EM300 Series

and

ET300 Series

COMMUNICATION PROTOCOL

Version 2 Revision 17
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Index

1.1 Introduction

The RS485 serial interface supports the MODBUS/JBUS (RTU) protocol. In this document only the information necessary to read/write from/to EM/ET300 SERIES has been reported (not all the parts of the protocol have been implemented).
For a complete description of the MODBUS protocol please refer to the latest revision of the "Modbus_Application_Protocol" document that is downloadable from the www.modbus.org web site.

1.2 MODBUS functions

These functions are available on EM/ET300 SERIES:

- 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 Registers) replacing the first digit ("3") with the number "4".
   1.2) "**Physical address**": it is the "word address" value to be included in the communication frame.
2) The functions 03h and 04h have exactly the same effect and can be used indifferently.
3) The communication parameters are to be set according to the configuration of the instrument (refer to EM/ET300 SERIES instruction manual)

1.2.1 Function 03h (Read Holding Registers)

This function 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 50 registers (words) with a single request, when not differently specified.
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 F7h (1 to 247)	
Function code	1 byte	03h	
Starting address	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
Quantity of registers (**N** word)	2 bytes	1 to 14h (1 to 20)	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (correct action)

Description	Length	Value	Note
Physical address	1 byte	1 to F7h (1 to 247)	
Function code	1 byte	03h	
Quantity of requested bytes	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 F7h (1 to 247)	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 (see note)	
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 50 register (word) with a single request, when not differently specified.
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 F7h (1 to 247)	
Function code	1 byte	04h	
Starting address	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
Quantity of registers (**N** word)	2 bytes	1 to 14h (1 to 20)	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (correct action)

Description	Length	Value	Note
Physical address	1 byte	1 to F7h (1 to 247)	
Function code	1 byte	04h	
Quantity of requested bytes	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 F7h (1 to 247)	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 content.
The correct response is an echo of the request, returned after the register content has been written.

Request frame

Description	Length	Value	Note
Physical address	1 byte	1 to F7h (1 to 247)	
Function code	1 byte	06h	
Starting address	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
Register value	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (correct action)

Description	Length	Value	Note
Physical address	1 byte	1 to F7h (1 to 247)	
Function code	1 byte	06h	
Starting address	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
Register value	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (incorrect action)

Description	Length	Value	Note
Physical address	1 byte	1 to F7h (1 to 247)	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 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 in a server.
EM/ET300 Series supports 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 F7h (1 to 247)	
Function code	1 byte	08h	
Sub-function	2 bytes	0000h	
Data (**N** word)	**N** *2 bytes	Data	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (correct action)

Description	Length	Value	Note
Physical address	1 byte	1 to F7 (1 to 247)	
Function code	1 byte	08h	
Sub-function	2 bytes	0000h	
Data (**N** word)	**N** *2 bytes	Data	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (incorrect action)

Description	Length	Value	Note
Physical address	1 byte	1 to F7h (1 to 247)	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 using address 00h.

1.3 Application notes

1.3.1 RS485 general considerations

1. To avoid errors due to the signal reflections or line coupling, it is necessary to terminate the bus at the beginning (master side, if not already embedded, by inserting a 120 ohm 1/2W 5% resistor between line B and A) and at the end (in EM/ET SERIES interface by connecting the terminal A- with the terminal T in the last instrument.
2. The network termination is necessary even in case of point-to-point connection and/or of short distances.
3. For connections longer than 1000 m or if in the network there are more than 160 instruments (with 1/5 unit load as used in EM/ET300 SERIES interface), a signal repeater is necessary.
4. For bus connection it is suggested to use an AWG24 balanced pair cable and to add a third wire for GND connection. If a shielded cable is used, connect the shield to GND.
5. The GND should be connected to ground only on the master side.
6. 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 is to be considered as not connected, faulty or reached with a wrong address. The same consideration is valid in case of CRC errors or incomplete response frames.

1.3.2 MODBUS timing

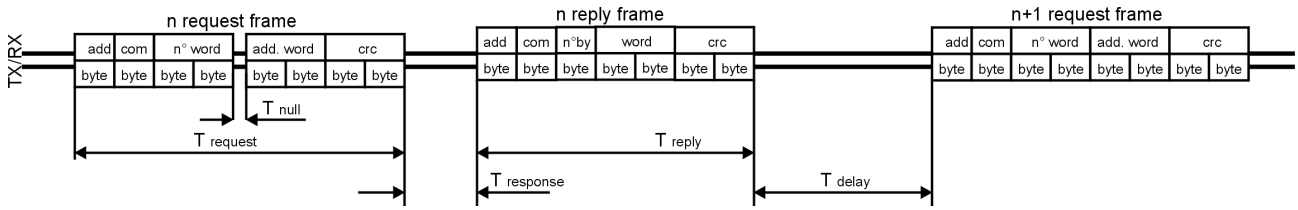


Fig. 1 : 2-wire timing diagram

Timing characteristics of reading function:	ms
T response: Answering time	500 ms
T delay: Minimum time before a new query	40 ms
T null: Max interruption time during the request frame	2,5 char

2 TABLES

2.1 Data format representation In Carlo Gavazzi instruments

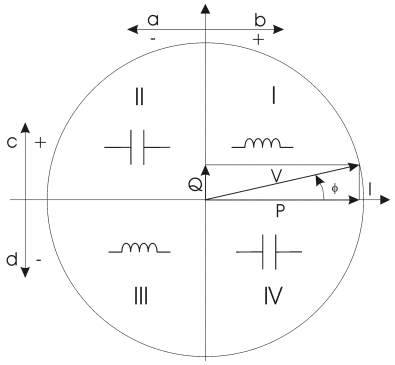
The variables are represented by integers or floating numbers, with 2's complement notation in case of "signed" format, using the following:

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 integer	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}

For all the formats the byte order (inside the single word) is MSB->LSB. In INT32, UINT32 and UINT64 formats, the word order is LSW-> MSW.

2.2 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 60253-23:



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

Fig. 2 : Geometric Representation

According to the measurement mode (easy connection or bidirectional), the following sign convention is used in EM/ET300 SERIES.

- Easy connection mode
  - I always >0
  - P always >0
  - kWh always increasing (correspondent to Annex D option PFA)
  - **kvarh increases only when Q>0**
  - PF only with C and L (without sign) indication

- Bidirectional mode)
  - I < or >0 (with indication of "-" sign)
  - P < or >0 (with indication of "-" sign)
  - kWh+ increasing only when P > 0 (correspondent to Annex D option PFB)
  - kWh- increasing only when P < 0
  - kvarh+ increasing only when Q > 0
  - kvarh- increasing only when Q < 0
  - PF with ±C or ±L indication

Application	Real measurement	Displayed values	Displayed energies	Notes
Easy connection Mode	Quadrant I	A, W, var, L PF	kWh increases kvarh increases	Measurement A or PFA models
	Quadrant II	A, W, -var, C PF	kWh increases kvarh does not increase	Measurement A or PFA models
	Quadrant III	A, W, var, L PF	kWh increases kvarh increases	Measurement A or PFA models
	Quadrant IV	A, W, -var, C PF	kWh increases kvarh does not increase	Measurement A or PFA models
Bidirectional Mode	Quadrant I	A, W, var, +L PF	kWh+ increases kvarh+ increases	Measurement B or PFB models
	Quadrant II	-A, -W, +var, -C PF	kWh- increases kvarh+ increases	Measurement B or PFB models
	Quadrant III	-A, -W, -var, -L PF	kWh- increases kvarh- increases	Measurement B or PFB models
	Quadrant IV	A, W, -var, +C PF	kWh+ increases kvarh- increases	Measurement B or PFB models

2.3 Maximum and minimum electrical values in EM/ET300 series

The maximum electrical input values are reported in the following table. If the input is above the maximum value the display shows “EEE”.

Table 2.3-1

	AV5 input		AV6 input		AV2 input	
	Max value	**Min value**	**Max value**	**Min value**	**Max value**	**Min value**
VL-N	485V	0	150V	0	299V	0
VL-L	840V	0	260V	0	518V	0
A	6,5A (displ. value = 6.5 A x CT ratio)	0	6,5A (displ. value = 6.5 A x CT ratio)	0	78A	0
VT	1000	1	1000	1	/	/
CT	1000	1	1000	1	/	/

Note: the product (CT ratio)x(VT ratio) shall be automatically limited to prevent overflow of kW indication on the meter (max power = 9999 kW).

The overflow indication “EEE“ is displayed when the MSB value of the relevant variable is 7FFFFFFFh (word order FFFF 7FFF).

2.4 Instantaneous variables and meters (grouped by variable type)

MODBUS: read only mode with functions code 03 and 04 Table 2.4-1

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300001	0000h	2	V L1-N	INT32	Value weight: Volt*10
300003	0002h	2	V L2-N	INT32	
300005	0004h	2	V L3-N	INT32	
300007	0006h	2	V L1-L2	INT32	
300009	0008h	2	V L2-L3	INT32	
300011	000Ah	2	V L3-L1	INT32	
300013	000Ch	2	A L1	INT32	Value weight: Ampere*1000
300015	000Eh	2	A L2	INT32	
300017	0010h	2	A L3	INT32	
300019	0012h	2	W L1	INT32	Value weight: Watt*10
300021	0014h	2	W L2	INT32	
300023	0016h	2	W L3	INT32	
300025	0018h	2	VA L1	INT32	Value weight: VA*10
300027	001Ah	2	VA L2	INT32	
300029	001Ch	2	VA L3	INT32	
300031	001Eh	2	var L1	INT32	Value weight: var*10
300033	0020h	2	var L2	INT32	
300035	0022h	2	var L3	INT32	
300037	0024h	2	V L-N sys	INT32	Value weight: Volt*10
300039	0026h	2	V L-L sys	INT32	
300041	0028h	2	W sys	INT32	Value weight: Watt*10
300043	002Ah	2	VA sys	INT32	Value weight: VA*10
300045	002Ch	2	var sys	INT32	Value weight: var*10
300047	002Eh	1	PF L1	INT16	Negative values correspond to exported active power, positive values correspond to imported active power. Value weight: PF*1000
300048	002Fh	1	PF L2	INT16	
300049	0030h	1	PF L3	INT16	
300050	0031h	1	PF sys	INT16	
300051	0032h	1	Phase sequence	INT16	The value "1" corresponds to L1-L3-L2 sequence, the value 0 corresponds to L1-L2-L3 sequence. The phase sequence value is meaningful only in a 3-phase system
300052	0033h	1	Hz	INT16	Value weight: Hz*10
300053	0034h	2	kWh (+) TOT	INT32	Value weight: kWh*10
300055	0036h	2	Kvarh (+) TOT	INT32	Value weight: kvarh*10
300057	0038h	2	kW dmd	INT32	Value weight: Watt*10
300059	003Ah	2	kW dmd peak	INT32	Value weight: Watt*10
300061	003Ch	2	kWh (+) PARTIAL	INT32	Value weight: kWh*10
300063	003Eh	2	Kvarh (+) PARTIAL	INT32	Value weight: kvarh*10
300065	0040h	2	kWh (+) L1	INT32	Value weight: kWh*10
300067	0042h	2	kWh (+) L2	INT32	Value weight: kWh*10
300069	0044h	2	kWh (+) L3	INT32	Value weight: kWh*10
300071	**0046h**	**2**	kWh (+) t1	INT32	Value weight: kWh*10
300073	**0048h**	**2**	kWh (+) t2	INT32	Value weight: kWh*10
300075	004Ah	2	kWh (+) t3	INT32	Not available, value =0
300077	004Ch	2	kWh (+) t4	INT32	Not available, value =0
300079	004Eh	2	kWh (-) TOT	INT32	Value weight: kWh*10
300081	0050h	2	kvarh (-) TOT	INT32	Value weight: kvarh*10
300083	0052h	2	kWh (-) PARTIAL	INT32	Not available, value =0
300085	0054h	2	Kvarh (-) PARTIAL	INT32	Not available, value =0
300087	0056h	2	kVAh TOT	INT32	Not available, value =0
300089	0058h	2	kVAh PARTIAL	INT32	Not available, value =0
300091	005Ah	2	Run hour meter	INT32	Value weight: hours*100, only ET series and EM330
300093	005Ch	2	Run hour meter kWh (-)	INT32	Not available, value =0
300095	005Eh	2	n.a.	INT32	Not available, value =0
300097	0060h	2	kWh (-) L1	INT32	Value weight: kWh*10, only ET series
300099	0062h	2	kWh (-) L2	INT32	Value weight: kWh*10, only ET series
300101	0064h	2	kWh (-) L3	INT32	Value weight: kWh*10, only ET series
300103	0066h	2	kWh (+) t5	INT32	Not available, value =0
300105	0068h	2	kWh (+) t6	INT32	Not available, value =0
300107	006Ah	2	kWh (+) t7	INT32	Not available, value =0
300109	006Ch	2	kWh (+) t8	INT32	Not available, value =0
300111	006Eh	2	n.a.	INT32	Not available, value =0
300113	0070h	2	n.a.	INT32	Not available, value =0
300115	0072h	2	n.a.	INT32	Not available, value =0
300117	0074h	2	n.a.	INT32	Not available, value =0
300119	0076h	2	n.a.	INT32	Not available, value =0
300121	0078h	2	n.a.	INT32	Not available, value =0
300123	007Ah	2	n.a.	INT32	Not available, value =0
300125	007Ch	2	n.a.	INT32	Not available, value =0
300127	007Eh	2	n.a.	INT32	Not available, value =0

300129	0080h	2	n.a.	INT32	Not available, value =0
300131	0082h	2	THD A L1	INT32	Value weight: %*100, not available
300133	0084h	2	THD A L2	INT32	Value weight: %*100, not available
300135	0086h	2	THD A L3	INT32	Value weight: %*100, not available
300137	0088h	2	THD V L-N sys	INT32	Value weight: %*100, not available
300139	008Ah	2	THD V L1-N	INT32	Value weight: %*100, not available
300141	008Ch	2	THD V L2-N	INT32	Value weight: %*100, not available
300143	008Eh	2	THD V L3-N	INT32	Value weight: %*100, not available
300145	0090h	2	THD V L-L sys	INT32	Not available, value =0
300147	0092h	2	THD V L1-L2	INT32	Not available, value =0
300149	0094h	2	THD V L2-L3	INT32	Not available, value =0
300151	0096h	2	THD V L3-L1	INT32	Not available, value =0
300153	0098h	2	An	INT32	Value weight: Ampere*1000, only ET series and EM330 (other cases: value =0)

2.5 Additional energy totalizers with 3-decimal resolution

MODBUS: read only mode with functions code 03 and 04 Table 2.5-1

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
301025	0400h	2	kWh (+) TOT – INTeger part	INT32	Value=INT(kWh)*1 Example: if kWh=1234.567, value=1234
301027	0402h	2	kWh (+) TOT – DECimal part	INT32	Value=DEC(kWh)*1000 Example: if kWh=1234.567, value=567 (Note: the MSW is always 0)
301029	0404h	2	kvarh (+) TOT – INTeger part	INT32	Value=INT(kvarh)*1 Example: if kvarh=1234.567, value=1234
301031	0406h	2	kvarh (+) TOT – DECimal part	INT32	Value=DEC(kvarh)*1000 Example: if kvarh=1234.567, value=567 (Note: the MSW is always 0)
301033	0408h	2	kWh (-) TOT – INTeger part	INT32	Value=INT(kWh)*1 Example: if kWh=1234.567, value=1234
301035	040Ah	2	kWh (-) TOT – DECimal part	INT32	Value=DEC(kWh)*1000 If PFA or X version with meas=A, value=0
301037	040Ch	2	kvarh (-) TOT – INTeger part	INT32	Value=INT(kvarh)*1 If PFA or X version with meas=A, value=0
301039	040Eh	2	kvarh (-) TOT – DECimal part	INT32	Value=DEC(kvarh)*1000 If PFA or X version with meas=A, value=0

Note: These additional totalizers are available only in EM340 manufactured from October 1st 2018 (from serial number YR2018 274xxxS and following)

MODBUS: read only mode with functions code 03 and 04 Table 2.5-2

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
	0500h	4	kWh (+) TOT	INT64	INT64 format: LSW-MSW (less significant word first, most significant word after) Within a word: MSB-LSB (most significant byte first, less significant byte after)
	0504h	4	Kvarh (+) TOT	INT64	
	0508h	4	kWh (+) Partial	INT64	
	050Ch	4	Kvarh (+) Partial	INT64	
	0510h	4	kWh (+) L1	INT64	
	0514h	4	kWh (+) L2	INT64	
	0518h	4	kWh (+) L3	INT64	
	051Ch	4	kWh (-) TOT	INT64	
	0520h	4	kWh (-) Partial	INT64	
	0524h	4	kvarh (-) TOT	INT64	
	0528h	4	kvarh (-) Partial	INT64	
	052Ch	4	kVAh TOT	INT64	Not available, value =0
	0530h	4	kVAh Partial	INT64	Not available, value =0

Note: These additional totalizers are available only in **EM330** manufactured from October 1st 2018 (from serial number YR2018 274xxxS and following)

2.6 Instantaneous variables and meters (grouped by phase)

MODBUS: read only mode with functions code 03 and 04 Table 2.6-1

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
System variables					
300249	00F6h	2	Run hour meter kWh (-)	INT32	Value weight: Ampere*1000, not available
300249	00F8h	2	A n	INT32	Value weight: Ampere*1000, only ET series and EM330 (other cases: value =0)
300251	00FAh	2	THD V L-N sys	INT32	Value weight: %*100, not available
300253	00FCh	2	THD V L-L sys	INT32	Value weight: %*100, not available
300255	00FEh	2	Run hour meter	INT32	Value weight: hours*100, only ET series and EM330
300257	0100h	2	n.a.	INT32	Not available, value =0
300259	0102h	2	V L-N sys	INT32	Value weight: Volt*10
300261	0104h	2	V L-L sys	INT32	Value weight: Volt*10
300263	0106h	2	W sys	INT32	Value weight: Watt*10
300265	0108h	2	VA sys	INT32	Value weight: VA*10
300267	010Ah	2	var sys	INT32	Value weight: var*10
300269	010Ch	2	PF sys	INT32	(*) Value weight: PF*1000
300271	010Eh	2	Phase sequence	INT32	The value "1" corresponds to L1-L3-L2 sequence, the value "0" corresponds to L1-L2-L3 sequence. The phase sequence value is meaningful only in a 3-phase system
300273	0110h	2	Hz	INT32	Value weight: Hz*10
Total energies and dmd power					
300275	0112h	2	kWh (+) TOT	INT32	Value weight: kWh*10
300277	0114h	2	Kvarh (+) TOT	INT32	Value weight: kvarh*10
300279	0116h	2	kWh (-) TOT	INT32	Value weight: kWh*10
300281	0118h	2	kvarh (-) TOT	INT32	Value weight: kvarh*10
300283	011Ah	2	W dmd	INT32	Value weight: Watt*10
300285	011Ch	2	W dmd peak	INT32	Value weight: Watt*10
Phase 1 variables					
300287	011Eh	2	V L1-L2	INT32	Value weight: Volt*10
300289	0120h	2	V L1-N	INT32	Value weight: Volt*10
300291	0122h	2	A L1	INT32	Value weight: Ampere*1000
300293	0124h	2	W L1	INT32	Value weight: Watt*10
300295	0126h	2	VA L1	INT32	Value weight: VA*10
300297	0128h	2	var L1	INT32	Value weight: var*10
300299	012Ah	2	PF L1	INT32	(*) Value weight: PF*1000
Phase 2 variables					
300301	012Ch	2	V L2-L3	INT32	Value weight: Volt*10
300303	012Eh	2	V L2-N	INT32	Value weight: Volt*10
300305	0130h	2	A L2	INT32	Value weight: Ampere*1000
300307	0132h	2	W L2	INT32	Value weight: Watt*10
300309	0134h	2	VA L2	INT32	Value weight: VA*10
300311	0136h	2	var L2	INT32	Value weight: var*10
300313	0138h	2	PF L2	INT32	(*) Value weight: PF*1000
Phase 3 variables					
300315	013Ah	2	V L3-L1	INT32	Value weight: Volt*10
300317	013Ch	2	V L3-N	INT32	Value weight: Volt*10
300319	013Eh	2	A L3	INT32	Value weight: Ampere*1000
300321	0140h	2	W L3	INT32	Value weight: Watt*10
300323	0142h	2	VA L3	INT32	Value weight: VA*10
300325	0144h	2	var L3	INT32	Value weight: var*10
300327	0146h	2	PF L3	INT32	(*) Value weight: PF*1000
Other energies					
300329	0148h	2	kWh (+) PARTIAL	INT32	Value weight: kWh*10
300331	014Ah	2	Kvarh (+) PARTIAL	INT32	Value weight: kvarh*10
300333	014Ch	2	kWh (+) L1	INT32	Value weight: kWh*10
300335	014Eh	2	kWh (+) L2	INT32	Value weight: kWh*10
300337	0150h	2	kWh (+) L3	INT32	Value weight: kWh*10
300339	0152h	2	kWh (+) t1	INT32	Value weight: kWh*10
300341	0154h	2	kWh (+) t2	INT32	Value weight: kWh*10
300343	0156h	2	kWh (+) t3	INT32	Not available, value =0
300345	0158h	2	kWh (+) t4	INT32	Not available, value =0
300347	015Ah	2	kWh (-) PARTIAL	INT32	Not available, value =0
300349	015Ch	2	Kvarh (-) PARTIAL	INT32	Not available, value =0
300351	015Eh	2	kVAh TOT	INT32	Not available, value =0
300353	0160h	2	kVAh PARTIAL	INT32	Not available, value =0
300355	0162h	2	n.a.	INT32	Not available, value =0
300357	0164h	2	n.a.	INT32	Not available, value =0
300359	0166h	2	n.a.	INT32	Not available, value =0
300361	0168h	2	n.a.	INT32	Not available, value =0
300363	016Ah	2	n.a.	INT32	Not available, value =0
300365	016Ch	2	kWh (-) L1	INT32	Value weight: kWh*10, only ET series
300367	016Eh	2	kWh (-) L2	INT32	Value weight: kWh*10, only ET series

300369	0170h	2	kWh (-) L3	INT32	Value weight: kWh*10, only ET series
300371	0172h	2	kWh (+) t5	INT32	Not available, value =0
300373	0174h	2	kWh (+) t6	INT32	Not available, value =0
300375	0176h	2	kWh (+) t7	INT32	Not available, value =0
300377	0178h	2	kWh (+) t8	INT32	Not available, value =0
300379	017Ah	2	n.a.	INT32	Not available, value =0
300381	017Ch	2	n.a.	INT32	Not available, value =0
300383	017Eh	2	n.a.	INT32	Not available, value =0
			Other Phase 1 variables		
300385	0180h	2	THD A L1	INT32	Value weight: %*100, not available
300387	0182h	2	THD V L1-N	INT32	Value weight: %*100, not available
300389	0184h	2	THD V L1-L2	INT32	Value weight: %*100, not available
300391	0186h	2	n.a.	INT32	Not available, value =0
300393	0188h	2	n.a.	INT32	Not available, value =0
300395	018Ah	2	n.a.	INT32	Not available, value =0
300397	018Ch	2	n.a.	INT32	Not available, value =0
300399	018Eh	2	n.a.	INT32	Not available, value =0
300401	0190h	2	n.a.	INT32	Not available, value =0
			Other Phase 2 variables		
300403	0192h	2	THD A L2	INT32	Value weight: %*100, not available
300405	0194h	2	THD V L2-N	INT32	Value weight: %*100, not available
300407	0196h	2	THD V L2-L3	INT32	Not available, value =0
300409	0198h	2	n.a.	INT32	Not available, value =0
300411	019Ah	2	n.a.	INT32	Not available, value =0
300413	019Ch	2	n.a.	INT32	Not available, value =0
300415	019Eh	2	n.a.	INT32	Not available, value =0
300417	01A0h	2	n.a.	INT32	Not available, value =0
300419	01A2h	2	n.a.	INT32	Not available, value =0
			Other Phase 3 variables		
300421	01A4h	2	THD A L3	INT32	Value weight: %*100, not available
300423	01A6h	2	THD V L3-N	INT32	Value weight: %*100, not available
300425	01A8h	2	THD V L3-L1	INT32	Not available, value =0
300427	01AAh	2	n.a.	INT32	Not available, value =0
300429	01ACh	2	n.a.	INT32	Not available, value =0
300431	01AEh	2	n.a.	INT32	Not available, value =0
300433	01B0h	2	n.a.	INT32	Not available, value =0
300435	01B2h	2	n.a.	INT32	Not available, value =0
300437	01B4h	2	n.a.	INT32	Not available, value =0

Note *
Negative values correspond to exported active power, positive values correspond to imported active power.

Note
Table 2.4-1 and 2.5-1 are equivalent and includes a copy of the same variable values.

Note
For meters that support also 1-phase and 2-phase systems, the values relevant to phase 2 and 3 can still be read with a valid value, equal to 0

Programming parameter note: reading values in addresses not specified in the below tables returns an illegal data address exception.

2.7 Firmware version and revision code

MODBUS: read only mode with functions code 03 and 04 Table 2.7-1

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300771	0302h	1	Version code	UINT 16	Value=0: Version “A”, =1: Version “B”, etc.
300772	0303h	1	Revision code	UINT 16	Value=0: Revision “0” etc.

2.8 Carlo Gavazzi Controls identification code

MODBUS: read only mode with functions code 03 and 04 limited to a word at a time

Table 2.8-1

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300012	000Bh	1	Carlo Gavazzi Controls identification code	UINT 16	See table 2.8-2

Table 2.8-2

Complete item number	CG identification code
EM330-DIN AV5 3 L S1 X	332
EM330-DIN AV5 3 L S1 PF A	332
EM330-DIN AV5 3 L S1 PF B	332
EM330-DIN AV5 3 H S1 X	332
EM330-DIN AV5 3 H S1 PF A	332
EM330-DIN AV5 3 H S1 PF B	332
EM330-DIN AV6 3 L S1 X	331
EM330-DIN AV6 3 L S1 PF A	331
EM330-DIN AV6 3 L S1 PF B	331
EM330-DIN AV6 3 H S1 X	331
EM330-DIN AV6 3 H S1 PF A	331
EM330-DIN AV6 3 H S1 PF B	331
EM331-DIN.AV5.3.H.OS.X	355
ET330-DIN AV5 3 L S1 X	335
ET330-DIN AV5 3 H S1 X	335
ET330-DIN AV6 3 L S1 X	336
ET330-DIN AV6 3 H S1 X	336
EM340-DIN AV2 3 X S1 X ENGINEERING SAMPLE ONLY (with MSW-LSW word order)	340
EM340-DIN AV2 3 X S1 X	341
EM340-DIN AV2 3 X S1 PF A	341
EM340-DIN AV2 3 X S1 PF B	341
EM341-DIN AV2 3 X OS X	346
ET340-DIN AV2 3 X S1 X	345

2.9 Programming parameter tables

2.9.1 Password configuration menu

MODBUS: read and write mode

Table 2.9-1

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
304097	1000h	1	PASSWORD (EM only)	UINT 16	Minimum valid value: 0d Maximum valid value: 9999d In ET always 0.

2.9.2 System configuration menu

MODBUS: read and write mode

Table 2.9-2

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
304099	1002h	1	Measuring system	UINT 16	Value=0: “3Pn” (3-phase with neutral) Value=1: “3P” (3-phase without neutral) Value=2: “2P” (2-phase with neutral)

2.9.3 PT and CT configuration menu

MODBUS: read and write mode

Table 2.9-3

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
304100	1003h	2	Current transformer ratio	UINT 32	Value min = 10 (CT=1,0) Value max = 10000 (CT=1000.0)
304102	1005h	2	Voltage transformer ratio	UINT 32	Value min = 10 (VT=1,0) Value max = 10000 (VT=1000.0)

Important note: the maximum (CT ratio)x(VT ratio) for AV5 model is 1057, for AV6 model is 3418.

2.9.4 Dmd and pulse outs configuration menu

MODBUS: read and write mode

Table 2.9-4

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
	1010h	2	Integration time for dmd power calculation	UINT 32	Value min = 1 Value max = 30
	1012h	2	Ton (Ton time for pulse output square wave)	UINT 32	Value min = 0 (30ms) Value max = 1 (100 ms)
	1020h	2	kWh per pulse relevant to digital out 1 (if existing)	UINT 32	
	1022h	2	kWh per pulse relevant to digital out 2 (if existing)	UINT 32	

2.9.5 Other functions configuration menu

MODBUS: read and write mode

Table 2.9-5

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
304353	1100h	1	Display mode	UINT 16	Value min = 0 (Full, default) Value max = 1 (Easy) Any other value = Full
304354	1101h	1	Tariff management enabling	UINT 16	Value min = 0 (OFF) Value max = 1 (ON) Any other value = OFF
304355	1102h	1	Home page selection (EM only)	UINT 16	Value min = 0 (page 0, default) Value max = 19 (page 19) Restrictions in case of display mode = Easy Any other value = page 0 In ET always = 0 EM330 and EM340 only The home page CAN NOT changed in the models with MID certification (PFA and PFB).
304356	1103h	1	Measurement mode selection	UINT 16	Value min = 0 (A) Value max = 1 (B) Any other value = A
304357	1104h	1	Wrong connection (Installing help) management enabling	UINT 16	Value min = 0 (ON) Value max = 1 (OFF) Any other value = ON
304358	1105h	1	Wrong connection (installing help) status	UINT 16	Bit 0 = 1 means: Wrong voltage sequence Bit 1 = 1 means: Phase 1 inverted Bit 2 = 1 means: Phase 2 inverted Bit 3 = 1 means: Phase 3 inverted Bit 4 = 1 means: Phases 1 and 2 exchanged Bit 5 = 1 means: Phases 1 and 3 exchanged Bit 6 = 1 means: Phases 2 and 3 exchanged Bit 7 = 1 means: Phases 1, 2, 3 exchanged In EM/ET330 only a bit at a time can be 1. In EM/ET340 more bits can be 1. In any case a sequence of wiring modifications is needed until the wiring is correct (all bit=0)
304359	1106h	1	THD calculation enabling	UINT 16	Value min = 0 (OFF) Value max = 1 (ON) = DEFAULT Any other value = OFF Available in ET series and EM330 (not present in EM340)
304360	1107h	2	Secondary start-up current of the run hour meter	UINT 32	Value weight: Ampere*1000 Value min = 10 Value max = 6000 Default value = 10 The primary start-up current shall be multiplied by CT ratio. Available in ET series and EM330 (not present in EM340)

2.9.6 Active tariff selection

MODBUS: read and write mode

Table 2.9-6

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
304609	1200h	1	Tariff mode selection (tariff management via digital input or serial comm.)	UINT 16	Value min = 0 (via digital inputs) Value max = 1 (via serial comm.) Any other value = via digital in.
304610	1201h	1	Tariff number selection via serial comm.	UINT 16	Value min = 1 (tariff 1) Value max = 2 (tariff 2) Any other value = tariff 1 If 1200h = 0 (tariff via digital input), this parameter is “read only” mode

2.9.7 Serial port configuration menu

MODBUS: read and write mode

Table 2.9-7

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
308193	2000h	1	RS485 instrument address	UINT 16	Value min = 1 (default) Value max = 247 Any other value = 1
308194	2001h	1	RS485 baud rate	UINT 16	Value 1 = 9.6 kbps (default) Value 2 = 19.2 kbps Value 3 = 38.4 kbps Value 4 = 57.6 kbps Value 5 = 115.2 kbps Any other value = 9.6 kbps
308195	2002h	1	RS485 parity	UINT 16	Value 1= no parity (default) Value 2 = even parity Any other value = no parity
308196	2003h	1	RS485 Stop bit	UINT 16	Value 0 = 1 stop bit Value 1= 1 (default) Value 2 =2 (only if parity is even) Any other value = 1 stop bit
308197	2004h	1	Max number of words readable with a single Modbus request	UINT 16	Value = 50 (words), only reading

Note: The number of stop bits is fixed to “1” if parity is EVEN.

2.9.8 Reset commands

MODBUS: read and write mode

Table 2.9-8

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
316385	4000h	1	Reset of all partial and tariff meters, kWdmd and kWdmd peak.	UINT 16	Value=0: reset done Value=1: execute the command All other values produce no effects
316386	4001h	1	Reset of total energy meters (only for non-MID versions, X option)	UINT 16	Value=0: reset done Value=1: execute the command All other values produce no effects
316387	4002h	1	Reset of run hour meter	UINT 16	Value=0: reset done Value=1: execute the command All other values produce no effects Available in ET series and EM330 (not present in EM340).

2.9.9 Serial number

MODBUS: read only mode

Table 2.9-9

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
320481	5000h	1	Letter 1 (from SX)	UINT 16	MSB: not to be used LSB: ASCII code
320482	5001h	1	Letter 2 (from SX)	UINT 16	MSB: not to be used LSB: ASCII code
320483	5002h	1	Letter 3 (from SX)	UINT 16	MSB: not to be used LSB: ASCII code
320484	5003h	1	Letter 4 (from SX)	UINT 16	MSB: not to be used LSB: ASCII code
320485	5004h	1	Letter 5 (from SX)	UINT 16	MSB: not to be used LSB: ASCII code
320486	5005h	1	Letter 6 (from SX)	UINT 16	MSB: not to be used LSB: ASCII code
320487	5006h	1	Letter 7 (from SX)	UINT 16	MSB: not to be used LSB: ASCII code

2.9-10 Production year

MODBUS: read only mode

Table 2.9-10

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
320497	5010h	1	Production year	UINT 16	

Note
This register is available only in EM330 and EM340 manufactured from October 1st 2018 (from serial number YR2018 274xxxS and following)

3 REVISIONS

- From rev. 2.7 to 2.8:
- assigned a memory address to Neutral current
- changed the name to some variables to have the same indication as in VMU-C and programming software

- From rev. 2.8 to 2.9:
- added THD, run hour meter and An in EM330

- From rev. 2.9 to 2.10:
- added EM331 ID code

- From rev. 2.10 to 2.11:
- modification of “1.3 Application notes. RS485 general considerations” (point 1)
- introduction of electrical limits in “2.3 Maximum and minimum electrical values in EM/ET300 series”

- From rev. 2.11 to 2.12:
- correction of Table 2.9.9 (Serial number)
- hidden THD measurement indications (not available)
- stated the limits for the maximum (CT ratio)x(VT ratio)
- correction of Modicom references in Table 2.9.6 (Active tariff selection)

• From rev. 2.12 to 2.13:
- introduction of additional energy totalizers with 3-decimal resolution for EM340 (Table 2.5-1)
- added the missing indication about the “1P” (1-phase) measuring system adjustment
- introduction of an additional register including the “Production year” reference (Table 2.9-10)

From rev. 2.13 to 2.17:
- modification of the timing table (see Point 1.3.2 _ pag.6)