Description of the MODBUS (RTU) protocol for PANTER III
v2.9

Content

1. Basic informations

1.1. Setup for initial RS-485 communication

Speed	9600 Baud
Stop bits	1
Parity	None

1.2. Supported functions

FUNCTION	DESCRIPTION
0x03	Reading of one or more 16-bit registers
0x10	Writing several 16-bit registers

1.3. Supported instructions

1.3.1. Control instructions

REGISTRY ADDRESS	ACCESS	FUNCTION	DESCRIPTION
0X0000	WRITE	0X10	Regulation of all groups (BROADCAST)
0X0001	WRITE	0X10	Regulation of a group
0X0002	WRITE	0X10	Regulation of ID
0X0003	WRITE	0X10	Adding a group for ID
0X0004	WRITE	0X10	Deleting one group for ID
0X0005	WRITE	0X10	Deleting all groups for ID
0X000A	WRITE	0X10	Set consumed energy value
0X000B	WRITE	0X10	Setting active - connected phases
0X000C	WRITE	0X10	Setting consecutive phases modulation
0X000D	WRITE	0X10	UART setup

1.3.2. Instructions for requesting the information about the state of the device

REGISTRY ADDRESS	ACCESS	FUNCTION	DESCRIPTION
0X0064	READING	0X03	Request for the state of the device
0x0065	READING	0X03	Request for consumed energy
0x0066	READING	0X03	Request for the software version
0X0067	READING	0X03	Request for the connected phases number
0X0068	READING	0X03	Request for the modulators temperature
0X0069	READING	0X03	Request for consecutive modulation setup

2. Control instructions

2.1. Regulation of all groups (Broadcast)

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X0000
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
BYTE COUNT	0X02
DATA (Hi)	VALUE
DATA (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Regulation BROADCAST

Level (0 – 100 %)

2.1.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X0000
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Regulation BROADCAST

2.2. Group regulation

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X0001
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0002
REGISTRY COUNT (Lo)	
BYTE COUNT	0X04
DATA (Hi)	VALUE
DATA (Lo)	
DATA (Hi)	VALUE
DATA (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Regulation of a group

Group (1 - 199)
Level (0 – 100 %)

2.2.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X0001
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X02
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

2.3. ID Regulation

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X0002
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0002
REGISTRY COUNT (Lo)	
BYTE COUNT	0X04
DATA (Hi)	VALUE
DATA (Lo)	
DATA (Hi)	VALUE
DATA (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

ID Regulation

ID (1 - 65535)
Level (0 – 100 %)

2.3.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X0002
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0002
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

ID Regulation

2.4. Adding a group for ID

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X0003
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0002
REGISTRY COUNT (Lo)	
BYTE COUNT	0X04
DATA (Hi)	VALUE
DATA (Lo)	
DATA (Hi)	VALUE
DATA (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Adding a group for ID

ID (1 - 65535)
Group (1 - 199)

2.4.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X0003
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X02
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Adding a group for ID

2.5. Deleting one group for ID

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X0004
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0002
REGISTRY COUNT (Lo)	
BYTE COUNT	0X04
DATA (Hi)	VALUE
DATA (Lo)	
DATA (Hi)	VALUE
DATA (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Deleting one group for ID

ID (1 - 65535)
Group (1 - 199)

2.5.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X0004
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0002
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Deleting one group for ID

2.6. Deleting all groups for ID

TITLE	(HEX)		
DEVICE ADDRESS	ADDRESS		
FUNCTION	0X10		
REGISTRY ADDRESS (Hi)	0X0005	Deleting all groups for ID	
REGISTRY ADDRESS (Lo)			
REGISTRY COUNT (Hi)	0X0001		
REGISTRY COUNT (Lo)			
BYTE COUNT	0X02		
DATA (Hi)	VALUE	ID (1 - 65535)	
DATA (Lo)			
CRC (Lo)	CRC		
CRC (Hi)			

2.6.1. Response

TITLE	(HEX)		
DEVICE ADDRESS	ADDRESS		
FUNCTION	0X10		
REGISTRY ADDRESS (Hi)	0X0005	Deleting all groups for ID	
REGISTRY ADDRESS (Lo)			
REGISTRY COUNT (Hi)	0X0001		
REGISTRY COUNT (Lo)			
CRC (Lo)	CRC		
CRC (Hi)			

2.7. Set consumed energy value

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X000A
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0002
REGISTRY COUNT (Lo)	
BYTE COUNT	0X04
DATA (Hi)	VALUE
DATA (Lo)	
DATA (Hi)	VALUE
DATA (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Set consumed energy value

Consumed energy*10

2.7.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X000A
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0002
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Set consumed energy value

2.8. Setting active - connected phases

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X000B
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
BYTE COUNT	0X02
DATA (Hi)	VALUE
DATA (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Set active - connected phases

Number of connected phases: 1 - 3

2.8.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X000B
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Set active - connected phases

2.9. Setting consecutive phases modulation

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X000C
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
BYTE COUNT	0X02
DATA (Hi)	VALUE
DATA (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Setting concurrent phases mod.

Consecutive modulation - 0 simultaneous, 1 - consecutive

2.9.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X000C
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
CRC (Hi)	CRC
CRC (Lo)	

Setting consecutive phases mod.

2.10.   UART setup

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X000D
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
BYTE COUNT	0X02
DATA (Hi)	VALUE
DATA (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

UART setup

Hi Byte - Baud Rate
Lo Byte - UART setup

2.10.1.   Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10
REGISTRY ADDRESS (Hi)	0X000D
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

UART setup

2.10.2.   Baud Rates values

Baud rate	High Byte value
1200	0
1800	1
2400	2
4800	3
9600	4
19200	5

2.10.3.   UART setup BYTE

Bit	8.	7.	6.	5.	4.	3.	2.	1.
Value	-	-	-	-	-	Stop bits	Parity	

Parity setup (2 bits):   0 - No parity   Stop bits (1 bit):   0 - 1 stop bit
                          1 - Even parity   1 - 2 stop bits
                          2 - Odd parity

2.10.4.   Error Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X10 + 0x80
Error code	According to the table of error codes
CRC (Lo)	CRC
CRC (Hi)	

Function + 0x80
Error code (table of error codes)

3. Instructions for requesting the information about the state of the device

3.1. Request for the state of the device

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
REGISTRY ADDRESS (Hi)	0X64
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

State of the device (table of states)

3.1.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
BYTE COUNT	0X02
DATA (Hi)	According to the
DATA (Lo)	table of states
CRC (Lo)	CRC
CRC (Hi)	

State of the device (table of states)

3.2. Request for consumed energy

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
REGISTRY ADDRESS (Hi)	0X65
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0003
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Consumed energy

3.2.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
BYTE COUNT	0X06
DATA (Hi)	According to the
DATA (Lo)	table of states
DATA (Hi)	Energy upper bytes
DATA (Lo)	Energy upper bytes
DATA (Hi)	Energy lower bytes
DATA (Lo)	Energy lower bytes
CRC (Lo)	CRC
CRC (Hi)	

Consumed energy * 10

3.3. Request for software version

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
REGISTRY ADDRESS (Hi)	0X66
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Software version

3.3.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
BYTE COUNT	0X02
DATA (Hi)	Version
DATA (Lo)	Sub-version
CRC (Lo)	CRC
CRC (Hi)	

Software version (version, sub-version)

3.3.2. Error response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03 + 0x80
Error code	According to the table of error codes
CRC (Lo)	CRC
CRC (Hi)	

Function + 0x80
Error code (table of error codes)

3.4. Request for the connected phases number

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
REGISTRY ADDRESS (Hi)	0X67
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Request for the connected phases number

3.4.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
BYTE COUNT	0X02
DATA (Hi)	0X00
DATA (Lo)	Active phases
CRC (Lo)	CRC
CRC (Hi)	

Set connected phases

3.4.2. Error response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03 + 0x80
Error code	According to the table of error codes
CRC (Lo)	CRC
CRC (Hi)	

Function + 0x80
Error code (table of error codes)

3.5. Request for the modulators temperature

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
REGISTRY ADDRESS (Hi)	0X68
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0003
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Request for the modulators temperature

3.5.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
BYTE COUNT	0X06
DATA (Hi)	0X00
DATA (Lo)	L1 temperature
DATA (Hi)	0X00
DATA (Lo)	L2 temperature
DATA (Hi)	0X00
DATA (Lo)	L3 temperature
CRC (Lo)	CRC
CRC (Hi)	

Phases temperature

Temperature in Celsius degrees

3.5.2. Error response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03 + 0x80
Error code	According to the table of error codes
CRC (Lo)	CRC
CRC (Hi)	

Function + 0x80
Error code (table of error codes)

3.6. Request for concurrent modulation setup

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
REGISTRY ADDRESS (Hi)	0X69
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Request for consecutive modulation setup

3.6.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
BYTE COUNT	0X02
DATA (Hi)	0X00
DATA (Lo)	Modulation setup
CRC (Lo)	CRC
CRC (Hi)	

0 - simultaneous modulation , 1 - consecutive modulation

3.6.2. Error response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03 + 0x80
Error code	According to the table of error codes
CRC (Lo)	CRC
CRC (Hi)	

Function + 0x80
Error code (table of error codes)

3.7. Request for UART setup

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
REGISTRY ADDRESS (Hi)	0X6A
REGISTRY ADDRESS (Lo)	
REGISTRY COUNT (Hi)	0X0001
REGISTRY COUNT (Lo)	
CRC (Lo)	CRC
CRC (Hi)	

Request for UART setup

3.7.1. Response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03
BYTE COUNT	0X02
DATA (Hi)	Baud rate set
DATA (Lo)	UART setup
CRC (Lo)	CRC
CRC (Hi)	

UART setup

3.7.2. Error response

TITLE	(HEX)
DEVICE ADDRESS	ADDRESS
FUNCTION	0X03 + 0x80
Error code	According to the table of error codes
CRC (Lo)	CRC
CRC (Hi)	

Function + 0x80
Error code (table of error codes)

3.7.3. Baud Rates values

Baud rate	High Byte value
1200	0
1800	1
2400	2
4800	3
9600	4
19200	5

3.7.4. UART setup BYTE

Bit	8.	7.	6.	5.	4.	3.	2.	1.
Value	-	-	-	-	-	Stop bits	Parity	

Parity setup (2 bits):   0 - No parity   Stop bits (1 bit):   0 - 1 stop bit
                             1 - Even parity   1 - 2 stop bits
                             2 - Odd parity

4. Table of states

STATE CODE (HEX)	TITLE	DESCRIPTION
0x0001	OK	The device is ready for coding.
0x0002	OK after coding	This code is returned at the first request on state of successful coding.
0x0003	Overheat after coding	This code is returned if the device was overheated during coding, thus the coding was not successful.
0x0004	Coding	This Code is returned if the coding hasn't finished yet and there is no error.
0x0005	Overheat	Information of an overheated device. It is necessary to wait for its cool-down.
0x0006	Missing power supply	Information that there is no power supply connected to the power modulators.
0x0007	Other error	Other specified problem.
0x0008	Modulator error	Hardware problem on some of the modulators or an overload.

Description of reporting states

If the device was switched on and there was no data modulated, it reports the "OK" state. This means that there was no modulation since the last request for state. The device is ready for another use, if it reports "OK after coding" state after modulating. This state will adjust to "OK", right after sending a request for state. We get "OK after coding" only when sending the first request for state after successful modulation. If the modulation goes wrong, the link will report an error state. If the link is ready to work after unsuccessful coding, it reports the "OK" state. A successful coding is verified by receiving the "OK after coding" state.

The "Overheat after" state is reported during the first request for state after registering device overheat. After that, only "Overheat" is reported. If the information "Overheat after" or "Overheat" is present, we cannot define the data as successfully sent.

During the "Modulator error" state, the device will continue modulating if it is possible, but it is necessary to figure out what kind of a problem it is. Most importantly, to exclude the possibility of an overloaded modulator.

5. Table of error codes

1. If the device has received a CRC error code, it will not send a response.

2. If the device is unable to perform an instruction, it will send one of the following codes:

| ERROR CODE (HEX)	TITLE	DESCRIPTION
0x01	Illegal function	Master has sent a function different than 0x03 or 0x10. Other instructions are not accepted.
0x02	Illegal data address	Master has sent an invalid address for the data writing. It is possible to write data only on addresses stated in the table of supported commands.
0x03	Illegal data	Master has sent invalid data. It is necessary to hold onto ranges of data stated in the table of supported commands.
0x04	Slave device failure	Error of a component in the PANTER III basically means overheat of other error of a modulator. In this case it is necessary to verify the state of the device by sending the instruction for verifying state.

5.1. Device address (8 bits)

BIT	DEVICE CLASS			DEVICE ADDRESS (DIP SWITCH)				
BIT	8(MSB)	7	6	5	4	3	2	1(LSB)
PANTER III	0	0	0	x	x	x	x	x
BROADCAST	0	0	0	0	0	0	0	0

5.2. DIP Switch

Contains 6 switches

Switches on the position of 1 – 5 are designated for setting address of the device on the RS-485 line. DIP 1 is least significant bit of address and DIP 5 is most significant bit of address.
The switch on position 6 is used for connecting or disconnecting a terminating resistor (TERMINATOR) of the RS-485 line.
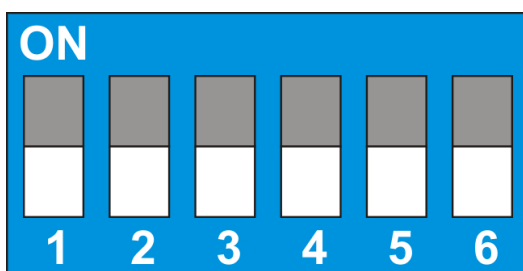
The device responds only on the address which is set on the switches. For changing the address, it is necessary to set a new address and restart the device.
Maximum of 31 PANTER III devices can be addressed on one line with addresses: 0x01 to 0x1F.
It also reacts to commands on broadcast address 0x00, but doesn't respond. Setup when all DIP switches are off on PNT unit is reserved for setup with initial RS485 parameters. It is possible to change RS485 speed, baud rate and stop bits. When you have PNT with unknown RS485 setup, use

reserved switch setup 00000 and PNT will react on address 0x01 on initial RS485 setup parameters showed at top of this document.

5.2.1. Address calculation according to DIP SWITCH setting.

Calculation based on the position of switches on the position 1 – 5 (bit 1 – bit 5)

Device address = (bit 1) x 2^0 + (bit 2) x 2^1 + (bit 3) x 2^2 + (bit 4) x 2^3 + (bit 5) x 2^4