

# 产 品 规 格 书

## PRODUCT SPECIFICATION

冷媒（制冷剂）泄漏监测传感器与系统

Refrigerant Leakage Detection Sensor & Systems

U9601 Series Rev. 01



| 版本<br>Version | 修订记录<br>Revision Record | 发行日期<br>Issue Date |
|---------------|-------------------------|--------------------|
| A0            | 初次发放<br>Initial Release | 2023-02-15         |

## 1. Product Introduction

### 1.1 Product Description

The U9601 and U96041 series are optical-based refrigerant leakage detection devices that utilize non-dispersive infrared (NDIR) technology to detect refrigerant gas concentrations in ambient air. Applying optimized optical cavities, precision calcium fluoride ( $\text{CaF}_2$ ) optics, and digital signal processing with multi-point temperature compensation algorithms, both series offer a superior signal-to-noise ratio, rapid response, and complete immunity to sensor poisoning and chemical drift. To address diverse HVAC&R manufacturing requirements, the portfolio is divided into two implementation form factors:

**U9601 Series (Compact OEM Module):** An ultra-lightweight (5.7g) bare-PCB sensor module designed for space-constrained, direct motherboard integration via standard pin headers, providing UART TTL, PWM, and optional I2C signals.

**U96041 Series (Integrated Mitigation System - RDS):** A fully enclosed standalone detection system (<65g, optional IP67 cable). It incorporates two independent onboard relays for active fan ventilation and compressor shut-off mitigation, diagnostic LED blink codes, and an RS485 telemetry interface, providing turnkey compliance with IEC/UL 60335-2-40.

### 1.2 Product Features

- ✧ Full-measurement-range calibration at multi-points temperature
- ✧ RMS noise less than 10 ppm @ zero
- ✧ Work-life more than 15 years
- ✧ Compact mechanical structure for easy installation
- ✧ Auto-calibration and Manual-calibration available
- ✧ Output signal PWM/UART/I<sup>2</sup>C

### 1.3 Application Field

- ✧ Refrigerant gas leakage monitoring of household HVAC system
- ✧ Refrigerant gas leakage monitoring of commercial HVAC system
- ✧ Refrigerant gas leakage monitoring of automotive HVAC system

#### 1.4 Application Notes

- a. During the soldering, installation, and use, avoid the optical chamber from pressure/stress in any direction; take ESD precautions during handling.
- b. 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. 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. Avoid exposure to corrosive gases as it would lead to sensor performance and reliability degradation.
- e. The auto-calibration function is enabled by default, and the default calibration period is 24 hours. If the sensor works in an unventilated environment, turn off the self-calibration function by sending a command.
- f. 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., 0 ppm).

## 2. Product Characteristics

### 2.1 Technical Specification

| Product Number          | U96010001                                                                                               | U96010002 | U96010003 | U96010004 | U96010031 |
|-------------------------|---------------------------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|
| Target Gas(1)           | R32                                                                                                     | R454B     | R454A     | R454C     | R290      |
| Measurement Range       | 0 ~ 50% LFL<br>(extended range to 100% LFL upon request <sup>(3)</sup> )                                |           |           |           |           |
| Accuracy                | ± 2.5% LFL for standard range<br>± 5% LFL for extended range <sup>(2)</sup>                             |           |           |           |           |
| Response Time           | < 30 s <sup>(4)</sup>                                                                                   |           |           |           |           |
| Operation Conditions    | -40 to 85 °C; 0 ~ 95% RH (Non-condensing)                                                               |           |           |           |           |
| Storage Conditions      | -40 °C ~ 85 °C                                                                                          |           |           |           |           |
| Power Supply            | DC 4.75 V ~ 5.25 V, Ripple voltage < 100 mV                                                             |           |           |           |           |
| Average Current         | < 50 mA                                                                                                 |           |           |           |           |
| Alarm Output            | Digital High/Low<br>(RELAY_1, RELAY_2, & LED, upon request <sup>(3)</sup> )                             |           |           |           |           |
| Communication Interface | UART (default)<br>PWM (upon request <sup>(3)</sup> )<br>I <sup>2</sup> C (upon request <sup>(3)</sup> ) |           |           |           |           |
| Life Expectancy         | 15 years                                                                                                |           |           |           |           |
| Long-term Stability     | ≤ 2% LFL                                                                                                |           |           |           |           |
| Weight                  | 5.7 grams                                                                                               |           |           |           |           |

|                      |                                                                             |           |           |           |           |
|----------------------|-----------------------------------------------------------------------------|-----------|-----------|-----------|-----------|
| Product Number       | U96040001                                                                   | U96040002 | U96040003 | U96040004 | U96040031 |
| Target Gas           | R32                                                                         | R454B     | R454A     | R454C     | R290      |
| Measurement Range[1] | 0 ~ 50% LFL<br>(extended range to 100% LFL upon request <sup>(3)</sup> )    |           |           |           |           |
| Accuracy             | ± 2.5% LFL for standard range<br>± 5% LFL for extended range <sup>(2)</sup> |           |           |           |           |
| Response Time        | < 30 s <sup>(4)</sup>                                                       |           |           |           |           |
| Operation Conditions | -40 to 85 °C, 0 to 95% RH (Non-condensing)                                  |           |           |           |           |
| Storage Conditions   | -40 °C to 85 °C                                                             |           |           |           |           |
| Power Supply         | AC/DC 10 V ~ 28 V, Ripple voltage < 100 mV                                  |           |           |           |           |
| Average Current      | < 50 mA @ 24V DC supply voltage                                             |           |           |           |           |
| Control Output       | Relay NC/NO (default) or Digital High/Low                                   |           |           |           |           |
| Communication        | RS485                                                                       |           |           |           |           |
| Life Expectancy      | 15 years                                                                    |           |           |           |           |
| Long-term Stability  | ≤ 2% LFL                                                                    |           |           |           |           |
| Compliance           | IEC 60335-2-40, UL 60335-2-40                                               |           |           |           |           |
| Weight               | < 65 grams                                                                  |           |           |           |           |

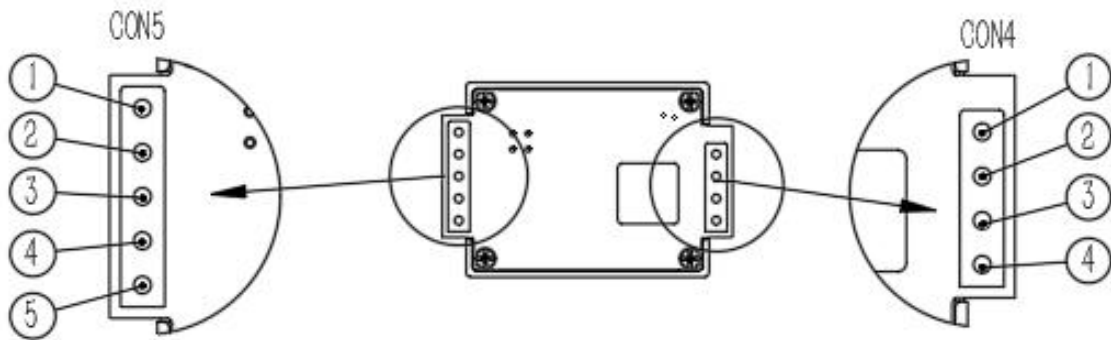
(1) Contact Unitense for monitoring of other refrigerant belongs to A2L, A3 safety group.

(2) Standard range: 0 to 25% LFL and -20 to 60 °C; Extended range: 25 to 50% LFL and -40 to 85 °C.

(3) Contact Unitense for customized request.

(4) Directly exposed to the refrigerant gas with concentration 25% LFL and Detection Threshold Limit Value set to 10% of LFL.

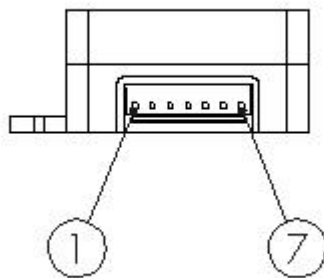
## 2.2 Pin Definition (U9601)



Bottom view from PCBA surface

| Pin-out |   | Description                                                 |
|---------|---|-------------------------------------------------------------|
| CON5    | 1 | Manual calibration<br>or LED output (upon request)          |
|         | 2 | Output change from UART to IIC (upon request)               |
|         | 3 | UART_TX                                                     |
|         | 4 | UART_RX                                                     |
|         | 5 | DC +3.3 V output (upon request)                             |
| CON4    | 1 | PWM output (upon request)<br>or Relay output (upon request) |
|         | 2 | Relay output                                                |
|         | 3 | GND                                                         |
|         | 4 | DC +5 V power supply                                        |

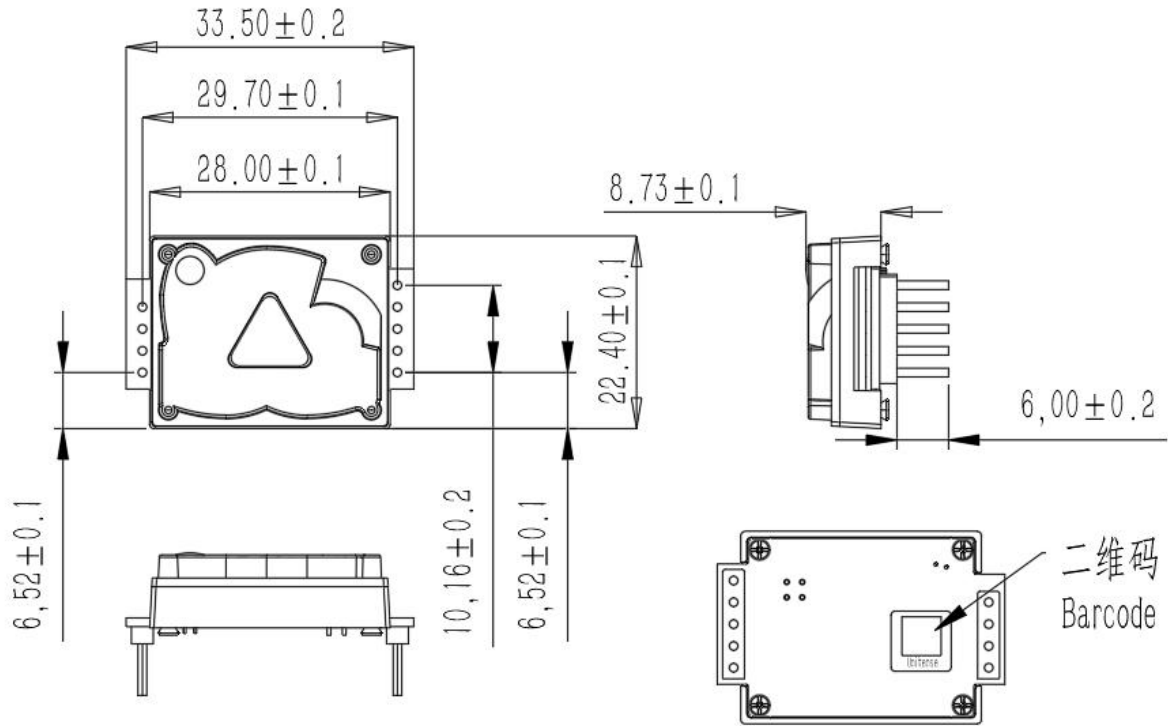
## Pin Definition(U9604)



Bottom view from PCBA surface

| Pin-out | Description         |
|---------|---------------------|
| 1       | Power Input         |
| 2       | GND                 |
| 3       | Relay Common        |
| 4       | Relay Normal Closed |
| 5       | Relay Normal Open   |
| 6       | RS485_A             |
| 7       | RS485_B             |

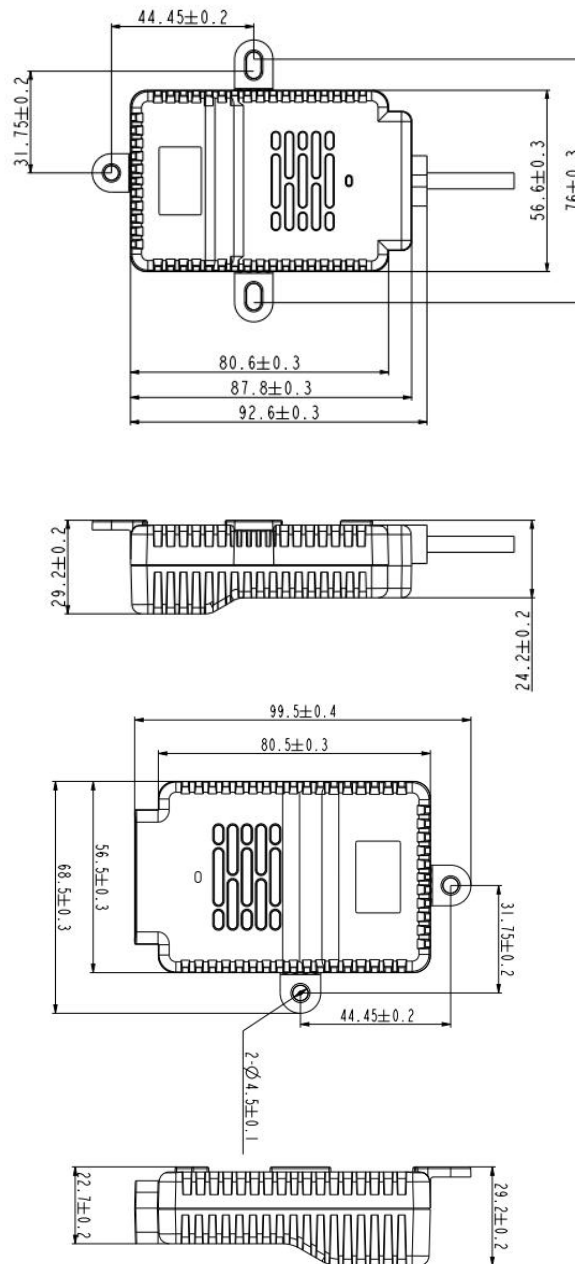
### 3. Product Outlines (unit: mm) (U9601)



扫描二维码 Scan 2D barcode for P/N

| P/N                 | Gas Type |
|---------------------|----------|
| U96010001XXXXXXXXXX | R32      |
| U96010002XXXXXXXXXX | R454B    |
| U96010003XXXXXXXXXX | R454A    |
| U96010004XXXXXXXXXX | R454C    |
| U96010031XXXXXXXXXX | R290     |

Product Outlines (unit: mm) (U9604)

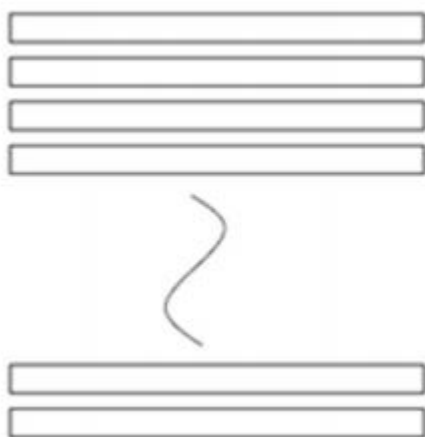


U960411XX: Cable type

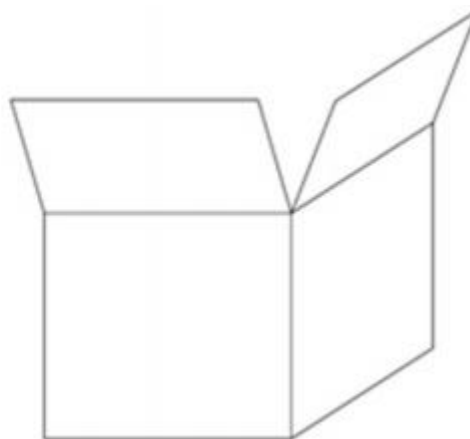
U960410XX: Connector type

#### 4. 包装规格 Packaging Specification

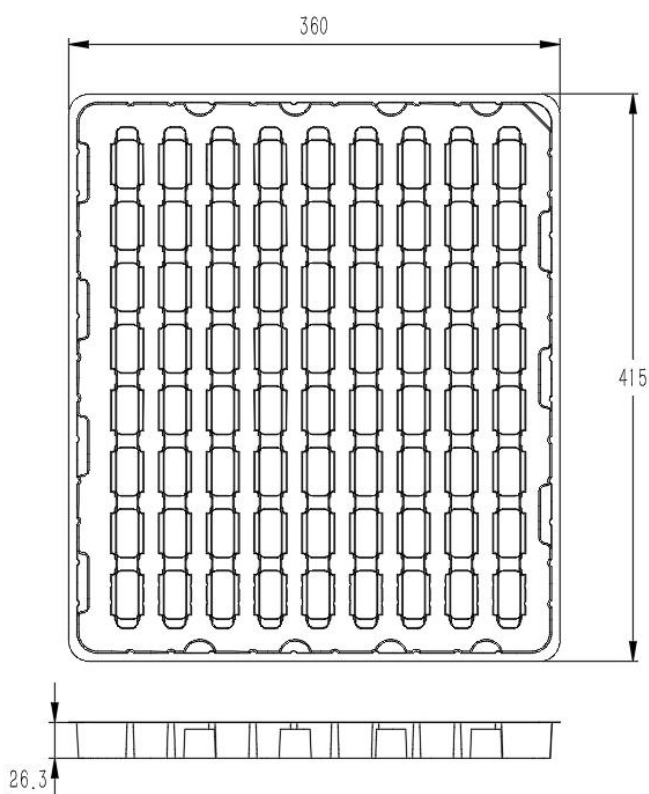
| 包装箱尺寸<br>Carton Size (W*L*H) |        |        | 产品托盘数<br>Tray Qty. | 每托盘产品数<br>Qty. per Tray | 总数<br>Total Qty. | 重量<br>Gross Weight |
|------------------------------|--------|--------|--------------------|-------------------------|------------------|--------------------|
| 415 mm                       | 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