

Multilin™ F35

FEEDER PROTECTION SYSTEM

Cost-Effective Protection and Control for Single/Multiple Distribution Feeders



KEY BENEFITS

- Cost-effective and flexible protection and control device for distribution feeder applications
- Improved system stability at reduced cost with control schemes using high-speed communications
- 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
- Reduced relay-to-relay wiring and associated installation costs through high-speed inter-relay communications
- Embedded IEC 61850 protocol with no external communications hardware required
- 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)
- Robust network security enabling Critical Infrastructure Protection through user command logging, and dual permission access control
- High-end fault and disturbance recording, including internal relay operating signals, eliminating the need for redundant recording devices
- Accurate built-in metering functions eliminate auxiliary metering devices and reduces cost
- Complete IEC 61850 Process Bus solution provides resource optimization and minimizes total P&C life cycle costs

APPLICATIONS

- Primary protection and control for multiple distribution feeders
- Distribution load shedding schemes based on voltage and frequency elements
- Busblocking/interlocking schemes
- Throw over schemes (bus transfer scheme applications)
- Distributed Generation (DG) interconnect protection, including active and passive anti-islanding

FEATURES

Protection and Control

- Instantaneous and time phase overcurrent protection
- Thermal overload, instantaneous and time ground/neutral/ negative sequence overcurrent protection, wattmetric ground fault directional
- Neutral and auxiliary overvoltage
- Phase and auxiliary undervoltage
- Under frequency
- Four shot autoreclose for up six breakers and broken conductor elements
- Built-in selector switch

Communications

- Networking interfaces: up to three Ethernet ports 100Mb fiber or copper, RS485, RS232, RS422, G.703, IEEE 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, EGD
- Direct I/O: secure, high-speed exchange of data between URs for direct transfer trip 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

- 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 F35 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 F35 into new or existing monitoring and control systems



Protection and Control

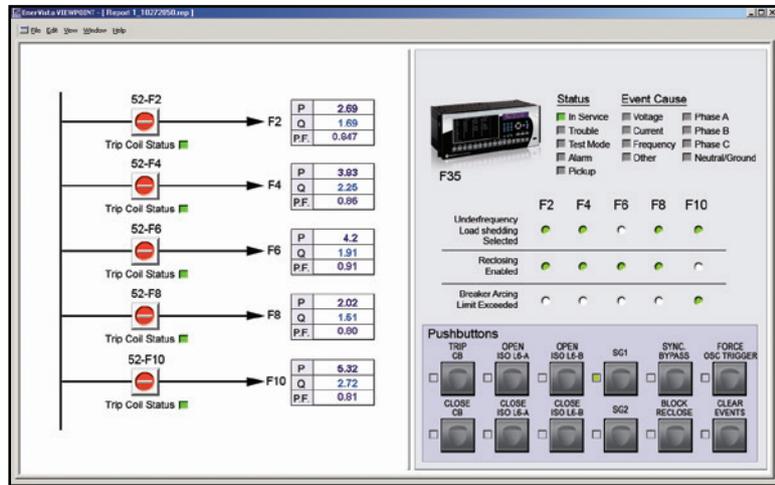
The F35 feeder protection system provides feeder protection, control, monitoring and metering in an integrated, economical, and compact package. As part of the Universal Relay (UR) Family, the F35 provides cost-effective solutions and features high-performance protection, expandable I/O options, integrated monitoring and metering, high-speed communications, and extensive programming and configuration capabilities. The F35 can be configured to protect up to six feeders or protect up to five feeders when bus voltage measurement is required. It also provides fast and deterministic execution of programmable logic, which is necessary for substation automation applications. Graphical programming tools (Viewpoint Engineer), supported by a library of logic components, make the F35 simple to use and configure. The F35 has a wide range of protection elements that have many years of proven field experience. Protection and control features include:

Overcurrent Protection

The F35 has built-in standard IEEE, IEC, IAC and FlexCurves overcurrent characteristics (TOC), most commonly used for primary and backup protection in various protective zones. The F35 has thermal overload and phase IOC elements with level detectors for each phase. Each TOC element has the following programmable characteristics:

- Pickup current level for trip, alarm, or control
- Choice of 17 curve shapes (including FlexCurves) and curve multipliers

F35 - Protection, Metering, Monitoring and Control



The F35 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.

- Instantaneous or linear reset time characteristic to coordinate with upstream transformer damage curves and downstream reclosers and fuses
- Voltage restraint to increase sensitivity

The majority of distribution systems are either solidly or low-impedance grounded. Fast fault clearance is required due to the ground fault impact. The following functions are incorporated in F35 to provide ground protection:

- Neutral IOC and TOC
- Ground IOC and TOC
- Negative Sequence IOC and TOC

Sensitive Ground Input

The F35 CT/VT modules may be ordered with a sensitive ground current input, which

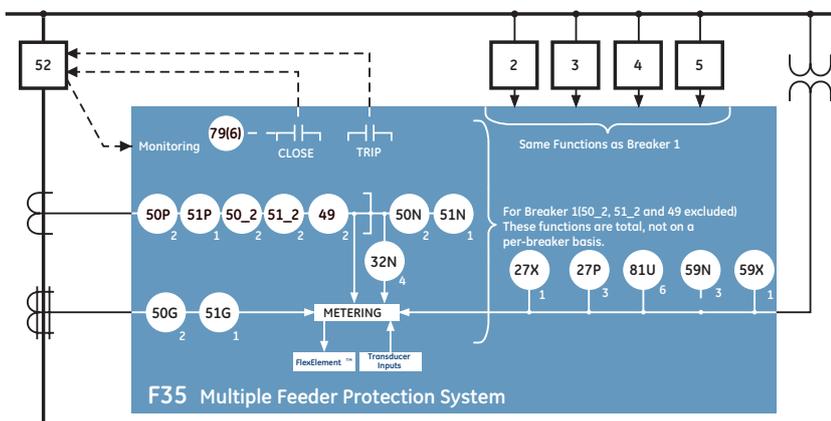
provides ground fault protection on high-impedance grounded systems. This can be especially important when using a residual CT connection to detect ground faults.

Wattmetric Ground Fault Protection

A sensitive wattmetric zero-sequence directional function can be used on isolated or resonant (Petersen coil) grounded, low-resistance grounded and solidly grounded systems to detect ground faults.

This function determines the presence and direction of ground faults by measuring the value and direction of zero-sequence power. This flexible element responds to power derived from zero-sequence voltage and current in a direction specified by the element characteristic angle. Power can be selected as active, reactive, or apparent.

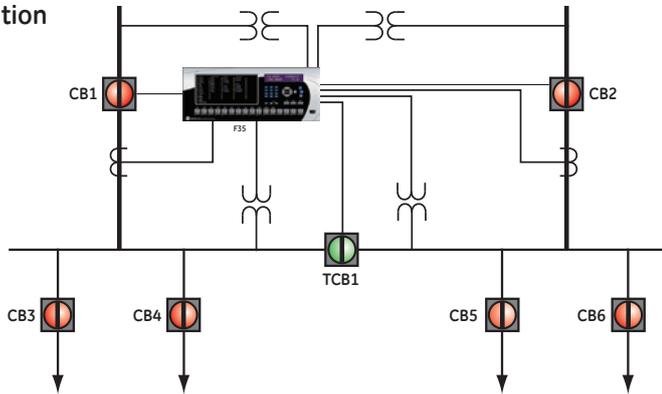
Functional Block Diagram



ANSI Device Numbers & Functions

Device Number	Function
27P	Phase Undervoltage
27X	Auxiliary Undervoltage
32N	Wattmetric Zero-Sequence Directional
49	Thermal Overload
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
59X	Auxiliary Overvoltage
79(6)	Automatic Recloser
81	Under Frequency

Auto-Transfer Scheme Solution



Cost-effective single box auto-transfer scheme solution.

Therefore, the element may be used to sense either forward or reverse ground faults.

- Backup motor protection to prevent automatic restart

Under/Over Voltage Protection

The F35 includes the following voltage elements:

- Up to 6 phase undervoltage elements
- Up to 3 auxiliary under/over voltage elements
- Up to 3 neutral overvoltage elements

The following are some of the key applications where voltage elements can be used:

- Source transfer schemes
- Load shedding schemes
- Backup capacitor bank protection and control

Autorecloser

Up to 6 programmable breaker autoreclosers for a variety of reclosing practices are provided. These elements are intended for use with distribution lines in tripping schemes for single breaker applications. Up to four selectable recloser “shots” are possible prior to locking out. Any of the six autoreclose elements can be dynamically blocked or unblocked by other F35 elements or user logic, providing coordination with other protection setting groups.

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
- Integrates with existing F35'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 Digital Energy web site for more details.

Advanced Automation

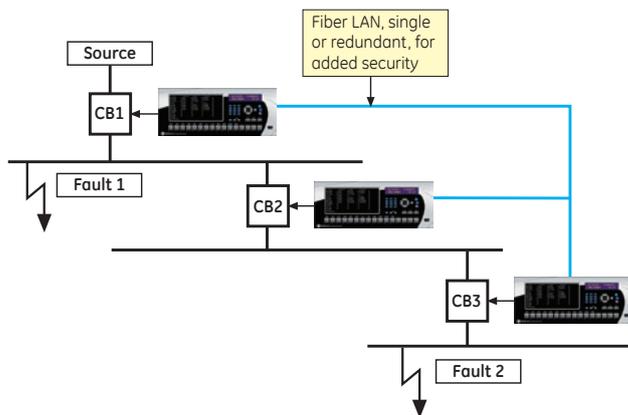
The F35 incorporates advanced automation features including powerful FlexLogic programmable logic, communication, and SCADA capabilities that far surpass what is found in the average line relay. The F35 integrates seamlessly with other UR relays for complete system protection, including the unit and auxiliary transformers, and balance of plant 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 F35 can be programmed to provide the required tripping logic along with custom scheme logic for line phase comparison (including interlocking with external synchronizers), transfer tripping schemes for remote breakers and dynamic setting group changes.

Scalable Hardware

The F35 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.



Reverse zone interlocking protection. By using the IEC 61850 GOOSE or high-speed direct I/O capability blocking signals can be transferred upstream, allowing for minimal coordination delays. Fast clearance can be provided for Fault 1 while still maintaining coordination for Fault 2.

- Multiple CT/VT configurations allow for the implementation of many differential schemes, including concurrent split-phase and differential protection
- Up to 80 digital inputs and up to 56 digital outputs are available
- 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 proper operation of the connected primary equipment
- Mechanically latching outputs can be used to develop secure interlocking applications and replace electromechanical lockout relays
- RTDs and DCmA inputs are available to monitor equipment parameters such as temperature and pressure

Monitoring and Metering

The F35 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 F35 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
 - Events up to 45s in length
- Oscillography
 - 64 digital & up to 40 analog channels
- 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 rates and large amount of storage space available for data recording in the F35 can eliminate the need for installing costly stand-alone recording equipment.

Advanced Device Health Diagnostics

The F35 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
- Input, outputs, trip circuits and analog channels are continuously monitored for accuracy and performance

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 F35 provides advanced communications technologies for remote data and engineering access, making it the easiest and most flexible feeder protection relay 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 without the need for intermediary communication hardware. The F35 supports the most popular industry standard protocols enabling easy, direct integration into DCS and SCADA systems.

- IEC 61850
- DNP 3.0
- Ethernet Global Data (EGD)
- 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

Use the F35 with integrated IEC 61850 to lower costs associated with substation 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, generation rejection and other special protection schemes.

- Communication with up to 16 UR relays in single or redundant rings rather than simplistic point-to-point configurations
- Connect to standard DS0 channel banks through standard RS422, G.703 or IEEE C37.94 interfaces or via direct fiber optic connections
- Built-in continuous loop and channel monitoring provides real-time diagnostics of your communication channels with no external or handheld tester required

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

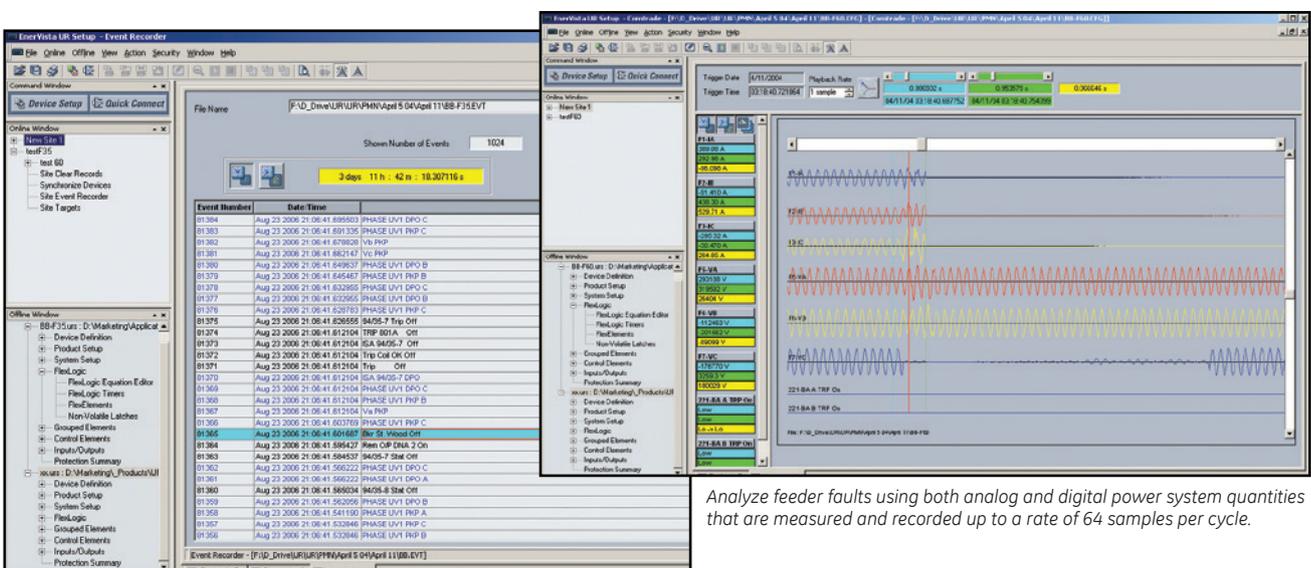
UR devices support multiple languages: English, French, Russian, Chinese, Turkish and German. These language options are available on the front panel, in the EnerVista setup software, and in the product manuals. Easily switch between English and an additional language on the local displays without uploading new firmware.

EnerVista Software

The EnerVista suite is an industry-leading set of software programs that simplifies every aspect of using the F35 relay. The EnerVista suite provides all the tools to monitor the status of feeders, maintain the relay, and integrate information measured by the F35 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.

Power System Troubleshooting

The F35 contains many tools and reports that simplify and reduce the amount of time required for troubleshooting power system events.



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

Record the operation of the internal F35 elements and external connected devices with 1ms time-stamped accuracy to identify the Sequence of Operation of station devices during feeder faults and disturbances.

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. 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 will allow you to configure and test 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

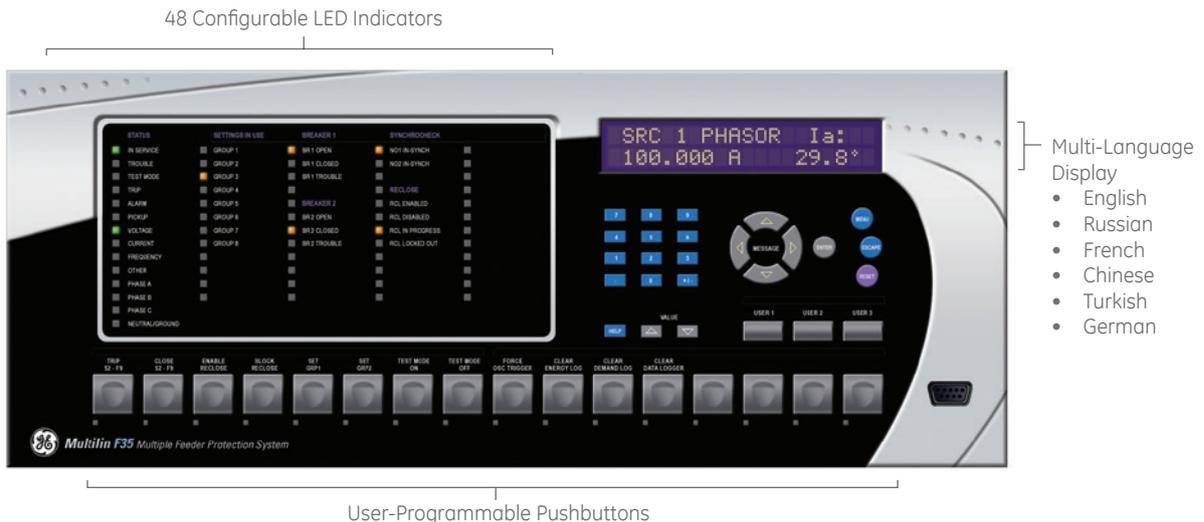
EnerVista Integrator

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 F35 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.



Ordering

Distribution Feeder Protection

	F35	-	*	**	-	H	*	-	F**	-	H**	-	M**	-	P**	-	U**	-	W	*	For Full Sized Horizontal Mount
Base Unit	F35																				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	AO	BO	CO	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 UR. Req UR FW 7.xx or higher
Mount / Coating					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	H	L												RH		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									8F		8F			8F							Standard 4CT/4VT Sensitive Ground 4CT/4VT Standard 8CT Sensitive Ground 8CT Standard 4CT/4VT w/ enhanced diagnostics Sensitive Ground 4CT/4VT w/ enhanced diagnostics Standard 8CT w/ enhanced diagnostics Sensitive Ground 8CT w/ enhanced diagnostics
IEC 61850 Process Bus											81										8 Port IEC 61850 Process Bus Module
Digital I/O									XX	XX	XX	XX	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								
Transducer I/O									5A	5A	5A	5A	4 dcmA Inputs, 4 dcmA Outputs 8 RTD Inputs 4 RTD Inputs, 4 dcmA Outputs 4 dcmA Inputs, 4 RTD Inputs 8 dcmA Inputs								
Inter-Relay Communications																					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 7T RS422, 1 Channel 7W RS422, 2 Channels 76 IEEE C37.94, 820 nm, multimode, LED, 1 Channel 77 IEEE C37.94, 820 nm, multimode, LED, 2 Channel

Ordering Note: 1. To view all the options available for F35, please visit GE's On-Line Store at <http://store.gedigitalenergy.com/viewprod.asp?model=F35>
2. Redundant power supply only available in horizontal unit. If redundant is chosen, must be same type. Maximum 2 per chassis

Accessories for the F35

- 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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