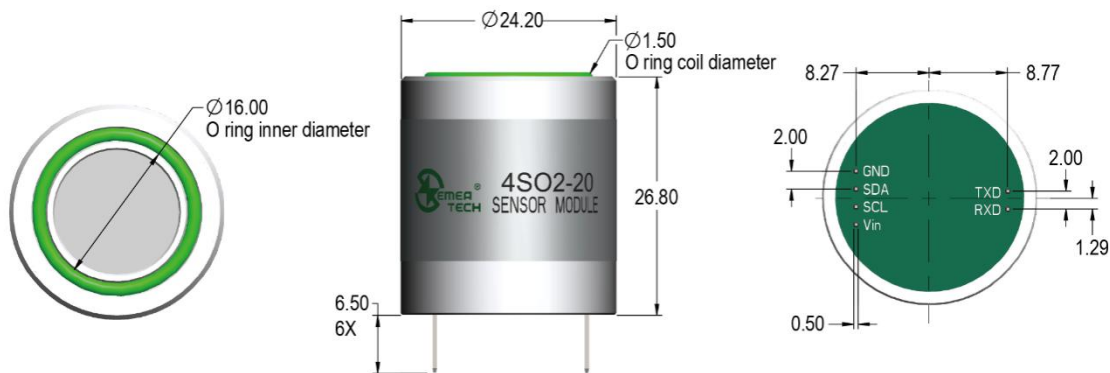


4ECM-SMART SENSOR MODULE

Description

This 4ECM-Smart Sensor Module consists of a data collection and processing PCB assembly, a SemeaTech 4-Series electrochemical (EC) sensor, and a metal enclosure. The PCB assembly in the module collects the data from the gas sensor output, and then processes it with amplification, sampling filtration, and temperature compensation through a built-in MCU to deliver stable and accurate digital output reflecting the actual target gas concentration. Any of SemeaTech 4-series EC sensors can be used to form a 4ECM-Smart Sensor Module that delivers the signal output through UART bus, which provides a good user experience for quickly integrating gas sensors into the existing systems for a variety of gas detection applications.



4ECM-Smart Sensor Module Dimensions and Pin Definition

Pin Definition

Vin	GND	TXD	RXD
Power input positive	Power input Negative	Serial Port Sending	Serial port receiving

Specifications

Product model	4ECM-Smart
Detectable gas types	Toxic and harmful gases such as CO, H2S and NO2
Detection Principle	Electrochemical
Gas concentration range	Refer to EC sensor datasheet
Resolution	Refer to EC sensor datasheet
Measurement error	< ±5%FS
Operating voltage	4 ~ 6 VDC

Operating current	≤ 2 mA @ +5.0 VDC
Output mode	UART (+3.3V TTL)
Operating temperature	-20°C ~ +50°C
Operating humidity	0% ~ 90%RH non-condensing
Operating pressure	1 ± 0.1 atm
Storage temperature	-20°C ~ +60°C
Dimensions	Φ 24.2 x 26.8 mm
Weight	10 g

Communication Settings

Baud rate	9600 bps
Data bits	8
Stop bit	1
Check bit	None

Communication Command

This module uses serial port (TXD/RXD) and uses question-and-answer mode for data transmission. All data transmission is in hexadecimal format (HEX).

1. Command for terminal Read Module Information

Example: AA 0F 01 C5 80 EE

- Byte1--AA: Start byte of a command;
- Byte2--0F: Information reading command;
- Byte3--01: Module address (default at 0x01);
- Byte4--C5: CRC16 (Modbus) Check high byte;
- Byte5--80: CRC16 (Modbus) Check low byte;
- Byte6--EE: Command end byte;

Note: In this command Byte 2 and Byte 3 will be checked with CRC 16 (Modbus).

Modular response (Sending Information Data to Terminal)

Example: AA 0F 01 0F 00 14 00 05 00 02 00 01 02 C5 99 EE

- Byte1--AA: Start byte of a command;
- Byte2--0F: Information reading command;
- Byte3--01: Module address (default at 0x01);
- Byte4--0F: Sensor type;
- Byte5/6--00/14: Modular measurement range (hexadecimal);
- Byte7/8--00/05: Calibration of gas concentration (hexadecimal);
- Byte9/10--00/02: High Alarm Point (Hexadecimal);

Byte11/12--00/01: Low Alarm Point (Hexadecimal);
Byte13--02: Sensor reading units
(% LEL: 0x00; % VOL: 0x01; PPM: 0x02; PPB: 0x03; N/A: 0x04);
Byte14--C5: CRC16 (Modbus) Check high byte;
Byte15--99: CRC16 (Modbus) Check low byte;
Byte16--EE: Command end byte;

Note: In this command Byte 2 ~ Byte 13 will be checked with CRC 16 (Modbus).

Addendum: Sensor type code

00 None 01 None 02 CO 03 O2 04 H2 05 CH4 06 None 07 CO2 08 O3 09 H2S 10 SO2 11 NH3
12 None 13 ETO 14 HCL 15 PH3 16 None 17 HCN 18 None 19 HF 20 None 21 NO 22 NO2 23 NOX
24 CLO2 25 None 26 None 27 None 28 None 29 None 30 None 31 THT 32 C2H2 33 C2H4 34 CH2O 35 None
36 None 37 None 38 None 39 CH3SH 40 C2H3CL

2. Commands for gas concentration request

Example: AA 01 01 C1 E0 EE

Byte1--AA: Start byte of a command;
Byte2--01: Command for concentration sending request;
Byte3--01: Module address (default at 0x01);
Byte4--C1: CRC16 (Modbus) Check high byte;
Byte5--E0: CRC16 (Modbus) Check low byte;
Byte6--EE: Command end byte;

Note: In this command Byte2 and Byte3 will be checked with CRC 16 (Modbus).

Modular response (sending concentration data to the terminal)

Example: AA 01 01 80 00 0000 15 CA EE

Byte1--AA: Start byte of a command;
Byte2--01: Command for concentration sending request;
Byte3--01: Module address (default at 0x01);
Byte4--80: Data symbol bit (0x80: negative; 0x00: positive);
Byte5/6--00/00: Data (ppm) integer part (0-65535);
Byte7--00: Data (ppm) fractional part (0.00-0.99);
Byte8--15: CRC16 (Modbus) Check high byte;
Byte9--CA: CRC16 (Modbus) Check low byte;
Byte10--EE: Command end byte;

Note: In this command Byte 2 ~ Byte 7 will be checked with CRC 16 (Modbus).

3. Command for terminal sending Module Zero-setting

Example: AA 02 01 C1 10 EE

Byte1--AA: Start byte of a command;
Byte2--02: Command for Zero-setting;
Byte3--01: Module address (default at 0x01);
Byte4--C1: CRC16 (Modbus) Check high byte;
Byte5--10: CRC16 (Modbus) Check low byte;
Byte6--EE: Command end byte;

- Note:** 1) In this command Byte 2 and Byte 3 will be checked with CRC 16 (Modbus);
2) During zero-setting, the LED flickers at a frequency of 1 second per time, lasting for 30 seconds.

Zero-setting success, module sending:

AA 02 01 10 D0 5C EE

Zero-setting failure, module sending:

AA 02 01 20 D0 48 EE

Byte1--AA: Start byte of a command;
Byte2--02: Command for Zero-setting;
Byte3--01: Module address (fixed at 0x01);
Byte4--10/20: Signs of success/failure;
Byte5--D0: CRC16 (Modbus) Check high byte;
Byte6--5C/48: CRC16 (Modbus) Check low byte;
Byte7--EE: Command end byte;

- Note:** In this command Byte 2 ~ Byte 4 will be checked with CRC 16 (Modbus).

4. Command for terminal sending Module Calibration

Example: AA 03 01 C0 80 EE

Byte1--AA: Start byte of a command;
Byte2--03: Command for Calibration;
Byte3--01: Module address (default at 0x01);
Byte4--C0: CRC16 (Modbus) Check high byte;
Byte5--80: CRC16 (Modbus) Check low byte;
Byte6--EE: Command end byte;

- Note:** 1) In this command Byte 2 and Byte 3 will be checked with CRC 16 (Modbus);
2) During calibration, the LED flickers at a frequency of 1 second per time, lasting for 120 seconds.

Calibration success, module sending:

AA 03 01 10 81 9C EE

Calibration failure, module sending:

AA 03 01 20 81 88 EE

Byte1--AA: Start byte of a command;
Byte2--03: Command for Calibration;
Byte3--01: Module address (default at 0x01);
Byte4--10/20: Signs of success/failure;
Byte5--81/81: CRC16 (Modbus) Check high byte;
Byte6--9C/88: CRC16 (Modbus) Check low byte;
Byte7--EE: Command end byte;

Note: In this command Byte 2 ~ Byte 4 will be checked with CRC 16 (Modbus).

5. Command for Module Address Modification

Example: AA 04 02 82 B1 EE

Byte1--AA: Start byte of a command;
Byte2--04: Command for Address Modification;
Byte3--02: Module new address;
Byte4--82: CRC16 (Modbus) Check high byte;
Byte5--B1: CRC16 (Modbus) Check low byte;
Byte6--EE: Command end byte;

Note: In this command Byte 2 and Byte 3 will be checked with CRC 16 (Modbus).

Address Modification success, module sending:

AA 04 02 10 30 AD EE

Byte1--AA: Start byte of a command;
Byte2--04: Command for Address Modification;
Byte3--02: Module new address;
Byte4--10: Signs of success/failure;
Byte5--30: CRC16 (Modbus) Check high byte;
Byte6--AD: CRC16 (Modbus) Check low byte;
Byte7--EE: Command end byte;

Note: In this command Byte 2 ~ Byte 4 will be checked with CRC 16 (Modbus).

6. Command for Adjustment of Calibration Gas Concentration

Example: AA 05 01 01 F4 51 3F EE

Byte1--AA: Start byte of a command;
Byte2--05: Command for concentration adjustment;
Byte3--01: Module address;
Byte4/5--01/F4: Concentration to be modified (hexadecimal, 0x1F4);
Byte6--51: CRC16 (Modbus) Check high byte;
Byte7--3F: CRC16 (Modbus) Check low byte;
Byte8--EE: Command end byte;

Note: In this command Byte 2 ~ Byte 5 will be checked with CRC 16 (Modbus).

Adjustment success, module sending:

AA 05 01 10 01 F4 E8 2E EE

Adjustment failure, module sending:

AA 05 01 20 01 F4 E8 21 EE

Byte1--AA: Start byte of a command;
Byte2--05: Command for concentration adjustment;
Byte3--01: Module address;
Byte4--10/20: Signs of success/failure;
Byte5/6--01/F4: Concentration to be modified (hexadecimal, 0x1F4);
Byte7--E8/E8: CRC16 (Modbus) Check high byte;
Byte8--2E/21: CRC16 (Modbus) Check low byte;
Byte9--EE: Command end byte;

Note: In this command Byte 2 ~ Byte 6 will be checked with CRC 16 (Modbus).

Warning!

- 1) This product does not have any intrinsic safety certification or explosion proof certification. Please do NOT use this product in any hazardous locations.
- 2) This product does not have reverse power protection and Electrostatic Discharge (ESD) protection. Please carefully verify the electrical polarity and make the ESD protection before each use or installation.
- 3) Please use a stable DC power supply for this gas sensor module. It is highly recommended to use a power supply with the output voltage fluctuation less than 1%.

Appendix 1: MODBUS CRC16 algorithm

```
unsigned short modbus_CRC16(unsigned char *ptr, unsigned char len)
{
    unsigned short wcr=0XFFFF; //
    int i=0, j=0;
    for (i=0; i<len; i++)
    {
        wcr^=*ptr++;
        for (j=0; j<8; j++)
        {
            if(wcr&0X0001)
            {
                wcr=wcr>>1^0XA001;
            }
            else
            {
                wcr>>=1;
            }
        }
    }
    return wcr<<8|wcr>>8; //little endian (LSB fist)
}
```