Inbuilt Modbus Protocol

Technical description

Revision 1.42
January 2016

1. Revisions History

Revision 1.0 original version
Revision 1.1 We introduced some corrections to the document (several errors in the protocol descriptions, without any real modification to the protocol itself).
Revision 1.2 Two new products (ECSEM113 and ECSEM114MID) added to the available list
Revision 1.3 Full revision of products list
Revision 1.4 One new product (ECSPM61) added to the products list
Revision 1.41 The name of ECSPM60 corrected in ECSPM61, and some other marginal correction.
Revision 1.42 One new product (ECSEM252 no MID version, and ECSEM253MID MID version) added to the products list

2. Preface

2.1. Overview

The present guide describes the RTU Modbus Protocol when implemented inside the Energy Meters, Power Meters and LED Network Analyzers of Herholdt Controls Srl. In these meters, ASCII Protocol is not supported.

The physical layer is standard RS-485.
The link parameters are selectable in the following ranges:
- Baud Rate: selectable among 1200, 2400, 4800, 9600, 19200 and 38400 in all all devices, except Network Analyzers (ECSAN03 and 04) and 32A single phase Energy Meters (ECSEM252 and 253MID), for which 38400 Baud rate is not available.
- Bits per byte: 8 (fixed)
- Parity: selectable among None, Even and Odd in all Energy and Power Meters. In Network Analyzers, it is a fixed parameter (always Parity=None)
- Number of Stop Bits: selectable between 1 and 2 in all Energy and Power Meters. In Network Analyzers, it is a fixed parameter (always 1 Stop Bit)

In Power and Energy Meters, the following parameters are configurable by means of keyboard/display interface and also by means of Modbus Protocol itself:
- Address (1…247)
- BaudRate (1200…38400, or 1200…19200 in ECSEM252 and 253MID)
- Parity (None, Odd or Even)
- Number of Stop Bits (1 or 2)

In LED Network Analyzers, the following parameters are configurable by means of keyboard/display interface and also by means of Modbus Protocol itself:
- Address (1…247)
- BaudRate (1200…19200)

Refer to the product instruction manual for parameters' modification by means of display/keyboard. The procedure differs from product to product.

When you order a product with inbuilt Modbus, you can choose between Big Endian format and Little Endian format, The default is Little Endian. The meaning of this feature will be explained later.

In the following table you can see the Herholdt Control products with inbuilt Modbus, including their available baud rates:

Energy Meter	1phase	32A	ECSEM252	1200…19200 baud	Selectable Parity & stop bits
Energy Meter	1phase	32A	ECSEM253MID	1200…19200 baud	Selectable Parity & stop bits
Energy Meter	1phase	63A	ECSEM213	1200…38400 baud	Selectable Parity & stop bits
Energy Meter	1phase	63A	ECSEM214MID	1200…38400 baud	Selectable Parity & stop bits
Energy Meter	1phase	125A	ECSEM106	1200…38400 baud	Selectable Parity & stop bits
Energy Meter	1phase	125A	ECSEM107MID	1200…38400 baud	Selectable Parity & stop bits
Energy Meter	3phase	../1-5A	ECSEM226	1200…38400 baud	Selectable Parity & stop bits
Energy Meter	3phase	../1-5A	ECSEM227MID	1200…38400 baud	Selectable Parity & stop bits
Energy Meter	3phase	63A	ECSEM113	1200…38400 baud	Selectable Parity & stop bits
Energy Meter	3phase	63A	ECSEM114MID	1200…38400 baud	Selectable Parity & stop bits
Power Meter	3phase	../1-5A	ECSPM48	1200…38400 baud	Selectable Parity & stop bits
Power Meter	3phase	63A	ECSPM50	1200…38400 baud	Selectable Parity & stop bits
Network Analyzer	3phase	../5A	ECSAN04	1200…19200 baud	
Network Analyzer	3phase	80A	ECSAN03	1200…19200 baud	
Power Meter EVO	3phase	../5A	ECSPM61	1200…38400 baud	Selectable Parity & stop bits

Note:
In the rest of this document, we will use the term "counter" to indicate a generic Energy Meter, Network Analyzer or Power Meter.

2.2. Default settings

These are the factory default settings:

- Protocol: Modbus RTU
- Modbus Address: 001
- Baud rate: 19200 bit/s
- Parity: None
- Stop bits: 1
- Big Endian/Little Endian (once fixed in factory, not changeable anymore. In case there is no specific agreement between herholdt Controls and the Customer, Big Endian is the default choice)

3. Modbus commands

The protocol supports only two functions, one for reading the register values, one for writing the configuration registers and/or to issue some commands. The reading is only possible for a block of registers (the command for a single register reading is not supported, but, of course, it is possible to read a block of one register only).

3.1. Read holding registers (function code 03)

This function code is used to read the contents of a contiguous block of holding registers. The Request frame specifies the starting register address and the number of registers.
The register data in the response message are packed as two bytes per register, with the binary contents left justified within each byte.
As we shall see in the next paragraphs:
- In case of Little Endian format, the first byte contains the least significant bits and the second contains the most significant bits.
- In case of Big Endian format, the first byte contains the most significant bits and the second contains the least significant bits.

In many cases, a value is stored in more than one register (more than one word of 16 bits). For example, the active energy is represented using 4 registers (4 words or 8 bytes). Please refer to the chapter "Internal registers" for details.

Maximum consecutive 100 registers
The maximum number of registers that can be read with a single reading request is 100. If the master tries to read more that 100 holding registers, the device will send an answer with Exception code 0x02 (illegal address). Of course, the minimum is 1 holding register.

Master Request for Read holding registers function

ADR	03	STh	STl	NRh	NRl	CRCh	CRCl

ADR Modbus Address
03 Read holding register function code (fixed)
STh Starting address register (high order bits)
STl Starting address register (low order bits)
NRh Number of registers (high order bits)
NRl Number of registers (low order bits)
CRCh Modbus Checksum (high order bits)
CRCl Modbus Checksum (low order bits)

3.2. Preset single register (function code 06)

This function code is used to write a single holding register in a slave counter. The Request specifies the address of the register to be written. The normal answer is an echo of the request, returned after the register contents have been written.

Master Request for Preset Single Register function

ADR	06	RAH	RAL	VALUE_H	VALUE_L	CRCh	CRCl

ADR	Modbus Address
06	Write single register function code (fixed)
RAH	Register address (MSbyte)
RAL	Register address (LSbyte)
VALUE_H	Register value (MSbyte)
VALUE_L	Register value (LSbyte)
CRCh	Modbus Checksum (MSbyte)
CRCl	Modbus Checksum (LSbyte)

3.3. Registers Addressing convention

The addresses of the registers listed in the following tables are exactly those that must be included in the Modbus Master reading/preset requests. There are some very well known Master Tools, freely downloadable from some Websites, in which you must write the address value N+1 when you want to read or preset the Holding Register N.

3.4. Values Reading conventions

As above explained, a reading request can ask for 1 to 100 registers. Each register is 2 bytes long. For example, suppose you want to read 4 holding register, starting from address 4119 from a slave at address 1. The reading request shall be:

0x01	0x03	0x10	0x17	0x00	0x04	0xF0	0xCD
slave address	Read holding registers function code	High and low byte of the address of the first register to be read (0x1017 = 4119)		High and low byte of the number of registers to be read (0x0004 = 4)		High and low byte of CRC16 calculation	

The answer will be:

0x01	0x03	0x08	…	…	…	…	…	…	…	…	…	…
same byte as in reading request		n. of data bytes in the answer (2 per register)	2 bytes of register at address 4119		2 bytes of register at address 4120		2 bytes of register at address 4121		2 bytes of register at address 4122		High and low byte of CRC16 calculation	

The way the data of registers are stored inside the answer depends on two options:

- **Big Endian** or **Little Endian** (meaningful for all registers excepts those containing ASCII strings)
- **Integer** or **Floating Point format** (meaningful for numerical values only)

3.4.1. Big Endian / Little Endian Selection

This option is configurable in factory only, hence it must be specified inside or before the purchasing order, with some agreement beteen the Customer and Herholdt Controls. This option affects the way the data are entered in the answers to a reading request. It affects all data (all holding registers) except Product Identification string (addresses from 4014 to 4110).

The values that are completely contained in one word (2 bytes), are inserted in the answer in one of the following ways: High Byte – Low Byte in case of Big Endian, or Low Byte – High Byte in case of Little Endian.
For example, suppose you are reading the Modbus Baud Rate value (register address = 4112) and that its value is = 19200 (=0x4B00 in hex notation).

- in case of Little Endian you will read 0x00 0x4B
- in case of Big Endian you will read 0x4B 0x00

The data belonging to an ASCII string (as the Product Identification) are not affected by this choice: they are always inserted in the natural sequence of the string. For example, when reading 2 registers (four bytes) of the Product Identification Code with the following characters "A2 z" (ASCII code 65, 50, 32, 122 in decimal notation, 0x41, 0x32, 0x20 and 0x7A in hex. notation) the data will have the following sequence: 0x41 0x32 0x20 0x7A

The data containing numerical values (that have a length of 2 or 4 registers, ie 4 or 8 bytes) are affected not only by BE/LE options, but also Integer/Floating Pont, selection, as you shall se in the next paragraph.

BE/LE selection does not affect the Preset Function. In the writing request, data are expected to be inserted in Big Endian sequence, regardless of the BE/LE selection. For example, in order to write a new value into the Modbus Baud Rate Register (register address 4112), the message is the following.

0x02	0x06	0x10	0x10	0x4B	0x00	0xBA	0x0C
slave address	Preset single Register function code	High and low byte of the address of register to be written (0x1010 = 4112)		High and low byte of the Baud Rate value (0x4B00 = 19200)		High and low byte of CRC16 calculation	

3.4.2. *Integer / Floating Point Selection*

This option is configurable through Modbus itself (with a Preset Single Register request at Register 4117). This options affects only the numerical values (instantaneous measures and accumulated energies). Inside the register list, in the next chapter, in case the value is numerical, it is tagged with N4 or N8:

N4 means:
4 bytes (2 registers) values
Voltages (Unit=Volt), Currents (Unit=Amp), Phase Powers (Unit=kW, kvar or kVA), Power Factors (from -1 to +1), Frequency (Unit=Hertz), THDs (unit=%), Maximum Demand Values (unit=kW, kvar or kVA), Maximum Peak Values (Unit = kW, Volt or Amp)

N8 means:
8 bytes (4 registers) values
All Energies, including Partial Energies (Unit=kWh or kvarh) and 3Phase Powers (Unit=kW, kvar or kVA)
Depending on the Integer/Floating Point and on the Big Endian/Little Endian selections, data will be inserted in the answer to a reading request in the different ways.

In case of Integer selection:

- a 4 bytes value (ie 2 registers value) is intended to be read multiplied by 10000. Suppose that a reading request of Phase 1 Apparent Power provides a read value = 65708700, it means the Phase 1 Apparent Power = 6570.8700 kVA.
- A 8 bytes value (ie 4 registers value) is more complicated.
  The value stored in the first 4 bytes must be multiplied by a factor of 10^9 (1000000000).
  Then it must be added to the value stored in the following 4 bytes.
  Finally, the result must be divided by 10000.
  Example: Imported T1 Active Energy for Phase 2 (addresses 4139, 4140, 4141 & 4142
  Integer value (most significat 4 bytes): 12344
  Integer value (less significant 4 bytes): 765532
  Original value: (12344*1000000000+765532)/10000=1234400076,5532 (kWh)

In case of Floating Point selection, the 32 bit Single Precision Floating Point notation is adopted (IEEE ANSI 754) is adopted:

SEEEEEEE EMMMMMMM MMMMMMMM MMMMMMMM
S = sign bit (1=negative)
EEEEEEEE = 8 bits of exponent, with 127 of bias. Exponent = EEEEEEEE-127.
MM…MMM = 23 bits of mantissa. These are fractional parte of the number, to be added to an implicit 1.0
(refer to Wikipedia page for more details: http://en.wikipedia.org/wiki/Single-precision_floating-point_format)
With floating point notation, the value is directly read in the assigned unit (no adaptation is required)

- a 4 bytes value (ie 2 registers value) is read at the same addresses as in case of Integer option, because it takes the same number of bytes
- In case of values that takes 8 bytes (4 registers, the FP value is read at the first two addresses, and the remaining two registers are read as null. (Be aware that, with this choice, the resolution of the read value is limited to 23 bits, hence less then 6 decimal digits)

3.4.3. *Reading a 4 bytes Value*

Suppose you want to read Voltage of L1-N (addresses 4267, 4268) and that the value of the voltage is 226.85 Volt.
In case of **Integer / Big Endian** you will read

```
0x00  0x22  0x9D  0x54        (0x00229D54 = 2268500, hence voltage is 22685/10000=226.85)
```

In case of **Integer / Little Endian** you will read

```
0x22  0x00  0x54  0x9D        because both registers have high and low bytes swapped
```

In case of **Floating Point / Big Endian** you will read (in fp format 226.85 = 0x43 0x62 0xD9 0x9A)

```
0x43  0x62  0xD9  0x9A        floating point is in the “natural sequence”
```

In case of **Floating Point / Little Endian** you will read

```
0x9A  0xD2  0x62  0x43        floating point read in reverse bytes sequence
                              MMMMMMMM MMMMMMMM MMMMMMME EEEEEEES
```

3.4.4. *Reading a 8 bytes Value*

Suppose you want to read “Active Energy 1st phase T1, imp (kWh)” and that its value is 187642,7800 kWh.
In case of **Integer / Big Endian** you will read

```
0x00  0x00  0x00  0x01  0x34  0x3D  0x3A  0x18
```

(as explained above, the value of the upper part of the integer (MS 4 bytes) is multiplied by 10^9, then the value of the 4 LS bytes is added. Finally, the result must be divided by 10000.)
4 MS bytes = 0x00000001 = 1
4 LS bytes = 0x343D3A18 = 876427800
Value = (1*10^9 + 876427800)/10000 = 187642,7800

In case of **Integer / Little Endian** you will read

```
0x00  0x00  0x01  0x00  0x3D  0x34  0x18  0x3A
```

(because all 4 registers registers have high and low bytes swapped)

In case of **Floating Point / Big Endian** you will read (in fp format 187642,7800 = 0x48 0x37 0x3E 0Xb2)

```
0x48  0x37  0x3E  0xB2  0x00  0x00  0x00  0x00
floating point is in the “natural sequence”, with 4 LS bytes not used, read as null
```

In case of **Floating Point / Little Endian** you will read

```
0xB2  0x3E  0x37  0x48  0x00  0x00  0x00  0x00
floating point read in reverse bytes sequence, with 4 LS bytes nos used, read as null
```

4. Internal registers

This is the complete list of the internal registers; some of them are different depending on the model.
LEGENDA:
Register access
R the register is read only
R/W the register is readable and writable
R=0 the re4gister is read only, and its value is always = 0
W, R=0 the register is writable, but its reading gives always a value = 0 (typically for commands)
NA the register is neither readable nor writable (any access is refused with Illegal address exception)

Type:
N4 numerical value (2 consecutive registers, 4 bytes) see previous paragraph for more details
N8 numerical value (4 consecutive registers, 8 bytes) see previous paragraph for more details
ASCII a pair of ASCII characters (not affected by Big Endian/Little Endian)
Blank non numerical value

Register Address	Register Tag	Single Phase Energy Meters 32A EM252 EM253MID	Single Phase Energy Meters 63 & 125A EM106 EM107MID EM213 EM214MID	Three Phase Energy Meters EM226 EM227MID EM113 EM114MID	Three Phase Power Meters PM48 PM50	Network Analyzers AN04 AN03	Graphic LCD Power Meter "EVO" PM61	Type
4088	Device_Description_and_Status	NA	NA	NA	NA	NA	R	
4089 & 4090	Maximum_Input_Phase_Current [Ampere]	NA	NA	NA	NA	NA	R	N4
4091	CT_ratio	NA	NA	NA	NA	NA	R	
4092	VT_ratio (future use, now always read as 0x0001)	NA	NA	NA	NA	NA	R	
4093	Current Year_and_Month	NA	NA	NA	NA	NA	R	
4094	Current Day_and_Hour	NA	NA	NA	NA	NA	R	
4095	Current Minute_and_Second	NA	NA	NA	NA	NA	R	
4096	Desired Year_and_Month	NA	NA	NA	NA	NA	R/W	
4097	Desired Day_and_Hour	NA	NA	NA	NA	NA	R/W	
4098	Desired Minute_and_Second	NA	NA	NA	NA	NA	R/W	
4099	Device type	R	R	R	R	R	R	
4100	Firmware version	R	R	R	R	R	R	
4101	Range overflow alarm	R=0	R	R	R	R	R	
4102	Running tariff	R=0	R	R	R	R	R	
4103	Read-only not used register.	R=0	R=0	R=0	R=0	R=0	R=0	
4104	PID (Product Identification) bytes 1 and 2	R	R	R	R	R	R	ASCII
4105	PID – bytes 3 and 4	R	R	R	R	R	R	ASCII
4106	PID – bytes 5 and 6	R	R	R	R	R	R	ASCII
4107	PID – bytes 7 and 8	R	R	R	R	R	R	ASCII
4108	PID – bytes 9 and 10	R	R	R	R	R	R	ASCII
4109	PID – bytes 11 and 12	R	R	R	R	R	R	ASCII
4110	PID – bytes 13 and 14	R	R	R	R	R	R	ASCII
4111	Not used read/write register.	R=0	R=0	R=0	R=0	R=0	R=0	
4112	Modbus Baud Rate	R/W	R/W	R/W	R/W	R/W	R/W	
4113	Modbus Parity	R/W	R/W	R/W	R/W	R	R/W	
4114	Modbus Stop Bits	R/W	R/W	R/W	R/W	R	R/W	
4115	Modbus Address	R/W	R/W	R/W	R/W	R/W	R/W	
4116	Not used read/write register.	R=0	R=0	R=0	R=0	R=0	R=0	
4117	Float Integer format	R/W	R/W	R/W	R/W	R/W	R/W	
4118	Reset energy counters command	W, R=0	W, R=0	W, R=0	W, R=0	W, R=0	W, R=0	
4119… 4122	Active Energy (L1, T1, imported) [kWh]	R	R	R	R	R	R	N8
4123… 4126	Active Energy (L2, T1, imported) [kWh]	R=0	R=0	R	R	R	R	N8
4127… 4130	Active Energy (L3, T1, imported) [kWh]	R=0	R=0	R	R	R	R	N8
4131… 4134	Active Energy (Σ, T1, imported) [kWh]	R=0	R=0	R	R	R	R	N8
4135… 4138	Active Energy (L1, T2, imported) [kWh]	R=0	R	R	R	R	R	N8
4139… 4142	Active Energy (L2, T2, imported) [kWh]	R=0	R=0	R	R	R	R	N8
4143… 4146	Active Energy (L3, T2, imported) [kWh]	R=0	R=0	R	R	R	R	N8

4147… 4150	Active Energy (Σ, T2, imported) [kWh]	R=0	R=0	R	R	R	R	N8
4151 & 4152	Active Power (L1) [kW]	R	R	R	R	R	R	N4
4153 & 4154	Active Power (L2) [kW]	R=0	R=0	R	R	R	R	N4
4155 & 4156	Active Power (L3) [kW]	R=0	R=0	R	R	R	R	N4
4157… 4160	Active Power (Σ) [kW]	R=0	R=0	R	R	R	R	N4
4161… 4164	Active Energy (L1, T1, exported) [kWh]	R	R	R	R	R	R	N8
4165… 4168	Active Energy (L2, T1, exported) [kWh]	R=0	R=0	R	R	R	R	N8
4169… 4172	Active Energy (L3, T1, exported) [kWh]	R=0	R=0	R	R	R	R	N8
4173… 4176	Active Energy (Σ, T1, exported) [kWh]	R=0	R=0	R	R	R	R	N8
4177… 4180	Active Energy (L1, T2, exported) [kWh]	R=0	R	R	R	R	R	N8
4181… 4184	Active Energy (L2, T2, exported) [kWh]	R=0	R=0	R	R	R	R	N8
4185… 4188	Active Energy (L3, T2, exported) [kWh]	R=0	R=0	R	R	R	R	N8
4189… 4192	Active Energy (Σ, T2, exported) [kWh]	R=0	R=0	R	R	R	R	N8
4193… 4196	Reactive Energy (L1, T1, imported) [kvarh]	R=0	R	R	R	R	R	N8
4197… 4200	Reactive Energy (L2, T1, imported) [kvarh]	R=0	R=0	R	R	R	R	N8
4201… 4204	Reactive Energy (L3, T1, imported) [kvarh]	R=0	R=0	R	R	R	R	N8
4205… 4208	Reactive Energy (Σ, T1, imported) [kvarh]	R=0	R=0	R	R	R	R	N8
4209… 4212	Reactive Energy (L1, T2, imported) [kvarh]	R=0	R	R	R	R	R	N8
4213… 4216	Reactive Energy (L2, T2, imported) [kvarh]	R=0	R=0	R	R	R	R	N8
4217… 4220	Reactive Energy (L3, T2, imported) [kvarh]	R=0	R=0	R	R	R	R	N8
4221… 4224	Reactive Energy (Σ, T2, imported) [kvarh]	R=0	R=0	R	R	R	R	N8
4225… 4228	Reactive Energy (L1, T1, exported) [kvarh]	R=0	R	R	R	R	R	N8
4229… 4232	Reactive Energy (L2, T1, exported) [kvarh]	R=0	R=0	R	R	R	R	N8
4233… 4236	Reactive Energy (L3, T1, exported) [kvarh]	R=0	R=0	R	R	R	R	N8
4237… 4240	Reactive Energy (Σ, T1, exported) [kvarh]	R=0	R=0	R	R	R	R	N8
4241… 4244	Reactive Energy (L1, T2, exported) [kvarh]	R=0	R	R	R	R	R	N8
4245… 4248	Reactive Energy (L2, T2, exported) [kvarh]	R=0	R=0	R	R	R	R	N8
4249… 4252	Reactive Energy (L3, T2, exported) [kvarh]	R=0	R=0	R	R	R	R	N8
4253… 4256	Reactive Energy (Σ, T2, exported) [kvarh]	R=0	R=0	R	R	R	R	N8
4257 & 4258	Reactive Power (L1) [kvar]	R=0	R	R	R	R	R	N4
4259 & 4260	Reactive Power (L2) [kvar]	R=0	R=0	R	R	R	R	N4
4261 & 4262	Reactive Power (L3) [kvar]	R=0	R=0	R	R	R	R	N4
4263… 4266	Reactive Power (Σ) [kvar]	R=0	R=0	R	R	R	R	N8
4267 & 4268	Phase Voltage (L1-N) [Volt]	R	R	R	R	R	R	N4
4269 & 4270	Phase Voltage (L2-N) [Volt]	R=0	R=0	R	R	R	R	N4
4271 & 4272	Phase Voltage (L2-N) [Volt]	R=0	R=0	R	R	R	R	N4
4273 & 4274	System Voltage (L1-L2) [Volt]	R=0	R=0	R	R	R	R	N4
4275 & 4276	System Voltage (L2-L3) [Volt]	R=0	R=0	R	R	R	R	N4

4277 & 4278	System Voltage (L3-L1) [Volt]	R=0	R=0	R	R	R	R	N4
4279 & 4280	Current (L1) [Ampere]	R	R	R	R	R	R	N4
4281 & 4282	Current (L2) [Ampere]	R=0	R=0	R	R	R	R	N4
4283 & 4283	Current (L3) [Ampere]	R=0	R=0	R	R	R	R	N4
4285 & 4286	Apparent Power (L1) [kVA]	R=0	R	R	R	R	R	N4
4287 & 4288	Apparent Power (L2) [kVA]	R=0	R=0	R	R	R	R	N4
4289 & 4290	Apparent Power (L3) [kVA]	R=0	R=0	R	R	R	R	N4
4291… 4294	Apparent Power (Σ) [kVA]	R=0	R=0	R	R	R	R	N8
4295 & 4296	Power Factor (L1)	R	R	R	R	R	R	N4
4297 & 4298	Power Factor (L2)	R=0	R=0	R	R	R	R	N4
4299 & 4300	Power Factor (L3)	R=0	R=0	R	R	R	R	N4
4301 & 4302	Power Factor (Σ)	R=0	R=0	R	R	R	R	N4
4303 & 4304	Frequency [Hz]	R	R	R	R	R	R	N4
4305 & 4306	Voltage Total Harmonic Distortion (L1) [%]	NA	R=0	R=0	R	NA	R	N4
4307 & 4308	Voltage Total Harmonic Distortion (L2) [%]	NA	R=0	R=0	R	NA	R	N4
4309 & 4310	Voltage Total Harmonic Distortion (L3) [%]	NA	R=0	R=0	R	NA	R	N4
4311 & 4312	Current Total Harmonic Distortion (L1) [%]	NA	R=0	R=0	R	NA	R	N4
4313 & 4314	Current Total Harmonic Distortion (L2) [%]	NA	R=0	R=0	R	NA	R	N4
4315 & 4316	Current Total Harmonic Distortion (L3) [%]	NA	R=0	R=0	R	NA	R	N4
4317 & 4318	Residual Leakage Current [Ampere]	NA	R=0	R	R	NA	R	N4
4319… 4222	Total Active Energy (Σ, T1+T2, imported) [kWh]	NA	R	R	R	NA	R	N8
4323… 4326	Total Active Energy (Σ, T1+T2, exported) [kWh]	NA	R	R	R	NA	R	N8
4327… 4330	Partial Active Energy (Σ, T1, imported) [kWh]	NA	R	R	R	NA	R	N8
4331… 4334	Partial Active Energy (Σ, T2, imported) [kWh]	NA	R	R	R	NA	R	N8
4335… 4338	Partial Active Energy (Σ, T1, exported) [kWh]	NA	R	R	R	NA	R	N8
4339… 4342	Partial Active Energy (Σ, T2, exported) [kWh]	NA	R	R	R	NA	R	N8
4343 … 4499	Not used read only registers	NA	NA	NA	NA	NA	R=0	
4500	Events Reset Commands	NA	NA	NA	NA	NA	W, R=0	
4501	Maximum Demand Interval	NA	NA	NA	NA	NA	R/W	
4502	Last Time and Date of Max.Dem. Reset (Year_and_Month)	NA	NA	NA	NA	NA	R	
4503	Last Time and Date of Max.Dem. Reset (Day_and_Hour)	NA	NA	NA	NA	NA	R	
4504	Last Time and Date of Max.Dem. Reset (Minute_and_Second)	NA	NA	NA	NA	NA	R	
4505 & 4506	Maximum Demand of Imported Active Power (kW →) since the beginning of the current month (Current_Month_kW_Maxd)	NA	NA	NA	NA	NA	R	N4
4507 & 4508	Maximum Demand of Imported Active Power (kW →) during the last month (Last_Month_kW_Maxd)	NA	NA	NA	NA	NA	R	N4
4509 & 4510	Maximum Demand of Imported Reactive Power (kvar →) since the beginning of the current month (Current_Month_kvar_Maxd)	NA	NA	NA	NA	NA	R	N4
4511 & 4512	Maximum Demand of Imported Reactive Power (kvar →) during the last month (Last_Month_kvar_Maxd)	NA	NA	NA	NA	NA	R	N4
4513 & 4514	Maximum Demand of Apparent Power (kVA →) since the beginning of the current month (Current_Month_kVA_Maxd)	NA	NA	NA	NA	NA	R	N4

4515 & 4516	Maximum Demand of Apparent Power (kVA) during the last month (Last_Month_kVA_Maxd)	NA	NA	NA	NA	NA	R	N4
4517 & 4518	Maximum Instantaneous Peak of Power (KW) (Max_P)	NA	NA	NA	NA	NA	R	N4
4519 & 4520	Maximum Instantaneous Peak of L1 Voltage (V) (Max_V1)	NA	NA	NA	NA	NA	R	N4
4521 & 4521	Maximum Instantaneous Peak of L2 Voltage (V) (Max_V2)	NA	NA	NA	NA	NA	R	N4
4523 & 4524	Maximum Instantaneous Peak of L3 Voltage (V) (Max_V3)	NA	NA	NA	NA	NA	R	N4
4525 & 4526	Maximum Instantaneous Peak of L1 Current (A) (Max_I1)	NA	NA	NA	NA	NA	R	N4
4527 & 4528	Maximum Instantaneous Peak of L2 Current (A) (Max_I2)	NA	NA	NA	NA	NA	R	N4
4529 & 4530	Maximum Instantaneous Peak of L3 Current (A) (Max_I3)	NA	NA	NA	NA	NA	R	N4
4531	Year_and_Month of Current_Month_kW_Maxd	NA	NA	NA	NA	NA	R	
4532	Day_and_Hour of Current_Month_kW_Maxd	NA	NA	NA	NA	NA	R	
4533	Minute_and_Second of Current_Month_kW_Maxd	NA	NA	NA	NA	NA	R	
4534	Year_and_Month of Last_Month_kW_Maxd	NA	NA	NA	NA	NA	R	
4535	Day_and_Hour of Last_Month_kW_Maxd	NA	NA	NA	NA	NA	R	
4536	Minute_and_Second of Last_Month_kW_Maxd	NA	NA	NA	NA	NA	R	
4537	Year_and_Month of Current_Month_kvar_Maxd	NA	NA	NA	NA	NA	R	
4538	Day_and_Hour of Current_Month_kvar_Maxd	NA	NA	NA	NA	NA	R	
4539	Minute_and_Second of Current_Month_kvar_Maxd	NA	NA	NA	NA	NA	R	
4540	Year_and_Month of Last_Month_kvar_Maxd	NA	NA	NA	NA	NA	R	
4541	Day_and_Hour of Last_Month_kvar_Maxd	NA	NA	NA	NA	NA	R	
4542	Minute_and_Second of Last_Month_kvar_Maxd	NA	NA	NA	NA	NA	R	
4543	Year_and_Month of Current_Month_kVA_Maxd	NA	NA	NA	NA	NA	R	
4544	Day_and_Hour of Current_Month_kVA_Maxd	NA	NA	NA	NA	NA	R	
4545	Minute_and_Second of Current_Month_kVA_Maxd	NA	NA	NA	NA	NA	R	
4546	Year_and_Month of Last_Month_kVA_Maxd	NA	NA	NA	NA	NA	R	
4547	Day_and_Hour of Last_Month_kVA_Maxd	NA	NA	NA	NA	NA	R	
4548	Minute_and_Second of Last_Month_kVA_Maxd	NA	NA	NA	NA	NA	R	
4549	Year_and_Month of Max_P	NA	NA	NA	NA	NA	R	
4550	Day_and_Hour of Max_P	NA	NA	NA	NA	NA	R	
4551	Minute_and_Second of Max_P	NA	NA	NA	NA	NA	R	
4552	Year_and_Month of Max_V1	NA	NA	NA	NA	NA	R	
4553	Day_and_Hour of Max_V1	NA	NA	NA	NA	NA	R	
4554	Minute_and_Second of Max_V1	NA	NA	NA	NA	NA	R	
4555	Year_and_Month of Max_V2	NA	NA	NA	NA	NA	R	
4556	Day_and_Hour of Max_V2	NA	NA	NA	NA	NA	R	
4557	Minute_and_Second of Max_V2	NA	NA	NA	NA	NA	R	
4558	Year_and_Month of Max_V3	NA	NA	NA	NA	NA	R	
4559	Day_and_Hour of Max_V3	NA	NA	NA	NA	NA	R	
4560	Minute_and_Second of Max_V3	NA	NA	NA	NA	NA	R	
4561	Year_and_Month of Max_I1	NA	NA	NA	NA	NA	R	
4562	Day_and_Hour of Max_I1	NA	NA	NA	NA	NA	R	
4563	Minute_and_Second of Max_I1	NA	NA	NA	NA	NA	R	
4564	Year_and_Month of Max_I2	NA	NA	NA	NA	NA	R	
4565	Day_and_Hour of Max_I2	NA	NA	NA	NA	NA	R	
4566	Minute_and_Second of Max_I2	NA	NA	NA	NA	NA	R	
4567	Year_and_Month of Max_I3	NA	NA	NA	NA	NA	R	
4568	Day_and_Hour of Max_I3	NA	NA	NA	NA	NA	R	
4569	Minute_and_Second of Max_I3	NA	NA	NA	NA	NA	R	

4.1. Time & Date Registers (ECSPM61 only)

These registers are used to read and write the Date and the Time in counter with an internal Real Time Clock. When the counter is switched off, the RTC supply is guaranteed for one week by means of an internal super capacitor. In case the counter is not powered up again within one week, the Date/Time is lost, (it is read as: 31/12/99 23:59:59) and must be updated.

Register	Tag	Description
4093	Current Year_and_Month	Read-only Register. Year and Month current values (read from internal RTC), in BCD format, with Year in the High Byte and Month in the Low Byte. For example, April 2014 is read as 0x1404 (Big Endian) or 0x0414 (Little Endian)

4094	Current Day_and_Hour	Read-only Register. Day and Hour current values (read from internal RTC), in BCD format, with Day in the High Byte and Hour in the Low Byte. For example, day=17 and hour=11 is read as 0x1711 (Big Endian) or 0x1117 (Little Endian)
4095	Current Minute_and_Second	Read-only Register. Minutes and Seconds current values (read from internal RTC), in BCD format, with Minutes in the High Byte and Seconds in the Low Byte. For example, 35:14 is read as 0x3514 (Big Endian) or 0x1435 (Little Endian)
4096	Desired Year_and_Month	Read/write Register. Month and Year desired values (to be written into RTC) The register format is BCD, as above described, and inside the Preset Single Register function is always written in Big Endian convention. The writing operation is immediately accepted, but the whole time and date is written into the RTC when also register 4098 (Minute and Second) is written through Modbus protocol
4097	Desired Day_and_Hour	Read/write Register. Day and hour desired values (to be written into RTC) The register format is BCD, as above described, and inside the Preset Single Register function is always written in Big Endian convention. The writing operation is immediately accepted, but the whole time and date is written into the RTC when also register 4098 (Minute and Second) is written through Modbus protocol
4098	Desired Minute_and_Second	Read/write Register. Minute and Second desired values (to be written into RTC) The register format is BCD, as above described, and inside the Preset Single Register function is always written in Big Endian convention. As soon as this registers is written through Modbus, all 3 registers of time and date (4096, 4097 and 4098) are used to store the whole new Time & Date into the internal RTC.

As described above, if you want to modify the time and/or the date, you must write "Desired Year_and_Month" register (address 4096) and/or "Desired Day_and_Hour" register (address 4097) , and then you must write (as last) "Desired Minute_and_Second" register (address 4098), even if you don't want to change minutes and seconds.

Warning!
In case you modify Time and Date, consider the opportunity to reset the Maximum Demand Intervals, and the Maximum values of Power, Voltages and Currents, because their Date/Time may be not coherent anymore with the new Time and Date.

4.2. General read-only registers

These registers store general read-only information.

Register	Tag	Description
4088	Device_Description_ and_Status	Group of bit-fields including general information (bit 0 is the lsbit, bit 15 is the MSbit): bits 1 & 0: 00: single phase counter 01: 3 phase, 4 wires counter 10: 3 phase, 3 wires counter 11: future use bits 3 & 2: 00: only one tariff 01: 2 tariffs (the counter has one digital hardware input dedicated to read the running tariff 1 or 2) 10: 4 tariffs (the counter has 2 digital hardware inputs dedicated to read the running tariff 1, 2, 3 or 4) 11: n.a. bit 4: 0: the counter is not MID certified (it is resettable) 1: the counter is MID certified (it is not resettable) bit 5: 0: the counter is directly connected (no external CTs) 1: the counter is CT operated (external CTs) bits 8,7&6: 011: the Counter is an "EVO" Graphic Power Meter any other combination of bits are reserved for future use bit 9: (the bit is meaningful only in CT operated counters) 0: The values of Energies, Power and Currents are referred to the Primary winding of external CTs 1: The values of Energies, Power and Currents are referred to the Secondary winding of external CTs. bit 10...15 future use (not used bits)
4089 & 4090	Maximum_Input_ Phase_Current (A)	It is the value of the maximum acceptable current measured by the counter (per each phase in case of 3phase counter). It is a numerical 4 bytes value (see the above dedicated paragraph for details and its format).

4091	CT_ratio	The register is meaningful only in CT operated counters (external CTs to measure currents). Otherwise, it is always read as 0x0001.
4092	VT_ratio	The register is meaningful only in VT operated counters (external VTs to measure voltages). Otherwise, it is always read as 0x0001.
4099	Device type	Code that identifies the type of device 1 Three phase counter 3 Single phase counter
4100	Firmware revision	0xFF00+Firmware revision of the counter. For example, revision 2.1 is read 0xFF21
4101	Range overflow alarm	The register is set by the counter if it has the detected a value over the voltage or the current nominal threshold. The lowest order byte of the register is bit-coded as follows: n.u.|n.u.|OFV3|OFI3|OFV2|OFI2|OFV1|OFI1 Where: OFV Voltage overflow (on phase 1, 2 and 3) OFI Current overflow (on phase 1, 2 and 3) n.u. Not Used
4102	Running tariff	0 Tariff 1 is currently in use 1 Tariff 2 is currently in use
4104… 4110	PID (product identification)	Product identification string (a maximum of 14 bytes), They are expected to be printable ASCII characters. These bytes are always read in Big ENdian format, regardless of BE/LE selection.

4.3. Writable parameters and command (Modbus configuration and Energy reset)

In most of devices the Parity and the Number of Stop Bits are neither writable nor readable.
One register (4118) is dedicated to reset the energy registers internal to the counter, including Partial Registers (**assuming that the counter is not MID certified**).

Register	Tag	Description
4112	Modbus Baud Rate	One of the following: 1200, 2400, 4800, 9600, 19200, 38400 (38400 not available is Network Analyzers)
4113	Modbus Parity	0=None, 1=Even, 2=Odd (not writable in Network Analyzers)
4114	Modbus Number of Stop Bits	1=One Stop Bit, 2=Two Stop Bits (not writable in Network Analyzers)
4115	Modbus address	From 1 to 247
4117	Float Integer format	0 Numeric values are coded as floating point 32 bit 1 Numeric values are coded as integers (see par. 4.4)
4118	Reset energy counters command. **The command is not accepted by MID certified counters.**	1 Reset active energy registers (including partial registers) 2 Reset reactive energy registers 3 Reset all the registers (including active partial registers)

4.4. Readable values (energy registers and instantaneous measurements)

These registers holds the electrical values measured or calculated by the counter. The number of available readable values depends on the counter type.

Register Address	**Register Tag**		**Single Phase Energy Meters** EM106 EM107MID EM213 EM214MID	**Three Phase Energy Meters** EM226 EM227MID EM113 EM114MID	**Three Phases Power Meters** PM48 PM50	**Network Analyzers** AN04 AN03	**Graphic Power Meter "EVO"** PM61	**Signed Unsigned & Length (bytes)**
4119… 4122	Active Energy (L1, T1, imported)	[kWh]	R	R	R	R	R	U 8
4123… 4126	Active Energy (L2, T1, imported)	[kWh]	R=0	R	R	R	R	U 8
4127… 4130	Active Energy (L3, T1, imported)	[kWh]	R=0	R	R	R	R	U 8
4131… 4134	Active Energy (Σ, T1, imported)	[kWh]	R=0	R	R	R	R	U 8
4135… 4138	Active Energy (L1, T2, imported)	[kWh]	R	R	R	R	R	U 8

4139… 4142	Active Energy (L2, T2, imported)	[kWh]	R=0	R	R	R	R	U 8
4143… 4146	Active Energy (L3, T2, imported)	[kWh]	R=0	R	R	R	R	U 8
4147… 4150	Active Energy (Σ, T2, imported)	[kWh]	R=0	R	R	R	R	U 8
4151 & 4152	Active Power (L1)	[kW]	R	R	R	R	R	S 4
4153 & 4154	Active Power (L2)	[kW]	R=0	R	R	R	R	S 4
4155 & 4156	Active Power (L3)	[kW]	R=0	R	R	R	R	S 4
4157… 4160	Active Power (Σ)	[kW]	R=0	R	R	R	R	S 8
4161… 4164	Active Energy (L1, T1, exported)	[kWh]	R	R	R	R	R	U 8
4165… 4168	Active Energy (L2, T1, exported)	[kWh]	R=0	R	R	R	R	U 8
4169… 4172	Active Energy (L3, T1, exported)	[kWh]	R=0	R	R	R	R	U 8
4173… 4176	Active Energy (Σ, T1, exported)	[kWh]	R=0	R	R	R	R	U 8
4177… 4180	Active Energy (L1, T2, exported)	[kWh]	R	R	R	R	R	U 8
4181… 4184	Active Energy (L2, T2, exported)	[kWh]	R=0	R	R	R	R	U 8
4185… 4188	Active Energy (L3, T2, exported)	[kWh]	R=0	R	R	R	R	U 8
4189… 4192	Active Energy (Σ, T2, exported)	[kWh]	R=0	R	R	R	R	U 8
4193… 4196	Reactive Energy (L1, T1, imported)	[kvarh]	R	R	R	R	R	U 8
4197… 4200	Reactive Energy (L2, T1, imported)	[kvarh]	R=0	R	R	R	R	U 8
4201… 4204	Reactive Energy (L3, T1, imported)	[kvarh]	R=0	R	R	R	R	U 8
4205… 4208	Reactive Energy (Σ, T1, imported)	[kvarh]	R=0	R	R	R	R	U 8
4209… 4212	Reactive Energy (L1, T2, imported)	[kvarh]	R	R	R	R	R	U 8
4213… 4216	Reactive Energy (L2, T2, imported)	[kvarh]	R=0	R	R	R	R	U 8
4217… 4220	Reactive Energy (L3, T2, imported)	[kvarh]	R=0	R	R	R	R	U 8
4221… 4224	Reactive Energy (Σ, T2, imported)	[kvarh]	R=0	R	R	R	R	U 8
4225… 4228	Reactive Energy (L1, T1, exported)	[kvarh]	R	R	R	R	R	U 8
4229… 4232	Reactive Energy (L2, T1, exported)	[kvarh]	R=0	R	R	R	R	U 8
4233… 4236	Reactive Energy (L3, T1, exported)	[kvarh]	R=0	R	R	R	R	U 8
4237… 4240	Reactive Energy (Σ, T1, exported)	[kvarh]	R=0	R	R	R	R	U 8
4241… 4244	Reactive Energy (L1, T2, exported)	[kvarh]	R	R	R	R	R	U 8
4245… 4248	Reactive Energy (L2, T2, exported)	[kvarh]	R=0	R	R	R	R	U 8
4249… 4252	Reactive Energy (L3, T2, exported)	[kvarh]	R=0	R	R	R	R	U 8
4253… 4256	Reactive Energy (Σ, T2, exported)	[kvarh]	R=0	R	R	R	R	U 8
4257 & 4258	Reactive Power (L1)	[kvar]	R	R	R	R	R	S 4
4259 & 4260	Reactive Power (L2)	[kvar]	R=0	R	R	R	R	S 4
4261 & 4262	Reactive Power (L3)	[kvar]	R=0	R	R	R	R	S 4
4263… 4266	Reactive Power (Σ)	[kvar]	R=0	R	R	R	R	S 8
4267 & 4268	Phase Voltage (L1-N)	[Volt]	R	R	R	R	R	U 4
4269 & 4270	Phase Voltage (L2-N)	[Volt]	R=0	R	R	R	R	U 4
4271 & 4272	Phase Voltage (L2-N)	[Volt]	R=0	R	R	R	R	U 4

4273 & 4274	System Voltage (L1-L2) [Volt]	R=0	R	R	R	R	U 4
4275 & 4276	System Voltage (L2-L3) [Volt]	R=0	R	R	R	R	U 4
4277 & 4278	System Voltage (L3-L1) [Volt]	R=0	R	R	R	R	U 4
4279 & 4280	Current (L1) [Ampere]	R	R	R	R	R	U 4
4281 & 4282	Current (L2) [Ampere]	R=0	R	R	R	R	U 4
4283 & 4283	Current (L3) [Ampere]	R=0	R	R	R	R	U 4
4285 & 4286	Apparent Power (L1) [kVA]	R	R	R	R	R	U 4
4287 & 4288	Apparent Power (L2) [kVA]	R=0	R	R	R	R	U 4
4289 & 4290	Apparent Power (L3) [kVA]	R=0	R	R	R	R	U 4
4291… 4294	Apparent Power (Σ) [kVA]	R=0	R	R	R	R	U 4
4295 & 4296	Power Factor (L1)	R	R	R	R	R	S 4
4297 & 4298	Power Factor (L2)	R=0	R	R	R	R	S 4
4299 & 4300	Power Factor (L3)	R=0	R	R	R	R	S 4
4301 & 4302	Power Factor (Σ)	R=0	R	R	R	R	S 4
4303 & 4304	Frequency [Hz]	R	R	R	R	R	U 4
4305 & 4306	Voltage Total Harmonic Distortion (L1) [%]	R=0	R=0	R	NA	R	U 4
4307 & 4308	Voltage Total Harmonic Distortion (L2) [%]	R=0	R=0	R	NA	R	U 4
4309 & 4310	Voltage Total Harmonic Distortion (L3) [%]	R=0	R=0	R	NA	R	U 4
4311 & 4312	Current Total Harmonic Distortion (L1) [%]	R=0	R=0	R	NA	R	U 4
4313 & 4314	Current Total Harmonic Distortion (L2) [%]	R=0	R=0	R	NA	R	U 4
4315 & 4316	Current Total Harmonic Distortion (L3) [%]	R=0	R=0	R	NA	R	U 4
4317 & 4318	Residual Leakage Current [Ampere]	R=0	R	R	NA	R	U 4
4319… 4222	Total Active Energy (Σ, T1+T2, imported) [kWh]	R	R	R	NA	R	U 8
4323… 4326	Total Active Energy (Σ, T1+T2, exported) [kWh]	R	R	R	NA	R	U 8
4327… 4330	Partial Active Energy (Σ, T1, imported) [kWh]	R	R	R	NA	R	U 8
4331… 4334	Partial Active Energy (Σ, T2, imported) [kWh]	R	R	R	NA	R	U 8
4335… 4338	Partial Active Energy (Σ, T1, exported) [kWh]	R	R	R	NA	R	U 8
4339… 4342	Partial Active Energy (Σ, T2, exported) [kWh]	R	R	R	NA	R	U 8

Notes
T1/T2 indicates the Tariff (1 or 2) of the accumulated Energy
The symbol **Σ** indicates a total amount value (for example: the Reactive Power Σ kvar value is the total Reactive Power on the three phases. It is of course significant in a three phase counter only).
imported/exported indicates whether the energy is generated (exported) or consumed (imported).
U 4: 4 bytes, unsigned
U 8 8 bytes, unsigned
S 4: 4 bytes, signed
S 8: 8 bytes, signed

4.5. Events related commands and parameters

The first register is used to reset Maximum Demand Peaks and Maximum Values of Power, Voltages and Currents, the second to configure the interval of the Maximum Demand.

Register	Tag	Description
4500	Events Reset Commands	Group of flags including some reset commands: (bit 0 is the lsbit, bit 15 is the MSbit). The Modbus master writes 1 into

		the bit to issue the command. The counter will reset the bit as soon as the command is completed. bit 0: set this bit high to reset all peaks of Maximum Demand function bit 1: set this bit high to reset the Maximum Power event. bit 2: set this bit high to reset the Maximum Phase Voltages Events. bit 3: set this bit high to reset the Maximum Phase Currents Events. bits 4…7: not used bits
4501	Maximum Demand Interval	Number of minutes (acceptable values are 5 to 60) of the Maximum Demand function interval, that is the "quantum" of time during which the Demand is calculated).

4.6. Last Time and Date of Maximum Demand Reset

As described in the previous paragraph, the Maximum demand peak values and Time/dates are resettable in 3 ways:
- through a Modbus command (by means of bit 0 of the Events Reset Commands).
- Through a manual command, by means of display and keyboard
- When the Interval value is modified with a lower value.

See the previous paragraphs for Time and Date format.

Register	Tag	Description
4502	Last Time and Date of Max.Dem. Reset (Year_and_Month)	Year and Month of the last Maximum demand reset
4503	Last Time and Date of Max.Dem. Reset (Day_and_Hour)	Day and Hour of the last Maximum demand reset
4504	Last Time and Date of Max.Dem. Reset (Minute_and Second)	Minute and Second of the last Maximum demand reset

4.7. Maximum demand recorded events.

In these read-only registers, the Maximum demand peak values and their Time/Date are available. In case a peak is not yet stored, both the peak and its Time/Date registers are read as 0x0000. The Time and Date is intended to have been stored at the end of the interval (for example, at the end of the quarter of hour). See the previous paragraphs for Time and Date format.
For each of the following values:
- Imported Active Power (kW→)
- Imported Reactive Power (kvar→)
- Apparent Power (kVA)

the energy meter continuously (every one minute) calculates the value averaged during the last Interval (see the above described Maximum Demand Interval at address 4382). For example, if the Interval=15 minutes, every one minute the average of the 3 above listed measures are calculated. The maximum demand of the current month and of the last month are stored into the device flash memory, and are readable through Modbus. For example, suppose that the current month is April, the interval is 15 minutes, and that the device is operated since more that 2 months ago. In this situation, for each of the above listed values, you can read:
- The value of the averaged measures over intervals of 15 minutes during which the power has been maximum since the beginning of April up to now, together with its time and date
- The value of the averaged measures over intervals of 15 minutes during which the power was maximum during March, together with its time and date

All the values are 4 bytes numerical values (2 registers each)

Register	Tag	Description
4505 & 4506	Maximum Peak Demand of Imported Active Power (kW→) during the current month (Current_Month_kW_Peak)	It is the value of the average Power (Three Phase total Imported Active Power) calculated on the interval in which the Demand has been maximum, during the current month.
4507 & 4508	Maximum Peak Demand of Imported Active Power (kW→) during the previous month (Last_Month_kW_Peak)	It is the value of the average Power (Three Phase total Imported Active Power) calculated on the interval in which the Demand was maximum, during the last month.
4509 & 4510	Maximum Peak Demand of Imported Reactive Power (kWh→) during the current month	It is the value of the average Power (Three Phase total Imported Reactive Power) calculated on the interval in which the Demand has been maximum, during the current month.

	(Current_Month_kvar_Peak)	
4511 & 4512	Maximum Peak Demand of Imported Reactive Power (kvar→) during the last month (Last_Month_kvar_Peak)	It is the value of the average Power (Three Phase total Imported Reactive Power) calculated on the interval in which the Demand was maximum, during the last month.
4513 & 4514	Maximum Peak Demand of Apparent Power (kVA) during the current month (Current_Month_kVA_Peak)	It is the value of the average Power (Three Phase total Apparent Power) calculated on the interval in which the Demand has been maximum, during the current month.
4515	Maximum Peak Demand of Apparent Power (kVA) during the last month (Last_Month_kVA_Peak)	It is the value of the average Power (Three Phase total Apparent Power) calculated on the interval in which the Demand was maximum, during the last month.

4.8. Maximum Power recorded event.

These read-only register contain the maximum peak of the instantaneous Total Active Power since the device first switch on, or since the last reset of Maximum Power Event (by means of bit 1 of the Events Reset Commands)
The values is a 4 bytes numerical value (2 registers)

Register	Tag	Description
4517 & 4518	Maximum Power (KW)	It is the Maximum value of the instantaneous Total Active Power since the device first switch on, or since the last reset of Maximum Power Event.

4.9. Maximum Voltages recorded events.

These read-only registers contain for each phase the Maximum Voltage values since the device first switch on, or since the last reset of Maximum Voltage Events (by means of bit 2 of the "Events Reset Commands" register). All the values are 4 bytes numerical values (2 registers each) and their Unit=Volt.

Register	Tag	Description
4519 & 4520	Maximum Voltage_L1-N (Volt)	It is the maximum value of L1 Voltage since the device first switch on, or since the last reset of Maximum Voltage Events (by means of bit 2 of the "Events Reset Commands" register).
4521 & 4522	Maximum Voltage_L2-N (Volt)	Same as above, for L2 voltage
4523 & 4524	Maximum Voltage_L3-N (Volt)	Same as above, for L3 voltage.

4.10. Maximum Currents recorded events.

These read-only registers contain for each phase the the Maximum Current values since the device first switch on, or since the last reset of Maximum Current Events (by means of bits 3 of the "Events Reset Commands" register). All the values are 4 bytes numerical values (2 registers each) and their Unit=Ampere.

Register	Tag	Description
4525 & 4526	Maximum_Current_L1 (Ampere)	It is the maximum value of L1 Current since the device first switch on, or since the last reset of Maximum Current Events (by means of bit 3 of the "Events Reset Commands" register).
4527 & 4528	Maximum Current _L2 (Ampere)	Same as above, for L2 current.
4529 & 4530	Maximum Current _L3 (Ampere)	Same as above, for L3 current.

4.11. Time and Date of recorded events

For all the above listed events, the corresponding Time and Date are stored in the permanent memory of the device and readable from addresses 4531 to 4569

See the previous paragraphs for Time and Date format.

5. References

For any further information concerning the Modbus protocol implementation, you can consult the following documents and references:

Modbus application protocol specifications V 1.1b, at http://www.modbus.org

Modbus over serial line – Specification and implementation guide V. 1.02, at http://www.modbus.org