

**INDEX**

- 1. Introduction..... 12
  - 1.1 Abbreviations ..... 12
  - 1.2 Modbus specifications ..... 12
  - 1.3 Type of Modbus network..... 12
- 2. MODBUS CONFIGURATION ..... 13
  - 2.1 Wiring ..... 13
  - 2.2 Parameter Configuration ..... 13
- 3. MODBUS REGISTERS..... 14
  - 3.1 Supported Modbus messages ..... 18
    - 3.1.1 Read holding Register (function code = 0x03) ..... 18
    - 3.1.2 Read Input Register (function code = 0x04) ..... 18
    - 3.1.3 Write Single Register (function code = 0x06) ..... 18
    - 3.1.4 Write Multiple Register (function code = 0x10)..... 19
  - 3.2 Example of Modbus message..... 19
    - 3.2.1 Reading Pump Power ..... 19
    - 3.2.2 Use of alternate operating mode in twin configuration ..... 20

**INDEX OF FIGURES**

- Figure 1: Example of a Modbus network with termination..... 13

**INDEX OF TABLES**

- Table 1: Abbreviations Table ..... 12
- Table 2: Modbus specifications ..... 12
- Table 3: Modbus- Rs485 connection ..... 13
- Table 4: Parameter Configuration from Display ..... 13
- Table 5: Modbus registers ..... 18
- Table 6: Modbus package structure ..... 18

## 1. INTRODUCTION

The aim of this document is to illustrate the correct use of the ModBus protocol, with the Rs485 interface.

Reading of this document presumes a fair knowledge of the wiring and programming of networks and devices equipped with the ModBus interface.

### 1.1 Abbreviations

0x	Preface indicating a hexadecimal number
RTU	Remote Terminal Unit
CRC	Cyclic Redundancy Check.

Table 1: Abbreviations Table

### 1.2 Modbus specifications

The table below describes the specifications of the Modbus interface present:

Modbus specifications	Description	Comments
Protocol	Modbus RTU	Only "Slave" mode is supported
Connector	Screw terminal	
Modbus connection	RS485 - 2 wire	
Slave address	1-247	Set at the first start by the display, otherwise by Modbus <sup>a</sup> message
Line termination	Absent on appliance	If necessary proceed as described in 2.1
Transmission speeds supported	1200, 2400, 4800, 9600, 19200, 38400 Kb/s	Set by display or Modbus <sup>a</sup> message
Start bit	1	
Data bit	8	
Stop bit	1 o 2	Set by display or Modbus <sup>a</sup> message
Parity	None, Even or Odd	Set by display or Modbus <sup>a</sup> message

Table 2: Modbus specifications

#### Notes:

- a) In the product **EVOPLUS SMALL** it is possible to set the parameters only from the display

### 1.3 Type of Modbus network

A Modbus network contemplates only one master device connected to the network and up to 247 SLAVE devices which can communicate on the bus **only** after a request made by the master.

The type of network recommended for connecting the device to a Modbus network is the "daisy chain" type, with the possibility of making small derivations, the maximum length of which depends on the baud rate chosen for transmission.

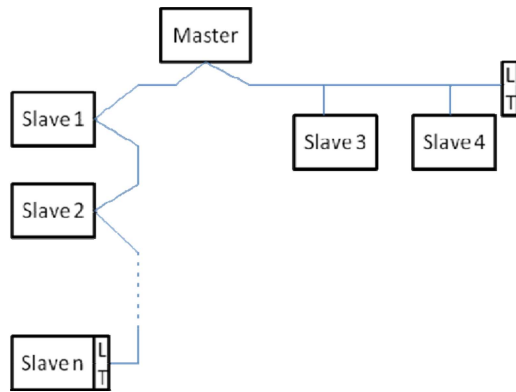


Figure 1: Example of a Modbus network with termination

The maximum number of devices connected to a network without repeaters is 32. As shown in Figure 1, it may be necessary to terminate the line at the end and at the beginning with terminating resistors (LT).

## 2. MODBUS CONFIGURATION

### 2.1 Wiring

Modbus communication with 2-wire RS485 contemplates the use of 3 cables (A, B and GND). Connect the 3 cables correctly. It is recommended to use a screened 2-pole cable, with a twisted pair.

MODBUS Terminals	Description
A	Terminal not inverted (+)
B	Terminal inverted (-)
Y	Screen

Table 3: Modbus- Rs485 connection

For the connections, see the product installation manual.

### 2.2 Parameter Configuration

To configure the Modbus parameters correctly, the user must the access the Modbus configuration menu, accessible from the display (see Installation manual). Table 4 describes the parameters that can be set from the menu.

Parameter Symbol	Description	Range	Default value	Measuring unit
Ad	Modbus address of the device	1-247	1	
Br	Serial communication baud rate	1.2, 2.4, 4.8, 9.6, 19.2, 38.4	19.2	Kb/s
Pa	Type of parity control	None, Odd, Even	Even	
Sb	Number of stop bits	1-2	1	
Rd	Minimum response time	0-3000	0	ms
En	Modbus enabling	Disable, Enable	Disable	

Table 4: Parameter Configuration from Display

After having set all the parameters, enable the Modbus peripheral by setting parameter En at **Enable**.

### 3. MODBUS REGISTERS

The registers have a 16-bit size, if the content of the register is 0x7FFF, the content is not available.

R/W registers are available to read with the function codes 0x03, 0x04, to write with the function codes 0x06, 0x10.

R registers are available in read-only mode with the function codes 0x03 e 0x04.

The data are all of the UNSIGNED type, except registers named Temperature (e.g. 00212 ), which have SIGNED data.

**Attention: The registers have a value from 1 to n, the address in the data package goes from 0 to n-1!!! (see example 3.2)**

Address	Name	Type	Range (Scale)	R/W <sup>a</sup>	Description
00001	SlaveMinimumReplyDelay		0-3000 (1 ms)	R/W <sup>a</sup>	The value indicates the minimum reply time of the Slave to a request from the Master.
00002	SetModbusAddress		1-247	R/W <sup>a</sup>	The value indicates the address that the device will have on the ModBus field bus. If a value is inserted that is not in the validity range, the previous value will be maintained.
00003	ModbusBaudRate		0-5	R/W <sup>a</sup>	The value defines the serial communication baud rate. 0 - 1200 bit/s 1- 2400 bit/s 2 - 4800 bit/s 3 - 9600 bit/s 4 - 19200 bit/s 5 - 38400 bit/s
00004	ModbusParityBits		0-2	R/W <sup>a</sup>	The value defines the type of parity used in serial transmission. 0 - No Parity 1 - Even parity 2 - Odd parity
00005	ModbusStopBits		1-2	R/W <sup>a</sup>	The value defines the number of Stop bits used. 1 - 1 Stop bit 2- 2 Stop bit
00006	AutoAckControlBits		0-1	R/W <sup>a</sup>	The value defines whether the user must manually reset at 0 the reset Alarm and ClearHistory registers. 0- The registers return to 0 automatically 1- The registers must be reset at 0 manually

Configuration block and system status			
00101	SystemResetAlarm	R/W <sup>b</sup>	The control bit resets the system alarms 0= Do not reset 1= Reset <b>Important!</b> The command is performed by writing 1 on the register in presence of the value 0.
00102	System ClearHistory	R/W <sup>b</sup>	Resets the alarm history of the entire system 0= Do not reset 1= Reset <b>Important!</b> The command is performed by writing 1 on the register in presence of the value 0.
00103	RegulationMode	R/W	The register value indicates the type of regulation chosen for the pump.
<b>Important!</b>			
<b>Evoplus M/L Software Version (A.B) 1.xx e 2.xx</b> 0= Proportional differential pressure regulation. 1= Proportional differential pressure regulation with set-point set by external signal (0-10V or PWM). 2= Proportional differential pressure regulation with set-point depending on temperature with positive increment. 3= Proportional differential pressure regulation with set-point depending on temperature with negative increment. 4= Regulation with constant differential pressure. 5= Constant differential pressure regulation with set-point set by external signal (0-10V or PWM). 6= Constant differential pressure regulation with set-point depending on temperature with positive increment. 7= Constant differential pressure regulation with set-point depending on temperature with negative increment. 8= Regulation with constant curve with set-point set from the register. 9= Regulation with fixed curve with set-point set by external signal (0-10V or PWM).		<b>Evoplus Small Software Version (A.B) 1.xx</b> 0= Proportional differential pressure regulation. 1= Proportional differential pressure regulation with set-point set by external signal (0-10V or PWM). 2= Regulation with constant differential pressure. 3= Constant differential pressure regulation with set-point set by external signal (0-10V or PWM). 4= Regulation with constant curve with set-point set from the register. 5= Regulation with fixed curve with set-point set by external signal (0-10V or PWM).	
		<b>Evoplus M/L Software Version (A.B) 3.xx</b> <b>Evoplus Small Software Version (A.B) 2.xx</b> 0= Proportional differential pressure regulation. 1= Proportional differential pressure regulation with set-point set by external signal (0-10V or PWM). 2= Proportional differential pressure regulation with set-point depending on temperature 3= Regulation with constant differential pressure. 4= Constant differential pressure regulation with set-point set by external signal (0-10V or PWM). 5= Constant differential pressure regulation with set-point depending on temperature. 6= Regulation with constant curve with set-point set from the register. 7= Regulation with fixed curve with set-point set by external signal (0-10V or PWM).	

<b>00104</b>	RegulationSetPoint	(0.1m)	R/W	The value indicates the regulation set point.
<b>00105</b>	RegulationTmax	0-100 (1°C)	R/W	The value indicates the parameter Tmax with which to make the curve depending on temperature
<b>00106</b>	RegulationAutoEconomy			The value indicates the choice to use "auto" or "economy" mode 0=auto 1=economy
<b>00107</b>	SetPointPerCentReduction	50- 90% (1%)	R/W	The value indicates the percentage reduction of the set point in "economy" mode.
<b>00108</b>	ExtSignalType	0-3	R/W	The value indicates the type of external signal that regulates the set point (used only in some modes). 0= 0-10V increasing (Set point increases as the value 0-10V increases) 1= 0-10V decreasing (Set point decreases as the value 0-10V decreases) 2= PWM increasing (Set point increases as the PWM duty cycle increases) 3= PWM decreasing (Set point decreases as the PWM duty cycle decreases)
<b>00109</b>	TwinPumpSystemMode	0-2	R/W	In the case of twin operation, the parameter indicates the operating mode 0= Simultaneous 1= Alternate every 24h 2= Main/Reserve
<b>00110</b>	MaxRpmPercent	25-100 (1%)	R/W	The value indicates the set point as a percentage of the value of the maximum allowed revs
<b>00111</b>	OnOffExt	0-2	R/W	The value indicates the Pump on or off status 0 - On 1 - Off 2 - Ext

Configuration block and status of Pump 1				
00201	Bit0: Pump1ResetAlarm Bit1: Pump1ClearHistory		R/W	If at 1 resets alarm history Important! The command is performed by writing 1 on the bit in presence of the value 0.
00202	Pump1Status	0-2	R	Indicates the pump status 0- Pump off 1- Charge status 2- Pump running
00203	Pump1Fault	0-1	R	Indicates if the inverter is stopped due to a fault 0- Ok 1- Fault
00211	Pump1ElectronicBoardTemperature	(1°C)	R	Ambient temperature value inside container
00212	Pump1ElectronicHeatsinkTemperature	(1°C)	R	Temperature value on heat sink.
00213	Pump1LineVoltage	(1V)	R	Input voltage value (Rms)
00214	Pump1OutCurrent	(1mA)	R	Output current value
00215	Reserved			
00216	Pump1RPM	(1rpm)	R	Motor revs per minute
00217	Pump1Power	(1W) <sup>c</sup>	R	Power delivered
00218	Pump1OperatingTimeHI	(1h)	R	Pump use time
00219	Pump1OperatingTimeLO	(1h)	R	Pump use time
00220	Pump1Head	(0.1m)	R	Pump head
00221	Pump1EstimatedFlow	(0.1m <sup>3</sup> /h)	R	Value of estimated flow in m <sup>3</sup> /h
00222	Pump1LiquidTemperature	(1 °C)	R	Value of temperature measured by internal sensor
00223	Pump1LiquidTemperatureExt	(1°C)	R	Value of temperature measured by external sensor
00224-00230	Reserved			
00231-00245	Pump1Alarm			Alarms history, the register 00231 contains the most recent alarm, while the register 00245 contains the least recent alarm. For the list of alarms, see the user manual.
00251	SoftwareNumberVersionA	0-255	R	
00252	SoftwareNumberVersionB	0-255	R	
00253	SoftwareNumberVersionC	0-255	R	
00254	SoftwareNumberVersionD	0-255	R	
00255	SoftwareNumberVersionE	0-255	R	
00256	SoftwareNumberVersionF	0-255	R	
00257	Unit Family		R	Indicates the name of the device family

Configuration block and status of Pump 1			
00258	UnitType	R	Indicates the type of device of the specific family
00259	Unit Version	R	Product version

Table 5: Modbus registers

**Notes:**

- In the product **EVOPLUS SMALL** the register is **read-only**.
- In the product **EVOPLUS SMALL** the writing operations take place **only with the WRITE SINGLE REGISTER control**.
- In the product **EVOPLUS SMALL** the unit of measure is in **mW**.

**3.1 Supported Modbus messages**

The maximum length of a Modbus package is 256 byte.  
The package structure is shown in **Error! Reference source not found.**

Slave address	Function Code	Data	CRC
1 byte	1 byte	0-252 byte	2 byte

Table 6: Modbus package structure

**3.1.1 Read holding Register (function code = 0x03)**

This function is for reading the value of the holding registers from the slave device. The request package specifies the start address and the quantity of registers to read.

Slave address	Function Code	Start address HI	Start address LO	Quantity of registers HI	Quantity of registers LO
0x01	0x03	0x00	0x02	0x00	0x01

The slave reply will contain the number of reply bytes and the content of the registers.

Slave address	Function Code	Bytes sent	HI value	LO value
0x01	0x03	0x02	0x00	0x00

**3.1.2 Read Input Register (function code = 0x04)**

This function is for reading the value of the input registers from the slave device. The request package specifies the start address and the quantity of registers to read.

Slave address	Function Code	Start address HI	Start address LO	Quantity of registers HI	Quantity of registers LO
0x01	0x04	0x00	0xFF	0x00	0x01

The slave reply will contain the number of reply bytes and the content of the registers.

Slave address	Function Code	Bytes sent	HI value	LO value
0x01	0x04	0x02	0x00	0x00

**3.1.3 Write Single Register (function code = 0x06)**

This function is for writing a register of the slave device. The request package specifies the register address and the value (2 byte) to write.

Slave address	Function Code	Start address HI	Start address LO	HI value	LO value
0x01	0x06	0x00	0x02	0x00	0x02



Slave reply:

Slave address	Function Code	Start address HI	Start address LO	HI value	LO value
0x01	0x06	0x00	0x02	0x00	0x02

### 3.1.4 Write Multiple Register (function code = 0x10)

This function is for writing one or more registers of the slave device. The request package specifies the start address, the quantity of registers to write, the number of bytes and the values to write.

Slave address	Function Code	Start address HI	Start address LO	Quantity of registers HI	Quantity of registers LO	Number of bytes HI	Register 00003 HI	Register 00003 LO	Register 00004 HI	Register 00004 LO
0x01	0x10	0x00	0x02	0x00	0x02	0x04	0x00			
0x00	0x00	0x01								

## 3.2 Example of Modbus message

Some examples of Modbus communication will be illustrated below.

### 3.2.1 Reading Pump Power

This section will illustrate how to take a reading of the power supplied by Pump. The value 0x01 will be used as the address in the example.

**Request from master to slave**

Byte	Value	Description
Slave address	0x01	
Function Code	0x03	Function "Read holding register"
Start Address HI	0x00	Start address is 0x0D8 = 216, so the Modbus address is 217
Start Address LO	0xD8	
Quantity HI	0x00	Quantity of registers to read = 1
Quantity LO	0x01	

Slave reply

Byte	Value	Description
Slave address	0x01	
Function Code	0x03	Function "Read holding register"
Number of bytes	0x02	
00223 HI	0x03	The value read is 0x3E8 = 1000 W
00324 LO	0xE8	

### 3.2.2 Use of alternate operating mode in twin configuration

This section will illustrate how to configure the system in alternate mode.

#### Request from master to slave

Byte	Value	Description
Indirizzo Slave	0x01	
Function Code	0x06	Function "Write holding register"
Start Address HI	0x00	Start address is 0x006C = 108, so the Modbus address is 109
Start Address LO	0x6C	
Write HI	0x00	Sets register at value 1, or alternate mode.
Write LO	0x01	

#### Slave reply

Byte	Value	Description
Slave address	0x01	
Function Code	0x06	Function "Write holding register"
Start Address HI	0x00	Start address is 0x006C = 108, so the Modbus address is 109
Start Address LO	0x6C	
Write HI	0x00	Sets register at value 1, or alternate mode.
Write LO	0x01	