MIG II

GENERATOR PROTECTION SYSTEM

Three-phase and ground protection for small generators

KEY BENEFITS

- Reduce troubleshooting and maintenance cost - event recording, and analog/digital oscillography
- Design flexibility - Easy to use programming logic
- Access to information - Modbus RTU communications
- Configurable logic, curves, digital I/Os, and LEDs
- Follow technology evolution - Flash memory for product field upgrade

- Two settings groups
- Password protection for local operation
- Automatic display of last fault information
- AC/DC power supply
- Access via front panel keypad or communication links
- EnerVista™ compatible
- Isolated RS232 port

APPLICATIONS

- Small generators and motors
- Component for bigger generator packages
- Standby/critical power protection main unit

- Small motor protection
- Transformer protection

FEATURES

Protection and Control

- Phase, ground TOC
- Phase, ground IOC
- Thermal image protection
- Circuit breaker control (open and close)
- Negative Sequence Element
- Restricted Ground Differential Element
- Undercurrent
- Maximum number of starts
- Locked rotor
- Configurable I/O
- Six outputs: trip, service, 4 auxiliary
- 4 pre-configured overcurrent curves (ANSI, IEC)

Monitoring and Metering

- 24-event record
- Analog/digital oscillography
- Per phase current metering
- Monitoring of the last 5 trips information from the display

User Interfaces

- 2x16 character LCD display
- 6 LED indicators, 4 configurable in function and color
- Front RS232 and rear RS485 ports using ModBus® RTU protocol up to 19,200 bps
- EnerVista™ Software - an industry leading suite of software tools that simplifies every aspect of working with GE Multilin devices

GE Digital Energy
Multilin

Overview

The MIG II, member of the MII Family of protection relays, is a microprocessor based relay that provides basic protection for electrical machines. The primary application is for the protection of generator equipment however, it can also be used for motor protection.

Basic protection features include thermal image protection, three phase time delayed overcurrent, phase instantaneous overcurrent, ground & neutral time delayed overcurrent, ground & neutral instantaneous overcurrent, negative sequence, undercurrent, starts/hour, and time between starts.

Each protection element can be selectively enabled either via the front panel or via communication. Flexible settings, selectable ANSI or IEC curves, plus the choice of a user configurable overcurrent curve enable accurate coordination with other devices.

The MIG II has two digital inputs and six configurable digital outputs. The MIG II has a total of six LEDs, four configurable in function and color.

The front panel also features a 5 button keypad and a 16x2 LCD display that provides an easy to use user interface.

The front keypad allows the user to set the baud rate and relay address for communication. A front RS232 and a rear RS485 communication port are provided for computer access using ModBus® RTU protocol. The rear RS485 can be converted to an RS232 or fiber optic port (plastic or glass fiber optics) by means of using an external converter, such as GE Multilin DAC300 or F485. Windows® based EnerVista™ software is provided free of charge with the relay to allow setup and configuration of MIG II features.

Computer access allows setting and configuration (inputs, outputs, LEDs and configurable logic) of the units, display of metering information and real time status of the unit. It also allows the display of event records and an oscillography record for the last fault.

The MIG II has a drawout construction in 1/4 of a 19" rack case.

Protection

Thermal Image Element

A thermal image unit is included to protect equipment against overheating due to excessive load. Several operating curves can be set as a function of heating time constant T1 (adjustable between 3 to 600 minutes). Cool down time constant T2 is adjustable from 1 to 6 the heating constant. The algorithm of the thermal image takes into account the effect of the negative sequence components via the K1 constant. This K1 value protects the machine against side effects caused by the negative component, which causes overheating in the stator and rotor, with the same effect as overload.

Unbalance

The presence of negative sequence current can result in greatly increased rotor heating. The unit can be set either with a definite time (up to 255s) or with a $I^2t=K$ curve model where K is a value between 1 to 100.

Three Phase Time Overcurrent

The MIG II provides time overcurrent protection that can be set from 0.1 to 2.4 times FLC. Four separate ANSI or IEC time overcurrent curves can be selected in addition to a user configurable curve. ANSI and IEC curves include: definite time, normal inverse, very inverse, and extremely inverse. For each curve, different time multipliers may be set. This allows the
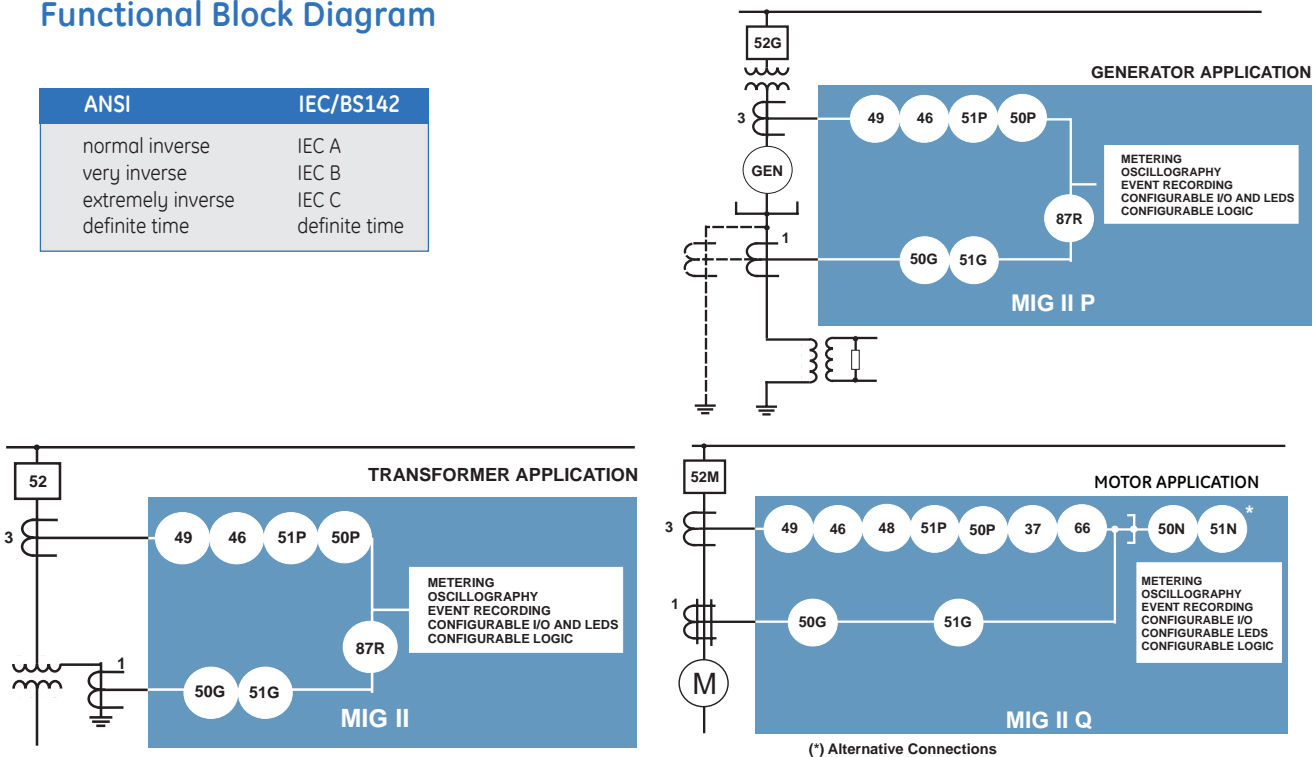
Functional Block Diagram

ANSI	IEC/BS142
normal inverse	IEC A
very inverse	IEC B
extremely inverse	IEC C
definite time	definite time

GENERATOR APPLICATION

52G

3

GEN

49 46 51P 50P

1

50G 51G

87R

METERING
OSCILLOGRAPHY
EVENT RECORDING
CONFIGURABLE I/O AND LEDS
CONFIGURABLE LOGIC

MIG II P

TRANSFORMER APPLICATION

52

3

49 46 51P 50P

1

50G 51G

87R

METERING
OSCILLOGRAPHY
EVENT RECORDING
CONFIGURABLE I/O AND LEDS
CONFIGURABLE LOGIC

MIG II

MOTOR APPLICATION

52M

3

49 46 48 51P 50P 37 66

50N 51N *

1

50G 51G

METERING
OSCILLOGRAPHY
EVENT RECORDING
CONFIGURABLE I/O
CONFIGURABLE LEDS
CONFIGURABLE LOGIC

M

MIG II Q

(*) Alternative Connections

selection of the optimum curve for coordination with fuses, feeders, motors, transformers, etc.

Phase Instantaneous Overcurrent

The MIG II includes one adjustable phase instantaneous overcurrent unit. Settings allow the pickup setpoint to be set from 0.1 to 30 times FLC and a time delay from 0 to 100 seconds to be set.

Ground Time Overcurrent

The ground time overcurrent protection has the same curve selection choices and settings as the phase time overcurrent unit. The ground signal is normally derived as the residual sum of the three phase CTs eliminating the need for an additional ground sensor. Alternatively, for more sensitive detection, an additional core balance (zero sequence) ground sensor encircling the 3 phase conductors can be used. The MIG II can also be ordered with more sensitive ground inputs, capable of measuring current values as low as 0.005 A.

Ground Instantaneous Overcurrent

The ground instantaneous overcurrent protection has the same settings and features as the phase instantaneous overcurrent unit.

Restricted Ground Differential Element (MIG II P model only)

This unit detects ground faults in solidly grounded generators, through resistance and high impedance reactance.

This feature calculates $3I_0$ TERMINAL current from the measured phase currents, and measures the generator ground current $3I_0$ NEUTRAL. The calculated difference between both values is the differential current Idiff. This value must exceed a user-programmable pick up value (setting) in order to activate the protection unit.

Negative Sequence Element

The MIG II relay incorporates a negative sequence protection element in order to detect system conditions that can cause unbalanced three-phase currents in the generator. As previously mentioned, these unbalances can be of higher magnitude than the load unbalance.

Undercurrent (MIG II Q model only)

The undercurrent function is mostly used in motor applications in order to detect a decrease in the machine current caused by a load decrease, and to prevent the pumps from working without load.

The unit can be selected either as an alarm or as a trip.

Starts/hour & Time Between Starts. (MIG II Q model only)

This units counts the number of the machine starts and makes sure they do not exceed a number programmed by the user. The number of starts is controlled over a period of time called the Time Window. If the number of starts is exceeded then the unit blocks any new attempts and maintains the trip contact closed during the restart block time.

Locked Rotor (MIG II Q model only)

This unit protects the machine for excessive long starts that can damage the rotor due to excessive overcurrent conditions during the start-up. This is of major importance for those critical power applications where the motor drives the generator into service.

Multiple Setting Groups

Two separate settings groups are stored in MIG II non volatile memory, with only one group active at a given time. Switching between setting groups 1 and 2 can be done by means of a setting, a communication command or digital input activation.

Settings are divided in 2 categories, main and advanced settings. This allows users to have access to main relay functionalities in an extremely simple, user friendly way by entering only main settings, while having access to complete functionality for more complex use through advanced settings.

Metering

MIG II provides metering values for phase and ground currents. The accuracy is 3% in the complete range, and 1% at the rated current.

Primary or Secondary Metering

The MIG II can monitor both the primary and secondary current metering values, by previously setting the corresponding CT ratio.

Event Recording

Events consist of a broad range of change of state occurrences, including pickups, trips, contact operations, alarms and self test status. The MIG II stores up to 24 events time tagged to the nearest millisecond. This provides the information needed to determine sequence of events which facilitates diagnosis of relay operation. Each event is individually maskable in order to avoid the generation of undesired events, and includes the values of currents and status of all the protection elements at the moment of the event.
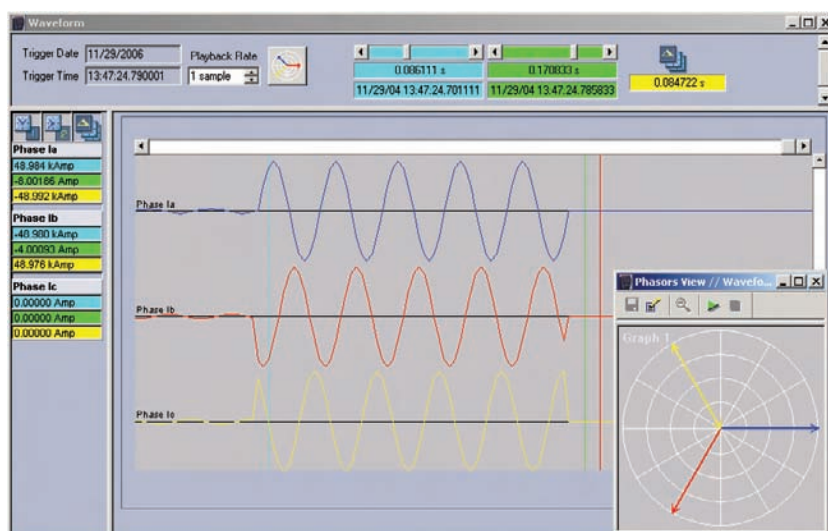
Use the oscillography feature as an accurate troubleshooting and diagnostics tool

Oscillography

MIG II captures current waveforms and digital channels at 8 samples per cycle. One oscillography record with a maximum length of 24 cycles is stored in memory. Oscillography is triggered either by internal signals or an external contact.

Configurable I/O and LEDs

Two digital inputs are user configurable. Out of the six digital outputs incorporated, two have a fixed function (trip and service required), while the other four are user programmable. Those configurable outputs can be assigned either to a set of pre-configured values, or an OR/NOT combination of the same values. Each configurable output can be independently latched, and individually selected as NO or NC by means of a jumper. Outputs 1 and 2 can be isolated from outputs 2 and 3 by removing jumper JX.

Four of the 6 LED indicators can also be programmed by the user. The first LED has a fixed assignment (relay in service), the second is fixed for trip, and the remaining four LEDs are configurable in function, memory and color (red or green).

Configurable Logic

Up to a maximum of 4 configurable logic schemes can be implemented into the MIG II by means of using a set of 4 pre-configured logic gates and timer cells. A graphical user interface is provided for configuration of MIG II logic. The inputs of the MIG II configurable logic can be assigned to contact outputs and/or LEDs.

Circuit Breaker Control

The MIG II permits operation of the circuit breaker. Breaker opening and closing operations can be carried out by programming specific outputs, and digital inputs can be used for verifying the success of the operation.

User Interfaces

Display

Measurement data (actual values), fault reports for the last five trips, and settings are shown on the 16x2 characters LCD display.
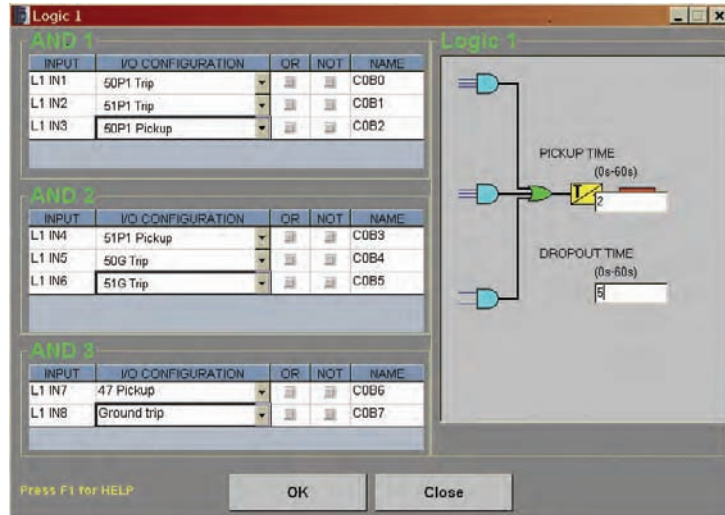
Use Programmable Logic to set the MIG II to meet specific application needs

Status LEDs

The MIG II incorporates 6 LED indicators in the front plate. The first one is a green LED identified as "READY", used to indicate the status of the protection elements. When "ON" it means the relay is energized and ready to protect, and at least one protection element has been enabled.

The second one is a red LED used for TRIP indication. It will be "ON" when a fault occurs and the relay energizes the trip outputs. Once energized, it will remain latched until the ESC/RESET key is pressed for three seconds to RESET the relay.

Four additional LEDs are programmable in function and color. The factory default functions of the programmable LEDs are: Phase Trip, Ground Trip, 50 Trip, and Pickup, while the color is set to RED, and

the status memory as self-resetting. The user may change the function and status memory through the use of the EnerVista™ software.

The LED color can be modified using the relay keypad. The status memory may be programmed either self-resetting or latching. If programmed as self-resetting, when the associated function drops out the corresponding LEDs turn off. If programmed as latched, the LED will remain "ON" until the ESC/RESET key is pressed for three seconds to reset the relay.

In order to test LEDs, pressing the ESC/RESET key for three seconds will turn "ON" all LEDs. When the key is released, the LEDs will turn off (except if the function pickups are still active). This allows easy testing of the equipment.

Connect up to 32 ModBus devices to your ethernet network including M II devices

Keypad

A five-button keypad allows user access for easy relay interrogation and change of settings.

Access to events and oscillography records, and unit configuration is possible only through PC communication.

Self-Test Diagnostics

Comprehensive self-test diagnostics occur at power up and continuously during relay operation. Any problem found by self-tests causes an alarm and an event is logged.

Communication Ports

A front mounted RS232 and a rear RS485 port allow easy user interface via a PC. ModBus® RTU protocol is used for all ports. The relay supports baud rates from 300 to 19,200 bps. Up to 32 GE Multilin devices can be addressed on a single communications channel. A unique address must be assigned to each relay via a setting when multiple relays are connected.

MultiNet™ compatible

MultiNet is a communications module that provides GE Multilin serial ModBus IEDs with ModBus TCP/IP communications over Ethernet, allowing connection to fiber optic LAN and WAN network systems.

MultiNet has the capability to connect up to 32 serial ModBus devices eliminating complex wiring and additional communications converters, and providing a streamlined and economical Ethernet hub. Unlike most communications converters that are designed for commercial use, MultiNet is environmentally hardened to withstand severe utility and industrial conditions.

- Converts Modbus RTU over RS485 into Modbus TCP/IP over Ethernet
- Supports both 10BaseT and 10BaseF fiber connections
- Connect up to 32 RS485 serial devices to an Ethernet network
- Modbus TCP/IP provides multiple SCADA masters allowing simultaneous communications to the same IED
- Flexible mounting options allow retro-fit to existing devices
- Industrially hardened for utility and industrial applications
- Simple "plug & play" device setup with EnerVista™ software

MultiNet gives you the ability to connect M II serial devices to new or existing Ethernet networks. It has a 10BaseF fiber optic interface that provides high EMI/RFI immunity and inherent electrical isolation over long cable runs. MultiNet setup is simple, with a Windows® based EnerVista™ software program for installing and configuring the communication drivers.

EnerVista™ Software

The EnerVista™ Suite is an industry-leading set of software programs that simplifies every aspect of using the relay. The EnerVista™ suite provides all the tools to monitor the status of the protected asset, maintain the relay, and integrate information measured into DCS or SCADA monitoring systems. Convenient waveform and Sequence of Events viewers are an integral part of the MII Setup software included with every MIG II relay, to carry out postmortem event analysis to ensure proper protection system operation.

EnerVista™ Launchpad

EnerVista™ Launchpad is a powerful software package that provides users with all of the setup and support tools needed for configuring and maintaining GE Multilin products. The setup software within Launchpad allows configuring devices in real-time by communicating using serial, Ethernet, or modem connections, or offline by creating setting files to be sent to devices at a later time.

Included in Launchpad is a document archiving and management system that ensures critical documentation is up-to-date and available when needed. Documents made available include:
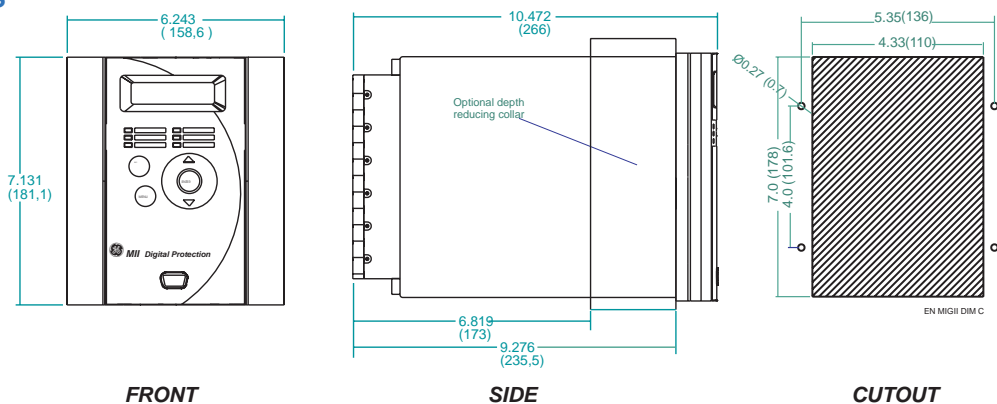
- Manuals
- Application Notes
- Guideform Specifications
- Brochures
- Wiring Diagrams
- FAQs
- Service Bulletins

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:

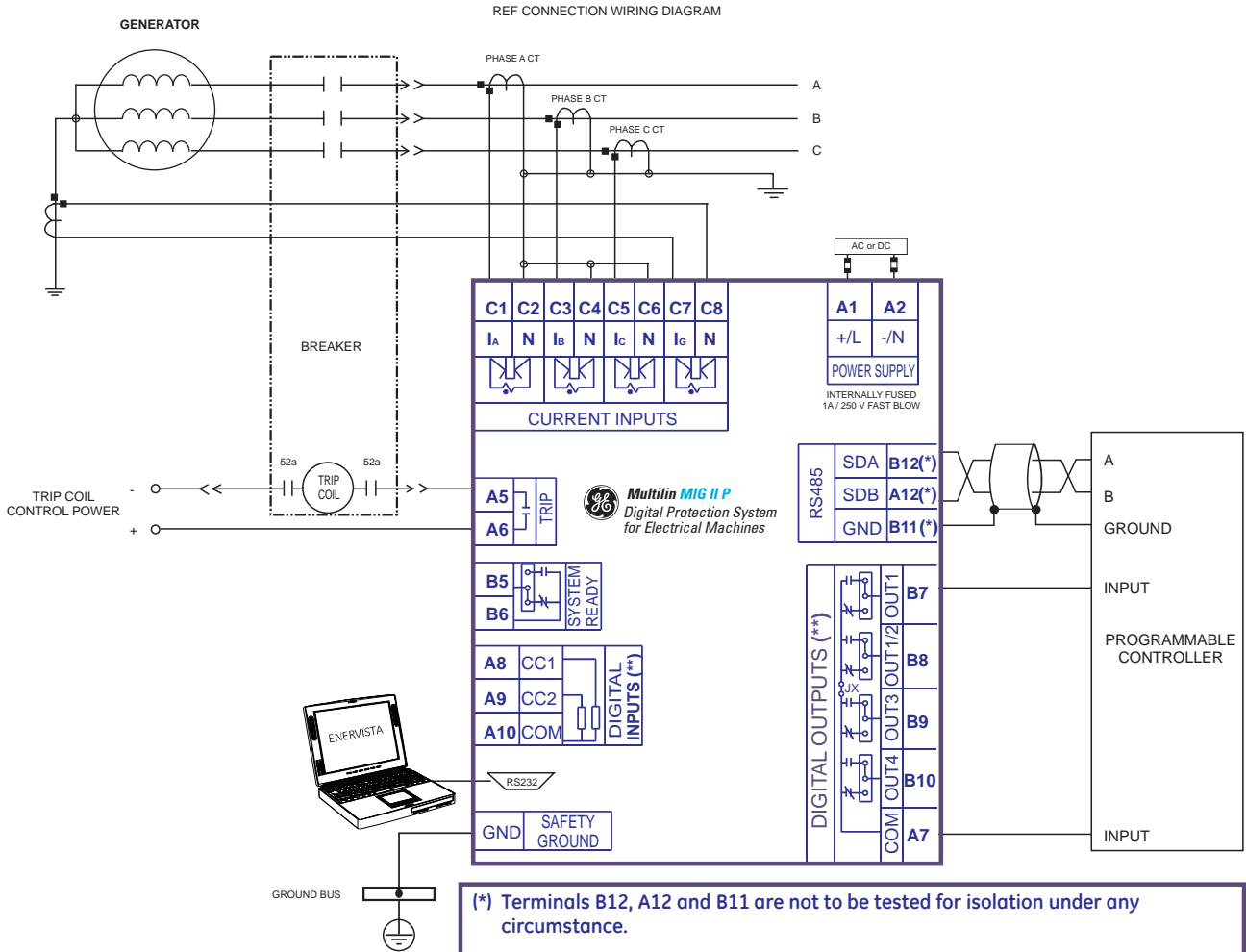- Plug-&-Play Device Monitoring
- System Single-Line Monitoring & Control
- Annunciator Alarm Screens
- Trending Reports
- Automatic Event Retrieval
- Automatic Waveform Retrieval

Dimensions

FRONT

6.243 (158,6)
7.131 (181,1)

SIDE

10.472 (266)
Optional depth reducing collar
6.819 (173)
9.276 (235,5)

CUTOUT

5.35(136)
4.33(110)
Ø0.27 (0.7)
7.0 (178)
4.0 (101.6)
EN MIGII DIM C

Typical Wiring

Note: Only for reference. For particular connections for any MIG II model, please refer to its external connections drawing.

REF CONNECTION WIRING DIAGRAM

(*) Terminals B12, A12 and B11 are not to be tested for isolation under any circumstance.

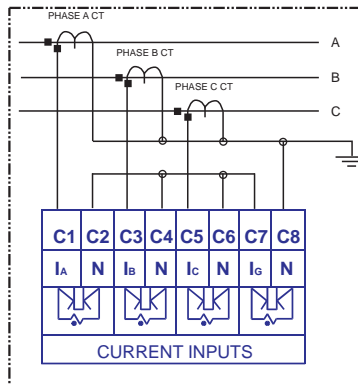**(**) In the default configuration, inputs and outputs are programmed as follows:**

INPUTS
CC1: Emergency Reset
CC2: External Trip
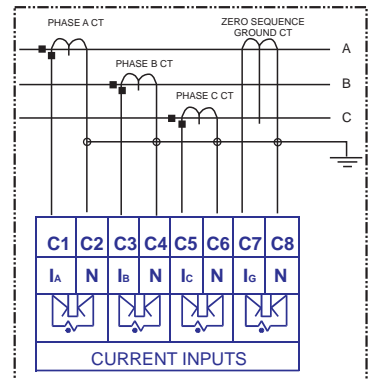
OUTPUTS
OUT1: 49 Trip
OUT2: Overcurrent Trip
OUT3: 46 Trip
OUT4: Pickup

WARNING:
GROUND PC TO RELAY GROUND.
OTHERWISE USE UNGROUNDED PC

ALTERNATIVE CT WIRING FOR
RESIDUAL GROUND DETECTION

ZERO SEQUENCE
GROUND SENSING CONNECTION

Technical Specifications

PROTECTION

PHASE AND GROUND TIME OVERCURRENT (51P, 51G)
Current:	Fundamental
Pickup level:	0.1 - 2.4 FLC in steps of 0.01
Drop out level	97% of the pickup level
Accuracy	±3% in the complete range
Curves	IEC or ANSI inverse, very inverse, extremely inverse, user defined (depending on model). Definite time 0.00 to 600.00 s in steps of 0.01 s
Reset type:	Instantaneous
Timer accuracy:	±50 ms or 3% for I > 1.2 times the pick up level

PHASE AND GROUND INSTANTANEOUS OVERCURRENT (50P, 50G)
Current:	Fundamental
Pickup level:	0.1 - 30 FLC in steps of 0.01
Drop out level:	97% of the pickup level
Accuracy:	±3% in the complete range
Overreach:	< 2%
Timer:	0.00 to 600.00 s in steps of 0.01 s
Reset type:	Instantaneous
Timer accuracy:	+50ms for timer set to 0 ms ±20 ms or 3% of total time for timer set to > 0 ms

THERMAL IMAGE (49)
Current:	Equivalent fundamental
Tap level:	0.1 - 2.4 FLC in steps of 0.01
Reset type:	97% of the tap level
Accuracy:	±3% in the complete range
Heating constant t1:	3 to 600 minutes in steps of 1 min.
Heating constant t2:	1 to 6 times t1 in steps of 1 t1
Overload alarm:	70-100% of Itap in steps of 1% Itap
Tripping time accuracy:	5% for times over 5 s.
Negative sequence constant K:	1 to 8 in steps of 1

CURRENT UNBALANCE (46)
Current:	Negative sequence fundamental
Pickup level:	0.05 to 0.99 FLC in steps of 0.01
Curve:	In accordance to k = I2 * t
K Constant:	1 to 100 in steps of 1
Definite time range:	0.00 to 600.00 s in steps of 0.01 s
Tripping time accuracy:	±250 ms or 5%

LOCKED ROTOR (48)
Current:	Fundamental
Pickup level:	1.01 to 10 FLC in steps of 0.01 FLC
Time:	
Tripping time accuracy:	±250 ms or 5%

UNDERCURRENT (37)
Current:	Fundamental
Pickup level:	0.1 to 10 FLC in steps of 0.1
Timing:	0.00 to 600.00 s in steps of 0.01 s
Tripping time accuracy:	±250 ms or 5%

MAXIMUM NUMBER OF STARTS (66)
Current:	Fundamental
Pickup level:	0 to 10 in steps of 1
Start blocking timer :	to 100 minutes in steps of 1 min.
Tripping time accuracy:	±250 ms or 5%

RESTRICTED GROUND DIFFERENTIAL (87R)
Current:	Fundamental
Minimum 3Iog Sensitivity (S):	2% In
Minimum 3Iog sensitivity (K1) :	2% In
Timer:	0.00 - 99.99 s
Tripping time accuracy:	±500 ms or 5%

COMMUNICATIONS
Local communication:	2×16 LCD display; 5 button front keypad

Remote communication:
(Local or remote PC and communications network):
Mode:	Modbus RTU
Baud rate:	300 to 19200 bps DB9 connector for RS232 ports on the front (1) and RS485 on the rear

OUTPUTS

TRIPPING CONTACTS
Contact capacity:
Max. Operating Voltage:	440 Vca
Continuous current:	16 A
Make and Carry:	48 A
Breaking:	4000 VA

OUTPUT RELAYS
Configuration:	6 electromechanical, form C
Contact Material:	silver alloy suited for inductive loads

Operating Time: 8 ms
Maximum ratings for 100.000 operations:

Voltage		Make & Carry	M&C Cont.	Break 0.2 seg	Max Load
DC Resist	24 Vdc	16A	48A	16A	384W
	48 Vdc	16A	48A	2.6A	125W
	125 Vdc	16A	48A	0.6A	75W
	250 Vdc	16A	48A	0.5A	125W
AC Resist	120Vdc	16A	48A	16A	1920 VA
	250 Vdc	16A	48A	16A	4000 VA
AC Induct PF=0.4	250 Vdc	10A	30A	10A	1000VA

INPUTS

AC CURRENT
Secondary Rated Current:	1A or 5 A depending on the selected model
Frequency:	50 / 60 Hz (The unit can be set to 50 or 60 Hz)
Relay Burden:	< 0.2 VA @ In = 5A secondary 0.08 VA @ In = 1A secondary
Current Withstand:	4 × In continuously. 100 × In for 1 sec.

DIGITAL INPUTS
High Range
Voltage Threshold:	75 Vdc
Maximum Voltage:	300 Vdc
Relay Burden:	5 mA @ 300 Vdc

Low Range
Voltage Threshold:	12 Vdc
Maximum Voltage:	57 Vdc
Relay Burden:	2 mA @ 57 Vdc

POWER SUPPLY
LOW RANGE
Rated DC Voltage:	24 to 48 Vdc
Min./Max. DC Voltage:	19 / 58 Vdc

HIGH RANGE
Rated DC Voltage:	110 to 250 Vdc
Min./Max. DC Voltage:	88 / 300 Vdc
Rated AC Voltage:	110 to 230 Vac @ 48 – 62 Hz
Min./Max. AV Voltage:	88 / 264 Vac @ 48 – 62 Hz
Power Consumption:	Max. = 10 W
Backup time:	(date, time and log memory) without power supply voltage> 1 week

METERING

THERMAL CAPACITY
Current Circuits
Continuously:	4 × In
During 3 Sec:	50 × In
During 1 Sec:	100 × In

MECHANICAL CHARACTERISTICS
· Metallic package in 1/4 19" rack and 4 units high
· Protection class IP52 (according to IEC 529)

ENVIRONMENTAL
Temperature:
Storage:	-40ºC to +80ºC
Operation:	-20ºC to +60ºC.
Humidity:	Up to 95% without condensing.

PACKAGING
Approximate Weight:
Net:	2.7 kgs (5.9 lbs)
Ship:	3.2 kgs (7 lbs)

TYPE TESTS
TEST	STANDARD	CLASS
Insulation Test Voltage:		
	IEC 60255-5	2kV, 50/60 Hz 1 min
Surge Test Voltage:		
	IEC 60255-5	5 kV, 0.5 J. (3 positive pulses and 3 negative.)
1 MHz Interference:		
	IEC 60255-22-1	III
Electrostatic Discharge:		
	IEC 60255-22-2	IV
	EN 61000-4-2	8 kV in contact, 15 kV through air
Radio interference:		
	IEC 60255-22-3: 40 MHz, 151 MHz, 450 MHz and cellular phone.	III
Radiated Electromagnetic fields with amplitude modulation:		
	ENV 50140	10 V/m
Radiated Electromagnetic fields with amplitude modulation. Common mode.		
	ENV 50141	10 V/m
Radiated Electromagnetic fields with frequency modulation.		
	ENV 50204	10 V/m
Fast Transients:		
	ANSI/IEEE C37.90.1	IV
	IEC 60255-22-4	IV
	BS EN 61000-4-4	IV
Magnetic fields at industrial frequency:		
	EN 61000-4-8	30 AV/m
Power Supply interruptions:		
	IEC 60255-11	
Temperature:		
	IEC 57 (CO) 22	
RF Emission:		
	EN 55011	B
Sinusoidal Vibration:		
	IEC 60255-21-1	II
Shock:		
	IEC 60255-21-2	I
Insulation Test:		
	IEC255-5 (Tested on CTs, Power Supply terminals, Contact Inputs and Contact Outputs)	

APPROVALS
CE:	Conforms to 89/336/CEE and 73/23/CEE
ISO:	Manufactured to an ISO9001 registered program

* Specifications subject to change without notice

User Interface

DISPLAY
16x2 characters LCD display for viewing setpoints, actual value messages, and fault reports
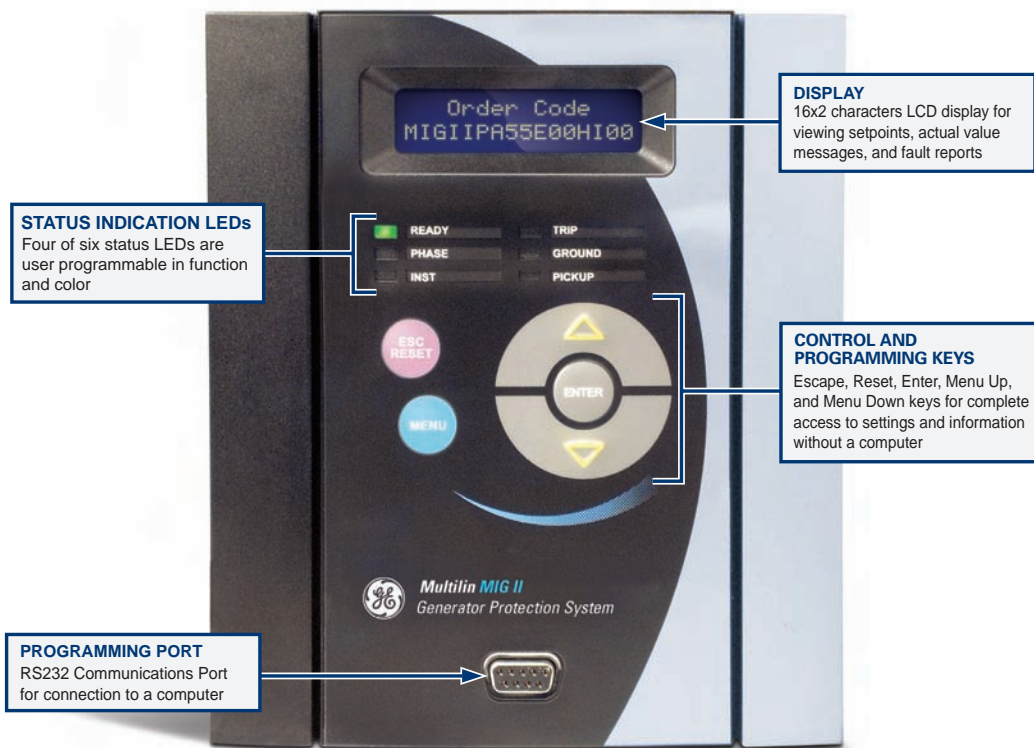
STATUS INDICATION LEDs
Four of six status LEDs are user programmable in function and color

CONTROL AND PROGRAMMING KEYS
Escape, Reset, Enter, Menu Up, and Menu Down keys for complete access to settings and information without a computer

PROGRAMMING PORT
RS232 Communications Port for connection to a computer

Ordering

To order select the basic model and the desired features from the Selection Guide below:

MIG II	*	*	*	*	E	0	0	*	0	0	Description
Application	P										Generator protection elements
	Q										Motor protection elements
Curves		A									ANSI
		I									IEC
		U									IAC
PHASE CT			5								CT In = 5 A (0.5 - 12 A)
			1								CT In = 1 A (0.1 - 2.4 A)
GROUND CT				5							CT In = 5 A (0.5 - 12 A)
				1							CT In = 1 A (0.1 - 2.4 A)
				N							CT In = 1 A (0.005 - 0.12 A) *
POWER SUPPLY								LO			24 - 48 Vdc (19.2 - 57.6 Vdc)
								HI			110 - 250 Vdc (88 - 300 Vdc)
											110 - 230 Vac (88 - 264 Vac)

Visit www.GEMultilin.com/MIGII to:

- View Guideform specifications
- Download the instruction manual
- Review applications notes and support documents
- Buy a MIG II online
- View the MIG II brochure