WM24-96

SERIAL COMMUNICATION PROTOCOL

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1 SERIAL COMMUNICATION PROTOCOL

1.1 INTRODUCTION

WM24-96 can be 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). Only one interface must be used at a time.

The command structure of the protocol allows the user to read and write from/in the µP RAM memory and EEPROM so that all the functions are completely transparent.
The communication parameters are fixed and in accordance with the following table:

Interface	Baud rate (bps)	Parity	Stop bit
RS232	9600	None	1
RS485	9600	None	1

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

- slave address: 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.
- 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 frame is received by the SLAVE, 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

WM24-96 accepts the following two commands:

- Read words (code 04h)
- Write one word (code 06h)

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 12 (24 byte).
- 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.

The MSB value of the request frame will be written in the specified address, the LSB one in the specified address+1.

IMPORTANT: if the address is 00 (zero) all the instruments connected to the network will execute the command but will not send an answer frame.

1.3 MEMORY AREA

WM24-96 manages three different memory areas addressed as follows.

Memory area	Area		Byte reading order
Internal RAM (page 0)	0080h	00FFh	LSB, MSB
Internal RAM (page 1)	0100h	017Fh	LSB, MSB
EEPROM	0C00h	0CFFh	LSB, MSB

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.

1.4 WM24-96 IDENTIFICATION CODE

Every Carlo Gavazzi's 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 WM24-96 code is 0012h.
This code can be read with 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**	**12h**	CRC	CRC

2 RAM VARIABLES MAP

2.1 INSTANTANEOUS VARIABLES MAP (RAM, PAGE 1)

	ADDRESS	BYTE	VARIABLE	Type		ADDRESS	BYTE	VARIABLE	Type
1	0200	2	V L1-N	V	25	0239	3	W dmd	P
2	0202	2	V L2-N	V	26	023C	2	Hz	H
3	0204	2	V L3-N	V	27	023E	1	Unit V	inf
4	0206	2	A L1	A	28	023F	1	Unit A	inf
5	0208	2	A L2	A	29	0240	1	Unit P	inf
6	020A	2	A L3	A	30	0241*	4	Wh (tot)	E
7	020C	3	W L1	P	31		4	Wh +	E
8	020F	3	W L2	P	32	0245*	4	varh (tot)	E
9	0212	3	W L3	P	33		4	Wh -	E
10	0215	3	var L1	P	34	0249*	4	Wh (t1)	E
11	0218	3	var L2	P	35		4	varh C+	E
12	021B	3	var L3	P	36	024D*	4	varh (t1)	E
13	021E	3	VA L1	P	37		4	varh C-	E
14	0221	3	VA L2	P	38	0251	1	Asy V	D
15	0224	3	VA L3	P	39				
16	0227	1	PF L1	C	40				
17	0228	1	PF L2	C	41				
18	0229	1	PF L3	C	42				
19	022A	2	V ∑	V	43				
20	022C	3	W ∑	P	44				
21	022F	3	var ∑	P	45				
22	0232	3	VA ∑	P	46				
23	0235	1	PF ∑	C	47				
24	0236	3	VA dmd	P					

NOTE *: the variable stored in this address is depending on the parameter "counter".
NOTE: all the variables in this table are contiguous. It is possible to read more variables at a time, up to 12 words at a time. Other maximum values are stored in the page 0 of the RAM.

2.1.1 Variable format

The value of all the instantaneous variables is stored as two's complement integer value. It is possible to read the C-, D- and H-type variables with a single read command, while two read command are requested for V-, A- and P-type variables (variable and decimal point position).
The decimal point and the multiplier have to be set according to the **Unit V, Unit A, Unit P** word coding (see the following table) for voltage (V), current (A) and power (P) variables, in the position "**1111**" for the D-type (%) variables, "**11.11**" for the H-type (Hz) variables, **"111.1k"** per the E-type (energy) variables, **"111.1"** for the M-type (cubic meter) variables and in position "**11.11**" 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 ∑" has neither L nor C sign indication.

Decimal point and multiplier coding

INF value	d.p	INF value	d.p
3	1.111	8	111.1k
4	11.11	9	1111k
5	111.1	10	11.11M
6	1111	11	111.1M
7	11.11k	12	1111M

The voltage, current and power variables format is depending on the current and voltage transformer ratios according to the following tables:

CT ratio	Model	Decimal point position for A-type variables
1 ÷ 10	All	1.111
11 ÷ 100	All	11.11
101 ÷ 1000	All	111.1
1001 ÷ 5000	All	1111

VT ratio	Model	Decimal point position for V-type variables
1.0 ÷ 10.0	100 VLL / 5A	111.1
	208 VLL / 5A	111.1
	400 VLL / 5A	111.1
	660 VLL / 5A	1111
10.1 ÷ 100.0	100 VLL / 5A	1111
	208 VLL / 5A	1111
	400 VLL / 5A	1111
	660 VLL / 5A	11.11k
100.1 ÷ 1000	100 VLL / 5A	11.11k
	208 VLL / 5A	11.11k
	400 VLL / 5A	11.11k
	660 VLL / 5A	111.1k
1000 ÷ 1999	100 VLL / 5A	111.1k
	208 VLL / 5A	111.1k
	400 VLL / 5A	111.1k
	660 VLL / 5A	1111k

CT ratio x VT ratio	Model	Decimal point position for P-type variables
1.0 ÷ 10.0	100 VLL / 5A	111.1
	208 VLL / 5A	111.1
	400 VLL / 5A	111.1
	660 VLL / 5A	1111
10.1 ÷ 100.0	100 VLL / 5A	1111
	208 VLL / 5A	1111
	400 VLL / 5A	1111
	660 VLL / 5A	11.11k
100.1 ÷ 1000.0	100 VLL / 5A	11.11k
	208 VLL / 5A	11.11k
	400 VLL / 5A	11.11k
	660 VLL / 5A	111.1k
1000.1 ÷ 10000.0	100 VLL / 5A	111.1k
	208 VLL / 5A	111.1k
	400 VLL / 5A	111.1k
	660 VLL / 5A	1111k

2.1.2 Instantaneous variables reading

***Example 1*: Reading of a single variable: `W1`**

Value request frame (8 byte):

01h	04h	02h	0Ch	00h	02h	CRC	CRC

Value answer frame (9 byte):

01h	04h	04h	0Eh	0Eh	00h	00h	CRC	CRC

Info request frame (8 byte):

01h	04h	02h	46h	00h	01h	CRC	CRC

Info answer frame (frame 7 byte):

01h	04h	02h	06h	1Fh	CRC	CRC

Stored value: 0E0Eh (3598 decimal)
Info value (P type): 06h
Variable value (W1): 3598 W

***Example 2*: Reading of a single variable: `PF1`**

Value request frame (8 byte):

01h	04h	02h	27h	00h	01h	CRC	CRC

Value answer frame (7 byte):

01h	04h	02h	A9h	00h	CRC	CRC

Stored value: A9h (-87 decimal)
Variable value (PF1): C 0.87

2.2 ALARM, STATUS, METER VALUES MAP (RAM, PAGE 0)

ADDRESS	BYTE	VARIABLE	Type	ADDRESS	BYTE	VARIABLE	Type
00B2	1	st_in1	S	00F4*	4	varh (t3)	E
00B4	1	st_out	S		4	m^3 water tot	M
00CF	1	Reserved			4	m^3 gas night	M
00E8*	4	Wh (t2)x	E	00F8	4	Wh (t4)	E
	4	varh l+	E	00FC	4	varh (t4)	E
00EC*	4	varh (t2)	E				
	4	varh L-	E				
00F0*	4	Wh (t3)	E				
	4	m^3 gas tot	M				
	4	m^3 gas day	M				

NOTE *: the variable stored in this address is depending on the parameter “counter”.

The contents of the S-type variables and the meaning of every byte are explained in the following paragraphs.

2.2.1 st_in1: modules identification and programming enable

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
R	R	R	R	R	R	IN_CFOUT	IN_ENPGM

R = Reserved.
IN_ENPGM = Programming:
0 = disabled
1 = enabled
IN_CFOUT = Digital output module:
0 = present
1 = not present

2.2.2 st_out: digital input and output status

bit 7	bit 6	bit 5	bit 4	Bit 3	bit 2	bit 1	bit 0
R	R	READ_IN2	READ_IN3	OUT_FISICO2	OUT_FISICO1	OUT_LOGICO2	OUT_LOGICO1

R = Reserved.
OUT_LOGICO1 = Alarm 1 status (independent from “delay”):
0 = Alarm OFF
1 = Alarm ON
OUT_LOGICO2 = Alarm 2 status (independent from “delay”):
0 = Alarm OFF
1 = Alarm ON
OUT_FISICO1 = Alarm 1 status:
0 = Alarm OFF
1 = Alarm ON
OUT_FISICO2 = Alarm 2 status:
0 = Alarm OFF
1 = Alarm ON
READ_IN3 = Digital input 3 status (0 = open; 1 = closed)
READ_IN2 = Digital input 2 status (0 = open; 1 = closed)

2.2.3 Reading of the instrument status

***Example 3*: reading of the "present modules+digital input status" word**

1-word read request frame (8 byte)

01h	04h	00h	B2h	00h	01h	CRC	CRC

1-word read answer frame (7 byte):

01h	04h	02h	**89h**	**77h**	CRC	CRC

Module variable value: 89h = 10001001
IN_CFPGM = 1 Programming: enabled
IN_CFOUT = 0 Digital output module: present

***Example 4*: Alarm status read command**

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

01h	04h	00h	B4h	00h	01h	CRC	CRC

Read command answer frame (7 byte):

01h	04h	02h	**35h**	**35h**	CRC	CRC

Alarm 1: Alarm ON Digital input 1: closed
Alarm 2: Alarm OFF Digital input 2: closed

2.2.4 Write command for remote digital output

If a digital output is set as "rem" (remote, see EEPROM map), it is possible to remotely set/reset it writing a word on address 00B4h according to the following table.

Alarm 1	Alarm 2	MSB	LSB
OFF	OFF	00h	00h
ON	OFF	01h	00h
OFF	ON	02h	00h
ON	ON	03h	00h

***Example 5*: Frame to set alarm 1 = ON and alarm 2 = OFF**

Request frame: A1 = ON and A2 = OFF (8 byte):

01h	06h	**00h**	**B4h**	**01h**	**00h**	CRC	CRC

Answer frame (8 byte):

01h	06h	**00h**	**B4h**	**01h**	**00h**	CRC	CRC

***Example 6*: Frame to set alarm 1 = OFF and alarm 2 = OFF**

Request frame: A1 = OFF and A2 = OFF (8 byte):

01h	06h	**00h**	**B4h**	**00h**	**00h**	CRC	CRC

Answer frame (8 byte):

01h	06h	**00h**	**B4h**	**00h**	**00h**	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 3.2.9).

2.2.5 Energy and utility metering and digital inputs

The number and the type of the working energy meters are depending on the "counter" parameter, according to the following table.

counter				RAM address
TOT	TOT – PAR	TOT – 1.CN	TOT – 2.CN	
kWh +	kWh tot	kWh +	kWh +	0241h
kWh -	kvarh tot	kWh -	kWh -	0245h
kvarh C+	kWh t1	kvarh C+	kvarh C+	0249h
kvarh C-	kvarh t1	kvarh C-	kvarh C-	024Dh
kvarh L+	kWh t2	kvarh L+	kvarh L+	00E8h
kvarh L-	kvarh t2	kvarh L-	kvarh L-	00ECh
	kWh t3	m^3 GAS day	m^3 GAS tot	00F0h
	kvarh t3	m^3 GAS night	m^3 WATER tot	00F4h
	kWh t4			00F8h
	kvarh t4			00FCh

Digital inputs determinate the active tariff for energy metering (t1, t2, t3 or t4) or for the gas tariff (day or night), or collect gas and water pulses or the synchronisation pulses for Wdmd and VAdmd calculation, according to the selected value of 'counter' parameter.

counter	input	description	dmd synchr.
TOT	IN3	Not used	Yes
	IN2		Yes
TOT – PAR	IN3	Selection of the current tariff for energy metering	Yes
	IN2		Yes
TOT – 1.CN	IN3	Selection of the current tariff for gas metering	No
	IN2	Gas pulses acquisition (weight of the pulse ='PrESCAL Cn.1')	No
TOT – 2.CN	IN3	Water pulses acquisition (weight of the pulse ='PrESCAL Cn.2')	No
	IN2	Gas pulses acquisition (weight of the pulse ='PrESCAL Cn.1')	No

If "counter" parameter is set to "TOT – PAR", the coding of the energy tariffs is the following.

Tariff	IN2	IN3
t1	open	open
t2	open	close
t3	close	open
t4	close	close

The current tariff is highlighted from the blinking of the t1, t2, t3 or t4 indication in the relevant display page.

If "counter" parameter is set to "TOT – 1.CN", the coding of the gas tariffs is the following.

Tariff	IN3
Day	open
Night	close
t3	open
t4	close

2.2.6 Energy and utility meters reading

The meter values are to be read from the RAM as explained in the following examples.

***Example 7*: Reading of total energy meter: kWh (tot) and kvarh (tot) (TOT-PAR mode)**

Value request frame (8 byte):

01h	04h	02h	41h	00h	03h	CRC	CRC

Value answer frame (13 byte):

01h	04h	08h	FFh	D6h	02h	00h	57h	AAh	04h	00h	CRC	CRC

Stored value (kWh tot): 0002D6FFh 18611.1 kWh
Stored value (kvarh tot): 0004AA57h 30575.1 kvarh

***Example 8*: Reading of the utility meters: gas (tot) and water (tot) (TOT-2.CN)**

Value request frame (8 byte):

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

Value answer frame (13 byte):

01h	04h	08h	FBh	5Ah	1Ah	00h	4Ah	1Ch	19h	01h	CRC	CRC

Stored value (m^3 gas tot): 001A5AFBh 172722.7 m^3
Stored value (m^3 water tot): 01191C4Ah 1842285.8 m^3

2.2.7 Resetting energy and utility meters

Energy and utility meters are to be reset using the following fixed frames.

***Example 9*: total meters reset command**

1-word write request command (8 byte):

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

Write answer command (8 byte):

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

The reset value is 0. The meters which are reset by this command are depending on the “counter” parameter:

- counter=TOT-PAR Reset meters: kWh (tot), kvarh (tot)

- counter=TOT, TOT-1.CN or TOT-2.CN Reset meters: kWh (+),kWh (-)
kvarh C+, kvarh C-, kvarh L+, kvarh L-

***Example 10*: partial meters reset command**

1-word write request command (8 byte):

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

Write answer command (8 byte):

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

The reset value is 0. The meters which are reset by this command are depending on the "counter" parameter:

- counter=TOT-PAR Reset meters: kWh (t1), kvarh (t1)
  kWh (t2), kvarh (t2)
  kWh (t3), kvarh (t3)
  kWh (t4), kvarh (t4)

- counter=TOT-1.CN Reset meters: m^3 gas (day), m^3 gas (night)

- counter=TOT-2.CN Reset meters: m^3 gas, m^3 water

***Example 11*: all meters reset command**

1-word write request command (8 byte):

01h	06h	00h	ECh	D4h	F0h	CRC	CRC

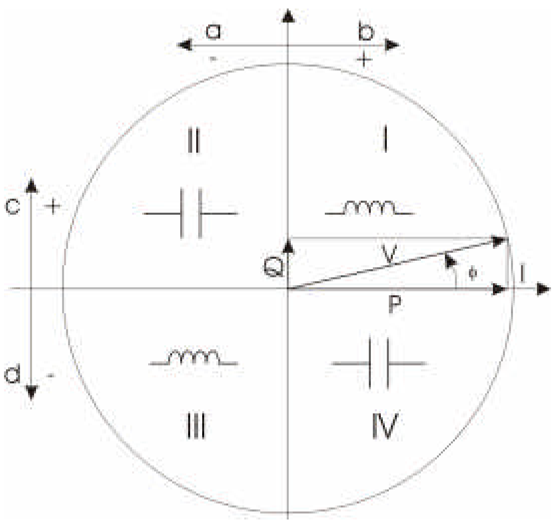
Write answer command (8 byte):

01h	06h	00h	ECh	D4h	F0h	CRC	CRC

All the total and partial meters will be reset by this command.

2.2.8 Agreement concerning active and reactive power and power factor signs

Active and reactive power and power factor signs in WM24-96 are in accordance with the agreement stated in enclosure E of the EN 61268 standard, as explained here below.



LEGEND

a : Exported active power
b : Imported active power
c : Imported reactive power
d : Exported reactive power

- The reference vector of the diagram is the current one.
- The phase angle between vector V and vector I is Ô.
- The phase angle Ô is to be considered positive trigonometric-wise (anticlockwise).

The active and reactive system powers are respectively calculated as algebraic sum of the single-phase active and reactive powers.
The system power factor is without sign. Without any input signal, the single-phase power factors are 0.00, the system one is 1.00.

2.2.9 Agreement concerning energy integration

The different meters, in function of the “counter” parameter, store the energy values integrating the active or reactive power according to the following agreement.

1) KWh tot: integration of the system active power only in positive
2) Kvarh tot: integration of the module of the system reactive power
3) KWh +: integration of the sum of the positive single-phase active powers
4) KWh –: integration of the sum of the negative single-phase active powers
5) Kvarh C+: integration of the sum of the single-phase reactive powers in quadrant II
6) Kvarh C-: integration of the sum of the single-phase reactive powers in quadrant IV
7) Kvarh L+: integration of the sum of the single-phase reactive powers in quadrant I
8) Kvarh L-: integration of the sum of the single-phase reactive powers in quadrant III

2.2.10 Energy and utility meters limit

The energy meters have a fixed resolution of 0,1 kWh (or kvarh) with 19.999.999k as maximum indication (from 0.0k to 1.999.999,9k and from 2.000.000k to 19.999.999k).
The utility meters have a fixed resolution of 0,1 m^3 with 1.999.999,9 m^3 as maximum indication.
When the maximum indication is reached, the meters are automatically reset.

3 EEPROM MAP

The information in the EEPROM memory are stored in two different areas:

EEPROM	Area		Byte reading order
Meters area	0C60h	0C87h	LSB..MSB
Programming parameters	0C8Eh	0CCBh	LSB..MSB

3.1 METERS AREA

The meter values are stored in EEPROM (only in case of power down) in the following addresses:

ADDRESS	BYTE	TYPE	DESCRIPTION	FORMAT
0C60*	4	Wh (tot)	Total active energy meter	E
	4	Wh +	Imported active energy meter	E
0C64*	4	varh (tot)	Total reactive energy meter	E
	4	Wh -	Exported active energy meter	E
0C68*	4	Wh (t1)	Tariff 1 active energy meter	E
	4	varh C+	Imported cap.reactive energy meter	E
0C6C*	4	varh (t1)	Tariff 1 reactive energy meter	E
	4	varh C-	Exported cap.reactive energy meter	E
0C70*	4	Wh (t2)	Tariff 2 active energy meter	E
	4	varh L+	Imported ind.reactive energy meter	E
0C74*	4	varh (t2)	Tariff 2 reactive energy meter	E
	4	varh L-	Exported ind.reactive energy meter	E
0C78*	4	Wh (t3)	Tariff 3 active energy meter	E
	4	Gas (day)	Day tariff gas meter	M
	4	Gas	Gas meter	M
0C7C*	4	varh (t3)	Tariff 3 reactive energy meter	E
	4	Gas (night)	Night tariff gas meter	M
	4	Water	Water meter	M
0C80	4	Wh (t4)	Tariff 4 active energy meter	E
0C84	4	varh (t4)	Tariff 4 reactive energy meter	E

NOTE *: the variable stored in this address is depending on the parameter “counter”.

The storage in EEPROM of the meter values is carried out only in case of power down.
For this reason the reading of these values must be carried out on the values stored in RAM.

3.2 PROGRAMMING PARAMETERS

ADDRESS	BYTE	PARAMETER	DESCRIPTION
0C8E	2	password	Password
0C90	2	Vt_ratio	Voltage transformer ratio
0C92	2	Ct_ratio	Current transformer ratio
0C94	4	Pt_ratio	Power transformation ratio
0C98	2	System	System type
0C9A	2	P_int	Integration period (dmd)
0C9C	2	Counter	Meter working mode selection
0C9E	2	Pre_cn1	Meter 1 prescaler (gas)
0CA0	2	Pre_cn2	Meter 2 prescaler (gas)
0CA2	2	Pulse 1	Pulse rate, pulse output 1
0CA4	2	Pulse 2	Pulse rate, pulse output 2
0CA6	2	Sel_pul1	Meter associated to pulse output 1
0CA8	2	Sel_pul2	Meter associated to pulse output 2
0CAA	2	Sel_dig1	Digital output 1 working mode selection
0CAC	2	Var_dig1	Variable associated with the alarm output 1
0CAE	2	Range_dig1	Alarm 1 setpoint format
0CB0	2	Dig_on1	Alarm 1 activation setpoint
0CB2	2	Dig_off1	Alarm 1 deactivation setpoint
0CB4	2	Rel_type1	Normally energised/de-energised output 1 (ND/NE)
0CB6	2	Rel_delay1	Alarm 1 delay time
0CB8	2	Sel_dig2	Digital output 2 working mode selection
0CBA	2	Var_dig2	Variable associated with the alarm output 2
0CBC	2	Range_dig2	Alarm 2 setpoint format
0CBE	2	Dig_on2	Alarm 2 activation setpoint
0CC0	2	Dig_off2	Alarm 2 deactivation setpoint
0CC2	2	Rel_type2	Normally energised/de-energised output 2 (ND/NE)
0CC4	2	Rel_delay2	Alarm 2 delay time
0CC6	2	Address	Address of the instrument (RS485)
0CC8	2	Filter_rng	Operating range of the digital filter
0CCA	2	filter_coe	Filtering coefficient

The maximum and minimum limits of the programmable parameters are listed below, together with their meaning and format.

3.2.1 password

MINIMUM	MAXIMUM	FORMAT
0	1000	1111

Note: entering the value 782 the programming mode can be entered via keypad (reset password).

3.2.2 vt_ratio

MINIMUM	MAXIMUM	FORMAT
10	50000	111.1

3.2.3 ct_ratio

MINIMUM	MAXIMUM	FORMAT
1	5000	1111

3.2.4 pt_ratio

MINIMUM	MAXIMUM	FORMAT
10	100000	111.1

Note: pt_ratio is the product between vt_ratio and ct_ratio: if ct_ratio and/or vt_ratio are modified via RS485, pt_ratio must be accordingly modified (non-automatic calculation).

3.2.5 system

MINIMUM	MAXIMUM	FORMAT
0	1	1111

VALUE	CODE DESCRIPTION
0	3-phase with neutral
1	3-phase without neutral

3.2.6 p_int

MINIMUM	MAXIMUM	FORMAT
1	30	1111 [minutes]

3.2.7 counter

MINIMUM	MAXIMUM	FORMAT
0	3	1111

VALUE	CODE DESCRIPTION
0	TOT: total meters
1	TOT-PAR: total and tariff meters
2	TOT-1.CN: total energy meter and dual gas tariff
3	TOT-2.CN: total energy meter, gas and water meter

3.2.8 pre_cn1 and pre_cn2

MINIMUM	MAXIMUM	FORMAT
0	100	111.1

3.2.9 pulse 1 and pulse 2

ct x vt	MINIMUM	MAXIMUM	FORMAT
From 1.0 to 10.0	1	100	1111 pulse/kWh(kvarh)
From 10.1 to 100.0	1	100	111.1 pulse/kWh(kvarh)
From 100.1 to 1000.0	1	100	11.11 pulse/kWh(kvarh)
From 1000.1 to 10000.0	1	100	1111 pulse/MWh(kvarh)

3.2.10 sel_pul1 and sel_pul2

COUNTER selection	MINIMUM	MAXIMUM	FORMAT
TOT-PAR	0	9	1111
TOT TOT.1.CN TOT_2.CN	0	5	1111

VALUE	CODE DESCRIPTION	
	Counter = TOT -PAR	TOT, TOT-1.CN or TOT-2.CN
0	Wh (tot)	Wh +
1	varh (tot)	Wh -
2	Wh (t1)	varh L+
3	varh (t1)	varh L-
4	Wh (t2)	varh C+
5	varh (t2)	varh C-
6	Wh (t3)	Not available
7	varh (t3)	
8	Wh (t4)	
9	varh (t4)	

3.2.11 sel_dig1 and sel_dig2

MINIMUM	MAXIMUM	FORMAT
0	2	1111

VALUE	CODE DESCRIPTION
0	Pulse output
1	Alarm output
2	Remote output

3.2.12 var_dig1 and var_dig2

MINIMUM	MAXIMUM	FORMAT
0	7	1111

VALUE	CODE DESCRIPTION
0	W ∑
1	VA ∑
2	var ∑
3	W dmd
4	VA dmd
5	V ∑
6	PF ∑
7	ASY V

3.2.13 range_dig1 and range_dig2

MINIMUM	MAXIMUM	FORMAT
0	3(1)	1111

This parameter is the multiplier associated to the setpoint of the digital outputs.
The real setpoint must be calculated as follows:

$$\text{setpoint alarm 1} = \text{dig\_on1} * 10^{\text{range\_dig1}}$$

The variable "setpoint alarm 1" is to be considered in the format of the relevant variable (in this example var_dig1) which can be an A-, V-, P-, D- or C-type (see paragraph 2.1.1).

Note: (1) the maximum value of the multiplier is depending on the variable type and on the instrument model according to the following table.

Variable	Model			
	100 VLL / 5A	208 VLL / 5A	400 VLL / 5A	660 VLL / 5A
W ∑	2	3	3	2
VA ∑	2	3	3	2
var ∑	2	3	3	2
W dmd	2	3	3	2
VA dmd	2	3	3	2
V ∑	1	2	2	1
PF ∑	0	0	0	0
ASY V	0	0	0	0

3.2.14 dig_on1(2)/dig_off1(2)

MINIMUM	MAXIMUM	FORMAT
–variable f.s.(W∑, var∑, Wdmd only) 0 (all the remaining variables)	Variable f.s.	As per range_dig1(2)

The **f.s.** for each variable is depending on the instrument model, on the range parameter and on the CT and VT ratios.
If CT ≤ 10, VT ≤ 10.0 and CT*VT ≤ 10.0, the following table is to be considered:

VARIABLE	RANGE	0	1	2	3
	MODEL	F.S.			
W ∑, VA ∑, var ∑, W dmd, VA dmd	100 VLL / 5A	1999 (199.9)	1999 (1999)	1247 (12.47k)	-
	208 VLL / 5A	1999 (199.9)	1999 (1999)	1999 (19.99k)	260 (26.0k)
	400 VLL / 5A	1999 (199.9)	1999 (1999)	1999 (19.99k)	499 (49.9k)
	660 VLL / 5A	1999 (1999)	1999 (19.99k)	824 (82.4k)	-
V ∑	100 VLL / 5A	1999 (199.9)	1200 (1200)	-	-
	208 VLL / 5A	1999 (199.9)	1999 (1999)	250 (2.50k)-	-
	400 VLL / 5A	1999 (199.9)	1999 (1999)	480 (4.80k)	-
	660 VLL / 5A	1999 (1999)	792 (7.92k)	-	-
PF ∑	100 VLL / 5A	100 (1.00)	-	-	-
	208 VLL / 5A	100 (1.00)	-	-	-
	400 VLL / 5A	100 (1.00)	-	-	-
	660 VLL / 5A	100 (1.00)	-	-	-
ASY V	100 VLL / 5A	100 (100)	-	-	-
	208 VLL / 5A	100 (100)	-	-	-
	400 VLL / 5A	100 (100)	-	-	-
	660 VLL / 5A	100 (100)	-	-	-

If VT is between 10.1 and 100.0, the values between brackets multiplied by 10 are valid when considering V ∑.
If VT is between 100.1 and 1000.0, the values between brackets multiplied by 100 are valid when considering V ∑, and so on.
If CT x VT is between 10.1 e 100.0, the values between brackets multiplied by 10 are valid when considering the powers.
If CT x VT is between 100.1 e 1000.0, the values between brackets multiplied by 100 are valid when considering the powers, and so on.

3.2.15 rel_type1 and rel_type2

MINIMUM	MAXIMUM	FORMAT
0	1	1111

VALUE	CODE DESCRIPTION
0	Normally De-energised
1	Normally Energised

3.2.16 rel_delay1 and rel_delay2

MINIMUM	MAXIMUM	FORMAT
0	255	1111 [seconds]

3.2.17 address

MINIMUM	MAXIMUM	FORMAT
1	255	1111

3.2.18 filter_rng

MINIMUM	MAXIMUM	FORMAT
0	100	1111 [%]

Range of the variable within which the filtering is carried out. The range must be calculated as a percentage of:

- nominal value of the voltages
- nominal value of the currents
- product between the nominal voltage and the nominal current (for powers)

3.2.19 filter_coe

MINIMUM	MAXIMUM	FORMAT
1	16	1111

3.2.20 Relationship between dig_out1(2) and the digital outputs on the modules

In WM24-96 it is possible to insert the digital output modules (relay or open collector) in both slot C and D. The relationship between the digital output parameter diGout1 e diGout2 in the programming menu and the real digital output (in the modules) is the following.

Modules		diGout1				diGout2			
SLOT C	SLOT D	C0	C1	D0	D1	C0	C1	D0	D1
1 Relay / 1 O.C.	1 Relay / 1 O.C.		na	X	na	X	na		na
1 Relay / 1 O.C.	2 Relay / 2 O.C.		na	X		X	na		X
2 Relay / 2 O.C.	1 Relay / 1 O.C.		X	X	na	X			na
2 Relay / 2 O.C.	2 Relay / 2 O.C.		X	X		X			X

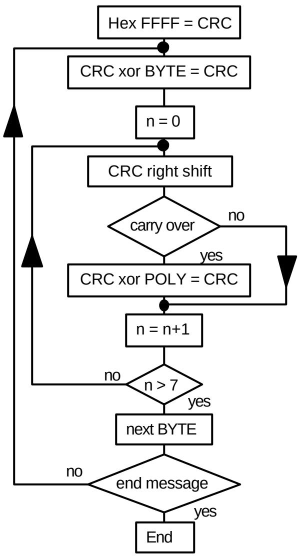
NOTA: na = not available, X = associated output.

4 CRC CALCULATION ALGORITHM

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

***Example 12*: calculation of CRC starting from frame 0207h**

CRC Inizialization	1111	1111	1111	1111	
Load first byte			0000	0010	
Execute XOR with the first byte of the frame	1111	1111	1111	1101	
Execute 1st 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 2nd 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 3rd right Shift	0110	0111	1111	1111	**0**
Execute 4th 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 5th right Shift	0100	1001	1111	1111	**0**
Execute 6th 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 7th right Shift	0100	0010	0111	1111	**0**
Execute 8th 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 the second byte of the frame			0000	0111	
Execute XOR with the second byte of the frame	1000	0001	0011	1001	
Execute 1st 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 2nd 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 3rd 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 4th right Shift	0110	0100	0001	0011	**0**
Execute 5° 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 6th right Shift	0100	1001	0000	0100	**0**
Execute 7th right Shift	0010	0100	1000	0010	**0**
Execute 8th right Shift	0001	0010	0100	0001	**0**
CRC Result	**0001**	**0010**	**0100**	**0001**	
	12h		**41h**		



POLY = crc calculation polynominal: A001h

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

5 HARDWARE SPECIFICATIONS

5.1 RS485/RS422 INTERFACE

General technical specifications		**Note**
Baud rate	9600bps	
Data format	8 data / 1 stop bit / no parity	
Address	1 to 255	
Broadcast	Yes (address 0 with function 06)	
Standard functions	04: Read function (max 12 words)	
	06: Write function (max 1 word)	
Special functions	Alarm output management	A
Answer buffer	24+5 byte	B
Writing protection	Yes	C
Identification code	18 (12h)	D
Synchr. Time-out	3 chars	E
Physical interface	MAX1482	
RX termination	Jumper between Rx+ and T terminals	
Available connections	4-wire (RS422 half duplex interface)	F
	2-wire (RS485 interface)	

Note:

A. It is possible to activate/deactivate a digital output (if available) writing a word in the proper location.

B. With a single request maximum 12 words can be read from WM24.

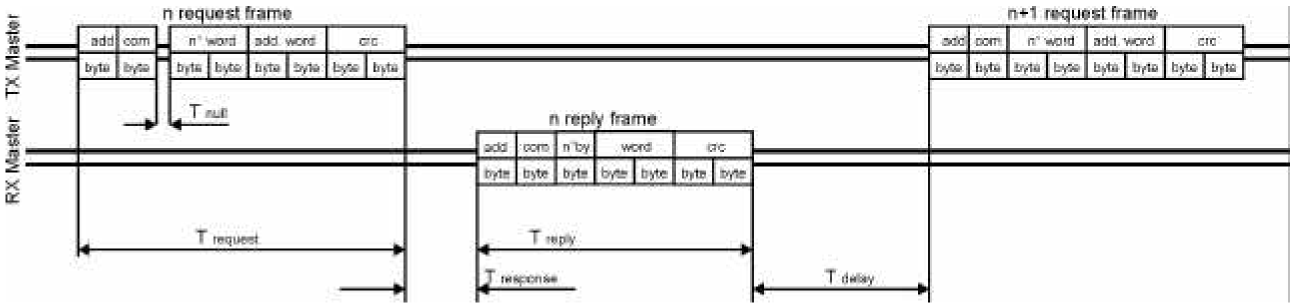
C. It is possible to write in the ram and eeprom areas specified in the present protocol.

D. See paragraph 1.4 WM24-96 identification code.

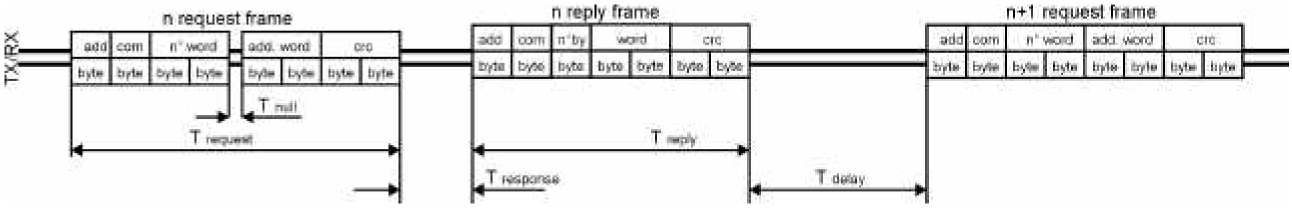
E. It is the time that must elapse without receiving any character before starting the analysis of the received frame.

F. RS422 interface is managed with the same protocol of the RS485 one: in this way only the half-duplex communication is allowed (TX and RX not simultaneous).

Timing characteristics for 4-wire communication	**msec**
T response: max answering time	500ms
T response: typical answering time	100ms
T delay1: minimum time for a new query on the same address	10ms
T delay2: minimum time for a new query on a different address	10ms
T null: maximum interruption time on the request frame	3 char



Timing characteristics for 2-wire communication	msec
T response: max answering time	500ms
T response: typical answering time	100ms
T delay1: minimum time for a new query on the same address	10ms
T delay2: minimum time for a new query on a different address	10ms
T null: maximum interruption time on the request frame	3 char



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 300.000).
4. To reset the maximum and minimum values the proper fixed frames are to be used.
5. To avoid reflections or couplings between the communication wires it is suggested to terminate the last instrument of the network and of the host. If some problems persist, bias the host reception line, then the host transmission line. It is advisable to terminate the network also in case of short point to point connections.
6. If the connection is longer than 1200 m, a signal amplifier has to be used.
7. To calculate the time required to scan all the instruments of a network, the following formulae are to be used:

$$Trequest = \frac{N^\circ bit}{Baud\_rate} * 8$$

$$Treply = \frac{N^\circ bit}{Baud\_rate} * N^\circ char$$

$$TS = T\_request + T\_response + T\_reply + T\_delay1$$

$$TA = TS * N^\circ reque$$

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

N° bit	10
N° char	5 + number of Words*2 (function 04); 8 (function 06)
N° word	Number of words to be read in the same request
TS	Reading execution time
Tdelay1	Minimum time for a new query on the same address
TA	Instrument data acquisition time
TM	Total network scanning time
N° instruments	Number of instruments connected in the network
Tdelay2	Minimum time for a new query on a different address

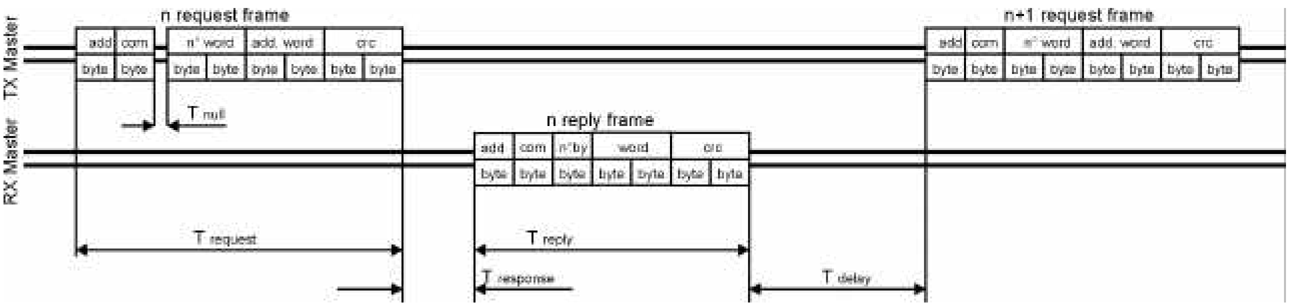
5.2 RS232 INTERFACE

General technical specifications		Note
Baud rate	9600 bps	
Data format	8 data / 1 stop bit / no parity	
Address	1 to 255	

9-pole female RS232 connector		Note
Pin 1	Not used	
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	Not used	

Note: to connect WM24 with a PC use a serial cable with "pin to pin" connections.

Timing characteristics for RS232 communication	msec
T response: max answering time	500ms
T response: typical answering time	100ms
T delay: minimum time for a new query	10ms
T null: maximum interruption time on the request frame	10ms



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 300.000).
4. Control lines are not managed.