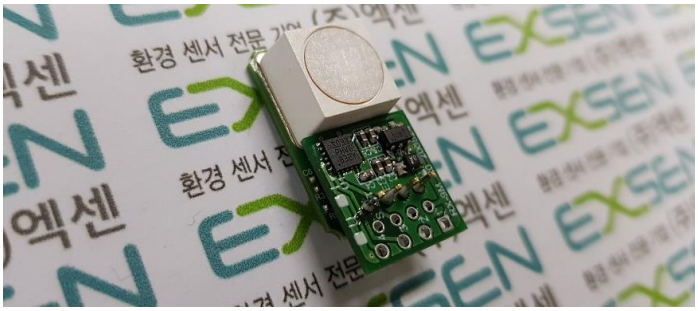
APPROVAL SHEET

MODEL NAME	CO2 SENSOR MODULE (RX-9M)
PART NUMBER	EX-NN-24125UN5KA
CUSTOMER NAME	-
CUSTOMER PART NUMBER	-
DATE	2020.09.03
REMARK	R00
SOFTWARE VERSION	V00
SOFTWARE CHECKSUM	0xC6329



EXSEN Inc.

	Written	Reviewed	Approved
Signature			
Name			
Date			

Customer

	Written	Reviewed	Approved
Signature			
Name			
Date			

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Contents

1. REVISION NOTE

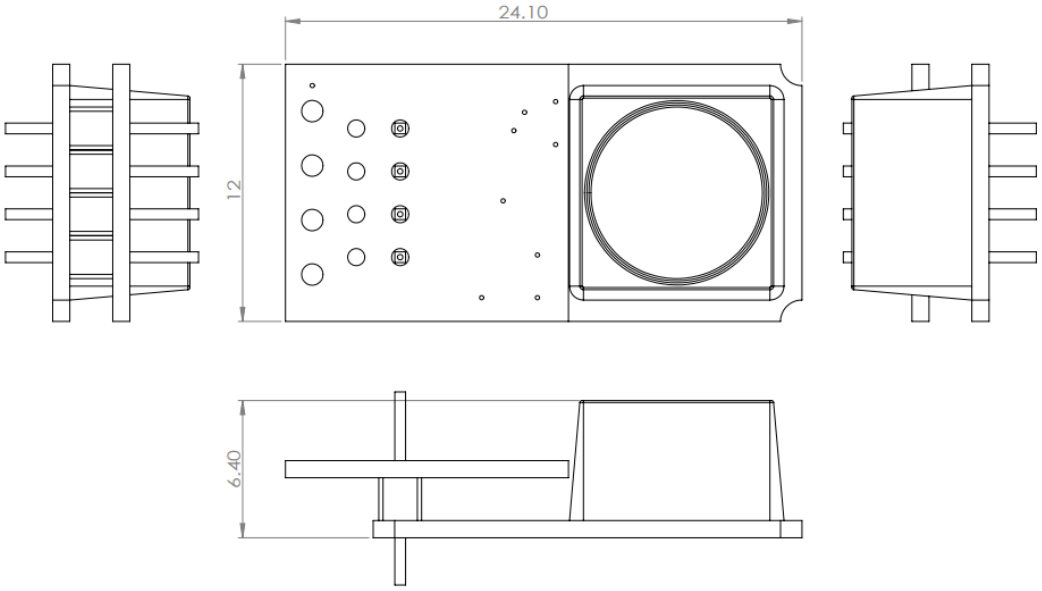
Date	Revision	Page	Remark
2020-09-03	INITIATE DOCUMENT	ALL	REV.00

2. DATA SHEET

MODEL NAME	CO2 SENSOR MODULE (RX-9M)
PART NUMBER	EX-NN-24125UN5KA
DIMENSION	30 x 18 (mm^2) , 6.4(T, mm, w/o CNT)
CO2 DETECTION RANGE	400~5,000 ppm
COMMUNICATION	UART
APPLICATION	Carbon dioxide concentration display General Purpose

(1) Dimension

- **Small Sensor Module, 24.1 x 12 x 6.4 (L x W x H, mm)**



Connector: Not specified. It depends on customer's requirement.

General Tolerance (mm)	
Linear	±0.3
Radius	±0.5

(2) Sensor & electrical performance specification (T_a = 25°C, 50%RH)

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[1]	At Normal temp, humidity, pressure	D_A	-10	After starting 15 min	10	%
			D_{A3}	-25	3 min	25	
			D_{A10}	-15	10 min	15	
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	-	0.6	0.8	W
Output	**Interface connections**	-	O_C		UART		V
	Sampling interval	-	T_{SPL}		1		Hz
	Connector	-	CNT		Not specified		
Ambient	**Operating Temp**	-	O_T	0	25	50	°C
	Operating Humidity	No condensing	O_H	0	-	90	%
	Storage Temp	-	S_T	-40	25	60	°C
	Storage Humidity	Pack in moisture proof bag	S_H	5	-	90	%
Calibration		-	CAL		Not required and Self mode is ready		-

1) Sensor requires to be exposed to fresh air from outdoor at least 1 minute per day. but you do not pay attention to handle this, if the room with windows is empty, air diffused from high concentration to low concentration naturally. It works like fresh air exposure.

2) Accuracy is defined after 2 days of continuous operation in home. If you want to use this to industrial like factory or agriculture, contact manufacturer.

(3) Sensor Characteristic graph

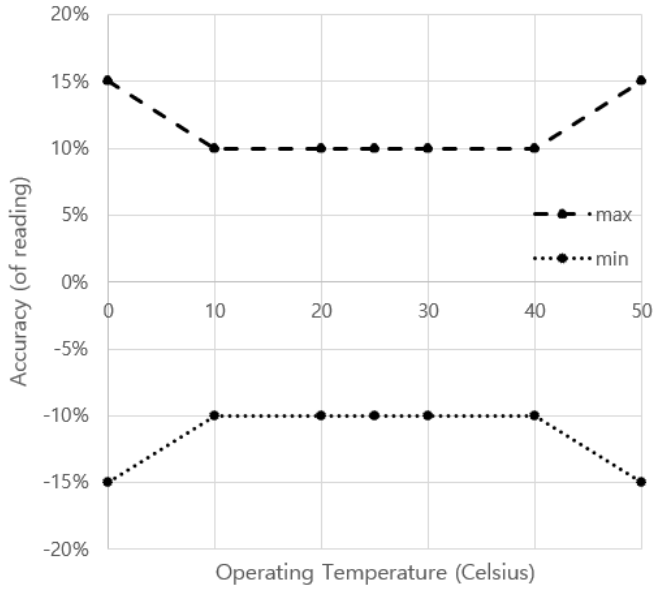


Fig. 1 Accuracy by temperature

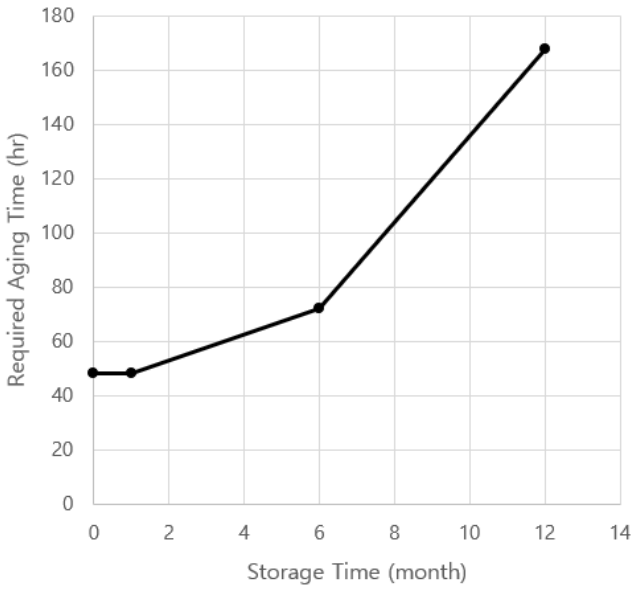


Fig. 2 Required aging time by storage time

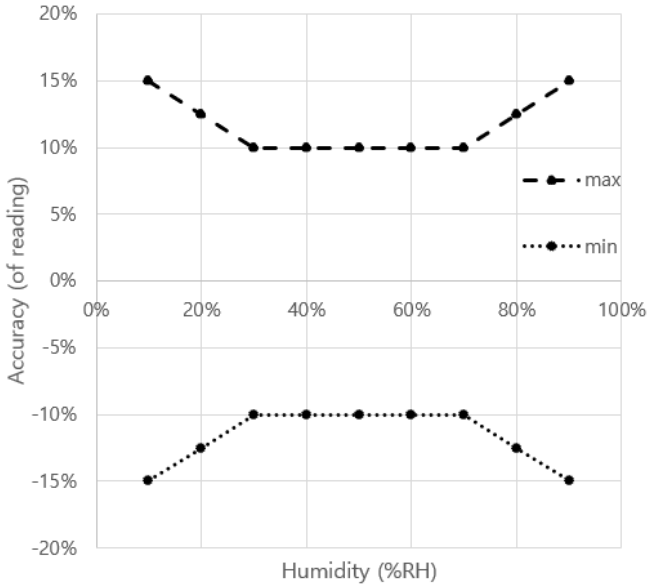


Fig. 3 Accuracy by Humidity

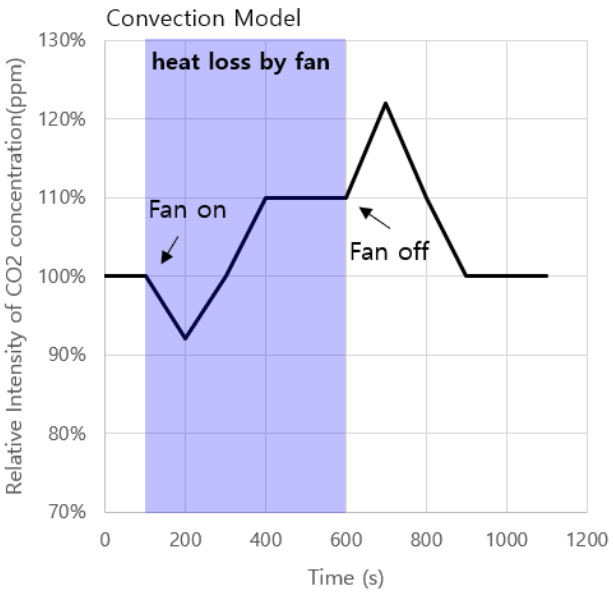


Fig. 4 Fluctuation by temperature changing

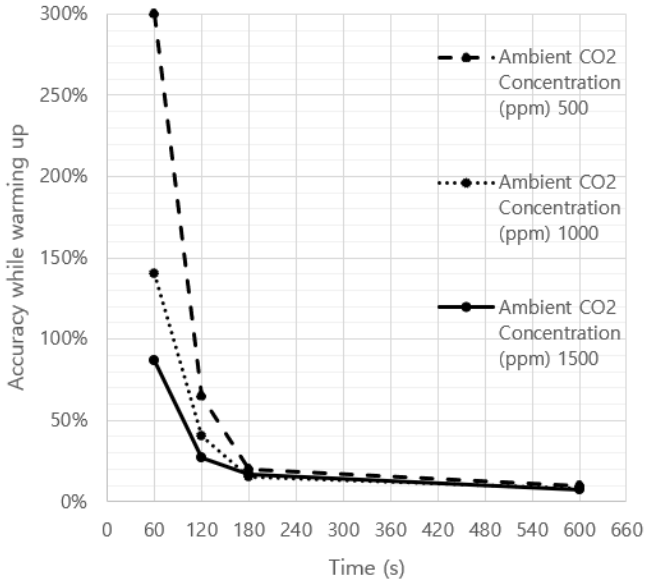


Fig. 5 Accuracy while warming up

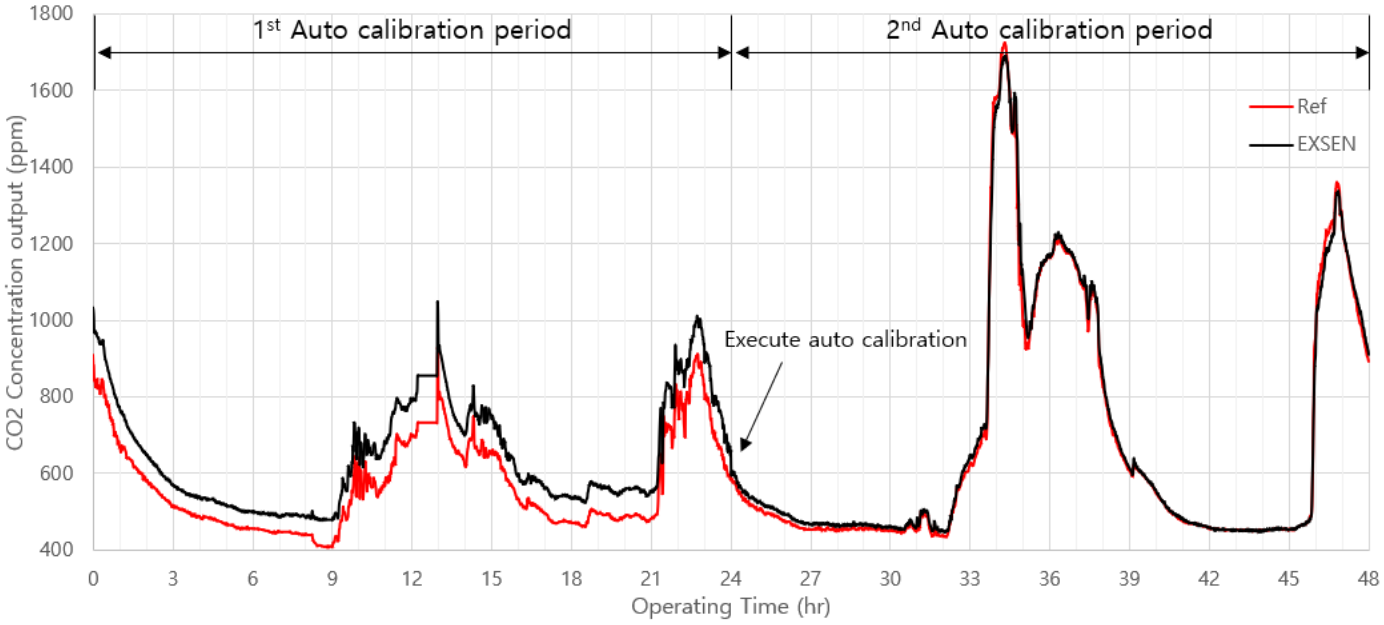


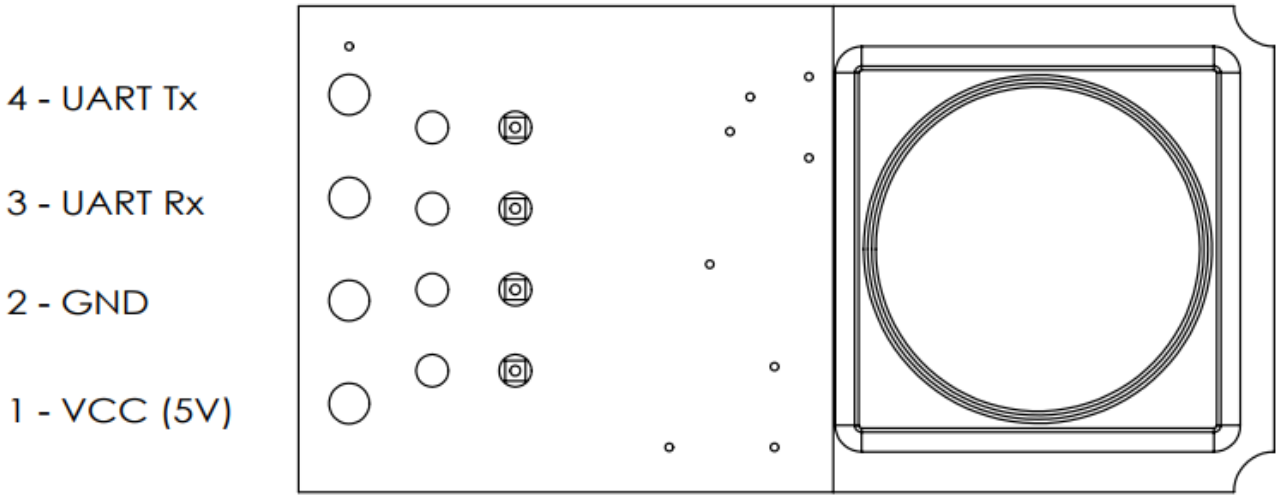
Fig. 6 Example of autocalibration

3. Terminal descriptions

- Connector

Model name	Maker	Type	Pin no	Pin to Pin
-	-	-	-	-

Pin No.	Symbol	Description
1	VCC	Supply, 5V
2	GND	Ground
3	Tx	UART Tx
4	Rx	UART Rx



4. Communication descriptions

(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

5 Cautions

(1) Moisture, Gas-Proof Package

1) When moisture or interfering gas is absorbed into the sensor module, it may cause malfunction. There is a possibility that may cause broad ppm tolerance of sensor. But normally sensor module can self-calibrated after 1 day. For this reason, the sensor module is used to keep moisture or interfering gas to minimum.

(2) Storage Conditions

1) Before/After opening the packing: The sensor module should be kept at 30℃ or less and 60%RH or less. The sensor module should be used within a 3 months. When storing the sensor module the cap sealing tape is should be attached.
2) EXSEN sensor is sensitive to ambient condition while storing, if the sensor module exposed to air direct w/o cap sealing tape, the sensor module should be operated for 4 days after that the sensor self-calibrated at clean air.
3) Please avoid rapid transition in ambient temperature, humidity, interfering gas, especially in high humidity environments where condensation can occur.

(3) Handling

1) The sensor module is very sensitive to human touching. Don't touch the sensor pin w/o glove. It may occur the sensor malfunction.
2) The sensor module is temperature compensation device, so don't apply rapid transition in temperature by conduction, convection, radiation. rapid temperature transition can make sensor output ppm fluctuation.
3) The sensor could be damaged from high concentrated interfering gas. For example, ethanol Isopropyl alcohol or solvent to clean the PCB could be harm to sensor.
4) PCB coating solution or resin is harm to sensor. While curing to PCB coating, the resin outgas the interfering gas to sensor. It damages to sensor sensitivity. Occasionally, the damage works permanently. If the coating is required to use the sensor, seal the top of sensor firmly.

(4) Initializing of sensor (warm-up)

1) The sensor takes 3 minutes to initialize their internal components. The sensor is basically heating device. so, the initializing means warming up the device to sense the carbon dioxide.
2) The accuracy depends on the warming-up time. The sensor shows ±25% deviation at 3 min after starting and ±15% at 5min.

(5) Auto Calibration

1) The sensor is monitored their output by program of MCU. The MCU calibrate the baseline of sensor output by 1 day.
2) It is required to auto-calibrate, the sensor should be exposed to clean atmosphere at least 5 min/day. Because the sensor learns the baseline of clean air.

3) The sensor shows reliable sensing data after 1 auto-calibration. Because storage condition of sensor could change the baseline of sensor at first. But this symptom is calibrated after 1 day by auto calibration.

4) After reliability test, the sensor should be exposed to clean air at least 3 days. The harmful environment change the sensor baseline. So give enough time to sensor to calibrate.

(6) Temperature changing

1) Rapid temperature changing makes signal fluctuation to sensor output. The fluctuation is stabilized soon when the temperature is stabilized.

2) The temperature changing is caused by convection, heat conduction, and thermal radiation.

3)

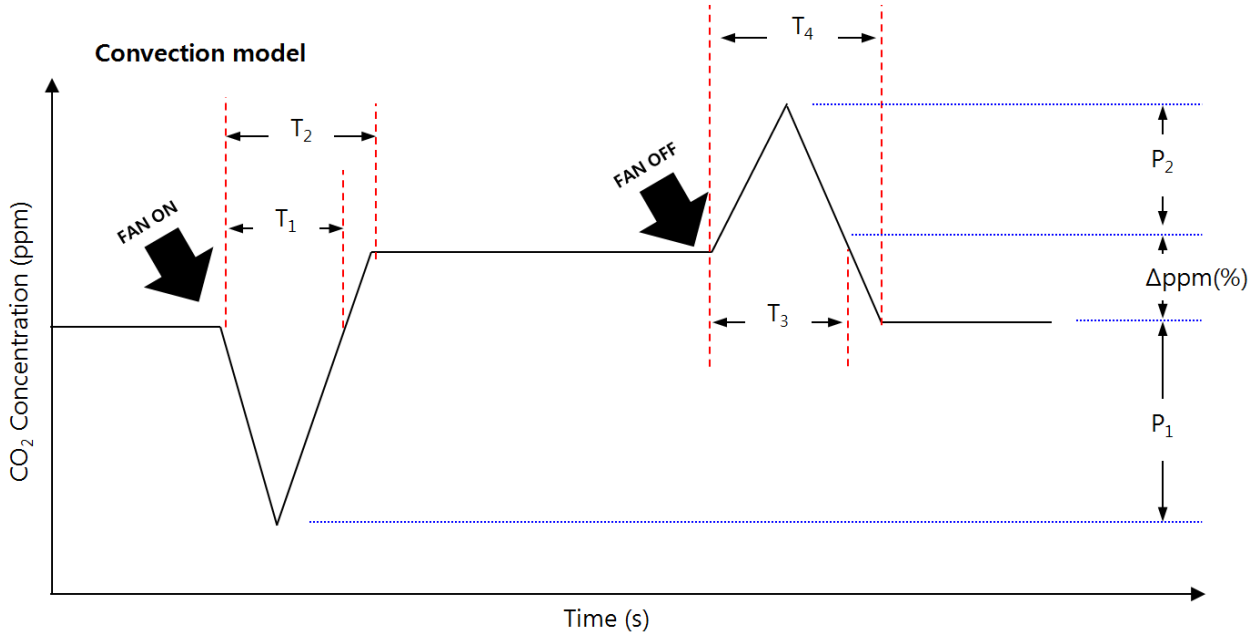


FIG. The convection model of temperature changing for sensor

output data, @400 ppm, Ambient Temp = 25℃

FAN speed	T1 (s)	T2 (s)	T3 (s)	T4 (s)	Δppm (%)	P1 (%)	P2 (%)
High	200	400	200	300	10	12	10
Low	175	300	200	300	8	10	8

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