1. Introduction

This document describes the capabilities of the Telaire T9501 Humidity & Temperature Sensor. The communications interface is based on Modbus protocol. There are no analog outputs.

The recommended reading for understanding Modbus is titled:

"MODBUS Application Protocol Specification V1.1b3." This document is available at the Modbus website (www.modbus.org).

This document will detail the Modbus requests available to the user, as well as general operating conditions of the device.

2. First Use

When the device is used for the first time, it will have the following default settings:

- Modbus Address – 0x10
- Baud Rate – 115,200 bits per second
- Parity – Even
- Data Bits – 8
- Stop Bits - 1

Multiple devices on a common bus each need a unique addresses.

3. Measurements

The engineering evaluation units default to the following measurements:

Measurement	Data Range
Relative Humidity	0-100%
Temperature	-20 ˚C to 70 ˚C

4. Modbus Requests & Responses

In the following examples, the default slave address (10) is assumed. For simplicity, the required CRC is not included in the example responses. It is recommended that the user verify the CRC in the response. If the address is changed, the CRC will need to be recalculated.

All Modbus PDU data is in hexadecimal format.

4.1 Input Registers

There are three (3) input registers available - Two (2) give the user access to the measurands. The remaining register give the user access to the firmware version and sensor status.

Input registers start at 5001.

Name	Address	Type	Access
FIRMWARE_REVISION	5001	uint16_t	RO
RELATIVE HUMIDITY	5005	uint16_t	RO
TEMPERATURE	5006	int16_t	RO

Examples are given below.

4.1.1 Firmware Revision – Input Register 5001

The firmware revision is an unsigned integer and therefore can be returned in 1 register.

Request:

Data	Description
0x10	Slave address (default)
0x04	Function code
0x13	Starting address (MSB)
0x89	Starting Address (LSB)
0x00	Quantity of Input Registers (MSB)
0x01	Quantity of Input Registers (LSB)
0xE7	Checksum
0xE5	Checksum

Response:

Data	Description
0x10	Slave address (default)
0x04	Function code
0x02	Byte Count
0x00	Input register (MSB)
0xD1	Input register (LSB)

In this case, the firmware revision was 2.09.

4.1.2 Relative Humidity – Input Register 5005

Relative Humidity (%) is an unsigned integer and therefore can be returned in 1 register.

Request:

Data	Description
0x10	Slave address (default)
0x04	Function code
0x13	Starting address (MSB)
0x8D	Starting Address (LSB)
0x00	Quantity of Input Registers (MSB)
0x01	Quantity of Input Registers (LSB)
0xA6	Checksum
0x24	Checksum

Response:

Data	Description
0x10	Slave address (default)
0x04	Function code
0x02	Byte Count
0x0F	Input register (MSB)
0xD9	Input register (LSB)

In this case, the Relative Humidity was 40.57% (i.e., 0x0FD9).

The calculation is as follows:

x=4057/100

=40.57%

4.1.3 Temperature – Input Register 5006

Temperature (˚C) is a signed integer and therefore can be returned in 1 register.

Request:

Data	Description
0x02	Slave address (default)
0x04	Function code
0x13	Starting address (MSB)
0x8E	Starting Address (LSB)
0x00	Quantity of Input Registers (MSB)
0x01	Quantity of Input Registers (LSB)
0x56	Checksum
0x24	Checksum

Response:

Data	Description
0x02	Slave address (default)
0x04	Function code
0x02	Byte Count
0x08	Input register #1(MSB)
0x81	Input register #1 (LSB)

In this case, the temperature returned was 21.77˚C.

The calculation is as follows:

x=2177/100

=21.77

4.2 Holding Registers

There are four (4) holding registers available. Generally, they allow the user to change the operating parameters of the device. Only three (3) will be detailed here. If not set properly, CONFIG_FLAG will render the device inoperable. Please consult the factory for more information on this register.

The remaining registers allow the user to change the slave address, baud rate and parity. The changes will not take effect until the device is power cycled.

Name	Address	Type	Access
CONFIG_FLAG	4004	uint16_t	RW
SLAVE_ADDRESS	4005	uint16_t	RW
BAUD_RATE	4006	uint16_t	RW
PARITY	4009	uint16_t	RW

The following Modbus functions for manipulating the Holding Registers are supported:

- Read Holding Registers:
  MODBUS Function Code 03 (0x03)
- Write Single Register:
  MODBUS Function Code 06 (0x06)
- Write Multiple Registers:
  MODBUS Function Code 16 (0x10)

See following examples.

4.2.1 Slave Address – Holding Register 4005

If the slave address hasn't been changed, a read of the Modbus register will return 0x10, which is the default slave address.

If the user wishes to change the slave address, then writing an allowable value (1-247) to this register will update the slave address on the next power cycle.

Reading the slave address.

Request:

Data	Description
0x10	Slave address (default)
0x03	Function code – Read Holding Register
0x0F	Starting address (MSB)
0xA5	Starting Address (LSB)
0x00	Quantity of Registers (MSB)
0x01	Quantity of Registers (LSB)
0x94	Checksum
0x7C	Checksum

Response:

Data	Description
0x10	Slave address (default)
0x03	Function code
0x02	Byte Count
0x00	Input register (MSB)
0x10	Input register (LSB)

In this case, the slave address is 0x10 (default).

Writing the slave address. Only the Write Single Register Modbus Function is detailed.

Request:

Data	Description
0x10	Slave address (default)
0x06	Function code – Write Single Register
0x0F	Register address (MSB)
0xA5	Register Address (LSB)
0x00	Register Value (MSB)
0x20	Register Value (LSB)
0x98	Checksum
0x64	Checksum

Response:

If no error occurs, the response is the same as the request.

In this case, the slave address will be 0x20 the next time the device is powered cycled.

4.2.2 Baud Rate - Holding Register 4006

If the baud rate hasn't been changed a read of the Modbus register will return 0x05 indicating the default setting of 115,200 baud.

There are only 5 selectable baud rates, which are:

- 1 - 9600
- 2 - 19200
- 3 - 38400
- 4 - 57600
- 5 - 115200 (default)

To change the baud rate, the user must write the value (1 through 5) to the holding register. The new rate will take effect on the next power cycle.

Examples below show the Modbus PDU. Note that the PDU only includes the function code and the function data. It does not include the address field or the trailing CRC bytes.

To change the baud, send the following PDU (shown in hexadecimal):

Baud	PDU
9600	0x06, 0x0F, 0xA6, 0x00, 0x01
19200	0x06, 0x0F, 0xA6, 0x00, 0x02
38400	0x06, 0x0F, 0xA6, 0x00, 0x03
57600	0x06, 0x0F, 0xA6, 0x00, 0x04
115200	0x06, 0x0F, 0xA6, 0x00, 0x05

4.2.3 Parity – Holding Register 4009

If the parity hasn't been changed, a read of the Modbus register will return 0x02, the default parity is even.

The following parity bits are available:

- Even - 1 start bit, 8 data bits, 1 parity bit, 1 stop bit
- Odd - 1 start bit, 8 data bits, 1 parity bit, 1 stop bit
- None - 1 start bit, 8 data bits, 2 stop bits

Even parity is selected by writing '2'. Odd parity by writing '1'. No parity is selected by writing '0' to the register. The default value is even.

The change takes effect after the device is power cycled.

The following examples show the Modbus PDU. Note: that the PDU only includes the function code and function data. It does not include the address field or the trailing CRC bytes.

4.2.3 Parity – Holding Register 4009 (Cont.)

To change the parity, send the following PDU (shown in hexadecimal):

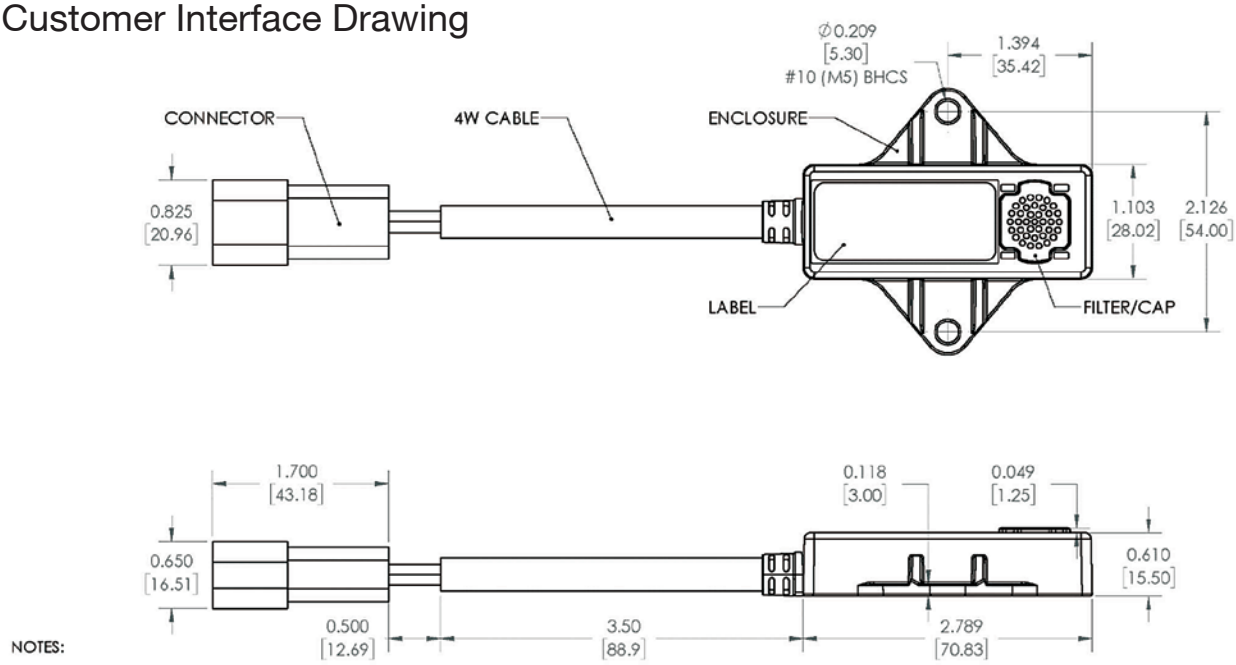
Parity	PDU
Even	0x06, 0x0F, 0xA9, 0x00, 0x02
Odd	0x06, 0x0F, 0xA9, 0x00, 0x01
None	0x06, 0x0F, 0xA9, 0x00, 0x00

5. Hardware Reference

Sensor Pinout

1. V+
2. Ground
3. RS485 A+
4. RS485 B-

Customer Interface Drawing



Warranty / Other

Warranty

12 months

This product is covered by one or more of the following patents:
5,650,624 / 5,721,430 / 5,444,249 / 5,747,808 / 5,834,777 /

5,163,332 / 5,340,986 / 5,502,308 / 6,344,798 / 6,023,069 /

5,370,114 / 5,601,079 / 5,691,704 / 5,767,776 / 5,966,077 /

6,107,925 / 5,798,700 / 5,945,924 / 5,592,147 / 6,255,653 /

6,250,133 / 6,285,290

Warranty Repairs

Amphenol Advanced 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 as specified in Table 1: Product Warranty Periods. For all warranty repairs, Amphenol Advanced Sensors will bear all product repair parts, labor, and standard ground shipping charges.

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