

Multilin™ M60

MOTOR PROTECTION SYSTEM

Comprehensive Protection for Medium to Large Motors



KEY BENEFITS

- Advanced motor protection and control elements including a flexible and powerful thermal model and standard, custom and voltage dependant overload curves
- Integrated automation and process control functions
- Simplified programming with the EnerVista™ M60 motor settings auto-configurator
- Three independent fiber or copper Ethernet ports for simultaneous/dedicated network connections with 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
- 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
- Enhanced motor-learned data provides critical information for preventative maintenance
- Complete IEC 61850 Process Bus solution provides resource optimization and minimizes total P&C life cycle costs

APPLICATIONS

- Protection and control of most popular construction type medium to large three-phase induction motors
- 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
- CT failure for each CT bank, VT fuse failure

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, EGD
- DeviceNet and Profibus protocol options available using the D485 and P485 protocol converters
- Direct I/O: secure, high-speed exchange of data between URs for direct transfer trip (DTT) applications

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 M60 configurations
- Motor starting characteristics for the last 250 motor starts

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 M60 into new or existing monitoring and control systems



imagination at work

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 Universal Relay (UR) family, the M60 provides superior protection and control that includes:

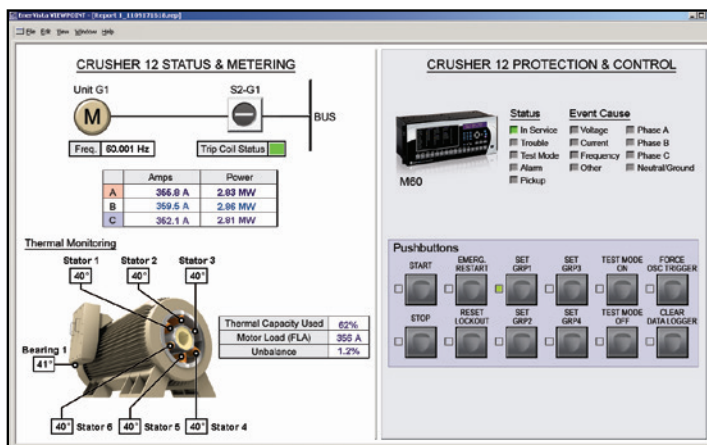
Motor Thermal Model

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 the configuration of the alarm and trip 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.

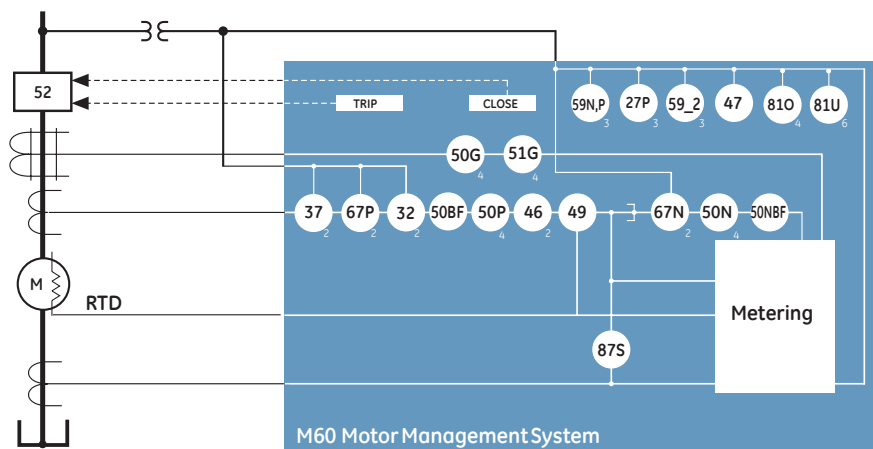
Mechanical Jam

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

Acceleration Time

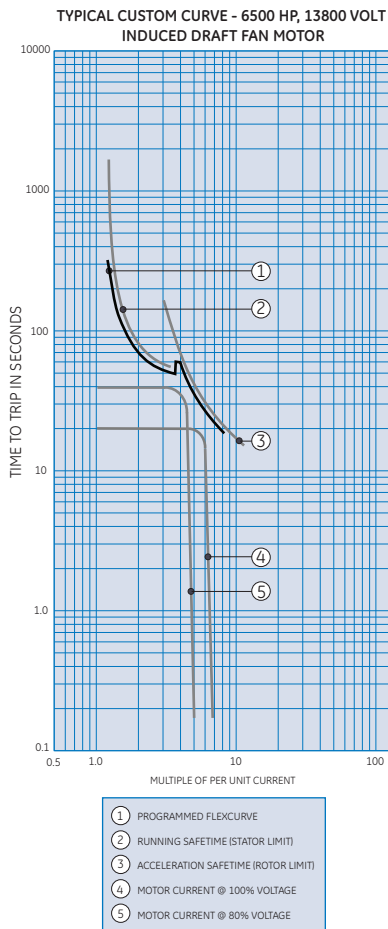
The M60 protects the motor from overheating in cases of abnormal loading during motor starts. The motor can be tripped if the motor does not reach a running condition within the programmable motor acceleration time.

Functional Block Diagram

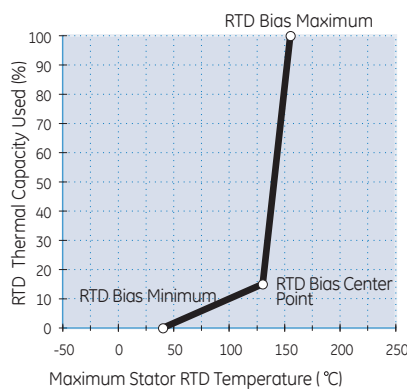


ANSI Device Numbers & Functions

Device Number	Function
27P	Phase Undervoltage
27X	Auxiliary Undervoltage
32	Sensitive Directional Power
37	Under Power
46	Current Unbalance
47	Phase Sequence Voltage
49	Thermal Overload
50BF	Breaker Failure
50G	Ground Instantaneous Overcurrent
50N	Neutral 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	Overfrequency
81U	Underfrequency
---	Mechanical Jam
---	Under Power



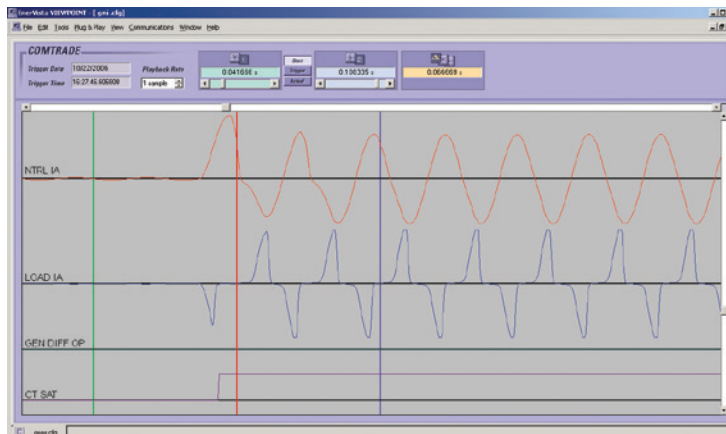
Typical FlexCurve overload curve.



RTD bias curve.

Stator Differential

The M60 provides stator differential protection for fast clearing of stator phase faults. Advanced CT saturation detection algorithms and dual-slope characteristics are incorporated for increased security during heavy faults.



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.

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 the starting of a motor when the motor is too hot and does not have a sufficient amount of 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 to trip the motor due to external conditions that can cause the load being pulled by the motor to drop below a preset level. This element is useful when the loss of the load results in a loss of cooling which will cause the asset to overheat.

Under/Over Frequency Protection

The under/over frequency protection element detects when the motor is

operating at off-nominal frequencies (which can damage the process) or signals to upstream protection or control 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 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 with standard RTD wiring.

Two-Speed Motor Protection

The two-speed motor protection feature allows for the 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.

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 undercurrent element.

Reduced Voltage Starting

The reduced voltage starting feature provides the controls for signaling the motor to switch over from a reduced voltage (that is used during startup) to the full voltage for motor running operation. This feature can issue the command to switch to full operating voltage, by detecting: a) if the motor load has reached a preset current level, or b) if a time delay has elapsed (after starting), or c) 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 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 M60'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 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 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 M60 can be programmed to provide the 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 the 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 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 up to 45s in length
- Data Logger and 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 stand-alone recording equipment.

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 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 three independent Ethernet ports, 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 with 61850-90-5 support
- 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

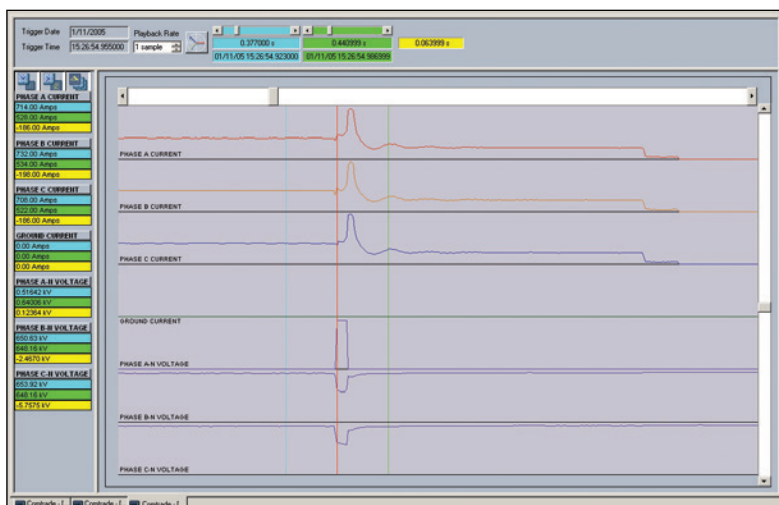
Interoperability with Embedded IEC 61850

Use the M60 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

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.

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 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 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 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 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.

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 UR Engineer

Viewpoint UR Engineer is a set of powerful tools that allows 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:

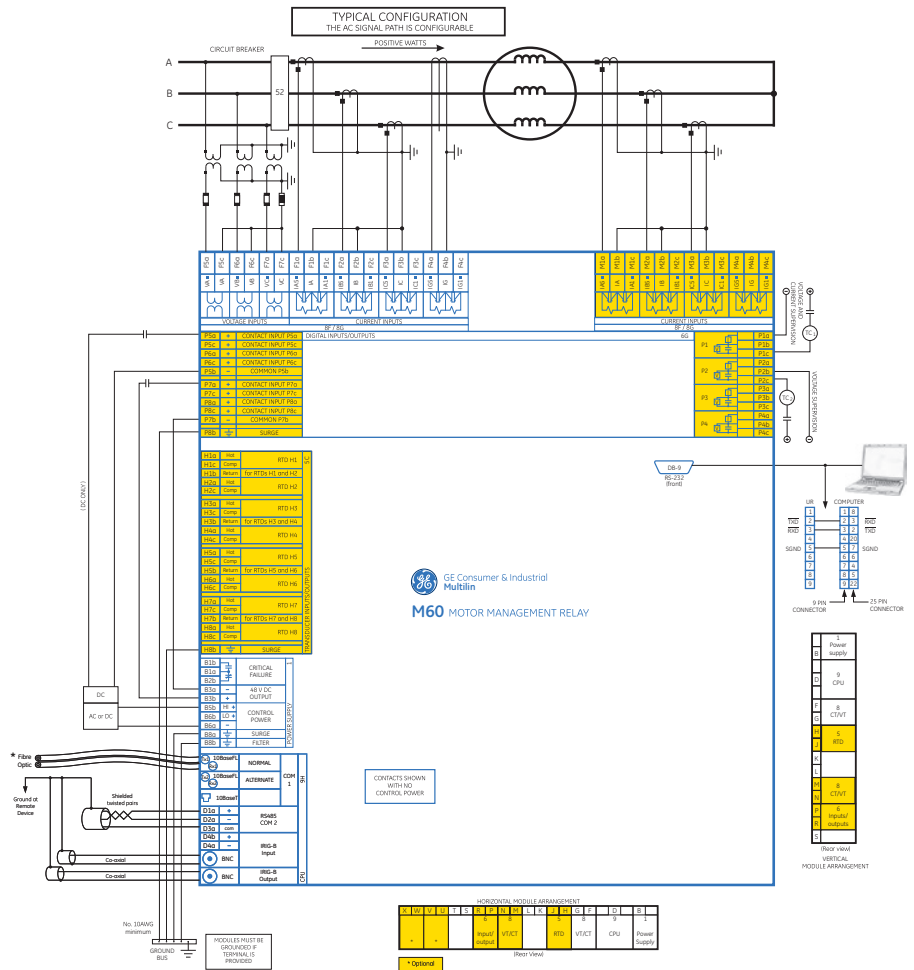
- Security/Change History Report
- Device Health Report
- Single-Click Fault Data Retrieval

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:

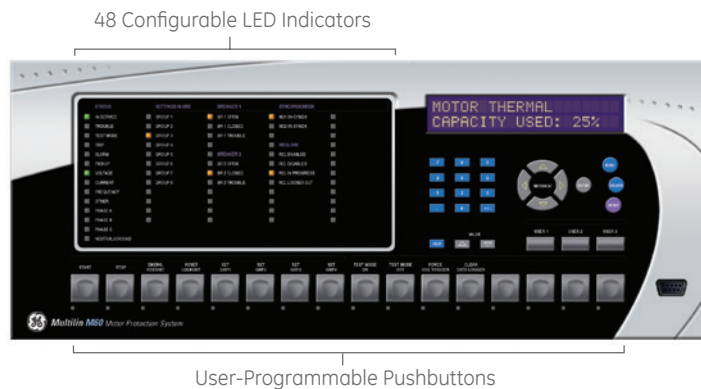
- OPC/DDE Server
- Multilin Drivers
- Automatic Event Retrieval
- Automatic Waveform Retrieval

Typical Wiring



User Interface

The M60 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.



- Multi-Language Display
- English
 - Russian
 - French
 - Chinese
 - Turkish
 - German

