Interface Description

Modbus Interface

RMA EcoSonic X12 USM

Revision

Document	Modifications	Checked	Date
UZ_01_00TD026_07_11	Translation, new layout		8/2018
UZ_01_00TD026_06_01	Measurement data as 32-bit, float and additional data types		20.02.15
UZ_01_00TD026_05_01	Addresses, decimal places corrected		

Contents

1. Overview and Function

The modbus interface of the EcoSonic X12 provides current measured values from the EcoSonic X12 ultrasonic gas meter (USM) and from the volume corrector (PTC), including meter readings, flow, pressure, temperature, …, compressibility, state factor. The EcoSonic X12 modbus interface implements the modbus protocol RS485.

The modbus interface is non-reactive. The data provided can only be read. Data and parameters can neither be entered nor modified via this modbus interface.

Meter readings and measured values which are provided via the modbus interface may not be used as a reference for custody transfer. Even though the ultrasonic gas meter (USM) and the volume corrector (PTC) of the EcoSonic X12 have been brought onto the market in compliance with the Measuring Instruments Directive, and these units are both certified and secured for custody transfer purposes, the measured values provided via the modbus interface are only copies of measured values for custody transfer.

1.1 Software Version

This document describes modbus implementations which are deployed together with EcoTouch Control versions 1.8 and higher.

2. Data Transmission

The modbus interface is operated in RTU mode. The interface is firmly set at

- 8 data bits
- 1 stop bit.

The interface parameters mentioned below can be configured via the EcoTouch operating unit or the EcoView program:

Modbus Slave ID	1 – 247
Transmission rate	0 = 9600 1= 19200 2 = 38400 *3 = 57600*[1] *4 = 115200*[1]
Parity	0 = no parity 1 = even parity 2 = odd parity

The EcoSonic X12 is usually delivered with the following presettings:

- Modbus Slave ID 10,
- 38400 bauds,
- odd parity

It is recommended to set an inter packet gap of at least 30 ms in order to avoid communication errors.

2.1 Data Packets

The modbus interface provides access to the measured values from the ultrasonic gas meter and from the volume corrector. The values are mapped as a "Holding Register" according to the specifications of the modbus and can be read via the modbus function code 0x03 ("Read Holding Register") or the modbus function code 0x04 ("Read Input Registers").

The interface receives data packets with function codes 0x03 and 0x04 and transmits the data with a response packet or responds with an error message.

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[1] These transmission rates can be set, safe communication at these high rates is, however, not yet consistently implemented.

2.1.1 Data request

Receiver	Function code	Start adress	Number of registers	CRC16
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Receiver	modbus ID of the EcoSonic X12 (1- 247)
Function code	0x03 (= function code Read Holding Register)
Start adress	start address from which point the "Numbers of Registers" are read
Number of registers	number of requested data bytes without checksum (0 - 1024 bytes)
CRC 16	CRC checksum of the data

2.1.2 Response

Transmitter	Function code	Length	Response data	CRC16
1 byte	1 byte	2 bytes	0 - 1024 bytes	2 bytes

Transmitter	modbus ID of the EcoSonic X12 (1- 247)
Command	Command + 0x80 (0x81-0xFE)
Length	number of the following data bytes without checksum
Response data	the requested data
CRC 16	CRC checksum of the data

2.1.2.1 Error message - modbus exception code

Modbus exception codes are possible responses of the implemented modbus, indicating why it has not been possible to execute a modbus command received.

0x01	ILLEGAL FUNCTION
0x02	ILLEGAL DATA ADDRESS
0x03	ILLEGAL DATA VALUE
0x04	SLAVE DEVICE FAILURE
0x05	ACKNOWLEDGE
0x06	SLAVE DEVICE BUSY
0x07	NEGATIVE ACKNOWLEDGEMENT
0x08	MEMORY PARITY ERROR

2.2 Register Assignment

The register assignment is subdivided into a number of blocks. The address space has the general structure given below:

Address space 0 to 13	test register
Address space 1000 to 1999	register of the ultrasonic gas meter (USM)
Address space 2000 to 2999	register of the volume corrector (PTC)
Address 3000	system information

(Addresses given in decimals)

The test registers are preset with fixed values of different data types (I16, U16, I32, …, float , double, string). An application can request these firmly defined values for development and testing purposes and then verify the data read, their presentation and the interpretation of the data type.

The data are provided several times for reading in the address spaces for the USM or the PTC in different data types and in different resolutions and units. Each first block gives the data in the internally used data types. In the following blocks, the measured data can be read encoded in different data types such as I32 or float.

2.2.1 Test Registers

Address	Description	Type	Number of registers	Request sequence Slave ID 10 = 0x0A
0	16-bit Test Register. Hex: AA55 I16: -21931 U16: 43605	I16/U16	1	0A 03 00 00 00 01 85 71
1	32-bit Test Register Hex: AA55 A55A I32: -1437227686 U32: 2857739610	I32/U32	2	0A 03 00 01 00 02 94 B0
3	64-bit Test Register Hex: AA55 A55A BBCC DDEE I64: -6172845905124991506 U64: 12273898168584560110	I64/U64	4	0A 03 00 03 00 04 B5 72
7	Float Test Register Hex: C7F1 2060 Float: -123456.75	float	2	0A 03 00 07 00 02 74 B1
9	Double Test Register Hex: C26D 1A94 A1FF E800 Double: -999999999999.25	double	4	0A 03 00 09 00 04 95 70
13	String Test Register String: "RMA MRT test" Encoding: ASCII	string	6	0A 03 00 0D 00 06 55 70

2.2.2 Ultrasonic Gas Meter (USM)

2.2.2.1 EcoSonic X12 internal data types

Address	Description	Type	Unit	Number of registers	Request sequence Slave ID 10 = 0x0A
1000	volume under measuring conditions DIR1 [FR1] (Vm1)	I64	1/10 000 m^3	4	0A 03 03 E8 00 04 C5 02
1004	volume under measuring conditions DIR2 [FR2] (Vm2)	I64	1/10 000 m^3	4	0A 03 03 EC 00 04 84 C3
1008	disturbance volume under measuring conditions DIR1 [FR1] (VmD1)	I64	1/10 000 m^3	4	0A 03 03 F0 00 04 45 05
1012	disturbance volume under measuring conditions DIR2 [FR2] (VmD2)	I64	1/10 000 m^3	4	0A 03 03 F4 00 04 04 C4
1016	flow rate (Q_m)	I32	1/100 m^3/h	2	0A 03 03 F8 00 02 44 C5
1018	average flow rate	I32	1/100 000 m/s	2	0A 03 03 FA 00 02 E5 05
1020	average speed of sound	U32	1/100 m/s	2	0A 03 03 FC 00 02 05 04
1022	pressure	U32	1/10 mbar	2	0A 03 03 FE 00 02 94 37
1024	temperature	I16	1/100 °C	1	0A 03 04 00 00 01 84 41

2.2.2.2 32-bit encoding

Address	Description	Type	Unit	Number of registers	Request sequence Slave ID 10 = 0x0A
1100	volume under measuring conditions DIR1 [FR1] (VmD1) max. 999999999 m^3	I32	m^3	2	0A 03 04 4C 00 02 05 97
1102	volume under measuring conditions DIR2 [FR2] (VmD2) max. 999999999 m^3	I32	m^3	2	0A 03 04 4E 00 02 A4 57

1104	disturbance volume under measuring conditions DIR1 [FR1] (VmD1) max. 999999999 m^3	I32	m^3	2	0A 03 04 50 00 02 C4 51
1106	disturbance volume under measuring conditions DIR2 [FR2] (VmD2) max. 999999999 m^3	I32	m^3	2	0A 03 04 52 00 02 65 91
1108	flow rate (Q$_m$)	I32	m^3	2	0A 03 04 54 00 02 85 90
1110	average flow rate	I32	m/s	2	0A 03 04 56 00 02 24 50
1112	average speed of sound	U32	m/s	2	0A 03 04 58 00 02 45 93
1114	pressure	U32	mbar	2	0A 03 04 5A 00 02 E4 53
1116	temperature	I32	°C	2	0A 03 04 5C 00 02 04 52
1118	pressure (bar)	U32	bar	2	0A 03 04 5E 00 02 A5 92

2.2.2.3 Float encoding

Address	Description	Type	Unit	Number of registers	Request sequence Slave ID 10 = 0x0A
1500	volume under measuring conditions DIR1 [FR1] (Vm1)	float	m^3	2	A 03 05 DC 00 02 04 46
1502	volume under measuring conditions DIR2 [FR2] (Vm2)	float	m^3	2	0A 03 05 DE 00 02 A5 86
1504	disturbance volume under measuring conditions DIR1 [FR1] (VmD1)	float	m^3	2	0A 03 05 E0 00 02 C4 4A
1506	disturbance volume under measuring conditions DIR2 [FR2] (VmD2)	float	m^3	2	0A 03 05 E2 00 02 65 8A
1508	flow rate (Q$_m$)	float	m^3	2	0A 03 05 E4 00 02 85 8B
1510	average flow rate	float	m/s	2	0A 03 05 E6 00 02 24 4B
1512	average speed of sound	float	m/s	2	0A 03 05 E8 00 02 45 88

Address	Description	Type	Unit	Number of registers	Request sequence
1514	pressure (mbar)	float	mbar	2	0A 03 05 EA 00 02 E4 48
1516	temperature	float	°C	2	0A 03 05 EC 00 02 04 49
1518	pressure (bar)	float	bar	2	0A 03 05 EE 00 02 A5 89

2.2.2.4 Double encoding

Address	Description	Type	Unit	Number of registers	Request sequence Slave ID 10 = 0x0A
1600	volume under measuring conditions DIR1 [FR1] (Vm1)	double	m^3	4	0A 03 06 40 00 04 44 2E
1604	volume under measuring conditions DIR2 [FR2] (Vm2)	double	m^3	4	0A 03 06 44 00 04 05 EF
1608	disturbance volume under measuring conditions DIR1 [FR1] (VmD1)	double	m^3	4	0A 03 06 48 00 04 C5 EC
1612	disturbance volume under measuring conditions DIR2 [FR2] (VmD2)	double	m^3	4	0A 03 06 4C 00 04 84 2D
1616	flow rate (Q_m)	double	m^3	4	0A 03 06 50 00 04 45 EB
1620	average flow rate	double	m/s	4	0A 03 06 54 00 04 04 2A
1624	average speed of sound	double	m/s	4	0A 03 06 58 00 04 C4 29
1628	pressure (mbar)	double	mbar	4	0A 03 06 5C 00 04 85 E8
1632	temperature	double	°C	4	0A 03 06 60 00 04 45 E4
1636	pressure (bar)	double	bar	4	0A 03 06 64 00 04 04 25

2.2.3 System

Address	Description	Type	Number of registers	Request sequence Slave ID 10 = 0x0A
3000	system status 0x00 normal operation (green LED) 0x01 warning (yellow LED) 0x02 error (red LED)	U16	1	0A 03 0B B8 00 01 07 70

3. Power Connection

Please observe the following for any work carried out on the EcoSonic X12

	DANGER

Explosion hazard, risk of death or injury

The pipeline with the EcoSonic X12 may be operated with gases that are detrimental to health and which are under high pressure at high temperatures.

Any work on the metering system or the gas-carrying system may only be carried out by qualified persons.

In order to actually connect the modbus interface to the power supply, please observe all safety instructions and information contained in the operating instructions of the EcoSonic X12 at all times.

The warning notice below is repeated here, so that the ignition protection class can be taken into account during any planning in advance.

The modbus interface of the EcoSonic X12 is connected to the power supply in the terminal compartment, at the terminal connections J5 and J6. The connection for the modbus via the RS485 interface is electrically separated from the USM electronics (according to EN 60747-5: U_{in} = - 9 to + 14 V). This interface provides access to the measured values of the EcoSonic X12.

	WARNING

Ignition protection class

The design of the modbus interface of the EcoSonic X12 comes under ignition protection class Ex-e. The ignition protection class must be taken into account for planning and for the safety related assessment of the metering point in order to ensure safe operation of the whole installation.

The modbus interface is connected to connection terminals J5 and J6 in the Ex-e terminal compartment.

Ex-e terminal connection	Designation	Connected load	Safety relevant voltage U_m [V]
J03	Do not connect when the modbus interface is operating.		
J04	Do not connect when the modbus interface is operating.		
J05	DSfG/Modbus RS485 B	galvanically separated	250
J06	DSfG/Modbus RS485 A	according to EN 60747-5	250
		U_{in} = -9 up to +14V	

3.1.1 Cables

	Specification	Please note
Type of cable	twisted in pairs, shielded; cable impedance approx. 120 Ω e.g. LiYCY (TP), PUR CP (TP)	connect shielding on the opposite side to the ground terminal connection
Min. cross section	2 x 0.25 mm^2	do not connect unused pairs of conductors; protect against unintended short-circuiting
Max. cable length	100 m at 0.25 mm^2 500 m or longer at 1.5 mm^2	
Cable diameter	*6 ... 12 mm*	terminal zone of the cable glands

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