LI-ION TAMER GEN 2+ OFF-GAS MONITOR (LT-SEN-M) USER MANUAL

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WARNING: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual may cause interference to radio communications. It has been tested and found to comply with the limits for class A computing devices pursuant to Subpart B of Part 15 of FCC Rules, which is designed to provide reasonable protection against such interference when devices are operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user will be required to correct the interference at his or her own expense.

Canadian Requirements

This digital apparatus does not exceed the Class A limits for radiation noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le present appareil numerique n'emet pas de bruits radio-electriques depassant les limites applicables aux appareils numeriques de la classe A prescrites dans le Reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

China RoHS Hazardous Substance Table

Component Name	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Chromium VI Compounds (Cr6+)	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
Monitoring Sensor, Gen2+	X	0	0	0	0	0
This table is prepared in accordance with the provisions of SJ/T 11364.						
0: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.						
X: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is above the limit requirement of GB/T 26572.						

- EPUP 10 years
- All other components, not listed in the table, do not contain restricted substances above the threshold level.

This symbol on our product shows a crossed-out "wheelie-bin" as required by law regarding the Waste of Electrical and Electronic Equipment (WEEE) disposal. This indicates your responsibility to contribute in saving the environment by proper disposal of this Waste i.e. Do not dispose of this product with your other wastes. To know the right disposal mechanism please check the applicable law.

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1 General

1.1 Scope

This document provides specification details of the Li-ion Tamer® GEN 2+ Off-Gas Monitor (OGM) and is intended to aid users in installation, operation, and maintenance.

1.2 Product Use Cases

The Li-ion Tamer GEN 2+ OGM is intended to be used as a signalling device that will provide a signal to battery control systems, such as the Battery Management System (BMS) or Energy Management System (EMS), and/or to a fire alarm control unit. It is not a standalone device and must be used with a compatible UL 864 listed control device (Honeywell LT-SEN-IM).

The alarm notification from this sensor should be used to electrically isolate the batteries, typically via a BMS or EMS, and activate emergency ventilation, typically via a fire alarm control unit, in accordance with relevant codes and regulations. In the case of emergency ventilation, the GEN 2+ OGM is permitted to serve as the primary means of activation and may be applied as part of an overall safety system for UL 9540.

1.3 Applications

The Li-ion Tamer GEN 2+ OGM is applicable to the following industries and key applications:

Industry Type	Key Applications
Stationary Battery Energy Storage (BESS)	• Containerized/ modular systems • Battery rack cabinets
Data Centers	• Battery UPS (deployed in form factors listed above)

It is not listed for use in residential applications.

1.4 Key Features

- Early warning of lithium-ion battery failures
- Provides a barrier to thermal runaway with proper mitigation actions
- Single cell failure detection without electrical or mechanical contact of cells
- Extended product lifetime
- Calibration-free product
- Highly reliable output signal
- Low power consumption
- Compatible with all lithium-ion battery form factors and chemistries
- Easy installation
- Independent and redundant perspective on battery health
- Auto diagnostic capabilities
- Reduction/ removal of false positive signals

1.5 Certifications and Compliance

The GEN 2+ OGM has been designed and tested to meet the following certifications and regulatory requirements:

- UL 2075 Recognized for H_2 detection (see Section 2.3)
- ETL listed to UL 61010 and CSA 22.2 NO. 61010 for product safety

- EN 61326 for EU Directive (2014/30/EU)
- RoHS 3 EU 2015/863
- CE
- UKCA
- FCC

1.6 Codes, Standards or Regulations

The GEN 2+ OGM is to be installed in lithium-ion battery systems according to the following codes and regulations:

- Any national or international standards or fire codes that require detection of flammable gases (H_2) at or below 10% of the LFL (ex. NFPA 855/ NFPA 69).
- Local codes and standards

1.7 Quality Assurance

1.7.1 Manufacturer

The manufacturer has an ISO 9001:2015 registered quality system and is committed to achieving the following objectives:

- Development of innovative process and product solutions.
- On-time delivery of products and services to our customers.
- Provide for the safety and empowerment of our team members.
- Continual improvement of operations and our quality system.

1.7.2 Equipment Supplier

- The equipment supplier shall be authorized trained by the manufacturer to calculate/design, install, test and maintain the Li-ion Tamer GEN 2+ OGM.
- The equipment supplier shall be able to produce a certificate of training from the manufacturer.

1.7.3 Installer

- The equipment installer shall be authorized and trained by the manufacturer and shall have the ability to design a system based on code requirements.
- The installer shall be capable of providing calculations, design, and testing documents upon request.

1.7.4 Warranty

- The manufacturer shall guarantee the product by warranty for a period of one year with a target lifetime of ten years.

1.7.5 Training

- The manufacturer or agent of the manufacturer shall train all personnel involved in the supply, installation, commissioning, operation and maintenance of the GEN 2+ OGM. Contact a Honeywell/ Xtralis or Nexceris representative to arrange training sessions.

1.8 Documentation

The following documentation shall be supplied by the manufacturer:

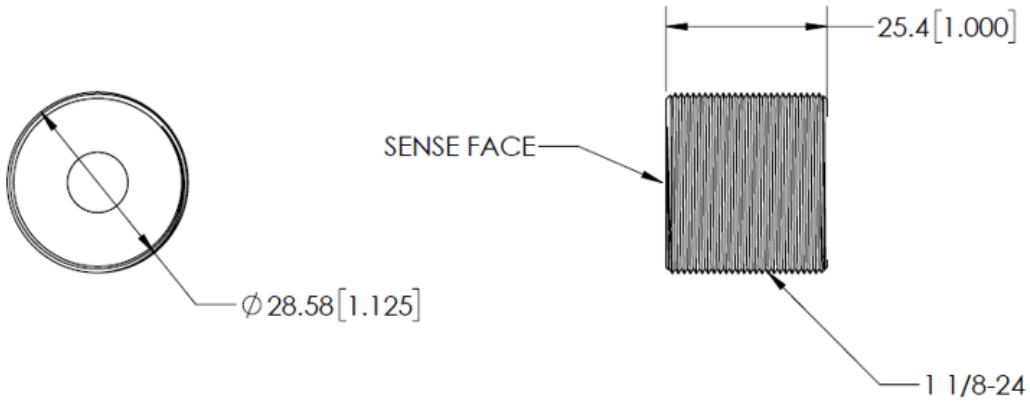
- Product technical datasheets and site layout drawings for sensor placement, when applicable.
- The manufacturer’s signal integration, operation and maintenance manuals shall be supplied to all installing and purchasing parties.
- The manufacturer’s commissioning manual shall be supplied to all suppliers and commissioning parties.

2 Off-Gas Monitor Specifications and Operation

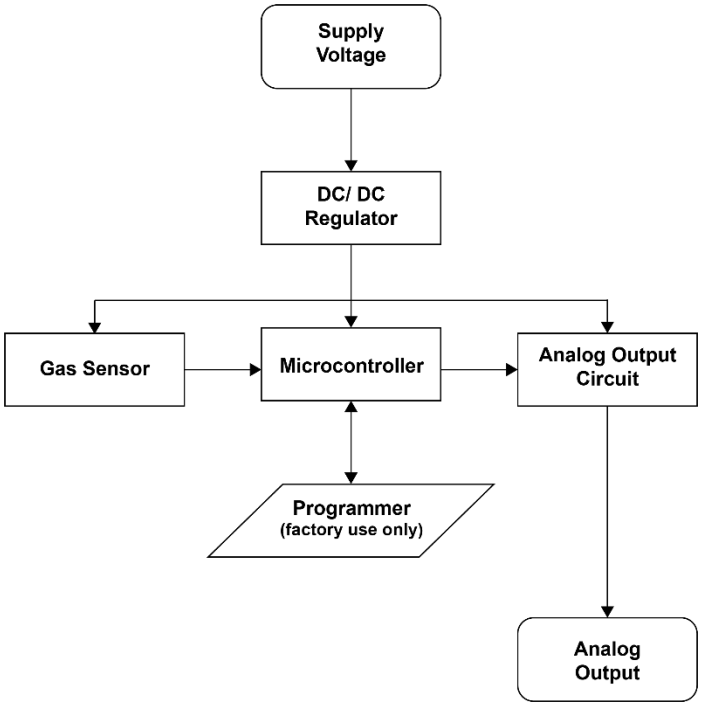
2.1 Construction

The OGM is commonly referred to as the Monitoring Sensor and is available from Honeywell/ Xtralis and the associated channels as (**LT-SEN-M**).

The sensor dimensions are shown below in mm [inches]:



A simplified function model of the off-gas monitor is depicted below. Note that all programming is performed by the manufacturer.



2.2 Detection Method and Output

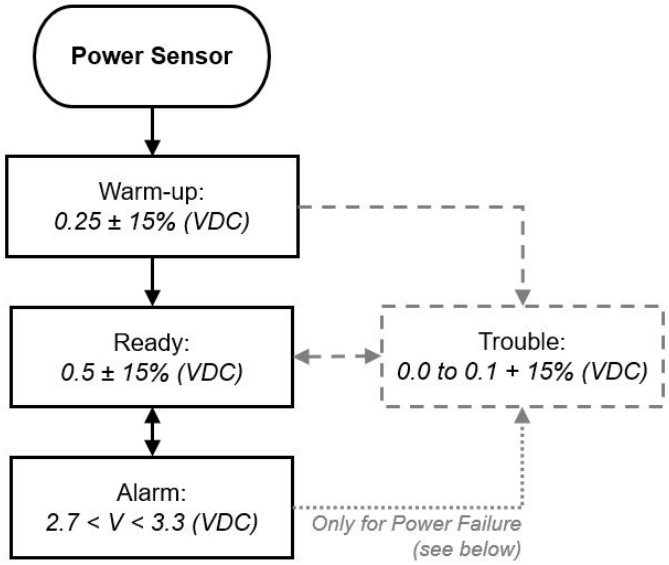
The detection method for all off-gas monitors is as follows:

1. Raw sensor signal is gathered as a continuous function.
2. Proprietary Li-ion Tamer Event Detection Algorithm processes the signal with a discrete algorithm function indicating event detection. Operates on a gas concentration rate of rise principal.

The gas detection specifications are as follows:

1. Listed for use with Hydrogen (H_2) gas – more details in section 2.3.
2. Minimum response time of 5 seconds
3. Single-cell failure fault detection capabilities

The off-gas monitor expected output signal is depicted below:



To properly integrate the sensor signal(s), the control device must be capable of distinguishing, at a minimum, between the states detailed above. The voltage states above account for standard tolerances, effects of cable length, wire gauge, and power supply voltage. Note that the warm-up state lasts 20 minutes after powering.

The fail-safe and self-diagnostic capabilities allow for the fault conditions detailed below to be detected, activating the Trouble output shown in the diagram above.

Fault Category	Potential Detectable Failures
Power failure (0.0 VDC) *Not shown in diagram above*	• Loss of power to device • Loss of internal DC/DC regulation • Failure of A/D output • Failure of critical component on circuit board • Component failure on output circuit
Signal out of range (0.1 VDC)	• Gas sensor signal resistance above maximum threshold • Gas sensor signal resistance below minimum threshold • Loss of sensor continuity • Failure of sensor heater • Failure of communication between sensing element and microcontroller

2.3 Sensitive Gases

The following is a list of common gases/compounds emitted by lithium-ion batteries that Li-ion Tamer is sensitive to:

- Hydrogen (H_2) –sensor provides detection of hydrogen at or below 10% of the LFL
  - Minimum Gas Rate: 10 ppm/sec
  - Maximum Gas Rate: 400 ppm/sec

Note that the sensor can respond to gas generation rates greater than this level, but this is the maximum recommended rate of change in accordance with sensor response time and adherence to NFPA 855/ NFPA 69 code requirements of activation prior to 10% of LFL concentration (4000 ppm H_2).

2.3.1 Potential Interfering Gases

The following is a list of gases/compounds that may be present in the application environment that Li-ion Tamer is sensitive to, and therefore should be avoided to prevent nuisance alarms:

- Ethyl Acetate
- Ethanol
- Acetone

2.4 Power Consumption

The power consumption requirements are detailed below:

Power Consumption Specifications	
Input Voltage	5 - 12 VDC ± 10% (5 VDC nominal)
Power Consumption Maximum	15 mA (200mW @ 13.2 VDC)

2.5 Environmental Specifications

The environmental operating conditions are detailed below. Operating outside of the specified ranges may lead to decreased performance and part damage.

Environmental Specifications	
Condition	**Specification**
Temperature	-40 to 50°C
Humidity	5 to 90% RH (non-condensing)
Storage Temperature Humidity	5 to 30°C, 10 to 80% RH
Pressure	95 to 110 kPa
Maximum Temperature Change	8.6°C/ min

3 Application

The following is a guideline for sensor placement. Precise location and orientation are to be determined by a trained Xtralis representative upon installation.

The OGMs must always be mounted in the pathway of gases exhausted from the batteries. Both the HVAC design and, in the case of air-cooled battery racks, the rack-level air flow will always coincide with generate **"hot" and "cold" aisles**. The cold aisle is defined as the location where fresh air enters the battery system, prior to passing through the battery racks. The hot aisle is defined as the location where exhaust air from the battery racks is expelled and then returned to the HVAC units. Therefore, the **OGMs should only be located in the hot aisles** to reliably detect gas from the batteries.

Several examples of potential rack-level air flow patterns and their corresponding sensor placement and orientation are shown below:

Example #1

Type: air enters from the back of the rack and exits out the front

Sensor placement: top front of the rack

Sensor orientation: sensing face pointing down (±45˚)

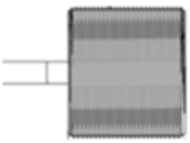
Sensing face
Pointing down

Example #2

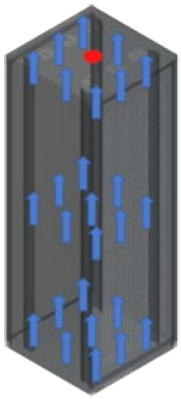
Type: air enters from the top of the rack and exits out the bottom

Sensor placement: bottom center of the rack

Sensor orientation: sensing face pointing at 90˚ to vertical (±45˚)



Sensing face
Pointing horizontal

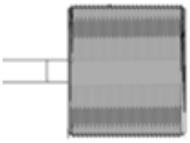


Example #3

Type: air enters from the bottom of the rack and exits out the top

Sensor placement: top center of the rack

Sensor orientation: sensing face pointing at 90° to vertical (±45°)



Sensing face
Pointing horizontal

4 Installation, Operation and Maintenance

4.1 System Installation

All installation should be performed by a trained Xtralis representative. The following steps outline the installation process:

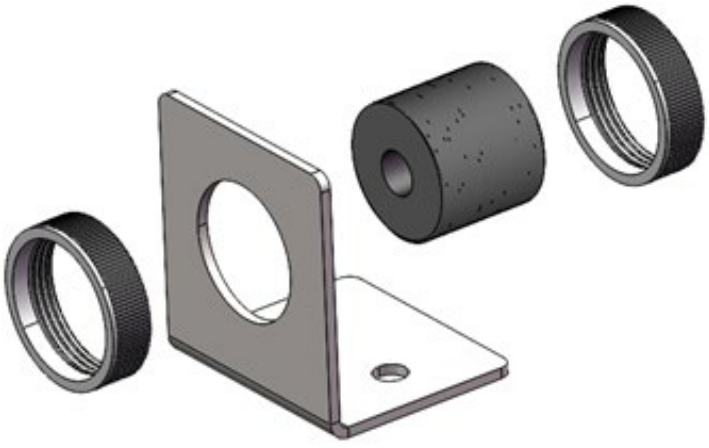
1. Mount sensors (off-gas monitors).
2. Route cables.
   - If applicable, locate the main cabling distribution area close to the central region of the installation site to minimize the cable distances.
   - Avoid mounting the cabling components in places that block accessibility to other equipment (such as a power strip or fans) in and out of the racks.
   - Label the cables with their destination at every termination point (to ensure that both the ends of the cable are labeled for identification and traceability).
   - Test every cable during installation and termination. If a problem occurs, tag the malfunctioning cables and separate them out.
   - Avoid exposing cables to areas of condensation and direct sunlight.
   - Utilize cable trays whenever possible.
   - Provide strain-relief when mounting cables to prevent connection issues.
   - Observe all recommended practices from the cable manufacturer including bend radius, etc.
3. Wire sensor to an appropriate control device.

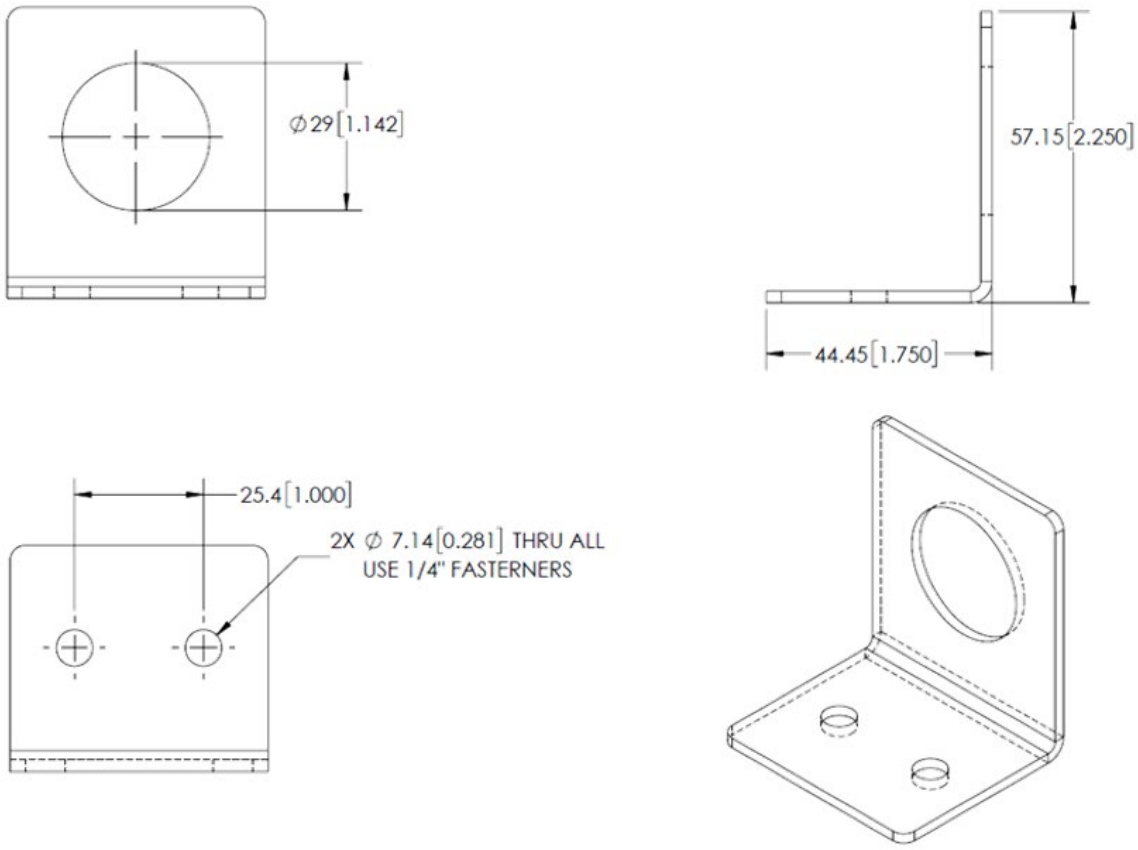
   WARNING: Ensure that cables are not in tension when connected to the sensor. Make sure to provide enough slack to avoid potential damage.
4. Follow the commissioning process.

4.1.1 Sensor Mounting

The GEN 2+ OGMs can be mounted using one of two methods: option 1 is to create a through-hole on the panel that the sensor is to be mounted on, as for option 2, depicted below, is to use the supplied mounting bracket. The following procedure should be followed:

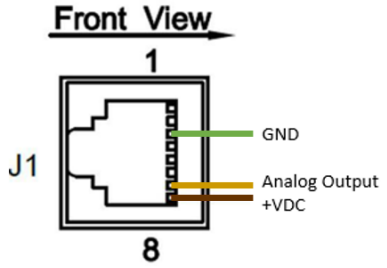
1. Fasten mounting bracket in position determined in the system layout.
2. Secure sensor to bracket using the supplied 1 1/8-24 mounting nuts.
3. Hand tighten nuts to secure the sensor to the bracket.





4.1.2 Wiring and Signal Integration

The pinout of the sensor's female RJ45 port is detailed below:

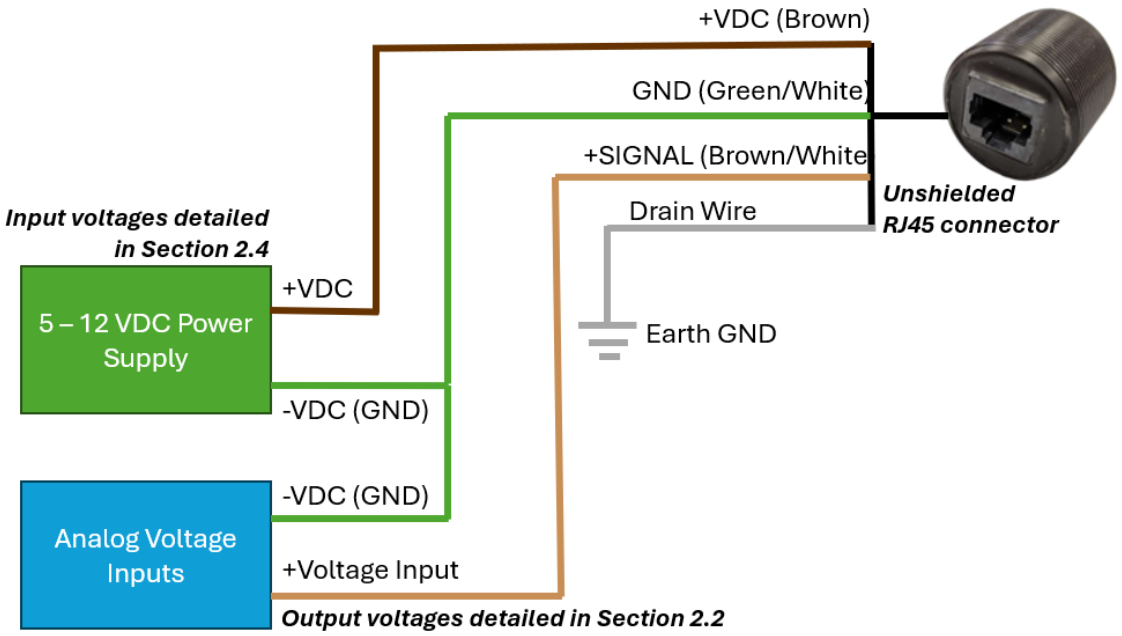


RJ45 Pin	Pin Definition
3	GND
7	Analog Output
8	+VDC

The requirements for cables used in this application are as follows:

- Must have at least one end terminated with a male RJ45 connector that is ***unshielded***.
  - Termination type on the opposite end may vary but must follow the pinout provided.
- Must be Cat 5e or Cat 6a, straight through, ***shielded*** (at least S/UTP), 24 – 26 AWG cable.
  - If using a double-terminated RJ45 cable, the connector plugged into the sensor must be ***unshielded*** and the connector plugged into the interfacing device must be ***shielded***.
- Must allow for connection of drain wire or shielding to earth GND.
- Maximum cable length 15.2m (50ft).

An example wiring diagram is shown below:



Note that the conductor color coding follows typical T568B pinout.

4.2 System Commissioning

The installer shall:

1. Confirm proper earth grounding by measuring resistance between RJ45 connector and earth ground.
   - Use a multimeter or an equivalent device to check the effectiveness of the connectivity between the different parts of the installed equipment to the ESS ground.
   - Using IEEE Std 142-2007 “Recommended Practice for Grounding” and IEEE Std 1100-2005 “Recommended Practice for Powering and Grounding Electronic Equipment”, the ideal grounding value would be less than 1Ω from the equipment into the Earth.
   - Recommended ground resistance measurements for Li-ion Tamer are **less than 25Ω** from the RJ45 connector to earth ground.
2. Conduct Gas bump tests to verify sensor performance, per standard procedure in section 4.2.1.

4.2.1 Bump Test Procedure

This section describes how to perform a bump test for commissioning and maintenance procedures. Bump testing is the process of exposing the gas sensor to a known concentration of reference gas that is of sufficient concentration to alarm the sensor. Follow the procedure below to correctly test sensors.

Required Materials for Testing:

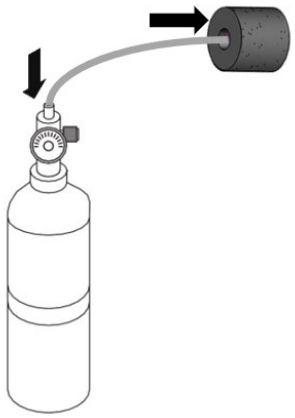
- 1000ppm H_2 Calibration Gas Balance Air
- Gas Regulator (must be minimum 0.5 lpm)
- Gas Tubing (vinyl is recommend) – maximum OD of 5/16 inch (~8mm)
- Safety Glasses (recommended)

Notes!

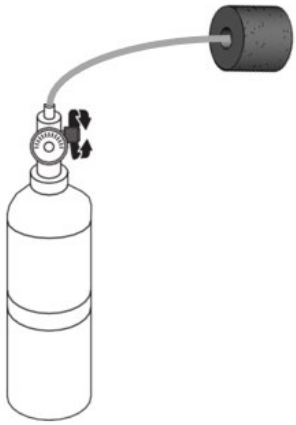
- Always use a flow regulator, tubing and fittings appropriate for the type of gas being applied.
- Always use a gas cylinder that is within its expiration date.
- Example Gas Suppliers: Calgaz (https://calgaz.com/), Cal Gas Direct (https://www.calgasdirect.com/)

How to Use:

1. Insert the tube from the calibration gas cylinder into the sensing face port on the sensor.



2. Refer to the regulator manufacturer for instructions on how to start and stop the gas flow from the cylinder.



3. Expose sensor to gas at a constant flow rate for 30 seconds.
   Flow rate and tubing length must be considered to ensure that the sensor is exposed to H_2 for the full duration.
4. Observe sensor response and confirm appropriate alarm activation.
5. If the sensor fails the bump test, it must be replaced.

> **Note!**
>
> You must perform a bump test at least once a year.

4.3 Maintenance and Service

4.3.1 Maintenance Tests

The procedure is detailed below and must be performed annually.

1. Immediately attend to any errors generated by the system's self-diagnostic fault condition.
2. Perform a visual inspection.
   - Inspect for physical damage to sensor(s), cabling, sensor placement, or other visual changes to the original system construction.
   - Inspect sensor for excessive dust build up at the inlet. Sensor inlet is protected by a 40µm breather vent. This prevents diffusion restriction from dust build up from impacting the operation of the off-gas monitor; however, excessive dust should be removed from the inlet of the sensor as a best practice.

Note!

Do not use compressed air dusters as they can alarm and potentially damage sensors.

- Ensure that mounting nuts are tightened to secure sensor to mounting bracket.

3. Perform standard gas bump test on sensor(s) to verify gas response.
   Bump test kits must be used according to instructions in section 4.2.1.

4.3.2 Spare Parts

Spare parts may be provided by Xtralis upon request.

4.3.3 System Decommissioning

Contact Xtralis representative for guidance on how to decommission the Li-ion Tamer GEN 2+ OGM.

5 Frequently Asked Questions

Q1: How do you know if the Li-ion Tamer GEN 2+ OGM is functioning properly?

A: The output of the Li-ion Tamer OGM is fail-safe and has self-diagnostic capability.

Q2: Can the Li-ion Tamer system be tested with a test-gas to activate the off-gas monitor?

A:

- Yes, the sensors must be bump tested according to section 4.2.1 at least once a year.
- Bump tests should only be performed by appropriately trained and qualified personnel.

Q3: Can any RJ45 cable (i.e. Ethernet cable) be used to connect an OGM?

A: No, cables must adhere to the specification requirements in section 4.1.2 of this manual.

Q4: How do we know the parts have not been tampered with between shipping and receival?

A: Every OGM is heat sealed in an ESD bag. If that seal is broken prior to commissioning and installation, please contact an Xtralis representative to request a replacement.