

DGS4 89x-Series Developer Kit

DGS4 89x-SERIES MODULE

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



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



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

899-100 SINGLE-GAS DEVELOPER KIT

The 89x-Series companion developer kits provide out-of-the-box solutions to accelerate development. The 899-100 Single-Gas Developer Kit includes a series of PCBs with user-solderable pin headers and sockets for flexible configuration. The 899-001 Single-Gas Adapter includes the mating mezzanine connector, I2C pullups, a captive threaded standoff, an M2 bolt to secure the 89x-Series module, and a pin header to breakout the connections. The 899-091 Adafruit QT Py SAMD21 Dev Board is pre-programmed with an open-source Arduino sketch that initializes the DGS4 89x-Series modules and streams gas sensor data to the serial port. The 899-002 89x-Series QT Py Shield conveniently bridges the connections between the QT Py M0 controller and the Single-Gas Adapter.

	891-xxx or 895-xxx		891-Series Sensors (13 x 19 mm) or 895-Series Sensors (18 x 24 mm)
	899-100 89x-Series Single-Gas Developer Kit	899-001	89x-Series Single-Gas Adapter <i>DGS4 Pin Adapter</i>
		899-091	Adafruit QT Py SAMD21 Dev Board <i>Programmed with the 89x-Series Single-Gas open-source Arduino sketch</i>
		899-002	89x-Series QT Py Shield

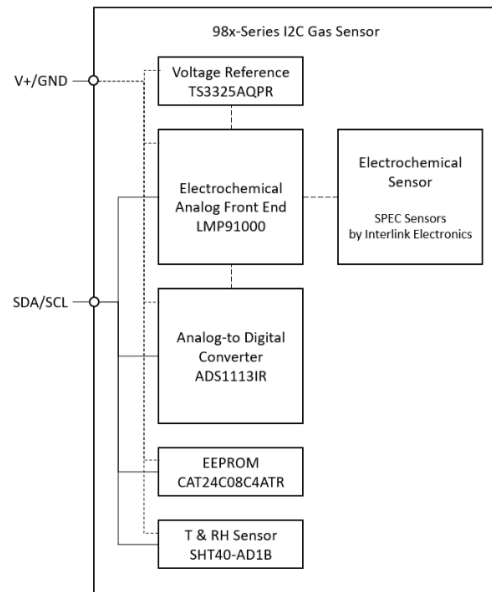
DGS4 89x-SERIES OVERVIEW

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.

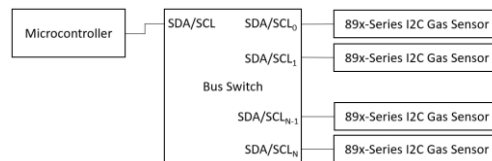
The I2C addresses of the peripheral components are fixed by the circuit implementation. More than one 89x-Series I2C Sensor Module may be implemented in a system by using an I2C bus switch.

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

98x-Series I2C Gas Sensor Simplified Block Diagram



Multigas Sensing Solution Simplified Block Diagram



899-100 SINGLE-GAS DEVELOPER KIT OVERVIEW

The 899-100 Single-Gas Developer Kit 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 all 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')

899-100 SINGLE-GAS DEVELOPER KIT – QUICK START

All Adafruit QT Py SAMD21 Dev Boards shipped by Interlink Electronics and its distributors, include the open-source firmware pre-loaded. If the Adafruit QT Py SAMD21 board was acquired from another source, proceed to Step 5 to download and install the firmware. The open-source firmware is intended to be an instructional starting point for integrating DGS4 89x-Series modules into a highly integrated gas-sensing solution.

1. **Solder the sockets and/or pin headers to the developer kit PCBs to suit your development needs.**
Connect all the modules together following the image on page 1.
 - a. Use sockets and pin headers to create a pluggable solution.
 - b. Use pin headers only to create a low-profile solution.
2. **Use a USB-C data cable (not included) to connect the Adafruit QT Py SAMD21 Dev Board to a computer.**
3. **Use a terminal program (PuTTY, TeraTerm, or similar) to open a serial connection to the appropriate COM port at 9600 baud.**
4. **Use the following ASCII character commands to retrieve data from the module.**

ASCII character command	Name	Description
\r [Enter]	Single Measurement	A measurement string is returned. (See Example Measurement String)
C (uppercase)	Continuous Measurement	Toggles on/off continuous measurement. A measurement string is returned approximately once per second. (See Example Measurement String)
e	EEPROM Settings	Settings and diagnostic info are returned. (See Example EEPROM Output)
A	Average	Set the number of data points included in the moving average: 1 – 300. The default value varies with module gas type.
Z	Zero	Zero the ppb measurement.

Notes: Commands are case-sensitive. When entering commands and parameters via a script or software, an inter-character delay may be necessary.

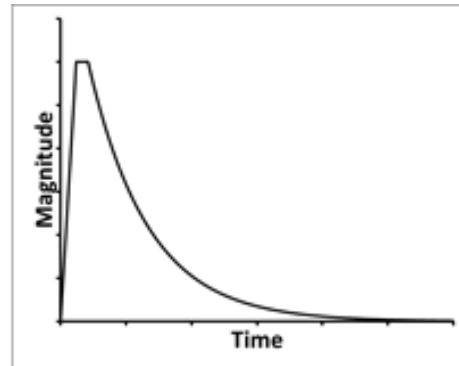
5. **Use the Arduino IDE to modify the open-source firmware for your application.**
 - a. Install the Arduino IDE
 - b. Add the Adafruit Board Manager and install the Adafruit SAMD Boards library.
 - c. Download the open-source firmware developed for the DGS4:
<https://github.com/InterlinkElectronics/DGS4-DevKit>
 - d. Open the DGS4_DevKit.ino in the Arduino IDE.
 - e. From the board manager, select Adafruit QT Py M0 (SAMD21)
 - f. Modify the sketch as needed for your application.
6. **Port the open-source firmware to the development platform of your choice.**

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.

EXAMPLE MEASUREMENT STRING

This is an example of a measurement string, returned by the module after receiving '\r' [Enter]:

```
032122030234, 1588, 24.36, 32.78, 32291, 26636, 20390<space><cr><ls>
```

The format of the output is:

Measurement Field	Example Measurement Value
Sensor SN	032122030234
PPB	1588
TEMPERATURE	24.36
RELATIVE HUMIDITY	32.78
ADC_G (GAS)	32291
ADC_T (TEMPERATURE)	26636
ADC_H (RELATIVE HUMIDITY)	20390

EXAMPLE EEPROM OUTPUT

This is an example of the EEPROM Output, returned by the module after receiving 'e':

```
*****
30JUN26, 032122030234 110102 CO 1603 3.62
nA/PPM 3.62, Avg 1, N 10.0
T Offset 0.00, RH Offset 0.00
LMP91000 0, 145, 3
OC ADC G 32237, T 27516, H 25942
Zero ADC G 32238, T 27524, H 26030
Span ADC G 65535, T 65535, H 65535
*****
```

The format of the output is:

EEPROM Output Line	Description	Stored
30JUN26, 032122030234 110102 CO 1603 3.62	Firmware revision date, Sensor barcode	QT Py FW DGS4 EEPROM
nA/PPM 3.62, Avg 1, N 10.0	Sensitivity Factor (nA/ppm), Average Window Size (Avg), Temp. Compensation Factor (N)	DGS4 EEPROM DGS4 EEPROM DGS4 EEPROM
T Offset 0.00, RH Offset 0.00	Temperature Offset (T Offset) Relative Humidity Offset (RH Offset)	DGS4 EEPROM DGS4 EEPROM
LMP91000 0, 145, 3	LMP91000 Potentiostat Settings	DGS4 EEPROM
OC ADC G 32237, T 27516, H 25942	Open-Circuit Zero	DGS4 EEPROM
Zero ADC G 32238, T 27524, H 26030	Zero	DGS4 EEPROM
Span ADC G 65535, T 65535, H 65535	Sensitivity Span	DGS4 EEPROM

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.