SPECIFICATION

Product Name: Electrochemical CO Sensor Module

Item No.: ECO-5011A

Version: V0.2

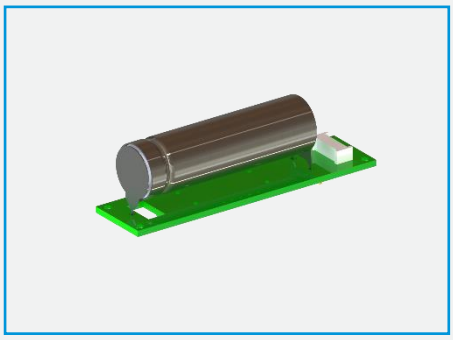
Date: May 27, 2022

Revision

No.	Version	Content	Date
1	V0.1	Preliminary version	2022.03.24
2	V0.2	1. Long-term output drift improves from 5% of reading/year to 3% of reading/year. 2. Add more commands to communication protocol.	2022.05.27

Electrochemical CO Sensor Module

ECO-5011A



Applications

- Residential and commercial CO detector
- Industrial CO monitoring
- Indoor and underground parking lot ventilation control
- Fire alarm
- Automotive safety alarm
- Smart home CO monitoring

Description

ECO-5011A module is a battery operable electrochemical sensor with good selectivity and stability. It is a combination of mature electrochemical detection technology and sophisticated circuit design, which can accurately measure CO in the air. Each sensor has UART interface, which can be calibrated separately and connected with user's device easily.

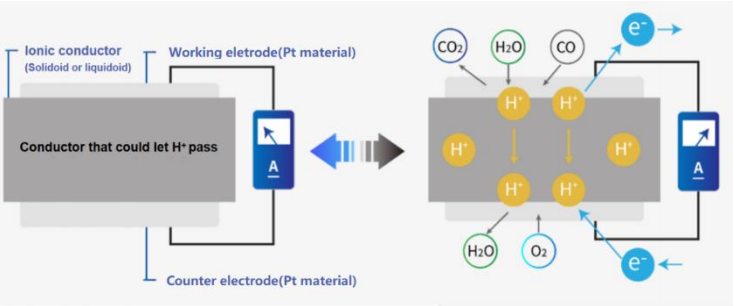
Features

- Battery operable
- Easy to be integrated into user's device
- Long lifetime (8+ years), good long-term stability
- With temperature compensation and output
- Factory calibrated; no user calibration required
- Maintenance free

Working Principle

ECO-5011 is a fuel cell type gas sensor. Carbon monoxide and oxygen undergo a corresponding redox reaction on the working and counter electrode, then release charges to form currents.

The generated current is proportional to the CO concentration and follows Faraday's law. The CO concentration can be determined by measuring the current.



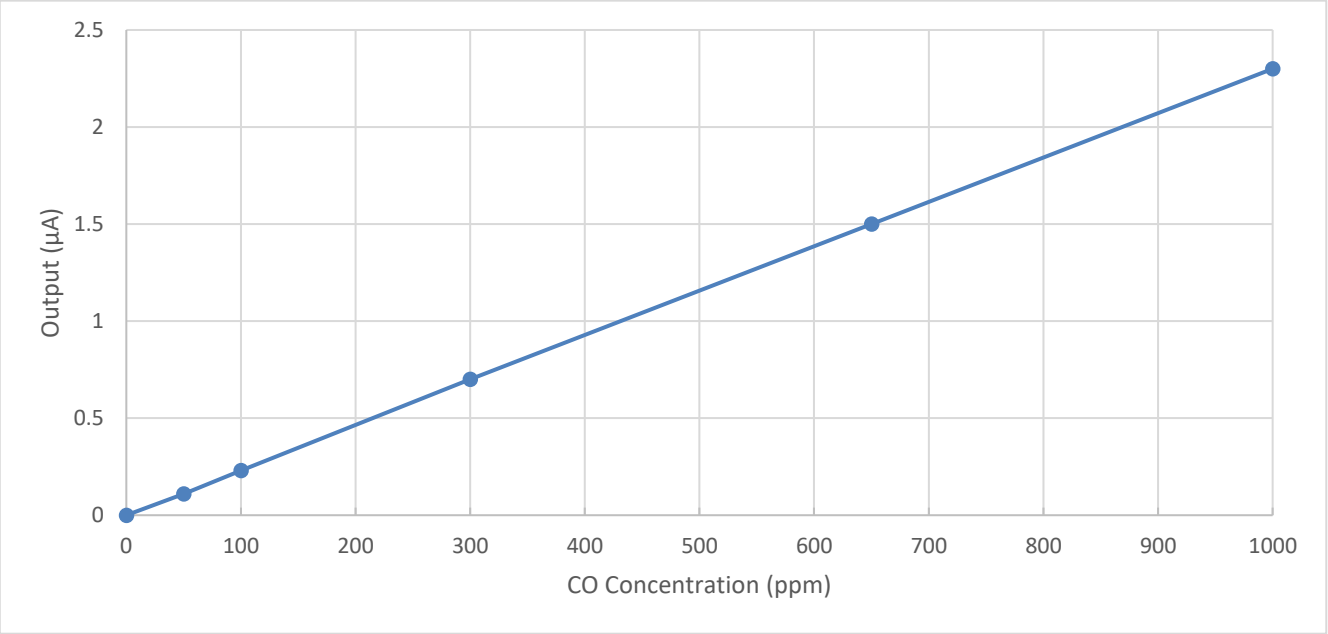
Specifications

ECO-5011A Gas Sensor Module Specification	
Target gas	Carbon monoxide (CO)
Working principle	Electrochemical technology
Measurement range	0~10000ppm
Accuracy	± 5ppm or ± 10%, whichever is larger
Repeatability	± 2% of reading
Resolution	0.5ppm
Response time (T90)	<60s
Zero drift (-20℃-40℃)	≤10ppm (equivalent to CO)
Long-term output drift	<3% of reading/year
Working Voltage	4.5 ~ 5.5V DC
Working Current	≤15mA
Output	UART TTL (3.3V)
Working temperature	-20 ~ +60℃
Storage temperature	-20 ~ +60℃
Relative humidity	5~99%RH (non-condensing)
Lifetime	8+ years
Weight	<20g

Sensitivity Characteristic Curve

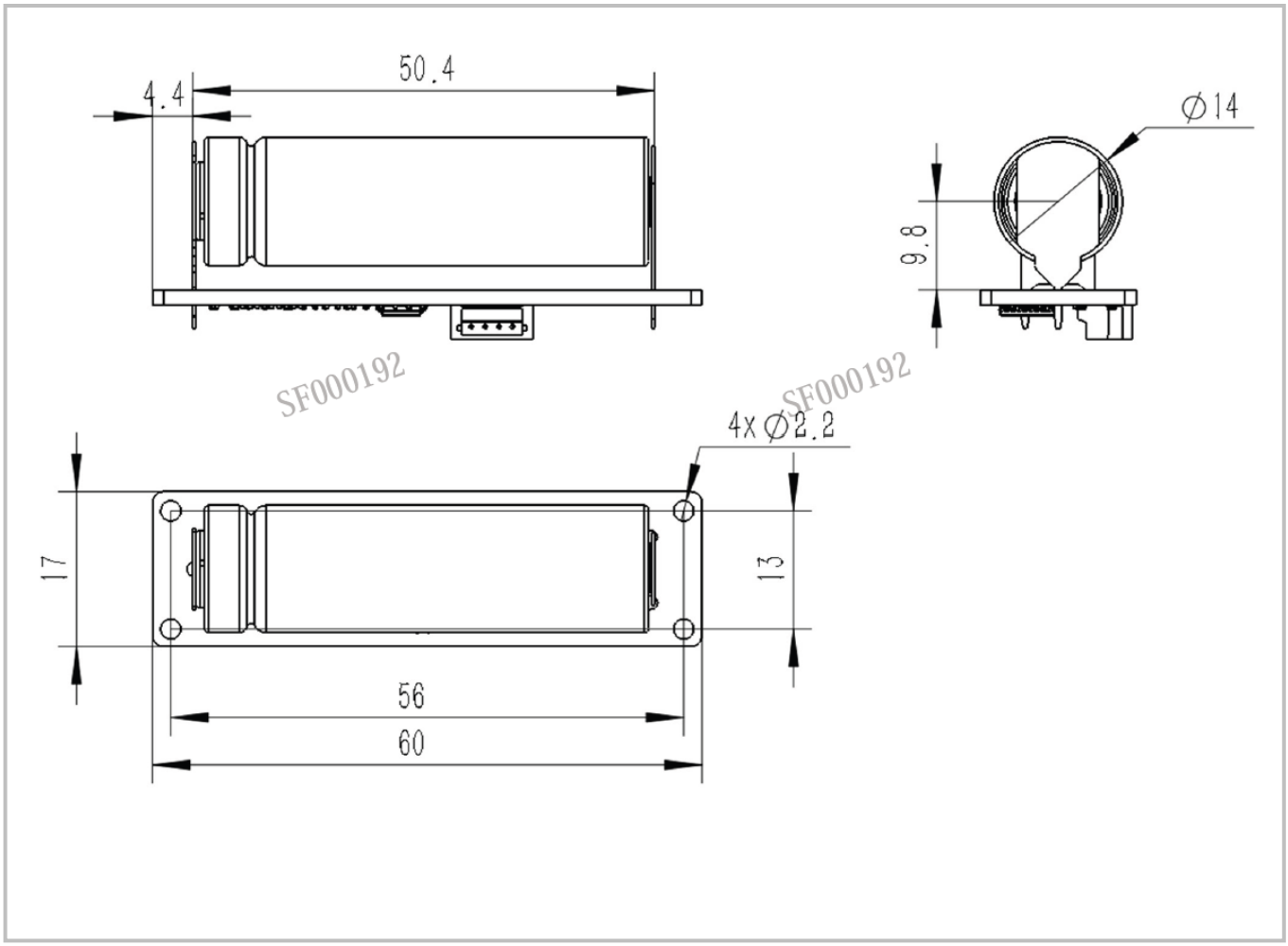
ECO-5011A measured a typical sensitivity characteristic curve under standard test conditions (20±2℃, 50%RH).

The vertical coordinate represents sensor's current output (μA) in CO gas, the horizontal coordinate represents CO gas concentration (ppm). It shows a high linearity within ±5% in the range of 0-10000ppm, figure as below:

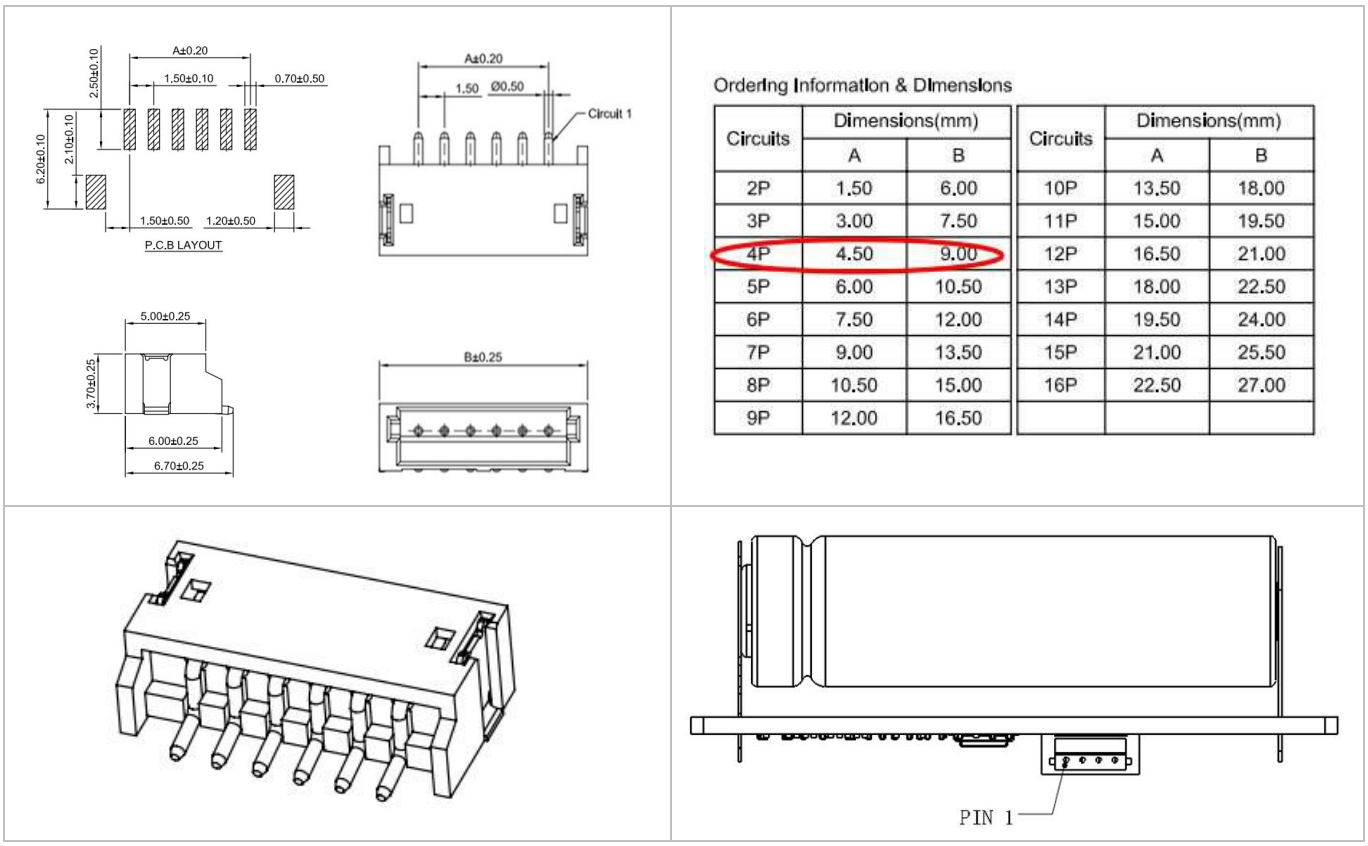


Product Dimensions

1. Dimensions (Unit: mm)



Interface and Pin Definition



Ordering Information & Dimensions

Circuits	Dimensions(mm)		Circuits	Dimensions(mm)	
	A	B		A	B
2P	1.50	6.00	10P	13.50	18.00
3P	3.00	7.50	11P	15.00	19.50
4P	4.50	9.00	12P	16.50	21.00
5P	6.00	10.50	13P	18.00	22.50
6P	7.50	12.00	14P	19.50	24.00
7P	9.00	13.50	15P	21.00	25.50
8P	10.50	15.00	16P	22.50	27.00
9P	12.00	16.50			

Figure 1: Interface and Connector Definitions

Table 1: Pin definition

No.	Pin	Description
1	GND	Power Input (Ground)
2	VCC	Power Input (+5V)
3	RXD	UART Receive
4	TXD	UART Send

UART Communication Protocol

1.Protocol Overview

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, higher byte is in front of lower byte.

3) Baud rate: 9600; Data Bits: 8; Stop Bits: 1; Parity: No

2.Format of Serial Communication Protocol

Host sending format:

Start bit	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 format	Detail description
Start bit	Host sending fixed as [11H]，Module response fixed as[16H]
Length	The frame byte length. LEN=data length+1(incl.CMD+DATA)
Command	Command
Data	Read or write data, length is not fixed
Check sum	The frame length and data (fault information and measurement results) are added by byte to get the lower byte of the checksum CS= 256-(HEAD+LEN+CMD+DATA)

3.Command Table of Serial Communication Protocol

No.	Function	Command	Function
1	Read CO Concentration	0x01	Read concentration of CO
2	Zero Adjustment	0x03	Adjust zero point of the sensor
3	Calibration	0x36	Calibrate concentration of CO
4	Inquiry Instrument Serial Number	0x1F	Inquiry Instrument Serial Number
5	Inquiry Firmware Version	0x1E	Inquiry Firmware Version

4.Protocol Detail Description

4.1 Read CO concentration

Send: 11 01 01 ED

Respond: 16 05 01 DF1-DF2 DF3-DF4 [CS]

Explanation:

(1) CO concentration = (DF1*256 + DF2)/5 (ppm)

(2) Temperature = (DF3*256 + DF4)/10 -50 (℃)

4.2 Zero Adjustment

Send: **11 02 03 00 [CS]**

Respond: **16 02 03 00 [CS]**

Explanation:

Send this command will adjust zero point of the sensor.

4.3 Calibration

Send: **11 06 36 STEP Temp_H Temp_L BD_H BD_L [CS]**

Respond: **16 06 36 STEP Temp_H Temp_L BD_H BD_L [CS]**

Explanation:

(1) STEP is the concentration calibration point

(1) STEP	0x01	0x04	0x05
CO	Zero Point	Span Point 1	Span Point 2

Note: Concentration at span point 1 should be smaller than span point 2.

(2) TEMP_H and TEMP_L are respectively the higher and lower byte of the temperature at calibration point.
Actual temperature value = (TEMP_H*256 + TEMP_L - 500)/10

(3) BD_H and BD_L are respectively the higher and lower byte of the concentration at calibration point.

(4) Actual concentration value = (BD_H *256 + BD_L) * 10

4.4 Inquiry Instrument Serial Number

Send: **11 01 1F CF**

Respond: **16 11 1F DF1~DF16 [CS]**

Explanation:

DF1~DF16 is the serial number of the instrument.

4.5 Inquiry Firmware Version

Send: **11 01 1E D0**

Respond: **16 0B 1E DF1~DF10 [CS]**

Explanation:

ASCII code of DF1~DF10 is the firmware version of the instrument.

Precautions

1. The power-on aging time should not be less than 30 minutes.
2. If the water in ECO-5011 sensor container gets quickly frozen (usually due to mishandling), sensor characteristics may get changed irreversibly. To avoid such a risk, please keep the cap (working electrode) facing upwards when storing ECO-5011.
3. If in need of a wider working temperature (current range is -20 ~ +60℃), please contact Cubic for more supports.

After-Sales Services and Consultancy

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