	<b>COMMUNICATION MODBUS PROTOCOL</b>	<b>PR140</b>
<b>KRNEMOD4 NEMO-D4Le – ROGOWSKI COIL INPUT</b>		20/10/2016 Pag. 1/22

## Contents

1.0 ABSTRACT .....	2
2.0 DATA MESSAGE DESCRIPTION .....	3
2.1 Parameters description.....	3
2.2 Data format.....	4
2.3 Description of CRC calculation.....	5
2.4 Error management .....	5
2.5 Timing.....	6
3.0 COMMANDS .....	7
4.0 VARIABLES.....	8
5.0 SETUP PARAMETERS .....	17

Rev	DESCRIPTION	Date	Sw
B	Formal revision	10/05/2016	➤ 1.01

## 1.0 ABSTRACT

### Physical level

The 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 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\_WORD : two WORDS - unsigned
- \* SD\_WORD : 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 */
```

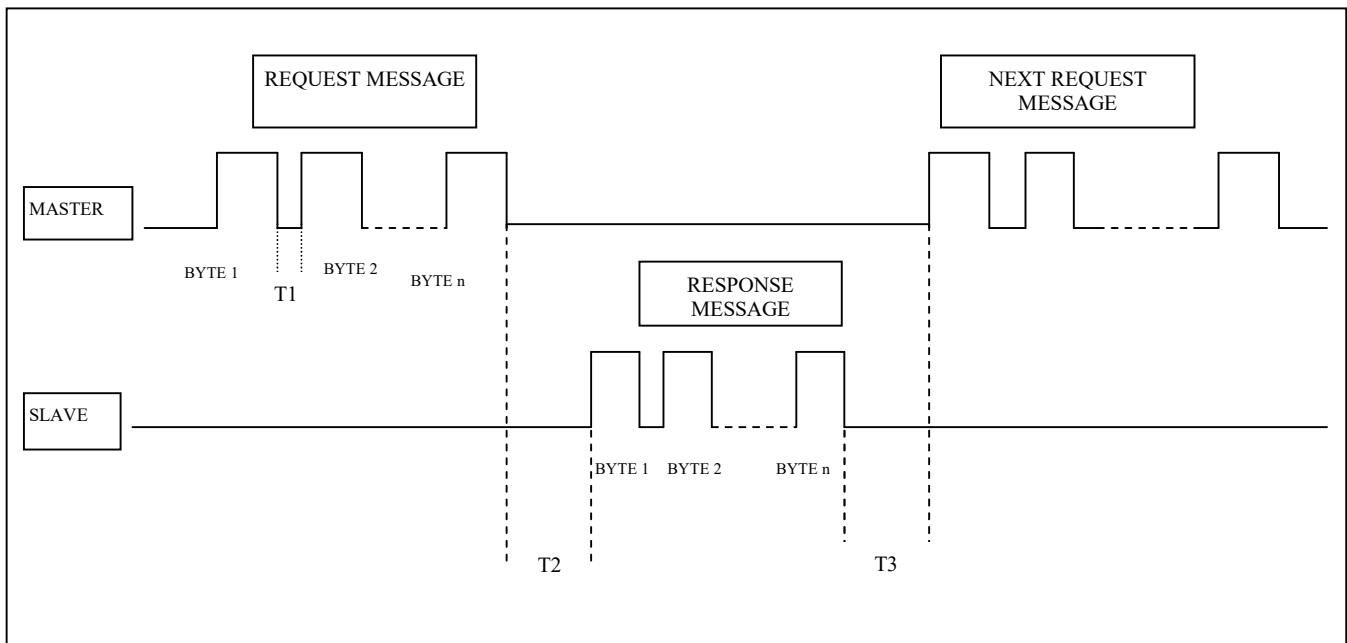
### 2.4 Error management

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	<b>Time between characters.</b> If this time exceeds the max. time allowed, the message is not considered by device.	Min = 3 msec Max = 99 msec
T2	<b>Slave response time</b> Minimum response delay to Master request.	Min = 10 ms.
T3	Time before a new message request from the Master can be issued	Min = 1 ms.

**Be careful :** among the setup parameters there is a timeout value that may be programmed  
**The value of 20 msec is suggested to keep compatibility with older IME devices.**  
**The minimum value is 3 msec.**

### 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	MSB	LSB	MSB	LSB		
Device address	Funct. Code	First WORD address		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

0x100	<b>U_WORD</b>	Current transformer ratio (KTA)	No unit (5)
0x102	<b>U_WORD</b>	Voltage transformer ratio (KTV)	No unit Format : 1/100 (hundredths) (e.g. KTV = 5 Reading = 500)
0x103	<b>U_WORD</b>	Energy mode accumulation	0 :Asyn 1 :Syn 2 :Tariff 3 :Pulse counting
0x300	<b>U_WORD</b>	Device identifier	0x06



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	(6)
0x101b	U_WORD	3-phase : sign of reactive power	(6)
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	(6)
0x1033	U_WORD	Phase 2 : sign of active power	(6)
0x1034	U_WORD	Phase 3 : sign of active power	(6)
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	(6)
0x103c	U_WORD	Phase 2 : sign of reactive power	(6)
0x103d	U_WORD	Phase 3 : sign of reactive power	(6)
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	Run hour meter	Hour
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)
0x107c	UD_WORD	Run hour meter	min

0x1200	U_WORD	Current transformer ratio (KTA)	No unit
0x1201	U_WORD	Voltage transformer ratio (KTV)	1/100 (hundredths) (e.g. KTV = 5 Reading = 500)
0x1202	UD_WORD	Not used	---
0x1204	U_WORD	Device identifier	0x06
0x1205	U_WORD	Not used	---
0x1206	U_WORD	Digital Input status	0x00 I1 O I2 O 0x01 I1 C I2 O 0x02 I1 O I2 C 0x03 I1 C I2 C

0x1250	UD_WORD	3-phase Positive total active energy	(4)
0x1252	UD_WORD	3-phase Positive total reactive energy	(4)
0x1254	UD_WORD	3-phase Negative total active energy	(4)
0x1256	UD_WORD	3-phase Negative total reactive energy	(4)
0x1258	UD_WORD	3-phase Positive partial active energy tariff 1 active energy (if option tariffs)	(4)
0x125a	UD_WORD	3-phase Negative partial active energy tariff 2 active energy (if option tariffs)	(4)
0x125c	UD_WORD	3-phase Positive partial reactive energy tariff 3 active energy (if option tariffs)	(4)
0x125e	UD_WORD	3-phase Negative partial reactive energy tariff 4 active energy (if option tariffs)	(4)

0x1300	<b>UD_WORD</b>	3-phase : active average power	(3)
0x1302	<b>UD_WORD</b>	3-phase : reactive average power	(3)
0x1304	<b>UD_WORD</b>	3-phase : apparent average power	(3)
0x1306	<b>UD_WORD</b>	3-phase : active average power tariffs 1	(3)
0x1308	<b>UD_WORD</b>	3-phase : reactive average power tariffs 1	(3)
0x130a	<b>UD_WORD</b>	3-phase : apparent average power tariffs 1	(3)
0x130c	<b>UD_WORD</b>	3-phase : active average power tariffs 2	(3)
0x130e	<b>UD_WORD</b>	3-phase : reactive average power tariffs 2	(3)
0x1310	<b>UD_WORD</b>	3-phase : apparent average power tariffs 2	(3)
0x1312	<b>UD_WORD</b>	3-phase : active average power tariffs 3	(3)
0x1314	<b>UD_WORD</b>	3-phase : reactive average power tariffs 3	(3)
0x1316	<b>UD_WORD</b>	3-phase : apparent average power tariffs 3	(3)
0x1318	<b>UD_WORD</b>	3-phase : active average power tariffs 4	(3)
0x131a	<b>UD_WORD</b>	3-phase : reactive average power tariffs 4	(3)
0x131c	<b>UD_WORD</b>	3-phase : apparent average power tariffs 4	(3)

0x1500	UD_WORD	Positive Active Energy - Low	Wh
0x1502	UD_WORD	Positive Active Energy - High	MWh
0x1504	UD_WORD	Positive Reactive Energy - Low	varh
0x1506	UD_WORD	Positive Reactive Energy - High	Mvarh
0x1508	UD_WORD	Negative Active Energy - Low	Wh
0x150A	UD_WORD	Negative Active Energy - High	MWh
0x150C	UD_WORD	Negative Reactive Energy - Low	varh
0x150E	UD_WORD	Negative Reactive Energy - High	Mvarh
0x1510	UD_WORD	Partial Active Energy - Low	Wh
0x1512	UD_WORD	Partial Active Energy - High	MWh
0x1514	UD_WORD	Partial Reactive Energy - Low	varh
0x1516	UD_WORD	Partial Reactive Energy - High	Mvarh
0x1518	SD_WORD	Signed 3-ph Active Power	W
0x151A	SD_WORD	Signed 3-ph Reactive Power	var
0x151C	SD_WORD	Signed Phase1 Active Power	W
0x151E	SD_WORD	Signed Phase2 Active Power	W
0x1520	SD_WORD	Signed Phase3 Active Power	W
0x1522	SD_WORD	Signed Phase1 Reactive Power	var
0x1524	SD_WORD	Signed Phase2 Reactive Power	var
0x1526	SD_WORD	Signed Phase3 Reactive Power	var
0x1528	SD_WORD	Signed 3-ph Power Factor	1/1000
0x152A	SD_WORD	Signed Phase1 Power Factor	1/1000
0x152C	SD_WORD	Signed Phase2 Power Factor	1/1000
0x152E	SD_WORD	Signed Phase3 Power Factor	1/1000

0x1530	UD_WORD	Apparent power	W
0x1532	UD_WORD	3-phase : active average power	W
0x1534	UD_WORD	3-phase : reactive average power	var
0x1536	UD_WORD	3-phase : apparent average power	VA
0x1538	UD_WORD	3-phase : active PMD power	W
0x153a	UD_WORD	3-phase : reactive PMD power	var
0x153c	UD_WORD	3-phase : apparent PMD power	VA

0x1580	U_WORD	Phase 1 : phase voltage crest factor	1/1000
0x1581	U_WORD	Phase 2 : phase voltage crest factor	1/1000
0x1582	U_WORD	Phase 3 : phase voltage crest factor	1/1000
0x1583	U_WORD	Phase 1 : current crest factor	1/1000
0x1584	U_WORD	Phase 2 : current crest factor	1/1000
0x1585	U_WORD	Phase 3 : current crest factor	1/1000
0x1586	U_WORD	Chained voltage : L1-L2 crest factor	1/1000
0x1587	U_WORD	Chained voltage : L2-L3 crest factor	1/1000
0x1588	U_WORD	Chained voltage : L3-L1 crest factor	1/1000

0x1600	<b>U_WORD</b>	phase displacement V1-V2 (V12-V23)	0.1 °
0x1601	<b>U_WORD</b>	phase displacement V2-V3 (V23-V31)	0.1 °
0x1602	<b>U_WORD</b>	phase displacement V3-V1 (V31-V12)	0.1 °
0x1603	<b>U_WORD</b>	phase displacement I1-I2	0.1 °
0x1604	<b>U_WORD</b>	phase displacement I2-I3	0.1 °
0x1605	<b>U_WORD</b>	phase displacement I3-I1	0.1 °
0x1606	<b>U_WORD</b>	phase displacement V1-I1	0.1 °
0x1607	<b>U_WORD</b>	phase displacement V2-I2	0.1 °
0x1608	<b>U_WORD</b>	phase displacement V3-I3	0.1 °
0x1609	<b>U_WORD</b>	phase displacement 3-ph	0.1 °

0x1620	<b>UD_WORD</b>	Pulse number - input 1	(Sw ver > 1.02)
0x1622	<b>UD_WORD</b>	Pulse number - input 2	(Sw ver > 1.02)
0x1624	<b>UD_WORD</b>	0	(Sw ver > 1.02)
0x1626	<b>UD_WORD</b>	0	(Sw ver > 1.02)
0x1628	<b>U_WORD</b>	Input 1 state	0: Open 1: Close (Sw ver > 1.02)
0x1629	<b>U_WORD</b>	Input 2 state	0: Open 1: Close (Sw ver > 1.02)
0x162a	<b>U_WORD</b>	0 - RFU	(Sw ver > 1.02)
0x162b	<b>U_WORD</b>	0 - RFU	(Sw ver > 1.02)

0x1700	<b>UD_WORD</b>	Positive Active Energy - Low	Wh
0x1702	<b>UD_WORD</b>	Positive Active Energy - High	MWh
0x1704	<b>UD_WORD</b>	Positive Reactive Energy - Low	varh
0x1706	<b>UD_WORD</b>	Positive Reactive Energy - High	Mvarh
0x1708	<b>UD_WORD</b>	Negative Active Energy - Low	Wh
0x170A	<b>UD_WORD</b>	Negative Active Energy - High	MWh
0x170C	<b>UD_WORD</b>	Negative Reactive Energy - Low	varh
0x170E	<b>UD_WORD</b>	Negative Reactive Energy - High	Mvarh
0x1710	<b>UD_WORD</b>	Partial+ Active Energy - Low	Wh
0x1712	<b>UD_WORD</b>	Partial+ Active Energy - High	MWh
0x1714	<b>UD_WORD</b>	Partial+ Reactive Energy - Low	varh
0x1716	<b>UD_WORD</b>	Partial+ Reactive Energy - High	Mvarh
0x1718	<b>UD_WORD</b>	Partial- Active Energy - Low	Wh
0x171a	<b>UD_WORD</b>	Partial- Active Energy - High	MWh
0x171c	<b>UD_WORD</b>	Partial- Reactive Energy - Low	varh
0x171e	<b>UD_WORD</b>	Partial- Reactive Energy - High	Mvarh
0x1720	<b>SD_WORD</b>	Signed 3-ph active power	W
0x1722	<b>SD_WORD</b>	Signed 3-ph reactive power	var
0x1724	<b>SD_WORD</b>	Signed phase1 active power	W
0x1726	<b>SD_WORD</b>	Signed phase2 active power	W
0x1728	<b>SD_WORD</b>	Signed phase3 active power	W
0x172A	<b>SD_WORD</b>	Signed phase1 reactive power	var
0x172C	<b>SD_WORD</b>	Signed phase2 reactive power	var
0x172E	<b>SD_WORD</b>	Signed phase3 reactive power	var
0x1730	<b>SD_WORD</b>	Signed 3-ph Power Factor	1/100
0x1732	<b>SD_WORD</b>	Signed phase1 Power Factor	1/100
0x1734	<b>SD_WORD</b>	Signed phase2 Power Factor	1/100
0x1736	<b>SD_WORD</b>	Signed phase3 Power Factor	1/100

0x7000	<b>U_WORD</b>	Current phase 1 - fundamental	1000
0x7001	<b>U_WORD</b>	Current phase 1 - 2 <sup>nd</sup> harmonic (percentage)	1/10 %
-----	-----	-----	
0x7031	<b>U_WORD</b>	Current phase 1 - 50 <sup>th</sup> harmonic (percentage)	1/10 %
0x7040	<b>U_WORD</b>	Current phase 2 - fundamental	1000
0x7041	<b>U_WORD</b>	Current phase 2 - 2 <sup>nd</sup> harmonic (percentage)	1/10 %
-----	-----	-----	
0x7071	<b>U_WORD</b>	Current phase 2 - 50 <sup>th</sup> harmonic (percentage)	1/10 %
0x7080	<b>U_WORD</b>	Current phase 3 - fundamental	1000
0x7081	<b>U_WORD</b>	Current phase 3 - 2 <sup>nd</sup> harmonic (percentage)	1/10 %
-----	-----	-----	
0x70B1	<b>U_WORD</b>	Current phase 3 - 50 <sup>th</sup> harmonic (percentage)	1/10 %
0x70C0	<b>U_WORD</b>	Voltage phase 1 (V12) - fundamental	1000
0x70C1		Voltage phase 1 (V12) - 2 <sup>nd</sup> harmonic (percentage)	1/10 %
-----	-----	-----	
0x70F1	<b>U_WORD</b>	Voltage phase 1 (V12) - 50 <sup>th</sup> harmonic (percentage)	1/10 %
0x7100	<b>U_WORD</b>	Voltage phase 2 (V23) - fundamental	1000
0x7101	<b>U_WORD</b>	Voltage phase 2 (V23) - 2 <sup>nd</sup> harmonic (percentage)	1/10 %
-----	-----	-----	
0x7131	<b>U_WORD</b>	Voltage phase 2 (V23) - 50 <sup>th</sup> harmonic (percentage)	1/10 %
0x7140	<b>U_WORD</b>	Voltage phase 3 (V31) - fundamental	1000
0x7141	<b>U_WORD</b>	Voltage phase 3 (V31) - 2 <sup>nd</sup> harmonic (percentage)	1/10 %
-----			
0x7171	<b>U_WORD</b>	Voltage phase 3 (V31) - 50 <sup>th</sup> harmonic (percentage)	1/10 %
0x7200	<b>UD_WORD</b>	Current phase 1 - fundamental (rms)	mA
-----			
0x7262	<b>UD_WORD</b>	Current phase 1 - 50 <sup>th</sup> harmonic (rms)	mA
0x7280	<b>UD_WORD</b>	Current phase 2 - fundamental (rms)	mA
-----			
0x72E4	<b>UD_WORD</b>	Current phase 2 - 50 <sup>th</sup> harmonic (rms)	mA
0x7300	<b>UD_WORD</b>	Current phase 3 - fundamental (rms)	mA
-----			
0x7364	<b>UD_WORD</b>	Current phase 3 - 50 <sup>th</sup> harmonic (rms)	mA
0x7380	<b>UD_WORD</b>	Voltage phase 1 (V12) - fundamental (rms)	mV
-----			
0x73E2	<b>UD_WORD</b>	Voltage phase 1 (V12) - 50 <sup>th</sup> harmonic (rms)	mV
0x7400	<b>UD_WORD</b>	Voltage phase 2 (V23) - fundamental (rms)	mV
-----			
0x7462	<b>UD_WORD</b>	Voltage phase 2 (V23) - 50 <sup>th</sup> harmonic (rms)	mV
0x7480	<b>UD_WORD</b>	Voltage phase 3 (V31) - fundamental (rms)	mV
-----			
0x74E2	<b>UD_WORD</b>	Voltage phase 3 (V31) - 50 <sup>th</sup> harmonic (rms)	mV

0x7500	<b>U WORD</b>	THD I1	1/10 %
0x7501	<b>U WORD</b>	THD I2	1/10 %
0x7502	<b>U WORD</b>	THD I3	1/10 %
0x7503	<b>U WORD</b>	THD V1 (V12)	1/10 %
0x7504	<b>U WORD</b>	THD V2 (V23)	1/10 %
0x7505	<b>U WORD</b>	THD V3 (V31)	1/10 %

(2) -----

Device programmed in "Alarm Output" mode :

0: No active Alarm  
1: Alarm active

(3) -----

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

(4) -----

<b>Transformer ratio</b>	<b>Measurement unit</b>	<b>Display Format</b>	<b>Protocol Format</b>
100 ≤ KTA*KTV < 1000	kWh (kvarh)	xxxxxxxx k	xxxxxxxx
1000 ≤ KTA*KTV < 10000	kWh (kvarh) * 10	xxxxxx.yy M	xxxxxyy

(5) -----

Depending on Rogowski coil type :

Rogowski 1000 A / 100 mV => KTA = 200  
Rogowski 3000 A / 100 mV => KTA = 600  
Rogowski 5000 A / 100 mV => KTA = 1000

(6) -----

0 : positive  
1 : negative



## 5.0 SETUP PARAMETERS

NEMO D4-Le parameters may be read and written accordingly to the procedure described in the following. The variable table to read and write the parameters are located at the same address.

It is allowed to write the setup parameters addressed at 0x2000 and 0x2200 only by a single telegram for each group.

### Standard Setup parameters (read and write)

Length : 16 BYTES

0x2000	<b>U_WORD</b>	RFU	
0x2001	<b>U_WORD</b>	RFU	
0x2002	<b>U_WORD</b>	RFU	
0x2003	<b>U_WORD</b>	RFU	
0x2004	<b>U_WORD</b>	Percentage of rated 3phase active power run hour meter	50..5000 means (0.5%..50.00%)
0x2005	<b>U_WORD</b>	Run hour meter active on	0:V1 1:P
0x2006	<b>U_WORD</b>	RFU	
0x2007	<b>U_WORD</b>	RFU	
0x2008	<b>U_WORD</b>	Backlight intensity	0:0% 1:35% 2:70% 3:100%
0x2009	<b>U_WORD</b>	RFU	
0x200a	<b>U_WORD</b>	Power Averaging time	0:5min 1:8min 2:10min 3:15min 4:20min 5:30min 6:60min
0x200b	<b>U_WORD</b>	Insertion type	0:3n-3e 1: 3-3e 2: 3-2e 3:1n-1e 4:3n-1e 5: 3-1e
0x200c	<b>U_WORD</b>	Measure on line 1 of custom page	0:V1 1:V12 2:I1 3:In 4:P 5:Q 6:S 7:P1 8:Q1 9:S1 10:PF 3-phase
0x200d	<b>U_WORD</b>	Measure on line 2 of custom page	0:V2 1:V23 2:I2 3:P 4:Q 5:S 6:P2 7:Q2 8:S2 9:Freq 10:I1

0x200e	<b>U_WORD</b>	Measure on line 1 of custom page	0:V3 1:V31 2:I3 3:P 4:Q 5:S 6:P3 7:Q3 8:S3 9:P1 10:I1
0x200f	<b>U_WORD</b>	RFU	-

**Output option Setup parameters (read and write)**
**Length : 24 BYTES**

0x2200	<b>U_WORD</b>	RFU	
0x2201	<b>U_WORD</b>	RFU	
0x2202	<b>U_WORD</b>	RFU	
0x2203	<b>U_WORD</b>	RFU	
0x2204	<b>U_WORD</b>	RFU	
0x2205	<b>U_WORD</b>	RFU	
0x2206	<b>U_WORD</b>	RFU	
0x2207	<b>U_WORD</b>	RFU	
0x2208	<b>U_WORD</b>	RFU	
0x2209	<b>U_WORD</b>	RFU	
0x220a	<b>U_WORD</b>	Pulse output or Alarm or output controlled remotely	0: Pulse out 1: Alarm out 2: Dual stable remote control 3: Remote Timer control
0x220b	<b>U_WORD</b>	Pulse duration	0: 50msec 1: 100msec 2: 200msec 3: 300msec 4: 400msec 5: 500msec
0x220c	<b>U_WORD</b>	Pulse weight	0: 0.01 kWh 1: 0.10 kWh 2: 1.00 kWh 3: 10.0 kWh 4: 0.10 MWh 5: 1.00 MWh 6: 10.0 MWh
0x220d	<b>U_WORD</b>	Pulse on	0: Act Energy 1: Rea Energy
0x220e	<b>U_WORD</b>	Output set as Alarm option = 1 : delay to OFF after condition has finished  Output set as remote control option 2 : pulse period after the remote command has been issued option 3 : delay to OFF after the remote OFF command has been issued	seconds
0x220f	<b>U_WORD</b>	Output set as Alarm option = 1 : delay to ON after condition has been reached  Output set as remote control option 2 : delay to ON after the remote command has been issued option 3 : delay to ON after the remote command has been issued	seconds
0x2210	<b>U_WORD</b>	Hysteresis	% (no decimals)
0x2211	<b>U_WORD</b>	Relay (NO/NC)	0: NO 1: NC
0x2212	<b>U_WORD</b>	Alarm on Min Value or Max Value	0: Min 1: Max
0x2213	<b>U_WORD</b>	Alarm set point	

0x2214	<b>U_WORD</b>	RFU	-
0x2215	<b>U_WORD</b>	Unit of set point	0: X.XXX 1: XX.XX 2: XXX.X 3: X.XXX k 4: XX.XX k 5: XXX.X k 6: X.XXX M 7: XX.XX M 8: XXX.X M
0x2216	<b>U_WORD</b>	Sign of Alarm set point	0: + 1: -
0x2217	<b>U_WORD</b>	Type of measurement	0: V1 1: V2 2: V3 3: V12 4: V23 5: V31 6: I1 7: I2 8: I3 9: Freq 10: Act Power 11: Rea Power

E.g. **Request**

FF 03 **22 00** 00 18 5A 66

**Answer :**

```

FF 03 30      0x2200  0x2201  0x2202  0x2203  0x2204  0x2205  0x2206  0x2207  0x2208
              W0      W1      W2      W3      W4      W5      W6      W7      W8
0x2209  0x220a  0x220b  0x220c  0x220d  0x220e  0x220f  0x2210  0x2211
W9      W10   W11   W12   W13   W14   W15   W16   W17
0x2212  0x2213  0x2214  0x2215  0x2216  0x2217
W18   W19   W20   W21   W22   W23   CRC WORD
    
```

```

FF 03 30 | 00 00 | 00 00 | 00 00 | 00 00 | 00 00 | 00 00 | 00 00 | 00 00 | 00 00 |
          | 00 00 | 00 00 | 00 00 | 00 00 | 00 00 | 00 00 | 00 00 | 00 00 | 00 00 |
          | 00 00 | 00 00 | 00 00 | 00 00 | 00 01 | 00 02 | 6D C1
    
```

W0 .. W9 / W20 are not used.

**Procedure to write**

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 parameters

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 it is mandatory to send the following commands :

Address 0x2700 : write WORD with value = 0x 5AA5 ( Master Unlock Key )

Address 0x2800 : write WORD with value = 0x YYYY ( any value )

This command will reset the NEMO 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 = 0x 5AA5 ( Master Unlock Key )

Address 0x2600 : write WORD with value = 0x YYYY ( any value )

**Write address table**

Address	Format	Description	Value
0x100	<b>U_WORD</b>	Current transformer ratio	200 600 1000
0x102	<b>U_WORD</b>	Voltage transformer ratio	1/10 (e.g. 4.3 Reading 43)
0x2000	<b>16 U_WORD</b>	Standard setup parameters	(16)
0x2200	<b>24 U_WORD</b>	Programming parameters of pulse and/or alarm output	(16)
0x2400	<b>U_WORD</b>	Reset Hour Meter, Maximum Powers, Maximum Voltages, Maximum Currents, Minimum Voltages, Active Partial Energy, Reactive Partial Energy	(12)
0x2600	<b>U_WORD</b>	Saving in EEPROM parameters changed by Remote commands	(13)
0x2700	<b>U_WORD</b>	Enable Remote Writing Operation	(14)
0x2800	<b>U_WORD</b>	Load previous setup parameters stored in EEPROM	(15)

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

0|0|0|0|0|0|0|0|0|b8|b7|b6|b5|b4|b3|b2|b1|b0

- b0 = 1 => Reset Hour Meter
- b1 = 1 => Reset Peak Maximum Demand
- b2 = 1 => Reset Maximum Voltage values
- b3 = 1 => Reset Maximum Current values
- b4 = 1 => Reset Minimum Voltage values
- b5 = 1 => Reset Active Partial Energy
- b6 = 1 => Reset Reactive Partial Energy
- b7 = 1 => Reset Counter Input 1
- b8 = 1 => Reset Counter Input 2

b9 .. b15 = 0

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

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

(15) Write any value to abort any remote programming write operation and reload the previous values.

(16) The parameters are read and written with the same sequence.