

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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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).

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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

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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 NA 96/96+ : **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

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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.

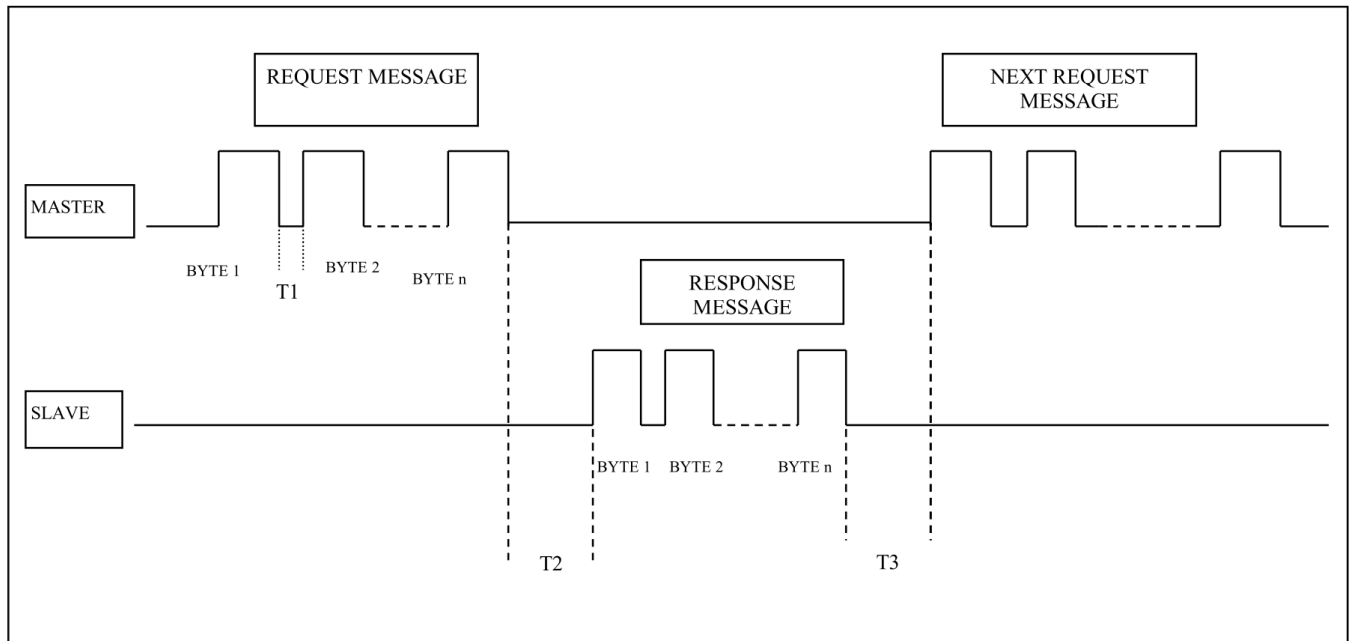
If the message is correct but there are errors (wrong functional code or data) it can't be accepted, so the slave answers with an error message.

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

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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.

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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

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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

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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

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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 %

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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

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				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

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(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
$1 \leq KTA \cdot KTV < 10$	Wh(varh) * 10	xxxxxx.yy k	xxxxxxyy
$10 \leq KTA \cdot KTV < 100$	Wh(varh) * 100	xxxxxxx.y k	xxxxxxxy
$100 \leq KTA \cdot KTV < 1000$	kWh(kvarh)	xxxxxxxx k	xxxxxxxx
$1000 \leq KTA \cdot KTV < 10000$	kWh(kvarh) * 10	xxxxxx.yy M	xxxxxxyy
$10000 \leq KTA \cdot KTV < 100000$	kWh(kvarh) * 100	xxxxxxx.y M	xxxxxxxy
$100000 \leq KTA \cdot KTV$	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.

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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

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5.0 REMOTE RESETS AND PROGRAMMING

NA 96/96+ 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 NA 96/96+

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 NA 96/96+ 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)

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

(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|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.

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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 |

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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)

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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

Neutral Current module

24 WORDs R/W

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.

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

I/O module

Functions

- (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 count : example for a NA96/96+ 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 NA96/96+ 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

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

Pulse counters - reset

Example for a NA96/NA96+ 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 NA96/NA96+ 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 NA96/NA96+ 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 NA96/NA96+ 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

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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	MSB LSB	MSB LSB
Device address	F.code	1 st 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	CRC16
Dev Add.	F. cod	BYTES num	WORD 1	WORD 2	WORD 3	WORD 4	
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

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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)

COMMUNICATION MODBUS PROTOCOL

MGF3900R-- NA96/NA96+ plug-in module for RS485
compatible with Modbus RTU/JBUS

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|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.