ELEGRP

A2L Refrigerant Sensor Specification

(A01)

Product Name: A2L Refrigerant Sensor (R32/R454B)

Product Model: PES25A0042B

(Part Number: A02301780004 **)**

Customer Confirmation:

Confirmation	Approved by	Date

Revision History:

No.	Version	Revision Date	Description	Modified	Remarks
1	Initial				
2	A01	2025-11-07	English Version	J. Zhan	

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1. Overview

Due to the significant difference in thermal conductivity between refrigerants and air, changes in refrigerant concentration produce measurable variations in the thermal conductivity of the gas mixture. This series of refrigerant leak detection sensors operates on this principle, accurately measuring refrigerant concentration in the air by detecting changes in thermal conductivity. These products are suitable for applications such as refrigerant leak detection and alarm in HVAC systems, as well as portable refrigerant leak detectors, covering common A2L refrigerants including R32 and R454B.

This sensor series incorporates the latest generation of high-performance thermal conductivity sensing chips, featuring high resolution, low noise, and long-term stability. The sensor utilizes a pulsed waveform drive to achieve dynamic balance between the chip temperature and the ambient temperature, significantly enhancing long-term reliability. Integrated humidity and pressure sensors provide automatic compensation for the effects of air humidity and altitude variations on thermal conductivity, ensuring measurement accuracy. With advantages including fast response, high integration, and excellent long-term stability, this product series is well-suited for demanding refrigerant leak monitoring applications.



(Figure 1)

2. Features

- Wide operating temperature and humidity range, suitable for harsh environments with stable and reliable long-term operation.
- Built-in temperature, humidity, and atmospheric pressure compensation effectively eliminates environmental influences for accurate detection.
- High anti-interference capability; insensitive to common contaminant gases, preventing false alarms.
- Patented "heat transfer cavity" structure ensures high sensitivity and excellent measurement repeatability.
- Short warm-up time; enters normal operating state within 5 seconds after power-on.
- Industry-leading response speed and detection concentration range, providing rapid feedback on abnormal conditions.
- Calibration-free and zero-adjustment-free design simplifies maintenance and reduces lifecycle operating costs.
- Compact structure with high protection rating design meets the installation requirements of diverse equipment.
- Dual-in-one design enables accurate detection of R32 and R454B refrigerants.

3. System Operation Description

3.1 Power-On Initialization

Upon power-on, the system initializes all hardware components, functions, and parameters. A 5-second warm-up countdown begins, after which the sensor enters normal operating mode.

3.2 Operating Cycle

During normal operation, the system continuously cycles through the following three states:

- Temperature Conditioning: The thermal conductivity chip temperature is acquired and regulated. Once stable, the system transitions to the Sensor Measurement state.
- Sensor Measurement: Data from the sensor channels is acquired and processed. Upon completion, the system transitions to the Cooling state.
- Cooling: Heating is turned off to allow the chip to cool. After the cooling period ends, the system returns to the Temperature Conditioning state.

These three states repeat continuously, enabling real-time monitoring and data processing.

3.3 Parallel Processing

Sensor communication and the operating cycle run in parallel without interference, ensuring real-time detection results.

4. Product Parameters

4.1 Technical Specifications

No.	Parameter	Specification	Remarks
1	Target Gas	R32/ R454B Compatible	
2	Operating Voltage	DC 5±0.2V	
3	Operating Current	≤22mA	
4	Communication Interface	RS485	
5	Concentration Detection Range	0~100%LFL	
6	Detection Accuracy	±2.5%LFL	Under normal conditions
7	Temperature Accuracy	±0.3℃	
8	Pressure Compensation Range	0.7~1.1 bar	
9	Response Time	≤15s	
10	Default Alarm Threshold	10%LFL	
11	Operating Temperature	-40~+85℃	
12	Operating Humidity	0~100%RH	Max. 40 ℃ dew point
13	Storage Temperature	-40~+80℃	
14	Storage Humidity	0~85%RH	Non-condensing
15	Ingress Protection Rating	IP54	

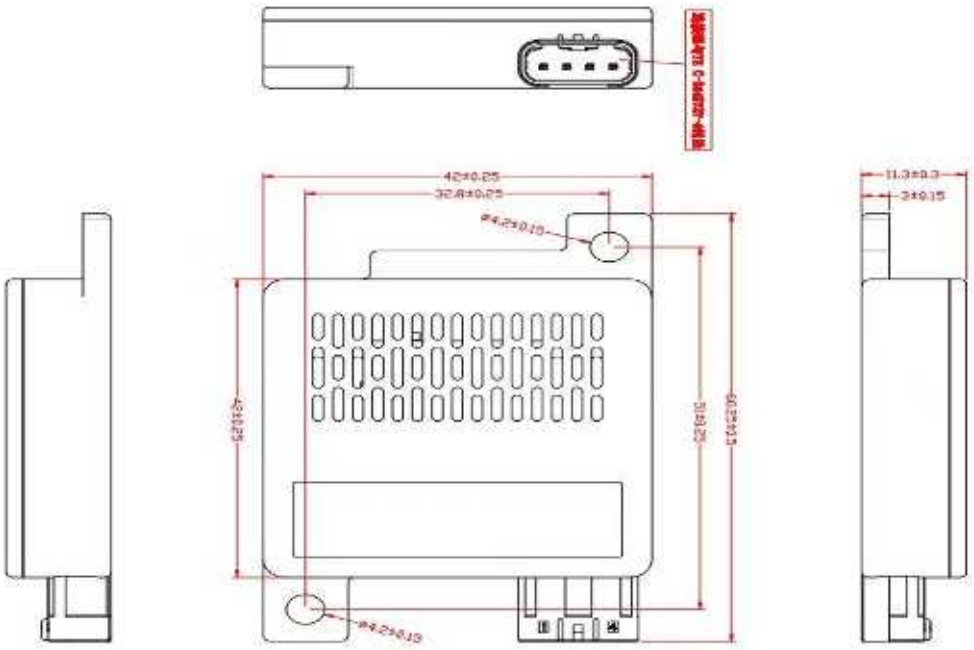
Remarks:

- The sensor must be connected to a compatible system to enable response functionality.
- Unless otherwise specified, sensor parameters are tested in accordance with UL 60335-2-40 Annex LL.2.1 DV.

Important Notes:

- Ensure the input voltage and current comply with the specifications to prevent damage to the device.
- The operating environment must not exceed the specified protection rating.
- The product shall be used within the rated temperature and humidity ranges.
- The product must be used in systems containing the correct target gases.

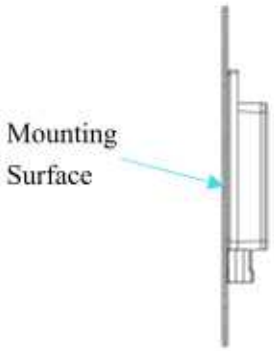
4.2 Product Dimensions



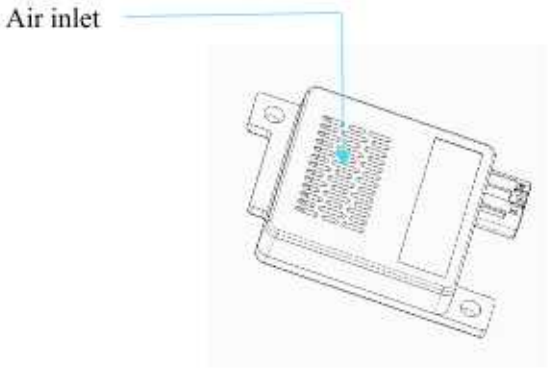
(Figure 2)

Note: Dimensions are in millimeters (mm)

5. Installation Instructions



(Figure 3)



(Figure 4)

Note: Secure the product to the reserved mounting location in the equipment using appropriate fasteners through the mounting holes.

Important Notes:

- The product shall be installed on a vertical surface with the air inlet facing the side where air circulates.
- Avoid installing the product with the air inlet facing upward, as water accumulation or dust settling on the surface may affect product performance.
- The mounting surface must be flat; deformation of the mounting surface may cause damage to the product.
- The waterproof breathable membrane inside the air inlet is a flexible material. Avoid puncturing it with sharp objects.
- The product contains no user-serviceable or replaceable parts. Damaged or malfunctioning units must be replaced entirely by qualified trained personnel.

6. Communication Protocol

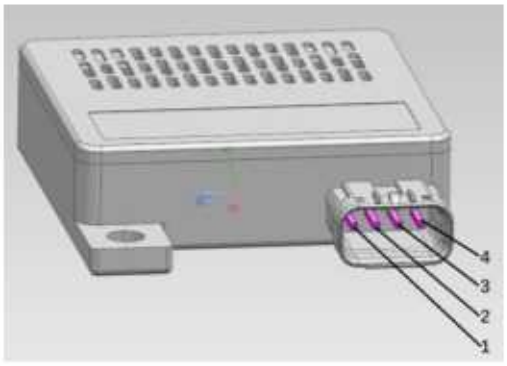
6.1 Terminology

Register: A specific memory unit in the protocol used to store sensor data (such as measurement values, status, and configuration parameters), accessed via read/write operations using addresses.

6.2 Communication Settings

Parameter	Specification
Communication Type	RS485
Baud Rate	2400 bps (default)
Data Format	1 start bit, 8 data bits, no parity, 2 stop bits
Protocol Format	Modbus RTU
Error Check	Modbus CRC, low byte first

6.3 Pin Definition



(Figure 5)

Pin	Definition	Description
1	+5V	Power Supply Input
2	RS485A	Data Comm.
3	RS485B	Data Comm.
4	GND	Power Ground

6.4 Communication Frame Definition

6.4.1 Command Frame Format

IP	CMD	REG_H	REG_L	LEN_H	LEN_L	CRC_L	CRC_H

Description:

Field	Description
IP	Modbus communication address (0x01–0x07, default: 0x01)
CMD	Command type: 0x03 = read register, 0x06 = write register
REG	Starting address of the target consecutive register (high byte first)
LEN	Length of the target consecutive register (high byte first)
CRC	Checksum (low byte first)

6.4.2 Response Frame Format

IP	CMD	LEN_H	LEN_L	REG_H	REG_L	……	CRC_L	CRC_H

Description:

Field	Description
IP	Modbus communication address (0x01–0x07, default: 0x01)
CMD	Command type: 0x03 = read register, 0x06 = write register
LEN	Data length in the response frame (high byte first)
REG	Starting address of the target consecutive register (high byte first)
CRC	Checksum (low byte first)

6.5 Register Table

Reg. Addr.	Access	Description	Definition	Remarks
0x0100	Read-only	Specification Version	uint16	Protocol specification version number
0x0101	Write-only	Device Reset	0: Default 1: Reset	Writing "1" to this register resets the sensor
0x0102	Read/Write	Baud Rate	0x01: 9600 0x02: 4800 0x03: 2400 0x04: 1200 0x05: 19200 0x06: 38400	Default: 0x03 (2400 bps)
0x0110	Read-only	Operating Mode	0: Startup 1: Measurement	No measurement values are available when the sensor is in
0x0111	Read-only	Leak Alarm	0: No leak 1: Leak alarm	Outputs 1 when detected concentration exceeds the alarm
0x0112	Read-only	Error Status	0: No error Else: Error	Error alarm; see Section 6.6 for error code definitions
0x0113	Read-only	Concentration Output	e.g., 25 = 2.5% LFL	Unit: 0.1% LFL
0x0114	Read-only	Temperature Output	e.g., 249 = 24.9 °C	Unit: 0.1 °C
0x0115	Read-only	Humidity Output	e.g., 249 = 24.9%	Unit: 0.1% relative humidity
0x0116	Read-only	Dew Point Output	e.g., 249 = 24.9 °C	Unit: 0.1 °C
0x0120	Read/Write	Device Address	Default: 1	Modbus slave address; range: 1–247; default: 1
0x0124	Read-only	Leak Threshold	Default: 100	Threshold for triggering leak alarm; default 100 = 10% LFL
0x0140	Read-only	Serial Number	YYYY-MM-DD-Serial Code	Unique sensor serial number
0x014A	Read-only	Firmware Version	uint16	Sensor firmware version number
0x014C	Read-only	Gas Type	1: R32 2: R454B 3: Compatible	Refrigerant type detected by the sensor. Default setting = 3 (Compatible).
0x014E	Read-only	Lifetime Usage	uint16	

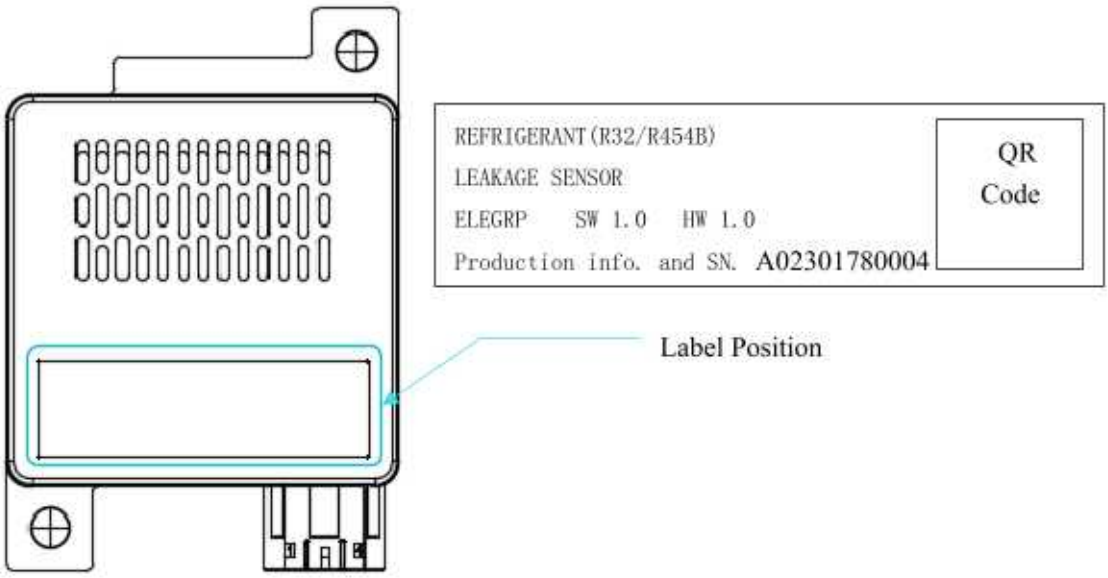
Register Addr.	Access	Description	Definition	Remarks
0x014F	Read-only	Maintenance Status	0: Normal 1: Lifetime warning	Sensor self-diagnosis status indicating whether end of life has been reached
0x0151	Read-only	Operating Time	uint32, unit: 1 second	Operating time since last reset
0x0157	Read-only	Sensor Code	String [20]	20-character ASCII string

6.6 Register 0x0112 Error Code Definition

Bit index	Error Type	Description	Recommended Action
Bit 0	Internal Error	Data unreliable alarm	Wait for recovery; reset sensor or power cycle
Bit 1	Out of Operating Range	Exceeds sensor operating range (e.g., dew point exceeding 40 °C)	Improve sensor operating environment
Bit 2	Self-Test Failure	Operating voltage or internal sensor error alarm	Check operating voltage; attempt sensor reset
Bit 3	Permanent Error	Irrecoverable sensor failure	Replace sensor
Bit 4	End of Life Exceeded	Sensor has exceeded its service life	Replace sensor
Bit 5	Low Voltage Alarm	Operating voltage out of specification	Check power supply voltage
Bit 6	Self-Test Failure	Other abnormalities beyond operating voltage issues	Reset sensor or power cycle
Bit7 ~ Bit15	Undefined	Undefined	Undefined

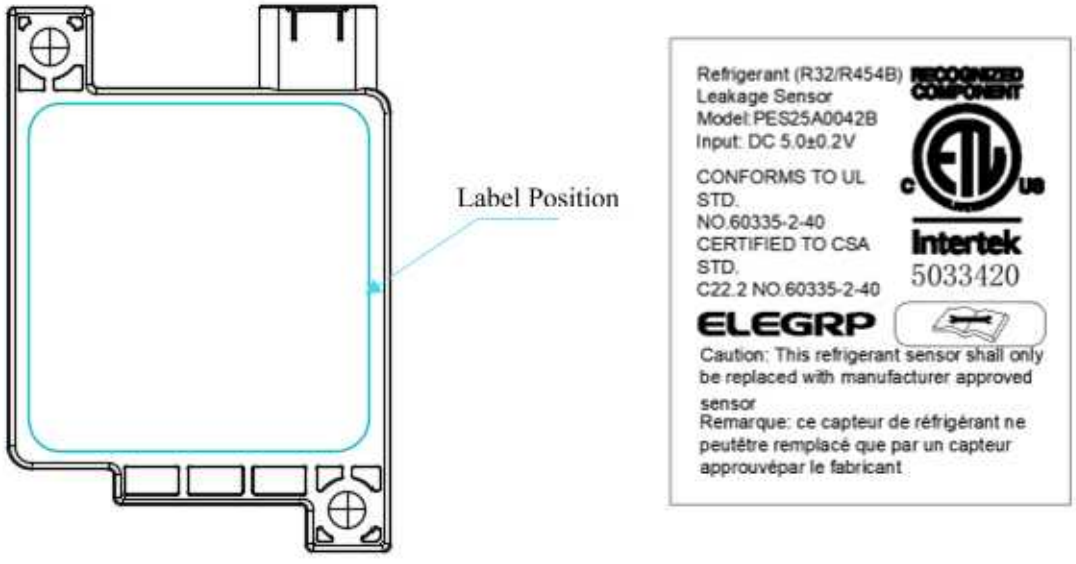
7. Product Label

7.1. Front Label



(Figure 6)

7.2 Back Label



(Figure 7)