WM14 Advanced
CPT-DIN Advanced

WM14 revisions 5 and following only
CPT-DIN revisions 6 and following only

COMMUNICATION PROTOCOL

Version 2 Revision 2

January 9th, 2008

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1 COMMUNICATION PROTOCOL

1.1 Introduction

Only CPT-DIN Advanced can be provided with up to two serial interfaces.
The standard version is supplied with one serial interface (defined as auxiliary serial) using a RJ12 plug (see Fig. 1 and Tab. 1-1). The data format , the baud-rate and the address are fixed:

- 1 start bit
- 8 data bit
- 1 stop bit
- Parity: NONE
- 4800 baud
- Address: 255

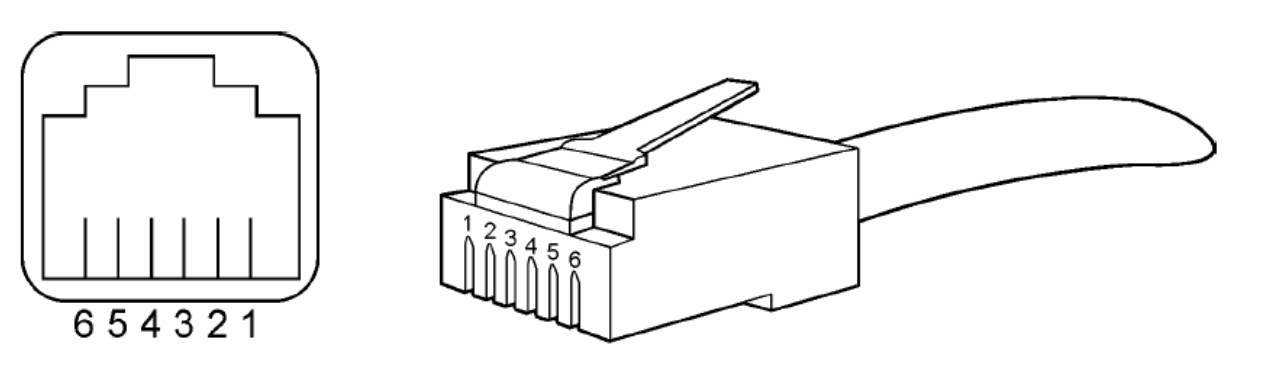

Fig. 1

RJ12 Pin Number	RS232 sub-din 9-pole connector (Female)	Description (PC side)	Physical Level	Logical Level
1	2	RX	…	…
2	3	TX	-	…
3	7	RTS	-10 V	False
4	5	GND	…	-
5	4	DTR	+10 V	True
6	9	Not Connected	…	…

Tab. 1-1 : RJ12 to RS232 pinout

Note: RTS and DTR must be set by the master (PC) to false and true respectively.

WM14-Advanced and CPT-DIN Advanced can be provided with an optional RS485 serial interface (**S1**). CPT-DIN Advanced only can also be provided with an optional RS232 serial interface (**S2**). The data format is fixed:

- 1 start bit
- 8 data bit
- 1 stop bit
- Parity: NONE

and the baud-rate can be selected among 4800, 9600, 19200 or 38400 baud.
Both the standard and optional interfaces use the MODBUS/JBUS (RTU) protocol.
The host starts the communication by sending the relevant request frame. Each frame is composed of 4 types of information:

- **slave address**: it is a number within the range from 1 to 255 which identifies each instrument connected to the network
- **function code (command)**: it defines the control type (reading of n words, writing of one word)
- **data field**: it defines the function parameters (e.g. address of the word to write, value of this word, etc.)
- **control word (CRC)**: it is used to detect transmission errors that may occur.

The master calculates the CRC after defining address, function number and data field. When the slave receives the query, it stores the data in a temporary buffer. After that, the CRC is calculated and compared with the one received. If the two CRC values are the same and the address is correct, the slave carries out the command and then sends back its reply.

1.2 MODBUS functions

These functions are available on WM14-Advanced and CPT-DIN Advanced:

- Reading of n "Holding Registers" (code 03h).
- Reading of n "Input Register" (code 04h).
- Writing of one "Holding Registers" (code 06h).
- Diagnostic (code 08h with sub-function code 00h).
- Broadcast mode (writing instruction on address 00h).

IMPORTANT:

1) In this document the "Modbus address" field is indicated in two modes:
   1.1) "**Modicom address**" : it is the "6 digit Modicom" representation with Modbus function code 04 (Read Input Registers) . It is possible to read the same values with function code 03 (Read Holding Register) substituting the first digit with number "4".
   1.2) "**Physical address**": it is the "word address" value included in the communication frame.
2) The functions 03h and 04h have exactly the same effect.
3) The communication parameters must be set in according to the configuration of the instrument (refer to WM14-Advanced or CPT-DIN Advanced instruction manual).

1.2.1 Function 03h (Read holding registers)

This function code is used to read the contents of a contiguous block of holding registers (word). The Request frame specifies the starting register address and the number of registers to be read. It is possible to read maximum 12 registers (words) with a single request. Only in CPT-DIN Advanced and using the auxiliary RS232 port it is possible to read up to 28 (1Ch) registers (words).
The register data in the response message are packed as two bytes per register (word), with the binary contents right justified within each byte. For each register, the first byte contains the high order bits (MSB) and the second contains the low order bits (LSB).

Request frame

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	03h	
Starting Address	2 bytes	0000h to 2000h	Byte order: MSB, LSB
Quantity of Registers (**N** word)	2 bytes	1 to 0Ch (1 to 12)	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (correct action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	03h	
Byte count	1 byte	**N** word * 2	
Register value	**N***2 bytes		Byte order: MSB, LSB
CRC	2 bytes		

Response frame (incorrect action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	Possible exception : 01h: illegal function 02h: illegal data address 03h: illegal data value 04h: slave device failure
Function code	1 byte	83h	
Exception code	1 byte	01h, 02h, 03h, 04h	
CRC	2 bytes		

1.2.2 Function 04h (Read input registers)

This function code is used to read the contents of a contiguous block of input registers (word). The Request frame specifies the starting register address and the number of registers to be read. It is possible to read maximum 12 registers (words) with a single request. Only in CPT-DIN Advanced and using the auxiliary RS232 port it is possible to read up to 28 (1Ch) registers (words).
The register data in the response message are packed as two bytes per register (word), with the binary contents right justified within each byte. For each register, the first byte contains the high order bits (MSB) and the second contains the low order bits (LSB).

Request frame

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	04h	
Starting Address	2 bytes	0000h to 2000h	Byte order: MSB, LSB
Quantity of Registers (**N** word)	2 bytes	1 to 0Ch (1 to 12)	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (correct action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	04h	
Byte count	1 byte	**N** word * 2	
Register value	**N***2 bytes		Byte order: MSB, LSB
CRC	2 bytes		

Response frame (incorrect action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	Possible exception : 01h: illegal function 02h: illegal data address 03h: illegal data value 04h: slave device failure
Function code	1 byte	84h	
Exception code	1 byte	01h, 02h, 03h, 04h	
CRC	2 bytes		

1.2.3 Function 06h (Write single holding register)

This function code is used to write a single holding register. The Request frame specifies the address of the register (word) to be written and its contents.
The correct response is an echo of the request, returned after the register contents have been written.

Request frame

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	06h	
Starting Address	2 bytes	0000h to 2000h	Byte order: MSB, LSB
Register value	2 bytes	0000h to 2000h	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (correct action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	06h	
Starting Address	2 bytes	0000h to 2000h	
Register value	2 bytes	0000h to 2000h	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (incorrect action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	Possible exception : 01h: illegal function 02h: illegal data address 03h: illegal data value 04h: slave device failure
Function code	1 byte	86h	
Exception code	1 byte	01h, 02h, 03h, 04h	
CRC	2 bytes		

1.2.4 Function 08h (Diagnostic with sub-function code 00h)

MODBUS function code 08h provides a series of tests to check the communication system between a client (Master) device and a server (Slave), or to check various internal error conditions within a server. WM14-Advanced and CPT-DIN Advanced support only 0000h sub-function code (Return Query Data). With this sub-function the data passed in the request data field is to be returned (looped back) in the response. The entire response message should be identical to the request.

Request frame

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	08h	
Sub-function	2 bytes	0000h	
Data (**N** word)	2 bytes	**N** word * 2	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (correct action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	
Function code	1 byte	08h	
Sub-function	2 bytes	0000h	
Data (**N** word)	2 bytes	**N** word * 2	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (incorrect action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 255)	Possible exception : 01h: illegal function 02h: illegal data address 03h: illegal data value 04h: slave device failure
Function code	1 byte	88h	
Exception code	1 byte	01h, 02h, 03h, 04h	
CRC	2 bytes		

1.2.5 Broadcast mode

In broadcast mode the master can send a request (command) to all the slaves. No response is returned to broadcast requests sent by the master. It is possible to send the broadcast message only with function code 06h and using address 00h.

1.3 Application notes

1.3.1 General consideration

1. In case of RS485 interface: to avoid errors due to the signal reflections or line coupling, it is necessary to terminate the input of the last instrument on the network, and also the reception of the Host. If this is not enough, it is also possible to bias the Host transmission (in case of 2-wire connection, it is only possible to either terminate or bias the Host, not both). The termination on both the instrument and the host is necessary even in case of point-to-point connection, within short distances.
2. In case of RS485 interface: the GND connection is optional if a shielded cable is used.
3. In case of RS485 interface: for connections longer than 1000m, a line amplifier is necessary.
4. 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.

1.3.2 MODBUS timing

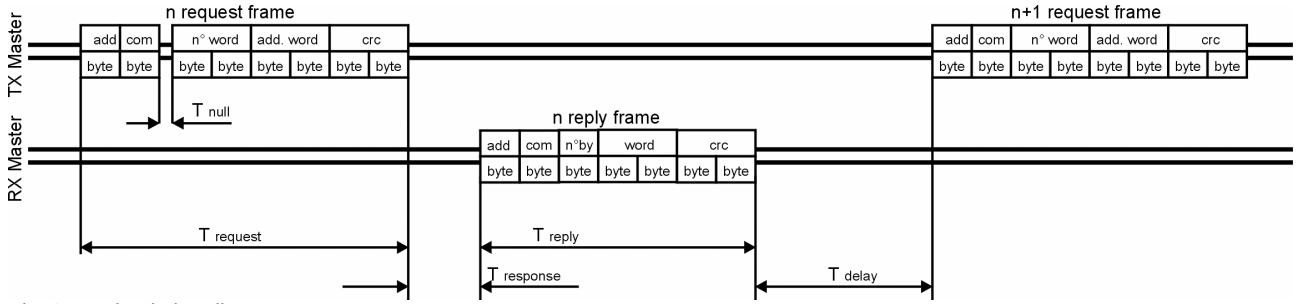

Fig. 2 : 4-wire timing diagram

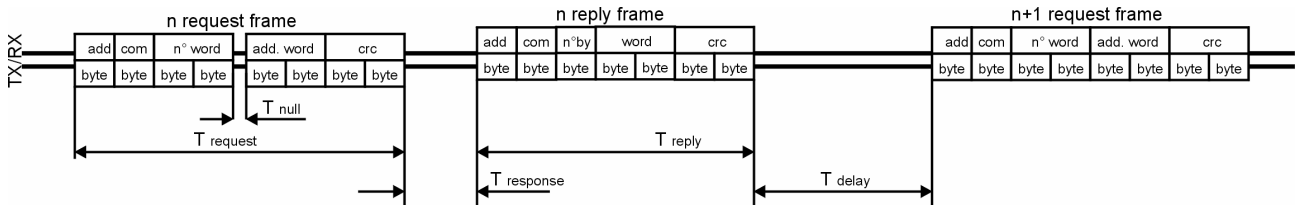

Fig. 3 : 2-wire timing diagram

Timing characteristics of reading function:	**msec**
T response: Max answering time	500ms
T response: Typical answering time	40ms
T delay: Minimum time for a new query	4800 baud-rate: 3,5 char 9600 baud-rate: 3,5 char 19200 baud-rate: 3,5 char 38400 baud-rate: 1,75 ms
T null: Max interruption time on the request frame	4800 baud-rate: 2,5 char 9600 baud-rate: 2,5 char 19200 baud-rate: 2,5 char 38400 baud-rate: 1,75 ms

Where: n char = n*10/baud rate

2 TABLES

2.1 Data format representation in Carlo Gavazzi instruments

The variables are represented by integers or floating numbers, with 2's complement notation in case of "signed" format, using the following:

Format	IEC data type	Description	Bits	Range
INT16	INT	Integer	16	-32768 .. 32767
UINT16	UINT	Unsigned integer	16	0 .. 65535
INT32	DINT	Double integer	32	-2^{31} .. 2^{31}
UINT32	UDINT	Unsigned double int	32	0 .. 2^{32}-1
UINT64	ULINT	Unsigned long integer	64	0 .. 2^{64}-1
IEEE754 SP		Single-precision floating-point	32	$-(1+[1-2^{-23}])x2^{127}$ .. 2^{128}

The IEEE754 representation of a 32-bit floating-point number as an integer is defined as follows:

32-bit floating-point

Bits		
31	30 … 23	22 … 0
Sign	Exponent	Mantissa

$$(-1)^{sign} * 2^{(Exponent-127)} * 1.Mantissa$$

The byte order in the MODBUS (and ANSI) frame is:

1st byte = Bits 15 … 8 of the 32-bit floating-point number in standard IEEE-754
2nd byte = Bits 7 … 0 of the 32-bit floating-point number in standard IEEE-754
3rd byte = Bits 31 … 24 of the 32-bit floating-point number in standard IEEE-754
4th byte = Bits 23 … 16 of the 32-bit floating-point number in standard IEEE-754

The integers are represented in UINT16 (16 bit) or UINT64 (64 bit) format without sign (the byte order inside the single word is MSB->LSB while the word order is LSW->MSW).

2.1.1 Geometric representation

According to the signs of the power factor , the active power P and the reactive power Q, it is possible to obtain a geometric representation of the power vector, as indicated in the drawing below, according to EN 62053:

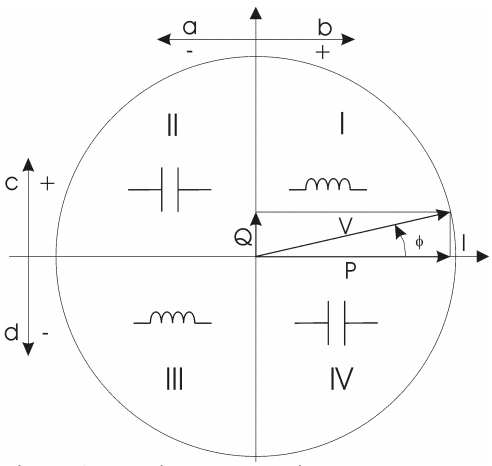

Fig. 4 : Geometric Representation

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

2.1.2 Maximum and minimum electrical values

The max and min electric values for each variable are indicated in the following table.
VL-N nom : 380V for AV5 model, 120V for AV6 model (Vmax = Vnom x 1,20)
VL-L nom : 660V for AV5 model, 208V for AV6 model (Vmax = Vnom x 1,20)
Inom = 5A (Imax = 6A)
VTmax = 6000, **CTmax** = 60000

Tab. 2

Engineering unit	Input model AV5 (400VL-L)		Input model AV6 (120VL-L)	
	max value	min value	max value	min value
V (L-N)	$2.73 \cdot 10^6$ =VL-Nnom·1.2·VTmax	0	$864 \cdot 10^3$ =VL-Nnom·1.2·VTmax	0
V (L-L)	$4.75 \cdot 10^6$ =VL-Lnom·1.2·VTmax	0	$1.49 \cdot 10^6$ =VL-Lnom·1.2·VTmax	0
A	$432 \cdot 10^3$ =Imax·CTmax	0	$432 \cdot 10^3$ =Imax·CTmax	0
W	$1.18 \cdot 10^{12}$	$-1.18 \cdot 10^{12}$	$373 \cdot 10^9$	$-373 \cdot 10^9$
VA	$1.18 \cdot 10^{12}$	0	$373 \cdot 10^9$	0
VAR	$1.18 \cdot 10^{12}$	$-1.18 \cdot 10^{12}$	$373 \cdot 10^9$	$-373 \cdot 10^9$
Phase sequence (*)	1	−1	1	−1
PF	1	−1	1	−1
Hz	60	40	60	40
Asymmetry (**)	100	0	100	0
KWh	99999999.9	0	99999999.9	0
KVARh	99999999.9	0	99999999.9	0
Hour Counter	99999.99	0	99999.99	0

Note :
(*) This variable doesn't have any engineering unit. Its value is a convention.
(**) This variable doesn't have any engineering unit. Its value is a convention percentage.

2.2 Istantaneous variables

MODBUS: read only mode with functions code 03 and 04

Tab. 3

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300001	0000h	2	V L1-N	IEEE 754	
300003	0002h	2	V L2-N	IEEE 754	
300005	0004h	2	V L3-N	IEEE 754	
300007	0006h	2	V L1-L2	IEEE 754	
300009	0008h	2	V L2-L3	IEEE 754	
300011	000Ah	2	V L3-L1	IEEE 754	
300013	000Ch	2	A L1	IEEE 754	
300015	000Eh	2	A L2	IEEE 754	
300017	0010h	2	A L3	IEEE 754	
300019	0012h	2	A N	IEEE 754	
300021	0014h	2	W L1	IEEE 754	
300023	0016h	2	W L2	IEEE 754	
300025	0018h	2	W L3	IEEE 754	
300027	001Ah	2	VA L1	IEEE 754	
300029	001Ch	2	VA L2	IEEE 754	
300031	001Eh	2	VA L3	IEEE 754	
300033	0020h	2	VAR L1	IEEE 754	
300035	0022h	2	VAR L2	IEEE 754	
300037	0024h	2	VAR L3	IEEE 754	
300039	0026h	2	Phase sequence	IEEE 754	The value **–1** indicates all the 3 phases are present and have the correct sequence. On the other side, **+1** indicates a wrong connection.
300041	0028h	2	PF L1	IEEE 754	Negative sign of this variable indicates a lead (C) type. Positive sign indicates a lag (L).
300043	002Ah	2	PF L2	IEEE 754	
300045	002Ch	2	PF L3	IEEE 754	
300047	002Eh	2	V L-N ∑	IEEE 754	
300049	0030h	2	V L-L ∑	IEEE 754	
300051	0032h	2	W ∑	IEEE 754	
300053	0034h	2	VA ∑	IEEE 754	
300055	0036h	2	VAR ∑	IEEE 754	
300057	0038h	2	PF ∑	IEEE 754	Negative sign of this variable indicates a lead (C) type. Positive sign indicates a lag (L).
300059	003Ah	2	Hz	IEEE 754	
300061	003Ch	2	Asymmetry L-N %	IEEE 754	
300063	003Eh	2	Asymmetry L-L %	IEEE 754	

2.3 Maximum variables

MODBUS: read only mode with functions code 03 and 04

Tab. 4

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300097	0060h	2	A MAX	IEEE 754	
300099	0062h	2	A MAX dmd	IEEE 754	
300101	0064h	2	A L1 MAX	IEEE 754	
300103	0066h	2	A L2 MAX	IEEE 754	
300105	0068h	2	A L3 MAX	IEEE 754	
300107	006Ah	2	W L1 MAX	IEEE 754	
300109	006Ch	2	W L2 MAX	IEEE 754	
300111	006Eh	2	W L3 MAX	IEEE 754	
300113	0070h	2	W MAX dmd	IEEE 754	
300115	0072h	2	VA MAX dmd	IEEE 754	
300135	0086h	2	V L1 MAX	IEEE 754	Only for Wm14 Advanced
300137	0088h	2	V L2 MAX	IEEE 754	Only for Wm14 Advanced
300139	008Ah	2	V L3 MAX	IEEE 754	Only for Wm14 Advanced

2.4 Minimum variables

MODBUS: read only mode with functions code 03 and 04

Tab. 5

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300117	0074h	2	PF L1 min	IEEE 754	
300119	0076h	2	PF L2 min	IEEE 754	
300121	0078h	2	PF L3 min	IEEE 754	
300123	007Ah	2	A L1 min	IEEE 754	Only for Wm14 Advanced
300125	007Ch	2	A L2 min	IEEE 754	Only for Wm14 Advanced
300127	007Eh	2	A L3 min	IEEE 754	Only for Wm14 Advanced
300129	0080h	2	V L1 min	IEEE 754	Only for Wm14 Advanced
300131	0082h	2	V L2 min	IEEE 754	Only for Wm14 Advanced
300133	0084h	2	V L3 min	IEEE 754	Only for Wm14 Advanced

2.5 DMD variables

MODBUS: read only mode with functions code 03 and 04

Tab. 6

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300065	0040h	2	A L1 dmd	IEEE 754	
300067	0042h	2	A L2 dmd	IEEE 754	
300069	0044h	2	A L3 dmd	IEEE 754	
300071	0046h	2	W L1 dmd	IEEE 754	
300073	0048h	2	W L2 dmd	IEEE 754	
300075	004Ah	2	W L3 dmd	IEEE 754	
300077	004Ch	2	VA L1 dmd	IEEE 754	
300079	004Eh	2	VA L2 dmd	IEEE 754	
300081	0050h	2	VA L3 dmd	IEEE 754	
300083	0052h	2	W dmd	IEEE 754	
300085	0054h	2	VA dmd	IEEE 754	

2.6 Maximum DMD variables

MODBUS: read only mode, with functions code 03 and 04

Tab. 7

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300099	0062h	2	A MAX dmd	IEEE 754	
300113	0070h	2	W MAX dmd	IEEE 754	
300115	0072h	2	VA MAX dmd	IEEE 754	

2.7 Total and partial energy meters

MODBUS: read only mode with functions code 03 and 04

Tab. 8

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300087	0056h	2	KWh tot.	UINT32	This number must be divided by 10 to obtain the correct value of the counter.
300099	0058h	2	KVARh tot.	UINT32	
300091	005Ah	2	KWh par.	UINT32	
300093	005Ch	2	KVARh par.	UINT32	

2.8 Hour counter

MODBUS: read only mode, with functions code 03 and 04

Tab. 9

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300095	005Eh	2	Hour Counter (1/100h)	UINT32	This value raises when one of the three phase currents is greater than zero. Its step is **36** seconds (1/100 of an hour).

2.9 Total Harmonic Distortions

MODBUS: read only mode with functions code 03 and 04

Tab. 10

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300141	008Ch	2	THD V1	IEEE 754	Only for Wm14 Advanced
300143	008Eh	2	THD V2	IEEE 754	Only for Wm14 Advanced
300145	0090h	2	THD V3	IEEE 754	Only for Wm14 Advanced
300147	0092h	2	THD I1	IEEE 754	Only for Wm14 Advanced
300149	0094h	2	THD I2	IEEE 754	Only for Wm14 Advanced
300151	0096h	2	THD I3	IEEE 754	Only for Wm14 Advanced

2.10 Carlo Gavazzi Controls identification code

MODBUS: read only mode with functions code 03 and 04

Tab. 11

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300212	00D3h	1	Carlo Gavazzi Controls identification code	UINT16	33 = CPT A AV5 3-phase 34 = CPT A AV6 3-phase 35 = CPT A AV5 1-phase 36 = CPT A AV6 1-phase 39 = WM14 A AV5 3-phase 40 = WM14 A AV6 3-phase

2.11 Firmware version and installed modules

MODBUS: read only mode with functions code 03 and 04

Tab. 12

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300223	00DEh	1	Firmware Revision	UINT16	MSB: none LSB: progressive number
300224	00DFh	1	Module Type	UINT16	**0x0000**: Standard (no module presents). **0x0001**: Serial Output RS485 or RS232 **0x0102**: 1 voltage analog output **0x0302** : 3 voltage analog outputs **0x0103**: 1 current analog output **0x0303** : 3 current analog outputs **0x0004**: 2 digital outputs **0x0005**: Serial Output RS485 and two digital output.

2.12 Digital output and virtual alarm status

MODBUS: read only mode with functions code 03 and 04

Tab. 13

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300245	00F4h	1	Start up deactivation of the virtual alarms	UINT16 (bit15 … bit0)	Bit N = 0 : the start up deactivation of the block (N+1) is ENABLED. Bit N = 1 : the start up deactivation of the block (N+1) is DISABLED or the start up condition is finished.
300246	00F5h	1	Virtual alarm status	UINT16 (bit15 … bit0)	Bit N = 0 : Virtual alarm condition of the block (N+1) is FALSE. Bit N = 1 : Virtual alarm condition of the block (N+1) is TRUE.
300260	0103h	1	Output 1	UINT16	0 = Output 1 is not in alarm condition 1 = Output 1 is in alarm condition
300261	0104h	1	Output 2	UINT16	0 = Output 1 is not in alarm condition 1 = Output 1 is in alarm condition

Note: It is possible to set until 16 virtual alarm conditions linked to a digital output.

2.13 Programming parameter tables

2.13.1 Password configuration menu

MODBUS: read and write mode

Tab. 14

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300410	0199h	1	PASSWORD	UINT16	Minimum valid value: 0d Maximum valid value: 999d If the value is outside the limits the instrument considers the value equal to 0 .

2.13.2 CT configuration menu

MODBUS: read and write mode

Tab. 15

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300411	019Ah	1	Current Transformer ratio	UINT16	Value min = 1 Value max = 60000 If the value is outside the limits the instrument considers the value equal to 1 .

2.13.3 VT configuration menu

MODBUS: read and write mode

Tab. 16

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300412	019Bh	1	Voltage Transformer ratio	UINT16	Value min = 1 Value max = 60000 **N.B.:** this value is internally divided by 10. If the value is outside the limits the instrument considers the value equal to 1 .

2.13.4 Filter scaling menu

MODBUS: read and write mode

Tab. 17

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300413	019Ch	1	Filter range	UINT16	Value min = 0 Value max = 100 If the value is outside the limits the instrument considers the value equal to 0.

2.13.5 Filter coefficient menu

MODBUS: read and write mode

Tab. 18

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300414	019Dh	1	Filter coefficient	UINT16	Value min = 1 Value max = 32 If the value is outside the limits the instrument considers the value equal to 1.

2.13.6 DMD calculation configuration menu

MODBUS: read and write mode

Tab. 19

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300415	019Eh	1	Power Integration Time	UINT16	Value min = 1 Value max = 30 **N.B.**: values in minutes. If the value is outside the limits the instrument considers the value equal to 1.
300416	019Fh	1	Current Integration Time	UINT16	

2.13.7 System measurement type menu

MODBUS: read and write mode

Tab. 20

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300417	01A0h	1	System type	UINT16	**0** : 3-ph, 4-wire, unbalanced load **0** : 3-ph, 3-wire, unbalanced load **1** : 1-ph, 2-wire **2** : 2-ph, 3-wire **3** : 3-ph, 3-wire, unbalanced load (3VT + 1 CT) **4** : 3-ph, balanced load (1VT + 1CT) **5** : 3-ph ARON, balanced load (3VT + 2CT), only WM14 Advanced

2.13.8 Serial port configuration menu

MODBUS: read and write mode

Tab. 21

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300418	01A1h	1	Address	UINT16	Value min = 1 Value max = 255 If the value is outside the limits the instrument considers the value equal to 1.
300419	01A2h	1	Baudrate	UINT16	0 : 4800baud. 1 : 9600baud. 2 : 19200baud. 3 : 38400baud .

2.13.9 Digital output configuration menu

MODBUS: read and write mode

Tab. 22

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300420	01A3h	1	Normal output status	UINT16	Physical output status in normal conditions (relevant to the alarm mode). 0000h : Both outputs are de-energized. 0001h : Output 1 only is energized. 0010h : Output 2 only is energized. 0011h : Both outputs are energized.
300423	01A6h	1	Output control register	UINT16	AAAAh : Both outputs as alarms. AABBh : Out 2 as alarm, Out 1 as pulse. AACCh : Out 2 as alarm, Out 1 remote-controlled. BBAAh : Out 2 as pulse, Out 1 as alarm. BBBBh : Both outputs as pulse. BBCCh : Out 2 as pulse, Out 1 remote-controlled. CCAAh : Out 2 remote-controlled, Out 1 as alarm. CCBBh : Out 2 remote-controlled, Out 1 as pulse. CCCCh : Both outputs remote-controlled.
300424	01A7h	1	Remote control	UINT16	Physical output status when remote-controlled. 0000h : Both outputs are de-energized. 0001h : Out 1 is energized, out 2 is de-energized. 0100h : Out 2 is energized, out 1 is de-energized. 0101h : Both outputs are energized.
300245	00F4h	1	Start up deactivation of the virtual alarms	UINT16 (bit15 … bit0)	Bit N = 0 : the start up deactivation of the block (N+1) is ENABLED. Bit N = 1 : the start up deactivation of the block (N+1) is DISABLED or the start up condition is finished.
300246	00F5h	1	Actual Output State	UINT16	Each bit indicates an alarm condition of the relevant Set-Point. 0 : alarm condition of the Set-point OFF. 1 : alarm condition of the Set-Point ON.
300248	00F7h	1	Set-point control	UINT16	Disable Set-point control when its value is C0C0h. Enable Set-point control when its valeu is different from C0C0h.

N.B. : To programm or modify a Set-point is necessary to follow the steps below

1. Set up the variable **Set-point control** (writing C0C0h).
2. Set up the variable **Output control register** (when necessary).
3. Write the correct **Digital Output Block** with the new parameters.
4. Write the new **Normal Output State**.
5. Reset the variable Set-point control.

2.13.10 Alarm configuration menu

MODBUS: read and write mode

Tab. 23

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300450	01C1h	8	Digital Output Block 1	Refer to Tab. 25	Refer to Tab. 24 Tab. 25
300458	01C9h	8	Digital Output Block 2		
300466	01D1h	8	Digital Output Block 3		
300474	01D9h	8	Digital Output Block 4		
300482	01E1h	8	Digital Output Block 5		
300490	01E9h	8	Digital Output Block 6		
300498	01F1h	8	Digital Output Block 7		
300506	01F9h	8	Digital Output Block 8		
300514	0201h	8	Digital Output Block 9		
300522	0209h	8	Digital Output Block 10		
300530	0211h	8	Digital Output Block 11		
300538	0219h	8	Digital Output Block 12		
300546	0221h	8	Digital Output Block 13		
300554	0229h	8	Digital Output Block 14		
300562	0231h	8	Digital Output Block 15		
300570	0239h	8	Digital Output Block 16		
300578	0241h	8	Digital Output Block 17	Refer to Tab. 27	Refer to Tab. 27
300586	0249h	8	Digital Output Block 18		

MODBUS: read and write mode

Tab. 24

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300692	02B3h	1	Alarm 1 ON / OFF	UINT16	Set this field to enable the relevant Set-Point. This value must be the same of the bit3 (Alarm status bit) in the variable DIGCR of the Digital Output Block N (see Tab. 25). Value min = 0 (alarm = OFF) Value MAX = 1 (alarm = ON)
300693	02B4h	1	Alarm 2 ON / OFF		
300694	02B5h	1	Alarm 3 ON / OFF		
300695	02B6h	1	Alarm 4 ON / OFF		
300696	02B7h	1	Alarm 5 ON / OFF		
300697	02B8h	1	Alarm 6 ON / OFF		
300698	02B9h	1	Alarm 7 ON / OFF		
300699	02BAh	1	Alarm 8 ON / OFF		
300700	02BBh	1	Alarm 9 ON / OFF		
300701	02BCh	1	Alarm 10 ON / OFF		
300702	02BDh	1	Alarm 11 ON / OFF		
300703	02BEh	1	Alarm 12 ON / OFF		
300704	02BFh	1	Alarm 13 ON / OFF		
300705	02C0h	1	Alarm 14 ON / OFF		
300706	02C1h	1	Alarm 15 ON / OFF		
300707	02C2h	1	Alarm 16 ON / OFF		

Tab. 25 : Alarm configuration parameters

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes	
Block address +0	Block address +0	1	Linked variable (LSB) and activation delay (MSB).	UINT16	The LSB contain the index of the variable to be linked to an alarm (see Tab. 26). Value min = 0 Value MAX = 42	
					The MSB contain the delay on activation time of this alarm. Value min = 0 sec Value MAX = 255 sec	
Block address +1	Block address +1	1	DIGCR (Digital Control Register)	UINT16	bit2 .. bit0	Type of alarm condition. UP and DOWN mode have an hysteresis threshold. 000b : UP type alarm 001b : DOWN type alarm 010b : INTERNAL type alarm 011b : EXTERNAL type alarm
					bit3	Alarm status: 0 : disabled 1 : enabled
					bit4	Physical Output linked with this digital block. 0 : Output 1 1 : Output 2
					bit5	Function type: more alarm conditions can be combined (AND or OR) by using this parameter. 0 : AND type function 1 : OR type function
					bit6	Wait for the value of the variable goes to a non-alarm condition before activating the alarm. 0 : disabled 1 : enabled
					bit7	Not used
					bit15 .. bit8	Not used
Block address +2	Block address +2	2	Low Set-point threshold	IEEE754	See Tab. 2 for the range of values.	
Block address +4	Block address +4	2	High Set-Point threshold	IEEE754		

N.B.: If bit6 of DIGCR is set, resetting an alarm condition requires to reset also the “Latch Alarm” and “Actual Output State” variables (see Tab. 22).

Tab. 26 : Variable index for alarm linking

Variable	Index	Variable	Index
V L1-N	0	PF L2	21
V L2-N	1	PF L3	22
V L3-N	2	V L-N ∑	23
V L1-L2	3	V L-L ∑	24
V L2-L3	4	W ∑	25
V L3-L1	5	VA ∑	26
A L1	6	VAR ∑	27
A L2	7	PF ∑	28
A L3	8	Hz	29
A N	9	Asymmetry L-N %	30
W L1	10	Asymmetry L-L %	31
W L2	11	A L1 dmd	32
W L3	12	A L2 dmd	33
VA L1	13	A L3 dmd	34
VA L2	14	W L1 dmd	35
VA L3	15	W L2 dmd	36
VAR L1	16	W L3 dmd	37
VAR L2	17	VA L1 dmd	38
VAR L3	18	VA L2 dmd	39
Phase sequence	19	VA L3 dmd	40
PF L1	20	W dmd	41
		VA dmd	42

Tab. 27 : Pulse configuration menu

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes	
Block address +0	Block address +0	1	Linked variable (LSB) and Output selection (MSB).	UINT16	LSB value = 43 : kWhTOT is linked to the output. value = 44 : kVARhTOT is linked to the output.	
					MSB	
					bit0	pulses output 1 0 : disabled 1 : enabled
					bit1	pulses output 2 0 : disabled 1 : enabled
					bit2	pulses output selection 0 : Physical Output 1 1 : Physical Output 2
					bit7 .. bit 3	Not used
Block address +1	Block address +1	1	Number of pulses for unit	UINT16	Value min = 1 Value MAX = 50000 N.B. : this value is internally divided by 100.	

2.13.11 Analogue outputs menu (only CPT Advanced)

MODBUS: read and write mode

Tab. 28

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300426	01A9h	1	Variable to be linked to the analogue output 1	UINT16	From 0 to 42, refer to Tab. 255
300427	01AAh	1	Analogue channel	UINT16	**1**: output #1
300428	01ABh	1	Low output value (%), out 1	UINT16	From 0 to 100
300429	01ACh	1	High output value (%), out 1	UINT16	From 0 to 100
300430	01ADh	2	Low electric value, out 1	IEEE754	Refer to par. 2.1.2
300432	01AFh	2	High electric value, out 1	IEEE754	Refer to par. 2.1.2
300434	01B1h	1	Variable to be linked to the analogue output 2	UINT16	From 0 to 42, refer to Tab. 255
300435	01B2h	1	Analogue channel	UINT16	**2**: output #2
300436	01B3h	1	Low output value (%), out 2	UINT16	From 0 to 100
300437	01B4h	1	High output value (%), out 2	UINT16	From 0 to 100
300438	01B5h	2	Low electric value, out 2	IEEE754	Refer to par. 2.1.2
300440	01B7h	2	High electric value, out 2	IEEE754	Refer to par. 2.1.2
300442	01B9h	1	Variable to be linked to the analogue output 3	UINT16	From 0 to 42, refer to Tab. 255
300443	01BAh	1	Analogue channel	UINT16	**3**: output #3
300444	01BBh	1	Low output value (%), out3	UINT16	From 0 to 100
300445	01BCh	1	High output value (%), out 3	UINT16	From 0 to 100
300446	01BDh	2	Low electric value, out 3	IEEE754	Refer to par. 2.1.2
300448	01BFh	2	High electric value, out 3	IEEE754	Refer to par. 2.1.2

2.13.12 Total Harmonic Distortion menu (only WM14 Advanced)

MODBUS: read and write mode

Tab. 29

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300417	01A8h	1	THD	UINT16	0 : Disabled 1 : Enabled

2.13.13 Reset commands

Pay attention to follow scrupulously the reset instructions and to send the exact frame, because a different write command could modify some calibration parameters, invalidating the accuracy of the measurements.

MODBUS: write only mode

Tab. 30

Modicom address	Physical address	Length (words)	Command Value	Data Format	Notes
608431	20EEh	1	0000h	UINT16	Reset all variables, including instantaneous, min, MAX, DMD and Counters.
			0100h		Reset all DMD values.
			0200h		Reset energy counters (partial and total) and hour counter.
			0300h		Reset total energy counters.
			0400h		Reset partial energy counters.
			0500h		Reset hour counters.
			0600h		Reset MAX and min value.

3 MODIFICATIONS OF THE PROTOCOL

3.1 Modifications from version 1 revision 2

- The Value word in the reset frames is 0X00h and not 000Xh (see pag.18)

3.2 Modifications from version 1 revision 3

- The “n char” formula has been added to the timing tables (see par. 1.3.2)
- New document layout

3.3 Modifications from version 2 revision 0

- The explanation of word 00F4h in paragraph 2.12 has been added
- The explanation of word 00F4h in paragraph 2.13.9 has been modified

3.4 Modifications from version 2 revision 1

- The meaning of the commands in word 01A7h in paragraph 2.13.9 has been modified