

• Description

The 4SMART-C01 sensor module is designed for 4-Series three-electrode electrochemical sensors, serving as a modular detection platform for real-time concentration detection of various types of toxic and hazardous gases in the environment. The module uses SemeaTech electrochemical sensor as the sensitive component (specific technical parameters of the sensor refer to the datasheet) and performs gas concentration detection through signal sampling, amplification, filtering, and conversion. It features built-in temperature compensation, linear correction, and other functions, ensuring excellent stability. The module supports UART signal output modes, allowing direct output of digital and analog voltage signals that represent gas concentration data. The user-friendly design simplifies operation and reduces the users' development cycle. It also includes an automatic shorting PIN function for zero-bias power failure, enabling stable operation within minutes of power-on for unbiased sensors. For biased sensors, it is recommended to power on for over 24 hours before use.

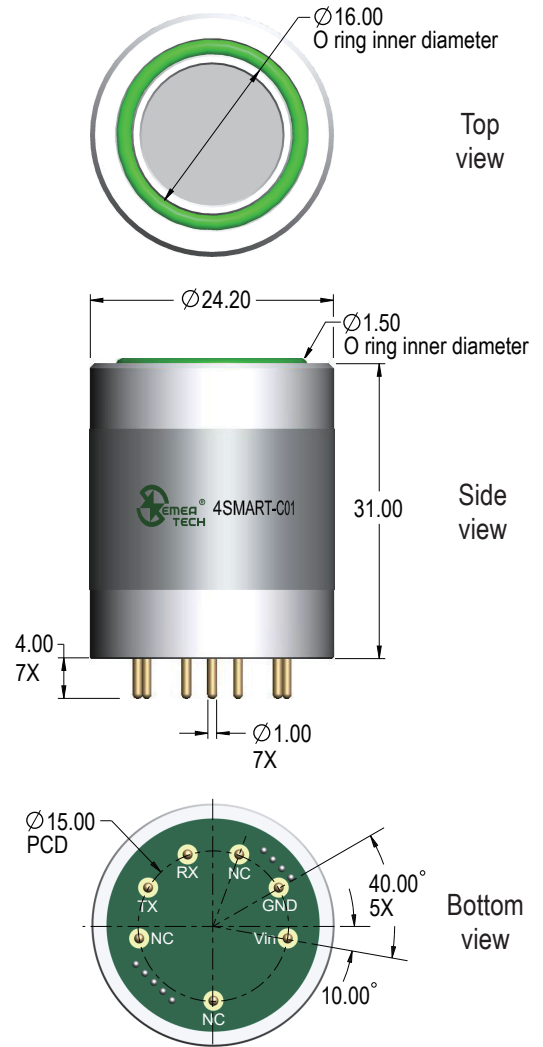
• Specifications

Product Model:	4SMART-C01
Detectable Gas Types:	Toxic and harmful gases
Detection Principle:	Electrochemical
Detection Range:	Refer to EC sensor datasheet
Detection Resolution:	Refer to EC sensor datasheet
Measurement error:	< ±5%FS
Operating Voltage:	(3.3 ~ 5.5) VDC
Operating Current:	≤ 5 mA @ 3.3 VDC
Output mode:	UART (3.0V TTL)
Installation:	7pins plug-in
Operating temperature:	-20°C ~ 50°C
Operating humidity:	0% ~ 90%RH non-condensing
Operating pressure:	1 ± 0.1 atm
Enclosure material:	Aluminum
Dimensions:	Φ 24.2 x 31.0 mm
Weight:	16 g

• Pin out

NC	Vacant
VIN	Power input positive
GND	Power input negative
RX	Serial port receiving
TX	Serial port sending
NC	Vacant

• Product Dimensions



All dimensions in mm

All tolerances ±0.20mm unless otherwise stated

• Communication Settings

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

This module utilizes a serial port (TX/RX) for data transmission, following a question-and-answer style communication method. All data transfers occur in hexadecimal (HEX) format.

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);

Byte5--80: CRC16 (Modbus);

Byte6--EE: Command end byte;

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

Module 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);

Byte15--99: CRC16 (Modbus);

Byte16--EE: Command end byte;

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

Addendum: Sensor type code

01 EX 02 CO 03 O2 04 H2 05 CH4 06 C3H8 07 CO2 08 O3 09 H2S 10 SO2 11 NH3 12 CL2
 13 ETO 14 HCL 15 PH3 16 HBr 17 HCN 18 AsH3 19 HF 20 Br2 21 NO 22 NO2 23 NOX 24 CLO2
 25 SiH4 26 None 27 None 28 None 29 None 30 None 31 THT 32 C2H2 33 C2H4 34 CH2O 35 None
 36 None 37 C6H6 38 H2O2 39 C2H3CL 40 VOC 41 CH3SH 42 C4H8

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

(In hexadecimal 0F= decimal 15, the sensor is a PH3 sensor)

2. Commands for gas concentration request

Example: **AA 01 01 C1 E0 EE**

Byte1--AA: Start byte of a command;

Byte2--01: Information reading command;

Byte3--01: Module address;

Byte4--C1: CRC16 (Modbus);

Byte5--E0: CRC16 (Modbus);

Byte6--EE: Command end byte;

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

Module response (Sending Information Data to Terminal).

Example: **AA 01 01 80 00 00 00 15 CA EE**

Byte1--AA: Start byte of a command;

Byte2--01: Information reading command;

Byte3--01: Module address;

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);

Byte9 -- CA: CRC16 (Modbus);

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;

Byte4--C1: CRC16 (Modbus);

Byte5--10: CRC16 (Modbus);

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 flashes at a rate of 1 second/time 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;

Byte4--10/20: Signs of success/failure

Byte5--D0: CRC16 (Modbus);

Byte6--5C/48: CRC16 (Modbus);

Byte7--EE: Command end byte;

Note: In this command Byte 2 、 Byte 3 and 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;

Byte4--C0: CRC16 (Modbus);

Byte5--80: CRC16 (Modbus);

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 flashes at a rate of 1 second /time 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;
Byte4--10/20: Signs of success/failure;
Byte5--81/81: CRC16 (Modbus);
Byte6--9C/88: CRC16 (Modbus);
Byte7--EE: Command end byte;

Note: In this command Byte 2 、 Byte 3 and Byte 4 will be checked with CRC 16 (Modbus).

5. Command for Module Address Modification

Example: AA 04 02 C82 B1 EE

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

Example: 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);
Byte6--AD: CRC16 (Modbus);
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);

Byte7--3F: CRC16 (Modbus);

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);

Byte8--2E/21: CRC16 (Modbus);

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

In CRC calculation, only 8 data bits, start bit and stop bit are used. If there are parity bit, including this bit, they are not involved in CRC calculation.

The CRC calculation method:

1. Load a 16 bit register with the value of 0 xffff, which is CRC register.
2. The XOR of the first 8-bit binary data (the first byte of communication information frame) and the 16 bit CRC register is still stored in the CRC register.
3. Move the contents of CRC register one bit to the right, fill the highest bit with 0, and detect whether the moved out bit is 0 or 1.
4. If the move out bit is zero, repeat the third step (move one bit to the right again); If the shift out bit is 1, the CRC register XORs with 0xa001.
5. Repeat steps 3 and 4 until the right shift is 8 times, so that the entire 8-bit data is processed.
6. Repeat steps 2 and 5 to process the next byte of the communication information frame
7. After all the bytes of the communication information frame are calculated according to the above steps, the high and low bytes of the 16 bit CRC register are exchanged
8. Finally, the content of CRC register is CRC check code.
9. For example, a command 05 01 01 F4 get the wrcr value 51 3F through the above program. In this way, we get the calibration command: AA 05 01 01 F4 51 3F EE.