Inbuilt Modbus Protocol M1PRO & M3PRO

Technical description

Revision 1.0
April 2019

1. Revisions History

Revision 1.0 The document is in first revision

2. Preface

2.1. Overview

The present guide describes the RTU Modbus Protocol when implemented inside the M1PRO and M3PRO Energy Meters. 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 devicesBits per byte: 8 (fixed)
- Parity: selectable among None, Even and Odd
- Number of Stop Bits: selectable between 1 and 2

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)
- Parity (None, Odd or Even)
- Number of Stop Bits (1 or 2)

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 Big Endian. The meaning of this feature will be explained later.

In the following table you can see the Herholdt Control products belonging to families M1PRO and M3PRO with inbuilt Modbus. All of them are MID certified.

M1PRO 40A Modbus	1 DIN-rail module 40 A Single Phase Energy Meter with inbuilt Modbus
M1PRO 80A Modbus	2 DIN-rail modules 80 A Single Phase Energy Meter with inbuilt Modbus
M3PRO CT connected Modbus	4 DIN-rail modules ../1A & ../5A Three Phase Energy Meter with inbuilt Modbus
M3PRO 80A Modbus	4 DIN-rail modules 80A Three Phase Energy Meter with inbuilt Modbus
M3PRO 125A Modbus	6 DIN-rail modules 125A Three Phase Energy Meter with inbuilt Modbus

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=%)

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	M1PRO 40A	M1PRO 80A M1PRO 125A	M3PRO CT connected M3PRO 80A	Type
4100	Firmware version	R	R	R	
4101	Range overflow alarm	R=0	R	R	
4102	Running tariff	R=0	R	R	
4103	Read-only not used register.	R=0	R=0	R=0	
4104	PID (Product Identification) bytes 1 and 2	R	R	R	ASCII
4105	PID – bytes 3 and 4	R	R	R	ASCII
4106	PID – bytes 5 and 6	R	R	R	ASCII
4107	PID – bytes 7 and 8	R	R	R	ASCII
4108	PID – bytes 9 and 10	R	R	R	ASCII
4109	PID – bytes 11 and 12	R	R	R	ASCII
4110	PID – bytes 13 and 14	R	R	R	ASCII
4111	Not used read/write register.	R=0	R=0	R=0	
4112	Modbus Baud Rate	R/W	R/W	R/W	
4113	Modbus Parity	R/W	R/W	R/W	
4114	Modbus Stop Bits	R/W	R/W	R/W	
4115	Modbus Address	R/W	R/W	R/W	
4116	Not used read/write register.	R=0	R=0	R=0	
4117	Float Integer format	R/W	R/W	R/W	
4118	Reset energy counters command (*)	W, R=0	W, R=0	W, R=0	
4119…4122	Active Energy (L1, T1, imported) [kWh]	R	R	R	N8
4123…4126	Active Energy (L2, T1, imported) [kWh]	R=0	R=0	R	N8
4127…4130	Active Energy (L3, T1, imported) [kWh]	R=0	R=0	R	N8
4131…4134	Active Energy (Σ, T1, imported) [kWh]	R=0	R=0	R	N8
4135…4138	Active Energy (L1, T2, imported) [kWh]	R=0	R	R	N8
4139…4142	Active Energy (L2, T2, imported) [kWh]	R=0	R=0	R	N8
4143…4146	Active Energy (L3, T2, imported) [kWh]	R=0	R=0	R	N8
4147…4150	Active Energy (Σ, T2, imported) [kWh]	R=0	R=0	R	N8
4151 & 4152	Active Power (L1) [kW]	R	R	R	N4
4153 & 4154	Active Power (L2) [kW]	R=0	R=0	R	N4
4155 & 4156	Active Power (L3) [kW]	R=0	R=0	R	N4
4157…4160	Active Power (Σ) [kW]	R=0	R=0	R	N4
4161…4164	Active Energy (L1, T1, exported) [kWh]	R	R	R	N8
4165…4168	Active Energy (L2, T1, exported) [kWh]	R=0	R=0	R	N8
4169…4172	Active Energy (L3, T1, exported) [kWh]	R=0	R=0	R	N8
4173…4176	Active Energy (Σ, T1, exported) [kWh]	R=0	R=0	R	N8
4177…4180	Active Energy (L1, T2, exported) [kWh]	R=0	R	R	N8
4181…4184	Active Energy (L2, T2, exported) [kWh]	R=0	R=0	R	N8
4185…4188	Active Energy (L3, T2, exported) [kWh]	R=0	R=0	R	N8
4189…4192	Active Energy (Σ, T2, exported) [kWh]	R=0	R=0	R	N8
4193…4196	Reactive Energy (L1, T1, imported) [kvarh]	R=0	R	R	N8
4197…4200	Reactive Energy (L2, T1, imported) [kvarh]	R=0	R=0	R	N8
4201…4204	Reactive Energy (L3, T1, imported) [kvarh]	R=0	R=0	R	N8
4205…4208	Reactive Energy (Σ, T1, imported) [kvarh]	R=0	R=0	R	N8
4209…4212	Reactive Energy (L1, T2, imported) [kvarh]	R=0	R	R	N8
4213…4216	Reactive Energy (L2, T2, imported) [kvarh]	R=0	R=0	R	N8
4217…4220	Reactive Energy (L3, T2, imported) [kvarh]	R=0	R=0	R	N8
4221…4224	Reactive Energy (Σ, T2, imported) [kvarh]	R=0	R=0	R	N8
4225…4228	Reactive Energy (L1, T1, exported) [kvarh]	R=0	R	R	N8
4229…4232	Reactive Energy (L2, T1, exported) [kvarh]	R=0	R=0	R	N8
4233…4236	Reactive Energy (L3, T1, exported) [kvarh]	R=0	R=0	R	N8
4237…4240	Reactive Energy (Σ, T1, exported) [kvarh]	R=0	R=0	R	N8

Register Address	Register Tag		M1PRO 40A	M1PRO 80A M1PRO 125A	M3PRO CT connected M3PRO 80A	Type
4241…4244	Reactive Energy (L1, T2, exported)	[kvarh]	R=0	R	R	N8
4245…4248	Reactive Energy (L2, T2, exported)	[kvarh]	R=0	R=0	R	N8
4249…4252	Reactive Energy (L3, T2, exported)	[kvarh]	R=0	R=0	R	N8
4253…4256	Reactive Energy (Σ, T2, exported)	[kvarh]	R=0	R=0	R	N8
4257 & 4258	Reactive Power (L1)	[kvar]	R=0	R	R	N4
4259 & 4260	Reactive Power (L2)	[kvar]	R=0	R=0	R	N4
4261 & 4262	Reactive Power (L3)	[kvar]	R=0	R=0	R	N4
4263…4266	Reactive Power (Σ)	[kvar]	R=0	R=0	R	N8
4267 & 4268	Phase Voltage (L1-N)	[Volt]	R	R	R	N4
4269 & 4270	Phase Voltage (L2-N)	[Volt]	R=0	R=0	R	N4
4271 & 4272	Phase Voltage (L2-N)	[Volt]	R=0	R=0	R	N4
4273 & 4274	System Voltage (L1-L2)	[Volt]	R=0	R=0	R	N4
4275 & 4276	System Voltage (L2-L3)	[Volt]	R=0	R=0	R	N4
4277 & 4278	System Voltage (L3-L1)	[Volt]	R=0	R=0	R	N4
4279 & 4280	Current (L1)	[Ampere]	R	R	R	N4
4281 & 4282	Current (L2)	[Ampere]	R=0	R=0	R	N4
4283 & 4283	Current (L3)	[Ampere]	R=0	R=0	R	N4
4285 & 4286	Apparent Power (L1)	[kVA]	R=0	R	R	N4
4287 & 4288	Apparent Power (L2)	[kVA]	R=0	R=0	R	N4
4289 & 4290	Apparent Power (L3)	[kVA]	R=0	R=0	R	N4
4291…4294	Apparent Power (Σ)	[kVA]	R=0	R=0	R	N8
4295 & 4296	Power Factor (L1)		R	R	R	N4
4297 & 4298	Power Factor (L2)		R=0	R=0	R	N4
4299 & 4300	Power Factor (L3)		R=0	R=0	R	N4
4301 & 4302	Power Factor (Σ)		R=0	R=0	R	N4
4303 & 4304	Frequency	[Hz]	R	R	R	N4
4305 & 4306	Voltage Total Harmonic Distortion (L1)	[%]	NA	R=0	R=0	N4
4307 & 4308	Voltage Total Harmonic Distortion (L2)	[%]	NA	R=0	R=0	N4
4309 & 4310	Voltage Total Harmonic Distortion (L3)	[%]	NA	R=0	R=0	N4
4311 & 4312	Current Total Harmonic Distortion (L1)	[%]	NA	R=0	R=0	N4
4313 & 4314	Current Total Harmonic Distortion (L2)	[%]	NA	R=0	R=0	N4
4315 & 4316	Current Total Harmonic Distortion (L3)	[%]	NA	R=0	R=0	N4
4317 & 4318	Residual Leakage Current	[Ampere]	NA	R=0	R	N4
4319…4222	Total Active Energy (Σ, T1+T2, imported)	[kWh]	NA	R	R	N8
4323…4326	Total Active Energy (Σ, T1+T2, exported)	[kWh]	NA	R	R	N8
4327…4330	Partial Active Energy (Σ, T1, imported)	[kWh]	NA	R	R	N8
4331…4334	Partial Active Energy (Σ, T2, imported)	[kWh]	NA	R	R	N8
4335…4338	Partial Active Energy (Σ, T1, exported)	[kWh]	NA	R	R	N8
4339…4342	Partial Active Energy (Σ, T2, exported)	[kWh]	NA	R	R	N8

(*) The reset of Energies is not applicable in MID certified Energy Meters

4.1. General read-only registers

These registers store general read-only information.

Register	Tag	Description
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.

4.2. 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
4113	Modbus Parity	0=None, 1=Even, 2=Odd
4114	Modbus Number of Stop Bits	1=One Stop Bit, 2=Two Stop Bits
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)

4.3. 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**		**M1PRO 40A**	**M1PRO 80A** **M1PRO 125A**	**M3PRO CT connected** **M3PRO 80A**	**Signed Unsigned & Length (bytes)**
4119…4122	Active Energy (L1, T1, imported)	[kWh]	R	R	R	U 8
4123…4126	Active Energy (L2, T1, imported)	[kWh]	R=0	R	R	U 8
4127…4130	Active Energy (L3, T1, imported)	[kWh]	R=0	R	R	U 8
4131…4134	Active Energy (Σ, T1, imported)	[kWh]	R=0	R	R	U 8
4135…4138	Active Energy (L1, T2, imported)	[kWh]	R	R	R	U 8
4139…4142	Active Energy (L2, T2, imported)	[kWh]	R=0	R	R	U 8
4143…4146	Active Energy (L3, T2, imported)	[kWh]	R=0	R	R	U 8
4147…4150	Active Energy (Σ, T2, imported)	[kWh]	R=0	R	R	U 8
4151 & 4152	Active Power (L1)	[kW]	R	R	R	S 4
4153 & 4154	Active Power (L2)	[kW]	R=0	R	R	S 4
4155 & 4156	Active Power (L3)	[kW]	R=0	R	R	S 4
4157…4160	Active Power (Σ)	[kW]	R=0	R	R	S 8
4161…4164	Active Energy (L1, T1, exported)	[kWh]	R	R	R	U 8
4165…4168	Active Energy (L2, T1, exported)	[kWh]	R=0	R	R	U 8
4169…4172	Active Energy (L3, T1, exported)	[kWh]	R=0	R	R	U 8
4173…4176	Active Energy (Σ, T1, exported)	[kWh]	R=0	R	R	U 8
4177…4180	Active Energy (L1, T2, exported)	[kWh]	R	R	R	U 8
4181…4184	Active Energy (L2, T2, exported)	[kWh]	R=0	R	R	U 8
4185…4188	Active Energy (L3, T2, exported)	[kWh]	R=0	R	R	U 8
4189…4192	Active Energy (Σ, T2, exported)	[kWh]	R=0	R	R	U 8
4193…4196	Reactive Energy (L1, T1, imported)	[kvarh]	R	R	R	U 8
4197…4200	Reactive Energy (L2, T1, imported)	[kvarh]	R=0	R	R	U 8
4201…4204	Reactive Energy (L3, T1, imported)	[kvarh]	R=0	R	R	U 8
4205…4208	Reactive Energy (Σ, T1, imported)	[kvarh]	R=0	R	R	U 8
4209…4212	Reactive Energy (L1, T2, imported)	[kvarh]	R	R	R	U 8
4213…4216	Reactive Energy (L2, T2, imported)	[kvarh]	R=0	R	R	U 8
4217…4220	Reactive Energy (L3, T2, imported)	[kvarh]	R=0	R	R	U 8
4221…4224	Reactive Energy (Σ, T2, imported)	[kvarh]	R=0	R	R	U 8
4225…4228	Reactive Energy (L1, T1, exported)	[kvarh]	R	R	R	U 8
4229…4232	Reactive Energy (L2, T1, exported)	[kvarh]	R=0	R	R	U 8
4233…4236	Reactive Energy (L3, T1, exported)	[kvarh]	R=0	R	R	U 8
4237…4240	Reactive Energy (Σ, T1, exported)	[kvarh]	R=0	R	R	U 8
4241…4244	Reactive Energy (L1, T2, exported)	[kvarh]	R	R	R	U 8
4245…4248	Reactive Energy (L2, T2, exported)	[kvarh]	R=0	R	R	U 8
4249…4252	Reactive Energy (L3, T2, exported)	[kvarh]	R=0	R	R	U 8
4253…4256	Reactive Energy (Σ, T2, exported)	[kvarh]	R=0	R	R	U 8
4257 & 4258	Reactive Power (L1)	[kvar]	R	R	R	S 4
4259 & 4260	Reactive Power (L2)	[kvar]	R=0	R	R	S 4
4261 & 4262	Reactive Power (L3)	[kvar]	R=0	R	R	S 4
4263…4266	Reactive Power (Σ)	[kvar]	R=0	R	R	S 8
4267 & 4268	Phase Voltage (L1-N)	[Volt]	R	R	R	U 4
4269 & 4270	Phase Voltage (L2-N)	[Volt]	R=0	R	R	U 4

Register Address	Register Tag		M1PRO 40A	M1PRO 80A M1PRO 125A	M3PRO CT connected M3PRO 80A	Signed Unsigned & Length (bytes)
4271 & 4272	Phase Voltage (L2-N)	[Volt]	R=0	R	R	U 4
4273 & 4274	System Voltage (L1-L2)	[Volt]	R=0	R	R	U 4
4275 & 4276	System Voltage (L2-L3)	[Volt]	R=0	R	R	U 4
4277 & 4278	System Voltage (L3-L1)	[Volt]	R=0	R	R	U 4
4279 & 4280	Current (L1)	[Ampere]	R	R	R	U 4
4281 & 4282	Current (L2)	[Ampere]	R=0	R	R	U 4
4283 & 4283	Current (L3)	[Ampere]	R=0	R	R	U 4
4285 & 4286	Apparent Power (L1)	[kVA]	R	R	R	U 4
4287 & 4288	Apparent Power (L2)	[kVA]	R=0	R	R	U 4
4289 & 4290	Apparent Power (L3)	[kVA]	R=0	R	R	U 4
4291…4294	Apparent Power (Σ)	[kVA]	R=0	R	R	U 4
4295 & 4296	Power Factor (L1)		R	R	R	S 4
4297 & 4298	Power Factor (L2)		R=0	R	R	S 4
4299 & 4300	Power Factor (L3)		R=0	R	R	S 4
4301 & 4302	Power Factor (Σ)		R=0	R	R	S 4
4303 & 4304	Frequency	[Hz]	R	R	R	U 4
4305 & 4306	Voltage Total Harmonic Distortion (L1)	[%]	R=0	R=0	R	U 4
4307 & 4308	Voltage Total Harmonic Distortion (L2)	[%]	R=0	R=0	R	U 4
4309 & 4310	Voltage Total Harmonic Distortion (L3)	[%]	R=0	R=0	R	U 4
4311 & 4312	Current Total Harmonic Distortion (L1)	[%]	R=0	R=0	R	U 4
4313 & 4314	Current Total Harmonic Distortion (L2)	[%]	R=0	R=0	R	U 4
4315 & 4316	Current Total Harmonic Distortion (L3)	[%]	R=0	R=0	R	U 4
4317 & 4318	Residual Leakage Current	[Ampere]	R=0	R	R	U 4
4319…4222	Total Active Energy (Σ, T1+T2, imported)	[kWh]	R	R	R	U 8
4323…4326	Total Active Energy (Σ, T1+T2, exported)	[kWh]	R	R	R	U 8
4327…4330	Partial Active Energy (Σ, T1, imported)	[kWh]	R	R	R	U 8
4331…4334	Partial Active Energy (Σ, T2, imported)	[kWh]	R	R	R	U 8
4335…4338	Partial Active Energy (Σ, T1, exported)	[kWh]	R	R	R	U 8
4339…4342	Partial Active Energy (Σ, T2, exported)	[kWh]	R	R	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

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