

P Communications Protocol



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1. INTRODUCTION

The used communications protocol is **MODBUS / JBUS** compatible.

Message physical transmission parameters are:

Baud rate : configurable
9600, 4800, 2400, 1200

Bit count : 8

Bit Stop : 1

Parity : none

2. PACKAGE DESCRIPTION

The generic data package is composed in this way :

Device number	Functional code	Data	Control CRC
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There are two possible answers :

Answer with data

Device number	Functional code	Data	Control CRC
---------------	-----------------	------	-------------

Answer by mistake

Device number	Functional code + 0x80	Mistake code	Control CRC
---------------	------------------------	--------------	-------------

2.1 Parameters description

Device number: Network device identification number

It must be the same for Control and Answer.

Format : 1 byte from 0 to 0xff

0 shows a message for all the devices (broadcast) and does not require an answer.

Functional Code: they are the control codes

The used functional codes are:

Format : 1 byte

0x03: reading from device

- Data:** They are:
- required WORDS addresses
 - the answer data
- Control CRC:** It is a WORD resulting from a calculation carried out on all the byte making up the package.

2.2 Data format

The generic datum base unit is BYTE.

The addresses are expressed on a WORD (2 BYTES) and they are always positive.

The data are expressed on BYTE, WORD and long (two WORDS).

In the event that required data item is a BYTE-type data item, it is anyway transmitted a WORD with MSB (Most Significant Byte) at 0 or anyway at a negligible value.

The 2-WORD data are transmitted with the most significant WORD preceding the less significant WORD.

Therefore, all the data are transmitted with an even number of bytes.

The data with sign follow the conventions for the numbers with sign as twos complement (this is valid for WORD or for long).

Example: 1000 = 0x 03 e8 or
 0x 00 00 03 e8 (if long)
-1000 = 0x f c 18 or
 0x f f f f f c 18 (if long)

2.3 CRC computation description

In the following example, you can find a procedure written in "C" computation of CRC.

```

unsigned int calc_crc (char *ptbuf,unsigned int num)
/*
*****
*   Description : it computes the CRC of a data buffer
*   Input      : ptbuf = first byte buffer pointer
*               num   = number of byte on which CRC must be computed
*   Output     : //
*   Return    :
**  *****/
{
    unsigned int crc16;
    unsigned int temp;
    unsigned char c, flag;

    crc16 = 0xffff;                /* it initializes the CRC */
    for (num; num>0; num--) {
        temp = (unsigned int) *ptbuf; /* it loads the byte in temp */
        temp &= 0x00ff;             /* it masks the MSB */
        crc16 = crc16 ^ temp;       /* crc16 in OR only with temp */
        for (c=0; c<8; c++) {
            flag = crc16 & 0x01;    /* it filters only the LSBit of crc16 */
            crc16 = crc16 >> 1;    /* it loses the Lsbit of crc16 */
            if (flag != 0)
                crc16 = crc16 ^ 0x0a001; /* crc16 in XOR with 0x0a001 */
        }
        ptbuf++;                    /* it points at next byte */
    }
    crc16 = (crc16 >> 8) | (crc16 << 8); /* it interchanges LBS with MSB */
    return (crc16);
} /* calc_crc */

```

2.4 Error handling

If received message is invalid (CRC16 does not coincide), the queried device (slave) does **not** answer.

If the message is right but it contains some irregularities (in the functional Code or in the Data) so that it cannot be acknowledged, the device answers with an error message. The error codes are defined afterwards.

3. COMMANDS

3.1 0x03 Code: reading of one or more consecutive WORDS

Command format:

		MSB	LSB	MSB	LSB	MSB	LSB
Device number	Code	1.st WORD address		WORDS number		CRC16	

Answer format:

			MSB	LSB	MSB	LSB
Device number	Code	Number of BYTES	WORDS 1		CRC16	

The number of BYTES must be always equal to the number of WORDS (in the command) * 2

Answer - error format :

			MSB	LSB
Device number	Code + 0x80	Error code	CRC16	

Error code:

- * 0x01 non-recognized functional code
- * 0x02 Wrong first WORD address
- * 0x03 Wrong data

Example

Request of 4 WORDS (8 BYTES) starting from address 0x301:

		MSB	LSB	MSB	LSB	MSB	LSB
Number of device	Code	1 WORD address		WORDS number		CRC16	
0x01	0x03	0x03	0x01	0x00	0x04	0x15	0x8d

In this case two variables have been required: one at 0x301 address and another at 0x302 address, as more clearly explained afterwards.

Answer

Variable in 0x301 : 0x00 00 d8 85

0x302 : 0x00 01 86 9f

			MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB
		N°. BYTES	WORD 1		WORD 2		WORD 3		WORD 4		CRC16	
0x01	0x03	0x08	0x00	0x00	0xd8	0x85	0x00	0x01	0x86	0x9f	0x68	0xd9

3.2 Used addresses and date meaning

Data can be required one by one for each address or grouped together.

The grouping is made by logical sections or type of data.

It is possible to require one or more data of the same group specifying the initial address as well as the required number of words.

The BYTE-type data are transmitted to WORD with MSB at 0 or anyway at a negligible value. The highest number of WORDS which can be required is 8 or 16 BYTES.

Group 1 : measurements (all the long-type data)

Group 2 : meter identification + setup parameters (all the BYTE-type data)

Group 3 : identification data for compatibility with communication protocol for already-existing meters

Group 4 : setup parameters (all the long-type data)

Group 5 : setup parameters (all the long-type data)

In the following table you can find the possible addresses with the meaning of the variables these addresses are referred to.

Address	Description	Type
	Group1	
0x301	present measurement	Long
0x302	highest measurement peak value	Long
0x303	lowest measurement peak value	Long
0x304	emperature value (if measurable)	Long
	Group 2	
0x300	device identification	Byte
0x400	state of the meter	Byte
0x401	measurement code	Byte
0x402	type of thermocouple	Byte
0x403	type of resistive sensor	Byte
0x404	decimal point position	Byte
0x405	type of alarm 1	Byte
0x406	type of alarm 2	Byte
0x407	input signals polarity	Byte

Address	Description	Type
	Group 3	
0x 0f	not used	
0x10	not used	
0x11	not used	
0x12	software version	Byte
0x13	not used	
0x14	not used	
0x15	device identification	Byte
0x16	not used	
	Group 4	
0x430	display full scale	Long
0x431	display scale beginning	Long
0x432	analog output full scale	Long
0x433	analog output scale beginning	Long
	Group 5	
0x440	alarm 1 set point	Long
0x441	alarm 2 set point	Long
0x442	alarm 1 hysteresis	Long
0x443	alarm 2 hysteresis	Long

3.3 Group 1

Group 1 contains the measurements.

According to the VIT-5 model, the measurements can be voltage/current (linearized with full scale values in the setup) or temperature.

The rendered measurements are exactly the ones displayed.

If, for instance, the present measurement is 63470 with the decimal point in third position from the left (634.70), the rendered value is 63470 in long form.

If we actually have a temperature measurement, for instance 0123.4 (the point is fixed in fourth position), the rendered value is 1234 in LONG form.

The degrees are always expressed in tenths.

0x301 : current measurement

Format : long type

0x302 : highest acquired measurement

Format : long type

0x303 : lowest acquired measurement

Format : long type

0x304 : meter inner temperature measurement expressed in tenths of degrees

Format : long type

Note : the temperature can be measured in the following cases

- meter in temperature with thermocouple
- meter in voltage with 60mV or 200mV full scale
- meter in current

Example

Request of 4 WORDS (8 BYTES) starting from address 0x303 :

		MSB	LSB	MSB	LSB	MSB	LSB
Device number	Code	1.st WORD address		WORDS number		CRC16	
0x01	0x03	0x03	0x03	0x00	0x04	0xb4	0x4d

In this case two variables have been required : one at 0x303 address and another at 0x304 address, both of them with 2 WORDS.

Answer

Variable in 0x303 : 0x00 00 d8 85

0x304 : 0x00 01 86 9f

			MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB
		N°. BYTES	WORD 1		WORD 2		WORD 3		WORD 4		CRC16	
0x01	0x03	0x08	0x00	0x00	0xd8	0x85	0x00	0x01	0x86	0x9f	0x39	0x19

3.4 Group 2

Group 2 contains the BYTE-type setup parameters.

Each parameter is transferred using a WORD with MSB at 0 or at a negligible value.

0x300 : device identification

Format : 1 BYTE (negligible MSB)

0x90 : meter configured in voltage

0x91 : meter configured in current

0x92 : meter in temperature with thermocouple

0x93 : meter in temperature with PT100/Ni100

0x400 : state of the meter

Format : 1 BYTE (negligible MSB)

bit 1 = 1 - alarm 1 on

bit 5 = 1 - alarm 2 on

bit 6 = 1 - overrange measurement

0 - measurement within the limits

0x401 : measurement code

Format : 1 BYTE (negligible MSB)

0 = 200V	1 = 20V	2 = 2V
3 = 200mV	4 = 60mV	5 = 200mA
6 = 20mA	7 = 4-20mA	8 = thermocouple
9 = PT100/NI100		

0x402 : type of thermocouple

Format : 1 BYTE (negligible MSB)

0 = J	1 = K	2 = T
3 = R	4 = S	

0x403 : type of resistive sensor

Format : 1 BYTE (negligible MSB)

0 = PT100	1 = NI100
-----------	-----------

0x404 : decimal point position useful to reconstruct the measurement in a correct way.

Format : 1 BYTE (negligible MSB)

The position is expressed by a number showing the digit after which the decimal point is placed.

Values : 0 .. 4

Value 0 shows the point position after the digit 1 starting from the left. The digits are numbered 1...5

Example: 3 means the point is after the 4th digit (1387.4)

0x405 : type of alarm 1

Format : 1 BYTE (negligible MSB)

0 = di min.
1 = di max.

0x406 : type of alarm 2

Format : 1 BYTE (negligible MSB)

0 = di min.
1 = di max.

0x407 : input signals polarity

Format : 1 BYTE (negligible MSB)

0 = unidirectional

1 = bidirectional

Example

Request of 4 WORDS (8 BYTES) starting from address 0x401 :

		MSB	LSB	MSB	LSB	MSB	LSB
Device number	Code	1.st WORD address		WORDS number		CRC16	
0x01	0x03	0x04	0x01	0x00	0x04	0x14	0xf9

In this case 4 variables have been required :

at address 0x401, 0x402, 0x403, 0x404 each of 1 BYTE

Answer

Variable in 0x401 : 0x00 08

0x402 : 0x00 01

0x403 : 0x00 00

0x404 : 0x00 03

			MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB
		N°. BYTES	WORD 1		WORD 2		WORD 3		WORD 4		CRC16	
0x01	0x03	0x08	0x00	0x08	0x00	0x01	0x00	0x00	0x00	0x03	0x61	0xd6

The variables are expressed on 1 BYTE with MSB, in this case null.

The received values mean :

- Temperature - thermocouple measurement
- K-type thermocouple
- Third value is negligible
- Fourth value shows that the decimal point is placed after the digit 4

3.5 Group 3

Group 3 contains some identifying data to keep the compatibility with other meters.

0x0f : not used (= 0)

Format : 1 BYTE

0x10 : not used (= 0)

Format : 1 BYTE

0x11 : not used (= 0)

Format : 1 BYTE

0x12 : software version

Format : 1 BYTE

It is a binary number that identifies the software version * 10.

Example : V3.2 is coded as 32 binary.

0x13 : not used (= 0)

Format : 1 BYTE

0x14 : not used (= 0)

Format : 1 BYTE

0x15 : meter identification

Format : as address 0x300

0x16 : not used (= 0)

Format : 1 BYTE

3.6 Group 4

Group 4 contains the full scale values loaded in the display and analog output setup. The format is the same described in **group 1**.

0x430 : display full scale

Format : long type

0x431 : display beginning of scale

Format : long type

0x432 : analog output full scale

Format : long type

0x433 : analog output beginning of scale

Format : long type

3.7 Group 5

Group 5 contains the set points and the hysteresis for each alarm. The format is the same described in **group 1**.

0x440 : set point for alarm 1

Format : long type

0x441 : set point for alarm 2

Format : long type

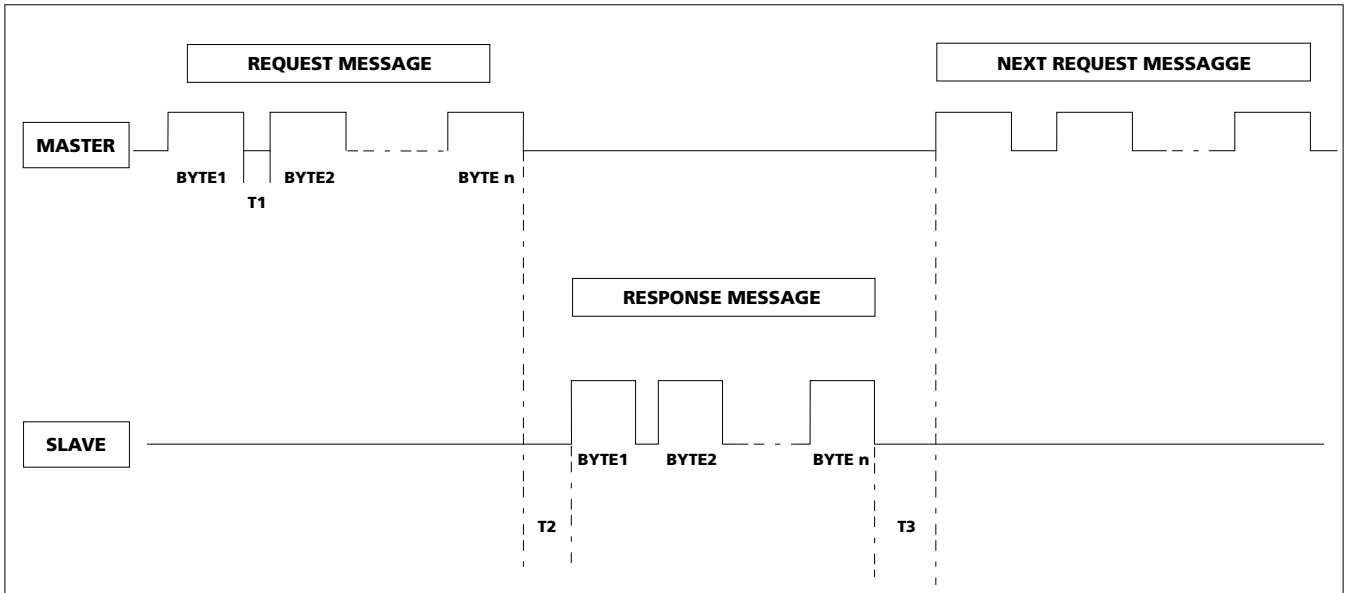
0x442 : hysteresis for alarm 1

Format : long type

0x443 : hysteresis for alarm 2

Format : long type

4.0 TIMING DIAGRAM



Where:

TIME	DESCRIPTION	Min & Max VALUES
T1	Timeout between characters. If this time exceeds the max. time allowed, the message is not considered by VIT5.	Max = 20ms.
T2	SLAVE response time. Min and Max time in which VIT5 replies to the MASTER request.	Min = 25ms. Max = 300ms.
T3	Time for a new message request from the MASTER.	Min = 20ms.