



IFC 070 Supplementary Instructions

Battery powered electromagnetic water meter with optional FlexPower

Battery powered (non-isolated Modbus):

Electronic revision: 5.1.0_[SW.REV.5.1.0_]; Modbus version: 1.1.1_

Flexpower (isolated Modbus):

Electronic revision: 5.1.0_[SW.REV.5.1.0_]; Modbus version: 1.1.0_



The documentation is only complete when used in combination with the relevant documentation for the flow sensor.

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The signal converter with the RS485 interface, is able to communicate with an external device (PC or other suitable computer system) using the Modbus protocol. This option allows data exchange between PC or computer and single or multiple devices.

The bus configuration consists of one external device as a master and one or more signal converters as slaves. For bus operation the device address, parity, baud rate, stop bits, data format and transmission delay must be set in the signal converter.

All devices connected to the bus, must have different unique addresses but the same baud rate and settings.



INFORMATION!

Changing the baud rate will greatly affect the units battery life, baud rate equal to and below 9600 bps are considered energy efficient while baud rates greater than 9600 bps are not.

2.1 General technical data

Interface	Available in two versions: - galvanically isolated (mains powered) - not isolated (battery powered)
Baud rate	1200, 2400, 3600, 4800, 9600 (default), 19200, 38400, 57600 or 115200
Protocol	Modbus RTU (documentation available on www.modbus.org)
Data encoding	All Modbus data fields are encoded according to IEC 61131-3 standard
Maximum participants on bus	32 per line, master included (may be extended by repeaters)
Coding	NRZ bit coding
Address range	Modbus: 1...247
Transmission procedure	Half duplex, asynchronous
Bus access	Master / slave
Device role	Slave
Cable	Shielded twisted pair for RS 485 applications
Distances	Isolated: Maximum 1.2 km / 3937 ft without repeater (dependant on baud rate and cable specifications) Non isolated: Maximum 100 m / 328 ft, without termination (dependent on baud rate and cable specifications)

Table 2-1: General technical data

2.2 Technical data of the Modbus interface (according to EIA standards)

Kind of signal transmission	Differential, 2-wire topology
Maximum number of transmitter/receivers	32
Voltage range on signal converter input	-7...+12 V
Maximum voltage on signal converter output	5 V
Minimum voltage on driver output, max. load	$U_{diff} > 1.5 \text{ V}$
Maximum input current (off state)	-20...+20 μA
Receiver input voltage	-7...+12 V
Sensitivity of the receiver	-200...+200 mV
Receiver input resistance	> 12 k Ω
Short circuit current	< 250 mA
Bus termination	120 Ω (nominal)

Table 2-2: Technical data of the Modbus interface (according to EIA standards)

For proper operation of Modbus in half duplex mode in multi-drop communication, it is recommended that a termination resistor is applied to both ends of the data line. The simplest form of termination is line-to-line resistor across the differential input.

In single Peer to Peer mode with a non isolated Modbus device, termination resistors are not allowed.

In RTU mode the Modbus protocol requires quiet periods on the communications bus for synchronisation. It is therefore important that the Modbus is not allowed to "REAL", i.e. unreferenced to 0 V, as this could lead to spurious signals due to noise pick-up. It is therefore necessary to employ biasing resistors at one point on the bus network, normally the "end".

Display	Description and settings
Slave Address	Selects the Modbus address of the device. Range: 1..247 (default = 1)
Baud Rate	Selects the baud rate of the device. Options: 1200 / 2400 / 3600 / 4800 / 9600 (default) / 19200 / 38400 / 57600 / 115200
Parity	Selects the parity. Options: even parity (default) / odd parity / no parity
Stop Bits	Selects the number of stop bits. Options: 1 (default for parity even / odd) / 2
Data Format	Selects the data format. Options: Big Endian (default) / Little Endian
Transmission Delay	Selects the delay between receiving the last byte of a request and sending the first byte of the response. Options: 0 (default) / 5 / 10 / 20 / 30 / 40 / 50 ms
ID	Sets the slave identification for identification purposes Range: 00000..99999 (default=00000)
MODBUS OFF	Disable MODBUS interface when main power is lost. Options: Modbus on / Modbus off (default)
Reception interval	Enable MODBUS reception every x seconds for a specific time (tbd). Note: this option can only be used in systems where the Modbus master requests data in timed intervals. Range: 0..3600 seconds (default = 0 seconds)

Table 4-1: Local configuration

Refer to the standard handbook of the signal converter for connection details.

Terminals	Description
B-	Sign. A (D0-)
B	Common 0 V
B+	Sign. B (D1+)

Table 5-1: Modbus connections

6.1 General information concerning the protocol

Using RTU (Remote Terminal Unit) format, data is transmitted as 8 bit binary characters. There are no special characters to determine the start and end of a message frame.

Synchronisation is achieved by a minimum silent period of at least 3.5 character times before the start of each frame transmission and a maximum silent period of 1.5 character times between characters in the same frame.

6.2 RTU frame format

The format of the query and response frames vary slightly depending upon the command function. The basic form is outlined below.

Command function	Frame format	Description
Silent period	3.5 x T	All transmissions must be preceded by a minimum silent period of 3.5 x T, where T is the transmission time of a single character. This can be calculated from the baud rate, e.g. at 19.2 kb even parity with 1 stop bit (11 bits), T = 573 µs.
Slave address	8 bits	This is a single byte slave address which is transmitted first and must be in the range of 1...247. Address 0 is reserved for a broadcast address which all slaves should recognise, and therefore requires no response.
Function code	8 bits	This is an eight bit code in the range of 1...255 although only 126 functions exist as the codes 129...255 represent an error condition. An error condition occurs when the addressed slave does not accept the command, in which case it responds with the function code + 128, i.e. with its MSB set to 1.
Register start address or byte count when required	8 bit byte count 16 bit address	Register start address: for a query command that requires data to be returned, this field will contain the 16 bit start address of the register (or data) to be returned. Note that the signal converter uses protocol addresses. Therefore the register address listed is the actual number required in the Modbus command. Byte count: In general this is only present in frames that are transferring data, and has a value equal to the number of bytes contained in the data field. The data field is limited to a maximum of 250 bytes.
Number of points or data bytes when required	n x 8 bits	Number of points: for a query command that requires data to be returned, this field will contain the number of registers to be returned regardless of their bit size. Data bytes: contains the data requested. The signal converter can use Big Endian format (MSB first) or Little Endian format (LSB first).
CRC	16 bits	This field contains a 16 bit CRC which is calculated on all the data bits of the message bytes.

Table 6-1: RTU frame format

6.3 Addressing

In the following tables the Modbus protocol addresses / data addresses are listed.

The address map is based on the shared memory model and is designed with interoperability in mind and has a limited address range of 0000...9999.

6.4 Overview of supported functions

The following table shows Modbus functions supported by RS485 interface.

Function code		Name	Access to
hex	dec		
01	01	Read Single Coil	-
02	02	Read Discrete Inputs	-
03	03	Read Holding Register	-
04	04	Read Input Register	-
05	05	Write Single Coil	-
08	08	Diagnostics	Link diagnostic counters.
10	16	Write Multiple Register	-
2B	43	Encapsulated Interface Transport	Read Device Identification

Table 6-2: Overview of supported functions

6.5 Device identification on the Modbus interface

The device identification is according to the category "Regular" according to the Modbus Application Protocol Specification V1.1a. Function code 43 / 14 (0x2B / 0x0E).

Modbus object Id	Object name / Description	Type	Content
0x00	VendorName	16 byte ASCII String	KROHNE
0x01	ProductCode	10 byte ASCII String	CG number; order code for the signal converter assembly
0x02	MajorMinorRevision	7 byte ASCII String	V1.0.xx
0x03	Vendor URL	32 byte ASCII String	www.krohne.com
0x04	ProductName	16 byte ASCII String	IFC 070
0x05	ModelName	16 byte ASCII String	Modbus
0x06	UserApplicationName	16 byte ASCII String	User tag, displayed on the local ID menu item; Value 00000...99999

Table 6-3: Device identification on the Modbus interface

6.6 Coil registers

These function codes are supported:

- 0x01 Read Single Coil
- 0x02 Read Discrete Inputs
- 0x05 Write Single Coil

For compatibility reasons all the coil registers can also be access by the integer oriented function codes on the same addresses in unsigned integer format.

All data types are specified according to IEC 61131-3; for further information refer to *Data type definitions* on page 30.

6.6.1 Device / bus control

No.	Modbus protocol address	Description	Settings			Type	No. of registers	Read / Write
1	1000	Restart Device	Write	0	-	BOOL	1	WO
			Write	1	Restart Device			
			Read	0	0			
			Read	1	-			
2	1001	Reset Errors	Write	0	-	BOOL	1	WO
			Write	1	Reset Errors			
			Read	0	0			
			Read	1	-			
3	1002	Apply Changes	Write	0	-	BOOL	1	WO
			Write	1	Apply Changes			
			Read	0	0			
			Read	1	-			
4	1003	Discard Changes	Write	0	-	BOOL	1	WO
			Write	1	Discard Changes			
			Read	0	0			
			Read	1	-			
5	1004	Load Factory Defaults	Write	0	-	BOOL	1	WO
			Write	1	Load Factory Defaults			
			Read	0	0			
			Read	1	-			

Table 6-4: Device / bus control

* Write only possible when logged in "Supervisor" mode.

6.6.2 Warning and error status

No.	Modbus protocol address	Description	Settings			Type	No. of registers	Read / Write
1	2000	Flowmeter measurement warning / error	Write	0	-	BOOL	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
2	2001	Battery low warning < 10% left	Write	0	-	BOOL	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
3	2002	Pressure measurement warning / error	Write	0	-	BOOL	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
4	2003	Temperature measurement warning / error	Write	0	-	BOOL	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
5	2004	EEPROM Error	Write	0	-	BOOL	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
6	2005	Empty pipe	Write	0	-	BOOL	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
7	2006	Communication error (Add-on <-> main board)	Write	0	-	BOOL	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
8	2007	Pressure > Maximum limit Alarm	Write	0	-	BOOL	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
9	2008	Pressure < Minimum limit alarm	Write	0	-	BOOL	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			

No.	Modbus protocol address	Description	Settings			Type	No. of registers	Read / Write
10	2009	Temperature > Maximum limit alarm	Write	0	-	BOOL	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
11	2010	Temperature < Minimum limit alarm	Write	0	-	BOOL	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
12	2011	Flow direction	Write	0	-	BOOL	1	RO
			Write	1	-			
			Read	0	Forward flow			
			Read	1	Reverse flow			

Table 6-5: Warning and error status

6.6.3 Counter controls

No.	Modbus protocol address	Description	Settings			Type	No. of registers	Read / Write
1	2500	Start / Stop Counter 1	Write	0	Stop counter	BOOL	1	R/W
			Write	1	Start counter			
			Read	0	Counter is stopped			
			Read	1	Counter is running			
2	2501	Start / Stop Counter 2	Write	0	Stop counter	BOOL	1	R/W
			Write	1	Start counter			
			Read	0	Counter is stopped			
			Read	1	Counter is running			
3	2502	Reset Counter 1	Write	0	-	BOOL	1	WO
			Write	1	Reset counter			
			Read	0	0			
			Read	1	-			
4	2503	Reset Counter 2	Write	0	-	BOOL	1	WO
			Write	1	Reset counter			
			Read	0	0			
			Read	1	-			

Table 6-6: Counter controls

6.7 Input registers

These function codes are supported:

- 0x03 Read Holding Register
- 0x04 Read Input Register
- 0x10 Write Holding Registers

For compatibility reasons all registers can be accessed by all function codes, as long as the read/write direction is observed.

The most important data has been continuously mapped, so it can be read with one access, for optimal access and compatibility this data has been banked into LREAL (double), REAL (float) and integer type banks.

All data types are specified according to IEC 61131-3; for further information refer to *Data type definitions* on page 30.

6.7.1 Device / bus control

No.	Modbus protocol address	Description	Settings			Type	No. of registers	Read / Write
1	1000	Restart Device	Write	0	-	WORD	1	WO
			Write	1	Restart Device			
			Read	0	0			
			Read	1	-			
2	1001	Reset Errors	Write	0	-	WORD	1	WO
			Write	1	Reset Errors			
			Read	0	0			
			Read	1	-			
3	1002	Apply Changes	Write	0	-	WORD	1	WO
			Write	1	Apply Changes			
			Read	0	0			
			Read	1	-			
4	1003	Discard Changes	Write	0	-	WORD	1	WO
			Write	1	Discard Changes			
			Read	0	0			
			Read	1	-			
5	1004	Load Factory Defaults	Write	0	-	WORD	1	WO*
			Write	1	Load Factory Defaults			
			Read	0	0			
			Read	1	-			

Table 6-7: Device / bus control

* Write only possible when logged in "Supervisor" mode.

6.7.2 Warning and error status

No.	Modbus protocol address	Description	Settings			Type	No. of registers	Read / Write
1	2000	Flowmeter measurement warning / error	Write	0	-	WORD	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
2	2001	Battery low warning < 10% left	Write	0	-	WORD	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
3	2002	Pressure measurement warning / error	Write	0	-	WORD	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
4	2003	Temperature measurement warning / error	Write	0	-	WORD	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
5	2004	EEPROM Error	Write	0	-	WORD	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
6	2005	Empty pipe	Write	0	-	WORD	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
7	2006	Communication error (Add-on <-> main board)	Write	0	-	WORD	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
8	2007	Pressure > Maximum limit Alarm	Write	0	-	WORD	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
9	2008	Pressure < Minimum limit alarm	Write	0	-	WORD	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			

No.	Modbus protocol address	Description	Settings			Type	No. of registers	Read / Write
10	2009	Temperature > Maximum limit alarm	Write	0	-	WORD	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
11	2010	Temperature < Minimum limit alarm	Write	0	-	WORD	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm Condition			
12	2011	Flow direction	Write	0	-	WORD	1	RO
			Write	1	-			
			Read	0	No Alarm			
			Read	1	Alarm condition			

Table 6-8: Warning and error status

6.7.3 Counter controls

No.	Modbus protocol address	Description	Settings			Type	No. of registers	Read / Write
1	2500	Start / Stop Counter 1	Write	0	Stop counter	WORD	1	R/W
			Write	1	Start counter			
			Read	0	Counter is stopped			
			Read	1	Counter is running			
2	2501	Start / Stop Counter 2	Write	0	Stop counter	WORD	1	R/W
			Write	1	Start counter			
			Read	0	Counter is stopped			
			Read	1	Counter is running			
3	2502	Reset Counter 1	Write	0	-	WORD	1	WO
			Write	1	Reset counter			
			Read	0	0			
			Read	1	-			
4	2503	Reset Counter 2	Write	0	-	WORD	1	WO
			Write	1	Reset counter			
			Read	0	0			
			Read	1	-			

Table 6-9: Counter controls

6.7.4 Measurement data LREAL format

No.	Modbus protocol address	Description	Settings	Type	No. of registers	Read / Write
1	3000	Flow speed [m/s]	-	LREAL	4	RO
2	3004	Volume flow [m ³ /s]	-	LREAL	4	RO
3	3008	Counter 1 [m ³]	Read and/or set counter 1	LREAL	4	R/W
4	3012	Counter 2 [m ³]	Read and/or set counter 2	LREAL	4	R/W
5	3016	Total flow volume counter [m ³]	-	LREAL	4	RO
6	3020	Forward flow volume counter [m ³]	-	LREAL	4	RO
7	3024	Reverse flow volume counter [m ³]	-	LREAL	4	RO
8	3028	Pressure [mbar]	-	LREAL	4	RO
9	3032	Temperature [°K]	-	LREAL	4	RO
10	3036	Pressure Alarm state 0: no alarms (b0) 1: Active minimum alarm condition (b1) 2: Active maximum alarm condition (b2) 4: Old unread minimum alarm condition (b3) 8: Old unread maximum alarm condition (b4) 16: Pressure sensor measurement error	Reading this register will acknowledge the alarm. If an alarm condition has appeared between readings, the old unread alarm condition flag will be set, and will be cleared when this register is read.	LWORD	4	RO
11	3040	Temperature Alarm state 0: no alarms (b0) 1: Active minimum alarm condition (b1) 2: Active maximum alarm condition (b2) 4: Old unread minimum alarm condition (b3) 8: Old unread maximum alarm condition (b4) 16: Temperature sensor measurement error	Reading this register will acknowledge the alarm. If an alarm condition has appeared between readings, the old unread alarm condition flag will be set, and will be cleared when this register is read.	LWORD	4	RO
12	3044	Error / warning states 0: no errors (b0) 1: Active flow measurement warning condition (b1) 2: Active <10% battery warning condition (b2) 4: Active EEPROM error condition (b3) 8: Active communication error condition (b4) 16: Empty Pipe (b5) 32: Mains Power Failure	-	LWORD	4	RO
13	3048	Battery type 1: Internal 1 battery 2: Internal 2 battery 3: External battery pack 0: None (mains supply)	-	ULINT	4	RO
14	3052	Battery capacity Ah	-	LREAL	4	RO
15	3056	Battery left Ah	-	LREAL	4	RO

No.	Modbus protocol address	Description	Settings	Type	No. of registers	Read / Write
16	3060	Current Flow direction 0: Forward flow 1: Reverse flow	-	ULINT	4	RO
17	3064	Pressure [Bar]	-	LREAL	4	RO
18	3068	Temperature [°C]	-	LREAL	4	RO

Table 6-10: Measurement data LREAL format

6.7.5 Measurement data REAL format



INFORMATION!
Data can be decrepitated.

No.	Modbus protocol address	Description	Settings	Type	No. of registers	Read / Write
1	4000	Flow speed [m/s]	-	REAL	2	RO
2	4002	Volume flow [m ³ /s]	-	REAL	2	RO
3	4004	Counter 1 [m ³]	Read and/or set counter 1	REAL	2	R/W
4	4006	Counter 2 [m ³]	Read and/or set counter 2	REAL	2	R/W
5	4008	Total flow volume counter [m ³]	-	REAL	2	RO
6	4010	Forward flow volume counter [m ³]	-	REAL	2	RO
7	4012	Reverse flow volume counter [m ³]	-	REAL	2	RO
8	4014	Pressure [mbar]	-	REAL	2	RO
9	4016	Temperature [°K]	-	REAL	2	RO
10	4018	Pressure Alarm state 0: no alarms (b0) 1: Active minimum alarm condition (b1) 2: Active maximum alarm condition (b2) 4: Old unread minimum alarm condition (b3) 8: Old unread maximum alarm condition (b4) 16: Pressure sensor measurement error	Reading this register will acknowledge the alarm. If an alarm condition has appeared between readings, the old unread alarm condition flag will be set, and will be cleared when this register is read.	DWORD	2	RO
11	4020	Temperature Alarm state 0: no alarms (b0) 1: Active minimum alarm condition (b1) 2: Active maximum alarm condition (b2) 4: Old unread minimum alarm condition (b3) 8: Old unread maximum alarm condition (b4) 16: Temperature sensor measurement error	Reading this register will acknowledge the alarm. If an alarm condition has appeared between readings, the old unread alarm condition flag will be set, and will be cleared when this register is read.	DWORD	2	RO

No.	Modbus protocol address	Description	Settings	Type	No. of registers	Read / Write
12	4022	Error / warning states 0: no errors (b0) 1: Active flow measurement warning condition (b1) 2: Active <10% battery warning condition (b2) 4: Active EEPROM error condition (b3) 8: Active communication error condition (b4) 16: Empty Pipe (b5) 32: Mains Power Failure	-	DWORD	2	RO
13	4024	Battery type 1: Internal 1 battery 2: Internal 2 battery 3: External battery pack 0: None (mains supply)	-	UDINT	2	RO
14	4026	Battery capacity Ah	-	REAL	2	RO
15	4028	Battery left Ah	-	REAL	2	RO
16	4030	Current Flow direction 0: Forward flow 1: Reverse flow	-	UDINT	2	RO
17	4032	Pressure [Bar]	-	REAL	2	RO
18	4034	Temperature [°C]	-	REAL	2	RO

Table 6-11: Measurement data REAL format

6.7.6 Measurement data integer format



INFORMATION!
Data can be deprecated.

No.	Modbus protocol address	Description	Settings	Type	No. of registers	Read / Write
1	5000	Flow speed [m/s]	-	UDINT	2	RO
2	5002	Volume flow [liter/h]	-	UDINT	2	RO
3	5004	Counter 1 [liter]	Read and/or set counter 1	UDINT	2	R/W
4	5006	Counter 2 [liter]	Read and/or set counter 2	UDINT	2	R/W
5	5008	Total flow volume counter [liter]	-	UDINT	2	RO
6	5010	Forward flow volume counter [liter]	-	UDINT	2	RO
7	5012	Reverse flow volume counter [liter]	-	UDINT	2	RO
8	5014	Pressure [mBar]	-	UDINT	2	RO
9	5016	Temperature [°K]	-	UDINT	2	RO

No.	Modbus protocol address	Description	Settings	Type	No. of registers	Read / Write
10	5018	Pressure Alarm state 0: no alarms (b0) 1: Active minimum alarm condition (b1) 2: Active maximum alarm condition (b2) 4: Old unread minimum alarm condition (b3) 8: Old unread maximum alarm condition (b4) 16: Pressure sensor measurement error	Reading this register will acknowledge the alarm. If an alarm condition has appeared between readings, the old unread alarm condition flag will be set, and will be cleared when this register is read.	DWORD	2	RO
11	5020	Temperature Alarm state 0: no alarms (b0) 1: Active minimum alarm condition (b1) 2: Active maximum alarm condition (b2) 4: Old unread minimum alarm condition (b3) 8: Old unread maximum alarm condition (b4) 16: Temperature sensor measurement error	Reading this register will acknowledge the alarm. If an alarm condition has appeared between readings, the old unread alarm condition flag will be set, and will be cleared when this register is read.	DWORD	2	RO
12	5022	Error / warning states 0: no errors (b0) 1: Active flow measurement warning condition (b1) 2: Active <10% battery warning condition (b2) 4: Active EEPROM error condition (b3) 8: Active communication error condition (b4) 16: Empty Pipe (b5) 32: Mains Power Failure	-	DWORD	2	RO
13	5024	Battery type 1: Internal 1 battery 2: Internal 2 battery 3: External battery pack 0: None (mains supply)	-	UDINT	2	RO
14	5026	Battery capacity Ah	-	UDINT	2	RO
15	5028	Battery left Ah	-	UDINT	2	RO
16	5030	Current Flow direction 0: Forward flow 1: Reverse flow	-	UDINT	2	RO
17	5032	Temperature [°C]	-	UDINT	2	RO

Table 6-12: Measurement data integer format

6.7.7 Measurement settings

No.	Modbus protocol address	Description / settings	Type	No. of registers	Read / Write
1	6000	counter 1 function 1: sum counter 2: + counter 3: - counter 0: off	WORD	1	R/W*
2	6001	counter 2 function 1: sum counter 2: + counter 3: - counter 0: off	WORD	1	R/W*
3	6002	Access control 0: Standard 1: Fiscal	WORD	1	RO
4	6003	AMR mode 0: off 1: on	WORD	1	R/W* [RO] <RO>
5	6004	AMR digits 0: 87654321 / 1: 8765432* 2: *7654321 / 3: 876543** 4: *765432* / 5: **654321 6: 87654*** / 7: *76543** 8: **65432* / 9: ***54321 10: 8765**** / 11: *7654*** 12: **6543** / 13: ***5432* 14: ****4321	WORD	1	R/W* [RO] <RO>
6	6005	Counter volume units 0: l / 1: m ³ / 2: gal 3: i. gal / 4: ft ³ / 5: a-ft / 6: a-in	WORD	1	R/W* [RO] <RO>
7	6006	Counters, number of decimals 99: default / 0: 0 decimals 1: 1 decimals / 2: 2 decimals 3: 3 decimals / 4: 4 decimals 5: 5 decimals / 6: 6 decimals 7: 7 decimals	WORD	1	R/W* [RO] <RO>
8	6007	Counters, multiplier value 99: default 1: x1 10: x10 100: x100 1000: x1000	WORD	1	R/W* [RO] <RO>
9	6008	Show forward counter 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
10	6009	Show reverse counter 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
11	6010	Flow rate units 0: l/s / 258: m ³ /h / 513: gal/m 769: i. gal/m / 1026: ft ³ /h / 1283: a-ft/d 1539: a-in/d	WORD	1	R/W* [RO] <R/W*>
12	6011	Flow rate time units 99: default 0: /s 1: /m 2: /h 3: /d	WORD	1	R/W* [RO] <R/W*>

No.	Modbus protocol address	Description / settings	Type	No. of registers	Read / Write
13	6012	Show flow rate 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
14	6013	Output 1 (Pulse op1) 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
15	6014	Output 2 (Pulse op2) 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
16	6015	Pulse config 90: 90deg 0: F-R 1: net positive volume	WORD	1	R/W* [RO] <R/W*>
17	6016	Pulse width output A,B 5: 5ms / 10: 10ms / 20: 20ms 50: 50ms / 100: 100ms / 200: 200ms	WORD	1	R/W* [RO] <R/W*>
18	6017	Pulse value 00100: litre xxxxx 0010.0: gallon xxx.x 0010.0: imp. gal. xxx.x 001.00: ft ³ xxx.xx 00.100: m ³ xx.xxx .00100: a-inch .xxxxx .00100: a-feet .xxxxx	REAL	1	R/W* [RO] <R/W*>
19	6019	Pulse output digit 99: programmable / 1: digit 1 / 2: digit 2 3: digit 3 / 4: digit 4 / 5: digit 5 6: digit 6 / 7: digit 7 / 8: digit 8	WORD	1	R/W* [RO] <R/W*>
20	6020	Output 3 Function 0: status op1 1: pulse op3 - forward counter 2: pulse op3 - reverse counter 3: pulse op3 - net pos. volume	WORD	1	R/W* [RO] <R/W*>
21	6021	Output 3 (Pulse op3) Unit 0: l / 1: m ³ / 2: gal 3: i. gal / 4: ft ³ / 5: a-ft 6: a-in	WORD	1	R/W* [RO] <R/W*>
22	6022	Output 3 (Pulse op3) pulse width 5: 5ms / 10: 10ms / 20: 20ms 50: 50ms / 100: 100ms / 200: 200ms	WORD	1	R/W* [RO] <R/W*>
23	6023	Output 3 (Pulse op3) Pulse value 00100: litre xxxxx 0010.0: gallon xxx.x 0010.0: imp. gal. xxx.x 001.00: ft ³ xxx.xx 00.100: m ³ xx.xxx .00100: a-inch .xxxxx .00100: a-feet .xxxxx	REAL	1	R/W* [RO] <R/W*>
24	6025	Output 3 (Status op1) Error 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
25	6026	Output 3 (Status op1) Battery Low 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
26	6027	Output 3 (Status op1) Battery Empty 0: off 1: on	WORD	1	R/W* [RO] <R/W*>

No.	Modbus protocol address	Description / settings	Type	No. of registers	Read / Write
27	6028	Output 3 (Status op1) Empty pipe 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
28	6029	Output 3 (Status op1) P/T error 0: Off 1: Pressure higher than max. 2: Pressure lower than min. 3: Temperature higher than max. 4: Temperature lower than min.	WORD	1	R/W* [RO] <R/W*>
29	6030	Output 4 (Status op2) Error 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
30	6031	Output 4 (Status op2) Battery Low 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
31	6032	Output 4 (Status op2) Battery Empty 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
32	6033	Output 4 (Status op2) Empty pipe 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
33	6034	Output 4 (Status op2) P/T error 0: Off 1: Pressure higher than max. 2: Pressure lower than min. 3: Temperature higher than max. 4: Temperature lower than min.	WORD	1	R/W* [RO] <R/W*>
34	6035	Pressure sensor 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
35	6036	Process pressure units 0: bar 1: mbar 2: psi	WORD	1	R/W* [RO] <R/W*>
36	6037	Pressure limit, maximum [mbar] 0...16000 mbar	INT	1	R/W* [RO] <R/W*>
37	6038	Pressure limit, minimum [mbar] -500...16000 mbar	INT	1	R/W* [RO] <R/W*>
38	6039	Show process pressure 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
39	6040	Temperature sensor 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
40	6041	Process temperature units 0: Celsius 1: Fahrenheit	WORD	1	R/W* [RO] <R/W*>
41	6042	Temperature limit, maximum [K] 273...343 K	WORD	1	R/W* [RO] <R/W*>
42	6043	Temperature limit, minimum [K] 268...343 K	WORD	1	R/W* [RO] <R/W*>

No.	Modbus protocol address	Description / settings	Type	No. of registers	Read / Write
43	6044	Show process temperature 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
44	6045	P/T measurement rate 0: equal to flow meas.rate 1: 1 minute 5: 5 minutes 10: 10 minutes 15: 15 minutes	WORD	1	R/W* [RO] <R/W*>
45	6046	Flow direction 0: Forward 1: Reverse	WORD	1	R/W* [RO] <RO>
46	6047	Sampling period Measuring Rate 1: 1s 5: 5s 10: 10s 15: 15s 10: 20s	WORD	1	R/W* [RO] <R/W*>
47	6048	Low-flow cut-off 0: 0mm/s 5: 5mm/s 10: 10mm/s	WORD	1	R/W* [RO] <R/W*>
48	6049	Empty Pipe Detection off/on 0: off 1: on	WORD	1	R/W* [RO] <RO>
49	6050	Current Setting 1: Low 3: High	WORD	1	R/W* [RO] <RO>
50	6051	Coil Current Low	WORD	1	R/W* [RO] <RO>
51	6052	Coil Current Med	WORD	1	R/W* [RO] <RO>
52	6053	Coil Current High	WORD	1	R/W* [RO] <RO>
53	6054	Meter size 250: 25mm 1" / 400: 40mm 1.5" / 500: 50mm 2" / 650: 65mm 2.5" / 800: 80mm 3" / 1000: 100mm 4" / 1250: 125mm 5" / 1500: 150mm 6" / 2000: 200mm 8" / 2500: 250mm 10" / 3000: 300mm 12" / 3500: 350mm 14" / 4000: 400mm 16" / 4500: 450mm 18" / 5000: 500mm 20" / 6000: 600mm 24"	WORD	1	R/W* [RO] <RO>
54	6055	Meter constant0 Depends on the setting of address 6050	LREAL	4	R/W* [RO] <RO>
55	6059	Meter constant1	LREAL	4	R/W* [RO] <RO>
56	6063	Meter constant2 Depends on the setting of address 6050	LREAL	4	R/W* [RO] <RO>
57	6067	Zero offset calibration 0 -> Progress indication	WORD	1	R/W* [RO] <RO>

No.	Modbus protocol address	Description / settings	Type	No. of registers	Read / Write
58	6068	Zero select 0: Default 1: Measured	WORD	1	R/W* [RO] <RO>
59	6069	Test outputs 0: Off 1: On 2: Disabled	WORD	1	R/W* [RO] <R/W*>
60	6070	All Counters Reset 8888 -> 0000	WORD	1	R/W* [RO] <RO>
61	6071	Verification mode 0: off 1: on	WORD	1	R/W* [RO] <R/W*>
62	6072	Battery type 0: None (Mains Supply) 1: 1x Internal 2: 2x Internal 3: External battery	WORD	1	R/W* [RO] <R/W*>
63	6073	Battery capacity xx.xxx Value to be programmed in Ah	REAL	2	R/W* [RO] <R/W*>
64	6075	Reset Battery Write 1 to execute	BOOL	1	R/W* [RO] <R/W*>
65	6076	Battery Lifetime [h]	DWORD	2	[RO]
66	6078	Zero point 0 [m/s]	REAL	2	R/W* [RO] <R/W*>
67	6080	Zero point 1 [m/s]	REAL	2	R/W* [RO] <R/W*>
68	6082	Zero point 2 [m/s]	REAL	2	R/W* [RO] <R/W*>
69	6084	Zero User 0 [m/s]	REAL	2	[RO]
70	6086	Zero User 1 [m/s]	REAL	2	[RO]
71	6088	Zero User 2 [m/s]	REAL	2	[RO]
72	6090	Unixtime in seconds since epoch	UDINT	2	R/W* [RO] <R/W*>

Table 6-13: Measurement settings

* Unlock access with passcode via access control register, and only with special write option enabled.

Service access has different passcode.

Passcodes can be obtained after NDA from the product management department of the manufacturer.

6.7.8 System / Modbus settings

No.	Modbus protocol address	Description / settings	Type	No. of registers	Read / Write
1	8000	Baudrate 1200 2400 3600 4800 9600 (default) 19200 38400 57600 115200	UDINT	2	R/W* [RO] <R/W*>
2	8002	Slave address	WORD	1	R/W* [RO] <R/W*>
3	8003	Parity 0: even parity (default) 1: odd parity 2: no parity	WORD	1	R/W* [RO] <R/W*>
4	8004	Data format 0: little endian 1: Big endian (default) 2: Mix endian with little endian words 3: Mix endian with big endian words	WORD	1	R/W* [RO] <R/W*>
5	8005	Transmission delay (ms) 0: 0 ms 5: 5 ms 10: 10 ms 20: 20 ms 30: 30 ms 40: 40 ms 50: 50 ms	WORD	1	R/W* [RO] <R/W*>
6	8006	Stop bits 1: 1 stop bit 2: 2 stop bits	WORD	1	R/W* [RO] <R/W*>
7	8007	Modbus off when no mainspower 0: Modbus off (default) 1: Modbus on	WORD	1	R/W* [RO] <R/W*>
8	8008	Reception interval 0...3600 seconds	WORD	1	R/W* [RO] <R/W*>
9	8009	Output load 0: no load on output 1: 2x120 ohm load on output	WORD	1	R/W* [RO] <R/W*>
10	8010	User application name: "IFC070-0000" (RO) + "00000" to "99999"	Array	8	R/W* [RO] <R/W*>
11	8499	Total uncommitted changes to settings	WORD	1	RO

Table 6-14: System / Modbus settings

* Unlock access with passcode via access control register, and only with special write option enabled.

Service access has different passcode.

Passcodes can be obtained after NDA from the product management department of the manufacturer.

6.7.9 System information

No.	Modbus protocol address	Description / settings	Type	No. of registers	Read / Write
1	8500	Converter Hardware Electronic Revision number	STRING	12	RO
2	8512	Converter Hardware Electronic serial number	DWORD	2	RO
3	8514	Order code number for assembly (CG number)	STRING	5	RO
4	8519	CG RAW number	STRING	5	RO
5	8524	System serial number	STRING	8	RO
6	8532	Sensor serial number	STRING	8	RO
7	8540	P/T Sensor serial number	STRING	8	RO
8	8548	Converter software version	STRING	2	RO
9	8550	Converter software checksum / crc	WORD	1	RO
10	8551	Modbus Addon software version	STRING	2	RO
11	8553	Modbus Addon software checksum / crc	WORD	1	RO
12	8554	GDC AddOn hwld	WORD	1	RO
13	8555	GDC AddOn Manufacture Date	DWORD	2	RO
14	8557	GDC AddOn Serial PCB	DWORD	2	RO
15	8559	GDC AddOn build number	STRING	4	RO
16	8563	Battery Daily usage Ah per day	LREAL	4	RO
17	8567	Battery longterm average usage Ah	LREAL	4	RO
18	8571	Battery usage last hour Ah	LREAL	4	RO
19	8575	Battery usage actual Ah	LREAL	4	RO
20	8579	Battery temperature K	LREAL	4	RO

Table 6-15: System information

6.7.10 Exception and diagnostics data

No.	Modbus protocol address	Description	Settings	Type	No. of registers	Read / Write
1	9900	Exception Register Note: Error conditions are reset after first valid frame has been sent, after error condition occurred. Normally the reply on the request of this register	Layout: MSB: Last Exception Function Code ISB1: Error code ISB2: Additional Error code (see AEC table) LSB: Additional information	DWORD	2	RO
2	9902	Diagnostic counter: Return Bus Message Count	-	WORD	1	RO
3	9903	Diagnostic counter: Return Bus Communication Error Count	-	WORD	1	RO
4	9904	Diagnostic counter: Return Slave Exception Error Count	-	WORD	1	RO
5	9905	Diagnostic counter: Return Slave Message Count	-	WORD	1	RO
6	9906	Diagnostic counter: Return Slave No Response Count	-	WORD	1	RO
7	9907	Diagnostic counter: Return Slave NAK Count	-	WORD	1	RO
8	9908	Diagnostic counter: Return Slave Busy Count	-	WORD	1	RO
9	9909	Diagnostic counter: Return Bus Character Overrun Count	-	WORD	1	RO

Table 6-16: Exception and diagnostics data

6.7.11 Access control

No.	Modbus protocol address	Description	Type	No. of registers	Read / Write
1	9998	Access control register Read: 0 when locked Read: > 0 Remaining access time in seconds Read: < 0 Remaining backoff time in seconds Write: Correct Access code -> access to specific level, access time running Write: Incorrect code, lock access, invalid data error, back off timer started.	DINT	2	R/W [RW] <R/W>

Table 6-17: Access control

6.7.12 Additional error code table (AEC)

No.	Error name	Description
0	No Error	-
1	Undefined Error	Error condition is not specified.
2	Access Denied	Reading or writing is (temporarily) not permitted.
3	Over Range Error	Value exceeds maximum limit.
4	Under Range Error	Value underruns minimum limit.
5	Invalid Selection	Invalid value for an enumeration.
6	Read Only Parameter	Parameter can never be written, because its read only.
7	Write Only Parameter	Parameter can never be read because its write only.
8	Device Busy	Internal processing exceeds time limit.
9	Insufficient Data Error	Not enough data was supplied for the requested function.
10	Parameter update error	Parameter could not be updated due to internal error.
11...127	Reserved	-
128...255	Device specific error codes	-

Table 6-18: Additional error code table (AEC)

6.8 Exception register description

The exception register stores the information of the last error condition, and will store this information until a valid function code was executed, if reading the exception register. For some error conditions additional information, besides the exception function code and exception error code will be available in the lower bytes of the exception register. The codes supplied in the additional error code field, can be looked up in the Additional Error Code table (AEC)

Some error conditions:

Illegal function 0x01:

For function codes; Write Multiple Register, Encapsulated transport

The exception register will hold the exception function code and exception error code and the additional error code byte will indicate if access was denied if no writing access was granted / enabled. Encapsulated Transport; Additional error code "invalid selection" will indicate that an invalid MEI type has been requested.

Illegal data address 0x02:

For function codes; Read Single Coil, Read Discrete Inputs, Read Holding Register, Read Input Register, Write Single Coil, ... Write Multiple Register, Encapsulated transport

The exception register will hold the exception function code and exception error code and the additional error code byte will indicate if the supplied address has underrun or exceeded the address range, or will indicate insufficient data when too few bytes were supplied for the address field in the PDU.

Encapsulated Transport; Either insufficient data has been sent, or the requested object ID is over range.

Illegal data value 0x03:

For function codes; Read Single Coil, Read Discrete Inputs, Read Holding Register, Read Input Register, Write Single Coil, ... Write Multiple Register, Encapsulated transport

The exception register will hold the exception function code and exception error code and the additional error code byte will indicate if the supplied quantity has underrun or exceeded the allowed quantity range, or will indicate insufficient data when too few bytes were supplied for the quantity field in the PDU.

Encapsulated Transport; Additional error code "invalid selection" will indicate that an invalid read device ID code has been requested.

Server device failure 0x04:

For function codes; Write Multiple Register

The exception register will hold the exception function code and exception error code and the additional error code byte will indicate if the supplied will indicate insufficient data when too few bytes were supplied for the data field in the PDU.

For multiple register writes the additional error information will contain the index of the register that caused the error. Note that the index is the index of the register in the datablock.

6.9 Diagnostics

The Modbus interface supports the diagnostic function defined by the "Modbus Application Protocol Specification". Function code is 08 (0x08).

Sub function code		Name
hex	dec	
00	00	Return Query Data
01	01	Restart Communication Option
04	04	Force Listen Only Mode
0A	10	Clear Counters
0B	11	Return Bus Message Count
0C	12	Return Bus Communication Error Count
0D	13	Return Bus Exception Count
0E	14	Return Slave Message Count
0F	15	Return Slave No Response Count
12	18	Return Bus Character Overrun Count

Table 6-19: Diagnostics

6.10 Data type definitions

IEC 61131-3 ¹	IEC 61158-5 ²	Equivalent in C	Bits	Modbus addresses	Co domain
BOOL	Boolean	_Bool / bool	1	1	[0, 1]
BYTE	Unsigned8	unsigned char	8	1	[0, 1] ⁸
WORD	Unsigned16	unsigned int (*)	16	1	[0, 1] ¹⁶
DWORD	Unsigned32	unsigned long (*)	32	2	[0, 1] ³²
LWORD	Unsigned64	unsigned long long (*)	64	4	[0, 1] ⁶⁴
SINT	Integer8	signed char	8	1	-128...127
INT	Integer16	int (*)	16	1	-32768...32767
DINT	Integer32	long (*)	32	2	-2 ³¹ ...2 ³¹ -1
LINT	Integer64	signed long long (*)	64	4	-2 ⁶³ ...2 ⁶³ -1
USINT	Unsigned8	unsigned char	8	1	0...255
WORD	Unsigned16	unsigned int (*)	16	1	0...65535
UDINT	Unsigned32	unsigned long (*)	32	2	0...2 ³² -1
ULINT	Unsigned64	unsigned long long (*)	64	4	0...2 ⁶⁴ -1
REAL	REAL32	float	32	2	-3.403 ³⁸ ...3.403 ³⁸
LREAL	REAL64	double	64	4	-1.798 ³⁰³ ...1.798 ³⁰³
STRING	Octet String	array of unsigned	n*8	n/2	[0...255] ⁿ

Table 6-20: Data type definitions

(*) depends on the implementation of integer

¹ IEC 61131-3:2013 Edition 3.0

² IEC 61158-5:2003

6.11 Data encoding

MODBUS uses a "Big Endian" representation for addresses and data items. This means that when a numerical quantity larger than a single byte is transmitted, the most significant byte is sent first.

So for example:

Register size value 16 - bits 0x1234 the first byte sent is 0x12 then 0x34

Non data parts of Modbus telegrams (addresses, sub-functions, quantities, etc.) must always use the Big Endian representation!

Byte order for strings

Since strings must be stored and transferred in Big Endian format. Each register will hold two octets/characters.

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