

产品规格书

PRODUCT SPECIFICATION

单通道二氧化碳气体传感器

Single Beam NDIR CO₂ Sensor

U91010001 Rev. A3



| 版本 Version | 修订记录 Revision Record | 发行日期 Issue Date |
|---------------|---|--------------------|
| A0 | 初次发放 Initial Release | 2022. 3. 1 |
| A1 | 更新为中英文版本 Update to Chinese/English version | 2022. 6. 11 |
| A2 | 更新包装方式 Update Packaging Method | 2022. 7. 4 |
| A3 | 补充通信指令 Supplement Communication Command | 2023. 2. 22 |

1. 产品介绍 Product Introduction

1.1 产品概述 Product Description

U91010001是一款光学二氧化碳传感器，其利用非色散红外（NDIR）原理探测空气中的CO₂浓度。本产品采用优化的光学设计、电路设计、数字信号处理算法和补偿算法，相较于市场同类型产品，其具有信噪比高、重复性好、响应快的特点。此外，通过稳健性设计，产品通过了多项严苛的环境测试和寿命测试，具有优越的稳定性和可靠性。U91010001 is an optical carbon dioxide (CO₂) sensor that utilizes the principle of non-dispersive infrared (NDIR) to detect CO₂ concentration in the air. This product applies optimized optical design, circuit design, digital signal processing algorithm, and compensation algorithm. Compared with the like products in the market, it has the characteristics of high signal-to-noise ratio, good repeatability, and fast response. In addition, through the robust design, the product has passed several environmental and life tests that guarantee superior stability and reliability.

1.2 产品特性 Product Features

- ◇ 多温度点/全量程校准 Full-measurement-range calibration at multi-points temperature
- ◇ RMS噪声小于1 ppm; RMS noise less than 1.0 ppm
- ◇ 使用寿命大于15年 Work-life more than 15 years
- ◇ 结构紧凑、便于安装 Compact mechanical structure for easy installation
- ◇ 提供自动校准模式和手动校准模式 Auto-calibration and Manual-calibration available
- ◇ 信号输出 PWM/UART/I2C; Output signal PWM/UART/I2C

1.3 应用领域 Application Field

- ◇ 室内空气监测 Indoor air quality monitoring
- ◇ 暖通空调、新风系统 HVAC system and fresh air system
- ◇ 车内空气监测 Cabin air quality control in automotive application
- ◇ 农业温室监控 Agriculture monitor and control systems such as green-house planting

1.4 使用注意事项 Application Notes

- a. 在传感器的焊接、安装、使用等过程中，应避免光学气室承受任何方向的压力；在操作时应采用防静电措施。During the soldering, installation, and use, avoid the optical chamber from pressure/stress in any direction; take ESD precautions during handling.
- b. 锡焊焊接时，温度设置须低于380 °C，尽量保证焊接时间小于3秒。选择性波峰焊可能导致热应力和光学气室形变，在工艺开发时应做充分验证。When performing tin soldering, set the temperature below 380 °C, and the soldering time shall be less than 3 seconds as far as possible. Selective wave soldering may cause thermal stress and optical chamber deformation, which should be carefully qualified when conducting process development.
- c. 确保传感器通风良好，勿遮挡气体扩散孔（防水透气膜）。如在风道中，避免气流直吹气体扩散孔。传感器应避免阳光直射和热辐射。Ensure that the sensor is well ventilated and the air diffusion holes (particle filter) are not blocked. For example, avoid blowing direct airflow at the air diffusion hole when placing the sensor in the air duct. Protect sensor from direct sunlight and thermal radiation.
- d. 应避免接触腐蚀性气体，以免传感器性能和可靠性退化。Avoid exposure to corrosive gases as it would lead to sensor performance and reliability degradation.
- e. 传感器出厂默认开启自校准功能，默认校准周期是72小时。如传感器工作在长期不通风的环境中，请通过指令关闭自校准功能。The auto-calibration function is enabled by default, and the default calibration period is 72 hours. If the sensor works in an unventilated environment, turn off the self-calibration function by sending a command.
- f. 通过引脚或校准命令进行手动校准时，传感器须在稳定的气体环境(例如400 ppm)下连续工作2分钟以上。When perform manual calibration with the pin or the calibration command, the sensor shall operate continuously for more than 2 minutes in a stable gas environment (e.g., 400 ppm).

2. 产品特性 Product Characteristics

2.1 技术指标 Technical Specification

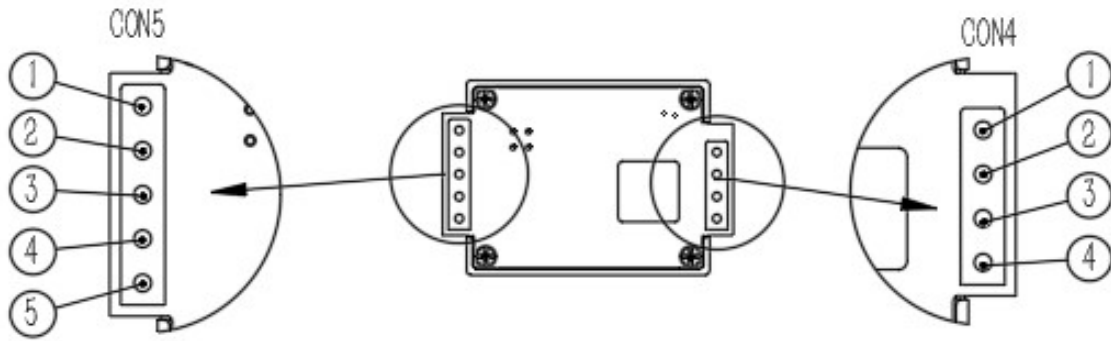
| | |
|---------------------------------|---|
| 产品型号 Product Number | U91010001 |
| 检测气体 Target Gas | Carbon Dioxide (CO ₂) |
| 检测范围 Measurement Range | 400 ppm~5000 ppm ⁽¹⁾ (extended range to 10000 ppm upon request ⁽³⁾) |
| 检测精度 Accuracy | ± (50 ppm + 5% reading) ⁽²⁾ |
| 响应时间 Response Time | < 40 seconds |
| 工作条件 Operation Conditions | -10~50 °C; 0~95% RH (Non-condensing) |
| 存储条件 Storage Conditions | -40 °C~70 °C |
| 供电电压 Power Supply | DC 4.5 V~5.5 V, Ripple voltage < 50 mV |
| 平均工作电流 Average Current | ~26 mA |
| 峰值电流 Peak Current | < 250 mA |
| 通讯接口 Communication Interface | 1) UART TTL (3.3 V) 2) PWM (Open-collector output; 100 ms, 500 ppm; 1000 ms, 5000 ppm) 3) I ² C (upon request) ⁽³⁾ |
| 产品寿命 Life Expectancy | 15 years |
| 长期稳定性 Long-term Stability | ≤ 2% F.S. |
| 重量 Weight | 5.7 grams |

(1) Specification is referenced to certificated calibration gas mixture (±2% uncertainty).

(2) Accuracy satisfied after three auto-calibration period.

(3) Contact Unitense for customized request.

2.2 引脚定义 Pin Definition



Bottom view from PCBA surface

| 序号 Pin-out | | 描述 Description |
|------------|---|---|
| CON5 | 1 | Manual calibration |
| | 2 | Output change from UART to IIC (upon request) |
| | 3 | UART_TX |
| | 4 | UART_RX |
| | 5 | DC +3.3 V output (100 mA) |
| CON4 | 1 | PWM output |
| | 2 | Alarm output (upon request) |
| | 3 | GND |
| | 4 | DC +5 V power supply |

2.3 数据传输 Data Communication

2.3.1 串口通信 Serial Port (UART) Communication

波特率Baud rate: 9600, 数据位Data Bits: 8, 停止位Stop Bits: 1, 校验位Parity: no, 流量控制Flow control: no

2.3.2 通讯协议格式 Format of Communication Protocol

| 发送-Send | | | | | | |
|--------------|--------|-----|-------|-----|-------|----------|
| 帧头 | 长度 | 命令 | 数据1 | ... | 数据n | 校验和 |
| Head | Length | CMD | DATA1 | ... | DATAn | Checksum |
| 0x10 | xx | xx | xx | ... | xx | xx |
| 返回- Response | | | | | | |
| 帧头 | 长度 | 命令 | 数据1 | ... | 数据n | 校验和 |
| Head | Length | CMD | DATA1 | ... | DATAn | Checksum |
| 0x20 | xx | xx | xx | ... | xx | xx |

2.3.3 通讯协议格式说明 Introduction about Format of Communication Protocol

| 项目 Items | 描述 Description | 字节数 Bytes |
|----------------|--|------------------|
| 帧头 (Head) | 发送是0x10, 返回是0x20。 Send 0x10 or Response 0x20. | 1 |
| 长度 (Length) | 帧数据字节长度, 等于CMD~DATAn的字节数。 Count of bytes from CMD to DATAn. | 1 |
| 命令 (CMD) | 详见命令列表。 See Command List. | 1 |
| 数据 (DATAx) | DATA1~DATAn. | 1 Byte per DATAx |
| 校验和 (CS) | CS = 256-(unsigned char)(Head+Length+CMD+DATA1+...+DATAn). | 1 |

2.3.4 命令列表 Command List

| 命令列表 Command List | |
|-------------------|--|
| 0x01 | 读取软件版本号 Get software version |
| 0x02 | 查询产品序列号 Get product serial number (SN) |
| 0x03 | 读取气体浓度值 Read gas concentration of CO ₂ in ppm |
| 0x04 | 手动校准 Manual calibration of reading |
| 0x05 | 设置自动校准参数 Setting parameter of automatic calibration |

2.3.5 指令格式 Command Format

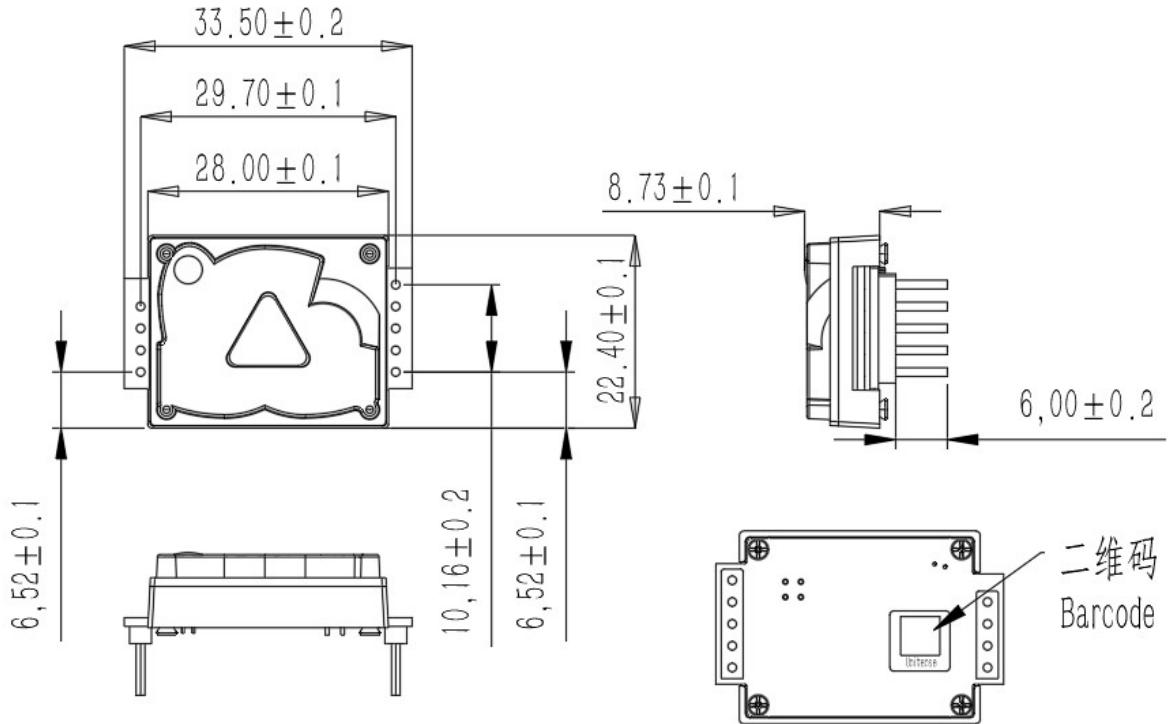
| 0x01 - 读取软件版本号 Get software version | | | | | | |
|---|--------|-------|-------|-----|---------|---------|
| 发送命令 Send | | | | | | |
| Byte0 | Byte1 | Byte2 | Byte3 | | | |
| Head | Length | CMD | CS | | | |
| 0x10 | 0x01 | 0x01 | 0xEE | | | |
| 返回值 Response | | | | | | |
| Byte0 | Byte1 | Byte2 | Byte3 | ... | Byten+2 | Byten+3 |
| Head | Length | CMD | DATA1 | ... | DATAn | CS |
| 0x20 | xx | 0x01 | xx | ... | xx | xx |
| DATA1~DATAn为软件版本号, 内容和长度会随着软件版本的升级而改变。 DATA1~DATAn is software version. It will be changed with the software update. | | | | | | |

| | | | | | | |
|--|--------------|--------------|--------------|-----|---------------|---------------|
| 0x02 - 查询产品序列号 Get product serial number (SN) | | | | | | |
| 发送命令 Send | | | | | | |
| Byte0 | Byte1 | Byte2 | Byte3 | | | |
| Head | Length | CMD | CS | | | |
| 0x10 | 0x01 | 0x02 | 0xED | | | |
| 返回值 Response | | | | | | |
| Byte0 | Byte1 | Byte2 | Byte3 | ... | Byte17 | Byte18 |
| Head | Length | CMD | DATA1 | ... | DATA15 | CS |
| 0x20 | 0x10 | 0x02 | xx | ... | xx | xx |
| DATA1~DATA15表示产品序列号,长度为15个字节。 DATA1~DATA15 is SN, 15 bytes. | | | | | | |

| | | | | | | | |
|---|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 0x03 - 读取气体浓度值 Read gas concentration of CO ₂ in ppm | | | | | | | |
| 发送命令 Send | | | | | | | |
| Byte0 | Byte1 | Byte2 | Byte3 | | | | |
| Head | Length | CMD | CS | | | | |
| 0x10 | 0x01 | 0x03 | 0xEC | | | | |
| 返回值 Response | | | | | | | |
| Byte0 | Byte1 | Byte2 | Byte3 | Byte3 | Byte3 | Byte5 | Byte6 |
| Head | Length | CMD | DATA1 | DATA2 | DATA3 | DATA4 | CS |
| 0x20 | 0x05 | 0x03 | xx | xx | xx | xx | xx |
| 浓度读数 Concentration reading = DATA1*256+DATA2. DATA3 and DATA4 are reserve. | | | | | | | |

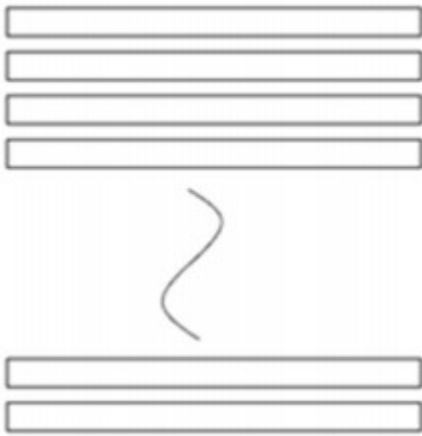
| | | | | | | |
|---|--------------|--------------|--------------|--------------|--------------|--|
| 0x04 - 手动校准 Manual calibration of reading | | | | | | |
| 发送命令 Send | | | | | | |
| Byte0 | Byte1 | Byte2 | Byte3 | Byte4 | Byte5 | |
| Head | Length | CMD | DATA1 | DATA2 | CS | |
| 0x10 | 0x03 | 0x04 | xx | xx | xx | |
| 返回值 Response | | | | | | |
| Byte0 | Byte1 | Byte2 | Byte3 | | | |
| Head | Length | CMD | CS | | | |
| 0x20 | 01 | 0x04 | 0xDB | | | |
| 校准目标值 Calibration target value = DATA1*256+DATA2. | | | | | | |

3. 外形尺寸 Product Outlines (unit: mm)

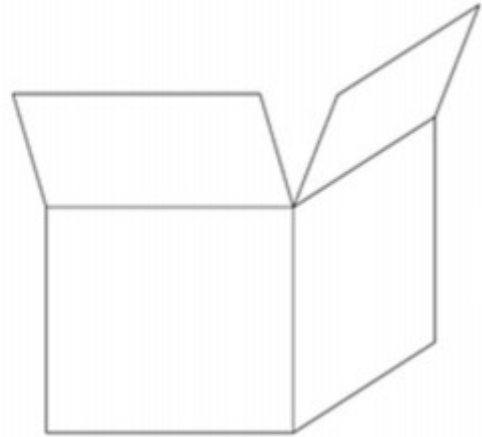


4. 包装规格 Packaging Specification

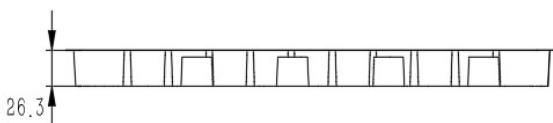
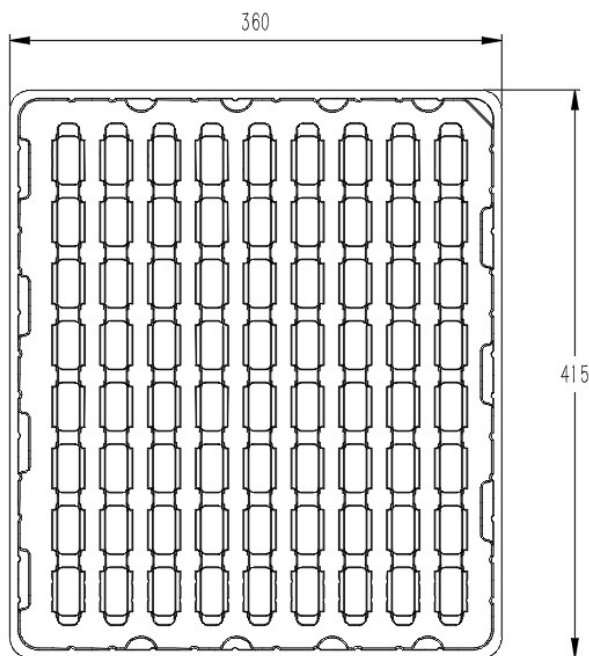
| 包装箱尺寸 Carton Size (W*L*H) | | | 产品托盘数 Tray Qty. | 每托盘产品数 Qty. per Tray | 总数 Total Qty. | 重量 Gross Weight |
|------------------------------|--------|--------|--------------------|-------------------------|------------------|--------------------|
| 415 mm | 355 mm | 215 mm | 8 pcs | 72 pcs | 576 pcs | Max.10.0 kg |



防静电吸塑托盘 Anti-static blister tray
数量 Qty.: 9 pcs



包装箱 Carton
1 pc



防静电吸塑托盘 Anti-static blister tray

注意:

顶部放置1pc空置的防静电吸塑托盘充当盖板

Note:

1pc empty anti-static blister tray serves as the cover on the top