

SPECIFICATION

Preliminary Version

Product Name: Electrochemical Formaldehyde Sensor Module

Item No.: CB-HCHO (Third Generation)

Version: V0.3

Date: January 18, 2020

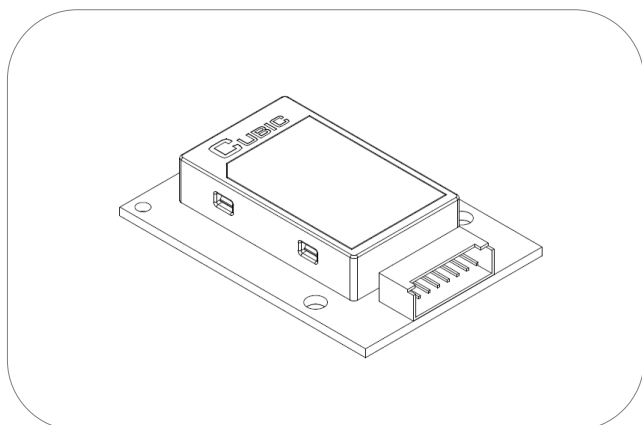
Writer	Audit	Approved
Mei Yang		

Revision

No.Version		Content	Reviser	Date
1	V0.1	First edition	Mei Yang	2019-10-12
2	V0.2	Add TVOC reading	Xingzong Sang	2019-12-30
3	V0.3	Add zero-calibration protocol	Xingzong Sang	2020-01-18

Formaldehyde Sensor Module

CB-HCHO (Third Generation)



Description

CB-HCHO the third generation formaldehyde sensor is an electrochemical gas concentration sensor. It adopts a dual-channel structure design and unique electrolyte packaging technology. Through mathematical algorithms and scientific calibration, it can simultaneously output formaldehyde and TVCO. Built-in digital temperature and humidity sensors combined with intelligent algorithms, product detection is more accurate and application is more convenient.

Working Principle

When formaldehyde gas passes through the sensor, the formaldehyde molecules undergo oxidation-reduction reaction on the electrode to form an electron transfer under the catalytic action of the electrolyte. This reaction produces a small current, which is proportional to the concentration of the gas present, and output the serial signal through the signal amplifying circuit.

Features

- ✧ High sensitivity up to 1ppb
- ✧ HCHO, VOC in-one design
- ✧ Full range temperature and humidity compensation
- ✧ Unique dual-channel design, good anti-interference
- ✧ Multiple communication methods: URAT、IIC、PWM
- ✧ Lifetime can reach 3 years (in air)

Applications

- ✧ Portable instrument
- ✧ Desktop air quality monitoring equipment
- ✧ Air Purifier
- ✧ HVAC system
- ✧ Air Conditioner
- ✧ Smart Home

Table 1 Specifications

Formaldehyde sensor specifications	
Working principle	Electrochemical
Measurement range	HCHO: 0~1ppm VOC: 0~10ppm (equivalent alcohol concentration) TVOC: 0~10ppm (equivalent alcohol concentration)
HOCHO Measurement accuracy	≤0.1ppm: ±0.025ppm >0.1ppm: ±25% reading (Reference instrument: Gasera one, 25±2℃, 50±10%RH)
Resolution	HCHO: 1ppb VOC: 0.01ppm TVOC: 0.01ppm
Response time T90	50s (@25±2℃, 50±10%RH)
Working condition	0~40℃; 15~95%RH (Non-condensing)
Storage condition	-20~50℃; 0~95%RH (Non-condensing)
Working voltage	DC (+3.5V ~ +5.5V)
Working current	<15mA
Signal Output	1、UART_TTL (3.3V) 2、IIC (Reserved) 3、PWM (Reserved)
Dimension	W23*H32*D7
Lifetime	3 years (@0.1ppm Formaldehyde concentration)

Outline Structure and Interface Definition

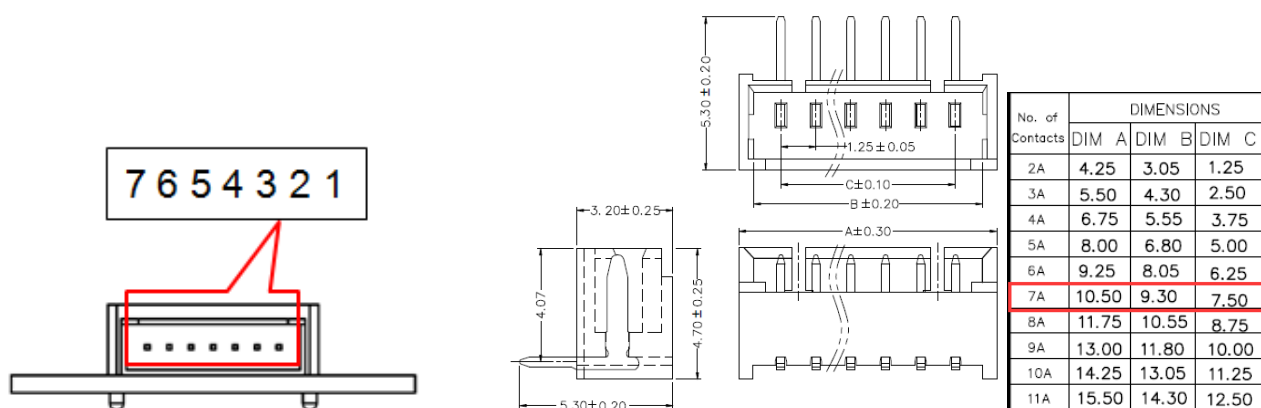


Figure 1: Interface and Connector Definition

Table 2: Pin Definition Table

No.	Pin	Description
1	NC	Reserved
2	NC	(Reserved)
3	GND	Power input (Ground)
4	VCC	Power input (+5V)
5	RXD	Signal receiver
6	TXD	Signal output
7	NC	Reserved

Sensor Dimension

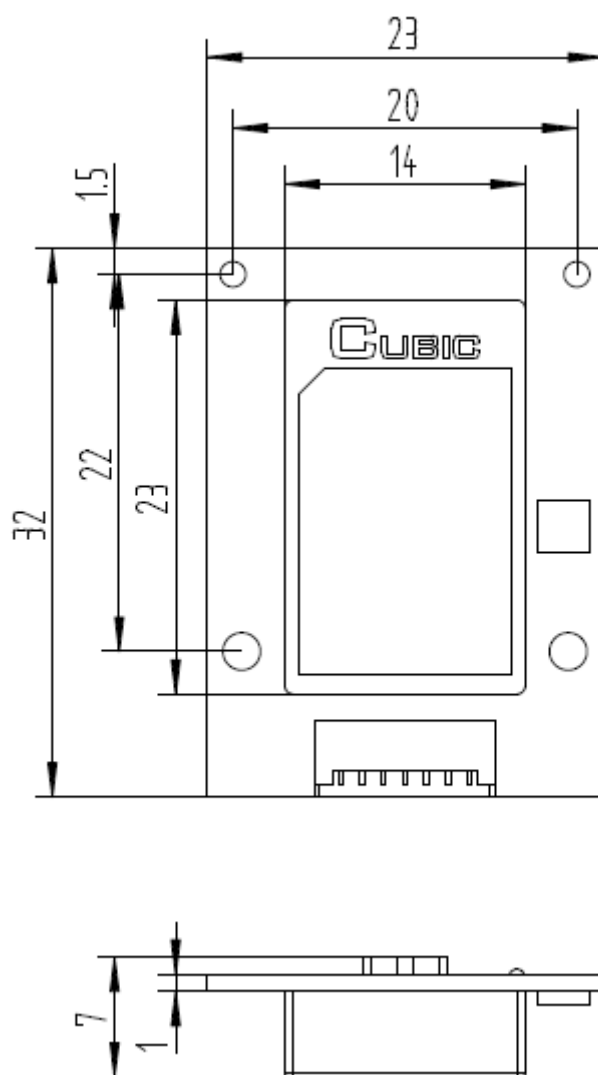


Figure 2: CB-HCHO (Third Generation) Appearance dimension drawing (unit: mm, tolerance $\pm 0.2\text{mm}$)

Communication Protocol

1. General Statement

- 1) The data in this protocol is all hexadecimal data. For example, “46” for decimal [70].
- 2) [xx] is for single-byte data (unsigned, 0-255); for double data, high byte is in front of low byte.
- 3) Baud rate: 9600; Data Bits: 8; Stop Bits: 1; Parity: No

2. Format of Serial Communication Protocol

Sending format of upper computer:

Start symbol	Length	Command	Data 1	...	Data n	Check Sum
HEAD	LEN	CMD	DATA1	...	DATAn	CS
11H	XXH	XXH	XXH	...	XXH	XXH

Detail description on protocol format:

Protocol	Description
Start symbol	Sending by upper computer is fixed as [11H], module respond is fixed as
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)

3. Command Table of Serial Protocol

No.	Function	Comman	Function description
1	Query Command	0x01	
2	Auto-Calibration	0x02	

4 Content of Protocol

4.1 Read formaldehyde concentration command

Send: 11 01 01 ED

Response: 16 0D 01 DF1-DF2 DF3-DF4 DF5-DF6 DF7-DF8 DF9-DF10 DF11-DF12 [CS]

Response Description:

- | | | | |
|---------------------------------|---|----------------------------------|------------------------------|
| 1. HCHO concentration value | = | $(DF1 \times 256 + DF2) / 1000$ | (Unit: ppm) |
| 2. VOC concentration value | = | $(DF3 \times 256 + DF4) / 1000$ | (Unit: ppm) |
| 3. Temperature value | = | $(DF5 \times 256 + DF6) / 10$ | (Unit: °C) |
| 4. Humidity value | = | $(DF7 \times 256 + DF8) / 10$ | (Unit: %) |
| 5. TVOC concentration value | = | $(DF9 \times 256 + DF10) / 1000$ | (Unit: ppm) |
| 6. Sensor Status byte | = | DF11 | Sensor Status byte |
| 7. Auto calibration switch byte | = | DF12 | Auto calibration switch byte |

Sensor status byte corresponds to the sensor state:

0	1	2	3
Sensor normal working	Sensor anomaly (Poison, lifetime end, damage and so on)	High alcohol environment	High formaldehyde environment

Auto calibration switch byte

0	1
Auto calibration is off	24hs auto calibration is on

4.2 Auto-calibration Setting command

Send: 11 02 03 DF1 [CS]

Response: 16 02 03 DF1 [CS]

Response Description:

- DF1 = 00, HCHO manual calibration
- DF1 = 01, HCHO auto-calibration
- DF1 = 02, HCHO calibration value zero clearing

Remark:

- The auto-calibration is off as default
- When auto-calibration is set open, the sensor needs to be continuously powered on. Once the sensor is power off, after it is powered on again, the auto-calibration is closed as default.

Notice

1. When using a formaldehyde sensor module, try to ensure that the test environment temperature, humidity and air velocity remain stable. An unstable environment will cause the sensor's display value to fluctuate.
2. The operating temperature range of the formaldehyde sensor module is 0 ~ 40 °C, and the relative humidity is 25% ~ 95%. High temperature and low humidity environment will reduce the service life of the module.
3. The best storage environment for formaldehyde sensor module is: temperature -5 ~ 25 °C, relative humidity is 25% ~ 95%, the storage environment air need to be clean, no dust, no pollution gas, no organic solvent.
4. During the long-term transportation of the formaldehyde sensor module, try to ensure that the temperature is within 50 °C and the maximum temperature does not exceed 60 °C.
5. Avoid contact with organic solvents (including glue, anti-paint, washing water and other substances that may emit high concentrations of organic gases) for the formaldehyde sensor module. These uncertain concentrations of gases may exceed the sensor's tolerance range, resulting in sensor poisoning.
6. If the formaldehyde sensor module is exposed to high-concentration gas for a short time, it may cause a short-term failure of the sensor (the failure time is related to the concentration and duration of the contacting gas). The sensor must be placed in a clean, ventilated environment and left to be recovered. The recovery time may be Up to 1-2 days.
7. If the formaldehyde sensor module is left in high concentration organic gas for a long time, it may cause irreversible damage to the sensor.
8. When testing the accuracy of the formaldehyde sensor module, avoid the interference of other gases on the sensor and cause the error of the result to increase.
9. When testing the accuracy of the formaldehyde sensor module, it is recommended to use a method of heating volatile paraformaldehyde powder or formaldehyde solution. The maximum concentration must not exceed 1ppm, and the formaldehyde concentration increase rate is less than 0.2ppm / min. If the formaldehyde concentration increase rate is too fast, it will cause sensor errors. (Considering that the rapid volatilization of high concentrations of formaldehyde does not occur in the daily application environment).
10. When multiple formaldehyde sensor modules are tested in the same closed environment, after volatile formaldehyde, you can first turn on the fan and stir for 3-5 minutes, then turn off the fan and let it stand for 1-2 minutes to ensure uniform concentration in the environment.
11. The formaldehyde sensor module (HCHO V0.3) can identify the interference of low-concentration alcohol (0-7ppm), especially when the concentration is stable; when the alcohol concentration is unstable, the sensor value may be disturbed (less than 0.05ppm) , When the concentration is stable, the interference will be automatically eliminated

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