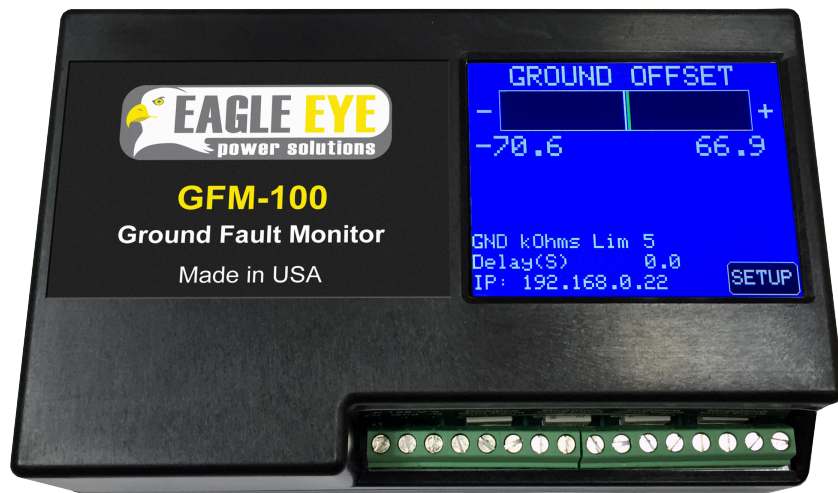


# GFM-100

## Ground Fault Monitor

*Installation & Operation Manual, Revised Dec 2, 2019*



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# 1. Description

The Ground Fault Monitor series reads battery bus status, detects out-of-limit conditions, and provides alarm indications at precise user settings. All models feature local digital display of conditions and contact outputs, as well as Ethernet connectivity to transmit status and alarms via Modbus. Each Monitor can be set to a fixed IP address, or can have an address assigned by a DHCP server elsewhere on the network.

The color touchscreen displays updated monitor status and enables input of user settings. The settings screen may be activated by one touch. Trigger limits may be set, along with desired delay and the Monitor's Ethernet IP Address.

The Ground Fault Monitor (GFM) is one of a family of digital monitors that read offset voltage from ground and alarms for ground faults. For users requiring voltage readings, the Voltage Monitor (VM) reads DC voltage level, and alarms for voltage levels outside of the user settings. The Voltage Ground Monitor (VGM) combines the functions of the GFM and VM models into a single unit.

## 2. Installation

The GFM digital monitors are designed for quick installation on walls, panels or 48mm DIN rails. Screw compression terminal blocks ease connection to power and relay contact outputs. If mounting to a wall or panel, first mount the included clip, then slide the GFM onto the top of the clip first, then pull down to push the monitor into the bottom of the clip. If included with the EE-NERC-BMS kit, the GFM will be pre-wired for voltage measurement. The enclosure will still require a ground to the building installed by the user.

### 2.1 Wiring

The GFM measures the total voltage of the battery system. 30 to 14 AWG wire (not included) should be used for the voltage connection from the GFM to the positive and negative bus of the battery. A ground cable is required in order for the GFM to have a reference to ground and operate correctly. It is recommended to use a 16 AWG ground cable (not included) which can be mounted to the battery or building ground point. The GFM will power on as soon as the correct voltage range is applied.

### 3. Operation

The GFM contains a small DC-DC converter power supply to provide regulated 5VDC power to the rest of the unit. The device is built around a microcontroller. The input voltage and ground voltages are scaled by resistor dividers to reduce the voltage to logic levels. These low-level voltages are measured by the microcontroller's on-board 10-bit ADC. The chip's firmware programming detects trigger conditions and controls the output relays through digital outputs. The microcontroller also drives the touchscreen and sends data to an Ethernet controller chip for transmission from the Monitor's LAN port.



When power is applied to the Monitor, the firmware reads the stored settings from the microcontroller's on-board EEPROM and begins monitoring. The touchscreen displays the ground fault resistance trigger level setting and the Monitor's IP address. A horizontal bar indicates the balance in ground fault resistance between the negative and positive battery buses. The status and bar indicator updates approximately twice per second.

If a ground fault occurs, the bar will turn red and an alarm message will be displayed. Alarm messages are white text with a red background. If a ground fault is detected, a POS GND FAULT or NEG GND FAULT message will appear.

### 4. Setting the Ground Fault Monitor

All models of the Ground Fault Monitor are shipped with default settings entered. If different settings are desired, they can be changed by tapping the Setup button on the touchscreen. The display will change to the settings screen, where the setting to be changed can be selected. The procedure is similar for all settings. All monitor alarms are disabled when in any Settings screen.

## 4.1 Gnd kOhms Setting

This is the ground fault resistance setting. The same value is used for both positive and negative ground faults. In the Settings screen, tap the black window displaying the current Gnd kOhms setting. The screen will change to a numeric keypad. Type the desired value. The new value will appear as it is typed. The Clear button will erase any typed number, and restart number entry. The Cancel button will exit the Gnd kOhms screen and return to the Settings screen. The Save button will save the newly entered value and return to the Settings screen.

## 4.2 Delay (S)

This sets the time delay setting for all alarms, it is set in seconds. In the Settings screen, tap the black window displaying the current DELAY setting. The screen will change to a numeric keypad. Type the desired value. The new value will appear as it is typed. The Clear button will erase any typed number, and restart the number entry. The Cancel button will exit the Delay screen and return to the Settings screen. The Save button will save the newly entered value and return to the Settings screen.

## 4.3 Calibration

The unit should be calibrated after installation and input of the Gnd kOhms setting. The calibration voltage must be the voltage applied to the unit at the time of calibration (the operating voltage from the battery). To calibrate follow the steps below:

- Install the unit and apply power from the battery float voltage
- Input the desired gnd kOhms setting (this is the only resistance value entered)
- Press SETUP then CALIBRATE
- Enter the float voltage as measured at the inputs of the GFM and press OK
- The unit will prompt "Connect [nn]k NEG-GND and press OK" ([nn]k is a resistor equal to the Gnd kOhms setting)
- Connect the resistor across the GND and -V terminals and press OK. Remove the resistor.
- Then the unit will prompt "Connect [nn]k POS-GND and press OK"
- Connect the resistor across the GND and +V terminals and press OK.
- The unit will display the message "AUTOCAL COMPLETE. RESETTING..." Remove the resistor and the unit will restart and begin monitoring.

### 4.3 IP Address

This sets the Ethernet IP address of the Monitor. It is set in nnn.nnn.nnn.nnn format and can be any legal IP address. In the Settings screen, tap the IP ADDR button. The screen will change to a numeric keypad. Type the desired value. The new value will appear as it is typed. The Clear button will erase any typed number, and restart the number entry. The Cancel button will exit the Delay screen and return to the Settings screen. The Save button will save the newly entered value and return to the Settings screen.

### 4.4 Exit

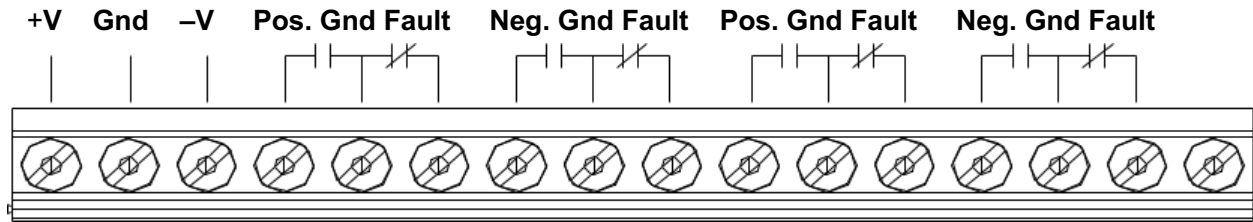
Returns from the Settings screen to the online display.

If the Monitor is in setting screen for 60 seconds without any button being tapped, the monitor will return to the monitoring screen using the last values saved.

## 5. Specifications

Part No.	Nominal Voltage	Voltage Range
<b>GFM-100-24V</b>	24V	18 – 32 VDC
<b>GFM-100-48V</b>	48V	38 – 60 VDC
<b>GFM-100-125V</b>	125V	90 – 160 VDC
<b>GFM-100-250V</b>	250V	180 – 320 VDC
<b>Accuracy</b>	Better than 1%	
<b>Fault Resistance Limit Set</b>	1 kOhm to 100 kOhm	
<b>Factory Set</b>	10 kOhm	
<b>Output Contacts</b>	2 Form C Dual Output Contacts – Positive & Ground Fault	
<b>Contact Rating</b>	<b>Voltage</b>	<b>Resistive</b>
	125 VAC / VDC	0.5 A
	30 VDC	2 A
	<i>Expected life – 5 x 10<sup>5</sup> operations at above ratings</i>	
<b>Maximum Switching Power</b>	60 W	
<b>Time Delay to Alarm</b>	Adjustable 1 – 999 seconds	
<b>Case Dimensions</b>	147 x 90.5 x 45 mm (5.77 x 3.56 x 1.77 in.)	
<b>Case Material</b>	10% glass-filled polycarbonate	
<b>Weight</b>	10 oz.	
<b>Temperature Range</b>	Operating 0 – 55°C (32 – 131°F)	
<b>Humidity</b>	0 – 95% R.H. non-condensing	

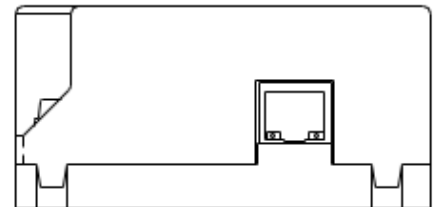
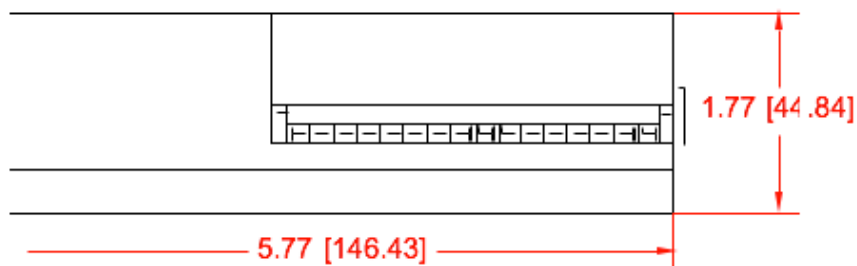
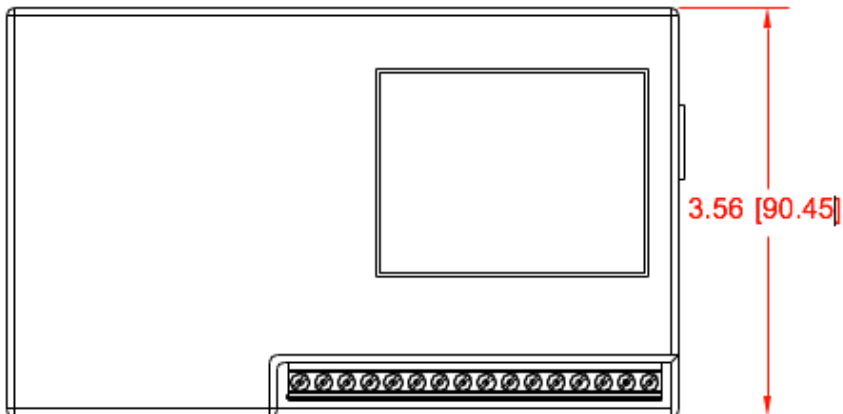
## 6. Dimensions & Connections



### Screw Connection Terminals:

Wire Size: 30 AWG – 14 AWG

Recommended: 22 AWG – 10 AWG



## 7. Modbus TCP/IP Functions

The VGM, VM, and GFM Battery Monitors are Modbus TCP/IP compatible. The Monitors write data readings to memory and update them each time the firmware scans the inputs. Holding Registers are used to store all values (read with 3x). The Registers are zero-based. All values are stored in decimal form, and all non-whole numbers are split between two Holding Registers so that the integer part is in one register, and the decimal portion is in the next register. Registers for alarm status indicate 1 for alarm, 0 for no alarm.

### 7.1 Register Mappings

Register 0: nominal voltage of unit – 12, 24, 48, 125, or 250

Register 1: Positive Ground Fault Alarm – 0 or 1

Register 2: Negative Ground Fault Alarm – 0 or 1

Register 5: Positive Ground Voltage, left of decimal

Register 6: Positive Ground Voltage, right of decimal

Register 7: Negative Ground Voltage, left of decimal (absolute value; NOT transmitted as a negative number)

Register 8: Negative Ground Voltage, right of decimal (absolute value; NOT transmitted as a negative number)

Register 9: Ground Fault Resistance setting (in k-ohms), left of decimal

Register 10: Ground Fault Resistance setting (in k-ohms), right of decimal

<b>Register 0</b>	Nominal voltage of unit – 12, 24, 48, 125, or 250
<b>Register 1</b>	Positive Ground Fault Alarm – 0 or 1
<b>Register 2</b>	Negative Ground Fault Alarm – 0 or 1
<b>Register 5</b>	Positive Ground Voltage, left of decimal
<b>Register 6</b>	Positive Ground Voltage, right of decimal
<b>Register 7</b>	Negative Ground Voltage, left of decimal (absolute value; NOT transmitted as a negative number)
<b>Register 8</b>	Negative Ground Voltage, right of decimal (absolute value; NOT transmitted as a negative number)
<b>Register 9</b>	Ground Fault Resistance setting (in k-ohms), left of decimal
<b>Register 10</b>	Ground Fault Resistance setting (in k-ohms), right of decimal