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1.   INTRODUCTION:

Following documents have been used for these specifications:

- GOULD MODBUS Protocol Reference Guide
  PI-MBUS-300 Rev B.

- EUROTHERM Group MODBUS Standard   Technical Note n°0998.

- RS485 / EIA Standard.

- Standard CEI 1131-3: programmable controllers
  - programming Languages

2.   MODBUS: GENERAL CHARACTERISTICS:

The goal of this paragraph is to remember the basic principle of MODBUS, issued from the Gould-Modbus specifications and the application to our product.

It isn't really a Fieldbus(MODBUS is not covered by the ISO from the OSI model).
Targeted at industrial automation use where timing is not critical.

2.1.   Protocol type:
Single Master/Multiple Slaves type. Several 'function codes' (see chapter 5.8 and following) are used to provide access to parameter data, either in 'blocks', or as single parameters. The protocol differentiates between digital and analogue values, but in our application, they are treated in the same way (function 1,2 and 3,4 are exactly the same).
Each value has its own separate address space.
Other function codes provide quick status information and loop back diagnostics. 125 registers may be transferred in a single block read/write.

2.2.   Medium used:
RS485 .

2.3.   Maximum device number:
32 (RS485) without repeaters, including master

2.4.   Typical baud rates:
9,600 – 19,200 bauds.

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2.5. Maximum network length:

1200 m at 9600 baud's.

2.6. Network performance:

The maximum speed of the network is conditioned by the rate at which the controller can service interrupts from the network. The maximum baud rate supported by the TE Series Interface is 19,200 bauds.
 A typical single parameter poll/reply message can be completed in around 15-20 ms using Modbus. This gives a transfer rate of 10 - 50 parameters per second.
Blocks of data may be transferred in one operation, allowing more efficient (and coherent) data transfer.
Typically, each additional value transmitted takes the transmission time for 10 bits, although a little extra message processing latency may be added for larger blocks.
Typical network scan time of the order of 1 second

2.7. Profiles:

Very few profiles defining devices on Modbus networks exist, although the CNOMO standard defines the addresses of a few key parameters. It is generally unwise to use Modbus addresses that are greater than 99, since many SCADA systems are unable of accessing them.

2.8. Configuration method:

Master, typically a PLC, SCADA system, or panel is hand programmed with parameter addresses, then programmed to poll data and write to parameters as required.

2.9. Conformance testing:

No standard testing.

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3.   GENERAL PRODUCT INFORMATIONS
(see the User Manual HA175874ENG for complete specification informations)

3.1.   REMIO MODBUS Interface characteristics:

The REMIO Interface is a <u>MODBUS Slave</u> Module according to Gould-Modicon specification.

<u>Bus connection</u> using shielded twisted pair (RS485).

<u>Speed:</u> 9,600 or 19,200 baud's selectable by switch.

<u>Parity:</u> 8 bits with no parity (9 bits parity EVEN available on demand).

<u>Interface status</u> indicated by LEDs. (See chapter 7)

<u>Address</u> set directly by the link from the Master (Unit address can be set or changed from the bus without any switch or jumper).
Exiting the factory, the address of the interface is set to 32 (decimal).

A <u>Watchdog Timer</u> monitors the elapsed time between two messages.
The watchdog is reset with each error free frame received, on recognition of the Station Number. In case of error, all the interface ports are set to logical 0 level in order to avoid malfunction.
The <u>Time Out</u> can be programmed from an appropriate control. A value <u>between 1s and 65s</u> can be selected.

<u>No redundancy available</u>.

3.1.1. Time Proportionning Outputs:
The REMIO Interface can be equipped with up to 2 optional modules carrying each one 16 Time Proportionning Outputs; allowing up to 48 Time Proportionning Outputs on one single unit.

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4.   INSTALLATION:

4.1.   Address setting:

The protocol provides for one Master and up to 247 slaves on a common line.
Before to start a MODBUS system, it must be assigned an unmatched address to each station.
The Slave Address can <u>ONLY BE SET BY THE LINK</u>. No jumper is available for this purpose. Because certain device restriction limit the address number to 99 (decimal), the <u>initial address (factory setting) is fixed at 32</u> (decimal).

This address is stored in a non-volatile memory and:
- <u>must be changed by the user before connection of the Unit to the link.</u>

OR

- <u>The address setting must be made with only one slave at the address 32 at the time on the link</u>.

That is, the slaves must be added one by one on the link and each time, be assigned a single address between 1 and 247. (excepted 32 in this second case.)

The Parameter address of the Device Address is 100 (decimal).
See chapter 5.6 for more information.

In addition MODBUS provide the possibility to WRITE certain parameters by <u>BROADCASTING at the Address 00</u>.

4.2.   Baud-rate selection:
The Baud rate is selected by the second switch on the top of the unit.
(Also see the User Manual HA175874ENG for more details)

SW1.2
baud rate
selection

SW1.3,SW1.4
Bus Terminal
Resistors
selection

SW1.1 port
configuration

SW1

ON 1 2 3 4
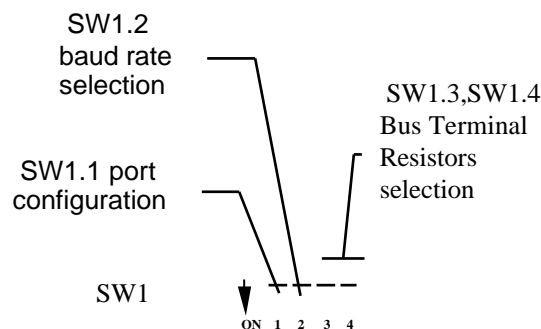
SW1.2= OFF = 9,600 bauds.
SW1.2 = ON = 19,200 bauds.

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4.3. Connections:

4.3.1. Connection on the main board:

4.3.1.1. Modbus connector:

The 6-pins connector on the bottom of the unit is used to connect the shielded twisted pair of the bus.

```
        ┌─ RX-/TX- ─┐
       ╱            ╲
      ╱  RX+/TX+     ╲
     ╱    ╱    ╲      ╲
    ────────────────────
     ∅   ∅   ∅   ∅   ∅   ∅

     61  62  63  64  65  66
```
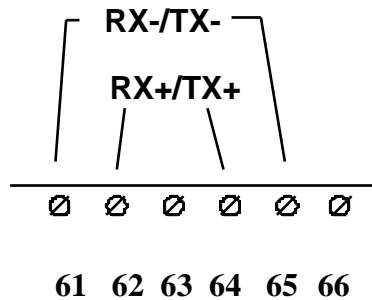
The connections number 61 and 65 are internally connected together, as well as the connections number 62 and 64.

The Communication electronics is insulated from the Control electronics.

One earth terminal is provided near the communication connector, at the bottom of the unit, for shielding purposes.

Wiring and shielding are described in the User Manual HA175874ENG.
Care must be particularly taken to the line impedance, to the impedance adaptation, maximal length, etc....

The Bus terminal resistors can be put in or out circuit using the 2 micro switches intended for this purpose on the top of the unit . <u>Note that only the last unit on the bus must have the impedance adaptation resistors fit</u>.

SW1.3, SW1.4
Bus Terminal
Resistors
selection

```
    │  ─ ─ ─ ─
    ▼
  ON  1  2  3  4
```
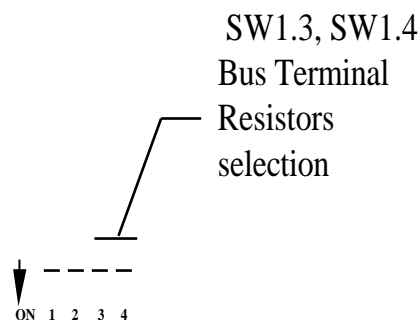
More than 32 stations can not be used without any repeater.

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5. MODBUS USER INFORMATION'S

5.1. Principle:

The protocol used is the MODBUS RTU. That is
- Coding system: 8 bit binary.
- Number of bits: 8 with no parity
  (a 9 bits parity EVEN is available on demand).
- Start bit: 1
- Stop bit: 1
- First bit: least significant bit.
- Error Checking: Cyclic Redundancy Check.

The protocol controls the query and response cycle which takes place between master and slave devices.

Each exchange comprises 2 messages, excepted in case of broadcasting where there Is no response sent.

MASTER		**SLAVE**
Slave Address	**Query** →	Slave Address
Function Code		Function Code
Data	**Response** ←	Data
Error Check		Error Check
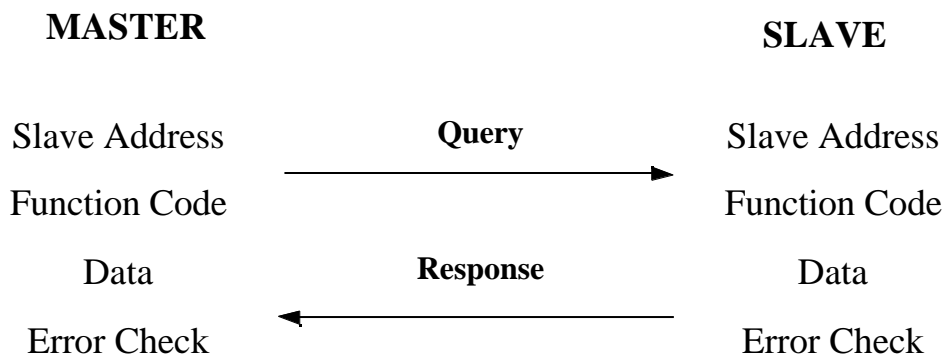
Only the Master initiates a transaction.

- Slave Address: Specifies which Slave is concerned by the Query frame.
- Function code: Indicates which operation has to be performed.
- Data's: all the parameters required by the function.
- Error Check: Cyclic Redundancy Code (CRC).

5.2. Query frame structure:

The query frame structure is as follows:

Slave Address	Function Code	Informations	CRC-16
= 1 Byte	= 1 Byte	= n Bytes	= 2 Bytes

<u>Function field:</u>

Code	Function
1 or 2	Read 1 or several bits
3 or 4	Read 1 or several words
5	Write 1 Bit
6	Write 1 Word
7	Read Exception Status
8	Diagnostic Test
15	Write multiple bits
16	Write multiple Words

These functions will be detailed below.
The message is accepted by the Slave only if the address matches its own address number and if the CRC word is correct.

5.3.   Response frame structure:

Slave Address	Function Code	Informations	CRC-16
= 1 Byte	= 1 Byte	= n Bytes	= 2 Bytes

The structure is the same for the Query and for the Response.

5.4.   Frame synchronisation:

The synchronisation is made by the time elapsed between 2 frames (Inter-frame gap). Following rules must be followed:

- The time between 2 characters inside a frame must not exceed 3 character time.

First Byte
Second Byte
Third Byte
REQUEST or RESPONSE FRAME

Tch   Tch   Tch

$< 3*Tch$ $< 3*Tch$

Inside the frame
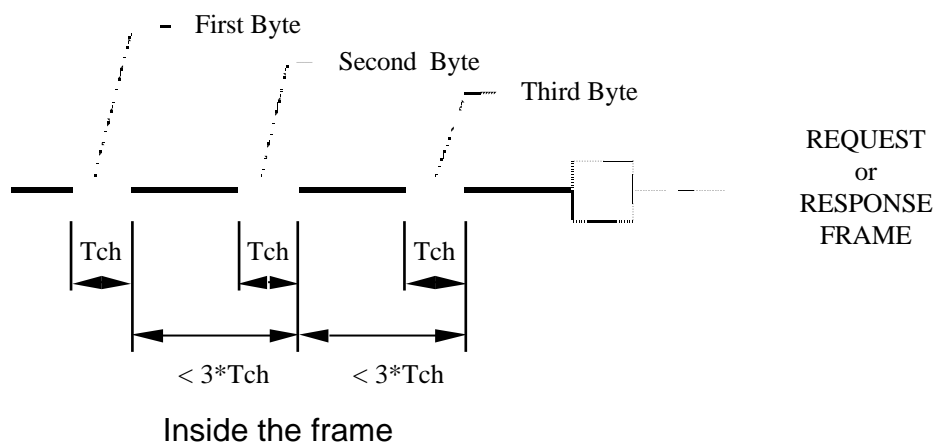
- The time between 2 frames must be greater than 3 character time.

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Between 2 frames
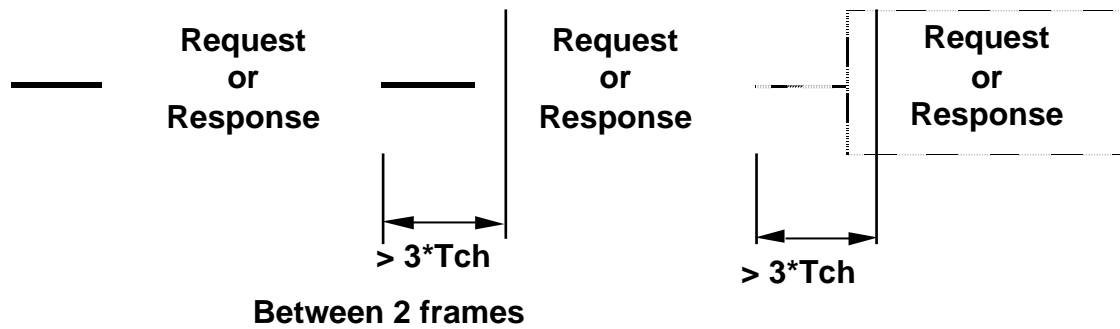
Note: The first character of the frame is comprised into the Inter-frame gap

5.5.   Error response messages:

An error frame message is as follows:

Slave Address	Function Code + 128	Error Code	CRC-16
= 1 Byte	= 1 Byte	= 1 Byte	= 2 Bytes

with following error codes:

CODE	ERROR
1	Illegal Function
2	Illegal Data Address
3	Illegal Data Value
4	Failure in Device
5	ACK
6	Busy
7	NACK
8	Data NOT Writable
9	No Data Request
10	Too many Data Request

5.6.   List of valid parameters addresses:

Address	Parameter	Format
1	Port1	0-255
2	Port3	0-255
3	Port5	0-255
4	Port2	0-255
5	Port4	0-255
6	Port6	0-255
11 to 26	Duty Cycle 1 to 16 (TPO)	0-255
27 to 42	Duty Cycle 1 to 16 (TPO)	0-255
43 to 58	Duty Cycle 1 to 16 (TPO)	0-255
100	Unit Address	0-247
101	Watchdog Time Out	0 and 1000-65535
102	Command Word	Bits
122	Instrument Identifier	0-65535

- Ports 1, 3, 5: are Output only (Readable and Writable)

Note:
> ⇒ These ports are also accessible on a TPO unit but in this case, writing to these ports has no physical effect (could be used as virtual ports).
> ⇒ Broadcast permissible on write operation.

- Ports 2, 4, 6:
   - ∗ are outputs (Readable and Writable) if SW1.1 = 1
   - ∗ are inputs (only Readable) if SW1.1 = 0

   (see User Manual HA175874ENG for more details)

Note:
> ⇒ These ports are also accessible on a TPO unit but in this case, writing to these ports has no physical effect (could be used as virtual ports).
> ⇒ Broadcast permissible on write operation.

- Duty cycle outputs (TPO): are Output only (Readable and Writable)

Note: Broadcast allowed on write operation on these outputs.

- Unit address: (Readable and Writable) At first power-on, the Unit Address is 32(decimal) by factory setting. Before any operation on the bus, the device must be assigned a single unmatched address between 1 and 247.

Note:
> ⇒ 32 is an authorised address, but care must be taken to have only one unit at this address on the bus.
> ⇒ This parameter is stored in the unit's non-volatile memory.
> ⇒ Broadcasting this parameter is not allowed.

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- Watchdog Time Out: (Readable and Writable) This parameter indicates the elapsed time allowed without any valid frame addressed to this unit.
 After this time, all the outputs are reset to 0, and the RED LED is lit, waiting the next valid frame.
Watchdog_Time_Out = 0 ===> Watchdog not active.
The allowed values are 1000 to 65535 (time out in ms)
or 0 (deactivated).

Note:
⇒ This parameter is stored in non-volatile memory of the unit.
⇒ Broadcast allowed on write operation.

- Command Word: (Readable and Writable) This parameter is bit decoded.

∗ CW[bit0] = 0 ===> Digital Input are read in negative logic. (Open contact gives a "0" logic level).
∗ CW[bit0] = 1 ===> Digital Input are read in positive logic. (Open contact gives a "1" logic level)

Note:
⇒ If the Command Word has to be changed, it is recommended to change it before any other operation.
⇒ Warning: CWH is reserved for factory setting. It is readable,but writing it in the normal way has no effect.
∗ CW[bit8] = 1 ===> TPO module 1 fit.(deactive port1 and port2).
∗ CW[bit9] = 1 ===> TPO module 2 fit.(deactive port3 and port4).
∗ CW[bit10] = 1 ===> TPO module 3 fit.(deactive port5 and port6).
∗ CW[bit11] shows the value of SW1.1
CW[bit11] = 0 ===> SW1.1= 0
ports2,4,6 configured as INPUT
CW[bit11] = 1 ===> SW1.1= 1
ports2,4,6 configured as OUTPUT

⇒ This parameter is stored in the non-volatile memory of the unit.
⇒ Writing this parameter by word (Function 6 or Function 16) is allowed but not recommended. It is preferable to change it bit by bit, by using function 5 only, avoiding unwanted bits modifications.
⇒ Broadcast allowed on write operation.

- Instrument Identifier: (only Readable) This parameter has no affectation yet but is required by the CNOMO. 0x0000 is returned.

✎ Important:
1. All writable parameters are broadcastable excepted Unit Address.
2. Do not insert write instructions of a non-volatile memory stored parameter in a Program loop.

5.7. List of valid bit addresses:

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- Only Port1, 2, 3, 4, 5, 6 and the Command Word CW can be accessed as bits.

- Bit addresses are as follows:

PORTS:

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Port1	8	7	6	5	4	3	2	1
Port3	16	15	14	13	12	11	10	9
Port5	24	23	22	21	20	19	18	17
Port2	32	31	30	29	28	27	26	25
port4	40	39	38	37	36	35	34	33
Port6	48	47	46	45	44	43	42	41

Command Word (CW):

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
CWL	108	107	106	105	104	103	102	101
CWH	116	115	114	113	112	111	110	109

- Only these bit addresses are valid.
- Bits 1 to 24 are output only (Readable and Writable)
- Bits 25 to 48 are:
  - ⇒ Output (Readable and Writable) if SW1.1= 1
  - ⇒ Input (only Readable) if SW1.1 = 0
- Bits 101 to 108 (CWL) are readable and writable (preferably with function 5 to avoid false bits modifications).
  - Bit 101 = 1L ===> port2, port4, port6 read in positive logic (when selected as Input).
- Bits 109 to 116 (CWH) are only readable. This byte is reserved for factory setting.
  - Bit 109 = 1L ===> TPO module 1 fit. (deactive port1 and port2).
  - Bit 110 = 1L ===> TPO module 2 fit. (deactive port3 and port4).
  - Bit 111 = 1L ===> TPO module 3 fit.(deactive port5 and port6).

  - Bit 112   = 0 ===> SW1.1 = 0   ports2,4,6 configured as INPUT
                = 1 ===> SW1.1 = 1   ports2,4,6 configured as OUTPUT

5.8.   Read 1 or several bits : function 1 / function 2

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REQUEST:

SLAVE ADDR.	'1'or '2'	First bit addr. MSB,LSB	Bit number MSB,LSB	CRC
= 1 Byte	= 1 Byte	= 2 Bytes	= 2 Bytes	= 2 Bytes

Note:
- Broadcast not allowed.

RESPONSE:

SLAVE ADDR.	'1'or '2'	Byte count n	Bit values First Byte ..... Last Byte	CRC
= 1 Byte	= 1 Byte	= 1 Byte	= n Bytes	= 2 Bytes

Bytes are filled in order from the LSB to the MSB.
The last byte is filled with zeros if necessary.
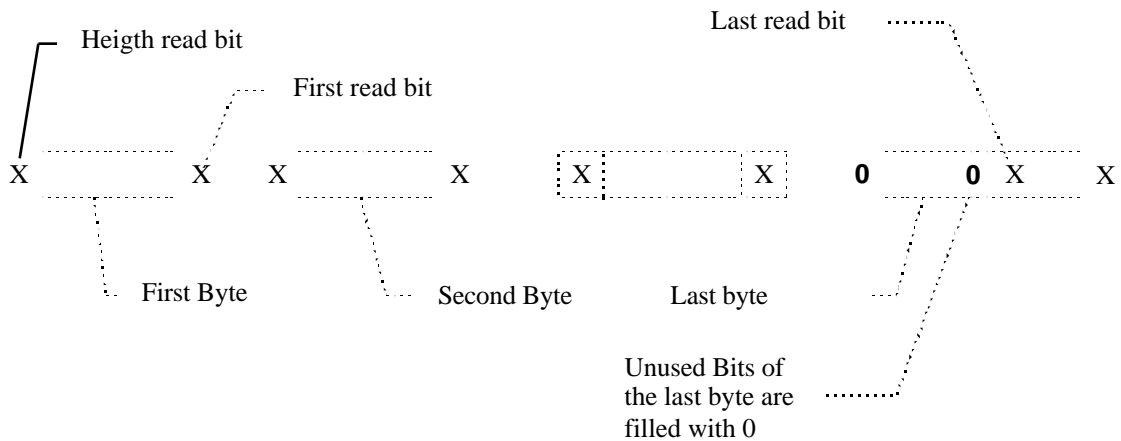
5.8.2. Example:

The 6 Ports of the device are as follows:

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```
Port1 ---> 0x56 =   0 1 0 1 0 1 1 0
Port3 ---> 0xB2 =   1 0 1 1 0 0 1 0
Port5 ---> 0x45 =   0 1 0 0 0 1 0 1
Port2 ---> 0xCF =   1 1 0 0 1 1 1 1
Port4 ---> 0x22 =   0 0 1 0 0 0 1 0
Port6 ---> 0x55 =   0 1 0 1 0 1 0 1
```

The address of the device is 50 (decimal)

The Request Frame is:

 0x32, 0x02, 0x00, 0x05, 0x00, 0x12, 0xED, 0xC5.
Request the 18 (decimal) bit values from the bit address 5

And the Response Frame is:

 0x32, 0x02, 0x03, 0x25, 0x5B, 0x00, 0x57, 0x76.

Another example with a faulty demand (bit address not existent):

Demand: 0x32, 0x02, 0x00, 0x23, 0x00, 0x12, 0x0C, 0x0E.

Response: 0x32, 0x82, 0x0A, 0x30, 0xA8.   (Error Code 10)

5.9.   Read 1 or several words : function 3 / function 4

5.9.1. Structure of the frames:

REQUEST:

SLAVE ADDR.	'3'or '4'	First Word addr. MSB,LSB	Word number MSB,LSB	CRC
= 1 Byte	= 1 Byte	= 2 Bytes	= 2 Bytes	= 2 Bytes

Note:
- Broadcast not allowed.
- Only a maximum of 8 values is permissible with this function.

RESPONSE:

SLAVE ADDR.	'3'or '4'	Byte count n	Word values First Word ..... Last Word	CRC

= 1 Byte	= 1 Byte	= 1 Byte	= n Bytes	= 2 Bytes

Notes:
- Each word take 2 Bytes MSB,LSB. In consequence, the total number of word is n/2.
- Only consecutive words can be read in the same sequence.

5.9.2. Example:

With the same Port values of the previous example:

Request: 0x32, 0x04, 0x00, 0x01, 0x00, 0x03, 0xE4, 0x08.
Reading of the 3 first ports of the device.

Response: 0x32, 0x04, 0x06, 0x00, 0x56, 0x00, 0xB2, 0x00, 0x45, 0x09, 0xBA.

5.10. Write 1 Bit: function 5

5.10.1.Structure of the frames:

REQUEST:

SLAVE ADDR.	'5'	Bit addr. MSB,LSB	Bit value	'0'	CRC
= 1 Byte	= 1 Byte	= 2 Bytes	= 1 Byte	= 1 Byte	= 2 Bytes

Note:
- Broadcast allowed at the Device address 00.
- Bit value =
    - $\Rightarrow$ 255   ----> 1L
    - $\Rightarrow$ 0   ----> 0L
other values are not accepted.

RESPONSE:

SLAVE ADDR.	'5'	Bit addr. MSB,LSB	Bit value	'0'	CRC
= 1 Byte	= 1 Byte	= 2 Bytes	= 1 Byte	= 1 Byte	= 2 Bytes

Notes:
- The response is simply the demand echoed.
- In case of broadcasting, there is no Response.

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5.10.2. Example:

Force the bit number 3 of port 5 (Bit 19) to 1L.

Request: 0x32, 0x05, 0x00, 0x13, 0xFF, 0x00, 0x78, 0x3C.

Response: 0x32, 0x05, 0x00, 0x13, 0xFF, 0x00, 0x78, 0x3C.

5.11. Write 1 Word: function 6

5.11.1. Structure of the frames:

REQUEST:

SLAVE ADDR. = 1 Byte	'6' = 1 Byte	Word addr. MSB,LSB = 2 Bytes	Word Value MSB,LSB = 2 Bytes	CRC = 2 Bytes

Note:
- Broadcast allowed at the Device address 00.

RESPONSE:

SLAVE ADDR. = 1 Byte	'6' = 1 Byte	Word addr. MSB,LSB = 2 Bytes	Word Value MSB,LSB = 2 Bytes	CRC = 2 Bytes

Notes:
- The response is simply the echoed request.
- In case of broadcasting, there is no Response.

✎ Important: Do not include this function in a program loop if the parameter is stored in non-volatile memory of the unit.

5.11.2. Example:
- first example: Force the Port 3 to 01010101 (0x55):

Request: 0x32, 0x06, 0x00, 0x02, 0x00, 0x55, 0xED, 0xF6.

Response: 0x32, 0x06, 0x00, 0x02, 0x00, 0x55, 0xED, 0xF6.

- Second example: Change the unit address parameter address 100 (decimal) from 50 (decimal) to 55 (decimal). This new address will be stored in the non-volatile memory of the unit.

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Request: 0x32, 0x06, 0x00, 0x64, 0x00, 0x37, 0x8C, 0x00.

Response: 0x32, 0x06, 0x00, 0x64, 0x00, 0x37, 0x8C, 0x00.

5.12. Read Exception Status: function 7

5.12.1.Structure of the frames:

REQUEST:

SLAVE ADDR.	'7'	CRC
= 1 Byte	= 1 Byte	= 2 Bytes

Note:
- Broadcast not allowed.

RESPONSE:

SLAVE ADDR.	'7'	'0'	CRC
= 1 Byte	= 1 Byte	= 1 Byte	= 2 Bytes

Note:
- This function has been added for compatibility purposes, but is not used (0x00 is returned).

5.12.2.Example:

Request: 0x32, 0x07, 0x55, 0x12.

Response: 0x32, 0x07, 0x00, 0xD2, 0x3F.

5.13. Diagnostic Test: function 8

5.13.1.Structure of the frames:

REQUEST:

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SLAVE ADDR.	'8'	Sub-code '0'	Data	CRC
= 1 Byte	= 1 Byte	= 2 Bytes	= 2 Bytes	= 2 Bytes

Note:
- Broadcast not allowed.
- Only the sub-code 00 is accepted.
- Any data value is accepted and echoed.

RESPONSE:

SLAVE ADDR.	'8'	Sub-code '0'	Data	CRC
= 1 Byte	= 1 Byte	= 2 Bytes	= 2 Bytes	= 2 Bytes

Note:
- This function has been added for compatibility purposes, but is not used.
- The response is simply the echoed request.

5.13.2. Example:

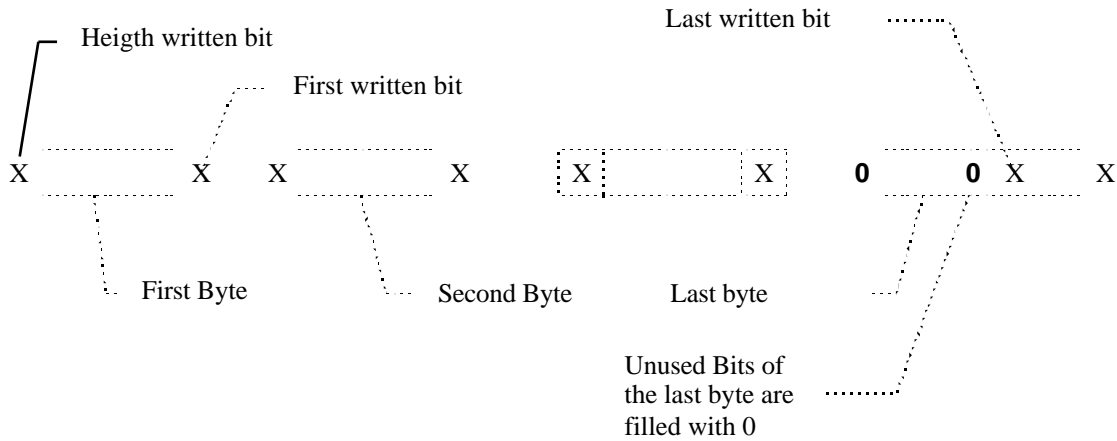Request: 0x32, 0x08, 0x00, 0x00, 0x00, 0x00, 0xE5, 0xC8.

Response: 0x32, 0x08, 0x00, 0x00, 0x00, 0x00, 0xE5, 0xC8.

5.14. Write multiple bits: function 15:

5.14.1. Structure of the frames:

REQUEST:

SLAVE ADDR.	'15'	First Bit addr. MSB,LSB = 2 Bytes	Bit number MSB,LSB	Total Byte number	Bit values First Byte ..... Last Bytes	CRC
= 1 Byte	= 1 Byte		= 2 Bytes	= 1 Byte	= n Bytes	= 2 Bytes

Note:
- Broadcast allowed at the Device address 00.

RESPONSE:

SLAVE ADDR.	'15'	First Bit addr. MSB,LSB	Bit number MSB,LSB	CRC
= 1 Byte	= 1 Byte	= 2 Bytes	= 2 Bytes	= 2 Bytes

Notes:
- In case of broadcasting, there is no response.

5.14.2. Example:

Request: 0x32, 0x0F, 0x00, 0x11, 0x00, 0x08, 0x01, 0x55, 0x81, 0xA8.

Response: 0x32, 0x0F, 0x00, 0x11, 0x00, 0x08, 0x01, 0xCB.

5.15. Write multiple Words: function 16:

5.15.1. Structure of the frames:

REQUEST:

_____

SLAVE ADDR.	'16 '	First Word addr. MSB,LSB	Word number MSB,LSB	Total Byte number	Word values First Word (MSB,LSB) ..... Last Word (MSB,LSB)	CRC
= 1 Byte	= 1 Byte	= 2 Bytes	= 2 Bytes	= 1 Byte	= n Bytes	= 2 Bytes

Note:
- Broadcast allowed at the Device address 00.
- Parameter addresses must be consecutive.
- Only a maximum of 8 values is permissible with this function.

RESPONSE:

SLAVE ADDR.	'16 '	First Word addr. MSB,LSB	Word number MSB,LSB	CRC
= 1 Byte	= 1 Byte	= 2 Bytes	= 2 Bytes	= 2 Bytes

Notes:
- In case of broadcasting, there is no response.

✎ Important: Do not include this function in a program loop if the parameters are stored in non-volatile memory.

5.15.2. Example:

Request: 0x32, 0x10, 0x00, 0x01, 0x00, 0x06, 0x0C, 0x00, 0xE5, 0x00, 0x54, 0x00, 0x82, 0x00, 0xA2, 0x00, 0x85, 0x00, 0xC2, 0x83, 0x62.

Response: 0x32, 0x10, 0x00, 0x01, 0x00, 0x06, 0x14, 0x08.

6. PERFORMANCES:

The system reaction time is dependant of the Master device used.
The maximum speed of the network is conditioned by the rate at which the controller can serve interrupts from the network.
The maximum baud rate available on the REMIO Interface is 19200 bauds. A typical single parameter poll/reply message can be completed in around 15-20 ms using Modbus.
This gives a transfer rate of 10 - 50 parameters per second.

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Blocks of data may be transferred in one operation, allowing more efficient (and coherent) data transfer.
Typically, each additional value transmitted takes the transmission time for 10 bits, although a little extra message processing latency may be added for larger blocks.
Typical network scan time of the order of 1 second

Examples @ 19,200 Bauds:

- In normal conditions,up to 2000 Digital Input or Output can be read or written in 1 second using blocs in function 3 (read) or 16 (write) to reach ports 1 to 6.

- Using blocs of 8 words, mesured time for Duty Cycle ports are as follows:

Request for writing 8 words (function 16)	13 ms
Response	4 ms
Total latency time	10ms
	Total 27 ms

===> about 250 to 300 TPO setpoints per seconde.

7.   TROUBLE SHOOTING:

7.1.   Modbus status leds :

The Interface is equipped with 2 LEDs.
- GREEN
- RED

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- The <u>GREEN LED</u> indicates that the unit is in the <u>Normal Operation State</u>. The master exchanges data's with it at a rate not exceeding the Watchdog Time-Out.

- The <u>RED LED</u> indicates that the Interface is not communicating with the master. The master has never addressed this device OR a Watchdog Time-Out has occurred before any valid communication with the Master.

In this case, following points must be verified:
⇒ connections
⇒ Bus cable
⇒ Bus length
⇒ Impedance adaptation
⇒ Address (Verify that any other Slave has not the same address).
⇒ Verify that the watchdog Time-Out is not too short according to the master scan rate.

At power-on, the LED's blink 3 times with the following sequence:

Green LED ON / Red LED OFF	for 500ms
Green LED OFF / Red LED ON	for 500ms

....

Then the RED LED remains ON until a valid frame is addressed to the unit.

7.2.   Input / Output status leds :

7.2.1. Digital Input/Output modules:

Each module is equipped with 2 LEDs.
- GREEN
- ORANGE

The <u>GREEN LED</u> indicates that all is in order with the corresponding module. (power supply and internal connections).

The <u>ORANGE LED</u> is lit when the bi-directional Input/Output Port at the bottom of the module is configured as INPUT and is ACTIVE. This Input is active when at least one Input contact is open.

7.2.2. Time Proportionning Ouput module (TPO module):

The <u>GREEN LED</u> indicates that all is in order with the corresponding module. (power supply and internal connections).

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