Communication Protocol MODBUS RTU used in TDS displays

Full protocol description

TDS: Modbus RTU

Datasheet

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CONTENT

DESCRIPTION

This document describes **MODBUS RTU communication protocol in TDS**[1] **and TDS57**[2] **displays. Hardware documentation for the displays and a description of their functions is available at** <u>en.papouch.com</u> **(detailed documentation can also be downloaded in PDF format).**

Basic communication parameters

Communication line..................................RS485

Communication speed.............................ranging 1.2 kBd to 115.2 kBd (*default: 9.6 kBd*)

Number of data bits................................8

Parity..no parity

Number of stop-bits...............................1

Delay before response...........................2 ms[3]

Starting address.....................................0x31

Default protocol set by manufacturer…….Spinel

Display configuration note: Main communication protocol of device is Spinel. Developing applications with this protocol is easy using <u>Spinel terminal</u>, <u>.NET SDK Spinel.NET on Githubu</u> and <u>online Spinel parser</u>. Spinel is factory set as the default communication protocol. Spinel is also used for all device configurations. Not all configuration options are available in Modbus RTU protocol as in Spinel (e.g. configuring the automatic display method or setting the indicator lights for a certain time). When using Modbus RTU communication protocol, it is recommended to first configure with Spinel or configuration software and then switch to Modbus RTU protocol.

List of changes by individual versions of firmware

version 02

MODBUS RTU protocol added. TDS is only able to communicate via one protocol at a time. Switching between the protocols is possible using a function described below. (The default protocol, set by the manufacturer, is Spinel. Its description can be found in a separate document.)

version 06

Modbus registers extension. This version can only be loaded into hardware version number 3.

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[1] Ordering code *TDS* (segment height 10 mm).

[2] Ordering code TDS_57_RS (segment height 57 mm, in plastic installation box).

[3] The delay has been incorporated to enable RS485 to switch the direction of communication.

MODBUS RTU COMMUNICATION PROTOCOL

For the initial device setup, we recommend using configuration software that can be downloaded from the device's website at papouch.com.

For general configuration of basic parameters of Modbus RTU protocol, we recommend using for example software ModbusConfigurator.

Instructions list

Depending on register type, device allows you to access its memory with following instructions:

- 0x03.............read holding registers

- 0x04.............read input registers

- 0x06.............write one holding register

- 0x10.............write multiple holding registers

- 0x11.............device identification

Device identification

Reading device identification string (Report slave ID).

Function codes:

0x11 – Report slave ID

Parametry:

Byte count	1 Byte	by string
ID	1 Byte	ID is same as device address
RI	1 Byte	Run Indicator – always 0xFF (enabled)
Data	N Byte	Same string as in Spinel protocol. For example: *TDS57; v0673.01.02; f66 97; rtc*

Holding Register

Device configuration, pulse counters and analogue outputs.

Address	Access	Function	Description
0 [4]	write	0x06	**Enable configuration** Writing value 0x00FF to this memory location must precede all instructions that write to the Holding Register at addresses 0 to 15. It is used to protect against unwanted configuration changes. It is not allowed to write Enable Configuration using Multiply write at the same time with any other parameters.

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[4] First register with address 0 is sometimes also referred as serial number 1. Similarly with next registers.

Address	Access	Function	Description
1	read, write	0x03, 0x06, 0x10	**Address (ID)[5]** Unique Device address in Modbus protocol. A number in range 1 to 247 is expected. *Default address is 0x0031.*
2	read, write	0x03, 0x06, 0x10	**Communication speed[5]** Speeds and their corresponding codes: 1 200 Bd..........0x0003 2 400 Bd..........0x0004 4 800 Bd..........0x0005 *9 600 Bd..........0x0006 (default)* 19 200 Bd..........0x0007 38 400 Bd..........0x0008 57 600 Bd..........0x0009 115 200 Bd..........0x000A
3	read, write	0x03, 0x06, 0x10	**Data word[5]** Data word is always 8-bit. | Value	Parita	Stop bits
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0x0000 (default)	*None*	*1*
0x0001	Even	1
0x0002	Odd	1
0x0003	None	2
0x0004	Even	2
0x0005	Odd	2
0x0006 to 0x00FF	None	1	
4	read, write	0x03, 0x06, 0x10	**Packeting[5]** Configures what delay between bytes will be considered as end of packet. Delay is specified in number of bytes. You can specify a value from 4 to 100. *Default value is 10.*
5	read, write	0x03, 0x06, 0x10	**Communication protocol[5]** Switches device to communication by another protocol. After sending a response, device switches to selected protocol and continues to communicate only with it. • Code for Spinel: *0x0001 (default)* • Code for Modbus RTU: *0x0002*
10 – 12	write	0x06, 0x10	**Setting address by serial number[5]** • reg. 10 – new address • reg. 11 – product type number • reg. 12 – part number Serial number is on label in format 0673/0001, where 0673 is product number and 0001 is piece number.

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[5] Writing to this memory location must be preceded by writing the value 0x00FF to address 0 (*Enable Configuration*). This is to protect against unwanted configuration changes. It is not allowed to write *Enable Configuration* using Multiply write at same time with another parameters.

Address	Access	Function	Description
100 101 102 103 104 105 106 107 108 109	read, write	0x03, 0x06, 0x10	**Displaying text** ASCII characters in the ranges 0 to 9, a to z, space, – and . . Characters are displayed in order of insertion. If a period is not displayed, send any other allowed character as the 5th character. For displays with colon: • If you wish to display a colon, send it as the last, fifth character. For example, the value 14:30 must be sent as following string: 1430: • You cannot display a colon and any of the dots at the same time. *Characters table:* ……0 to 9 ……a to j ……k to u ……a to z ……dash
113	read, write	0x03, 0x06, 0x10	**Displaying the number (integer)** A number in the range 0 to 9999.
114	read, write	0x03, 0x06, 0x10	**Control of colon and additional segments** Lower byte from this memory position allows to control individual additional segments of the display. Bits which is 1, means the lighted segment.[6]
115	read, write	0x03, 0x06, 0x10	**Character control – 1st character from left** Lower byte from this memory position allows to control individual segments of character. Bits which is 1, means the lighted segment. Lowest bit (LSb) is the a segment, and the highest bit is the decimal point.
116	read, write	0x03, 0x06, 0x10	**Character control – 2st character from left**
117	read, write	0x03, 0x06, 0x10	**Character control – 3st character from left**
118	read, write	0x03, 0x06, 0x10	**Character control – 4st character from left**
119 120	read, write	0x03, 0x10	**NTP time[7]** Current device time in NTP format. (If no real-time circuit is installed, device responds with an error code.)

[6] On displays without a colon, the settings of bits controlling colon are not affected.

[7] Implemented only in TDS-57.

Address	Access	Function	Description
110	read, write	0x03, 0x06, 0x10	**Brightness** Display brightness has several levels, depending on display type. • *TDS:* 0 to 4, 0 = off, 4 = max. brightness, default is 3 • *TDS-57:* 0 to 36, 0 = off, 36 = max. bright., default is 25
111	read, write	0x03, 0x10	**Time validity of displayed value** Display validity time in seconds. After this time, it displays four dashes (- - - - -). Entered time is valid not only for the currently displayed data, but also for the next data sent. To cancel this function, enter the number 0 here. (This function is suitable for periodically updating a displayed data. If dashes are displayed, the operator will know that the data is not being refreshed.) TDS-57: Depending on the setting of the date and time instructions, after period expired, TDS-57 can automatically display time and/or date.
112	read, write	0x03, 0x10	**Remaining display time** The time in seconds remaining until the display is ended. (You can also write, but we recommend using the previous option.)
121	read, write	0x03, 0x10	**Automatic brightness** [8] 0 = Automatic brightness control is off 1 = display brightness is controlled automatically according to ambient light
122	read, write	0x03, 0x10	**Automatic brightness – minimum** [8] Minimum brightness that can be set automatically. A number between 6 and 36 is expected.
123	read, write	0x03, 0x10	**Automatic brightness – maximum** [8] Maximum brightness that can be set automatically. A number between 6 and 36 is expected.
124	read, write	0x03, 0x10	**Automatic brightness – correction** [8] By entering a value from 0 to 100 (in percent), it is possible to adjust the value from light sensor. A value 0 means no correction.

Input Register

Reading value from temperature sensor, if connected.

Address	Access	Function	Description
0 [4]	read	0x04	**Temperature from external sensor** [7] Integer in signed int format. If thermometer is not connected, the device responds with an error code. Example: Value 30.6 °C represented as 306.

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[8] Automatic brightness control is only available on TDS-57 displays that have a light sensor above the colon.

SWITCHING BETWEEN PROTOCOLS

The default protocol set by the manufacturer is Spinel. For switching into MODBUS, use the following instructions in the Spinel protocol.

Spinel → MODBUS RTU

Configuration Permission

Enables to carry out a service instruction. This instruction must immediately precede the instruction for "Switchover.

This instruction may not be used with a universal or broadcast address.

Request:

Instruction code: E4H

Response:

Acknowledgement code: ACK 00H

Examples:

Request:
2AH,61H,00H,05H,01H,02H,E4H,88H,0DH
Configuration permission.
Response:
2AH,61H,00H,05H,01H,02H,00H,6CH,0DH
Instruction receipt acknowledged.

Switchover

The protocol can be switched over by a special instruction of the Spinel protocol, format 97. Only the address of a particular module can be used here (it is not possible to use a so called "broadcast" or universal address). This instruction must be intermediately preceded by the "Configuration Permission" instruction.

Request:

Instruction code: EDH

Response:

Acknowledgement code: ACK 00H

Examples:

Request:
2AH,61H,00H,06H,66H,02H,EDH,02H,17H,0DH
Instruction to switch from Spinel to MODBUS RTU.
Response:
2AH,61H,00H,05H,66H,02H,00H,07H,0DH
Instruction receipt acknowledged. After sending this response THT communicates via MODBUS RTU.

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