CO_2 Sensor Module - EX-14

EXSEN EXSEN Inc.

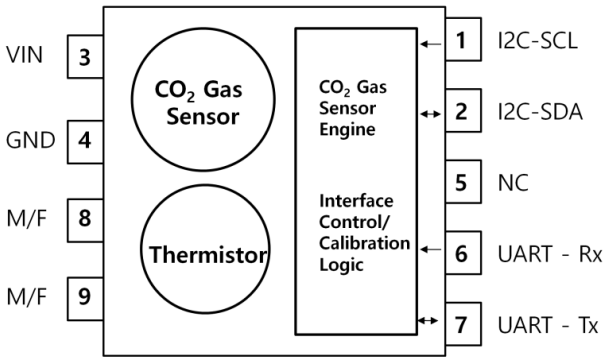
Features

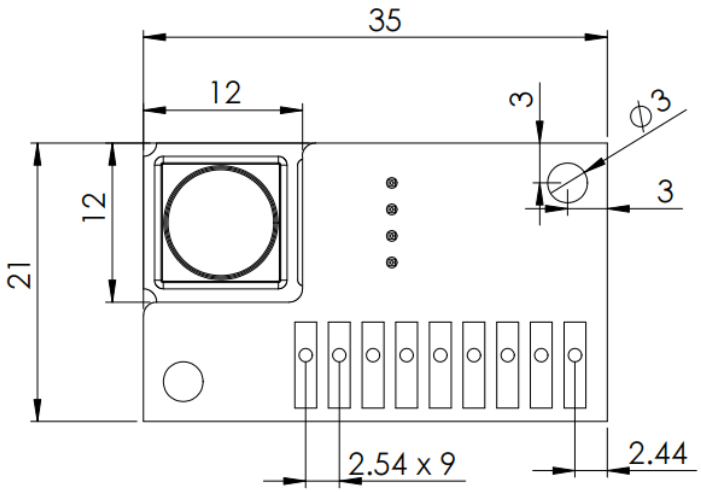
- Electrochemical type CO_2 gas sensor
- High reliability performance
- Long life time, 10 years
- Fast response time
- Compatible with I2C, UART, AVO
- Super compact size module
- Auto calibration
- Low power consumption
- Maintenance free
- Suitable to indoor environment.
- 9 Pin module

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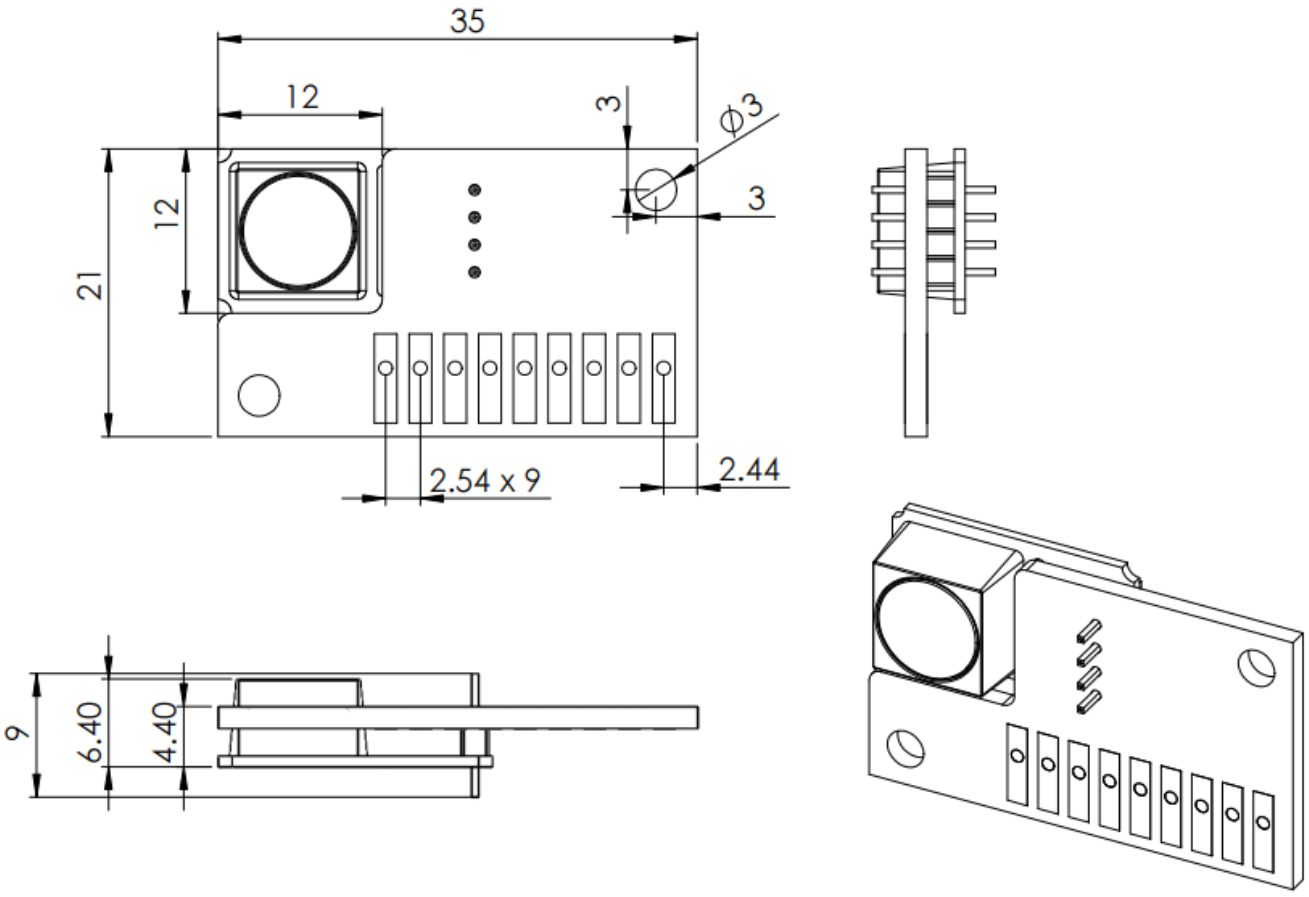
Sensor & electrical performance specification (T_a = 25°C)

Parameters		Condition	Symbol	Min	Typ	Max	Unit
Gas	**Target gas**	-	T_{Gas}	CO_2			-
Data	**Sensor type**	-	EC	Electrochemical			
	Detection range	-	DD_R	400-6,200			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}	3.2	5	5.1	V
	Current Consumption	-	P_A	-	0.11	0.12	A
	Warm-up consumption	-	P_W	0.35	0.55	1	W
Output	**Interface connections**	-	O_C	UART, I2C			
	I2C-ppm	-	I2C_ppm	400~6,200			ppm
	UART-ppm	-	UART_ppm	400~6,200			ppm
	State	-	Stat	0: Normal, 1:Warm-up			
	Error	-	Error	0:Normal, 1:Error			
	Sampling interval	-	T_{SPL}		1		Hz
	Connector	-	CNT	2.54 pitch hole, not specified connector It depends on customer's requirements			
Ambient	**Operating Temp**	-	O_T	-20	25	60	°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.

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.

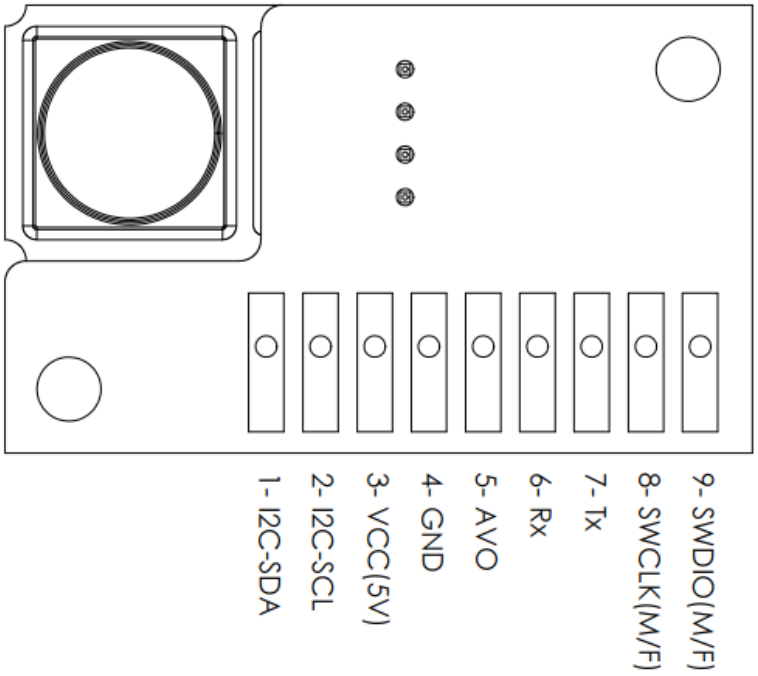
Calibration

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	SCL	Digital input, Serial clock for I2C communication
2	SDA	Digital bidirectional, Serial Address and Data
3	VCC	Supply, 3.2~5.1V
4	GND	Ground
5	NC	NC
6	Rx	UART Rx
7	Tx	UART Tx
8	Manufacturer	SWCLK
9	Manufacturer	SWDIO



I2C

output range: 400 ppm ~ 6200 ppm (Device Address: 0x23)

SCL Frequency: 200kHz

* **Master, Slave**

S	Address(W)	A	Command	A	S	Address(R)	A	DATA1	A	Data n	NA	P

General-purpose registers

Address	Data Bit	Default Value	Access	Name	Description
0xA1	[2:0]	-	RO	ACON	CO2 data (ppm)
	[3]	-	RO	STAT	0:Normal 1:Warm up
	[4]	-	RO	ERROR	0:Normal 1:Warm up
0xA2	[2:0]	-	RO	ACON	CO2 data (ppm)
0xA5	[0]	-	RO	STAT	0:Normal 1:Warm up
	[1]	-	RO	ERROR	0:Normal 1:Warm up
0x90	[0]	0	R/W	CALI	0:Auto CAL mode 1:Manual CAL mode
					10: Manual CAL Action Manual CAL Sequence (1)Manual CAL mode --> (2)Manual CAL Action --> (3) Auto CAL mode

Arduino I2C Sample code: Contact EXSEN (ykkim@exsen.co.kr)

UART

Baud rate: 9600

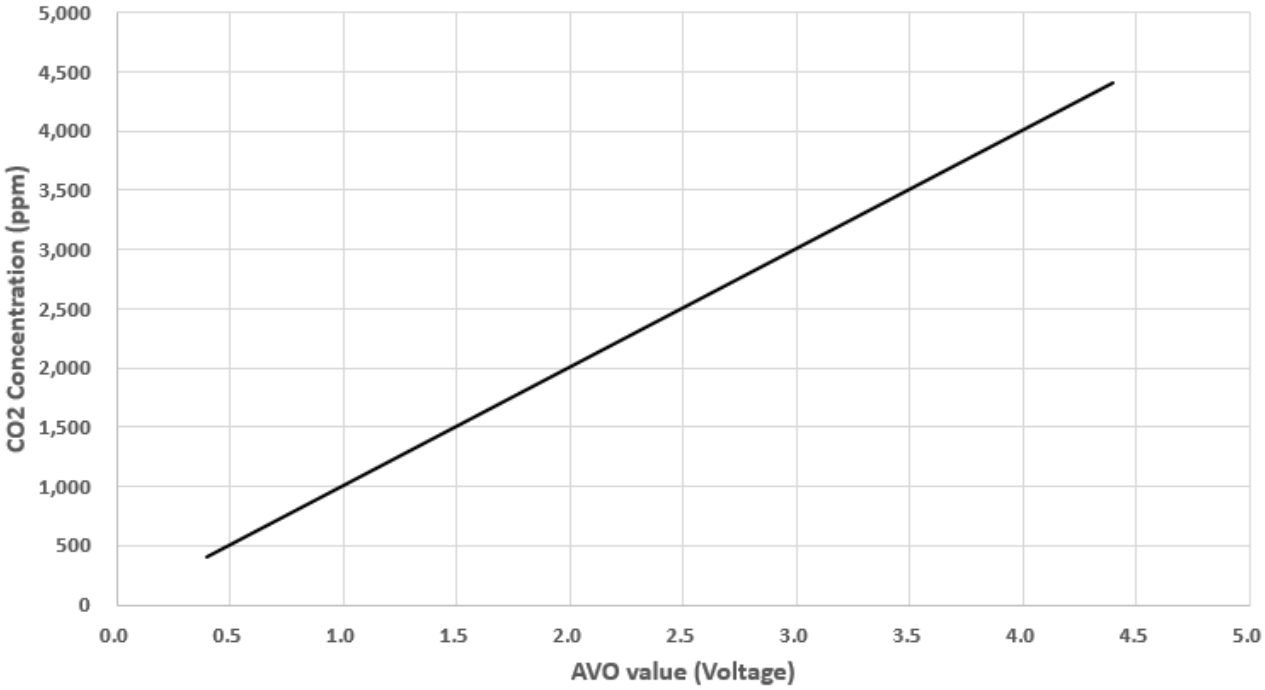
data expression: # 5000 Nr Nr

	#	Space	CO2 Concentration (ppm)	Space	Warm up Status	Space	Sensor Status
Data type	#		####		Wu/Nr		Er/Nr
Description	Start		Four digit		Wu: Warm up Nr: Stable		Er: sensor is not working properly. Nr: normal status

Arduino UART Sample code: Contact EXSEN (ykkim@exsen.co.kr)

AVO

Output range: 400 ppm ~ 4400 ppm



Voltage	ppm	Voltage	ppm	Voltage	ppm	Voltage	ppm
0.4	400	1.4	1,400	2.4	2,400	3.4	3,400
0.5	500	1.5	1,500	2.5	2,500	3.5	3,500
0.6	600	1.6	1,600	2.6	2,600	3.6	3,600
0.7	700	1.7	1,700	2.7	2,700	3.7	3,700
0.8	800	1.8	1,800	2.8	2,800	3.8	3,800
0.9	900	1.9	1,900	2.9	2,900	3.9	3,900
1.0	1,000	2.0	2,000	3.0	3,000	4.0	4,000
1.1	1,100	2.1	2,100	3.1	3,100	4.1	4,100
1.2	1,200	2.2	2,200	3.2	3,200	4.2	4,200
1.3	1,300	2.3	2,300	3.3	3,300	4.3	4,300
1.4	1,400	2.4	2,400	3.4	3,400	4.4	4,400
1.5	1,500	2.5	2,500	3.5	3,500		
1.6	1,600	2.6	2,600	3.6	3,600		
1.7	1,700	2.7	2,700	3.7	3,700		

$$CO_2 = AVO \times 1000$$

Revision history

Rev No.	Date	Page	Details
R01	Mar 2019	ALL	Initiate EX-14, CO_2 sensor module specification

The EX-14 module 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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