N ** -	S **-	U**-W/X	**	**For Horizontal Mount**
Base Unit	L90										Base Unit
CPU		E									RS485 + RS485 (IEC 61850 option not available)
		J									RS485 + multimode ST 100BaseFX
		K									RS485 + multimode ST Redundant 100BaseFX
		N									RS485 + 10/100 BaseT
		T									RS485 + three multimode SFP LC 100BaseFX. Requires FW v7xx or higher
		U									RS485 + two multimode SFP LC 100BaseFX + one SFP RJ45 100BaseT. Requires FW v7xx or higher
		V									RS485 + three SFP RJ45 100BaseT. Requires FW v7xx or higher
Software Options (see note 2)		00									No Software Options
		02									Breaker and Half software
		03									IEC 61850
		05									Breaker and Half + IEC 61850
		06									Phasor Measurement Unit (PMU)
		07									IEC 61850 + Phasor Measurement Unit (PMU)
		08									Breaker & Half + Phasor Measurement Unit (PMU)
		09									Breaker & Half + IEC 61850 + Phasor Measurement Unit (PMU)
		24									In-zone TX protection
		25									In-zone TX protection + IEC 61850
		26									In-zone TX protection + PMU
		27									In-zone TX protection + IEC 61850 + PMU
		A0									CyberSentry UR Lvl 1. Requires UR FW 7.xx or higher
		B0									IEEE 1588. Requires UR FW 7.xx or higher
		C0									PRP
		D0									IEEE 1588 + CyberSentry UR Lvl 1. Requires UR FW 7.xx or higher
Mount / Coating			H								Horizontal (19" rack) - Standard
			A								Horizontal (19" rack) - Harsh Chemical Environment Option
			V								Vertical (3/4 size) - Standard
			B								Vertical (3/4 size) - Harsh Chemical Environment Option
User Interface				F							Vertical Front Panel with English Display
				I							Enhanced German Front Panel
				J							Enhanced German Front Panel with User-Programmable Pushbuttons
				K							Enhanced English Front Panel
				L							Enhanced English Front Panel with User-Programmable Pushbuttons
				M							Enhanced French Front Panel
				N							Enhanced French Front Panel with User-Programmable Pushbuttons
				Q							Enhanced Russian Front Panel
				T							Enhanced Russian Front Panel with User-Programmable Pushbuttons
				U							Enhanced Chinese Front Panel
				V							Enhanced Chinese Front Panel with User-Programmable Pushbuttons
				W							Enhanced Turkish Front Panel
				Y							Enhanced Turkish Front Panel with User-Programmable Pushbuttons
Power Supply (see note 3)					H						125 / 250 V AC/DC
					H					RH	125/250 V AC/DC with redundant 125/250 V AC/DC
					L						24 - 48 V (DC only)
CT/VT DSP						8L	8L				Standard 4CT/4VT w/ enhanced diagnostics
						8N	8N				Standard 8CT w/ enhanced diagnostics
IEC 61850 Process Bus							81				8 Port IEC 61850 Process Bus Module
Digital I/O						XX	XX	XX	XX	XX	No Module
						4A	4A	4A	4A	4A	4 Solid State (No Monitoring) MOSFET Outputs
						4C	4C	4C	4C	4C	4 Solid State (Current w/opt Voltage) MOSFET Outputs
						4D	4D	4D	4D	4D	16 Digital Inputs with Auto-Burnish
						4L	4L	4L	4L	4L	14 Form-A (No Monitoring) Latchable Outputs
						67	67	67	67	67	8 Form-A (No Monitoring) Outputs
						6C	6C	6C	6C	6C	8 Form-C Outputs
						6D	6D	6D	6D	6D	16 Digital Inputs
						6E	6E	6E	6E	6E	4 Form-C Outputs, 8 Digital Inputs
						6F	6F	6F	6F	6F	8 Fast Form-C Outputs
						6K	6K	6K	6K	6K	4 Form-C & 4 Fast Form-C Outputs
						6L	6L	6L	6L	6L	2 Form-A (Current w/ opt Voltage) & 2 Form-C Outputs, 8 Digital Inputs
						6M	6M	6M	6M	6M	2 Form-A (Current w/ opt Voltage) & 4 Form-C Outputs, 4 Digital Inputs
						6N	6N	6N	6N	6N	4 Form-A (Current w/ opt Voltage) Outputs, 8 Digital Inputs
						6P	6P	6P	6P	6P	6 Form-A (Current w/ opt Voltage) Outputs, 4 Digital Inputs
						6R	6R	6R	6R	6R	2 Form-A (No Monitoring) & 2 Form-C Outputs, 8 Digital Inputs
						6S	6S	6S	6S	6S	2 Form-A (No Monitoring) & 4 Form-C Outputs, 4 Digital Inputs
						6T	6T	6T	6T	6T	4 Form-A (No Monitoring) Outputs, 8 Digital Inputs
						6U	6U	6U	6U	6U	6 Form-A (No Monitoring) Outputs, 4 Digital Inputs
						6V	6V	6V	6V	6V	2 Form-A (Cur w/ opt Volt) 1 Form-C Output, 2 Latching Outputs, 8 Digital Inputs
Transducer I/O						5A	5A	5A	5A	5A	4 dcmA Inputs, 4 dcmA Outputs
						5F	5F	5F	5F	5F	8 dcmA Inputs
Inter-Relay Communications										2B	C37.94SM, 1300nm singlemode, ELED, 2 Channel singlemode
										2I	Channel 1 - IEEE C37.94, 820nm, multimode fiber, 64/128 kbps; Channel 2 - 1300 nm, singlemode, LASER
										2J	Channel 1 - IEEE C37.94, 820nm, multimode fiber, 64/128 kbps; Channel 2 - 1550 nm, singlemode, LASER
										7A	820 nm, multimode, LED, 1 Channel
										7B	1300 nm, multimode, LED, 1 Channel
										7C	1300 nm, singlemode, ELED, 1 Channel
										7H	820 nm, multimode, LED, 2 Channels
										7I	1300 nm, multimode, LED, 2 Channels
										7J	1300 nm, singlemode, ELED, 2 Channels
										7S	G.703, 2 Channels
										7V	RS422, 2 Channels, Dual Clock
										7W	RS422, 2 Channels
										73	1550 nm, singlemode, LASER, 2 Channel
										76	IEEE C37.94, 820 nm, multimode, LED, 1 Channel
										77	IEEE C37.94, 820 nm, multimode, LED, 2 Channel

Ordering Notes:
1. For vertical mounting order codes, please visit our online store
2. To view all the options available for L90, please visit GE's On-Line Store http://store.gedigitalenergy.com/viewprod.asp?model=L90
3. Redundant power supply only available in horizontal unit. If redundant is chosen, must be same type. Maximum 2 per chassis.