



**MILLENNIUM BASIC
COMBUSTIBLE GAS DETECTOR**

ANALOG OUTPUT

User Manual

ML1050E-SIR100

(MLB-A-SIR100)



ISO 9001:2000



Part Number: MAN-0061-00 Rev 0

IMPORTANT INFORMATION

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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 distributor 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

The Millennium series is Net Safety's latest innovation in a line of continuously evolving industrial gas detectors. The microcontroller based system provides fast, accurate and continuous monitoring of gases in extreme environments.

THE PRODUCT

The Millennium Basic is an analog output, explosion-proof, Class 1, Division 1 for hazardous areas, combustible gas detector for use with the SIR100 sensor (methane/propane or methane/butane).

THE MANUAL

The manual has been designed to make installation of the Millennium product easy. To ensure proper installation, follow the 7 simple steps outlined in the following pages. Throughout this manual are tips and warnings to make your installation experience more efficient. 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 — CALIBRATE

Step 6 — MONITOR

Step 7 — MAINTAIN

STEP 1 — PLAN

LOCATE CONTROLLER/SENSOR

Prior to the installation process, a location plan for placing the Controller and Sensor should be developed. Although there are no absolute rules for determining the quantity and location of a sensor or controller, the following points should be considered when planning the installation.

- Locate the Controller where it will be accessible and visible.
- Carefully locate the sensor in an area where gases may potentially accumulate.
- Use redundant systems to enhance protection and reliability.
- Light gases tend to rise; heavy gases tend to accumulate in low areas.
- Consider air movement patterns within the facility.
- Consider the construction of the facility (such as trenches where heavy gases may accumulate or peaks where light gases may accumulate).
- Seek advice from experts knowledgeable about the primary gas to be detected.
- Use common sense and refer to various regulatory publications that discuss general guidelines for your industry.

The two most common installation options are as follows:

Option 1

The Sensor is attached directly to the Controller. A calibration cup is slipped onto the bottom of the Sensor and the gas is attached to the side calibration fitting.

See "Wiring—Controller and Sensor" on page 9 for detailed instructions.

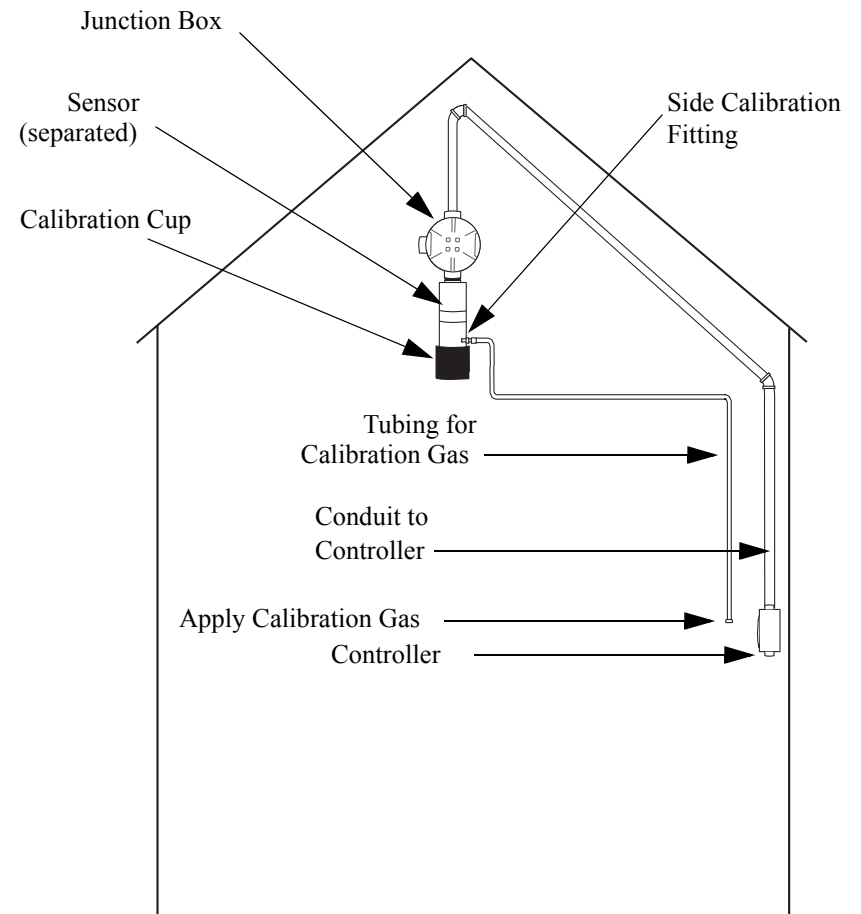
Option 2

Locate Sensor separate from Controller using a Junction Box.

The Controller is located at eye-level, while the Sensor is located where gas is most likely to accumulate (for example, high up for a light gas). Conduit then connects the two devices. A calibration cup is slipped onto the Sensor to concentrate the gas and the calibration gas.

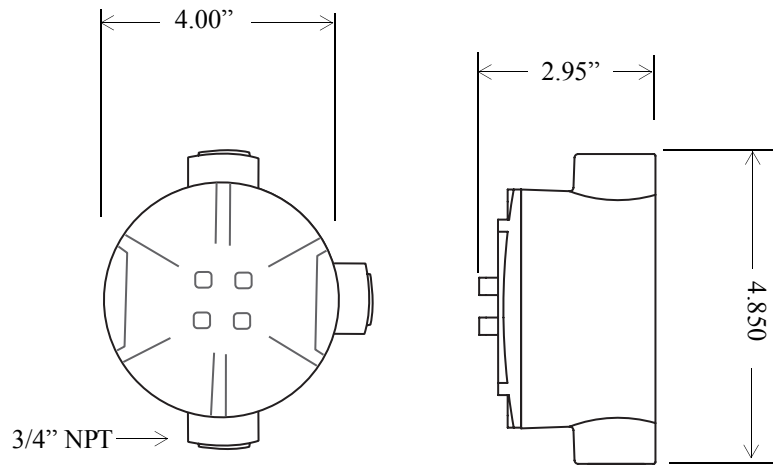
See "Wiring—Sensor Separation" on page 10 for detailed instructions.

Figure 1: Locate Sensor/Controller



TIP: The Calibration Cup prevents air circulation affecting the calibration process and concentrates the gas during calibration. If the Calibration Cup is not used, the area must be free of drafts or wind and the flow rate of calibration gas must be 3.0 liters per minute or greater.

Figure 2: Controller Housing



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 distributor or Net Safety Monitoring immediately.

THE CONTROLLER HOUSING

The Housing is explosion-proof, Class 1, Division 1, Groups C, D for hazardous applications.

It is designed a 1-man, intrusive calibration.

The Sensor can be attached directly to the Housing or separated using a junction box.

To remove the cover, simply screw the cover counter clockwise.

THE SENSOR

There are two types of SIR 100, combustible gas sensors; 0-100% LEL for methane/propane or methane/butane detection.

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 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.
- The Controller contains semiconductor devices susceptible to damage by electrostatic discharge. Use caution when handling. For more information on proper ESD handling, refer to the Appendix A.

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'.

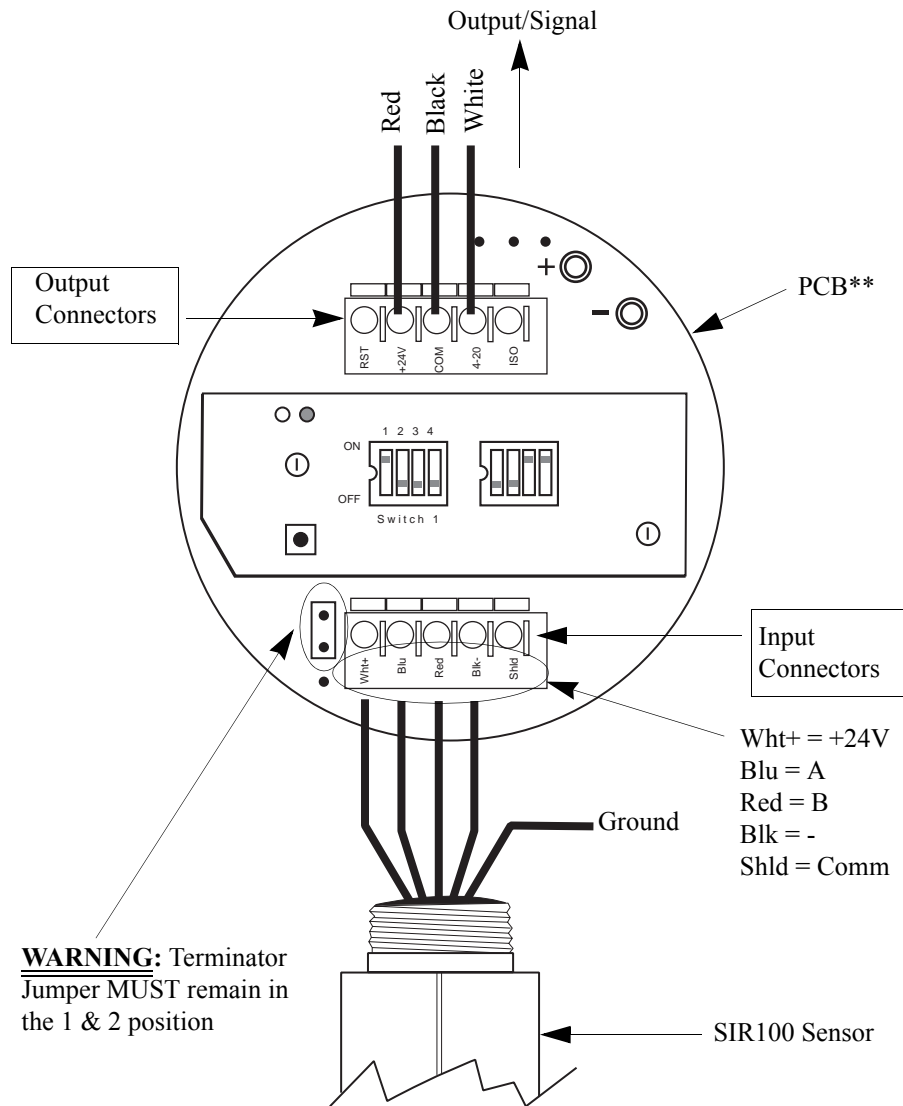
MOUNT

The Controller should be mounted at eye-level and be easily accessible for calibration and maintenance purposes. The Sensor should be placed where gas is likely to accumulate.

To avoid water damage to electronic components, ensure the Sensor is installed under the explosion-proof Controller. To further prevent water damage, seal conduit at all points of entry to the Controller or junction box.

The Sensor may be installed directly to the Controller or may be mounted separately using a junction box (see "Wiring—Sensor Separation" on page 10).

Figure 3: Wiring—Controller and Sensor



WIRING—SENSOR AND CONTROLLER

WARNING:

Power to the unit must be OFF before wiring.

Note: The Sensor may be factory installed to the Controller. If so, you need only connect the Controller to the output/signal source.

If you wish to separate the Controller and Sensor, refer to "Wiring—Sensor Separation" on page 10.

1. Remove the Controller's housing cover.
2. Connect the Sensor to the Input connectors (if necessary) and the Output connectors to the output/signal wires.

Table 1: Controller/Sensor Connectors

Marked/Wire Colour		
Wht+ (white)	=	+24V
Blu (blue)	=	A
Red (red)	=	B
Blk (black)	=	Comm
Shld (green)	=	Ground

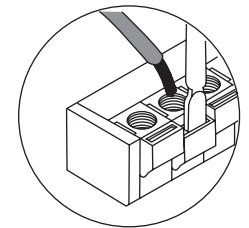
Note: For Sensor Separation instructions, see Figure 4, "Wiring—Sensor Separation", on page 10.

3. Replace the Controller's housing cover.
4. Restore power to the unit.
5. Ensure the Status LED is Red, Slow Flash and the meter read s3 mA. This is the start-up delay sequence which will last approximately 90 seconds.

Connecting Wires

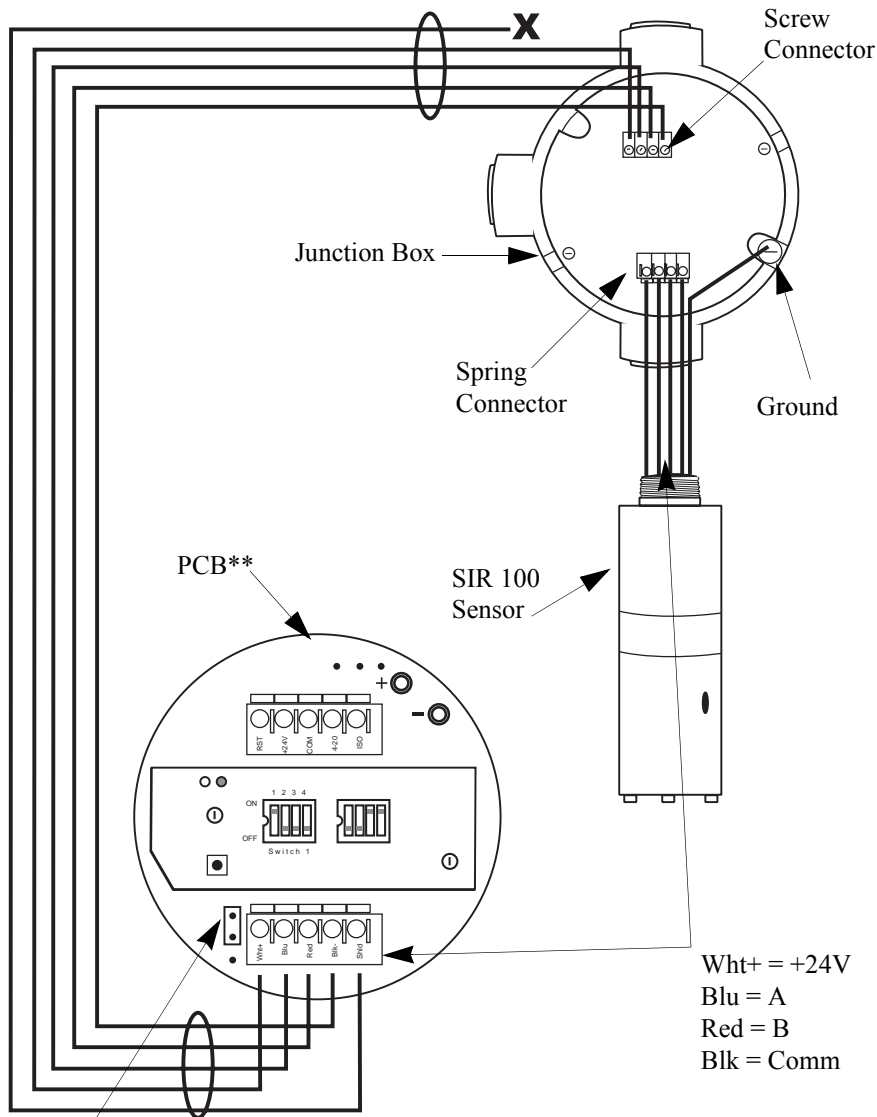
1. Use a small screw driver to gently press down and hold the spring connector open.
2. Insert appropriate wire into open connector hole.
3. Release screw driver to secure wire.

WARNING: The Terminator (shorting jack) must remain in the position indicated in Figure 3, "Wiring—Controller and Sensor" opposite.



** PCB shown without Housing

Figure 4: Wiring—Sensor Separation



WARNING: Terminator Jumper MUST remain in the 1 & 2 position

** PCB shown without Housing

WIRING—SENSOR SEPARATION

As the Sensor must be located where gas is likely to accumulate and the Controller where it can be easily reached, it is often necessary to “separate” the Controller and Sensor.

The Sensor separation kit (JB2-4-ASSY) is composed of a junction box and terminal strip. Refer to Option 1, Figure 1, "Locate Sensor/Controller", on page 6 for an example.

Shielded copper instrument wire (minimum 18 AWG) should be used for separations up to 1000 feet.

Shielded copper instrument wire (minimum 16 AWG) should be used for separations up to 2000 feet.

Contact Net Safety if separation above 2000 feet is required.

Ensure that the appropriate wire is used for the 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 Common terminal.

Table 2: Wiring for Sensor Separation

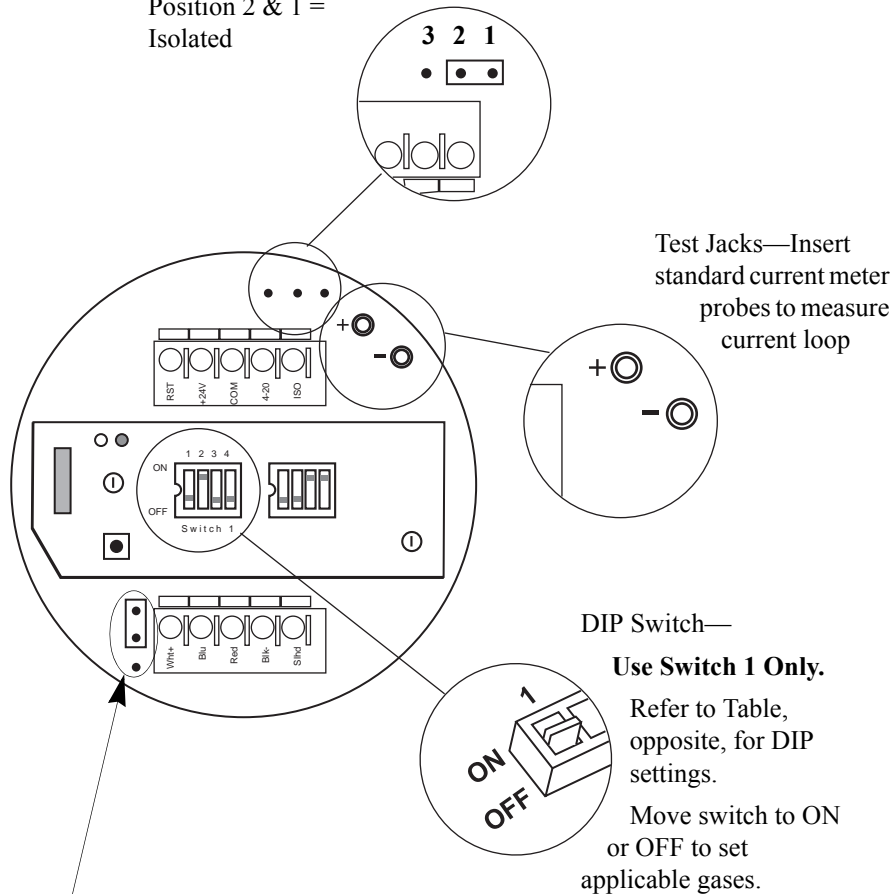
Sensor	➔	Junction Box (spring connector)
White wire		+24V
Blue wire		A
Red wire		B
Blk		Comm
Green		Ground
PCB	➔	Junction Box (screw connector)
Wht+		+24V
Blu		A
Red		B
Blk		Comm

Figure 5: Set Up

Jumper—Position Jumper (shorting jack) over pins to set current output.

Position 3 & 2 = Non isolated (default)

Position 2 & 1 = Isolated



Note: Terminator Jumper MUST remain in the 1 & 2 position

** PCB shown without Housing

SET NON-ISOLATED/ISOLATED 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 5, "Set Up" opposite).

Note: Unless otherwise specified, all models ship with non-Isolated as the default.

CURRENT LOOP MEASUREMENT (TEST JACKS)

Use a standard meter to measure current loop during various states.

Table 3: Current Loop Measurement

State	Current	State	Current
Calibrate Sensor	3 mA	Apply 50% span calibration gas	3.3 mA
Start-up delay	3 mA	Span is set, remove gas	3.6 mA
White sensor lead open	2.5 mA	Normal	4 mA
Black sensor lead open	2.5 mA	Gas present	>4.0 - 20.00 mA
Red sensor lead open	2.5 mA	Calibration failure	3.0 to 3.3 mA
Auto zero set	3 mA		

The Controller's Housing cover must be removed to access the Test Jacks.

SET DIP SWITCH

Set the first switch (1) of Dip Switch 1, to ON or OFF to determine which gas the unit detects.

Only Switch 1, Position 1, should be used.

Table 4: DIP Switch Settings

DIP Switch 1		
DIP 1	Sensor Type 1	Sensor Type 2
OFF position	Methane	Methane
ON position	Propane	Butane

STEP 4 — OPERATE

CONTROLLER PCB

The Controller consists of three PCBs enclosed in one of two housings. Below is a description of the functionality found within the Controller.

Figure 6: Controller Functionality

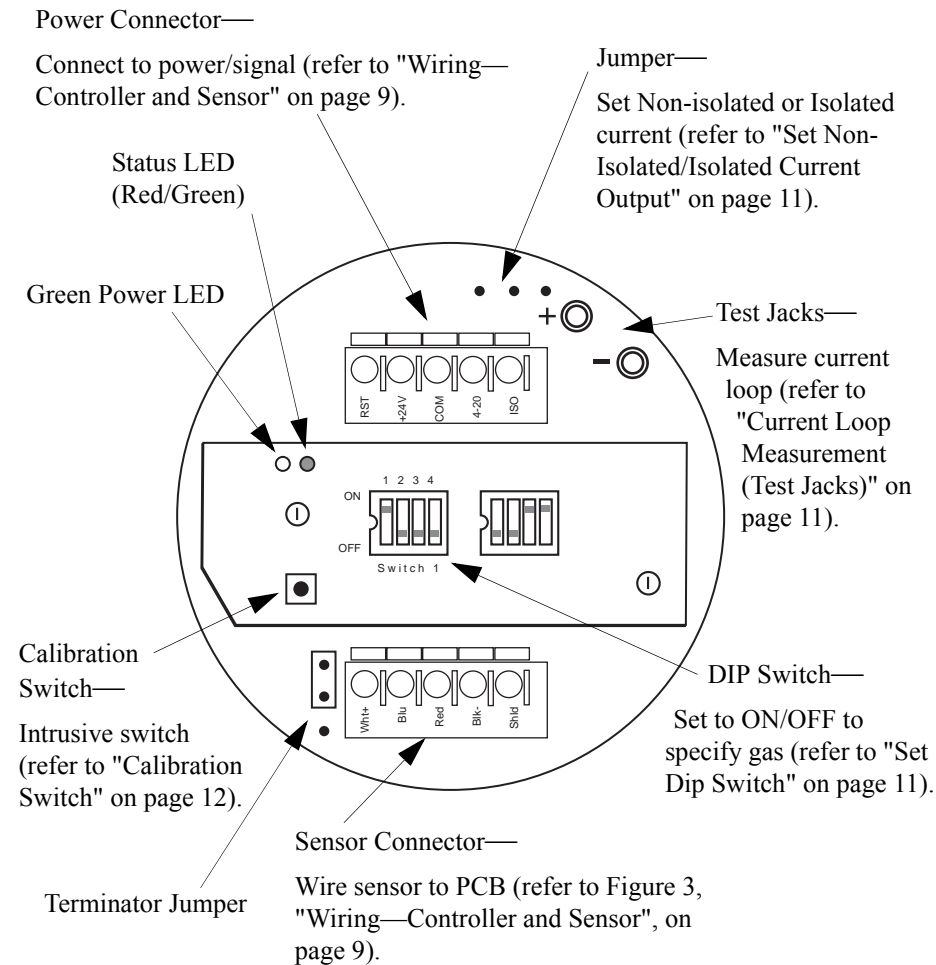


Table 5: State LEDs

State	Current O/P	STATUS LED	
		RED	GREEN
Calibrate Sensor	3 mA	N/A	N/A
Start-up delay	3 mA	Slow flash	
White sensor lead open	2.5 mA	Fast Flash	
Black sensor lead open	2.5 mA	Fast Flash	
Red sensor lead open	2.5 mA	Fast Flash	
Auto zero set	3 mA		Solid
Apply calibration gas	3.3 mA	Fast Flash	
Span is set, remove gas	3.6 mA		Solid
Normal	4 mA		Blip/ Blink
Gas present	>4.0 - 20.00 mA	Blip/ Blink	
Calibration failure	3.0 to 3.3 mA	Flash	Flash

CALIBRATION SWITCH

The Calibration Switch allows for a 1-man, intrusive calibration. As the Controller's housing must be open to access the switch, the area must be de-classified before using.

Press and/or hold the Calibration Switch to calibrate and monitor. Refer to the LEDs and the current meter readings to determine status.

POWER UP

When power is first applied, a 90 second warm-up routine will begin. During this time, output will be 3.0 mA and the Status LED will flash slow red.

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

After warm-up, the Controller will enter normal operation (clear) mode, the analog output will change to 4.0 mA and the Status LED will blip/blink green.

STEP 5 — CALIBRATE

CALIBRATE SENSOR

WARNING: The calibration procedure requires about 5 minutes to complete. If gas is not applied at the appropriate time, a calibration failure may occur (refer to "Calibration Failure" on page 14 for specific information).

Recommendation: Power up the unit for at least 4 hours BEFORE first calibration.

For proper performance, the Millennium should be calibrated using 50% full scale of the specific gas of concern. The concentration of gas, corresponding to 100% of full scale, is converted to a linear 4 to 20 mA output signal which can be powered from the primary DC supply of the instrument.

The following calibration procedure should be followed to ensure an accurate correlation between the 4 to 20 mA output signal and the gas concentration.

Calibration Procedure

1. Confirm successful power up of Controller—LED green blip/blink every 2 seconds; no fault indicated.
2. Connect a standard current meter to the Controller's Test Jacks.
3. Press and hold the Calibration Switch for 10-15 seconds.
4. When 3 mA displays and Status LED Green, solid, apply zero gas (clean air).
Recommendation: Flow certified ZERO AIR at a rate of 1.0 litres per minute through the side calibration fitting, when using the calibration cup (if separated or not using the calibration cup , a rate of 3.0 litres per minute is recommended).
5. When 3.3 mA displayed, apply specific gas (50% of full span).
During gas application, LED will fast flash red.
6. When 3.6 mA displayed and LED solid green, remove gas.
7. Apply zero gas (clean air) again to purge system.
8. Controller will return to normal operation.

Note: Always apply test gas after calibration to verify operation.

Figure 7: Calibration Procedure

Meter Reads	4 mA		3 mA	3.3 mA	3.6 mA		
Action	Power ON Normal	Connect meter	Magnet to Reed Switch Calibration Switch 10-15 seconds	Zero gas (clean air)	Specific gas 50% full span	Remove gas	Purge System
Status LED	Green blip/blink		Green solid	Red flash	Green solid		

Calibration Failure

If the calibration procedure fails, the Status LED alternates red and green flashes and the analog output changes back and forth from 3.0 to 3.3 mA.

The unit remains in a failed state until manually reset.

Manual Reset

A Manual Reset is required after a calibration failure or to clear an alarm. Simply place and hold the Magnet against the Reed Switch or press and hold the Calibration Switch for 3-5 seconds. The unit will return to the normal operation using previous calibration values if not calibrated for service.

STEP 6 — MONITOR

SENSOR FAULT

WARNING: The fault detection circuitry does not monitor the operation of external response equipment or the external wiring to these devices. It is important that these devices be checked periodically to ensure they are operational.

To ensure proper response, the Millennium features self-testing circuitry that continuously checks for problems. When power is applied, the system automatically begins a test to ensure proper functionality.

During normal operation, it 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 flashes fast red and current output displays 2.5 mA.

SENSOR LIFE

Depending on various factors, sensor response may slowly deteriorate over a period of years. If calibration becomes impossible for any reason, the analog output will switch repeatedly between 3.0 mA and 3.3 mA and the red and green LEDs flash.

Install a new SIR100 Sensor and re-calibrate. The calibration function automatically adjusts span amplifier gain across a broad range without any need for manual adjustment of potentiometers or jumpers.

NORMAL

With no gas present and no fault detected, green LED will blip/blink and analog output will display as 4.0 mA.

OUTPUT

A 4-20 mA DC current output is used to transmit the alarm status and fault codes to other devices. This output can be wired for isolated or non-isolated operation.

A 4.0 mA output indicates normal operation; a >4.0 - 20.0 mA output indicates the presence of gas.

Current output of 2.5 mA indicates the presence of a system fault; 3.0 to 3.3 mA indicates calibration failure.

STEP 7 — MAINTAIN

Net Safety Monitoring recommends a response check every 3 months. This involves the application of calibration gas to the sensor, then the observation of 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 Millennium response to calibration gas is within the specified accuracy then it is not necessary to perform a calibration. For example, when 50% of full scale is applied, the response is expected to be between 11.5 mA (47% of full scale) and 12.5 mA (53% 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% of full scale then the reading may be from 10.7 mA (42% of full scale) to 13.3 mA (58% of full scale).

STEP 8 — TROUBLESHOOT

Response to the input should be checked and, if necessary, calibration should be performed whenever any of the following occur.

- Sensor or transmitter supplying a signal to the Millennium is added or removed

The Millennium is not designed to be repaired in the field. If a problem should develop, first calibrate the device and carefully check for faulty wiring. If it is determined that the problem is caused by an electronic defect, the device must be returned to the factory for repair.

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

3rd Floor, 2721 Hopewell Place NE
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.

SPARE PARTS/ACCESSORIES

Table 6: Part Numbering

Description	Net Safety Part Number
Separation Kit	JB2-4-ASSY

Appendix A: 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 B: RESISTANCE TABLE

Table 7: Wire Resistance In 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	33.10	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 C: SPECIFICATIONS

SENSOR (SIR100) SPECIFICATIONS

- Operating Temperature Range: -40°C to +75°C (-40F to +167F)
- Enclosure Material: Powder Coated or Anodized Aluminum (optional stainless steel)
- Range of Detection: 0 to 100% LEL methane/propane or methane/butane
- Accuracy: "3% LEL up to 50% LEL "5% LEL above 50% LEL
- Response Time: <30 seconds to T90
- Linearity/Repeatability: "3% LEL / "2% LEL
- Certification: CSA and NRTL/C certified for hazardous locations. Class I, Division 1, Groups B, C and D, NEMA 4X and 7. IEC Rating Exd IIB+H2T5

CONTROLLER SPECIFICATIONS

MILLENNIUM	4-20 mA ANALOG OUTPUT
Operating Temperature Range	-40°C to +75°C (-40F to +167F)
Power Consumption (at 24 VDC)	Nominal (100 mA, 2.40 W) Maximum (110 mA, 2.64 W)
Humidity Range	0 to 100% Relative humidity, non-condensing
Operating Voltage Range	10.5 to 32.0 VDC when measured at the field controller
Enclosure Material	Copper Free Cast Aluminum
Certifications:	CSA and NRTL/C certified for hazardous locations. Class I, Division 1, Groups C and D, NEMA 4 and 7. IEC Rating Ex d II B T5.
	NOTE: Electronics only - CSA and NRTL/C certified for hazardous locations Class I, Division 2 Groups A, B, C and D.
Weight (with SIR100)	4 lbs
(1) Current Output	Yes
Intrusive Calibration	Yes
(1) 4 to 20 mA - Into a maximum loop impedance of 800 Ohms at 32 VDC or 150 Ohms at 10.5 VDC. Isolated or non-isolated loop supply	

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