Conto D4-Pd - 3 single phase meter

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1.0 INTRODUCTION

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.
Up to 255 different instruments can be managed by the protocol.
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 could be necessary and it is specified for each device (timing).

2.0 DATA PACKET 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 Parameter 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 (not used)

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 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

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 */
```

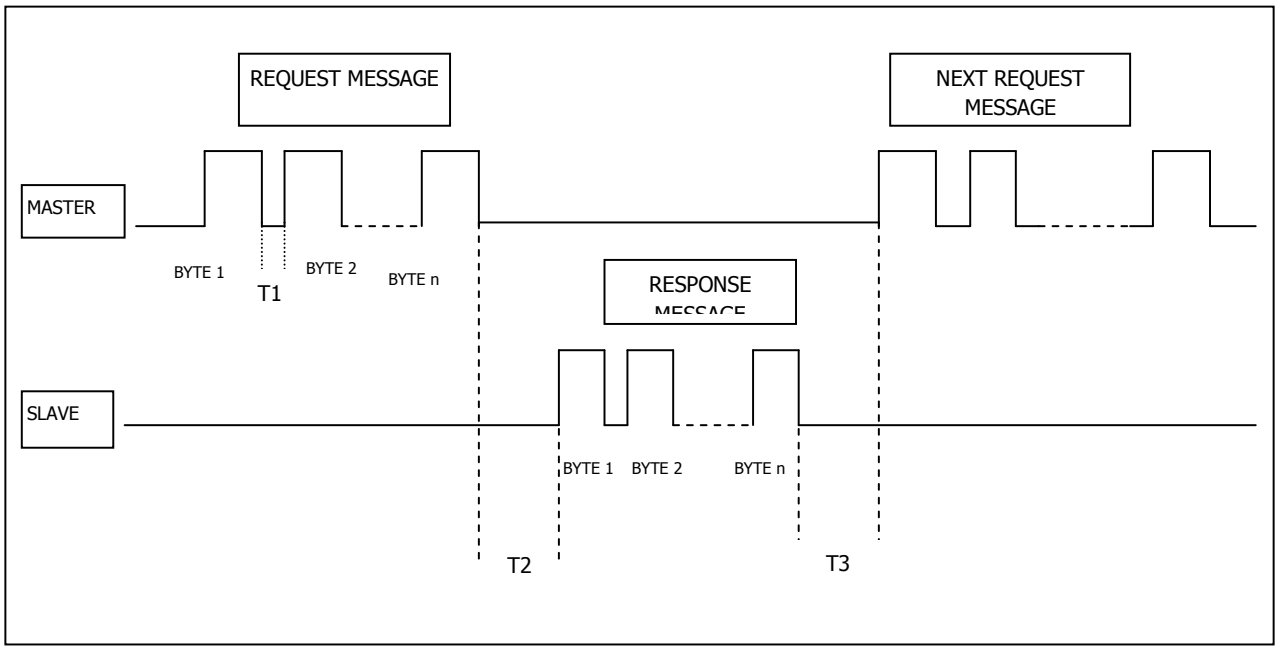
2.4 Error management

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

TIMING DIAGRAM FOR COMMUNICATION



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	**Message pause time** 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

4.1 Data addresses

In the following there is the table with the addresses and the meanings of the variables.
Variables can be retrieved up to 100 BYTES.

	Address	Format	Description	Unit
First energy meter (phase 1)	0x2000	UD_WORD	voltage	mV
	0x2002	UD_WORD	current	mA
	0x2004	UD_WORD	active power	W/100
	0x2006	UD_WORD	sign of active power	(2)
	0x2007	UD_WORD	reactive power	Var/100
	0x2009	U_WORD	sign of reactive power	(2)
	0x200a	U_WORD	power factor	1/100
	0x200b	U_WORD	sector of power factor (cap or ind)	(1)
	0x200c	UD_WORD	average power	W/100
	0x200e	UD_WORD	peak maximum demand	W/100
	0x2010	UD_WORD	Elapsed time	min
	0x2012	UD_WORD	total positive active energy	kWh/100
	0x2014	UD_WORD	total positive reactive energy	kvarh/100
	0x2016	U_WORD	Frequency	Hz/10
Second energy meter (phase 2)	0x2020	UD_WORD	voltage	mV
	0x2022	UD_WORD	current	mA
	0x2024	UD_WORD	active power	W/100
	0x2026	U_WORD	sign of active power	(2)
	0x2027	UD_WORD	reactive power	Var/100
	0x2029	U_WORD	sign of reactive power	(2)
	0x202a	U_WORD	power factor	1/100
	0x202b	U_WORD	sector of power factor (cap or ind)	(1)
	0x202c	UD_WORD	average power	W/100
	0x202e	UD_WORD	peak maximum demand	W/100
	0x2030	UD_WORD	Elapsed time	min
	0x2032	UD_WORD	total positive active energy	kWh/100
	0x2034	UD_WORD	total positive reactive energy	kvarh/100
	0x2036	U_WORD	Frequency	Hz/10
Third energy meter (phase 3)	0x2040	UD_WORD	voltage	mV
	0x2042	UD_WORD	current	mA
	0x2044	UD_WORD	active power	W/100
	0x2046	U_WORD	sign of active power	(2)
	0x2047	UD_WORD	reactive power	Var/100
	0x2049	U_WORD	sign of reactive power	(2)
	0x204a	U_WORD	power factor	1/100
	0x204b	U_WORD	sector of power factor (cap or ind)	(1)
	0x204c	UD_WORD	average power	W/100
	0x204e	UD_WORD	peak maximum demand	W/100

0x2050	UD_WORD	Elapsed time	min
0x2052	UD_WORD	total positive active energy	kWh/100
0x2054	UD_WORD	total positive reactive energy	kvarh/100
0x2056	U_WORD	Frequency	Hz/10

	Address	Format	Description	Unit
	0x110	UD_WORD	Power Threshold for starting meter 1	Percentage *100 (2.50% => 250)
	0x112	UD_WORD	Power Threshold for starting meter 2	Percentage *100 (2.50% => 250)
	0x114	UD_WORD	Power Threshold for starting meter 3	Percentage *100 (2.50% => 250)
	0xC8	U_WORD	Accumulated quantities reset	(3)
	0300	U_WORD	Device identifier	0x03

(1) ----------

0 : PF = 0 or 1
1 : ind
2 : cap

(2) ----------

0 : positive
1 : negative

(3) ----------

WRITABLE ONLY

0x01 : reset peak maximum demand counter 1
0x02 : reset peak maximum demand counter 2
0x04 : reset peak maximum demand counter 3
0x08 : reset timer counter 1
0x10 : reset timer counter 2
0x20 : reset timer counter 3

4.2 Variables description

Energy

Positive energy
Format : long
Measurement unit : Hundreds of kWh/kvarh

Average power

Average power
This is the power calculated with the shifting average algorithm. It is updated every minute.
Format : long
Measurement unit : W/100
Peak maximum demand
This is the power obtained as the maximum of the average powers and it is updated at the end of average period.
Format : long
Measurement unit : W/100

Operating time counter

Format : long
Measurement unit : min

Example

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

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