239

MOTOR PROTECTION SYSTEM

Motor protection and management for small to medium size motors

KEY BENEFITS

- Enhanced Motor Overload Protection with Thermal Modeling
- Simple configuration and system monitoring using EnerVista™ 239 Setup software
- Reduced cost and commissioning time with Protection, Monitoring, and Control in a single device
- Scalable protection with optional RTD inputs and advanced Motor Protection elements
- Simplified testing and commissioning with built in simulation features
- Field upgradable firmware and relay options
- Easy access to system and relay information using Modbus RTU

APPLICATIONS

- Multiple groups of protection settings allows flexible protection for flexible systems
- Small to Medium sized three phase AC induction and synchronous motors
- Pumps, conveyors, compressors, fans, etc.

FEATURES

Protection and Control

- Thermal Overload (15 selectable curves) - Trip and alarm, immediate current overload alarm
- Phase short circuit
- Mechanical jam
- Thermal memory lockout
- Single-Phasing /Current unbalance
- Ground fault - trip and alarm
- Overtemperature: via thermistor or optional RTD inputs
- Undercurrent
- Breaker Failure
- Trip/alarm/auxiliary/service outputs
- Multi-speed motor protection
- Motor start supervision

Communications

- RS485 Serial Communications
- Modbus RTU protocol

Monitoring and Metering

- Status/current/temperature display
- Fault diagnosis
- Trending
- Trip record, last 5
- Process control
- Optional analog output

User Interface

- 40 Character backlit display for easy viewing of settings and actual values
- 6 Motor and relay status LED's
- Multiple programming keys to allow easy access to system values and relay settings

EnerVista™ Software

- State of the art software for configuration and commissioning GE Multilin products
- Document and software archiving toolset to ensure reference material and device utilities are up-to-date
- EnerVista™ Integrator providing easy integration of data in the 239 into new or existing monitoring and control systems

Multilin

Protection and Control

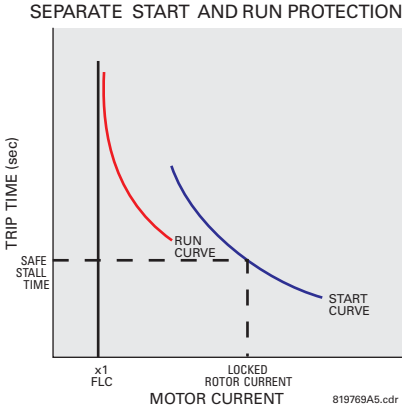
The 239 is a digital motor protection system designed for three phase AC motors and associated mechanical equipment. Advanced protection features include:

Thermal Overload

This function calculates the thermal capacity used by the motor during different stages of the motor operation. The value is updated based on the time-current overload characteristics and the motor overload lockout time setpoints.

Motor Starting

During acceleration, the motor is protected by an I^2t overcurrent curve which passes through the setpoints "Locked Rotor Current" and cold "Safe Stall Time." The running overload curve is not active during acceleration, therefore providing starting protection independent of running protection.



Separate start and run modeling provides optimum rotor and stator protection.

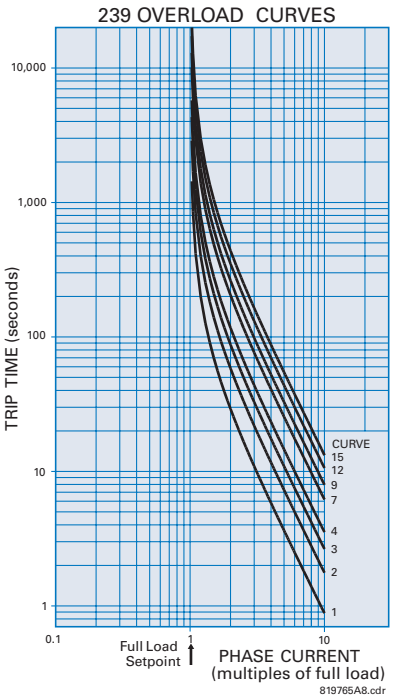
Motor Running

To protect the motor against overloads while it is running, select one of 15 different curves to accurately match the motor overload characteristic. Curves automatically adjust for hot motor compensation to ensure correct thermal modeling. For some non-typical applications, the relay can be ordered with additional custom programmable overload curves, allowing the user to construct the precise curve that matches the thermal characteristics of the protected motor (MOD 506).

A user-programmable overload lockout time controls the motor cooling rate. If the process criteria require shorter cooling periods, particularly for small motors, a different time can be used.

The minimum level of thermal capacity that the relay will calculate under normal operation will be determined by the Hot/Cold stall time ratio, which distinguishes between cold and hot motor conditions. An Auto Reset feature resets the overload trip once the thermal capacity has decreased to 15% or less.

An immediate overload alarm alerts the operator. This may be useful for systems that do not normally experience overloads.



Trip time overload curves, data and formulae are provided for protection and co-ordination.

An immediate overload pickup setpoint is also available. The relay can also be ordered with the option to allow the relay to learn the thermal capacity used during successful starts.

Hot Motor

This function utilizes thermal capacity used (TCU) value to initiate a hot motor alarm when the TCU is approaching the motor thermal limit (100% TCU).

Immediate Overload Alarm

This function is used to alarm on a motor overload condition that requires an immediate intervention to eliminate the cause of the sudden overload.

Phase Short Circuit

This element provides complete phase-to-phase and Phase-to-ground protection. Trip or Auxiliary contacts can be selected to operate instantaneously, or with a time delay up to 60 seconds.

Mechanical Jam

This function prevents motor damage during abnormal operational conditions. Quick motor shut down can reduce damage to gears, bearings, and other mechanical parts associated with the drive system. A current surge will cause the relay assigned to the mechanical jam protection to become active. The user may set the pickup level, time delay, and inhibits.

Undercurrent

This function is typically used to protect pumps from loss of suction, fans from loss of airflow due to a closed damper, or conveyor systems from a broken belt. This function can be used as an alarm or as a trip, or disabled if not required. Alternatively this feature can be used as a pre-overload warning by setting the undercurrent pickup above the normal operating current but below the rated full load current.

Single-Phase (Unbalance)

Current unbalance is another significant contributor to motor overheating. The unbalance protection function has an unbalance pickup level and time delay that can trigger a trip or an alarm. Typical pickup is intended to detect and clear single phasing. Use the alarm level as a warning for system voltage unbalance.

Breaker Failure

This function allows tripping of all breakers feeding a fault in the event that the breaker protected by the 239 fails to operate and clear the fault.

Ground Fault Protection

Aging and thermal cycling can cause the stator insulation to break down, resulting in ground faults. Ground faults can also occur in motors because of environmental conditions such as moisture or conductive

dust. The 239 can trigger a trip or an alarm if the ground pickup level is exceeded. A time delay may be entered for time coordination of systems with several levels of ground fault detection. There are two ground inputs available in the 239, allowing two methods of ground protection.

- Core balance (Zero sequence) High Impedance Ground Fault (HGF) current transformers with 5A secondary
- Core balance (Zero sequence) current transformers with a 50:0.025 Amp current ratio for sensitive current detection.

When the residual connection of the phase CTs is used to detect ground currents, nuisance trips can occur during start due to unequal saturation of CTs. This may cause Zero sequence currents to appear, of sufficient magnitude to reach the pickup setting of the Ground Fault protection function. To avoid this, the 239 has two independent time delay settings, one for motor starting, and one for motor running. The 239 can be ordered with MOD512 for 1A ground current input and MOD 509 for direction ground fault sensing.

Overheating

Direct temperature sensing is necessary to detect the effects of motor overheating due to blocked ventilation or high ambient temperature. Temperature rise under these types of conditions is usually slow enough to allow the accurate sensing of the actual motor temperature. A motor temperature input for a thermistor is standard on the 239. Additionally, three RTDs located in the stator and/or bearings can be connected to the 239 with the RTD temperature sensing option. This provides displayed temperatures as well as alarm and trip settings for both bearing and stator RTDs. Four RTD types are supported: 100Pt, 120Ni, 100Ni, and 10Cu. A RTD failure alarm is also provided.

Monitoring and Metering

The 239 provides users with advanced monitoring and metering functions that include:

Metering

Measured values include:

- Phase current
- Ground current
- Current unbalance
- Current % of full load
- Motor load current as a % of full load
- Motor thermal capacity used
- Stator temperature (RTD option)
- Bearing temperature (RTD option)

Multi-Speed Motors

Optional switches allow alternate parameters to be activated for protection of multi-speed motors. Additional settings provided with multiple speed motor protection include:

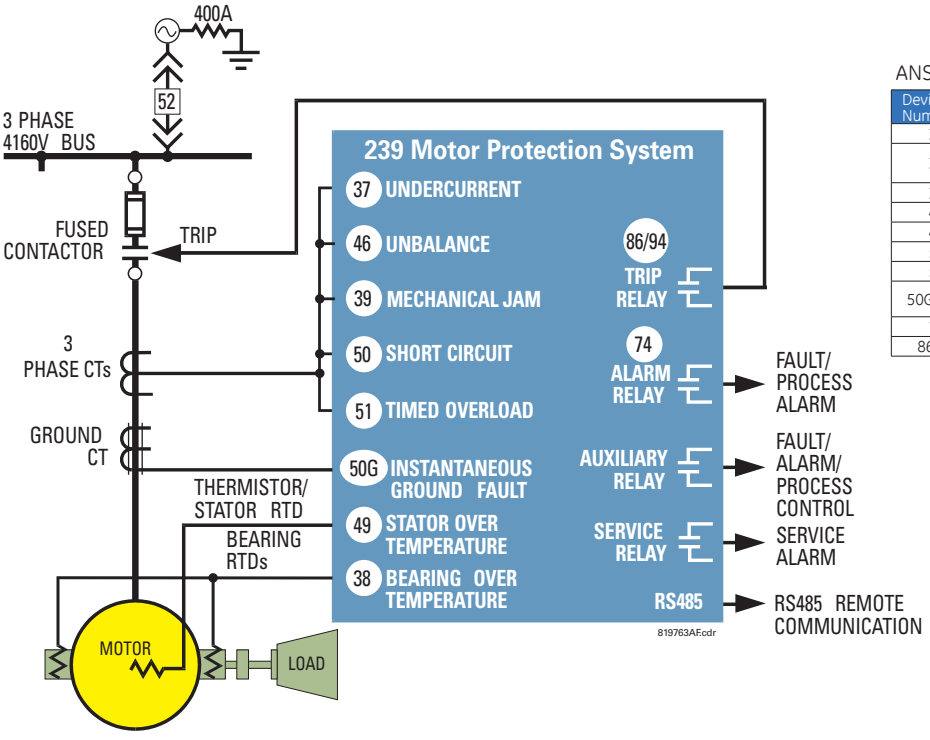
- Phase CT primary
- Full load current
- Overload curve
- Short circuit trip settings

Motor Start Supervision (MOD 505)

The 239 relay can be furnished with this function, which is an enhanced protection against multiple starts. The function consist of 2 elements:

- Time Between Starts
- Starts per Hour

Functional Block Diagram



ANSI Device Numbers & Functions

Device Number	Function
37	Undercurrent/minimum load
38	Motor/load bearing Overtemperature
39	Mechanical jam
46	Current unbalance
49	Stator winding overtemperature
50	Phase short circuit
51	Timed overload
50G/50N	Ground fault instantaneous or definite time
74	Alarm relay
86/94	Lockout and trip relay

Fault Diagnosis

The 239 keeps a record of the cause of the last five trips issued. The relay will also record the phase current, ground current, and RTD temperatures measured at the time of the last trip.

Motor Alarming

Alarm functions include immediate overload warning, unbalance, undercurrent and internal self check fault. Often an alarm can be generated soon enough to enable corrective action to be taken before a trip occurs.

Testing

While periodic calibration is not required, the PICKUP LED is useful during commissioning or routine verification to indicate the pickup point for phase overload or ground. A simulation mode is also available that enables simulated currents to be used without the need for a relay test set. This is ideal for verification of settings and training. It allows forcing of output relays, LEDs, switch inputs, RTD, Thermistor input resistance, and Analog outputs.

Automation

Analog Output Option

The analog output option provides an isolated 0 to 1, 0 to 20, or 4 to 20 mA signal for interface to a PLC. This output can be programmed as: average phase current, motor full load %, thermal capacity used, or RTD temperature. For local operator monitoring, a thermal capacity meter can be used with this output. Information such as process loading and proximity to tripping or overheating can be obtained with this output.

Output Relays

The 239 has three output relays. They are the Trip, Alarm, and Aux contacts. The trip relay acts as the main latched output relay.

The Alarm and Auxiliary relays may be programmed for latched or unlatched modes. All relays may be programmed fail-safe or non fail-safe. If configured as latched relays, they can be reset via an external reset switch connected to one of the 239 digital inputs, from the keypad or via serial communication.

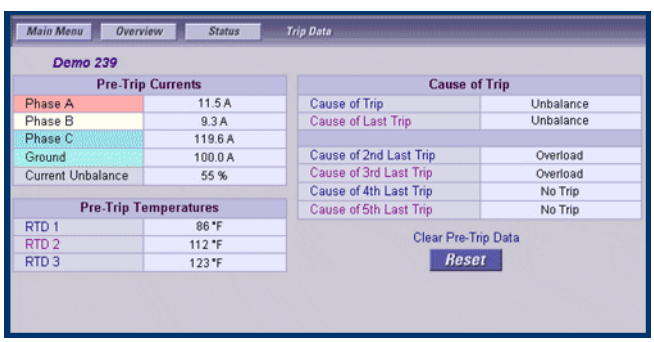
Switch Inputs

The 239 has three fixed and two user definable switch inputs:

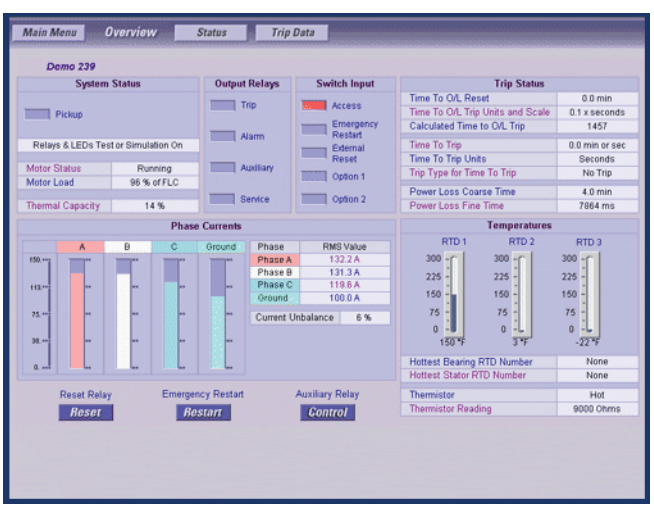
- Setpoint access: these terminals must be shorted together for keypad setpoint configuration
- Emergency restart: momentarily shorting these terminals together when the motor is stopped will reset the thermal capacity used to 0%, allowing for an immediate restart after an overload trip. As this will compromise the thermal protection functions of the 239, making it possible to damage the motor, this function should only be used in emergency situations
- External reset: this input allows remote or automatic reset ing of latched trips or alarms

Communications

The 239 features an RS485 connection with ModBus® RTU protocol to communicate with most types of PLCs and computers. This allows any monitored value, status



Troubleshoot motor faults using the 239 Cause Of Last Trip record



Use Viewpoint monitoring to receive instant feedback of the motor and relay status

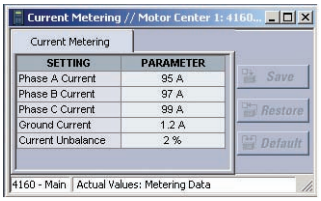
and setpoints to be remotely accessed by a PLC or SCADA system. A front panel LED verifies correct operation of the communication port.
The 239 is also capable of being integrated into a local area network using the Multinet™ Serial to Ethernet converter. Networking allows easy access to information from multiple monitoring and control devices such as SCADA's and HMI's.

User Interface

The 40 character LCD and keypad provide convenient local communications and control. Setpoints can be modified locally using the keypad and display. To help prevent unauthorized setpoint changes, a setpoint access input must be shorted before changes can be made.

LED Indicators

Six LED indicators on the front panel provide quick visual indication of status.



View motor current, temperature, statistics and status.

EnerVista™ Software

The EnerVista™ Suite is an industry leading set of software programs that will simplify every aspect of using the 239 relay. Tools to monitor the status of your motor, maintain your relay, and integrate information measured by the 239 into HMI or SCADA monitoring systems are available.

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. 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

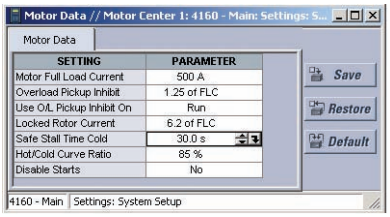
Viewpoint Monitoring

Viewpoint Monitoring is a powerful yet simple-to-use monitoring and data recording of small systems. Viewpoint Monitoring provides a complete HMI package with the following functionality:

- Plug-&-Play Device Monitoring
- Single-Line Monitoring & Control
- Annunciator Alarming
- Trending Reports

EnerVista™ Integrator

EnerVista™ Integrator is a toolkit that

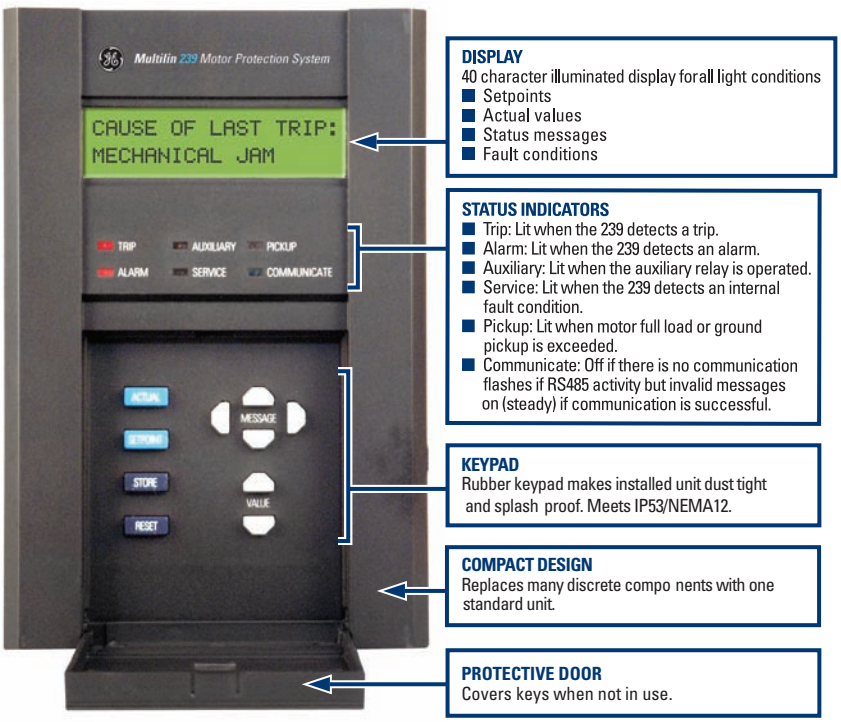


Enter setpoints directly to the 239 or copy/save relay settings to a file.

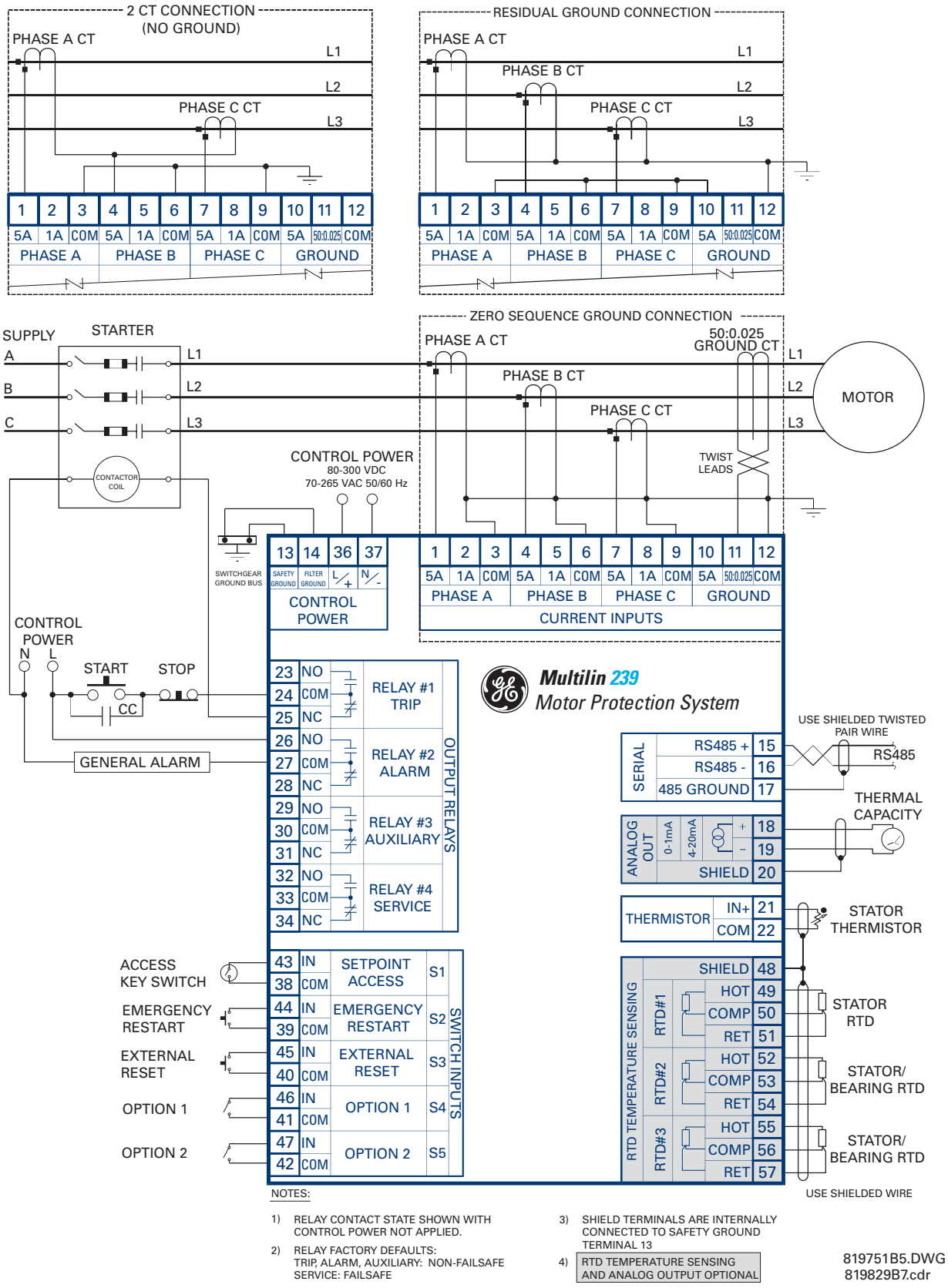
allows seamless integration of GE Multilin devices into new or existing automation systems.
Included in EnerVista™ Integrator is:

- OPC/DDE Server
- GE Multilin Drivers

User Interface



Typical Wiring



NOTES:

1) RELAY CONTACT STATE SHOWN WITH CONTROL POWER NOT APPLIED.
2) RELAY FACTORY DEFAULTS:
TRIP, ALARM, AUXILIARY: NON-FAILSAFE
SERVICE: FAILSAFE
3) SHIELD TERMINALS ARE INTERNALLY CONNECTED TO SAFETY GROUND TERMINAL 13
4) RTD TEMPERATURE SENSING AND ANALOG OUTPUT OPTIONAL

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819829B7.cdr

Technical Specifications

PROTECTION

THERMAL MODEL / OVERLOAD

Overload Curves: Separate Start and Run Overload Curves
Run: 15 Curves, fixed shape
Start: Per Equation: $T(I) = Tsst \times \frac{I^2}{I^2LRC}$
Where: Tsst = Save Stall Time
I_{LRC} = Locked Rotor Current
Save Stall Time Range: 1.0 - 600.0 sec
Locked Rotor Current Range: 0.5 - 11.0 x FLC
Overload Pickup Range (FLC): 0.1-150 A for CT Pri Set < 50A
1-1500 A for CT Pri Set > 50 A
Accuracy:
Pickup: ± 1% of displayed value
Time: ± 2% of trip time or ± 1 sec whichever is greater
Overload Pickup Inhibit Range: 1.0 - 5.0 x FLC
Hot Motor Alarm Pickup Range: 1 - 100%
Hot Motor Alarm Time: Instantaneous
Cooling Features: Separate stop and run cooling rates. Exponential cool down
Lockout Time (cool down Rate):
Stop: 1-5000 min programmable
± 20% power ON or OFF
Run: 50% of stopped cooling time
Hot/Cold Stall Time Ratio Range: 5 - 100%

OVERLOAD CURVES TRIP TIME

Curves: 15 curves, fixed shape
Overload pickup inhibit: 1.0 – 5.0 x FLC
Pickup level: 1 – 1500 A
Accuracy:
Pickup: ±1% of displayed value
Time: ±2% of trip time or ±1 sec whichever is greater

SHORT CIRCUIT AND GROUND TRIP

Ground trip level: 0.05 – 15 A (50:0.025 CT)
3 – 100% (5 A CT)
S/C trip level: 1 – 11 x CT PRI/OFF
Intentional delay: INST. or 10 ms to 60000 ms programmable
Instantaneous: 20 – 45 ms
***Total delay:** Instantaneous + intentional
***trip time accuracy guaranteed if current >1.4 x trip level setting**

BREAKER FAILURE TIMING

Delay: INST. or 10 ms to 60000 ms programmable
Instantaneous: 20 – 45 ms
***Total delay:** Instantaneous + intentional
***trip time accuracy guaranteed if current >1.4 x trip level setting**

START PROTECTION

Thermal: Separate start and run protection
Activation: Inrush 3 phase current increase from <5% to >101% FLC in 1 sec
Deactivation: Current drops to <100% FLC running if current >5% FLC
Locked rotor: 0.5 – 11.0 x FLC
Safe stall time: 1.0 – 600.0 sec

UNBALANCE

Range: 5 – 100% / OFF
Accuracy: ±2%
Delay: 0 – 60 sec
Calculation:

$$\text{if } I_{av} > I_{FLC} \quad UB\% = \left|\frac{I_m - I_{av}}{I_{av}}\right| \times 100$$

$$\text{if } I_{av} < I_{FLC} \quad UB\% = \left|\frac{I_m - I_{av}}{I_{FLC}}\right| \times 100$$

where: I_{av} = average phase current
I_m = current in phase with maximum deviation from I_{av}
I_{FLC} = full load current setting

UNDERCURRENT

Range: 5 – 100% FLC / OFF
Delay: 0 – 250 sec

PROTECTION

THERMAL MODEL / OVERLOAD

RTDS (OPTION)

Inputs: 3 RTDs, stator/bearing programmable
Type: 100 Pt (DIN 43760), 100 Ni, 120 Ni 10 Cu programmable
Range: -40 to 200° C/ -40 to 400° F
Trip/alarm range: 0 to 200° C/ 0 to 400° F
Dead band: 2° C/ 4° F
Accuracy: ±2° C/ 4° F
Lead Resistance: Pt or Ni RTD: 25 Ω max
Cu RTD: 3Ω max 3-wire lead resistance compensation

THERMISTOR

Type: PTC or NTC programmable
Hot resistance: 100 – 30,000 Ω
Cold resistance: 100 – 30,000 Ω
Delay: 2 sec
Accuracy: ±5% or 100 Ω (whichever is greater)

METERING

PHASE CURRENT INPUTS

Conversion: True RMS, 16 samples/cycle
CT Input: 1 A and 5 A secondary
Range: 0.1 to 11 x phase CT primary
Frequency: 20 – 300 Hz
Accuracy: ±2% of full scale

GROUND CURRENT INPUTS

Conversion: True RMS, 16 samples/cycle
CT input: 5 A secondary and 50:0.025
Range: 0.03 to 1.4 x CT primary (5 A CT)
0.05 to 16.0 A (50:0.025 CT)
Frequency: 20 – 300 Hz
Accuracy
5A CT: ±2% of full scale (5 A CT)
50:0.025 CT: ±0.03 A (0 – 0.49 A)
±0.07 A (0.50 – 3.99 A)
±0.20A (4.00 – 16.00 A)

INPUTS

SWITCH INPUTS

Type: Dry contacts
Output: 29 VDC, 10 mA (pulsed)
Duration: 100 ms minimum

	CT INPUT (A)	BURDEN (VA)	BURDEN (Z)
Phase CT (1 A)	1	0.009	0.01
	5	0.2	0.01
	20	3.5	0.01
Phase CT (5 A)	5	0.04	0.002
	25	0.9	0.002
	100	16	0.002
Ground CT (5 A)	5	0.04	0.002
	25	1.1	0.002
	100	17	0.002
Ground CT (50:0.025)	0.025	0.07	116
	0.1	1.19	119
	0.5	30.5	122

	WITHSTAND 1 SEC x CT	WITHSTAND 5 SEC x CT	CONTINUOUS x CT
Phase CT (1 A)	100	40	3
Phase CT (5 A)	100	40	3
Ground CT (5 A)	100	40	3

50:0.025 GROUND INPUT WITHSTAND	
Continuous	150 mA
Maximum	12 A for 3 cycles

50:0.025 input can be driven by a 50:0.025 CT

POWER SUPPLY

Input: 90 – 300 VDC or 70 – 265 VAC, 50 / 60 Hz
Power: 10 VA (nominal), 20 VA (max)
Holdup
Non-failsafe trip: 200 ms
Failsafe trip: 100 ms both times at 120 VAC / 125 VDC

Note: It is recommended that all 239 relays be powered up at least once per year to avoid deterioration of electrolytic capacitors in the power supply.

COMMUNICATIONS

Type: RS485 2 wire, half duplex, isolated
Baud rate: 1200 – 19,200 bps
Protocol: ModBus® RTU
Functions: Read/write setpoints, read actual values, execute commands

OUTPUTS

ANALOG OUTPUT (OPTION)

	Programmable		
OUTPUT	0 – 1 mA	0 – 20 mA	4 – 20 mA
MAX LOAD	2400 Ω	600 Ω	600 Ω
MAX OUTPUT	1.1 mA	21 mA	21 mA

Accuracy: ±2% of full scale reading
Isolation: 36 VDC isolated, active source

OUTPUT RELAYS

VOLTAGE		M/C CONT.	M/C 0.2 SEC	BREAK
DC Resistive	30 VDC	10 A	30 A	10 A
	125 VDC	10 A	30 A	0.5 A
	250 VDC	10 A	30 A	0.3 A
DC Inductive	30 VDC	10 A	30 A	5 A
	125 VDC	10 A	30 A	0.25 A
(L/R = 7 ms)	250 VDC	10 A	30 A	0.15 A
AC Resistive	120 VAC	10 A	30 A	10 A
	250 VAC	10 A	30 A	10 A
AC Inductive	120 VAC	10 A	30 A	10 A
PF = 0.4	250 VAC	10 A	30 A	10 A
Configuration:		Form C NO/NC		
Contact Material:		Silver Alloy		

PRODUCTION TESTS

Dielectric strength: 1.836 kVAC for 1 sec to relays, CTs, power supply

FUSE TYPE/RATING

5 x 20 mm, 2.5 A, 250 V
Slow blow, high breaking capacity

ENVIRONMENTAL

Temperature range
Operating: 0° C to 60° C
Storage: -40° C to 70° C ambient
Humidity: 95% non-condensing
Pollution degree: 2
Overvoltage category: 2
IP class: 40
Insulation voltage: 300 V
NOTE: LCD contrast impaired below -20° C

TYPE TESTS

Insulation resistance: IEC 255-5 500 VDC
Transients: ANSI C37.90.1 oscillatory 2.5 kV/1 MHz
ANSI C37.90.1 fast rise 5 kV/10 ns
Ontario Hydro A-28M-82
IEC 255-4 impulse / high frequency disturbance class III level
Impulse test: IEC 255-5 0.5 J 5 kV
RFI: 50 MHz/15 W transmitter
EMI: C37.90.2 electromagnetic interference @ 150 MHz and 450 MHz, 10 V/m
Static: IEC 801-2 static discharge
Environment: IEC 68-2-38 temperature/humidity cycle
Dust/moisture: NEMA 12/IP53
Dielectric strength: 2.0 kVAC for 1 min to relays, CTs, power supply
Temperature: -10° C to 60° C ambient

PACKAGING

Shipping box: 8.5" L x 6" H x 6" D (215 mm x 152 mm x 152 mm)
Ship weight: 5 lbs (2.3 kg)

INSTALLATION

Warning: Hazard may result if the product is not used for its intended purpose.
Ventilation requirements: None
Cleaning requirements: None

APPROVALS

Manufactured under an ISO9001 registered system
UL: Recognized under E83849
CSA: Approved under LR41286

*Specifications subject to change without notice.

Ordering

239	*	*	*	
239				Basic unit
	RTD			3 RTDs: stator/bearing; programmable type: platinum, nickel, copper
		AN		Single isolated, analog output: 0 – 1, 0 – 20, 4 – 20 mA Programmable output parameters: thermal capacity, % full load, phase current, RTD1, RTD2, RTD3 temperature
			H	Harsh enviornment conformal coating

Modifications

MOD500: Portable test/carrying case
MOD501: 20 to 60 V DC /20 to 48 V AC control power
MOD504: Removable terminal blocks
MOD505: Enhanced start protection
MOD506: Custom programmable overload curve
MOD509: Directional ground sensing with 120 V AC polarizing voltage
MOD512: 1 Amp ground CT input
MOD513: Class 1 Division 2 operation
MOD517: Australian Mines approval

Accessories for the 239

- Viewpoint Monitoring VP-1
- 50:0.025 Ground CT HGF3
- Multinet Serial to Ethernet converter MULTINET-FE
- 2.25" Shallow Mount Collar 1009-0068

Visit www.GEMultilin.com/239 to:

- View Guideform Specifications
- Download the instruction manual
- Review applications notes and support documents
- Buy an 239 online