

CARLO GAVAZZI CONTROLS	PQT-90 Serial Communication Protocol V1 R5	Firmware revision: A02
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PQT-90
(Rev. A02 and following)

SERIAL COMMUNICATION PROTOCOL

Vers. 1 Rev. 5

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1 SERIAL COMMUNICATION PROTOCOL

1.1 INTRODUCTION

PQT-90 is equipped with a RS485 or RS232 serial interface. The serial communication protocol, MODBUS-RTU, is the same on both interfaces. When using RS485, it is possible to connect up to 255 instruments using MODBUS protocol. When using RS232 it is only possible to connect a single instrument (multidrop feature is not available).

The time-out for the answer is fixed in 90 ms.

The command structure of the protocol allows the user to read and write from/in the μ P and the system peripherals (data eeprom, calibration eeprom, real time clock and flash memory), so that all the functions are completely transparent.

The communication parameters are programmable, as indicated in the following table:

Interface	Baud rate (bps)	Parity	Stop bit
RS232	9600, 38400 bps	None	1
RS485	From 1200 to 9600 bps	None	1

Note: for details about the programming mode, refer to the user manual.

The communication can be started only by the HOST unit, which sends the request frame. Each frame contains the following information:

- slave address: it is a number from 1 to 255, which identifies the instrument connected to the network. Address 0 (zero) is accepted (in write frames only) by all the instruments, which will execute the relevant command but won't send any answer frame.
NOTE: The request frame must always contain the address even if, when using RS232, it is not considered (every legal value from 1 to 255 is accepted).
- command: it defines the command type (e.g. read function, write function etc.).
- data fields: these numbers define the operating parameters of the command (e.g. the address of the word, the value of the word to be written, etc.).
- CRC word: it allows detecting transmission errors that may occur. CRC calculation is carried out by the MASTER unit once it has defined address, command and data fields. When the SLAVE receives the frame, it is stored in a temporary buffer. The CRC is calculated and then compared with the received one. If they correspond and the address is recognised by the SLAVE unit, the command is executed and an answer frame is sent.

If the CRC is not correct, the frame is discarded and no answer is sent.

1.2 FUNCTIONS

PQT-90 accepts the following commands:

- Read words (code 04)
- Write one word (code 06)
- Read words from Flash Memory (code 80h)

NOTE: the memory addressing is different according to the used function. It is explained in detail in the paragraph 1.3 .

The functions 04h and 06h are carried out according to the Modbus protocol, whereas in the function 80h there are some differences respect to the standard.

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1.2.1 Function 04 (read words)

Request frame

Address	Function	Data address		n° of words		CRC	
1 byte	1 byte	2 byte		2 byte		2 byte	
from 1 to 255	04h	MSB	LSB	MSB	LSB	MSB	LSB

NOTE: - The maximum number of word is 118 (236 bytes).
- The address 00 is not allowed (it generates no answer)

Answer frame

Address	Function	n° byte (=2 x n° word)	Values	CRC	
1 byte	1 byte	1 byte	n° byte (=2 x n° word)	2 byte	
from 1 to 255	04h	MSB	LSB	MSB	LSB

1.2.2 Function 06 (write one word)

Request frame

Address	Function	Data address		Value		CRC	
1 byte	1 byte	2 byte		2 byte		2 byte	
from 1 to 255	06h	MSB	LSB	MSB	LSB	MSB	LSB

Answer frame

Address	Function	Data address		Value		CRC	
1 byte	1 byte	2 byte		2 byte		2 byte	
from 1 to 255	06h	MSB	LSB	MSB	LSB	MSB	LSB

NOTE: the answer frame is an echo of the request frame, which confirm the execution of the command.

If the address is set to 00, all the instruments connected carry out the command, without sending back the answer frame.

1.2.3 Function 80h (read words from Memory Flash)

Request frame

Address	Function	word address and n° word		CRC	
1 byte	1 byte	4 bytes		2 bytes	
From 1 to 255	80h	MSB	LSB	MSB	LSB

Answer frame

Address	Function	n° bytes	Value	CRC	
1 byte	1 byte	1 byte	n° bytes	2 byte	
From 1 to 255	80h	01		MSB	LSB

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1.3 MEMORY AREA

In the PQT-90, four types of memory are available, addressed as follows:

Reading and writing by using the functions 04h and 06h

Memory	Area		reading sequence
Internal Ram	0000h	1fffh	LSB, MSB
Data Eeprom	2000h	3fffh	MSB, LSB
Real Time Clock	4000h	5fffh	LSB

Reading by using function 80h .

Memory	Area		Reading sequence
Memory Flash	0000h	xxxxxxh	MSB, LSB

The Flash memory is composed of 4095 pages, divided into three blocks containing different kind of information:

- from page 0000 to page 3993: the data logging info
- from page 3994 to page 3995: the numbers and SMS info relevant to the GSM modem
- from page 3996 to page 4095: load profile data

It must be taken into consideration that, after loading all the “data logging” info, a complete reset of the relevant memory area must be carried out, by sending a rigid-structure frame (see following pages).

The Flash memory addressing requires to indicate the page number (from 0 to 4095), followed by the word address (from 0 to 527) within the page and the number of words to be read. To do it, 4 bytes are used, to be written as a single 32-bit word. The 14 most-significant bits represent the page, whereas the following 10 bits define the address within the page. The remaining 8 bits are used to define the number of words to be read (max 132 words).

Flash Memory addressing table.

Memory area	Word address + num. Words (4 bytes)			Byte reading order
	14 bit	10 bit	8 bit	
Memory Flash	xxpppppppppppppp	iiiiiiiiiii	wwwwwww	MSB, LSB

where

xxpppppppppppppp = page number (14 bit)

iiiiiiiiiii = word address inside the xxpppppppppppp page (10 bit)

wwwwwww = number of words to be read (8 bit)

It is only possible to reset the logged data from the Flash Memory using fixed frames (see paragraph 5.1)

NOTE: in the following pages the following notation will be used:

- 1 int = 4 byte;
- 1 short = 2 byte;
- 1 word = 2 byte;
- 1 byte = 8 bit.

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1.4 PQT-90 IDENTIFICATION CODE AND SERIAL NUMBER

Every Carlo Gavazzi instrument is identified by means of a code stored in address 0Bh, in order to recognise the type of the instrument via serial communication
The code relevant to the PQT-90 is 0017h.

This value can be read by using the following fixed frame.

Instrument code request frame (8 byte):

01h	04h	00h	0Bh	00h	01h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Instrument code answer frame (7 byte):

01h	04h	02h	00h	17h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----

The serial number of the instrument is stored as short (2 bytes) on the location 0218h

1.5 PQT-90 FIRMWARE VERSION

Firmware version request frame (8 byte):

add	04h	FFh	EEh	DDh	CCh	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Firmware version request frame (15-byte frame):

add	04h	0Ah	10byte ASCII	CRC	CRC
-----	-----	-----	--------------	-----	-----

Warning: a fixed frame is similar to a standard Modbus command. The difference is on the bytes following the address, which have fixed values that have nothing to do with their usual meaning. These commands are used to carry out particular requests, which would be almost impossible to obtain with standard commands.

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2 RAM VARIABLES MAP

2.1 INSTANTANEOUS VARIABLES MAP

Word	ADDRESS	BYTE	VARIABLE	Type	Word	ADDRESS	BYTE	VARIABLE	Type
1	000	4	V L1-N	V	31	078	4	THD V2	D
2	004	4	A L1	A	32	07C	4	THDe V2	D
3	008	4	W L1	P	33	080	4	THDo V2	D
4	00C	4	V L2-N	V	34	084	4	THD V3	D
5	010	4	A L2	A	35	088	4	THDe V3	D
6	014	4	W L2	P	36	08C	4	THDo V3	D
7	018	4	V L3-N	V	37	090	4	THD A1	D
8	01C	4	A L3	A	38	094	4	THDe A1	D
9	020	4	W L3	P	39	098	4	THDo A1	D
10	024	4	V L1	V	40	09C	4	THD A2	D
11	028	4	V L2	V	41	0A0	4	THDe A2	D
12	02C	4	V L3	V	42	0A4	4	THDo A2	D
13	030	4	VA L1	P	43	0A8	4	THD A3	D
14	034	4	var L1	P	44	0AC	4	THDe A3	D
15	038	4	PF L1	C	45	0B0	4	THDo A3	D
16	03C	4	VA L2	P	46	0B4	4	A dmd	A
17	040	4	var L2	P	47	0B8	4	VA dmd	P
18	044	4	PF L2	C	48	0BC	4	TPF avg	C
19	048	4	VA L3	P	49	0C0	4	W dmd	P
20	04C	4	var L3	P	50	0C4	4	Hz	H
21	050	4	PF L3	C	51	0C8	4	ASY	D
22	054	4	V Σ	V	52	0CC	4	VL-N Σ	V
23	058	4	A Σ	A	53	0D0	4	var dmd	P
24	05C	4	W Σ	P	54	0D4	4	UN	V
25	060	4	VA Σ	P	55		4		
26	064	4	var Σ	P	56		4		
27	068	4	PF Σ	C	57		4		
28	06C	4	THD V1	D	58		4		
29	070	4	THDe V1	D		0E8	2	Unit V,A	inf1
30	074	4	THDo V1	D		0EA	2	Unit P,x	Inf2

NOTE: All variables in this table are contiguous. It is possible to read the whole area of them with a single command, by sending the address 00h and n° of word 118 (0076h).
The values of the instantaneous variables are stored in the addresses from 000h to 0E7h. The data are sent in 4-byte groups in the following order: MSB, ..., ..., LSB.

2.2 VARIABLE FORMAT

The value of all the instantaneous variables is stored as a 4 byte (2 word) integer value. The decimal point and the multiplier have to be set according to the **inf1/2** word coding (see the following table) for voltage (V), current (A) and power (P), in the position "111.1" for the THD-type (%) and H-type (Hz) type variables and in position "1.111" for the C-type variables (PF). The single phase PF variables are stored with a positive value if the power factor is "L" (inductive), and with a negative value if the power factor is "C" (capacitive). The variable "PF Σ " has neither L nor C sign indication.

Variable format info map

Address	Byte	Variable	Type
0E8	1	Info voltage value	inf1
0E9	1	Info current value	inf1
0EA	1	Info power value	inf2

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0EB	1	---	
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Decimal point and multiplier coding

INF value	d.p	INF value	d.p
0	1.111m	8	111.1k
1	11.11m	9	1111k
2	111.1m	10	11.11M
3	1.111	11	111.1M
4	11.11	12	1111M
5	111.1	13	11.11G
6	1111	14	111.1G
7	11.11K	15	

NOTE: if a power value exceeds 9999, the autoranging function will intervene and modify the inf2 value. If the power value is lower than 99999 the inf2 will be increased of 1 unit, if the power value is greater than 99999 but lower than 999999 the inf2 will be increased of 2 units and so on.

Note: it is strongly recommended not to modify the RAM contents, unless this operation is explicitly allowed as for example to close the remote contacts.

Example 1: reading of an int variable stored at address 100h

An int variable is 4 byte (2 word) long, so a 2-word read request must be sent:

Read command request frame

Address	Function	Word address		n° of words		CRC	
1 byte	1 byte	2 byte		2 byte		2 byte	
from 1 to 255	04	01h	00h	00h	02h	MSB	LSB

Read command answer frame

Address	Function	n° byte	Value of int type variable				CRC	
1 byte	1 byte	1 byte	1 st byte	2 nd byte	3 rd byte	4 th byte	2 byte	
from 1 to 255	04	04	LSB			MSB	MSB	LSB

Example 2: reading of 4 char variables (4 bytes=2 words) starting from address 1C0h

Char type variables (1 byte) must always be read carrying out a 1-word (2-bytes) read request and taking only the needed byte into account. Note that the first sent byte is the byte relevant to the specified word address. The following bytes are relevant to the previous address+1.

Read command request frame

Address	Function	Word address		n° of words		CRC	
1 byte	1 byte	2 byte		2 byte		2 byte	
From 1 to 255	04	01h	C0h	00h	02h	MSB	LSB

Read command answer frame

Address	Function	n° byte	Value	Value	Value	Value	CRC	
1 byte	1 byte	1 byte	1 st byte	2 nd byte	3 rd byte	4 th byte	2 byte	
From 1 to 255	04	04	01C0h	01C1h	01C2h	01C3h	MSB	LSB

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2.3 READING OF INSTANTANEOUS VARIABLES

As indicated on page 6, the instantaneous variables are readable by using the format MSB, ... LSB. Each of them is composed of four bytes, so that it does not make sense to read only one word. After asking for a reading and receiving the relevant bytes, they shall be "packed" in groups of four, by obtaining 32-bit integer values. These values shall then be converted from binary to decimal according to the two-complement format.

If the result is >9999, the module shall be divided by 10 till it is <10000. The relevant inf byte shall be incremented as much as the original variable has been divided by 10. At the end of this conversion, the variable will be represented with max 4dgt and the relevant inf will indicate the position of the decimal point and the engineering unit to be used (see table with inf code)

Example 3: reading of variable VL1

Request «value» (8-byte frame):

01h	04h	00h	00h	00h	02h	71h	CBh
-----	-----	-----	-----	-----	-----	-----	-----

Answer «value» (9-byte frame):

01h	04h	04h	00h	00h	09h	0Bh	BCh	13h
-----	-----	-----	-----	-----	-----	-----	-----	-----

Request «info» (8-byte frame):

01h	04h	00h	E8h	00h	01h	B1h	FEh
-----	-----	-----	-----	-----	-----	-----	-----

Answer «info» (9-byte frame):

01h	04h	02h	07h	07h	FAh	C2h
-----	-----	-----	-----	-----	-----	-----

Stored value: 090Bh (2315 decimal)
info (V type) value: 07h
This value does not need to be divided
Variable value: 23.15 kV

Example 4: calculation of WL1 by reading all the instantaneous variables.

All instantaneous values (+ info) request frame (8 byte):

01h	04h	00h	00h	00h	76h	71h	ECh
-----	-----	-----	-----	-----	-----	-----	-----

All instantaneous values (+ info) answer frame (241 byte):

01h	04h	ECh	00h	00h	...	08h	03h	07h	03h	B0h	CDh
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

WL1 stored value: 00009264h=37476d
.....
.....
Info V value: 08h
Info A value: 03h
Info P value: 07h

The decimal value of WL1 is 37476. Because of the autoranging function, the info value is increased from 7 to 8.

Variable value (WL1): 374.7kW

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2.4 ENERGY METERS MAP

Table 1

ADDRESS	BYTE	SEASON	PERIOD	METER TYPE
0EC	4	TOTAL		Kwh+ (LSB)
0F0	4			Kwh- (LSB)
0F4	4			KVARh+ (LSB)
0F8	4			KVARh- (LSB)
0FC	1			Kwh+ (MSB)
0FD	1			Kwh- (MSB)
0FE	1			KVARh+ (MSB)
0FF	1			KVARh- (MSB)
100	4	WINTER	1	Kwh+ (LSB)
104	4			Kwh- (LSB)
108	4			KVARh+ (LSB)
10C	4			KVARh- (LSB)
110	4		2	Kwh+ (LSB)
114	4			Kwh- (LSB)
118	4			KVARh+ (LSB)
11C	4			KVARh- (LSB)
120	4		3	Kwh+ (LSB)
124	4			Kwh- (LSB)
128	4			KVARh+ (LSB)
12C	4			KVARh- (LSB)
130	4		4	Kwh+ (LSB)
134	4			Kwh- (LSB)
138	4			KVARh+ (LSB)
13C	4			KVARh- (LSB)
140	4	SUMMER	1	Kwh+ (LSB)
144	4			Kwh- (LSB)
148	4			KVARh+ (LSB)
14C	4			KVARh- (LSB)
150	4		2	Kwh+ (LSB)
154	4			Kwh- (LSB)
158	4			KVARh+ (LSB)
15C	4			KVARh- (LSB)
160	4		3	Kwh+ (LSB)
164	4			Kwh- (LSB)
168	4			KVARh+ (LSB)
16C	4			KVARh- (LSB)
170	4		4	Kwh+ (LSB)
174	4			Kwh- (LSB)
178	4			KVARh+ (LSB)
17C	4			KVARh- (LSB)
180	4	HOLYDAY	1	Kwh+ (LSB)
184	4			Kwh- (LSB)
188	4			KVARh+ (LSB)
18C	4			KVARh- (LSB)
190	4		2	Kwh+ (LSB)
194	4			Kwh- (LSB)
198	4			KVARh+ (LSB)
19C	4			KVARh- (LSB)
1A0	4		3	Kwh+ (LSB)
1A4	4			Kwh- (LSB)
1A8	4			KVARh+ (LSB)
1AC	4			KVARh- (LSB)
1B0	4		4	Kwh+ (LSB)
1B4	4			Kwh- (LSB)
1B8	4			KVARh+ (LSB)

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1BC	4			KVARh- (LSB)
-----	---	--	--	--------------

Table 2

ADDRESS	BYTE	SEASON	PERIOD	METER TYPE
8E8	1	WINTER	1	Kwh+ (MSB)
8E9	1			KWh- (MSB)
8EA	1			KVARh+ (MSB)
8EB	1			KVARh- (MSB)
8EC	1		2	Kwh+ (MSB)
8ED	1			KWh- (MSB)
8EE	1			KVARh+ (MSB)
8EF	1			KVARh- (MSB)
8F0	1		3	Kwh+ (MSB)
8F1	1			KWh- (MSB)
8F2	1			KVARh+ (MSB)
8F3	1			KVARh- (MSB)
8F4	1		4	Kwh+ (MSB)
8F5	1			KWh- (MSB)
8F6	1			KVARh+ (MSB)
8F7	1			KVARh- (MSB)
8F8	1	SUMMER	1	Kwh+ (MSB)
8F9	1			KWh- (MSB)
8FA	1			KVARh+ (MSB)
8FB	1			KVARh- (MSB)
8FC	1		2	Kwh+ (MSB)
8FD	1			KWh- (MSB)
8FE	1			KVARh+ (MSB)
8FF	1			KVARh- (MSB)
900	1		3	Kwh+ (MSB)
901	1			KWh- (MSB)
902	1			KVARh+ (MSB)
903	1			KVARh- (MSB)
904	1		4	Kwh+ (MSB)
905	1			KWh- (MSB)
906	1			KVARh+ (MSB)
907	1			KVARh- (MSB)
908	1	HOLIDAY	1	Kwh+ (MSB)
909	1			KWh- (MSB)
90A	1			KVARh+ (MSB)
90B	1			KVARh- (MSB)
90C	1		2	Kwh+ (MSB)
90D	1			KWh- (MSB)
90E	1			KVARh+ (MSB)
90F	1			KVARh- (MSB)
910	1		3	Kwh+ (MSB)
911	1			KWh- (MSB)
912	1			KVARh+ (MSB)
913	1			KVARh- (MSB)
914	1		4	Kwh+ (MSB)
915	1			KWh- (MSB)
916	1			KVARh+ (MSB)
917	1			KVARh- (MSB)

A further table, relevant to the monthly energy meters, will be explained afterwards.

Note: Table 1 and Table 2 are not contiguous. For each table, the variables contained are contiguous, so that it is possible to read every variables with two request frames. With the first request frame the 106 words included in Table 1 could be read, with the second request frame the 24 words included in Table 2 could be read.

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The values of all the total and partial energy meters are stored as a 5-byte integer (the first 4 bytes are the less significant part, the 5th is the most significant one). The resolution of the meters is 10W (the decimal point position has to be set to "1.11Kwh (Kvarh)").

The total meters MSB (5th byte) is contiguous to the less significant bytes, whereas the partial meters MSB (5th byte) is stored in a different area of the memory. For this reason it is required to carry out two different read commands in order to get all the energy meter information.

2.5 READING OF THE ENERGY METERS VALUE

Example of reading

8-bytes request frame (read command, 10 word):

01h	04h	00h	ECh	00h	0Ah	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

25-byte answer frame (read command):

			1	2	3	4	5	6	7	8	9	10
01h	04h	14h	00h	00h	00h	00h	94h	59h	FFh	FFh	94h	02h

11	12	13	14	15	16	17	18	19	20		
00h	00h	BEh	FEh	FFh	FFh	00h	00h	00h	00h	CRC	CRC

Starting from address ECh, it is possible to read all the energy meters by means of a single read command (10 word, see the example above).

Reconstruction of the kWh+ total meter

The first 4 data bytes (less significant bytes) have to be placed side by side in the opposite order:

4	3	2	1
Efh	EEh	EDh	ECh
00h	00h	00h	00h

00000000h=0

The obtained 32-bit value has to be interpreted as a two's complement value.

The relevant kWh+ MSB (byte n° 17), which has to be interpreted as a two's complement value too, must be multiplied by 1000000000 (decimal value). The result has to be algebraically added to the previous value.

17
FCh
00h

1000000000*0=0

Finally the last result has to be divided by 100.

0+0/100=0 kWh

Example 5: reconstruction of the kWh- total meter

5	6	7	8
F0h	F1h	F2h	F3h
94h	59h	FFh	FFh

FF FF 59 94h = -42604

18
FDh

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00h

$$1000000000*0 = 0$$

$$(- 42604 + 0*1000000000)/100 = - 426.04 \text{ kWh}$$

2.6 WRITING OF THE ENERGY METERS VALUE

The user is not allowed to write in the energy meter memory area. It is only possible to reset the energy meter using fixed frames.

2.7 ENERGY METERS RESET COMMANDS

The fixed frames to be used to reset the energy meters are listed below:

1. General reset command (reset of all the total, partial and monthly meters)

Reset request frame (8 byte):

01h	06h	00h	ECh	D4h	F0h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Reset answer frame (8 byte):

01h	06h	00h	ECh	D4h	F0h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

2. Total positive energy meters (kWh+ and kvarh+) and monthly meters reset command

Reset request frame (8 byte):

01h	06h	01h	00h	A5h	F0h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Reset answer frame (8 byte):

01h	06h	01h	00h	A5h	F0h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

3. Total negative energy meters (kWh- and kvarh-) and monthly meters reset command

Reset request frame (8 byte):

01h	06h	01h	04h	23h	44h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Reset answer frame (8 byte):

01h	06h	01h	04h	23h	44h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

4. Partial positive energy meters (kWh+ and kvarh+) and monthly meters reset command

Reset request frame (8 byte):

01h	06h	01h	08h	87h	35h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Reset answer frame (8 byte):

01h	06h	01h	08h	87h	35h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

5. Partial negative energy meters (kWh- and kvarh-) and monthly meters reset command

Reset request frame (8 byte):

01h	06h	01h	C0h	59h	12h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Reset answer frame (8 byte):

01h	06h	01h	C0h	59h	12h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

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2.8 GAS AND WATER METERS

Table 3

ADDRESS	BYTE	METER TYPE
9C8	4	GAS TOTAL
9CC	4	GAS DAY
9D0	4	GAS NIGHT
9D4	4	H2O TOTAL

The utility meters contain integer values. It is possible to enable/disable the utility metering modifying the contents of the address 2036h (see EEPROM map).

Their resolution is 0.1 m³ and, after reaching 99999999.9 m³ the total meters will be reset and start again from 0. The day/night gas meters full maximum value is 50000000.0 m³.

To reset an utility meter two write requests (write 0000h) are to be sent to the instrument: the first to reset the two most significant bytes, the second to reset the two less significant bytes.

Example 6: Reset of the day gas meter:

1st Reset request frame (8 byte):

01h	06h	09h	CEh	00h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

1st Reset answer frame (8 byte):

01h	06h	09h	CEh	00h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

2nd Reset request frame (8 byte):

01h	06h	09h	CCh	00h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

2nd Reset answer frame (8 byte):

01h	06h	09h	CCh	00h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

2.9 ALARM STATUS MAP

Table 4

ADDRESS	BYTE	Variable type
1C0	1+1	Diagn0 , diagn1
1C2	1+1	Diagn2 , diagn3
1C4	1+1	alarm0 , alarm1
1C6	1+1	alarm2 , alarm3
1C8	2	control type 0
1CA	2	control type 1
1CC	2	control type 2
1CE	2	control type 3
1D0	2	Relay 0 state
1D2	2	Relay 1 state
1D4	2	Relay 2 state
1D6	2	Relay 3 state
1D8	2	alarm 0 variable
1DA	2	alarm 1 variable
1DC	2	alarm 2 variable
1DE	2	alarm 3 variable
1E0	2	ON 0 threshold
1E2	2	ON 1 threshold
1E4	2	ON 2 threshold
1E6	2	ON 3 threshold
1E8	2	OFF 0 threshold
1EA	2	OFF 1 threshold
1EC	2	OFF 2 threshold
1EE	2	OFF 3 threshold
1F0	2	delay 0
1F2	2	delay 1

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1F4	2	delay 2
1F6	2	delay 3

Table 5

ADDRESS	BYTE	Variable type
8D8	1+1	Remote1 , remote2
8DA	1+1	Remote3 , remote4

NOTE: the variables included in each of the previous tables are contiguous: it is possible to read every variables with two request frames. With the first request frame the 28 words included in Table 4 can be read, with the second request frame the 2 words included in Table 5 can be read. In order to know the current digital output settings, see the EEPROM map paragraph.

2.10 READING OF ALARM, DIAGNOSTIC AND REMOTE CONTROL OUTPUT STATUS

The n^{th} digital output can work as pulse output, alarm output, diagnostic output or remote control output.

In order to know if the n^{th} digital output is set as alarm, the n^{th} alarm byte (“alarm n”) must be read. If the byte is equal to 0 it means that the digital output is not set as alarm, if it is equal to 1 the alarm status is OFF, if it is equal to 2 the alarm status is ON.

The same considerations are valid in case of diagnostic output (“diagn n” byte must be read) or remote control output (“Remote n” byte must be read).

Of course, only one among “alarm n”, “diagn n” and “remote n” byte can be different from 0. If all these three bytes are equal to 0, it means that the n^{th} digital output is set as pulse output.

If the digital outputs are set as alarm, the values stored in addresses from 1C8h to 1CEh indicate the control type, coded as follows:

- 0 = UP
- 1 = UP-LATCH
- 2 = DOWN
- 3 = DOWN LATCH

The values stored in addresses from 1D0h to 1D6h explain if the relay is normally energised or de-energised:

- 0 = Normally de-energised
- 1 = Normally energised

In the addresses from 1D8h to 1DEh the variables associated to the alarms are stored, according to the “Variable type coding” table (see paragraph 3.1.1).

Example: if a control on variable W1 has been associated to alarm1, in the address 1DAh the value 12 must be stored

The set-point ON and OFF values are stored as unsigned short.

The delay values are stored as short and must be included in the range from 0 to 255 seconds.

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Example 7: “Diagnostic” read command

2-word read command request frame (8 byte):

01h	04h	01h	C0h	00h	02h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Read command answer frame (9 byte):

01h	04h	04h	00h	00h	01h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----	-----

Digital output 0: NO Diagnostic
 Digital output 1: NO Diagnostic
 Digital output 2: Diagnostic OFF
 Digital output 3: NO Diagnostic

Example 8: “Alarm” read command

2-word read command request frame (8 byte):

01h	04h	01h	C4h	00h	02h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Read command answer frame (9 byte):

01h	04h	04h	00h	01h	00h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----	-----

Digital output 0: NO Alarm
 Digital output 1: Alarm OFF
 Digital output 2: NO Alarm
 Digital output 3: NO Alarm

Example 9: “Control type” read command

4-word read command request frame (8 byte):

01h	04h	01h	C8h	00h	04h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Read command answer frame (13 byte):

			LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB		
01h	04h	08h	00h	CRC	CRC							

Digital output 0: Not used (digital output 0 is not set as alarm, see previous example)
 Digital output 1: UP control
 Digital output 2: Not used
 Digital output 3: Not used

Example 10: “Relay status” read command

4-word read command request frame (8 byte):

01h	04h	01h	D0h	00h	04h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Read command answer frame (13 byte):

01h	04h	08h	00h	00h	01h	00h	00h	00h	00h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Digital output 0: Not used (digital output 0 is not set as alarm, see example 7)
 Digital output 1: Normally energised
 Digital output 2: Not used
 Digital output 3: Not used

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Example 11: “Variable associated to the alarm” read command

4-word read command request frame (8 byte):

01h	04h	01h	D8h	00h	04h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Read command answer frame (13 byte):

01h	04h	08h	00h	00h	26h	00h	00h	00h	00h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Digital output 0: not used (digital output 0 is not set as alarm, see example 7)
 Digital output 1: THD A1
 Digital output 2: not used
 Digital output 3: not used

Example 12: “ON Set-point” (alarm activation) read command

4-word read command request frame (8 byte):

01h	04h	01h	E0h	00h	04h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Read command answer frame (13 byte):

01h	04h	08h	00h	00h	64h	00h	00h	00h	00h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Digital output 0: not used (digital output 0 is not set as alarm, see example 7)
 Digital output 1: 10.0% (0064h = 100 decimal)
 Digital output 2: not used
 Digital output 3: not used

Example 13: “OFF Set-point” (alarm deactivation) read command

4-word read command request frame (8 byte):

01h	04h	01h	E8h	00h	04h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Read command answer frame (13 byte):

01h	04h	08h	00h	00h	32h	00h	00h	00h	00h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Digital output 0: not used (digital output 0 is not set as alarm, see example 7)
 Digital output 1: 5.0% (0032h = 50 decimal)
 Digital output 2: not used
 Digital output 3: not used

Example 14: “Alarm activation delay” read command

4-word read command request frame (8 byte):

01h	04h	01h	F0h	00h	04h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Read command answer frame (13 byte):

01h	04h	08h	00h	00h	04h	00h	00h	00h	00h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Digital output 0: not used (digital output 0 is not set as alarm, see example 7)
 Digital output 1: 4 seconds
 Digital output 2: not used
 Digital output 3: not used

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Example 15: “Latch alarm” reset command

To reset a UP-LATCH or DOWN-LATCH alarm, the relevant alarm byte must be set to 1.

Reset command request frame (8 byte):

01h	06h	01h	C4h	00h	01h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Reset command answer frame (8 byte):

01h	06h	01h	C4h	00h	01h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

To reset the alarm 1, the byte at address 01C5h must be set to 1. The byte at address 01C4h must be set to 00h, since it is relevant to alarm 0.

2.11 WRITE COMMAND FOR REMOTE CONTROL OUTPUT

The remote control digital output memory area is described in Table 5 and consists in 4 bytes starting from address 08D8h (Remote1=8D8h, Remote2=8D9h, and so on).

To switch ON the nth remote control output, the value 02h must be written in the “Remote n” byte, while to switch OFF the nth remote control output, the value 01h must be written in the “Remote n” byte. Note again that the write command always writes 1 word (2 bytes).

Request frame: R1 = ON and R2 = OFF (8 byte):

01h	06h	08h	D8h	02h	01h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Answer frame (8 byte):

01h	06h	08h	D8h	02h	01h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Request frame: R1 = OFF and R2 = OFF (8 byte):

01h	06h	08h	D8h	01h	01h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Answer frame (8 byte):

01h	06h	08h	D8h	01h	01h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

NOTE: a digital output can be used as remote control output only if the relevant “digital output type” variable stored in EEPROM is correctly set (see paragraph 3.1.19).

2.12 FORMAT OF THE “PRESENT MODULES+DIGITAL INPUT STATUS” WORD

ADDRESS	BYTE	Code	Variable type
800	2	XXXXXXXXXXXXXXXXXX	module

Coding for board identification variable and state of digital input lines

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
*	*	*	*										*	*	
Gas	F1	kvarh+	kWh+	AG34	AG12	INGAN	S3	S4	S2	232	CLK	485	F2	Water	

** : the bit marked with * identify only the state of the digital input line, not the presence of an optional module.*

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Serial output

485	RS485
0	not present
1	present

CLK	RTC Clock
0	not present
1	present

232	RS232 module
0	not present
1	present

Digital output code

S3	S4	S2	Available digital outputs on the inserted modules
0	0	0	1,2,3,4
0	0	1	1,2,3,4
0	1	0	1,2,3,4
0	1	1	1,2
1	0	0	3,4
1	0	1	3,4
1	1	0	1,2,3,4
1	1	1	none

Digital inputs code

kWh	Digital input
0	ON
1	OFF

Kvarh	Digital input
0	ON
1	OFF

F1	Tariff
0	ON
1	OFF

F2	Tariff
0	ON
1	OFF

Gas	Digital input
0	ON
1	OFF

Water	Digital input
0	ON
1	OFF

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ING_AN	AQ1018
0	not present
1	present

AG12	Analogue outputs SLOT A
0	not present
1	present

AG34	Analogue outputs SLOT B
0	not present
1	present

Warning: the digital input H2O can be used to determine the day/night time band of the gas counter or, alternatively, as water counter according to the digital input settings on the location 2036h.

Example 16: reading of the “present modules+digital input status” word

1-word read request frame (8 byte)

01h	04h	08h	00h	00h	01h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

1-word read answer frame (8 byte):

01h	04h	02h	70h	F4h	CRC	CRC
-----	-----	-----	------------	------------	-----	-----

Module variable value: 70F4h = 0111000011110100

Available modules: RS232, clock, digital output 1 and 2.

Digital inputs: Gas = ON
Water = ON
kWh+ = OFF
kvarh+ = OFF
Tariff F1= OFF
Tariff F2= OFF

2.13 HARMONIC ANALYSIS MAP

Harmonic order	VOLTAGES ¹ (%)			CURRENTS (%)			RELATIVE ANGLES ² (°)		
	L1-N ADD.	L2-N ADD.	L3-N ADD.	L1 ADD.	L2 ADD.	L3 ADD.	L1 ADD.	L2 ADD.	L3 ADD.
THD	224	226	228	22A	22C	22E	230	232	234
1°	238	23A	23C	23E	240	242	244	246	248
2°	24C	24E	250	252	254	256	258	25A	25C
3°	260	262	264	266	268	26A	26C	26E	270
4°	274	276	278	27A	27C	27E	280	282	284
5°	288	28A	28C	28E	290	292	294	296	298
6°	29C	29E	2A0	2A2	2A4	2A6	2A8	2AA	2AC
7°	2B0	2B2	2B4	2B6	2B8	2BA	2BC	2BE	2C0
8°	2C4	2C6	2C8	2CA	2CC	2CE	2D0	2D2	2D4
9°	2D8	2DA	2DC	2DE	2E0	2E2	2E4	2E6	2E8
10°	2EC	2EE	2F0	2F2	2F4	2F6	2F8	2FA	2FC
11°	300	302	304	306	308	30A	30C	30E	310
12°	314	316	318	31A	31C	31E	320	322	324
13°	328	32A	32C	32E	330	332	334	336	338
14°	33C	33E	340	342	344	346	348	34A	34C
15°	350	352	354	356	358	35A	35C	35E	360
16°	364	366	368	36A	36C	36E	370	372	374
17°	378	37A	37C	37E	380	382	384	386	388
18°	38C	38E	390	392	394	396	398	39A	39C
19°	3A0	3A2	3A4	3A6	3A8	3AA	3AC	3AE	3B0
20°	3B4	3B6	3B8	3BA	3BC	3BE	3C0	3C2	3C4
21°	3C8	3CA	3CC	3CE	3D0	3D2	3D4	3D6	3D8
22°	3DC	3DE	3E0	3E2	3E4	3E6	3E8	3EA	3EC
23°	3F0	3F2	3F4	3F6	3F8	3FA	3FC	3FE	400
24°	404	406	408	40A	40C	40E	410	412	414
25°	418	41A	41C	41E	420	422	424	426	428
26°	42C	42E	430	432	434	436	438	43A	43C
27°	440	442	444	446	448	44A	44C	44E	450
28°	454	456	458	45A	45C	45E	460	462	464
29°	468	46A	46C	46E	470	472	474	476	478
30°	47C	47E	480	482	484	486	488	48A	48C
31°	490	492	494	496	498	49A	49C	49E	4A0
32°	4A4	4A6	4A8	4AA	4AC	4AE	4B0	4B2	4B4
33°	4B8	4BA	4BC	4BE	4C0	4C2	4C4	4C6	4C8
34°	4CC	4CE	4D0	4D2	4D4	4D6	4D8	4DA	4DC
35°	4E0	4E2	4E4	4E6	4E8	4EA	4EC	4EE	4F0
36°	4F4	4F6	4F8	4FA	4FC	4FE	500	502	504
37°	508	50A	50C	50E	510	512	514	516	518
38°	51C	51E	520	522	524	526	528	52A	52C
39°	530	532	534	536	538	53A	53C	53E	540
40°	544	546	548	54A	54C	54E	550	552	554
41°	558	55A	55C	55E	560	562	564	566	568
42°	56C	56E	570	572	574	576	578	57A	57C
43°	580	582	584	586	588	58A	58C	58E	590
44°	594	596	598	59A	59C	59E	5A0	5A2	5A4
45°	5A8	5AA	5AC	5AE	5B0	5B2	5B4	5B6	5B8
46°	5BC	5BE	5C0	5C2	5C4	5C6	5C8	5CA	5CC
47°	5D0	5D2	5D4	5D6	5D8	5DA	5DC	5DE	5E0
48°	5E4	5E6	5E8	5EA	5EC	5EE	5F0	5F2	5F4
49°	5F8	5FA	5FC	5FE	600	602	604	606	608
50°	60C	60E	610	612	614	616	618	61A	61C
THDo	620	622	624	626	628	62A	62C	62E	630
THDe	634	636	638	63A	63C	63E	640	642	644

NOTE:

¹ According to the selected electrical system, the voltages can be Phase to Phase Voltage or Phase to Neutral Voltages.

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² Negligible values when the selected system is without neutral.

All the variables of the previous table are contiguous. Note that using a single read command it is possible to read at most 120 words.

The values of the harmonic and distortion variables are represented as short (2 byte long). The decimal point must be set to "111.1" for distortion and angle variables (THD, THDo, THDe), and to "111.11" for the harmonic variables (h).

The stored values have physical meaning only if the harmonic analysis of the relevant phase is enabled (please refer to the user manual for FFT enable function, see also EEPROM map, address 200Ch).

Example 17: reading of the VL1 3rd order harmonic

"Value" request frame (frame 8 byte):

01h	04h	02h	5Ch	00h	01h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

"Value" answer frame (frame 7 byte):

01h	04h	02h	13h	0Dh	CRC	CRC
-----	-----	-----	-----	-----	-----	-----

Variable value: 0D13h 3347 (decimal)
Value format: 111.11
VL1 3rd order harmonic value 33.47% (the display shows 33.4%)

Example 18: reading of the phase 1 - 3rd order relative angle

"Value" read request frame (frame 8 byte):

01h	04h	02h	68h	00h	01h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

"Value" read answer frame (frame 7 byte):

01h	04h	02h	EFh	06h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----

Variable value: 06EFh 1775 (decimal)
Value format: 111.1
Phase 1-3rd order relative angle: 177.5° (the display shows 177°)

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3 EEPROM MEMORY MAP

3.1 PQT-90 CONFIGURATION MAP

ADD.	VARIABLE	MAX	MIN	DEFAULT	BIT CHECK
2000	Password	500	0	0	0101XXXX XXXXXXXX
2002	System	4	0	2	0101XXXX XXXXXXXX
2004	CT	60000	1	10	not present
2006	VT	60000	1	10	not present
2008	type avg	1	0	0	0101XXXX XXXXXXXX
200A	time avg	30	1	15	0101XXXX XXXXXXXX
200C	enable fft	***	***	***	0100XXXX XXXXXXXX
200E	type digit	1	0	0	0101XXXX XXXXXXXX
2010	field 1 e 2	***	***	***	0101XXXX XXXXXXXX
2012	field 3 e 4	***	***	***	0101XXXX XXXXXXXX
2014	address RS485	255	1	1	not present
2016	baud RS485	3	3	3 (9600)	not present
2018	parity RS485	0	0	0	not present
201A	Baud RS232	1	0	0(38400)	not present
201C	Reserved				not present
201E	Filter range	1000	1	10	not present
2020	Filter coeff.	255	1	3	not present
2022	Event selection	***	***	***	XXXXXXXX XXXXXXXX
2024	Event selection	***	***	***	XXXXXXXX XXXXXXXX
2026	F.S. Digital inputs	4	0	0	0101XXXX XXXXXXXX
2028	USA/EURO clock format	1	0	0	0101XXXX XXXXXXXX
202A	Language	4	0	0	not present
202C	Pulse-retransmitted tariff	***	***	***	not present
202E	Input type	1	0	---	0101 See Note(1)
2030	Data log time interval	1	0		0101XXXX XXXXXXXX
2032					
2034					
2036	Enabled digital inputs	***	***	***	See Note(1)
2038	Const. Imp./m3 Gas	1000	1		
203A	Const Imp./m3 H2O	1000	1		
203C	dmd alarm tariff	4	0	0	0101XXX XXX XXX XXX
203E	type dig out	***	***	***	not present
2040	pulses/KWh out1	1000	1	1	01XXXXXX XXXXXXXX
2042	pulses/KWh out2	1000	1	1	01XXXXXX XXXXXXXX
2044	pulses/KWh out3	1000	1	1	01XXXXXX XXXXXXXX
2046	pulses/KWh out4	1000	1	1	01XXXXXX XXXXXXXX
2048	info out 1	***	***	***	not present
204A	delay out 1	255	0	0	0101XXXX XXXXXXXX
204C	set-point out 1	f.s	b.s.	0	XXXXXXXX XXXXXXXX
204E	Alarm off threshold 1	f.s	0	0	XXXXXXXX XXXXXXXX
2050	info out 2	***	***	***	not present
2052	delay out 2	255	0	0	0101XXXX XXXXXXXX
2054	set-point out 2	f.s	b.s.	0	XXXXXXXX XXXXXXXX
2056	Alarm off threshold 2	f.s	0	0	XXXXXXXX XXXXXXXX
2058	info out 3	***	***	***	not present
205A	delay out 3	255	0	0	0101XXXX XXXXXXXX
205C	set-point out 3	f.s	b.s.	0	XXXXXXXX XXXXXXXX
205E	Alarm off threshold 3	f.s	0	0	XXXXXXXX XXXXXXXX
2060	info out 4	***	***	***	not present
2062	delay out 4	255	0	0	0101XXXX XXXXXXXX
2064	set-point out 4	f.s	b.s.	0	not present

***: see EEPROM data format table

PQT-90 configuration map (continue)

ADD.	VARIABLE	MAX	MIN	DEFAULT	BIT CHECK
2066	Alarm off threshold 4	f.s	0	0	not present
2068	Daylight saving time	1	0	1	0101XXXX XXXXXXXXX
206A	Installed power 1				
206C	Installed power 2				
206E	Installed power 3				
2070	Installed power 4				
2072	Installed power min				
2074	DMD variables	***	***	***	See info coding
2076	DMD variables	***	***	***	See info coding
2078	SMS EVENTS				See info coding
207A	Modem events				See info coding
207C	PHONE NUMBERS	5	1		not present
207E	SMS PASSWORD	255	1		not present
2080	MODEM/GSM	2	0		not present
2082	Pulses/kWh input	1000000	1	1000	XXXXXXXX XXXXXXXXX
2084					XXXXXXXX XXXXXXXXX
2086	Pulses/kvarh input	1000000	1	1000	XXXXXXXX XXXXXXXXX
					XXXXXXXX XXXXXXXXX
208A	Tariff managementtype	2	0		XXXXXXXX XXXXXXXXX
208C	DMD, Min, Max selection	1	0		0101XXXX XXXXXXXXX
208E	Enable of digital inputs logging				xxxx0000 00000xx0
2090	Modem Time-out	1000	50	100	not present
20A8					
20AA					
20AC					
20AE					
20B0					
20B2					
20B4					
20B6					
20B8					
20BA					
20BC					
20BE					
20C0	Variable type MAX1	---	---		0101XXXX XXXXXXXXX
20C2	Variable type MAX2	---	---		0101XXXX XXXXXXXXX
20C4	Variable type MAX3	---	---		0101XXXX XXXXXXXXX
20C6	Variable type MAX4	---	---		0101XXXX XXXXXXXXX
20C8	Variable type MAX5	---	---		0101XXXX XXXXXXXXX
20CA	Variable type MAX6	---	---		0101XXXX XXXXXXXXX
20CC	Variable type MAX7	---	---		0101XXXX XXXXXXXXX
20CE	Variable type MAX8	---	---		0101XXXX XXXXXXXXX
20D0	Variable type MAX9	---	---		0101XXXX XXXXXXXXX
20D2	Variable type MAX10	---	---		0101XXXX XXXXXXXXX
20D4	Variable type MAX11	---	---		0101XXXX XXXXXXXXX
20D6	Variable type MAX12	---	---		0101XXXX XXXXXXXXX
20D8	Variable type MIN1	---	---		0101XXXX XXXXXXXXX
20DA	Variable type MIN2	---	---		0101XXXX XXXXXXXXX
20DC	Variable type MIN3	---	---		0101XXXX XXXXXXXXX
20DE	Variable type MIN4	---	---		0101XXXX XXXXXXXXX
20E0	Variable type MIN5	---	---		0101XXXX XXXXXXXXX
20E2	Variable type MIN6	---	---		0101XXXX XXXXXXXXX
20E4	Variable type MIN7	---	---		0101XXXX XXXXXXXXX
20E6	Variable type MIN8	---	---		0101XXXX XXXXXXXXX
2100	val MAX1(msb)				
2101	val MAX1(lsb)				
2102	val MAX2(msb)				

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2103	val MAX2 (lsb)				
2104	val MAX3 (msb)				
2105	val MAX3 (lsb)				
2106	val MAX4 (msb)				
2107	val MAX4 (lsb)				
2108	val MAX5 (msb)				
2109	val MAX5 (lsb)				

PQT-90 configuration map (continue)

ADD.	VARIABLE	MAX	MIN	DEFAULT	BIT CHECK
210A	val MAX6 (msb)				
210B	val MAX6 (lsb)				
210C	val MAX7 (msb)				
210D	val MAX7 (lsb)				
210E	val MAX8 (msb)				
210F	val MAX8 (lsb)				
2110	val MAX9 (msb)				
2111	val MAX9 (lsb)				
2112	val MAX10 (msb)				
2113	val MAX10 (lsb)				
2114	val MAX11 (msb)				
2115	val MAX11 (lsb)				
2116	val MAX12 (msb)				
2117	val MAX12 (lsb)				
2118					
2119					
211A					
211B					
211C					
211D					
211E					
211F					
2120	val MIN1 (msb)				
2121	val MIN1 (lsb)				
2122	val MIN2 (msb)				
2123	val MIN2 (lsb)				
2124	val MIN3 (msb)				
2125	val MIN3 (lsb)				
2126	val MIN4 (msb)				
2127	val MIN4 (lsb)				
2128	val MIN5 (msb)				
2129	val MIN5 (lsb)				
212A	val MIN6 (msb)				
212B	val MIN6 (lsb)				
212C	val MIN7 (msb)				
212D	val MIN7 (lsb)				
212E	val MIN8 (msb)				
212F	val MIN8 (lsb)				

Note1: if no optional modules are installed, these cells are to be set to 0

******: See EEPROM data format table***

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3.2 EEPROM CONFIGURATION DATA FORMAT

3.2.1 Variable type coding

VARIABLE	Code	VARIABLE	Code
V L1-N	0	PF Σ	27
V L2-N	1	Hz	28
V L3-N	2	THD V1	29
VL-N Σ	3	THDe V1	30
V L1	4	THDo V1	31
V L2	5	THD V2	32
V L3	6	THDe V2	33
v Σ	7	THDo V2	34
A L1	8	THD V3	35
A L2	9	THDe V3	36
A L3	10	THDo V3	37
An	11	THD A1	38
W L1	12	THDe A1	39
W L2	13	THDo A1	40
W L3	14	THD A2	41
w Σ	15	THDe A2	42
Var L1	16	THDo A2	43
Var L2	17	THD A3	44
Var L3	18	THDe A3	45
VAR Σ	19	THDo A3	46
VA L1	20	A dmd	47
VA L2	21	VA dmd	48
VA L3	22	TPF avg	49
va Σ	23	w dmd	50
PF L1	24	Var dmd	51
PF L2	25	ASY	52
PF L3	26		

3.2.2 System coding

System	selection
XXXXXXXX XXXXX000	1-phase
XXXXXXXX XXXXX001	3+N phases bal
XXXXXXXX XXXXX010	3+N phases unbal
XXXXXXXX XXXXX011	3 phases bal
XXXXXXXX XXXXX100	3 phases unbal
XXXXXXXX XXXXXXXX	bit check

3.2.3 Average type coding

type digit	selection
XXXXXXXX XXXXXXX0	avg fixed
XXXXXXXX XXXXXXX1	avg float
0101XXXX XXXXXXXX	bit check

3.2.4 Output(1,2,3,4) info coding

Info out	selection
01XXXXXX XX000000	variable type (from 000000 to 110011, default 110011)
01XXXX00 00XXXXXX	control type «up» (default)
01XXXX00 01XXXXXX	control type «up.1»
01XXXX00 10XXXXXX	control type «do»

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01XXXX00 11XXXXXX	control type «do.l»
01XXXX0XX XXXXXXXX	relay nd
01XXXX1XX XXXXXXXX	relay ne

3.2.5 Field (1 and 2) coding

Field	Selection
XXXXXXXX XX000000	field 1 variable
XXXX0000 00XXXXXX	field 2 variable
0101XXXX XXXXXXXX	bit check

3.2.6 Field (3 and 4) coding

Field	Selection
XXXXXXXX XX000000	field 1 variable
XXXX0000 00XXXXXX	field 2 variable
0101XXXX XXXXXXXX	bit check

3.2.7 MAX and MIN type coding

Type MAX and MIN	Selection
XXXXXXXX XX000000	field 1 variable(from 000000 to 110011, see TABLE «A»)
0101XXXX XXXXXXXX	bit check

3.2.8 Display mode coding

Type digit	Selection
XXXXXXXX XXXXXX0	4 digit display
XXXXXXXX XXXXXX1	3½ digit display
0101XXXX XXXXXXXX	bit check

3.2.9 RS485 baud rate coding

Baud RS485	Selection
XXXXXXXX XXXXXX00	9600b
XXXXXXXX XXXXXX01	VALUE NOT ALLOWED
XXXXXXXX XXXXXX10	VALUE NOT ALLOWED
XXXXXXXX XXXXXX11	VALUE NOT ALLOWED

3.2.10 RS232 baud rate coding

Any modification is effective after switchin off an on the instrumnet.

Baud RS232	Selection
XXXXXXXX XXXXXX00	38400b
XXXXXXXX XXXXXX01	9600b
XXXXXXXX XXXXXX10	VALUE NOT ALLOWED
XXXXXXXX XXXXXX11	VALUE NOT ALLOWED

3.2.11 Tariff associated to the pulse outputs

Alarm tariff	Selection
----- --- --- XXX	Out 1 Tariff from 0 to 4 (tariff 0 is the total)
----- --- XXX ---	Out 1 Tariff from 0 to 4 (tariff 0 is the total)
----- XXX --- ---	Out 1 Tariff from 0 to 4 (tariff 0 is the total)
----XXX --- --- ---	Out 1 Tariff from 0 to 4 (tariff 0 is the total)

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3.2.12 FFT enabled coding

Enable fft	Selection
XXXXXXXX XXXXXX1	Fft V1-I1 disabled
XXXXXXXX XXXXXX0	Fft V1-I1 enabled
XXXXXXXX XXXXXX1X	fft V2-I2 disabled
XXXXXXXX XXXXXX0X	fft V2-I2 enabled
XXXXXXXX XXXXX1XX	fft V3-I3 disabled
XXXXXXXX XXXXX0XX	fft V3-I3 enabled

3.2.13 Analogue outputs (1, 2, 3, 4) coding

Info ang	Selection
XXXXXXXX XX000000	Variable ang X (from 000000 to 110011, see TABLE «A»)

3.2.14 Enabled digital inputs coding

Diginput_on	Selection
----- --- --X	Input A1 enabled if bit=1, disabled if bit=0
----- --- --X-	Input A2 enabled if bit=1, disabled if bit=0
----- --- --X--	Input A3 enabled if bit=1, disabled if bit=0
----- --- -X---	Input C1 enabled if bit=1, disabled if bit=0
----- --- -X- ---	Input C2 enabled if bit=1, disabled if bit=0
----- --- X-- ---	Input C3 enabled if bit=1, disabled if bit=0
----- X-- --- ---	Input A2 H2O counter if bit=0, GAS tariff GAS if bit=1
-----X --- --- ---	if bit= 1 then A1 and A2 negative energy counters, if bit=1 then the bit 9 takes meaning

3.2.15 Input type coding

Field	Selection
XXXXXXXX XXXXXX0	Measure (from analogue input module)
XXXXXXXX XXXXXX1	Pulse (pulses from official watthourmeter)
0101XXXX XXXXXXXX	bit check

3.2.16 Coding of the tariff associated to the W dmd alarm

Alarmtarif	Selection
----- --- --- XXX	Alarm1 from 0 to 4 (tariff 0 is the total)
----- --- XXX ---	Alarm2 from 0 to 4 (tariff 0 is the total)
----- XXX --- ---	Alarm3 from 0 to 4 (tariff 0 is the total)
----XXX --- --- ---	Alarm4 from 0 to 4 (tariff 0 is the total)
0101XXXX XXXXXXXX	bit check

3.2.17 Event selection

type dig out	Selection
XXXXXXXX XXXXXXXX	Bit 31 bit 16
XXXXXXXX XXXXXXXX	Bit 15 bit 0
12 MAX, 8 MIN,	Bit 0 → MAX 1, bit 1 → MAX 2,, bit 12 → MIN 1,,
4 Diagnostics,	Bit 19 → MIN 8, bit 20 → DGN 1,, bit 23 → DGN 4,,
4 Remote, 4 Alarms	Bit 24 → REM 1,, bit 28 → ALARM 1, ..., bit 31 → ALARM 4

3.2.18 Digital outputs type coding

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type dig out	Selection
XXXXXXXX XXXXXX00	dig out 1 pulse (default type out 1)
XXXXXXXX XXXXXX01	dig out 1 alarm
XXXXXXXX XXXXXX10	dig out 1 control
XXXXXXXX XXXXXX11	dig out 1 remote
XXXXXXXX XXXX00XX	dig out 2 pulse (default type out 2)
XXXXXXXX XXXX01XX	dig out 2 alarm
XXXXXXXX XXXX10XX	dig out 2 control
XXXXXXXX XXXX11XX	dig out 2 remote
XXXXXXXX XX00XXXX	dig out 3 pulse (default type out 3)
XXXXXXXX XX01XXXX	dig out 3 alarm
XXXXXXXX XX10XXXX	dig out 3 control
XXXXXXXX XX11XXXX	dig out 3 remote
XXXXXXXX 00XXXXXX	dig out 4 pulse (default type out 4)
XXXXXXXX 01XXXXXX	dig out 4 alarm
XXXXXXXX 10XXXXXX	dig out 4 control
XXXXXXXX 11XXXXXX	dig out 4 remote
XXXXXX00 XXXXXXXX	pulse 1 Kwh+ (default) (see note 1)
XXXXXX01 XXXXXXXX	pulse 1 Kwh- (see note 1)
XXXXXX10 XXXXXXXX	pulse 1 KVARh+ (see note 1)
XXXXXX11 XXXXXXXX	pulse 1 KVARh- (see note 1)
XXXX00XX XXXXXXXX	pulse 2 Kwh+ (default) (see note 1)
XXXX01XX XXXXXXXX	pulse 2 Kwh- (see note 1)
XXXX10XX XXXXXXXX	pulse 2 KVARh+ (see note 1)
XXXX11XX XXXXXXXX	pulse 2 KVARh- (see note 1)
XX00XXXX XXXXXXXX	pulse 3 Kwh+ (default) (see note 1)
XX01XXXX XXXXXXXX	pulse 3 Kwh- (see note 1)
XX10XXXX XXXXXXXX	Pulse 3 KVARh+ (see note 1)
XX11XXXX XXXXXXXX	Pulse 3 KVARh- (see note 1)
00XXXXXX XXXXXXXX	Pulse 4 Kwh+ (default) (see note 1)
01XXXXXX XXXXXXXX	Pulse 4 Kwh- (see note 1)
10XXXXXX XXXXXXXX	Pulse 4 KVARh+ (see note 1)
11XXXXXX XXXXXXXX	Pulse 4 KVARh- (see note 1)

note1: the multiplier type depends on the «info P» (see instantaneous variables map).

3.2.19 DMD variables coding .

VARIABLE	bit	VARIABLE	Bit
V L1-N	0	var L1	16
V L2-N	1	var L2	17
V L3-N	2	var L3	18
VL-N Σ	3	VAR Σ	19
V L1	4	VA L1	20
V L2	5	VA L2	21
V L3	6	VA L3	22
v Σ	7	VA Σ	23
A L1	8	PF Σ	24
A L2	9	THDV1	25
A L3	10	THDA1	26
A Σ	11	THDV2	27
W L1	12	THDA2	28
W L2	13	THDV3	29
W L3	14	THDA3	30
W Σ	15		

4 BYTE	
XXXXXXXX XXXXXXXX	→ if the "i" bit = 0, then the variable is not selected
XXXXXXXX XXXXXXXX	→ if the "i" bit = 1, then the variable is selected

The max number of selectable variables is 8.

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3.2.20 SMS/Modem event coding

VARIABLE	Bit
Alarm1	0
Alarm2	1
Alarm3	2
Alarm4	3

4 BYTE	
XXXXXXXX XXXXXXXX	→ if the n th bit = 0, then the variable is not selected
XXXXXXXX XXXXXXXX	→ if the n th bit = 1, then the variable is selected

For both the SMS and Modem (analogue) events, only the first four bits (Y) are evaluated.

3.2.21 Phone numbers.

2 BYTE	
XXXXXXXX XXXXXXXX	Telephone numbers to call for SMS alarm messages (from 1 to 5)

3.2.22 SMS Password .

2 BYTE	
XXXXXXXX XXXXXXXX	→ Password value, from 0 to 255

3.2.23 Modem selection coding.

2 BYTE	
-----XX	→ 0 = no modem, 1 = Analogue, 2 = GSM

3.2.24 Input pulses/kWh (kvarh).

4 BYTE	MAX Limit
XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX	1000000

The internal value of the constant is an integer from 1 to 1000000. It is considered as decimal type with fixed point, from 0.01 to 10000.00.

3.2.25 Tariff management coding.

2 BYTE	
XXXXXXXX XXXXXX00	Single tariff
XXXXXXXX XXXXXX01	Dual tariff
XXXXXXXX XXXXXX10	Multi tariff

3.2.26 dmd, Min, Max coding

2 BYTE	
XXXXXXXX XXXXXX00	only dmd values
XXXXXXXX XXXXXX01	dmd+Min+Max (see Memory Card)

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3.2.27 Enable of digital inputs logging

2 BYTE	
XXXX-----XX- A1,C3,C2,C1,..., A3,A2	dig. input logging enabled if X=1, dig. input logging disabled if X=0 Refer to memory cell 0x0800 for input type

3.2.28 Modem time-out

2 BYTE	
XXXXXXXX XXXXXXXX	inter-character modbus time-out during communication by modem

Warning : When requested, the check bit must be inserted correctly within the min and max limits. If the value is wrong, the PQT-90 loads default values, which could cause unexpected working.

3.3 EVENT LOGGING

Event logging map

2300	4 words	Event 1
2308	4 words	Event 2
2310	4 words	Event 3
2318	4 words	Event 4
2320	4 words	Event 5
2328	4 words	Event 6
-----	-----	-----
31F8	4 words	Event 480

The stored information relevant to every event are the following: event type, hour, minutes, seconds, day, month, year, value.

All these data are included in the relevant 4 words, coded as follow.

To reset the events, it is necessary to write 0 in every of the sideways listed addresses and to reset the event counter, placed at the address 80Ch.

Nth event coding

	hour	min	event type
Word1	XXXXX	XXXXXX	XXXXX

	month	day	year
Word2	XXXX	XXXXX	XXXXXXXX

	Seconds	variable type
Word3	0101XXXXXX	XXXXXX

	value
Word4	XXXXXXXXXXXXXXXXXX

Power variable format:

Power variable format	
XXXXXXXX XXXXYYYY	XXXXXXXXXXXXXXXXX -> MANTISSA YYYY -> EXPONENT

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The mantissa is lower than 2000 and the exponent lower than 16.
The YYYY value corresponds to the value on the "INF" table, with which it is possible to find the engineering unit to be associated to the XXXXXXXXXXXX mantissa.

Event type coding:

MAX		1
MIN		2
DIAGNOSTIC1	ON	3
DIAGNOSTIC2	ON	4
DIAGNOSTIC3	ON	5
DIAGNOSTIC4	ON	6
DIAGNOSTIC1	OFF	7
DIAGNOSTIC2	OFF	8
DIAGNOSTIC3	OFF	9
DIAGNOSTIC4	OFF	10
REMOTE1	ON	11
REMOTE2	ON	12
REMOTE3	ON	13
REMOTE4	ON	14
REMOTE1	OFF	15
REMOTE2	OFF	16
REMOTE3	OFF	17
REMOTE4	OFF	18
ALARM1	ON	19
ALARM2	ON	20
ALARM3	ON	21
ALARM4	ON	22
ALARM1	OFF	23
ALARM2	OFF	24
ALARM3	OFF	25
ALARM4	OFF	26
CHANGE OF STATE DIG. INPUT		27

3.3.1 Event reset (fixed frame)

Reset of the event buffer

Request frame:

01h	06h	33h	E0h	F4h	D5h	79h	E7h
-----	-----	-----	-----	-----	-----	-----	-----

Answer frame :

01h	06h	33h	E0h	F4h	D5h	79h	E7h
-----	-----	-----	-----	-----	-----	-----	-----

3.4 MONTHLY ENERGY METERS

The reading of the values of the energy meters relevant to the previous three months is feasible by reading the data stored in the three tables described below. The tables have the same structure: they are composed of 14 32-bytes pages where the total and partial meter values are stored on the first day of the month at 0.00.00. The storing order of the table is the following (assuming, for example, to begin the PQT use in January): January data = table A, February data = table B, March data = table C, April data = table A (overwriting the January data), and so on.

Pages structure:

Page 1: the initial 16 bytes, grouped 4 by 4, are the four-total meter LSB part (KWh+, KWh-, Kvarh+, Kvarh-)

Page 2: the initial 20 bytes, grouped 5 by 5, are the four-winter tariff 1 partial meters values

Page 3: the initial 20 bytes, grouped 5 by 5, are the four-winter tariff 2 partial meters values

Page 4: the initial 20 bytes, grouped 5 by 5, are the four-winter tariff 3 partial meters values

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Page 5: the initial 20 bytes, grouped 5 by 5, are the four-winter tariff 4 partial meters values
Page 6: the initial 20 bytes, grouped 5 by 5, are the four-summer tariff 1 partial meters values
Page 7: the initial 20 bytes, grouped 5 by 5, are the four-summer tariff 2 partial meters values
Page 8: the initial 20 bytes, grouped 5 by 5, are the four-summer tariff 3 partial meters values
Page 9: the initial 20 bytes, grouped 5 by 5, are the four-summer tariff 4 partial meters values
Page 10: the initial 20 bytes, grouped 5 by 5, are the four-holiday tariff 1 partial meters values
Page 11: the initial 20 bytes, grouped 5 by 5, are the four-holiday tariff 2 partial meters values
Page 12: the initial 20 bytes, grouped 5 by 5, are the four-holiday tariff 3 partial meters values
Page 13: the initial 20 bytes, grouped 5 by 5, are the four-holiday tariff 4 partial meters values
Page 14: the initial 4 bytes are the four-total meter MSB part, then 10 not used bytes follow, then the following two bytes are relevant respectively to the year and month when the table were stored.

How to reconstruct the energy meter values:

The energy values have to be reconstructed according to the procedure described in paragraph 2.5. The value of byte 5, multiplied by 1000000000, must be added to the byte1-byte2-byte3-byte4 value and the sum divided by 100.

Total meters: byte5 is stored at page 14 of the relevant monthly table. byte1-byte2-byte3-byte4 are stored at page 1 (byte 1 has the lower address).

Partial meters: byte5 and byte1-byte2-byte3-byte4 are consecutively stored starting from the address of the required meter (byte 5 has the lower address, then byte 1 is stored, etc.).

To obtain the energy consumption relevant to a given month, the tables relevant to the end and the beginning of that month must be read, and the difference between the respective values must be carried out.

3.4.1 Monthly energy meters map

ADDRESS	BYTE	SEASON	PERIOD	METER TYPE
3220	4	TOTAL	LSB	Kwh+ (LSB)
3224	4			Kwh- (LSB)
3228	4			KVARh+ (LSB)
322C	4			KVARh- (LSB)
	4			
	4			
	4			
	4			
3240	4	WINTER	1	Kwh+ (LSB)
3244	1			Kwh+ (MSB)
3245	4			KVARh+ (LSB)
3249	1			KVARh+ (MSB)
324A	4			Kwh- (LSB)
324E	1			Kwh- (MSB)
324F	4			KVARh- (LSB)
3253	1			KVARh- (MSB)
3254	12			
3260	4	WINTER	2	Kwh+ (LSB)
3264	1			Kwh+ (MSB)
3265	4			KVARh+ (LSB)
3269	1			KVARh+ (MSB)
326A	4			Kwh- (LSB)
326E	1			Kwh- (MSB)
326F	4			KVARh- (LSB)
3263	1			KVARh- (MSB)
3264	12			

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33A0	4	HOLIDAY	4	Kwh+ (LSB)
33A4	1			Kwh+ (MSB)
33A5	4			KVARh+ (LSB)
33A9	1			KVARh+ (MSB)
33AA	4			Kwh- (LSB)
33AE	1			Kwh- (MSB)
33AF	4			KVARh- (LSB)
33B3	1			KVARh- (MSB)
33B4	12			
33C0	1	TOTAL MSB		Kwh+ (MSB)
33C1	1			Kwh- (MSB)
33C2	1			KVARh+ (MSB)
33C3	1			KVARh- (MSB)
33C4	10			
33CE	1	YEAR/MONTH		YEAR
33CF	1			MONTH
33D0	16			

Table A

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counters are stored, referring to time 00:00:00 of the first day of each of the last three months

3.5 ANALOGUE OUTPUT AND CONFIGURATION MAP

ADD.	BYTE	VARIABLE	MAX	MIN	DEFAULT	BIT CHECK
3B80		variable 1	---	---	?	not present
3B82		min % 1	1000	0	0	not present
3B84		max % 1	1000	0	1000	not present
3B86		min input 1	f.s.	b.s.	b.s.	not present
3B88		max input 1	f.s.	b.s.	f.s.	not present
3B8A		variable 2	---	---	?	not present
3B8C		min % 2	1000	0	0	not present
3B8E		max % 2	1000	0	1000	not present
3B90		min input 2	f.s.	b.s.	b.s.	not present
3B92		max input 2	f.s.	b.s.	f.s.	not present
3B94		variable 3	---	---	?	not present
3B96		min % 3	1000	0	0	not present
3B98		max % 3	1000	0	1000	not present
3B9A		min input 3	f.s.	b.s.	b.s.	not present
3B9C		max input 3	f.s.	b.s.	f.s.	not present
3B9E		variable 4	---	---	?	not present
3BA0		min % 4	1000	0	0	not present
3BA2		max % 4	1000	0	1000	not present
3BA4		min input 4	f.s.	b.s.	b.s.	not present
3BA6		max input 4	f.s.	b.s.	f.s.	not present

f.s. = full scale

b.s. = beginning of the scale

To define an analogue output, it is necessary to set respectively:

- 1) The variable to be associated to the output.
- 2) The minimum and maximum percentage, for which the last figure is always decimal. (e.g. 585= 58.5%)
- 3) The input range relevant to the selected variable.

3.5.1 Reading and programming of analogue outputs

This example is relevant to the following settings:

Analogue out: 2

Variable: VL3-N

Output range: 15.0% - 92.5%

Input range: 2000V to 15000V

CT= 2.0

VT= 50.0

Request frame for "infoA"

01h	04h	00h	E8h	00h	02h	F1h	FFh
-----	-----	-----	-----	-----	-----	-----	-----

Answer "info"

01h	04h	04h	07h	04h	06h	03h	F8h	90h
-----	-----	-----	-----	-----	-----	-----	-----	-----

Value info V: 07h

Value info A: 04h

Value info W: 06h

Considering that the locations relevant to the analogue out 2 are 3B8Ah to 3B92h, the following frames are to be sent.

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Writing of analogue out 2 (frame 8 byte):

01h	06h	3Bh	8Ah	00h	02h	24h	C5h
-----	-----	-----	-----	-----	-----	-----	-----

Writing of minimum percent (150d=0096h)

01h	06h	3Bh	8Ch	00h	96h	C5h	6Bh
-----	-----	-----	-----	-----	-----	-----	-----

Writing of max percent (925d = 039h)

01h	06h	3Bh	8Eh	03h	9Dh	25h	9Ch
-----	-----	-----	-----	-----	-----	-----	-----

Writing of minimum input (2.00k = 200d = 00C8h)

01h	06h	3Bh	90h	00h	C8h	85h	55h
-----	-----	-----	-----	-----	-----	-----	-----

Writing of maximum input (1500d=05CDh)

01h	06h	3Bh	92h	05h	DCh	27h	CAh
-----	-----	-----	-----	-----	-----	-----	-----

With reference to power variables, the input settings shall be different, as indicated in the example on 2.3. The power variables are represented according to a “mantissa-exponent” code.

NOTE: The exponent are to be the same for both minimum and maximum input values.

3.6 EXAMPLES: HOW TO READ THE DATA FROM EEPROM

NOTE: EEPROM is structured in word (if not differently advised) which are sent in the order MSB, LSB.

The value of the variables stored in EEPROM are 4-byte integer except from the values of the power which are stored in a different way. Refer to example 22 to know how to read the power values.

3.6.1 MIN and MAX reading and reset

Example 19: “12th MAXIMUM variable type” read command

4-word read command request frame (8 byte):

01h	04h	20h	D6h	00h	01h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

read command answer frame (7 byte):

01h	04h	02h	50h	0Ah	CRC	CRC
-----	-----	-----	-----	-----	-----	-----

12th MAX-variable type address:

20D6h

Stored variable value:

0Ah = 10 (decimal)

Variable type:

A L3 (phase 3 current)

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Example 23: “12th MAXIMUM” reset command

1-word write request command (8 byte):

01h	06h	21h	16h	00h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Write answer frame (8 byte):

01h	06h	21h	16h	00h	00h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

3.6.2 MAX and MIN reset (fixed frame)

It is possible to reset the min and max values by using the following fixed frame

1-word write request command (8 byte):

01h	06h	33h	E1h	F5h	D6h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

Write answer frame (8 byte):

01h	06h	33h	E1h	F5h	D6h	CRC	CRC
-----	-----	-----	-----	-----	-----	-----	-----

3.6.3 EVENTS READING

The reading of the information regarding an event is carried out by transferring 4 words starting from the first address of the selected event location, according to the Event Logging Map table (see paragraph 3.2).

The description of the event is obtained by decoding the data contained in the 4 words, according to “nth event coding” table.

In accordance to the above listed procedure, before reading a MAX or MIN event, the variable associated to the MAX or MIN must be known. Then the info of the variable (decimal point position) must be acquired. Finally the stored value must be read.

With relevance to the power measurement, the 12 most-significant bytes represent the value, never greater than 2000, whereas the bit 0-1-2-3 define both the decimal point and the engineering unit (see “inf” table)

Example 24: read command of the event stored at address 2328h

4-word read command frame (8 byte):

01h	04h	23h	28h	00h	04h	7Ah	45h
-----	-----	-----	-----	-----	-----	-----	-----

read command answer frame (13 byte):

01h	04h	08h	B0h	21h	30h	83h	58h	D9h	BBh	54h	EFh	C1h
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Word 1: B021h = 1011000000100001
 Word 2: 3083h = 11000010000011
 Word 3: 58D9h = 101100011011001
 Word 4: BB54h = 1011101101010100

Event Type	0001	1	MAX
Seconds	100011	35	
Minutes	000001	1	
Hour	10110	22	
Day	00001	1	
Month	0011	3	
Year	0000003	3	
Variable type	100101	25	SYS

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As above explained, both value and engineering unit of powers are contained in the same word (BB54h)

Value: BB5h = -1099d (two complement)

Info: 4h = 4d

This means that the value -1099 shall be combined to the info XX.XX, so that the final value is -10.99 var.

3.7 RTC MAPPING

ADD.	BYTE	VARIABLE	Coding (with bit check)
4000	1	Seconds	Hex value
4001	1	Minutes	Hex value
4002	1	Hours	Hex value
4003	1	Week day	Hex value
4004	1	Month day	Hex value
4005	1	Month	Hex value
4006	1	Year	Hex value
4007	1		
4008	1		
4009	1		
400A	1(LSB)	Winter starting date	XXXXXXXX
	1(MSB)		0101010X
400C	1(LSB)	Winter finish date	XXXXXXXX
	1(MSB)		0101010X
400E	1(LSB)	End of 1 st Winter period	XXXXXXXX
	1(MSB)		010WWXXX
4010	1(LSB)	End of 2 nd Winter period	XXXXXXXX
	1(MSB)		010WWXXX
4012	1(LSB)	End of 3 rd Winter period	XXXXXXXX
	1(MSB)		010WWXXX
4014	1(LSB)	End of 4 th Winter period	XXXXXXXX
	1(MSB)		010WWXXX
4016	1(LSB)	End of 5 th Winter period	XXXXXXXX
	1(MSB)		010WWXXX
4018	1(LSB)	End of 6 th Winter period	XXXXXXXX
	1(MSB)		010WWXXX
401A	1(LSB)	End of 7 th Winter period	XXXXXXXX
	1(MSB)		010WWXXX
401C	1(LSB)	End of 8 th Winter period	XXXXXXXX
	1(MSB)		010WWXXX
401E	1(LSB)	End of 1 st Summer period	XXXXXXXX
	1(MSB)		010WWXXX
4020	1(LSB)	End of 2 nd Summer period	XXXXXXXX
	1(MSB)		010WWXXX
4022	1(LSB)	End of 3 rd Summer period	XXXXXXXX
	1(MSB)		010WWXXX
4024	1(LSB)	End of 4 th Summer period	XXXXXXXX
	1(MSB)		010WWXXX
4026	1(LSB)	End of 5 th Summer period	XXXXXXXX
	1(MSB)		010WWXXX
4028	1(LSB)	Start Holiday	XXXXXXXX
	1(MSB)		010WWXXX
402A	1(LSB)	End Holiday	XXXXXXXX
	1(MSB)		010WWXXX
402C	1(LSB)	Holiday rate	XXXXXXXX
	1(MSB)		010WWXXX
402E	1		

Note : the MSB-LSB notation is used only to define how the data should be reconstructed (see below). The LSB is always sent before the MSB, in both reading and writing frames.

The first 7 bytes are relevant to the system clock. They shall be written according to the Modbus protocol. If the PQT is programmed as dual tariff or multi tariff, the locations from 400Ah to 402Dh

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are to be programmed according to the following coding.

Winter starting date.

2 BYTE	
0101010X XXXYYYYY	bit Y 0←→4 first winter day bit X 5←→8 month of the first winter day

End Winter.

2 BYTE	
0101010X XXXYYYYY	bit Y from 0←→4 last winter day bit X from 5←→8 month of the last winter day

The summer season is defined automatically, after setting the winter one.

Holiday starting date

2 BYTE	
0101010X XXXYYYYY	bit Y from 0←→4 first holiday day bit X from 5←→8 month of the first holiday day

Holiday finish date

2 BYTE	
0101010X XXXYYYYY	bit Y from 0←→4 Last holiday day bit X from 5←→8 month of the last holiday day

Day periods finish hour (Winter, Summer, Holiday).

2 BYTE	
010WWXXX XXXYYYYY	010 check bit, bit Y Minutes, bit X Hours, bit W Tariff

WARNING: to read the RTC RAM, the byte are to be addressed two by two, starting only from the even addresses.

NOTE: when the time is updated by serial commands, the AM-PM coding is not allowed

Example 24: RTC data read command:

4-word read command frame (8 byte)

01h	04h	40h	00h	00h	04h	E4h	09h
-----	-----	-----	-----	-----	-----	-----	-----

read command answer frame (13 byte):

			Sec.	Min.	Hour	Week day	Month day	Month	Year			
01h	04h	08h	2Eh	1Ch	0Ch	01h	11h	03h	03h	00h	CRC	CRC

Seconds: 2Eh = 46
Minutes: 1Ch = 28
Hour: 0Ch = 12
Day of the week 01h = 1 (Monday)
Day of the month: 11h = 17
Month: 03h = 3
Year: 0003h = 3 (2003)

4 CRC CALCULATION ALGORITHM

CRC is calculated according to the relevant flow diagram (see below). An explanatory example will follow.

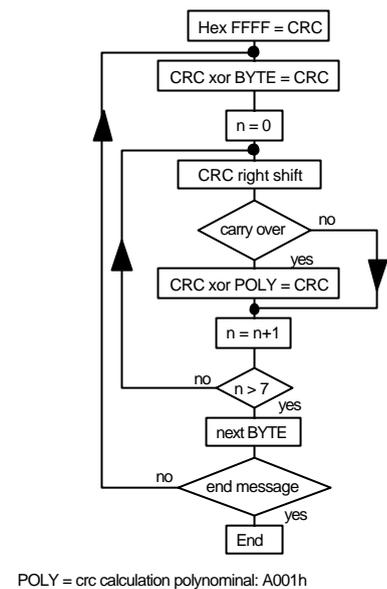
Example 25: calculation of CRC starting from frame 0207h

Init CRC	1111 1111 1111 1111
Load first character	0000 0010
Execute the XOR with the first char. of the frame	1111 1111 1111 1101
Execute first right shift	0111 1111 1111 1110 1
Carry = 1, load polynomial	1010 0000 0000 0001
Execute XOR with the polynomial	1101 1111 1111 1111
Execute 2 nd right shift	0110 1111 1111 1111 1
Carry = 1, load polynomial	1010 0000 0000 0001
Execute XOR with the polynomial	1100 1111 1111 1110
Execute 3 rd right shift	0110 0111 1111 1111 0
Execute 4 th right shift	0011 0011 1111 1111 1
Carry = 1, load polynomial	1010 0000 0000 0001
Execute XOR with the polynomial	1001 0011 1111 1110
Execute 5 th right shift	0100 1001 1111 1111 0
Execute 6 th right shift	0010 0100 1111 1111 1
Carry = 1, load polynomial	1010 0000 0000 0001
Execute XOR with the polynomial	1000 0100 1111 1110
Execute 7 th right shift	0100 0010 0111 1111 0
Execute 8 th right shift	0010 0001 0011 1111 1
Carry = 1, load polynomial	1010 0000 0000 0001
Execute XOR with the polynomial	1000 0001 0011 1110

Load second character of the frame	0000 0111
Execute XOR with the second character of the frame	1000 0001 0011 1001
Execute 1 st right shift	0100 0000 1001 1100 1
Carry = 1, load polynomial	1010 0000 0000 0001
Execute XOR with the polynomial	1110 0000 1001 1101
Execute 2 nd right shift	0111 0000 0100 1110 1
Carry = 1, load polynomial	1010 0000 0000 0001
Execute XOR with the polynomial	1101 0000 0100 1111
Execute 3 rd right shift	0110 1000 0010 0111 1
Carry = 1, load polynomial	1010 0000 0000 0001
Execute XOR with the polynomial	1100 1000 0010 0110
Execute 4 th right shift	0110 0100 0001 0011 0
Execute 5 th right shift	0011 0010 0000 1001 1
Carry = 1, load polynomial	1010 0000 0000 0001
Execute XOR with the polynomial	1001 0010 0000 1000
Execute 6 th right shift	0100 1001 0000 0100 0
Execute 7 th right shift	0010 0100 1000 0010 0
Execute 8 th right shift	0001 0010 0100 0001 0

CRC result 0001 0010 0100 0001
 12h 41h

Note: the byte 41h is sent first (even if it's the LSB), then byte 12h is sent.



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5 MEMORY FLASH VARIABLE MAP

The Flash memory is divided into three blocks, containing different kind of information:

- from page 0000 to page 3993: logged data
- from page 3394 to page 3395: telephone numbers and SMS messages
- from page 3396 to page 4095: load profile data

Refer to paragraph 5.5.1 for the Flash memory read command.

After loading all the “data logging” info, a complete reset of the relevant memory area must be carried out, by sending a rigid-structure frame.

Two types of logging can be selected:

- 1) Average of max 8 variables
- 2) Average of max 8 variables, plus min and max of each variable, within its integration time.

Configuration map in case of 2-variable logging (pages from 00 to 3993)

Page 000h

ADD.	BYTE	VARIABLE	MAX	MIN	DEFAULT	BIT CHECK
000		Sample 1				
00C		Sample 2				
018		Sample 3				
024		Sample 4				
030		Sample 5				
03C		Sample 6				

204		Sample 44				

Page 001h

ADD.	BYTE	VARIABLE	MAX	MIN	DEFAULT	BIT CHECK
000		Sample 45				
00C		Sample 46				
018		Sample 47				
024		Sample 48				
030		Sample 49				
03C		Sample 50				

204		Sample 88				

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Configuration map in case of logging with max and min (pages from 00 to 3993) – two variables

Page 000h

ADD.	BYTE	VARIABLE	MAX	MIN	DEFAULT	BIT CHECK
000		Sample 1				
014		Sample 2				
028		Sample 3				
03C		Sample 4				
050		Sample 5				
064		Sample 6				

1F4						

Page 001h

ADD.	BYTE	VARIABLE	MAX	MIN	DEFAULT	BIT CHECK
000		Sample 34				
014		Sample 35				
028		Sample 36				
03C		Sample 37				
050		Sample 38				
064		Sample 39				

1F4		Sample 66				

The number of samples contained on the first 3994 pages of the Flash Memory is stored as integer on the RAM location 0210h
Refer to chapter 5 for details.

Configuration map for telephone numbers and SMS messages (pages 3994 and 3995) refer to paragraph 5.4.

Configuration map for of load profiles (pages from 3996 to 4095)

Page 000h

ADD.	BYTE	VARIABLE	MAX	MIN	DEFAULT	BIT CHECK
000		Sample 1				
006		Sample 2				
00C		Sample 3				
012		Sample 4				
024		Sample 5				
02C		Sample 6				

20A		Sample 88				

The number of samples contained on the 100 pages from 3996 to 4095 of the Flash Memory is stored at the RAM location 09ECh.

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5.1 DATA LOGGING SAMPLE FORMAT

Every sample includes the following information:

- Number of logged variable (1 <= n <= 8)
- Type of variable 1
- Value of variable 1
- ...
- Type of variable n
- Value of variable n
- Hour and date

The sample is coded in a number of bytes which is depending on the number of logged variables (n) according to the following formula: $\text{byte} = 6 + n \times 3$. In the next example the coding of a sample is explained in detail.

Example 26: data logging sample coding

In the following example every sample includes 2 variables.

Byte	ADDRESS	BYTE	VARIABLE	VALUE	MEANING
1	000	1	N° of logged variables	02h	2 variables
2	001	1	Variable type	00h	VL1-N
3	002	1	Variable value (MSB)	01h	
4	003	1	Variable value (LSB)	7Eh	017Eh = 382 V
5	004	1	Variable type	0Fh	wΣ
6	005	1	Variable value (MSB)	09h	
7	006	1	Variable value (LSB)	65h	15.0 W
8,9	007	2	Day, month, year	0593h	19 December 2002
10	009	1	Hour	0Dh	13
11	00A	1	Minutes	01h	01
12	00B	1	Seconds	00h	00
13	00C	1	N° of logged variables	02h	2 variables
14	00D	1	Variable type	00h	VL1-N
15	00E	1	Variable value (MSB)	01h	
16	00F	1	Variable value (LSB)	7Fh	017Fh = 383 V
17	010	1	Variable type	0Fh	wΣ
18	011	1	Variable value (MSB)	09h	
19	012	1	Variable value (LSB)	75h	15.1 W
20,21	013	2	Day, month, year	0593h	19 December 2002
22	015	1	Hour	0Dh	13
23	016	1	Minutes	02h	02
24	017	1	Seconds	00h	00
			

NOTE: the year-month-day format is the following:

-----	Year	Month	Day
Byte8 + Byte9	XXXXXXXX	XXXX	XXXXX

Example: 0593h=0000 0101 1001 0011

Year = 0000 010 = 2 → 2002

Month = 1 100 = 12 → December

Day = 1 0011 = 19

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Coding of info relevant to the generic sample

Byte1	Num. of variables XXXXXXXX
-------	-------------------------------

Byte2	Variable1 XXXXXXXX
-------	-----------------------

Byte3 + Byte4	Value1 MSB XXXXXXXX	Value1 LSB XXXXXXXX
---------------	------------------------	------------------------

Byte5	Variable2 XXXXXXXX
-------	-----------------------

Byte6 + Byte7	Value2 MSB XXXXXXXX	Value2 LSB XXXXXXXX
---------------	------------------------	------------------------

Byte8 + Byte9	Year XXXXXX	Month XXXX	Day XXXX
---------------	----------------	---------------	-------------

Byte10	Hour XXXXX
--------	---------------

Byte11	Minutes XXXXXX
--------	-------------------

Byte12	Seconds XXXXXX
--------	-------------------

5.2 DATA FORMAT OF “DMD + MIN + MAX” SAMPLES

Each sample stored from page 00 to page 3993 is structured as follows:

- Number of sampled variables
- Type of variable 1 stored
- Value of variable 1
- Type of variable 2 stored
- Value of variable 2
- Variable 1 min
- Variable 1 max
- Variable 2 min
- Variable 2 max
- Minute, seconds, day, month, year

The sample is coded in a number of bytes which is depending on the number of logged variables (n) according to the following formula: $byte=6 + nx7$. In the next example the coding of a sample is explained in detail.

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Example 27: map on one of the 3994 pages, considering 2 variables for sample.

Logging with dmd + min + max values

Byte	ADDRESS	BYTE	VARIABLE	VALUE	MEANING
1	000	1	N° of sampled variables	02h	2 variables
2	001	1	Variable 1 type	0Fh	wΣ
3	002	1	Variable 1 Value (MSB)	32h	
4	003	1	Variable 1 Value (LSB)	15h	80.1W
5	004	1	max value Variable1 (MSB)	45h	
6	005	1	max value Variable1 (LSB)	55h	110.9W
7	006	1	min value Variable1 (MSB)	29h	
8	007	1	min value Variable1 (LSB)	55h	66.1 W
9	009	1	Variable 2 type	00h	VL1-N
10	00A	1	Variable 2 Value (MSB)	01h	
11	00B	1	Variable 2 Value (LSB)	7Fh	017Fh = 383V
12	00C	1	max value Variable2 (MSB)	01h	
13	00D	1	max value Variable2 (LSB)	8Dh	018Dh = 397V
14	00E	1	min value Variable2 (MSB)	01h	
15	00F	1	min value Variable2 (LSB)	5Eh	015Eh = 350 V
16,17	010	2	Day, Month, Year	0670h	March 08, 2003
18	011	1	Hour	07h	
19	012	1	Minutes	15h	
20	013	1	Seconds	00	
21	014	1	N° of sampled variables	02h	2 variables
22	015	1	Variable 1 type	0Fh	wΣ
23	016	1	Variable 1 Value (MSB)	35h	
24	017	1	Variable 1 Value (LSB)	85h	3585h = 85.6W
25	018	1	max value Variable1 (MSB)	46h	
26	019	1	max value Variable1 (LSB)	05h	4605h = 110.0W
27	01A	1	min value Variable1 (MSB)	2Ah	
28	01B	1	min value Variable1 (LSB)	A5h	2AA5h = 68.2 W
29	01C	1	Variable 2 type	00h	VL1-N
30	01D	1	Variable 2 Value (MSB)	01h	
31	01E	1	Variable 2 Value (LSB)	7Ch	017Ch = 380V
32	01F	1	max value Variable2 (MSB)	01h	
33	020	1	max value Variable2 (LSB)	86h	0186h = 390V
34	021	1	min value Variable2 (MSB)	01h	
35	022	1	min value Variable2 (LSB)	63h	0163h = 355 V
36,37	023	2	Day, Month, Year	0593h	19 December 2002
38	024	1	Hour	0Bh	
39	025	1	Minutes	15h	
40	026	1	Seconds	00	

coding of generic sample

-----	Num. of variables
Byte1	XXXXXXXX

-----	Variable1
Byte2	XXXXXXXX

-----	Value1 MSB	Value1 LSB
Byte3 + Byte4	XXXXXXXX	XXXXXXXX

-----	Variable2
Byte5	XXXXXXXX

-----	Value2 MSB	Value2 LSB
Byte6 + Byte7	XXXXXXXX	XXXXXXXX

-----	Val.Max1 MSB	Val.Max1 LSB
Byte8 + Byte9	XXXXXXXX	XXXXXXXX

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-----	Val.Min1 MSB	Val.Min1 LSB
Byte10 + Byte11	XXXXXXXX	XXXXXXXX

-----	Val.Max2 MSB	Val.Max2 LSB
Byte12 + Byte13	XXXXXXXX	XXXXXXXX

-----	Val.Min2 MSB	Val.Min2 LSB
Byte14 + Byte15	XXXXXXXX	XXXXXXXX

-----	Year	Month	Day
Byte16 + Byte17	XXXXXXXX	XXXX	XXXXX

-----	Hour
Byte18	XXXXX

-----	Minutes
Byte19	XXXXXX

-----	Seconds
Byte20	XXXXXX

5.3 LOAD PROFILE SAMPLE FORMAT

Each sample stored from page 3996 to page 4095 is structured as follows:

- Value of Wdmd
- Minutes
- Seconds
- Day
- Month

The sample is coded into 6 bytes.

Map in one of the 100 pages dedicated to load profiles.

Byte	ADDRESS	BYTE	VARIABLE
Sample 1			
1	000	1	Value (MSB)
2	001	1	Value (LSB)
3,4	002	2	Seconds,Month,Day
5,6	004	2	Rate,Hour,Minutes
Sample 2			
7	006	1	Value (MSB)
8	007	1	Value (LSB)
9,10	008	2	Seconds,Months,Day
11,12	00A	2	Rate,Hour,Minutes
-----	-----	-----	-----
-----	-----	-----	-----
Sample 88			
523	20A	1	Value (MSB)
524	20B	1	Value (LSB)
525,526	20C	2	Seconds,Months,Day
527,528	20E	2	Rate,Hour,Minutes

The bytes at address 000h and 001h are respectively the MSB and LSB of the Wdmd value.

The 2nd (MSB) and 3rd (LSB) shall be joined into a short, structured as follows:

First 6 bits: seconds

Five least-significant bits: day

Remaining four "middle" bits: sampling month

The fourth (MSB) and fifth (LSB) bytes compose a short, structured as follows:

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First most-significant bits: rate
Six least-significant bits: minutes
Remaining five "middle" bits: hour

Load profile sample coding

-----	Value1 MSB	Value1 LSB
Byte1 + Byte2	XXXXXXXX	XXXXXXXX

-----	Seconds	Month	Day
Byte3 + Byte4	XXXXXXX	XXXX	XXXXX

-----	Rate	Hour	Minutes
Byte5 + Byte6	XXXXXXX	XXXX	XXXXX

NOTE: the format of the power variables in EEPROM and FLASH memory is the following:

Power variable format	
XXXXXXXX XXXXYYYY	XXXXXXXXXXXXX -> MANTISSA YYYY -> EXPONENT

The mantissa is lower than 2000 and the exponent lower than 16.
The YYYY value corresponds to the value on the "INF" table, with which it is possible to find the engineering unit to be associated to the XXXXXXXXXXXX mantissa.

5.4 DATA FORMAT RELEVANT TO THE SMS AND PHONE NUMBERS

The pages 3994 and 3995 are used to store the SMS messages and phone numbers (GSM and fixed network)

Map of page 3994.

Byte	ADDRESS	BYTE	VARIABLE
1	000	1	First 100 bytes used to
2	001	1	store the 1 st SMS message
3	002	1	combined to the alarm 1
4	003	1	activation
5	004	1	

100	099		
101	100	1	Second section of 100 bytes
102			used to store the 2 nd
103			SMS message combined to the
104			alarm 2 activation
105			

200	199		
201	200	1	Third section of 100 bytes
202	201	1	used to store the 3 rd
203	202	1	SMS message combined to the
204	203	1	alarm 3 activation
205	204	1	

300	299		
301	300	1	Fourth section of 100 bytes
302			used to store the 4 th
303			SMS message combined to the
304			alarm 4 activation

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305			
400			
401	400	1	Start of a section of 5
402			contiguous groups of 16
403			bytes each, used to store
404			5 GSM phone numbers.
405			
480			The number must always start with the international prefix (39 for Italy)

Map of page 3995.

Byte	ADDRESS	BYTE	VARIABLE
1	000	1	First 100 bytes used to
2	001	1	store the 1 st SMS message
3	002	1	combined to the alarm 1
4	003	1	de-activation
5	004	1	
100	099		
101	100	1	Second section of 100 bytes
102			used to store the 2 nd
103			SMS message combined to the
104			alarm 2 de-activation
105			
200	199		
201	200	1	Third section of 100 bytes
202	201	1	used to store the 3 rd
203	202	1	SMS message combined to the
204	203	1	alarm 3 de-activation
205	204	1	
300	299		
301	300	1	Fourth section of 100 bytes
302			used to store the 4 th
303			SMS message combined to the
304			alarm 4 de-activation
305			
400			
401	400	1	Start of a section of 5
402			contiguous groups of 16 bytes
403			each, used to store 5 phone
404			numbers from fixed network
405			
480			

NOTE the number must begin with the international prefix without 00 or + (for example 39xxxxxxxxxx for Italy).

NOTE messages and phone numbers must be stored using only the first 127 ASCII characters. The last character of each message must be the CR (13 decimal).

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5.5 FLASH MEMORY RESET

It is only possible to reset the flash memory using a fixed frame, where the address of the instrument, the 80h read command and the value DFh in the sixth byte must be written. Byte nr. 3, 4 and 5 can assume any value.

Flash memory reset request frame (8 byte):

01h	80h	XXh	XXh	XXh	DFh	XXh	XXh
-----	-----	-----	-----	-----	-----	-----	-----

Flash memory reset answer frame (8 byte):

01h	80h	XXh	XXh	XXh	DFh	XXh	XXh
-----	-----	-----	-----	-----	-----	-----	-----

5.5.1 Example of reading from Flash Memory

Reading of three samples of two variables each, starting from address 60 (hex 3C) of page 6 of the Flash memory.

Reading of 18 words (36 bytes)

01h	80h	00h	18h	3Ch	12h	11h	1Eh
-----	-----	-----	-----	-----	-----	-----	-----

Answer frame (36 bytes):

01h	80h	12h	02h	32h	3Ch	68h	33h	00h	00h	02h	8Dh	0Fh	20h	34h	---	---	E7h	11h
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

3rd byte: number of words transmitted (differently than command 04h, where it indicates the number of bytes).

4th byte: number of sampled variables (two).

5th byte: the first of the two variables is W dmd

6th and 7th bytes: the Wdmd value is 15464.

8th byte: the second variable is var dmd.

9th and 10th : the var dmd value is 0.

11th (MSB) and 12th (LSB) bytes read as a word: 028Dh; 7 most-significant bits = year 01 (2001), 5 least-significant bits = day 13, remaining four bits = month 4 (April).

13th byte: hour (15).

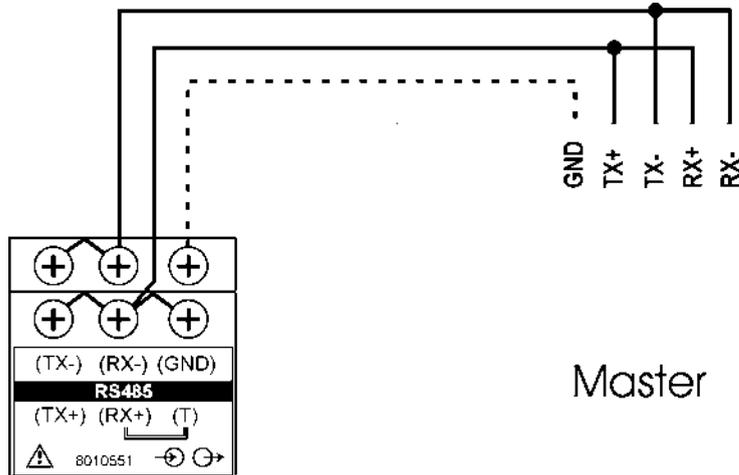
14th byte: minutes (32).

15th seconds (52).

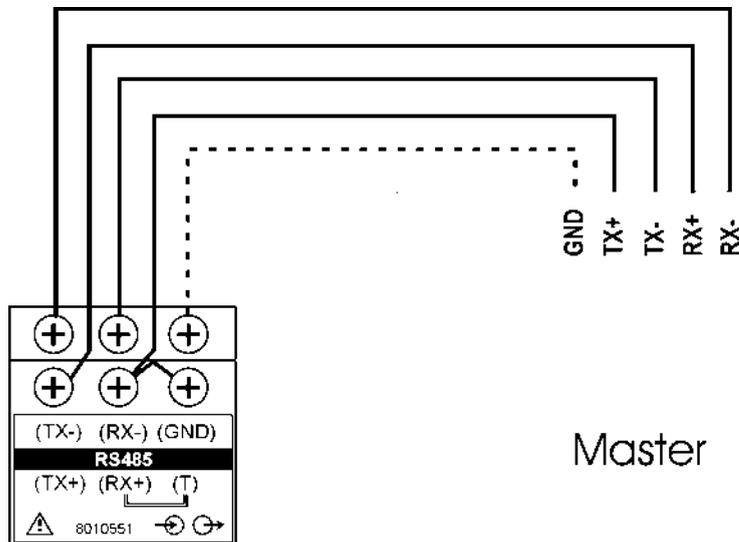
In this example, the data relevant to the first sample finish with the 15th byte.

6 CONNECTIONS

6.1 TWO-WIRE CONNECTION



6.2 FOUR-WIRE CONNECTION



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7 HARDWARE DETAILS

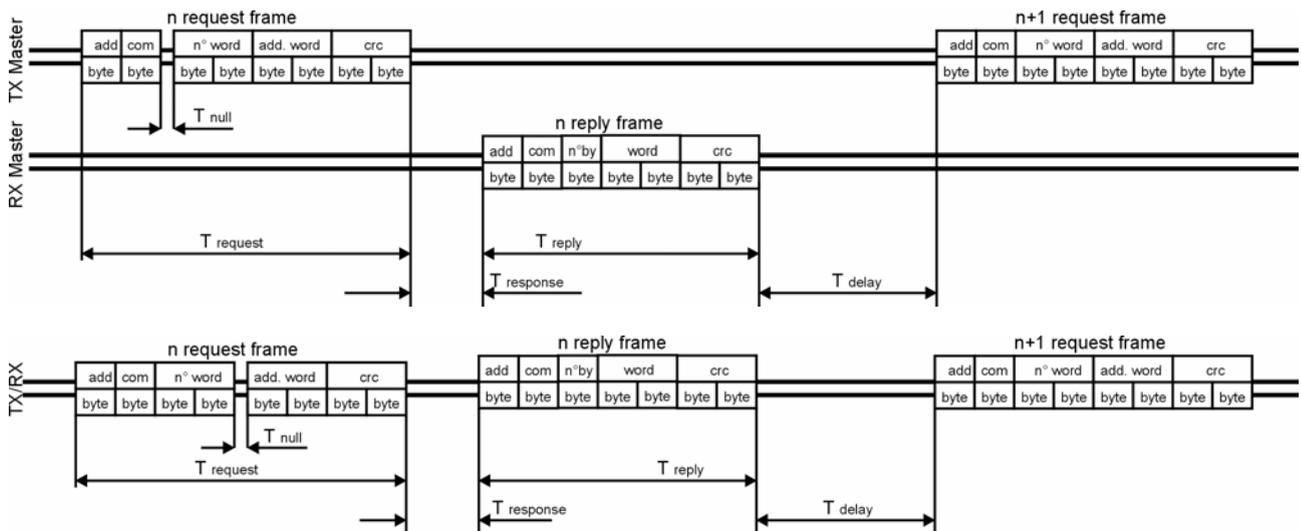
7.1 RS485 INTERFACE

General specifications		Note
Baud-rate	1200, 2400, 4800, 9600bps	
Data format	8 data / 1 stop bit / no parity 8 data / 1 stop bit / parity even 8 data / 1 stop bit / parity odd	
Address	1-255	
Broadcast	yes (Address 0 for function 06)	
Standard functions	04 Reading (max 118 words) 06 Writing of one word	
Special functions	80 Reading of data-logging from flash	
Answer Buffer	264+5 byte (reading of max 132 words)	A
Instrument code	16	B
Sync Time-out	3 characters	C
Physical interface	MAX1482	
RX Termination	Jumper on terminals	
Connections	4 wires (RS422 half duplex) 2 wires (RS485)	D

Notes:

- A. It is the max number of bytes readable from the PQT by a single request.
- B. It is the identification code for the instrument family.
- C. Time without receiving any characters, after which the frame is processed.
- D. The RS422 interface is managed by using the same RS485 protocol, allowing the communication only in half-duplex mode (RX and TX not contemporaneous).

7.1.1 Timing



Timing characteristics of reading function, 4-wires/2-wires connections	msec
T response: Max answering time	600ms
T response: Typical answering time	100ms
T delay: Minimum time for a new query	10ms
T null: Max interruption time on the request frame	3 char

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7.1.2 Application notes

1. If an instrument does not answer within the “max answering time”, it is necessary to repeat the query. If the instrument does not answer after 2 or 3 consecutive queries, it must be considered as not connected, faulty or with wrong address. The same consideration is valid in case of CRC errors or incomplete frames.
2. By entering the programming mode (by pushing the “S” key) the communication is interrupted. Any data received during the programming mode are ignored.
3. The writing is allowed only for C.G. Controls internal and service use.
4. For the timing calculation, please refer to the following formulae:

$$T_{request} = \frac{N^{\circ} bit}{Baud_rate} * 8$$

$$T_{reply} = \frac{N^{\circ} bit}{Baud_rate} * N^{\circ} char$$

$$TS = T_request + T_response + T_reply + T_delay1$$

$$TA = TS * N^{\circ} word$$

$$TM = (TS + Tdelay2) * N^{\circ} instruments$$

N°bit	10
N°char	5+num. Word*2 if function 04 o 03, 8 if function 06
N°word	Number of words to be read in an instrument
TS	Execution time of one reading
Tdelay1	Minimum time for new query on the same address
TA	Data acquiring time from one instrument
TM	Monitoring time of all the instruments
N°instruments	Number of instruments connected to the network.
Tdelay2	Minimum time for new query on a different address

7.2 RS232 INTERFACE

General technical specifications		Note
Baud rate	2400, 4800, 9600, 38400 bps	
Data format	8 data / 1 stop bit / no parity	
Address	Not managed	A

Note:

- A. Nevertheless in the address cell a value from 1 to 255 must be.

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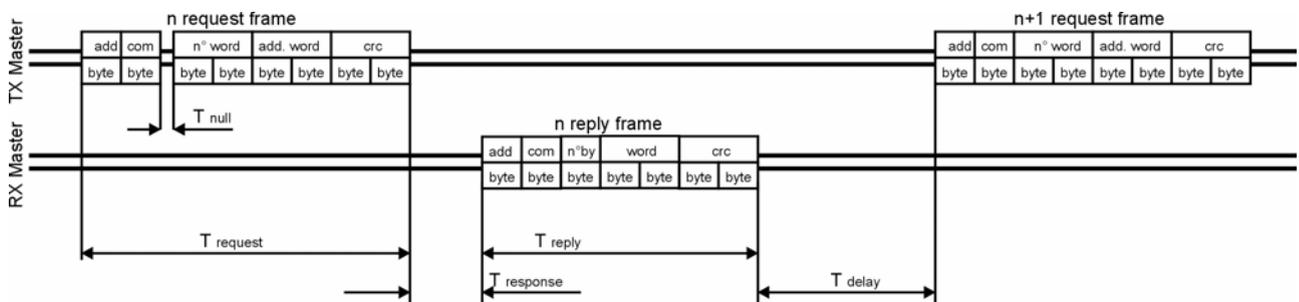
9-pole female RS232 connector		Note
Pin 1	DCD	Used only for modem connection
Pin 2	TX	To be connected to the RX terminal of the PC COM
Pin 3	RX	To be connected to the TX terminal of the PC COM
Pin 4	Not used	
Pin 5	GND	To be connected to the GND terminal of the PC COM
Pin 6	Not used	
Pin 7	Not used	
Pin 8	Not used	
Pin 9	RING	Used only for modem connection

Note: to connect WM4 with a PC use a serial cable with “pin to pin” connections.

7.2.1 Timing

Timing characteristics for RS232 communication	msec
T response: max answering time	600ms
T response: typical answering time	100ms
T delay: minimum time for a new query	10ms
T null: maximum interruption time on the request frame	50msec

Note: T null is independent of the selected baud-rate value



7.2.2 Application notes

1. If the instrument does not answer within the “max answering time”, it is necessary to repeat the query. If the instrument does not answer after 2 or 3 consecutive queries, it must be considered as not connected, faulty or having a different address. The same consideration is valid in case of CRC errors or incomplete frames.
2. By entering the programming mode (by pressing the “S” key) the communication is interrupted. Any data received during the programming mode are ignored.
3. EEPROM read and write commands must be carried out to manage “static” variables. Use them only during the instrument set-up and not during the normal measuring mode in order to avoid to extend the answer time and to limit the writing in EEPROM (max 100.000).
4. Control lines are not managed.

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8 MODEM MANAGEMENT

8.1 INTRODUCTION

PQT-90 can be connected to the fixed telephone network by means of analogue modems or to the mobile telephone network by means of a GSM modem. The different possibilities are listed in the following table:

PQT interfacing capabilities		
PQT	↔	PC
PQT	↔	Analogue Modem ↔ Fixed phone network ↔ Analogue Modem ↔ PC
PQT	↔	GSM Modem ↔ Mobile phone network ↔ Mobile phone

8.2 VALIDATED MODEM

The following models of modem and relevant accessories have been tested and validated:

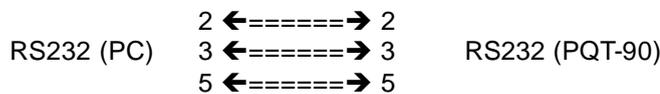
- 3Com 56K Faxmodem by U.S. Robotics (analogue modem);
- TC35 Terminal by Siemens (GSM modem, code SMTTC35Terminal).
Power supply for TC35T (code SMTALIM-M20T-TC35T).
Vehicular antenna SME (code XAT573/2)
Magnetic antenna SME (code XAT574)

The communication parameters (connection between PQT and analogue or GSM modem) are the following:

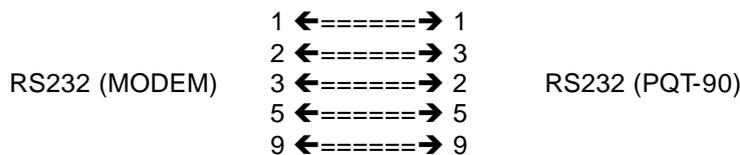
- Baud rate: 9600 bps
- No parity
- 1 stop bit.

8.3 CONNECTIONS

To connect PQT with a PC 9-pole serial cables with "pin to pin" connections are to be used.



To connect PQT-90 with a modem 9-pole Null modem serial cables are to be used.



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8.4 MODEM CONFIGURATION

Both an analogue modem and a GSM one are to be interfaced respecting the following conditions:

- Transparent working mode, 9600 bps, no parity, 1 stop bit.
- Automatic answer after 3 rings (only for analogue modems).
- Carrier Detect (CD) control signal activated.
- Flow control deactivated.

To configure the modem (both analogue and GSM):

- connect the modem to the PC RS232 serial port using a “pin to pin” serial cable;
- launch Hyperterminal software.
- send to the modem the relevant AT commands (please refer to the modem manual).

8.5 AT COMMANDS FOR MODEM CONFIGURATION

3Com 56K FaxModem by U.S. Robotics:

- AT\$0=3
- AT&N6
- AT&U6
- AT&I0
- AT&H0
- AT&K0
- AT&C1
- AT&D0
- AT&Y1
- AT&W1

GSM TC35 Terminal Modem by Siemens:

- AT\$0=3
- AT\Q0
- AT&C1
- AT&D0
- \AT&S1
- AT+CBST=7,0,1
- AT+CMGF=1
- AT+CMGS=1
- AT&W1

8.6 GSM MODEM COMMUNICATION

To enable the communication via GSM modem, PQT-90 serial port is to be opportunely set (menu serial output/RS232/GSM).

The communication from/to PQT-90 via GSM modem is performed using the SMS messaging, both in active and passive working mode.

GSM modem is to be equipped with a SIM CARD whose P.I.N. is to be previously disabled (for example Vodafone Omnitel rechargeable Fax/modem Internet Card).

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8.6.1 Active working mode

PQT-90 is able to call up to 5 different phone numbers and send an SMS message in case of activation or deactivation of up to 4 alarms.

The connection between PQT-90 and the GSM modem is to be carried out after storing on the Flash memory the phone number to which the messages are to be sent and the text messages to be associated both to the alarm activation and alarm deactivation (see paragraph 5.2).

The text messages associated to the alarms will be sent only if this function is enabled (see EEPROM addresses 2078h and 207Ah). It is required to specify the number of telephone number towards which the messages are to be sent (maximum 5, see EEPROM address 207Ch). The messages will be sent to every selected phone numbers in the specified order.

8.6.2 Passive working mode

PQT-90 is able to answer to a SMS message, sending the required values of the selected variables (instantaneous variables, data logging variables, energy meters or alarm status).

The connection between PQT-90 and the GSM modem is to be carried out after storing the 3-digit password value to be used to identify the instrument (see EEPROM address 207Eh).

The instrument can be interrogated by means of a SMS message whose fixed text is to be inferred by the following table.

Variables to be read	Request SMS text	Answer SMS text
VL1, VL2, VL3, VLΣ	PQT.xxx.VN	PQT.xxx:
V1-2, V2-3, V3-1, VΣ	PQT.xxx.VL	PQT.xxx:
AL1, AL2, AL3, AΣ	PQT.xxx.A	PQT.xxx:
WL1, WL2, WL3, WΣ	PQT.xxx.W	PQT.xxx:
VAL1, VAL2, VAL3, VAΣ	PQT.xxx.VA	PQT.xxx:
varL1, varL2, varL3, varΣ	PQT.xxx.VAR	PQT.xxx:
PFL1, PFL2, PFL3, PFΣ	PQT.xxx.PF	PQT.xxx:
Wdmd, VAdmd, vardmd, PFdmd	PQT.xxx.DMD	PQT.xxx:
Log1, Log2, Log3, Log4, Log5, Log6, Log7, Log8	PQT.xxx.LOG	PQT.xxx:
Total kWh+, kvar+ , kWh-, kvar-	PQT.xxx.TOTAL	PQT.xxx:
Winter kWh+, kvar+ , kWh-, kvar-	PQT.xxx.ENGWn	PQT.xxx:
Summer kWh+, kvar+ , kWh-, kvar-	PQT.xxx.ENGSn	PQT.xxx:
Holiday kWh+, Kvar+ , kWh-, Kvar-	PQT.xxx.ENGHn	PQT.xxx:
Status Alarm1, Alarm2,	PQT.xxx.ALARM	PQT.xxx:

Where:

"xxx" is the SMS password

"ENGW1" "ENGH4" are the partial energy meter of each season: for example ENGW1 means "energy meter winter tariff1"; ENGH4 means "energy meter holiday tariff4".

"Log1" ... "Log8" are the last logged variables stored on the Flash memory.

Example 30: dmd variables request (SMS password 123)

Request SMS text: PQT.123.DMD

Answer SMS text: PQT.123.DMD.12.45KW dmd, 16.04KVA dmd, 3.45Kvar dmd, 0.79PF

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8.7 ANALOGUE MODEM COMMUNICATION.

To enable the communication via analogue modem, PQT serial port is to be opportunely set (menu serial output/RS232/MODEM).

8.7.1 Passive working mode

PQT automatically answers the remote PC after 3 rings. The communication will start using the Modbus protocol as the PQT is directly connected to the PC.

Note: the modem connected to PQT is to be configured with automatic answer after 3 rings (see the relevant AT commands on the modem manual).

8.7.2 Active working mode

PQT is able to call a remote PC and communicate the activation or deactivation of up to 4 alarms. The connection between PQT and the analogue modem is to be carried out after storing on the Flash memory the phone number to which the message is to be sent and the text messages to be associated both to the alarm activation and alarm deactivation (see paragraph 5.2). It is required to specify the number of telephone number towards which PQT has to try to send the message (maximum 5, see EEPROM address 207Ch). The messages will be to the first telephone number. Only if the connection is not possible, PQT will try with the second number and so on. PQT has to send a fixed frame request to the remote PC to establish if the connection is correctly settled. The PC has to answer with another fixed frame to confirm the correct connection and to communicate it is in waiting status. Every message has to finish with the ASCII code 26 (Ctrl+Z) and has to include less than 100 characters.

Connection request (from PQT-90 to the remote PC, 7-byte frame)

Address	Function				CRC	
1 byte	1 byte	1 byte	1 byte	1 byte	2 byte	
from 1 to 255	04	AA	55	AA	MSB	LSB

Correct connection answer (from the remote PC to PQT-90, 8-byte frame)

Address						CRC	
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	2 byte	
from 1 to 255	BE	AD	9C	8B	7A	MSB	LSB