NET SAFETY MONITORING INC

GAS SHIELD
JUNIOR & SENIOR

Models: GS2J-A/R
& GS2S-A/R/AR

USER MANUAL

ISO 9001:2000
QMI REGISTERED

Part Number: MAN-0068 Rev 08
June 2008

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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.

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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.

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If further language translation for this manual is required please contact:

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INTRODUCTION

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

THE PRODUCT

The Gas Shield comes with a standard single gas detection sensor. There are two models available: the Senior has an LED display, two output options and many other user interface features; the Junior has all the basic detector 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 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

LOCATE CONTROLLER/SENSOR

Prior to the installation, 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 are most likely to accumulate.
- Oxygen deficiency can be caused by O2 consumption from such activities as 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; 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 the 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 Junction Box.

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. A calibration cup can be attached to the Sensor. Tubing can be run from the calibration cup to a convenient location for calibration gas to be injected.

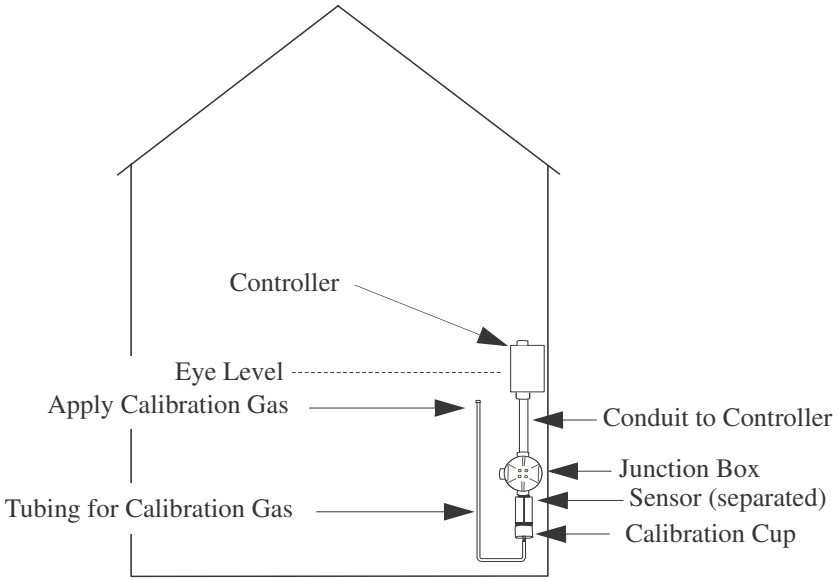
See "Wiring—Sensor Separation" on page 7 for detailed instructions.

Option 2

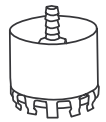
The Sensor is attached directly to the Controller. A calibration cup and tubing may also be used to facilitate calibration.

See "Wiring—Controller and Sensor" on page 6 for detailed instructions.

Figure 1: Locate Sensor/Controller—Separated



TIP: The Calibration Cup allows for tubing to be affixed 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 Calibration Cup can also act as a splash guard, protecting sensors when mounted low to the ground.

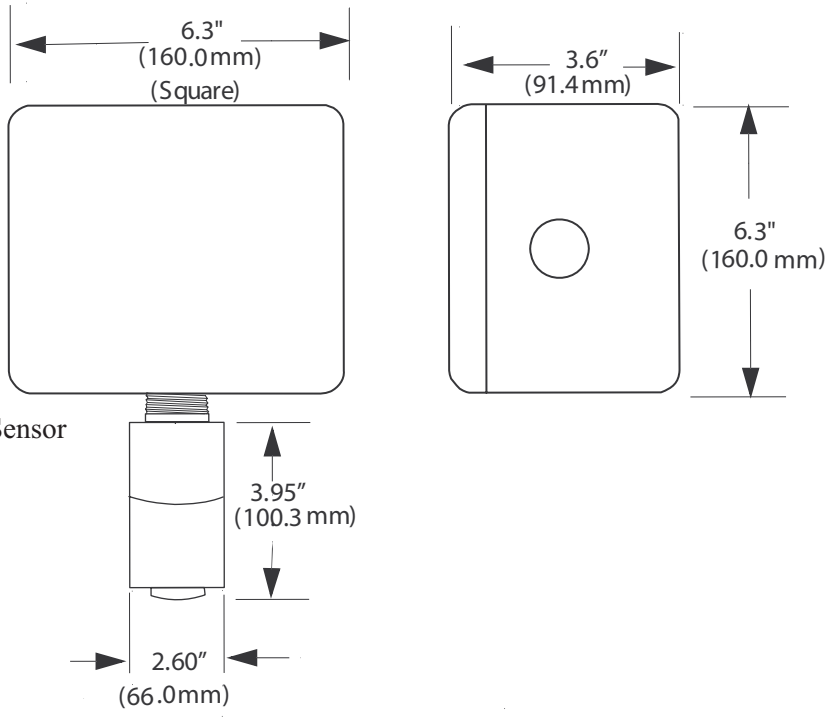


CCS-1

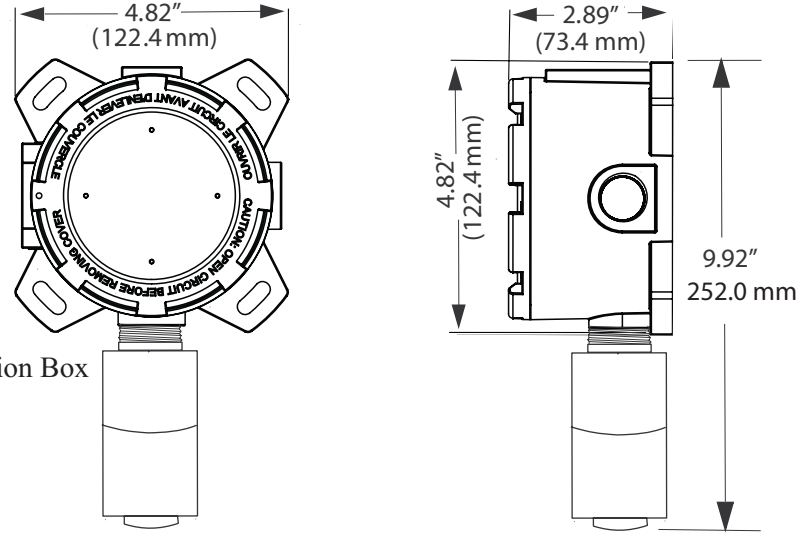
WARNING:

To compensate for 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 by applying gas directly at the sensor.

Figure 2: Dimensional Drawing



Controller with Sensor



Multi-purpose Junction Box with sensor

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 HOUSING

The Housing is rated Class 1, Division 2, Groups A, B, C and D for hazardous locations.

The Sensor can be attached directly to the Controller or separated using a junction box and 3-conductor shielded cable.

To open the Controller Cover, unscrew the cover from the front of the Controller.

THE SENSOR

Advanced electrochemical and solid state sensors are used for increased accuracy and reliability.

Note: A Certified Junction Box is used when the controller and sensor are separated. See **MAN-0081** when wiring for sensor separation.

OUTPUT BOARD CONFIGURATION

There are various output boards available for the Gas Shield.

- Analog 4-20 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.

SENIOR

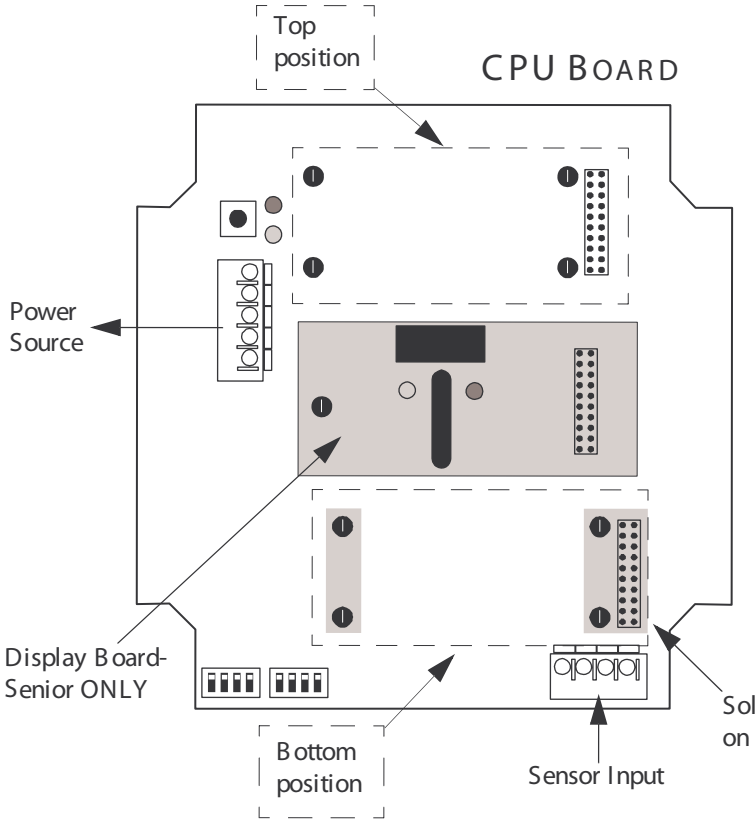
Two different output boards or a single output board can be inserted on top of the CPU board in the Senior Controller.

The board location is interchangeable, so either board can be installed in the top or bottom position (refer to Figure 3, "Output Boards").

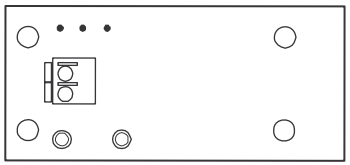
JUNIOR

Only one board may be installed in the Junior Controller. It must be installed in the top position (refer to Figure 3, "Output Boards").

Figure 3: Output Boards

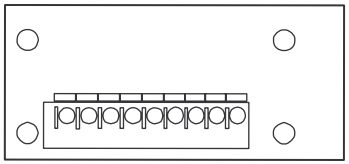


ANALOG BOARD



Labelled (from top to bottom)	Function
+V-Iso	Input supply power- isolated mode
4-20	4-20 mA output

RELAY



Labelled (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 non-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.
- 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 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.
- 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.
- To avoid water damage to electronic components, seal conduit at all points of entry to the Controller or junction box.

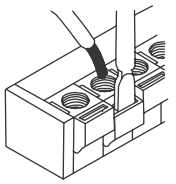
MOUNT

The Controller should be mounted near eye-level and be easily accessible for calibration 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" on page 7).

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.



WIRING—CONTROLLER AND SENSOR

Note: The Sensor may be factory installed to the Controller. If so, you need only connect the Controller to external equipment.
If you wish to separate the Controller and Sensor, refer to "Wiring—Sensor Separation" on page 7.

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

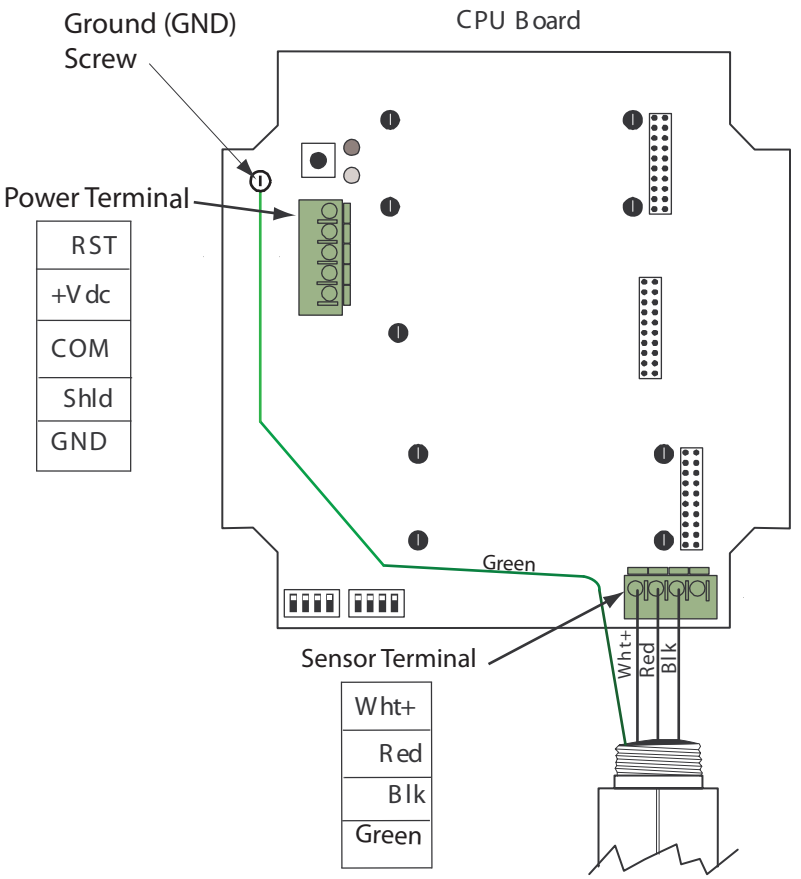
1. Open the Controller Cover.
2. Connect the Sensor to the Sensor Input (if necessary) and the Output connectors to the output/signal/power source.

Table 1: Controller and Sensor Connectors

Sensor wires		Power Source	
Colour	Function	Labelled	Function
White	+Vdc	RST	Remote Reset
Red	Sig	+Vdc	10.5-32 V dc
Black	Comm (-)	COM	Comm (-)
Green	Ground	Shld	Shield
		GND	Earth Ground

3. Restore power to the unit.
4. Ensure the Status LED is Red Slow Flash (if analog board installed, meter reads 3 mA). This is the Start-up Delay sequence which varies with the sensor type.
5. Close the Controller Cover and tighten screws.

Figure 4: Wiring—Controller and Sensor



WARNING:
Ensure ground wire is connected to the Ground screw inside controller's 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 convenient to "separate" the Controller and Sensor.

The Sensor separation kit is composed of a junction box and terminal strip Refer to the Net Safety Multi-purpose Junction Box (MAN-0081) for terminal designation when wiring for separation.

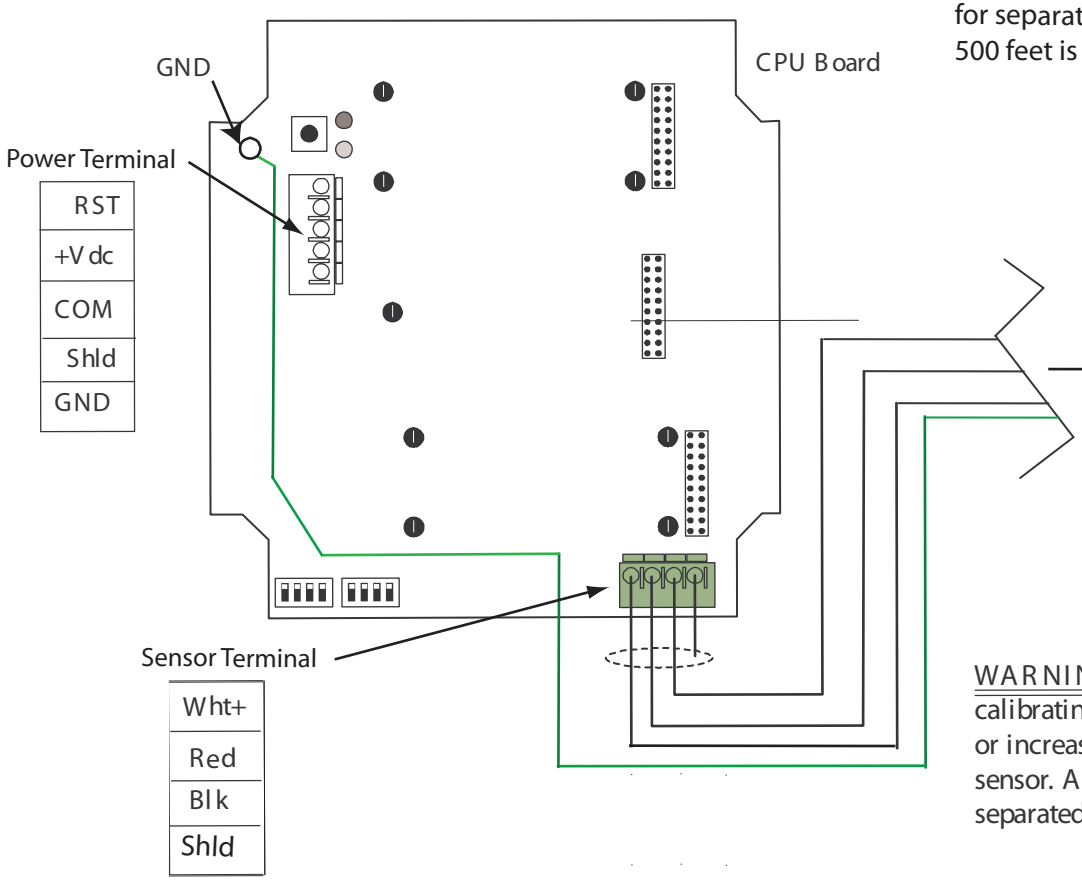
Use appropriate wire for Class 1/Division 2, hazardous applications.

Table 2: Sensor wires and function

Sensor wires	Function
White	+V dc
Red	Signal
Black	- (COM)
Green	Ground

WARNING: Ensure grounding wire is attached to the ground (GND) screw inside the junction box.

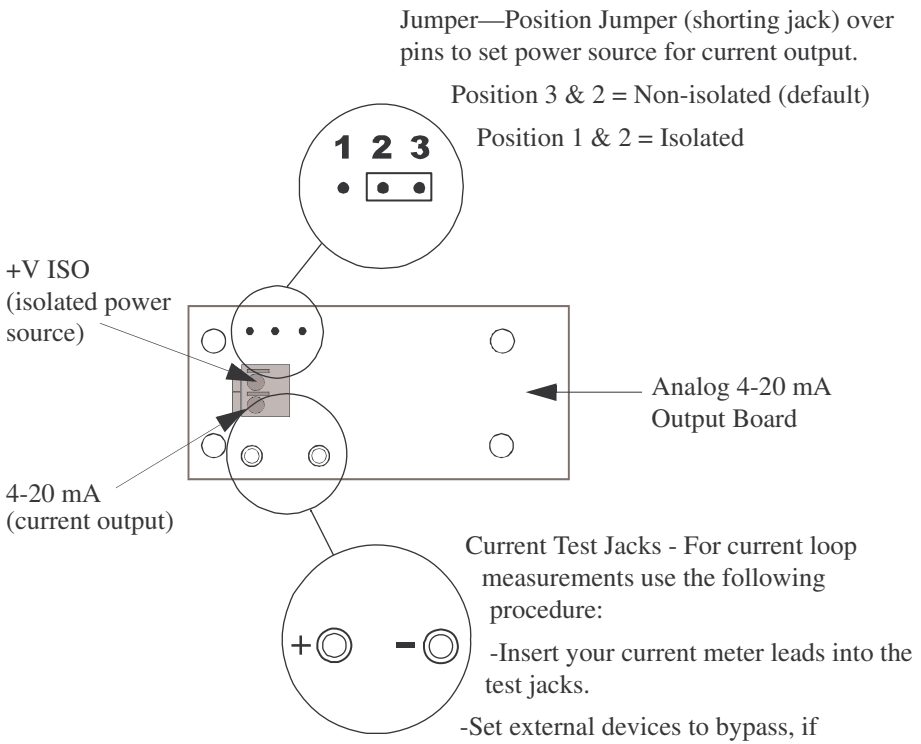
Figure 5: Wiring—Sensor Separation



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

WARNING: To compensate for 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 by applying gas at the sensor (not separated).

Figure 6: Jumper Position and Test Jacks—Analog Board



Set Non-Isolated/Isolated Current Output

The Gas Shield is capable of providing an isolated power source when the Analog Output Board is installed. To set isolated, simply move the Jumper (shorting jack) to the isolated position and apply power to +V-Iso to power the current loop output (refer to Figure 6, "Jumper Position and Test Jacks—Analog Board" for pin positions).

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

Current Loop Measurement (Test Jacks)

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

Table 3: Status LEDs and Current Output

		STATUS LED	
State	**Current O/P**	**RED or GREEN**	
Start-up delay / warm up	3 mA	Slow flash	
Normal	4 mA		Blip/ Blink
Memory Error (contact factory)	* 2.5 mA	Fast Flash	
Sensor lead open	* 2.5 mA	Fast Flash	
Setting Zero	3 mA		Solid
Apply Calibration Gas During Calibration	3.3 mA	Fast Flash	
Span is set, remove gas	3.6 mA		Solid
Return to Normal operation	4.0 mA		Blip/Blink
Gas present	>4.0-20.00 mA	Blip/ Blink	
Fail Calibration	3.0 to 3.3 mA	Flash	Flash

* A 22 mA option is available for Memory Error and Sensor lead open output.

Remote Reset

The Gas Shield has a remote reset connection. A normally open Push Button must be connected between the RST terminal and the COM terminal and the relay latch status set to Latching. When the switch is pushed the unit will reset.

STEP 4 — OPERATE

CONTROLLER - SENIOR

Figure 7: Senior Controller Functionality

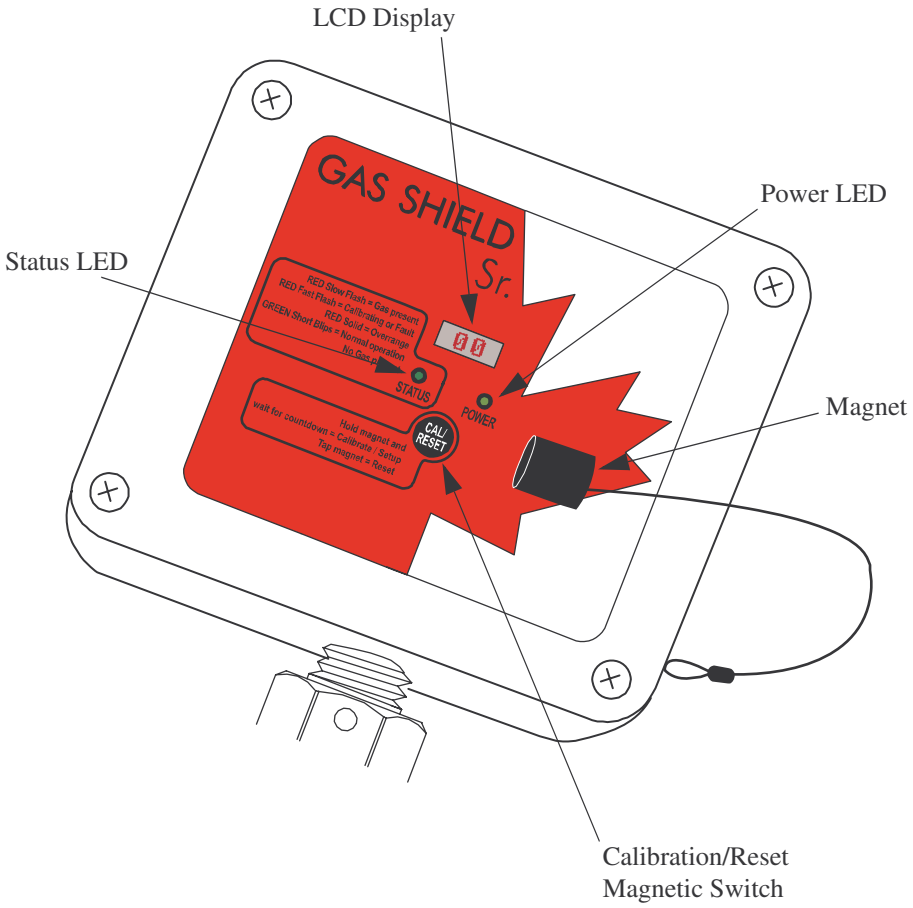


Table 4: Display Messages — Senior

State	Alphanumeric Display	
	Toxic Sensors	Oxygen Sensor
Start-up delay (approximately 90 seconds for electrochemical sensors and 15 min for solid state sensors)	`Start Delay Gas Shield Net Safety`	
Prompt to begin calibration procedure or New Sensor electronics with no data	`Calibrate Sensor`	
Sensor communication error	`Sensor Communication Fault`	
Auto zero set	`Apply Clean Air`	
Apply calibration gas	`Apply XX ppm`	`Apply 21% Air`
Calibrating Sensor	`Calibrating`	
Span is set, remove gas	`Remove Cal Gas`	
Return to normal operation	`Cal Complete`	
Normal	`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

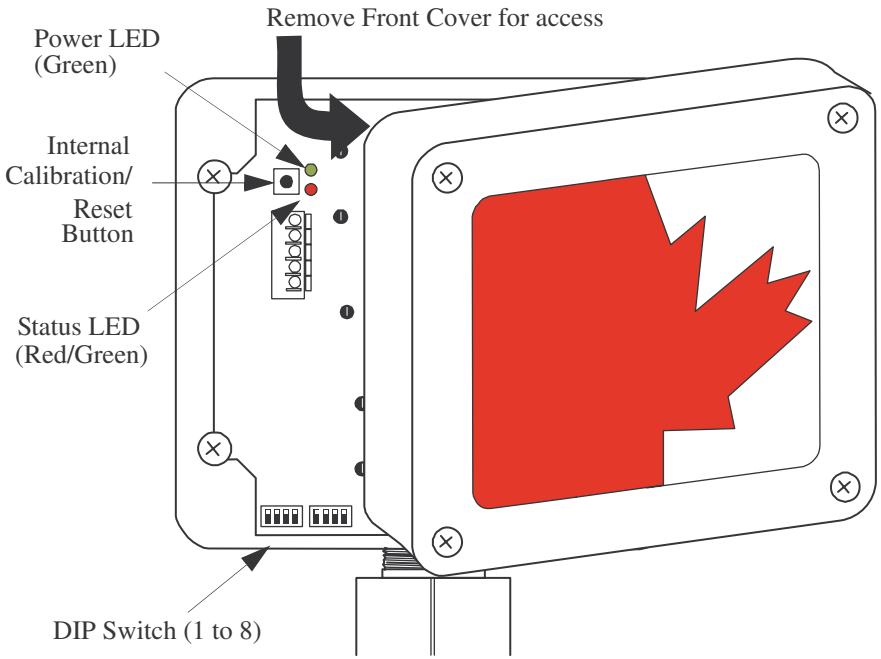
A magnet is used to access menus for setup and calibration as well as for clearing latched alarms.

Hold the magnet on **CAL/RESET** to access the menus.

Tap the magnet on **CAL/RESET** to make a selection or clear a latched alarm.

CONTROLLER - JUNIOR

Figure 8: Junior Controller Functionality



INTERNAL CALIBRATION/RESET BUTTON - JUNIOR

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 and monitor. Refer to the Status LEDs and, if available, current loop measurements to monitor state. See Table 3, "Status LEDs and Current Output", on page 8.

POWER UP

Junior

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, output will be 3.0 mA and the Status LED will Red Slow Flash. After the Start-up Delay, the Controller will enter normal operation.

Senior

When power is first applied, a warm-up routine will begin (approximately 90 seconds for electromchemical and 15 min for Solid State sensors). During this time, the message **`Start Delay Gas Shield Net Safety`** displays, the Status LED will Red Slow Flash and output is 3.0 mA. After the Start-up Delay the Controller will enter normal operation.

ALERT: To avoid immediate alarms, biased Ammonia, Vinyl Chloride and Solid State sensors MUST Bypass the main system during start up and remain in Bypass until the first site calibration is complete (approximately 24 hours after start up). A calibration should be done after 24 hours to ensure full stabilization for normal operation.

MAIN MENU - SENIOR

Depending upon which Output Board is installed, the Senior Gas Shield 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.
4. A selection is acknowledged by a flashing **`YES`** on the display.
5. If no options are selected, the unit will return to normal operation.

Select Display Language - Senior

Step:1 When **`Select Display Language`** displays tap the magnet on **CAL/RESET**.
The flashing **`YES`** confirms the selection.

Step: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

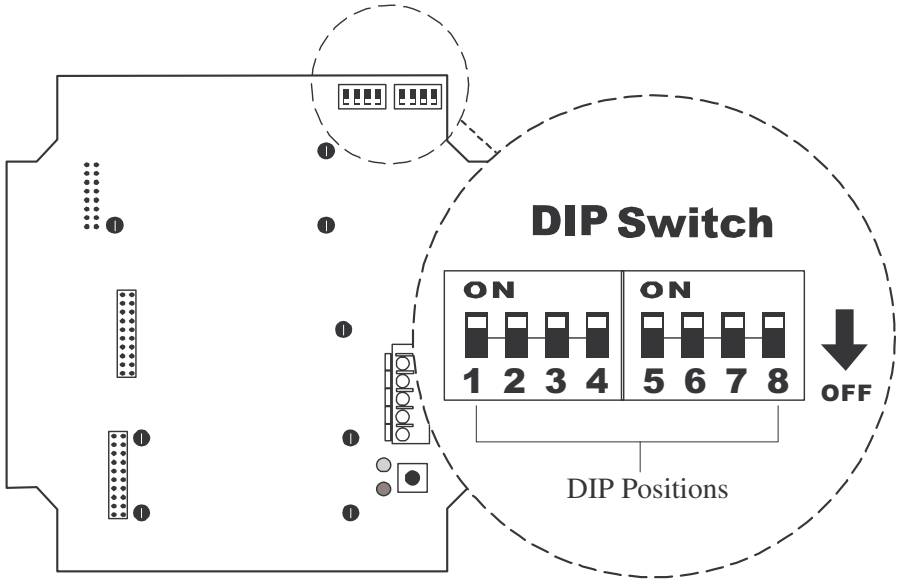
With the exception of DIP Switch Position 8, DIP Switch settings apply only to the Gas Shield Junior and are used to define relay/alarm settings.

DIP 3 through 7 are turned ON or OFF, in combination, to set Alarm levels.

Refer to Table 5, "DIP Switch Settings - Toxic Sensors", on page 11 for specific settings.

EXCEPTION:OXYGEN sensors have specific settings. Refer to Table 6, "DIP Switch Settings - OXYGEN Sensor", on page 12 for settings.

Figure 9: DIP Switch Location



DIP Switch - TOXIC Sensor

Table 5: DIP Switch Settings - Toxic Sensors

DIP Switch	Setting		Function/Explanation
Position 1	ON	Energized	Coil Status
	OFF	De-energized (default)	
Position 2	ON	Latching	Latch Status
	OFF	Non-Latching (default)	
Position 3	ON	32	Alarm #2 Alarm #1*
	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	

* The Alarm #1 is automatically set to half of Alarm #2.

**Defaults determined by % of full scale for the different sensors.

Note: Refer to "Alarm Settings - Senior" on page 17 for details on setting Senior relay/alarms settings.

DIP Switch - OXYGEN Sensor

Table 6: DIP Switch Settings - OXYGEN Sensor

DIP Switch	Setting		Function/ Explanation
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	

Note: For the GS2 Junior, the maximum Alarm #2 setting available is 62% of full scale (for example, at a scale of 50 ppm the maximum Alarm #2 available is 62% or 31 ppm).

ALARM SETTINGS - JUNIOR

To set Alarm Settings for the Junior Gas Shield the DIP Switch must be set. Refer to " Relay Options" on page 11 for location and instructions for setting DIP switches.

Note: Alarm Settings apply to the Junior model using a Relay board only.

Set Energized/de-energized
Set DIP Switch Position 1 to ON for Energized.
Set DIP Switch Position 1 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 9, "DIP Switch Location", on page 11 for location of DIPs.

Set Alarm #1

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

EXCEPTION: OXYGEN sensors use DIP Positions 3, 4 and 7 to set Alarm #1 below 20.9. ON/OFF combinations produce a Step of 1%.

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 OFF setting always equates to 0). The values set on each position are added to obtain the Alarm #2 alarm level. Refer to the example below.

EXCEPTION: OXYGEN sensors use DIP Positions 5, 6 and 7 to set Alarm #2 above 20.9. ON/OFF combinations produce a Step of 0.5%.

Example: Setting Alarm #1 and #2 - Toxic

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 position 7 set to 0 (OFF). The total Alarm #2 Point would be 44% of the scale (the combined total of the ON position settings) and Alarm #1 would automatically be set to 22% .

ALARM SETTINGS - SENIOR

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 Alarm #1 level for Alarm #1 are set first and then Alarm #2 coil energization, latch status and Alarm #2 level.

Step 1: Enter Main Menu (refer to "Access Main Menu - Senior" on page 10).

Step: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.

Step 3: The message **`Alarm #1`** displays.

Step 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 retained.

Step 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**.
The flashing **`YES`** confirms the selection. If nothing selected, previous setting retained.

Step 6: 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.

Step 7: The message **`Alarm #2`** displays.

Step 8: As for Alarms #1, select the Coilt Status and then Latch Status for Alarm #2.

Step 9: 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, nor higher than 100% of the maximum range.

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

Note: Alarm levels are based on sensor range at 1 point less than maximum range.

STEP 5 — CALIBRATE

Once the Controller and Sensor have been wired and powered up, Sensors require a warm-up period. Approximately 24 hours after power up, check the calibration and repeat if necessary. If a sensor requires more or less then 24 hours to warm-up, it will be specified in this manual.

The Gas Shield must be calibrated using the specified ppm/ppb range, 0.5 litres per minute, with gas of concern. (Confirm the gas concentration required by referencing the Calibration Gas label on the sensor housing.) 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 or an isolated supply.

Note: Ammonia (NH3) - Apply 50 ppm calibration gas when calibrating Ammonia sensors (range 50ppm or 100ppm).

Note: OXYGEN O_2- When calibrating O_2 use 20.9% certified calibration oxygen or ambient air confirmed at 20.9% oxygen.

If the calibration procedure is not performed correctly, the Gas Shield Status LED alternates Red and Green and the analog output changes back and forth from 3.0 to 3.3 mA. The unit will remain in this state until acknowledged by a Manual Reset (refer to "Manual Reset - Junior" on page 17). After Manual Reset the unit will return to the normal operation using previous calibration values. Always verify calibration by re-applying using the same gas.

The calibration procedure requires about 3 minutes to complete. If gas is not applied at the appropriate time, a calibration failure may occur (refer to "Calibration Failure - Junior" on page 17 and "Calibration Failure - Senior" on page 17 for specific information).(this also applies to Chlorine sensors although they are not biased).

An Ozone generator must be used for OZONE (O_3) Sensor calibration. Only use Teflon or Tygon® E-200 tubing. Range is measured in ppb (parts per billion).

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 units into system 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, 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 ammonia or interfering gases. If in doubt, use a portable detector.
- Humidity levels in the surrounding air during Sensor calibration should be similar to those expected during normal operation.
- DO NOT use bottled dry air as the zero reference when calibrating Ammonia or Vinyl Chloride sensors—use ambient air. When clean ambient air at the sensor is confirmed, begin calibrating as described in the following instructions. The system will use the ambient air reading as the zero setting after which the specific calibration gas can be applied at a flow rate of 0.5 litres per minute.
- Re-calibrate three weeks after initial calibration; then begin regular maintenance cycle.

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 by applying gas directly at the sensor (not separated).

Note: Solid state sensors may require up to 1 hour to stabilize and allow transmitter to go into normal operation.

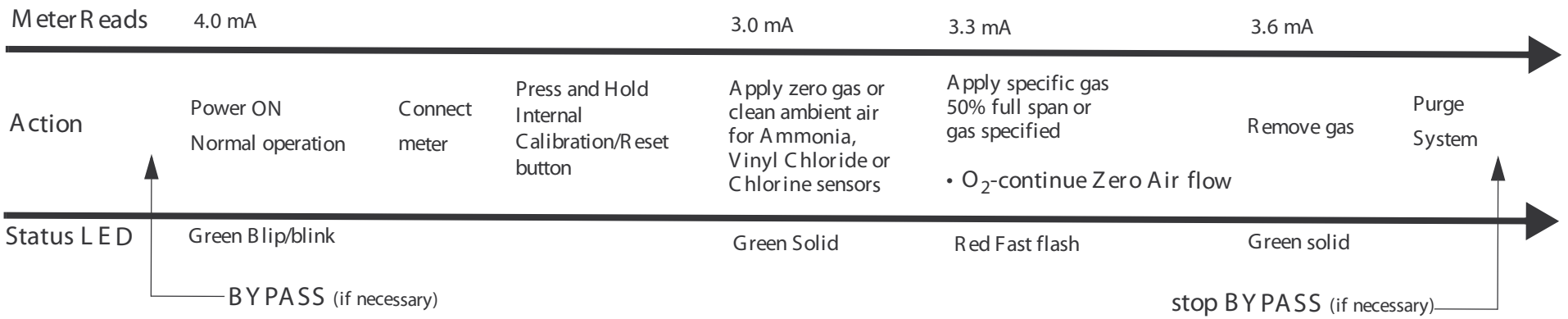
Calibration Procedure - Junior

1. Confirm successful power up of Controller—Status LED Green Blip/blink; no fault indicated.
2. Connect a standard current meter to the Controller's Test Jacks (if analog board installed).
3. Press and hold the Internal Calibration/Reset button for approximately10-15 seconds. The Status LED will begin blank, go Solid Red and then Solid Green. Release on the Solid Green.
4. When 3 mA displays and Status LED is Green Solid, apply zero gas—Ammonia/Vinyl Chloride/Chlorine sensors use clean ambient air ONLY (refer to"Electrochemical Biased and Solid State Sensors—AMMONIA AND VINYL CHLORIDE" on page 14 for further information).
   Recommendation: For other sensors flow certified ZERO AIR at a rate of 0.5 litres per minute using a calibration cup.
5. When Status LED changes to Red Fast Flash and output reads 3.3 mA, apply specific gas at ppm/ppb range specified. During gas application, LED will Red Fast flash. For O_2 continue to apply Zero Air.
6. Continue to apply gas until span is set—indicated by Status LED Green Solid and a current output of 3.6 mA. Remove gas.
7. Apply zero gas (clean air) to purge system.
8. Controller will return to normal operation (Status LED Green, Blip/blink and current output 4.0 mA).

Note: If the calibration procedure fails, the Status LED alternates Red and Green and the analog output changes back and forth from 3.0 to 3.3 mA. The unit will remain in this state until acknowledged by a Manual Reset (refer to "Manual Reset - Junior" on page 17). After Manual Reset the unit will return to the normal operation using previous calibration values.

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

Figure 10: Calibration Procedure—Junior

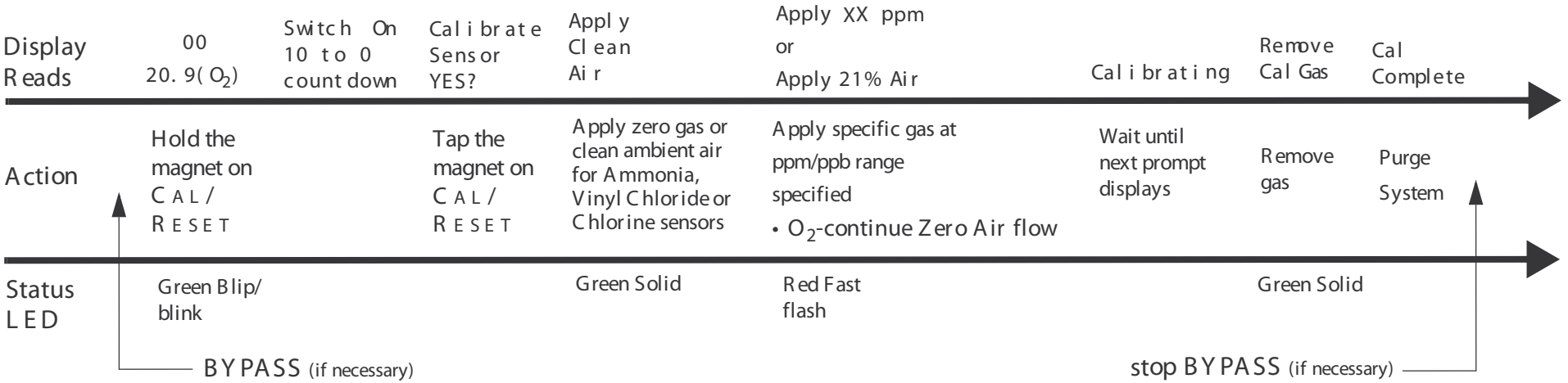


Calibration Procedure - Senior

1. Confirm successful power up of Controller—no fault indicated.
2. Hold the magnet on CAL/RESET.
3. Switch On will display and a countdown, 10 to 0, will begin.
4. When Calibrate Sensor YES? displays, tap the magnet on CAL/RESET. The controller begins calibration.
5. When Apply Clean Air displays and Status LED is Green Solid, apply zero gas (clean air)—Ammonia/Vinyl Chloride/Chlorine sensors use clean ambient air ONLY (refer to"Electrochemical Biased and Solid State Sensors—AMMONIA AND VINYL CHLORIDE" on page 14 for further information).
   Recommendation: For other sensors flow certified ZERO AIR at a rate of 0.5 litres per minute using a calibration cup.
6. Follow the display instructions to calibrate the unit:
   When Apply XX ppm displays apply specific gas at ppm/ppb range specified. For O_2, the message Apply 21% Air displays...continue to apply Zero Air.
7. Calibrating displays once gas is detected (Status LED Red Fast flash).
8. When Remove Cal Gas displays remove Span Gas (Status LED Green Solid).
9. When Cal Complete displays calibration is complete. Unit will return to normal operation.
10. Apply zero gas (clean air) to purge system.

Note: If span setting does not complete successfully within ten minutes of starting the calibration sequence Span Failed will display. The unit will remain in this state until acknowledged by a Manual Reset (see "Manual Reset - Senior" on page 17). After Manual Reset the program will return to normal operation using previous calibration values.

Figure 11: 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. The unit remains in this failed state until manually reset.

Calibration Failure - Senior

If the calibration procedure fails, the display reads **`Span Failed`**, the Status LED alternates Red/Green Flashes and output changes back and forth from 3.0 to 3.3 mA. The unit remains in this failed state until manually reset.

Manual Reset - Junior

A Manual Reset is required after a calibration failure or to clear an 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 calibration values.

Remote Reset

Refer to "* A 22 mA option is available for Memory Error and Sensor lead open output." on page 8 for details.

ALARM SETTINGS - SENIOR

Review Relay Settings - Senior

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 and the relay settings are displayed.
3. The Fault, Alarm #1 and Alarm #2 settings will display.

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

The Gas Shield 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 failure, 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
   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 7: Part Numbering

Net Safety Part Number	Description
GS2-ANLG-KIT	Replacement Analo Board
GS2-RLY-KIT	Replacement Relay Board
GS2-DISP-KIT	Replacement Display Board
PCB-0252E	Connector Board
ST7201-20/50/100	Hydrogen Sulfide H2S (0-20/50/100 ppm)
ST7250-10	Hydrogen Flouride HF(0-10 ppm)
ST7270-20	Hydrogen Chloride HCl (0-20 ppm)
ST7290-10	Hydrogen Cyanide HCN (0-10 ppm)
ST7300-20	Sulphur Dioxide SO2 (0-20 ppm)
ST7300-100	Sulphur Dioxide SO2 (0-100 ppm)
ST7400-25	Oxygen Difiency O2 (0-25%)
ST7410-1	Ozone O3 (0-1 ppm/100 ppb)
ST7500-10	Chlorine Cl2 (0-10 ppm)
ST7510-1	Chlorine Dioxide ClO2 unfiltered (0-1 ppm)
ST7511-1	Chlorine Dioxide ClO2 filtered (0-1 ppm)
ST7600-500/1000	Carbon Monoxide CO (0-500/1000 ppm)
ST7700-50/100	Ammonia NH3 (0-50/100 ppm)
ST7710-100	Nitric Oxide NO (0-100 ppm)
ST7720-10	Nitrogen Dioxide NO2 (0-10 ppm)
ST7800-20	Vinyl Chloride C2H3Cl (0-20 ppm)
Magnet-1	Magnet Assembly
CCS-1	Calibration Cup
JB-MPNS-A/S	Aluminium/ Stainless steel JBox no switch

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
- Enure 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 (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 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-T90	<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.

Sensor Specification (Solid State)

Sensor Element	**Ammonia NH_3 (ST7701)**											
Range of Detection	0-50/100/ 300ppm											
Linearity	3% (50ppm), 4% (100ppm), 5% (300ppm)											
Span Drift	2% of Full Scale/ Month											
Response Time	50ppm<1 Minute 100ppm<90 Seconds 300ppm<2 Minutes											
Operating Temperature Range	-40°C to +50°C (-40F to 122F)											
Humidity Range	15-90% non-condensing											
Enclosure Material	Anodized 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	Less than 2W											
Certifications	**CSA Field Certification for General Purpose location only.** **Not intend for use in Hazardous Locations.**											

Controller Specification

Gas Shield Controller	JUNIOR		SENIOR		
	Analog	**Relay**	**Analog**	**Relay**	**Analog & Relay**
Operating Voltage Range	10.5 to 32.0 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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