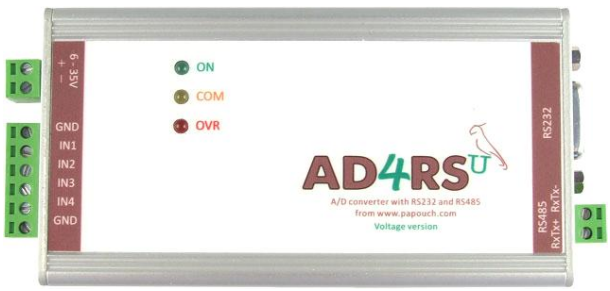
Communication protocol MODBUS RTU used in AD4RS, AD4USB and Drak 4

Comprehensive protocol description



MODBUS RTU

Datasheet

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CONTENT

DESCRIPTION

This document describes MODBUS RTU communication protocol used in measuring converters AD4RS and AD4USB and in the table measuring device Drak 4. The documentation of the hardware of the converters and the description of their functionality are available on the web site http://www.papouch.com/ (detailed documentation also downloadable in the PDF format).

Basic communication parameters

AD4RS

Communication line..... RS232 and RS485

Communication speed ..... ranging from 1.2 kBd to 115.2 kBd (default: 9,6 kBd)

Number of data bits..... 8

Parity..... no parity

Number of stop-bits..... 1

Starting address.....0x31

AD4USB

Communication line..... USB version 1.1 (USB 2.0 and 3.0 compatible)

Communication speed ..... 115 200 Bd (fixed)

Number of data bits..... 8

Parity..... no parity

Number of stop-bits..... 1

Starting address.....0x31

AD4ETH

It is not possible to switch AD4ETH to MODBUS RTU. In the family of MODBUS protocols, AD4ETH is able to use MODBUS TCP.

Drak 4

Communication line..... USB version 1.1 (USB 2.0 and 3.0 compatible)

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

Number of data bits..... 8

Parity..... no parity

Number of stop-bits..... 1

Starting address.....0x31

LIST OF CHANGES

AD4RS and AD4USB

version 05

Protocol MODBUS RTU added. It is only possible to switch AD4RS or AD4USB to MODBUS RTU protocol using a special instruction described below.

version 04

Changes only in the Spinel protocol.

version 03

Drak3 protocol added. Switching between the protocols is described in a separate document downloadable from the web page of AD4 modules.

Drak 4

version 01

First version.

MEMORY ORGANIZATION

Holding Register

Address	*Access*	*Function*	*Name*	*Page*
Communication parameters				
0x0000	read, write	0x03, 0x10	Permission for configuration	7
0x0001	read, write	0x03, 0x10	Address (ID)	7
0x0002	read, write	0x03, 0x10	Communication speed	8
0x0004	read, write	0x03, 0x10	Packet end distinction	8
0x0005	read, write	0x03, 0x10	Communication protocol	9

Input Register

Address	*Access*	*Function*	*Name*	*Page*
Values and states of individual channels				
0x0000	read	0x03	Channel 1	10
0x0004	read	0x03	Channel 2	10
0x0008	read	0x03	Channel 3	10
0x000C	read	0x03	Channel 4	10
Values from channels sorted by the significance				
0x001E	read	0x03	Channels states	11
0x0022	read	0x03	Values as integers	11
0x0026	read	0x03	Values as float value	12
0x002E	read	0x03	Net values from the internal converter	12
Inputs and outputs[1]				
0x0000	read	0x02	Input states reading	13
0x0000	read	0x01	Output states reading	14
0x0000	read	0x05, 0x0F	Output setup	15

[1] Registers from this part are only available in the Drak 4 measuring device.

DETAILED INFORMATION ON INSTRUCTIONS

Communication parameters

Configuration permission

This instruction has to precede *any* configuration instruction. It is not allowed to write the Configuration permission for together with other parameters using Multiply write.

Function codes:

0x03 – Read Holding 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 Bytes	0x00FF = configuration permission accepted

Address of the device

Address (ID) of the device. Devices connected to one communication interface must hold unique addresses. The address unambiguously identifies the device within the network. The default address is 0x31.

Function codes:

0x03 – Read Holding 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 Bytes	Device address within the range 1 to 247

Serial line communication speed

To configure the speed of the communication line.

Function codes:

0x03 – Read Holding 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 Bytes	Speed code: 1200 - 0003H 2400 - 0004H 4800 - 0005H *9600 - 0006H (default setting)* 19200 - 0007H 38400 - 0008H 57600 - 0009H 115200 - 000AH

Packet end distinction

To configure the delay between the bytes that will be understood as the end of the packet. The delay is entered as a number of bytes. It is possible to enter a value ranging from 4 to 100. The default value is 10.

Function codes:

0x03 – Read Holding 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 Bytes	The delay as a number of bytes. It is possible to enter a value ranging from 4 to 100.

Communication protocol

This function enables the device to be switched to a different protocol. There is a choice of several protocols depending on the device type. After sending the response, the device switches to the selected protocol and communicates through it from this point on. (Every protocol contains an instruction for switching between protocols.)

Function codes:

0x03 – Read Holding 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 Bytes	Protocol code: Spinel - 0001H MODBUS RTU - 0002H Drak3 - 0003H (AD4RS and AD4USB only) Drak4 - 0004H (Drak 4 only)

Channels

Values and current states of individual channels

This defines how to read the last measured value from all or from some of the converter's channels. It returns values as integers and also converted to decimal numbers (32 bit float according to IEEE 754).

The values are sent in two formats simultaneously. The first one is the 16bit value within the range from 0 to 10 000 (integer in the sequence of MSB:LSB). The second one is a value converted for the current range according to the current setup[2] as a decimal number in the 32 bit float format according to IEEE 754[3].

Function codes:

0x04 – Read Input register

Memory position and length:

Starting address	2 Bytes	Channel 1: 0x0000 Channel 2: 0x0004 Channel 3: 0x0008 Channel 4: 0x000C
Register count	2 Bytes	4

Parameters:

Number of bytes	1 Byte	8
State	2 Bytes	*0x0000* – value is valid and within the range *0x0001* – value is not available yet *0x0002* – upper limit exceeded *0x0003* – lower limit exceeded (only for the current range of 4 to 20 mA) *other values* – other error
INT value	2 Bytes	Measured value. Integer within the interval 0 to 10 000
Float value	4 Bytes	Measured value. 32 bit float according to IEEE 754

[2] Setup of conversions is only possible with the Spinel protocol.

[3] Description of the IEEE 754 standard is available for example on: http://en.wikipedia.org/wiki/IEEE_754

Individual values

States of channels

This is the way to read the states of all the channels at once.

Function codes:

0x04 – Read Input register

Memory position and length:

Starting address	2 Bytes	Channel 1: 0x001E Channel 2: 0x001F Channel 3: 0x0020 Channel 4: 0x0021
Register count	2 Bytes	4

Parameters:

Number of bytes	1 Byte	2
State	2 Bytes	*0x0000* – value is valid and within the range *0x0001* – value is not available yet *0x0002* – upper limit exceeded *0x0003* – lower limit exceeded (only for the current range of 4 to 20 mA) *other values* – other error

Measured value – as an integer

This is the way to read the states of all the channels at once. They are available here as signed integers, i.e. the measured value multiplied by ten (e.g. the value 25.6 is sent as 256).

Function codes:

0x04 – Read Input register

Memory position and length:

Starting address	2 Bytes	Channel 1: 0x0022 Channel 2: 0x0023 Channel 3: 0x0024 Channel 4: 0x0025
Register count	2 Bytes	4

Parameters:

Number of bytes	1 Byte	2
Value INT	2 Byte	Measured value as a signed integer.

Measured value – as a decimal number

This is the way to read the states of all the channels at once. They are available here as 32 bit float numbers according to IEEE 754.

Function codes:

0x04 – Read Input register

Memory position and length:

Starting address	2 Bytes	Channel 1: 0x0026 Channel 2: 0x0028 Channel 3: 0x002A Channel 4: 0x002C
Register count	2 Bytes	8

Parameters:

Number of bytes	1 Byte	4
Value float	4 Bytes	Measured value. 32 bit float according to IEEE 754.

Measured value – RAW value from ADC

This is the way to get values directly from the internal A/D converter without any conversion. Values are 16 bit numbers directly from the converter.

Function codes:

0x04 – Read Input register

Memory position and length:

Starting address	2 Bytes	Channel 1: 0x002E Channel 2: 0x002F Channel 3: 0x0030 Channel 4: 0x0031
Register count	2 Bytes	2

Parameters:

Number of bytes	1 Byte	2
Value float	2 Bytes	Measured 16 bit value from the converter.

Inputs and outputs

Reading the states of inputs

(This functionality is available only in the Drak 4 meter.)

This function code is dedicated for reading digital inputs for contact. It reads one or both inputs. The number of the first read input and the number of inputs to be read are specified here. The input addresses start from zero. The addresses of inputs 1 and 2 are 0 and 1.

In the response, inputs states are represented by individual bits. Value 1 means an active input (voltage is connected or contact is on), value 0 stands means an inactive input. The lowest bit in the first byte of the response represents the state of the first input that was addressed in the request.

Function codes:

0x02 – Read Discrete

Memory position and length:

Starting address	2 Bytes	0x0000 to 0xFFFF
Number of inputs	2 Bytes	1 or 2

Parameters:

Number of values	1 Byte	1
State	1 Byte	State of inputs

Example:

Example of the input reading.

Request:	
Function code	0x02
MSB address	0x00
LSB address	0x00
Number of MSB inputs	0x00
Number of LSB inputs	0x02

Response:	
Function code	0x02
Number of bytes	0x01
State of inputs	0x01

The result of the request is the byte 0x01, which is 0000 0001 in the binary code. Individual bits correspond to the states of the inputs. The lowest bit represents the input number 1.

Reading the states of outputs

(This functionality is only available in the Drak 4 meter.)

This function code is dedicated for reading output states. The address of the output is 0.

In the response, output states are represented by individual bits. The value 1 means a connected output, the value 0 stands for a disconnected output. Output states are represented by the lowest bit in the first byte of the response.

Function codes:

0x01 – Read Coils

Memory position and length:

Starting address	2 Bytes	0x0000 to 0xFFFF
Number of outputs	2 Bytes	1

Response:

Number of values	1 Byte	1
State	1 Byte	Input state

Example:

Example of reading outputs 1 and 2.

Request:	
Function code	0x01
MSB address	0x00
LSB address	0x00
Number of MSB outputs	0x00
Number of LSB outputs	0x01

Response:	
Function code	0x01
Number of bytes	0x01
State of outputs	0x01

The result of the request is the byte 0x01, which is 0000 0001 in the binary code. The second lowest bit is set. The output 1 is on. (The remaining bits are filled with zeros.)

Output setup

(This functionality is only available in the Drak 4 meter.)

This function code controls the output. The address of the output is 0.

The requested output states are specified in the variable *State of outputs*. The logical value 1 means the output is connected, the logical 0 means the output is disconnected.

Function codes:

0x05 – Write Single Coils

0x0F – Write Multiple Coils

Memory position and length:

Starting address	2 Bytes	0x0000 to 0xFFFF
Number of outputs	2 Bytes	1

Parameters:

Number of bytes	1 Byte	1
Values	1 Byte	State of the output

Example:

Example of output state writing:

Request:	
Function code	0x0F
MSB address	0x00
LSB address	0x00
Number of MSB outputs	0x00
Number of LSB outputs	0x01
Number of bytes	0x01
MSB values	0x00
LSB values	0x01

Response:	
Function code	0x0F
MSB address	0x00
LSB address	0x00
Number of MSB outputs	0x00
Number of LSB outputs	0x01

The result of the request is the byte 0x01, which is 0000 0001 in the binary code. The output is connected. (The remaining bits are filled with zeros.)

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