EC Sense
Easy Gas Sensors

⚠ **Please read this instruction carefully before using the module**

TB600B Series
Gas Detection Module Manual

Contents

1.Product Overview

TB600 series gas detection module `s core sensor adopts German EC Sense solid polymer gas sensor which has the smallest volume of electrochemistry field in the world. It can replace our nose to detect toxic and harmful air elements, and achieve accurate monitoring to air pollution gas. Furthermore, UART digital signal output will liberate customers' understanding to both sensor application and the tedious calibration work.

The TB600 series gas detection module is further subdivided into 6 series, including H2, CO, H2S, HCHO, TVOC gas and air quality. It is widely used in industry, commerce, civil fields. 1. Industrial safety monitoring field such as petroleum, chemical industry, metallurgy, new energy manufacturing. 2. Environmental air quality monitoring field such as air pollution assessment, toxic and harmful gas emissions. 3. Living environment health monitoring include indoor environment health, in-car HCHO etc. It has influence respectively on both production and life aspects.

2.Products Features

★ New improvement and upgrade of formula, material and production process for 4th generation formaldehyde sensors.

★ Strong anti-interference performance, good anti-interference ability to low concentration of ethanol, CO, aromatic hydrocarbons, odor, smoke, air freshener etc.

★ The new micro circuit design, easy to use, short warm time

★ T100 is quickly response, F100 is quickly go down

★ Independent temperature and humidity digital sensor, combined with intelligent algorithm leads to stronger environmental adaptability, higher accuracy and long-term stability.

3.Product appearance and structure

4. Principle

The electrochemical sensing technology of solid polymer is a revolutionary innovation of electrochemical detection technology field. The principle is based on the of electrochemical gas detection, which is used to detect gases that can be chemically decomposed.
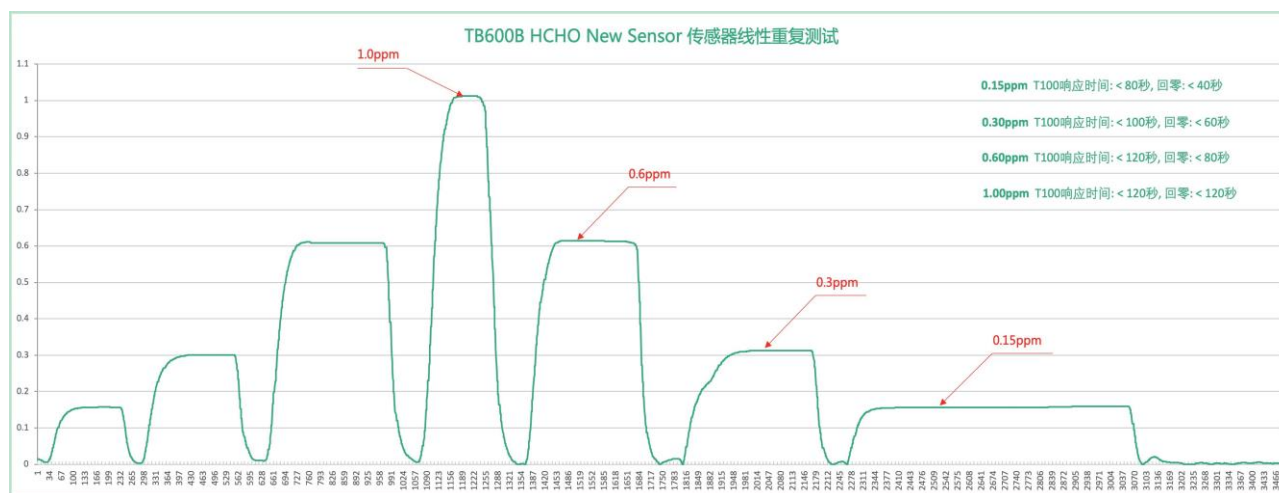
The sensor consists of 3 electrodes in contact with the electrolyte, typical electrodes that composed of large surface area noble metals and other matrix materials. The electrode and electrolyte by contact air, and the gas diffuses into the working electrode of the sensor through the back of the porous film. The gas is oxidized or reduced reaction on the electrode. This electrochemical reaction generation the electricity flowing through the external circuit.

Except measurement, the system also conducts to amplification signal and others signal processing. The outer circuit maintains the voltage across the sensor and the voltage of a two-electrode reverse reference sensor, an opposite reaction is produced at the reverse electrode, as the working electrode is oxidized while the opposite electrode is reduced. The solid polymer sensor signal is a linear proportional output to the gas concentration, the linear output of solid polymer sensor principle is one of the advantages over others technical sensors principle. Other sensors need to be linearized calibration before output. Linear output senor can detect low concentration gas accurately, and is easy to calibration (only zero point and one target point need to be calibration).As soon as the solid polymer electrochemical sensor is calibrated, it is stable over time.

Linear repeatability test of formaldehyde sensor

Environment temperature：19℃；Environment humidity：50%；　Air chamber volume：25cm³；　Vent flow rate of the distribution system：6000sccm

TB600B HCHO New Sensor 传感器线性重复测试

0.15ppm T100响应时间: < 80秒, 回零: < 40秒
0.30ppm T100响应时间: < 100秒, 回零: < 60秒
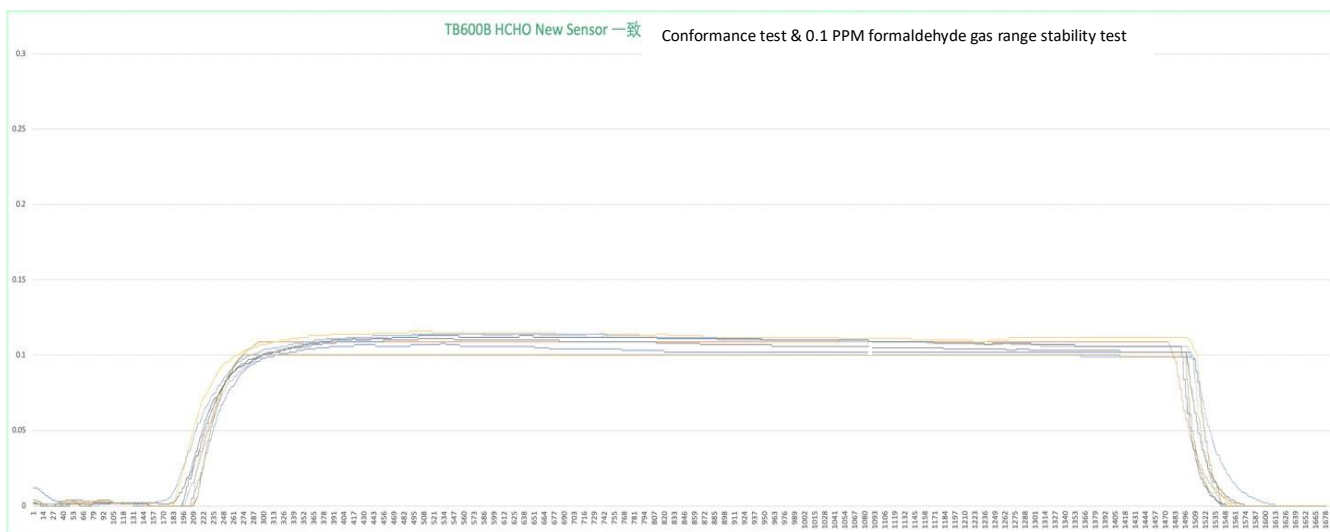0.60ppm T100响应时间: < 120秒, 回零: < 80秒
1.00ppm T100响应时间: < 120秒, 回零: < 120秒

Formaldehyde sensor Continuous zero point stability test over 20 hours

Environment temperature：19℃； Environment humidity：45%； Environment space：3m³clean room，Turn on the fresh air system and air purifier before the test to ensure relatively

clean air indoor.

Formaldehyde sensor Conformance test & 0.1 PPM formaldehyde gas range stability test

Environment temperature：19℃； Environment humidity：50%； Air chamber space：25cm3； Vent flow rate of the distribution system：7000sccm；
Formaldehyde gas concentration：0.1ppm

5.Specification

• Detection Principle	EC Sense solid polymer electrochemical detection technology
Part number	TB600B-WQ-HCHO-1；
Gas	Formaldehyde
Detection range	0-1ppm，Maximum load range：2ppm；
Minimum detection	0.01ppm
Linear accuracy error	0.08ppm error±5ppb； 0.15ppm error ±8ppb； 0.30ppm error ±10ppb； Above0.60ppm error±20ppb；
Warm-up time	Store in clean air, first power on<60s Store in unclean air, first power on <180s
Response time	<3s (T50: <40s； T90: <80s； T100: <120s；)
Reset time	0.10ppm reset time<40s； 0.15ppm reset time<60s； 0.30ppm reset time<80s； 0.60ppm reset time<120s；
Calibration material	0.6ppm range：0.3ppm Formaldehyde gas calibration; 1ppm range：0.6ppm Formaldehyde gas calibration；
Lifetime expectancy	Over 3 years under clean air、temperature within 0-25℃、humidity within 30-70%
Safety alarm value	First class：0.05ppm sensitization；second class：0.08ppm carcinogenesis
Relative temperature error	±0.2℃（typical value）
Relative humidity error	±2%（typical value）
Output signal	3.3V level UART digital signal (See below for communication protocol)
Get data command	Interface definition: VCC- red, GND- black, RX- yellow, TX- green; Poter rate: 9600, data bits: 8 bits, stop point: 1 bit；For the convenience of user testing, factory default for active upload, concentration value is upload every 1 second Gas concentration = high gas concentration *256+ low gas concentration. See details in 《TB600 Gas detection module series operating instructions 》
Working voltage	4.5-5.5V DC
Working current	5V DC @ 5mA
Power consumption	25mW @ 5V DC
Accuracy	±5% FSD
Repeatability	±1% FSD
Operating temperature	-20~55℃
Optimum operating temperature	25℃
Operating humidity	10%-95% RH.
Optimum operating humidity	50% RH.
Operating pressure	Barometric pressure±10%
Circuit board size	23 x 25.5X10.2mm（with sensor）
Circuit board size	23 x 25.5X4.85mm（without sensor）
Weight	3.1g
Signal line	Standard length is shown in the figure. It can be customized for special requirements

Selection table :

Product name	Order number	Detection range	Index resolution
TB600B type Formaldehyde gas detection module	TB600B-WQ-HCHO-1	0-1ppm	0.001ppm

Note: If you have any special requirements, please contact our company for customization

6.Communication protocol

6.1 User Communication Protocol

6.1.1 General Settings

The sensor module uses serial communication, and the communication configuration parameters are as follows：

Baud rate	9600
data bits	8 Bits
Stop bit	1 Bit
parity bit	None

6.1.2 Communication command

Communication both of automation upload and question and answer mode, Factory acquiesced automation upload, interval 1s send concentration value.

The command line format as follow:

0	1	2	3	4	5	6	7	8
Start bit	command	High gas concentration (ug/m3)	Low gas concentration (ug/m3)	Full range high	Full range low	High gas concentration (ppb)	Low gas concentration (ppb)	proof test value
0xFF	0x86	0x00	0x2A	0x00	0x00	0x00	0x20	0x30

Gas concentration value = high gas concentration *256+ low gas concentration;

(The high and low concentration should be converted from hexadecimal to decimal before being substituted into this formula)

Switch to question and answer mode, the command line format is as follows：

0	1	2	3	4	5	6	7	8
start bit	retain	Switch command	answer	retain	retain	retain	retain	proof test value
0xFF	0x01	0x78	0x41	0x00	0x00	0x00	0x00	0x46

Switch to active upload and the command line format is as follows:

0	1	2	3	4	5	6	7
start bit	retain	Switch command	answer	retain	retain	retain	proof test value
0xFF	0x01	0x78	0x40	0x00	0x00	0x00	0x47

The read gas concentration format is as follows：

0	1	2	3	4	5	6	7	8
start bit	retain	Switch command	answer	retain	retain	retain	retain	proof test value
0xFF	0x01	0x86	0x00	0x00	0x00	0x00	0x00	0x79

The sensor return value format is as follows：

0	1	2	3	4	5	6	7	8
Start bit	command	High gas concentration (ug/m3)	Low gas concentration(ug/m3)	Full range high	Full range low	High gas concentration(ppb)	Low gas concentration (ppb)	proof test value
0xFF	0x86	0x00	0x2A	0x00	0x00	0x00	0x20	0x30

Gas concentration value = high gas concentration *256+ low gas concentration

(The high and low concentration should be converted from hexadecimal to decimal before being substituted into

this formula)

6.2 Get module information instruction

Get sensor type, maximum range, unit, unit decimal number instruction：0xD1

returned value：

0	1	2	3	4	5	6	7	8
Sensor style	Maximum range high	Maximum range low	unit	retain	retain	retain	Data decimal (bit[4]~bit[7]| Data sign (bit[0]~bit[3])	parity bit
0x17	0x00	0XC8	0x02	0x00	0x00	0x00	0x01	0x1E

check sum calculator

* functional description：summation check（Take to send、Receiving agreement 1\2\3\4\5\6\7 and opposite of +1）

* Function description：The number of elements in the group 1- the second last element is added and then inverted +1（The number of elements must be more than 2）

unsigned char FucCheckSum(unsigned char *i, unsigned char ln)

{

unsigned char j, tempq=0;

i+=1;

for(j=0; j<(ln-2); j++)

{

tempq+=*i;

i++;

}

tempq=(~tempq)+1;

return(tempq);

}

6.3 Into sleep mode

Order:

0	1	2	3	4	5
0XAF	0X53	0X6C	0X65	0X65	0X70

Return:

0	1
0X4F	0X4B

Exit sleep mode

Order:

0	1	3	4
0XAE	0X45	0X69	0X74

Return:

0	1
0X4F	0X4B

Remark: After exiting the sleep mode, it takes 5 seconds to recover, and there is no data within 5 seconds.

Get current temperature and humidity

Order

:0xD2

Return:

0	1	2	3
8 bit higher temperature	8 bit lower temperature	8 bit higher humidity	8 bit lower humidity
0X0A	0X09	0X11	0XF4

The temperature is signed with two decimal data, the unit is ℃. The pseudocode calculation formula is

T = (float)((int)((0x0A<<8)|0x09))/100

The humidity is signed with two decimal data, the unit is (rh%). The pseudocode calculation formula is

Rh = (float)((uint)((0x0A<<8)|0x09))/100

7.Package List

No.	Items	Unit	Quantity	Remark
1	Gas detection module	set	1	
2	Cable	pcs	1	

8.Maintenance and repair

8.1 General operating instructions

▪ Do not bump the board and sensor during installation；

▪ Users are not allowed to replace the electrical components on the repair circuit board；

▪ Do not install on heat source and vibration source；

▪ It is forbidden to store the gas detection module in dusty areas；

▪ Do not use irritating chemicals, cleaning agents or concentrated detergents to clean the gas detection module;

▪ Keep all operation and calibration gas detection module operation logs;

8.2 Fault analysis

Question	Possible reason	Solution
No reaction to gas	1).Sensor film is dirty or clogged 2).Sensor failure	1).Clean or replace the sensor 2). Change senor
No signal output	1).The output wiring is not connected well 2).The power supply is broken 3).The power cable connection is not good	1).Reconnect the output cable 2).Detect the voltage value of the power supply 3).Reconnect the power cord
The output value is over or less than 0 in the absence of the measured gas	1).Zero drift 2).Temperature influence causes zero deviation 3).Interference gas in the site environment	Pass nitrogen and test if the output is 4mA，if not, correct the zero point
The output value constant beats, cannot be stabilized.	1).The condition of the cable is not good 2).High frequency interference 3). High voltage interference	1).Check cable 2).Move the module to another environment and observe whether the output value is stable

9.Notes and Instructions

Thank you for choosing the solid polymer gas sensor of German EC Sense. Before use, please read this document carefully to use our products correctly and effectively.

9.1 Sensor storage：

9.1.1 The best environment conditions for TB600B formaldehyde sensor module storage: temperature 5 ℃ ~25 ℃, relative humidity 25% ~ 50% (condensation);

9.1.2 The storage environment shall be kept clean with no pollution gas, high concentration organic gas, dust and smoke.

9.1.3 Avoid storage with liquid and solid states of alcohol (ethanol), perfume, sodium silicate and polyurethane components.

9.2   Packaging and transportation of sensors：

9.2.1 Avoid direct sunlight for a long time in the transportation process to prevent the rain from penetrating;

9.2.2 Transport packaging should be shockproof bubble film or no odor environmental friendly sponge

9.2.3 During long-term and long-distance transportation process, temperature inside sensor packaging should be kept within 50 ℃, the highest temperature should not exceed 55 ℃；

9.3 Sensor usage：

9.3.1 The main function of the gas sensor is to detect the composition and content of the gas, please avoid liquid contact with any parts of sensor

9.3.2 The three pin electrodes of the sensor cannot be connected reversely. Reverse connection may lead to permanent damage of the internal electrode of the sensor due to high current.

9.3.3 Different gas sensors have different concentration measurement span (range), it is not allowed to measure high concentration gas over the measuring range for a long time in use.

9.3.4 The white or yellow sheet on the sensor is waterproof and breathable film, please pay attention not to scratch it off.

9.3.5 The ventilation surface of the sensor should not be blocked or contaminated. Sometimes, blockage is the reason for the reduced sensitivity and response time;

9.3.6 When using the sensor in the condition of pumping and suction detection, the gas flow shall be controlled within 400ml-800ml per minute;

9.3.7 Avoid measured gas blowing from the front side when determining the gas sensitivity, and use the standard gas cap with both inlet and outlet (small inlet and large outlet in normal conditions).

9.3.8 The pin shall not be broken or bent or the internal structure of the sensor may be damaged

9.3.9 Avoid excessive impact or vibration. If the shell is damaged, please make sure the structure is intact. If the shell is cracked and the internal structure is exposed, the output is not reliable anymore (the signal may be too large, too small or with no output).

9.3.10 It takes time to recover to the initial state after long-term use in high concentration gas environment, and the recovery speed is proportional to the multiple of the over range

9.3.11 Avoid long-term contact with high concentration and strong viscosity of the gas when the sensor works undera low range within 2ppm

9.3.12 Please do not disassemble the sensor optionally, or it will damage the sensor

9.3.13 Not need to do electrical level pin short connection for EC Sense sensor

9.3.14 ES1 series sensor pin can be directly welded (temperature should not be too high< 300 ° C, and the shorter the duration, the better, high temperature and long contact time can cause internal physical damage)

9.3.15 Calibration and testing, the electrochemical gas sensor and reactivity of target gas will change over time with temperature and humidity, and they are detected using the relative comparison method: Use a zero and a standard concentration gas to calibrate linear change for a standard curve. When measuring, compare the electrical signals generated from target gas with that generated from standard gas to calculate the accurate gas density. Therefore, zero calibration of equipment at any time and constant calibration of equipment are necessary to ensure accurate measurement.

9.3.16 Cross-interference of sensors. Generally speaking, each sensor corresponds to a specific detection gas, but no gas sensor can be absolutely specific. Therefore, when using the gas sensor, the interference of other gases should be avoided to ensure the accurate detection of the specific gas.

9.3.17 Measuring range and accuracy: Select the gas sensor that matches the range and precision according to the application and requirements; Otherwise, it may not be able to distinguish the gas and provide accurate data and the sensor can be damag.

9.4 Sensor quality inspection

9.4.1 Each sensor produced by EC Sense has an ex-factory inspection and test report, and the comprehensive performance test is carried out on the main indicators of the sensor;

9.4.2 All formaldehyde modules are ventilated and calibrated through formaldehyde standard gas to ensure the consistency and accuracy of the sensor.

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9.5 Special remarks

9.5.1 When the TB600B Formaldehyde sensor module is with no electricity for a long time, it needs a certain stable time for the first time when it is powered on. Generally, in the condition of clean air, the stable time of the sensor can reach optimal working state within 3 minutes.

9.5.2 During on-site detection of formaldehyde gas, the interference of other on-site gases on the formaldehyde sensor should be avoided or it may lead to a larger error rate of detection results;

9.5.3 To ensure the long life of the sensor and the best working state, the sensor should be kept in the continuous power state as far as possible due to the characteristics of the electrochemical sensor,

9.5.4 Formaldehyde gas detection module shall not be stored and used in conditions with humidity below 10% and temperature above 60 ° C degrees for a long time. Otherwise, the sensor life will be reduced or failure will occur;

9.5.5 When the formaldehyde sensor module encounters high concentration gas in use, such as formaldehyde gas, ethanol gas and volatile organic gas, the normal recovery time is slow, and the recovery time can be shortened by placing in a clean air environment.

10.After-sales service

10.1 Service mission: Fast, accurate, thorough

10.2 Service target: customer's satisfaction

10.3 Service principle: The product warranty is 12 months. During the warranty period, the supplier will repair and replace the parts damaged by quality for free!

11.Disclaimer for product usage

To ensure the normal use, users should strictly follow the relevant instructions listed in this document when using the tb600b-hcho-1 formaldehyde sensor module due to the principle and characteristics of the solid-state polymer electrochemical sensor. EC Sense does not accept any responsibility for any quality problems caused by improper storage and usage.

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