
ModBus RTU communication protocol for THT sensors

Complete protocol description



MODBUS RTU for THT

Datasheet

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DESCRIPTION

This document describes ModBus RTU communication protocol embedded into an intelligent sensor for temperature and humidity, THT. Datasheet and manual can be both downloaded from <http://www.papouch.com/> in PDF format.

Basic communication parameters

| | |
|------------------------------------|--|
| Communication line..... | RS485 |
| Communication speed | from 1.2 kBd to 115.2 kBd (default: 9.6 kBd) |
| Data bits..... | 8 |
| Parity..... | no parity |
| Stop bits | 1 |
| Delay before response is sent..... | 2 ms ¹ |
| Default address..... | 0x31 |
| Default protocol..... | Spinel |

Firmware change log

Version 04

ModBus RTU protocol added. THT is capable of communication via one protocol at once. Active protocol can be set by special instruction described below. (Default protocol is Spinel described in other document.)

¹ Delay is added in order to allow the device to switch the direction of RS485 communication.

SWITCHING THE PROTOCOLS

Default communication protocol is Spinel. For switching the protocol to ModBus RTU, following Spinel instruction must be sent to the device.

Spinel → ModBus RTU

Allow configuration

This instruction allows service instructions. It has to forego the switching instruction.

Instruction cannot be used with universal or broadcast address.

Request:

Instruction code: E4H

Response:

Acknowledge code: ACK 00H

Examples:

| |
|---|
| Request: |
| 2AH, 61H, 00H, 05H, 01H, 02H, E4H, 88H, 0DH |
| Allow configuration. |
| Response: |
| 2AH, 61H, 00H, 05H, 01H, 02H, 00H, 6CH, 0DH |
| Instruction acknowledged. |

Switching

Switching the protocol is executed by special Spinel 97 instruction. Address of a specific module has to be used (the instruction cannot be used with universal or broadcast address.) Allow configuration instruction must forego this instruction.

Request:

Instruction code: EDH

Response:

Acknowledge code: ACK 00H

Examples:

| |
|---|
| Request: |
| 2AH, 61H, 00H, 06H, 66H, 02H, EDH, 02H, 17H, 0DH |
| Switching instruction: Spinel to ModBus RTU. |
| Response: |
| 2AH, 61H, 00H, 05H, 66H, 02H, 00H, 07H, 0DH |
| Instruction acknowledged. From this point on THT communicates via ModBus RTU. |

MODBUS RTU → Spinel

The way to switch is documented on page 10 of this document.

MEMORY LAYOUT

Holding Register

| Address | Access | Function | Designation | Page |
|---------------------------------|-------------|------------------|------------------------|------|
| Communication parameters | | | | |
| 0x0000 | read, write | 0x03, 0x06, 0x10 | Allow configuration | 5 |
| 0x0001 | read, write | 0x03, 0x06, 0x10 | Address (ID) | 7 |
| 0x0002 | read, write | 0x03, 0x06, 0x10 | Communication speed | 8 |
| 0x0003 | read, write | 0x03, 0x06, 0x10 | Data word | 9 |
| 0x0004 | read, write | 0x03, 0x06, 0x10 | Packet end distinction | 9 |
| 0x0005 | read, write | 0x03, 0x06, 0x10 | Communication protocol | 10 |

Input Register

| Address | Access | Function | Designation | Page |
|---|--------|----------|--|------|
| Values and states of channels – ordered by number of channel | | | | |
| 0x0000 | read | 0x04 | Temperature – Status | 12 |
| 0x0001 | read | 0x04 | Temperature – Signed integer value | 12 |
| 0x0002 | read | 0x04 | Temperature – Float value (3. and 2. byte) | 13 |
| 0x0003 | read | 0x04 | Temperature – Float value (1. and 0. byte) | 13 |
| 0x0004 | read | 0x04 | Humidity – Status | 12 |
| 0x0005 | read | 0x04 | Humidity – Signed integer value | 12 |
| 0x0006 | read | 0x04 | Humidity – Float value (3. and 2. byte) | 13 |
| 0x0007 | read | 0x04 | Humidity – Float value (1. and 0. byte) | 13 |
| 0x0008 | read | 0x04 | Dew point – Status | 12 |
| 0x0009 | read | 0x04 | Dew point – Signed integer value | 12 |
| 0x000A | read | 0x04 | Dew point – Float value (3. and 2. byte) | 13 |
| 0x000B | read | 0x04 | Dew point – Float value (1. and 0. byte) | 13 |
| Values and states of channels – ordered by type | | | | |
| 0x001D | read | 0x04 | Temperature – Status | 12 |
| 0x001E | read | 0x04 | Humidity – Status | 12 |
| 0x001F | read | 0x04 | Dew point – Status | 12 |
| 0x0020 | read | 0x04 | Temperature – Signed integer value | 12 |
| 0x0021 | read | 0x04 | Humidity – Signed integer value | 12 |
| 0x0022 | read | 0x04 | Dew point – Signed integer value | 12 |
| 0x0023 | read | 0x04 | Temperature – Float value (3. and 2. byte) | 13 |
| 0x0024 | read | 0x04 | Temperature – Float value (1. and 0. byte) | 13 |
| 0x0025 | read | 0x04 | Humidity – Float value (3. and 2. byte) | 13 |
| 0x0026 | read | 0x04 | Humidity – Float value (1. and 0. byte) | 13 |
| 0x0027 | read | 0x04 | Dew point – Float value (3. and 2. byte) | 13 |
| 0x0028 | read | 0x04 | Dew point – Float value (1. and 0. byte) | 13 |
| 0x0029 | read | 0x04 | Temperature – RAW value | 13 |
| 0x002A | read | 0x04 | Humidity – RAW value | 13 |

DETAILED INFORMATION ABOUT INSTRUCTIONS

Communication parameters

Allow configuration

This instruction has to forego all instructions that write into the holding register. It is in place to protect the device against unwanted changes in configuration.

Allow Configuration has to forego every configuration instruction. It is not allowed to write by Multiple write Allow configuration and other parameters.

Function codes:

0x03 – Read Holding register

0x06 – Write Single Register

0x10 – Write Multiple registers

Memory position and length:

| | | |
|------------------|---------|--------|
| Starting Address | 2 Bytes | 0x0000 |
| Register count | 2 Bytes | 1 |

Parameters:

| | | |
|-----------------|--------|---------------------------------------|
| Number of bytes | 1 Byte | 2 |
| Result | 2 Byte | 0x00FF = allow configuration accepted |

Device's address

It is the address (ID) of the device. There have to be devices with unique addresses on the same communication bus. The address explicitly identifies the device on bus. Default address is 0x31.

Function codes:

0x03 – Read Holding register

0x06 – Write Single Register

0x10 – Write Multiple registers

Memory position and length:

| | | |
|------------------|---------|--------|
| Starting address | 2 Bytes | 0x0001 |
| Register count | 2 Bytes | 1 |

Parameters:

| | | |
|-----------------|--------|-------------------------------------|
| Number of bytes | 1 Byte | 2 |
| Address | 2 Byte | Address of the device from 1 to 247 |

Serial line communication speed

Configures the speed of RS485 line.

Function codes:

0x03 – Read Holding register

0x06 – Write Single Register

0x10 – Write Multiple registers

Memory position and length:

| | | |
|------------------|---------|--------|
| Starting address | 2 Bytes | 0x0002 |
| Register count | 2 Bytes | 1 |

Parameters:

| | | |
|-----------------|--------|--|
| Number of bytes | 1 Byte | 2 |
| Speed code | 2 Byte | Speed code: 1200 - 0003H 2400 - 0004H 4800 - 0005H 9600 - 0006H (<i>default settings</i>) 19200 - 0007H 38400 - 0008H 57600 - 0009H 115200 - 000AH |

Data word format

This instruction configures parameters of the data word (parity, data bits and stop bits).

Function codes:

- 0x03 – Read Holding register
- 0x06 – Write Single Register
- 0x10 – Write Multiple registers

Memory position and length:

| | | |
|------------------|---------|--------|
| Starting address | 2 Bytes | 0x0003 |
| Register count | 2 Bytes | 1 |

Parameters:

| | | |
|-----------------|--------|---|
| Number of bytes | 1 Byte | 2 |
| Speed code | 2 Byte | Code according to the table below. (Default is 0x0000.) |

| Code | Data bits | Parity | Stop bits |
|------------------|-----------|----------|-----------|
| 0x0000 (default) | 8 | none (N) | 1 |
| 0x0001 | 8 | even (E) | 1 |
| 0x0002 | 8 | odd (O) | 1 |
| 0x0003 | 8 | none (N) | 2 |
| 0x0004 | 8 | even (E) | 2 |
| 0x0005 | 8 | odd (O) | 2 |
| 0x0006 to 0x00FF | 8 | none (N) | 1 |

Packet end distinction

Configures what delay between bytes is considered an end of the packet. Delay is entered as bytes count. You can enter 4 to 100 bytes. Default value is 10.

Function codes:

- 0x03 – Read Holding register
- 0x06 – Write Single Register
- 0x10 – Write Multiple registers

Memory position and length:

| | | |
|------------------|---------|--------|
| Starting address | 2 Bytes | 0x0004 |
| Register count | 2 Bytes | 1 |

Parameters:

| | | |
|-----------------|--------|---|
| Number of bytes | 1 Byte | 2 |
| Delay | 2 Byte | Delay as a bytes count. You can enter 4 to 100 bytes. |

Communication protocol

This instruction allows THT to be switched to Spinel protocol. After sending the response, THT switches to Spinel protocol and communicates with it from this point on.

Function codes:

0x03 – Read Holding register

0x06 – Write Single Register

0x10 – Write Multiple registers

Memory position and length:

| | | |
|------------------|---------|--------|
| Starting address | 2 Bytes | 0x0005 |
| Register count | 2 Bytes | 1 |

Parameters:

| | | |
|-----------------|--------|--|
| Number of bytes | 1 Byte | 2 |
| Protocol code | 2 Byte | Protocol code: Spinel - 0001H MODBUS RTU - 0002H |

Quantities

Values and current states of channels

This is how you read measured-out values from THT. Returns values as an integer and also recalculated as a decimal number (32bit float according to IEEE 754).

Values are sent in two formats at once. As a signed integer (16bit value) multiplied by a factor of ten (i.e. temperature 24.6°C is sent as 256). Or as a recalculated decimal number in 32bit float format according to IEEE 754².

In this area values are ordered by channels in the memory. In following areas they are ordered by type.

Function codes:

0x04 – Read Input register

Memory position and length:

| | | |
|------------------|---------|--|
| Starting address | 2 Bytes | Temperature: 0x0000 Humidity: 0x0004 Dew point: 0x0008 |
| Register count | 2 Bytes | 3 |

Parameters:

| | | |
|-----------------|--------|---|
| Number of bytes | 1 Byte | 8 |
| Status | 2 Byte | 0x0000 – value is valid and within range 0x0001 – value not yet available 0x0002 – upper limit exceeded Other values – other error |
| Value INT | 2 Byte | Measured-out value. Signed integer. |
| Float value | 4 Byte | Measured-out value. 32 bit float according to IEEE 754 |

² Description of IEEE 754 standard is available here: http://en.wikipedia.org/wiki/IEEE_754

Channels' states

This way all states of all quantities in THT can be read.

Function codes:

0x04 – Read Input register

Memory position and length:

| | | |
|------------------|---------|--|
| Starting address | 2 Bytes | Temperature: 0x001D Humidity: 0x001E Dew point: 0x001F |
| Register count | 2 Bytes | 3 |

Parameters:

| | | |
|-----------------|--------|---|
| Number of bytes | 1 Byte | 2 |
| Status | 2 Byte | 0x0000 – value is valid and within range 0x0001 – value not yet available 0x0002 – upper limit exceeded Other values – other error |

Measured-out value – signed integer

All values can be read from THT at once, in this case as signed integer (16bit value) multiplied by a factor of ten (i.e. temperature 24.6°C is sent as 256).

Function codes:

0x04 – Read Input register

Memory position and length:

| | | |
|------------------|---------|--|
| Starting address | 2 Bytes | Temperature: 0x0020 Humidity: 0x0021 Dew point: 0x0022 |
| Register count | 2 Bytes | 3 |

Parameters:

| | | |
|-----------------|--------|--------------------------------------|
| Number of bytes | 1 Byte | 2 |
| Value INT | 2 Byte | Measured-out value as signed integer |

Measured-out value – decimal number

All values can be read from THT as 32 bit float numbers according to IEEE 754.

Function codes:

0x04 – Read Input register

Memory position and length:

| | | |
|------------------|---------|--|
| Starting address | 2 Bytes | Temperature: 0x0023 Humidity: 0x0025 Dew point: 0x0027 |
| Register count | 2 Bytes | 6 |

Parameters:

| | | |
|-----------------|--------|---|
| Number of bytes | 1 Byte | 4 |
| Float value | 4 Byte | According to value. 32 bit float according to IEEE 754. |

Measured-out value – RAW value from ADC

You can also get all values directly from internal A/D converter without any conversion. Values are 16bit numbers directly from A/D converter. (RAW value of the dew point is not available as it is calculated from temperature and humidity.)

Function codes:

0x04 – Read Input register

Memory position and length:

| | | |
|------------------|---------|---|
| Starting address | 2 Bytes | Temperature: 0x0029 Humidity: 0x002A |
| Register count | 2 Bytes | 2 |

Parameters:

| | | |
|-----------------|--------|--|
| Number of bytes | 1 Byte | 2 |
| Float value | 2 Byte | Measured-out 16bit value from A/D converter. |

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