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Digital Energy
Multilin

369 Motor Management Relay

Chapter 1: Introduction

1.1 Ordering

1.1.1 General Overview

The 369 Motor Management Relay is a digital relay that provides protection and monitoring for three phase motors and their associated mechanical systems. A unique feature of the 369 Relay is its ability to 'learn' individual motor parameters and to adapt itself to each application. Values such as motor inrush current, cooling rates and acceleration time may be used to improve the 369 Relay's protective capabilities.

The 369 Relay offers optimum motor protection where other relays cannot, by using the FlexCurve™ custom overload curve, or one of the fifteen standard curves.

The 369 Relay has one RS232 front panel port and three RS485 rear ports. The Modbus RTU protocol is standard to all ports. Setpoints can be entered via the front keypad or by using the EnerVista 369 Setup software and a computer. Status, actual values and troubleshooting information are also available via the front panel display or via communications.

As an option, the 369 Relay can individually monitor up to 12 RTDs. These can be from the stator, bearings, ambient or driven equipment. The type of RTD used is software selectable. Optionally available as an accessory is the remote RTD module which can be linked to the 369 Relay via a fibre optic or RS485 connection.

The optional metering package provides VT inputs for voltage and power elements. It also provides metering of V, kW, kvar, kVA, PF, Hz, and MWhrs. Three additional user configurable analog outputs are included with this option along with one analog output included as part of the base unit.

The Back-Spin Detection (B) option enables the 369 Relay to detect the flow reversal of a pump motor and enable timely and safe motor restarting. 369 Relay options are available when ordering the relay or as upgrades to the relay in the field. Field upgrades are via an option enabling passcode available from GE Multilin, which is unique to each relay and option.

1.1.2 Ordering

Select the basic model and the desired features from the selection guide below:

Table 1–1:

369	*	*	*	*	*	*	*	
369	|	|	|	|	|	|	|	Base unit (no RTD)
	HI	|	|	|	|	|	|	50-300 VDC / 60-265 VAC control power
	LO	|	|	|	|	|	|	20-60 VDC / 20-48 VAC control power
		R	|	|	|	|	|	Optional 12 RTD inputs (built-in)
		0	|	|	|	|	|	No optional RTD inputs
			M	|	|	|	|	Optional metering package
			B	|	|	|	|	Optional backspin detection (incl. metering)
			0	|	|	|	|	No optional metering or backspin detection
				F	|	|	|	Optional Fiber Optic Port
				0	|	|	|	No optional Fiber Optic Port
					E	|	|	Optional Modbus/TCP protocol interface
					P	|	|	Optional Profibus-DP protocol interface
					P1	|	|	Optional Profibus-DPV1 protocol interface
					D	|	|	Optional DeviceNet protocol interface
					0	|	|	No optional protocol interfaces
						H	|	Harsh environment option
						0	|	No Harsh environment option
							E	Enhanced diagnostics with Enhanced faceplate
							0	No Enhanced diagnostics with Basic faceplate

NOTE

1. One Analog Output is available with the 369 base model. The other three Analog Outputs can be obtained by purchasing the metering or backspin options.
   The control power (HI or LO) must be specified with all orders. If a feature is not required, a 0 must be placed in the order code. All order codes have 10 digits. The 369 is available in a non-drawout version only.

   Examples: **369-HI-R-0-0-0-0-E:** 369 with HI voltage control power and 12 RTD inputs, and enhanced diagnostics
   369-LO-0-M-0-0-0-E: 369 relay with LO voltage control power and metering option, and enhanced diagnotics

2. Features available only in Enhanced option (E)
   - Enhanced faceplate with motor status indicators
   - Motor Health Report
   - Enhanced learned data
   - Motor Start Data Logger
   - Enhanced event recorder
   - Security audit trail events

1.1.3 Accessories

EnerVista 369 Setup software: Setup and monitoring software provided free with each relay.

RRTD: Remote RTD Module. Connects to the 369 Relay via a fibre optic or RS485 connection. Allows remote metering and programming for up to 12 RTDs.

F485: Communications converter between RS232 and RS485 / fibre optic. Interfaces a PC to the relay.

CT: 50, 75, 100, 150, 200, 300, 350, 400, 500, 600, 750, 1000 (1 A or 5 A secondaries)

HGF: Ground CTs (50:0.025) used for *sensitive* earth fault detection on high resistance grounded systems.

515: Blocking and test module. Provides effective trip blocking and relay isolation.

DEMO: Metal carry case in which 369 is mounted.

FPC15: Remote faceplate cable, 15'.

1.1.4 Firmware History

Table 1–2: FIRMWARE HISTORY (Sheet 1 of 2)

FIRMWARE REVISION	BRIEF DESCRIPTION OF CHANGE	RELEASE DATE
53CMB110.000	Production Release	June 14, 1999
53CMB111.000	Changes to Backspin Detection algorithm	June 24, 1999
53CMB112.000	Changes to Backspin Detection algorithm	July 2, 1999
53CMB120.000	Capability to work with the Remote RTD module	October 15, 1999
53CMB130.000	Improvements to the Remote RTD communications	January 3, 2000
53CMB140.000	Changes to Backspin Detection algorithm and improved RS232 communications	March 27, 2000
53CMB145.000	Minor firmware changes	June 9, 2000
53CMB160.000	Profibus protocol, waveform capture, phasor display, single analog output, demand power and current, power consumption	October 12, 2000
53CMB161.000	Minor firmware changes	October 19, 2000
53CMB162.000	Minor firmware changes	November 30, 2000
53CMB170.000	Autorestart feature added	February 9, 2001
53CMB180.000	Modbus/TCP feature added	June 15, 2001

Table 1–2: FIRMWARE HISTORY (Sheet 2 of 2)

FIRMWARE REVISION	BRIEF DESCRIPTION OF CHANGE	RELEASE DATE
53CMB190.000	Number of Event Recorders increased to 250; Hottest Overall RTD value added	November 23, 2001
53CMB201.000	Added Starter Failure, MWhrs as analog output parameter, and Motor Load Averaging feature.	April 16, 2004
53CMB210.000	Added support for variable frequency drives; minor changes to Modbus TCP.	November 5, 2004
53CMB220.000	Implementation of DeviceNet protocol and starter operation monitor.	April 11, 2005
53CMB230.000	Implemented Profibus DPV1, Force Outputs and Protection Blocking.	September 19, 2005
53CMB240.000	Custom Curve enhancement, increase range from 0 to 32767 to 0 to 65534.	November 21, 2005
53CMB250.000	Implementation of start control relay timer setting for reduced voltage starting, additional Modbus address added for starts/hour lockout time remaining, correction to date and time Broadcast command Modbus addresses, fix for latched resets with multiple local/remote assigned relays, fix for repeated “Motor Stopped” and “Motor Running” events.	April 28, 2006
53CMC310.000	Profibus loss of trip, trip contact seal in undervoltage auto restart, Motor Health Report, Enhanced learned data, motor start data logger, enhanced event recorder, security audit trail events, DeviceNet enhanced polling.	June 7, 2007
53CMC320.000	2-speed motor feature, Datalogger feature, speed of last trip display, latched trip and alarm note.	March 20, 2008
53CMC330.000	Added Ethernet Loss of Comms Trip.	May 7, 2009
53CMC340.000	Added DeviceNet Loss of Comms Trip.	July 7, 2010

1.1.5 PC Program (Software) History

Table 1–3: SOFTWARE HISTORY

PC PROGRAM REVISION	BRIEF DESCRIPTION OF CHANGES	RELEASE DATE
1.10	Production Release	June 14, 1999
1.20	Capability to work with the Remote RTD module	October 15, 1999

Table 1–3: SOFTWARE HISTORY

PC PROGRAM REVISION	BRIEF DESCRIPTION OF CHANGES	RELEASE DATE
1.30	Capability to communicate effectively with version 1.30 firmware	January 3, 2000
1.40	Changes made for new firmware release	March 27, 2000
1.45	Changes made for new firmware release	June 9, 2000
1.60	Profibus protocol, waveform capture, phasor display, single analog output, demand power and current, power consumption	October 23, 2000
1.70	Changes made for new firmware release	February 9, 2001
1.80	Changes made for new firmware release	June 7, 2001
1.90	Changes made for new firmware release	November 23, 2001
2.00	Changes made for new firmware release	September 9, 2003
3.01	New features and enhancements	August 16, 2004
3.11	Added support for firmware revision 2.1x	November 16, 2004
3.20	Changes made for firmware revision 2.2x	April 13, 2005
3.30	Changes made for firmware revision 2.3x	September 19, 2005
3.40	Changes made for firmware revision 2.4x	November 25, 2005
3.50	Changes made for firmware revision 2.5x	May 15, 2006
3.70	Changes made for firmware revision 3.1x	June 7, 2007
3.80	Changes made for firmware revision 3.2x	March 20, 2008
3.90	Changes made for firmware revision 3.3x	May 7, 2009
4.00	Changes made for firmware revision 3.4x	July 7, 2010

1.1.6 369 Relay Functional Summary

The front view for all 369 Relay models is shown below, along with the rear view showing the Profibus port, the Modbus/TCP port, and the DeviceNet port.

Digital Energy
Multilin

369 Motor Management Relay

Chapter 2: Product Description

2.1 Overview

2.1.1 Guideform Specifications

Motor protection and management shall be provided by a digital relay. Protective functions include:

- phase overload standard curves (51)
- overload by custom programmable curve (51)
- I^2t modeling (49)
- current unbalance / single phase detection (46)
- starts per hour and time between starts
- short circuit (50)
- ground fault (50G/50N 51G/51N)
- mechanical jam / stall
- two-speed motor protection

Optional functions include:

- under / overvoltage (27/59)
- phase reversal (47)
- underpower (37)
- power factor (55)
- stator / bearing overtemperature with twelve (12) independent RTD inputs (49/38)
- backspin detection

Management functions include:

- statistical data

- pre-trip data (last 40 events)
- ability to learn, display and integrate critical parameters to maximize motor protection
- a keypad with 40 character display
- flash memory

The relay is capable of displaying important metering functions, including phase voltages, kilowatts, kvars, power factor, frequency and MWhr. In addition, undervoltage and low power factor alarm and trip levels are field programmable. The communications interface include one front RS232 port and three independent rear RS485 ports with supporting PC software, thus allowing easy setpoint programming, local retrieval of information and flexibility in communication with SCADA and engineering workstations.

2.1.2 Metered Quantities

METERED QUANTITY	UNITS	OPTION
Phase Currents and Current Demand	Amps	
Motor Load	× FLA	
Unbalance Current	%	
Ground Current	Amps	
Input Switch Status	Open / Closed	
Relay Output Status	(De) Energized	
RTD Temperature	°C or °F	R
Backspin Frequency	Hz	B
Phase/Line Voltages	Volts	M
Frequency	Hz	M
Power Factor	lead / lag	M
Real Power and Real Power Demand	Watts	M
Reactive Power and Reactive Power Demand	Vars	M
Apparent Power and Apparent Power Demand	VA	M
Real Power Consumption	MWh	M
Reactive Power Consumption/Generation	±Mvarh	M

2.1.3 Protection Features

ANSI/ IEEE DEVICE	PROTECTION FEATURES	OPTION	TRIP	ALARM	BLOCK START
14	Speed Switch		•		
27	Undervoltage	M	•	•	•
37	Undercurrent / Underpower	/M	•	•	
38	Bearing RTD	R or RRTD	•	•	
46	Current Unbalance		•	•	
47	Voltage Phase Reversal	M	•		
49	Stator RTD	R or RRTD	•	•	

ANSI/ IEEE DEVICE	PROTECTION FEATURES	OPTION	TRIP	ALARM	BLOCK START
50	Short Circuit & Backup		•		
50G/51G	Ground Fault & Ground Fault Backup		•	•	
51	Overload		•	•	•
55	Power Factor	M	•	•	
59	Overvoltage	M	•	•	
66	Starts per Hour/Time Between Starts				•
74	Alarm			•	
81	Over/Under Frequency	M	•	•	
86	Lockout				•
87	Differential Switch		•		
	General Switch		•	•	
	Reactive Power	M	•	•	
	Thermal Capacity			•	
	Start Inhibit (thermal capacity available)				•
	Restart Block (Backspin Timer)				•
	Mechanical Jam		•	•	
	Acceleration Timer		•		
	Ambient RTD	R or RRTD	•	•	
	Short/Low temp RTD	R or RRTD		•	
	Broken/Open RTD	R or RRTD		•	
	Loss of RRTD Communications	RRTD		•	
	Trip Counter			•	
	Self Test/Service			•	
	Backspin Detection	B			•
	Current Demand			•	
	kW Demand	M		•	
	kvar Demand	M		•	
	kVA Demand	M		•	
	Starter Failure			•	
	Reverse Power	M		•	
	Undervoltage Autorestart	M or B			

2.2 Specifications

2.2.1 Inputs

CONTROL POWER

LO range: DC: 20 to 60 V DC
AC: 20 to 48 V AC at 50/60 Hz

HI range: DC: 50 to 300 V DC
AC: 60 to 265 V AC at 50/60 Hz

Power: nominal: 20 VA; maximum: 65 VA

Holdup: non-failsafe trip: 200 ms; failsafe trip: 100 ms

FUSE

T 3.15 A H 250 V (5 × 20 mm)
Timelag high breaking capacity

PHASE CURRENT INPUTS (CT)

CT input (rated): 1 A and 5 A secondary

CT primary: 1 to 5000 A

Range:

for 50/60 Hz nominal frequency: 0.05 to 20 × CT primary amps

for variable frequency: 0.1 to 20 × CT primary amps

Full Scale: 20 × CT primary amps or 65535 A maximum

Frequency: 20 to 100 Hz

Conversion: True RMS, 1.04 ms/sample

Accuracy:

at ≤ 2 × CT: ±0.5% of 2 × CT for 50/60 Hz nominal freq.
±1.0% of 2 × CT for variable frequency (for sinusoidal waveforms)

at > 2 × CT: ±1.0% of 20 × CT for 50/60 Hz nominal freq.
±3.0% of 12 × CT or less for variable frequency (for sinusoidal waveforms)

PHASE CT BURDEN

PHASE CT	INPUT (A)	BURDEN	
		VA	(Ω)
1 A	1	0.03	0.03
	5	0.64	0.03
	20	11.7	0.03
5 A	5	0.07	0.003
	25	1.71	0.003
	100	31	0.003

PHASE CT CURRENT WITHSTAND

PHASE CT	WITHSTAND TIME		
	1 s	2 s	continuous
1 A	100 × CT	40 × CT	3 × CT
5 A	100 × CT	40 × CT	3 × CT

DIGITAL / SWITCH INPUTS

Inputs: 6 optically isolated

Input type: Dry Contact (< 800 Ω)

Function: Programmable

GROUND CURRENT INPUT (GF CT)

CT Input (rated): ..... 1 A/5 A secondary and 50:0.025
CT Primary: ..... 1 to 5000 A (1 A/5 A)
Range: ..... 0.1 to 1.0 × CT primary (1 A/5 A)
0.05 to 25.0 A (50:0.025)
Full Scale: ..... 1.0 × CT primary (1 A/5 A)
25 A (50:0.025)
Frequency: ..... 20 to 100 Hz
Conversion: ..... True RMS 1.04ms/sample
Accuracy at 50/60 Hz:
for 1 A/5 A: ..... ±1.0% of full scale (1 A/5 A)
for 50:0.025 ..... ±0.07 A at <1 A
±0.20 A at <25 A
Accuracy at variable frequency:
for 1 A tap: ..... ±1.5% for 40 to 100 Hz
±2.5% for 20 to 39 Hz
for 5 A tap: ..... ±2% for 40 to 100 Hz
±3% for 20 to 39 Hz
for 50:0.025: ..... ±0.2 A at <1 A
±0.6 A at <25 A

GROUND CT BURDEN

GROUND CT	INPUT (A)	BURDEN	
		VA	(Ω)
1 A	1	0.04	0.036
	5	0.78	0.031
	20	6.79	0.017
5 A	5	0.07	0.003
	25	1.72	0.003
	100	25	0.003
50:0.025	0.025	0.24	384
	0.1	2.61	261
	0.5	37.5	150

GROUND CT CURRENT WITHSTAND

GROUND CT	WITHSTAND TIME		
	1 s	2 s	continuous
1 A	100 × CT	40 × CT	3 × CT
5 A	100 × CT	40 × CT	3 × CT
50:0.025	10 A	5 A	150 mA

PHASE/LINE VOLTAGE INPUT (VT) (OPTION M)

VT ratio: ..... 1.00 to 240.00:1 in steps of 0.01
VT secondary: ..... 240 V AC (full scale)
Range: ..... 0.05 to 1.00 × full scale
Frequency: ..... 20 to 100 Hz
Conversion: ..... True RMS 1.04 ms/sample
Accuracy: ..... ±2.5% of full scale for ≤ 200 V at 20 to 39 Hz
±1% of full scale for 12 to 240 V at > 40 Hz
Burden: ..... >200 kΩ
Max. continuous: ..... 280 V AC

BSD INPUTS (OPTION B)

Frequency: ..... 1 to 120 Hz
Dynamic BSD range: ..... 20 mV to 480 V RMS
Accuracy: ..... ±0.02 Hz
Burden: ..... >200 kΩ

RTD INPUTS (OPTION R)

Wire Type: ..... 3 wire
Sensor Type: ..... 100 Ω platinum (DIN 43760), 100 Ω nickel, 120 Ω nickel, 10 Ω copper
RTD sensing current: ..... 3 mA
Range: ..... –40 to 200°C or –40 to 392°F
Accuracy: ..... ±2°C or ±4°F
Lead resistance: ..... 25 Ω max. per lead for Pt and Ni type; 3 Ω max. per lead for Cu type
Isolation: ..... 36 Vpk

2.2.2 Outputs

ANALOG OUTPUTS (OPTION M)

	PROGRAMMABLE		
OUTPUT	0 to 1 mA	0 to 20 mA	4 to 20 mA
MAX LOAD	2400 Ω	600 Ω	600 Ω
MAX OUTPUT	1.01 mA	20.2 mA	20.2 mA

Accuracy: ..... ±1% of full scale
Isolation: ..... fully isolated active source

OUTPUT RELAYS

	RESISTIVE LOAD (pf = 1)	INDUCTIVE LOAD (pf = 0.4)(L/R – 7ms)
RATED LOAD	8 A at 250 V AC 8 A at 30 V DC	3.5 A at 250 V AC 3.5 A at 30 V DC
CARRY CURRENT	8A	
MAX SWITCHING CAPACITY	2000 VA 240 W	875 VA 170 W
MAX SWITCHING V	380 V AC; 125 V DC	
MAX SWITCHING I	8 A	3.5 A
OPERATE TIME	<10 ms (5 ms typical)	
CONTACT MATERIAL	silver alloy	

This equipment is suitable for use in Class 1, Div 2, Groups A, B, C, D or Non-Hazardous Locations only if MOD502 is ordered.

Hazardous Location – Class 1, Div 2 output rating if MOD502 is ordered: 240 V, 3 A max, as per UL1604. The contact rating is only for Make and carry operations, and shall not be used for breaking DC current.

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