NET SAFETY MONITORING INC.

GAS SHIELD JUNIOR & SENIOR

USER MANUAL

Models:

GS2J-A/R

GS2S-A/R/AR

ISO 9001:2000

QMI REGISTERED

Part Number: MAN-0068 Rev 09
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IMPORTANT INFORMATION

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INTRODUCTION

THE PRODUCT

The Gas Shield is a cost effective, micro-processor based gas detector for Class 1, division 2, non-hazardous locations.

THE PRODUCT

The Gas Shield controller (transmitter) comes with a standard single gas detection sensor. There are two models available: Gas Shield Junior (GS2J) and Gas Shield Senior (GS2J). The senior has an LED display, two output options and many other user interface features; the junior has all the basic functionality without a display and has a single output.

The product is a simple and effective detector providing easy calibration and configuration.

THE MANUAL

The manual has been designed to make installation of the product easy. To ensure proper installation, follow the simple steps outlined in the following pages. Throughout this manual are tips and warnings to make installation 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 (transmitter) 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 are most likely to accumulate.
- Oxygen deficiency can be caused by O2 consumption from such activities as a chemical reaction or combustion and/or displacement by other gases; certain processes can create an oxygen enriched environment.
- Use redundant systems to enhance protection and reliability.
- Light gases tend to rise and 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.

Sudden changes in ambient humidity can cause temporary false readings which in turn could cause a false alarm. To minimize the likelihood of such a situation, consider atmospheric conditions when locating sensor. Avoid locations with rapidly changing humidity levels, such as the exhaust from internal combustion engines or drafts due to ventilation (indoor air/outdoor air mixing).

The two most common installation options are as follows:

Option 1

Locate sensor separate from controller using a Certified Junction Box. **If the Net Safety Multi-purpose Junction Box is being used, refer to MAN-0081 for terminal designations.** The controller is located near eye-level. Conduit is run from the controller to the sensor which is located where gas is likely to accumulate. A junction box is used to connect the conduit from the controller to the sensor. Tubing can be run from the Calibration Cup (CCS-1) to a convenient location for calibration gas to be injected.

Option 2

The sensor is attached directly to the controller. A Calibration Cup (CCS-1) and tubing may also be used to facilitate calibration.

See “Wiring –Controller and Sensor” for detailed instructions.

TIP: The CCS-1 allows for tubing to be fitted to a sensor mounted in remote locations. The tubing is directed to a level, usually close to the controller, for easy injection of calibration gas. The CCS-1 can also act as a splash guard, protecting sensors mounted near ground level.

Figure 1: Locate Sensor/Controller-Separated

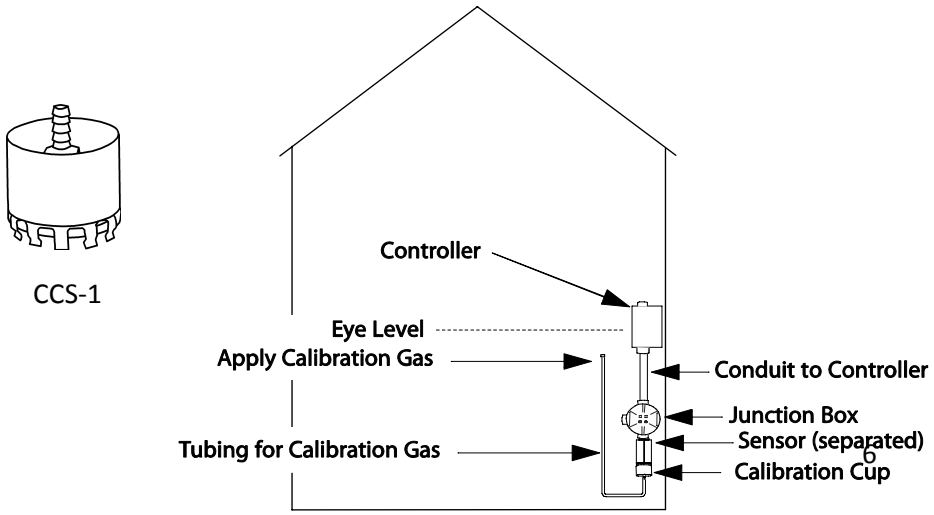
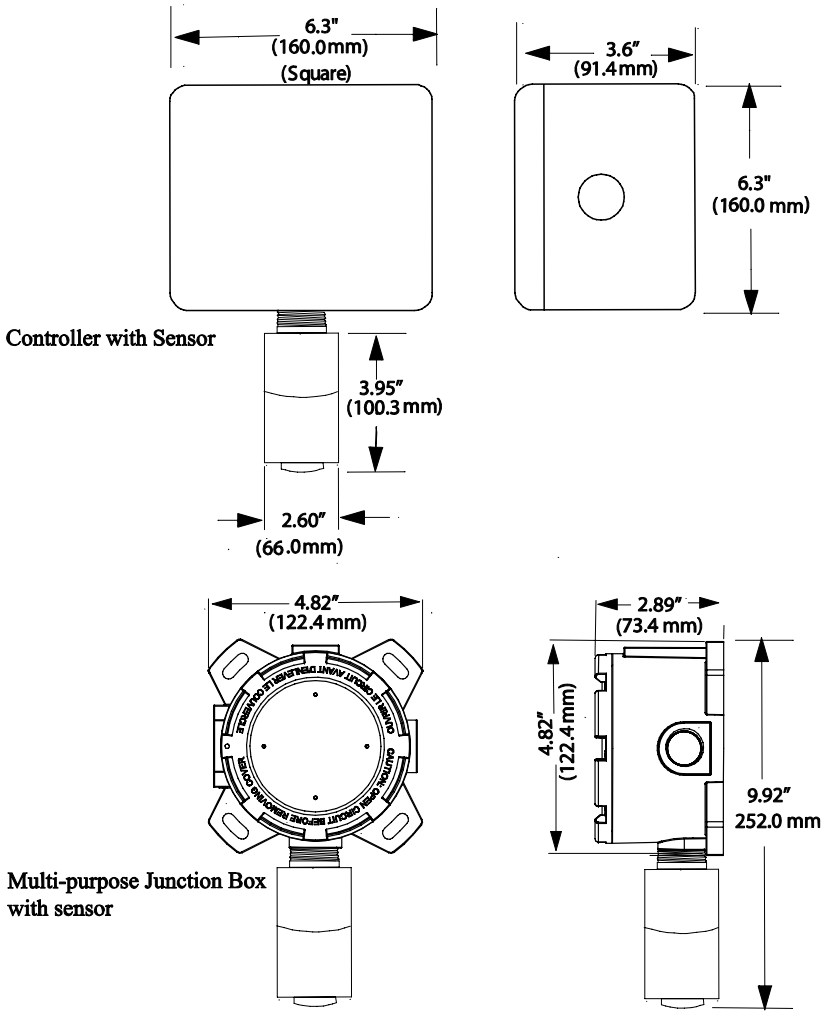


Figure 2: Dimensional Drawing



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 contact Net Safety Monitoring immediately.

The Controller's Housing

The housing is rated Class 1, Division 2, Groups A, B, C and D for hazardous locations. To open the Controller's Housing, unscrew the cover from the front of the controller.

The Sensor

Advanced electrochemical and solid state sensors are used for increased accuracy and reliability. Sensors can be attached directly to the controllers or separated using a junction box and 3-conductor shielded cable.

Note: A Certified Junction Box should be used when the controller and sensor are separated. See the **Net Safety Multi-purpose Junction Box manual (MAN-0081) when wiring for separation**.

OUTPUT BOARD CONFIGURATION

There are various outputs boards available for the Gas Shield.

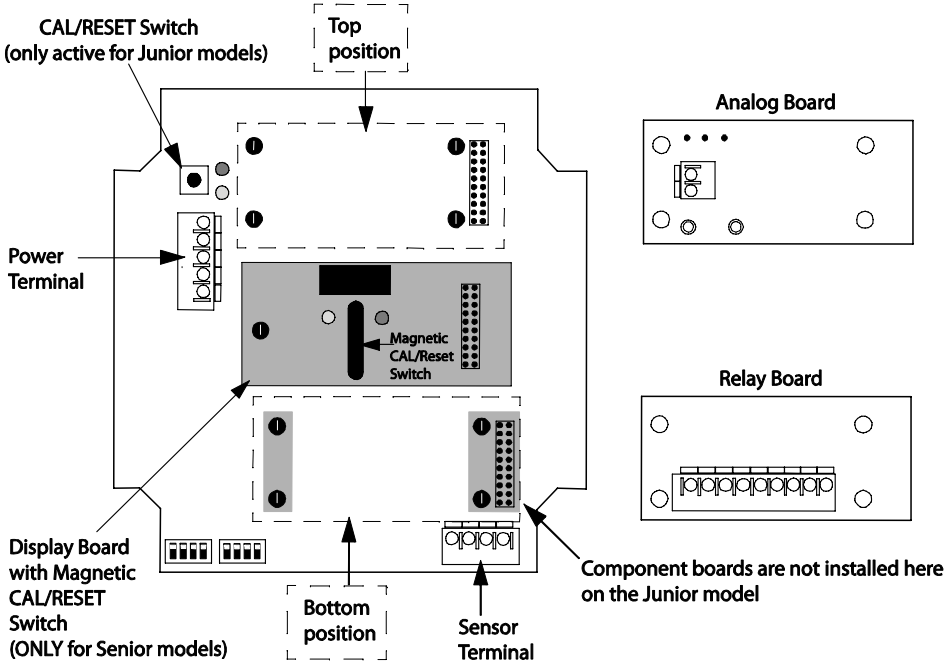
Analog 40-20 mA Output Board:

Contains test jacks for monitoring current loop and a jumper to set Isolated and Non-Isolated current output.

Relay Output Board:

Contains Fault, Alarm #1 and Alarm #2 relays

Figure 3: Output Boards



SENIOR

The different output boards or a single output board can be inserted on top of the CPU Board in the Senior Controller.
Board location is interchangeable, so either the analog or relay board can be installed in the top or bottom position. Refer to Figure 3.

JUNIOR

Only one board may be installed at a time in the Junior Controller. It must be installed in the top position. Refer to Figure 3.

Analog Board Terminal	
Labeled (from top to bottom)	Function
+VISO	Input supply power-isolated mode
4-20	4-20mA output

Relay Board Terminal	
Labeled (from left to right)	Function
FNO	Fault Normally Open
FCOM	Fault Common
FNC	Fault Normally Closed
1NO	Alarm#1 Normally Open
1COM	Alarm#1 Common
1NC	Alarm#1 Normally Closed
2NO	Alarm#2 Normally Open
2COM	Alarm#2 Common
2NC	Alarm#2 Normally Closed

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 Appendix A, “Electrostatic Sensitive Device (ESD)”.

SEAL

The use of seals is recommended to further protect the system against any unwanted water ingression, and equipment should be installed according to applicable local electrical codes. Seals are especially recommended for installations that use high-pressure or steam cleaning devices in proximity to the transmitter and/or sensor.

• 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 than18 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, particles 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

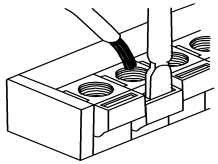
The controller should be mounted at eye-level and be easily accessible for monitoring and maintenance purposes. The sensor should be placed where gas is likely to accumulate.

The sensor may be installed directly to the controller or may be mounted separately using a junction box. See “Wiring-Sensor Separation”.

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 4: Securing wires



WIRING — SENSOR AND CONTROLLER

WARNING: Power to the unit must be OFF before wiring. Also ensure area is de-classified before removing housing cover.

The sensor may be fitted directly to the controller. If so, the user needs only to connect the controller to external equipment. When installing the sensor and controller in a "separated" configuration refer to "Wiring-Sensor Separation".

Follow the steps below when wiring controller to sensor.

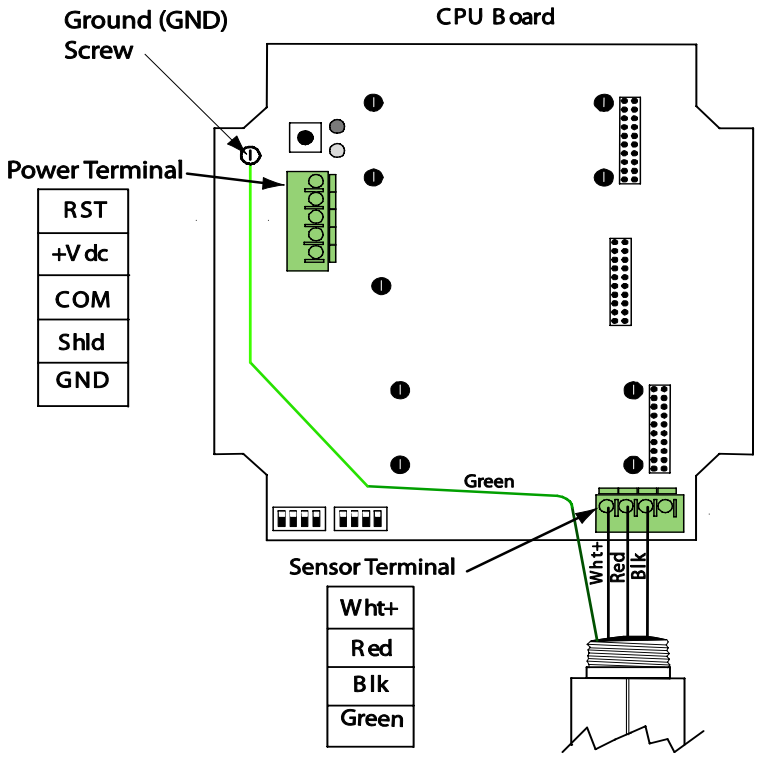
1. Remove the Controller Housing Cover by unscrewing the four screws.
2. Connect the sensor to the sensor terminals (if necessary).
3. Connect Controller Power Terminals to signal and power supply wires.

Table 1: Controller Terminal Connections

Sensor Terminals			Controller Power Terminals	
Sensor wire colour	**Terminal designations/function**		**Terminal designations**	**Power Connections**
White	Wht(+)		RST	Remote Reset
Red	Red		+24V	Power (+) +VDC
Black	Blk / COM(-)		COM	Power(-)
Green	Green/ Ground		Shld	Shield
	Shld		GND	Earth Ground

Figure 5: Wiring-Controller and Sensor

Note: Ensure ground wire is connected to Ground screw inside controller's housing.



WIRING — SENSOR SEPARATION

Since 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. This is done with the aid of the Sensor Separation kit. This kit is composed of a **Net Safety Multi-purpose Junction Box** and terminal strip. **For terminal definitions refer to the Multi-purpose Junction Box manual (MAN-0081)**.

Figure 6: Wiring- Sensor Separation

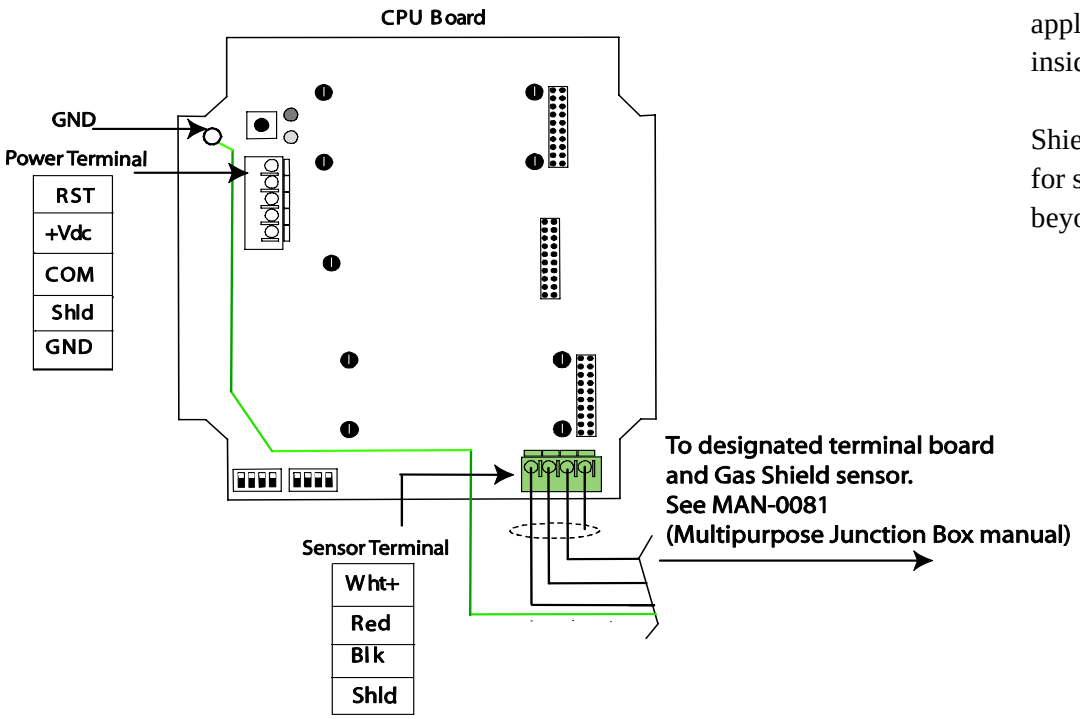


Table 2: Sensor wires and function

Sensor wires	
Wire colour	**Function**
White	VDC (+)
Red	Signal
Black	COM(-)
Green	Ground

Note: Use appropriate wire for Class 1 Division2, hazardous applications. Also, ensure ground wire is connected to Ground screw inside controller’s housing.

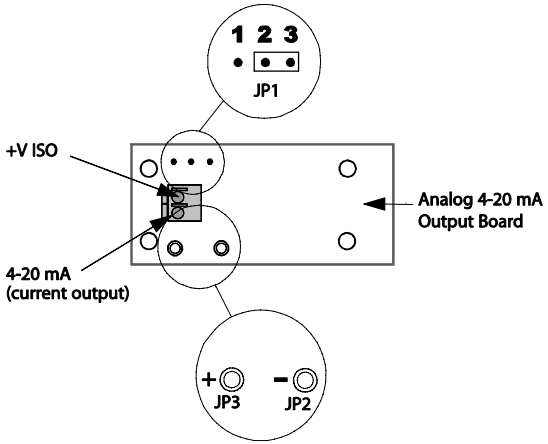
Shielded copper instrument wire (minimum 18AWG) should be used for separations up to 500 feet. Contact Net Safety if separation is beyond 500 feet.

CURRENT OUTPUT

To set the current output, simply position jumper (shorting jack) over pins located on the Analog 4-20 mA output board to the isolated or non isolated current position. Refer to Figure 7.

Note: Unless otherwise specified, all models ship with this jumper in the non-isolated current position (Pin 2 and Pin 3 jumpered). Refer to Figure 7.

Figure 7: Jumper Position and Test Jacks-Analog Board



Jumper positions to set power source for current output.

Isolated & Non-Isolated Current Jumper - Place Jumper (shorting jack) over Pin 3 and Pin 2 (default position) for Non-Isolated configuration (source).

Place Jumper over Pin 1 and Pin 2 for remaining configurations. See Figure 8

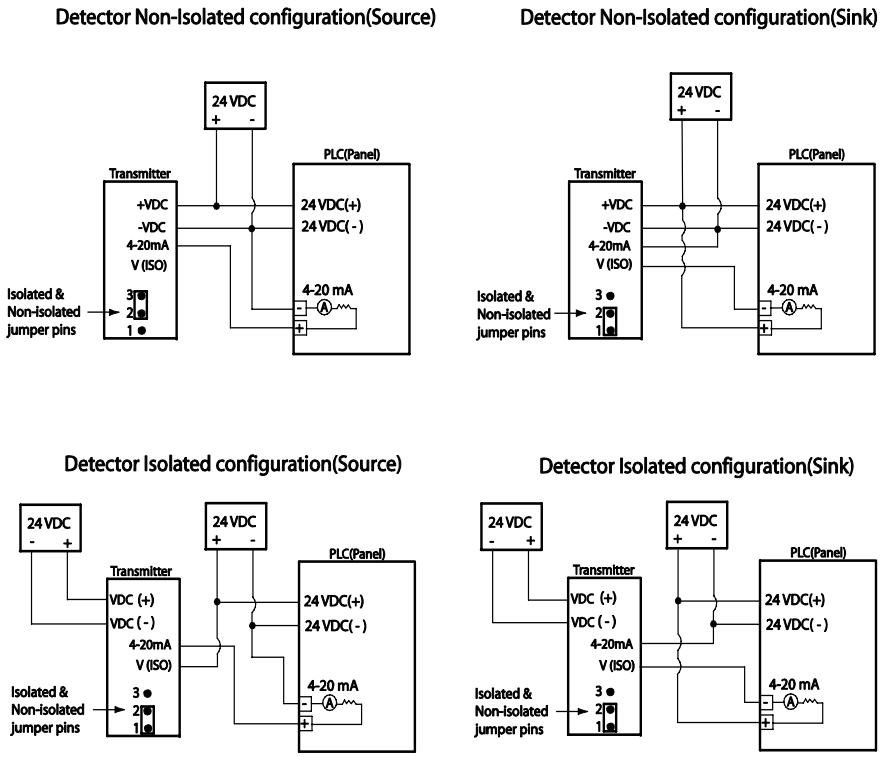
NON-ISOLATED AND ISOLATED POWER CONFIGURATIONS

For current source using Non-Isolated configuration, the jumper must remain in the default position (Pin 2 and Pin 3 jumpered). The jumper is placed over Pin1 and Pin 2 for current sink using Non-Isolated configuration.

For Isolated configuration using a separate power supply to isolate the current loop, the jumper must be placed over Pin 1 and Pin 2 for source and sink. See Figure 7 and Figure 8.

Note the Jumper position for each configuration.

Figure 8: Current Source and Sink Drawing.



CURRENT LOOP MEASUREMENTS

Test Jacks are only available when the 4-20mA Output Board is installed. Use a current meter to measure and monitor the current loop during various states. The Gas Shield cover must be removed to access the Test Jacks.

Table 3: Status LEDs and Current Output

State	Current O/P	Status LED (Red or Green)
Start-up delay/warm up	3.0mA	Red slow flash
Normal Operation	4.0mA	Green blip/blink
Memory Error (contact factory)	*2.5mA	Red fast flash
Sensor lead(s) open	*2.5mA	Red fast flash
Setting Zero	3.0mA	Green solid
Apply calibration Gas during calibration	3.3mA	Red fast Flash
Span is set, remove gas	3.6mA	Green solid
Return to normal operation	4.0mA	Green blip/blink
Gas present	>4.0-20.0mA	Red blip/blink
Fail Calibration	3.0 to 3.3mA	Red flash/ Green flash

* A 22 mA option is available for Memory Error and sensor lead open (sensor fault). Contact factory for this option.

Remote Reset

The Gas Shield has a remote reset connection. If the relays are set for latching a remote reset can be done to reset the relays. This is done with a normally open Push Button Switch connected between the RST and COM terminal. When there is a latched alarm the switch is pushed and the unit resets clearing the alarm.

STEP 4 — OPERATE

CONTROLLER – SENIOR MODEL

Figure 9: Gas Shield Senior Controller Functionality

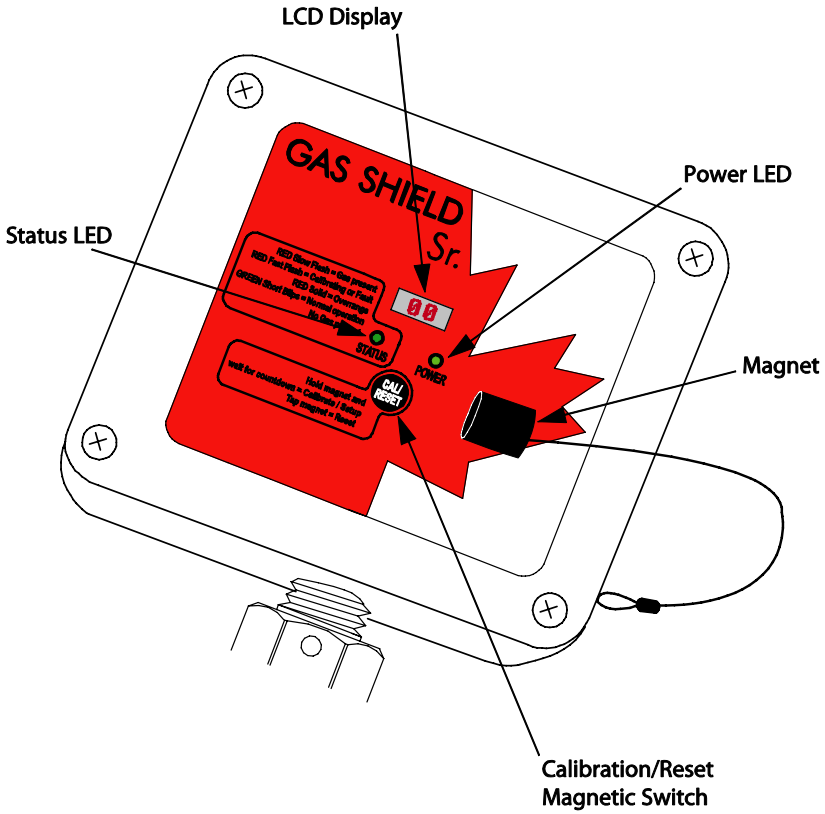


Table 4: Display Messages - Senior

State	Alphanumeric Display	
	Toxic sensor	Oxygen sensor
Start-up delay (approximately 90 seconds for electrochemical sensors and 15 minutes for solid state sensors)	Start Delay Gas Shield Net Safety	
Prompt to begin calibration procedure	Calibrate Sensor	
Sensor communication error	Sensor Communication Fault	
Auto Zero set	Apply Clean Air	
Apply calibration gas	Apply xx ppm	Apply 21% Air
Calibrate sensor	Calibrating	
Span set, remove gas	Remove Cal. Gas	
Return to normal operation	Cal. Complete	
Normal operation	00	20.9
Calibration procedure failed, unstable signal or missing calibration gas	Span Failed	
Gas present	> 0 to 100% of full scale	Above/below 20.9

CAL/RESET MAGNETIC SWITCH FUNCTIONALITY- SENIOR

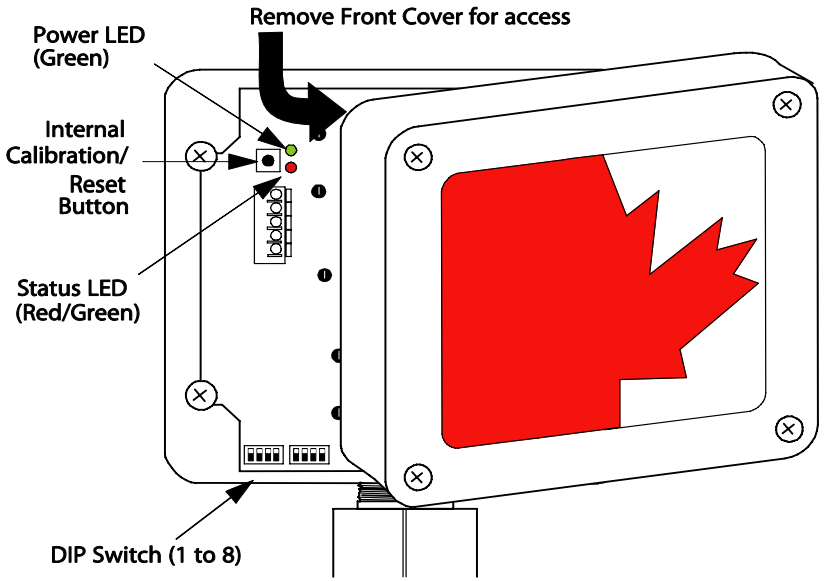
A magnet is used to access menu for setup and calibration as well as for clearing latched alarms.

-Hold the magnet on Cal/Reset to access the menu.

-Tap the magnet on Cal/Reset to make a selection or clear a latched alarm. Note that the Internal **Calibration/Reset Button is disabled for Gas Shield Senior models**.

CONTROLLER - JUNIOR

Figure 10: Gas Shield Junior Controller Functionality



INTERNAL CALIBRATION/RESET BUTTON- JUNIOR

Warning Ensure area is de-classified before removing housing cover.

The controller's cover must be removed to access the Internal Calibration/Reset button and view LEDs. Press and hold the internal Calibration/Reset button to calibrate. Refer to Status LEDs and if available, current loop measurements to monitor the states. See Table 3 "Status LEDs and Current Output".

POWER UP

Junior Model

When power is first applied, a warm-up routine will begin (approximately 90 seconds for electrochemical sensors and 15 min for Solid State sensors). During this time, the output will be 3.0 mA (indicated by analog models) and the Status LED will flash slow Red. After the Start-up Delay, the controller will enter normal operation.

Senior Model

When power is first applied, a warm-up routine will begin (approximately 90 seconds for electrochemical and 15 min for Solid State sensors). During this time, the message **Start Delay Gas Shield Net Safety** displays, the Status LED will flash slow Red and output is 3.0 mA (indicated by analog/analog-relay models). After the Start-up Delay the controller will enter normal operation.

ALERT: To avoid immediate alarms, when using biased sensors (Ammonia, Vinyl Chloride), and sensors such as Chlorine as well as Solid State sensors, the user MUST put the system in Bypass during start up and allow it to remain in Bypass until the first site calibration is complete (approximately 24 hours after start up); perform calibration after 24 hours to ensure full stabilization.

MAIN MENU - SENIOR

Depending upon which Output Board is installed, the Gas Shield Senior may have up to four options in the Main Menu.

- Calibrate Sensor
- Review Relay Settings (optional)
- Set Relay Options (optional)
- Select Display Language

Access Main Menu - Senior

1. Hold the magnet on **CAL/RESET** until **Switch On** is displayed and wait for the countdown (10 to 0) to finish.

2. The Main Menu options are displayed.
3. Tap the magnet on **CAL/RESET** to select an option when it is displayed; hold the magnet on **CAL/RESET** to select the next option. A selection is acknowledged by a flashing **YES** on the display. If no options are selected, the unit will return to normal operation.

Select Display Language - Senior

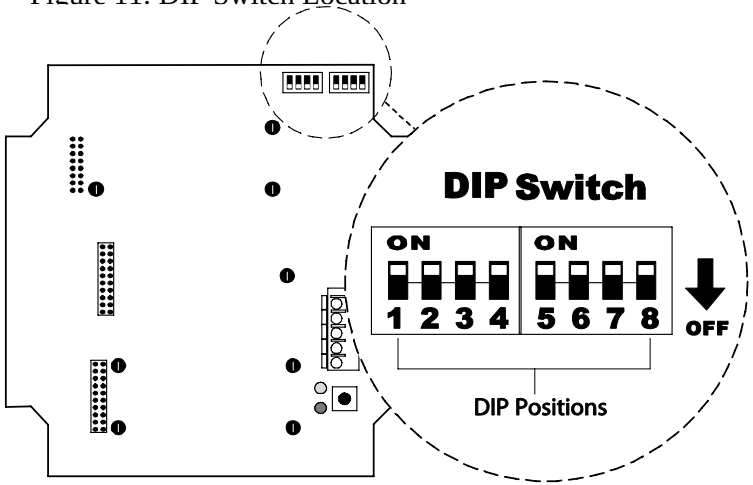
1. When **Select Display Language** displays tap the magnet on **CAL/RESET**. The flashing **YES** confirms the selection.
2. When the preferred language displays (English YES?, Espanol Si?, Francais Oui?) tap the magnet on **CAL/RESET** to select. The flashing **YES** confirms the selection.

RELAY OPTIONS - Junior Settings

With the exception of DIP Switch Position 8, DIP Switch settings apply only to the Gas Shield Junior and are used to define relay/alarm settings.
DIP Switch Position 3 through 7 is turned ON or OFF, in combination, to set Alarm levels.
Refer to Table 5, "DIP Switch Settings - Toxic Sensors", for specific settings.

EXCEPTION: OXYGEN sensors have specific settings. Refer to Table 6, "DIP Switch Settings - OXYGEN Sensor", for settings.

Figure 11: DIP Switch Location



DIP Switch – TOXIC Sensor

Table 5: DIP Switch Settings-Toxic sensors

DIP Switch	Setting		Functions
Position 1	ON	Energized	Coil Status
	OFF	De-energized	
Position 2	ON	Latching	Latch Status
	OFF	Non-Latching	
Position 3	ON	32	Alarm #2
	OFF	0	
Position 4	ON	16	
	OFF	0	
Position 5	ON	8	
	OFF	0	
Position 6	ON	4	
	OFF	0	
Position 7	ON	2	
	OFF	0	
Position 8	ON	Factory Default	Modbus RS485 Communication usage (Junior and Senior)
	OFF	User settings	

When Alarm #2 is set, Alarm # 1 is automatically set to half of Alarm #2.
Note: Default Alarm levels are determined by % of full scale for different sensors.
For the Gas Shield Junior, the maximum Alarm#2 setting available is 62% of full scale.
Example: For a sensor with scale/range of 50 ppm, the maximum Alarm#2 available is 62% of 50 ppm which is 31 ppm.

Refer to “Alarm Settings – Senior” for details on setting the Gas Shield Senior model relay/Alarm settings.

ALARM SETTINGS - JUNIOR

To set Alarm Settings for the Gas Shield Junior, DIP Switch positions must be set. Refer to "Relay Options" for location and instructions for setting DIP switches.
Note: DIP Switch Alarm Settings apply to the Relay model Gas Shield Junior only.

Set Energized/de-energized

Set DIP Switch Position1 to ON for Energized.
Set DIP Switch Position1 to OFF for De-energized.

Set Latching/Non-latching

Set DIP Switch Position 2 to ON for Latching.
Set DIP Switch Position 2 to OFF for Non-latching.
Refer to Figure 11, "DIP Switch Location", for location of DIP Switch. Also see Table 5 and Table 6.

Set Alarm #1

The Alarm#1is automatically set to a value of half the defined Alarm #2 level.

Set Alarm #2

To set Alarm#2, set DIP Switch position 3 through 7. Each ON/OFF position is assigned a value to a combined maximum of 62 (the OF F setting always equates to 0).The values set on each position are added to obtain the Alarm #2 alarm level.

Example: SettingAlarm#1 and #2-Toxic units
DIP Switch position 3 is set to 32 (ON) and position 4 is set 0 (OFF); position 5 is set to 8 (ON), position 6 is set to 4 (ON) and position7 set to 0 (OF F). The total Alarm #2 Point would be the combined

EXCEPTION: Oxygen units

Oxygen sensors use DIP Positions 3, 4 and 7 to set Alarm #1 below 20.9. ON/OF F combinations produce a step of 1%. These sensors use DIP Positions 5, 6 and7 to set Alarm #2 above 20.9.ON/OFF combinations produce a step of 0.5%.

Table 6: DIP Switch Settings – OXYGEN Sensor

DIP Switch	Setting		Functions
Position 1	ON	Energized	Coil Status
	OFF	De-energized (default)	
Position 2	ON	Latching	Latch Status
	OFF	Non-Latching (default)	
ALARM #1 (below 20.9%)			
Position 3	Position 4	Position 7 ON Step of 1%	Position 7 OFF Step of 0.5%
OFF	OFF	16	18.5(default)
OFF	ON	17	19
ON	OFF	18	19.5
ON	ON	19	20
ALARM #2 (above 20.9%)			
Position 5	Position 6	Position 7 ON	Position 7 OFF
OFF	OFF	22	22
OFF	ON	23	22.5
ON	OFF	24	23(default)
ON	ON	25	23.5
Position 8	ON	Factory Default	Modbus RS485 Communication usage (Junior and Senior)
	OFF	User settings	

ALARM SETTINGS - SENIOR

Review Relay Settings

This option allows you to review the current relay settings. It is read-only.

1. Access the Main Menu.
2. Tap the magnet on **CAL/RESET** when prompted with **Review Relay Settings.** The output current will drop to 3.0 mA (indicated by analog/analog-relay models) and the relay settings are displayed.
3. The Fault Alarm, Alarm #1 and Alarm #2 settings will display.

Set Relay Options

This option allows you to set alarm levels, coil status and latch status for the Alarm #1 and Alarm #2 relays (Fault Alarm is fixed).

There are option settings for Alarm #1 and Alarm #2 relays. The **Fault Relay is fixed** as normally Energized/Non-latching and cannot be changed. The coil energization, latch status and level for Alarm #1 are set first and then Alarm #2 coil energization, latch status and level is set.

Steps in configuring alarms:

1. Enter Main Menu (refer to "Access Main Menu - Senior").
2. When **Set Relay Options** displays tap the magnet on **CAL/RESET**. The flashing **YES** confirms the selection and current output drops to 3.0 mA (indicated by analog/analog-relay models).
3. The message **Alarm #1** displays.
4. The message **Coil Status** displays. When **Energized** displays, tap the magnet on **CAL/RESET** to select or wait for **De-Energized** to display and tap the magnet on **CAL/RESET**. The flashing **YES** confirms the selection. If nothing selected, previous setting is retained.
5. The message **Latch Status** displays. When **Latching** displays, tap the magnet on **CAL/RESET** to select or wait for **Non-Latching** to display and tap the magnet on **CAL/RESET**.
6. The flashing **YES** confirms the selection. If nothing selected, previous setting retained.
7. The message **Set Alarm #1** displays. Based on ppm/ppb range, Alarm #1 set-points are displayed in ascending order. When the required level displays, tap the magnet on **CAL/RESET** to select. The level selected will flash to confirm the selection.
8. The message **Alarm #2** displays.
9. Select the Coil Status and then Latch Status for Alarm #2.
10. The message **Set Alarm #2** displays. Based on ppm/ppb range, Alarm #2 set-points are displayed in ascending order, starting at the level set for Alarm #1. When the required level displays, tap the magnet on **CAL/RESET** to select.* the level selected will flash to confirm the selection.

* Alarm #2 relay cannot be set to a value lower than the Alarm #1 level, or higher than 100% of the maximum range. Alarm levels are based on the sensor's range.

Note: Alarm #2 for OXYGEN sensors can be set below 20.9% - for Gas Shield Senior models ONLY.

STEP 5 — CALIBRATE

Once the controller/transmitter and sensor have been wired and powered up, sensors will require a warm-up period. Approximately 24 hours after power, perform a calibration and repeat if necessary. If the sensor requires more or less than 24 hours to warm up it will be specified in this manual.

The Gas Shield must be calibrated using the specified ppm/ppb span gas of concern. **To assist in using the correct gas for calibration, refer to** '**Table 7: Gas Shield sensors and corresponding calibration gas**", **also confirm the gas concentration required by referencing the Calibration Gas label on the sensor's housing**. The concentration of gas corresponding to 100% of full scale is converted to a linear 4-20mA signal output signal which can be powered from the primary dc supply of the instrument or an isolated supply.

Important Points for different sensors:

AMMONIA (NH3) – Apply 50 ppm calibration gas when calibrating Ammonia sensors (whether or not the sensor's range is 50ppm or 100ppm).

OXYGEN (O2) – Apply 20.9% Certified Calibration Oxygen or clean ambient air (free of contaminants) confirmed at 20.9% oxygen.

If the calibration procedure is not performed correctly, the Gas Shield LED will alternate Red and Green flashes and the analog output changes back and forth from 3.0 to 3.3 mA (indicated by analog Gas Shield Junior models and analog /analog-relay Gas Shield Senior models). The unit will remain in this state until acknowledged by a Manual Reset (Refer to "Manual Reset"). After a manual reset, the unit will return to normal operation with previous calibration values. Always verify calibration confirming the Gas Shield's response using the same gas.

The calibration procedure takes approximately 3 minutes to complete. If gas is not applied at the appropriate time, a calibration failure may occur. Refer to "Calibration Failure- Junior" and "Calibration Failure – Senior", for specific information.

An Ozone generator must be used for OZONE (O3) sensor calibration. Use only Teflon or Tygon E-200 tubing. Range is measured in parts per billion (ppb).

ELECTROCHEMICAL BIASED AND SOLID STATE SENSORS – Ammonia and Vinyl Chloride

- Biased sensors, such as Ammonia and Vinyl Chloride, have set up, monitoring or calibration requirements which are unique due to the nature of the specific gas. Read the following instructions when installing Ammonia or Vinyl Chloride sensors.
- Place the transmitter into bypass during the entire 24 hour warm up period and initial calibration to avoid alarm activation.
- Sensors must run for a minimum of 24 hours before initial site calibration.

- Once powered up, the display will show % PPM full range. The range will begin to drop during the following 24 hours until the baseline signal is stable.
- Prior to calibration, ensure ambient air surrounding the sensor is clean and free of contaminants (Ammonia or other interfering gases). If in doubt, use a portable detector.
- Humidity levels in the surrounding air during calibration should be similar to those expected during normal operation.
- **DO NOT use bottled dry air**, as zero reference when zeroing Ammonia or Vinyl Chloride sensors, **use clean ambient air**. After performing a 'Zero', begin calibration by applying the required calibration gas at a flow rate of 0.5 liters per minute. See "Calibration Procedure-Junior" or "Calibration Procedure-Senior".
- Recalibrate three weeks after initial calibration, and then begin regular maintenance cycle.

Solid State sensors may require up to 1.0 hour for stabilizing, allowing the Gas Shield Controller/Transmitter to go into normal operation.

Note: Chlorine sensors will also exhibit similar characteristics to biased sensors mentioned above. **A warm up period of 24 hours** should also be allowed for **Chlorine sensors**. **Use clean surrounding air when zeroing. Do not use bottled dry air for zeroing**.

WARNING  To compensate for friction loss and dilution over the distance when remotely calibrating (sensor wired for separation), decrease the tubing diameter or increase the calibration gas flow rate between gas canister and sensor. Always confirm calibration (sensor response) by applying gas directly at the sensor.

Table 7: Gas Shield sensors and corresponding calibration gas

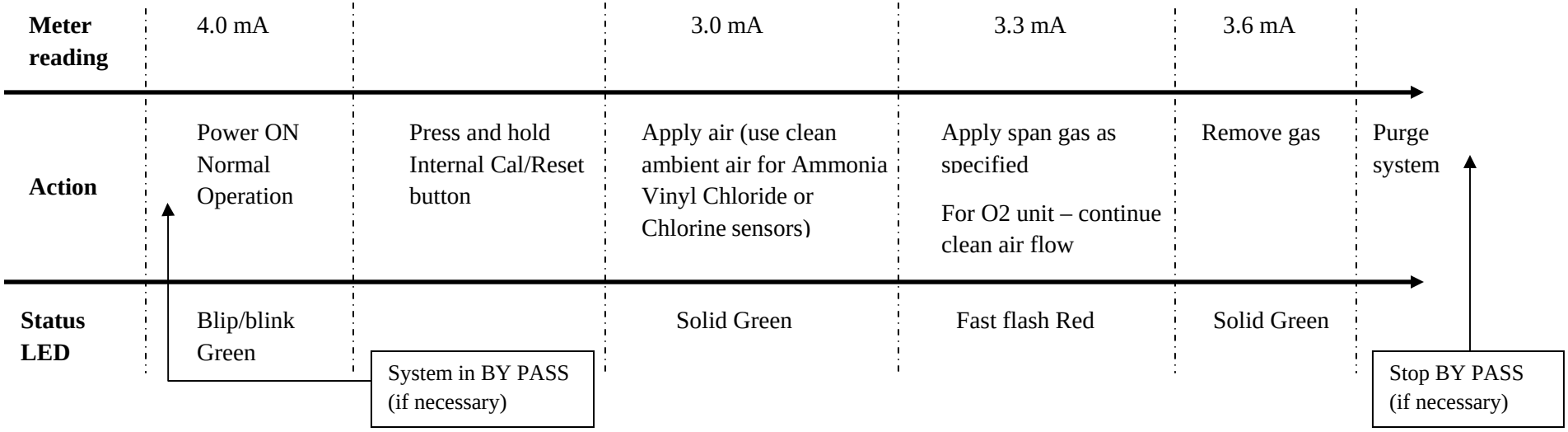
Gas Shield Sensors	Gas Shield Sensor description	Calibration (Span) gas required
ST7201-20	Hydrogen Sulphide (H2S) Sensor, 0-20 ppm	10 ppm H2S (air or nitrogen balanced)
ST7201-50	Hydrogen Sulphide (H2S) Sensor, 0-50 ppm	25 ppm H2S (air or nitrogen balanced)
ST7201-100	Hydrogen Sulphide (H2S) Sensor, 0-100 ppm	50 ppm H2S (air or nitrogen balanced)
ST7250-10	Hydrogen Fluoride (HF) Sensor, 0-10 ppm	10 ppm HCL (air or nitrogen balanced)
ST7270-20	Hydrogen Chloride (HCL) Sensor, 0-20 ppm	10 ppm HCL (air or nitrogen balanced)
ST7290-10	Hydrogen Cyanide (HCN) Sensor, 0-10 ppm	5 ppm HCN (air or nitrogen balanced)
ST7300-20	Sulphur Dioxide (SO2) Sensor, 0-20 ppm	10 ppm SO2 (air or nitrogen balanced)
ST7300-100	Sulphur Dioxide (SO2) Sensor, 0-100 ppm	50 ppm SO2 (air or nitrogen balanced)
ST7400-25	Oxygen (O2) Sensor, 0-25 %	Clean air (20.9% O2)
ST7410-1	Ozone (O3) Sensor, 0-1ppm	1ppm O3 (air balanced)
ST7500-10	Chlorine (Cl2) Sensor, 0-10 ppm	5 ppm Cl2 (air or nitrogen balanced)
ST7500-5	Chlorine (Cl2) Sensor, 0-5 ppm	5 ppm Cl2 (air or nitrogen balanced)
ST7510-1	Chlorine Dioxide sensor (ClO2) UN-FILTERED, 0-1 ppm	3 ppm Cl2 (air or nitrogen balanced)
ST7600-500	Carbon Monoxide (CO) Sensor, 0-500 ppm	250 ppm CO (air or nitrogen balanced)
ST7600-1000	Carbon Monoxide (CO) Sensor, 0-1000 ppm	500 ppm CO (air or nitrogen balanced)
ST7700-50	Ammonia (NH3) Sensor, 0-50 ppm	50 ppm NH3 (air or nitrogen balanced)
ST7700-100	Ammonia (NH3) Sensor, 0-100 ppm	50 ppm NH3 (air or nitrogen balanced)
ST7710-100	Nitric Oxide (NO) sensor, 0-100 ppm	50 ppm NO (air or nitrogen balanced)
ST7720-10	Nitrogen Dioxide (NO2) Sensor, 0-10 ppm	5 ppm NO2 (air or nitrogen balanced)
ST7800-20	Vinyl Chloride (C2H3Cl) Sensor, 0-20 ppm	10 ppm Vinyl Chloride (air or nitrogen balanced)

Calibration Procedure – Junior

1. Confirm successful power up of the controller/transmitter- Status LED Blip/Blink Green; no fault indicated.
2. Put current meter on mA scale, connect meter leads to controller's Test Jacks (if analog board is installed).
   Press and hold the internal Calibration/Reset button for approximately 10-15 seconds. The Status LED will go Blank, Red and then Solid Green.
3. Release the button on Solid Green.
4. When 3.0 mA displays and the Status LED is Solid Green, apply zero gas at a rate of 0.5 liters per minute using a calibration cup – **For AMMONIA, VINYLCHLORIDE and CHLORINE sensors use clean ambient air ONLY. Refer to "Electrochemical Biased and Solid State Sensors – Ammonia and Vinyl Chloride for more information.**
5. When the Status LED flashes Fast Red (current output at 3.3 mA from analog board), apply calibration gas at ppm/ppb range specified. During gas application, The Status LED will flash Fast Red. For Oxygen units/sensors continue to apply clean AIR.
6. Continue to apply gas until span is set – indicated by the Status LED being Solid Green (current output at 3.6 mA from analog units). Remove gas.
7. Apply air (use **clean air ambient air for AMMONIA, VINYLCHLORIDE and CHLORINE sensors**) to purge the system.
8. The controller will return to normal operation. The Status LED will be blip/blink Green (current output at 4.0 mA from analog units)

If the calibration procedure fails, the Status LED will alternate between Red and Green (current output alternates between 3.0 and 3.0 mA from analog units). The unit will remain in this state until acknowledge by a Manual Reset. Refer to "Manual Reset". After a Manual Reset, the unit will return to normal operation (current output at 4.0 mA from analog units) using previous calibration values. **Always apply test gas after calibration to verify operation.**

Figure 12: Calibration Procedure - Junior

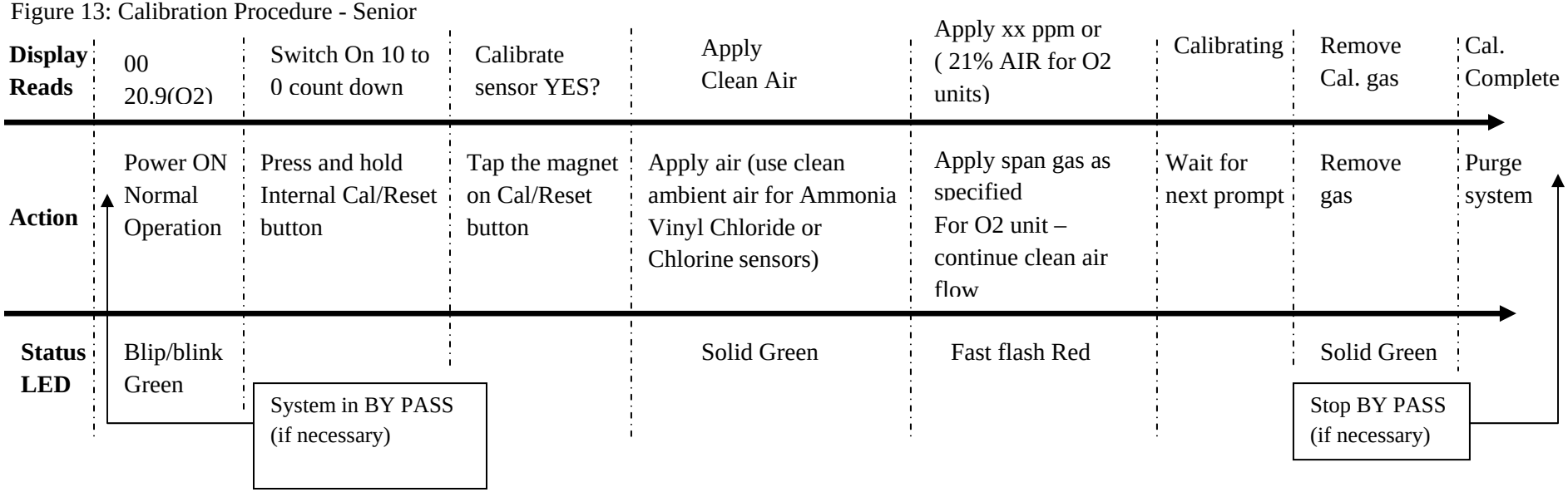


Calibration Procedure – Senior

1. Confirm successful power up of the controller/transmitter- Status LED Blip/Blink Green; no fault indicated.
2. Hold the magnet on Calibration/Reset button, Switch On will display and a countdown, 10 to 0 will begin.
3. When *Calibrate Sensor YES*? , displays tap the magnet on Cal/Reset. The calibration process will begin.
4. When apply *Clean Air* displays, and the Status LED is Solid Green, apply zero gas(clean air) at a rate of 0.5 liters per minute using a calibration cup – **For AMMONIA, VINYLCHLORIDE and CHLORINE sensors use clean ambient air ONLY. Refer to "Electrochemical Biased and Solid State Sensors – Ammonia and Vinyl Chloride for more information.**
5. Follow the display instructions to calibrate the unit; when *Apply xx ppm*, displays, apply the specific gas at ppm/ppb range specified. For Oxygen units/sensors the message *Apply 21% Air* displays….continue to apply Zero AIR.
6. *Calibrating* displays once gas is detected (Status LED flashes Red). When remove *Cal gas* displays, remove span gas. (Status LED will be solid Green).
7. When *Cal Complete* displays, calibration is complete. Apply air (use **clean air ambient air for AMMONIA, VINYLCHLORIDE and CHLORINE sensors**) to purge the system.
8. The controller will return to normal operation. The Status LED will be blip/blink Green.

If the calibration procedure fails, the Status LED will alternate between Red and Green (current output alternates between 3.0 and 3.0 mA from analog/analog-relay units). The unit will remain in this state until acknowledged by a Manual Reset. Refer to "Manual Reset". After a Manual Reset, the unit will return to normal operation (current output at 4.0 mA from analog/analog-relay units) using previous calibration values. **Always apply test gas after calibration to verify operation**.

Figure 13: Calibration Procedure - Senior



STEP 6 — MONITOR

Calibration Failure – Junior

If the calibration procedure fails, the status LED alternates Red/Green and output changes back and forth from 3.0 to 3.3 mA (indicated by analog units). The unit remains in this failed state until a Manual Reset is done.

Calibration Failure – Senior

If the calibration procedure fails, the display reads **Span failed**, the status LED alternates Red/Green and output changes back and forth from 3.0 to 3.3 mA (indicated by analog/analog-relay units). The output remains in this failed state unit a Manual Reset is done.

Manual Reset – Junior

A Manual Reset is required after a calibration failure or to clear a latched alarm. Simply press and hold the Internal Calibration/Reset button for 3-5 seconds. The unit will return to normal operation using previous calibration values.

Manual Reset – Senior

A Manual Reset is required after a calibration failure or to clear an alarm. Simply tap the magnet on CAL/RESET for 3-5 seconds. The unit will return to normal operation using previous values.

Remote Reset

A normally open Push Button Switch must be connected between the RST terminal and the COM terminal on the terminal board. If relay is set to **Latching**, a Remote Reset is possible.

Outputs

Current

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; $> 4.0 \leq 20.0$ mA output indicates the presence of gas. Current output of 2.5 mA indicates the presence of a system fault.

Relays (Optional)

Note: The Fault relay output is not used to activate an automatic shut down procedure. The fault output indicates a potential problem with the controller.

Standard Electro-mechanical relay outputs have Form C SPDT contacts rated 5 Amps at 30 V dc/ 250 V ac. Three relay outputs are available; one for Fault, one for Low alarm and one for High alarm. All relays have normally open and normally closed contacts available at the output terminals.

The Fault relay is set for normally energized operation and is non-latching. If a system fault is detected, the Fault relay becomes de-energized. The Fault relay is factory set and cannot be altered. The Low alarm and High alarm relays can be selected for either normally energized or normally de-energized operation and latching or non-latching.

The available output for the Gas Shield Junior can either be analog or relay, while the Gas Shield Senior can have an analog, relay or both analog and relay outputs.

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 Status LEDs, analog output and external monitoring equipment. Be sure to prevent unwanted response of external monitoring devices and equipment during this procedure. If the 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).

TROUBLESHOOT

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

- Sensor or transmitter is connected or disconnected.
- Long term or high concentration exposure to gas.

See the “Table 8: Troubleshooting guide” for assistance in troubleshooting. Also refer to “How to Return Equipment”, if returning equipment.

Repairs to Net Safety products should not be performed in the field. Repairs to faulty or damaged equipment should only be performed at the factory; otherwise warranty on the product will be voided.

Table 8: Troubleshooting guide

Condition	Possible Cause	Possible Solution
Intermittent power	• Faulty power supply or /wiring. • Voltage is below operational voltage. • Failed electronic component(s).	• Correct power supply or / wiring. • Correct input voltage to unit. • Contact factory.
Unit not powering up	• Faulty wiring/power supply. • Voltage is below operational voltage. • Blown inline fuse. • Water invasion of electronics. • Failed electronic component(s).	• Correct wiring and power supply. • Correct input voltage to unit. • Replace inline fuse. • Contact factory. • Contact factory.
Unit powers up without display (display not available for Junior models)	• Loose electronic boards. • Water invasion of electronics. • Failed electronic component(s).	• Tightly fit electronic boards. • Contact factory. • Contact factory.
Sensor fault displays	• Faulty power supply. • Faulty sensor. • Faulty sensor wiring. • Faulty junction box wiring. • Water invasion of electronics/ junction box. • Failed electronic component(s).	• Replace or correct power supply. • Replace sensor. • Correct sensor wiring at controller. • Correct junction box wiring. • Contact factory. • Contact factory.
Unstable 4-20 mA signal	• Unshielded cables used for wiring. • Water invasion of electronics. • Failed electronic component(s)	• Use shielded cables for wiring. • Contact factory. • Contact factory.
No 4-20 mA Output signal (analog model Gas Shield Junior, analog /analog – relay Gas Shield Senior units)	• Current loop wiring is open. • Missing or incorrect placement of current output jumper. • Failed electronic component(s)	• Close 4-20 mA signal loop. • Place current output jumper in correct position. See ‘Current Output’. • Contact factory.
Undesirable change in relay state (Relay model Gas Shield Junior, analog – relay Gas Shield Senior units)	• Incorrect relay settings in menu. • Voltage applied to relay contacts outside relay ratings. • Failed electronic component(s).	• Correct relay settings in menu. • Correct voltage applied to relay dry contacts. See Appendix for specification. • Contact factory.
Chattering relays (Relay model Gas Shield Junior, analog – relay Gas Shield Senior units)	• Voltage is below operational voltage. • Loose electronic boards or/ loose wiring. • Failed electronic component(s).	• Correct input voltage to unit. • Tightly fit electronic boards or/ fit wires. • Contact factory.

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 resolve 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 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 9: Spare Parts and accessories

Net Safety Part Number	Description
GS2-ANLG-KIT	Gas Shield 2 Analog Board
GS2-RLY-KIT	Gas Shield 2 Relay Board
GS2-DISP-KIT	Gas Shield 2 Display Board
ST7201-20	Hydrogen Sulphide (H2S) Sensor, 0-20 ppm
ST7201-50	Hydrogen Sulphide (H2S) Sensor, 0-50 ppm
ST7201-100	Hydrogen Sulphide (H2S) Sensor, 0-100 ppm
ST7250-10	Hydrogen Fluoride (HF) Sensor, 0-10 ppm
ST7270-20	Hydrogen Chloride (HCl) Sensor, 0-20 ppm
ST7290-10	Hydrogen Cyanide (HCN) Sensor, 0-10 ppm
ST7300-20	Sulphur Dioxide (SO2) Sensor, 0-20 ppm
ST7300-100	Sulphur Dioxide (SO2) Sensor, 0-100 ppm
ST7400-25	Oxygen (O2) Sensor, 0-25 %
ST7410-1	Ozone (O3) Sensor, 0-1ppm
ST7500-10	Chlorine (Cl2) Sensor, 0-10 ppm
ST7510-1	Chlorine Dioxide sensor (ClO2) UN-FILTERED, 0-1 ppm
ST7600-500	Carbon Monoxide (CO) Sensor, 0-500 ppm
ST7600-1000	Carbon Monoxide (CO) Sensor, 0-1000 ppm
ST7700-50	Ammonia (NH3) Sensor, 0-50 ppm

Table 9: Spare Parts and accessories cont'd

ST7700-100	Ammonia (NH3) Sensor, 0-100 ppm
ST7710-100	Nitric Oxide (NO) Sensor , 0-100 ppm
ST7720-10	Nitrogen Dioxide (NO2) Sensor, 0-10 ppm
ST7800-20	Vinyl Chloride (C2H3Cl) Sensor, 0-20 ppm
Magnet-1	Magnet Assembly
CCS-1	Calibration Cup
JB-MPG-A/S	Multipurpose Junction Box (Aluminum or Stainless Steel)
PCBA-0252E	Multipurpose Junction Box Terminal Board

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 (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

Appendix B: Resistance Table (cont'd)

Distance (Feet)	AWG #20	AWG #18	AWG #16	AWG #14	AWG #12	AWG #10	AWG #8
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
10000	102.00	63.90	40.20	25.30	15.90	9.99	6.28

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

Appendix C: SPECIFICATIONS

Sensor Specification (Electrochemical)

Sensor Element	Hydrogen Sulfide H_2S (ST7200)	Sulphur Dioxide SO_2 (ST7300)	Chlorine CL_2 (ST7500)	Carbon Monoxide CO (ST7600)	Ammonia NH_3 (ST7700)	Hydrogen Cyanide HCN (ST7290)	Nitrogen Dioxide NO_2 (ST7720)	Nitric Oxide NO (ST7710)	Oxygen O_2 (ST7400)	Ozone O_3 (ST7410)	Vinyl Chloride C_2H_3CL (ST7800)	Hydrogen Fluoride HF (ST7250)
Range of Detection	0-25/50/100 ppm	0-20 ppm	0-10 ppm	0-500/1000 ppm	0-50/100 ppm	0-10 ppm	0-10 ppm	0-100 ppm	0-25%	0-1000 ppb	0-10/20 ppm	0-10 ppm
Linearity	±3% full scale/1% full scale				<5% full scale			<2% full scale	-	<10% full scale	<5%	<5%
Span Drift	2% full scale / month			5% full scale / year	<2% / month	<5% / month		<2% / month	<5% / year	-	<5% / year	<10% / month
Response Time	<30s-T90		<60s -T90	<30s-T90	<90s-T90	<150s-T90	<30s-T 90	<15s-T90	<15s-T95	<60s-T90	<140s-T90	<90s-T90
Operating Temperature Range	-40°C to +50°C (-40F to 122F)					-20°C to +50°C (-4F to 122F)	-20°C to +40°C (-4F to 104F)	-20°C to +50°C (-4F to +122F)	-20°C to +50°C (-4F to +122F)	-20°C to +40°C (-4F to 104F)	-20°C to +50°C (-4F to +122F)	-20°C to +35°C (-4F to +95F)
Humidity Range	15-90% non-condensing						10-95% non-condensing	15-90% non-condensing	15% to 99% RH non-condensing	15% to 90% non-condensing		
Enclosure Material	Powder Coated aluminum											
Operating Voltage	10.5 to 32.0 V dc measured at the controller terminals with sensor and current loop active, 24 V dc nominal											
Power Consumption	19.5 mA @ 10.5 to 32 V dc power supply range equal to 0.47 W @ 24 V dc											
Certifications	Certified to CSA C22.2 No: 14-90M, CSA C22.2 No: 142-87, CEC. Class 1, Division 2, Groups B, C, and D T4 U											

Note: For additional gases or sensor ranges contact Net Safety.

Controller Specification

Gas Shield Controller	JUNIOR		SENIOR		
	Analog	Relay	Analog	Relay	Analog & Relay
Operating Voltage Range	10.5 V dc measured at the controller terminals with sensor and current loop active, 24 V dc nominal				
Power Consumption @ 24 V dc	Nom 47 mA/1.12 W Max 71 mA/1.7 W		Nom 56 mA/1.34 W Max 82 mA/1.96 W		Nom 78 mA/1.87 W Max 117 mA/2.8 W
Power Consumption @ 12 V dc	Nom 72 mA/0.86 W Max 120 mA/1.44 W		Nom 90 mA/1.08 W Max 140 mA/1.68 W		Nom 129 mA/1.54 W Max 195 mA/2.34 W
Operating Temperature Range	-40°C to +75°C (-40F to +167F)				
Humidity Range	0 to 100% non-condensing				
Enclosure Material	Powder Coated Aluminum				
Weight (with sensor)	4.4 lbs				
ANALOG 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				
RELAY Output	Form C contacts rated 5 Amps at 30 V dc, 5 Amps at 250 V ac. Selectable energized/de-energized, latching/non-latching. Configurable Alarms #1 and #2; Fault alarm is fixed.				
Certification (Controller and Sensor)	CSA certified to CSA C22.2 213.14 Class 1, Division 2, Groups A, B, C and D T4. Exn AC IIC Type 4 Enclosure.				

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