SPECIFICATION

Product Name: Single Beam NDIR CO_2 Sensor Module

Item No.: CM1106H-NS

Version: V0.5

Date: June 21, 2021

Revision

No.	Version	Content	Date
1	V0.1	Issue the high-end version CM1106H-NS	2019.04.01
2	V0.2	Revise information of range, ABC calibration, and dimension picture	2019.07.12
3	V0.3	Add range note for accuracy	2019.11.22
4	V0.4	Revise the power supply, description of ABC cycle and drawing	2020.05.26
5	V0.5	Update package information	2021.06. 21

Single Beam NDIR CO_2 Sensor Module

CM1106H-NS

Applications

- HVAC industry
- IAQ monitor
- Air purifier
- Automotive
- IoT devices
- Plant growth

Description

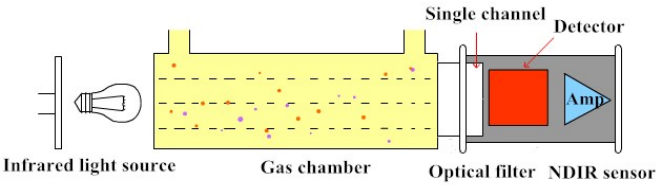
CM1106H-NS is a single beam NDIR CO_2 sensor module, based on non-dispersive infrared (NDIR) technology, which can detect CO_2 concentration of indoor air. With high accuracy, high stability, small size, it is widely used for ventilation system, air purifier, air conditioner, HVAC transmitter, IAQ monitor, etc.

Features

- NDIR technology with independent intellectual property
- High accuracy, long term stability, long life (>10years)
- Temperature calibration within whole measurement range
- Auto-calibration, no need of maintenance
- Signal output PWM/UART
- Small size and compact structure, easy to install

Working Principle

The main components of an NDIR CO_2 sensor are an infrared source, a sample chamber, a filter and an infrared detector. The infrared light is directed by the infrared source passing through the gas chamber towards the detector.



CO_2 molecules inside the gas chamber will only absorb a specific wavelength of the light. The filter allows only the specific wavelength corresponded to pass through it. The detector measures the intensity of infrared light that is related to the intensity of CO_2 and can be described through the Lambert-Beer's Law. The change in sensor signal reflects the change in gas concentration.

Specifications

Single Beam NDIR CO_2 Sensor Specification	
Target gas	Carbon dioxide (CO_2)
Operating principle	Non-dispersive infrared (NDIR)
Measurement range	PWM: 0-2000ppm UART: 0-10000ppm (Note 1)
Working temperature	-10°C ~ 50°C
Working humidity	0-95%RH (non-condensing)
Storage temperature	-30°C ~ 70°C
Storage humidity	0-95%RH (non-condensing)
Accuracy	± (30ppm+3% of reading) @ -10°C~50°C ,0-85%RH, UART/PWM 0-2000ppm
Sampling frequency	1s
Time to first reading	≤30s
Power supply	DC4.5V-5.5V
Ripple wave	<50mV
Working current	<50mA @ 1s
Dimensions	33x19.7x8.9mm
Weight	5g
Signal output	UART_TTL PWM
Life span	≥15 years
Maintenance	Maintenance-free for normal indoor application with Auto-calibration

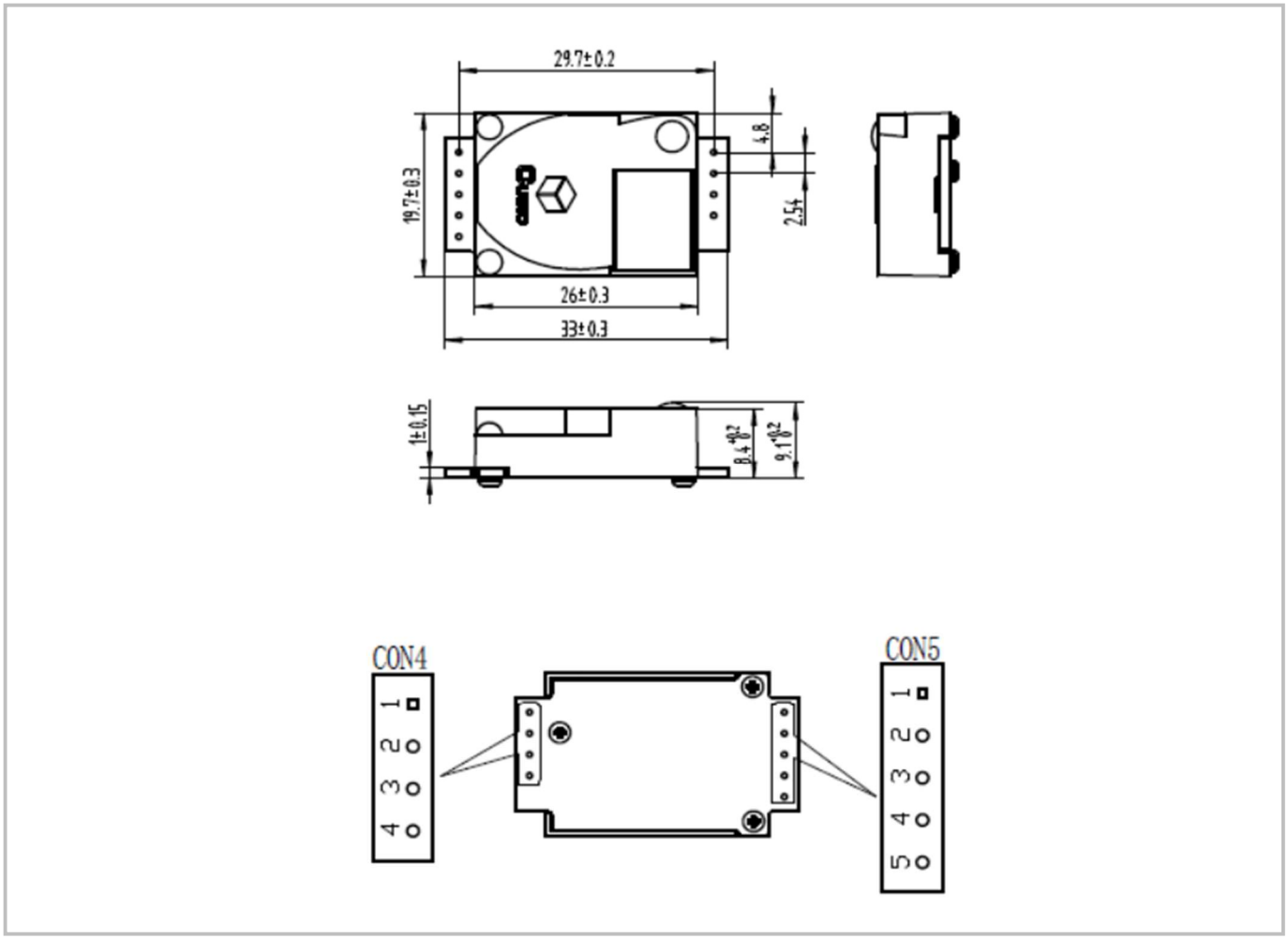
Note 1： Sensor is designed to measure in the range 0~2000ppm (PWM), 0-10000ppm (UART) with specified in the table. Nevertheless, exposure to concentrations below 400ppm may result in incorrect operation of ABC algorithm and shall be avoided for model with ABC ON.

Note 2: In normal IAQ applications, accuracy is defined after minimum three (3) ABC periods of continuous operation with ABC on. Some industrial applications do require maintenance. Contact Cubic for further information.

Note 3: Specification is referenced to certified calibration mixtures. Uncertainty of calibration gas mixtures (±2% currently) is to be added to the specified accuracy for absolute measurement.

Dimensions and Connector

1. Dimensions (Unit mm, tolerance ±0.2 mm)

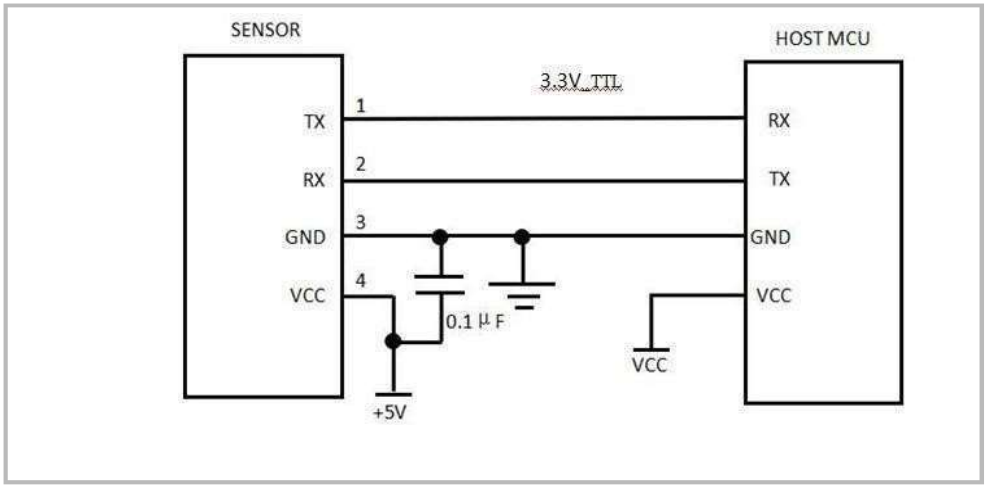


2. I/O Connector Pinout

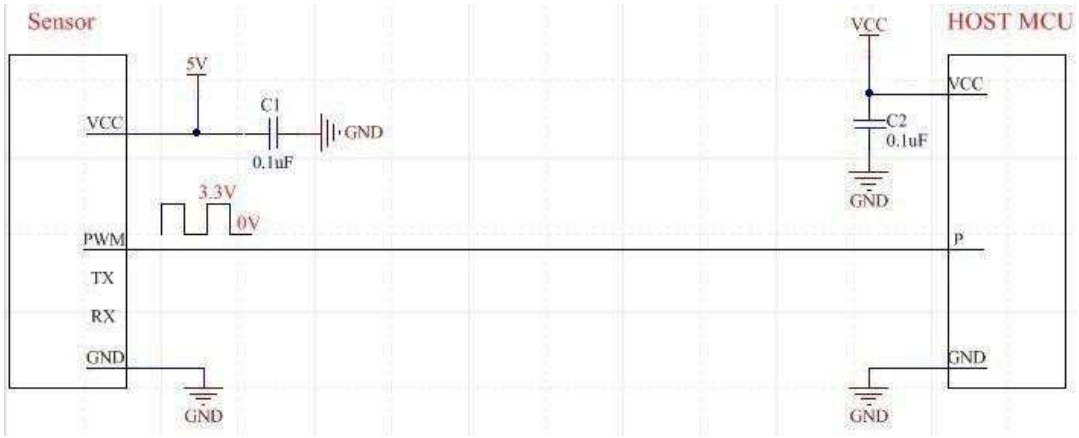
CON4			CON5		
Pin	Name	Description	Pin	Name	Description
1	+5V	Power supply input (4.5V-5.5V)	1	+3.3	Power supply output (3.3V/100mA)
2	GND	Power supply input (GND)	2	RX	UART receiving (3.3V TTL)
3	A	Alarming (Reserved)	3	TX	UART sending (3.3V TTL)
4	PWM	PWM output	4	R/T	RS485 control site （Reserved）
			5	CA	Manual calibration

Typical Application Circuit

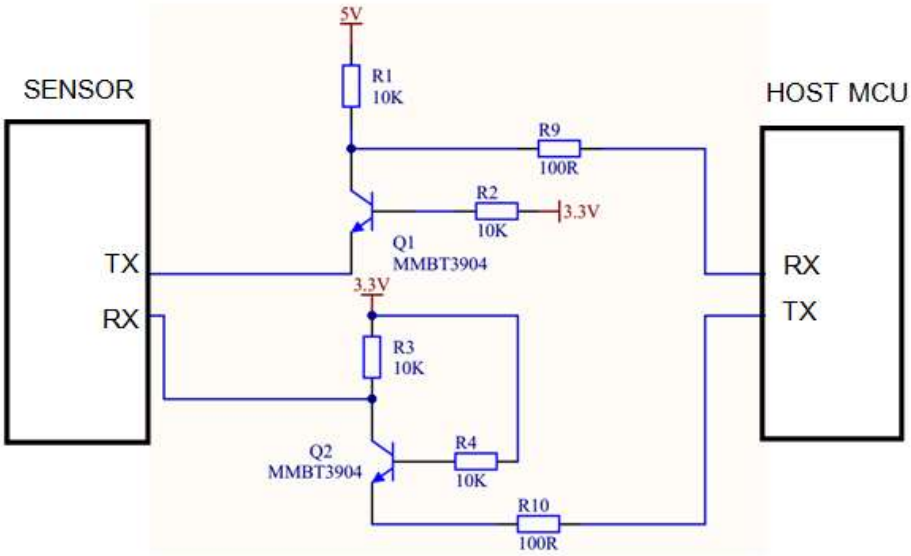
Case 1: Application scene: UART_TTL serial port output



Case 2: PWM output



Case 3: 3.3V- 5V conversion circuit



Description of Calibration

Auto Calibration:

Rough installing and influence of transportation might result in reducing of sensor measuring accuracy and baseline drift, sensor will correct the drift by the built-in self-correcting logic, and the auto baseline correction period is 24h+7 days. Powering on the sensor for 24 hours continuously, it will record the lowest CO2 concentration measurement value during the 24 hours, which will be regarded as baseline (400ppm) when sensor implements auto calibration after the 24 hours working, and then the sensor will enter regular 7 days correction cycle, auto calibration will be implemented every 7 days. In order to ensure correct auto calibration, please make sure working environment of the sensor can reach to outdoor fresh air level (400ppm) during the 24 hours and regular 7 days auto baseline correction cycle.

Note: Please contact with Cubic for more detailed auto calibration strategy.

Manual Calibration:

Rough installing and influence of transportation might result in a reducing of sensor reading accuracy and baseline drift. If need to recover accuracy quickly after installing, users can do manual calibration. Put the sensor in the environment where the CO_2 concentration level can reach 400ppm, and to ensure the CO_2 concentration in this environment is stable before calibration. The CA pin of sensor should be well connected at least 2 seconds when doing the manual calibration. Sensor will activate the calibration program after 6 seconds. In addition, sensor also can do manual calibration by sending command, please refer to the communication protocol for more details.

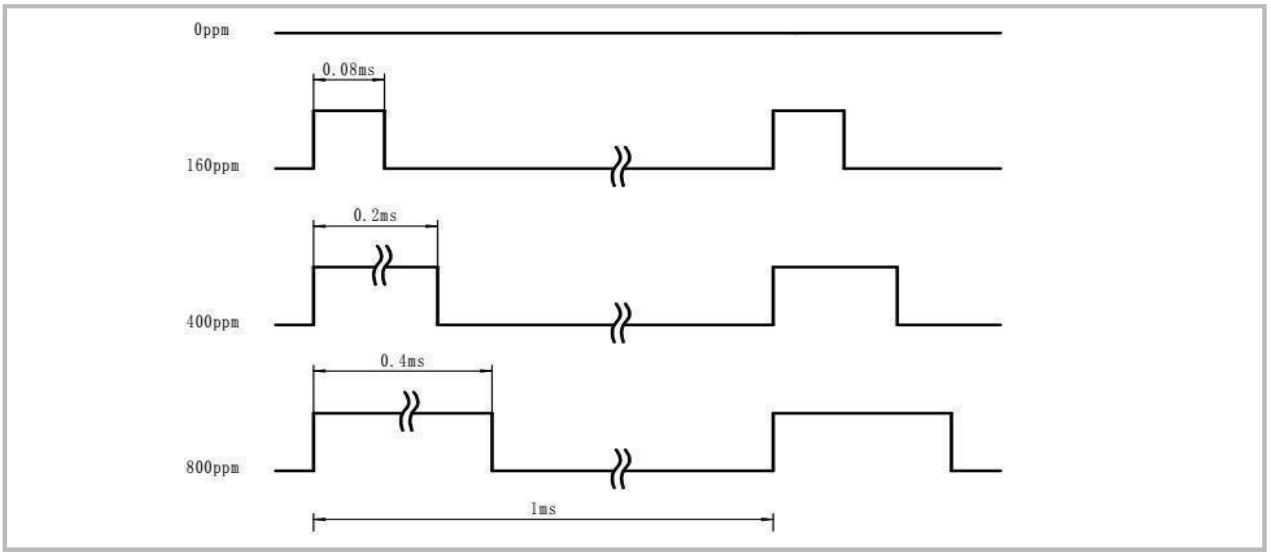
PWM and Alarm Output

PWM cycle: 1ms

Positive pulse width: PPM/2000

CO2 level measurement: (PWM positive pulse width)

*2000 PWM output schema:

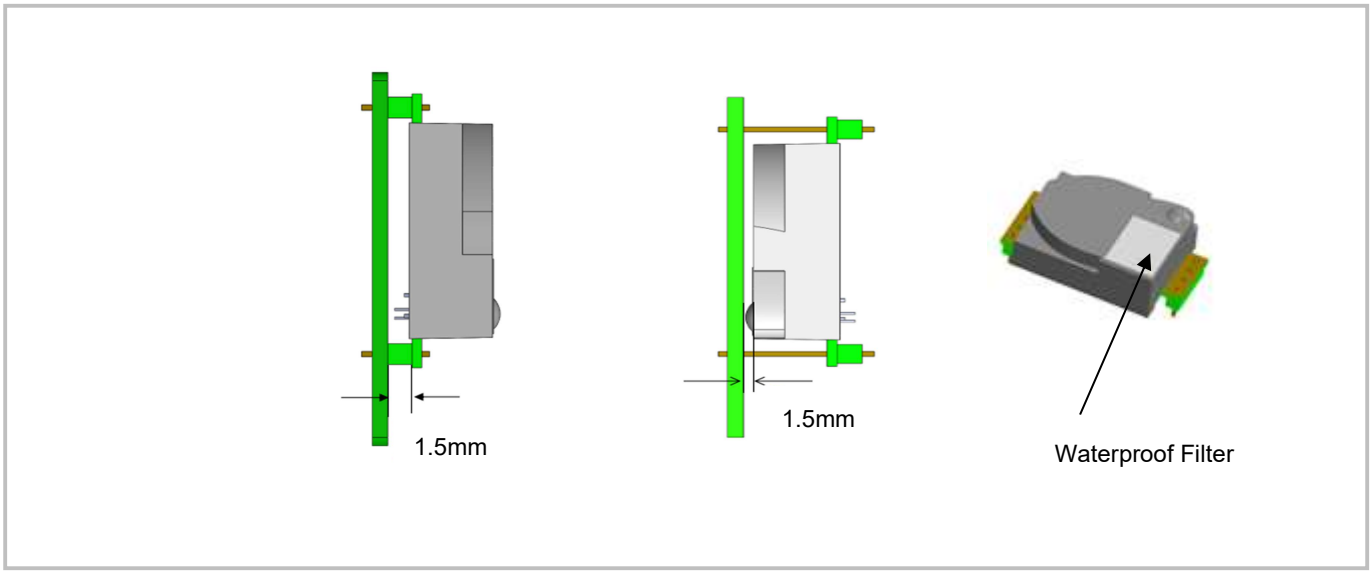


Alarm Output (reserved function)

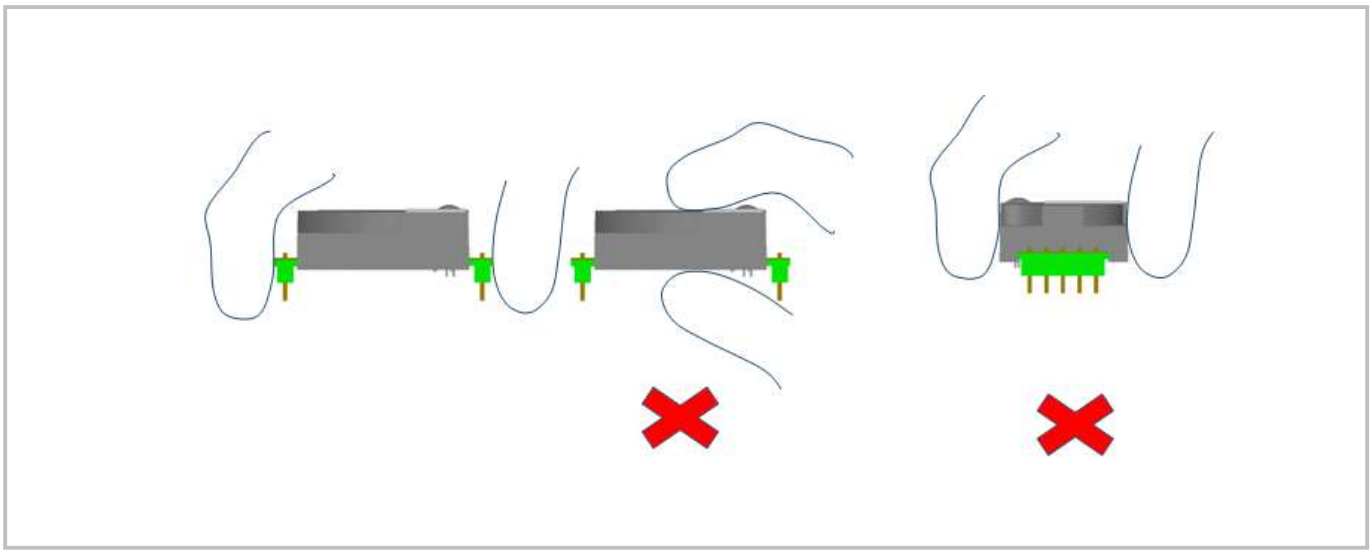
If the CO_2 concentration rises up to more than 1000ppm, the alarming will be triggered and output high level. When the CO_2 concentration goes down to below 800ppm, the alarming will stop and output low level.

Product Installation

1. In order to ensure airflow diffusion into the sensor inner, make sure the minimum distance between the area of waterproof filter and the other components is 1.5 mm, otherwise, quick response time of the sensor will be effected.
Reference as below:



2. To avoid the influence of stress on sensor, please soldering by hand as much as possible when mounting the sensor to the PCB.
Reference as below:



UART Communication Protocol

1. General Statement

1).The data in this protocol is all hexadecimal data. Example: “46” for decimal [70].

2). Baud rate: 9600, Data Bits: 8, Stop Bits: 1, Parity: No, Flow control: No.

3). [x x] is for single-byte data (unsigned, 0-255); for double data, high byte is in front of low byte.

2. Format of Serial Communication Protocol

Sending format of test software:

Start Symbol	Length	Command	Data1	…	Data n.	Check Sum
HEAD	LEN	CMD	DATA1	…	DATAn	CS
11H	XXH	XXH	XXH	…	XXH	XXH

Detail description on protocol format:

Protocol Format	Description
Start Symbol	Sending by test software is fixed as [11H], module response is fixed as [16H]
Length	Length of frame bytes= data length +1 (including CMD+DATA)
Command	Command
Data	Data of writing or reading, length is not fixed
Check Sum	Cumulative sum of data = 256-(HEAD+LEN+CMD+DATA)%256

3. Command Table of Serial Protocol

Item No.	Function Name	Command
1	Read measured result of CO_2	0x01
2	Open/ Close ABC and set ABC parameter	0x10
3	Calibrate concentration value of CO_2	0x03
4	Read the serial number of the sensor	0x1F
5	Read software version	0x1E

4. Detail Description of Protocol

4.1 Read Measured Result of CO_2

Send: 11 01 01 ED

Response: 16 05 01 DF1- DF4 [CS]

Function: Read measured result of CO2 (Unit: ppm)

Note:

CO_2 measured result = DF1*256+DF2

DF3 is status bit

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved	1: Drift 0: Normal	1: Light Aging 0: Normal	1: Non-calibrated 0: Calibrated	1: Less than Measurement Range 0: Normal	1: Over Measurement Range 0: Normal	1: Sensor Error 0: Operating normal	1: Preheating 0: Preheat complete

DF4 is reserved

Example:

Response: 16 05 01 02 58 00 00 8A

Explanation:

Hex is converted to decimal: 02 is 02; 58 is 88 , so CO_2 concentration =02*256+88 = 600ppm

4.2 Open/Close ABC and Set ABC Parameter

Send: 11 07 10 DF1 DF2 DF3 DF4 DF5 DF6 CS

Response: 16 01 10 D9

Explanation:

DF1: reserved, default 100 (0x64)

DF2: open/close auto calibration (0: open; 2: close)

DF3: calibration cycle (1-30 days optional, default is 7 days)

DF4: High base value (2 bytes)

DF5: Low base value (2 bytes)

DF6: reserved, default is 100 (0x64)

Note: The auto calibration function is opened with 7 days calibration cycle by default.

The default value of DF4 and DF5 is 400, that is DF4: 01; DF5:90

4.2.1 Close ABC

In Cubic sensor, the ABC function is default opened status. If want to close it, should set the DF2=2.

Example:

Send: 11 07 10 64 02 07 01 90 64 76

Response: 16 01 10 D9

4.2.2 Open ABC and Set Calibration Cycle

When ABC function is closed and you want to re-open ABC function, then should set the DF2=0.

Example:

The user could send below command to open ABC function and set the calibration cycle 7 days.

Send: 11 07 10 64 00 07 01 90 64 78
Response: 16 01 10 D9

4.2.3 Change the Calibration Cycle

The calibration cycle is 7 days by default. For example, if want to change the calibration cycle to 10 days, you should set the DF3=0A.

Example:
Send: 11 07 10 64 00 0A 01 90 64 75
Response: 16 01 10 D9

4.3 Calibration of CO_2 Concentration

Send: 11 03 03 DF1 DF2 CS
Response: 16 01 03 E6
Function: Calibration of CO_2 concentration

Note:
1. Calibration target value = DF1*256+DF2 Unit: PPM, range (400-1500ppm)
2. Before calibration, please make sure CO_2 concentration in current ambient is calibration target value. Keeping this CO_2 concentration for two 2 minutes, then begin calibration.

Example:
When you need to calibrate CO_2 concentration of the sensor to 600ppm, send command:
Send: 11 03 03 02 58 8F
Hex is converted to decimal: 02 is 02; 58 is 88, so CO_2 concentration =02*256+88 = 600ppm

4.4 Read the Serial Number of the Sensor

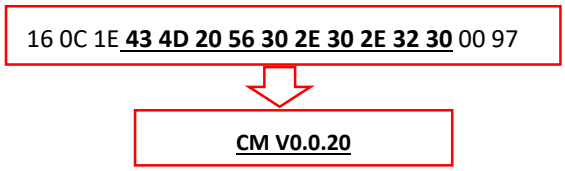
Send: 11 01 1F CF
Response: 16 0B 1F (SN1) (SN2) (SN3) (SN4) (SN5) [CS]
Function: Read the serial number of the sensor
Note: Read the serial number of the sensor. SNn: 0~9999, 5 integer form 20-digit number

4.5 Read Software Version

Send: 11 01 1E D0
Response: 16 0C 1E DF1-DF11 CS
Function: Read software version
Note: DF1-DF10:stand for ASCII code of software version, DF11 is reserved

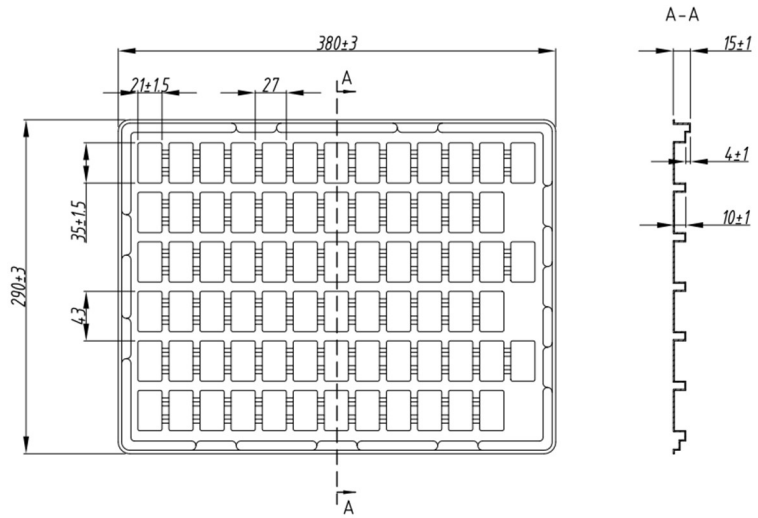
Example:
When the sensor version is CM V0.0.20, response data as follows:

Hexadecimal converted to ASCII code:
Note: when 20 converted to ASCII code, it equals to blank space.

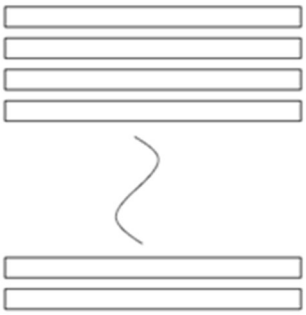


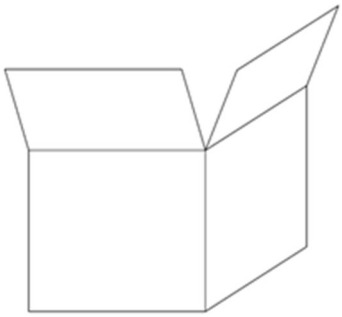
Packing Information

Tray Size



Tray Qty 15





Note: every 5 trays are packed by a plastic vacuum bag;

Sensor per Tray	Tray Qty	Sensor per	Carton Dimensions	Packing Material
75 pcs	15 layers	1125 pcs	W395 * L310 * H200 mm	Anti-static PS

After-Sales Services and Consultancy

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