CO_2 Sensor Module – HX-2000U

EXSEN EXSEN Inc.

Features

- Electrochemical type CO_2 gas sensor
- High reliability performance
- Long life time, 10 years
- Fast response time
- Compatible with UART
- Super compact size module
- Auto calibration
- Low power consumption
- Maintenance free
- Suitable to indoor environment.
- 7 Pin module
- Pin to Pin with P-company CO2 sensor (UART)

Applications

- Indoor air quality maintenance system
  - Home net room panel
  - Air conditioner
  - Air cleaner
  - Diffuser
  - Climate control system
  - Total heat exchanger
- IOT based indoor watching system
  - Security
  - Home automation
  - Set-top box
  - Lighting
  - Dash-Cam

CO_2 sensor overview

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Sensor & electrical performance specification (T_a = 25°C)

Parameters		Condition	Symbol	Min	Typ	Max	Unit
Gas	**Target gas**	-	T_{Gas}		CO_2		-
Data	**Sensor type**	-	EC		Electrochemical		
	Detection range	-	DD_R		400-5,000		ppm
	Resolution	-	D_R		1		ppm
	Accuracy	-	D_A	**-40 ppm -3% of reading**	**After Starting 15 min[1)2)]**	**+40 ppm +3% of reading**	%
		-	D_{A3}	-70 ppm -5% of reading	10 min	+70 ppm +5% of reading	
		-	D_{A10}	-100 ppm - 10% of reading	3 min	+100 ppm +10% of reading	
Time	**Response**	-	T_{Res}		2min for 90% for diffusion sampling method		
	Warm-up	-	T_{WU}	1	3	-	min
	Life-time	-	T_{LT}		10		Years
Power	**Input**	-	V_{IN}	4.5	5	5.5	V
	Current Consumption	-	P_A	-	0.12	0.15	A
	Warm-up consumption	-	P_W	0.35	0.6	0.75	W
Output	**Interface connections**	-	O_C		UART		
	Sampling interval	-	T_{SPL}		1		Hz
	Connector	-	CNT		2.0 pitch hole x 7, connector is not specified It depends on customer's requirements		
Ambient	**Operating Temp**	-	O_T	-20	25	70	°C
	Operating Humidity	No condensing @25℃	O_H	0	-	95	%
	Storage Temp	-	S_T	-40	25	105	°C
	Storage Humidity	Pack in moisture proof bag	S_H	5	-	90	%
Calibration		-	CAL		Not required. and Self mode is ready		-

Note

1) In normal IAQ applications (Air Cleaner, Indoor IAQ monitor), accuracy is defined after minimum 4 days with continuous operating.
2) The sensor is temp-compensation device. With rapid temperature changing, sensor don't show stable output.

Sensor Characteristic graph

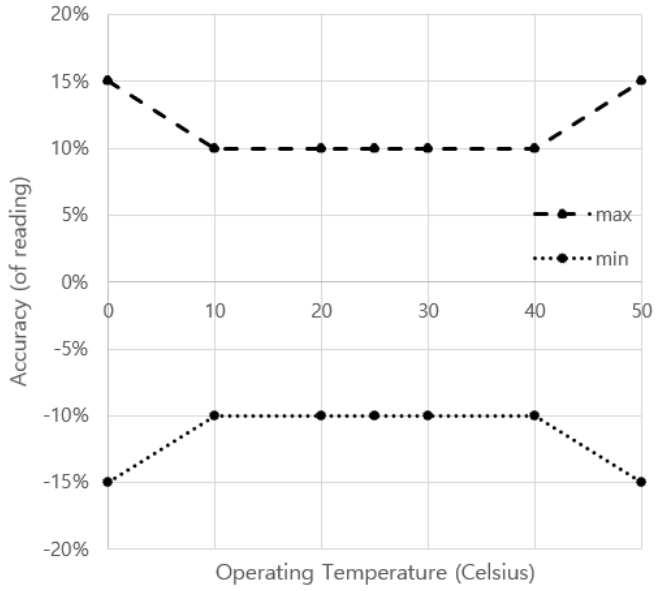


Fig. 1 Accuracy by temperature

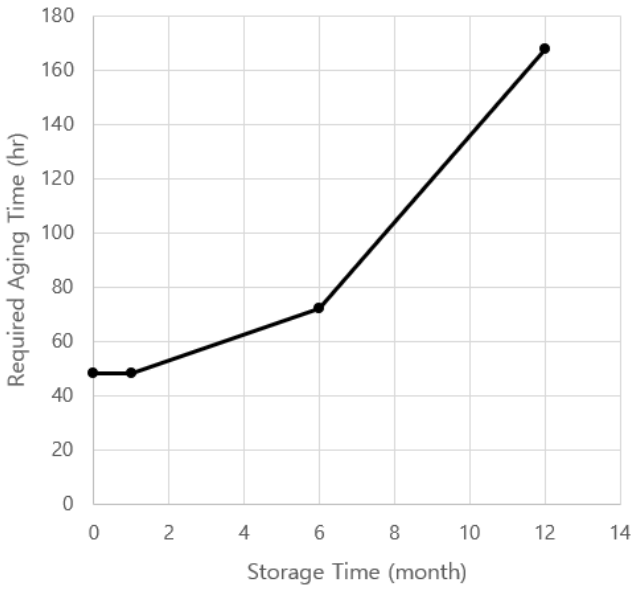


Fig. 2 Required aging time by storage time

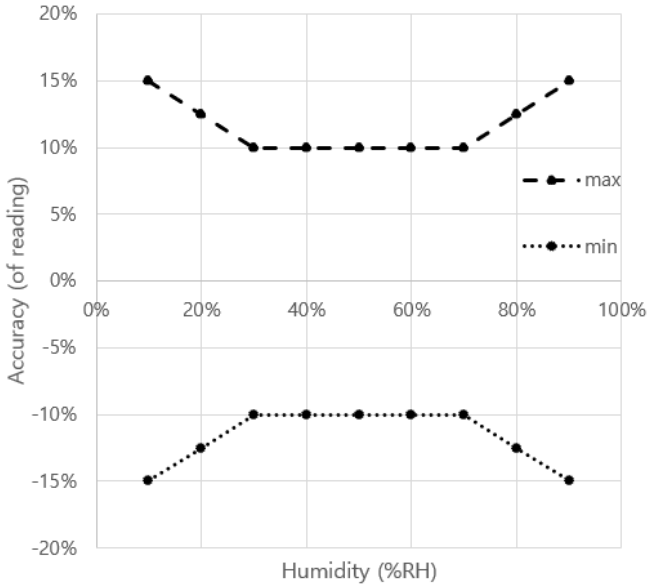


Fig. 3 Accuracy by Humidity

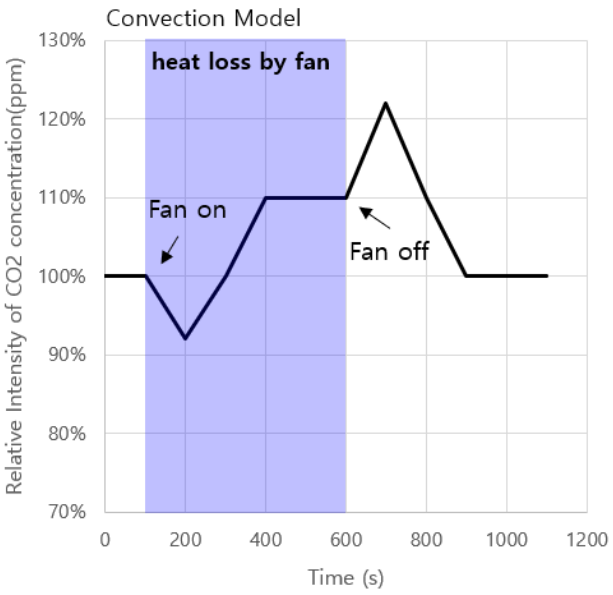


Fig. 4 Fluctuation by temperature changing

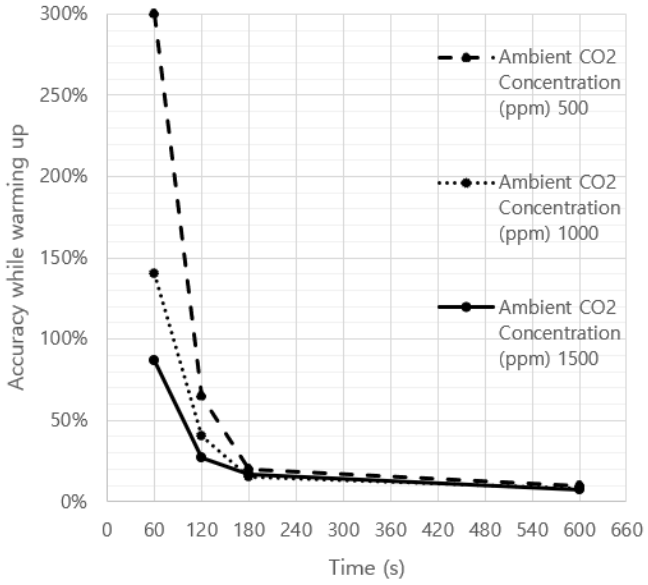


Fig. 5 Accuracy while warming up

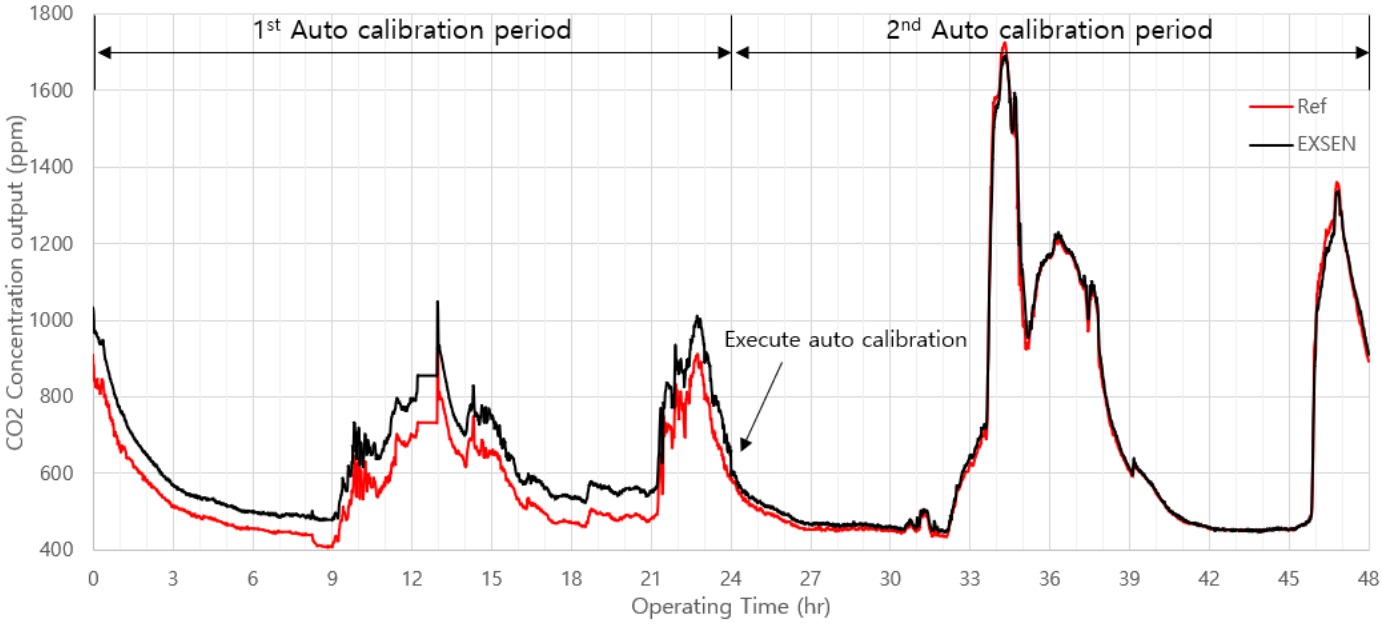
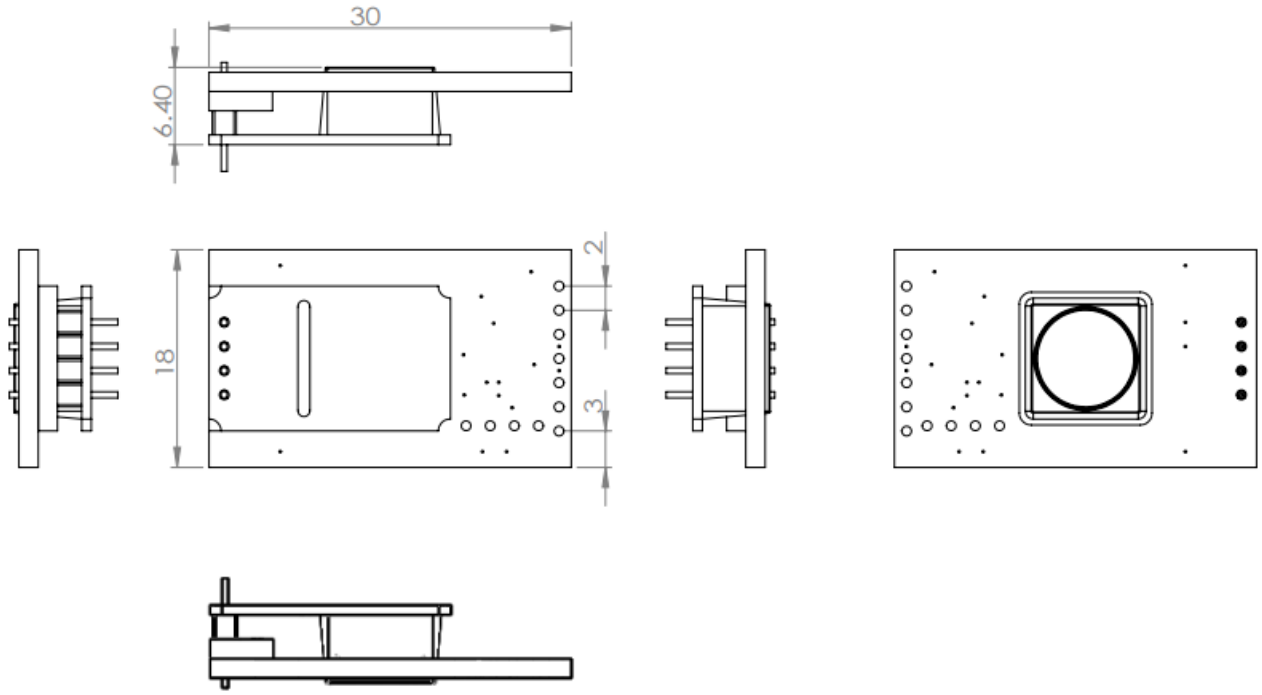


Fig. 6 Example of autocalibration

Module Overview



Theory of operation

Introduction

The CO_2 Sensor module is a gas sensor system that has been optimized for carbon dioxide. It is highly sensitive system including gas sensor and self-calibration. CO_2 sensor is operated by following 3 steps.

1. Warm-up
2. Normal operating
3. Calibration

Warm-up

Electrochemical CO_2 sensor is consisted with micro heater and sensing material. The sensing material should be heated for 1~15 minutes to measure specific CO_2 level. About 15 minutes later, the module shows stable and correct value of CO_2 concentration.

The module consumes about 0.5 W while warm-up. And after warming-up, it reduced to about 0.1W.

Normal operating

In continuous operation, CO_2 sensor module shows stable and linear signal by CO_2 concentration. If the module is turned off, warm-up is required again to measure CO_2 concentration after turning on.

Calibration

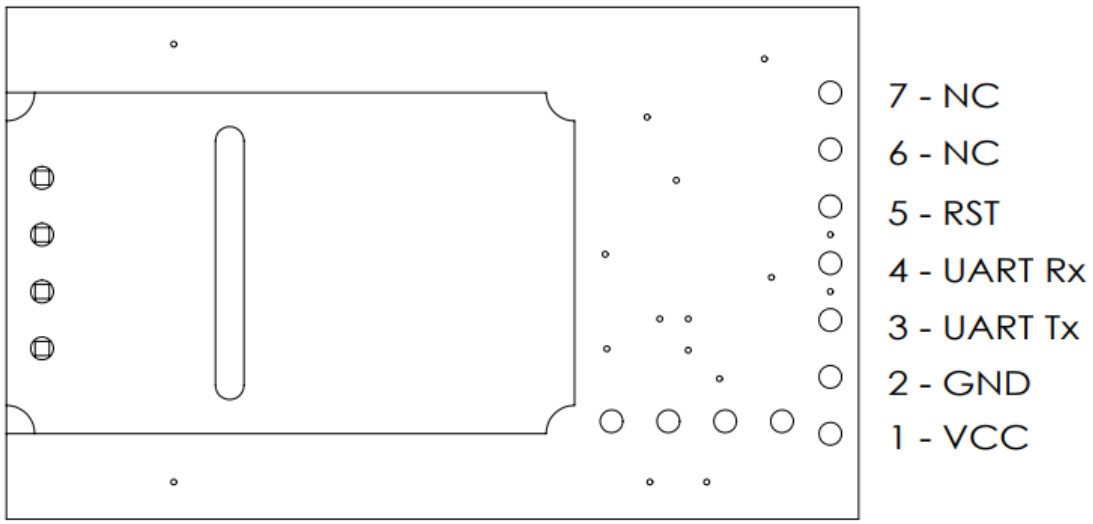
After applying power to the module, the measurement value may be deviated in 2 days. The deviation is related

with installation environment. However, if the module is operated continuously over 2 days, the module learns about the installation environment and shows higher accuracy than specification sheet value by self-calibration logic.

Terminal descriptions

Connector is not specified. It will be discussed between customer and EXSEN. Basically, connector is not attached.

Pin No.	Symbol	Description
1	VCC	Supply, 5V
2	GND	Ground
3	Tx	UART Tx
4	Rx	UART Rx
5	RST	Reset
6	NC	Not connected
7	NC	Not connected



UART

(1) Interface

- UART
- Baud rate: 9600 bps
- Check bit: None
- Stop bit: 1 bit

(2) Protocol

- Host Send (Read CO2 Conc.)

Start byte 1	Start byte 2	Command	Parmeter 1	Paremater 2	CHKSUM high	CHKSUM low
0x42	0x4d	0xe3	0x00	0x00	0x01	0x72

- Sensor Feed back (transmit CO2 Conc.)

Start byte 1	Start byte 2	Command		CO2 High	CO2 Low	Cal_A High	Cal_A Low	Cal_B High	Cal_B Low	CHKSUM high	CHKSUM low
0x42	0x4d	0x00	0x08	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00

- Start byte 1, byte2 and command is constant value.
- CO2~Cal_B value is variable.
- CO2 value is concentration of CO2, unit: ppm
- Conversion CO2 value = CO2_High * 256 + CO2_low
- Cal_A and Cal_B is calibration number, it is not required to calculate CO2 Conc.
- CHKSUM byte is check sum value of uart protocol.
- CHKSUM_High = (0x42 + 0x4d + 0x00 + 0x08 + CO2_High + CO2_Low + Cal_A_High + Cal_A_Low + Cal_B_High + Cal_B_Low) **/** 256;
- CHKSUM_Low= (0x42 + 0x4d + 0x00+ 0x08 + CO2_High + CO2_Low + Cal_A_High + Cal_A_Low + Cal_B_High + Cal_B_Low) **%** 256;
- Example
- If CO2 value = 400 ppm, cal_A = 300, cal_B = 65.0

Start byte 1	Start byte 2	Command		CO2 High	CO2 Low	Cal_A High	Cal_A Low	Cal_B High	Cal_B Low	CHKSUM high	CHKSUM low
0x42	0x4d	0x00	0x08	0x01	0x90	0x01	0x2C	0x41	0x00	0x01	0x96

- If CO2 value = 1500 ppm, cal_A = 250, cal_B = 70.01

Start byte 1	Start byte 2	Command		CO2 High	CO2 Low	Cal_A High	Cal_A Low	Cal_B High	Cal_B Low	CHKSUM high	CHKSUM low
0x42	0x4d	0x00	0x08	0x05	0xDC	0x00	0xFA	0x46	0x01	0x02	0xB9

Revision history

Rev No.	Date	Page	Details
R01	Aug 2020	ALL	Initialize

The product can be changed without notice. Before designing the structure of system, please contact EXSEN. The module dimension and electrical, general specification could be changed. (Contact info: ykkim@exsen.co.kr)

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