DGS4 89x-Series I2C Gas Sensor Datasheet

DGS4 89x-Series I2C Gas Sensor

FEATURES

- **100% factory calibrated gas concentration**
- **EEPROM-stored calibration coefficients**
- **I2C interface**
- **High performance electrochemical gas sensors**
- **Temperature and relative humidity sensors**
- **Small size**
- **Low-profile mezzanine connector**
- **Accurate, linear, & fast response**
- **Multiplex 89x-Series sensors for a custom array**
- **Open-source firmware for rapid development**
- **Long life (10+ years)**
- **RoHS & REACH compliant**

891-xxx
I2C Gas Sensor
(13 x 19 mm)

DESCRIPTION

Interlink Electronics' Screen Printed ElectroChemical Sensors (SPEC Sensor™) revolutionize the current state of the art, enabling new applications in consumer, medical and industrial safety. SPEC Sensors offer high-performance sensing at a fraction of the price.

The 89x-Series I2C Gas Sensors are small, low-profile, factory calibrated sensors with an I2C interface for easy integration into wireless, portable, and other IoT sensor solutions.

Available in two convenient package sizes:

(1) 13 x 19 mm, ideal for space-constrained applications like wearables and indoor IoT devices.
(2) 18 x 24 mm, ideal for industrial and outdoor air quality applications

895-xxx
I2C Gas Sensor
(18 x 24 mm)

89x-SERIES PRODUCT FAMILY

At Standard Conditions: 25 °C, 50% RH and 1 atm			
PN	**Gas Type**	**Range (ppm) [1]**	**Resolution (ppm) [1,2]**
891-Series Sensors (13 x 19 mm)			
891-110	CO-HS	0 - 20	0.03
891-200	EtOH	0 - 600	0.3
891-700	NO	0 - 20	0.02
891-001	H2	0 - 100	0.2
895-Series Sensors (18 x 24 mm)			
895-100	CO	0 - 400	0.2
895-200	EtOH	0 - 600	0.3
895-300	H2S	0 - 10	0.01
895-400	O3	0 - 20	0.02
895-450	Cl2	0 - 20	0.02
895-500	NO2	0 - 30	0.03
895-600	SO2	0 - 40	0.03
895-650	C2H4	0 - 40	0.02
895-700	NO	0 - 20	0.02
895-800	IAQ	0 - 100 [CO]	0.05
895-850	HCHO	0 - 20	0.03
895-900	RESP	0 - 20 [NO2]	0.02
895-001	H2	0 - 100	0.2
895-Series High Sensitivity Sensors (18 x 24 mm)			
895-110	CO-HS	0 - 20	0.03
895-440	O3-HS	0 - 10	0.01
895-640	SO2-HS	0 - 20	0.02
895-540	NO2-HS	0 - 15	0.02
895-860	HCHO-HS	0 - 10	0.01
Developer Kits See the *DGS4 89x-Series Developer Kit User Guide* for more details			
899-100	89x-Series Single-Gas Developer Kit *DGS4 Pin Adapter + Adafruit QT Py Shield*		
899-141	891-Series 4-Gas Array Developer Kit *DGS4 891-Series Array Adapter w/ I2C MUX + Adafruit QT Py Shield*		
899-145	895-Series 4-Gas Array Developer Kit *DGS4 895-Series Array Adapter w/ I2C MUX + Adafruit QT Py Shield*		

MEASUREMENT PERFORMANCE CHARACTERISTICS

At Standard Conditions: 25 °C, 50% RH and 1 atm	
Measurement Accuracy [1,4]	± 15%
Measurement Repeatability	< ± 3% or Resolution (ppm), whichever is greater.
Response Time [5]	< 15 seconds
Power Consumption	50 µW, minimum
Expected Operating Life [6]	> 5 years (10 years @ 25 ± 10 °C; 60 ± 30% RH)
Operating Temperature Range [1,5]	-20 to 40 °C (-30 to 55 °C, intermittent)
Operating Humidity Range	15 to 95% (0 to 100% non-condensing, intermittent)

ABSOLUTE MAXIMUM SPECIFICATIONS

Parameter	Conditions	Min.	Typ.	Max.	Units
Maximum Concentration	Short term exposure			120	% Range
Storage Temperature	Vapor sealed @ 50% RH	5	20	30	˚C
Storage Humidity	Non-condensing, vapor sealed	20	50	80	% RH
Storage Pressure	Vapor sealed	0.8	1	1.2	atm
Storage Time	Vapor sealed	-	12	-	Months
Operating Temperature	< 10 hours	-40	-	50	˚C
Operating Humidity	< 10 hours, non-condensing	0	-	100	% RH
Operating Pressure	Transient pulses	-0.5	0	0.5	atm
Operating Temperature	Continuous	-30	25	50	˚C
Operating Humidity	Continuous, non-condensing	10	50	95	% RH
Operating Pressure	Continuous	0.8	1	1.2	atm
ESD Rating	Human Body Model	2		8	kV

ELECTRICAL SPECIFICATIONS

Parameter	Conditions	Min.	Typ.	Max.	Units
Supply Voltage, V+		2.7	3.3	5.25	V
Supply Current	V+ = 3.3 V, Idle V+ = 3.3 V, 1 Hz @ 860 S/s V+ = 3.3 V, 1 Hz @ 128 S/s V+ = 3.3 V, 1 Hz @ 8 S/s		15.0 15.2 16.1 31.9		µA
I2C Interface Voltage			V+		V

Notes:

[1] DGS4 system specifications consider combined electronics, firmware, and sensor performance. DGS4 system specifications may be different than individual sensor specifications.

[2] Based on standard deviation of noise at zero ppm, 1 Hz measurement, 60 measurements average.

[3] When zeroed after 24 hours of power-on stabilization.

[4] Based on *sensor-level* factory calibration. User calibration can improve accuracy. *Module-level* factory calibration of DGS2 can be specified for your application and ordered directly from SPEC Sensors.

[5] Consult individual sensor datasheets for more details.

[6] Functional lifetime will vary based on sensor drift as a function of the application environment and accuracy requirements.

COMMON GAS SENSOR APPLICATIONS

	CO	NO2	O3	SO2	HCHO	IAQ	RESP	H2S	Cl2	C2H4	EtOH	NO	H2
Indoor Air Quality	✓	✓	✓	✓	✓	✓	✓	✓					
Outdoor Air Quality	✓	✓	✓	✓									
Safety & Emissions	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓
Early Fire Detection	✓	✓											
Health & Wellness	✓					✓	✓	✓			✓	✓	✓
Food & Agriculture			✓	✓				✓		✓	✓		
Air Purification & Sterilization Control		✓	✓					✓	✓	✓			

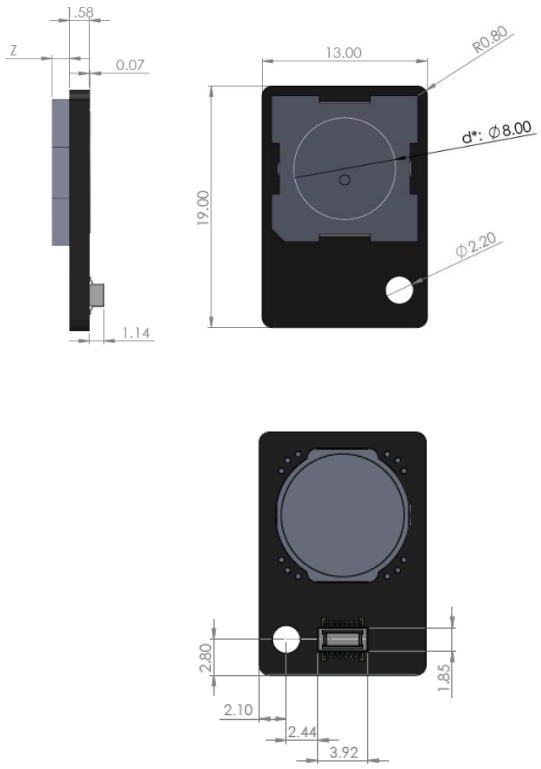
CROSS SENSITIVITY

The following table lists the sensor responses to common interfering gases. For additional cross sensitivity information, please refer to the gas sensor datasheets.

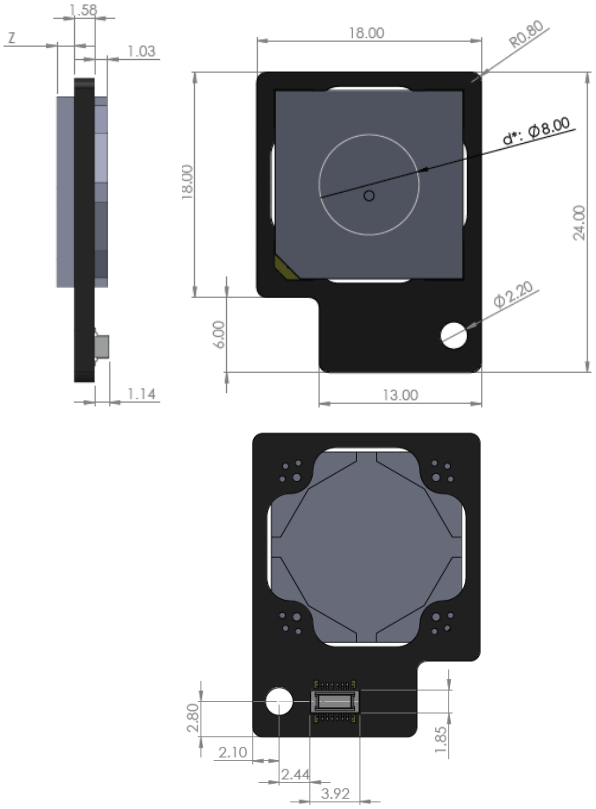
		Measured Gas Sensor Response												
	Measured (PPM) / Applied (PPM)	CO 110-102	EtOH 110-202	H2S 110-303	O3 110-406	Cl2 110-450	NO2 110-507	SO2 110-610	C2H4 110-650	NO 110-701	IAQ 110-801	HCHO 110-850	RESP 110-901	H2 110-005
Applied Test Gas	CO	**400** / **400**	43 / 400	16 / 400	0 / 400	0 / 400	0 / 400	0 / 400	9.1 / 400	1.8 / 400	**50** / **50**	98 / 400	-52 / 400	4.1 / 400
	EtOH	0.2 / 200	**200** / **200**	15 / 200	0 / 200	0 / 200	0 / 200	0 / 200	0.6 / 200	0.2 / 200	221 / 200	99 / 200	10.5 / 200	-11 / 200
	H2S	< 1 / 25	88 / 25	**10** / **10**	0 / 25	0 / 25	0 / 25	97 / 25	72 / 10	44 / 10	119 / 25	53.6 / 25	-44 / 10	0 / 25
	O3	0 / 0.82	-0.5 / 0.82	-0.09 / 0.82	**0.82** / **0.82**	1.1 / 0.82	0 / 0.82	-0.8 / 0.82	-1 / 0.82	-0.3 / 0.82	-0.3 / 0.82	-0.1 / 0.82	0.2 / 0.82	0 / 0.82
	Cl2	-0.2 / 10	-3.7 / 10	-0.9 / 10	4 / 10	**10** / **10**	1.3 / 10	-8.7 / 10	-2.8 / 10	-1.5 / 10	-3.9 / 10	-1.9 / 10	2.9 / 10	-0.2 / 10
	NO2	0 / 5	0 / 5	-0.6 / 5	4.2 / 5	9.7 / 5	**5** / **5**	-9.1 / 5	0.7 / 5	1 / 5	0.6 / 5	0.7 / 5	**5** / **5**	0.2 / 5
	SO2	0 / 10	5.7 / 10	1.5 / 10	0.05 / 10	0 / 10	0 / 10	**10** / **10**	11 / 10	6.5 / 10	6.6 / 10	3.6 / 10	-7.6 / 10	0 / 10
	C2H4	79 / 50	44 / 50	10.4 / 50	0.02 / 50	0 / 50	0 / 50	0 / 50	**50** / **50**	16 / 50	83 / 50	41 / 50	-6.9 / 10	186 / 50
	NO	3.4 / 10	8.9 / 10	1.9 / 10	0.2 / 10	0 / 10	0 / 10	0 / 10	17.2 / 10	**10** / **10**	16 / 10	7.5 / 10	0 / 10	0.3 / 10
	HCHO	0.3 / 10	15 / 10	4 / 10	0 / 10	0 / 10	0 / 10	0 / 10	18 / 10	4 / 10	22 / 10	**10** / **10**	-6.6 / 10	-0.7 / 10
	H2	151 / 200	31 / 200	7.5 / 200	0 / 200	-0.1 / 200	0 / 200	0.4 / 200	1.1 / 200	0.3 / 200	26 / 200	11.2 / 200	-3 / 200	**200** / **200**
	IPA	1.3 / 200												
	Methane	< 1 / 3000	< 5 / 500	0.1 / 500	<0.05 / 500								0 / 10	
	Ammonia	0 / 100	0 / 100	0 / 100	-0.3 / 100	0 / 100	0 / 100	0.2 / 100	-0.9 / 100	-0.3 / 100	-0.3 / 100	-0.1 / 10	0 / 100	0 / 100
	CO2	< 1 / 5000												
	n-Heptane	< 1 / 500	-13 / 500	<0.05 / 500	0.2 / 500								0 / 10	
	Toluene	< 1 / 200												
	Acetone	< 1 / 200												

PACKAGE OUTLINE DRAWING & DIMENSIONS

891-Series



895-Series



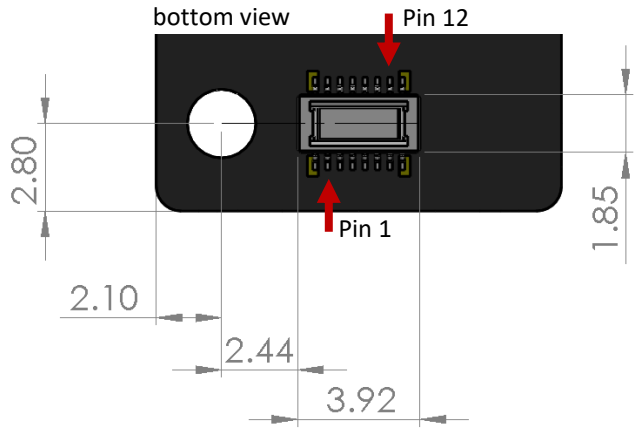
PN	Gas Type	Dim. Z (mm)
891-Series Sensors (13 x 19 mm)		
891-110	CO-HS	1.37
891-200	EtOH	0.39
891-700	NO	0.39
891-001	H2	1.65

PN	Gas Type	Dim. Z (mm)
895-Series Sensors (18 x 24 mm)		
895-100	CO	1.37
895-200	EtOH	0.39
895-300	H2S	0.39
895-400	O3	0.39
895-450	Cl2	0.39
895-500	NO2	1.14
895-600	SO2	0.39
895-650	C2H4	0.39
895-700	NO	0.39
895-800	IAQ	0.39
895-850	HCHO	0.39
895-900	RESP	0.39
895-001	H2	1.65
895-Series High Sensitivity Sensors (18 x 24 mm)		
895-110	CO-HS	1.37
895-440	O3-HS	0.39
895-640	SO2-HS	0.39
895-540	NO2-HS	1.14
895-860	HCHO-HS	0.39

Notes:
Weight: TBD
***Tolerances*: ± 0.2 mm**
***d**: Features of the gas inlet region may vary with sensor type. See gas sensor datasheets for more details. Do not contact the sensor within this region.**

CONNECTOR

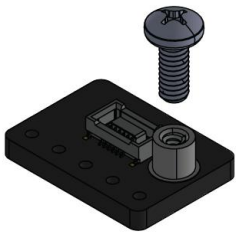
The 89x-Series sensor module features a Hirose DF40C-12DP-0.4V(##) mezzanine connector.



89x-Series Pinout		
Pin #	**Function**	**Description**
1	N/C	Not Connected
2	N/C	Not Connected
3	GND	Ground
4	N/C	Not Connected
5	SCL	I2C Clock
6	N/C	Not Connected
7	SDA	I2C Data
8	N/C	Not Connected
9	V+	Supply Voltage
10	N/C	Not Connected
11	N/C	Not Connected
12	N/C	Not Connected

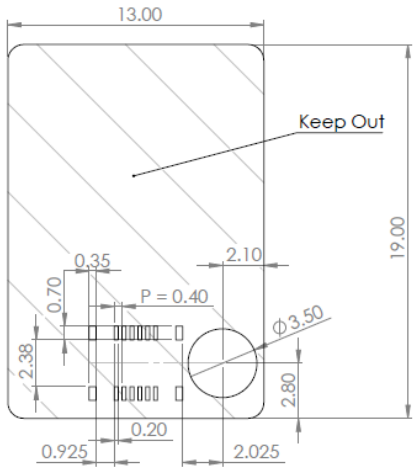
LANDING PATTERN & MATING CONNECTOR

The mating connector for the 89x-Series sensor module is Hirose DF40B-12DS-0.4V(##). To add retention, use a captive threaded standoff, such as PEM MSOFS-M2-3, or similar. The landing patterns shown below include the pattern for the Hirose connector, a 3.5 mm hole for the standoff, and a keep out area under the 89x-Series sensor module.

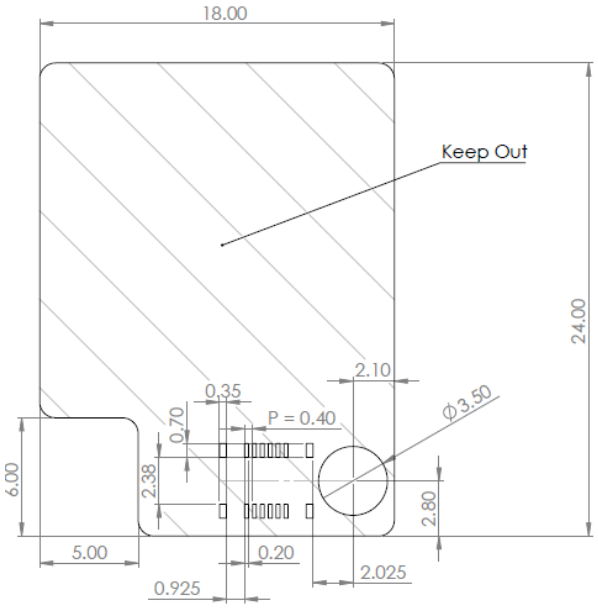


Mating connector and captive standoff. Shown: Single-Gas Adapter, available as part of the 899-100 Single-Gas Developer Kit

891-Series



895-Series

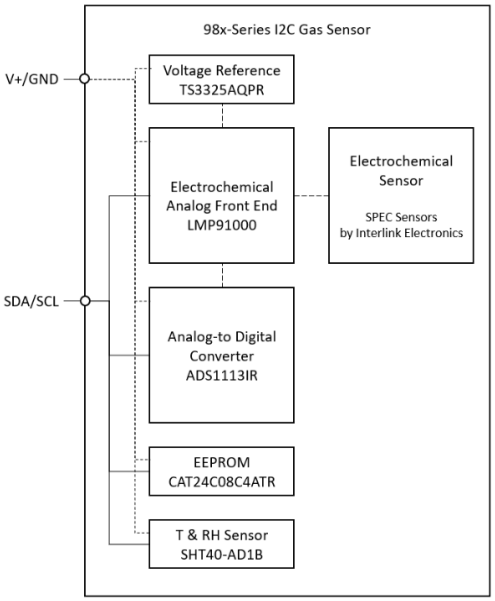


DGS4 OVERVIEW

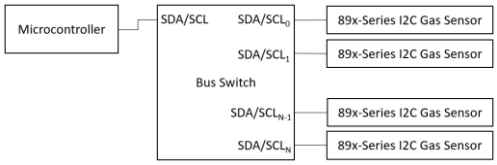
The DGS4 89x-Series sensor module is a system implementation of multiple I2C components, each with their own fully specified datasheets. The DGS4 89x-Series module does not include a microprocessor. The host microprocessor, implemented by the user, communicates with each I2C component to initialize the module, retrieve data, and calculate the gas concentration. Developer kits and fully functional code are available from Interlink Electronics.

The I2C addresses of the peripheral components are fixed by the circuit implementation. More than one 89x-Series I2C Sensor Module may be implemented in a system by using an I2C bus switch.

98x-Series I2C Gas Sensor Simplified Block Diagram



Multigas Sensing Solution Simplified Block Diagram



89x-Series I2C Components		
MFR PN	**I2C Address**	**Description**
SPEC Sensors by Interlink Electronics *various*	N/A	Electrochemical Gas Sensor
Texas Instruments *LMP91000*	1001 000[R/W]	Electrochemical Sensor Analog Front End
Texas Instruments *ADS1113IR*	1001 011[R/W]	Analog to Digital Converter
onsemi *CAT24C08C4ATR*	1010 000[R/W]	EEPROM
Sensirion *SHT40-AD1B*	1000 100[R/W]	Temperature and Relative Humidity Sensor
STMicro *TS3325AQPR*	N/A	Voltage Reference, 2.5V

899-100 SINGLE-GAS DEVELOPER KIT OVERVIEW

The 899-100 Single-Gas Developer Kit, available for Interlink Electronics, includes an Adafruit QT Py SAMD21 Dev Board that is pre-loaded with open-source firmware. The firmware can also be downloaded here: https://github.com/InterlinkElectronics/DGS4-DevKit.

When components of the developer kit are connected and powered, the QT Py firmware follows the control flow:

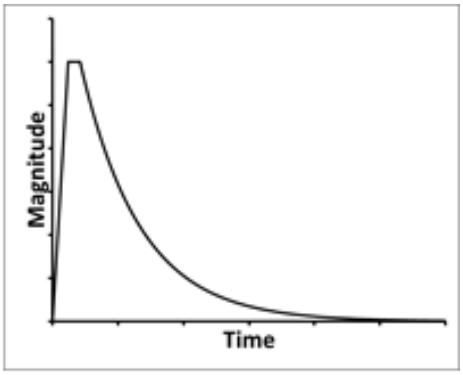
- Retrieve operational settings and calibration coefficients from the DGS4 module EEPROM
- Set the operational settings of the LMP91000 Electrochemical Sensor Analog Front End.
- Monitor for user input commands.
- Maintain a measurement period:
  - Verify the LMP91000 Settings
  - Read T, RH from SHT40
  - Read ADC (gas sensor)
  - Calculate PPB gas concentration
  - Write data to serial port (if 'C' is toggled) or store data until requested ('\r')

NORMAL SENSOR STARTUP

The electrochemical sensor output has the normal power-on startup profile pictured here. When powering the sensor, its output magnitude will rapidly increase followed by a gradual decrease. Once this process is complete, the sensor output will be the most accurate and stable. The time, magnitude, and polarity of this response may vary depending on the sensor type and the length of time the sensor has been unpowered.

After storage and/or shipping, the startup duration will be 1 - 24+ hours.

For best performance: a 24+ hour startup duration is recommended. Following startup, the module should remain always on power.



The electrochemical sensor output has the normal power-on startup profile pictured here.

IMPORTANT PRECAUTIONS

All sensor designs are made for air monitoring @ 1 atm +/- 0.2 atm. Because applications of use and device implementation are outside our control, SPEC Sensors cannot guarantee performance in a given device or application, and disclaims any and all liability therefore. **Customers should test under their own conditions to ensure the sensors are suitable for their requirements.**

Contact the factory to discuss specific concerns that might damage the sensor performance or life.

- Condensation and Water [1]
- High Temperature Operation (> 40C) for more than 1 month
- Low Humidity Operation (< 15% RH) for more than 3 months
- Highly contaminated air over a prolonged period
- High levels of particles or soot (unless proper filtering is provided) [2]
- High Altitudes
- Low oxygen levels

[1] Use of porous PTFE membrane or filter cap may address this concern)
[2] Use of replaceable filter recommended where dust and particulate is expected.

SENSOR STORAGE, HANDLING AND SOLDERING

This information embodies various general recommendations concerning the storage, handling, and manual soldering conditions for SPEC SENSORS products. It is only applicable for products guaranteed by SPEC SENSORS stated in SPEC SENSORS Sensor Specification Sheet. Moreover, SPEC SENSORS' products are NOT warranted and should NOT be used in high temperature soldering (reflow) or pre-tinning baths.

Sensor & Module Handling

Handle sensors with care. Take precautions, including but not limited to the following:

A. DO NOT apply excessive pressure to the top or bottom of the sensor module.
B. Whenever possible, handle or make contact with the sensor module from the sides of the PCB or substrate.
C. Light vacuum pressure is possible during handling, DO NOT apply vacuum over gas sensor port.
D. If the sealed sensor package is opened, DO NOT re-seal using vacuum or nitrogen gas. DO NOT reseal with desiccant.
E. DO NOT obstruct the gas sensor port by making direct contact with any tape, apparatus, weights, etc.
F. DO NOT use silicone or other conformal coatings around the sensor or gas port-holes.
G. Operators are requested to wear powder free antistatic gloves.

Manufacturing Assembly Floor Environment

SPEC SENSORS recommends that the manufacturing assembly floor environment be maintained at controlled conditions:

A. Temperature: 18 - 26°C
B. Relative Humidity: 40 to 60%
C. Pressure: 1.0 ± 0.2 atm

Sensor & Module Storage Conditions

SPEC SENSORS recommends that sensor components should be stored in the factory-sealed bag at the following conditions:

A. Temperature: 5 to 25 °C
B. Relative Humidity: 20 to 80%
C. Pressure: 1.0 ± 0.2 atm
D. Storage Time: 12 months

When moving from Storage Conditions to the Manufacturing Assembly Floor Environment, the sensors should be allowed to equilibrate at the new conditions for at least 24 hours prior to testing.

Module Attach Soldering Process

Hand solder only. Keep the soldering iron or solder process tool away from the sensor. The sensor should not see pre-heat temperatures above 70 °C. There have been suggested cases where a heat sink cover over the sensor may be applicable to protect the sensor during processing. No Application notes to this approach available. To be used as reference only.

A. DO NOT heat sensor above 70 °C.
B. Hand or peripheral process type approach.
C. Use solder wire alloy with the lowest possible eutectic temperature.
D. Use lowest possible soldering iron temperature.
E. Contact the host board with the soldering iron at a 45° angle on the solder pad.
F. Keep the soldering iron away from the top and bottom of the sensor module.
G. DO NOT place in reflow, wave or IR reflow type processes.
H. DO NOT place mounted board in a wash.