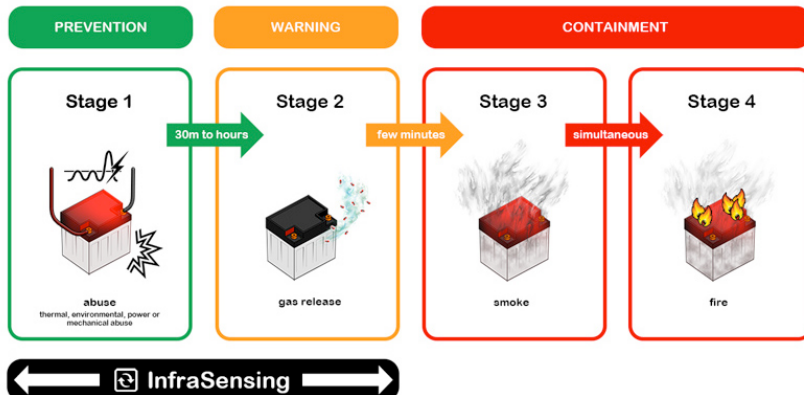




# Stage 2 Li-ion Off-gas Detection

## The 4 Stages Of Li-ion Battery Fire



There are 4 stages in a battery fire. Stage 3 and 4 is the smoke & fire phase. These are being addressed by fire detection and suppression systems.

InfraSensing complements such fire systems with early warning (Stage 2 off-gas) and prevention (Stage 1) to offer a unique complete solution to try preventing catastrophic failures while also maximizing ESS life span and thus protecting the CAPEX.

In Stage 1, we deploy our sensors to detect abuses or anomalies. These are thermal, environmental, power, or mechanical. If those anomalies are left unattended, then they could escalate into disastrous failures. Stage 1 monitoring also ensures that ESS infrastructure runs in the best possible conditions and thus maximize life span.

Stage 2 moves into more detailed scrutiny, where our sensors meticulously monitor for tell-tale gases produced during initial venting events. These are often early warning signals preceding a thermal runaway situation. By promptly detecting off-gas occurrences, a stop signal is sent for the affected battery module in order to try to prevent the propagation of a thermal runaway event.

## System Configuration Overview

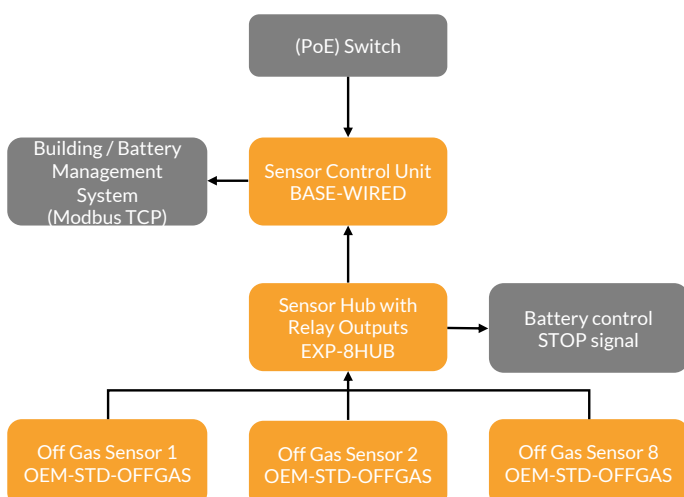
InfraSensing's off-gas sensing solution detects and analyzes VOC and optionally CO2 gas emissions from lithium-ion batteries to ensure early identification of Stage 2 risks. It can be programmed to automatically send a stop command to the battery management system. It supports multiple industrial protocols for integration with BMS, EPMS or other monitoring platforms.

The hardware consists of the following components:

- **BASE-WIRED:** The logical module for acquiring, analyzing, and comparing data from all sensors.
- **EXP-8HUB:** The expansion hub enables the connection of multiple off-gas sensors and 2 relay outputs for control.
- **OEM-STD-OFFGAS:** Stage 2 sensor for off-gas detection

The off-gas sensors measure emissions from lithium-ion batteries and transmit the data to the BASE-WIRED module for processing and comparison to compensate from background gases.

## System Architecture



Using standard RJ45 CAT 6/7 cables, Off Gas Sensors (OEM-STD-OFFGAS) connect to the SensorHub (EXP-8HUB), which is linked to the BASE-WIRED.

By default the BASE-WIRED can be powered by PoE and optionally 24v, -48v or 110/240v AC.

With the use of Industrial Protocols such as Modbus TCP or MQTT, this enables you to integrate the sensors with Building /Battery Management Systems or Cloud Platforms.

The EXP-8HUB facilitates the connection of multiple off-gas sensors for comprehensive battery system monitoring.



# Stage 2 Li-ion Off-gas Detection

## Technical Specification

### SensorGateway (BASE-WIRED)

TCP/IP:	IPv4 at 10/100 Mbps
Power source:	PoE: IEEE 802.3af or BASE-PWR (Optional AC power adapter) or BASE-PWR-USB (USB power adapter)
Power usage:	684 mW (without sensors attached)
Network data transfer:	SNMP GET (50 - 130 bytes), SNMP Trap (143 - 280 bytes)
Built-in:	Web server, SNMP v1, v2 & v3 (MD5/AES), Modbus TCP
Built-in alerting options:	Email, SMS (over IP) & SNMP Traps
External sensors probes:	2 sensor probes through straight RJ45 CAT6/7 cable with max distance of 100m or 330ft(subject to cable quality and interference).
Max distance to switch:	CAT6/CAT7 up to 100m / 300ft

### Sensorhub (EXP-8HUB)

Power source:	SensorGateway (BASE-WIRED)
Power usage:	235 mW
Expansion ports for external sensor probes:	8
Dry contact input ports:	4
Dry contact output ports:	4 (digital sink 100mA)
Relay outputs:	2 (400 VAC/150VDC and 200VA/192W)
Auxillary supply:	maximum current capacity of 500mA at 9 to 12VDC

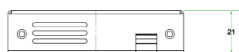
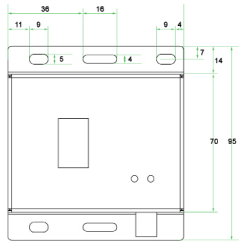
### Stage 2 Gas (OEM-STD-OFFGAS)

Power source:	SensorGateway (BASE-WIRED)
Power usage:	260 mW
CO2 output range:	0-40,000ppm
CO2 measurement accuracy:	± 40 ppm
CO2 repeatability:	± 10 ppm
VOC measurement output range:	0 - 500 VOC Index
VOC repeatability:	<±5 VOC index points or % mass volume(m.v.)
Temperature measurement range:	- 10°C - 60°C
Temperature accuracy:	± 0.8 °C(15 °C - 35 °C)
Relative humidity measurement range:	0 to 100 % RH
Relative humidity accuracy:	15 °C - 35 °C, 20 %RH - 65 %RH = ±6 %RH

## Environmental & Physical Specification

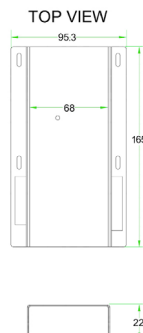
### SensorGateway (BASE-WIRED)

Operating temperature range:	0°C to +75°C (+167°F)
Humidity (operating and storage):	< 90% rH (non-condensating)
Dimensions:	97 mm (3.7") x 88 mm (3.4") x 21 mm (0.8")
Weight:	0.19 kg (0.42 lbs)



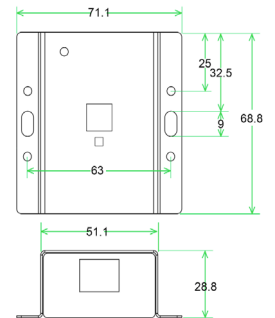
### Sensorhub (EXP-8HUB)

Operating temperature range:	0°C to +75°C (32°F to +167°F)
Humidity (operating and storage):	< 90% rH (non-condensating)
Dimensions:	167 mm (6.57") x 94 mm (3.7") x 24 mm (0.9")
Weight:	0.326 kgs (0.72 lbs.)



### Stage 2 Gas (OEM-STD-OFFGAS)

Operating temperature range:	0°C to 50°C (32°F to 122°F)
Humidity (operating and storage):	< 90% rH (non-condensating)
Dimensions:	72.96 mm (2.87") x 68.8 mm (2.7") x 29.41 mm (1.16")
Weight:	0.13kg (0.29 lbs)



## Product Certification

Our products are specifically designed for industrial environments and undergo DFMEA (Design Failure Mode and Effects Analysis) compliance and 3rd party lab testing to ensure their reliability. They have undergone rigorous testing and obtained various certifications to ensure safety compliance.

- BASE-WIRED: FCC, CE, EMC certified and UL listed
- EXP-8HUB: CE, EMC and IEC61010 certified.
- OEM-STD-OFFGAS: CE, EMC and IEC61010 certified.

These certifications guarantee that our products meet performance criteria and comply with regulations, offering reliable and trusted solutions for our customers.

Copyright © 2023 InfraSensing Distribution BV All rights reserved. Reproduction without permission is prohibited.

InfraSensing Distribution BV has prepared this document to the best of its abilities. However, InfraSensing Distribution BV disclaims any responsibility for its usage or any potential violations of third-party rights that may arise from its use.

Please note that this product may contain inadvertent technical or typographical errors. To rectify such errors, periodic updates are made to the information provided in this document, and these updates are included in subsequent editions of the publication. Actual product dimensions and product visuals may vary.