

Multilin™ N60

NETWORK STABILITY & SYNCHROPHASOR MEASUREMENT

Synchrophasors, load shedding, remedial
action, special protection schemes



KEY BENEFITS

- Scalable Synchrophasor measurements with up to 4 PMUs per IED reducing Synchrophasor cost by up to 75%
- Complete IEC 61850 Process Bus solution providing resource optimization and minimizing total P&C life cycle costs
- Exceeds the latest IEEE C37.118 standard for PMU measurement devices with a total vector error less than 1% and latest P & M-class Synchrophasor.
- Uninterrupted Synchrophasor measurements during fault and disturbances providing highly reliable capture of data for critical control functions and post-mortem analysis
- Real time access to remote analog data providing for advanced wide area applications and enhanced system security
- Simplified system integration with direct connection to JungleMUX SONET, TN1U SDH and TN1Ue SDH networks
- Hi-speed digital and analog peer-to-peer communications providing early detection & fast automated response to power system events
- PMU data transmission over IEC 61850 and via direct communication with other Multilin UR Relays

APPLICATIONS

- Decrease blackouts by identifying network instabilities and taking fast preventative action
- Increase utilization of existing investments by identifying power transfer capability on existing lines
- Compliments existing protection and control by sharing power and utilization information with existing systems to enhance system security
- Facilitate contingency planning through continuous Synchrophasor data collection and post mortem analysis
- Provides enhanced state estimation for SCADA to optimize system wide load shedding and remedial action schemes
- Mitigate system critical conditions such as power system dampening and loss of synchronism through the use of enhanced automated control to reduce outages

FEATURES

Protection and Control

- Underfrequency, overfrequency, and rate of change of frequency (df/dt)
- Out-of-step tripping and power swing blocking
- Thermal overload and Phase instantaneous overcurrent
- Synchrocheck
- Overvoltage, undervoltage
- FlexMath for performing automated network control for applications such as automatic load shedding, power balancing and remedial action schemes

Communications

- Synchrophasor streaming over Ethernet – rates from 1 to 60 Phasors/sec
- Direct I/O for exchange of binary and analog data with N60 located locally or wide areas apart
- IEC 61850 enabled including Analog GOOSE
- N60 to N60 communications using direct fiber or through multiplexers using G.703, RS422, or C37.94 interfaces

IEC 61850 Process Bus Interface

- Robust communications with up to 8 HardFiber Bricks
- Seamless integration with existing N60 functions
- Redundant architecture for dependability and security

Monitoring and Metering

- Synchrophasor Recording – 25MB memory with multiple recording and triggering options, 46 configurable channels
- Metering – current, voltage, power, energy frequency
- Data Logger – Up to 16 channels with sampling rate up to 1 sample/cycle
- Setting Security Audit Trail for tracking changes to N60 configuration

EnerVista™ Software

- Document and software archiving toolset to ensure reference material and device utilities are up-to-date
- Easy to use setup software to streamline the configuration process
- Graphical Logic Designer and Logic Monitor to simplify designing and testing procedures



Digital Energy

Overview

The N60 Network Stability and Synchrophasor Measurement System is a flexible device intended for the development of load shedding, remedial action, special protection schemes and wide area monitoring and control. Special protection schemes are unique to each installation and are carefully matched to a given system topology, operating practices and system protection philosophies of a given utility. The N60 provides an exceptionally flexible platform to easily integrate and facilitate the specific special protection schemes needed for a wide range of applications.

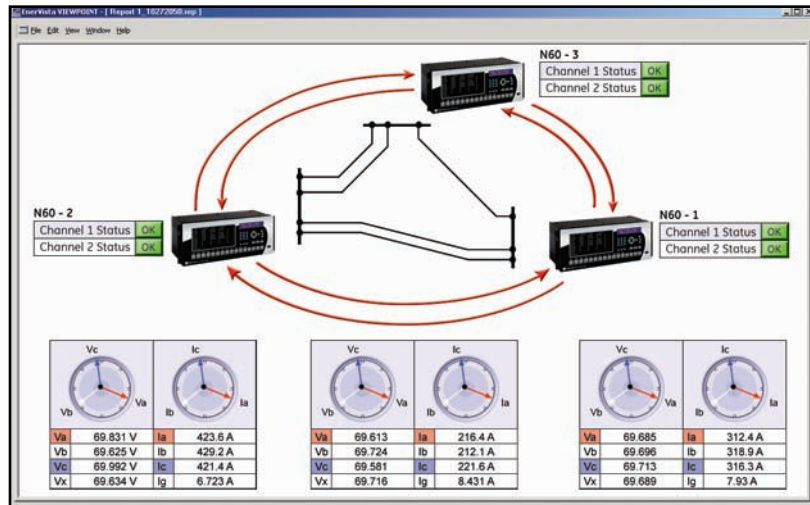
Synchrophasors

The N60 is also a source of synchronized Phasor measurements known as Synchrophasors. The N60 meets all and exceeds many of the requirements of the IEEE C37.118 Synchrophasors for Power Systems standard. The N60 can simultaneously stream P and M class Synchrophasors over its Ethernet ports at configurable discrete rates of 1 to 120 frames per second. In addition to streaming Synchrophasors, the N60 can be controlled through programmable triggers to store snapshot records of Synchrophasor data in the 25MB of onboard memory.

Peer-to-Peer Communications

The N60 provides two distinct methods, Direct I/O and IEC 61850 GOOSE, for

N60 - Protection, Metering, Monitoring and Control



The N60 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.

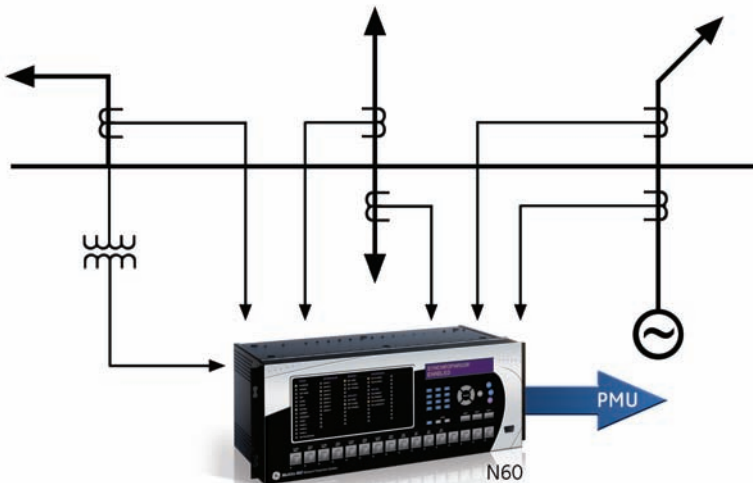
sharing of information about the state of a local station to other local or remote N60s. Using Direct I/O messaging, the N60's can share real-time analog information and local control decisions to other remote sites to facilitate a desired control action. In addition, local control commands can be sent to other IEDs via the IEC 61850 GOOSE mechanisms where digital point-to-point messaging can be achieved in 4ms. Further operational sophistication can be achieved by using the Analog GOOSE capability to transfer analog values between local devices.

Special Protection Schemes

The advanced local and remote communications ability of the N60, along with its superior automation control functions, provide a flexible platform for addressing a broad range of network stability applications including:

- Controlled openings of interconnections
- Controlled islanding of the local system
- Load shedding
- Fast-Valving
- Tripping of generators

Functional One-Line Diagram



The N60 can monitor and control up to 5 power system circuits

ANSI Device Numbers & Functions

Device Number	Function
25	Synchrocheck
27P	Phase Undervoltage
32	Sensitive Dir Power
49	Thermal Protection
50DD	Disturbance Detector
50P	Phase Inst Overcurrent
59P	Phase Overvoltage
68	Power Swing Blocking
81O	Overfrequency
81U	Underfrequency
81R	Rate of Change of Frequency

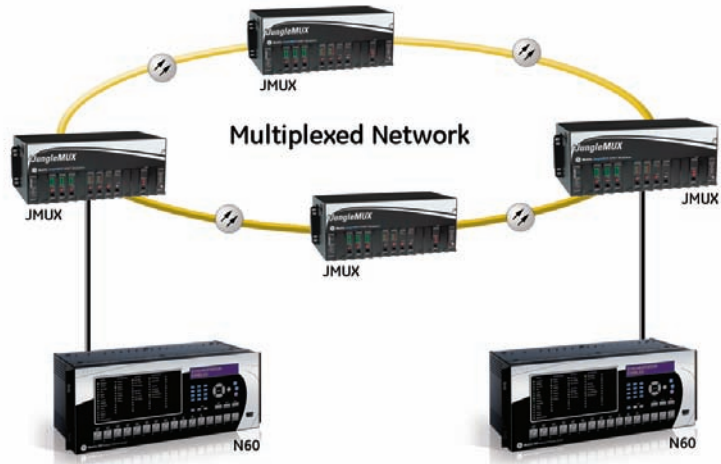
- Fast dispatch of generation
- HVDC power control adjustments
- Series capacitor Automatic Voltage Regulator (AVR) setpoint and tap change control

Truly distributed architecture

Sophisticated special protection schemes can be developed exclusively using N60 devices without any other central controllers required. The N60 can be configured to make smart decisions based on real-time information that it has received from N60's located across a large geographic area. The N60 has built-in abilities to detect failures of communications to other devices, which allows for configuring the devices to self-adjust or adapt it's decisions based on the information that is available to it.

Monitor multiple power circuits

The N60 can monitor from one up to six three-phase power circuits and can be configured to simultaneously provide as many as 4 Phasor Measurement Units (PMUs). The N60 provides metering of many power system quantities including active, reactive and apparent power on a per-phase, and three-phase basis; true RMS value, Phasors, and symmetrical components of currents and voltages; power factor, and frequency. Frequency



N60's can be directly connected to Multiplexed networks using a variety of different interfaces to communicate with other N60's spread out across the transmission network.

can be measured independently and simultaneously from up to six different signals including currents if needed. The N60 allows for creating and processing virtual sums of currents through its user configuration mechanism of "signal sources".

The HardFiber System is designed to integrate seamlessly with the existing Universal Relay applications, including protection functions, FlexLogic, metering and communications.

The Multilin HardFiber System offers the following benefits:

- Communicates using open standard IEC 61850 messaging
- Drastically reduces P&C design, installation and testing labor by eliminating individual copper terminations

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.

Figure 1

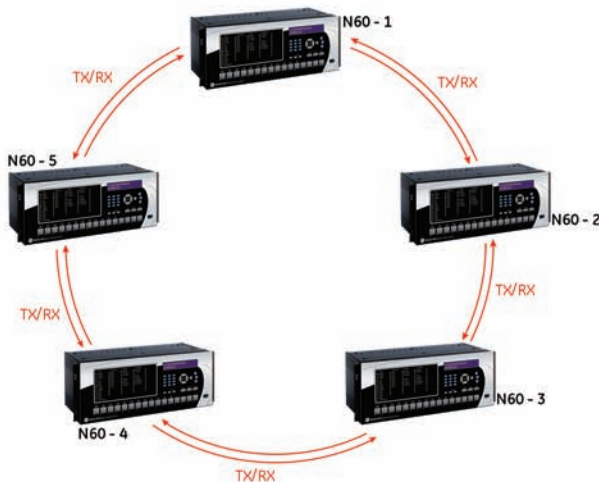
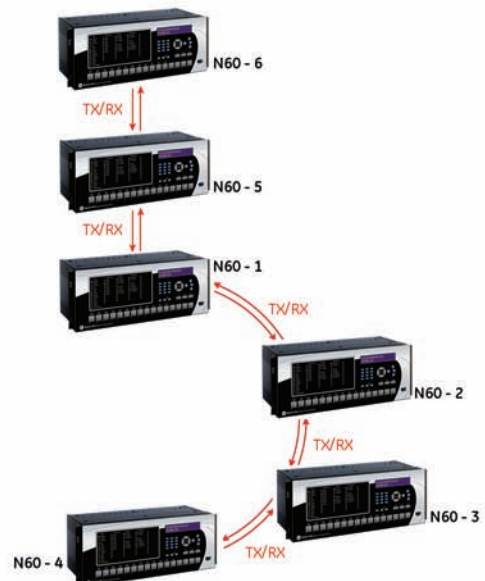


Figure 2



N60's can be directly connected to other N60's in a ring configuration providing network redundancy as seen in figure 1, or an open ring configuration to span long distances as seen in Figure 2.

- Integrates with existing N60's by replacing traditional CT/VT inputs with 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.

Communications

The N60 has the most advanced communications capabilities for sharing information about the power system with other local or remote devices in the protection and control industry. Using direct Peer-to-Peer communications for sharing information with other N60s distributed across the network, and using the many available SCADA protocols, the N60 can provide the complete solution for carrying out special protection schemes and SCADA monitoring and control functions.

Direct I/O and Direct Analog

The Direct I/O and Direct Analog features allow for sharing of both digital and analog information with up to 16 other N60 devices connected directly through fault tolerant fiber optic ring networks or through a multiplexed communications network. The N60 supports dual channel communications where each channel can support a different physical connection thus providing the ability for connecting to completely segregated networks and allowing for truly redundant inter-substation communication architectures. The communications interfaces available include direct fiber optics (up to 100km), G.703, and RS422 interfaces and is fully compatible with Multilin's JMUX SONET, TN1U SDH and TN1Ue SDH multiplexers.

Direct I/O

Using the Direct I/O, each N60 can send the status of up to 64 ON/OFF digital states to the N60's spread across the network. The message delivery from one N60 to another varies with the number of other N60s located between the sending and receiving devices, but delivery times of one to two cycles is achievable for very large networks and will be repeatable

and deterministic for all communications between those two devices. This high-speed sharing of information allows for N60's to obtain real-time information about the status of other parts of the network and of decisions made by other devices on the network.

Direct Analogs

Direct Analogs provide the ability to share the value of analog quantities measured by the local N60 with other N60's distributed across the network. This analog data is transmitted across the network whenever the value varies beyond a preset deadband, up to a rate of every 250ms. With this information, N60's can evaluate what is happening around the rest of the network and make smart decisions about what control actions to take as implemented for the various special protection schemes.

Network Communications Diagnostics

The N60 Direct I/O and Direct Analogs incorporate sophisticated self-monitoring and diagnostic functions that can be monitored and evaluated to identify problems with the integrity of the communications network. Included in these diagnostics features are a 32-bit CRC, an unreturned messages count, and a count of the total number of lost packets.

SCADA Integration

The N60 embraces the most advanced communication technologies available today for remote data and engineering access that provide an easy method of integrating information from around a network into new or existing infrastructures. Direct support for redundant fiber optic Ethernet provide high-bandwidth communications allowing for low-latency controls and high-speed file transfer of Synchrophasor and event recording information transfers in a cost effective fault tolerant network.

The N60 supports the most popular industry standard communications protocols enabling easy, direct integration into SCADA systems.

- IEC 61850
- DNP3.0

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

Interoperability with Embedded IEC 61850

Use the N60 with integrated IEC 61850 to lower costs associated with substation protection, control and automation. GE Energy's leadership in IEC 61850 comes from 1000's of installed devices and follows on seven years of development experience with UCA 2.0.

- Replace expensive copper wiring between devices with direct transfer of data using GOOSE messaging
- Configure systems based on IEC 61850 and also monitor and troubleshoot them in real-time with EnerVista Viewpoint Engineer
- Integrate Multilin IEDs and generic IEC 61850-compliant devices seamlessly in EnerVista Viewpoint Monitoring

Protection and Control

The N60 incorporates a wide range of protection and control functions that are typically required for special protection schemes. These protection and control elements along with the use of the advanced Flexlogic, FlexMath, and FlexElements, allow for creating automated system controls for customized special protection schemes.

Abnormal Frequency Protection

Detecting changes in the frequency at a particular location and relaying that information to other N60's deployed across the network can allow for creating customized schemes such as shedding some load or islanding parts of the system to counter the affect of impending system problems. Frequency elements include Underfrequency, Overfrequency, and the Rate of Change of Frequency.

Power Swing / Out of Step

The power swing blocking element provides blocking of protection elements under power swing conditions. Additionally, the out-of-step tripping element can be used for tripping the generator when an unstable power swing is detected

Directional Power

Two separate directional power elements are provided to detect reverse power and low forward power to interconnections that involve co-generation. Each element can be used to provide both alarming and tripping upon the detection of undesired power flow conditions

Synchrocheck

The N60 provides elements to monitor differences in voltage magnitudes, phase angles, and frequency to perform synchronism check across up to two breakers. The N60 can verify synchronism on both sides of a breaker before making decisions to close a breaker or before accepting commands to close a breaker from remote systems.

Advanced Automation

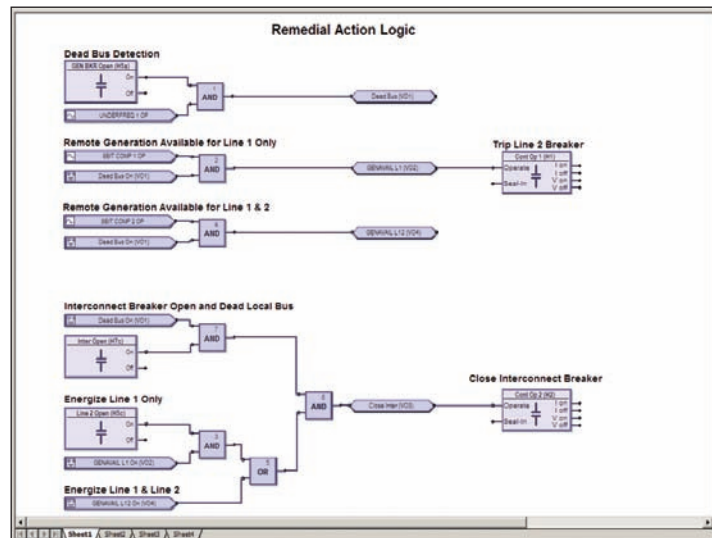
Flexlogic™

Flexlogic™ is the powerful UR-platform programming logic engine that provides the ability of creating customized protection and control schemes based on information measured locally by the N60 and received from remote N60s sent to it over the communications network. With Flexlogic™, the N60 can use the status of measured inputs, along with the output of the protection elements, FlexElements™ and FlexMath™ summators, in Boolean logic equations to perform automated function for customized special protection schemes.

FlexMath™

FlexMath™ uses a summator function to analyze and compare analog information that has been measured locally by the N60 and analog information that has been sent to it from remote N60s. Using summators, the N60 can identify differences in power quantities measured across the network and be configured to make smart decisions on this information such as what breakers to automatically close to restore power to non-energized part of the system. Each FlexMath™ equation is executed every power system cycle that allows for the N60 to react in real-time to changing power system events.

FlexLogic™ Designer



The N60 contains Flexlogic™ and FlexMath™ equations that allow for creating automated wide area protection and control schemes, remedial action schemes, and other special protection applications.

FlexElements™

FlexElements™ can be used to create User-Defined protection elements that are based on analog parameters measure by the N60 including currents, voltages, power, frequency and power factor. Each FlexElement™ will analyze the programmed analog parameter for absolute changes in the input, the rate of change of the input, or by comparing the difference of two measured inputs.

Scaleable Hardware

The N60 is available with a multitude of I/O configurations to suit the most demanding application needs. Each N60 can be configured to monitor up to 6 power system circuits, and when connected to other N60s using inter-IED communications modules, can create a distributed logic scheme with each N60 measuring and protecting a particular portion of the system.

- Multiple CT/VT configurations allow for measuring inputs from up to 6 power system circuits
- Types of digital outputs include trip-rated Form-A and Solid State Relay (SSR) mechanically latching, and Form-C outputs
- RTDs and DCmA inputs are available to monitor equipment parameters such as temperature & pressure

Monitoring and Metering

The N60 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.

Synchrophasors

With the ability of having up to 4 PMU in one device, the N60 Synchrophasor measuring permits accurate measurement of Synchrophasors over an extremely wide frequency range. The N60 exceeds the IEEE C37.118 requirements for Total Vector Error (TVE) less than 1% over a range of 40Hz to 70Hz. Additionally, the N60 can measure and report Synchrophasors over a frequency range from 30Hz to 90Hz with little affect on TVE and the new P & M Class synchrophasor. A special feature of the N60 Synchrophasor implementation is the ability to apply magnitude and phase angle correction on a per-phase basis for known CT and PT magnitude and phase errors. The N60 can apply magnitude correction of up to +/- 5% and phase correction of up to +/- 5 degrees, both can be applied to each phase. The N60 also provides the ability of adjusting for Delta-Wye phase angle shifts or polarity reversal in the Synchrophasor reporting of the sequence voltages and currents.

Synchrophasor Records

The N60 has the ability recording files of Synchrophasor measured data when instructed by user-configurable digital and analog triggers. The storing of Synchrophasor data can be programmed to record records of a pre-defined length, or have a dynamic recording length that will continue recording as long as the trigger remains in the High state or the internal memory of the N60 is filled. The user can select to have old Synchrophasor records automatically be overwritten when new data is available, or have them protected until later cleared manually. Synchrophasor records can be analyzed using the COMTRADE viewer included with the EnerVista software.

Fault and Disturbance Recording

The advanced disturbance and event recording features within the N60 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

EnerVista™ Software

The EnerVista™ Suite is an industry-leading set of software programs that simplifies every aspect of using the N60 relay. The EnerVista suite provides all the tools to monitor the status of your system, maintain your relay, and integrate information measured by the N60 into DCS or SCADA monitoring systems. Convenient COMTRADE and Sequence of Events viewers are an integral part of the UR Setup software included with every UR relay, to carry out postmortem event analysis to ensure proper protection system operation.

EnerVista™ Launchpad

EnerVista™ Launchpad is a powerful software package that provides users with all of the setup and support tools needed for configuring and maintaining Multilin products. The setup software within Launchpad allows configuring devices in real-time by communicating using serial, Ethernet, or modem connections, or

offline by creating setting files to be sent to devices at a later time.

Included in Launchpad is a document archiving and management system that ensures critical documentation is up-to-date and available when needed. Documents made available include:

- Manuals
- Application Notes
- Guideform Specifications
- Brochures
- Wiring Diagrams
- FAQ's
- Service Bulletins

Viewpoint Monitoring

Viewpoint Monitoring is a simple-to-use and full-featured monitoring and data recording software package for small systems. Viewpoint Monitoring provides a complete HMI package with the following functionality:

- Plug-&-Play Device Monitoring
- System Single-Line Monitoring & Control
- Annunciator Alarm Screens
- Trending Reports
- Automatic Event Retrieval
- Automatic Waveform Retrieval

Viewpoint Engineer

Viewpoint Engineer is a set of powerful tools that will allow you to configure and test UR relays at a system level in an easy-to-use graphical drag-and-drop environment. Viewpoint Engineer provides the following configuration and commissioning utilities:

- Graphical System & Logic 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

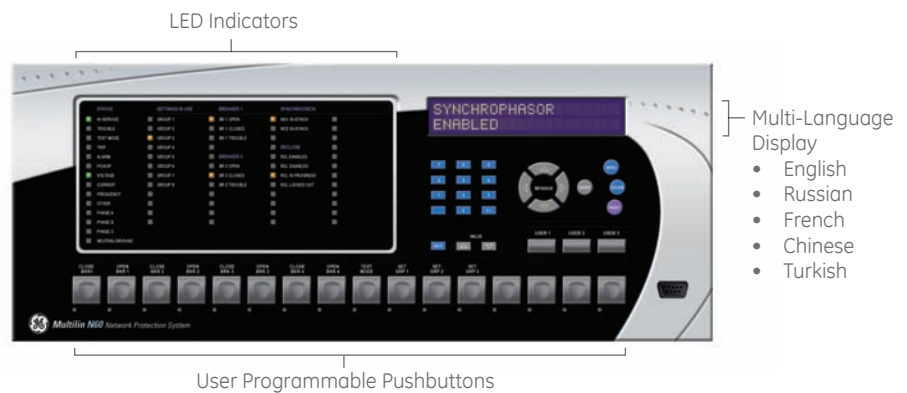
EnerVista™ Integrator

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

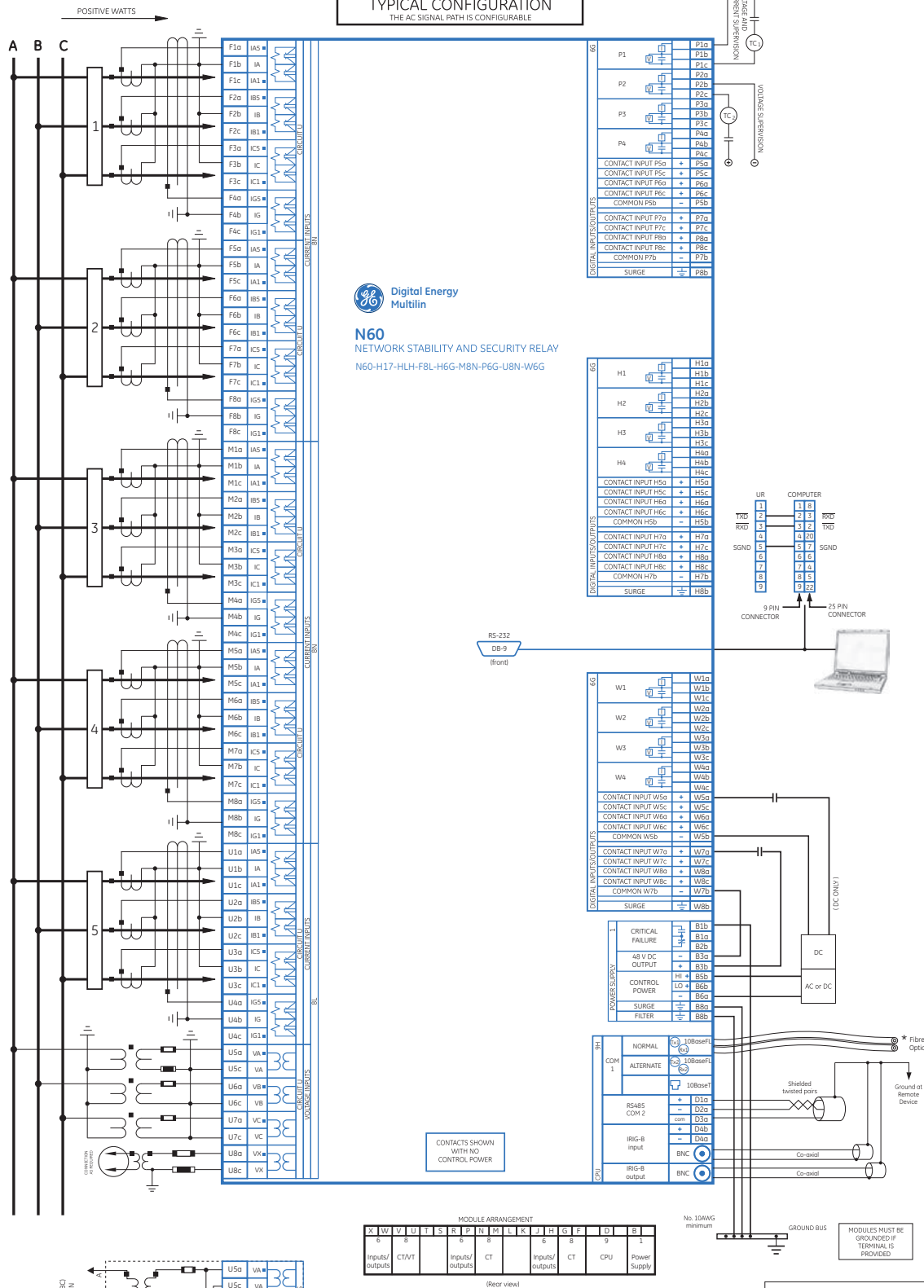
- OPC/DDE Server
- Multilin Drivers
- Automatic Event & Waveform Retrieval

User Interface

The N60 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



Specialized Protection & Control

This diagram is based on the following order code:
N60-H17-HLH-F8L-H6G-M8N-P6G-U8N-W6G
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

	N60-	*	**	H	*	*	F**	H**	M**	P**	U**	W/X**	For Full Sized Horizontal Mount
Base Unit	N60												Base Unit
CPU		E											RS485 & RS485 (IEC 61850 option not available)
		G											RS485 + Multi-mode ST 10BaseF
		H											RS485 + Multi-mode ST Redundant 10BaseF
		J											RS485 + Multi-mode ST 100BaseFX
		K											RS485 + Multi-mode ST Redundant 100BaseFX
		N											RS485 + 10/100 BaseT
Software Options			00										No Software Options
			03										IEC 61850
			06										1 Phasor Measurement Units (PMU)
			07										1 Phasor Measurement Units (PMU) + IEC 61850
			14										2 Phasor Measurement Units (PMU)
			15										2 Phasor Measurement Units (PMU) + IEC 61850
			16										4 Phasor Measurement Units (PMU)
			17										4 Phasor Measurement Units (PMU) + IEC 61850
Mount				H									Horizontal (19" rack) - Standard
				A									Horizontal (19" rack) - Harsh Chemical Environment Option
User Interface					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
					R								Enhanced Russian Front Panel with User-Programmable Pushbuttons
					T								Enhanced Chinese Front Panel
					U								Enhanced Chinese Front Panel with User-Programmable Pushbuttons
					V								Vertical Front Panel with English display
					W								Enhanced Turkish Front Panel
					X								Enhanced Turkish Front Panel with User-Programmable Pushbuttons
Power Supply						H							125/250 V AC/DC
						L							24 - 48 V (DC only)
CT/VT DSP	Required for PMU Option						8L		8L				Standard 4CT/4VT w/ enhanced diagnostics
	Required for PMU Option						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	XX	No Module
							67	67	67	67	67	67	8 Form-A (No Monitoring) Outputs
							6A	6A	6A	6A	6A	6A	2 Form-A (Voltage w/ opt Current) & 2 Form-C Outputs, 8 Digital Inputs
							6B	6B	6B	6B	6B	6B	2 Form-A (Voltage w/ opt Current) & 4 Form-C Outputs, 4 Digital Inputs
							6C	6C	6C	6C	6C	6C	8 Form-C Outputs
							6D	6D	6D	6D	6D	6D	16 Digital Inputs
							6E	6E	6E	6E	6E	6E	4 Form-C Outputs, 8 Digital Inputs
							6F	6F	6F	6F	6F	6F	8 Fast Form-C Outputs
							6L	6L	6L	6L	6L	6L	2 Form-A (Current w/ opt Voltage) & 2 Form-C Outputs, 8 Digital Inputs
							6N	6N	6N	6N	6N	6N	4 Form-A (Current w/ opt Voltage) Outputs, 8 Digital Inputs
							6P	6P	6P	6P	6P	6P	6 Form-A (Current w/ opt Voltage) Outputs, 4 Digital Inputs
							6R	6R	6R	6R	6R	6R	2 Form-A (No Monitoring) & 2 Form-C Outputs, 8 Digital Inputs
							6S	6S	6S	6S	6S	6S	2 Form-A (No Monitoring) & 4 Form-C Outputs, 4 Digital Inputs
							6T	6T	6T	6T	6T	6T	4 Form-A (No Monitoring) Outputs, 8 Digital Inputs
							6U	6U	6U	6U	6U	6U	6 Form-A (No Monitoring) Outputs, 4 Digital Inputs
							6V	6V	6V	6V	6V	6V	2 Form-A (Cur w/ opt Volt) 1 Form-C Output, 2 Latching Outputs, 8 Digital Inputs
							4D	4D	4D	4D	4D	4D	16 Digital Inputs with Auto-Burnish
							4L	4L	4L	4L	4L	4L	14 Form-A (No Monitoring) Latchable Outputs
Transducer I/O							5A	5A	5A	5A	5A	5A	4 dcma Inputs, 4 dcma Outputs
							5C	5C	5C	5C	5C	5C	8 RTD Inputs
							5F	5F	5F	5F	5F	5F	8 RTD Inputs
Inter-Relay Communications													7C 7C 1300 nm, single-mode, ELED, 1 channel
													7H 7H 820 nm, multi-mode, LED, 2 Channels
													7I 7I 1300 nm, multi-mode, LED, 2 Channels
													7J 7J 1300 nm, single-mode, ELED, 2 Channels
													7M 7M Channel 1 - RS422; Channel 2 - 1300 nm, multi-mode, LED
													7R 7R G.703, 1 Channel
													7S 7S G.703, 2 Channels
													7T 7T RS422, 1 Channel
													7W 7W RS422, 2 Channels, Single Clock
													73 73 1550 nm, single-mode, LASER, 2 Channels
													76 76 IEEE C37.94, 820 nm, multimode, LED, 1 Channel
													77 77 IEEE C37.94, 820 nm, multimode, LED, 2 Channel
													2A 2A C37.94SM, 1300 nm Singlemode, ELED, 1 Channel Single mode
													2B 2B C37.94SM, 1300 nm Singlemode, ELED, 2 Channel Single mode
													7V 7V RS422, 2 Channels, Dual ClockV

Ordering Notes:

- 1 - For vertical mounting order codes, please visit our online store
- 2 - To view the latest options available for the N60, or to order the UR Classic Front Panel, please visit our online store for more details.

Accessories for the N60

- UR Applications I Learning CD TRCD-URA1-C-S-1
- Multilink Ethernet Switch ML2400-F-HI-HI-A2-A2-A6-G1
- Viewpoint Engineer VPE-1
- Viewpoint Maintenance VPM-1
- Viewpoint Monitoring IEC 61850 VP-1-61850

Visit www.GEMultilin.com/N60 to:



- View guideform specifications
- Download the instruction manual
- Review applications notes and support documents
- Buy a N60 online
- View the UR Family brochure