M60

MOTOR PROTECTION SYSTEM

Comprehensive protection for medium to large motors

KEY BENEFITS

- Improved protection sensitivity through a flexible and powerful thermal model including Standard, Custom, and Voltage Dependant Overload curves
- Complete IEC 61850 Process Bus solution providing resource optimization and minimizing total P&C life cycle costs
- Simplified programming with the EnerVista™ M60 motor settings auto-configurator
- Robust network security enabling Critical Infrastructure Protection through user command logging, and dual permission access control
- Integrated automation and process control functions
- Application flexibility with multiple I/O options and programmable logic (FlexLogic™)
- High-end fault and disturbance recording
- Reduced relay to relay wiring and associated installation costs through high-speed inter-relay communications
- Enhanced motor learned data provides critical information for preventative maintenance
- Ambient temperature monitoring with alarming when outside temperature exceeds upper thresholds

APPLICATIONS

- Protection and control of medium to large thee phase induction motors of most popular construction types
- Automation or Process Control functionality
- Protection of medium to large synchronous motors when paired with the SPM Synchronous Motor Protection System
- Stand-alone protection or component in automated substation control system

FEATURES

Protection and Control

- Enhanced Thermal Model with RTD and current unbalance compensation
- Stator Differential
- Mechanical Jam / Stall
- Short Circuit Tripping
- Under Current / Under Power
- Phase Reversal
- Reverse/Low Forward Power protection
- Two speed motor protection
- Reduced voltage starting
- Optional Internal RTDs & External RTD Module

Communications

- Networking interfaces – 100Mbit Fiber Optic Ethernet, RS485, RS232, RS422, G.703, C37.94
- Multiple Protocols - IEC 61850, DNP 3.0 Level 2, Modbus RTU, Modbus TCP/IP, IEC 60870-5-104
- DeviceNet and Profibus protocols options available using the D485 and P485 protocol convertors
- Direct I/O – secure, high-speed exchange of data between URs for Direct Transfer Trip applications
- Embedded Managed Ethernet Switch with 4 - 100 Mbit Fiber optic ports and 2 copper ports

IEC 61850 Process Bus Interface

- Robust communications with up to 8 HardFiber Bricks
- Seamless integration with existing G60 functions
- Redundant architecture for dependability and security

Monitoring and Metering

- Metering - current, voltage, power, energy, frequency
- Oscillography – analog and digital parameters at 64 samples/cycle
- Event Recorder - 1024 time tagged events with 0.5ms scan of digital inputs
- Data Logger - 16 channels with sampling rate up to 1 sample / cycle
- Setting Security Audit Trail for tracking changes to M60 configuration
- Motor Starting characteristics for the last 250 motor starts

EnerVista™ Software

- Graphical Logic Designer and Logic Monitor to simplify designing and testing procedures
- Maintenance software to reduce troubleshooting and system maintenance
- EnerVista™ Integrator providing easy integration of data in the M60 into new or existing monitoring and control systems

Protection and Control

The M60 Motor Protection System offers comprehensive protection and control solutions for medium to large sized three phase motors. The M60 includes advanced automation and communication capabilities, extensive I/O options, and powerful fault recording features that can simplify postmortem fault analysis and help minimize motor downtime. As part of the UR Family, the M60 provides superior protection and control that includes:

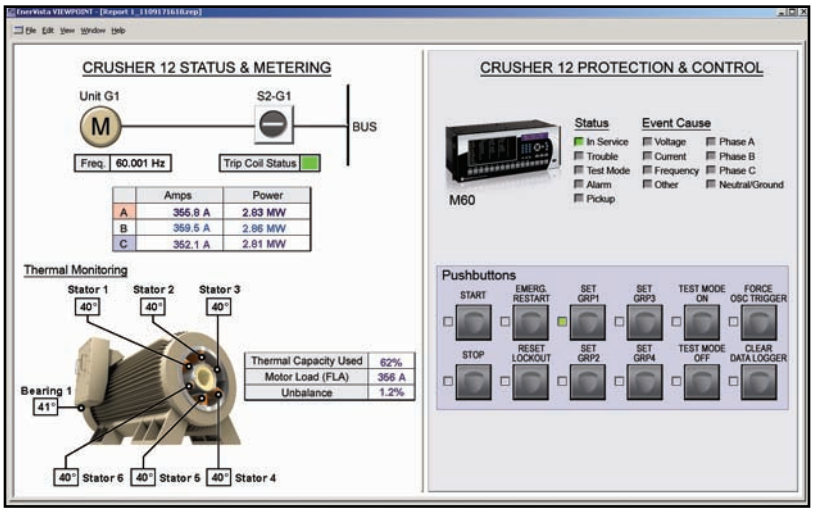
Motor Thermal Model

The M60 features an enhanced Motor Thermal Model consisting of the following elements:

- Thermal limit curves - NEMA standard, voltage dependent and customized
- IEC 60255-8 Thermal overload curves
- Current unbalance biasing
- Independent running and stopped exponential cooling curves
- Optional RTD biasing of the Thermal Model to adapt to real-time temperature measurements
- Compensation for Hot/cold motor conditions

The M60 thermal model integrates both stator and rotor heating and cooling into a single model.

M60 - Protection, Metering, Monitoring and Control



The M60 provides protection, control, metering, and monitoring in a single device, easily integrated into existing HMI or SCADA monitoring and control systems

FlexCurves™

For applications that require greater flexibility, FlexCurves™ can be used to define custom curve shapes. These curves can be used to protect motors with different rotor and stator damage curves, allowing complete protection over the total motor capacity.

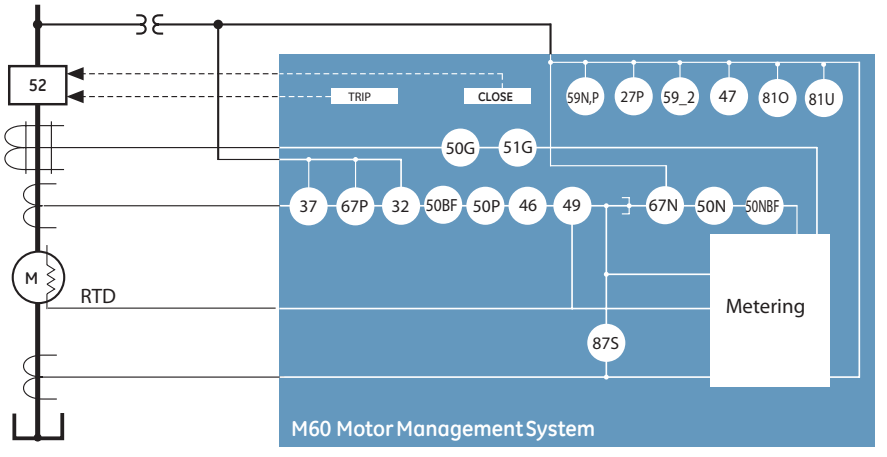
Overtemperature Protection

The M60 supports up to 16 programmable RTD inputs that allow for configuring the Alarming and Tripping Temperature of each RTD, detecting RTD shorting conditions, and selecting RTD voting that requires more than one RTD to detect an over-temperature condition before it will issue a Trip command.

Mechanical Jam

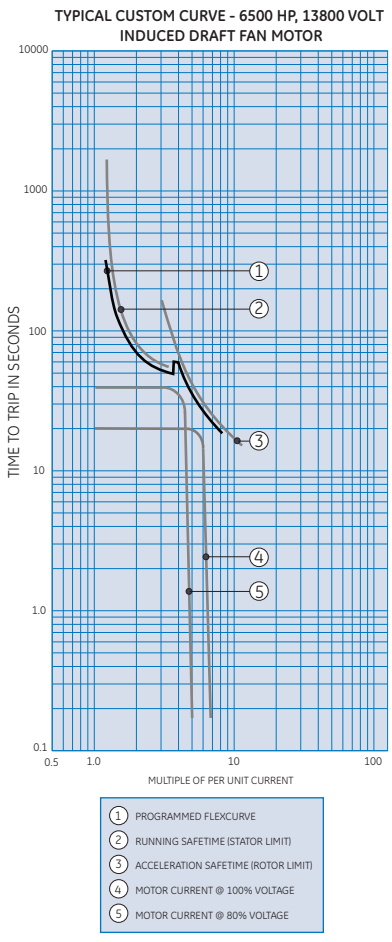
The Mechanical Jam element senses increased loading associated with process or load related faults such as a overloaded conveyor. A programmable delay setting can be used to allow the process to attempt clear itself before issuing a trip.

Functional Block Diagram

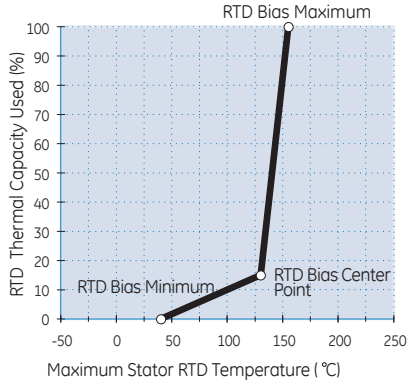


ANSI Device Numbers & Functions

Device Number	Function
27P	Phase Undervoltage
27X	Auxiliary Undervoltage
32	Sensitive Directional Power
37	Under Current
46	Current Unbalance
47	Phase Sequence Voltage
49	Thermal Overload
50BF	Breaker Failure
50G	Ground Instantaneous Overcurrent
50P	Phase Instantaneous Overcurrent
51G	Ground Time Overcurrent
59N	Neutral Overvoltage
59P	Phase Overvoltage
59X	Auxiliary Overvoltage
59_2	Negative Sequence Overvoltage
66	Starts Per Hour, Time Between Starts
67N	Neutral Directional Overcurrent
67P	Phase Directional Overcurrent
87S	Stator Differential
81O	Over Frequency
81U	Under Frequency
---	Mechanical Jam
---	Under Power



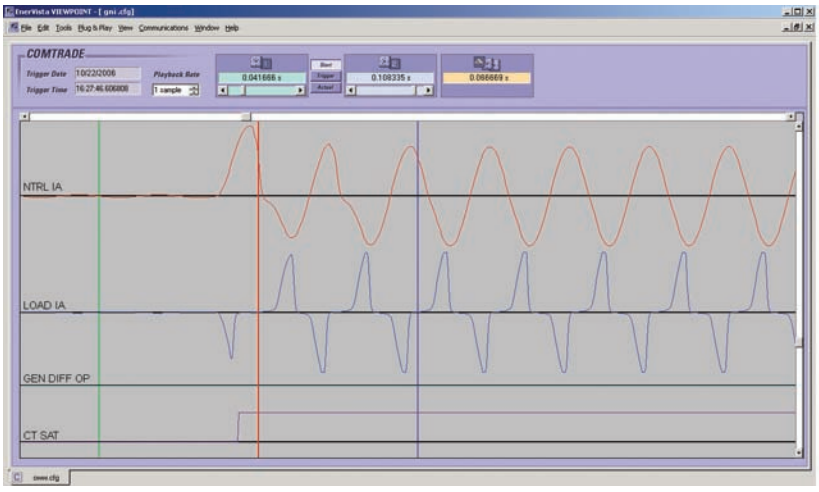
Typical FlexCurve™ overload curve



RTD Bias curve.

Acceleration Time

The M60 protects the motor from overheating in cases of abnormal loading during motor starts. The motor can be tripping if the motor does not reach a running condition within the programmable Motor Acceleration time



The M60 Percent Differential Element has enhanced saturation detection algorithms to provide additional security against AC and DC saturation that can occur during faults near the Motor.

Stator Differential

The M60 provides Stator Differential Protection for fast clearing of stator phase faults. Advanced CT saturation detection algorithms as well as dual slope characteristic are incorporated for increased security during heavy faults

Short Circuit Protection

Short Circuit Overcurrent protection protects damage to the motor during a locked rotor condition. The M60 comes with up to 8 Instantaneous Overcurrent elements that can be configured for protection, alarming, and control during locked rotor conditions.

Start Inhibit

The Start Inhibit function prevents starting of a motor when the motor is too hot and does not have a sufficient amount thermal capacity available to allow a start without being tripped offline.

Breaker Failure Protection

The Breaker Failure protection element monitors for timely operation of the connected breaker. If a trip command is not successful in operating the breaker and clearing the fault, the breaker failure element can be used to send trip signals to upstream breakers to clear the fault

Undercurrent Protection

The Undercurrent Protection element provides the ability of tripping the motor due to external conditions that can cause the load being pulled by the motor to drop below a pre-set level. This element is useful when the loss of the load results in a loss of cooling which will cause the asset to overheat.

Overfrequency / Underfrequency Protection

The Overfrequency and Underfrequency protection element provides the ability to detect when the motor is operating at off-nominal frequencies that can damage to the process or, to signal to upstream protections or controls to implement load-shedding actions.

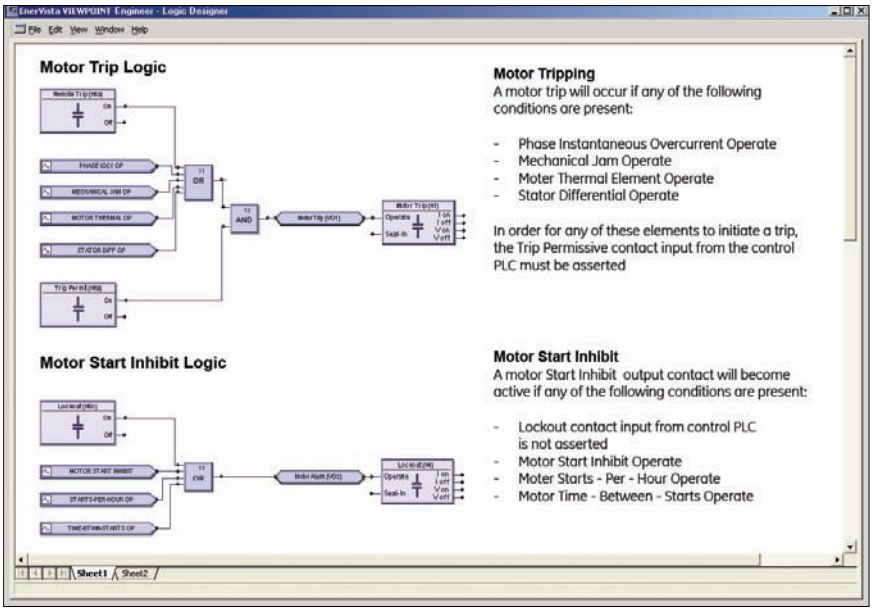
RTD Protection (Module Option 5C)

The M60 RTD option provides 8 programmable RTD inputs per module that are used for monitoring the Stator, Bearing and the ambient temperatures. Each RTD input has 2 operational levels: alarm and trip. The M60 supports RTD trip voting and provides open RTD failure alarming. Alternatively, a remote RTD module "RRTD", which supports 12 RTD inputs, can also be used with the M60 for temperature monitoring. The RRTD provides cost savings compared to standard RTD wiring.

Two-Speed Motor Protection

The Two-Speed Motor protection feature allows for protection of motors that can operate at two different speeds and have different full load capacity levels at each speed. This feature can be used on motors that have two sets of windings on each stator where each set is used to operate the motor at a different speed.

FlexLogic™ Designer



Flexlogic™ allows for customizing the M60 to operate and control the breakers and other auxiliary devices needed to fit most Motor protection schemes and applications.

Underpower Protection

The Underpower protection feature provides for sensitive detection of a loss of load condition. The Underpower protection element can be more sensitive for detecting loss of load conditions caused by process related problems than is possible using a standard under undercurrent element.

Reduced Voltage Starting

The Reduced Voltage Starting feature can provide the controls for signaling the motor to switch over from a reduced voltage that is being used during starting, to the full voltage for motor running operation. This feature can issue the command to switch to full operating voltage by detecting the motor load has reached a pre-set current level, that a time delay after starting has elapsed, or both of these conditions combined.

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 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
- Integrates with existing G60'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.

Advanced Automation

The M60 incorporates advanced automation features including powerful FlexLogic™ programmable logic, communication, and SCADA capabilities that far surpass what is found in the average motor protection relay. The M60 integrates seamlessly with other UR relays for complete system protection, including the adjacent motors, feeders and other Balance of Plant protections.

FlexLogic™

FlexLogic™ is the powerful UR-platform programming logic engine that provides the ability of creating customized protection and control schemes thereby minimizing the need, and the associated costs, of auxiliary components and wiring. Using FlexLogic™, the M60 can be programmed to provide required tripping logic along with custom scheme logic for Motor breaker control (including interlocking with internal motor start supervision and synchrocheck) interlocking schemes with adjacent protections (for example preventing sympathetic tripping of healthy feeders) and dynamic setting group changes.

Scalable Hardware

The M60 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.

- Multiple CT/VT configurations allow for implementation of many protection schemes, including applications with high impedance machine grounding
- RTD inputs allow biasing of the motor thermal model, as well as overtemperature protection of the Stator, bearings, and other heat sensitive components of the motor
- Types of digital outputs include trip-rated Form-A and Solid State Relay (SSR) mechanically latching, and Form-C outputs
- DCmA inputs are available to monitor equipment and process parameters

Monitoring and Metering

The M60 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.

Advanced Device Health Diagnostics

The M60 performs advanced motor health diagnostics and records this information for each of the last 250 consecutive motor starts. Analyzing this diagnostic

information for operating parameters that have changed over these successive starts can indicate maintenance requirements before damage occurs and costly repairs are required

For each motor start, the M60 will provide a record that contains the following information:

- Date of each motor start
- Motor acceleration time
- Motor starting current
- Motor thermal capacity used during starts
- Average motor load
- Running time after a start

Advanced Motor Diagnostics

The Multilin M60 provides advanced motor diagnostics including a broken rotor bar detection function. The broken rotor bar detection is a condition maintenance function that continuously monitors the motor's health while in operation. The advanced Motor Current Signature Analysis (MCSA) continuously analyzes the motor current signature and based on preset algorithms will determine when a broken rotor bar is present in the motor.

With fully programmable alarms, the broken rotor bar function will provide early detection of any rotor problems and advise maintenance personnel of the impending issue allowing for predictive maintenance of the motor and prevention of catastrophic motor failures.

By providing early indication of potential rotor problems, serious system issues such as: reduced starting torque, overloads, torque and speed oscillation and bearing wear can be avoided. With the advanced broken rotor bar detection system, advanced warning of impending problems reduces catastrophic failures, maximizing motor life and system uptime.

Fault and Disturbance Recording

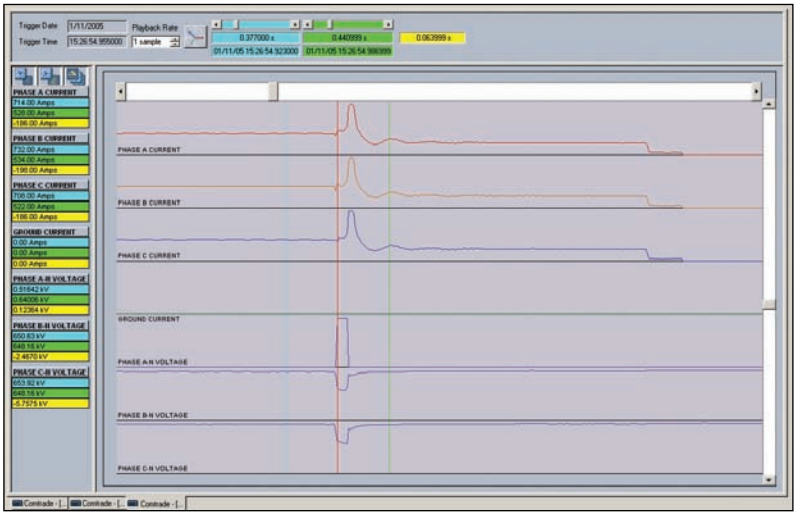
The advanced disturbance and event recording features within the M60 can significantly reduce the time needed for postmortem analysis of power system events and creation of regulatory reports. Recording functions include:

- Sequence of Event (SOE)
  - 1024 time stamped events
- Oscillography,
  - 64 digital & up to 40 Analog channels
- Data Logger, disturbance recording
  – 16 channels up to 1 sample / cycle / channel

The very high sampling rates and the large amount of storage space available for data recording in the M60 can eliminate the need for installing costly standalone recording equipment.

Power System Troubleshooting

The M60 contains many tools and reports that simplify and reduce the amount of time required for troubleshooting power system events.



Analyze motor operating characteristics by recording analog waveforms during system voltage recovery.

Communications

The M60 provides advanced communications technologies for remote data and engineering access, making it the easiest and most flexible Motor 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 redundant Ethernet option and the embedded managed Ethernet switch provide the means of creating fault tolerant communication architectures in an easy, cost-effective manner without the need for intermediary communication hardware.

The M60 supports the most popular industry standard protocols enabling easy, direct integration into DCS and SCADA systems.

- IEC 61850
- DNP3.0
- Ethernet Global Data (EGD)
- IEC 60870-5-104
- Modbus RTU, Modbus TCP/IP

Interoperability with Embedded IEC 61850

Use the M60 with integrated IEC 61850 to lower costs associated with substation protection, control and automation. GE Energy's leadership in IEC 61850 comes from thousands 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

Direct I/O Messaging

Direct I/O allows for 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 blocking 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 – no external or handheld tester required

Multi-Language

The M60 supports English, French, Russian, Chinese and Turkish Languages on the front panel, EnerVista setup software, and product manual. 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 M60 relay. The EnerVista™ suite provides all the tools to monitor the status of your motor, maintain your relay, and integrate information measured by the M60 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
- FAQs
- Service Bulletins

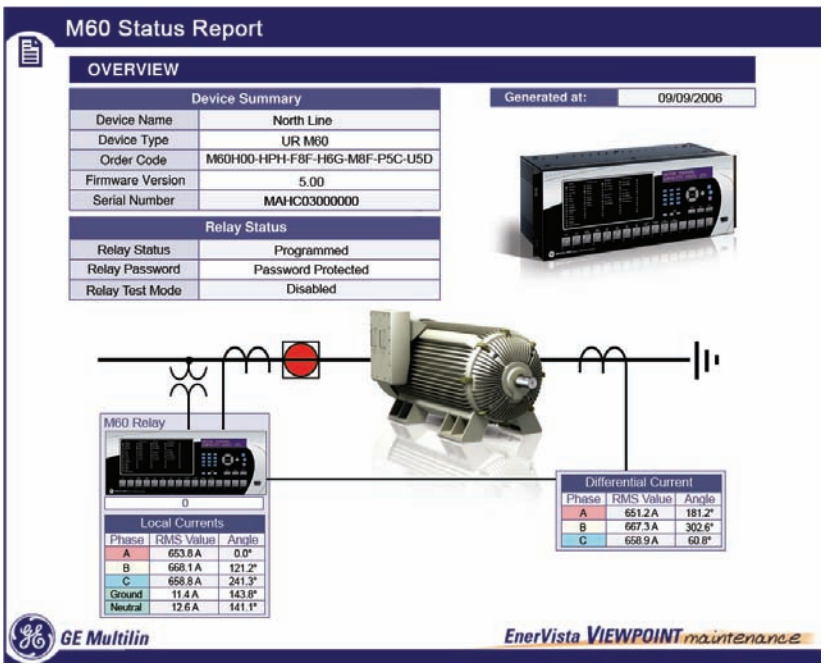
The UR Setup software now contains an M60 **Motor Setting Auto-Configurator** that configures all of the settings required to protect and control a motor in six simple steps. Simply entering the motor nameplate data, the CT and VT parameters, motor starting data, and application information, will allow the UR Setup Software to generate a complete setting file customized for protecting and controlling the motor.

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

Simplifying Commissioning and Testing



The internal operation of the M60 elements, logic, and outputs can be monitored in real time to simplify commissioning and troubleshooting procedures

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 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:

- Security/Change History Report
- Device Health Report
- Single Click Fault Data Retrieval

EnerVista™ Integrator

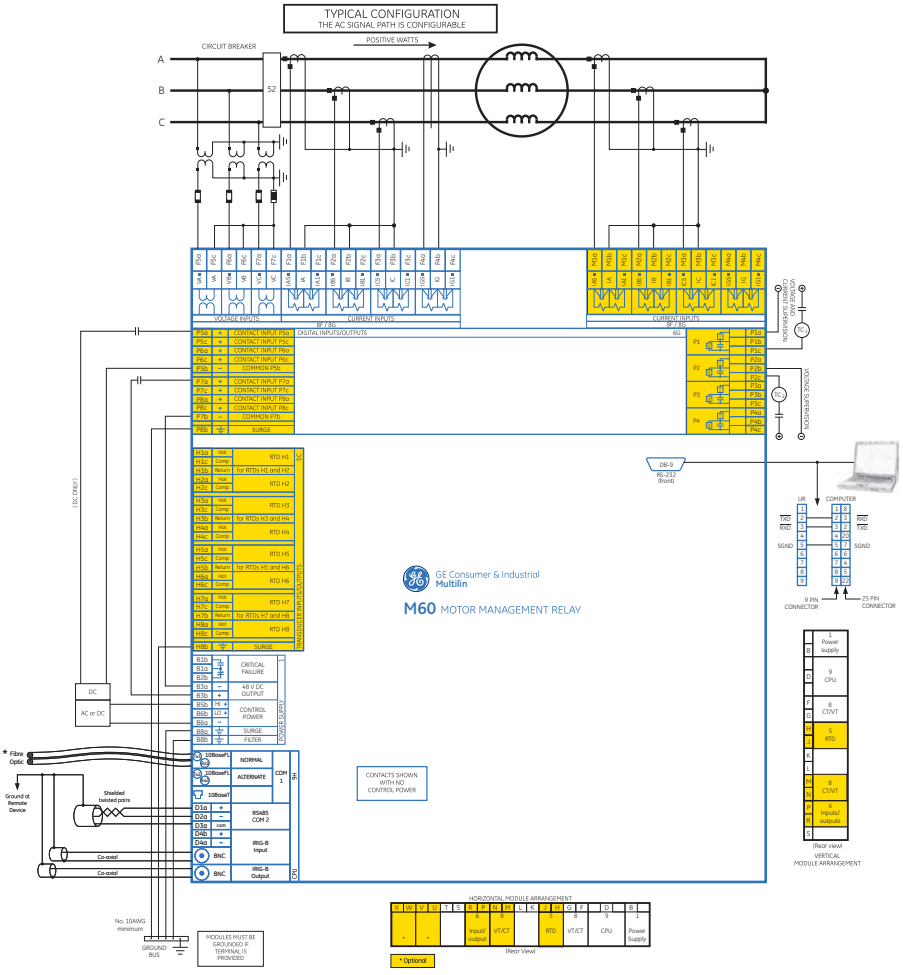
EnerVista™ Integrator is a toolkit that allows seamless integration of Multilin devices into new or existing automation systems. Included in EnerVista™ Integrator is:

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

User Interface

The M60 front panel provides extensiv local HMI capabilities. The local displa is used for monitoring, status messaging fault diagnosis, and device configuratior User configurable messages that combin text with live data, can be displayed whe user-defined conditions are met.

Typical Wiring



Ordering

	M60 -	*	00	- H	*	* -	F ** -	H ** -	M ** -	P ** -	U **	- W/X**	For full sized horizontal mount
Base Unit	M60												Base Unit
CPU		E											RS485 + RS485 (IEC 61850 option not available)
		G											RS485 + Multi-mode ST 10BaseF
		H											RS485 + Mutli-mode ST Redundant 10BaseF
		J											RS485 + Multi-mode ST 100BaseFX
		K											RS485 + Multi-mode ST Redundant 100BaseFX
		N											RS485 + 10/100 BaseT
		S											RS485 + 6 port, 100 Mbps, Managed Ethernet Switch
Software Options			00										No Software Options
			03										IEC 61850
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					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
					F								Vertical Front Panel with English display
					W								Enhanced Turkish Front Panel
					Y								Enhanced Turkish Front Panel with User-Programmable Pushbuttons
Power Supply						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)
						L						RL	24 - 48 V (DC only) with redundant 24 - 48 V (DC only)
CT/VT DSP							8L		8L				Standard 4CT/4VT w/ enhanced diagnostics
							8M		8M				Sensitive Ground 4CT/4VT w/ enhanced diagnostics
							8N		8N				Standard 8CT w/ enhanced diagnostics
							8R		8R				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	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								5C	5C	5C	5C	5C	8 RTD Inputs
								5E	5E	5E	5E	5E	4 dcmA Inputs, 4 RTD Inputs
								5F	5F	5F	5F	5F	8 dcmA Inputs
Inter-Relay Communications												7A	820 nm, multi-mode, LED, 1 Channel
												7B	1300 nm, multi-mode, LED, 1 Channel
												7H	820 nm, multi-mode, LED, 2 Channels
												7I	1300 nm, multi-mode, LED, 2 Channels
												2S	6 port, 100 Mbps, Managed Ethernet Switch, HI (125/250V AC/DC)
												2T	6 port, 100 Mbps, Managed Ethernet Switch, LO (24-48 Vdc)

Ordering Note:

1 - For vertical mounting order codes, please visit our online store

2 - To view the latest options available for the M60, or to order the UR Classic Front Panel, please visit our online store for more details.

Accessories for the M60

• UR Applications I Learning CD	TRCD-URA1-C-S-1
• Multilink Ethernet Switch	ML2400-F-HI-HI-A2-A2-A6-G1
• Remote RTD Module	RRTD
• Viewpoint Engineer	VPE-1
• Viewpoint Maintenance	VPM-1
• Viewpoint Monitoring IEC 61850	VP-1-61850
• D485 DeviceNet Converter	D485-C
• P485 Profibus Converter	P485-C

Visit www.GEMultilin.com/M60 to:

- View Guideform specifications
- Download the instruction manual
- Review applications Notes and support documents
- Buy a M60 online
- View the UR Family brochure