Communication Protocol

MGF3900S--

NA96/NA96+ plug-in module for data storage via RS485

Version B

1. New function : data record type 4
2. New function : energy reading
3. New function : real time reading
4. New function : failures management

CONTENTS

1.0 INTRODUCTION

Data link level

The communication protocol used is MODBUS / JBUS compatible.
Up to 255 different instruments can be managed by the protocol.
Data are transmitted in messages and are checked by mean of a CRC16 WORD
There are no limitations to the number of possible retries done by the master.

Physical level

The physical 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 polling the slave instruments and waiting for the answers.

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 :

speed : programmable
bit n. : 8
stop bit : 1
parity : programmable

2.0 DATA MESSAGE 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 Data field 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 (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 and the number 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

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* 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.

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 readable in other variables.

2.3 Description of CRC calculation

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

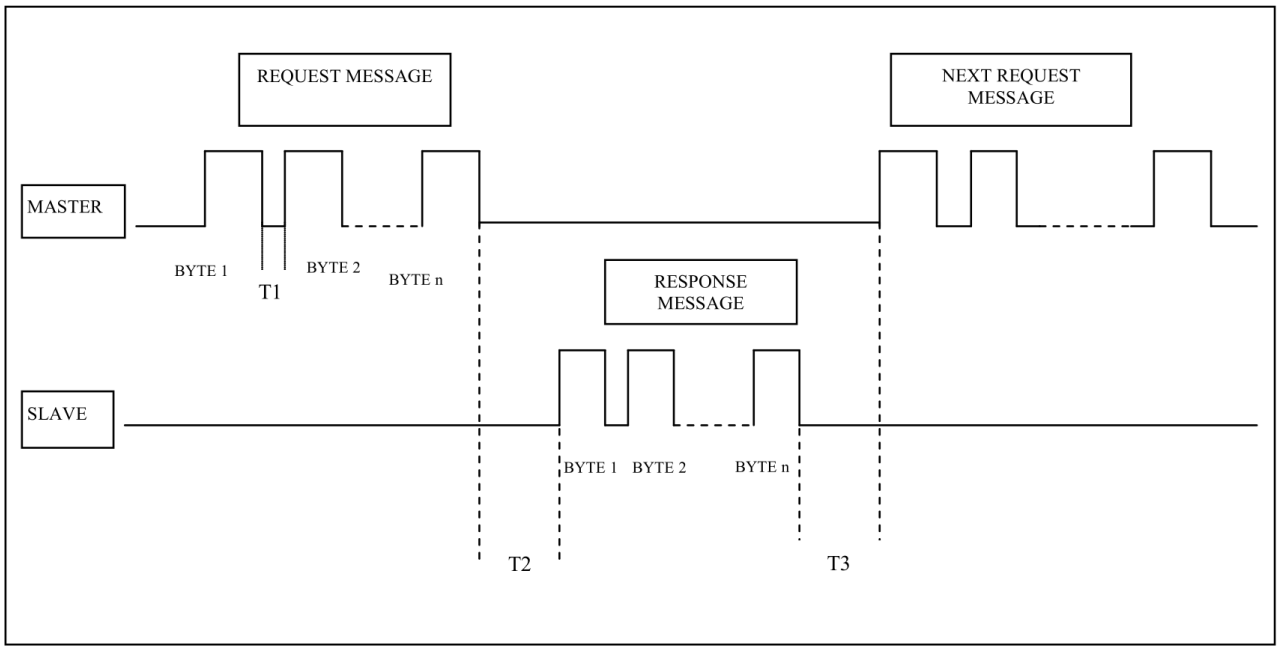
```
unsigned int calc_crc (char *ptbuf, unsigned int num)
/*    ****************************************************************
 *    Descrizione : calculates a data buffer CRC WORD
 *    Input       : ptbuf = pointer to the first byte of the buffer
 *                  num   = number of bytes
 *    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 kept */
              crc16 = crc16 >> 1;              /* LSBit di crc16 is lost */
              if (flag != 0)
                   crc16 = crc16 ^ 0x0a001;    /* crc16 XOR with 0x0a001 */
        }
        ptbuf++;                               /* points 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) 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



Values :

T1 (time between characters) = 25 msec (max)
T2 (slave response time) = 100 msec (max)
T3 (delay time) = 25 msec (min)

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 (wrong request) :

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

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 (containing data) :

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 (wrong request) :

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

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

4.0 VARIABLES

4.1 Reading

NOTE : the format of date and time data are in BCD format

Address	Byte n.	Description	Example
0x5120	12	Current date and time	(1.1)
0x5140	4	Saving interval period and record data type	(1.2)
0x5500	12	Initial date and time for energy data reading	(1.3)
0x5510	12	Date and time for start of Daylight Saving Time period	(1.4)
0x5520	12	Date and time for end of Daylight Saving Time period	(1.5)
0x5A00	12	Initial date and time for real time data reading	(1.6)
0x5000	XX	Energy stored data page reading	(1.7)
0x5010	XX	Real Time Stored data page reading	(1.8)
0x3700		Real time measurements : bit map	

(1.1) Current date and time reading :

Request **FF 03 51 20 00 06 C1 20**
Answer FF 03 0C 00 02 00 01 00 00 00 02 00 46 00 35 B3 1A (02/01/00 02:46:35)

(1.2) Saving interval period for Real Time data and Energy data and record data type reading :

Request **9b 03 51 40 00 03 09 19**
Answer 9b 03 06 00 01 00 00 00 00 ce 13 (5 seconds Type 0 5minutes)

Real Time interval period		Record data type		Energy interval period	
Reading Value	Meaning	Reading Value	Meaning	Reading Value	Meaning
00 00	2 sec	00 00	Type 0	00 00	5 min
00 01	5 sec	00 01	Type 1	00 01	10 min
00 02	10 sec	00 02	Type 2	00 02	15 min
00 03	30 sec	00 03	Type 3		
00 04	60 sec	00 04	Type 4		
00 05	2 min				
00 06	5 min				
00 07	10 min				

Type 4 : new type. Possibility to choose the measurements to store.

(1.3) Date and time of the first record of integrated data (energies and average powers) :

Request **FF 03 55 00 00 06 C1 DA**
Answer FF 03 0C 00 01 00 01 00 00 00 00 00 00 00 00 E4 5C (01/01/00 00:00:00)

(1.4) Date and time of start of Daylight Saving Time period :

Request **FF 03 55 10 00 06 C0 1F**
Answer FF 03 0C 00 29 00 03 00 09 00 03 00 00 00 00 A1 9C (29/03/09 03:00:00)

(1.5) Date and time of end of Daylight Saving Time period :

Request **FF 03 55 20 00 06 C0 10**
Answer FF 03 0C 00 25 00 10 00 09 00 02 00 00 00 00 7A 3C (25/10/09 02:00:00)

(1.6) Date and time of the first record of real time data (voltages, currents etc.) reading :

Request **FF 03 5A 00 00 06 C2 CE**
Answer FF 03 0C 00 01 00 01 00 00 00 00 00 00 00 00 E4 5C (01/01/00 00:00:00)

(1.7) Energy data page reading :

Request **FF 03 50 00 00 00 41 14**
Answer FF 03 F0

```
18 06 09          Data of current record  n
13 50 00          Time of current record  n
00 01 D5  88      Active Positive Energy
00 02 BE  58      Active Negative Energy
00 03 5A  FC      Reactive Positive Energy
00 00 01  84      Reactive Negative Energy
00 00 03  1D      Average Power
00 00 04  AF      Maximum Power Demand

18 06 09          Data for current record  n+1
14 05 00          Time for current record  n+1
00 01 D5  88      Active Positive Energy
00 02 BE  58      Active Negative Energy
00 03 5A  FC      Reactive Positive Energy
00 00 01  84      Reactive Negative Energy
00 00 03  1D      Average Power
00 00 04  AF      Maximum Power Demand

18 06 09          Data for current record  n+2
14 20 00          Time for current record  n+2
00 01 D5  88      Active Positive Energy
00 02 BE  58      Active Negative Energy
00 03 5A  FC      Reactive Positive Energy
00 00 01  84      Reactive Negative Energy
00 00 03  1D      Average Power
00 00 04  AF      Maximum Power Demand

18 06 09          Data for current record  n+3
14 35 00          Time for current record  n+3
00 01 D5  88      Active Positive Energy
00 02 BE  58      Active Negative Energy
00 03 5A  FC      Reactive Positive Energy
00 00 01  84      Reactive Negative Energy
00 00 03  1D      Average Power
00 00 04  AF      Maximum Power Demand
```

```
18 06 09          Data for current record  n+4
14 50 00          Time for current record  n+4
00 01 D5  88      Active Positive Energy
00 02 BE  58      Active Negative Energy
00 03 5A  FC      Reactive Positive Energy
00 00 01  84      Reactive Negative Energy
00 00 03  1D      Average Power
00 00 04  AF      Maximum Power Demand

18 06 09          Data for current record  n+5
13 51 33          Time for current record  n+5
00 01 D5  88      Active Positive Energy
00 02 BE  58      Active Negative Energy
00 03 5A  FC      Reactive Positive Energy
00 00 01  84      Reactive Negative Energy
00 00 03  1D      Average Power
00 00 04  AF      Maximum Power Demand

18 06 09          Data for current record  n+6
15 05 00          Time for current record  n+6
00 01 D5  88      Active Positive Energy
00 02 BE  58      Active Negative Energy
00 03 5A  FC      Reactive Positive Energy
00 00 01  84      Reactive Negative Energy
00 00 03  1D      Average Power
00 00 04  AF      Maximum Power Demand

18 06 09          Data for current record  n+7
15 20 00          Time for current record  n+7
00 01 D5  88      Active Positive Energy
00 02 BE  58      Active Negative Energy
00 03 5A  FC      Reactive Positive Energy
00 00 01  84      Reactive Negative Energy
00 00 03  1D      Average Power
00 00 04  AF      Maximum Power Demand
3E FD
```

Energy data reading – new function

The most recent data that are not in the long term memory, now can be required using the same command.
Should the record not be completed with all the 8 records, only the available data will be transmitted.

(1.8) Real Time stored data reading: (for a Data record - Type 0)

Request **[ff][03][50][10][00][00][40][d1]**
Answer [ff][03][e4]

[18][06][09]	Date for current record n
[13][51][33]	Time for current record n
[00][01][d5][88]	V1
[00][02][be][58]	V2
[00][03][5a][fc]	V3
[00][00][01][84]	I1
[00][00][03][1d]	I2
[00][00][04][af]	I3
[00][00][02][bd]	In
[00][03][fc][b4]	V12
[00][05][49][84]	V23
[00][04][8f][30]	V31
[00][00][58][69]	P
[00][00][99][9b]	Q
[00][00][b1][16]	S
[00][31]	PF
[00][01]	sect PF
[01][f4]	Freq
[00][00][08][fe]	P1
[00][00][1b][dd]	P2
[00][00][33][8e]	P3
[00][00][0f][e3]	Q1
[00][00][30][86]	Q2
[00][00][59][32]	Q3
[00][31]	PF1
[00][31]	PF2
[00][32]	PF3
[00][01]	sect PF1
[00][01]	sect PF2
[00][01]	sect PF3
[00][00]	V1thd
[00][00]	V2thd
[00][00]	V3thd
[00][00]	I1thd
[00][00]	I2thd
[00][00]	I3thd
[00][00]	Relay status

[18][06][09]	Date for current record n +1
[13][51][33]	Time for current record n +1
[00][01][d5][88]	V1
[00][02][be][58]	V2
[00][03][5a][fc]	V3
[00][00][01][84]	I1
[00][00][03][1d]	I2
[00][00][04][af]	I3
[00][00][02][bd]	In
[00][03][fc][b4]	V12
[00][05][49][84]	V23
[00][04][8f][30]	V31
[00][00][58][69]	P
[00][00][99][9b]	Q
[00][00][b1][16]	S
[00][31]	PF
[00][01]	sect PF
[01][f4]	Freq
[00][00][08][fe]	P1
[00][00][1b][dd]	P2
[00][00][33][8e]	P3
[00][00][0f][e3]	Q1
[00][00][30][86]	Q2
[00][00][59][32]	Q3
[00][31]	PF1
[00][31]	PF2
[00][32]	PF3
[00][01]	sect PF1
[00][01]	sect PF2
[00][01]	sect PF3
[00][00]	V1thd
[00][00]	V2thd
[00][00]	V3thd
[00][00]	I1thd
[00][00]	I2thd
[00][00]	I3thd
[00][00]	Relay status
[7a][81]	

Real data reading - new function

In this new protocol version, real time data can be stored on user selection.

For this

See : variable bit mapped at address 0x3700

4.2 Writing

Address	Byte n.	Description	Example
0x5120	12	Current date and time	(2.1)
0x5140	4	Saving real time data interval and packet data type	(2.2)
0x5142	2	Saving energy data interval	(2.X)
0x5500	12	Initial date and time for energy data reading	(2.3)
0x5510	12	Date and time for start of Daylight Saving Time period	(2.4)
0x5520	12	Date and time for end of Daylight Saving Time period	(2.5)
0x5A00	12	Initial date and time for real time data	(2.6)
0x5B00	8	Reset all energy data memory	(2.7)
0x5C00	8	Reset all real time data memory	(2.8)

Note : write the right number of bytes to any address otherwise errors can occur.

(2.1) Current date and time :

Command **FF 10 51 20 00 06 0C 00 17 00 06 00 09 00 12 00 11 00 47 33 52**
(17/06/09 12:11:47)
Answer FF 10 51 20 00 06 44 E3

(2.2) Saving interval time period and record data type :

Command FF 10 51 40 00 02 04 00 06 00 02 50 27
(5 minutes Type 2)
Answer FF 10 51 40 00 02 45 3E

Writing Value	Meaning	Writing Value	Meaning
00 00	2 sec	00 00	Type 0
00 01	5 sec	00 01	Type 1
00 02	10 sec	00 02	Type 2
00 03	30 sec	00 03	Type 3
00 04	60 sec	00 04	Type 4
00 05	2 min		
00 06	5 min		
00 07	10 min		

Note : writing a new value for data record type has the effect to erase the real time data memory.
Writing a new value for saving interval time period has no effect on the stored data that have been already saved in the memory.

(2.3) Initial date and time for integrated data (energies and average powers) (17/06/09 12:11:47) :

Command **FF 10 55 00 00 06 0C 00 17 00 06 00 09 00 12 00 11 00 47 68 4B**
Answer FF 10 55 00 00 06 44 19

(2.4) Date and time for start of Daylight Saving Time period (01/02/09 01:01:01) :

Command **FF 10 55 10 00 06 0C 00 01 00 02 00 09 00 01 00 01 00 01 18 FB**
Answer FF 10 55 10 00 06 45 DC

(2.5) Date and time for end of Daylight Saving Time period (11/09/09 02:00:00) :

Command **FF 10 55 20 00 06 0C 00 11 00 09 00 09 00 02 00 00 00 00 FF 1F**
Answer FF 10 55 20 00 06 45 D3

(2.6) Initial date and time for real time data (voltages, currents etc.) (15/10/08 02:30:50) :

Command **FF 10 5A 00 00 06 0C 00 15 00 10 00 08 00 02 00 30 00 50 71 67**
Answer FF 10 5A 00 00 06 47 0D

(2.7) Reset all energy data memory :

Command **FF 10 5B 00 00 04 08 52 65 73 65 74 4D 65 6D 85 53**
Answer FF 10 5B 00 00 04 C7 30

(2.8) Reset all real time data memory :

Command **FF 10 5C 00 00 04 08 52 65 73 65 74 44 61 64 9C D0**
Answer FF 10 5C 00 00 04 C6 44

(2.9) Failures management

It is possible to know if currently there are any FAILURE events or which was the last one, as in the following table :

ADDRESS	Number of bytes	Meaning
0x200	4	bitmap of current errors (I)
0x204	4	date of last error event
0x208	4	hour of last error event
0x20C	4	bitmap of last error event

Request FF 03 02 00 00 08 50 6A
Answer FF 03 10 00 00 00 00 00 05 0C 0B 00 0B 1C 1D 00 00 20 00 33 D8

00 00 00 00 currently no Failure event active
00 05 0C 0B 05/12/11 date of last Failure event
00 0B 1C 1D 11:28:29 hour of last Failure event
00 00 20 00 bitmap of last Failure event (No communication between NEMO96 and Memory module)

(I) 0x00000001 bit 0 Voltages Phase Sequence Error
0x00000002 bit 1 Data Setup Error
0x00000004 bit 2 Slot Position Error
0x00000008 bit 3 Data Calibration Error
0x00000010 bit 4 Error on SLOT 0
0x00000020 bit 5 Error on SLOT 1
0x00000040 bit 6 Error on SLOT 2
0x00000080 bit 7 Error on SLOT 3
0x00000100 bit 8 Communication Error with Analog Output on SLOT2
0x00000200 bit 9 Communication Error with Analog Output on SLOT3
0x00000400 bit 10 Communication Error with Input Output on SLOT2
0x00000800 bit 11 Communication Error with Input Output on SLOT3
0x00001000 bit 12 Communication Error with Temperature Module on SLOT3
0x00002000 bit 13 Communication Error with Memory Module on SLOT0

4.3 Data record types

Type 0

Byte n.	Description	Unit
Long	Phase 1 : phase voltage	mV
Long	Phase 2 : phase voltage	mV
Long	Phase 3 : phase voltage	mV
Long	Phase 1 : current	mA
Long	Phase 2 : current	mA
Long	Phase 3 : current	mA
Long	Neutral current	mA
Long	Chained voltage : L1-L2	mV
Long	Chained voltage : L2-L3	mV
Long	Chained voltage : L3-L1	mV
Long	3-phase : active power	
Long	3-phase : reactive power	
Long	3-phase : apparent power	
WORD	3-phase : power factor	1/100
WORD	3-phase : sector of power factor (cap or ind)	1 : ind 2 : cap
WORD	Frequency	Hz/10
Long	Phase 1 : active power	
Long	Phase 2 : active power	
Long	Phase 3 : active power	
Long	Phase 1 : reactive power	
Long	Phase 2 : reactive power	
Long	Phase 3 : reactive power	
WORD	Phase 1 : power factor	1/100
WORD	Phase 2 : power factor	1/100
WORD	Phase 3 : power factor	1/100
WORD	Phase 1 : power factor sector	1 : ind 2 : cap
WORD	Phase 2 : power factor sector	1 : ind 2 : cap
WORD	Phase 3 : power factor sector	1 : ind 2 : cap
WORD	Phase 1 : THD V1	%
WORD	Phase 2 : THD V2	%
WORD	Phase 3 : THD V3	%
WORD	Phase 1 : THD I1	%
WORD	Phase 2 : THD I2	%
WORD	Phase 3 : THD I3	%
WORD	Output relay status	

Type 1

Byte n.	Description	Unit
Long	Phase 1 : phase voltage	mV
Long	Phase 2 : phase voltage	mV
Long	Phase 3 : phase voltage	mV
Long	Phase 1 : current	mA
Long	Phase 2 : current	mA
Long	Phase 3 : current	mA
Long	Neutral current	mA
Long	3-phase : active power	
Long	3-phase : reactive power	
Long	3-phase : apparent power	
WORD	3-phase : power factor	1/100
WORD	3-phase : sector of power factor (cap or ind)	1 : ind 2 : cap
WORD	Frequency	Hz/10
Long	Phase 1 : active power	
Long	Phase 2 : active power	
Long	Phase 3 : active power	
Long	Phase 1 : reactive power	
Long	Phase 2 : reactive power	
Long	Phase 3 : reactive power	
WORD	Phase 1 : power factor	1/100
WORD	Phase 2 : power factor	1/100
WORD	Phase 3 : power factor	1/100
WORD	Phase 1 : power factor sector	1 : ind
		2 : cap
WORD	Phase 2 : power factor sector	1 : ind
		2 : cap
WORD	Phase 3 : power factor sector	1 : ind
		2 : cap
WORD	Output relay status	

Type 2

Byte n.	Description	Unit
Long	Phase 1 : current	mA
Long	Phase 2 : current	mA
Long	Phase 3 : current	mA
Long	Neutral current	mA
Long	Chained voltage : L1-L2	mV
Long	Chained voltage : L2-L3	mV
Long	Chained voltage : L3-L1	mV
Long	3-phase : active power	
Long	3-phase : reactive power	
Long	3-phase : apparent power	
WORD	3-phase : power factor	1/100
WORD	3-phase : sector of power factor (cap or ind)	1 : ind 2 : cap
WORD	Frequency	Hz/10
WORD	Output relay status	

Type 3

Byte n.	Description	Unit
Long	Phase 1 : phase voltage	mV
Long	Phase 2 : phase voltage	mV
Long	Phase 3 : phase voltage	mV
Long	Phase 1 : current	mA
Long	Phase 2 : current	mA
Long	Phase 3 : current	mA
Long	Neutral current	mA
Long	3-phase : active power	
Long	3-phase : reactive power	
Long	3-phase : apparent power	
WORD	3-phase : power factor	1/100
WORD	3-phase : sector of power factor (cap or ind)	1 : ind 2 : cap
WORD	Frequency	Hz/10
WORD	Output relay status	

Data Record Type 1 reading

Request **[ff][03][50][10][00][00][40][d1]**
Answer **[ff][03][b4]**

[23][06][09]	Date for current record n
[17][40][16]	Time for current record n
[00][03][7c][f8]	V1
[00][03][7b][cc]	V2
[00][03][7c][30]	V3
[00][00][13][68]	I1
[00][00][0f][56]	I2
[00][00][0d][fe]	I3
[00][00][0d][7d]	In
[00][02][8d][29]	P
[00][01][78][63]	Q
[00][02][f1][b5]	S
[00][56]	PF
[00][01]	PF sector
[01][f4]	Freq
[00][01][81][23]	P1
[00][00][bf][66]	P2
[00][00][4c][a0]	P3
[00][00][dc][e4]	Q1
[00][00][6f][05]	Q2
[00][00][2c][7a]	Q3
[00][56]	PF1
[00][56]	PF2
[00][56]	PF3
[00][01]	PF1 sector
[00][01]	PF2 sector
[00][01]	PF3 sector
[00][00]	Relay status
[23][06][09]	Date for current record n+1
[17][40][26]	Time for current record n+1
[00][03][7c][f8]	V1
[00][03][7b][cc]	etc..
[00][03][7c][30]	
[00][00][13][68]	
[00][00][0f][56]	
[00][00][0d][fe]	
[00][00][0d][7d]	
[00][02][8d][29]	
[00][01][78][63]	
[00][02][f1][b5]	
[00][56]	
[00][01]	
[01][f4]	
[00][01][81][23]	
[00][00][bf][66]	
[00][00][4c][a0]	
[00][00][dc][e4]	
[00][00][6f][05]	
[00][00][2c][7a]	
[00][56]	
[00][56]	
[00][56]	
[00][01]	
[00][01]	
[00][01]	
[00][00]	
[9e][37]	CRC

Data Record Type 2 reading

Request **[ff][03][50][10][00][00][40][d1]**
Answer **[ff][03][d8]**

[24][06][09]	Date for current record n
[10][24][25]	Time for current record n
[00][00][13][68]	I1
[00][00][0f][56]	I2
[00][00][0d][fe]	I3
[00][00][0d][7d]	In
[00][06][07][5c]	V12
[00][06][06][f8]	V23
[00][06][0a][e0]	V31
[00][02][8d][29]	P
[00][01][78][63]	Q
[00][02][f1][b5]	S
[00][56]	PF
[00][01]	PF sector
[01][f4]	Freq
[00][00]	Relay status
[24][06][09]	Date for current record n+1
[10][24][36]	Time for current record n+1
[00][00][13][68]	
[00][00][0f][56]	
[00][00][0d][fe]	
[00][00][0d][7d]	
[00][06][07][5c]	
[00][06][06][f8]	
[00][06][0a][e0]	
[00][02][8d][29]	
[00][01][78][63]	
[00][02][f1][b5]	
[00][56][00][01]	
[01][f4]	
[00][00]	
[24][06][09]	Date for current record n+2
[10][24][45]	Time for current record n+2
[00][00][13][68]	
[00][00][0f][56]	
[00][00][0d][fe]	
[00][00][0d][7d]	
[00][06][07][5c]	
[00][06][06][f8]	
[00][06][0a][e0]	
[00][02][8d][29]	
[00][01][78][63]	
[00][02][f1][b5]	
[00][56]	
[00][01]	
[01][f4]	
[00][00]	
[24][06][09]	Date for current record n+3
[10][24][55]	Time for current record n+3
[00][00][13][68]	
[00][00][0f][56]	
[00][00][0d][fe]	
[00][00][0d][7d]	
[00][06][07][5c]	
[00][06][06][f8]	
[00][06][0a][e0]	
[00][02][8d][29]	

[00][01][78][63]	
[00][02][f1][b5]	
[00][56]	
[00][01]	
[01][f4]	
[00][00]	
[dc][3b]	CRC

Data Record Type 3 reading

Request **[ff][03][50][10][00][00][40][d1]**
Answer **[ff][03][d8]**

[24][06][09]	Date for current record n
[13][33][42]	Time for current record n
[00][03][7c][f8]	V1
[00][03][7b][cc]	V2
[00][03][7c][30]	V3
[00][00][13][68]	I1
[00][00][0f][56]	I2
[00][00][0d][fe]	I3
[00][00][0d][7d]	In
[00][02][8d][29]	P
[00][01][78][63]	Q
[00][02][f1][b5]	S
[00][56]	PF
[00][01]	Power Factor sector
[01][f4]	Frequency
[00][00]	Relay status
[24][06][09]	Date for current record n+1
[13][33][53]	Time for current record n+1
[00][03][7c][f8]	
[00][03][7b][cc]	
[00][03][7c][30]	
[00][00][13][68]	
[00][00][0f][56]	
[00][00][0d][fe]	
[00][00][0d][7d]	
[00][02][8d][29]	
[00][01][78][63]	
[00][02][f1][b5]	
[00][56]	
[00][01]	
[01][f4]	
[00][00]	
[24][06][09]	Date for current record n+2
[13][34][03]	Time for current record n+2
[00][03][7c][f8]	
[00][03][7b][cc]	
[00][03][7c][30]	
[00][00][13][68]	
[00][00][0f][56]	
[00][00][0d][fe]	
[00][00][0d][7d]	
[00][02][8d][29]	
[00][01][78][63]	
[00][02][f1][b5]	
[00][56]	
[00][01]	
[01][f4]	
[00][00]	
[24][06][09]	Date for current record n+3
[13][34][13]	Time for current record n+3
[00][03][7c][f8]	
[00][03][7b][cc]	
[00][03][7c][30]	
[00][00][13][68]	
[00][00][0f][56]	
[00][00][0d][fe]	
[00][00][0d][7d]	

[00][02][8d][29]	
[00][01][78][63]	
[00][02][f1][b5]	
[00][56]	
[00][01]	
[01][f4]	
[00][00]	
[68][db]	CRC

Real time data : bit mapped variable reading

For Data Type 0, 1, 2, 3 there is a fixed format; Data Type 4 has a variable format for data.
This means that in the case of Data Type 4 user can choose which variable to save.
To select the right measurements, there is a bit map that can be read or written.

```
Address : 0x3700
Format  : b34 ... b0
```

The variable is 10 BYTES long but only the LSByte 4..0 are used at the moment. If a 1 is written in the proper position, the correspondent variable is stored.

```
b34    relay status
b33    THD I3
b32    THD I2

b31    THD I1
b30    THD V3
b29    THD V2
b28    THD V1
b27    PF3 sect
b26    PF2 sect
b25    PF1 sect
b24    PF3

b23    PF2
b22    PF1
b21    Q3
b20    Q2
b19    Q1
b18    P3
b17    P2
b16    P1

b15    Freq
b14    Pf sect
b13    PF
b12    S
b11    Q
b10    P
b9     V31
b8     V23

b7     V12
b6     In
b5     I3
b4     I2
b3     I1
b2     V3
b1     V2
b0     V1
```

For example :

```
Answer        9B  03  37  00  00  05  96  47
Response      9B  03  0A  00  00  00  00  00  05  55  55  55  55  CF 5E


00000000  00000000  00000000  00000000  00000000  0000 0101  01010101  01010101  01010101  01010101
                                                    b34                                       b0
```

Any record is composed as in the following :

```
b34 Relay status
b32 THD I2

b30 THD V3
b28 THD V1
b26 PF2 sect
b24 PF3

b22 PF1
b20 Q2
b18 P3
b16 P1

b14 PF sect
b12 S
b10 P
b8  V23

b6  In
b4  I2
b2  V3
b0  V1
```

Real time data : bit mapped variable writing

To write the bit mapped variable, the following procedure is mandatory :

1. Write 0x5AA5 to 0x2700 to unlock the procedure
2. Write at 0x3700 the data

```
Command1      9B 10  27 00  00 01 02   5A A5  D9  2F
Answer        9B 10  27 00  00 01 16   87
```

```
Command2      9B 10 37 00  00 05 0A  00 [55] 00 [55] 00 [55] 00 [55] 00 [05] D9  2F
                                        (A)     (B)     (C)     (D)     (E)
Answer        9B 10 27 00  00 01 16  87
```

```
(A) 00000000 01010101          b7   b6   b5  b4   b3  b2   b1   b0
(B) 00000000 01010101          b15 b14  b13 b12  b11 b10   b9   b8
(C) 00000000 01010101          b23 b22  b21 b20  b19 b18  b17  b16
(D) 00000000 01010101          b31 b30  b29 b28  b27 b26  b25  b24
(E) 00000000 00000101          b34 b33  b32
```

Real time data reading

As an example of data reading, in this case we have :

Set as starting date 01/01/01 and as time 00:00:00

```
Command     ff 10 5a 00 00 06 0c 00 01 00 01 00 01 00 00 00 00 00 00 10 34
Answer      ff 10 5a 00 00 06 47 0d

Command     ff 03 50 10 00 00 c1 10
Answer      ff 03 f8
            06 12 11 14 00 00     06/12/2011  14:00:00

            (BLOCK A)
            00 02 c3 08           V1
            00 03 5a fc           V3
            00 00 04 c9           I2
            00 00 04 1d           In
            00 05 8b 88           V23
            00 01 11 7c           P
            00 01 23 26           S
            00 01                 Sect PF
            00 00 26 b1           P1
            00 00 91 24           P3
            00 00 20 df           Q2
            00 5d                 PF1
            00 5d                 PF3
            00 01                 Sect PF2
            00 00                 V1 THD
            00 00                 V3 THD
            00 02                 I2 THD
            00 00                 relay status

            06 12 11 14 00 30
            AS BLOCK (A)


            06 12 11 14 01 00
            AS BLOCK (A)

            06 12 11 14 01 30
            AS BLOCK (A)

            [7e][d9]                    CRC16
```