EosArrayLite

COMMUNICATION PROTOCOL

VMUMLAS1TXX03

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1 Introduction MODBUS

For a complete description of the MODBUS protocol refer to "Modbus_Application_Protocol_V1_1a.pdf" and "Modbus_Messaging_Implementation_Guide_V1_0a.pdf" documents that can be download from the www.modbus.org web site.

1.1 MODBUS functions

These functions are available on VMU-M:

- Reading of n "Holding Registers" (code 03h)
- Reading of n "Input Register" (code 04h)
- Writing of one "Holding Registers" (code 06h)

IMPORTANT:

1) In this document the "Modbus address" field is indicated in two mode:
   1.1) "**Modicon address**" : it is the "6 digit Modicom" representation with Modbus function code 04 (Read Input Registers) . It is possible to read the same values with function code 03 (Read Holding Register) substituting the first digit with number "4".
   1.2) "**Physical address**": it is the "word address" value included in the communication frame.
2) The functions 03h and 04h have exactly the same effect.
3) The communication parameters must be set in according to the configuration of the instrument (refer to VMU instruction manual)

1.1.1 Function 03h (Read holding registers)

This function code is used to read the contents of a contiguous block of holding registers (word). The Request frame specifies the starting register address and the number of registers to be read. It is possible to read maximum 125 register (word) with a single request.
The register data in the response message are packed as two bytes per register (word), with the binary contents right justified within each byte. For each register, the first byte contains the high order bits (MSB) and the second contains the low order bits (LSB).

Request frame

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	03h	
Starting Address	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
Quantity of Registers (**N** word)	2 bytes	1 to 7Dh (1 to 125)	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (correct action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	03h	
Byte count	1 byte	**N** word * 2	
Register value	**N***2 bytes		Byte order: MSB, LSB
CRC	2 bytes		

Response frame (incorrect action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	Possible exception : 01h: illegal function 02h: illegal data address 03h: illegal data value 04h: slave device failure
Function code	1 byte	83h	
Exception code	1 byte	01h, 02h, 03h, 04h	
CRC	2 bytes		

1.1.2 Function 04h (Read input registers)

This function code is used to read the contents of a contiguous block of input registers (word). The Request frame specifies the starting register address and the number of registers to be read. It is possible to read maximum 125 register (word) with a single request.
The register data in the response message are packed as two bytes per register (word), with the binary contents right justified within each byte. For each register, the first byte contains the high order bits (MSB) and the second contains the low order bits (LSB).

Request frame

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	04h	
Starting Address	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
Quantity of Registers (**N** word)	2 bytes	1 to 7Dh (1 to 125)	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (correct action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	04h	
Byte count	1 byte	**N** word * 2	
Register value	**N***2 bytes		Byte order: MSB, LSB
CRC	2 bytes		

Response frame (incorrect action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	Possible exception : 01h: illegal function 02h: illegal data address 03h: illegal data value 04h: slave device failure
Function code	1 byte	84h	
Exception code	1 byte	01h, 02h, 03h, 04h	
CRC	2 bytes		

1.1.3 Function 06h (Write single holding register)

This function code is used to write a single holding register. The Request frame specifies the address of the register (word) to be written and its contents.
The correct response is an echo of the request, returned after the register contents have been written.

Request frame

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	06h	
Starting Address	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
Register value	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (correct action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	06h	
Starting Address	2 bytes	0000h to FFFFh	
Register value	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (incorrect action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	Possible exception : 01h: illegal function 02h: illegal data address 03h: illegal data value 04h: slave device failure
Function code	1 byte	86h	
Exception code	1 byte	01h, 02h, 03h, 04h	
CRC	2 bytes		

1.2 Application notes

1.2.1 General consideration

1. To avoid errors due to the signal reflections or line coupling, it is necessary to terminate the input of the last instrument on the network, and also the reception of the Host. The termination on both the instrument and the host is necessary even in case of point-to-point connection, within short distances.
2. The GND connection is optional if a shielded cable is used.
3. For connections longer than 1000m, a line amplifier is necessary.
4. If an instrument does not answer within the “max answering time”, it is necessary to repeat the query. If the instrument does not answer after 2 or 3 consecutive queries, it must be considered as not connected, faulty or with wrong address. The same consideration is valid in case of CRC errors or incomplete frames.

1.2.2 MODBUS timing

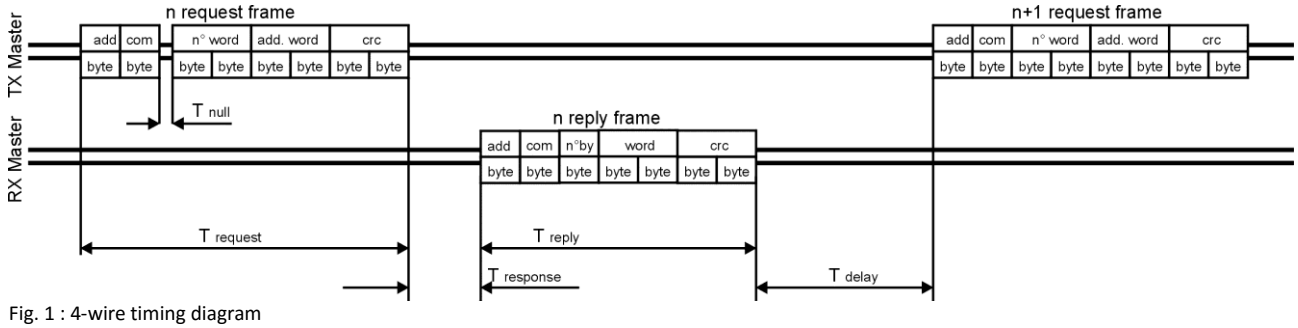

Fig. 1 : 4-wire timing diagram

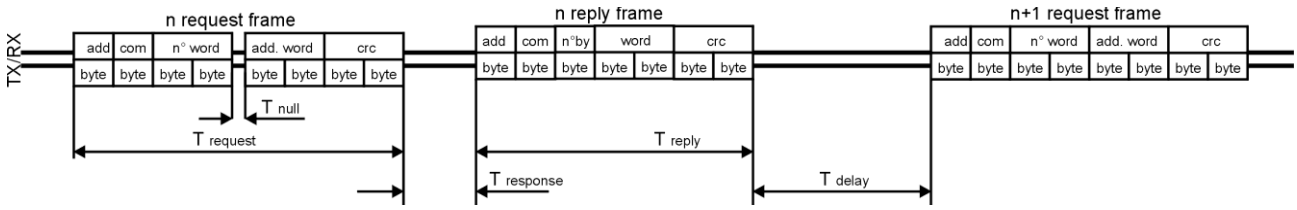

Fig. 2 : 2-wire timing diagram

Characteristics of reading function:	Timing:
T response: Max answering time	500ms
T response: Typical answering time	40ms
T delay: Minimum time for a new query	9600 baud-rate: 3,5 char 19200 baud-rate: 3,5 char 38400 baud-rate: 1,75 ms 115200 baud-rate: 1,75 ms
T null: Max interruption time on the request frame	9600 baud-rate: 2,5 char 19200 baud-rate: 2,5 char 38400 baud-rate: 1,75 ms 115200 baud-rate: 1,75 ms

Where: n char = n*10/baud rate

2 TABLES

2.1 Data format representation

The variables are represented by integers, with 2's complement notation in case of "signed" format.

Format	IEC data type	Description	Bits	Range
INT16	INT	Integer	16	-32768 .. 32767
UINT16	UINT	Unsigned integer	16	0 .. 65535
INT32	DINT	Double integer	32	-2^{31} .. 2^{31}

All the decimal points present in this document are indicated in virtual mode. The real value in the memory has not any decimal point. The byte order inside the single word is MSB->LSB while the word order is LSW->MSW).

2.2 Table of instantaneous variables

Table 2.2-1- Instantaneous variables: read only mode with functions code 03 and 04

	Description	Modicom address	Physical address	Length (words)	Special Firmware
Module sub-address=0 (it is always the VMU-M)	Module code	**30769**	**0300h**	1	A1
	Module status	30770	0301h	1	A1
	Word 1	30771	0302h	1	A1
	Word 2	30772	0303h	1	A1

Table 2.2-2 - Organisation of the instantaneous variable vs. module type

Module Type	Description	Address	Length (words)	Data Format	Notes	Special Firmware
VMUM	Module code	Base+0h	1	UINT16	(*)**17h=VMUMLAS1TXX03**	A1
	Temperature channel 2	Base+3h	1	INT16	(**)-60.0 to 400.0 (°C or °F)	A1

(*) If the value is 0, the module is not present.
(**)If the value is equal to 7FFFh (32767), the measurement is not enabled (not present).
(**)If the value is equal to 7FFEh (32766), the measurement is in over-range condition.
(**)If the value is equal to 7FFDh (32765), the measurement is in under-range condition.

2.3 Table of programming parameters

Table 2.3-1 – Programming parameter: read and write mode organisation for VMU-M module

Modicon address	HEX Physical address	Description	Data Format	Notes	Firmware Special Firmware
30081	0050h	Password	UINT16	0 … 9999	A1
30084	0053h	Temperature Engineering unit	UINT16	0=Celsius; 1=Fahrenheit	A1
30085	0054h	Temperature Probe	UINT16	0=Pt100 3W; 1= Pt100 2W; 2=Pt1000 3W; 3=Pt1000 2W	A1
30099	0062h	**(**)** RS485 Address	UINT16	1 … 247	A1
30100	0063h	**(**)** RS485 BaudRate	UINT16	0=9600; 1=19200; 2=38400; 3=115200	A1
30101	0064h	**(**)** RS485 Parity	UINT16	0=none; 1=odd; 2=even	A1