NET SAFETY
MONITORING INC.

4-20 mA FIRE HEAD

with

Analog/RS-485 Modbus (AD)

CONTROLLER

User Manual

ISO 9001:2000

QMI
REGISTERED

IMPORTANT INFORMATION

This manual is for informational purposes only. Although every effort has been made to ensure the correctness of the information, technical inaccuracies may occur and periodic changes may be made without notice. Net Safety Monitoring Inc., assumes no responsibility for any errors contained within this manual.

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Net Safety Monitoring Inc., products are carefully designed and manufactured from high quality components and can be expected to provide many years of trouble free service. Each product is thoroughly tested, inspected and calibrated prior to shipment. Failures can occur which are beyond the control of the manufacturer. Failures can be minimized by adhering to the operating and maintenance instructions herein. Where the absolute greatest of reliability is required, redundancy should be designed into the system.

Warranty

Net Safety Monitoring Inc., warrants its sensors against defective parts and workmanship for a period of 24 months from date of purchase; other electronic assemblies for 36 months from date of purchase.

No other warranties or liability, expressed or implied, will be honoured by Net Safety Monitoring Inc.

Contact Net Safety Monitoring Inc., or an authorized representative for details.

We welcome your input at Net Safety Monitoring. If you have any comments please contact us at the phone/address below or visit our web site and complete our on-line customer survey: www.net-safety.com.

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INTRODUCTION

Net Safety's line of premium industrial controllers are a microcontroller based system providing fast, accurate and continuous monitoring in extreme environments.

THE PRODUCT

Fire Head

Net Safety's 4-20 mA output UV/IRS, UVS, IRS, and Phoenix IR3S fire detector heads can be used in conjunction with the Digital Controller.

The Controller

The Controller has an explosion-proof Housing, rated Class 1, Division 1, Groups B, C, and D for hazardous applications. It was designed for either a 1-man, intrusive calibration or 2-man non-intrusive calibration.

The Manual

The manual has been designed to make installation of the product easy. To ensure proper installation, follow the steps outlined in the following pages. If you encounter problems during operation, consult the troubleshooting section or contact your sales representative.

Step 1 — PLAN

Step 2 — INSTALL

Step 3 — WIRE

Step 4 — OPERATE

Step 5 — MONITOR

Step 6 — MAINTAIN

STEP 1 — PLAN

Figure 1: Dimensional Drawings

Controller
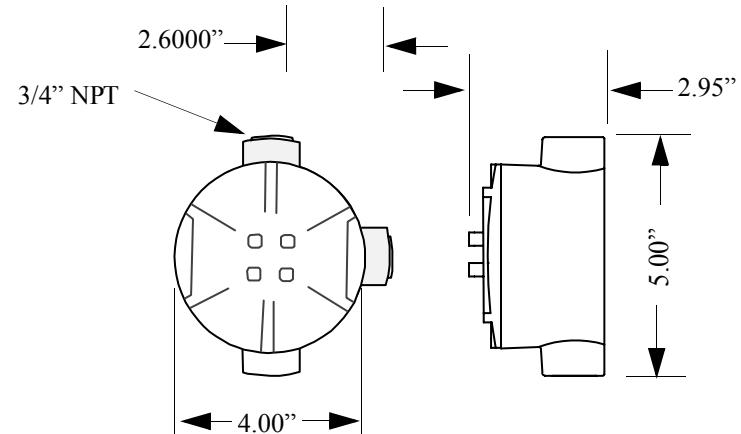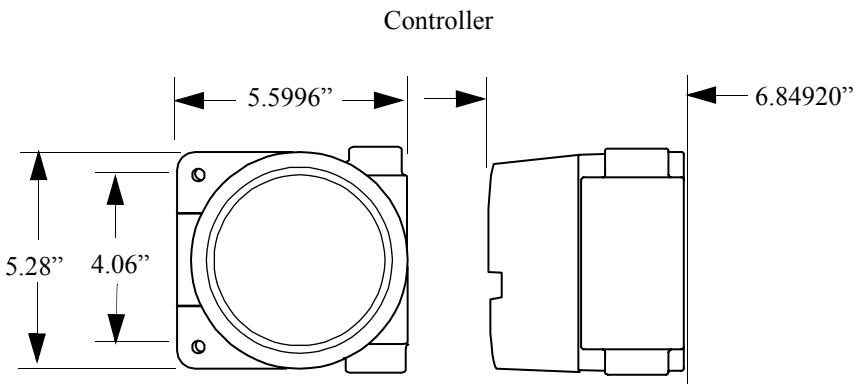
Junction Box

Note: Refer to the specific Fire Head manual for Fire Head dimensions.

STEP 2 — INSTALL

UNPACK

Carefully remove all components from the packaging. Check components against the enclosed packing list and inspect all components for obvious damage such as broken or loose parts.

If you find any components missing or damaged, notify the representative or Net Safety Monitoring immediately.

Figure 2: Components
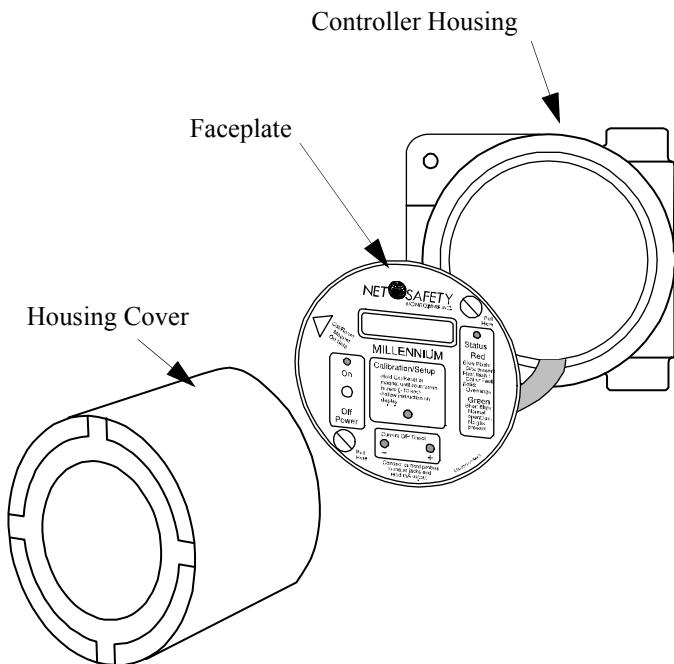
Note: Refer to the specific Fire Head manual for components.

LOCATE CONTROLLER/FIRE HEAD

Fire Head

Locate Fire Heads as per the manual provided with the specific product.

Controller

The Controller should be mounted near eye-level and be easily accessible for maintenance purposes.

Ensure all devices are securely mounted, taking into consideration all requirements.

> Use the Face Rotation Option to mount the Controller at a different orientation (refer to "Face Rotation Option" on page 12 for detailed instructions).

STEP 3 — WIRE

FIELD INSTALLATION

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

• If the 4-20 mA output signal is not used, connect a jumper between the 4-20 terminal and the Common terminal.

• The use of shielded cable is highly recommended for signal, input, output and power wires to protect against interference caused by extraneous electrical or electromagnetic 'noise'.

• In applications where the wiring cable is installed in conduit, the conduit must not be used for wiring to other electrical equipment.

• The maximum distance between the Sensor and Controller is limited by the resistance of the connecting wiring, which is a function of the gauge of the wire being used.

• When developing a RS-485 chain of devices, the last device in the chain requires end of line termination.

• RS-485 connection 2-wire, multipoint serial line.

SEAL

• Water-proof and explosion-proof conduit seals are recommended to prevent water accumulation within the enclosure.

• Seals should be located as close to the device as possible and not more than 18 inches (46 cm) away.

• Explosion-proof 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 fibre dam to assure proper formation of the seal. Seals should never be poured at temperatures below freezing.

• The jacket and shielding of the cable should be stripped back to permit the seal to form around the individual wires. This will prevent air, gas and water leakage through the inside of the shield and into the enclosure.

• It is recommended that explosion-proof drains and conduit breathers be used. In some applications, alternate 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'.

Connecting Wires

1. Use a small screw driver to gently press down and hold the spring connector open.
2. Insert appropriate wire into open connector hole.
3. Release screw driver to secure wire.
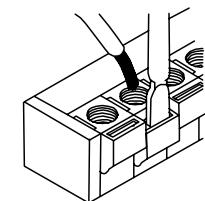
Figure 3: Internal PCB Boards

Option Board/RS-485 Modbus RTU Communication Board (refer to Figure 4 for details).

Terminal Board (refer to Figure 4 for details).

Sensor Board (refer to Figure 4 for details).
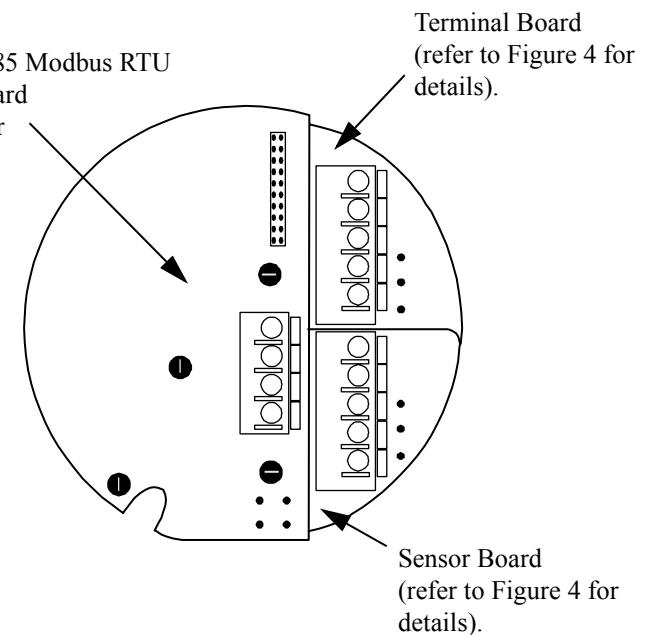
WIRING—CONTROLLER

WARNING: ⚠️
Power to the unit must be OFF before wiring.

1. Once the Controller's Housing Cover is removed, connect the Fire Head to the Junction Box, the Junction Box to the Controller and the Output Terminals to the output signal wires.
2. Replace the Controller's Housing Cover and turn Controller On.
3. Ensure display reads **Start Delay**, Status LED is Red Slow Flash and current output displays 3.0 mA. This is the start-up delay sequence which will last approximately 90 seconds.

Shielded copper instrument wire (minimum 18 AWG) should be used for separations up to 500 feet. Shielded copper instrument wire (minimum 16 AWG) should be used for separations up to 2000 feet. Consult the factory if a greater separation distance is required. Ensure the appropriate wire is used for Class 1/Division 1 hazardous applications.

Note: If the 4-20 mA signal is not used, connect a jumper between the 4-20 terminal and the COM terminal on the Terminal Board.

RS-485 Communication

Connect devices in a chain via the Modbus terminals. The last device in the chain requires end of line termination (refer to "MODBUS Termination" on page 6).

Figure 4: Wiring—Fire Head, Junction Box and Controller
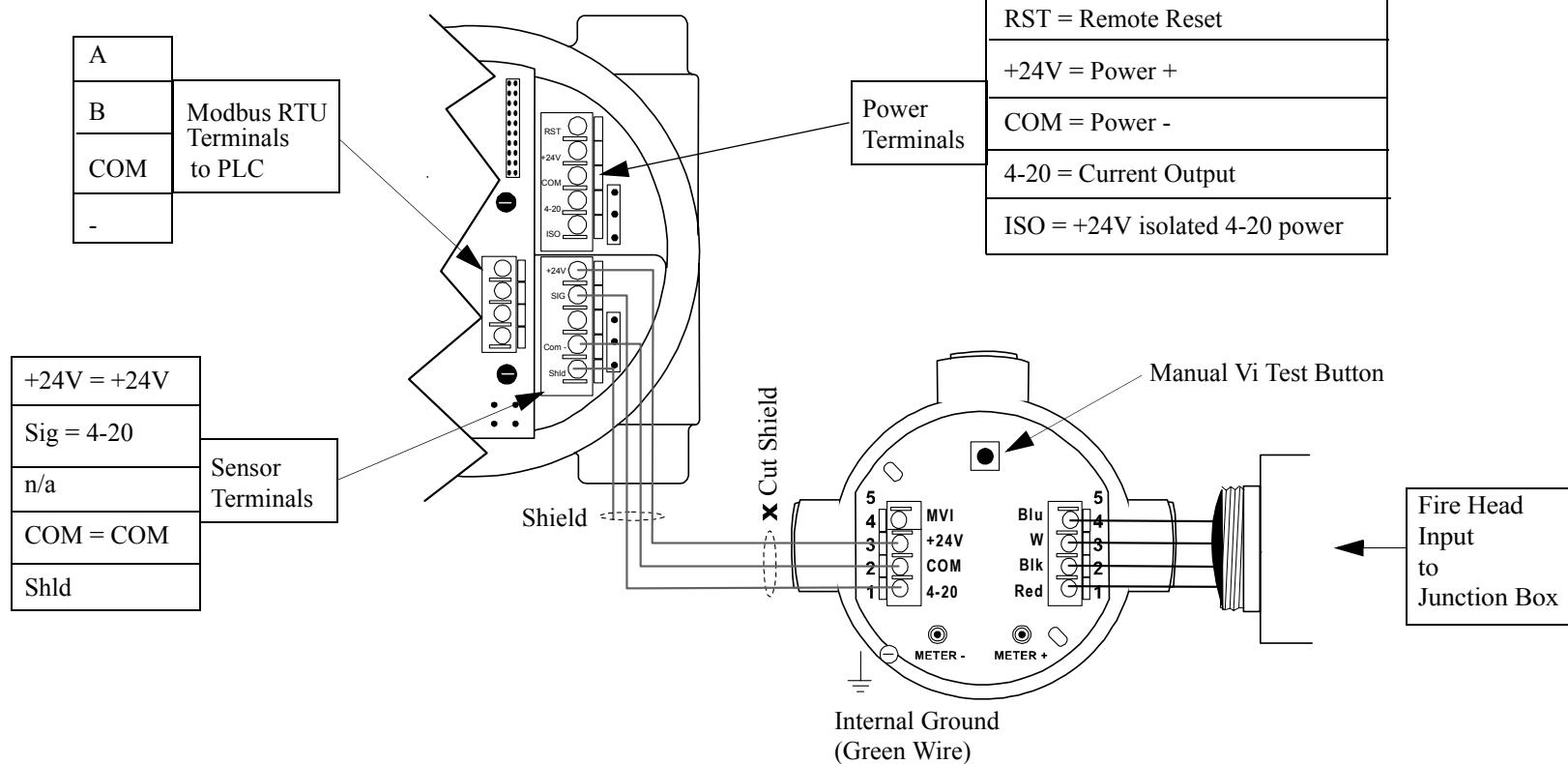
NON-ISOLATED/ISOLATED WIRING

Terminal Connection

Figure 5: Non-isolated Terminal Connection
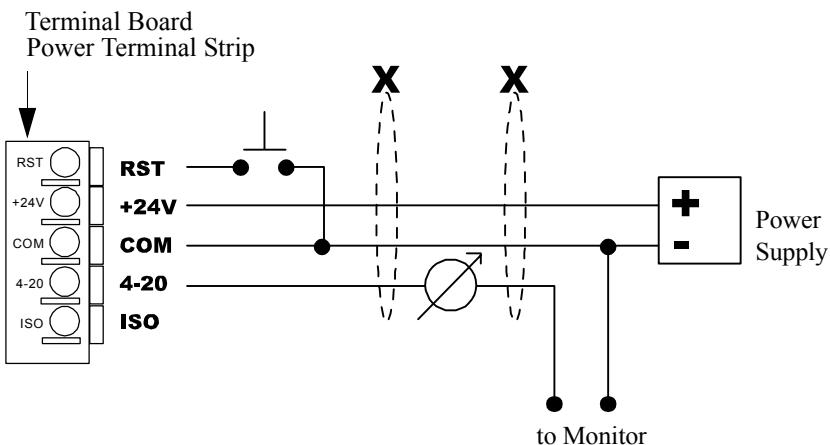
Figure 6: Isolated Terminal Connection
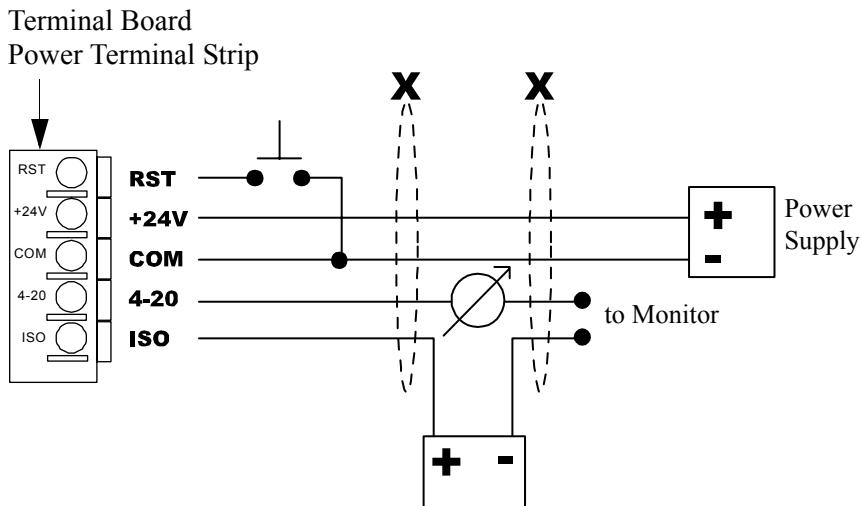
Current Output

To set an isolated current output, simply move the Jumper (shorting jack) to either the isolated or non-isolated current position (refer to Figure 7).

Note: Unless otherwise specified, all models ship with non-Isolated current output.

Figure 7: Jumper Positions-Current Output
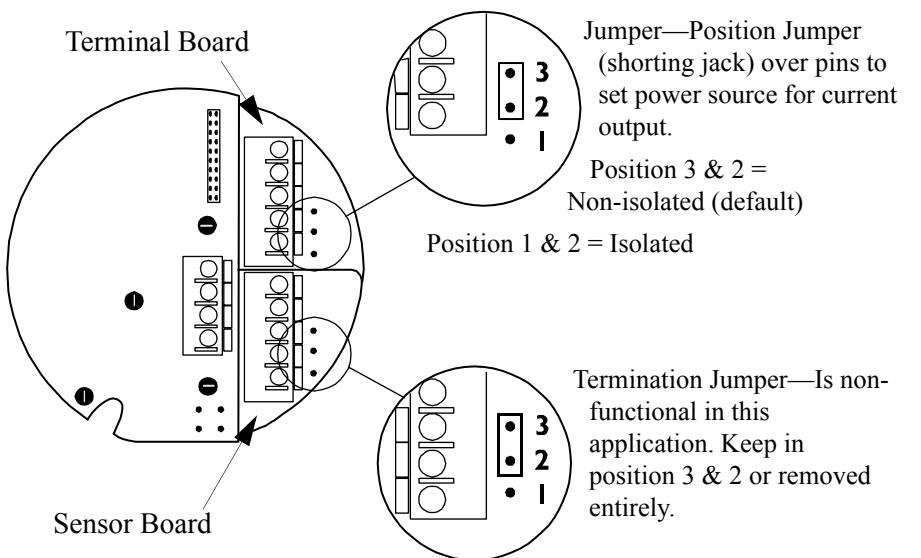
MODBUS TERMINATION

Devices are networked in a daisy chain. The device located at the end of the chain requires end of line termination. Place both jumpers over the pins, as shown in Figure 8, for end of line termination.

Figure 8: Modbus Termination Jumpers
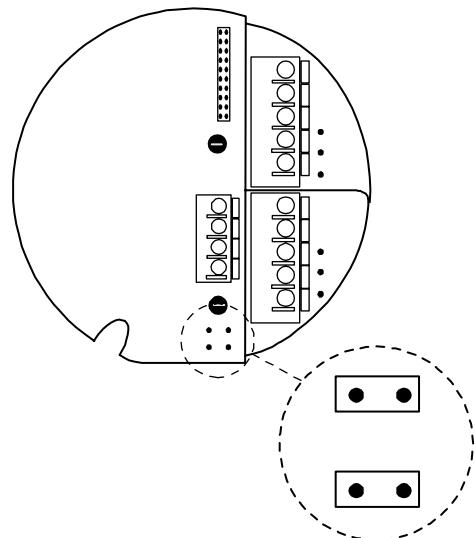
STEP 4 — OPERATE

The Controller faceplate contains most functional elements of the user interface. Below is a description of that functionality.

Figure 9: Controller Functionality

Scrolling 8-character display - provides various status messages and prompts. Refer to Table 4, "Current Output, LEDs and Display Messages", on page 10.

Magnetic Reed Switch - provides non-intrusive access for programming and resetting.

-Place magnet against Housing (where indicated) for less than one second to initiate a basic system reset (clear a latched alarm) and make selections.

-Place magnet against Housing (where indicated) and hold to program and view current settings.

Refer to "Magnetic Reed Switch" on page 8 for further information.

Pull Here knob - unscrew the two screws and gently pull to remove faceplate. Removal allows access to the PCB boards. The faceplate remains attached by the ribbon cable.

Status Light (Red and Green) - indicates status of unit. Refer to Table 4, "Current Output, LEDs and Display Messages", on page 10 for detailed explanation of states/status.

ON/OFF Switch - used to turn Controller on and off. Housing must be removed to access.

Pull Here knob - unscrew the two screws and pull to remove faceplate. Removal allows access to the PCB boards. The faceplate remains attached by the ribbon cable.

Calibration Button* - provides intrusive access for programming and resetting.

-Push for less than one second to initiate a basic system reset (clear a latched alarm) and make selections.

-Push and hold to program and view settings.

Refer to "Calibration Button" on page 8 for further information.

Current Test Jacks - to take current loop measurements use the following procedure:

-Insert your current meter leads into the Test Jacks.

-Set external devices to bypass, if necessary, to avoid unwanted alarm response

-Review current loop measurements.

Refer to "Current Loop Measurement (Test Jacks)" on page 8 and Table 4, "Current Output, LEDs and Display Messages", on page 10.

Figure callouts:

NET SAFETY MONITORING INC.

Pull Here

Cal/Reset Magnet On Side

MILLENNIUM

Status
Red
Slow Flash: Gas present
Flast flash : Cal or Fault
Solid: Overrange
Green
Short Blips: Normal operation. No gas present

On
Off
Power

Calibration/Setup
-Hold Cal/Reset or magnet until countdown is zero (~10 sec)
-Follow instruction on display

Current O/P Check
Connect current probes to meter jacks and read mA output
−   +

Pull Here

LBL-3211.00 RevG

* Fire Heads do not require calibration. The button is used for reset and setup.

THE MAIN MENU

The Main Menu allows for:

• Modbus Setup - Select Node Address and Baud Rate
• Select a display language - English, Spanish or French

Note: The current output will drop to 3.0 mA while in the Main Menu.

Accessing the Main Menu

There are two ways to activate the Main Menu:

• Calibration Button found on the faceplate (the Housing cover must be removed to access)
• Magnetic Reed Switch (a magnet must be used to activate)

Calibration Button

The Calibration Button provides access to the Main Menu, which allows options to be reviewed and set. Refer to Figure 9 for more information.

• **Press and hold** the Calibration Button to access Main Menu.

• **Briefly press** to make a selection (select `YES?`).

WARNING: ⚠️
Opening the Controller's Housing should be avoided when the presence of gas is possible (when in a hazardous environment). Do not power up the system, with the Housing removed, unless the area has been de-classified.

Magnetic Reed Switch

The Magnetic Reed Switch is provided to avoid opening the Housing in an environment where gas may be present. The Magnetic Reed Switch functions in the same manner as the Calibration Button but in a non-intrusive manner. Refer to Figure 9 for more information.

Attached to the side of the Controller is a magnet:

• **Place and hold** the magnet to the Controller's Housing (10 o'clock position) to access Main Menu.

• **Briefly place** the magnet to the Controller's Housing (10 o'clock position) to make a selection (select `YES?`).

Main Menu Functionality

1. Ensure that the Controller has been turned on and no fault is present.
2. Hold the magnet against the Reed Switch or press and hold the Calibration Button until the message `Switch On` displays and the countdown (10 to 0) finishes.
3. An option will scroll across the display followed by the prompt `YES?`.
4. To select an option, momentarily place the magnet to the Reed Switch or press the Calibration Button at the `YES?` prompt.
5. If you do not wish to select that option wait until the next option appears and then select `YES?`.
6. A selection is acknowledged with a flashing `YES`.
7. If no option is selected, the Controller returns to normal operation.

Power Up

Turn power switch On. A 90 second warm-up routine will begin. The display shows `Start Delay Millennium Net Safety`, the Status LED is Red Slow Flash and current output displays 3.0 mA.

When power is applied, the system is automatically tested to ensure proper functionality.

After warm-up, the Controller will enter normal operation, the display reads `NORM`, Status LED will Green Blip/blink and analog output will change to 4.0 mA.

Current Loop Measurement (Test Jacks)

Use a standard meter to measure current loop during various states. The Controller's Housing cover must be removed to access the Test Jacks.

Refer to Table 4, "Current Output, LEDs and Display Messages," on page 10 for a detailed list and Figure 9 for more information.

Status LED

The Status LED will remain solid, flash, blip and/or blink, in either Red or Green, to indicate various states. Refer to Table 4, "Current Output, LEDs and Display Messages," on page 10 for a detailed list.

SELECT DISPLAY LANGUAGE

Step 1: Wait for `Select Display Language YES?` to display. Press the Calibration Button or use the Reed Switch to select.
The flashing `YES` confirms the selection.

Step 2: When the required language displays (`English`, `Espanol`, `Francais`) press the Calibration Button or use the Reed Switch to select.
The flashing `YES` confirms the selection.

Note: Factory default is English.

MODBUS OPTIONS

The digital RS-485 Modbus RTU protocol is used. There are two Modbus options: Node Address and Baud Rate.

Note: When a modbus option is changed, the message `BUSY` will display for a few seconds while the unit is updated.

Node Address

Each device connected to the chain must be assigned a unique node address. The last number of the address is selected first.

Step 1: When `Modbus Setup? YES?` displays press the Calibration Button or use the Reed Switch to select.
The flashing `YES` confirms the selection.

Step 2: The current node address will display `Node: 000`.

Step 3: Wait for the prompt `New Address? YES?` and press the Calibration Button or use the Reed Switch to select.

Step 4: Use the Calibration Button or Reed Switch to select each of three numbers in the new address:
- select the last number in the address first: `0` thru `9`.
- select the next number in the address: `0` thru `9`.
- select the first number in the address last: `0 1 2`.

Baud Rate

The transmission speed must be defined.

Step 1: When `Modbus Setup? YES?` displays press the Calibration Button or use the Reed Switch to select.
The flashing `YES` confirms the selection.

Step 2: After setting the Node Address, the current Baud Rate will display `XX.X BPS`.

Step 3: Wait for the prompt `New Baud Rate? YES?` and press the Calibration Button or use the Reed Switch to select.

Step 4: The available baud rates will display: `2400s`, `4800s`, `9600s`, `14.4s`, `19.2s`, `28.8s`, `38.4s`, `57.6s`.

Step 5: Use the Calibration Button or use the Reed Switch to select baud rate when it displays.

Step 6: The flashing `YES` confirms the selection.

RESET

Manual Reset

A Manual Reset may be required to clear a latched relay alarm. Simply place and hold the magnet against the Reed Switch or press and hold the Calibration Button for 3-5 seconds. The unit will return to normal operation.

STEP 5 — MONITOR

There are a variety of ways to indicate the status of the connected detectors: current output, LEDs and Display Messages.

Table 4: Current Output, LEDs and Display Messages

LED Status	Current O/P	Status LED (red)	(green)	Display Messages
Internal Power Fault or system power out of range	1.0 mA	Fast Flash	-	Sensor Fault
Automatic or manual VI Test Failure	2.0 mA	Fast Flash	-	VI Fault
Start Delay (90 seconds)	3.0 mA	Blip	-	Start Delay Millennium
Normal Operation	4.0 mA	-	Blip	NORM
Background radiation source UV	6.0 mA	Flash	-	UV Present
Background radiation source IR	8.0 mA	Flash	-	IR Present
Early Warning - Intermittent radiation detected	16.0 mA	Flash	-	Warning!!
Fire confirmed	20.0 mA	Flash	-	FIRE (flashes)
Writing to memory	-	-	Solid	BUSY

RTU REGISTERS

Register 40001 = RTU Output (read only)

Register 40002 = RTU Status (read only)

Register 40101 = Reset latched relays (write)

Note: Many registers are used by the controller. Please do not write outside the three registers.

Table 5: RTU Output Register (40001) Read Only (binary)

RTUfire_power_up	0x0001	power up delay
RTUfire_vi_fault	0x0002	failed self test
RTUfire_normal	0x0004	normal operation
RTUfire_fault	0x0008	fire head fault
RTUfire_ir_present	0x0010	background IR
RTUfire_uv_present	0x0020	background UV
RTUfire_warning	0x0040	Warning Fire
RTUfire_alarm	0x0080	Fire present

Table 6: RTU Status Register (40002) Read Only (binary)

RTUstat_fault	0x0001	fault (sensor...)
RTUstat_mem_error	0x4000	memory error

STEP 6 — MAINTAIN

The Controller on its own requires no maintenance. Refer to the Maintenance Section of the specific Fire Head manual for Fire Head maintenance and testing procedures.

HOW TO RETURN EQUIPMENT

A Material Return Authorization number is required in order to return equipment. Please contact Net Safety Monitoring at **(403) 219-0688** before returning equipment or consult our Service Department to possibly avoid returning equipment.

If you are required to return equipment, include the following information:

1. A Material Return Authorization number (provided over the phone to you by Net Safety).
2. A detailed description of the problem. The more specific you are regarding the problem, the quicker our Service department can determine and correct the problem.
3. A company name, contact name and telephone number.
4. A Purchase Order, from your company, authorizing repairs or request for quote.
5. Ship all equipment, prepaid to:

   Net Safety Monitoring Inc
   2721 Hopewell Place N. E.
   Calgary, Alberta, Canada
   T1Y 7J7

6. Mark all packages: **RETURN for REPAIR**

Waybills, for shipments from outside Canada, must state:

   Equipment being returned for repair
   All charges to be billed to the sender

Also, please ensure a duplicate copy of the packing slip is enclosed inside the box indicating item 1-4 along with the courier and account number for returning the goods.

All Equipment must be Shipped prepaid. Collect shipments will not be accepted.

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

FACE ROTATION OPTION

In some applications, it is necessary for the Controller to be mounted in a non-standard orientation. To accommodate such installations and ensure that the display will appear at the correct angle for viewing, the PCB Assembly can be rotated inside the Controller.

**Figure 10:** Non-standard Orientation
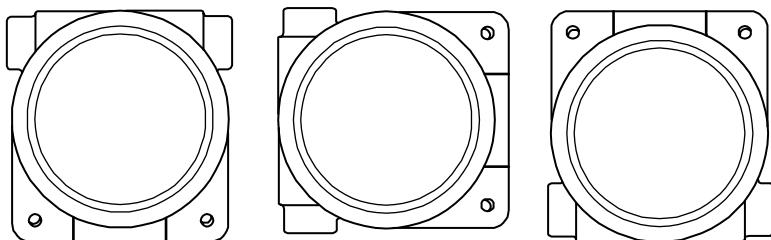
Note: Ensure orientation allows for connections and excess wire within Controller Housing.

WARNING: ⚠ See Appendix D, "Electrostatic Sensitive Device (ESD)", on page 13 for handling instructions of electronic components.

Rotate PCB Assembly

1. Remove the Controller's Housing Cover.
2. Turn the power to the detector off.
3. Unscrew both the knobs marked "Pull Here".
4. Lift Controller faceplate from Housing and allow to hang from ribbon cable.
5. Unscrew the two metal standoffs.
6. Carefully remove the PCB Assembly from the Housing.
7. The Rotator plate is secured to the bottom of the Housing and is accessible after the PCB Assembly has been removed.
8. Rotate the PCB Assembly to desired position and line up the standoffs with the mounting holes.
9. Insert standoffs in the appropriate horizontal or vertical mounting holes.
10. Tighten standoffs to secure PCB Assembly.
11. Replace faceplate and tighten "Pull Here" knobs.
12. Return power to detector and replace Housing Cover.

Figure 11: Rotate PCB Assembly
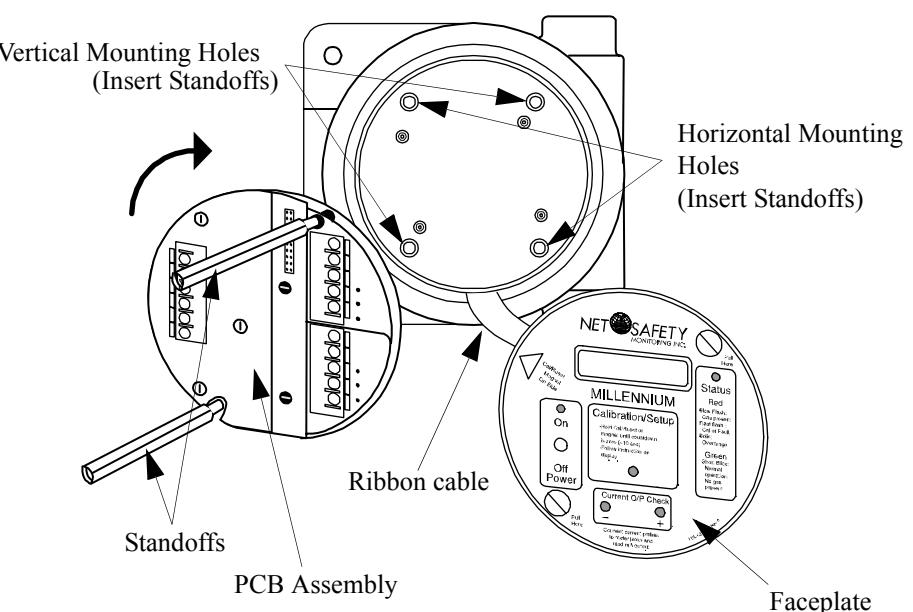
Appendix D: ELECTROSTATIC SENSITIVE DEVICE (ESD)

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—ESD! 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 metal shields—taking care not to touch electronic components

• Wear grounded wrist or foot straps, or ESD shoes or heel grounders to dissipate unwanted static energy

• Prior to handling boards, dispel any charge in your body or equipment

• Ensure components are transported and stored in static 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.

A warning label is placed on the packaging, identifying product using electrostatic sensitive semiconductor devices.

Appendix E: RESISTANCE TABLE (OHMS)

Distance (Feet)	AWG #20	AWG #18	AWG #16	AWG #14	AWG #12	AWG #10	AWG #8
100	1.02	0.64	0.40	0.25	0.16	0.10	0.06
200	2.03	1.28	0.80	0.51	0.32	0.20	0.13
300	3.05	1.92	1.20	0.76	0.48	0.30	0.19
400	4.06	2.55	1.61	1.01	0.64	0.40	0.25
500	5.08	3.20	2.01	1.26	0.79	0.50	0.31
600	6.09	3.83	2.41	1.52	0.95	0.60	0.38
700	7.11	4.47	2.81	1.77	1.11	0.70	0.44
800	8.12	5.11	3.21	2.02	1.27	0.80	0.50
900	9.14	5.75	3.61	2.27	1.43	0.90	0.57
1000	10.20	6.39	4.02	2.53	1.59	1.09	0.63
1250	12.70	7.99	5.03	3.16	1.99	1.25	0.79
1500	15.20	9.58	6.02	3.79	2.38	1.50	0.94
1750	17.80	11.20	7.03	4.42	2.78	1.75	1.10
2000	20.30	12.80	8.03	5.05	3.18	2.00	1.26
2250	22.80	14.40	9.03	5.68	3.57	2.25	1.41
2500	25.40	16.00	10.00	6.31	3.97	2.50	1.57
3000	30.50	19.20	12.00	7.58	4.76	3.00	1.88
3500	35.50	22.40	14.10	8.84	5.56	3.50	2.21
4000	40.60	25.50	16.10	10.00	6.35	4.00	2.51
4500	45.70	28.70	18.10	11.40	7.15	4.50	2.82
5000	50.10	32.00	20.10	12.60	7.94	5.00	3.14
5500	55.80	35.10	22.10	13.91	8.73	5.50	3.46
6000	61.00	38.30	24.10	15.20	9.53	6.00	3.77
6500	66.00	41.50	26.10	16.40	10.30	6.50	4.08
7000	71.10	44.70	28.10	17.70	11.10	7.00	4.40
7500	76.10	47.90	30.10	19.00	12.00	7.49	4.71
8000	81.20	51.10	23.10	20.20	12.70	7.99	5.03
9000	91.40	57.50	36.10	22.70	14.30	8.99	5.65
10 000	102.00	63.90	40.20	25.30	15.90	9.99	6.28

Note: Resistance shown is one way. This figure should be doubled when determining closed loop resistance.

Appendix F: SPECIFICATIONS

CONTROLLER SPECIFICATION

Controller	4-20 mA ANALOG OUTPUT	RS-485 MODBUS OUTPUT
Operating Temperature Range	-40°C to +85°C (-40F to +185F)	
Fire Head Power Consumption @ 24 V dc	Nominal 170 mA / 4.08 W Maximum 230 mA / 5.52 W	
Humidity Range	0 to 100% relative humidity, non-condensing	
Operating Voltage Range	10.5 to 32.0 V dc at units power terminals	
Enclosure Material	Powder coated Copper Free Cast Aluminum	
Certifications	CSA and NRTL/C certified for hazardous locations. Class I, Division 1, Groups B, C and D. Temperature T5. IEC Rating Ex d IIB+H2 T5 (Class1, Zone 1, Group 11B+H2 T5). Maximum operating ambient of 85°C. Enclosure Type 4X. Note: Electronics only-CSA and NRTL/C certified for hazardous locations Class I, Division 2 Groups A, B, C and D.	
Weight	3.2 Kg (7.0 lb)	
Current Output	4 to 20 mA - Into a maximum loop impedance of 800 Ohms at 32 V dc or 150 Ohms at 10.5 V dc. Isolated or non-isolated loop supply.	--
Digital Output	--	Digital RS-485 Modbus RTU Protocol

Note: Units are factory sealed.

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