ALTERED CARBON

PRECISION GRAPHENE SENSORS

K9 Sense Evaluation Kit
Engineering sample

DATE OF PUBLICATION: APRIL 2020

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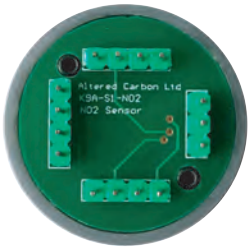
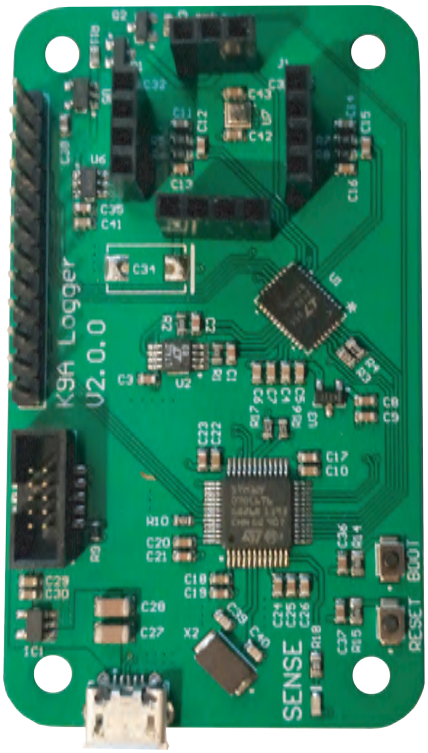
K9 Sense

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

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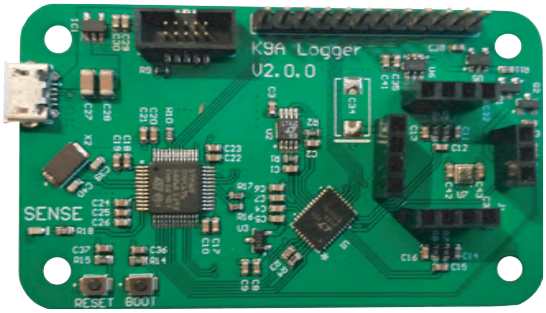

Applications

- 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

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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 9 mA in active mode (typically on for < 1 sec) 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

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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

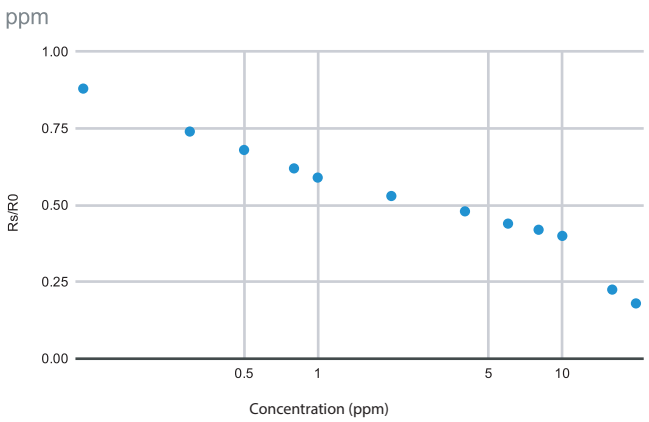

Figure 3

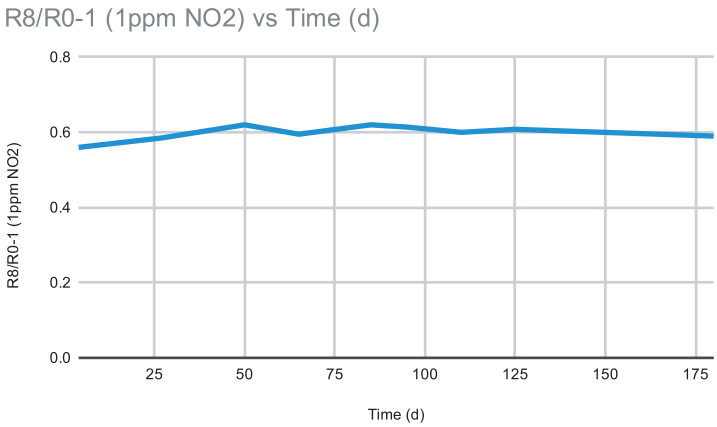

Figure 4

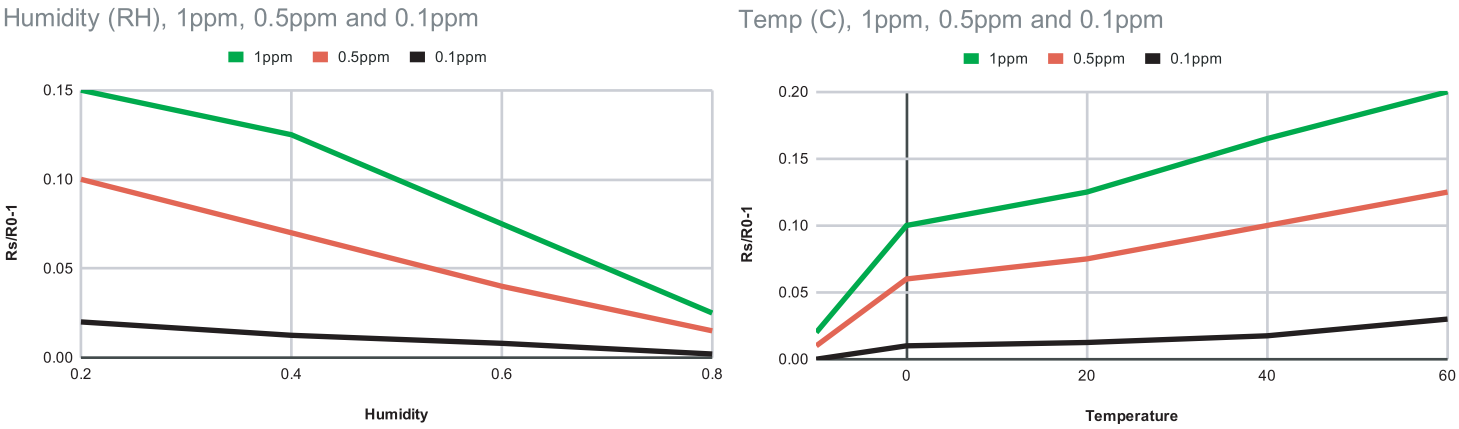

Figure 5

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

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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

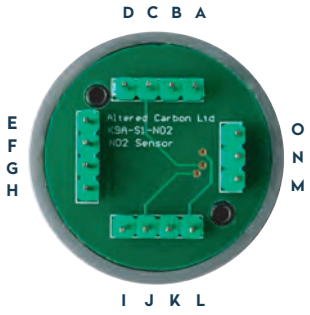
Voltage level: **3.3V**

Baud: **115200**

Data bits: **8**

Stop bits: **1**

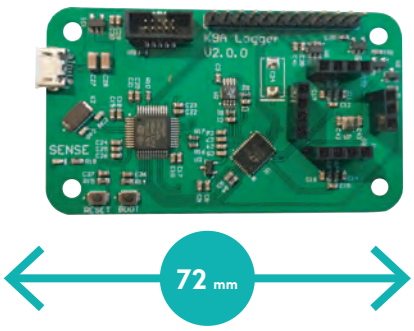
Parity: **None**



With a 2.54 mm header

PACKAGE OUTLINE DRAWING & DIMENSIONS

With a 2.54 mm header



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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.

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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.