

EM2

ENTRANCE MONITOR



Installation and Operation Manual

Warning

Use this product only in the manner described in this manual.

**If the equipment is used in a manner not specified by CTI,
the protection provided by the equipment may be impaired.**

This equipment should be installed by qualified personnel.

Table of Contents

General description	4
Installation	4
Locating the entrance monitor	4
Installation guidelines	4
Wiring	5
Operation	10
Power-up.....	10
Operator interface.....	10
Contrast	10
Home screen.....	10
Alarm condition	11
Status screens.....	11
Top Menu screen.....	12
Configuration mode	13
Test mode	16
In/Out adjust.....	17
Start-up	18
Maintenance	18
Specifications	20
Warranty	21

For technical support, contact:

CTI

920 N Tradewinds Pkwy
Columbia, MO 65201

866-394-5861

Sales@ctiengineering.com

www.ctiengineering.com

General Description

This manual covers the EM2-24 and EM2-120 entrance monitors. The EM2-120 includes an installed AC-DC power supply that allows for 120Vac input and converts it to 24Vdc power for the EM2.

The EM2 terminates the gas sensor's 4-20 mA signal, and re-transmits the 4-20 mA signal to another analog input device such as gas detection controller or plant PLC. If no connection is made to the signal output terminal, the unit will act as a stand-alone device. Multiple entrance monitors can be installed in series, providing flexible remote viewing options.

The EM2 provides continuous real-time monitoring of the sensor. Gas concentrations and alarm status are indicated on the monochrome LCD display.

The EM2 is assembled into a wall mounted enclosure designed for non-classified locations. The gas sensor (not included) is installed at the location where gas is to be detected. The total distance between the sensor and EM2, and the EM2 and the power supply should not exceed 1,000 ft.

A calibration mode setting allows for sensor maintenance and calibration without tripping the relay and locks the analog output signal at 4 mA. The onboard relay has adjustable on/off time delays to prevent unnecessary cycling during a fault or alarm condition.

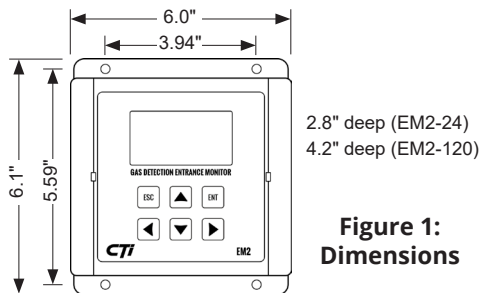
Installation

Locating the Entrance Monitor

The EM2 can be installed indoors or outdoors and should be installed for easy viewing and accessibility by operating personnel.

Installation Guidelines:

- Mount on solid surface with minimal vibration.
- Mount readout in a general-purpose location only. Do not install in a hazardous environment.
- Mount readout away from electromagnetic interference.
- Protect readout from physical damage.
- If mounting on a wall with studs, the mounting screws should be screwed into the studs.



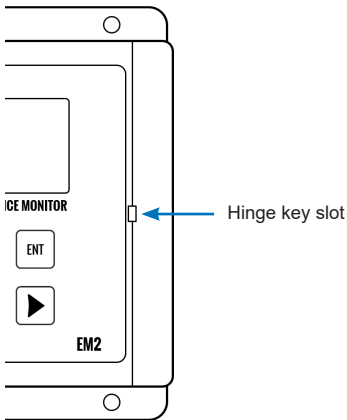
**Figure 1:
Dimensions**

Opening the enclosure

The left and right hinges hold the top cover to the base.

Insert a small (0.12" (3 mm) or smaller) slotted screwdriver into the hinge key slot on the right hinge. In one quick, firm motion, pry hinge to the right. This should unclasp the hinge.

The left hinge is locked and typically shouldn't be opened. If necessary, it can be unclamped by removing the key lock.



Wiring

Electrical wiring must comply with all applicable codes.

Wiring Guidelines:

- Always use 3-conductor, insulated, stranded, shielded copper cable for all sensor cables.
- Do not pull sensor wiring with AC power cables. This can cause electrical interference.
- Be sure to land the shield conductors of the sensor cables at the shield terminals of the sensor connectors.
- Bonding between metallic conduit connections is not automatic with the non-conductive enclosure. Separate bonding must be provided.
- Use stranded, copper wire/cable with a minimum of 75°C rating (167°F).
- To maintain the IP rating of the enclosure, conduit fittings of the same rating or better must be used.

DC Power: (EM2-24)

Requires 24VDC, 350 mA (not including other connected devices).

AC Power: (EM2-120)

100-240 VAC, 0.7A 50/60 Hz.

The EM2-120 is shipped with flying leads attached to the power supply terminals.

Sensor Wiring:

- 4-20 mA, 261 Ohm input impedance.
- Refer to sensor manual for cable recommendations (typically 18/3 shielded cable (General Cable #C2535A or equivalent)).
- Cable should not exceed 1,000 feet total length from the sensor to the power supply.

Relay Wiring:

- AC wiring must be run in separate conduit from the sensor cables, if length of run is more than 10 ft.
- If a separate relay cable conduit hole is needed, do not drill or punch hole on hinge sides of enclosure.
- The alarm relay has Form C dry contacts, and is rated 8A @ 120-240 VAC or 5A @ 24 VDC (dry contacts require external power connection). The relay is de-energized in the normal state (continuity between C and NC), unless Failsafe is selected from the menu. It will transition to the alarm state upon sensor alarm. The alarm relay has a green status LED to show the state of the relay. The green status LED indicates when the relay is energized.

Stand-Alone and Feed-Through Applications

The EM2 terminates the gas sensor's 4-20 mA signal, and re-transmits the 4-20 mA signal to another analog input device such as gas detection controller or plant PLC. If no connection is made to the signal output terminal, the unit will act as a stand-alone device.

Stand-Alone wiring specifications:

- Cable recommendations: 18/3 shielded cable (General Cable #C2535A or equivalent).
- Cable should not exceed 1,000 feet total length from the sensor to the power supply.

Feed-through wiring specifications:

- Maximum input impedance: 700 Ohms.
- Cable recommendations: 18/3 shielded cable (General Cable #C2535A or equivalent).
- Cable should not exceed 1,000 feet total length from the sensor to the power supply.

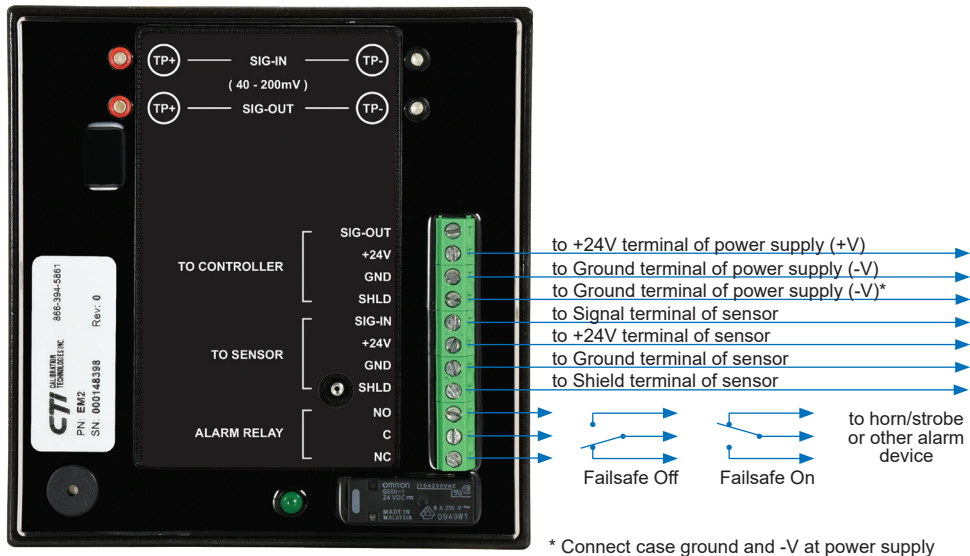


Figure 2: Wiring Diagram (Stand-Alone application)

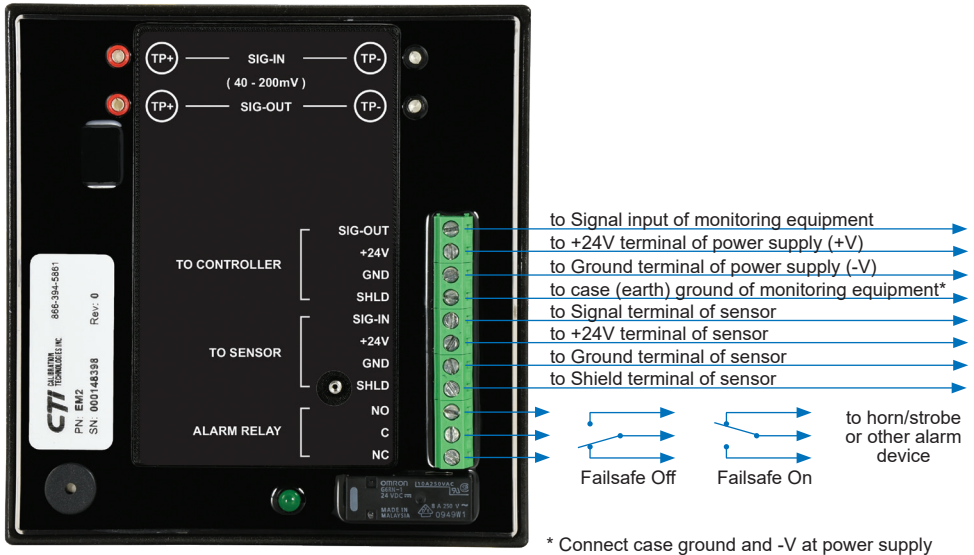


Figure 3: Wiring Diagram (Feed-Through application)

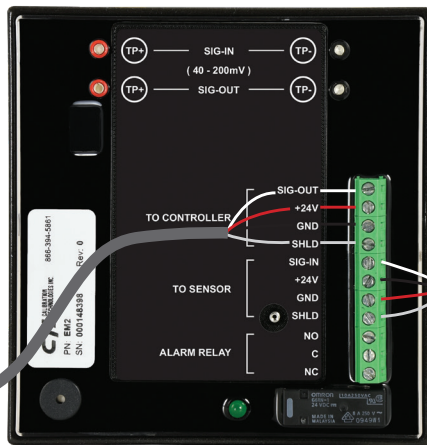
Entrance monitor wiring example

1. Run cable from power source (PLC, controller or power supply) into "TO CONTROLLER" terminal.
2. Run cable from "TO SENSOR" terminal to the next entrance monitor in sequence.
3. Repeat step 2 until you have fed through every entrance monitor in sequence.
4. On the last entrance monitor, finish by running cable to the sensor.
5. If multiple EM2's are connected in series, additional power supplies and/or heavier gauge cable may be required. Contact CTI for assistance.

Example 1



Example 2



Next entrance monitor or sensor

Gas detection controller, PLC or power supply

Operation

Power-up

Before applying power, make a final check of all wiring for continuity, shorts, grounds, etc. It is usually best to disconnect external alarms and other equipment from the EM2 entrance monitor until the initial start-up procedures are completed.

Operator Interface

All operator functions are performed from the pushbuttons on the front of the panel. Below is a list of the common key functions used for the LCD operations:



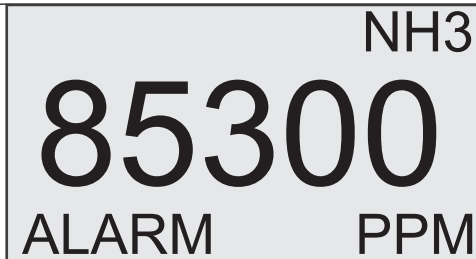
Enter key is used to enter the Top menu, edit and save configuration parameters and save changes while exiting.



Escape key is used to go back to previous menu screen or exit out of a field without saving changes.



Up/Down/Left/Right keys are used to navigate the menu and field lists.



In some fields, the arrow keys can be held in to dramatically increase the speed at which the number increments/decrements.

Contrast

To adjust the contrast of the LCD, use the ◀▶ keys from the Home screen or Status screen. The contrast setting is shown on the Status screen.

Home screen

The Home screen of the LCD provides an at-a-glance indication of the gas concentration, along with gas type, unit of measurement, and alarm status. The menu tables also allow for other units of measurement, such as temperature, pressure, etc.

In cold temperatures, the LCD response time slows down. The refresh rate will automatically slow down to compensate for this to make it easier to read.

Inactivity of the operator interface after 5 minutes will return the LCD to the Home screen.

Alarm condition

Once the signal exceeds the alarm setpoint for the Set Delay time, ALARM will flash on the screen and the alarm relay will change states. Once the signal falls below the alarm setpoint for the Reset Delay time, the ALARM message will clear and the relay will return to its resting state. However, if LATCHING is turned on, the ALARM message will remain and PRESS ESC TO RESET will also flash on the screen. Pressing the **ESC** key will clear the alarm and reset the relay back to its resting state.

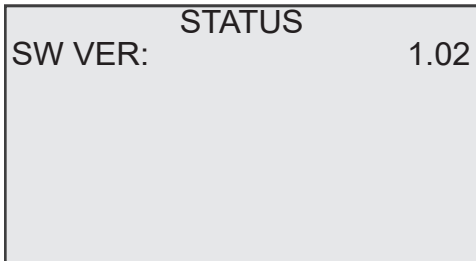
Status screens

Pressing the **▲** or **▼** arrows will allow viewing of the Status screens as seen on the following page. The parameters are configured in Configuration mode. No changes can be made from the Status screens.

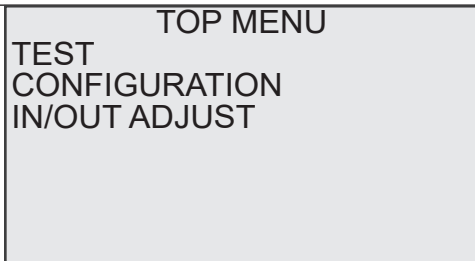
STATUS	
GAS:	NH3
UNITS:	PPM
# OF DEC POINTS:	0
4 MA:	0
20 MA:	100
ALARM SET PT:	25
DEADBAND:	2

STATUS	
SET DELAY (SEC):	2
RESET DLY (SEC):	10
ALARM DIR:	UPSCALE
LATCHING:	YES
FAILSAFE:	ON
RLY TRIP ON FLT:	ON
BACKLIGHT:	ON

STATUS	
BEEP:	ON
TOP MENU:	ON
AVERAGING:	OFF
CONTRAST:	21
TEMP (F):	82.4
HEATER:	0
REFRESH RATE (S):	1.0



There are four more sets of screens explained on the following pages: Top Menu, Configuration, Test, and In/Out mA Adjust.



Top Menu screen

The Top Menu screen allows access to the three other modes on the entrance monitor.

To access the Top Menu screen, press the **ENT** key.

Use the **▲** **▼** keys and then press the **ENT** key to select the mode.

To add a layer of security, the Top Menu screen can be turned off in the Configuration menu. With the Top Menu turned off, entering these three screens are only possible by using specific key combinations, as described in the following sections of this manual.

CONFIGURATION

GAS:	NH3
UNITS:	PPM
# OF DEC POINTS:	0
4 MA:	0
20 MA:	100
ALARM SET PT:	25
DEADBAND	2

CONFIGURATION

SET DELAY (SEC):	2
RESET DLY (SEC):	10
ALARM DIR:	UPSCALE
LATCHING:	YES
FAILSAFE:	ON
RLY TRIP ON FLT:	ON
BACKLIGHT	ON

CONFIGURATION

BEEP:	ON
TOP MENU:	ON
AVERAGING:	OFF

Configuration Mode

To enter Configuration mode, press the **ESC**, **◀** and **▶** keys at the same time to enter Configuration mode, or select it from the Top Menu if turned On. Use the **▲** **▼** keys to scroll to each field.

While many of the programming labels are pre-populated with choices, there's an option of adding custom labels. Note that custom labels font size will shrink to fit the LCD. The top and bottom lines of the LCD will fit either 10 or 19 characters, depending on the font size.

When exiting Configuration mode, take care to press the **ENT** key to save changes, press **ESC** to exit without saving, or press the **▶** to return to Configuration mode.






PRESS ESC TO EXIT
AND LOSE CHANGES







PRESS ENT TO EXIT
AND SAVE CHANGES



▶ TO RETURN

Gas

Use this field to select target gas type. Pressure, Temperature and Other are also available. Default is NH₃.

Press the  key to highlight the gas type, and then use the  /  arrow keys to make the selection. Then press  to accept or  to exit without saving.

Note: If "OTHER" is chosen, press the  key to get the flashing cursor for a custom label. Use the   keys for character selection. Use the  key to move to the next character until finished. To make corrections, the   keys can be used to move to the previous / next letter.

Then press the  key to save the gas type selection. Now use your  arrow key to move to the next field.

Understanding this key functionality will help with programming all of the configuration parameters.

Units




Select unit of measurement. Default is PPM.

of Decimal Points

Select number of decimal points displayed on the LCD. Typically, a full-scale range of 100 or greater will have 0 decimal places.




4 mA

Select zero value. For most gas detectors, 4 mA will be equal to "0" ppm. A few examples of when the values are not 0 are oxygen sensors ranged 15 to 25% (4 mA = 15) and temperature sensors ranged -60 to 150 (4 mA = -60).

Use the   keys to set the value, then press the  key to save it.

20 mA

Select the full-scale value. For example, a gas detector ranged 0.00-1.00% will have a full-scale value of 1.00 (20 mA = 1.00). 1.00% can also be displayed as 10000 ppm, whichever is preferred.

Use the   keys to set the value, then press the  key to save it.

Alarm Setpoint

The EM2 has one alarm relay output. Use this field to select the value of the alarm setpoint. The alarm setpoint can only be set between 5% and 100% of full-scale.

Deadband

The deadband or zero-blanking value prevents the screen from showing values lower than the deadband setpoint. For example, a deadband setpoint of 5 on a range of 0-100 ppm would only display 0 ppm until the input reaches 5 ppm. Deadband values range from 0-5% of full-scale in 1% increments.

Set Delay

Select the delay time for the relay to change states once the alarm setpoint is reached. The maximum delay time is 900 seconds (15 minutes). Default value is 2 seconds.

Reset Delay

Select the length of time for the relay to reset once the signal drops down below the alarm setpoint. The maximum delay time is 900 seconds (15 minutes). Default value is 10 seconds.

Alarm Direction

Select either Upscale or Downscale for alarm direction. Typically, Downscale would only be used for oxygen depletion applications, although other applications such as temperature and pressure monitoring may require a Downscale alarm. Default value is Upscale.

Latching

Selecting Yes will allow the relay to latch (recommended for equipment shutdown) requiring manual reset from the keypad only after the alarm has cleared. Selecting No allows the relay to reset automatically after the alarm has cleared. Default value is Yes.

Failsafe

Selecting On allows the relay to be energized during normal operation. Loss of power or an alarm condition will cause the relay to change states. Default value is On.

Relay Trip On Fault

Selecting On will cause the relay to change states if a sensor fault is detected (1mA or less). Default value is On.

Backlight

Select On or Off for preferred viewing. Default value is On.

Beep

Select On or Off for keypad beep. Default value is On.

Top Menu

To add a layer of security, the Top Menu screen can be turned Off. With the Top Menu turned Off, entering the Config, Test and In/Out Adjust screens are only possible by using specific key combinations, described in this manual. Default value is On.

Averaging

Select On or Off. With averaging On, the sensor signal will be averaged over a 1 minute time-weighted average. This feature can help smooth out jumpy readings. Default value is Off.

TEST	
CAL MODE:	OFF
RELAY TEST:	OFF
FORCE OUTPUT:	OFF
TIME-OUT:	60:00

Test Mode

Enter Test mode by pressing the **ESC** and **▼** keys at the same time, or access from the Top Menu if turned On.

Cal Mode

Calibration mode allows for sensor calibration and maintenance without causing external alarm conditions. To activate Calibration mode, press the **▶** key and then use the **▲** / **▼** arrow keys to select On. Then press the **ENT** key again to activate. This display will switch back to the Home screen with a countdown timer indicating how much time is left before Calibration mode times out. See Time-Out section on this page for details.

In Calibration mode, the relay will remain locked in the non-alarm condition, and the analog output will remain locked at 4 mA.

Relay Test

The Relay Test allows for testing of the relay output function without gassing the sensor. To test the relay output, press the **▶** key and then use the **▲** / **▼** arrow keys to select ALARM or OFF. Once the relay output has been verified to function as intended, press the **ESC** key to end Relay Test.

Note: The Relay Test will automatically time-out after the adjustable time-out counts down to 0.

Force Output

The Force Output tests the analog output signal against the reading at the PLC or other analog input device. Use the **▲** / **▼** arrow keys to select desired output. The arrow keys can be held in to dramatically increase the speed at which the number increments/decrements. Force Output values range from 0-100% of full-scale in 1% increments.

Note: The Force Output will automatically time-out after the adjustable time-out counts down to 0.

Time-out

Select the length of time for the three test modes, from 1 second to 60 minutes. Then press the **ENT** key to select.

The arrow keys can be held in to dramatically increase the speed at which the number increments/decrements.

IN/OUT ADJUST	
IN 4 MA ADJ:	0.07
IN 20 MA ADJ:	1.002
OUT 4 MA ADJ:	-0.01
OUT 20 MA ADJ:	1.000
0	PPM

In/Out Adjust

The EM2 comes factory adjusted and should only require minimal adjustment after installation.

The In/Out Adjustment mode provides fine zero offset and gain adjustments of the incoming and outgoing analog signals. These adjustments allow compensation for slight differences between the connected transmitter, EM2 display and analog input device such as a PLC.

Enter In/Out Adjustment mode by pressing the **ENT** and **▼** keys at the same time, or access from the Top Menu if turned On.

In 4 mA Adjust

Adjust + or - to achieve correct zero display on the EM2 from the incoming analog signal such as a gas detector. For example, a 0-250 ppm detector with a 4.00 mA signal should read 0 ppm. If the EM2 is displaying 1 ppm, decrease the value until the display shows 0 ppm.

In 20 mA Adjust

Adjust + or - to achieve correct full-scale gain display from incoming analog signal. This can be accomplished with a loop calibrator or forcing the connected transmitter full-scale to 20.00 mA.

Out 4 mA Adjust

Adjust + or - to achieve a matching zero display on the connected PLC or other analog input device.

Out 20 mA Adjust

Adjust + or - to ensure that with a full-scale reading, the EM2 display matches the display on the connected PLC or other analog input device.

Start-Up

Start-up Test

After setup and programming is complete, it is recommended to perform a functionality test of the unit. Refer to sensor manual for proper warm-up time of sensor prior to any sensor test.

Because sensors are normally located at a distance from the main unit, the test time required and accuracy of the response checks will be improved if two people perform the start-up procedure and use radio contact.

Start-Up Test:

- 1) One person exposes the sensor to calibration gas or test gas.
- 2) The second person stays at the control unit to determine that when exposed to the gas, the alarm functions as intended.

Signal Levels

The EM2 is designed to over-range approximately 8% up to 21.3 mA. Monitoring equipment must be configured to indicate a fault if the analog input signal is below 1 mA. All analog input signals over 20 mA must be considered high gas concentrations.

Maintenance

All gas detection systems should be calibrated with certified calibration gas once every six months. At this interval, all alarm functions and outputs should be tested, verified and documented.

If sensor span or zero cannot be adjusted, refer to the sensor manual. The sensor may be approaching its end of life and may need to be replaced. Keep an operation log of all maintenance, calibrations and alarm events.

To clean the controller, use a mild cleaning solution and soft cloth.

Always disconnect power before performing any wiring at the controller.

Replacement parts:

EM2-24 (entrance monitor, 24Vdc)

EM2-120 (entrance monitor, 120Vac)

EM2-PS-KIT (120Vac power supply kit with back-box)

EM2-PS (120Vac power supply, 1.1A)

EM2-Latch (set of two enclosure latches)

EM2-Key (hinge lock key)

EM2-MP (mounting plate, black, powder-coated aluminum)



1) Input and Output Signal Testpoints:

These testpoints provide measurements of the in/out 4-20 mA (measured 40-200 mVdc).

2) Wiring Terminal:

Make sure wiring is correct and securely fastened into terminals. If the entrance monitor lid is opened and closed often, cable wires can be prone to breakage where they connect at the wire terminals.

3) Relay:

The Form C dry contact relay is de-energized in the normal state (continuity between C and NC), unless Failsafe is selected from the menu. The green LED next to the relay is in series with the relay coil, indicating whether the relay is energized or de-energized.

4) Buzzer:

The onboard buzzer is intended to provide audible feedback when pressing the operator interface pushbuttons (keys). This can be turned Off in the menu.

Figure 4: Components and Troubleshooting

Specifications

Power Requirements:

EM2-24: 24 VDC, 350 mA max (not including other connected devices).

EM2-120: 100-240 VAC, 0.7A 50/60 Hz

Output 24 VDC Power available for sensors and audio/visual devices:

0.75A @ 40°C (104°F).

0.50A @ 50°C (122°F).

Dimensions:

6.1" high x 6.0" wide x 2.8" deep (EM2-24)

6.1" high x 6.0" wide x 4.0" deep (EM2-120)

Weight:

1.5 lbs (EM2-24)

2.5 lbs (EM2-120)

Enclosure:

Polycarbonate IP68, with PU gasket and hinged lid. For non-classified areas. Rated for outdoors and washdown locations. Powder-coated aluminum mounting plate.

Temperature Range:

-40°F to +122°F (-40°C to +50°C)

Humidity Range:

0% to 100% condensing

Sensor Inputs:

(1) 4-20 mA, 261 Ohm input impedance

Analog Output:

4-20 mA (max input impedance: 700 Ohms)

Relay Outputs:

(1) SPDT relay, Form C dry contacts.

5A @ 24 VDC or 8A @ 120-240 VAC.

Wiring Connections:

3 conductor, shielded, stranded, 18 AWG cable (Belden 8770 or equivalent). Cable should not exceed 1,000 feet total length from the sensor to the power supply.

Terminal Blocks (Field Wiring):

26-16 AWG, torque 4.5 lbs-in.

LCD:

Monochrome, 2.7" x 1.5" viewing area.

Certification:

ETL Listed: Confirms to UL 61010-1

Certified to CSA C22.2 No. 61010-1

Limited Warranty & Limitation of Liability

Calibration Technologies, Inc. (CTI) warrants this product to be free from defects in material and workmanship under normal use and service for a period of two years, beginning on the date of shipment to the buyer. This warranty extends only to the sale of new and unused products to the original buyer. CTI's warranty obligation is limited, at CTI's option, to refund of the purchase price, repair, or replacement of a defective product that is returned to a CTI authorized service center within the warranty period. In no event shall CTI's liability hereunder exceed the purchase price actually paid by the buyer for the product.

This warranty does not include:

- a) routine replacement of parts due to the normal wear and tear of the product arising from use;
- b) any product which in CTI's opinion, has been misused, altered, neglected or damaged by accident or abnormal conditions of operation, handling or use;
- c) any damage or defects attributable to repair of the product by a person other than an authorized dealer or contractor, or the installation of unapproved parts on the product

The obligations set forth in this warranty are conditional on:

- a) proper storage, installation, calibration, use, maintenance and compliance with the product manual instructions and any other applicable recommendations of CTI;
- b) the buyer promptly notifying CTI of any defect and, if required, promptly making the product available for correction. No goods shall be returned to CTI until receipt by the buyer of shipping instructions from CTI; and
- c) the right of CTI to require that the buyer provide proof of purchase such as the original invoice, bill of sale or packing slip to establish that the product is within the warranty period.

THE BUYER AGREES THAT THIS WARRANTY IS THE BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. CTI SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, WHETHER ARISING FROM BREACH OF WARRANTY OR BASED ON CONTRACT, TORT OR RELIANCE OR ANY OTHER THEORY.



CT2-DOC1-1
20200109

ctiengineering.com | 866-394-5861