EM511

COMMUNICATION PROTOCOL

Internal version

rev. 1.8

May 23rd, 2023

Sommario

Energy Management

1   Introduction

The RS485 serial interface supports the MODBUS (RTU) protocol. In this document only the information necessary to read/write from/to EM500 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.

2   MODBUS functions

These functions are available on EM500 SERIES:
- Reading of n "Holding Registers" (code 03h)
- Reading of n "Input Register" (code 04h)
- Writing of one "Holding Registers" (code 06h)
- Writing of one "Holding Registers" (code 10h)
- 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

EM511 Communication Protocol

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 125 registers (words) [250 bytes] with a single request.
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:
Function code	1 byte	83h	01h: illegal function
Exception code	1 byte	01h, 02h, 03h, 04h (see note)	02h: illegal data address
CRC	2 bytes		03h: illegal data value
			04h: slave device failure

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 125 register (word) [250 bytes] with a single request.
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:
Function code	1 byte	84h	01h: illegal function
Exception code	1 byte	01h, 02h, 03h, 04h	02h: illegal data address
CRC	2 bytes		03h: illegal data value
			04h: slave device failure

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:
Function code	1 byte	86h	01h: illegal function
Exception code	1 byte	01h, 02h, 03h, 04h	02h: illegal data address
CRC	2 bytes		03h: illegal data value
			04h: slave device failure

2.4 *Function 10h (Write multiple registers)*

This function code is used to write a block of contiguous registers (maximum 123 word [246 bytes]). The requested values to be written are specified in the request data field. Data is packed as two bytes per register. The correct response returns the function code, starting address, and the quantity of written registers.

Request frame

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 247)	
Function code	1 byte	10h	
Starting Address	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
Quantity of Registers (**N** word)	2 bytes	0001h to 0078h	Byte order: MSB, LSB
Byte count	1 byte	**N** word * 2	
Register value	**N** * 2 bytes	value	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	10h	
Starting Address	2 bytes	0000h to FFFFh	Byte order: MSB, LSB
Quantity of Registers (**N** word)	2 bytes	0001h to 0078h	Byte order: MSB, LSB
CRC	2 bytes		

Response frame (incorrect action)

Description	Length	Value	Note
Physical Address	1 byte	1 to F7 (1 to 247)	Possible exception:
Function code	1 byte	90h	01h: illegal function
Exception code	1 byte	01h, 02h, 03h, 04h	02h: illegal data address
CRC	2 bytes		03h: illegal data value
			04h: slave device failure

EM511 Communication Protocol

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 10h using address 00h.

2.6   ***Application notes***

2.7   ***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 EM500 interface by connecting the terminal B+ 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 1000m or if in the network there are more than 160 instruments (with 1/5 unit load as used in EM500 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 at the host 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.

2.8   ***MODBUS timing***
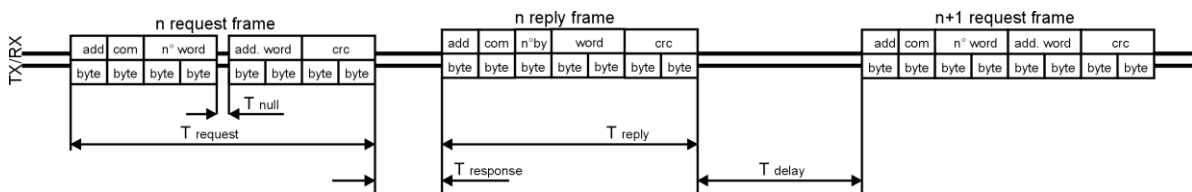
Fig. 1 : 2-wire timing diagram

TIMING CHARACTERISTICS OF READING FUNCTION:	ms
T response: Max answering time	500 ms
T response: Typical answering time	40 ms
T delay: Minimum time before a new query	3,5 char
T null: Max interruption time during the request frame	2,5 char

EM511 Communication Protocol

3 Data Format, Variables and param

3.1 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	$-(1+[1-2^{-23}])\times2^{127} .. 2^{128}$

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.

3.2 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:
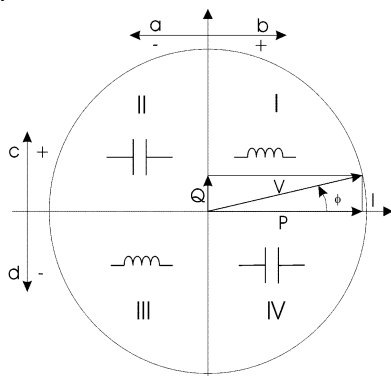
a = Exported active power

b = Imported active power

c = Imported reactive power

d = Exported reactive power

Fig. 2 : Geometric Representation

According to the measurement mode, the following sign convention is used.

- o P < or > 0 (with indication of "-" sign)
- o kWh+ increasing only when P > 0
- o kWh- increasing only when P < 0
- o kvarh+ increasing only when Q > 0
- o kvarh- increasing only when Q < 0
- o PF with ±C or ±L indication

EM511 Communication Protocol

3.3   *Maximum electrical values*

If the input is above the maximum value, the display shows "EEE".
When in "EEE" the relevant modbus variable is represented as 0x7FFF for 16-bit registers, 0x7FFFFFFF for 32-bit registers.

3.4   *Other input error conditions*

There are two particular input conditions that influence different variables other than the one with the value out of range:

- When the frequency is outside the limits, the Voltage, the Current, the PF, the THDs are in error (i.e. the display shows "EEE" and the modbus reading returns 0x7FFF for 16-bit registers, 0x7FFFFFFF for 32-bit registers)

- When the current is below the I_{start} (20mA) the Power Factor is forced to 1 (read as 1000) and the "Inductive/Capacitive Load" is forced to L (read as 1)

EM511 Communication Protocol

4   Part number available

Part Number	Family	SubFamily	Gavazzi Code		FW	Note
			Decimal Format	Hex16 format		
EM511DINAV81XS1X	EM511-IS	X	1792	0700	X	EM511 with RS485, dig IN, standard device
EM511DINAV81XS1PFA	EM511-IS	PFA	1793	0701	PFx	EM511 with RS485, dig IN, MID Absolute Counter
EM511DINAV81XS1PFB	EM511-IS	PFB	1794	0702	PFx	EM511 with RS485, dig IN, MID Bidirectional Counter
EM511DINAV81XS1SFA	EM511-IS	SFA	1795	0702	PFx	EM511 with RS485, dig IN ,SWISS MID Absolute Counter

Protocol ID shall be used into MODBUS map to distinguish the differences between models. If registers are available for every model the FW code shall be substituted with ALL.

EM511 Communication Protocol

Important notes:

- Reading values in addresses not specified in the below tables returns an illegal data address exception;
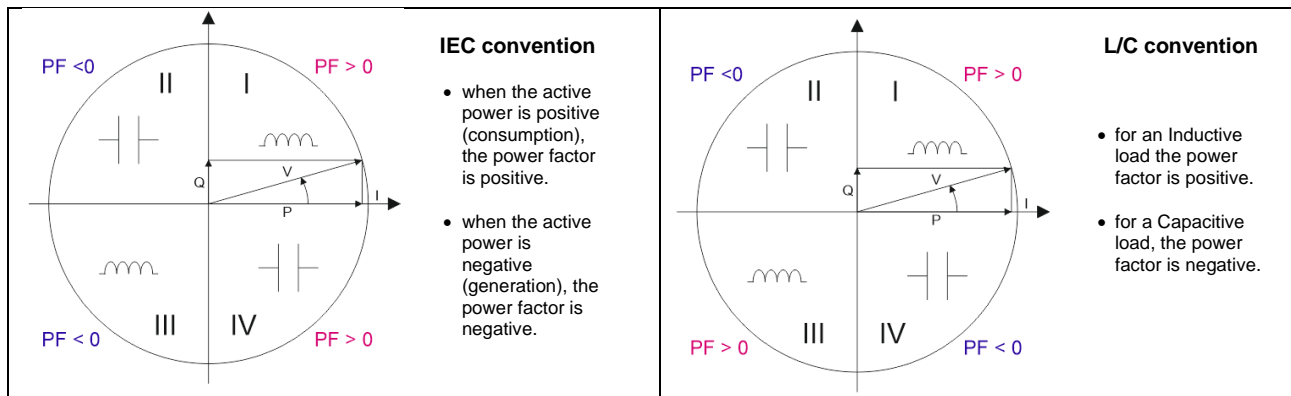- writing is inhibited when in menu Setup or Reset

4.1 *Instantaneous variables and meters (grouped by variable type)*

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

Table 4.1-1

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300001	0000h	2	V L-N	INT32	Value weight: Volt*10
300003	0002h	2	A	INT32	Value weight: Ampere*1000
300005	0004h	2	W	INT32	Value weight: Watt*10
300007	0006h	2	VA	INT32	Value weight: VA*10
300009	0008h	2	Var	INT32	Value weight: var*10
300011	000Ah	2	W dmd	INT32	Value weight: Watt*10
300013	000Ch	2	W dmd peak	INT32	Value weight: Watt*10
300015	000Eh	1	PF (IEC convention – see Note)	INT16	Value weight: PF*1000
300016	000Fh	1	Hz	INT16	Value weight: Hz*10
300017	0010h	2	kWh (+) TOT	INT32	Value weight: kWh*10
300019	0012h	2	Kvarh (+) TOT	INT32	Value weight: kvarh*10
300021	0014h	2	kWh (+) PARTIAL	INT32	Value weight: kWh*10
300023	0016h	2	Kvarh (+) PARTIAL	INT32	Value weight: kvarh*10
300025	0018h	2	kWh (+) t1	INT32	Value weight: kWh*10
300027	001Ah	2	kWh (+) t2	INT32	Value weight: kWh*10
300029	001Ch	2	n.a.	INT32	Not available, value =0
300031	001Eh	2	n.a.	INT32	Not available, value =0
300033	0020h	2	kWh (-) TOT	INT32	Value weight: kWh*10
300035	0022h	2	kvarh (-) TOT	INT32	Value weight: kvarh*10
300037	0024h	2	kWh (-) PARTIAL	INT32	Value weight: kWh*10
300039	0026h	2	kvarh (-) PARTIAL	INT32	Value weight: kvarh*10
300041	0028h	2	kVAh TOT	INT32	Value weight: kVAh*10
300043	002Ah	2	kVAh PARTIAL	INT32	Value weight: kVAh*10
300045	002Ch	2	Hour counter	INT32	Value weight: hours*100
300047	002Eh	2	Hour counter Neg	INT32	Value weight: hours*100,
300049	0030h	2	Lifetime counter	INT32	Value weight: hours*100,
300051	0032h	2	THD A	INT32	Value weight: %*100
300053	0034h	2	THD V L-N	INT32	Value weight: %*100
300055	0036h	2	Hour counter PARTIAL	INT32	Value weight: hours*100
300057	0038h	2	Hour counter Neg PARTIAL	INT32	Value weight: hours*100,
300059	003Ah	2	A dmd	INT32	Value weight: Ampere*1000
300061	003Ch	2	A dmd peak	INT32	Value weight: Ampere*1000
300063	003Eh	2	n.a.	INT32	Not available, value =0
300065	0040h	2	VA dmd	INT32	Value weight: VA*10
300067	0042h	2	VA dmd peak	INT32	Value weight: VA*10
300069 to 300112	0044h to 006Fh		n.a.	INT32	Not available, value =0
300113	0070h	1	PF (L/C convention – see Note)	INT16	Value weight: PF*1000
300114	0071h	1	Inductive/Capacitive Load	INT16	L=+1, C = -1

Note: power factor conventions

4.2   *Instantaneous variables and meters (grouped by phase)*

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

Table 4.2-1

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
System variables					
300257	0100h	2	A	INT32	Value weight: Ampere*1000
300259	0102h	2	V L-N	INT32	Value weight: Volt*10
300261	0104h	2	n.a.	INT32	Not available, value =0
300263	0106h	2	W	INT32	Value weight: Watt*10
300265	0108h	2	VA	INT32	Value weight: VA*10
300267	010Ah	2	var	INT32	Value weight: var*10
300269	010Ch	2	PF (IEC convention – see Note table 4.1-1)	INT32	Value weight: PF*1000
300271	010Eh	2	n.a.	INT32	Not available, value =0
300273	0110h	2	Hz	INT32	Value weight: Hz*10
Total energies and dmd					
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
300287	011Eh	2	n.a.	INT32	Not available, value =0
300289	0120h	2	A dmd	INT32	Value weight: Ampere*1000
300291	0122h	2	A dmd peak	INT32	Value weight: Ampere*1000
300293	0124h	2	n.a.	INT32	Not available, value =0
300295	0126h	2	VA dmd	INT32	Value weight: VA*10
300297	0128h	2	VA dmd peak	INT32	Value weight: VA*10
300287 to 300327	012Ah to 0146h	2	n.a.	INT32	Not available, value =0
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	n.a.	INT32	Not available, value =0
300335	014Eh	2	n.a.	INT32	Not available, value =0
300337	0150h	2	n.a.	INT32	Not available, value =0
300339	0152h	2	kWh (+) t1	INT32	Value weight: kWh*10
300341	0154h	2	kWh (+) t2	INT32	Value weight: kWh*10
300343	0156h	2	n.a.	INT32	Not available, value =0
300345	0158h	2	n.a.	INT32	Not available, value =0
300347	015Ah	2	kWh (-) PARTIAL	INT32	Value weight: kWh*10
300349	015Ch	2	Kvarh (-) PARTIAL	INT32	Value weight: kvarh*10
300351	015Eh	2	kVAh TOT	INT32	Value weight: kVAh*10
300353	0160h	2	kVAh PARTIAL	INT32	Value weight: kVAh *10
300365	016Ch	2	n.a.	INT32	Not available, value =0
300367	016Eh	2	n.a.	INT32	Not available, value =0
300369	0170h	2	n.a.	INT32	Not available, value =0
300371	0172h	2	n.a.	INT32	Not available, value =0
300373	0174h	2	n.a.	INT32	Not available, value =0
300375	0176h	2	n.a.	INT32	Not available, value =0
300377	0178h	2	n.a.	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

Note   Table 4.1-1 and 4.2-1 are equivalent and, apart from the "Hour counter" and "Lifetime" register, includes a copy of the same variable values.

EM511 Communication Protocol

Energy Management

4.3   *Other Instantaneous variables and meters (read only)*

Modicom address	Physical address	Length (words)	VARIABLE ENG. UNIT	Data Format	Notes
300769	0300h	1	Digital input status	INT16	0 = input open 1 = input closed
300770	0301h	1	Active tariff	INT16	0 = no-one 1 = tariff 1 2 = tariff 2
300774	0305h	1	Reserved	UINT 16	
300775	0306h	1	Alarm status	INT16	0 = not active (including waiting for delay to elapse) 1 = active
301279	04FEh	2	Reserved	INT32	
301281	0500h	4	kWh (+) TOT	INT64	Value weight: Wh
301285	0504h	4	Kvarh (+) TOT	INT64	Value weight: VARh
301289	0508h	4	kWh (+) PARTIAL	INT64	Value weight: Wh
301293	050Ch	4	Kvarh (+) PARTIAL	INT64	Value weight: VARh
301297	0510h	4	n.a.	INT64	Not available, value =0
301301	0514h	4	n.a.	INT64	Not available, value =0
301305	0518h	4	n.a.	INT64	Not available, value =0
301309	051Ch	4	kWh (-) TOT	INT64	Value weight: Wh
301313	0520h	4	kWh (-) PARTIAL	INT64	Value weight: Wh
301317	0524h	4	kvarh (-) TOT	INT64	Value weight: varh
301321	0528h	4	kvarh (-) Partial	INT64	Value weight: varh
301325	052Ch	4	kVAh TOT	INT64	Value weight: VAh
301329	0530h	4	kVAh PARTIAL	INT64	Value weight: VAh
301333	0534h	2	Run hour meter	INT32	Value weight: hours*100
301335	0536h	2	Run hour meter kWh (-)	INT32	Value weight: hours*100
301337	0538h	2	Run hour meter PARTIAL	INT32	Value weight: hours*100
301339	053Ah	2	Run hour meter kWh (-) PARTIAL	INT32	Value weight: hours*100
301341	053Ch	2	Hz	INT32	Value weight: Hz*1000
301343	053Eh	2	Run hour Life Counter	INT32	Value weight: hours*100

EM511 Communication Protocol

15

4.4 *Firmware version and revision code*

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

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
300771	0302h	1	Major, Minor and Revision	UINT 16	MSB: Bit 0..3 = Minor Bit 4..7 = Major (e.g. 01000011b / 43h / 67d = 4.3) LSB: Revision	N/A	ALL
300772	0303h	1	Reserved	UINT 16		N/A	ALL
300785	0310h	1	Reserved	UINT 16		N/A	ALL

4.5 *Carlo Gavazzi Controls identification code*

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

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
300012	000Bh	1	Carlo Gavazzi Controls identification code	UINT 16	See Part number available	N/A	ALL

4.6 *Programming parameter tables*

4.6.1 *Password configuration menu*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
304097	1000h	1	PASSWORD	UINT 16	Min value: 0d (no password) Max valid value: 9999d	0	ALL

4.6.2 *DMD time calculation*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
304113	1010h	2	Integration time for DMD power calculation	UINT 32	Value 0 = 1 min Value 1 = 5 min Value 2 = 10 min Value 3 = 15 min Value 4 = 20 min Value 5 = 30 min Value 6 = 60 min	3 (15 min)	ALL

Energy Management

4.6.3 *Alarm configuration*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
304117	1014h	1	Alarm Enable	UINT 16	Value 0 = Disabled Value 1 = Enabled	0 (Disabled)	ALL
304118	1015h	1	Alarm linked	UINT 16	Value 1 = Active Power [kW] Value 2 = Apparent Power [kVA] Value 3 = Reactive Power [kVAR] Value 4 = Power Factor Value 5 = Currents [A] Value 6 = Voltages[V]	1 (Active Power)	ALL
304119	1016h	2	Alarm SetPoint1 (on)	INT 32	Value min -100000 = -1000.00 Value max +100000 = +1000.00 Example: value 123 = 1.23	0 (0,00)	ALL
304121	1018h	2	Alarm SetPoint2 (off)	INT 32	Value min -100000 = -1000,00 Value max +100000 = +1000.00 Example: value 123 = 1.23	0 (0,00)	ALL
304123	101Ah	1	Delay	UINT 16	Value min 0 = 0 [s] Value max 3600 = 3600 [s]	0[s]	ALL

4.6.4 *Tariff enabling*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
304354	1101h	1	Tariff management enabling only for Modbus command management	UINT 16	Value 0 = OFF Value 1 = ON	1 (ON)	ALL

Notes:
- Tariff configuration at "Active Tariff Selection"
- If 1200h register is set to 0, the value of configuration at register 1101h is ignored

4.6.5 *Measure mode*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW	
304356	1103h	1	Measurement mode selection ([1])	UINT 16	Value 0 = A mode (Absolute) Value 1 = B mode (Bidirectional)	0 (A mode) ([1])	X PFx[1]	1.0 1.0

[1] = register is read-only and the default value matches the part number: 0 (A) for PFA, SFA, 1 (B) for PFB.

4.6.6 *Wizard display configuration*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
304362	1109h	1	Quick set up at next power on	UINT 16	Value min = 0 (Disabled menu) Value max = 1 (Enabled menu)	1 (Enabled)	ALL
304363	110Ah	1	*Reserved*	*UINT 16*			ALL

4.6.7 *Hour counter configuration*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
304360	110Bh	2	Primary start-up current of run hour counter (I_st_CountH)	UINT 32	Value weight: Ampere*1000 Value min = 20 -- [20mA] Value max = 45000 [45A]	20 (20mA)	ALL

EM511 Communication Protocol

4.6.8   *Phase – Terminal Block configuration*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW	
304439	1156h	1	Input 1 Current direction	UINT 16	Value 0 = Direct Value 1 = Inverse	0 (Direct)	X	1.0

Note: Not Available for MID version

4.6.9   *Digital input and Active Tariff selection*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
304609	1200h	1	Digital inputs selector	UINT 16	Value 0 = tariff management via digital Value 1 = only remote status input Value 2 = Partial Meter enabled Value 3 = Reset partial counter	1 (Remote)	ALL
304610	1201h	1	Tariff number selection via serial communication	UINT 16	Value 1 = Tariff1 selected Value 2 = Tariff2 selected	1 (Tariff1)	ALL

Notes:
- Remote status always available by protocol or display
- If 1200h register is set to 0, the value of configuration at register 1201h is ignored
- If 1200h register is set to 0, the value of configuration at register 1101h is ignored

4.6.10   *Pages filter, Screen Saver and Home Page*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW	
305633	1600h	1	Pages filter Enable	UINT 16	Value 0 = Disabled Value 1 = Enabled	0 (Disabled)	X PFx[0]	1.0 1.0
305634	1601h	1	Inactivity time enable	UINT 16	Value 0 = Disabled Value 1 = Home (goes to home page after timeout and stays there) Value 2 = Slide (goes to home page after timeout and scrolls pages)	1 (Home)	X PFx[1]	1.0 1.0
305635	1602h	1	Screen Saver time	UINT 16	Value min = 0 (Disabled) Value max = 20 (Seconds)	5	X PFx[2]	1.0 1.0
305636	1603h	1	Home page	UINT 16	Value min = 1 (Page 1) Value max = 25 (Page 25)	1 (Page 1)	X PFx[3]	1.0 1.0
305637	1604h	1	Backlight Time	UINT 16	Value 0 = Always ON Value 1 = 1 min Value 2 = 2 min Value 3 = 5 min Value 4 = 10 min Value 5 = 15 min Value 6 = 30 min Value 7 = 60 min Restart timing on button press	0 (Always ON)	ALL	
	…		Reserved	UINT 16				
305649	1610h	1	Page 1	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	2 (Screensaver)	X PFx[4]	1.0 1.0
305650	1611h	1	Page 2	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	1 (filter)	X PFx[4]	1.0 1.0
305651	1612h	1	Page 3	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	2 (Screensaver)	X PFx[4]	1.0 1.0
305652	1613h	1	Page 4	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	2 (Screensaver)	X PFx[4]	1.0 1.0
305653	1614h	1	Page 5	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	2 (screensaver)	X PFx[4]	1.0 1.0

EM511 Communication Protocol

305654	1615h	1	Page 6	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no filter)	X PFx[4]	1.0 1.0
305655	1616h	1	Page 7	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	1 (filter)	X PFx[4]	1.0 1.0
305656	1617h	1	Page 8	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no filter)	X PFx[4]	1.0 1.0
305657	1618h	1	Page 9	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no filter)	X PFx[4]	1.0 1.0
305658	1619h	1	Page 10	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	1 (filter)	X PFx[4]	1.0 1.0
305659	161Ah	1	Page 11	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	1 (filter)	X PFx[4]	1.0 1.0
305660	161Bh	1	Page 12	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	1 (filter)	X PFx[4]	1.0 1.0
305661	161Ch	1	Page 13	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no Filter)	X PFx[4]	1.0 1.0
305662	161Dh	1	Page 14	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no filter)	X PFx[4]	1.0 1.0
305663	161Eh	1	Page 15	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no filter)	X PFx[4]	1.0 1.0
305664	161Fh	1	Page 16	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no Filter)	X PFx[4]	1.0 1.0
305665	1620h	1	Page 17	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no Filter)	X PFx[4]	1.0 1.0
305666	1621h	1	Page 18	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no filter)	X PFx[4]	1.0 1.0
305667	1622h	1	Page 19	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no filter)	X PFx[4]	1.0 1.0
305668	1623h	1	Page 20	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no filter)	X PFx[4]	1.0 1.0
305669	1624h	1	Page 21	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no Filter)	X PFx[4]	1.0 1.0
305670	1625h	1	Page 22	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no Filter)	X PFx[4]	1.0 1.0
305671	1626h	1	Page 23	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no filter)	X PFx[4]	1.0 1.0
305672	1627h	1	Page 24	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no filter)	X PFx[4]	1.0 1.0
305673	1628h	1	Page 25	UINT 16	0 = no filter 1 = Filter 2 = Screen Saver	0 (no filter)	X PFx[4]	1.0 1.0

Notes:

- PFx[0] : in MID version is Read Only, always 1 (Enabled)

- PFx[1] : in MID version is Read Only, always 1 (Home)

- PFx [2] : in MID version is Read Only, always disabled

- PFx [3] : in MID version is Read Only, always 1

- PFx [4] : in MID version only value 0 and 1 available (no screen saver)

EM511 Communication Protocol

4.7 *Serial port configuration*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
308193	2000h	1	RS485 instrument address	UINT 16	Value min = 1 Value max = 247	1	ALL
308194	2001h	1	RS485 baud rate	UINT 16	Value 1 = 9.6 kbps Value 2 = 19.2 kbps Value 3 = 38.4 kbps Value 4 = 57.6 kbps Value 5 = 115.2 kbps	1 (9.6 kbps)	ALL
308195	2002h	1	RS485 parity	UINT 16	Value 1= no parity Value 2 = even parity	1 (None)	ALL
308196	2003h	1	RS485 Stop bit	UINT 16	Value 0 = 1 stop bit (default) Value 1 = 2 stop bit	0 (1 stop bit)	ALL
308197	2004h	1	RS485 Delay on replay	UINT 16	Value min = 0 Value max = 1000 [ms]	0	ALL

Note:

- The number of stop bits is fixed to "1" if parity is EVEN.

4.8 *Reset commands*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
316388	4003h	1	Reset of total energy counters, total run hour counters (lifetime hour counter excluded) and counters offset (no MID)	UINT 16	Value = 1: command executed Value ≠ 1: no effect	0 (fixed)	X 1.0
316389	4004h	1	Reset of partial energy counters and partial run hour counters	UINT 16	Value = 1: command executed Value ≠ 1: no effect	0 (fixed)	ALL
316390	4005h	1	Reset of DMD, and DMD max values	UINT 16	Value = 1: command executed Value ≠ 1: no effect	0 (fixed)	ALL
316391	4006h	1	Reset Tariff Counters	UINT16	Value = 1: command executed Value ≠ 1: no effect	0 (fixed)	ALL
316417	4020h	1	Factory setting (Restore default)	UINT 16	Write 0x0A0A; after this, there is one second to write 0xC1A0 (into this register) to trigger a "Restore Default". Restores all parameters to their default and restores wizard (no counter)		X 1.0 PFx[1] 1.0

Notes:

- PFx[1] = MID parameters not reset (CT and TOT counters)

- For these registers the write operation triggers the relative function but the register value does not change. Read value is always 0.

	Reset total	Reset partial	Reset Tariff	Reset DMDs
kWh (+) TOT	X*			
Kvarh (+) TOT	X*			
kWh (+) PARTIAL	X*	X		
Kvarh (+) PARTIAL	X*	X		
kWh (-) TOT	X*			
kvarh (-) TOT	X*			
kWh (-) PARTIAL	X*	X		
Kvarh (-) PARTIAL	X*	X		
kVAh TOT	X*			
kVAh PARTIAL	X*	X		
kWh (+) t1			X	
kWh (+) t2			X	
Run hour meter	X*			
Run hour meter kWh (-)	X*			
Run hour meter PARTIAL	X*	X		
Run hour meter kWh (-) PARTIAL	X*	X		

EM511 Communication Protocol

W DMD					X
VA DMD					X
A DMD					X
W DMD MAX					X
VA DMD MAX					X
A DMD MAX					X

* = only for non-MID models

4.9 *Offset*

Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW	
316641	4100h	1	Enable Offset KWh + tot	UINT16	Reads as 0, can be written as 0 or 1. (See procedure below)	0	X	1.0
316642	4101h	1	Enable Offset KWh – tot	UINT16	Reads as 0, can be written as 0 or 1. (See procedure below)	0	X	1.0
316643	4102h	1	Enable Offset Kvarh + tot	UINT16	Reads as 0, can be written as 0 or 1. (See procedure below)	0	X	1.0
316644	4103h	1	Enable Offset Kvarh - tot	UINT16	Reads as 0, can be written as 0 or 1. (See procedure below)	0	X	1.0
316645	4104h	1	Enable Offset KVAh + tot	UINT16	Reads as 0, can be written as 0 or 1. (See procedure below)	0	X	1.0

Modbus functions: 0x03, 0x04 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW	
316897	4200h	4	Offset KWh + tot	UINT64	Value min = 0, Value max = 99999999999 (Wh) See procedure below	0	X	1.0
316901	4204h	4	Offset KWh - tot	UINT64	Value min = 0, Value max = 99999999999 (Wh) See procedure below	0	X	1.0
316905	4208h	4	Offset Kvarh + tot	UINT64	Value min = 0, Value max = 99999999999 (Wh) See procedure below	0	X	1.0
316909	420Ch	4	Offset Kvarh - tot	UINT64	Value min = 0, Value max = 99999999999 (Wh) See procedure below	0	X	1.0
316657	4210h	4	Offset KVAh + tot	UINT64	Value min = 0, Value max = 99999999999 (Wh) See procedure below	0	X	1.0

Writing offset procedure: write 1 into Enable Offset register and then, within 3 s, write the relative offset register. The counter is updated and then the offset is written. Time window closes after 3 s.

4.10 *Serial number*

Modbus functions: 0x03, 0x04

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
320481	5000h	1	Letter 1 (from SX) Letter 2 (from SX)	UINT 16	MSB: ASCII code LSB: ASCII code		ALL
320482	5001h	1	Letter 3 (from SX) Letter 4 (from SX)	UINT 16	MSB: ASCII code LSB: ASCII code		ALL
320483	5002h	1	Letter 5 (from SX) Letter 6 (from SX)	UINT 16	MSB: ASCII code LSB: ASCII code		ALL
320484	5003h	1	Letter 7 (from SX) Letter 8 (from SX)	UINT 16	MSB: ASCII code LSB: ASCII code		ALL
320485	5004h	1	Letter 9 (from SX) Letter 10 (from SX)	UINT 16	MSB: ASCII code LSB: ASCII code		ALL
320486	5005h	1	Letter 11 (from SX) Letter 12 (from SX)	UINT 16	MSB: ASCII code LSB: ASCII code		ALL
320487	5006h	1	Letter 13 (from SX)	UINT 16	MSB: ASCII code LSB: not to be used		ALL
320488	5007h	1	Production year	UINT 16	4 digits (e.g.: "2020")		ALL

EM511 Communication Protocol

Energy Management

4.11 Device Name
Modbus functions: 0x03, 0x04, 0x06 and 0x10

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
320489	5008h	1	Name Configurable	UINT 16	MSB: ASCII code LSB: ASCII code	0000h (empty)	ALL
320490	5009h	1	Name Configurable	UINT 16	MSB: ASCII code LSB: ASCII code	0000h (empty)	ALL
320491	500Ah	1	Name Configurable	UINT 16	MSB: ASCII code LSB: ASCII code	0000h (empty)	ALL
320492	500Bh	1	Name Configurable	UINT 16	MSB: ASCII code LSB: ASCII code	0000h (empty)	ALL
320493	500Ch	1	Name Configurable	UINT 16	MSB: ASCII code LSB: ASCII code	0000h (empty)	ALL
320494	500Dh	1	Name Configurable	UINT 16	MSB: ASCII code LSB: ASCII code	0000h (empty)	ALL
320495	500Eh	1	Name Configurable	UINT 16	MSB: ASCII code LSB: ASCII code	0000h (empty)	ALL
320496	500Fh	1	Name Configurable	UINT 16	MSB: ASCII code LSB: ASCII code	0000h (empty)	ALL

4.12 Device state

Modbus functions: 0x03, 0x04

Modicom address	Physical address	Length [word]	VARIABLE ENG. UNIT	Data Format	Notes	Default	FW
320499	5012h	1	Device state	UINT 16	Value 0 = RUN Value 1 = FAULT (prevails on value "2")	N/A	ALL
320500	5013h	2	Reserved	UINT32	Internal use	N/A	N/A
320502	5015h	2	Reserved	UINT32	Internal use	N/A	N/A
320504	5017h	2	Reserved	UINT32	Internal use	N/A	N/A
320506	5019h	1	Reserved	UINT16	Internal use	N/A	N/A
320521	5028h	2	Reserved	UINT 32	Internal use	N/A	N/A
320523	502Ah	2	Reserved	UINT 32	Internal use	N/A	N/A
320525	502Ch	2	Reserved	UINT 32	Internal use	N/A	N/A
320527	502Eh	2	Reserved	UINT 32	Internal use	N/A	N/A
320529	5030h	2	Reserved	UINT 32	Internal use	N/A	N/A

5   Changelog

Revisions	Date	Authors	Note
Rev. 1.0	24/Jul/2020		Start from EM111 (EVO) rev 2.10 and EM530/540 Add new part number Add new register from FRS Filled FW column
Rev. 1.1	26/Jun/2021	M. Lunardi	Added addresses for new registers and for High resolution registers Added "Digital Input Status" and "Active Tariff" registers Updated Max value for offset counters
Rev. 1.2	08/Jul/2022	M. Lunardi	Reformatted document Added Wizard display configuration Updated ranges, max, min Updated Gavazzi Code Updated FW column Removed pages 26 and 27
Rev. 1.3	08/Sep/2022	M. Lunardi	Added more details on modbus values when the variable is out of range.
Rev. 1.4	24/Oct/2022	M. Lunardi	Updated default setting of Pages and Digital input
Rev. 1.5	14/Nov/2022	M. Lunardi	Added chapter 3.4 which describes other conditions that could cause values to be out of range.
Rev. 1.6	7/Dec/2022	M. Lunardi	Added registers 0070h (PF WM30 style) and 0071h (PF load). Changed out of range condition of PF when the current was below I$_{start}$ (FW 1.1.3).
Rev. 1.7	03/May/2023	M. Lunardi	Fixed n/a addresses between *VA dmd peak* and *PF (WM30 style)*
Rev. 1.8	23/May/2023	L. De Col	Improved description of PF conventions (IEC or L/C) in tables 4.1-1 and 4.2-1.

EM511 Communication Protocol