ALTERED CARBON

PRECISION GRAPHENE SENSORS

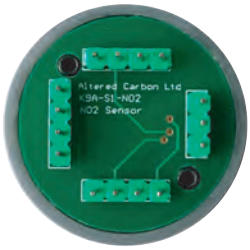
**K9 Sense Evaluation Kit**
**Engineering sample**

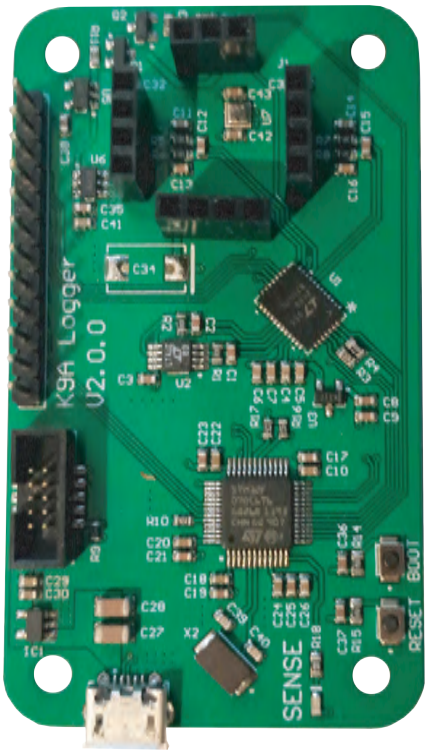
**DATE OF PUBLICATION: APRIL 2020**

WWW.ALTERED-CARBON.COM

# K9 Sense

## Beta Evaluation Kit




### General Information

Works with 5V supply

Low power : <5 mW in passive sense mode outputs
- Temperature
- Relative Humidity
- Gas Concentration

Simple Virtual Com Port Interface

Operating temperature: 0oC - 55oC

RoHS compliant

Small Form Factor (30mm D x 15mm H)

Lightweight (< 6 g)

### Components Used

BME280 Temperature and humidity

LTC2498CUHF#PBF Nano power ADC chip

STM32 Cortex M0 processor

### Content Includes

Analog gas sensor development board

Sample of Altered Carbon K9Sense sensors

Micro USB to USB

Link to setup and logging utility

Link to full design documentation
- Schematic
- Parts list (BOM)
- Gerber/design files
- Firmware

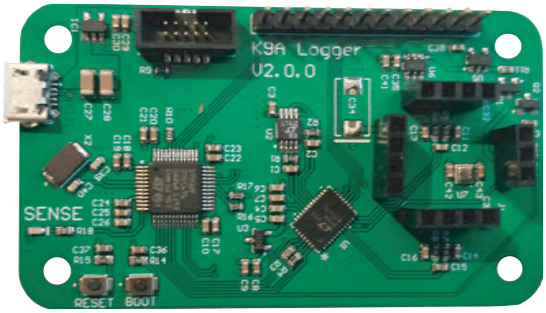
ALTERED CARBON

PRECISION GRAPHENE SENSORS

# K9 Sense Evaluation Kit Engineering sample

**DATE OF PUBLICATION: APRIL 2020**

WWW.ALTERED-CARBON.COM




## Applications

- Air pollution monitoring
- Indoor air quality
- Breath analysis
- Exhaust gas monitoring
- Gas alert system

## Benefits

- Low Power – <5 mW
- FastResponse – <120 s typical
- FastRecovery – <120 s
- Calibrated & temp compensated output
- Simple virtual com port interface
- Integrated T & RH monitoring
- Lightweight sensor (< 6 g)
- I2C Interface

ALTERED CARBON

PRECISION GRAPHENE SENSORS

**K9 Sense Evaluation Kit**
**Engineering sample**

**DATE OF PUBLICATION: APRIL 2020**

WWW.ALTERED-CARBON.COM

# ANALOG GAS SENSOR DEVELOPMENT BOARD

## Description

K9 Sensors are making it easy for the Internet of Things developers to integrate gas sensing in their products. Gas alert systems, air pollution monitoring, indoor air quality, breath analysis are some of the known gas sensing applications that demand high-performance measurement. A solid-state nano-tech chemiresistor gas sensing transducer is the preferred solution for these applications due to measurement performance and the ultra-low power consumption needed for battery operation.

## MEASUREMENT PERFORMANCE CHARACTERISTICS

| Gas Sensor | Measurement Range (ppb) | Resolution (1) (ppm) |
|---|---|---|
| Nitrogen dioxide (NOx/NO2) | 0.1 - 2000 | 0.05 |

Note (1) - Based on the standard deviation of noise at 200 ppb, 0.1 Hz measurement 60 second average.

| Based on Standard Conditions 25 °C, 50% RH and 1 atm. | |
|---|---|
| Measurement Repeatability | <±1% of reading |
| Recommended Warm-Up Time | 10 seconds from power applied to USB port |
| Power Consumption | 200 µA at 1Hz polling<br>9 mA in active mode (typically on for < 1 sec)<br>14 mA when reading from USB in real-time |
| Expected Operating Life | > 5 years (3 years @ 25 ± 10°C; 60 ± 30% RH) |
| Operating Temperature Range | 0°C to 55°C |
| Operating Humidity Range | 10 to 90% (0 to 100% non-condensing intermittent) |
| Mechanical Dimensions of Sensor | 9 x 5.5 x 1.3 mm |
| Mechanical Dimensions of Sensor Carrier Board | 30mm D x 15mm H |
| Mechanical Dimensions of Development Board | 66 x 30 x 8 mm |
| Weight | < 6 g |

ALTERED CARBON

PRECISION GRAPHENE SENSORS

# K9 Sense Evaluation Kit Engineering sample

**DATE OF PUBLICATION: APRIL 2020**

WWW.ALTERED-CARBON.COM

## ABSOLUTE MAXIMUM RATINGS

| Parameter | Conditions | Min | Rec | Max | Units |
|---|---|---|---|---|---|
| **Maximum Concentration** | Short term exposure | | 1000 | 10000 | ppb |
| **Supply Voltage** | Regulated | 4.5 | 5.0 | 5.5 | V |
| **Storage Temperature** | Vapour sealed @ 50% RH | 10 | | 40 | $^0$C |
| **Storage Humidity** | Non-condensing, vapour sealed | 20 | | 80 | % RH |
| **Storage Pressure** | Vapour sealed | | 1 | | atm |
| **Storage Time** | Vapour sealed | | 24 | | months |
| **Operating Temperature** | Continuous | 0 | 25 | 50 | $^0$C |
| **Operating Humidity** | Continuous, non-condensing | 10 | | 90 | % RH |
| **Operating Pressure** | Continuous | | 1 | | atm |
| **ESD Rating** | Human Body Model | 2 | | 8 | kV |

## ELECTRICAL CHARACTERISTICS

| Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Supply Current | Passive sensing mode | 0.2 | 0.2 | 14 | mA |
| Power Consumption | Passive sensing mode | 1 | 1 | 70 | mW |

# Characteristic Figures

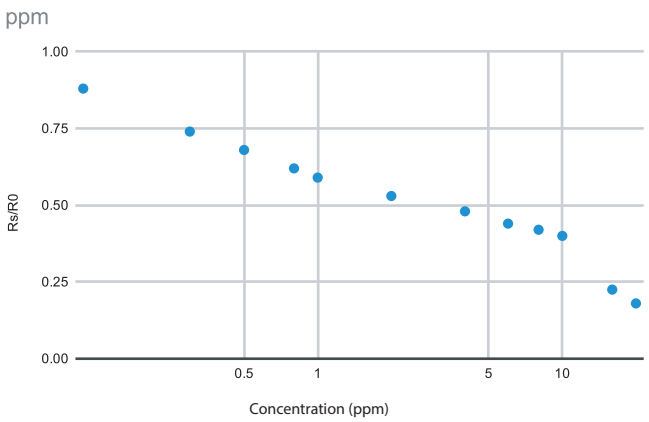



Figure 3

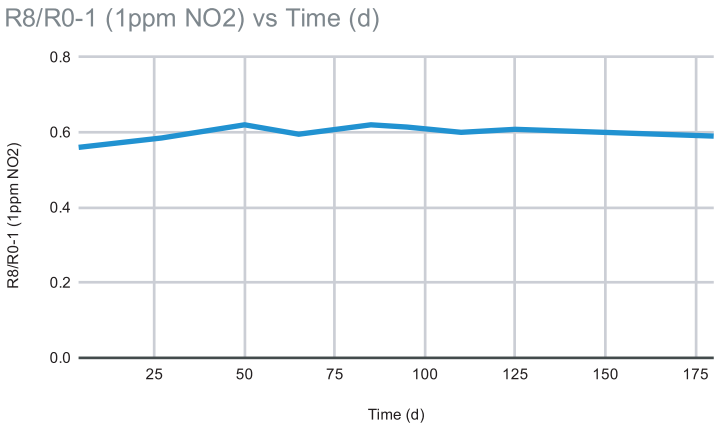



Figure 4

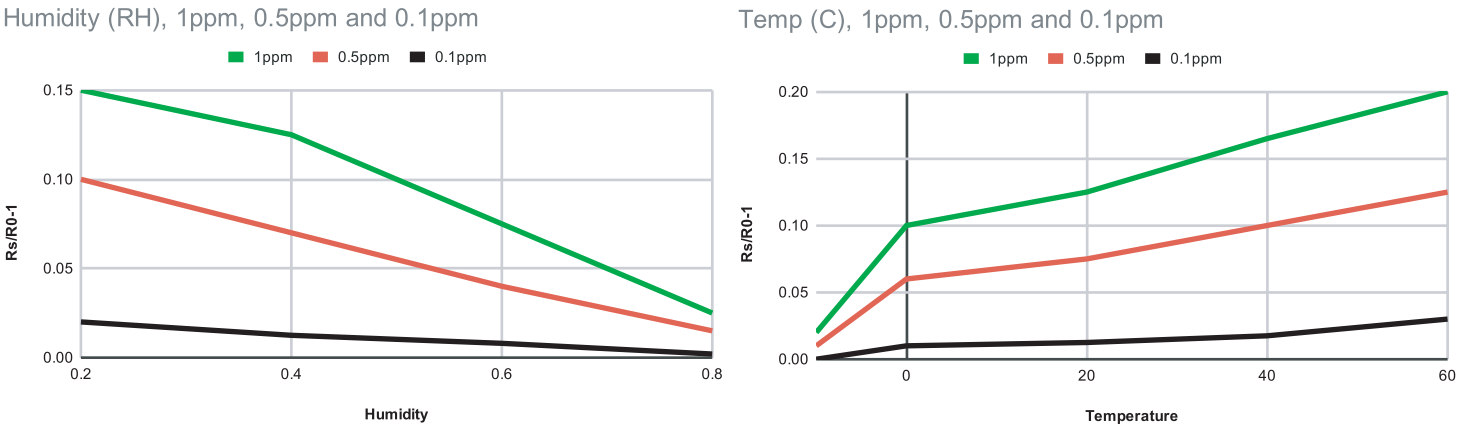



Figure 5

In the figure, Rs represents the resistance value of the sensor in different concentrations of gas, and R0 represents the resistance value of the sensor in clean air. All tests in the figure are completed under standard test conditions.

Figure 3: The sensitivity curve of sensors
Figure 4: The sensitivity of the sensor versus temperature
Figure 5: Stability test of sensors

ALTERED CARBON

PRECISION GRAPHENE SENSORS

# K9 Sense Evaluation Kit Engineering sample

**DATE OF PUBLICATION: APRIL 2020**

WWW.ALTERED-CARBON.COM

## Bridge board PINOUT

| Pin# | Function | Notes |
|---|---|---|
| A | VREF1 | VREF 2V5 |
| B | S1 - | Net J1 S1 - |
| C | S1 + | Net J1 S1 + |
| D | S1 GND | GND |
| E | VCC | 3V3 |
| F | SCL | SCL |
| G | SDA | SDA |
| H | GND | GND |
| I | S2 GND | GND |
| J | S2 + | Net J1 S2 + |
| K | S2 - | Net J1 S2 - |
| L | VREF2 | VREF 2V5 |
| M | THERM | Temperature |
| N | HEAT GND | Net J1 HEAT GND |
| O | VHEAT | 3V3 |

**Virtual COM port SETTINGS**

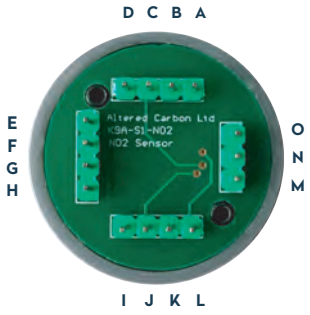
Voltage level: **3.3V**

Baud: **115200**

Data bits: **8**

Stop bits: **1**

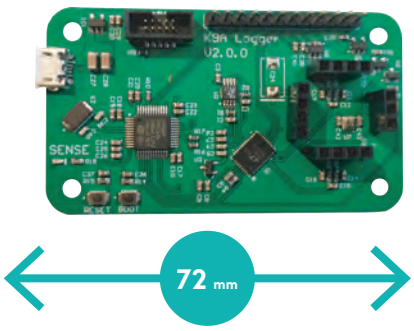
Parity: **None**




With a 2.54 mm header

## PACKAGE OUTLINE DRAWING & DIMENSIONS


With a 2.54 mm header






With a 2.54 mm header

ALTERED CARBON

PRECISION GRAPHENE SENSORS

**K9 Sense Evaluation Kit**
**Engineering sample**

**DATE OF PUBLICATION: APRIL 2020**

WWW.ALTERED-CARBON.COM

# QUICK START

## TERMINAL PROGRAM OPERATION

1. Download and install a Serial Plot.
(https://hackaday.io/project/5334-serialplot-realtime-plotting-software)

2. Connect the K9 Sensor Development Board to the Micro USB to USB on your computer.

3. Connect the USB to your computer.
   a. If device drivers are not automatically downloaded and installed, you can find device drivers for your operating system by going to:
   https://www.st.com/en/development-tools/stsw-stm32102.html

4. Determine the COM port that is associated with the module.
   a. On Windows operating systems, locate and open the Device Manager.
   b. The K9 Dev board should be listed under the heading, "Ports (COM & LPT)", as "STM Virtual COM Port", where XX is the unique port number associated with the device.
   c. Make a note of the unique port number.

5. Open SerialPlot.
   a. Underneath the graph window, look for the "Port" drop down menu.
   b. In the drop down list, select the appropriate COM port, identified above..
   c. Below the Port drop down menu, select the "Baud Rate" drop down menu, and
      - Baud: 115200
      - Data bits: 8
      - Stop bits: 1
      - Parity: None
      - Flow Control: None
   d. Select "OK"

6. Initial Sensor Burn Time
   a. Takes up to 24 hour + to establish first readings.
   b. Then you will see the basline level out.

7. Initial ZERO (Clean Air) Calibration.
   a. Takes up to 10 mins to establish baseline in new atmosphere.
   b. WAIT 30 mins - 1 hour to calibrate in clean air the longer the better.

## SENSOR OPERATION

Sensor has an on-board eeprom so that it will be automatically identified by the development board.

ALTERED CARBON

PRECISION GRAPHENE SENSORS

**K9 Sense Evaluation Kit**
**Engineering sample**

**DATE OF PUBLICATION: APRIL 2020**

WWW.ALTERED-CARBON.COM

# IMPORTANT PRECAUTIONS

## All sensor designs are made for air monitoring @ 1 atm +/- 0.2 atm

Due to user applications of use and device implementation being outside our control, K9 Sensors cannot guarantee performance in a given device or application, therefore disclaiming any and all liability.

**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 (> 40oC) 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]

[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.

ALTERED CARBON

PRECISION GRAPHENE SENSORS

**K9 Sense Evaluation Kit**
**Engineering sample**

**DATE OF PUBLICATION: APRIL 2020**

WWW.ALTERED-CARBON.COM

# ENGINEERING SAMPLE DISCLAIMER

Altered Carbon LTD ("AC") is offering Engineering Sample Devices (ES) which are pre-production products meant to be used by its customers for evaluation, test, development and prototyping prior to the start of the product's volume production at AC.

**If and when using the AC ES, customers accept the following terms and conditions:**

Engineering Sample Devices are made available solely for purposes of research, development and prototyping. All Engineering Sample Devices are sold "as-is" with no warranty of any kind, neither express or implied. AC does not warrant that Engineering Sample Devices are fully verified, tested, or will operate in accordance with data sheet specifications. AC disclaims any obligations for technical support and bug fixes.

AC shall not be liable for any damages including; without limitation, direct, indirect, incidental, special, reliance, or consequential damages arising from or in connection with the use of Engineering Sample Devices in any manner whatsoever, even if AC has been advised of the possibility thereof. AC makes no representation that Engineering Sample Devices provide any particular functionality, or that Engineering Sample Devices will meet the requirements of a particular user application. AC does not warrant that Engineering Sample Devices are error-free, nor does AC make any other representations or warranties, whether express or implied, statutory or otherwise, including, but not limited to, implied warranties of merchantability, fitness for a particular purpose, or non-infringement.

The foregoing states the entire liability of AC with respect to Engineering Sample Devices.

Customers shall indemnify and hold harmless AC from all and any claims of Third Parties arising from or in connection with the use of ES in any manner whatsoever, even if AC has been advised of the possibility thereof.

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Altitude Technology:

k9-no2