



Multilin™ MM300 Enhanced

Integrated Automation and Protection for Low Voltage Motors

The MM300 Enhanced integrates protection, control, automation, metering, diagnostics and multiple communication protocols in a rugged compact device for low voltage motor applications. Designed for NEMA and IEC Motor Control Centers, the MM300 delivers superior protection and control to extend equipment life and maximize process uptime.

Key Benefits

- Full-featured protection for low voltage AC motors
- Advanced automation capabilities for providing customized protection and integrated process control
- Advanced FlexLogic™ reduces requirement for local controllers
- Reduced space requirements through integration of multiple devices
- Enhanced troubleshooting tools including sequence of event records and waveform capture
- Powerful communications including serial, Ethernet (single/redundant) and Profibus protocols
- CyberSentry™ Advanced Security including features such as AAA, Radius, RBAC, and Syslog helps NERC® CIP compliance
- Small form factor and remote display options designed to fit in MCC buckets of various types
- Universal device for all motor power ratings
- No CTs required for less than 5A motor ratings
- Thermistor input to monitor the ambient or motor temperature
- Support for Hand Held Display (HHD) that provides a graphical color local interface allowing local operators to view and change setting files and quickly access relay diagnostic information

Applications

- Low Voltage three phase AC motors
- MCC or stand alone panel mount applications
- Process control and applications requiring automation or control i.e. conveyor systems or well recovery pumps
- IEC or NEMA class motors and Motor Control Centers (MCCs)
- System architecture requiring multiple simultaneous communications
- Applications requiring full-voltage reversing or non-reversing, two-speed, wye-delta open transition, inverter, soft starter or autotransformer motor starting

Protection and Control

- Enhanced Thermal Modeling
- Mechanical Jam & Stalled Rotor
- Undercurrent & Underpower
- Acceleration Time & Current Unbalance
- Phase Overcurrent (IOC & TOC)
- Ground & Sensitive Ground Fault
- Phase Overvoltage / Undervoltage
- Thermistor & RTD Overtemperature

Automation

- Programmable Flexlogic™ option
- Starter Control & Process Interlocks
- Programmable Inputs and Outputs
- Undervoltage Auto-restart

Metering & Monitoring

- Metering - current, voltage, power, energy, frequency, power factor, RTD & thermistor
- Oscillography (@32 samples/cycle), Motor Start Records, Event Recorder, Fault Recorder, Last Trip Data & Datalogger
- Advanced Motor Health report

Communications

- Two wire RS485, up to two RJ45 Ethernet
- Programming ports - USB, RS485, Ethernet
- Multiple protocols (Modbus RTU or TCP, internally powered Profibus, IEC61850 Ed.2, IEC 62439-3 (PRP / HSR)
- IEEE 1588 (PTP) and SNTP time synchronization

EnerVistaFlex Toolsuite

- Simplify setup and configuration
- Powerful maintenance tool and troubleshooting tool
- Testing facility



Protection and Control

The MM300 Enhanced is a digital motor protection and control system, designed for Low Voltage motor applications. Flexible and powerful, the MM300 Enhanced's protection can be scaled to the specific requirements of your system.

Motor Thermal Model

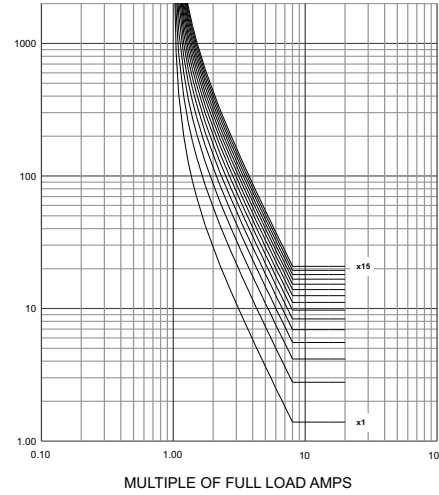
To provide optimal protection and maximize run time, the MM300 Enhanced employs an advanced thermal model, consisting of six key elements:

- Overload Curves
- Unbalance Biasing
- Hot/Cold Safe Stall Ratio
- Motor Cooling Time Constants
- Start Inhibit and Emergency Restart
- RTD Biasing (Optional)

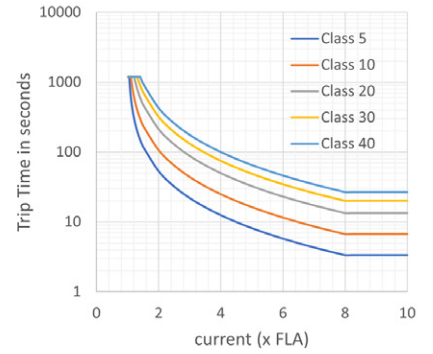
Overload Curves

The MM300 Enhanced's thermal model can be programmed with one of 15 standard overload curves. Additionally, IEC trip class curves 5,10,20,30,40 are also supported according to IEC 60947-4-1. This facilitates better thermal protection for different motor applications.

When properly selected to match the motor manufacturer's thermal damage curves, the MM300 Enhanced overload curve and overload pickup level will determine the thermal capacity accumulated within the motor.



15 Standard Curves available in the MM300 Enhanced



IEC Trip Class Curves supported in MM300 Enhanced

Unbalance (Negative Sequence) Biasing

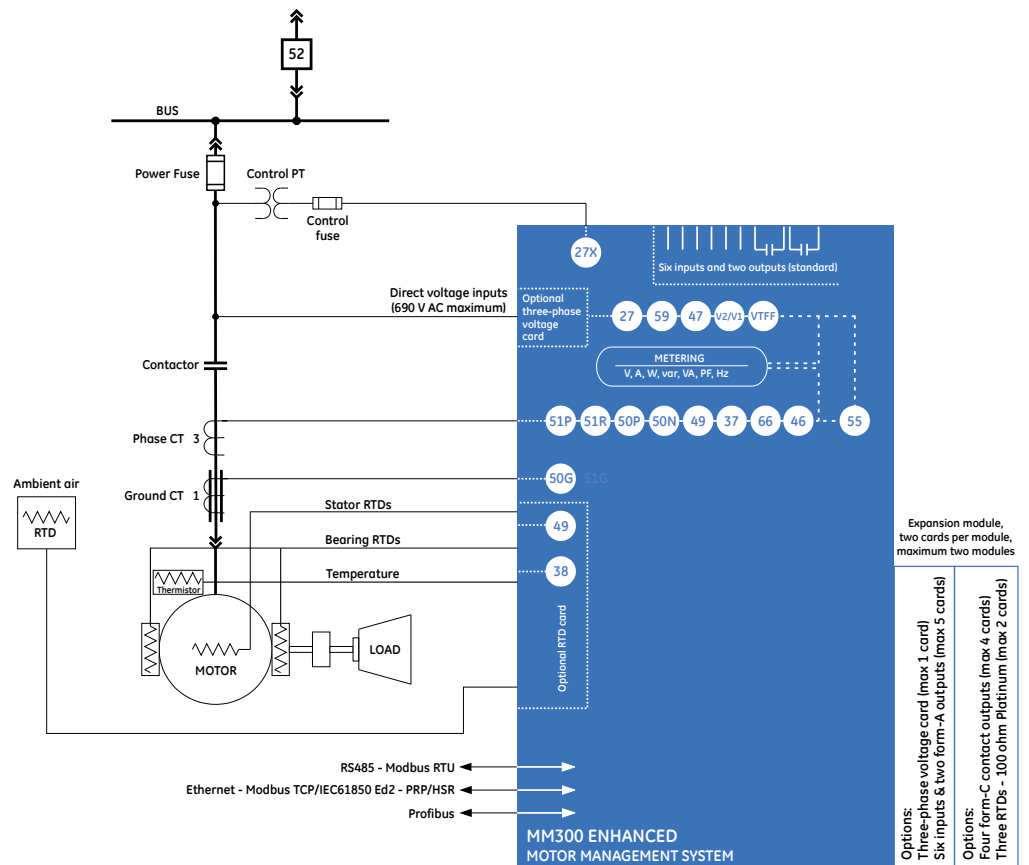
Negative sequence current, which causes additional rotor heating, is not accounted for in the thermal limit curves provided by the manufacturer.

The MM300 Enhanced measures current unbalance as a ratio of negative to positive sequence current. The thermal model is then biased to reflect the additional rotor heating. A programmable K factor setting allows the amount of derating to be adjusted.

Functional Block Diagram

ANSI® Device Numbers & Functions

DEVICE NUMBER	FUNCTION
27AUX	Undervoltage - Auxiliary Input
27	Undervoltage - Three Phase
37	Undercurrent/Underpower
38	Bearing Temperature RTD
46	Current Unbalance
47	Voltage Phase Reversal
49	Thermal Overload
50P	Phase Instantaneous Overcurrent
51P	Phase Time Overcurrent
50G	Ground Instantaneous Overcurrent
50N	Neutral Instantaneous Overcurrent
51R	Locked/Stalled Rotor/Mechanical Jam
55	Power Factor
59	Overvoltage - Three Phase
60VTS	Fuse Failure
66	Starts/Hour & Time Between Starts

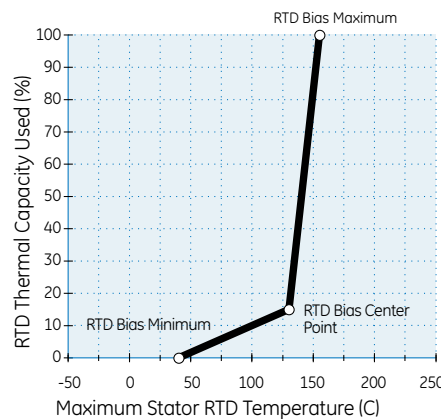


Hot / Cold Safe Stall Ratio

This ratio defines the steady state level of thermal capacity used (TCU) by the motor. This level corresponds to normal operating temperature of a fully loaded motor and will be adjusted proportionally if the motor load is lower than rated.

Motor Cool Time Constants

When the MM300 Enhanced detects that the motor is running at a load lower than the overload pickup setpoint or the motor is stopped, it will start reducing the TCU value exponentially, based on the programmed cool time constants. As cooling occurs at different rates for stopped and running motors, two separate constants are used.



RTD Biasing curve

RTD Biasing

The Thermal Model relies solely on measured current to determine motor heating, assuming an ambient temperature of 40°C and normal motor cooling. The actual motor temperature will increase due to abnormally high ambient temperatures or if the motor cooling systems have failed. RTD Biasing enhances the motor thermal model by calculating the thermal capacity used based on available Stator RTD temperatures.

RTD Biasing does not replace the TCU calculated using the motor current. It provides a second and independent measure of thermal capacity used. Based on a programmable curve, the MM300 Enhanced will calculate the TCU at any given temperature. This TCU is then compared to that of the thermal model, and the larger of the two will be used.

To protect against faulty stator RTD's, a TCU of 100% based on RTD Biasing will not cause a trip to be issued unless the motor current has exceeded the Overload Pickup Level.

Motor Start Supervision

Motor Start Supervision consists of the following features: Time-Between-Starts, Start-per-Hour, Restart Time.

These elements guard the motor against excessive starting duty, which is normally defined by motor manufacturer in addition to the thermal damage curves.

Mechanical Jam and Acceleration Time

These two elements are used to prevent motor damage during abnormal operating conditions such as driven load jams and excessively long acceleration times

Ground Fault

This function is designed to protect motors against phase to ground faults. The MM300 Enhanced comes with two separate ground CT inputs intended for one of two different ground measurement modes:

- Core balance (Zero sequence) .
- Residual

Undercurrent / Underpower

The undercurrent function is used to detect a decrease in motor current caused by a decrease in motor load. This is especially useful for indication of conditions such as: loss of suction for pumps, loss of airflow for fans, or a broken belt for conveyors. A separate undercurrent alarm may be set to provide early warning.

Phase Overcurrent

Multiple independent stages for phase overcurrent element available to set it for Definite time or IDMT operation. Additional to the definite time and predefined IDMT curve selection, programmable/user defined curves for customized operation and resetting are available.

Current Unbalance

In addition to thermal model biasing, current unbalance is available in the MM300 Enhanced relay as an independent element with a built-in single phasing detection algorithm.

Voltage Protection

The MM300 Enhanced has a single phase voltage input as standard, providing single phase underpower, auxiliary undervoltage and optional undervoltage auto-restart.

Optional 3 phase voltage inputs offer the additional following protection elements:

- Undervoltage
- Overvoltage
- Phase Reversal
- Three Phase Underpower
- VT Fuse Failure

Voltage Unbalance

The MM300 Enhanced provides monitoring of voltage unbalance condition to protect motor from severe damage due to overheating. Voltage unbalance element detects asymmetrical system voltage condition, loss of one or two phases of the source, or reversed phase sequence of voltages. Voltage unbalance is measured using the negative to positive sequence voltages ratio that reflects asymmetry in phase voltages with unequal magnitudes, phase shifts that are not equal to 120 degrees, or a combination of both.

Motor Power Factor Protection

The MM300 Enhanced provides monitoring of the Power Factor. Once the power factor is less than either the Lead or Lag level, for the specified delay, a trip or alarm will occur indicating a Lead or Lag condition. The power factor alarm can be used to detect loss of excitation and out of step.

Thermistor

A single input from a motor winding thermistor is provided with the MM300 Enhanced. The MM300 Enhanced can accept both positive temperature coefficient (PTC) and negative temperature coefficient (NTC) sensors. A thermistor level can be selected for both alarm and trip.

Advanced Automation

The MM300 Enhanced's powerful I/O and programmable FlexLogic options offer advanced automation, reducing the need for additional programmable controllers or discrete control relays.

FlexLogic™

The MM300 Enhanced optionally includes a control logic engine called FlexLogic™. This provides the ability to create customized protection and control schemes thereby minimizing the need and the associated costs, of auxiliary components and wiring.

Using FlexLogic™, the MM300 Enhanced can be configured to specify what actions will be taken based on the status of protection or control elements, as well as inputs driven by connected sensors and equipment.

Scalable Hardware

The MM300 Enhanced is available with a multitude of I/O configurations to suit most application needs. The expandable modular design allows for easy configuration and future upgrades.

- Up to 30 digital inputs (voltage rating up to 300V) and up to 18 digital outputs are available and can be used to monitor and control a wide range of auxiliary equipment
- Types of digital outputs include trip-rated Form-A and Form-C

Monitoring and Metering

The MM300 Enhanced includes high accuracy metering for all AC signals. Voltage, current, power metering, and temperature are measured. Currents and voltages are displayed as RMS magnitudes with phase angles.

Fault and Disturbance Recording

The advanced disturbance diagnostic features within the MM300 Enhanced can significantly reduce the time needed for troubleshooting power system events and reconstruction. Recording functions include:

- Sequence of Event Recorder (SOE)
- Enhanced diagnostics with:
 - Waveform Recorder
 - Fault Recorder
 - Data Logger

Waveform Recorder

The MM300 Enhanced captures waveforms at the same sampling rate as other relay data at the point of trigger. In addition to four phase currents and four phase voltages, users can select up to 16 analog and 32 digital channels. Users can configure the sampling rate to 32/c, 16 /c, or 8 /c. A maximum of 320 cycles (at 32 samples per cycle) can be captured per record and the trigger point can be adjusted to anywhere within the set cycles.

Fault Recorder

The MM300E supports up to 5 fault records. This feature stores pre-fault data upon the trigger of pre-fault condition and waits for the fault trigger as long as the pre-fault trigger is asserted. When the fault trigger occurs, the fault data is stored and the complete record is created. The user programmable fault record contains device information, date & time of trigger, all current & voltage phasors, pre-fault and fault values of all the programmed analog channels.

Data logger

The MM300 Enhanced provides a comprehensive datalogging facility where the average values of analog metering values can be recorded at a user selectable interval. The datalogger can store information from up to 10 analog channels, selected from any analog values calculated by the relay. Capture rates range from once per nominal power system cycle, up to once per hour storage.

Advanced Motor Health Report

The MM300 Enhanced health report provides a quick snapshot of the motor operating and diagnostic information in an easy way to allow users to make decisions about health of the motor. Based on the graphical representation and trend values of the motor historical data gathered by the MM300 Enhanced, users can quickly identify process issues and maintenance requirements before damage occurs and costly repairs are required. The motor health report quickly provides a motor operation summary with detailed information in seven categories.

- Device Overview
- Status Overview
- Trip Summary
- Motor Operating History
- Motor Starting Learned Data
- Motor Start Records
- Motor Stopping/Tripping

Motor Start Records

The MM300 Enhanced provides motor start recording in COMTRADE file format. The recording includes thermal profile, phase and ground currents & voltages, current unbalance, real, reactive, and apparent power, frequency, and motor status. This information allows users to investigate and diagnose the motor operating condition during starting. MM300 Enhanced can store up to 6 records

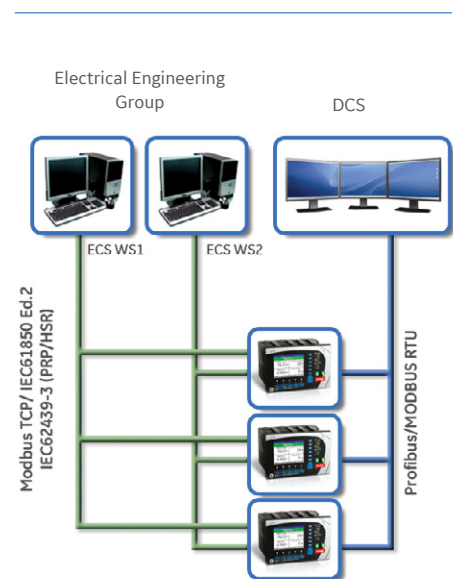
each of 30 sec length with a sampling rate of 1 sample per 100 msec. The recorded files are stored in non-volatile memory and can be downloaded and displayed in EnerVista Flex Software.

Motor Learned Records

The MM300 Enhanced Learned Data feature can learn up to five successful motor starts. The Learned Data recorder can measure and record up to 250 data record sets. The learned data includes acceleration time, starting thermal capacity, average load current, average real, reactive, and apparent power, average run time, and RTD max temperature. MM300 Enhanced also permits clearing of the stored learned data and recording of the date and time.

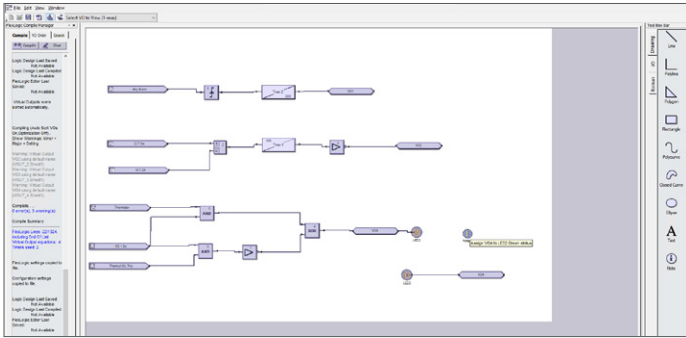
Advanced Device Health Diagnostics

The MM300 Enhanced performs comprehensive device health diagnostic tests during startup and continuously at runtime to test its own major functions and critical hardware. These diagnostic tests monitor for conditions that could impact the MM300 Enhanced’s performance, evaluate the criticality of this impact and present the device status via SCADA communications and the front panel display. Providing continuous monitoring and early detection of possible issues helps improve system availability by employing predictive maintenance



MM300 Enhanced concurrent communication architecture

FlexLogic™ Designer



FlexLogic™ and additional I/O options allow the MM300 to replace local programmable controllers in LV applications.

Communications

The MM300 Enhanced utilizes the most advanced communications technologies available today making it the easiest and most flexible motor protection relay to use and integrate into new and existing infrastructures. Multiple communication ports and protocols allow control and easy access to information from the MM300 Enhanced. All communication ports are capable of communication simultaneously.

The MM300 Enhanced supports the most popular industry standard protocols enabling easy, direct integration into HMI and electrical SCADA systems. Modbus RTU and Modbus TCP is provided as standard with an RS485 and RJ45 Ethernet networking port.

The following protocols are available:

- Modbus RTU
- Modbus TCP
- Fieldbus Protocol with dedicated port
 - Internally powered Profibus
- IEC61850 Edition 2
- IEC62439-3 (PRP/HSR) redundancy protocol
- IEEE 1588 (PTP) for time synchronization

The MM300 Enhanced can support concurrent operation of Serial, Fieldbus and Ethernet protocols. This enables MM300 Enhanced to communicate with the DCS and Electrical Control Systems simultaneously and seamlessly integrate with other protection & control devices on the station bus. The Ethernet option in a device initially connected with a serial protocol can provision for a future communications upgrade to Ethernet.

Single and redundant Ethernet options are available over copper physical link(s) (RJ45).

Redundant Ethernet protocols PRP and HSR are available to order for ensuring higher availability and zero data loss during communication.

Profibus DP

Providing a high degree of communication flexibility, the MM300 Enhanced supports both Profibus DP-V0 and DP-V1. Profibus DP-V0 provides high-speed cyclic data exchange between distributed field devices and the Profibus master. In addition to the high-speed cyclic data communication with DP-V0, DP-V1 provides communication

of acyclic data information between the slaves and the engineering workstation, which allows for independent diagnosing and fine-tuning of each slave on the network.

IEC61850 Station Bus Protocol

MM300 Enhanced supports IEC61850 Ed.2 as an ordering option. IEC 61850 offers high-speed data exchange, peer-to-peer communication, reporting, disturbance record extraction and time synchronization.

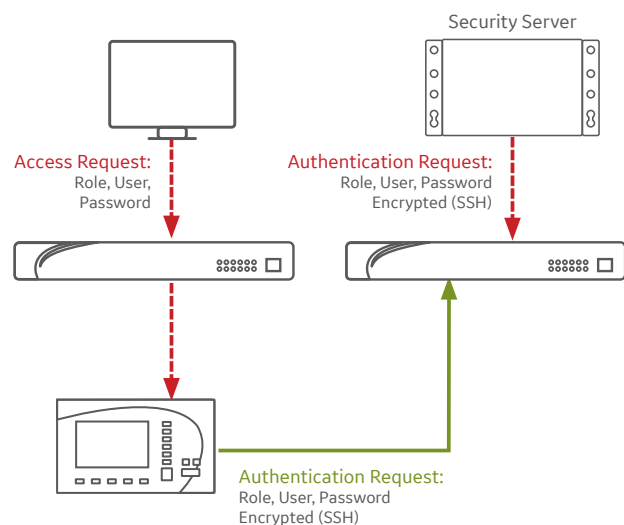
MM300 Enhanced offers 128 virtual inputs, and superior GOOSE performance.

IEEE 1588 Time Synchronization

MM300 Enhanced supports precision time synchronization over Ethernet with 1µsec accuracy. This ensures unified event records & metering data, accurate time stamping for GOOSE, MMS and accurate process control.

Cybersecurity

The MM300 Enhanced delivers a host of cybersecurity features that help operators to comply with NIS and NERC CIP guidelines, or other security regulations.



Cybersecurity with Radius Authentication

- Authentication/authorization/accounting server support (AAA - Radius)
- Role Based Access Control (RBAC)
- Non-erasable cyber event recorder (Syslog for SEM)

Testing Mode

The MM300 Enhanced provides a facility to test LEDs, contact inputs and contact output relays. This feature eases commissioning activities.

Single Setting File

The MM300 Enhanced has a single configuration file which combines settings, logic and communications. This facilitates easy tracking and control of versioning for configuration management. The single setting file supports CID (configured IED description) format.

EnerVista Flex Toolsuite

The EnerVista toolsuite provides all the tools to monitor the status of the protected asset, maintain the relay, and integrate information measured by the MM300 Enhanced into DCS or SCADA monitoring systems. Convenient COMTRADE and Sequence of Events viewers are an integral part of EnerVista Flex software, 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 GE Multilin products. 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

User Interface

The MM300 Enhanced can be ordered with or without a control panel or display. If local control or monitoring is required, there are two available options:

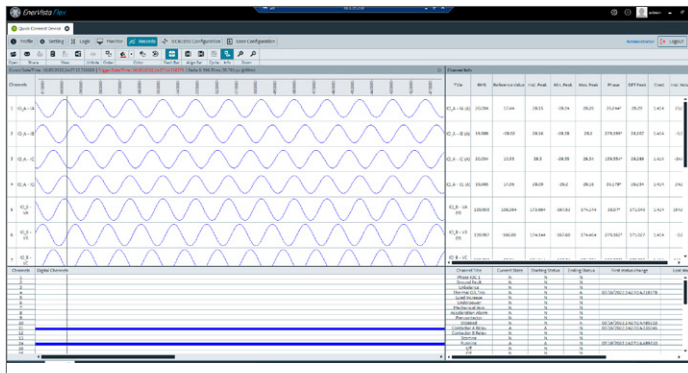
1. Control Panel
2. Color HMI Display

Distribution & Industry Platform

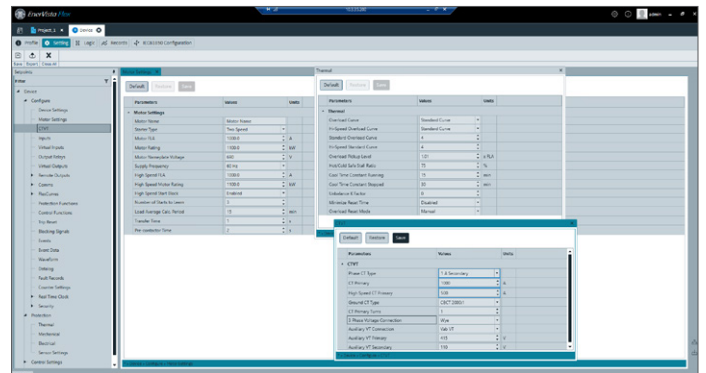
The MM300 Enhanced is built upon the same powerful shared platform as the P40 Agile Enhanced and 8 Series. This encourages mixed usage in projects without additional training needs.

Power System Troubleshooting

The MM300 contains many tools and reports that simplify and reduce the amount of time required for troubleshooting power system events.

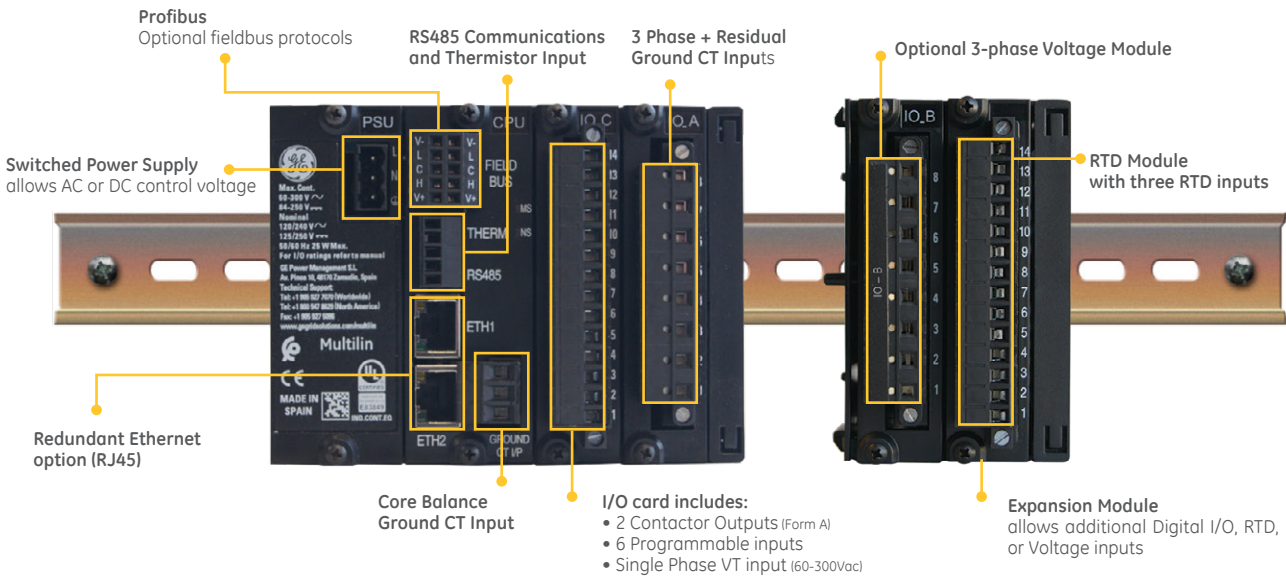
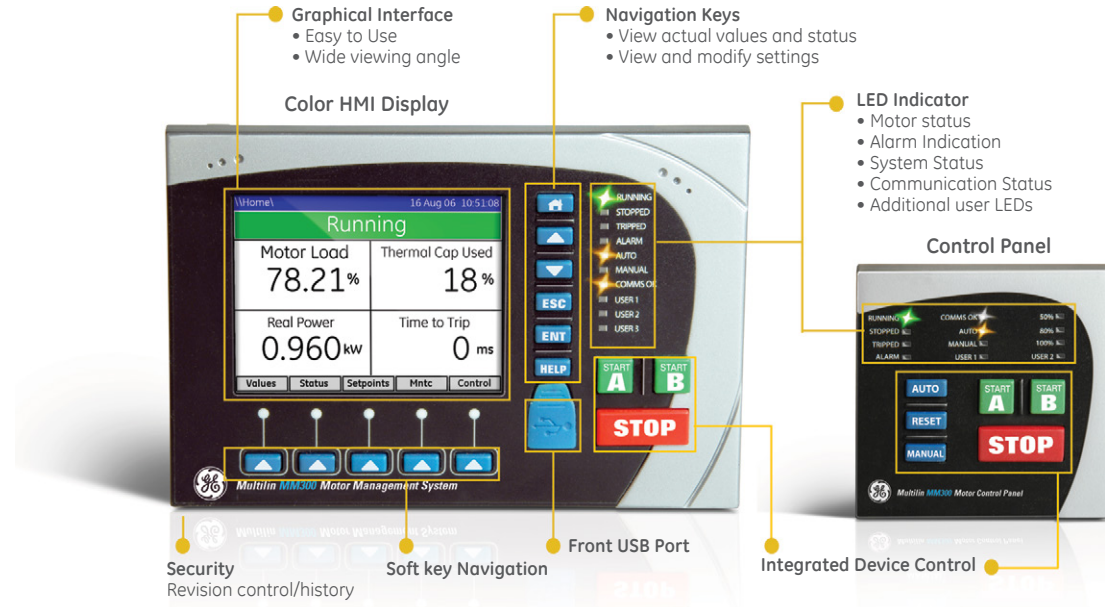


Analyze motor faults using both analog and digital power system quantities that are measured and recorded up to a rate of 32 samples per cycle.

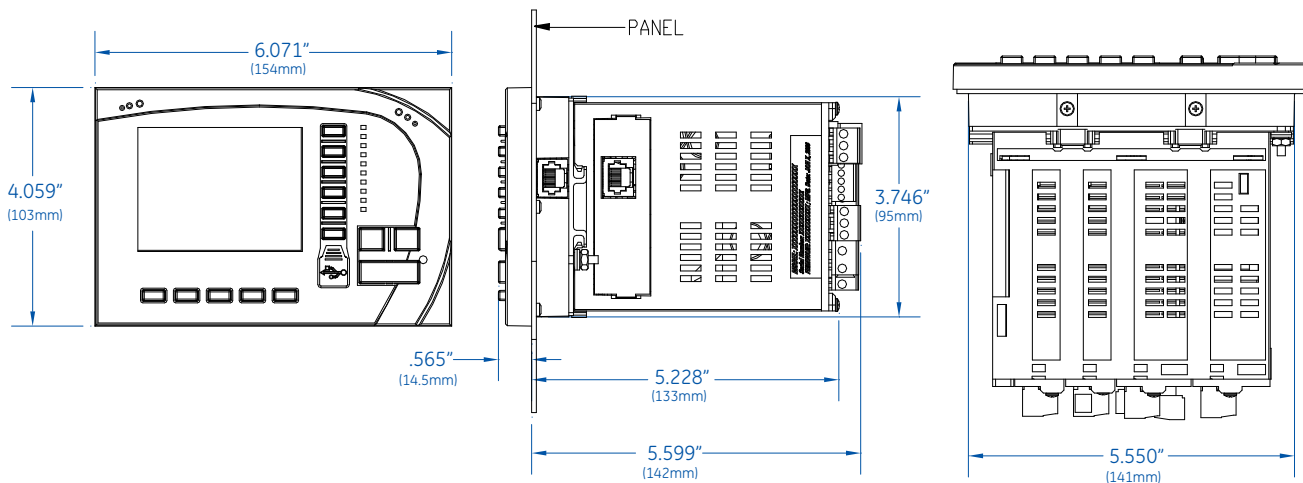


Configure MM300 Enhanced using intuitive EnerVistaFlex setup program.

User Interface

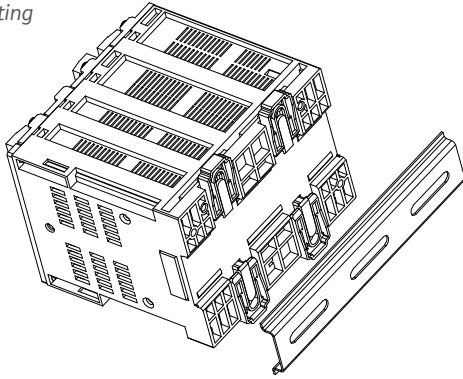


Dimensions

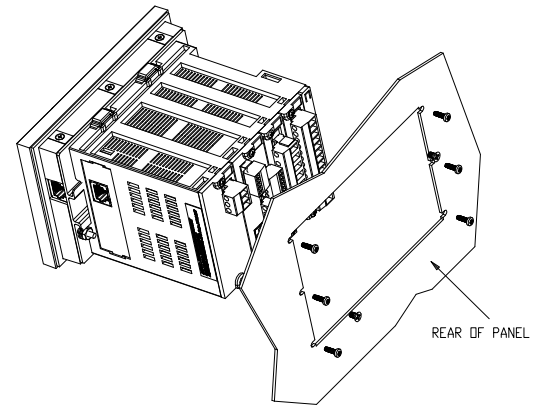


Mounting

DIN Rail Mounting



Door Mounting



The Hand Held Display (HHD) provides a rugged local interface for MM300 Motor Protection Systems where a local display is not used in the MCC.

The HHD provides a graphical color local interface to the MM300 Motor Protection Systems allowing local operators to view and change setting files and quickly access relay diagnostic information.

The HHD provides a clear and detailed view of all motor settings, diagnostic information and metering data available in the MM300 allowing local operators to make informed decisions on the motors' operation.

Ordering

	BASE UNIT						EXPANSION				ENHANCED		
MM300 Enhanced	*	*	*	*	*	*	*	*	*	*	*	E	Description
Control Panel	X												None
	B												Basic Control Panel, no USB
	G												Graphical Control Panel inc USB
Language		E											English (Standard)
Power Supply			H										High (60-300 Vac/80-250Vdc)
			L										Low (24-48 Vdc)
Communication				C									Standard : 1xRS485 (Modbus RTU) + 1x RJ45 (Modbus TCP)**
				E									Standard + Profibus DP Slave + IEC61850 ED2
				R									Standard + 1x RJ45 (Modbus TCP/IEC61850 Ed2-(PRP/HSR)** + Profibus DP Slave
Options				S									Standard: Starter control, Event recorder, Oscillography, Datalogger and Flexlogic
				1									Option1: Standard + Undervoltage autorestart*
Base unit Input/Output					C								Two (2) 10A form-A relays and six (6) 60 to 300V AC digital Inputs
					M								Two (2) 10A form-A relays and six (6) 20 to 60V DC digital input (Dry or 24V DC wetting configurable)
Current inputs						A							3 Phase and Ground Standard CT (1A/5A) + 1 Core Balance CT
Protection & Expansion							X	X	X	X			No Additional Protection
Input/Outputs							B						Three-phase voltage metering and three-phase underpower, undervoltage, overvoltage, phase reversal
							C	C	C	C			Two (2) 10A form-A relays and six (6) 60 to 300V AC digital Inputs
							D	D	D	D			Four (4) 10A form-C relays
							M	M	M	M			Two (2) 10A form-A relays and six (6) 20 to 60V DC digital inputs (Dry or 24V DC wetting configurable)
							G	G	G	G			Bank of three (3) RTDs: 100PT (maximum of 2 banks)
Cybersecurity											B		Basic
											A		Advanced

Note:

- *The UV Restart feature is not supported with the Low-Voltage power supply option
- ** ETH 1 will be also dedicated for maintenance purposes.
- Expansion I/O slots must be chosen sequentially.
- Maximum 2 'G' module options.
- If the ordered unit does not include Graphical Control Panel (GCP), RS232 to RJ45 to cable is required to be ordered for future upgrading purposes.

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