STATIC ENERGY METER (CE4D – Fc770)

Version 1.0

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1.0 INTRODUCTION

Logical level

The communication protocol used is MODBUS / JBUS compatible.
Up to 255 different instruments can be managed by the protocol.
The data are transmitted in a packet form (message) and are checked by a word (CRC).
There are no limitations to the number of possible retries done by the master.

Phisical level

The phisical communication line respects 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 phisical 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 :

speed	: programmable
bit n.	: 8
stop bit	: 1
parity	: none

2.0 DATA PACKET DESCRIPTION

The generic data message is composed as following :

Instrument address	Functional code	Data	CRC word

Two answers are possible :

Answer containing data

Instrument address	Functional code	Data	CRC word

Error answer

Instrument address	Functional code + 0x80	Error code	CRC word

2.1 Parameter description

Instrument address : instrument 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 made on all the bytes in the message

2.2 Data format

Three types of format are used for the data :

- * BYTE
- * WORD : two BYTES
- * long : two WORDS

The base data format is the WORD.
If the required data is in a BYTE format, a WORD with the MSB (Most Significant Byte) set to 0 is anyway transmitted and this BYTE comes before the LSB (Least Significant Byte).
If the required data is in a long format, 2 WORDS are transmitted and the MSW comes before the LSW.
Briefly :

MSB	LSB	MSB	LSB
Most Significant WORD		Least Significant WORD	

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

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

All data are positive and the sign indications are reported in other variables.

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 */
```

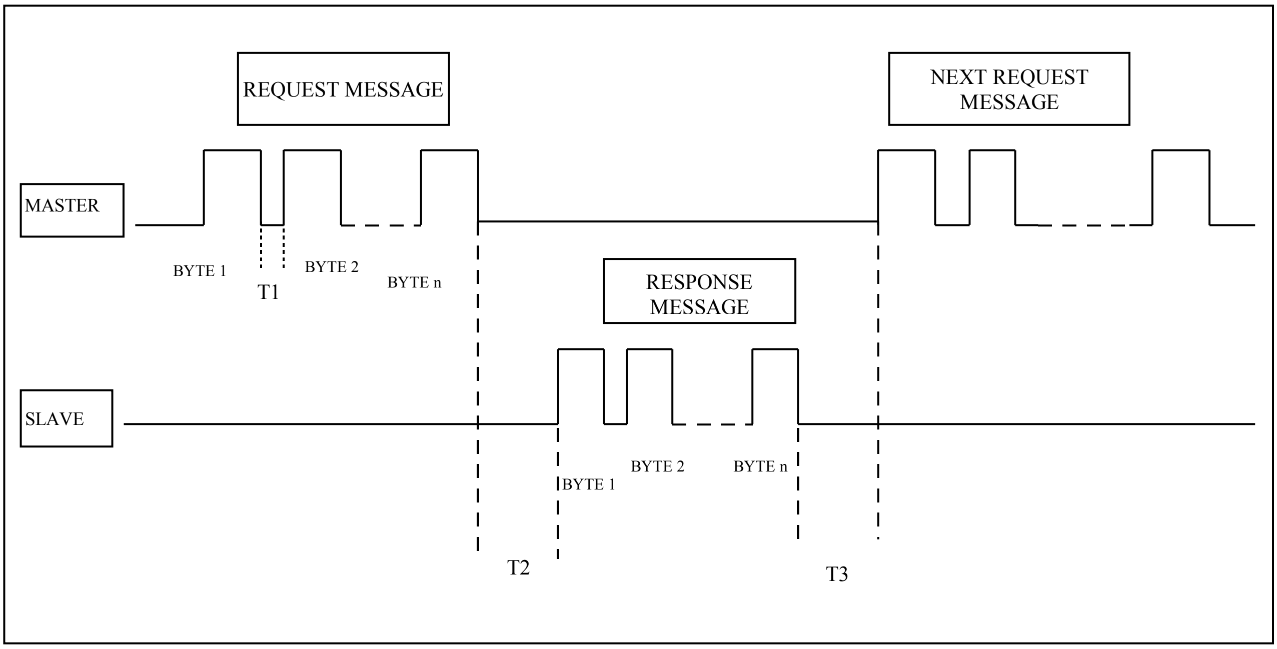
2.4 Error management

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

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

2.5 Timing

2.5.1 TIMING DIAGRAM FOR CONTO D4S COMMUNICATION



Where:

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	MSB LSB
Instrument address	Funct. Code	First WORD address	WORDS number	CRC16

Answer format (containing data) :

BYTE	BYTE	BYTE	MSB LSB	MSB LSB	MSB LSB
Instrument 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	MSB LSB
Instrument 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 (where available)

Command format :

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

Answer format (for CE4D device) :

BYTE	BYTE	BYTE	MSB LSB	MSB LSB	MSB LSB
Instrument Address	Funct. Code	BYTES number	First WORD address	00 00	CRC16

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

Answer format (the demand was wrong) :

BYTE	BYTE	BYTE	MSB LSB
Instrument Address	Funct. Code + 0x80	Error code	CRC16

Error codes :

- 0x01 : incorrect functional code
- 0x02 : wrong first WORD address
- 0x03 : incorrect data

4.0 VARIABLES TABLE

Address	Variable type	Variable Name	DESCRIPTION	Unit	Notes
0x300h	CHAR	identify	*Device type*	-	
0x301h	LONG	V1	*Phase 1: Phase voltages*	0,1V	
0x305h	LONG	V2	*Phase 2: Phase voltages*	0,1V	
0x309h	LONG	V3	*Phase 3: Phase voltages*	0,1V	
0x30Dh	LONG	I1	*Phase 1: Phase current*	mA	
0x311h	LONG	I2	*Phase 2: Phase current*	mA	
0x315h	LONG	I3	*Phase 3: Phase current*	mA	
0x319h	LONG	P attiva trifase	*3 Phase: Active Power*	(1)	
0x31Dh	LONG	P reattiva trifase	*3 Phase: Reactive Power*	(1)	
0x321h	LONG	P apparente trifase	*3 Phase: Apparent Power*	(1)	
0x325h	LONG	EAT	*Total Active Energy*	(2)	
0x329h	LONG	U12	*Chained voltage L1-L2*	0,1V	
0x32Dh	LONG	U23	*Chained voltage L2-L3*	0,1V	
0x331h	LONG	U31	*Chained voltage L3-L1*	0,1V	
0x335h	LONG	Void	*0 not used*	-	
0x339h	INT	FR	*Frequency*	0,1Hz	
0x33Bh	INT	Void	*0 not used*	-	
0x33Dh	INT	FP	*Power Factor*	0,01	
0x33Fh	CHAR	SIGPF	*Sector of power factor (0:FP=1 1:FP=Ind. 2:FP=Cap.)*	-	
0x340h	CHAR	Void	*0 not used*	-	
0x341h	INT	Void	*0 not used*	-	
0x343h	LONG	ERT	*Total Reactive Energy*	(2)	
0x347h	CHAR	Power sign	*Sign of Power (bit mapped)* *0 -> Pos; 1->Neg* *Bit 7 — 3 Phase:Sign react. Power* *Bit 6 — 3 Phase:Sign act. Power* *Bit 5 — Phase 3:Sign react. Power* *Bit 4 — Phase 2:Sign react. Power* *Bit 3 — Phase 1:Sign react. Power* *Bit 2 — Phase 3:Sign act. Power* *Bit 1 — Phase 2:Sign act. Power* *Bit 0 — Phase 1:Sign act. Power*	-	
0x348h	LONG	Void	*0 not used*	-	
0x34Ch	CHAR	Power sign	*(*)*	-	
0x34Dh	CHAR	Void	*0 not used*	-	
0x34Eh	CHAR	Void	*0 not used*	-	
0x34Fh	CHAR	Void	*0 not used*	-	
0x350h	LONG	P med	*Average Power*	(1)	
0x354h	LONG	PMD	*Peak Maximum Demand*	(1)	
0x358h	CHAR	Void	*0 not used*	-	
0x359h	LONG	Void	*0 not used*	-	
035Dh	LONG	P1	*Phase 1: Active Power*	(1)	
0361h	LONG	P2	*Phase 2: Active Power*	(1)	
0x365h	LONG	P3	*Phase 3: Active Power*	(1)	
0x369h	CHAR	Power sign	*(*)*	-	
0x36Ah	CHAR	Power sign	*(*)*	-	

0x36Bh	CHAR	Power sign	*(*)*	-	
0x36Ch	LONG	Q1	*Phase 1: Reactive Power*	(1)	
0x370h	LONG	Q2	*Phase 2: Reactive Power*	(1)	
0x374h	LONG	Q3	*Phase 3: Reactive Power*	(1)	
0x100h	INT	KTI	*Current transformer ratio*	(3)	
0x102h	INT	KTV	*Voltage transformer ratio*	(4)	

(1) KTI*KTV < 6000 0,01W/0,01var/0,01VA
KTI*KTV >= 6000 W/var/VA

(2) For energies metering unit see the table below

Transformer ratio	**Measurement unit**
KTA*KTV < 10	**000000,00 kWh/kvar**
10 < KTA*KTV < 100	0000000,0 kWh/kvarh
100 < KTA*KTV < 1000	**00000000 kWh/kvarh**
1000 < KTA*KTV < 10000	**000000,00 MWh/Mvarh**
10000 < KTA*KTV	0000000,0 MWh/Mvarh

(3) The current transformer ratio is the ratio between the rated primary value and the rated secondary value. i.e. 100/5 -> KTI=20

(4) The voltage transformer ratio is the ratio between the rated primary value and the rated secondary value multiplied by 10. i.e. (380/100) x 10 -> KTV=38

Example

Demand of 4 WORDS (8 BYTES – 2 variables) starting from the address 0x0325 :

BYTE	BYTE	MSB	LSB	MSB	LSB	MSB	LSB
Instrum. address	F.code	1st WORD address		WORDS number		CRC16	
0x01	0x03	0x03	0x25	0x00	0x04	0x55	0x86

Answer

BYTE	BYTE	BYTE	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB
		BYTES number	WORD 1		WORD 2		WORD 3		WORD 4		CRC16	
0x01	0x03	0x08	0x00	0x00	0x64	0x8c	0x00	0x00	0x35	0x54	0x9a	0x83

In the above case, the information is :
WORD 1 ,WORD 2 : Total active energy 0x0000648C = 25740

WORD 3 ,WORD 4 : Total reactive energy 0x00003554 = 13652