# Application Note 251222

## 4LEL-SMART-C01 Sensor Module

## • Description

This 4LEL-Smart-C01 Sensor Module consists of a data collection and processing PCB assembly, a SemeaTech 4-Series Catalytic combustion (LEL) 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 and filtration through a built-in MCU to deliver stable and accurate digital output reflecting the actual target gas concentration. The 4LEL-Smart-C01 Sensor Module 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. Users can visit the website for detailed sensor parameters.

## • Specifications

| | |
|---|---|
| Product Model: | 4LEL-Smart-C01 |
| Detectable Gas Types: | Combustible gas |
| Detection Principle: | Catalytic combustion |
| Gas Concentration Range: | 0 ~ 100% LEL |
| Resolution: | 1% LEL |
| Measurement Error: | < ±5%FS |
| Operating Voltage: | (3.3 ~ 5.0) VDC |
| Operating Current: | ≤ 110 mA |
| Output Mode: | UART (3.0V TTL) |
| Operating Temperature: | -20°C ~ 55°C |
| Operating Humidity: | ≤ 98%RH (25°C) |
| Operating Pressure: | 86 ~ 116 KPa |
| Storage Temperature: | -20°C ~ 40°C |
| Dimensions: | Φ 24.2 x 31.0 mm |
| Weight: | 32 g |

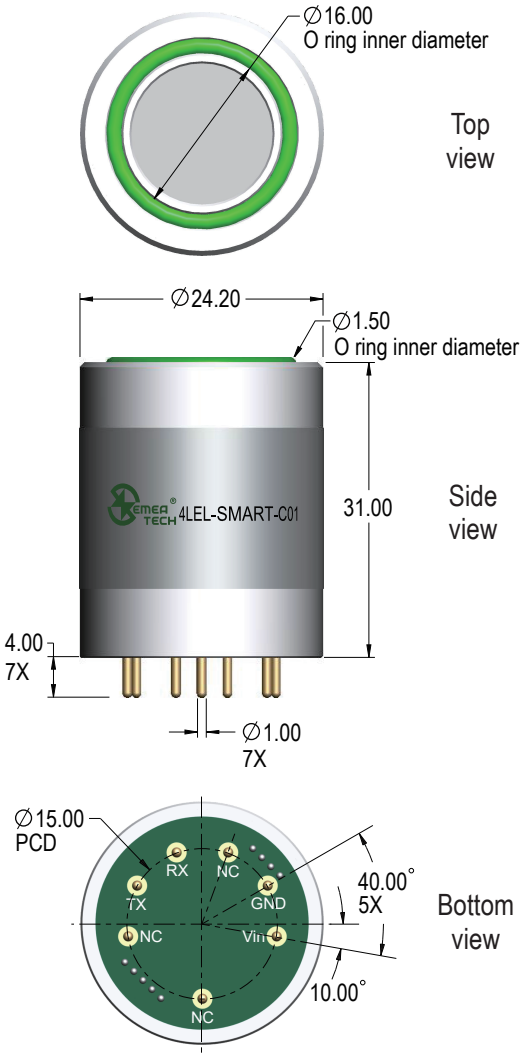
## • Pin Definitions

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

## • Communication Settings

| | |
|---|---|
| Baud rate: | 9,600 bps |
| Data bits: | 8 |
| Stop bit: | 1 |
| Check bit: | None |

## • Product Dimensions




All dimensions in mm
All tolerances ±0.20mm unless otherwise stated

## • 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

| Start byte of a command | Information reading command | Module address (default at 0x01) | CRC16 (Modbus) Check high byte | CRC16 (Modbus) Check low byte | Command end byte |
|---|---|---|---|---|---|
| AA | 0F | 01 | C5 | 80 | EE |

For example: AA 0F 01 C5 80 EE

**Note: In this command Byte 2 and Byte 3 will be checked with CRC16 (Modbus).**

### Modular response (sending information data to terminal)

| Start byte of a command | Information reading command | Module address (default at 0x01) | Sensor type (LEL) | Modular measure-ment range (hexadecimal) | Modular measure-ment range (hexadecimal) |
|---|---|---|---|---|---|
| AA | 0F | 01 | 05 | 00 | 64 |
| Calibration of gas concentration (hexadecimal) | Calibration of gas concentration (hexadecimal) | High Alarm Point (Hexadecimal) | High Alarm Point (Hexadecimal) | Low Alarm Point (Hexadecimal) | Low Alarm Point (Hexadecimal) |
| 00 | 19 | 00 | 19 | 00 | 0F |
| Sensor reading units (% LEL) | CRC16 (Modbus) Check high byte | CRC16 (Modbus) Check low byte | Command end byte | | |
| 00 | 63 | 84 | EE | | |

Byte13 - 00: Sensor reading unit (%LEL: 0x00; %VOL: 0x01; PPM: 0x02; PPB: 0x03; None: 0x04)

For example: AA 0F 01 05 00 64 00 19 00 19 00 0F 00 63 84 EE

**Note: In this command Byte 2 ~ Byte 13 will be checked with CRC16 (Modbus).**

### 2. Commands for gas concentration request

| Start byte of a command | Command for concentration sending request | Module address (default at 0x01) | CRC16 (Modbus) Check high byte | CRC16 (Modbus) Check low byte | Command end byte |
|---|---|---|---|---|---|
| AA | 01 | 01 | C1 | E0 | EE |

For example: AA 01 01 C1 E0 EE

**Note: In this command Byte2 and Byte3 will be checked with CRC16 (Modbus).**

**Modular response (sending concentration data to terminal)**

| Start byte of a command | Command for concentration sending request | Module address (default at 0x01) | Data symbol bit (0x80: negative; 0x00: positive) | Fixed to zero | Data (% LEL), Hex format |
|---|---|---|---|---|---|
| AA | 01 | 01 | 80 | 00 | 00 |
| Fixed to zero | CRC16 (Modbus) Check high byte | CRC16 (Modbus) Check low byte | Command end byte | | |
| 00 | 15 | C | EE | | |

Byte 4: Data sign bit (0x80: negative; 0x00: positive)
Byte 5/6: Sensor reading (LEL) integer part (0–65535)
Byte 7: Sensor reading fractional part (0.00–0.99)
For example: AA 01 01 80 00 00 00 15 CA EE
**Note: In this command Byte 2 ~ Byte 7 will be checked with CRC16 (Modbus).**

### 3. Command for terminal sending Module Zero-setting

| Start byte of a command | Command for Zero-setting | Module address (default at 0x01) | CRC16 (Modbus) Check high byte | CRC16 (Modbus) Check low byte | Command end byte |
|---|---|---|---|---|---|
| AA | 02 | 01 | C1 | 10 | EE |

For example: AA 02 01 C1 10 EE
**Note: 1) In this command Byte 2 and Byte 3 will be checked with CRC16 (Modbus);**

**Zero-setting success, module sending:**

AA 02 01 10 D0 5C EE

**Zero-setting failure, module sending:**

AA 02 01 20 D0 48 EE

| Start byte of a command | Command for Zero-setting | Module address (fixed at 0x01) | Signs of success/failure | CRC16 (Modbus) Check high byte | CRC16 (Modbus) Check low byte | Command end byte |
|---|---|---|---|---|---|---|
| A | 02 | 01 | 10/20 | D0/D0 | 5C/48 | EE |

**Note: In this command Byte 2 ~ Byte 4 will be checked with CRC16 (Modbus).**

### 4. Command for terminal sending Module Calibration

| Start byte of a command | Command for Calibration | Module address (default at 0x01) | CRC16 (Modbus) Check high byte | CRC16 (Modbus) Check low byte | Command end byte |
|---|---|---|---|---|---|
| AA | 03 | 01 | C0 | 80 | EE |

For example: AA 03 01 C0 80 EE

**Note: 1) In this command Byte 2 and Byte 3 will be checked with CRC16 (Modbus);**

**Calibration success, module sending:**

AA 03 01 10 81 9C EE

**Calibration failure, module sending:**

AA 03 01 20 81 88 EE

| Start byte of a command | Command for Calibration | Module address (default at 0x01) | Signs of success/failure | CRC16 (Modbus) Check high byte | CRC16 (Modbus) Check low byte | Command end byte |
|---|---|---|---|---|---|---|
| A | 03 | 01 | 10/20 | 81/81 | 9C/88 | EE |

**Note: In this command Byte 2 ~ Byte 4 will be checked with CRC16 (Modbus).**

### 5. Command for Module Address Modification

| Start byte of a command | Command for Address Modification | Module new address | CRC16 (Modbus) Check high byte | CRC16 (Modbus) Check low byte | Command end byte |
|---|---|---|---|---|---|
| AA | 04 | 02 | 82 | B1 | EE |

For example: AA 04 02 82 B1 EE

**Note: In this command Byte 2 and Byte 3 will be checked with CRC16 (Modbus).**

**Address Modification success, module sending:**

AA 04 02 10 30 AD EE

| Start byte of a command | Command for Address Modification | Module new address | Signs of success/failure | CRC16 (Modbus) Check high byte | CRC16 (Modbus) Check low byte | Command end byte |
|---|---|---|---|---|---|---|
| A | 04 | 02 | 10 | 30 | AD | EE |

**Note: In this command Byte 2 ~ Byte 4 will be checked with CRC16 (Modbus).**

### 6. Command for Adjustment of Calibration Gas Concentration

| Start byte of a command | Command for concentration adjustment | Module address (default at 0x01) | Fixed to zero | Concentration to be modified (%LEL, Hex format) | CRC16 (Modbus) Check high byte |
|---|---|---|---|---|---|
| AA | 05 | 01 | 00 | 32 | D0 |
| CRC16 (Modbus) Check low byte | Command end byte | | | | |
| FD | EE | | | | |

Byte 4/5 – Standard gas concentration to be set (hexadecimal; e.g., 0x032)

For example: AA 05 01 00 32 D0 FD EE

**Note: In this command Byte 2 ~ Byte 5 will be checked with CRC16 (Modbus).**

**Adjustment success, module sending:**

AA 05 01 10 00 32 69 EC EE

**Adjustment failure, module sending:**

AA 05 01 20 00 32 69 E3 EE

| Start byte of a command | Command for Adjustment | Module address (default at 0x01) | Signs of success/failure | Fixed to zero | Concentration to be modified (%LEL, Hex format) |
|---|---|---|---|---|---|
| AA | 05 | 01 | 10/20 | 00 | 32 |
| CRC16 (Modbus) Check high byte | CRC16 (Modbus) Check low byte | Command end byte | | | |
| 69/69 | E3/E3 | EE | | | |

Byte 5/6 – Standard gas concentration to be set (hexadecimal; e.g., 0x032)

**Note: In this command Byte 2 ~ Byte 6 will be checked with CRC16 (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 wcrc=0XFFFF; / /
int  i=0, j=0;
for (i=0; i<len; i++)
          {
                    wcrc^=*prt++;
                    for ( j=0; j<8; j++)
                         {
                              if (wcrc&0X0001)
                                {
                                    wcrc=wcrc>>1^0XA001;
                                 }
                              else
                                {
                                    wcrc>>=1;
                                 }
                         }
           }
return wcrc<<8| wcrc>>8;   //little endian (LSB fist)

}
```