1. Introduction

The T3400 refrigerant sensor measures R454B refrigerant concentration in air by measuring the change in thermal conductivity of the gas mixture.

The T3400, refrigerant sensor uses a MEMS thermal conductivity sensing element. It features a “heat transfer cavity” that achieves highly sensitive and repeatable thermal conductivity measurement by eliminating possible occurrences of natural convection inside the cavity. Because thermal conductivity measurements are accomplished completely inside the sensor chip, maximum miniaturization can be realized at the device level. To account for changes in thermal conductivity due to humidity and barometric pressure variations, the T3400 refrigerant sensor incorporates a relative humidity sensor and a barometric pressure sensor for compensation.

Integration of the sensing element with signal conditioning and communication electronic circuits, transducer calibration, and a robust package/enclosure results in a sensor module for use in refrigerant leak detection systems (RDS).

The T3400 refrigerant sensor utilizes RS485 Modbus RTU communications protocol.

2. Electrical Connectivity

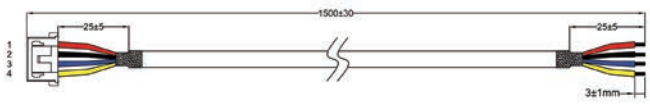
Pin Connections

PIN	Description	Color
1	+5 Vdc	Red
2	Ground	Black
3	B-	Blue
4	A+	Yellow

PIN Identification

Connector/Cable Detail

Connector/Cable Dimensions (mm)



22 AWG wire, UL1007/UL2464; Zuch HP2502J-B-4Y

3. Communication protocol

Interface Setting

a. Initial baud rate is 2400 bps

b. 1 start bit, 8 data bits, 2 stop bits, and no parity

c. Master/slave asynchronous communication, half-duplex mode

d. End-of-frame definition: If the received data exceeds a 1.5-character interval without receiving the next byte, it is considered that the data reception is finished this time

Frame Definition

Definition of the normal communication frame

Data length n is 0-251

Address (1 byte)	Function Code (1 byte)	Data (n bytes)	CRC (2 bytes)

Address

1. When the master sends, the address sent is the target slave address, which is used to instruct the receiver. When all the slaves are required to receive and process the message, it sends its own address 0x00, and all the slaves respond but do not return an answer. Otherwise, it sends a single slave address, which instructs the slave to process the message.
2. When the slave sends, the address sent is its own address, which is used to instruct the answering party.

Function Code

Function Code	Name	Function	Answer Function Code	
			Normal	Abnormal
0x03	Read multiple registers	Read registers	0x03	Function code +0x80
0x06	Write single register	Write single register	0x06	
0x10	Write multiple holding registers	Write multiple holding registers	0x10	

Data Composition

Data composition when the function code is 0x03:

Slave ID	Function Code (0x03)	Register Address		Register Quantity		Crc-16	
		MSB	LSB	MSB	LSB	LSB	MSB
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte

Data composition when the normal response is 0x03:

Slave ID	Function Code 0x03	Data Bytes	Register Data 1		----	
			MSB	LSB	MSB	LSB
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte

Register Data n		Crc-16	
MSB	LSB	LSB	MSB
1 Byte	1 Byte	1 Byte	1 Byte

Data composition when the function code is 0x06:

Slave ID	Function Code (0x06)	Register Address		Data		Crc-16	
		MSB	LSB	MSB	LSB	LSB	MSB
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte

Data composition when 0x06 is answered normally:

Slave ID	Function Code (0x06)	Register Address		Data		Crc-16	
		MSB	LSB	MSB	LSB	LSB	MSB
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte

Data composition when the function code is 0x10:

Slave ID	Function Code (0x10)	Register Address		Register Quantity		Bytes Quantity
		MSB	LSB	MSB	LSB	
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte

Data 1		Data		Crc-16	
MSB	LSB	MSB	LSB	LSB	MSB
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte

Data composition when 0x10 is answered normally:

Slave ID	Function Code (0x10)	Register Address		Register Quantity		Crc-16
		MSB	LSB	MSB	LSB	
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte

Data composition when the function code is an abnormal answer function code:

Slave ID	Function Code (0x90)	Exception Code	Crc-16	
		01 or 02 or 03 or 04	LSB	MSB
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte

Explanation of terms:

1. **Register address:** the starting position of the register to be operated in the table, occupied as 1 word
2. **Register quantity:** the number of registers to be operated, occupied as 1 word
3. **Bytes quantity:** the length of the content of the register to be operated, the unit is 1 Byte, 0x00 for no content
4. **Data content:** the content of all registers corresponding to the operation to be performed
5. **Exception code:** indicates the reason for the exception, see the description in the Exception Code section for details

CRC Checksum

The CRC checksum is 16-bit, calculated by the sending device. The calculation uses polynomial 0XA001, with an initial value of 0xFFFF. The calculation starts from the address code. Only the data bits are calculated, not the start bit, stop bit, or check bit. The receiving device recalculates the CRC value after receiving the message, and compares the calculation result with the received CRC value. If the two values are not equal, it is invalid data.

When the CRC is added to the message, the low byte is added first, then the high byte.

Register Description

Access	Name	Register Address	Number of Registers	Type	Description
R	Register specification version	0x0100	1	[uint8, uint8]	Version of the protocol specification; high byte is major, low byte is minor number
W	Device reset	0x0101	1	bool	The sensor is reset if a “1” is written to this register Range: 0-1

Data query

R	Operating mode	0x0110	1	enum	The operating mode of the device; there are no measurements available during startup 0: Startup 1: Measuring
R	Leak signal	0x0111	1	bool	A flag that turns on when the concentration exceeds the alarm threshold. By default, the leak signal is sustained for 5 minutes after the concentration is again below the leak signal threshold 0: No leak detected 1: Active leak detection or sustained period after leak detection
R	Errors	0x0112	1	uint16	See error table
R	Gas concentration LFL	0x0113	1	int16	The last measured gas concentration in %LFL, multiplied by 10 (example: 251 for 25.1 %LFL) Resolution: 0.1 %LFL Range: 0 %LFL - 100 %LFL (clamped)
R	Sensor temperature	0x0114	1	int16	The last measured sensor temperature in °C, multiplied by 10 (example: 210 for 21°C) Resolution: 0.1°C Range:-40°C - +125°C
R	Sensor humidity	0x0115	1	int16	The last measured sensor humidity in %RH, multiplied by 10 (example: 305 for 30.5 %RH) Resolution: 0.1 %RH Range: 0 %RH – 100 %RH

Settings

R/W	Device address	0x0120	1	uint8	Slave address of the Modbus interface Range: 1-247 (as per Modbus specification) Default: 1 A soft reset or power cycle is required to apply a change of this value
	Leak signal threshold	0x0124	1	uint16	The gas concentration level that triggers the leak signal Resolution: 0.1 %LFL (example: 251 for 25.1 %LFL)

Register Description (cont.)

Device Info

Access	Name	Register Address	Number of Registers	Type	Description
R	Device marking	0x0140	10	String[20]	Reads the device marking. To be set, no default. Represented as 0-paddedstring without 0-termination
R	Firmware version	0x014A	1	uint8[2]	Firmware version Format: High byte: major version Low byte: minor version
R	Gas type	0x014C	1	enum	The gas type the sensor is configured for. 0: R32 1: R454B
R	Lifetime counter	0x14E	1	uint16	The device's elapsed lifetime Resolution: 1 day (example: 365 for 1 year) Range: 0 days - 65535 days (179 years)

Register Definition

Bit index	Error	Description
0	Internal error	Errors that result in untrustworthy measurement data. For example, internal communication errors
1	Value out of limit	The sensor detects is out of the specified T, RH, and concentration limits
3	Self-check failed	Errors resulting from internal check on proper operations, invalid settings, etc.
4	Dead	Any sensor error that is unrecoverable and requires sensor replacement
5	Over lifetime limit	The lifetime limit is reached

Warranty

Warranty - 12 months

Warranty Repairs

Amphenol Sensors will repair a Telaire product that fails to meet the terms provided for in the Return and Warranty Policy Statement (See, http://www.telaire.com).Warranty period shall start from date of manufacture and be based on product category and type of equipment. For all warranty repairs, amphenol sensors will bear all product repair parts, labor, and standard ground shipping charges.

Contact:
www.telaire.com
North America and Asia +1 814 834 9140
Europe +44 1823 335 200