



FM2

FEEDER PROTECTION SYSTEM

Economical and compact feeder protection for low voltage feeders

KEY BENEFITS

- Comprehensive low voltage feeder management system - Integrated feeder protection and process control in a small package
- Cost effective solution - Low cost modular design
- Small footprint and compact design - With or without display, fits into standard Power Control Center buckets
- Ease of use - EnerVista™ compatible
- Remote monitoring - via serial communications, Modbus RTU
- Easy installation and integration - Door mount option
- Reduced number of devices - Replaces of bi-metal overload elements, integrates timers, relays, meters, switches, indicators
- Integrated trip pushbutton
- Easy to read two line display

APPLICATIONS

- Feeder protection and management system for low voltage distribution feeders
- Integrated process and electrical control
- Specifically designed for Power Control Centre applications

FEATURES

Protection and Control

- Thermal overload protection
- Current unbalance
- Ground fault protection
- Open contactor/Welded contactor
- Under voltage autoreclose
- Outputs: 2 fixed, 1 programmable and 1 emergency shutdown
- Inputs: 6 fixed, 10 programmable

Monitoring & Metering

- Display phase current, ground current, current unbalance, voltage, power, energy, etc.
- Trip record and pre-trip values
- Maintenance information

Communications

- RS485 ModBus™, 1200 - 19,200 bps
- Front Panel 11 LEDs, key pad, and 2x20 LCD display
- Front Panel control push buttons
- Includes EnerVista™ software

EnerVista™ Software

- EnerVista™ software - an industry leading suite of software tools that simplifies every aspect of working with GE Multilin devices
- EnerVista™ Integrator providing easy integration of data in the FM2 into new or existing monitoring and control systems

Protection and Control

The FM2 is available with a variety of protection and control features. FM2 can be used for fuse contactors feeders or feeders with breakers having built in trip units.

Thermal Overload

Thermal overload trip occurs when the thermal capacity value equals 100%. Thermal capacity used is calculated from accumulated I^2t value and chosen overload curves. True RMS current sensing ensures correct response to the heating effect of harmonics. One of 3 different I^2t time overcurrent overload curves may be selected from standard IEC curves.

After an overload trip, the thermal capacity value decreases exponentially to model the load cooling characteristic. An overload trip can be reset when the thermal capacity value decreases to 15%.

Ground Fault

Aging and thermal cycling can cause cable and equipment insulation to break down, resulting in ground faults. Ground faults can be detected by either from the residual connection of the phase CTs or from the zero sequence CT. The FM2 can trigger a trip or an alarm if the ground fault pickup level is exceeded. A time delay may be entered for time coordination of systems with several levels of ground fault detection.

Contactors/Circuit Breaker Failure

The FM2 monitors the contactor/circuit breaker while performing close and open commands. If the contactor does not change status an 'open control circuit' or 'welded contactor' alarm is triggered.

If circuit breaker doesn't change status a 'breaker failed to close' or 'breaker failed to open' alarm is generated.

Additional Alarms

The FM2 has programmable alarms to warn of a number of abnormal conditions. These include: contactor inspection, and process interlock switch open.

Undervoltage Autoreclose

The feeder can be automatically reclosed after a momentary power loss when this feature is enabled. When the control voltage drops below the dropout voltage the contactors are de-energized. The FM2 can initiate timers to reclose selected feeder upon the return of supply voltage. It has one instantaneous and two delayed reclose settings. If control voltage is restored within the programmed reclose time, the feeder will be reclosed immediately. If the control voltage takes longer to be restored, the FM2 can be programmed to attempt a reclose after a programmed time delay.

Outputs

The FM2 has two output relays (A and B). Relay A and Relay B can be controlled independently for controlling a breaker. Relay A is used as close contact and Relay B is used as a trip contact for the breaker. There is also a programmable relay available on the FM2, which can be assigned to any one of the relay functions. FM2 has an emergency shutdown (ESD) relay, which can be energized externally by applying 24VDC.

Switched Inputs

The FM2 has six fixed control inputs. These are used for close A and B, open, test status, and contactor A and B status. The FM2 also has 10 programmable switch inputs. Each input can have one of a number of interlock functions assigned to it. A function can be assigned to one interlock input.

Monitoring and Metering

The FM2 offers advanced monitoring and metering which includes:

Metering

The FM2 meters and displays:

- RMS current of each phase
- Ground fault leakage current
- Phase current imbalance (%)
- Power (kW)
- Energy (kWhr)
- Voltage

Trip Record

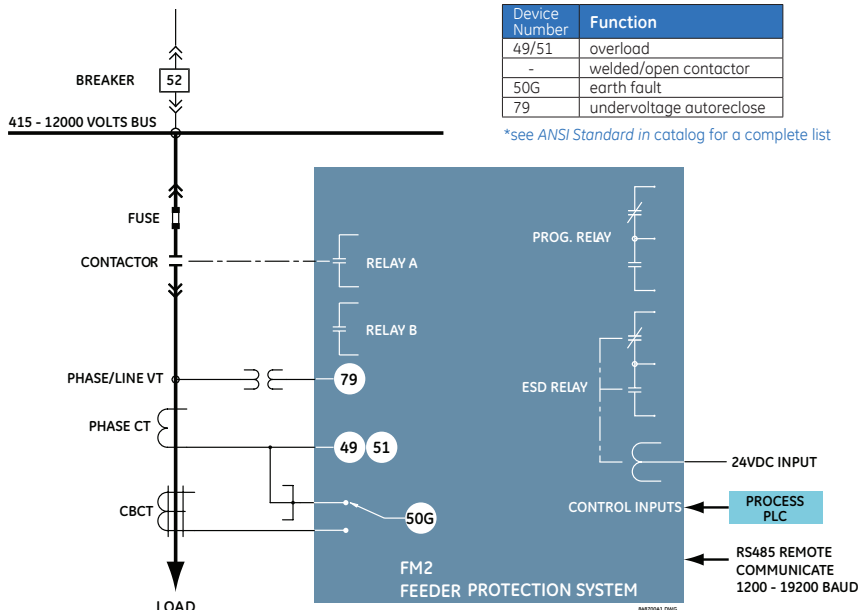
When the FM2 issues a trip command a record is generated which includes the cause and pre-trip current values.

Statistics and Maintenance

The FM2 records statistical data about relay and feeder operation, allowing the user to set the interval at which routine maintenance tasks should be performed. When the times are exceeded an alarm is generated. This includes:

- Contactor inspection: number of contactor/breaker operations after which contactor contacts must be inspected for wear

Functional Block Diagram



User Interfaces

The user can communicate with the FM2 through a variety of interfaces:

Display and Control Keys

The panel mount model has a large user OPEN key which opens feeder contactor/breaker. The panel mount model comes with a two-line 40 character display and additional control keys. The display and keypad can be used for local programming, showing information on alarms and trips, and displaying monitoring and metering values.

Indicator LEDs

The panel mount FM2 has nine status LEDs and has two additional LEDs which indicate auto mode or manual control mode.

Communications

The FM2 uses a ModBus® RTU RS485 connection for communication. Up to 32 FM2s can be daisy-chained together on a

single communication channel. The FM2 supports operation at 1200 to 19,200 bps. A RS232/485 converter module may be used to connect a personal computer to the FM2.

Models

Mounting Configurations

The FM2 can be ordered in either chassis mount or panel mount with display.

The chassis mount model comes with any of the option models. Setpoints are loaded through the RS485 port.

The panel mount with display model may be ordered with any option model. It is mounted on the front panel of the PCC with its two by 20 alphanumeric display, full keypad, and 11 status LEDs exposed to the operator for complete local viewing and setpoint programming. The setpoints can also be loaded into the relay through the RS485 communications port.

Models

Model 712:

- 120V, 50 or 60Hz AC VT input and switch input voltage rating

Model 722:

- 240V, 50 or 60Hz AC CT input and switch input voltage rating



The panel mount with display model is the "Top of the Line" FM2.

EnerVista™ Software

A single PC setup software package is required to access, configure, and monitor the FM2 relay. The EnerVista™ FM2 Setup Software extracts the model number, version, and configuration parameters from the connected relay to display only the relevant data and options for the relay it is communicating with. This eliminates having to manually configure the relay within the software and provides a simple and easy to use operator user interface.

The FM2 relay is supplied with Windows® based EnerVista™ FM2 Setup Software. EnerVista™ software may be run on a PC with any Windows® based operating system. The program may be used locally on the RS232 front port or remotely on the RS485 port. It provides full access to the relay data with the following features:

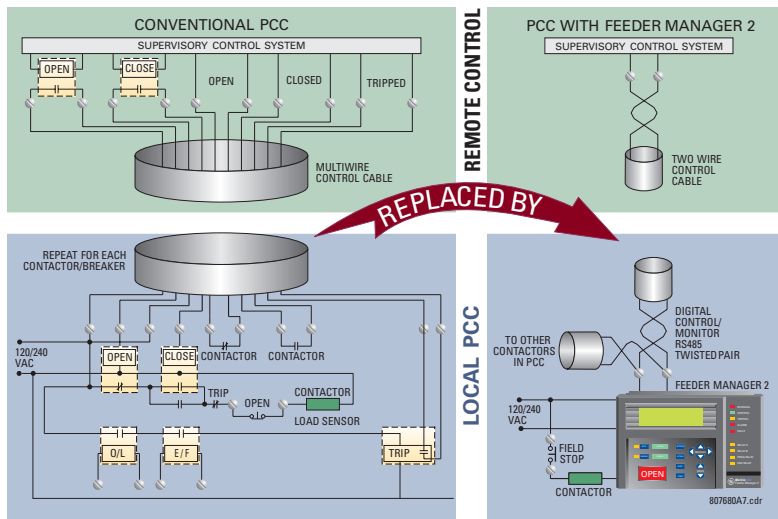
- View relay status and actual values
- View/edit settings on-line/off-line
- View event recorder for trouble-shooting
- Configure inputs, outputs and LEDs through configurable logic
- Utilize a configurable protection curve
- Relay firmware programming for upgrades

In addition, all status information such as target messages and digital input/output states may be viewed with EnerVista™ FM2 Setup Software.



The chassis mount model is the "black box" version of the FM2. It is mounted inside the power control center (PCC).

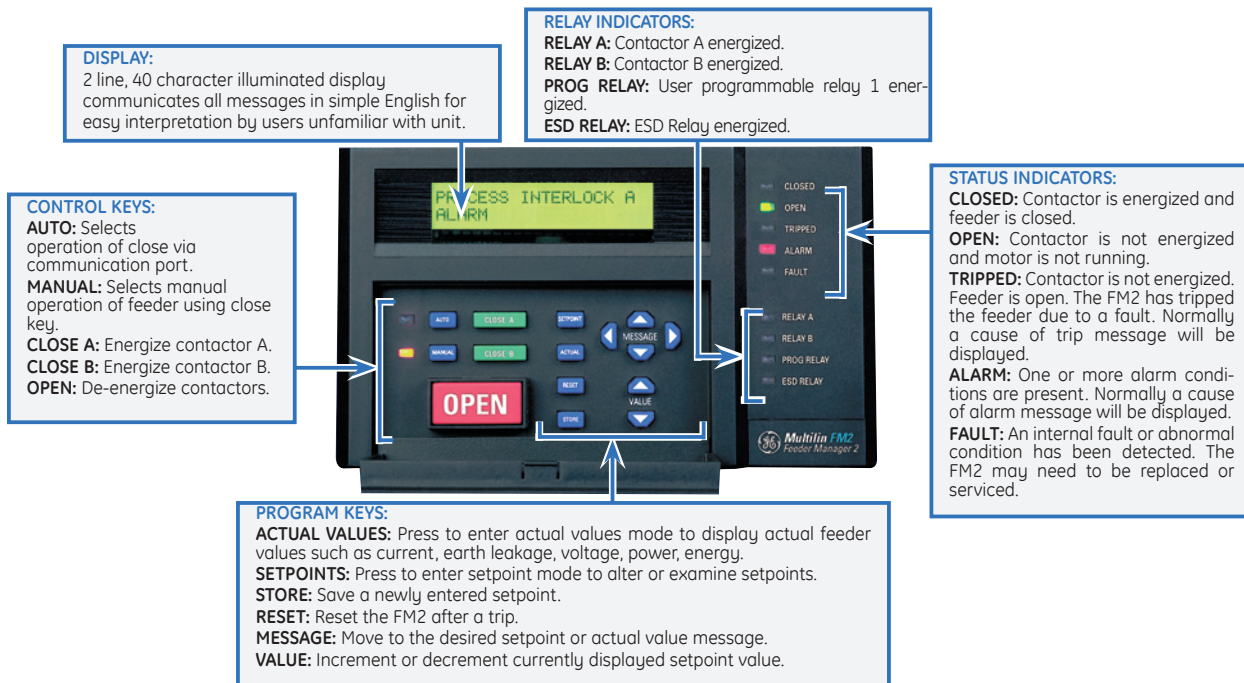
Cost Effective PCC Wiring with FM2.



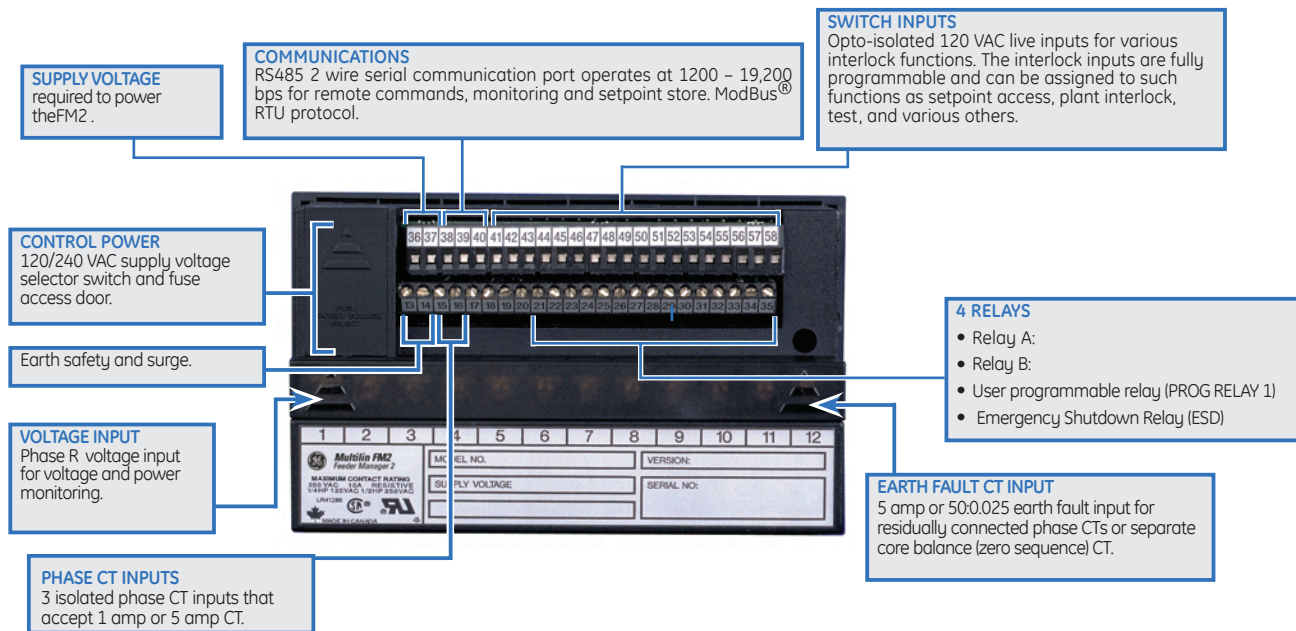
Features

Distribution Feeder Protection

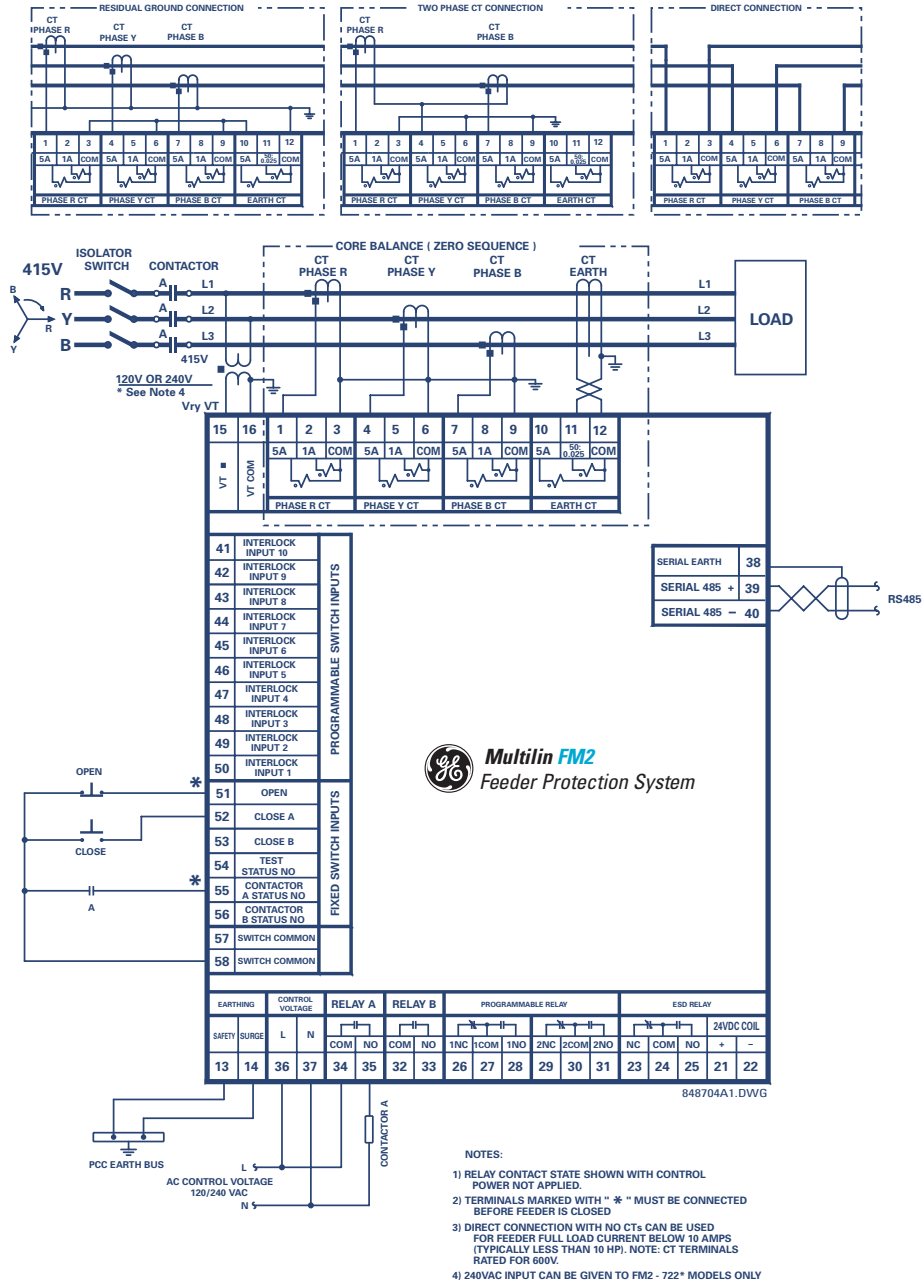
Front View



Rear View

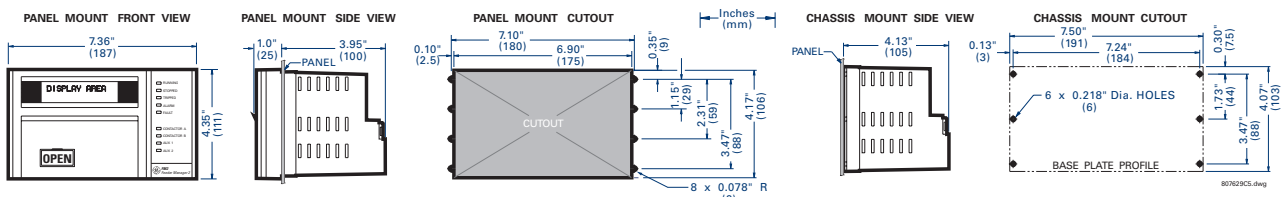


Typical Wiring



Distribution Feeder Protection

Dimensions



FM2 Technical Specifications

PROTECTION

IEC OVERLOAD CURVES IEC A, IEC B, IEC C
Trip time: ±200 ms up to 10 sec
Accuracy: ±2% of trip time over 10 sec
Detection level: ±1% of primary CT amps

GROUND FAULT TRIP TIME
Accuracy: -0 ms, +50 ms, 0.0 = <50 ms

UNDERVOLTAGE – SUPPLY VOLTAGE
Undervoltage: 65% of nominal (120 VAC or 240 VAC) immediate reclose for maximum dip time of 0.1 – 0.5 sec or OFF delay 1 reclose for maximum dip time of 0.1 – 10.0 sec/unlimited time delay 2 reclose for maximum dip time of 0.5 – 60.0 min/off

Delay reclose range: 0.2 – 300 sec
Delay restart accuracy: ±0.2 sec

MONITORING

VOLTAGE INPUT/POWER READING
Conversion: True RMS, sample time: 12 samples/cycle for 50Hz 10 samples/cycle for 60Hz

Voltage full scale: 1.5 x VT primary
Voltage accuracy: ±2% of VT primary or ±2% of reading (whichever is greater)

Power accuracy: ±5% of nominal or ±5% of reading (whichever is greater)

Power range: -12500kW to +12500kW
Input voltage: Nominal: 120 VAC or 240 V
Max: 150 VAC for 712 model 300 VAC for 722 model

VT burden: 0.01 VA

PHASE IMBALANCE

Range: Greater than 30% U/B trip, alarm 15%

Accuracy: ±2 percentage points

Trip delay: 5 sec, ±1 sec

Calculation method: If $I_{AV} \geq I_{FLC} \cdot \frac{|I_M - I_{AV}|}{I_{AV}} \times 100$

If $I_{AV} < I_{FLC} \cdot \frac{|I_M - I_{AV}|}{I_{AV}} \times 100$

Where: I_{AV} = average phase currents
 I_M = current in a phase with maximum deviation from I_{AV}
 I_{FLC} = motor full load current setting

METERING

PHASE CURRENT INPUTS

Conversion: True RMS, sample time: 12 samples/cycle for 50Hz 10 samples/cycle for 60Hz

Range: 0.1 – 8 x phase CT primary amps setpoint

Full scale: 8 x phase CT primary amps setpoint

Accuracy: ±2% of Phase CT primary amps setpoint or ±2% of reading, whichever is greater

GROUND FAULT CURRENT INPUT

Conversion: True RMS, sample time: 12 samples/cycle for 50Hz 10 samples/cycle for 60Hz

Range: 0.1 to 1.0 x Phase CT primary amps setpoint (5 A secondary CT)
 0.5 to 15.0 amps (2000:1 CT)

Full scale: 1.5 x CT primary amps setpoint (5 A secondary CT)
 (15 A (2000:1 CT))

Accuracy: 5 A secondary: ± 2% of full scale
 2000:1 CT: ± 0.10A (0.0 to 3.99 A)
 ± 0.20 A (4.00 to 15.00 A)

OUTPUTS

RELAY CONTACTS

FM2 CONTACTOR A & B AND ESD RELAY

| VOLTAGE | MAKE/CARRY CONTINUOUS | MAKE/CARRY 0.2 sec | BREAK |
|--------------------|-----------------------|--------------------|--------|
| 30 VDC | 10 A | 30 A | 10 A |
| RESISTIVE 125 VDC | 10 A | 30 A | 0.5 A |
| 250 VDC | 10 A | 30 A | 0.3 A |
| 30 VDC | 10 A | 30 A | 5 A |
| INDUCTIVE 125 VDC | 10 A | 30 A | 0.25 A |
| IL/R = 7ms 250 VDC | 10 A | 30 A | 0.15 A |
| RESISTIVE 120 VAC | 10 A | 30 A | 10 A |
| 250 VAC | 10 A | 30 A | 10 A |
| INDUCTIVE 120 VAC | 10 A | 30 A | 10 A |
| (PF = 0.4) 225 VAC | 10 A | 30 A | 8 A |

CONFIGURATION CONTACTOR A & B – FORM A
 ESD RELAY – FORM C

CONTACT MATERIAL SILVER ALLOY (AgCdO)

MAX OPERATING VOLTAGE 280 VAC, 250 VDC

MINIMUM PERMISSIBLE LOAD 5 VDC, 100 mA

FM2 PROG RELAY 1 OUTPUT

| VOLTAGE | MAKE/CARRY | MAKE/CARRY 0.2 sec | BREAK |
|--------------------|------------|--------------------|--------|
| RESISTIVE 30 VDC | 5 A | 15 A | 5 A |
| 125 VDC | 5 A | 15 A | 0.25 A |
| INDUCTIVE 30 VDC | 5 A | 15 A | 2.5 A |
| IL/R = 7ms 125 VDC | 5 A | 15 A | 0.1 A |
| RESISTIVE 120 VAC | 5 A | 15 A | 5 A |
| 250 VAC | 5 A | 15 A | 5 A |
| INDUCTIVE 120 VAC | 5 A | 15 A | 5 A |
| (PF = 0.4) 225 VAC | 5 A | 15 A | 3 A |

CONFIGURATION AUX RELAY 1 – DUAL FORM C

CONTACT MATERIAL SILVER ALLOY (AgCdO)

MAX OPERATING VOLTAGE 280 VAC, 125 VDC

INPUTS

CT INPUTS

| | CT INPUT (A) | BURDEN | |
|-------------------------------------|--------------|--------|-------|
| | | (VA) | (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 |
| Earth CT (5 A) | 5 | 0.04 | 0.002 |
| | 25 | 1.1 | 0.002 |
| | 100 | 17 | 0.002 |
| Sensitive Earth Fault CT (50:0.025) | 0.025 | 0.07 | 116 |
| | 0.1 | 1.19 | 119 |
| | 0.5 | 30.5 | 122 |

| | WITHSTAND | | |
|----------------|------------|------------|-----------------|
| | 1 SEC x CT | 5 SEC x CT | CONTINUOUS x CT |
| Phase CT (1 A) | 100 | 40 | 3 |
| Phase CT (5 A) | 100 | 40 | 3 |
| Earth CT (5 A) | 100 | 40 | 3 |

50:0.025 EARTH FAULT INPUT WITHSTAND

| | |
|------------|-------------------|
| Continuous | 150 mA |
| Maximum | 12 A for 3 cycles |

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

DIGITAL INPUTS

Inputs: 6 fixed & 10 configurable inputs optically isolated.

Input Type: Dry contact

POWER SUPPLY

SUPPLY VOLTAGE

AC nominal: 120 VAC, range 108 – 135 VAC
 240 VAC, range 216 – 250 VAC

Frequency: 50/60 Hz
Power consumption: 25 VA (Maximum)
 7 VA (Nominal)

*CE units limited to 250 V unless external fuse rated to 300 V is used.

COMMUNICATIONS

Type: RS485 2 wire, half duplex
Baud rate: 1,200 – 19,200 bps
Protocol: ModBus® RTU
Functions: Read/write setpoints, read actual values, execute commands, read coil status, read device status, loopback test

ENVIRONMENTAL

Pollution degree: 2
Overvoltage category: 2
Insulation voltage: 300 V
Operating temperature range: 0° C to 60° C
Dust and moisture rating: NEMA Type 12+12K

TYPE TESTS

UL: E83849
Transients: ANSI/IEEE C37.90.1 oscillatory/fast risetime transients IEC 255-22-4 electrical fast transient/burst requirements IEC 255-5 5 kV impulse voltage test IEC 255-22-3 5 v/m with portable transmitter IEC 255-22-2 electrostatic discharge
Hipot: 1500 V, 1 min all input >30 V

PACKAGING

Max weight: 4 lbs (1.8 kg)
Shipping dimensions: 8.3" x 5.625" x 5.8" (211 mm x 143 mm x 147 mm)

FUSE TYPE/RATING

0.5 A 250 V
 Fast blow, high breaking capacity

INSTALLATION

WARNING: HAZARD may result if the product is not used for its intended purpose
Ventilation requirements: None
Cleaning requirements: None

CERTIFICATION

CE: IEC 61010-1
cULus: E83849 UL listed for USA & Canada

*Specifications subject to change without notice.

Ordering

| FM2 | * | - | * | - | * | - | * | Product Family |
|-----------|-----|-----|---|---|---|---|----|-------------------------------------|
| Base Unit | FM2 | | | | | | | 120V AC VT and Switch input voltage |
| Model | | 712 | | | | | | 240V AC VT and Switch input voltage |
| | | | | | | | PD | Panel mount with Display |
| | | | | | | | C | Chassis mount (Black box) |

Visit www.GEMultilin.com/FM2 to:



- View Guideform specifications
- Download the instruction manual
- Review applications notes and support documents
- Buy a FM2 online
- View the FM2 brochure