

Net Safety™ Millennium II Multi-Channel Transmitter



Important instructions

Net Safety Monitoring, Inc (Net Safety™) designs, manufactures and tests products to function within specific conditions. Because these products are sophisticated technical instruments, it is important that the owner and operation personnel must strictly adhere both to the information printed on the product nameplate and to all instructions provided in this manual prior to installation, operation, and maintenance.

WARNING

Installing, operating or maintaining a Net Safety product improperly could lead to serious injury or death from explosion or exposure to dangerous substances. Comply with all information on the product, in this manual, and in any local and national codes that apply to the product. Do not allow untrained personnel to work with this product. Use Net Safety parts and work procedures specified in this manual.

WARNING

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

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Section 1: Introduction

1.1 Models covered

A Net Safety™ Millennium II gas detection system is composed of a field mounted transmitter and Net Safety Millennium II series sensors which you can mount integrally to the transmitter or remotely.

The transmitter is certified for use in hazardous locations and is available as a single or dual sensor system. You can access all operator controls, including configuration and calibration, without opening the enclosure by using other communication devices and the attached magnet to actuate magnetic reed switches. Available outputs are: conventional 4 to 20 mA analog, Analog/HART®, electromechanical relays, or Modbus® RTU digital.

1.2 Service support

For technical support, contact your local Emerson representative or the Technical Support department at +1 866 347 3427 (toll free) or Safety.CSC@Emerson.com.

1.3 Return of material

To expedite the return of this product, proper communication between the customer and the factory is important. Before returning a product, call +1 866 347 3427 (toll free) or email Safety.CSC@Emerson.com for a Return Material Authorization (RMA) number.

On the return of the equipment, include the following information:

1. RMA number provided to you by Net Safety™
2. Company name and contact information
3. Ship all equipment, prepaid to:
Rosemount
6021 Innovation Boulevard
Shakopee, MN 55379
4. Mark all packages with the **RMA number** and type of return (e.g. return for evaluation)

Pack items to protect them from damage and use anti-static bags or aluminum-backed cardboard as protection from electrostatic damage.

All equipment must be shipped prepaid. Emerson will not accept collect shipments.

1.4 Product recycling/disposal

Consider recycling equipment and packaging and dispose of it accordance with local and national legislations/regulations.

Section 2: Install

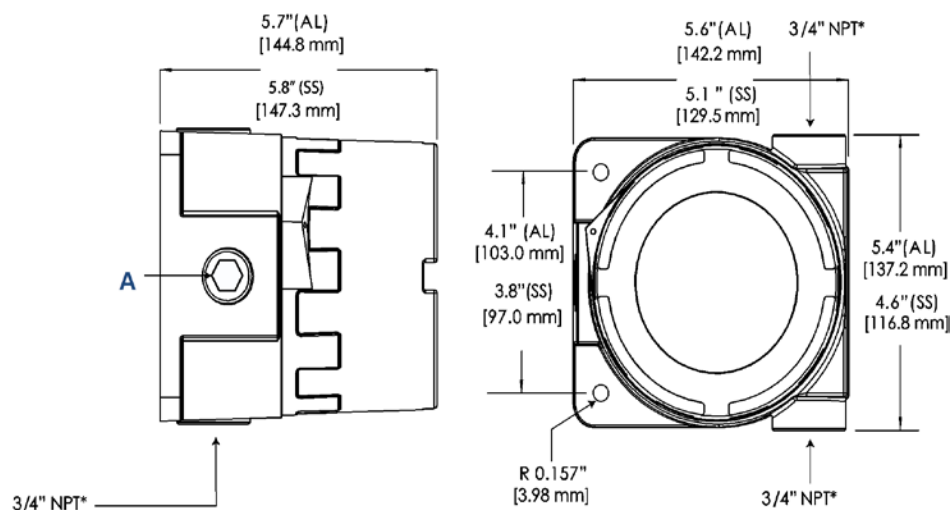
2.1 Unpack and inspect

Carefully remove all of the components from the packaging and verify them against the enclosed packing list. Inspect all components for any obvious damage such as broken or loose parts. If you find any components missing or damaged, notify your local Net Safety™ representative or the factory immediately.

2.2 Dimensions

The Net Safety™ MillenniumII transmitter enclosure is available in aluminum (A359) and stainless steel (SS316). Dimensions are provided in inches and [millimeters].

Figure 2-1 - Dimensions



A. ATEX stop plug fitted

*M20, 1/2-in. NPT, and 1/2-in. BSP threads also available

2.3 Mount

Ensure transmitter and sensor are securely mounted as per local regulations. The transmitter has mounting holes to allow mounting to a wall or pole as desired. Mounting kit hardware is required when mounting the transmitter a pole. Contact your local Net Safety™ representative for detailed information on the pole mounting kits. Mount the transmitter at eye-level and make sure it is easily accessible for monitoring and maintenance.

2.3.1 Transmitter orientation options

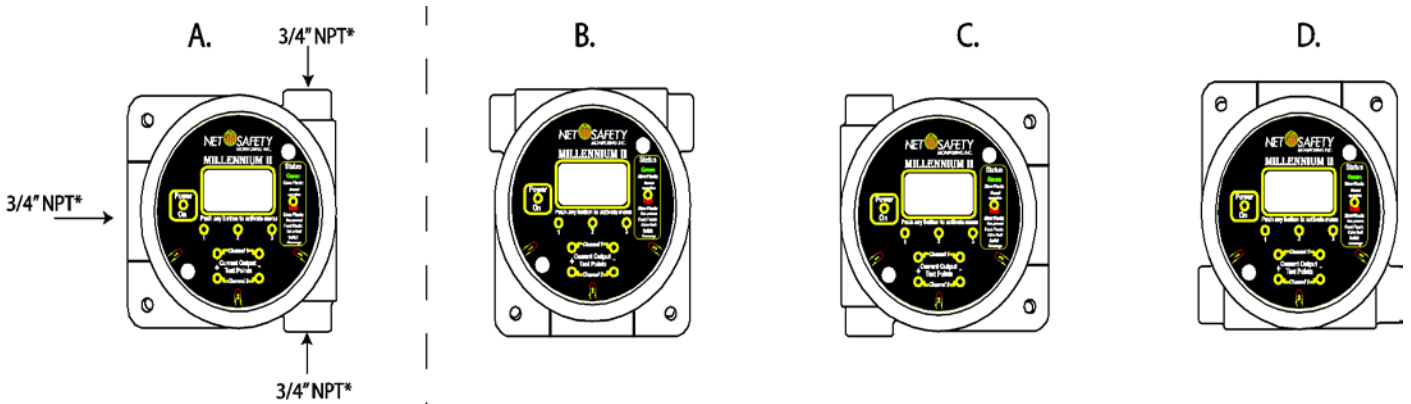
Depending on the installation and mounting requirements, you can mount the transmitter enclosure (housing) in different orientations as seen in Figure 2-2. To accommodate the different mounting orientations, you can rotate the electronics module inside the transmitter enclosure.

NOTICE

Ensure the orientation allows proper wiring and adequate wire length inside the transmitter enclosure.

When determining suitable enclosure orientation for specific applications, observe all local regulations and guidelines for mounting enclosures.

Figure 2-2 Different Endosure Orientations



A. Standard enclosure orientation

B, C, and D: Enclosure rotated to show different orientations.

Note: You can also rotate the electronics module to suit housing orientation.

2.3.2 Faceplate rotation

⚠ WARNING

Before wiring or rotating electronics, ensure that the power to transmitter is switched off. Do not open the transmitter enclosure in a classified area.

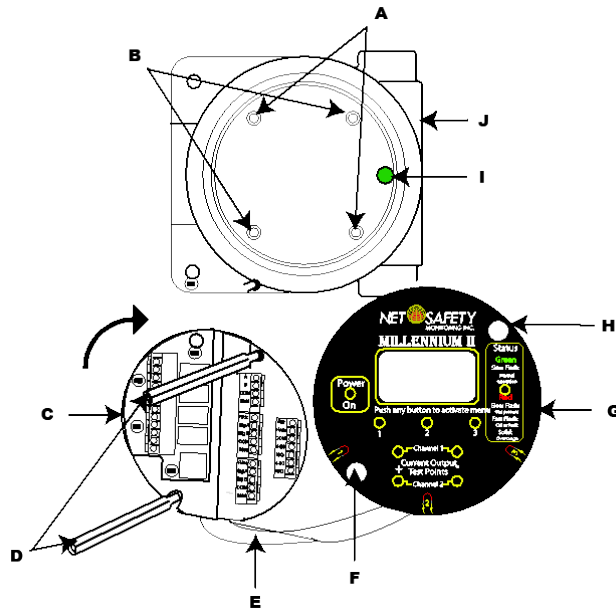
Avoid touching electronic components, as they are susceptible to electrostatic discharge (ESD). Refer to [Section 8](#): for more information.

When the transmitter enclosure is mounted in different orientations (B, C, and D) as outlined in [Figure 2-2](#), rotate the electronics module to ensure the operator can easily read the display. The electronics module consists of the relay board, faceplate (Display/CPU assembly), and main terminal board. To rotate the electronics module, follow these instructions:

1. Turn off power to transmitter and ensure area is declassified.
2. Remove the enclosure cover.
3. Unscrew both the locking knobs and free from two metal standoffs.
4. Lift transmitter faceplate from enclosure.
5. Disconnect existing wiring.
6. Unscrew the two metal standoffs using a ¼-in. hex tool.

7. Carefully remove the electronics module.
8. Rotate the electronics module to desired position.
9. Align metal standoffs with the mounting holes of the electronics module and enclosure base.
10. Insert metal standoffs in the appropriate mounting holes.
11. Tighten metal standoffs with ¼-in. hex tool to secure electronics module.
12. Reconnect wiring.
13. Replace faceplate; then fit and hand tighten locking knobs to metal standoffs by turning clockwise.
14. Replace enclosure cover.

Figure 2-3 Rotating Electronics Module



- A. Horizontal mounting holes (insert standoffs)
- B. Vertical mounting holes (insert standoffs)
- C. Electronic board
- D. Metal standoffs
- E. Ribbon cable
- F. Locking knob
- G. Faceplate (display/CPU assembly)
- H. Locking knob
- I. Enclosure ground screw
- J. Enclosure base

2.4 Wiring

2.4.1 General requirements

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury. Ensure that only qualified personnel perform the installation.

Electrical shock could cause death or serious injury. Use extreme caution when making contact with the leads and terminals.

Do not open the transmitter, sensor, or junction box enclosure when in a classified area or when an explosive atmosphere may be present unless the power to the transmitter has been removed.

NOTICE

Wiring codes and regulations may vary. Wiring must comply with all applicable regulations relating to the installation of electrical equipment in a hazardous area and is the responsibility of the installer. If in doubt, consult a qualified official before wiring the system.

When separating the sensor from the transmitter, Emerson highly recommends using a shielded cable to meet electromagnetic compatibility (EMC) requirements and to protect against interference caused by extraneous electrical or electromagnetic noise. In applications where the wiring is installed in conduit, do not use the conduit for wiring to other equipment.

If not using the 4-20 mA signal, connect a jumper between the 4-20 mA terminal and the common terminal to allow analog current levels to be monitored at the test jacks on the faceplate.

For effective communication, Net Safety™ limits sensor separation to 2,000 feet (600 meters) using 16 AWG wires.

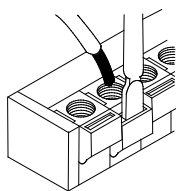
Modbus® RS-485 connection 2-wire mode, multipoint serial line available. Up to 247 addresses are allowed. When developing a RS-485 chain of devices, the last device in the chain requires an end of line termination resistor (120 Ohms).

2.4.2 Terminal connection

When connecting cable wires, use a small screwdriver to gently press down and hold the spring connector open. Insert the appropriate wire into the open connector hole, releasing the screwdriver to secure the wire as shown in [Figure 2-4](#).

The connector will accommodate wire sizes between 14 and 20 AWG.

Figure 2-4 Terminal Connection



2.4.3 Cable choice and guidelines

Radio frequency interference (RFI) can be caused by nearby electrical devices (e.g. transformers or high voltage equipment) as well as handheld communication devices/radios, which when activated, may impede the proper functioning of the transmitter and sensor. Selecting the right instrumentation cable and making proper grounding connections within the junction box will reduce or eliminate interference. Visible symptoms of RFI include inconsistent, incorrect, and erratic LEL and ppm readings.

2.4.4 Important wiring guidelines

Gas detection instruments are an important part of a safety alarm and shutdown system. The system is composed of:

- Detection instruments
- Customer connected equipment
- Wiring

Net Safety™ designs and manufactures its detection equipment under rigid quality control management systems and makes every effort to design for the harshest of industrial environments. The other components of the system (the customer-connected equipment and wiring) are also important contributors to the overall quality and performance of the safety system.

It is important to implement wiring that ensures the reliability and integrity of the safety system. Field wiring practices and the choice of cable type specified vary from project to project. Poor practices and choices are often found to be the source of unwanted system disruptions. RFI and electromagnetic interference (EMI) are usually very powerful disruptive forces in industrial facilities, and these forces act upon the system through the wiring.

The cable used should be a very high quality instrument grade, certified for the application conditions, consisting of a rugged protective outer jacket, an overall electrical shield of fine braided copper or metallic foil, and internal pairs or triads of foil shielded copper wire of suitable gauge for the power conducted over the specified length.

The shields must be electrically continuous from the instrument junction box through other junction boxes and finally to the connected equipment. The shield must be connected to a suitable ground sink as specified in the instrument manual in order to protect the system from electrical disturbances.

In general, do not run communication cables and power cables in parallel for any significant length and do not put them in the same cable tray. Through inductance, high currents in power cables can induce significant *noise* in communication cables running parallel alongside power cables.

2.4.5 Internal ground screw

To access enclosure grounding screw, remove the electronics module by following steps 1 through 7 in Section 2.3.2.

2.4.6 External ground

In order to ensure proper operation of the sensor, Emerson recommends using an external ground screw to connect the transmitter to the grounding point on the enclosure.

2.4.7 Seals

Emerson recommends using seals to further protect the system against water ingress. Install equipment according to applicable local electrical codes. Emerson especially recommends seals for installations that use high-pressure or steam cleaning devices in proximity to the transmitter.

- Emerson recommends waterproof and explosionproof conduit seals to prevent water accumulation within the enclosure.
- Locate seals as close to the device as possible and not more than 18 inches (46 cm) away.
- Explosionproof installations may require an additional seal where conduit enters a non-hazardous area; ensure conformity with local wiring codes.
- When pouring a seal, use a fiber dam to ensure proper formation of the seal. Never pour seals at temperatures below freezing.
- Strip back the jacket and shielding of the cable to permit the seal to form around the individual wires. This will prevent air particles and water leakage through the inside of the shield and into the enclosure.
- Emerson recommends using explosion-proof drains and conduit breathers. In some applications, changes in temperature and barometric pressure can cause breathing, which allows moist air to enter and circulate inside the conduit. Joints in the conduit system are seldom tight enough to prevent this breathing.

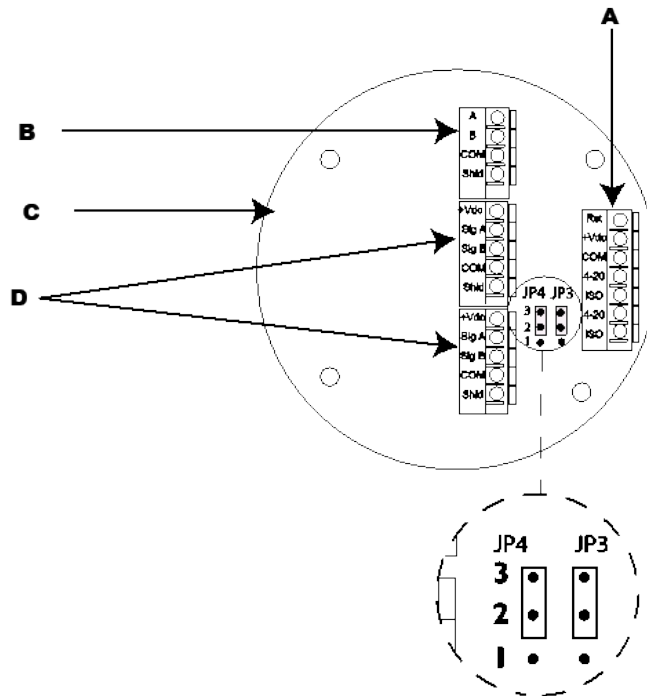
2.4.8 Analog output, isolated supply, non-isolated supply and jumper configuration

The analog output may be powered from the main instrument power supply or a separate, independent power supply, in which case an isolated wiring configuration is necessary.

To set a non-isolated or isolated current output, simply move the jumpers/shorting jacks (JP3 and JP4) to either the non-isolated or isolated current position. For non-isolated current output, ensure pins 3 & 2 at JP3 and JP4 location on the main terminal board are jumped (shorted). Factory standard models ship with jumpers at JP3 and JP4 in the non-isolated current output position.

For isolated current output, pins 1 & 2 at JP3 & JP4 should be jumped (shorted). Note that JP3 is for configuring channel 1, and JP4 is for configuring channel 2. Jumpers and pins are located next to the power and 4-20 output terminals on the main terminal board. See [Figure 2-5](#) for reference.

Figure 2-5 Non-isolated and isolated current jumpers



- A. Power and 4-20 output terminals
- B. Modbus terminal
- C. Main terminal board
- D. Sensor terminal;

Position jumper (shorting jack) over pins JP4 and JP3 to set power source for current outputs.

Jumper configurations/settings:

- Position 3 and 2: Non-isolated (default)
- Position 2 and 1: Isolated

NOTICE

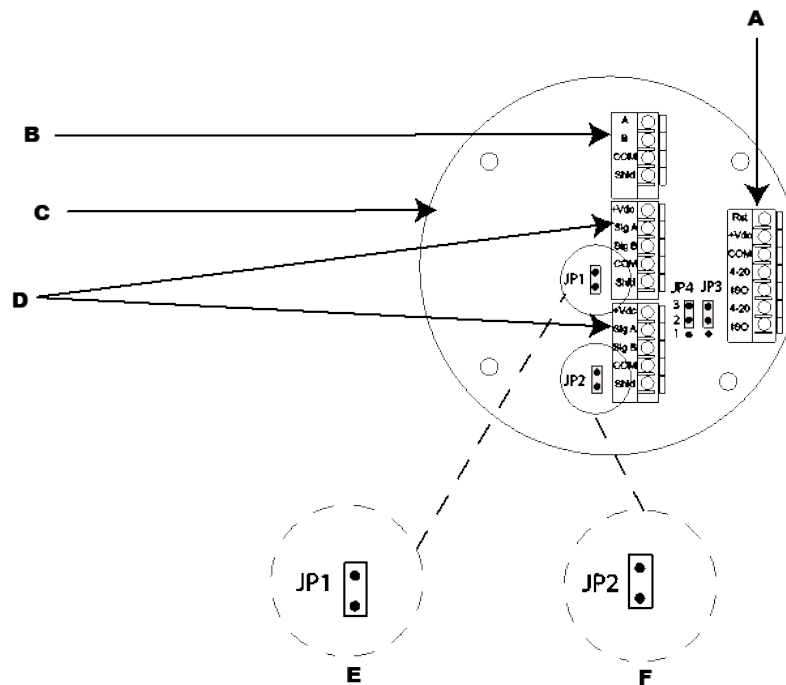
Always ensure that JP3 and JP4 jumpers are in the correct position depending on the current output configuration chosen

2.4.9 Jumper configuration for remotely mounted sensors

Sensor separation from the transmitter may extend up to 2,000 ft/ (600 m,) in which case a junction box is required.

When mounting sensor remotely (separating sensor from transmitter), install jumpers JP1 and JP2 over the pins. Jumpers and pins are located on the main terminal board near the sensor terminals. JP1 is for channel 1, and JP2 is for channel 2. Refer to [Figure 2-6](#).

Figure 2-6 Separation jumper positions



- A. Power and 4-20 output terminals
- B. Modbus terminal
- C. Main terminal board
- D. Sensor terminals
- E. Separation jumper for channel 1
- F. Separation jumper for channel 2

NOTICE

When separating sensor and transmitter, install JP1 and JP2 over pins.

2.4.10 Sensor and transmitter terminals

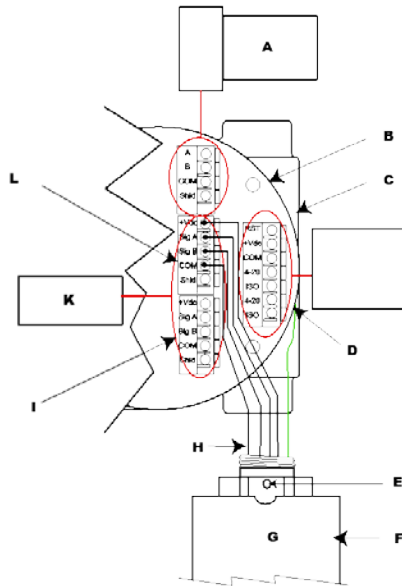
⚠ WARNING

Before wiring, ensure power to the unit is switched off. Connect the sensor wires to the sensor terminals of the transmitter and connect the transmitter's power and output terminals to the wiring leading to the power source/panel. Refer to the configuration tables below for sensor as well as transmitter power and output terminal designations.

Sensor terminals	
Sensor wires	Transmitter sensor board terminal designation
White	+Vdc (from transmitter)
Red	Signal A
Blue	Signal B
Black	Communication
Green	Earth ground

Transmitter power terminals	
Transmitter terminal designation	Function
RST	Remote Reset
+Vdc (10.5-32Vdc)	Power (+)
COM	Power (-)
4-20 (Channel 1)	Channel #1 current loop output
ISO (Channel 1)	+Vdc isolated 4-20mA power, channel #1
4-20 (Channel 2)	Channel #2 current loop output
ISO (Channel 2)	+Vdc isolated 4-20mA power, channel #2

Figure 2-7 Sensor wiring and terminal connections

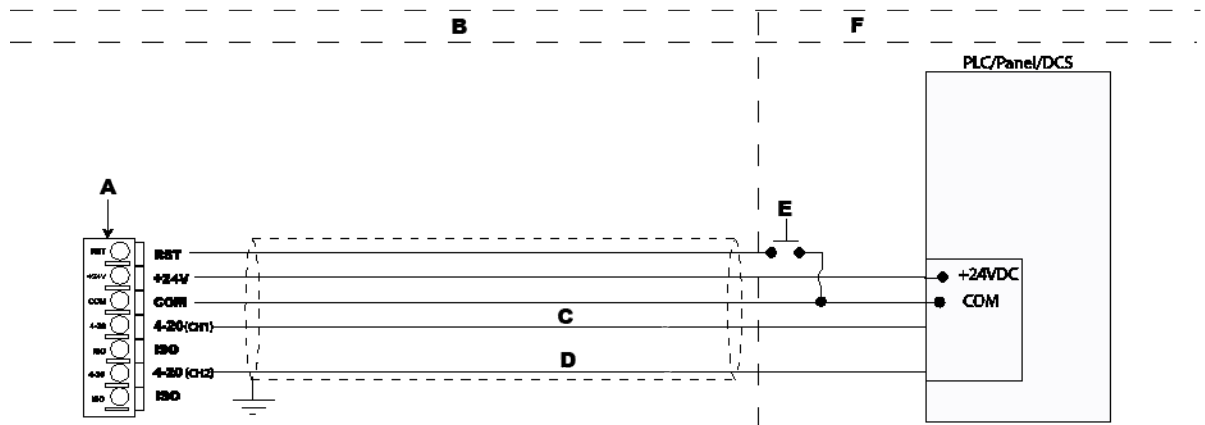


- A. Modbus RTU terminals to PLC
 - A
 - B
 - Communication
 - Shield
- B. Transmitter terminal main board
- C. Enclosure
- D. Power and 4-20 mA output terminals
- E. Green wire – to internal housing ground
- F. External ground facility
- G. Enclosure
- H. Sensor 1
- I. Sensor wires
- J. Channel 2 sensor terminal
- K. Sensor terminals (2)
 - +Vdc: white
 - Signal A: red
 - Signal B: blue
 - Communication: black
 - Shield
- L. Channel 1 sensor terminal

2.4.11 Remote reset

If the alarm relays are configured for latching operation, you may want to reset latched alarms from a remote location. In this case, you can connect a normally open, momentary pushbutton switch across terminals RST and COM.

Figure 2-8 Remote Reset Wiring



- A. Transmitter power and output terminal
- B. Field
- C. Channel 1: 4-20 mA signal
- D. Channel 2: 4-20 mA signal
- E. Normally open push button switch
- F. Control

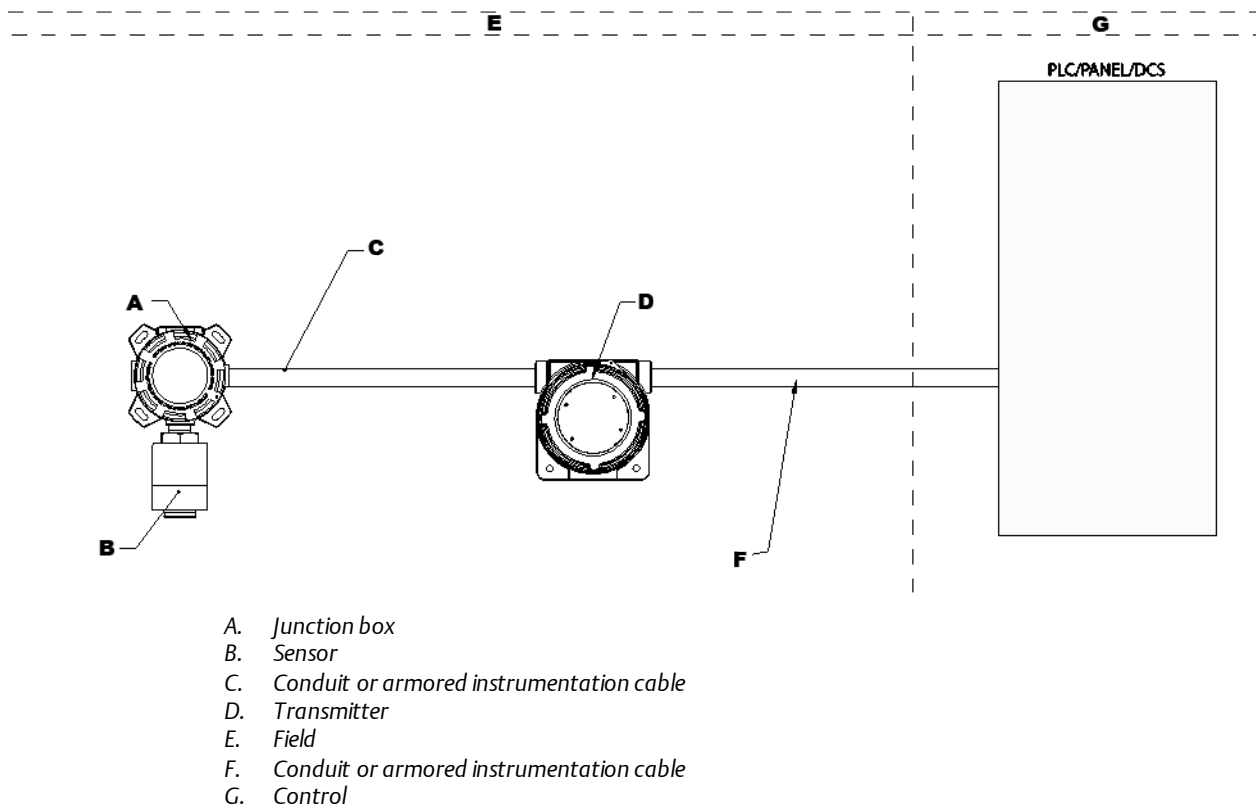
2.5 Sensor separation/remote mounting of sensor

When it is necessary to mount the sensor remotely (separated from transmitter), by way of junction box and conduit, it is important that the installer follow the necessary requirements and guidelines relating to sensor separation and cable selection. See [Figure 2-9](#) for typical remote mounting of sensor. Also refer to [Section 2.4](#) for information on wiring guidelines.

When sensors are being mounted remotely, consult the multipurpose junction box manual for wiring instructions. Always ensure that the transmitter is supplying 10.5 - 32 Vdc across the sensor power terminals (Vdc + and COM) of Net Safety™ junction box (JB-MPD-A/S).

The maximum distance between the sensor and transmitter is limited by the resistance of the connecting wiring, which is a function of the gauge of the wire being used. For effective communication, Net Safety limits the separation distance between sensor and transmitter to 2,000 ft (600 m) using 16 AWG wire. See [Section 9](#) for information on typical wire gauge and resistance.

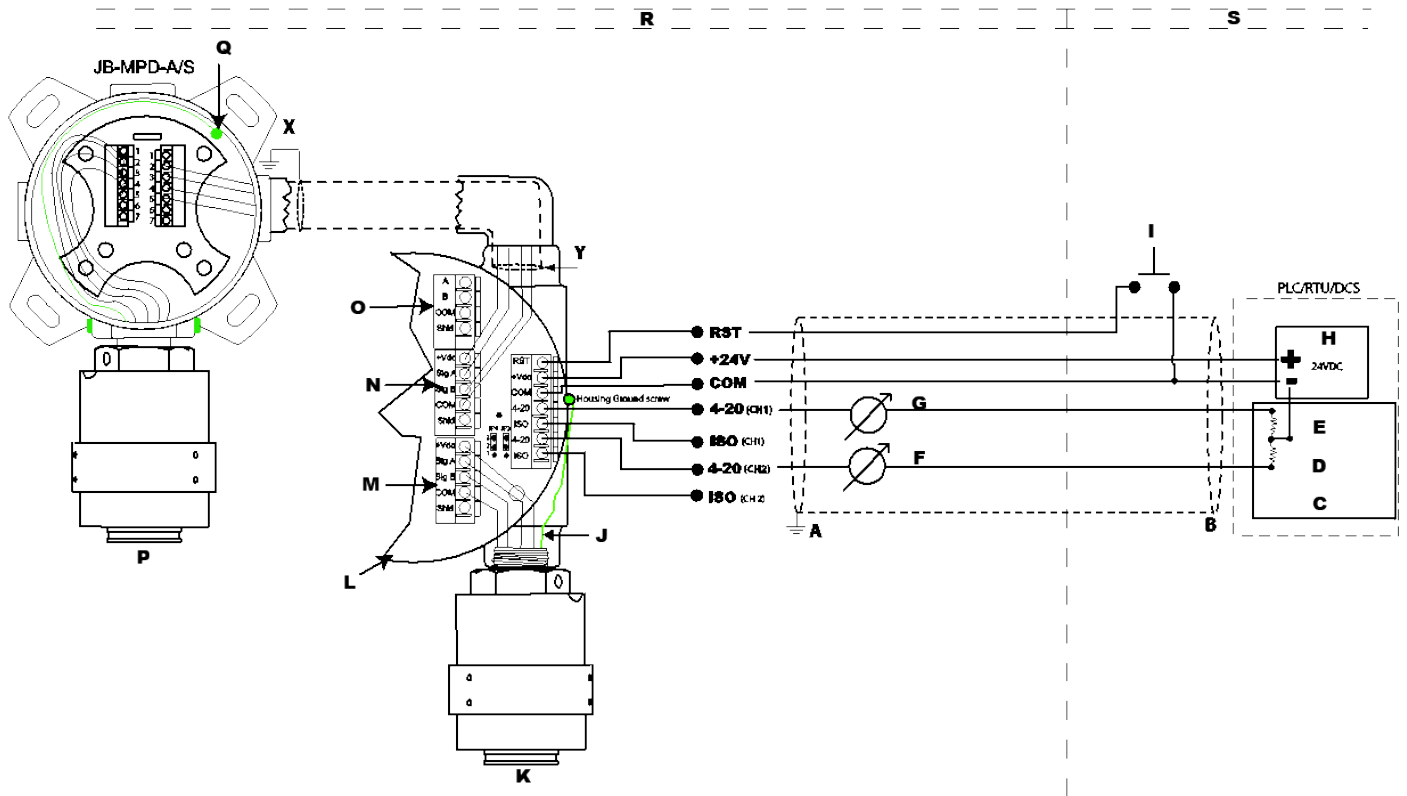
Figure 2-9 Sensor Separation/Remote Mounting



2.5.1 Wiring diagrams

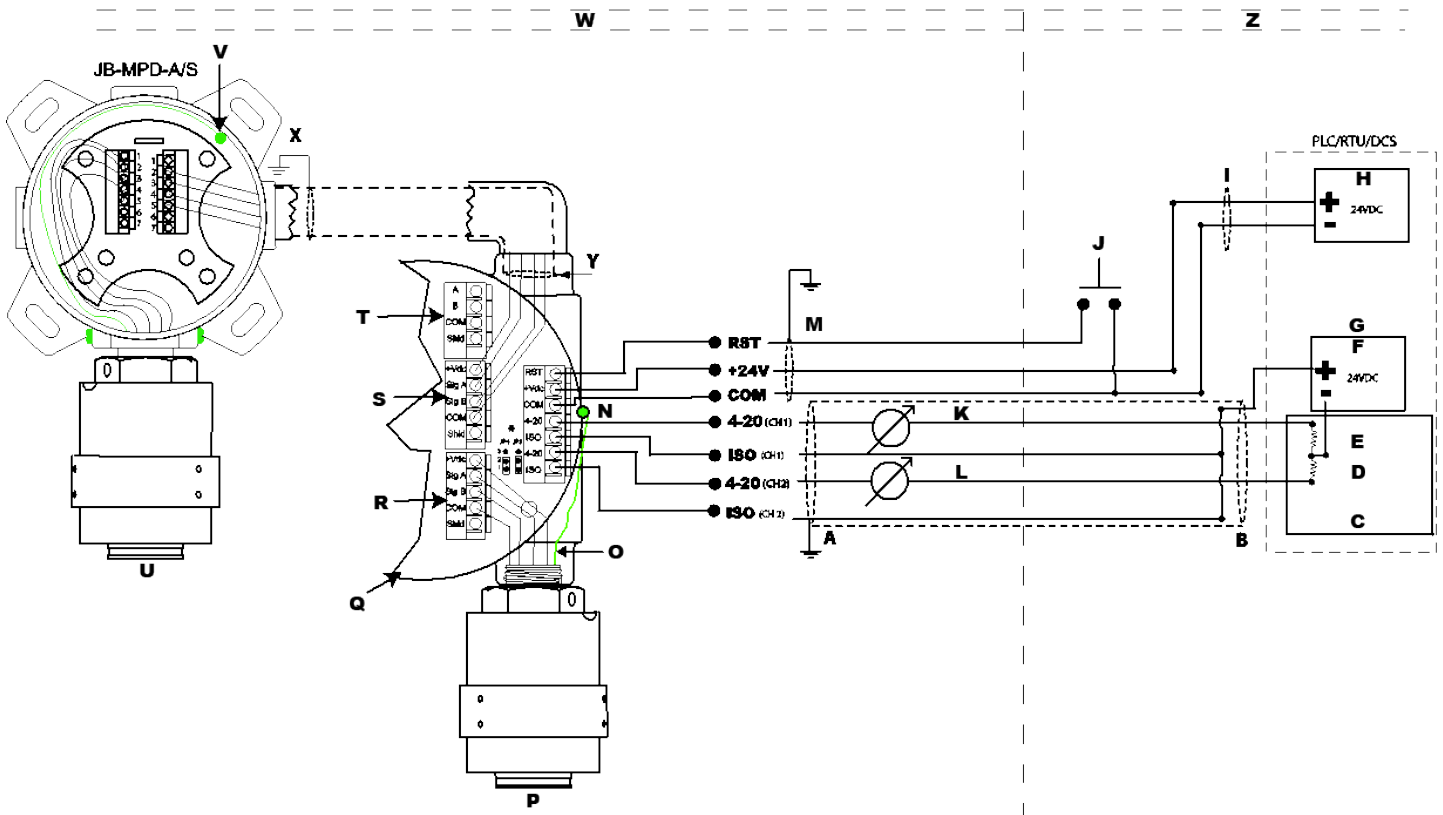
Wiring drawings show general ways in wiring the system for analog signal output. Consult qualified personnel on specific wiring requirements.

Figure 2-10 Non-Isolated Terminal Connection



- A. Connect this end of shield to earth ground.
- B. Cut this end of shield.
- C. Analog input module
- D. Channel 2 input resistance
- E. Channel 1 input resistance
- F. Channel 2 4-20 mA output
- G. Channel 1 4-20 mA output
- H. Power supply
- I. Normally open switch for resetting latched alarms
- J. Sensor green wire to internal housing ground screw
- K. Net Safety Millennium II sensor .
- L. Net Safety Millennium II transmitter terminal board
- M. Channel 2 sensor terminal
- N. Channel 1 sensor terminal
- O. Modbus termina.
- P. Net Safety Millennium II sensor 1
- Q. Housing ground screw
- R. Field
- S. Control
- X. Connect this end of shield to earth ground.
- Y. Cut this end of shield.

Figure 2-11 Isolated Terminal Connection



- A. Connect this end of shield to earth ground.
- B. Cut this end of shield.
- C. Analog input module
- D. Channel 2 input resistance
- E. Channel 1 input resistance
- F. Power supply
- G. Isolated
- H. Power supply
- I. Cut this end of shield
- J. Normally open switch for resetting latched alarms
- K. Channel 1: 4-20 mA output
- L. Channel 2: 4-20 mA output
- M. Connect this end of shield to earth ground
- N. Housing ground screw
- O. Sensor green wire to internal housing ground screw
- P. Net Safety Millennium II sensor 2
- Q. Net Safety Millennium II transmitter terminal board
- R. Channel 2 sensor terminal
- S. Channel 1 sensor terminal
- T. Modbus terminal
- U. Net Safety Millennium II sensor 1
- V. Housing ground screw
- W. Field
- X. Connect this end of shield to earth ground.
- Y. Cut this end of shield.
- Z. Control

Note the position of JP3 & JP4 on the terminal board. For this configuration, Pins 3 and 2 should be jumpered (default position).

Sensor wire function	Color	Junction box terminals
Earth ground	Green	1 (or housing ground screw)
+Vdc	White	2
Communication	Black	3
Signal A	Red	4
Signal B	Blue	5

2.6 Installation checklist

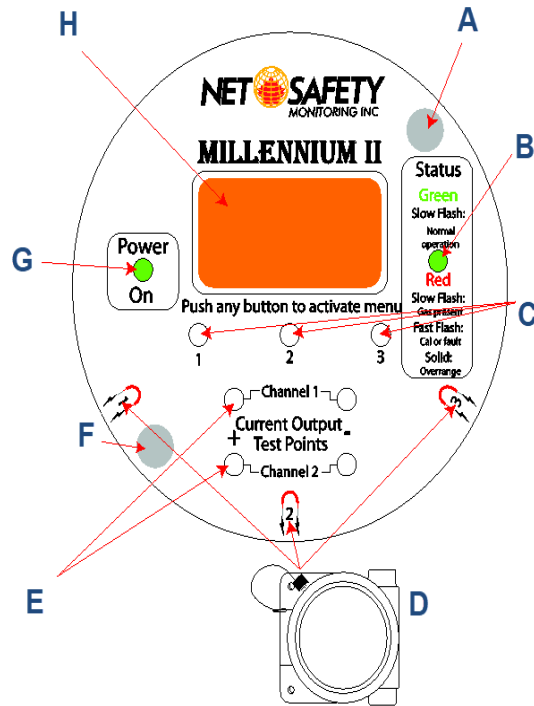
Review the following checklist prior to turning the power on to the transmitter after installation has been completed:

- Ensure that the transmitter and sensor are properly and firmly mounted.
- Ensure that stopping plugs are securely tightened on any unused conduit entries.
- Ensure that the transmitter and sensor are not obstructed, transmitter and sensor are accessible, and target gas is not inhibited from reaching the sensor.
- Ensure adherence to applicable local guidelines and requirements on wiring and sealing of equipment in hazardous and non-hazardous areas.
- Ensure that proper shielding and grounding practices are adhered to and local codes are being followed.
- Check system operational voltage and conditions, ensuring that they are within the applicable specifications of the transmitter and sensor.
- Verify wiring at all termination and junction points (transmitter, junction box, and power supply).
- Ensure that the transmitter housing cover and sensor cap are secured tightly.

Section 3: Operation

3.1 Transmitter and faceplate description

Figure 3-1 Faceplate Description



- A. Locking knob: Unscrew the knob and gently pull to remove faceplate. Removal allows access to terminal boards. The faceplate remains attached by the ribbon cable.
- B. Status light (red and green): Indicates status of unit.
- C. Menu buttons: Provides access for programming, calibrating, and resetting.
- D. Magnetic reed switch: Provides non-intrusive access for programming, calibrating, and resetting.
- E. Current test jacks: To take current loop measurements:
- F. Insert your current meter into the test jacks.
- G. Review current loop measurements.
- H. Locking knob
- I. Power LED (green): Shows power status (On/Off).
- J. OLED display: Provides various status messages and prompts.

3.1.1 Display

The Net Safety™ Millennium II is equipped with an organic LED (OLED) display. It allows the operator to see the concentration of gas present for each individual channel and the various options offered. The display has a wide temperature rating and will operate well in lowly lit conditions. In order to extend the life of the display, a screen saver is enabled if the menu is not in use. To exit the screen saver mode, move the magnet close to any of the three reed switch locations (8 o'clock, 6 o'clock, or 4 o'clock position).

3.1.2 Status LED

The Status LED can be solid red or green or flashing red or green to indicate various states of the transmitter and sensor.

3.1.3 Current loop measurement (test jacks)

⚠ WARNING

Do not open the transmitter, sensor, or junction box enclosure when in a classified area or when an explosive atmosphere may be present unless the power to the transmitter has been removed.

For convenience, a pair of test jacks for each analog output is provided on the front face of the display module. Attach ammeter probes to these jacks to check loop current without opening the circuit to insert the meter.

3.1.4 Menu buttons and access

The main menu can be accessed in two ways: intrusive (opening the enclosure and pressing menu buttons) and non-intrusive (keeping the enclosure closed and using the magnet and reed switches).

3.1.4.1 *Intrusive access*

The menu buttons provide access to the Net Safety™ Millennium II's Main Menu options, allowing the operator to review and configure existing options under sub menus and perform calibration. There are three visible main menu buttons that are located directly under the display screen. They are designated 1, 2, and 3.

3.1.4.2 *Non-intrusive access/magnetic reed switch access*

You can also access the main menu and make selections with an attached magnet and reed switches.

The reed switches are located in the 8 o' clock, 6 o' clock, and 4 o' clock positions on the face plate and indicated by horse shoe shape print magnets. To select a reed switch, place and hold the magnet close to the transmitter enclosure at 8, 6, or 4 o'clock position.

NOTICE

Menu buttons and reed switches provide the same functions. The term "switch" is used throughout to represent menu buttons and reed switches.

3.2 Power up transmitter

After you apply power to the transmitter, a warm-up routine will begin, the duration of which depends on the sensor type. The display will indicate the sensor warming up and the Status LED will flash slow red and the current output will be 3.0 mA. After the warm-up period, the transmitter will enter normal operation and the screen will display: "Channel 1 00%LEL (or ppm), Channel 2 00%LEL (or ppm)." For dual channel models either channel can be disabled if not in use. If a channel is disabled, the screen will display "Disabled" for that particular channel. The enabled channel analog output will be to 4.0 mA during normal operation.

A slow flash is defined as the Status LED being “ON” for 50 milliseconds and “OFF” for 1 second, while a fast flash is the LED being “ON” for 250 milliseconds and “OFF” for 250 milliseconds and a very fast flash is the LED “ON” for 50 milliseconds and “OFF” for 50 milliseconds.

Section 4: Program

4.1 Menu options

The main menu provides access to various functional settings/options, as seen in the list below. Each menu option has a submenu, where configuration is completed.

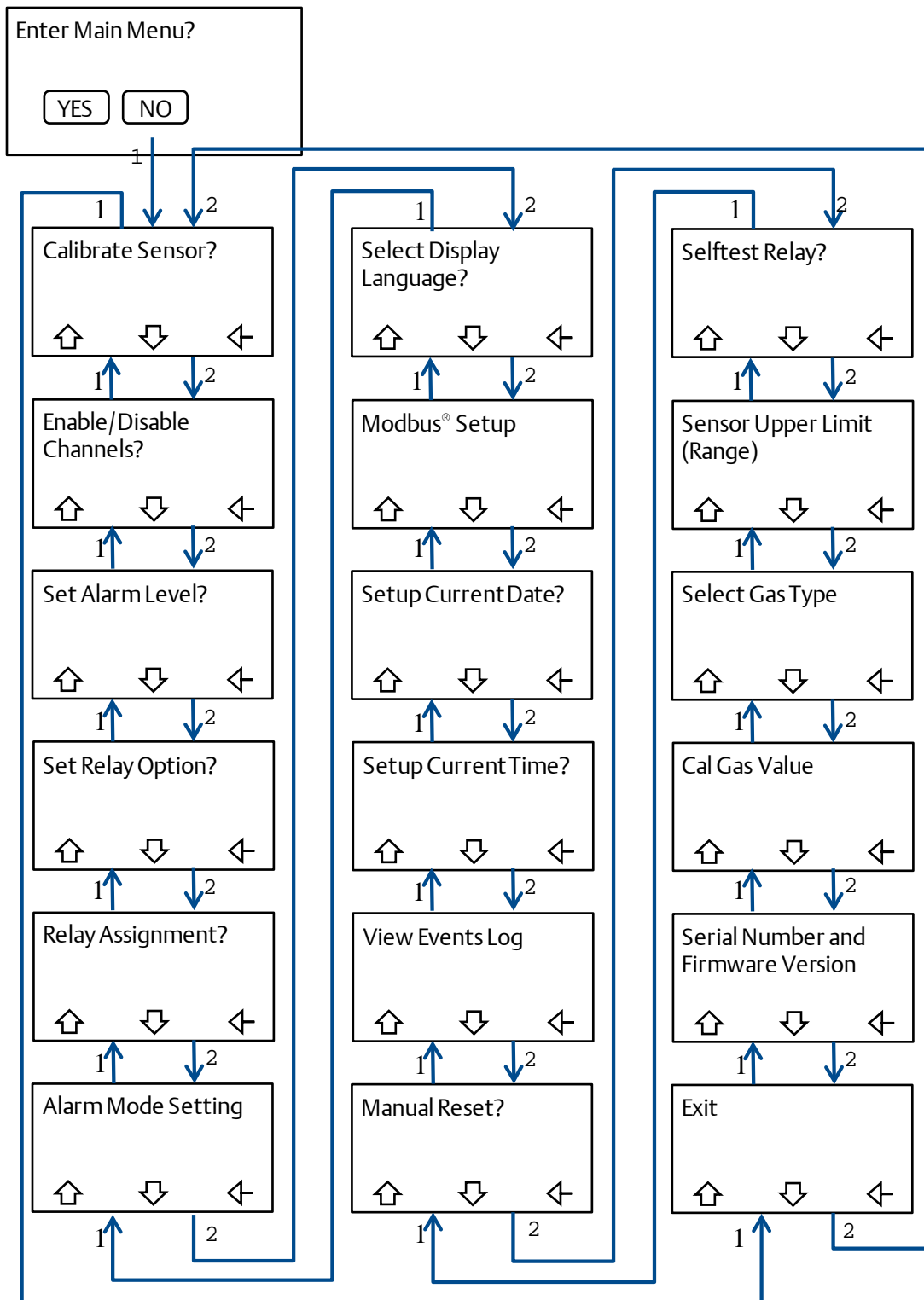
- Calibrate sensor
- Enable/disable channels
- Set alarm level
- Set relay option (available on relay models)
- Relay assignment (available on relay models)
- Alarm mode setting
- Select display language
- Modbus setup (available on Modbus models)
- Setup current date
- Setup current time
- View Events log
- Manual reset
- Self-test relay
- Sensor upper limit (range)
- Select gas type
- Cal gas value
- Serial number and firmware version
- Exit

4.2 Navigate main menu

To navigate through the menu options, press menu button 1 or 2. You can also do this using the magnet to select reed switch 1 (indicated by printed magnet in the 8' o'clock position on the faceplate) or reed switch 2 (indicated by printed magnet in the 6' o'clock position on the faceplate).

1. Enter the main menu, either intrusive or non-intrusive (using the magnet), by pressing any button then select "yes" by using switch 1.
The message "Calibrate Sensor?" will be displayed.
2. Press Up or Down buttons (switch 1) or (switch 2) to scroll/navigate through main menu options.
3. Press the Enter key (switch 3) to display sub menu.
4. To exit the main menu, continue using the navigation keys (up-down keys) and select "Exit" with enter key at each menu stage (sub menu and main menu).
5. The main menu will be exited automatically if no option is selected; it takes fifty (50) seconds to exit to each of the previous options or stage entered. If left untouched, this continues until the main menu is fully exited.

Figure 4-1 Programming Flowchart



4.3 Calibrate sensor

This menu function allows the user to perform a calibration on the connected sensor. Refer to [Section 5](#) for the calibration procedure.

4.4 Enable/disable channels

This option allows you to enable or disable the Net Safety™ Millennium II Transmitter channels. The default value is channel 1 (CH1) enabled for single sensor models (model M21) while channel 2 (CH2) is permanently disabled. Both channels are enabled for two sensor models (model M22).

1. Enter the main menu by pressing any key to get the “Enter Main Menu” prompt, then press switch 1 to select “Yes”.
2. Select the Down arrow key (switch 2) with the magnet, and scroll to “Enable/Disable Channel?”
3. Press the Enter key (switch 3) to enter the option. The sub menu options: “CH 1 Enabled” will be highlighted.
4. To disable a channel 1, activate the Enter key (switch 3). “CH1 disabled” will now be highlighted / displayed.
5. To disable channel 2, highlight “CH2 Enabled” use switch 2, then activate the enter key (switch 3) to configure to “CH2 disabled”.
6. To exit the main menu, select “Exit” with Enter key at each menu stage (sub menu and main menu).

4.5 Set alarm level

This option enables you to view and set up the channel low and high alarm levels. Alarm levels (points) for each channel are user determined. Alarm Point 1 and Point 2 for channel 1 do not relate to Alarm Point 1 and Point 2 for channel 2. The channel 2 selection is only available on M22 models.

1. Enter the Main Menu by selecting/activating any key to get the “Enter Main Menu” prompt, then press switch 1 to select “Yes”.
2. Press the Up key (switch 1) or the Down key (switch 2) until “Set Alarm Level?” is highlighted / displayed.
3. Press switch 3 to enter the “Set Alarm Level” option. Sub menu options ‘Set CH1 Level’, ‘Set CH2 Level’ and ‘Exit’ will be displayed. ‘Set CH1 Level’ will be highlighted.
4. To view channel 1 alarm points, press switch 3. ‘CH1 Point 1’ and ‘CH1 Point 2’ will be displayed.
5. To view channel 2 alarm points use switch 2, at step 3, highlight ‘Set CH2 Level’; then press switch 3. ‘CH2 Point 1’ and ‘CH2 Point 2’ will be displayed.
6. To configure channel 1 alarm levels (Point 1 or Point 2), after step 4, use switch 3 to select CH 1 Point 1 (already highlighted) and proceed to step 8, or highlight CH1 Point 2 using switch 2, then activate switch 3 and proceed to step 8.
7. To configure channel 2 alarm levels (Point 1 or Point 2), after step 5, use switch 3 to select CH2 Point 1 and proceed to step 8, or use switch 2 to highlight CH2 Point 2; then press switch 3 to make a selection. Proceed to step 8.

8. Use switch 1 to increase the existing values representing previously set alarm levels/points and switch 2 to highlight and scroll across values.
9. After setting desired alarm points, select “Exit” at each menu stage (sub menu and main menu).
10. Apply test gas to confirm alarm level settings.

Alarm Point 1 and Alarm Point 2 are values completely under the control of the operator. If the operator chooses, Alarm Point 1 can be assigned a value corresponding to a high alarm condition and Alarm Point 2 assigned a value corresponding to a low alarm condition. To avoid confusion, however, most operators may want to assign Alarm Point 1 as the low alarm condition and Alarm point 2 as the high alarm condition.

4.6 Set relay option

This option allows you to configure the alarm relay coils as energized or de-energized and latching or non-latching.

- Fault relay: The Fault relay is energized and non-latching. This relay is not configurable.
 - Alarm relays 1, 2, and 3: Factory set as de-energized and non-latching. These relays are configurable.
1. Enter the Main Menu by activating any key to get the “Enter Main Menu” prompt; then press switch 1 to select “Yes”.
 2. Press the Up key (switch 1) or Down key (switch 2) until, “Set Relay Options?” is displayed.
 3. Press the Enter key (switch 3) to enter the option. The sub menu options are: “Fault relay”, “Alarm relay 1”, “Alarm relay 2”, and “Alarm relay 3”.
 4. Press the Down key (switch 2) or Up key (switch 1) to highlight configurable alarm relays (“Alarm relay 1”, “Alarm relay 2”, and “Alarm relay 3”).
 5. Press the enter key (switch 3) to configure the desired alarm relay.
 6. “Norm. Energized” or “Norm.De-Energized” will be highlighted at the top of the display screen. To change the energized or de-energized setting, press the Enter key (switch 3).
 7. To change the latching or non-latching setting, press the Down key (switch 2) to highlight “Latching” or “Non-Latching”; then press the Enter key (switch 3).
 8. Once you have made the desired relay settings, select “Exit” at each menu stage (sub menu and main menu).

4.7 Assign relays

This option allows the transmitter two channels (with alarm levels/points) to be configured under the three Alarm relays. When configuring under sub menu Alarm relay 1, “RL1:CH1 (Point 1, Point 2, Disabled)” and “RL1: CH2 (Point 1, Point 2, Disabled)” is displayed. Under sub menu Alarm relay 2, “RL2:CH1 (Point 1, Point 2, Disabled)” and “RL2:CH2 (Point 1, Point 2, Disabled)” is displayed, and under sub menu Alarm relay 3, “RL3:CH1 (Point 1, Point 2, Disabled)” and “RL3:CH2 (Point 1, Point 2, Disabled)” is displayed.

RL1, RL2 and RL3 represents Alarm relays 1, 2, and 3. CH1 and CH2 represent channel 1 and channel 2. Point 1 and Point 2 are Alarm level 1 and Alarm level 2. Alarm levels (points) are user determined and are unique to the specific channel.

Prior to assigning relays, configure the alarm levels (points). See [Section 4.5](#) and then follow the steps and example below to configure the Alarm relays. Also see the table below.

1. Enter the Main Menu by pressing any key to get the “Enter Main Menu” prompt; then press switch 1 to select “Yes”.
2. Press the Up key (switch 1) or Down key (switch 2) until “Relay Assignment?” is displayed.
3. Press the Enter key (switch 3) to enter the option. The sub menus: “Alarm Relay 1”, “Alarm Relay 2”, and “Alarm Relay 3” as well as “Exit” will be displayed.
4. Choose the alarm relay (Alarm relay 1, Alarm relay 2, or Alarm relay 3) for configuration, by using the Up- Down arrow keys.
5. Press the Enter key (switch 3) to make the selection. The relay (RL) and channel (CH) with alarm level setting will be highlighted. The alarm level settings available are: Point 1, Point 2, and Disabled.
6. Under the specific relay with channel, press the Enter key (switch 3) to choose the appropriate setting. See the table below.

Table 4-1 Relays and Assignment Options

Channel and alarm points(levels)	Alarm Relay1 (RL1) with channel number and alarm points (levels)	Alarm relay 2 (RL2) with channel number and alarm points (levels)	Alarm relay 3 (RL3) with channel number and alarm points (levels)
CH1 POINT 1= Alarm level 1 POINT 2= Alarm level 2	RL1:CH1 Point 1/Point 2/Disabled	RL2:CH1 Point 1/Point 2/Disabled	RL3:CH1 Point 1/Point 2/Disabled
CH2 POINT 1= Alarm level 1 POINT 2= Alarm level 2	RL1:CH2 Point 1/ Point 2/Disabled	RL2:CH2 Point 1/ Point 2/Disabled	RL3:CH2 Point 1/Point 2/Disabled

7. Once the appropriate settings are chosen, use the Up or Down arrow key (switch 1) or (switch 2) and switch 3 to exit.

Example: LEL combustible sensor connected to channel 1 and H₂S sensor connected to channel 2.

1. Set Alarm Levels (points): Set up alarm levels for each channel (e.g., Channel 1 point 1 = 20% LEL, Channel 1 point 2 = 40% LEL, Channel 2 point 1 = 10 ppm, and Channel 2 point 2 = 20 ppm). Refer to [Section 4.5](#) when setting alarm levels.
2. Set Relay Options: Each alarm relay can be set up for energized or de-energized and latching or non-latching. Configure alarm relays options as desired. See [Section 4.6](#).
3. Relay Assignment: There are (3) alarm relays and (2) channels. Assign alarm relays to channels as desired, for example:
 - o Alarm relay 1 assigned to Channel 1 Point 1 (20% LEL)
 - o Alarm relay 2 assigned to Channel 2 Point 1 (10 ppm)
 - o Alarm relay 3 assigned to Channel 1 Point 2 (40% LEL)
 - o Alarm relay 3 assigned to Channel 2 Point 2 (20 ppm)

4.8 Set alarm mode

Only use this mode on oxygen (Net Safety™ ST341) sensors.

This option is available for detecting oxygen levels. The user is allowed to set up two points/levels (normal oxygen level is 20.9 percent) under three available alarm modes. These alarm modes are: Above-Above, Below-Below and Below-Above. The alarm mode you choose depends on the particular application/operation. If using surrounding air for calibration, ensure that no contaminants are present. Refer to the Oxygen sensor manual for detailed information.

4.9 Select display language

This option allows the display language to be selected. The default language is English. There are also options for Spanish, French, and Portuguese.

1. Enter the Main Menu by pressing any key to get the “Enter Main Menu” prompt; then press switch 1 to select “Yes”.
2. Press the Up key (switch 1) or Down key (switch 2) until “Select Display Language?” is displayed.
3. Press the Enter key (switch 3). The default language, “English”, will be displayed.
4. Locate other languages by pressing the Enter key (switch 3).
5. Once the desired language is displayed, select “Exit” at each menu stage (sub menu and main menu).

4.10 Set up Modbus®

This option enables the following Modbus parameters to be set:

- Addressing: From 001 (default) to 247.
 - Baud Rate: 02400 bps, 04800 bps, 09600 bps (default), 19200 bps, and 57600 bps.
 - Frame Format: EVEN Parity (default), ODD Parity, NO Parity.
1. Enter the main menu by pressing any key to get the “Enter Main Menu” prompt; then press switch 1 to select “yes”.
 2. Select the Up arrow key (switch 1) or Down arrow key (switch 2) until the “Modbus Setup” option is displayed.
 3. Press the Enter key (switch 3) to display “slave address” (default address: 001).
 4. Use the Up key (switch 1) to increase the address and the Down key (switch 2) to decrease the value. The value range is 001-247.
 5. Press the Enter key (switch 3) when the desired value is displayed.
 6. After setting the slave address, exit to this sub menu option using switch 3.
 7. Press the Down key (switch 2) to highlight “baud rate”; then press the Enter key (switch 3) to display the current baud rate.
 8. Use the Up key (switch 1) to increase the baud rate and the down key (switch 2) to decrease it.

9. Press the Enter key (switch 3) when the desired value is displayed.
10. After setting the baud rate, exit this sub menu option using switch 3, and then press the down arrow key (switch 2) to highlight "Parity Bit".
11. Press switch 3; then press the Up key (switch 2), or the Down key (switch 1) to choose a value.
12. Press the Exit key (switch 3) when the desired value is displayed; then select "Exit" at each menu stage (sub menu and main menu).

4.11 Set current date

This option allows you to set the current date for event logging. The default date is set at the factory in Mountain Time.

1. Enter the Main Menu by selecting any key to get the "Enter Main Menu" prompt; then use switch 1 to select "Yes".
2. Select the Up key (switch 1) or Down key (switch 2) until "Setup Current Date?" option is displayed.
3. Select Enter (switch 3) to display the sub menu options: "year", "month", and "day".
4. Select the Up key (switch 1) to change the current year/month/day settings and switch 2 to cycle across "year", "month", "day" values and "OK".
5. After desired setting are made, navigate to "OK?" and activate the Enter key (switch 3) to confirm. To exit the Main Menu, select "Exit" at each menu stage (sub menu and main menu).

4.12 Set current time

This option allows you to set the current time for event logging. The default time is in Mountain Time.

1. Enter the Main Menu by selecting any key to get the "Enter Main Menu" prompt; then use switch 1 to select "Yes".
2. Select the Up key (switch 1) or Down key (switch 2) until "Setup Current Time?" is displayed.
3. Select the Enter key (switch 3) to display the sub menu: "hour", "minute", and "seconds".
4. Use the Up arrow key (switch 1) to change the current hour/minute/second settings; then use switch 2 to cycle across "hour", "minute", and "seconds" values and "OK".
5. After desired settings are made, navigate to "OK" and select the enter key (switch 3) to confirm. To exit the Main Menu, select "Exit" at each menu stage (sub menu and main menu).

4.13 View Events Log

The transmitter has the ability to store up to 980 events. You can view events by navigating through the Events Log. The most recent events are shown first.

1. Enter the Main Menu by selecting any key to get the "Enter Main Menu" prompt; then use switch 1 to select "Yes".
2. Navigate through the Main Menu using switch1 or switch 2 until "View Event Log?" is displayed.

3. Select the Enter key (switch 3) to display the sub menu. The most recent event will be displayed.
4. Select the Up arrow key (switch 1) and the Down arrow key (switch 2) to toggle through all past events.
5. After viewing, select “Exit” at each menu stage (sub menu and main menu).

The on-screen Events Format/host includes:

- Channel Number: CH1, CH2 or transmitter: ML2. Events that occurred under these formats will be logged.
- Event Types: There are a total of 11 events that are stored and displayed. See table below for a list of the events, and how they are displayed on the transmitter screen.
- Date and Time: Each event is date and time stamped.

Event Types	Display on Screen	Events Format /host
Power up or reset	Power UP / RST	ML2
Communication fault	Communication Err	CH1 or CH2
High level alarm	High Alarm	CH1 or CH2
Low level alarm	Low Alarm	CH1 or CH2
Calibration completed	Cal Complete	CH1 or CH2
Calibration zero failed	Cal Zero fail	CH1 or CH2
Calibration span fail	Cal Span Fail	CH1 or CH2
Calibration aborted	Cal Abort	CH1 or CH2
Sensor fail	Sensor Fail	CH1 or CH2
Channel enabled	Enabled	CH1 or CH2
Channel disabled	Disabled	CH1 or CH2

4.14 Manual reset

A manual reset is required after a calibration failure or to clear a latched alarm relay. After a manual reset, the transmitter will return to normal operation.

1. Enter the Main Menu by selecting any key to get the “Enter Main Menu” prompt; then use switch 1 to select “Yes”.
2. Select the Up key (switch 1) or Down key (switch 2) until “Manual Reset?” is displayed.
3. Select the Enter key (switch 3) to display the sub menu: “Initiate Reset”.
4. Select “Yes” using switch 1 to reset.

4.15 Self-test relay

WARNING

When using the self-test relay function, ensure all external equipment is disabled to prevent unwanted alarm activation. Enable external equipment once testing is completed.

The self-test relay option continuously turns relays on and off to ensure that they are functioning properly. The transmitter tests the Fault relay first, automatically followed by tests on Relay 1, 2, and 3. After the transmitter has tested all the relays, “Relay Test Complete” will be displayed. See steps to initiate relay self-test below.

Proper functioning electromechanical relays have a clicking sound during this test.

1. Enter the Main Menu by selecting any key to get the “Enter Main Menu” prompt; then use switch 1 to select “Yes”.
2. Select the Up arrow key (switch 1) or Down arrow key (switch 2) until “Self-test Relay?” option is displayed.
3. Select the Enter key (switch 3) to display the sub menu: “Self-Test Relay. Caution, will trip alarm”.
4. Select “Yes” using switch 1. The transmitter will display “Ensure alarm response items are disconnected”.
5. Ensure all external alarm devices are deactivated, and then select “Yes” using switch 1.
6. After test is successfully completed, select “Exit”.

4.16 Sensor upper limit (range)

This option is used to set the upper limit (range) of the gas being detected. The upper limit will vary depending on the sensor used and may not be selectable for all sensors.

1. Enter the Main Menu by selecting any key to get the “Enter Main Menu” prompt; then use switch 1 to select “Yes”.
2. Select the Up key (switch 1) or Down key (switch 2), until “Sensor Upper Limit (Range)” option is displayed.
3. Select the Enter key (switch 3) to display the sub menu: “CH1: range” or “CH2: range”.
4. Select the channel (sensor) to be configured and adjust the sensor’s range using the up-down arrow keys (switch 1) or (switch 2). The specific sensor provides the upper limits/ranges.

If no selections appear when using the up/down arrow keys at this stage, the specific sensor only has one upper limit/range, which cannot be altered.

5. Select the Enter key (switch 3) when the desired upper limit/range is reached.
6. To exit, select “Exit” at each menu stage (sub menu and main menu).

4.17 Select gas type

The “Select Gas Type” option allows you to select a particular target gas and/or Correction (“K”) Factor in the case of catalytic bead sensors (model SC310) or choose the type of LEL gas (gas curve) in the case of infrared (model SC311) sensors. See specific sensor manual in relation to this menu option.

4.18 Set calibration gas value

This option allows you to select the calibration gas value in the transmitter main menu. Although Emerson recommends using 50 percent span gas for calibration, for some sensors, the transmitter will allow tolerance/flexibility in the calibration gas available. Some sensor types allow 10 percent to 60 percent span gas. See specific sensor manual.

1. Enter the Main Menu by selecting any key to get the “Enter Main Menu” prompt; then use switch 1 to select “Yes”.
2. Select the Up key (switch 1) or Down key (switch 2), until the “Cal. Gas value” option is displayed.
3. Select the enter key (switch 3). Channel 1 and channel 2 existing calibration gas values will be displayed in three numeric groups: hundreds, tens, and ones. For example: 0 5 0 indicates a calibration gas value of 50% span.
4. Highlight the required channel with calibration gas value using the navigation keys (switch 1) or (switch 2), then select using switch 3. Switch 1 is used to increase /change a value in each numeric group, while switch 2 is used to cycle across the numeric groups.
5. To exit, select “Exit” at each menu stage (sub menu and main menu).

4.19 Serial number and firmware version

Use this option when you need the transmitter’s the serial number or firmware version.

1. Enter the Main Menu by selecting any key to get the “Enter Main Menu” prompt; then use switch 1 to select “Yes”.
2. Select the Up key (switch 1) or Down key (switch 2), until “Serial Number and Firmware Version” option is displayed.
3. Select the Enter key (switch 3). The firmware version and serial number will be displayed.
4. To exit, select “Exit” at each menu stage (sub menu and main menu).

4.20 Exit

This option allows you to exit the menu system and return to the normal operation mode.

Section 5: Calibrate

5.1 Full calibration procedure

Prior to attempting calibration read and understand the calibration procedure below. Also see [Figure 5-1](#) for additional reference.

Complete the following calibration procedure to ensure an accurate correlation between the output signal and the gas concentration. For accurate performance, calibrate the transmitter using 50 percent. The transmitter will however, allow some flexibility in the use of calibration gas with some sensors; calibration gas outside of 50 percent span (10 percent to 60 percent span gas) will be allowed on specific sensor models (see specific sensor manual for details). The calibration gas value can be chosen by selecting it under “cal. gas value” in the main menu. A full calibration will take approximately 5 minutes to complete.

WARNING

Air movement, drafts, and wind can cause dilution of calibration gas flow, which can cause an erroneous calibration and inaccurate performance. To avoid this, use a calibration cup attached to the bottom of the sensor. The cup doesn't have to be removed for normal operation. When the cup is in place, inject calibration gas at a rate of 0.5 – 1.0 liter per minute.

Ensure the transmitter is functioning properly as indicated by the status LED and current output.

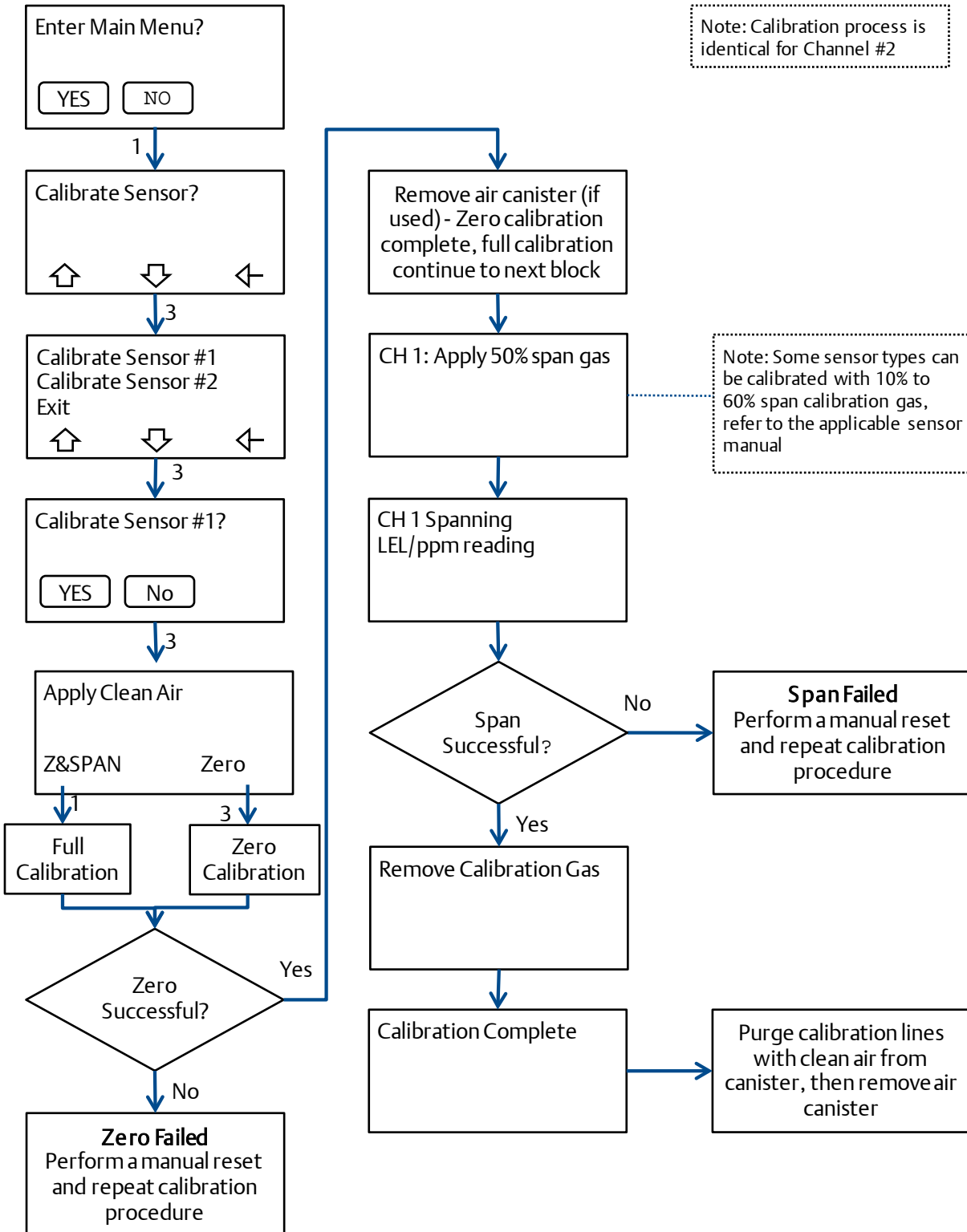
1. Enter the Main Menu by selecting any key to get the “Enter Main Menu” prompt; then use switch 1 to select “Yes”.
2. When “Calibrate Sensor?” is displayed, select the Enter key (switch 3).
3. When “Calibrate Sensor #1?” is highlighted, select the Enter key (switch 3) if this is the sensor to be calibrated.
4. If sensor #2 is to be calibrated, select the Down arrow key (switch 2) to scroll to “Calibrate Sensor #2?”
5. Use the Enter key (switch 3) to select the desired sensor to be calibrated (1 or 2)
6. Select “YES” with switch 1 to confirm the selection, and then apply clean air (zero gas) from canister when “Apply Clean Air” is displayed. Ensure no contaminant gases are around if using ambient air.
7. Select “Z & Span” using switch 1 for normal (full) calibration. “Setting zero” will be displayed as the sensor is being zeroed.
8. Apply 50 percent calibration gas (or % cal. gas value chosen) when prompted.
9. The display will show “Spanning” with the gas value (%LEL or PPM depending on the sensor) as the gas is detected.
10. Remove the calibration gas when “Remove Cal Gas” is displayed.
“Cal Complete” will be displayed when calibration is complete.
11. Apply zero gas (clean air) to purge system. This is particularly important when using long tubing.

NOTICE

Select the “Zero” calibration option if the sensor is only being zeroed (this not a complete calibration).

It does not require span gas, as only the sensor’s zero point is adjusted. Ensure that no contaminants are present, if the surrounding air is to be used for zeroing. If doing a zero calibration, at step 7 above, select “Zero” using switch 3).

Figure 5-1 Calibration flowchart



5.2 Status conditions during calibration

Condition	Current output	LED indication		Relay outputs	
		Red	Green	Fault	Alarm
Sensor is zeroing itself.	3 mA	Off	Solid	Normal state	Normal state
Sensor is waiting until it detects application of calibration gas.	3.3 mA	Very fast	Off	Normal state	Normal state
Sensor waits until gas level stabilizes, then begins spanning.	3.3 mA	Very fast	Off	Normal state	Normal state
Spanning is complete; operator asked to remove calibration gas.	3.6 mA	Off	Solid	Normal state	Normal state
Displayed for 4 seconds once gas concentration drops to 3% full-scale after operator asked to remove calibration gas.	3.6 mA	Off	Solid	Normal state	Normal state
Signal was too unstable to acquire an accurate zero after ninety (90) seconds.	3.0/3.3	Solid	Solid	Fault state	Normal state
Displayed for 4)seconds if the calibration gas was remove prematurely or if a 90 second time limit has elapsed and the signal was too unstable to acquire accurate data.	3.0/3.3	Solid	Solid	Fault state	Normal state

Section 6: Monitor and outputs

6.1 Analog 4-20 mA

Use a 4-20 mA current output to send the transmitter and sensor status and fault codes to other devices. You can wire this output for isolated or non-isolated operation. A 4.0 mA output indicates normal operation; the transmitter's output current range is 4.0 - 20.0 mA. For a full list of output current values and what they indicate, see [Section 6.5](#).

The transmitters offer a variable 4-20 mA analog output. This output will provide gas concentration through the 4-20 mA range, where 4 mA equals zero gas concentration and 20 mA equals the high range of the sensor (e.g. 100% LEL or 100 ppm). Other conditions, such as faults and calibration notifications (e.g., apply gas), are indicated in the 0-3.9 mA range. Faults are indicated at either 0 mA or 2.5 mA.

NOTICE

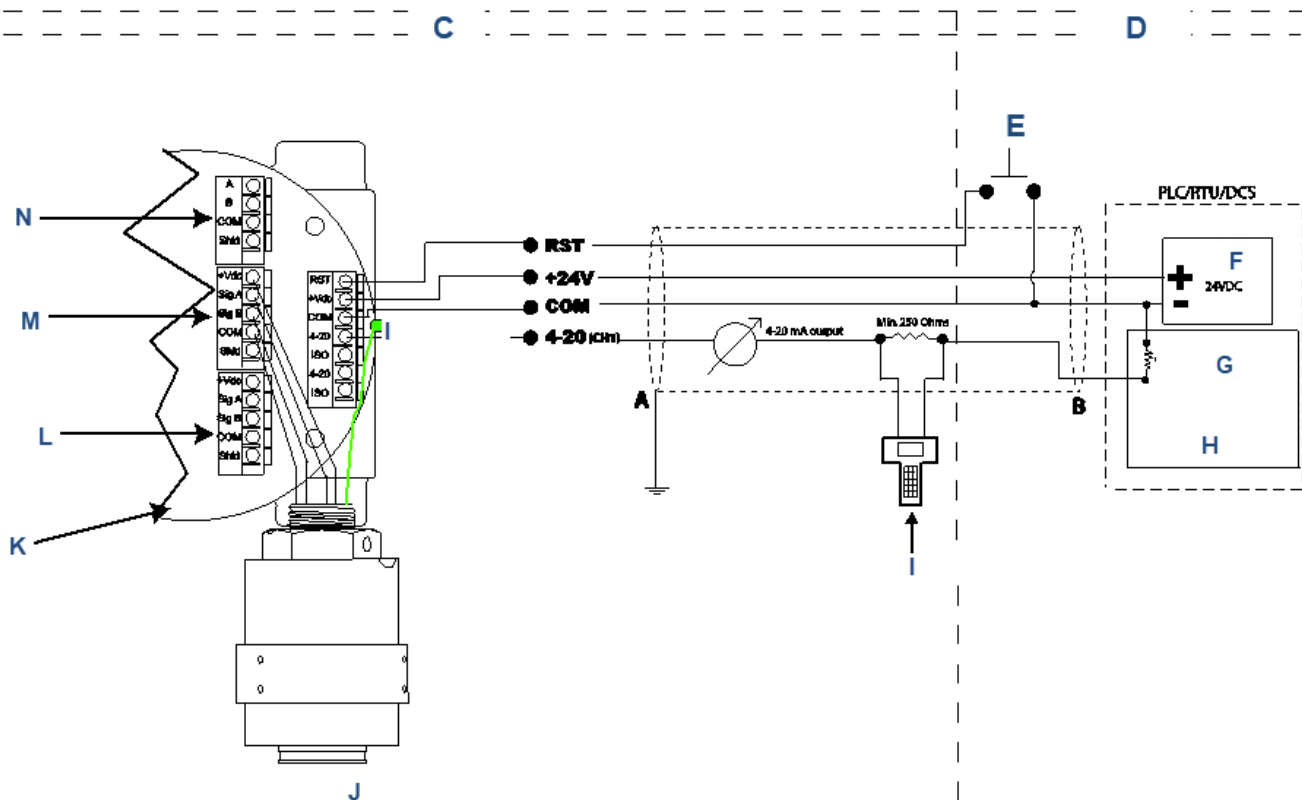
To differentiate between conditions resulting in 2.5 mA, view the Event Log. See Event Log menu option.

6.2 HART[®] communication (optional)

The HART protocol is a powerful communication technology, enabling operators to access the full functionality of the transmitter. The HART communication option is only available with the single channel version of the Net Safety™ Millennium II Transmitter. The Net Safety Millennium II Transmitter is a generic device that will work with other universal communication devices.

You may connect the HART Communicator to the single channel analog/HART model Net Safety Millennium II Transmitter via the HART Port connector (HPT-001), which provides the necessary interface for communication. The HART Port connector is fitted to one of the 3/4-in. NPT conduit entries and its communication wires fitted to the HART Pins located at J5 near the ribbon cable on the underside of the display/CPU assembly. The HART Communicator probe wires (leads) are then connected to HART Port connector contact points. You can also do HART Communication remotely using a designated Net Safety Multipurpose Junction box (JB-MPH-A/S). See the HART Port connector manual (MAN-0083) for more details. When doing remote HART Communication, ensure the HART jumper is connected across pins at J5 near ribbon cable on display/CPU assembly. By default the jumper is connected across pins. The HART Communicator can be connected directly in the 4-20 mA signal wiring across a 250 - 600 Ohm resistor. Do not install resistor within transmitter. See [Figure 6-1](#).

Figure 6-1 Analog/HART Wiring Single Channel Model Net Safety Millennium II



- A. Connect this end of shield to earth ground.
- B. Cut this end of shield.
- C. Field
- D. Control
- E. Normally open switch for resetting latched alarms
- F. Power supply
- G. Channel 1 input resistance
- H. Analog input module
- I. HART Communicator
- J. Net Safety Millennium II sensor
- K. Transmitter terminal board
- L. Channel 2 sensor terminal (not active)
- M. Channel 1 sensor terminal (active)
- N. Modbus® terminal

6.3 Relays (optional)

Optional electromechanical relays have Form-C SPDT contacts rated 5 amps at 30 Vdc/ 250 Vac. There are four physical relays; one fault and three alarm relays. These relays have normally open and normally closed contacts at the output terminals.

6.3.1 Alarm relay(s)

You can order the transmitters with three programmable alarm relays. These relays will change state from their non-alarm state to an alarm state when gas concentrations, as read by the sensor, reach the programmed alarm points set in the transmitter.

You can program the alarm relays to change states on alarm point #1 or alarm point #2 for either channel. You can also program them to be energized or de-energized under normal conditions, and then either latching or non-latching.

6.3.2 Fault relay

Net Safety™ Millennium II transmitters and sensors continually check for situations that may prevent the transmitter and sensor from providing an expected response to ambient conditions and records these as a fault condition in the message log and the output(s) of the transmitter. When the transmitter detects a system fault, the red Status LED will flash fast (250 milliseconds on, 250 milliseconds off), the analog output will output a 2.5 mA signal, and the fault relay will change states (de-energize to provide a fault condition).

The fault relay is normally energized when no fault conditions are present and is set up for non-latching. The operation of the fault relay is not configurable.

The transmitter provides various fault conditions to indicate that the transmitter or connected sensor(s) are not operating as expected. These fault conditions will override any alarm conditions because the sensor may be unable to detect a gas exposure reliably. Examples of fault conditions can range from no detection due to memory or communication errors and sensor failure. Other faults can provide unreliable detection due to sensor drift or sensor nearing the end of its life. When a transmitter is in fault mode, take immediate action to determine the source and correct the fault condition.

NOTICE

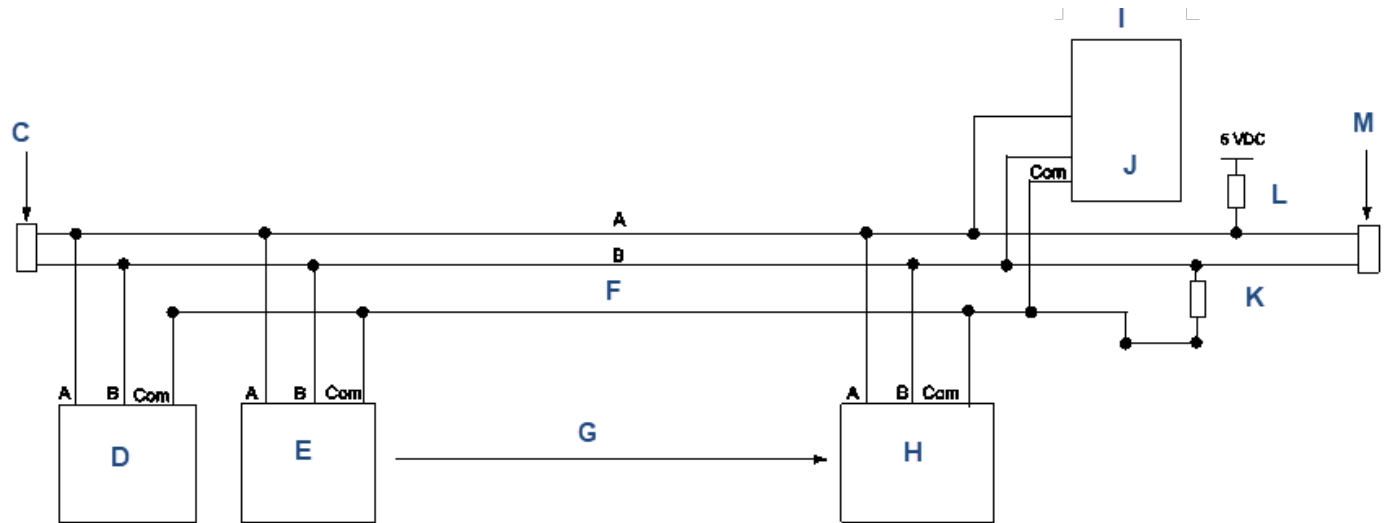
The fault relay output is not commonly used to imitate an automatic shutdown. The fault output indicates a potential problem with the transmitter not an alarm condition.

6.4 RS-485 Modbus® RTU (optional)

Optional RS-485 Modbus RTU protocol is available. The tables on the following pages give the detailed Modbus registers and the bit values for the transmitter register.

The transmitter uses two-wire Modbus RS-485 multi-serial mode. This Modbus solution implements a two-wire electrical interface in accordance with the EIA/TIA-485 standards. For this Modbus configuration, it is important to use a third wire for connecting all the “Common” (COM) in the chain. Also, a 120 Ohm line termination is required for the last device in the line. See [Figure 6-2](#). The instrument engineer is responsible for calculating line length and adhering to Modbus protocols.

Figure 6-2 Two-wire Modbus configuration



- A. Wire A
- B. Wire B
- C. Line termination
- D. Net Safety Millennium II Transmitter 1
- E. Net Safety Millennium II Transmitter 2
- F. Common wire
- G. Transmitters and addresses
- H. Net Safety Millennium II Transmitter 247
- I. PLC/panel/DCS
- J. Master
- K. Pull down resistor
- L. Pull up resistor
- M. Line termination

6.4.1 Modbus registers

Req#	Meaning	Readable	Writeable
40001	Concentration value as calculated by sensor (RTUsensor_out), Channel 1	X	
40002	Sensor status (RTUsensor_stat), Channel 1	X	
40003	Temperature of sensor element housing in Kelvin (RTU temperature), Channel 1	X	
40004	RFU, Channel 1, always read as 0x0000	X	
40005	RFU, Channel 1, always read as 0x0000	X	
40006	Concentration value as calculated by sensor (RTUsensor_out), Channel 2	X	
40007	Sensor status (RTUsensor_stat), Channel 2	X	
40008	Temperature of sensor element housing in Kelvin (RTU temperature), Channel 2	X	
40009	RFU, Channel 2, always read as 0x0000	X	
40010	RFU, Channel 2, always read as 0x0000	X	
*40021	Transmitter status	X	
40091	Initialize quick calibration, Channel 1 to 2	X	X
40092	Initialize normal Calibration, Channel 1 to 2	X	X
NOTE: Alarm points can be set up through Modbus registers 40093 to 40096			
40093	Channel 1 high alarm limit	X	X
40094	Channel 1 low alarm limit	X	X
40095	Channel 2 high alarm limit	X	X
40096	Channel 2 low alarm limit	X	X
40101	Reset latch relays		X

RFU – Reserved for future use

* The transmitter Status register (Register 40021) is a bit flag register. The following table shows the detailed meaning of each bit in the register.

Bit	Meaning
0x0000	Normal sensor operation: no fault or alarm has happened
0x0001	Channel 1 sensor fault status tripped. Communication Fault, Calibration Fault, etc.
0x0002	Channel 1 Low Alarm tripped
0x0004	Channel 1 High Alarm tripped
0x0008	Channel 2 sensor fault status tripped. Communication Fault, Calibration Fault, etc
0x0010	Channel 2 Low Alarm tripped
0x0020	Channel 2 High Alarm tripped
0x0040	Channel 1 needs calibration
0x0080	Channel 2 needs calibration

6.5 Transmitter output operation

The following table outlines the operation of the outputs of the transmitter under different conditions. These outputs include the analog output, LED indications, and the relay outputs. For the outputs' status, refer to the descriptions below the table.

Condition	Current output	LED indication		Relay outputs	
		Red	Green	Fault	Alarm
No gas present	4 mA	Off	Slow	Normal state	Normal state
Gas present, concentration below alarm points	4-20 mA depending on gas concentration	Slow	Off	Normal state	Normal state
Gas present, concentration at or above alarm points	4-20 mA depending on gas concentration	Slow	Off	Normal state	Alarm state
Fault condition present, no gas present	2.5 mA	Very fast	Off	Fault state	Normal state
Fault condition present, gas present	2.5 mA	Very fast	Off	Fault state	Normal state
Fault condition present, gas above alarm points	2.5 mA	Very fast	Off	Fault state	Normal state
Electrochemical XChem sensors only: Sensor end of life condition present, gas above or below alarm points	2.5 mA for 10 seconds, 4-20 mA for 50 seconds	Very fast	Off	Fault state for 5 seconds, normal state for 55 seconds	Normal state

Fault relay: Fault state means that the relay is in the de-energized state. Normal state means that the relay is in the energized state.

LED indications: Flash rates are outlined in the following table:

Flash description	On	Off
Slow	50 milliseconds	1 second
Fast	250 milliseconds	250 milliseconds
Very fast	50 milliseconds	50 milliseconds

Alarm relay(s): Alarm state means that if the relay is programmed for normally de-energized, the relay will energize to alarm; if the relay is programmed for normally energized, the relay will de-energize to alarm. Normal state is what state that the relay is programmed for (e.g. normally energized or normally de-energized).

6.6 Monitor faults

Self-testing circuitry continuously checks for problems that could prevent proper response. When you apply power to the transmitter, a microcontroller automatically tests the system to ensure that it is functioning properly. During normal operation, the microcontroller continuously monitors the signal from the internal sensor source. In addition, a “watchdog” timer is maintained to ensure the program is running correctly. When a system fault is detected, the Status LED will have a red fast flash and the fault signal will output a 2.5 mA signal. The transmitter’s event log may be viewed in order to distinguish the fault condition. Refer to the Event Log menu option.

⚠ WARNING

The fault detection circuitry does not monitor the operation of external response equipment or external wiring to the transmitter. Check external equipment and wiring periodically to ensure they are operational.

6.7 Fault conditions

⚠ WARNING

Fault conditions will override any alarm conditions because the sensor may be unable to detect a gas exposure reliably; as such, the alarm relay will not provide an output.

Fault conditions provided by an instrumentation device are critical indicators that the device is not operating as expected; therefore, when a fault condition is present, give immediate attention to the fault.

Net Safety strongly recommends that the 2.5 mA analog fault condition and fault relay (if used) be monitored in conjunction with alarm levels on the analog output and the alarm relay, if used.

6.7.1 Transmitter fault conditions

Fault conditions that the transmitter detects are as follows:

Fault condition	M21	M22
Input voltage less than 8 Vdc	✓	✓
Input voltage more than 33 Vdc	✓	✓
Critical memory fault	✓	✓
Onboard power supply fault	✓	✓

6.7.2 Sensor fault conditions

Fault conditions that the various Net Safety Millennium II sensors detect are as follows:

Fault condition	SC310	SC311	ST322	ST332	ST340	ST320	ST330	ST341	ST360
Zero calibration failure	✓	✓	✓	✓	✓				
Span calibration failure	✓	✓	✓	✓	✓	✓	✓	✓	✓
Low temperature	✓		✓	✓	✓				
High temperature	✓		✓	✓	✓				
Low power	✓	✓	✓	✓	✓				
High power	✓	✓	✓	✓	✓				
Replace sensor	✓	✓	✓	✓	✓	✓	✓	✓	✓
Zero drift		✓				✓	✓	✓	✓
Signal invalid		✓							
Over-range		✓				✓	✓	✓	✓
Memory fault	✓	✓	✓	✓	✓	✓	✓	✓	✓
Power supply fault	✓	✓	✓	✓	✓				
Sensor end of life	✓		✓	✓		✓	✓		✓
Sensor weak signal	✓		✓	✓	✓				
Sensor thermistor fault		✓							

Section 7: Maintenance

7.1 Periodic response check

Net Safety™ recommends that you perform a bump test every 90 days to ensure continued functionality and accuracy of the detection system. Net Safety recommends full calibration when the sensor fails to meet acceptable accuracy standards. This involves applying calibration gas to the sensor and then observing the response LEDs, analog output, and external monitoring equipment. Be sure to prevent unwanted response of external monitoring devices and equipment during this procedure. If the Net Safety™ Millennium II's response to calibration gas is within the specified accuracy then it is not necessary to perform a calibration.

Example: When 50 percent of full scale is applied, the response is expected to be between 11.5 mA (47 percent of full scale) and 12.5 mA (53 percent of full scale). An additional consideration is the accuracy tolerance of the calibration gas which may be + or - a few percent. If the calibration gas is + or - 10 percent of full scale then the reading may be from 10.7 mA (42 percent of full scale) to 13.3 mA (58 percent of full scale).

7.2 Troubleshoot

Check input response and, if necessary, calibrate whenever the accuracy of this check is not satisfactory. Also check the system when a sensor or transmitter is added or removed. If problems develop, first check for faulty wiring, confirm proper voltage to transmitter and attempt a calibration. If problems persist, please contact the Net Safety Service Department first by phone to try and resolve any issues. If issues cannot be resolved, please follow the procedure in [Section 1.3](#).

7.3 Storage

Store the transmitter and its electronic components/parts in locations free from dust and moisture. The storage temperature should be well within the limits of the certified temperatures of the equipment. See [Section 9](#) for storage temperatures.

7.4 Spare parts and accessories

Description	Part number
3/4 NPT ATEX certified plug - aluminum	CP-AL-002
3/4 NPT ATEX certified plug – stainless steel	CP-SS-001
Aluminum separation kit	JB-MPD-A
Stainless steel separation kit	JB-MPD-S
Magnet assembly	MAGNET-1
Conduit reducer - 3/4-in. to M20 - aluminum	M20R
Conduit reducer - 3/4-in. to M20 – stainless steel	M20R-SS
Sun shade kit - requires UN-MK-1	SSK-2
1-in. pipe mounted sun shade kit/rain guard - Includes UN-MK-31	SSK-51
2-in. pipe mounted shade kit/rain guard - includes UN-MK-32	SSK-52
3-in. pipe mounted shade kit/rain guard - Includes UN-MK-33	SSK-53
Single channel transmitter with analog output	TX-M21-A
Single channel transmitter with analog & mechanical relay outputs	TX-M21-AR
Single channel transmitter with analog & digital Modbus® outputs	TX-M21-AD
Single channel transmitter with analog , mechanical relay, & digital Modbus output	TX-M21-ARD
Single channel transmitter with analog / HART® communication output	TX-M21-AH
Single channel transmitter with analog / HART communication output for wireless capable transmitters	TX-M21-AH-FC
Single channel transmitter with analog / HART communication & relay output	TX-M21-AHR
Single channel transmitter with analog / HART communication & relay output for wireless capable transmitters	TX-M21-AHR-FC
Dual channel transmitter with analog output	TX-M22-A
Dual channel transmitter with analog and mechanical relay output	TX-M22-AR
Dual channel transmitter with analog & digital Modbus output	TX-M22-AD
Dual channel transmitter with analog, relay, & digital Modbus output	TX-M22-ARD
2-in. pipe mounting kit (stainless steel)	UN-MK-1
1-in. pipe mounting kit - All Net Safety Millennium II & ECO-SENSE gas detectors (stainless steel)	UN-MK-31
2-in. pipe mounting kit - All Net Safety Millennium II & ECO-SENSE Gas Detectors (stainless steel)	UN-MK-32

Description	Part number
3-in. pipe mouting kit - All Net Safety Millennium II & ECO-SENSE gas detectors (stainless steel)	UN-MK-33

Section 8: Electrostatic sensitive device

Definition: Electrostatic discharge (ESD) is the transfer, between bodies, of an electrostatic charge caused by direct contact or induced by an electrostatic field.

The most common cause of ESD is physical contact. Touching an object can cause a discharge of electrostatic energy. If the charge is sufficient and occurs near electronic components, it can damage or destroy those components. In some cases, damage is instantaneous and an immediate malfunction occurs. However, symptoms are not always immediate—performance may be marginal or seemingly normal for an indefinite period of time, followed by a sudden failure.

To eliminate potential ESD damage, review the following guidelines:

- Handle boards by the sides—taking care not to touch electronic components.
- Wear grounded wrist or foot straps, ESD shoes, or heel grounders to dissipate unwanted static energy.
- Prior to handling boards, dispel any charge in your body or equipment by touching a grounded metal surface.
- Ensure all components are transported and stored in ESD safe packaging.
- When returning boards, carefully package in the original carton and static protective wrapping.
- Ensure ALL personnel are educated and trained in ESD Control Procedures.

In general, exercise accepted and proven precautions normally observed when handling electrostatic sensitive devices.



Section 9: Wire resistance table

Distance feet (meters)	AWG #20 0.5 mm ²	AWG #18 0.8 mm ²	AWG #16 1.0 mm ²	AWG #14 2.0 mm ²
100 (30.5)	1.02	0.64	0.40	0.25
200 (61)	2.03	1.28	0.80	0.51
300 (91.4)	3.05	1.92	1.20	0.76
400 (121.9)	4.06	2.55	1.61	1.01
500 (152.4)	5.08	3.20	2.01	1.26
600 (182.9)	6.09	3.83	2.41	1.52
700 (213.4)	7.11	4.47	2.81	1.77
800 (243.8)	8.12	5.11	3.21	2.02
900 (274.3)	9.14	5.75	3.61	2.27
1000 (304.8)	10.20	6.39	4.02	2.53
1250 (381)	12.70	7.99	5.03	3.16
1500 (457.2)	15.20	9.58	6.02	3.79
1750 (533.4)	17.80	11.20	7.03	4.42
2000 (609.6)	20.30	12.80	8.03	5.05
2250 (685.8)	22.80	14.40	9.03	5.68
2500 (762)	25.40	16.00	10.00	6.31
3000 (914.4)	30.50	19.20	12.00	7.58
3500 (1066.8)	35.50	22.40	14.10	8.84
4000 (1219.2)	40.60	25.50	16.10	10.00
4500 (1371.6)	45.70	28.70	18.10	11.40
5000 (1524)	50.10	32.00	20.10	12.60
5500 (1676.4)	55.80	35.10	22.10	13.91
6000 (1828.8)	61.00	38.30	24.10	15.20
6500 (1981.2)	66.00	41.50	26.10	16.40
7000 (2133.6)	71.10	44.70	28.10	17.70
7500 (2286)	76.10	47.90	30.10	19.00
8000 (2438.4)	81.20	51.10	33.10	20.20
9000 (2743.2)	91.40	57.50	36.10	22.70
10000 (3048)	102.00	63.90	40.20	25.30

Resistance shown is one way. This figure must be doubled when determining closed loop resistance.

Section 10: Specifications

10.1 Electrical

10.1.1 Operating voltage range

10.5 to 32 Vdc

18 to 32 Vdc (HART® versions only)

10.1.2 Power consumption

2.4 W at 24 Vdc (average - varies by sensor types/quantities)

10.1.3 EMC compliance

EN 50270:2006 per EMC directive 2004/108/EC

10.2 Environmental

10.2.1 Operating temperature

-67 to +185°F (-55 to +85°C) - stainless steel

-58 to +185°F (-50 to +85°C) - stainless steel - North American explosion-proof certification

-40 to +185°F (-40 to +85°C) - aluminum

10.2.2 Relative humidity

0 - 95 percent relative humidity non-condensing

10.2.3 Ingress protection

IP66 (aluminum)

IP67 (stainless steel)

IP64 (with sensors)

Type 4X (transmitter only)

10.3 Mechanical

10.3.1 Enclosure material

Cast aluminum (A359)

Stainless steel (SS316)

10.3.2 Conduit opening

¾-in. NPT (3X)

10.3.3 Weight

Aluminum: 5.5 lb. (2.5 kg)
Stainless steel: 7.0 lb. (3.2 kg)

10.4 Warranty

3 years

Section 11: Certifications

11.1 North American



Class I, Division 1, Groups BCD T5
Class I, Zone 1, AEX/Ex d IIB+H₂ T5
-50 °C ≤ Ta ≤ +85 °C
NEMA Type 4X/IP67
FM6320, ANSI/ISA 12.13.01, CSA 22.2 No. 152:2006

11.2 IECEx

Ex db IIB+H₂ T5 Gb
IECEx PRE 16.0054X (aluminum) IP66, controller only
IEC 60079-0: 2017 & IEC 60079-1: 2014

Special conditions for safe use:

1. All cable glands, blanking elements, and thread adapters must be suitable certified as Ex d and maintain the IP66 rating of the enclosure.
2. To minimize the risk of electrostatic charge, provisions shall be made for adequate grounding of equipment. Equipment shall be installed in such a manner so that accidental discharge shall not occur.
3. For ambient temperatures above 70 °C, care shall be taken to select cable that is suitably rated for the intended ambient temperature range.
4. Flameproof joints are not intended to be repaired.

Ex d IIB+H₂ T5 Gb
IECEx FMG 12.0006X (stainless steel) IP67, controller only
IEC 60079-0: 2007-10 & IEC 60079-1: 2007:04

Special conditions for safe use:

1. Consult the manufacturer if dimensional information on the flameproof joints is necessary.

Section 12:Ordering information

12.1 Net Safety™ M21 single channel transmitter

Model	Description
M21	Net Safety Millennium II Single Channel Transmitter
Output	Description
A	Analog output
AD	Analog and digital RS-485 Modbus® RTU protocol outputs
AH	Analog and HART® protocol outputs
AHR	Analog, HART protocol, and relay outputs
AR	Analog and relay outputs
ARD	Analog, relay, and digital RS-485 Modbus RTU protocol outputs
Enclosure	Description
A	Aluminum
S	Stainless steel
Wireless	Description
-	Not required
FC	Wireless ready - THUM capable (used only with AH or AHR outputs)

12.2 Net Safety™ M22 dual channel transmitter

Model	Description	
M22	Net Safety Millennium II Dual Channel Transmitter	
	Output	Description
	A	Analog output
	AD	Analog and digital RS-485 Modbus® RTU protocol outputs
	AR	Analog and relay outputs
	ARD	Analog, relay, and digital Modbus RTU protocol outputs
	Enclosure	Description
	A	Aluminum
	S	Stainless Steel

Emerson.com/FlameGasDetection



<https://linkedin.com/company/Emerson-Automation-Solutions>



twitter.com/Rosemount_News



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Americas

Emerson

6021 Innovation Blvd.

Shakopee, MN 55379

USA

T +952 906 8888

F +952 949 7001

SAFETY.CSC@Emerson.com

Europe

Emerson

Neuhofstrasse 19a P.O. Box 1046

CH-6340 Baar

Switzerland

T + 41 (0) 41 768 6111

F +41 (0) 41 768 6300

SAFETY.CSC@Emerson.com

Middle East and Africa

Emerson

Emerson FZE

Jebel Ali Free Zone

Dubai, UAE

P.O. Box 17033

T +971 4 811 8100

F + 971 4 886 5465

SAFETY.CSC@Emerson.com

Asia Pacific

Emerson

Asia Pacific Private Limited

1 Pandan Crescent

Singapore 128461

Republic of Singapore

T + 65 6 777 8211

F + 65 6 777 0947

SAFETY.CSC@Emerson.com

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