

Multilin™ D30

LINE DISTANCE PROTECTION SYSTEM

Cost-Effective, High-Speed Primary and Backup Distance Protection



KEY BENEFITS

- Cost-effective, five zone quad or mho, phase and ground distance protection
- Programmable logic for building customized pilot schemes
- Application flexibility: multiple I/O options, programmable logic (FlexLogic™)
- Simplified teleprotection interfaces with direct I/O communications hardware for transfer trip and custom-built pilot-aided distance schemes
- Three independent fiber or copper Ethernet ports for simultaneous/ dedicated network connections with advanced 1 microsecond time synchronization via LAN with IEEE® 1588 support
- Reduced relay-to-relay wiring and associated installation costs through high-speed inter-relay communications
- Embedded IEC® 61850 protocol
- 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)
- Complete IEC 61850 Process Bus solution provides resource optimization and minimizes total P&C life cycle costs

APPLICATIONS

- Overhead sub-transmission lines and underground cables including series compensated lines
- Circuits requiring three-pole autoreclosing and independent synchrocheck supervision
- Circuits with in-zone power transformers
- 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
- Out-of-step tripping and power swing blocking
- Line pickup
- Phase and negative sequence directional overcurrent, neutral directional with dual polarity criteria, broken conductor and thermal overload
- Synchronism check
- Four-shot autorecloser
- VT fuse failure detector
- Customize protection and control functions with FlexLogic, FlexCurves™, and FlexElements™

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 URs for direct transfer trip and pilot-aided distance schemes
- 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

- Metering: current, voltage, power, energy, frequency
- Advanced recording capabilities deliver a 1024 event recorder, configurable and extended waveform capture and data logger
- Setting for security audit trails for tracking changes to D30 configurations

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
- EnerVista Integrator providing easy integration of data in the D30 into new or existing monitoring and control systems



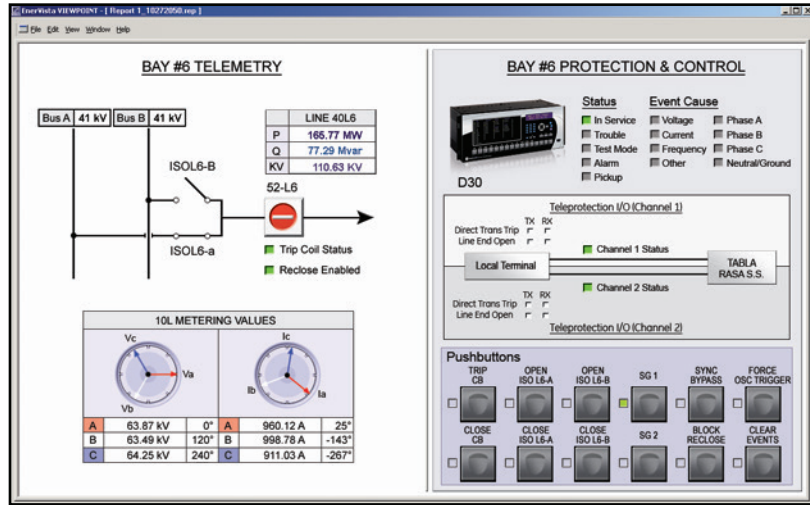
Protection and Control

The D30 is a cost-effective distance protection relay intended for protecting sub-transmission lines and underground cables of different voltage levels. Part of the Universal Relay (UR) family, the D30 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.

Distance Protection

The core of the D30 relay is the distance function providing a high degree of sensitivity and selectivity for all types of faults. The D30 comes with five zones of phase distance and ground distance providing the user maximum flexibility to cater to different applications, including primary sub-transmission line protection and backup protection for busbars, EHV and HV transmission lines, 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

D30 - Protection, Metering, Monitoring and Control



The D30 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.

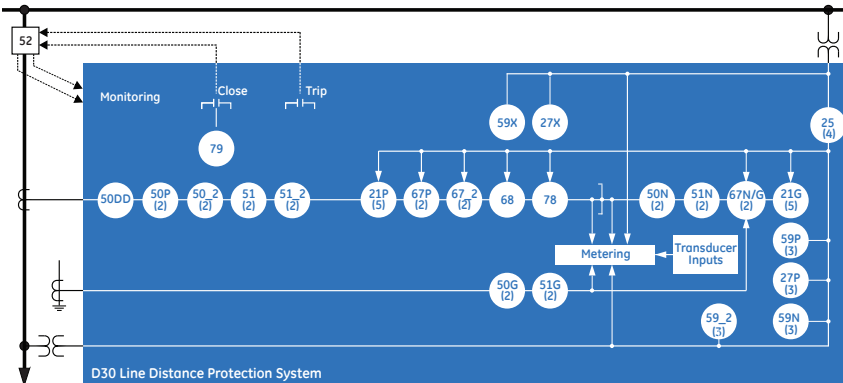
to suit different power system conditions. The advanced comparator-based distance elements provide utmost security, sensitivity and selectivity for different types of faults. Superior digital filtering techniques provide secure and optimum reach accuracy even under worst-case CVT transients. Secure directional discrimination is achieved by using positive sequence memory voltage polarization providing reliable directionality for worst-case close-in faults. 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. 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

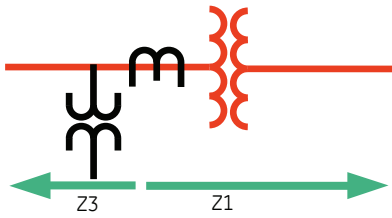
Phase distance elements in the D30 can be used to detect faults through different types of three-phase wye/delta transformers, allowing the application of the D30 for backup protection on generators. VTs and CTs can be installed independently on either side of the power transformer. The relay automatically compensates for transformer connections, to guarantee accurate reach for any type of fault.

Functional Block Diagram

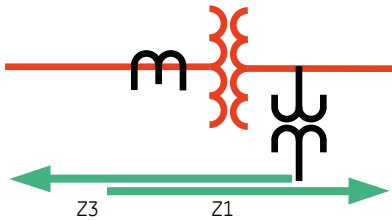


ANSI Device Numbers & Functions

Device Number	Function
21G	Ground Distance
21P	Phase Distance
25	Synchronism Check
27P	Phase Undervoltage
27X	Auxiliary Undervoltage
49	Thermal Overload
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
59.2	Negative Sequence Overvoltage
67N	Neutral Directional Overcurrent
67P	Phase Directional Overcurrent
67.2	Negative Sequence Directional Overcurrent
68	Power Swing Blocking
78	Out-of-Step Tripping
79	Automatic Recloser



Z1 looking through a transformer.



Z1 & Z3 looking through a transformer.

Load Encroachment

The load encroachment feature offers discrimination between line loading 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 load conditions and enables optimum operation of the line while meeting regulatory requirements for line loading.

Fault Locator

The integrated fault locator provides distance to fault in kilometers or miles. Parallel line zero-sequence current compensation and load current compensation enables the D30 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 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 D30 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).

Oversvoltage and Undersvoltage Protection

Long lines under lightly loaded or no-load conditions may experience voltages exceeding the rated insulation voltage level of the line. Use the three phase oversvoltage elements of the D30 to

initiate a local trip as well as a remote trip using direct I/O. The D30 also provides additional voltage functions including neutral oversvoltage, negative sequence oversvoltage and phase undersvoltage.

Overcurrent Functions

The D30 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 D30 provides multi-shot auto reclosing (up to 4 shots) for three-pole autoreclose on all types of faults with independent settings for each shot. The autoreclose element can be dynamically blocked or unblocked by other elements or user logic. This way they can be coordinated with the D30 protection setting groups.

Synchronism Check

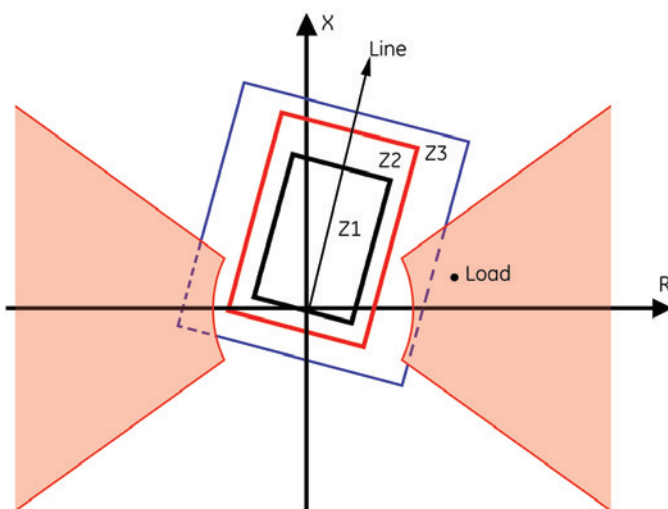
The D30 provides four synchrocheck elements that monitor voltage difference, phase angle difference and slip frequency to ensure proper breaker closure as per user-defined settings. The D30 provides additional enhancements in synchronizing by checking dead source conditions for synchronism bypass under these conditions.

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.

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



Distance relay quadrilateral characteristics supervised by the load encroachment function.

- Integrates with existing D30'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 Multilin web site for more details.

Advanced Automation

The D30 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 used for subtransmission. The D30 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 D30 can be programmed to provide the required tripping logic along with custom scheme logic for breaker control (including interlocking), transfer tripping schemes for remote breakers and dynamic setting group changes.

Scalable Hardware

The D30 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 (SSR) mechanically latching, and Form-C outputs
- Form-A and SSR outputs available with optional circuit continuity monitoring and current detection to verify continuity and health of the associated circuitry
- Mechanically latching outputs can be used to develop secure interlocking applications and replace electromechanical lockout relays

Monitoring and Metering

The D30 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 D30 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 D30 can eliminate the need for installing costly stand-alone recording equipment.

Advanced Device Health Diagnostics

The D30 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 D30 provides advanced communications technologies for remote data and engineering access, making it easy and flexible to use and integrate into new and existing infrastructures. Direct support for fiber optic Ethernet provides high-bandwidth communications allowing for low-latency controls and high-speed file transfers of relay fault and event record information. The available 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 D30 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 D30 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

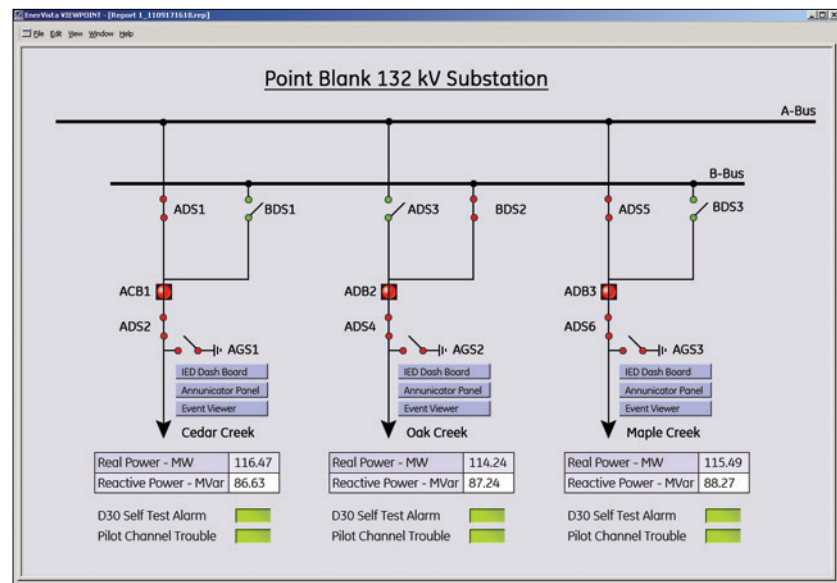
Direct I/O Messaging

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

Direct I/O provides superior relay-to-relay communications that can be used in advanced interlocking, 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

Substation Monitoring



Monitor the status of your substation using the easy to use Viewpoint Monitoring HMI.

- 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

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.

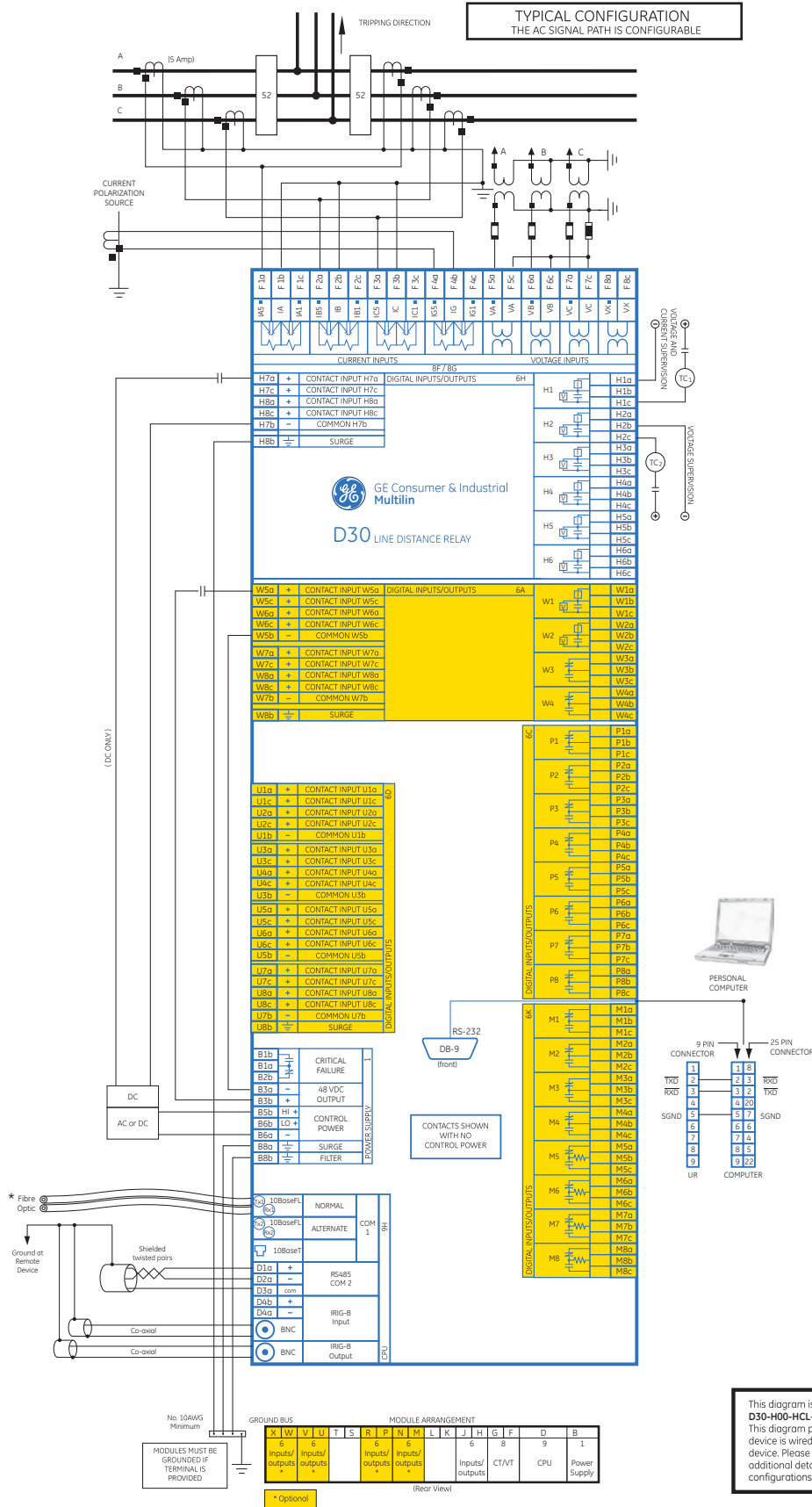
EnerVista Software

The EnerVista suite is an industry-leading set of software programs that simplifies every aspect of using the D30 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 D30 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 using serial, Ethernet, or modem connections, or offline by creating setting files to be sent to devices at a later time.

Typical Wiring



This diagram is based on the following order code:
D30-H00-HCL-F8F-H6H-M6K-P6C-U6D-W6A
 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

	D30	-	*	**	-	H	*	*	-	F**	-	H**	-	M**	-	P**	-	U**	-	W**	For Full Sized Horizontal Mount	
Base Unit	D30																				Base Unit	
CPU			E	J	K	N	T	U	V												RS485 + RS485 (IEC 61850 option not available) RS485 + Multimode ST 100BaseFX RS485 + Multimode ST Redundant 100BaseFX RS485 + 10/100 BaseT RS485 + three Multimode SFP LC 100BaseFX. Req FW v7xx or higher RS485 + two Multimode SFP LC 100BaseFX + one SFP RJ45 100BaseT. Req FW v7xx or higher RS485 + three SFP RJ45 100BaseT. Req FW v7xx or higher	
Software Options (see note 1 below)			00	03	A0	B0	C0	DO													No Software Options IEC 61850 CyberSentry UR Lvl 1. Req UR FW 7.xx or higher IEEE 1588. Req UR FW 7.xx or higher PRP IEEE 1588 + CyberSentry. Req UR FW 7.xx or higher	
Mount						H	A	V	B												Horizontal (19" rack) - Standard Horizontal (19" rack) - Harsh Chemical Environment Option Vertical (3/4 size) - Standard Vertical (3/4 size) - Harsh Chemical Environment Option	
User Interface							F	I	J	K	L	M	N	O	Q	T	U	V	W	Y		Vertical Front Panel with English Display Enhanced German Front Panel Enhanced German Front Panel with User-Programmable Pushbuttons Enhanced English Front Panel Enhanced English Front Panel with User-Programmable Pushbuttons Enhanced French Front Panel Enhanced French Front Panel with User-Programmable Pushbuttons Enhanced Russian Front Panel Enhanced Russian Front Panel with User-Programmable Pushbuttons Enhanced Chinese Front Panel Enhanced Chinese Front Panel with User-Programmable Pushbuttons Enhanced Turkish Front Panel Enhanced Turkish Front Panel with User-Programmable Pushbuttons
Power Supply (see note 2 below)							H	L													125 / 250 V AC/DC 125/250 V AC/DC with redundant 125/250 V AC/DC power supply 24 - 48 V (DC only)	
CT/VT DSP										8L											Standard 4CT/4VT w/ enhanced diagnostics Sensitive Ground 4CT/4VT w/ enhanced diagnostics 8 Port IEC 61850 Process Bus Module	
IEC 61850 Process Bus Digital I/O											8M										No module 4 Solid State (No Monitoring) MOSFET Outputs 4 Solid State (Current w/opt Voltage) MOSFET Outputs 16 Digital Inputs with Auto-Burnish 14 Form-A (No Monitoring) Latchable Outputs 8 Form-A (No Monitoring) Outputs 8 Form-C Outputs 16 Digital Inputs 4 Form-C Outputs, 8 Digital Inputs 8 Fast Form-C Outputs 4 Form-C & 4 Fast Form-C Outputs 2 Form-A (Current w/ opt Voltage) & 2 Form-C Outputs, 8 Digital Inputs 2 Form-A (Current w/ opt Voltage) & 4 Form-C Outputs, 4 Digital Inputs 4 Form-A (Current w/ opt Voltage) Outputs, 8 Digital Inputs 6 Form-A (Current w/ opt Voltage) Outputs, 4 Digital Inputs 2 Form-A (No Monitoring) & 2 Form-C Outputs, 8 Digital Inputs 2 Form-A (No Monitoring) & 4 Form-C Outputs, 4 Digital Inputs 4 Form-A (No Monitoring) Outputs, 8 Digital Inputs 6 Form-A (No Monitoring) Outputs, 4 Digital Inputs 2 Form-A (Cur w/ opt Volt) 1 Form-C Output, 2 Latching Outputs, 8 Digital Inputs 4 dcmA Inputs, 4 dcmA Outputs 8 dcmA Inputs	
Transducer I/O																					2B IEEE C37.94SM, 1300nm singlemode, ELED, 2 Channel singlemode 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, single mode, 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 7W RS422, 2 Channels 73 1550 nm, singlemode, LASER, 2 Channels 77 IEEE C37.94, 820 nm, multimode, LED, 2 Channel	
Inter-Relay Communications																						

Ordering Note: 1. To view all the options available for D30, please visit GE's On-Line Store <http://store.gedigitalenergy.com/viewprod.asp?model=D30>
2. Redundant power supply only available in horizontal unit. If redundant is chosen, must be same type. Maximum 2 per chassis.

Visit GEMultilin.com/D30 to:



- View guideform specifications
- Download the instruction manual
- Review application notes and support documents
- Buy a D30 online
- View the UR Family brochure

Accessories for the D30

- UR Applications I Learning CD TRCD-URA1-C-S-1
- Multilink Ethernet Switch ML2400-F-HI-HI-A2-A2-A6-F1
- Viewpoint Engineer VPE-1
- Viewpoint Maintenance VPM-1
- Viewpoint Monitoring IEC 61850 VP-1-61850

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