IF96017 MODBUS COMMUNICATION PROTOCOL

CONTENTS

1.0 ABSTRACT

Physical level

The physical communication line complies with the EIA-RS485 standard in half-duplex modality.
In this case, as only two wires are used, only one instrument at a time can engage the line; this means that there must be a master which polls the slave instruments so the demand and the request are alternated.

On the same physical line only 32 instruments can be attached (master included). In order to increase the number of the slave instrument, the necessary repeaters must be used.

The communication parameters are :

Baud rate programmable (device dependant)
bit n. : 8
stop bit : 1
parity : programmable (device dependant)

Data link level

The data are transmitted in a packet form (message) and are checked by a word (CRC).
See the description of the data packet in the next paragraphs for more details.

Application level

The communication protocol used is MODBUS / JBUS compatible. The address of the IF96017 module is the same as the NEMO on which the module itself is mounted.
Up to 255 different instruments can be managed (1..255)
There are no limitations to the number of possible retries done by the master.
A delay between the response from the slave and the next command is necessary and it is specified in **the following.**

2.0 DATA MESSAGE DESCRIPTION

The generic data message is composed as following :

Device address	Functional code	Data	CRC word

Two answers are possible :

Answer containing data

Device address	Functional code	Data	CRC word

Error answer

Device address	Functional code + 0x80	Error code	CRC word

2.1 Parameters description

Device address : device identification number in the network.
It must be the same for the demand and the answer.
Format : 1 BYTE from 0 to 0xff
0 is for broadcast messages with no answer

Functional code : command code
Used functional code :
Format : 1 BYTE
0x03 : reading of consecutive words
0x10 : writing of consecutive words

Data : they can be
- the address of the required words (in the demand)
- the data (in the answer)

CRC word : it is the result of the calculation done on all the bytes in the message

2.2 Data format

The following types of format are used for the data values :

* U_WORD : one WORD - unsigned
* S_WORD : one WORD - signed
* UD_WORDS : two WORDS - unsigned
* SD_WORDS : two WORDS - signed

If the required data is in a DWORD format, 2 WORDS are transmitted and the MSW comes before the LSW (depending on the setting in the NEMO 96 : **big endian / little endian / swap WORDS**

MSB	LSB	MSB	LSB
Most Significant WORD		Least Significant WORD	

Example : 1000 = 0x 03 e8 or
0x 00 00 03 e8 (if UDWORD)

MSB	LSB	MSB	LSB
0x00	0x00	0x03	0xe8

2.3 Description of CRC calculation

The following is an example of the CRC calculation in C language.

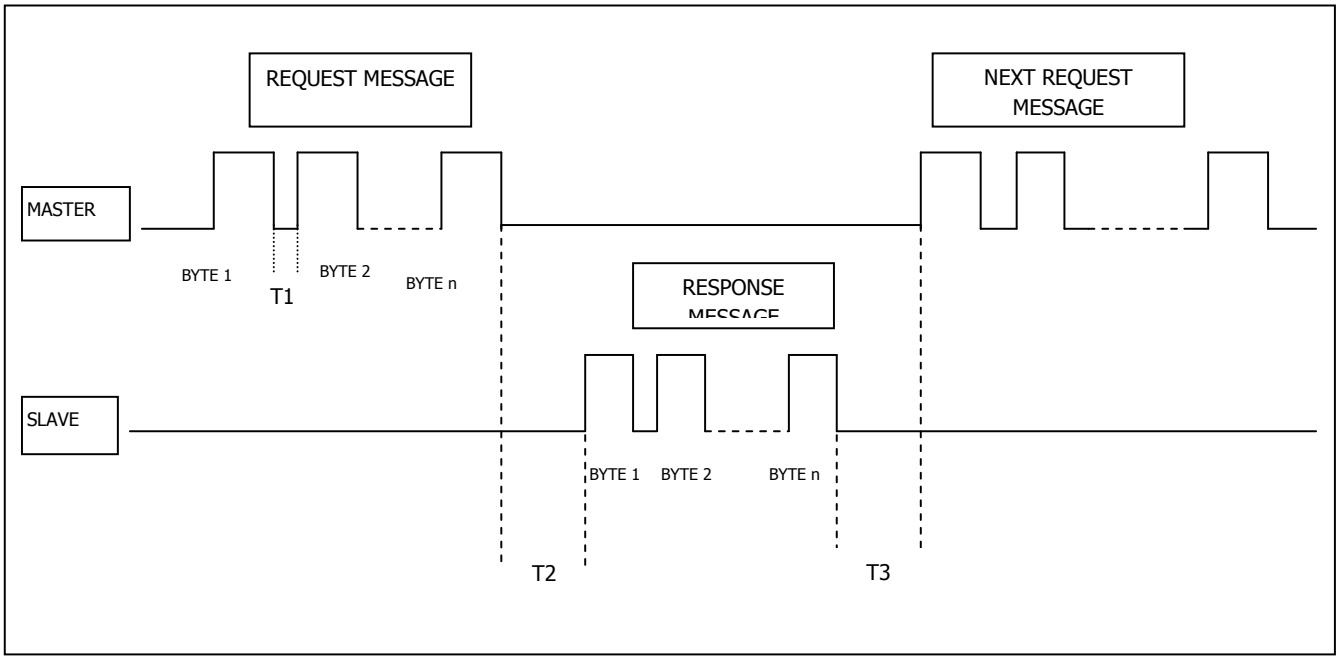
```
unsigned int calc_crc (char *ptbuf, unsigned int num)
/*     ************************************************************
 *     Descrizione : calculates a data buffer CRC WORD
 *     Input       :       ptbuf = pointer to the first byte of the buffer
 *                  num    = number of bytes
 *     Output      : //
 *     Return      :
**     ************************************************************/
 {
  unsigned int crc16;
  unsigned int temp;
  unsigned char c, flag;


  crc16 = 0xffff;                              /* init the CRC WORD */
  for (num; num>0; num--) {
        temp = (unsigned int) *ptbuf;          /* temp has the first byte */
        temp &= 0x00ff;                        /* mask the MSB */
         crc16 = crc16 ^ temp;                 /* crc16 XOR with temp */
        for (c=0; c<8; c++) {
              flag = crc16 & 0x01;             /* LSBit di crc16 is mantained */
              crc16 = crc16 >> 1;              /* Lsbit di crc16 is lost */
              if (flag != 0)
                   crc16 = crc16 ^ 0x0a001;    /* crc16 XOR with 0x0a001 */
        }
        ptbuf++;                               /* pointer to the next byte */
  }

  crc16 = (crc16 >> 8) | (crc16 << 8);         /* LSB is exchanged with MSB */

  return (crc16);

} /* calc_crc */
```

2.4 Error management

If the received message is incorrect (CRC16 is wrong) the polled slave doesn't answer.
If the message is correct but there are errors (wrong functional code or data) it can't be accepted, so the slave answers with an error message.

The error codes are defined in the following part of the document.

2.5 Timing



TIME	DESCRIPTION	Min & Max VALUES
T1	**Time between characters.** If this time exceeds the max. time allowed, the message is not considered by device.	Max < 20 ms.
T2	**Slave response time** Minimum and maximum response time of device to the Master request.	Min = 20 ms. Max = 300ms.
T3	Time before a new message request from the Master	Min = 20 ms.

3.0 COMMANDS

Code 0x03 : reading of one or more consecutive WORDS

Command format :

BYTE	BYTE	MSB LSB	MSB LSB	
Device address	Funct. Code	First WORD address	WORDS number	CRC16

Answer format (containing data) :

BYTE	BYTE	BYTE	MSB LSB	MSB LSB	
Device address	Funct. Code	BYTES number	WORD 1	WORD N.	CRC16

The BYTES number must always match the WORDS number (in the demand) * 2.

Answer format (the demand was wrong) :

BYTE	BYTE	BYTE	
Device address	Funct. Code + 0x80	Error code	CRC16

Error codes :
* 0x01 : incorrect functional code
* 0x02 : wrong first WORD address
* 0x03 : incorrect data

Code 0x10 : writing of more consecutive WORDS

Command format :

BYTE	BYTE	MSB LSB	MSB LSB	BYTE	MSB LSB	MSB LSB	
Device address	Funct. Code	First WORD address	WORDS number	BYTE numbers	Word Value		CRC16

Answer format (containing data) :

BYTE	BYTE	BYTE	MSB	LSB	MSB	LSB	
Device address	Funct. Code	BYTES number	WORD 1		WORD N.		CRC16

The BYTES number must always match the WORDS number (in the demand) * 2.

Answer format (the demand was wrong) :

BYTE	BYTE	BYTE	
Device address	Funct. Code + 0x80	Error code	CRC16

Error codes :
* 0x01 : incorrect functional code

* 0x02 : wrong first WORD address
* 0x03 : incorrect data

4.0 VARIABLES

Variables or groups of variables may be required up to 240 BYTES

0x7000	**U_WORD**	Current phase 1 - fundamental	1000
0x7001	**U_WORD**	Current phase 1 - 2nd harmonic (percentage)	1/10 %
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0x7031	**U_WORD**	Current phase 1 - 50th harmonic (percentage)	1/10 %
0x7040	**U_WORD**	Current phase 2 - fundamental	1000
0x7041	**U_WORD**	Current phase 2 - 2nd harmonic (percentage)	1/10 %
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0x7071	**U_WORD**	Current phase 2 - 50th harmonic (percentage)	1/10 %
0x7080	**U_WORD**	Current phase 3 - fundamental	1000
0x7081	**U_WORD**	Current phase 3 - 2nd harmonic (percentage)	1/10 %
------	------	----------	
0x70B1	**U_WORD**	Current phase 3 - 50th harmonic (percentage)	1/10 %
0x70C0	**U_WORD**	Voltage phase 1 (V12) - fundamental	1000
0x70C1		Voltage phase 1 (V12) - 2nd harmonic (percentage)	1/10 %
------	------	----------	
0x70F1	**U_WORD**	Voltage phase 1 (V12) - 50th harmonic (percentage)	1/10 %
0x7100	**U_WORD**	Voltage phase 2 (V23) - fundamental	1000
0x7101	**U_WORD**	Voltage phase 2 (V23) - 2nd harmonic (percentage)	1/10 %
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0x7131	**U_WORD**	Voltage phase 2 (V23) - 50th harmonic (percentage)	1/10 %
0x7140	**U_WORD**	Voltage phase 3 (V31) - fundamental	1000
0x7141	**U_WORD**	Voltage phase 3 (V31) - 2nd harmonic (percentage)	1/10 %

0x7171	**U_WORD**	Voltage phase 3 (V31) - 50th harmonic (percentage)	1/10 %
0x7200	**UD_WORD**	Current phase 1 - fundamental (rms)	mA

0x7262	**UD_WORD**	Current phase 1 - 50th harmonic (rms)	mA
0x7280	**UD_WORD**	Current phase 2 - fundamental (rms)	mA

0x72E4	**UD_WORD**	Current phase 2 - 50th harmonic (rms)	mA
0x7300	**UD_WORD**	Current phase 3 - fundamental (rms)	mA

0x7364	**UD_WORD**	Current phase 3 - 50th harmonic (rms)	mA
0x7380	**UD_WORD**	Voltage phase 1 (V12) - fundamental (rms)	mV

0x73E2	**UD_WORD**	Voltage phase 1 (V12) - 50th harmonic (rms)	mV

0x7400	**UD_WORD**	Voltage phase 2 (V23) - fundamental (rms)	mV

0x7462	**UD_WORD**	Voltage phase 2 (V23) - 50th harmonic (rms)	mV
0x7480	**UD_WORD**	Voltage phase 3 (V31) - fundamental (rms)	mV

0x74E2	**UD_WORD**	Voltage phase 3 (V31) - 50th harmonic (rms)	mV

0x7500	**U_WORD**	THD I1	1/10 %
0x7501	**U_WORD**	THD I2	1/10 %
0x7502	**U_WORD**	THD I3	1/10 %
0x7503	**U_WORD**	THD V1 (V12)	1/10 %
0x7504	**U_WORD**	THD V2 (V23)	1/10 %
0x7505	**U_WORD**	THD V3 (V31)	1/10 %

0x6170	**U_WORD**	Phase 1 : phase voltage crest factor	1/1000
0x6171	**U_WORD**	Phase 2 : phase voltage crest factor	1/1000
0x6172	**U_WORD**	Phase 3 : phase voltage crest factor	1/1000
0x6173	**U_WORD**	Phase 1 : current crest factor	1/1000
0x6174	**U_WORD**	Phase 2 : current crest factor	1/1000
0x6175	**U_WORD**	Phase 3 : current crest factor	1/1000
0x6176	**U_WORD**	RFU	1/1000
0x6177	**U_WORD**	Chained voltage : L1-L2 crest factor	1/1000
0x6178	**U_WORD**	Chained voltage : L2-L3 crest factor	1/1000
0x6179	**U_WORD**	Chained voltage : L3-L1 crest factor	1/1000

0x617a	**U_WORD**	phase displacement V1-V2 (V12-V23)	1/10 °
0x617b	**U_WORD**	phase displacement V2-V3 (V23-V31)	1/10 °
0x617c	**U_WORD**	phase displacement V3-V1 (V31-V12)	1/10 °
0x617d	**U_WORD**	phase displacement I1-I2	1/10 °
0x617e	**U_WORD**	phase displacement I2-I3	1/10 °
0x617f	**U_WORD**	phase displacement I3-I1	1/10 °