Contents

Rev	DESCRIPTION	Date	Sw
B	Formal revision	10/05/2016	➢ 3.18

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.
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 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.

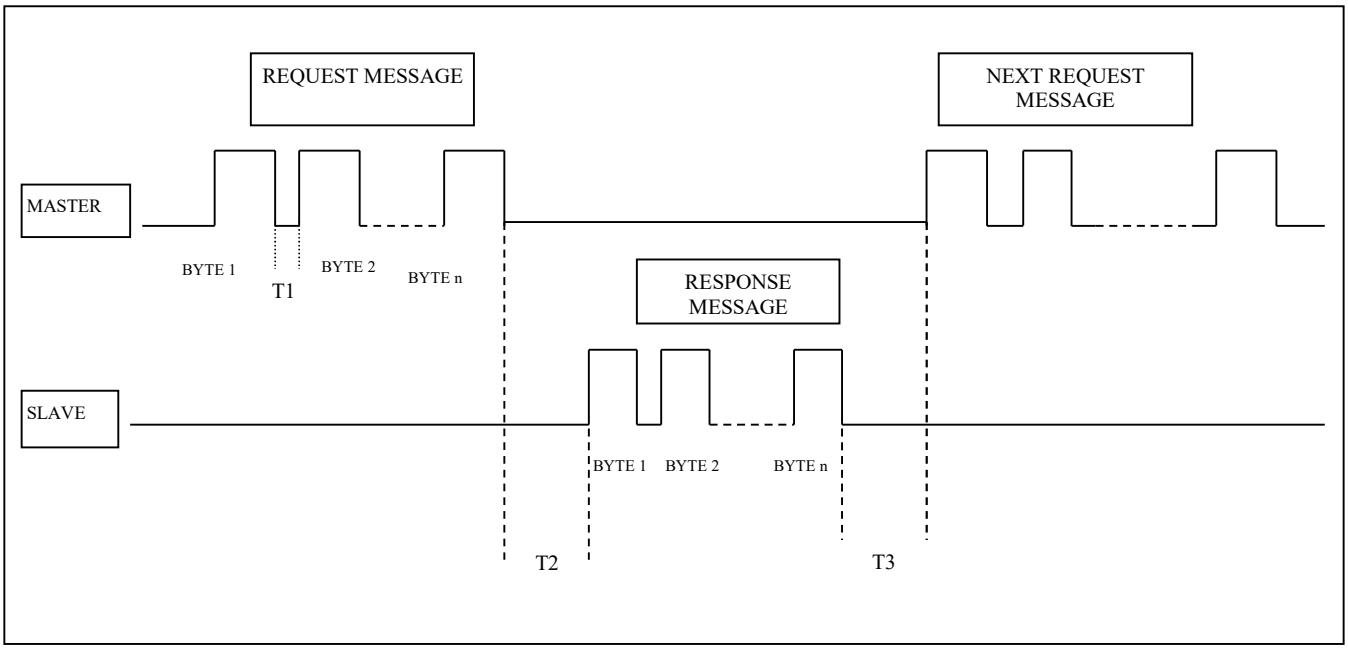
```
unsigned int calc_crc (char *ptbuf, unsigned int num)
/*     ************************************************************
 *     Descrizione : calculates a data buffer CRC WORD
 *     Input       :       ptbuf = pointer to the first byte of the buffer
 *                  num    = number of bytes
 *     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	CRC16
Device address	Funct. Code	First WORD address	WORDS number	

Answer format (containing data) :

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

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

Answer format (the demand was wrong) :

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

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

Answer format (containing data) :

BYTE	BYTE	MSB LSB	MSB LSB	CRC16
Device address	Funct. Code	First WORD address	WORD N.	

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

Answer format (the demand was wrong) :

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

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 100 BYTES (sw. version < 1.09)
Variables or groups of variables may be required up to 240 BYTES (sw. version >= 1.09)

Address	Format	Description	Unit
0x301	**UD_WORD**	Phase 1 : phase voltage	mV
0x305	**UD_WORD**	Phase 2 : phase voltage	mV
0x309	**UD_WORD**	Phase 3 : phase voltage	mV
0x30d	**UD_WORD**	Phase 1 : current	mA
0x311	**UD_WORD**	Phase 2 : current	mA
0x315	**UD_WORD**	Phase 3 : current	mA
0x319	**UD_WORD**	3-phase : active power	(3)
0x31d	**UD_WORD**	3-phase : reactive power	(3)
0x321	**UD_WORD**	3-phase : apparent power	(3)
0x325	**UD_WORD**	3-phase : positive active energy	(4)
0x329	**UD_WORD**	Chained voltage : L1-L2	mV
0x32d	**UD_WORD**	Chained voltage : L2-L3	mV
0x331	**UD_WORD**	Chained voltage : L3-L1	mV
0x335	**UD_WORD**	3-phase : negative active energy	(4)
0x339	**U_WORD**	Frequency	Hz/10
0x33b	**U_WORD**	Operating timer counter	h
0x33d	**S_WORD**	3-phase : power factor	1/100 signed
0x33f	**U_WORD**	3-phase : sector of power factor (cap or ind)	0 : PF = 1 1 : ind 2 : cap
0x340	**U_WORD**	Voltages sequence diagnostic	1 : OK 2 : error
0x341	**U_WORD**	Output relay status	(2)
0x343	**UD_WORD**	3-phase : positive reactive energy	(4)
0x347	**U_WORD**	3-phase : sign of active power	(5)
0x348	**UD_WORD**	3-phase : negative reactive energy	(4)
0x34c	**U_WORD**	3-phase : sign of reactive power	(5)
0x34d	**U_WORD**	0	
0x34e	**U_WORD**	0	
0x34f	**U_WORD**	0	
0x350	**UD_WORD**	3-phase : average power	(3)
0x354	**UD_WORD**	3-phase : peak maximum demand	(3)
0x358	**U_WORD**	Time counter for average power	minutes
0x359	**UD_WORD**	Neutral current	mA
0x35d	**UD_WORD**	Phase 1 : active power	(3)
0x361	**UD_WORD**	Phase 2 : active power	(3)
0x365	**UD_WORD**	Phase 3 : active power	(3)
0x369	**U_WORD**	Phase 1 : sign of active power	(5)
0x36a	**U_WORD**	Phase 2 : sign of active power	(5)
0x36b	**U_WORD**	Phase 3 : sign of active power	(5)
0x36c	**UD_WORD**	Phase 1 : reactive power	(3)
0x370	**UD_WORD**	Phase 2 : reactive power	(3)
0x374	**UD_WORD**	Phase 3 : reactive power	(3)
0x378	**U_WORD**	Phase 1 : sign of reactive power	(5)
0x379	**U_WORD**	Phase 2 : sign of reactive power	(5)
0x37a	**U_WORD**	Phase 3 : sign of reactive power	(5)
0x37b	**UD_WORD**	Phase 1 : apparent power	(3)
0x37f	**UD_WORD**	Phase 2 : apparent power	(3)
0x383	**UD_WORD**	Phase 3 : apparent power	(3)
0x387	**S_WORD**	Phase 1 : power factor	1/100 signed
0x389	**S_WORD**	Phase 2 : power factor	1/100 signed
0x38b	**S_WORD**	Phase 3 : power factor	1/100 signed
0x38d	**U_WORD**	Phase 1 : power factor sector	0 : PF = 1 1 : ind 2 : cap

0x38e	**U_WORD**	Phase 2 : power factor sector	0 : PF = 1 1 : ind 2 : cap
0x38f	**U_WORD**	Phase 3 : power factor sector	0 : PF = 1 1 : ind 2 : cap
0x390	**U_WORD**	Phase 1 : THD V1	%
0x392	**U_WORD**	Phase 2 : THD V2	%
0x394	**U_WORD**	Phase 3 : THD V3	%
0x396	**U_WORD**	Phase 1 : THD I1	%
0x398	**U_WORD**	Phase 2 : THD I2	%
0x39a	**U_WORD**	Phase 3 : THD I3	%
0x39c	**UD_WORD**	Phase 1 : I1 average	mA
0x3a0	**UD_WORD**	Phase 2 : I2 average	mA
0x3a4	**UD_WORD**	Phase 3 : I3 average	mA
0x3a8	**UD_WORD**	Phase 1 : I1 peak maximum	mA
0x3ac	**UD_WORD**	Phase 2 : I2 peak maximum	mA
0x3b0	**UD_WORD**	Phase 3 : I3 peak maximum	mA
0x3b4	**UD_WORD**	(I1+I2+I3)/3	mA
0x3b8	**UD_WORD**	Phase 1 : V1 min	mV
0x3bc	**UD_WORD**	Phase 2 : V2 min	mV
0x3c0	**UD_WORD**	Phase 3 : V3 min	mV
0x3c4	**UD_WORD**	Phase 1 : V1 max	mV
0x3c8	**UD_WORD**	Phase 2 : V2 max	mV
0x3cc	**UD_WORD**	Phase 3 : V3 max	mV
0x3d0	**UD_WORD**	3-phase : active partial energy	(4)
0x3d4	**UD_WORD**	3-phase : reactive partial energy	(4)
0x3d8	**UD_WORD**	3-phase : active average power	(3)
0x3dc	**UD_WORD**	3-phase : reactive average power	(3)
0x3e0	**UD_WORD**	3-phase : apparent average power	(3)
0x3e4	**UD_WORD**	3-phase : active PMD power	(3)
0x3e8	**UD_WORD**	3-phase : reactive PMD power	(3)
0x3ec	**UD_WORD**	3-phase : apparent PMD power	(3)

0x100	**U_WORD**	Current transformer ratio (KTA)	Integer
0x102	**U_WORD**	Voltage transformer ratio (KTV)	1/10 (tenths)
0x104	**UD_WORD**	Device configuration	(1)
0x106	**U_WORD**	Voltage transformer ratio (KTV)	1/100
0x300	**U_WORD**	Device identifier	0x10

A second address table is implemented in the software and the user may decide to use one or both freely.

Address	Format	Description	Unit
0x1000	**UD_WORD**	Phase 1 : phase voltage	mV
0x1002	**UD_WORD**	Phase 2 : phase voltage	mV
0x1004	**UD_WORD**	Phase 3 : phase voltage	mV
0x1006	**UD_WORD**	Phase 1 : current	mA
0x1008	**UD_WORD**	Phase 2 : current	mA
0x100a	**UD_WORD**	Phase 3 : current	mA
0x100c	**UD_WORD**	Neutral current	mA
0x100e	**UD_WORD**	Chained voltage : L1-L2	mV
0x1010	**UD_WORD**	Chained voltage : L2-L3	mV
0x1012	**UD_WORD**	Chained voltage : L3-L1	mV
0x1014	**UD_WORD**	3-phase : active power	(3)
0x1016	**UD_WORD**	3-phase : reactive power	(3)
0x1018	**UD_WORD**	3-phase : apparent power	(3)
0x101a	**U_WORD**	3-phase : sign of active power	(5)
0x101b	**U_WORD**	3-phase : sign of reactive power	(5)
0x101c	**UD_WORD**	3-phase : positive active energy	(4)
0x101e	**UD_WORD**	3-phase : positive reactive energy	(4)
0x1020	**UD_WORD**	3-phase : negative active energy	(4)
0x1022	**UD_WORD**	3-phase : negative reactive energy	(4)
0x1024	**S_WORD**	3-phase : power factor	1/100 signed
0x1025	**U_WORD**	3-phase : sector of power factor (cap or ind)	0 : PF = 1 1 : ind 2 : cap
0x1026	**U_WORD**	Frequency	Hz/10
0x1027	**UD_WORD**	3-phase : average power	(3)
0x1029	**UD_WORD**	3-phase : peak maximum demand	(3)
0x102b	**U_WORD**	Time counter for average power	minutes
0x102c	**UD_WORD**	Phase 1 : active power	(3)
0x102e	**UD_WORD**	Phase 2 : active power	(3)
0x1030	**UD_WORD**	Phase 3 : active power	(3)
0x1032	**U_WORD**	Phase 1 : sign of active power	(5)
0x1033	**U_WORD**	Phase 2 : sign of active power	(5)
0x1034	**U_WORD**	Phase 3 : sign of active power	(5)
0x1035	**UD_WORD**	Phase 1 : reactive power	(3)
0x1037	**UD_WORD**	Phase 2 : reactive power	(3)
0x1039	**UD_WORD**	Phase 3 : reactive power	(3)
0x103b	**U_WORD**	Phase 1 : sign of reactive power	(5)
0x103c	**U_WORD**	Phase 2 : sign of reactive power	(5)
0x103d	**U_WORD**	Phase 3 : sign of reactive power	(5)
0x103e	**UD_WORD**	Phase 1 : apparent power	(3)
0x1040	**UD_WORD**	Phase 2 : apparent power	(3)
0x1042	**UD_WORD**	Phase 3 : apparent power	(3)
0x1044	**S_WORD**	Phase 1 : power factor	1/100 signed
0x1045	**S_WORD**	Phase 2 : power factor	1/100 signed
0x1046	**S_WORD**	Phase 3 : power factor	1/100 signed
0x1047	**U_WORD**	Phase 1 : power factor sector	0 : PF = 1 1 : ind 2 : cap
0x1048	**U_WORD**	Phase 2 : power factor sector	0 : PF = 1 1 : ind 2 : cap
0x1049	**U_WORD**	Phase 3 : power factor sector	0 : PF = 1 1 : ind 2 : cap
0x104a	**U_WORD**	Phase 1 : THD V1	1/10 %
0x104b	**U_WORD**	Phase 2 : THD V2	1/10 %
0x104c	**U_WORD**	Phase 3 : THD V3	1/10 %
0x104d	**U_WORD**	Phase 1 : THD I1	1/10 %

0x104e	**U_WORD**	Phase 2 : THD I2	1/10 %
0x104f	**U_WORD**	Phase 3 : THD I3	1/10 %
0x1050	**UD_WORD**	Phase 1 : I1 average	mA
0x1052	**UD_WORD**	Phase 2 : I2 average	mA
0x1054	**UD_WORD**	Phase 3 : I3 average	mA
0x1056	**UD_WORD**	Phase 1 : I1 peak maximum	mA
0x1058	**UD_WORD**	Phase 2 : I2 peak maximum	mA
0x105a	**UD_WORD**	Phase 3 : I3 peak maximum	mA
0x105c	**UD_WORD**	(I1+I2+I3)/3	mA
0x105e	**UD_WORD**	Phase 1 : V1 min	mV
0x1060	**UD_WORD**	Phase 2 : V2 min	mV
0x1062	**UD_WORD**	Phase 3 : V3 min	mV
0x1064	**UD_WORD**	Phase 1 : V1 max	mV
0x1066	**UD_WORD**	Phase 2 : V2 max	mV
0x1068	**UD_WORD**	Phase 3 : V3 max	mV
0x106a	**UD_WORD**	3-phase : active partial energy	(4)
0x106c	**UD_WORD**	3-phase : reactive partial energy	(4)
0x106e	**U_WORD**	Operating timer counter	H
0x106f	**U_WORD**	Output relay status	(2)
0x1070	**UD_WORD**	3-phase : active average power	(3)
0x1072	**UD_WORD**	3-phase : reactive average power	(3)
0x1074	**UD_WORD**	3-phase : apparent average power	(3)
0x1076	**UD_WORD**	3-phase : active PMD power	(3)
0x1078	**UD_WORD**	3-phase : reactive PMD power	(3)
0x107a	**UD_WORD**	3-phase : apparent PMD power	(3)

0x1200	**U_WORD**	Current transformer ratio (KTA)	integer
0x1201	**U_WORD**	Voltage transformer ratio (KTV)	1/10 tenths) e.g. KTV = 5 Reading = 50)
0x1202	**UD_WORD**	Device configuration	(1)
0x1204	**U_WORD**	Device identifier	0x10
0x1205	**U_WORD**	Voltages sequence diagnostic	1 : OK 2 : error
0x1206	**U_WORD**	RFU	
0x1207	**U_WORD**	Voltage transformer ratio (KTV)	1/100

				SW version
0x1500	**UD_WORD**	Low Positive Active Energy	(7)	2.30
0x1502	**UD_WORD**	High Positive Active Energy	(8)	2.30
0x1504	**UD_WORD**	Low Positive Reactive Energy	(7)	2.30
0x1506	**UD_WORD**	High Positive Reactive Energy	(8)	2.30
0x1508	**UD_WORD**	Low Negative Active Energy	(7)	2.30
0x150A	**UD_WORD**	High Negative Active Energy	(8)	2.30
0x150C	**UD_WORD**	Low Negative Reactive Energy	(7)	2.30
0x150E	**UD_WORD**	High Negative Reactive Energy	(8)	2.30
0x1510	**UD_WORD**	Low Partial Active Energy	(7)	2.30
0x1512	**UD_WORD**	High Partial Active Energy	(8)	2.30
0x1514	**UD_WORD**	Low Partial Reactive Energy	(7)	2.30
0x1516	**UD_WORD**	High Partial Reactive Energy	(8)	2.30
0x1518	**SD_WORD**	Signed Total Active Power	(9)	2.30
0x151A	**SD_WORD**	Signed Total Reactive Power	(9)	2.30
0x151C	**SD_WORD**	Signed Phase1 Active Power	(9)	2.30
0x151E	**SD_WORD**	Signed Phase2 Active Power	(9)	2.30
0x1520	**SD_WORD**	Signed Phase3 Active Power	(9)	2.30
0x1522	**SD_WORD**	Signed Phase1 Reactive Power	(9)	2.30
0x1524	**SD_WORD**	Signed Phase2 Reactive Power	(9)	2.30
0x1526	**SD_WORD**	Signed Phase3 Reactive Power	(9)	2.30
0x1528	**SD_WORD**	Signed Total Power Factor	1/100	2.30
0x152A	**SD_WORD**	Signed Phase1 Power Factor	1/100	2.30
0x152C	**SD_WORD**	Signed Phase2 Power Factor	1/100	2.30
0x152E	**SD_WORD**	Signed Phase3 Power Factor	1/100	2.30

0x1530	**UD_WORD**	Apparent power	(9)	3.00
0x1532	**UD_WORD**	Average active power	(9)	3.00
0x1534	**UD_WORD**	Average reactive power	(9)	3.00
0x1536	**UD_WORD**	Average apparent power	(9)	3.00
0x1538	**UD_WORD**	Max active power	(9)	3.00
0x153a	**UD_WORD**	Max reactive power	(9)	3.00
0x153c	**UD_WORD**	Max apparent power	(9)	3.00

				SW version
0x2000	16 **U_WORD**	Standard setup parameters	(6)	ALL
0x2100	24 **U_WORD**	Programming parameters of Module on SLOT 1	(6)	ALL
0x2200	24 **U_WORD**	Programming parameters of Module on SLOT 2	(6)	ALL
0x2300	24 **U_WORD**	Programming parameters of Module on SLOT 3	(6)	ALL

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

Variable			
MSB (BYTE 3)	BYTE 2	BYTE 1	LSB (BYTE 0)
Slot 3	Slot 2	Slot 1	Slot 0

Type of slot :
'-' : NO MODULE
'A' : RS485
'b' : PULSES OUT
'C' : ALARMS OUT
'd' : ANALOG OUT
'E' : NEUTRAL CURRENT
'F' : I/O MODULE
'h' : TEMPERATURE
'H' : THD and HARMONICS MODULE
'M' : MEMORY MODULE

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

Variable			
BIT 3	BIT 2	BIT 1	BIT 0
Alarm 3	Alarm 2	Alarm 1	alarm 0

Example : 0x0003 = alarm 0 and 1 active

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

W, var, VA / 100 if KTA*KTV < 5000
W, var, VA if KTA*KTV >= 5000

(4) ----------

Transformer ratio	**Measurement unit**	**Display Format**	**Protocol Format**
1 ≤ KTA*KTV < 10	Wh(varh) * 10	xxxxxx.yy k	xxxxxxyy
10 ≤ KTA*KTV < 100	Wh(varh) * 100	xxxxxxx.y k	xxxxxxxy
100 ≤ KTA*KTV < 1000	kWh(kvarh)	xxxxxxxx k	xxxxxxxx
1000 ≤ KTA*KTV < 10000	kWh(kvarh) * 10	xxxxxx.yy M	xxxxxxyy
10000 ≤ KTA*KTV < 100000	kWh(kvarh) * 100	xxxxxxx.y M	xxxxxxxy
100000 ≤ KTA*KTV	kWh(kvarh) * 100	xxxxxxxx M	xxxxxxxx

(5) ----------

0 : positive
1 : negative

(6) ----------

It is possible to read the setup parameters for each slot mounted in the device.
The data area dedicated for each slot is 24 WORDS long even if not all are used.

For instance : Pulse Output Module has three setup Parameters for each output (six for the whole Module), instead Alarm Output Module has ten setup Parameters for each output(twenty for each Module).

For each module, 24 WORDS are always transmitted :

W23 | …. | W0

W23 is the first transmitted WORD and W0 the last

(7) ----------

High part of energy.

Always in MWh / MVArh

(8) ----------

Low part of energy.

Always in Wh / VArh

(9) ----------

Always in W / Var / VA/100

5.0 REMOTE RESETS AND PROGRAMMING

NEMO 96 parameters may be read and written accordingly to the procedure described in the following.

Master Unlock Key Writing

Every write operation must be preceded by a "Master Unlock Key" command.

Address 0x2700 : write word with value = 0x5AA5 (Master Unlock Key)

Reset of NEMO 96

Any writing operation of any parameter will have effect **only** in the volatile memory (RAM).
After any writing operation of parameters described in the following of the document, if necessary to go back to the default then it is mandatory to send the following commands :

Address 0x2700 : write word with value = 0x5AA5 (Master Unlock Key)
Address 0x2800 : write word with value = 0xYYYY (any value)

This command will reset the NEMO 96 and in this way all changes will be lost so returning to the previous conditions.

EEPROM savings

If it is necessary to save the new parameters in EEPROM it is mandatory to send these following messages :

Address 0x2700 : write word with value = 0x5AA5 (Master Unlock Key)
Address 0x2600 : write word with value = 0xYYYY (any value)

ADDRESS TABLE

Address	Format	Description	Value
0x100	WORD	Write Current transform ratio	1 - 9999
0x102	WORD	Write Voltage transform ratio	(7)
0x2000	16 WORD	Write Standard setup parameters	(6)
0x2100	24 WORD	Write Programming parameters of Module on SLOT 1	(6)
0x2200	24 WORD	Write Programming parameters of Module on SLOT 2	(6)
0x2300	24 WORD	Write Programming parameters of Module on SLOT 3	(6)
0x2400	WORD	Reset Hour Meter, Maximum Powers, Maximum Voltages, Maximum Currents, Minimum Voltages, Active Partial Energy, Reactive Partial Energy	(8)
0x2600	WORD	Saving in EEPROM parameters changed by Remote commands	(9)
0x2700	WORD	Enable Remote Writing Operation (master Unlock Key)	(10)
0x2800	WORD	Load previous setup parameters stored in EEPROM	(11)

(7) This value is in V/10
For instance, write 50 to have KTV = 5.0

(8) To reset desired measurements write the following word (in binary) :

0|0|0|0|0|0|0|0|0|b6|b5|b4|b3|b2|b1|b0

b0 = 1 => Reset Hour Meter
b1 = 1 => Reset Maximum Powers
b2 = 1 => Reset Maximum Voltages
b3 = 1 => Reset Maximum Currents
b4 = 1 => Reset Minimum Voltages
b5 = 1 => Reset Active Partial Energy
b6 = 1 => Reset Reactive Partial Energy

b7 .. b15 = 0

(9) Write any value to save the new parameters changed by Remote commands

(10) To do any remote programming write operation, it's mandatory to write a safety key = 0x5AA5.

(11) Write any value to abort any remote programming write operation and go back to previous values.

Pulse Output Module

24 WORDs R/W
x|x|x|x|x|x|x|x|x|x|x|x|x|x|x|x|W5|W4|W3|W2|W1|W0

W0,W1,W2 for OUT1
W3,W4,W5 for OUT2

W0 and W3
  0 => Energy Type ACTIVE
  1 => Energy Type REACTIVE

W1 and W4
  0 => Pulse Weight 0.01 K
  1 => Pulse Weight 0.1 K
  2 => Pulse Weight 1.0 K
  3 => Pulse Weight 10.0 K
  4 => Pulse Weight 100.0K
  5 => Pulse Weight 1.0 M
  6 => Pulse Weight 10.0 M

W2 and W5
  0 => Pulse Duration 50 ms
  1 => Pulse Duration 100 ms
  2 => Pulse Duration 200 ms
  3 => Pulse Duration 300 ms

NOTES : x means that this word value is without meaning.

(7) in Wh up to 999999 for any CT and VT
(8) in MWh up to **99999999** for any CT and VT
(9) Powers are in W/var/VA for any CT and VT

Alarm OUT module

```
24 WORDs R/W
x|x|x|x|W19|W18|W17|W16|W15|W14|W13|W12|W11|W10|W9|W8|W7|W6|W5|W4|W3|W2|W1|W0

W9, W8, W7, W6, W5, W4, W3, W2, W1, W0  for OUT1
W19,W18,W17,W16,W15,W14,W13,W12,W11,W10 for OUT2

W0 and W10
  0        =>  Alarm on V phase 1
  1        =>  Alarm on V phase 2
  2        =>  Alarm on V phase 3
  3        =>  Alarm on I phase 1
  4        =>  Alarm on I phase 2
  5        =>  Alarm on I phase 3
  6        =>  Alarm on V12
  7        =>  Alarm on V23
  8        =>  Alarm on V31
  9        =>  Alarm on P phase 1
 10        =>  Alarm on P phase 2
 11        =>  Alarm on P phase 3
 12        =>  Alarm on Q phase 1
 13        =>  Alarm on Q phase 2
 14        =>  Alarm on Q phase 3
 15        =>  Alarm on P  threephase
 16        =>  Alarm on Q  threephase
 17        =>  Alarm on PF threephase
 18        =>  Alarm on Frequency
 19        =>  Alarm on Active Power Demand
 20        =>  Alarm on Reactive Power Demand
 21        =>  Alarm on Current SUM
 22        =>  Alarm on Temperature Channel 1
 23        =>  Alarm on Temperature Channel 2


W1 and W11
  0        =>     Sign + for Set Point
  1        =>     Sign - for Set Point (Possible only for Powers)

W2 and W12
  0        =>     Decimal Point Position X.XXX
  1        =>     Decimal Point Position XX.XX
  2        =>     Decimal Point Position XXX.X

W3 and W13
  0        =>     kilo for Powers (Inductive  for PF)(V  for Voltages) (A  for Currents)
                  (Hz for Frequency)
  1        =>     Mega for Powers (Capacitive for PF)(kV for Voltages) (kA for Currents)
                  (Hz for Frequency)
W4 and W14
  0 - 9999 =>     Value of the Set Point (threshold)

W5 and W15
  0        =>     Alarm active when Lower than Set Point
  1        =>     Alarm active when higher than Set Point

W6 and W16
  0        =>     Relay normally Open
  1        =>     Relay normally Close
```

W7 and W17
  0-10 => 0-10 % Hysteresys of Set Point
    11 => 15 % Hysteresys of Set Point
    12 => 20 % Hysteresys of Set Point

W8 and W18
  0 - 99 => Alarm activation delay

W9 and W19
  0 - 99 => Alarm de-activation delay

Analogue OUT module

```
24 WORDs R/W
x|x|x|x|W19|W18|W17|W16|W15|W14|W13|W12|W11|W10|W9|W8|W7|W6|W5|W4|W3|W2|W1|W0

W9, W8, W7, W6, W5, W4, W3, W2, W1,  W0 for OUT1
W19,W18,W17,W16,W15,W14,W13,W12,W11,W10 for OUT2

W0 and W10
  0  =>   range 4-20 mA
  1  =>   range 0-20 mA
W1 and W11
  0        =>  Transduced Measurement  V phase 1
  1        =>  Transduced Measurement  V phase 2
  2        =>  Transduced Measurement  V phase 3
  3        =>  Transduced Measurement  I phase 1
  4        =>  Transduced Measurement  I phase 2
  5        =>  Transduced Measurement  I phase 3
  6        =>  Transduced Measurement  V12
  7        =>  Transduced Measurement  V23
  8        =>  Transduced Measurement  V31
  9        =>  Transduced Measurement  P phase 1
 10        =>  Transduced Measurement  P phase 2
 11        =>  Transduced Measurement  P phase 3
 12        =>  Transduced Measurement  Q phase 1
 13        =>  Transduced Measurement  Q phase 2
 14        =>  Transduced Measurement  Q phase 3
 15        =>  Transduced Measurement  P  threephase
 16        =>  Transduced Measurement  Q  threephase
 17        =>  Transduced Measurement  PF threephase
 18        =>  Transduced Measurement  Frequency
 19        =>  Transduced Measurement Active Power Demand
 20        =>  Transduced Measurement Reactive Power Demand
 21        =>  Transduced Measurement Current SUM
 22        =>  Transduced Measurement Temperature Channel 1
 23        =>  Transduced Measurement Temperature Channel 2


W2 and W12
  0        =>    Sign + for Begin Scale
  1        =>    Sign - for Begin Scale (Possible only for Powers)
W3 and W13
  0        =>    Decimal Point Position X.XXX
  1        =>    Decimal Point Position XX.XX
  2        =>    Decimal Point Position XXX.X
W4 and W14
  0        =>    kilo for Powers (Inductive  for PF)(V  for Voltages) (A  for Currents)
                 (Hz for Frequency)
  1        =>    Mega for Powers (Capacitive for PF)(kV for Voltages) (kA for Currents)
                 (Hz for Frequency)

W5 and W15
  0 - 9999 as value for Begin Scale

W6 and W16
  0        =>    Sign + for End Scale
  1        =>    Sign - for End Scale

W7 and W17
  0        =>    Decimal Point Position X.XXX
  1        =>    Decimal Point Position XX.XX
  2        =>    Decimal Point Position XXX.X

W8 and W18
  0        =>    kilo for Powers (Inductive  for PF)(V  for Voltages) (A  for Currents)
                 (Hz for Frequency)
  1        =>    Mega for Powers (Capacitive for PF)(kV for Voltages) (kA for Currents)
                 (Hz for Frequency)
```

W9 - W19 => 0 - 9999 as value for End Scale

Neutral Current module

24 WORDs R/W
x|x|x|x|x|x|x|x|x|x|x|x|x|x|x|x|x|x|x|x|x|x|x|W0

Writing

Only W0 has the following meaning

1 - 9999 => Current Transformer Ratio for Neutral Current Module

Value Reading

The value of the neutral current is given back at the same address where In is in all tables.

I/O module

Funtions

- **(in) pulse counter – input status**
- **(in) pulse counter – reset**
- **(out) remote relay – control**
- **(out) remote relay – control and setting**
- **(out) alarm out – setting**
- **(in) tariffs management – setting**
- **(in) tariffs management – reading**

Address	Format	Description	Note	Position
0x03F0	UDWORD	Pulse counting 1 on IO Module	(1.1)	Slot 2
0x03F4	UDWORD	Pulse counting 2 on IO Module	(1.1)	Slot 2
0x03F8	UDWORD	Pulse counting 3 on IO Module	(1.1)	Slot 3
0x03FC	UDWORD	Pulse counting 4 on IO Module	(1.1)	Slot 3
0x0400	UWORD	Status of input 1 on IO Module	(1.1)	Slot 2
0x0401	UWORD	Status of input 2 on IO Module	(1.1)	Slot 2
0x0402	UWORD	Status of input 3 on IO Module	(1.1)	Slot 3
0x0403	UWORD	Status of input 4 on IO Module	(1.1)	Slot 3
0x0510	UWORD	Code to reset one Pulse Counting		
0x2700	UWORD	Enable Remote Writing Operation		
0x3100	UWORD	To set relays on LOCAL or REMOTE control		
0x3200	UWORD	To open or close relays on IO Module		

Pulse counter – input status

Pulse cont : example for a NEMO96HD with address 255 (0xFF) – input 4

Request **FF | 03 | 03 | FC | 00 | 02 | 11 | A1**
Answer **FF | 03 | 04 | 00 | 00 | 00 | 0B | A4 | 3B**

This means that the Pulse Counter has counted 11(0x0000000B) pulses.

Input status : example for a NEMO96HD with address 255 (0xFF) – input 2

Request : **FF | 03 | 04 | 01 | 00 | 01 | C1 | 24**
Answer : **FF | 03 | 02 | 00 | 00 | 91 | 90**

This means that **00 | 00** is the value that indicates OPEN (otherwise **00 | 01** for CLOSE).

(1.1) Wrap around at 100.000.000

Pulse counters - reset

Example for a NEMO96HD with address 255 (0xFF) :

1° writing to take control of remote operations.
Command : **FF | 10 | 27 | 00 | 00 | 01 | 02 | 5A | A5 | 43 | ED**
Answer : **FF | 10 | 27 | 00 | 00 | 01 | 1E | A3**

2° writing
Command : **FF | 10 | 05 | 10 | 00 | 01 | 02 |** RESET **| C1 | C2**
Answer : **FF | 10 | 05 | 10 | 00 | 00 | D4 | DE**

RESET

0x10 RESET of Pulse Counter 1 on SLOT 2
0x01 RESET of Pulse Counter 2 on SLOT 2
0x1000 RESET of Pulse Counter 1 on SLOT 3
0x100 RESET of Pulse Counter 2 on SLOT 3

Remote relay - control

Example for a NEMO96HD with address 255 (0xFF) :

1° writing to take control of remote operations.
Command : **FF | 10 | 27 | 00 | 00 | 01 | 02 | 5A | A5 | 43 | ED**
Answer : **FF | 10 | 27 | 00 | 00 | 01 | 1E | A3**

2° writing to store the new setting
Command : **FF | 10 | 31 | 00 | 00 | 01 | 02 |** RELAY DRIVER **| C1 | C2**
Answer : no answer but "SAVE" is showing on display

NOTE :after this commands the NEMO96HD resets and in the visualization page of alarms state, on the fourth line, a letter "r" appears :

e.g. ALM1 6-7 r

RELAY DRIVER

0xAA BOTH RELAYS on SLOT 2 are remotely controlled
0xFF BOTH RELAYS on SLOT 2 are locally controlled
0xAA00 BOTH RELAYS on SLOT 3 are remotely controlled
0xFF00 BOTH RELAYS on SLOT 3 are locally controlled

Remote relay - control and setting

Example for a NEMO96HD with address 255 (0xFF) :

1° writing to enable remote operations
Command : **FF | 10 | 27 | 00 | 00 | 01 | 02 | 5A | A5 | 43 | ED**
Answer : **FF | 10 | 27 | 00 | 00 | 01 | 1E | A3**

2° writing to store the new setting
Command : **FF | 10 | 31 | 00 | 00 | 01 | 02 |** RELAY DRIVER **| C1 | C2**
Answer : no answer but "SAVE" is showing on display

3° writing to set relays on IO Module
Command : **FF | 10 | 32 | 00 | 00 | 01 | 02 |** RELAY OUTPUT **| C1 | C2**
Answer : **FF | 10 | 32 | 00 | 00 | 01 | 1A | AF**

Depending on code RELAY OUTPUT we have the following relays setting :

RELAY OUTPUT

0x F F 8 8	Relay 1 OPEN / relay 2 OPEN on SLOT 2
0x F F 9 8	Relay 1 CLOSE / relay 2 OPEN on SLOT 2
0x F F 8 9	Relay 1 OPEN / relay 2 CLOSE on SLOT 2
0x F F 9 9	Relay 1 CLOSE / relay 2 CLOSE on SLOT 2
0x 8 8 F F	Relay 1 OPEN / relay 2 OPEN on SLOT 3
0x 9 8 F F	Relay 1 CLOSE / relay 2 OPEN on SLOT 3
0x 8 9 F F	Relay 1 OPEN / relay 2 CLOSE on SLOT 3
0x 9 9 F F	Relay 1 CLOSE / relay 2 CLOSE on SLOT 3

Alarm out - setting

24 WORDs R/W
x|x|W21|W20|W19|W18|W17|W16|W15|W14|W13|W12|W11|W10|W9|W8|W7|W6|W5|W4|W3|W2|W1|W0

W9, W8, W7, W6, W5, W4, W3, W2, W1, W0 for OUT1
W20, W19,W18,W17,W16,W15,W14,W13,W12,W11 for OUT2

W0 and W11
2 => Alarm on V phase 1
3 => Alarm on V phase 2
2 => Alarm on V phase 3
3 => Alarm on I phase 1
4 => Alarm on I phase 2
5 => Alarm on I phase 3
6 => Alarm on V12
7 => Alarm on V23
8 => Alarm on V31
9 => Alarm on P phase 1
10 => Alarm on P phase 2
12 => Alarm on P phase 3
12 => Alarm on Q phase 1
13 => Alarm on Q phase 2
14 => Alarm on Q phase 3
15 => Alarm on P threephase
24 => Alarm on Q threephase
25 => Alarm on PF threephase
26 => Alarm on Frequency
27 => Alarm on Active Power Demand
28 => Alarm on Reactive Power Demand
29 => Alarm on Current SUM
30 => Alarm on Temperature Channel 1
31 => Alarm on Temperature Channel 2

W1 and W12
0 => Sign + for Set Point
1 => Sign - for Set Point (Possible only for Powers)

W2 and W13
0 => Decimal Point Position X.XXX
1 => Decimal Point Position XX.XX
2 => Decimal Point Position XXX.X

W3 and W14
0 => kilo for Powers (Inductive for PF)(V for Voltages) (A for Currents) (Hz for Frequency)
1 => Mega for Powers (Capacitive for PF)(kV for Voltages) (kA for Currents) (Hz for Frequency)

W4 and W15
0 - 9999 => Value of the Set Point (threshold)

W5 and W16
2 => Alarm active when Lower than Set Point
3 => Alarm active when higher than Set Point

W6 and W17
0 => Relay normally Open
1 => Relay normally Close

W7 and W18
  0-10 => 0-10 % Hysteresys of Set Point
    11 => 15 % Hysteresys of Set Point
    12 => 20 % Hysteresys of Set Point

W8 and W19
  0 - 99 => Alarm activation delay

W10 => 0

W9 and W20
  0 - 99 => Alarm de-activation delay

W21 => pulse counting / tariff input selector
  0 => pulse counting
  1 => tariff selector

Tariffs management - settings

1° reading of 24 WORDS to get actual settings

2° writing to enable remote operations
Command : **FF | 10 | 27 | 00 | 00 | 01 | 02 | 5A | A5 | 43 | ED**
Answer : **FF | 10 | 27 | 00 | 00 | 01 | 1E | A3**

3° writing of 24 WORDS to set the tariffs modality – only W21 changed

W21 => pulse counting / tariff input selector
  0 => pulse counting
  1 => tariff selector

ATTENTION

Input for tariff selection metering – only input 1 of the module in slot 2

e.g.
if module on slot 2 => input 1
if module on slot 3 => not possible
if both modules => only input 1 of module on slot 2

Tariffs management - readings

0x101c	UDWORD	Tariff 1 : positive active energy	See standard table
0x101e	UDWORD	Tariff 1 : positive reactive energy	See standard table
0x106a	UDWORD	Tariff 2 : active partial energy	See standard table
0x106c	UDWORD	Tariff 2 : reactive partial energy	See standard table

Temperature measurement module

Only on slot 3
2 WORDs Read only

Address	Format	Description	Unit	SW version
0x1100	SWORD	Signed temperature First Channel	°C	>= 3.00
0x1101	SWORD	Signed temperature Second Channel	°C	>= 3.00

Address	Format	Description	Unit	SW version
0x03F8	UDWORD	Temperature First Channel	°C/100	Up to 2.33
0x03FC	UDWORD	Temperature Second Channel	°C/100	Up to 2.33
0x0402	WORD	Sign Temperature First Channel	0(+)/1(-)	Up to 2.33
0x0403	WORD	Sign Temperature Second Channel	0(+)/1(-)	Up to 2.33

Standard Programming Parameters

16 WORD R/W
x|x|x|x|x|x|x|W8|W7|W6|W5|W4|W3|W2|W1|x

W1 : custom page – line 1
(for all wirings)

0 => V phase 1
1 => V12
2 => I phase 1
3 => I Neutral
4 => P 3-phase
5 => Q 3-phase
6 => S 3-phase
7 => P phase 1
8 => Q phase 1
9 => S phase 1
10 => PF 3-phase

W2 : custom page – line 2
(for all wirings)

0 => V phase 2
1 => V23
2 => I phase 2
3 => P 3-phase
4 => Q 3-phase
5 => S 3-phase
6 => P phase 2
7 => Q phase 2
8 => S phase 2
9 => Frequency
10 => I phase 1

W3 : custom page – line 3
(for all wirings)

0 => V phase 3
1 => V31
2 => I phase 3
3 => P 3-phase
4 => Q 3-phase
5 => S 3-phase
6 => P phase 3
7 => Q phase 3
8 => S phase 3
9 => P phase 1
10 => I phase 1

W4 : wiring
0 => 3N3E
1 => 3-3E
2 => 3-2E
3 => 1N1E

```
W5 : average maximum demand calculation
 0 =>  5 minutes
 1 =>  8 minutes
 2 => 10 minutes
 3 => 15 minutes
 4 => 20 minutes
 5 => 30 minutes
 6 => 60 minutes

W6 : display contrast
 0 =>  level 0
 1 =>  level 1
 2 =>  level 2
 3 =>  level 3

W7 : backlight intensity
 0 =>    0%
 1 =>   30%
 2 =>   70%
 3 =>  100%

W8 : rated current
 0 =>   5A
 1 =>   1A
```

Reading Example

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

BYTE	BYTE	MSB | LSB	MSB | LSB	
Device address	F.code	1st WORD address	WORDS number	CRC16
0x01	0x03	0x10 | 0x1C	0x00 | 0x04	0x81 | 0x0F

Answer

BYTE	BYTE	BYTE	MSB | LSB	MSB | LSB	MSB | LSB	MSB | LSB	
Dev Add.	F. cod	BYTES num	WORD 1	WORD 2	WORD 3	WORD 4	CRC16
0x01	0x03	0x08	0x00 | x00	0x64 | 0x8c	0x00 | 0x00	0x35 | 0x54	0x9a | 0x83

In the above case, the information is :

WORD 1 ,WORD 2 : Positive active energy 0x0000648C = 25740

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

5.0 REMOTE RESETS AND PROGRAMMING

Data are written at the same way as they are read. The WORD sequence is the same.

In writing the messages sequence is :

1) write word 0x5AA5 to address 0x2700
2) write the number of necessary WORDS at the address where the standard parameters or the module variables are mapped

Note that parameters will be changed **only** in volatile memory.

If it is necessary to go back to the old parameters saved in EEPROM, it is mandatory to send also these following messages :

1) write word 0x5AA5 to address 0x2700
2) write word 0xYYYY to address 0x2800 (Y = any value)

If it is necessary to save new parameters in EEPROM it is mandatory to send these following messages :

1) write word 0x5AA5 to address 0x2700
2) write word 0xYYYY to address 0x2600 (Y = any value)

WRITE ADDRESS TABLE

Address	Format	Description	Value
0x100	UWORD	Write Current transform ratio	1 - 9999
0x102	UWORD	Write Voltage transform ratio	(7)
0x2000	16 UWORD	Write Standard setup parameters	(6)
0x2100	24 UWORD	Write Programming parameters of Module on SLOT 1	(6)
0x2200	24 UWORD	Write Programming parameters of Module on SLOT 2	(6)
0x2300	24 UWORD	Write Programming parameters of Module on SLOT 3	(6)
0x2400	UWORD	Reset Hour Meter, Maximum Powers, Maximum Voltages, Maximum Currents, Minimum Voltages, Active Partial Energy, Reactive Partial Energy	(8)
0x2600	UWORD	Saving in EEPROM parameters changed by Remote commands	(9)
0x2700	UWORD	Enable Remote Writing Operation	(10)
0x2800	UWORD	Load previous setup parameters stored in EEPROM	(11)

(7) This value is in V/10
For instance, write 50 to have KTV = 5.0

(8) To reset desired measurements write the following word (in binary) :

0|0|0|0|0|0|0|0|0|b6|b5|b4|b3|b2|b1|b0

b0 = 1 => Reset Hour Meter
b1 = 1 => Reset Maximum Powers
b2 = 1 => Reset Maximum Voltages
b3 = 1 => Reset Maximum Currents
b4 = 1 => Reset Minimum Voltages
b5 = 1 => Reset Active Partial Energy
b6 = 1 => Reset Reactive Partial Energy

b7 .. b15 = 0

(9) Write any value to save the new parameters changed by Remote commands

(10) To do any remote programming write operation, it's mandatory to write a safety key = 0x5AA5.

(11) Write any value to abort any remote programming write operation and go back to previous values.