ABB MEASUREMENT & ANALYTICS | COMMUNICATIONS SUPPLEMENT

AquaMaster4

Electromagnetic flowmeter transmitter

Harness the power of electromagnetic flowmeters

The ideal flowmeter for potable water distribution networks, revenue metering and irrigation applications

Measurement made easy

Introduction

AquaMaster4 is a high performance electromagnetic flowmeter for the measurement of electrically-conductive fluids and is normally supplied as a factory-configured, calibrated system.

This publication provides details of Modbus coil and register definitions for Modbus-enabled AquaMaster4 integral and remote transmitters.

For more information

Further publications for AquaMaster4 are available for free download from: http://new.abb.com/products/measurement-products

Contents

1 Health, safety and security

Safety precautions

Be sure to read, understand and follow the instructions contained within this manual before and during use of the equipment. Failure to do so could result in bodily harm or damage to the equipment.

WARNING – BODILY INJURY
Installation, operation, maintenance and servicing must be performed:

- by suitably trained personnel only
- in accordance with the information provided in this manual
- in accordance with relevant national and local regulations

Security

IMPORTANT (NOTE)
This product is designed to be connected to and to communicate information and data via a network interface. It is your sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be). You shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data and installation of anti-virus programs) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and / or theft of data or information. ABB Limited and its affiliates are not liable for damages and / or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and / or theft of data or information.

Intended use

This flowmeter is intended for the following uses:

- To transmit fluid media with electrical conductivity.
- To measure flow rate, flow velocity, volume flow (forward, reverse and net) and pressure (option).

The flowmeter has been designed for use exclusively within the technical limit values indicated on the identification plate and in the data sheets.

In terms of the measuring medium, observe the following points:

- Wetted parts such as measuring electrodes, liner, grounding electrodes, grounding rings, protection flanges must not be damaged because of the chemical and physical characteristic of the measuring medium.
- The information on the name plate must be observed.

Improper use

The following are considered to be instances of improper use of the flowmeter:

- For operating as a flexible adapter in piping, for example. for compensating pipe offsets, pipe vibrations, pipe expansions.
- For use as a climbing aid, e.g. for mounting purposes.
- For use as a support for external loads, e.g. as a support for piping, etc.
- Material application, e.g. by painting over the name plate or welding/soldering on parts.
- Material removal, e.g. by spot drilling the housing.

Information on ROHS Directive 2011/65/EU (RoHS II)

ABB, Industrial Automation, Measurement & Analytics, UK, fully supports the objectives of the ROHS II directive. All in-scope products placed on the market by IAMA UK on and following the 22nd of July 2017 and without any specific exemption, will be compliant to the ROHS II directive, 2011/65/EU.

Communications protocol security

Modbus RTU is an insecure communications protocol. Users should take appropriate measures to mitigate any associated security vulnerabilities.

2 AquaMaster4 Modbus

Modbus protocol is a messaging structure used to establish master-slave / client-server communication between intelligent devices. Modbus is an open standard that is owned and administered by an independent group of device manufacturers called the Modbus Organization (www.Modbus.org). Using the Modbus protocol, devices from different manufacturers exchange information on the same communications bus without the need for special interface equipment.

AquaMaster 4 flow meter transmitters ordered with factory fitted EIA-485 interfaces can be used as slave devices on a Modbus bus for automatic meter reading, diagnostics retrieval and settings configuration.

Definitions, abbreviations and acronyms

Definition	Description
Coil	A single bit value that can be read or written by the Modbus master. See also Discrete Input and Output Coil.
CRC	Cyclic redundancy Check. Calculation performed on a message's contents to ensure its integrity.
DI	Discrete Input. A read-only single bit value that can be read by the Modbus master.
EIA-485	Electrical interface specification for point-to-point or multi-drop serial data transmission over a differential balanced line. Also known as RS485.
Holding Register	16bit register that can be read or written to by the Modbus master.
IEEE-754 format	Common format for floating-point computation.
Input Register	16bit register that can be read by the Modbus master. Input Register data is read-only.
Register	Modbus protocol defined 16bit data-type. See also Holding Register and Input Register, page 19.
RO	Read-only access.
RW	Read-write access.
0x…	Prefix to indicate a hexadecimal number, eg 16 is represented in hexadecimal as 0x10.

3 Modbus interface

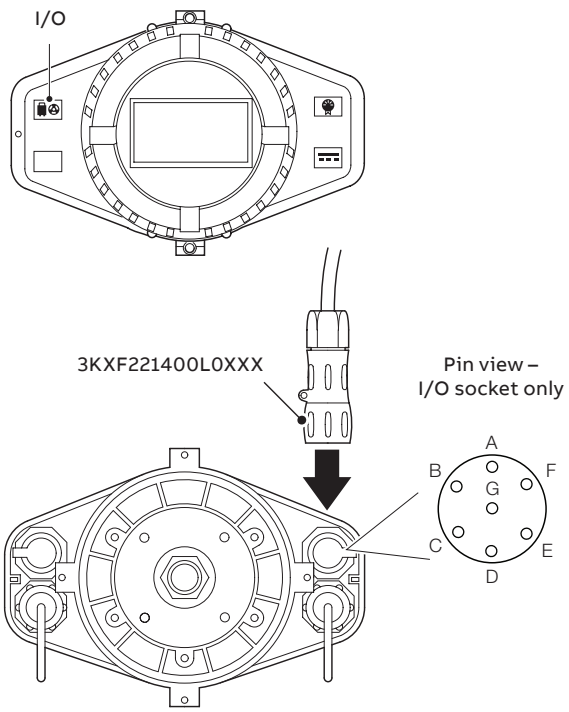
General data

Supported protocol	Modbus RTU over 2-wire EIA-485
Supported baud rates	9600, 19200
Maximum devices on bus segment	32
Maximum response time, 1 register read	60 ms
Maximum response time, 1 register write	600 ms

EIA-485 installation overview

AquaMaster 4 flow meters are designed for single point connections to a master device such as a Modbus RTU outstation. Multi point connections are possible, although frequent bus communications adversely affect the battery life of battery powered systems.

For cable and connector suitable for AquaMaster 4 EIA-485 interface, use ABB part 3KXF221400L0XXX connected to the AquaMaster 4 transmitter's I/O connector.



3KXF221400L0XXX connections

PIn	EIA-485 function
A	Data D0
B	Data D1
C	Not used
D	Not used
E	Not used
F	Not used
G	Signal ground

Where D0 < D1 for data bit logic 1, D1 < D0 for data bit logic 0

EIA-485 cable properties

The end-to-end length of the trunk cable must be limited. The maximum length depends on the Baud rate, the cable (gauge, capacitance or characteristic impedance), the number of loads on the daisy chain and the network configuration (2-wire or 4-wire).

For 9600 Baud rate and AWG26 (or wider) gauge, the maximum length is 1000 m (3280 ft.). Where 4-wire cabling is used as a 2-wire cabling system, the maximum length must be divided
by 2.

The tap cables must be short, never more than 20 m (65.6 ft.).

If a multi-port tap is used with n derivations, each one must have a maximum length of 40 m (131 ft.) divided by n.

The maximum serial data transmission line length for EIA485 systems is 1200 m (3937 ft.). The lengths of cable that can be used are determined by the cable type, typically:

- Up to 6 m (19.7 ft.) – standard screened or twisted pair cable.
- Up to 300 m (984 ft.) – twin twisted pair with overall foil screen and an integral drain wire – for example, Belden 9502 or equivalent.
- Up to 1200 m (3937 ft.) – twin twisted pair with separate foil screens and integral drain wires – for example, Belden 9729 or equivalent.

Category 5 cables may be used for EIA485-Modbus to a maximum length of 600 m (1968 ft).

For the balanced pairs used in an EIA485-system, a characteristic impedance with value higher than 100 Ohm is preferred especially for 19200 and higher Baud rates.

Line termination and polarization

EIA485 specifications recommend terminating the end of the bus at both ends in order to reduce interference caused by signal reflections that can cause communications errors.

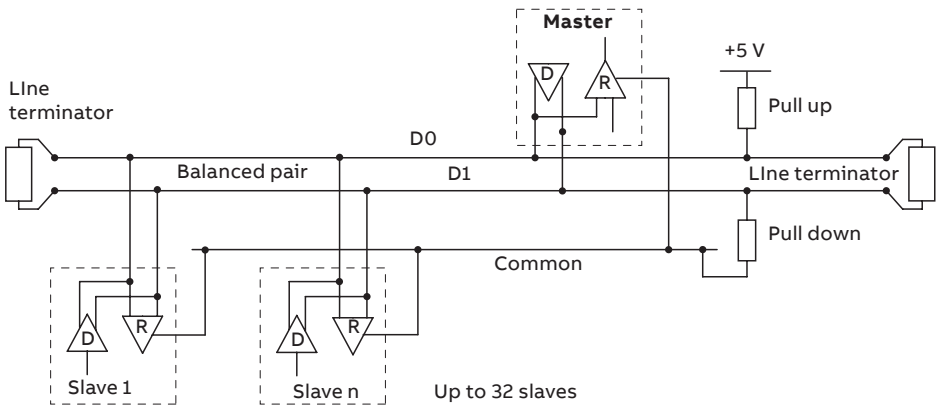
A Line Terminator is required at both ends of the bus as the communications waveform propagates bi-directionally along the bus. These must be connected directly on the main trunk, not on any tap cable. Note that, extra terminators must not be connected to the bus. Line termination must be connected between the two conductors of the balanced line: as shown in Figure 1.

Line termination may be a 150 Ohm value (0.5 W) resistor, although a serial capacitor (1 nF, 10V minimum) with a 120 Ohm (0.25 W) resistor is a better choice when a polarization of the pair must be implemented.

When there is no data activity on an EIA485 balanced pair, the lines are not driven and are thus susceptible to external noise or interference. To ensure that its receiver stays in a constant state when no data signal is present, the signal lines need to be biased from a single point on the bus (for example, at or close to the Master). A pair of resistors (values between 450 Ohm and 650 Ohm) must be connected on the EIA485 balanced pair to bias the signals:

- 560 Ohm Pull-Up Resistor to a 5V Voltage on D1 circuit
- 560 Ohm Pull-Down Resistor to the common circuit on D0 circuit.

AquaMaster 4 requires that such biasing is provided externally on the bus.



For example AquaMaster 4

Figure 1 Line termination

… 3 Modbus interface

Impact on battery life

In AquaMaster 4 flowmeters configured for battery power operation, a number of energy saving measures are adopted to give maximum battery life. However, activities such as communications require the flowmeter to be held in a higher power state for the duration of the transactions plus a short listening period afterwards before returning to a power saving mode. Systems externally powered from mains or connected to renewable energy generating sources flowmeters are not affected in this way except when the external power is not available, in which case they revert to a similar energy saving mode of operation as battery powered systems.

The impact on battery life can be mitigated by minimizing the amount of Modbus master requests and the frequency of repetition. It is common to poll a sequence of values from the slave device on a periodic basis, for example, reading the totalizers every 15 minutes. By exploiting the Modbus capability to request multiple items on consecutive addresses, it is possible to optimize the sequence to reduce time and consume less energy than making individual requests. Similarly, minimizing the gap between successive Modbus master requests reduces the time that the flowmeter needs to spend in its powered up state and setting the polling period to be the minimum required for the process, eg if 15 minute resolution is required, poll at 15 minute intervals rather than every minute.

Since a battery powered AquaMaster 4 remains in a high power state during and shortly after activity on the communications bus, connecting multiple slave devices on the same segment as an AquaMaster 4 with periodic communication between these and the Modbus master will add to the amount of time that the AquaMaster 4 is kept in its powered up state and thus reduce battery life expectancy. So while AquaMaster 4 supports multi-drop Modbus communications, a one-to-one connection between a Modbus master and a single AquaMaster 4 flowmeter is better for its battery life.

If a Modbus frame is received during low power mode, the flowmeter will switch to a higher power mode. However, it will not be able to respond to this frame, so expect that one Modbus master request retry will be needed for the first frame of each polling sequence and ensure that subsequent requests in the sequence are sent by the Modbus master within 10 s of it receiving a response from the flowmeter.

4 AquaMaster 4 data types

The following data types are defined within AquaMaster 4. These are mapped into Modbus coils and discrete inputs for bit data, and registers (16bit words) for all other data.

Data type	Description
Bit	Single bit with logic (range Off / 0 or On / 1)
Uint8	8-bit unsigned value (range 0 to 255). Data is found in the lower byte of a register with the upper byte containing value 0x00.
Uint16	16-bit unsigned value (range 0 to 65535). Occupies a single register.
Uint32	32-bit unsigned value (range 0 to 4294967295). Occupies two consecutive registers. Most significant 16bit word of the value is in the least significant register by default.
Int8	8bit signed value (range –128 to 127). Data is found in the lower byte of a register with upper byte containing value 0x00.
Int16	16bit signed value (range –32768 to 32767). Occupies a single register.
Int32	32-bit signed value (range –2147483648 to 2147483647). Occupies two consecutive registers. Most significant 16bit word of the value is in the least significant register by default.
Float	32bit floating point value coded in IEEE-754 format. Occupies two consecutive registers. Exponent is in the least significant register by default.
Double	64bit double precision floating point value coded in IEEE-754 format. Occupies four consecutive registers. Exponent is in the least significant register by default.
String	Array of 8bit ASCII encoded text characters with NULL terminating character. Read / written as a multiple of consecutive Uint8 data.

5 Modbus functionality

Flowmeter configuration

The following Modbus settings can be configured via the Velox smartphone app – refer to User Guide (OI/FET400-EN).

AquaMaster has a several of settings for configuring its Modbus interface as in the following table. The Data Format setting configures the expected order of registers in data types occupying two or more registers, e.g. Uint32 or float data. The default Data Format for AquaMaster4 is Most Significant Register First, which is compatible with the register ordering format of AquaMaster3.

Setting	Value range / options
Modbus slave address	1 to 247 (default 1)
Communications parameters (baud rate, number of data bits, parity setting N=none, O=odd, E=even. Always 1 stop bit.)	9600_7_N 9600_7_O 9600_7_E 9600_8_N 9600_8_O 9600_8_E 19200_7_N 19200_7_O 19200_7_E 19200_8_ N (default) 19200_8_O 19200_8_E
Data format	Least Significant Register First Most Significant Register First (default)

Supported function codes

The following Modbus function codes are supported by AquaMaster 4.

Function code	Function code description	Applicable AquaMaster 4 data types
2	Read Discrete Inputs	Diagnostic status bits
3	Read Holding Registers	Read-write Byte parameters Read-write Short parameters Read-write Integer parameters Read-write Float parameters Read-write Double parameters Read-write Byte string parameters
4	Read Input Registers	Read-only Byte parameters Read-only Short parameters Read-only Integer parameters Read-only Float parameters Read-only Double parameters Read-only Byte string parameters
6	Write Single Holding Register	Read-write Byte parameters Read-write Byte string parameters Action parameters
16	Write Multiple Holding Registers	Read-write Byte parameters Read-write Byte string parameters Read-write Float parameters Action parameters

AquaMaster 4 will accept requests for multiple reads or writes of up to 120 registers.

By convention, Modbus data items are grouped into tables consecutively accessible items as follows:

Coil / Discrete Input / Register Numbers	Data Addresses (hexadecimal)	Access type	Table Name
00001-09999	0x0000 to 0x270E	Read-Write	Coils
10001-19999	0x0000 to 0x270E	Read-Only	Discrete Inputs
30001-39999	0x0000 to 0x270E	Read-Only	Input Registers
40001-49999	0x0000 to 0x270E	Read-Write	Holding Registers

Note the number 0, 1, 3 or 4 prefixed to the data address to define a coil, discrete input or register number is only to create the table groupings of items accessible by the same function codes. Coil, DI or register numbers start at 1, whereas their corresponding addresses start at 0, so to determine the address, subtract 1 from the coil, DI or register number.

It is important to use the correct function code for the required data since using the wrong function code could access data from an unintended location.

For example, the first holding register 40001 has address 0x0000. Similarly the first input register 30001 also has address 0x0000. Sending a request to read a register at address 0x0000 using function code 3 will return the value of register 40001, whereas a request to read a register at address 0x0000 using function code 4 will return the value of register 30001. Sending a request to write a new value to address 0x0000 using function code 6 will write this value to register 40001.

AquaMaster 4 Modbus mappings are backwards compatible with the Modbus definitions of AquaMaster 3. However, AquaMaster 3 includes holding register definitions above 9999, which by extending the conventional Modbus data tables could be considered to be in the range 410001 to 413999 and occupy holding register addresses in the range 0x2710 to 0x36AE. For example the forward totalizer can be read in the AquaMaster3 totalizer value format as a 32bit integer from two holding registers starting at register number 12003. This could be considered to be register 412003 in an extension of the Modbus convention, and would be accessible via the read holding registers command (function code 3) for two registers starting at address 0x2EE2.

...5 Modbus functionality

Function code formats

This section details the function, and request and response formats for all Modbus Function Codes supported by AquaMaster 4.

FC 2: Read Discrete Inputs

Used to read the state of one or more consecutive discrete inputs from a slave device.

The format for a Read Discrete Inputs request is as follows:

Byte number	Description
1	Slave address.
2	Read Discrete Inputs Function Code, 0x02.
3,4	Discrete input address. 16-bit value indicating the address of the first discrete input to be read.
5,6	Number of discrete inputs. 16-bit value indicating the number of discrete inputs to be read.
7,8	Message CRC.

The format for a Read Discrete Inputs response is as follows:

Byte number	Description
1	Slave address.
2	Read Discrete Inputs Function Code, 0x02.
3	Byte count (‘n’), number of data bytes in response.
4..(4+n)-1	Discrete input data. Up to 2000 discrete inputs can be read in one request, if available.
(4+n), (4+n)+1	Message CRC.

FC 3: Read Holding Registers

Used to read the value of one or more consecutive holding registers from a slave device.

The format for a Read Holding Registers request is as follows:

Byte number	Description
1	Slave address.
2	Read Holding Registers Function Code, 0x03.
3,4	Holding register address. 16-bit address indicating the address of the first holding register to read.
5,6	Holding register count. 16-bit value indicating the number of holding registers to read.
7,8	Message CRC.

The format for a Read Holding Registers response is as follows:

Byte number	Description
1	Slave address.
2	Read Holding Registers Function Code, 0x03.
3	Holding register data byte count (‘n’). 8-bit value indicating the number of holding register data bytes returned in the message.
4..(4+n)-1	Holding register data starting with the holding register specified in the request.
(4+n), (4+n)+1	Message CRC.

FC 4: Read Input Registers

Used to read the value of one or more input registers from a slave device.

The format for a Read Input Registers request is as follows:

Byte number	Description
1	Slave address.
2	Read Input Registers Function Code, 0x04.
3,4	Input register address. 16-bit address indicating the address of the first input register to read.
5,6	Input register count. 16-bit value indicating the number of consecutive input registers to read.
7,8	Message CRC.

The format for a Read Input Registers response is as follows:

Byte number	Description
1	Slave address.
2	Read Input Registers Function Code, 0x04.
3	Input register data byte count (‘n’). 8-bit value indicating the number of input register data bytes returned in the message.
4..(4+n)-1	Input register data starting with the input register specified in the request.
(4+n), (4+n)+1	Message CRC.

FC 6: Write Single Holding Register

Used to write a new value to one holding register in the slave device.

The format for a Write Single Holding Register request is as follows:

Byte number	Description
1	Slave address.
2	Write Single Holding Register Function Code, 0x06.
3,4	16-bit holding register address.
5,6	Holding register value. 16-bit value indicating the value to write.
7,8	Message CRC.

The format for a Write Single Holding Register response is as follows.

Byte number	Description
1	Slave address.
2	Read Input Registers Function Code, 0x04.
3,4	Holding register address. 16-bit value indicating the address of the holding register that was written.
5,6	Holding register value. 16-bit value indicating the value that was written to the holding register.
7,8	Message CRC.

...5 Modbus functionality

...Function code formats

FC 16: Write Holding Registers

Used to write a set of new values to one or more consecutive holding registers in the slave device.

The format for a Write Multiple Holding Registers request is as follows:

Byte number	Description
2	Write Multiple Registers Function Code, 0x10.
3,4	Holding register address. 16-bit value indicating the address of the first holding register to write.
5,6	Holding register count. 16-bit value indicating the number of holding registers to write.
7	Byte count ('n'), number of data bytes in the request.
8..(8+n)-1	Holding register message data. The data to write to the holding registers.
(8+n), (8+n)+1	Message CRC.

The format for a Write Multiple Holding Registers response is as follows:

Byte number	Description
1	Slave address.
2	Write Multiple Registers Function Code, 0x10.
3,4	Holding register address. 16-bit value indicating the address of the first holding register.
5,6	Holding register count. 16-bit value indicating the number of holding registers written.
7,8	Message CRC.

Exception codes

In event of an error occurring during processing of a request, an exception response is returned. This is characterized by 0x80 being added to the request Function Code in the response frame. A single byte exception code then follows detailing the nature of the exception. The following exception codes are supported.

Exception Code	Description
1	ILLEGAL_FUNCTION An unrecognized command has been received, or the device is in an incorrect state to handle the request.
2	ILLEGAL_DATA_ADDRESS An invalid register/coil address has been requested.
3	ILLEGAL_DATA_VALUE The request structure is incorrect, or the data in the request is invalid.
4	SLAVE_DEVICE_FAILURE An internal device error occurred whilst processing the request.

The format for exception responses is as follows:

Byte number	Description
1	Slave address.
2	Function Code with 0x80 added.
3	Exception code.
4,5	Message CRC

6 Meter readings

Reading flow, pressure and velocity

The flow, pressure and velocity can be read from input registers.

AquaMaster 4 periodically logs the flow and pressure values to a defined schedule. However, the flow and pressure values read from Modbus registers are the instantaneous measured values at the time of the Modbus request rather than sourced from the flow and pressure log. Similarly the velocity value is also the instantaneous measured value.

Example request parameters for reading the flow rate (register 35017) as a Float value:

Function code	0x04 (read input registers)
First register address	0x13, 0x98
Register count	0x00, 0x02

The units associated with the flow, pressure or velocity values can be read separately to the values using the read holding registers function code.

Example request parameters to read the flow units (register 48015) as a Uint8 value:

Function code	0x03 (read holding registers)
First register address	0x14, 0x4E
Register count	0x00, 0x01

Reading totalizers

Totalizer values are available in several formats: either Float or Double format from Input Registers, or Uint32 format from Holding Registers to maintain AquaMaster 3 compatibility. Due to the inherent constraints of these formats, there could be some small difference in the least significant digits. The Double format is the closest representation to the AquaMaster 4 display value.

AquaMaster 4 periodically logs the totalizer values to a defined schedule. However, the totalizer values passed back in Modbus response frames are the instantaneous totalizer values at the time of the Modbus request rather than sourced from the totalizer log.

Example request parameters for single precision float form of the forward totalizer:

Function code	0x04 (read input registers)
First register address	0x00, 0x06
Register count	0x00, 0x02

Example request parameters for double precision float form of the forward totalizer:

Function code	0x04 (read input registers)
First register address	0x00, 0x0C
Register count	0x00, 0x04

The volume units associated with the totalizer values can be read separately using the read holding registers function code.

Example request parameters to read the volume units (register 48002) as a Uint8 value:

Function code	0x03 (read holding registers)
First register address	0x1F, 0x41
Register count	0x00, 0x01

Changing units selections

Flow, velocity, pressure and volume units are user selectable items that can be changed by a Modbus master via writes to their respective holding registers.

Example request parameters to change the volume units to US gallons:

Function code	0x06 (write single holding register)
Register address	0x1F, 0x41
New register data	0x00, 0x05

Reading diagnostics

Diagnostic bit states can be read either individually or collectively as a multiple. Where the amount read does not completely fill a byte, then the remainder of the space is filled with bit value 0.

Example of requesting all of the diagnostic bit states a single transaction:

Function code	0x02 (read discrete inputs)
First DI address	0x00, 0x00
Number of DI to read	0x00, 0x2C

Duplicates of some diagnostic bit states can be read from discrete inputs starting at 501 for backwards compatibility with definitions for AquaMaster 3.

7 Modbus tables

The following lists the AquaMaster Modbus coils, discrete inputs and registers grouped in tables by type.

Where possible, AquaMaster 4 has Modbus mappings that correspond to equivalent functionality in AquaMaster 3. Where there is not an equivalent item to map, the associated space is reserved as unused. For backwards compatibility with systems that are set up to request data in blocks from an AquaMaster 3, data access requests to areas not supported in AquaMaster4 will not result in Modbus exceptions being returned if the read is part of a block request starting with a valid AquaMaster4 mapping. Data for such unsupported areas are returned as bytes with value 0. Attempts to individually access the unsupported areas will result in a Modbus exception being returned.

Access is defined for meter operation with the flowmeter transmitter's lock switch in its unlocked state and for meters that are not configured to be MID compliant. In the case of lock switch in the locked state or for meters configured to be MID compliant, the RW values will be read only.

Discrete inputs table

DI number / Address	Description	Access	Default value
1:0001 / 0x0000	"All OK". 0 if any of the other diagnostic conditions are being indicated. 1 when no other diagnostic conditions are being indicated.	RO	1
1:0002 / 0x0001	Totaliser reset. 0 after startup or after diagnostic values are reset. 1 when the totalisers have been reset.	RO	0
1:0003 / 0x0002	Flow sensor communications error. 0 if there are no sensor communications problems. 1 when the sensor is not connected, or there is a problem with the sensor communications.	RO	0
1:0004 / 0x0003	High flow. 0 when the flow is below the high flow alarm setting. 1 when the flow exceeds the high flow alarm setting.	RO	0
1:0005 / 0x0004	Reserved for future use.	RO	0
1:0006 / 0x0005	Low flow. 0 when the flow is above the low flow alarm setting. 1 when the flow below the low flow alarm setting.	RO	0
1:0007 / 0x0006	Reserved for future use.	RO	0
1:0008 / 0x0007	Empty pipe condition. 0 when sensor pipe is full. 1 when sensor pipe is empty or less than 50 % full.	RO	0
1:0009 / 0x0008	Pulse output error. 0 when pulse outputs are working normally. 1 when pulse output frequency is being clipped (required rate exceeds maximum possible output frequency).	RO	0
1:0010 / 0x0009	Simulation mode warning. 0 when no simulation mode are active. 1 if one or more simulation modes are active.	RO	0
1:0011 / 0x000A	Calibration or Verification mode warning. 0 when neither Calibration nor Verification modes are active. 1 if Calibration or Verification mode is active.	RO	0
1:0012 / 0x000B	Pulse output simulation. 0 when pulse output frequency is not from simulated value. 1 when pulse output frequency is from simulated value.	RO	0
1:0013 / 0x000C	Flow measurement simulation warning. 0 when flow measurement simulation is not active. 1 if a flow measurement simulation mode is active.	RO	0
1:0014 / 0x000D	Totaliser rollover. 0 after startup or after diagnostic values are reset. 1 if one of the totaliser values has rolled over at its range limit.	RO	0
1:0015 / 0x000E	Coil drive current calibration mode warning. 0 when coil drive current calibration mode is not active. 1 when coil drive current calibration mode is active.	RO	0
1:0016 / 0x000F	Real-time clock calibration mode warning. 0 when real-time clock calibration mode is not active. 1 when real-time clock calibration mode is active.	RO	0
1:0017 / 0x0010	Data object not initialized. 0 for normal startup. 1 if one or more flow meter parameters failed to initialize correctly during startup.	RO	0

DI number / Address	Description	Access	Default value
1:0018 / 0x0011	MID compliant behavior not being enforced. 0 for non-MID certified systems or for a MID certified system when the “MID switch” is on. 1 for MID certified system when the “MID switch” is off, or for a mixed system (MID certified transmitter with a non-MID calibrated sensor or vice versa).	RO	0
1:0019 / 0x0012	Flow sensor coil open circuit. 0 for sensor coil resistance within normal range. 1 for sensor coil resistance above expected range.	RO	0
1:0020 / 0x0013	Flow sensor coil short circuit. 0 for sensor coil resistance within normal range. 1 for sensor coil resistance below lower range.	RO	0
1:0021 / 0x0014	Reserved / unused.	RO	0
1:0022 / 0x0015	Reserved / unused.	RO	0
1:0023 / 0x0016	Reserved / unused.	RO	0
1:0024 / 0x0017	Flow sensor measurement electrode voltage high warning. 0 while the flow sensor measurement electrode voltage is within normal range. 1 while the flow sensor measurement electrode voltage is exceeding maximum normal range.	RO	0
1:0025 / 0x0018	Reserved / unused.	RO	0
1:0026 / 0x0019	Reserved / unused.	RO	0
1:0027 / 0x001A	Reserved / unused.	RO	0
1:0028 / 0x001B	Flow measurement electrode under unstable voltage conditions. 0 when the flow measurement electrode voltage is within normal range. 1 when the voltage on the flow measurement electrode is unstable.	RO	0
1:0029 / 0x001C	Flow measurement capture saturation error. 0 when the flow measurement capture is operating within normal range. 1 when the flow measurement capture cannot work due to external fault condition such as excessive AC voltage pickup on flow sensor measurement electrode.	RO	0
1:0030 / 0x001D	Low flow sensor coil current. 0 when sensor coil current is within normal operating range. 1 when sensor coil current is below minimum of operating range.	RO	0
1:0031 / 0x001E	Flow verification warning. 0 while the flowmeter transmitter self-gain check passes. 1 when the flowmeter transmitter self-gain check fails.	RO	0
1:0032 / 0x001F	Non-volatile memory write error. 0 after startup and while there have been no non-volatile memory write errors. 1 when an attempt to change a value backed up in transmitter or sensor non-volatile memory fails (including attempting to write to the sensor when the sensor is not connected).	RO	0
1:0033 / 0x0020	Non-volatile memory read error. 0 after startup and while there have been no non-volatile memory read errors. 1 when an attempt to read from transmitter non-volatile memory has failed.	RO	0
1:0034 / 0x0021	Default user password warning. 0 if the user access password has been changed from the factory default value. 1 if the user access password is the factory default value.	RO	0
1:0035 / 0x0022	Mains power off warning. (Units configured with mains power supplies.) 0 if the mains power is on. 1 if the mains power is off.	RO	0
1:0036 / 0x0023	Battery power low warning. (Units configured with fitted batteries.) 0 if battery voltage is above the low threshold. 1 if battery voltage is below the low threshold.	RO	0
1:0037 / 0x0024	Battery power critical warning. (Units configured with fitted batteries.) 0 if battery voltage is above the critical threshold. 1 if battery voltage is below the critical threshold.	RO	0
1:0038 / 0x0025	Renewable power low warning. (Units configured with renewable power supplies.) 0 if renewable power voltage is above the low threshold. 1 if renewable power voltage is below the low threshold.	RO	0
1:0039 / 0x0026	Reserved for future use.	RO	0
1:0040 / 0x0027	Internal power critical warning. 0 when internal backup power voltage is above critical threshold. 1 when internal backup power voltage is below critical threshold.	RO	0
1:0041 / 0x0028	Transmitter not formatted error. 0 when the flowmeter correctly initializes configuration data backed up in the transmitter non-volatile memory. 1 when the flowmeter could not initialize configuration data backed up in the transmitter non-volatile memory.	RO	0

...7 Modbus tables

...Discrete inputs table

DI number / Address	Description	Access	Default value
1:0042 / 0x0029	Sensor not formatted error. 0 when the flowmeter correctly initializes configuration data backed up in the sensor non-volatile memory. 1 when the flowmeter could not initialize configuration data backed up in the sensor non-volatile memory.	RO	0
1:0043 / 0x002A	Real-time clock not set. 0 if the real-time clock has been set since last power on. 1 if the real-time clock has not been set since power on.	RO	0
1:0044 / 0x002B	Low sensor coil insulation resistance. 0 if the sensor coil insulation resistance is within normal range. 1 if the sensor coil insulation resistance is below normal range.	RO	0
1:0045 / 0x002C	Reverse flow. 0 if the measured flow is zero or in the forward direction. 1 if the measured flow is in the reverse direction.	RO	0

The following definitions are arranged for backwards compatibility with AquaMaster 3 definitions and include many duplicates of discrete inputs already defined.

1:0501 / 0x01F4	Flow sensor is reverse wired. 0 if sensor is wired correctly for forward flow indication. 1 if sensor is reverse wired (meaning flow measurements are being internally inverted so that correct direction is indicated).	RO	0
1:0502 / 0x01F5	Flow sensor is an insertion probe. 0 if flow sensor is not an insertion probe type. 1 if flow sensor is an insertion probe type.	RO	0
1:0503 / 0x01F6	Lock switch engaged. 0 if Lock switch is in the unlocked position. 1 if Lock switch is in the locked position.	RO	0
1:0504 / 0x01F7	Reserved / unused.	RO*	0
1:0505 / 0x01F8	Battery power low warning. (Units configured with fitted batteries.) 0 if battery voltage is above the low threshold. 1 if battery voltage is below the low threshold.	RO	0
1:0506 / 0x01F9	Battery power critical warning. (Units configured with fitted batteries.) 0 if battery voltage is above the critical threshold. 1 if battery voltage is below the critical threshold.	RO	0
1:0507 / 0x01FA	Flow sensor communications error 0 if there are no sensor communications problems. 1 when the sensor is not connected, or there is a problem with the sensor communications.	RO	0
1:0508 / 0x01FB	Flow sensor coil open circuit 0 for sensor coil resistance within normal range. 1 for sensor coil resistance above expected range	RO	0
1:0509 / 0x01FC	Empty pipe condition 0 when sensor pipe is full. 1 when sensor pipe is empty or less than 50 % full.	RO	0
1:0510 / 0x01FD	Mains power off warning. (Units configured with mains power supplies.) 0 if the mains power is on. 1 if the mains power is off.	RO	0
1:0511 / 0x01FE	Flow measurement capture saturation error. 0 when the flow measurement capture is operating within normal range. 1 when the flow measurement capture cannot work due to external fault condition such as excessive AC voltage pickup on flow sensor measurement electrode.	RO	0
1:0512 / 0x01FF	High flow. 0 when the flow is below the high flow alarm setting. 1 when the flow exceeds the high flow alarm setting	RO	0
1:0513 / 0x0200	Low flow. 0 when the flow is above the low flow alarm setting. 1 when the flow below the low flow alarm setting.	RO	0
1:0514 / 0x0201	Reserved / unused.	RO*	0
1:0515 / 0x0202	Reverse flow. 0 if the measured flow is zero or in the forward direction. 1 if the measured flow is in the reverse direction.	RO	0

* Read is only possible as part of a block read starting on a valid address.

Input registers table

Register number / Address	Description	Data format	Bytes / Registers	Access	Default value
3:0001 / 0x0000	Flow rate in user specified flow units.	Float	4 / 2	RO	0.0
3:0003 / 0x0002	Pressure in user specified pressure units.	Float	4 / 2	RO	0.0
3:0005 / 0x0004	Velocity in user specified velocity units.	Float	4 / 2	RO	0.0
3:0007 / 0x0006	Forward flow totaliser in user specified volume units.	Float	4 / 2	RO	0.0
3:0009 / 0x0008	Reverse flow totaliser in user specified volume units.	Float	4 / 2	RO	0.0
3:0011 / 0x000A	Net flow totaliser in user specified volume units.	Float	4 / 2	RO	0.0
3:0013 / 0x000C	Forward flow totaliser in user specified volume units. (Higher precision value.)	Double	8 / 4	RO	0.0
3:0017 / 0x0010	Reverse flow totaliser in user specified volume units. (Higher precision value.)	Double	8 / 4	RO	0.0
3:0021 / 0x0014	Net flow totaliser in user specified volume units. (Higher precision value.)	Double	8 / 4	RO	0.0
3:0025 / 0x0018 to 3:1001 / 0x03E8	Reserved / unused.	Uint8	1 / 1	RO*	0
3:1002 / 0x03E9	Coil drive mode	Uint16	2 / 1	RO	2
3:1003 / 0x03EA	Flow sensor lining material: 0 : Special 2 : PFA 3 : PTFE 4 : FEP 5 : ABR 6 : Soft elastomer 7 : Polyurethane 8 : High temperature elastomer 9 : Polypropylene 10 : PES 11 : Polyethylene 12 : PPS 13 : Viton 26 : PEEK 27 : Hard elastomer 28 : Linatex	Uint8	1 / 1	RO	0 : Special
3:1004 / 0x03EB	Flow sensor electrode material: 0 : Special 1 : N/A 14 : Stainless steel 18 : Titanium 19 : Hastelloy B 20 : Hastelloy C 21 : Platinum iridium 22 : Tantalum 24 : Super austenitic stainless steel	Uint8	1 / 1	RO	0 : Special
3:1005 / 0x03EC	Flow sensor flange material: 0 : Special 1 : N/A 14 : Stainless steel 15: Carbon steel 16 : Brass 25 : Wafer device	Uint8	1 / 1	RO	0 : Special
3:1006 / 0x03ED to 3:1010 / 0x03F1	Reserved / unused.	Uint8	1 / 1	RO*	0
3:1011 / 0x03F2	Flow sensor calibration accuracy type: 0 : Normal calibration 1 : Class 1 2 : Class 2 3 : MID Class 1 4 : MID Class 2	Unit8	1 / 1	RO	0
3:1012 / 0x03F3 to 3:1013 / 0x03F4	Reserved / unused.	Uint8	1 / 1	RO*	0

...7 Modbus tables

...Input registers table

Register number / Address	Description	Data format	Bytes / Registers	Access	Default value
3:1014 / 0x03F5	Reynolds number correction factor Sv.	Uint8	1 / 1	RO	0
3:1015 / 0x03F6	Reynolds number correction factor Sc.	Uint8	1 / 1	RO	0
3:1016 / 0x03F7	Flow sensor zero (battery power). Value is mm/s x 100.	Uint8	1 / 1	RO	0
3:1017 / 0x03F8	Elevated Access PIN.	Uint16	2 / 1	RO	0
3:1018 / 0x03F9	Reserved / unused.	Uint8	1 / 1	RO*	0
3:1019 / 0x03FA	System power type: 0 : Battery (2x D cell) 1 : Mains 2 : External renewable	Uint8	1 / 1	RO	1 : Mains
3:1020 / 0x03FB to 3:2000 / 0x07CF	Reserved / unused.	Uint8	1 / 1	RO*	0
3:2001 / 0x07D0	Flowmeter application firmware program version number.	String	11 / 2	RO	“”
3:2012 / 0x07DB to 3:2018 / 0x07E1	Reserved / unused.	Uint8	1 / 1	RO*	0
3:2019 / 0x07E2	Flow sensor contract serial number.	String	32 / 16	RO	“”
3:2035 / 0x07F2 to 3:2036 / 0x07F3	Reserved / unused.	Uint8	1 / 1	RO*	0
3:2037 / 0x07F4	Sensor first factory calibration date.	String	11 / 6	RO	0
3:2043 / 0x07FA to 3:2072 / 0x0817	Reserved / unused.	Uint8	1 / 1	RO*	0
3:2073 / 0x0818	Sensor certificate number.	String	32 / 16	RO	“”
3:2090 / 0x0828 to 3:2108 / 0x083B	Reserved / unused.	Uint8	1 / 1	RO*	0
3:2109 / 0x083C	Transmitter type.	String	32 / 16	RO	“”
3:2125 / 0x084C to 3:2126 / 0x084D	Reserved / unused.	Uint8	1 / 1	RO*	0
3:2127 / 0x084E	Manufacturer.	String	32 / 16	RO	“”
3:2143 / 0x085E to 3:2144 / 0x085F	Reserved / unused.	Uint8	1 / 1	RO*	0
3:2145 / 0x0860	Address Line 1.	String	32 / 16	RO	“”
3:2161 / 0x0870 to 3:2162 / 0x0871	Reserved / unused.	Uint8	1 / 1	RO*	0
3:2163 / 0x0872	Address Line 2.	String	32 / 16	RO	“”
3:2179 / 0x0882 to 3:2180 / 0x0883	Reserved / unused.	Uint8	1 / 1	RO*	0
3:2181 / 0x0884	Address Line 3.	String	32 / 16	RO	“”
3:2197 / 0x0894 to 3:2198 / 0x0895	Reserved / unused.	Uint8	1 / 1	RO*	0
3:2199 / 0x0896	Address Line 4.	String	32 / 16	RO	“”
3:2215 / 0x08A6 to 3:2468 / 0x09A3	Reserved / unused.	Uint8	1 / 1	RO*	0
3:2469 / 0x09A4	Bootloader firmware program version number	String	11 / 06	RO	“”
3:2475 / 0x09AB to 3:2468 / 0x09A4	Reserved / unused.	Uint8	1 / 1	RO*	0
3:2487 / 0x09B6	UAM firmware program version number	String	11 / 06	RO	“”
3:2493 / 0x09BC to 3:4000 / 0x0F9F	Reserved / unused.	Uint8	1 / 1	RO*	0

Register number / Address	Description	Data format	Bytes / Registers	Access	Default value
3:4001 / 0x0FA0	Flow sensor unique ID	Uint32	4 / 2	RO	0
3:4003 / 0x0FA2	Flow sensor firmware program version number	Uint32	4 / 2	RO	0
3:4005 / 0x0FA4	Flow sensor hardware version number	Uint32	4 / 2	RO	0
3:4007 / 0x0FA6 to 3:4010 / 0x09A9	Reserved / unused.	Uint8	1 / 1	RO*	0
3:4011 / 0x09AA	Transmitter hardware version number	Uint32	4 / 2	RO	0
3:4013 / 0x09AC	Transmitter unique ID	Uint32	4 / 2	RO	0
3:4015 / 0x0FAE to 3:4026 / 0x0FB9	Reserved / unused.	Uint8	1 / 1	RO*	0
3:4027 / 0x0FBA	Forward flow totaliser x100 in user specified volume units. (Integer digits only, compatible with AquaMaster 3 definition.)	Uint32	4 / 2	RO	0
3:4029 / 0x0FBC	Reverse flow totaliser x100 in user specified volume units. (Integer digits only, compatible with AquaMaster 3 definition.)	Uint32	4 / 2	RO	0
3:4031 / 0x0FBE	Net flow totaliser x100 in user specified volume units. (Integer digits only, compatible with AquaMaster 3 definition.)	Int32	4 / 2	RO	0
3:4033 / 0x0FC0 to 3:5004 / 0x138B	Reserved / unused.	Uint8	1 / 1	RO*	0
3:5005 / 0x138C	Flow sensor bore in mm.	Float	4 / 2	RO	0.0
3:5007 / 0x138E	Flow sensor span calibration factor.	Float	4 / 2	RO	0.0
3:5009 / 0x1390	Flow sensor span trim.	Float	4 / 2	RO	0.0
3:5011 / 0x1392	Empty pipe zero offset.	Float	4 / 2	RO	0.0
3:5013 / 0x1394 to 3:5016 / 0x1397	Reserved / unused.	Uint8	1 / 1	RO*	0
3:5017 / 0x1398	Flow rate in user specified flow units.	Float	4 / 2	RO	0.0
3:5019 / 0x139A	Flow as a percentage of full scale flow.	Float	4 / 2	RO	0.0
3:5021 / 0x139C	Reserved	Float	4 / 2	RO	0.0
3:5023 / 0x139E	Reserved	Float	4 / 2	RO	0.0
3:5025 / 0x13A0	Pressure in user specified pressure units.	Float	4 / 2	RO	0.0
3:5027 / 0x13A2 to 3:5028 / 0x13A3	Reserved / unused.	Uint8	1 / 1	RO*	0
3:5029 / 0x13A4	Flow sensor electrode A impedance in Ohms.	Float	4 / 2	RO	0.0
3:5031 / 0x13A6	Flow sensor electrode B impedance in Ohms.	Float	4 / 2	RO	0.0
3:5033 / 0x13A7 to 3:5034 / 0x13A8	Reserved / unused.	Uint8	1 / 1	RO*	0
3:5035 / 0x13AA	Flow sensor coil drive current span factor.	Float	4 / 2	RO	0.0
3:5037 / 0x13AB to 3:5038 / 0x13AC	Reserved / unused.	Uint8	1 / 1	RO*	0
3:5039 / 0x13AE	Flow sensor coil drive current in mA.	Float	4 / 2	RO	0.0
3:5041 / 0x13B0	Pulse output frequency in Hz.	Float	4 / 2	RO	0.0
3:5043 / 0x13B2	Factory setting for transmitter span factor.	Float	4 / 2	RO	0.0
3:5045 / 0x13B4	Factory setting for transmitter zero offset.	Float	4 / 2	RO	0.0
3:5047 / 0x13B6 to 3:5050 / 0x13B9	Reserved / unused.	Uint8	1 / 1	RO*	0
3:5051 / 0x13BA	Velocity in user specified velocity units.	Float	4 / 2	RO	0.0
3:5053 / 0x13BC to 3:5056 / 0x13BF	Reserved / unused.	Uint8	1 / 1	RO*	0
3:5057 / 0x13C0	Voltage reference in V.	Float	4 / 2	RO	0.0
3:5059 / 0x13C2	Factory setting for pressure transducer output in mV / V.	Float	4 / 2	RO	0.0
3:5061 / 0x13C4	Factory setting for pressure transducer zero offset in mV / V.	Float	4 / 2	RO	0.0
3:5063 / 0x13C6	Flow sensor electrode A voltage in V.	Float	4 / 2	RO	0.0

...7 Modbus tables

...Input registers table

Register number / Address	Description	Data format	Bytes / Registers	Access	Default value
3:5065 / 0x13C8	Flow sensor electrode B voltage in V.	Float	4 / 2	RO	0.0
3:5067 / 0x13CA to 3:5068 / 0x13CB	Reserved / unused.	Uint8	1 / 1	RO*	0
3:5069 / 0x13CC	External battery / power supply voltage in V.	Float	4 / 2	RO	0.0
3:5071 / 0x13CE	Internal battery voltage in V.	Float	4 / 2	RO	0.0

* Read is only possible as part of a block read starting on a valid address.

Holding registers table

Register number / Address	Description	Data format	Bytes / Registers	Access	Default value
4:8001 / 0x1F40	User zero offset adjust in mm/s x 100, ie 1 = 0.01 mm/s.	Int16	1 / 1	RW	0
4:8002 / 0x1F41	Volume units. Selectable from option list: 0 : Custom units 1 : l 2 : m^3 3 : Imperial gallon 4 : Ft^3 5 : US gallon 6 : Ml 7 : US mega gallon 8 : Imperial mega gallon 9 : ml 10: hl 11 : US kilo gallon 12 : Acre foot	Uint8	1 / 1	RW	2 : m^3
4:8003 / 0x1F42 to 4:8009 / 0x1F48	Reserved / unused.	Uint8	1 / 1	RO*	0
4:8010 / 0x1F49	Digital Outputs 1 and 2, pulse output configuration. Selectable from option list: 0 : Disabled 1 : Enabled (forward flow pulses on DO1, reverse flow pulses on DO2) 2 : Enabled (forward flow pulses on DO1, reverse flow pulses on DO2) 3 : Enabled (forward and reverse flow pulses on DO1, direction indication on DO3)	Uint8	1 / 1	RW	1 : Enabled
4:8011 / 0x1F4A	Reserved / unused.	Uint8	1 / 1	RO*	0
4:8012 / 0x1F4B	Digital Output 3, alarm output configuration. Selectable from option list: 0 : Always off 1 : Always on 2 : Normally off (triggered to on by alarm condition) 3 : Normally on (triggered to off on by alarm condition)	Uint8	1 / 1	RW	0 : Always off
4:8013 / 0x1F4C	Reserved / unused.	Uint8	1 / 1	RO*	0
4:8014 / 0x1F4D	Velocity units. Selectable from option list: 1 : m/s 2 : Ft/s 3 : Ft/minute	Uint8	1 / 1	RW	1 : m/s

...7 Modbus tables

...Holding registers table

Register number / Address	Description	Data format	Bytes / Registers	Access	Default value
4:8015 / 0x1F4E	Flow units. Selectable from option list: 0 : Custom units 1 : l/s 2 : l/minute 3 : l/hour 4 : Ml/day 5 : m3/s 6 : m3/minute 7 : m3/hour 8 : m3/day 9 : Imperial gallon/s 10 : Imperial gallon/minute 11 : Imperial gallon/hour 12 : Imperial mega gallon/day 13 : Ft3/s 14 : Ft3/minute 15 : Ft3/hour 16 : US gallon/s 17 : US gallon/minute 18 : US gallon/hour 19 : US mega gallon/day 20 : ml/s 21 : ml/minute 22 : hl/hour 23 : kl/s 24 : kl/minute 25 : kl/hour 26 : Ft3/day 27 : US gallon/day 28: US kilo gallon/day 29: Imperial gallon/day	Uint8	1 / 1	RW	1 : l/s
4:8016 / 0x1F4F	Factory setting for velocity cut off in mm/s (non-mains powered operation).	Uint8	1 / 1	RW	0
4:8017 / 0x1F50	User setting for flow cut off as a percentage of full scale flow.	Uint8	1 / 1	RW	0
4:8018 / 0x1F51	Pressure units. Selectable from option list: 0 : Custom units 1 : Bar 2 : mBar 3 : kPa 4: mm Hg 5 : m H20 6 : psi 7 : Ft H20 8 : Pa	Uint8	1 / 1	RW	1 : Bar
4:8019 / 0x1F52	Trip point for high flow as a percentage of full scale flow.	Int16	2 / 1	RW	120
4:8020 / 0x1F53	Trip point for low flow as a percentage of full scale flow.	Int16	2 / 1	RW	0
4:8021 / 0x1F54	Hysteresis for flow trip points as percentage of full scale flow.	UInt8	1 / 1	RW	2
4:8022 / 0x1F55	Empty pipe impedance threshold in kOhms.	UInt16	2 / 1	RW	200
4:8023 / 0x1F56 to 4:8028 / 0x1F5B	Reserved / unused.	Uint8	1 / 1	RO*	0
4:8029 / 0x1F5C	Process cycle period (measurement rate) in seconds. Applies to non-mains powered operation.	Uint8	1 / 1	RW	15
4:8030 / 0x1F5D to 4:8034 / 0x1F61	Reserved / unused.	Uint8	1 / 1	RO*	0
4:8035 / 0x1F62	Logger flow / pressure record interval in seconds.	Uint16	1 / 1	RW	60
4:8036 / 0x1F63	Reserved / unused.	Uint8	1 / 1	RO*	0
4:8037 / 0x1F64	Logger flow / pressure record retrieval interval in seconds.	Uint16	1 / 1	RW	60
4:8038 / 0x1F65	Reserved / unused.	Uint8	1 / 1	RO*	0

Register number / Address	Description	Data format	Bytes / Registers	Access	Default value
4:8039 / 0x1F66	Pressure transducer type. Selectable from option list: 0 : Gauge 1 : Absolute	Uint8	1 / 1	RW	1 : Absolute
4:8040 / 0x1F67 to 4:8047 / 0x1F6E	Reserved / unused.	Uint8	1 / 1	RO*	0
4:8048 / 0x1F6F	Pressure transducer height offset in mm (positive value if pressure transducer is higher than level of pipeline).	Int16	1 / 1	RW	0
4:8049 / 0x1F70 to 4:8055 / 0x1F76	Reserved / unused.	Uint8	1 / 1	RO*	0
4:8056 / 0x1F77	System startup count.	Uint16	1 / 1	RW	0
4:8057 / 0x1F78	System watchdog reset count.	Uint16	1 / 1	RW	0
4:8058 / 0x1F79 to 4:8080 / 0x1F8F	Reserved / unused.	Uint8	1 / 1	RO*	0
4:8081 / 0x1F90	Totaliser record logging hour (hour of day for daily totaliser record, 0=00:00, 1=01:00 etc)	Uint8	1 / 1	RW	0
4:8082 / 0x1F91 to 4:10000 / 0x270F	Reserved / unused.	Uint8	1 / 1	RO*	0
4:10001 / 0x2710	Flow sensor user calibration date.	String	11/6	RW	0
4:10007 / 0x2716 to 4:10036 / 0x2733	Reserved / unused.	Uint8	1 / 1	RO*	0
4:10037 / 0x2734	Meter tag.	String	32 / 16	RW	“”
4:10053 / 0x2744 to 4:10054 / 0x2745	Reserved / unused.	Uint8	1 / 1	RO*	0
4:10055 / 0x2746	Custom volume units name.	String	10 / 5	RW	“”
4:10060 / 0x274B to 4:10144 / 0x279F	Reserved / unused.	Uint8	1 / 1	RO*	0
4:10145 / 0x27A0	Custom flow units name.	String	10 / 5	RW	“”
4:10150 / 0x27A5 to 4:10198 / 0x27D5	Reserved / unused.	Uint8	1 / 1	RO*	0
4:10199 / 0x27D6	Flow sensor location.	String	32 / 16	RW	“”
4:10215 / 0x27E6 to 4:10216 / 0x27E7	Reserved / unused.	Uint8	1 / 1	RO*	0
4:10217 / 0x27E8	Meter owner.	String	32 / 16	RW	“”
4:10233 / 0x27F8 to 4:12002 / 0x2EE1	Reserved / unused.	Uint8	1 / 1	RO*	0
4:12003 / 0x2EE2	Forward flow totaliser in user specified volume units. (Integer digits only, compatible with AquaMaster 3 definition.)	Uint32	4 / 2	RO	0
4:12005 / 0x2EE4	Reverse flow totaliser in user specified volume units. (Integer digits only, compatible with AquaMaster 3 definition.)	Uint32	4 / 2	RO	0
4:12007 / 0x2EE6	Net flow totaliser in user specified volume units. (Integer digits only, compatible with AquaMaster 3 definition.)	Int32	4 / 2	RO	0
4:12009 / 0x2EE8 to 4:12012 / 0x2EEB	Reserved space definintion.	Uint8	1 / 1	RO*	0
4:12013 / 0x2EEC	Diagnostic alarm bits in AquaMaster3 format.	Uint32	4 / 2	RO	0
4:12015 / 0x2EEE to 4:13000 / 0x32C7	Reserved space definintion.	Uint8	1 / 1	RO*	0
4:13001 / 0x32C8	Flow sensor empty pipe scaling factor.	Float	4 / 2	RO	0.0385
4:13003 / 0x32CA	Flow sensor user span adjustment.	Float	4 / 2	RW	1.0
4:13005 / 0x32CC	Flow sensor profile factor (for insertion probe flow sensors).	Float	4 / 2	RW	1.0
4:13007 / 0x32CE	Flow sensor insertion factor (for insertion probe flow sensors).	Float	4 / 2	RW	1.0
4:13009 / 0x32D0	Pipe bore in mm (for insertion probe flow sensors).	Float	4 / 2	RW	300.0

...7 Modbus tables

...Holding registers table

Register number / Address	Description	Data format	Bytes / Registers	Access	Default value
4:13011 / 0x32D2	Scaling factor for custom volume units.	Float	4 / 2	RW	1.0
4:13013 / 0x32D4	Pulses per unit of volume (for pulse outputs).	Float	4 / 2	RW	1.0
4:13015 / 0x32D6	Reserved / unused.	Uint8	1 / 1	RO*	0
4:13017 / 0x32D8	Scaling factor for custom flow units.	Float	4 / 2	RW	1.0
4:13019 / 0x32DA	Maximum nominal flow rate (Q3) in user specified flow units.	Float	4 / 2	RW	1413.0
4:13021 / 0x32DC	Reserved / unused.	Uint8	1 / 1	RO*	0
4:13023 / 0x32DE	Scaling factor for custom pressure units.	Float	4 / 2	RW	1.0
4:13025 / 0x32E0 to 4:13042 / 0x32F1	Reserved / unused.	Uint8	1 / 1	RO*	0
4:13043 / 0x32F2	Flow measurement filter response time (s).	Float	4 / 2	RW	3.0
4:13043 / 0x32F4	Pressure measurement filter response time (s).	Float	4 / 2	RW	1.0

* Read is only possible as part of a block read starting on a valid address.

Acknowledgments

MODBUS is a registered trademark of Schneider Electric USA Inc.

ABB Limited
Measurement & Analytics
Oldends Lane
Stonehouse
Gloucestershire
GL10 3TA
UK
Tel: +44 (0)1453 826661
Fax: +44 (0)1453 829671
Email: instrumentation@gb.abb.com

ABB Engineering (Shanghai) Ltd.
Measurement & Analytics
No. 4528, Kangxin Highway
Pudong New District
Shanghai, 201319
P.R. China
Tel: +86(0) 21 6105 6666
Fax: +86(0) 21 6105 6677
Email: china.instrumentation@cn.abb.com

ABB Inc.
Measurement & Analytics
125 E. County Line Road
Warminster
PA 18974
USA
Tel: +1 215 674 6000
Fax: +1 215 674 7183

abb.com/measurement

COI/FET400/MODBUS-EN REV. A 03.2019