500 Series Electromagnetic Flowmeter

Remote Communications Guide

AQUAMONIX

Measure. Monitor. Master.

Technical Support

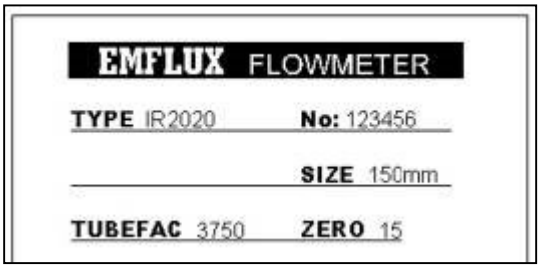
For technical support, please quote the following details which are located on the instrument enclosure.

Serial Number, example 123456

Part Number, example IR2020

Name and Model: Emflux Flowmeter

Power supply, voltage and frequency, if known.



Reference Documents

Associated documents available for the 500 Series Flowmeter includes:

500 Series Electromagnetic Flowmeter Operation and Configuration Manual

500 Series Electromagnetic Flowmeter Remote Communications Guide

500 Series Electromagnetic Flowmeter File Download Protocol Guide.

500 Series Electromagnetic Flowmeter
Remote Communications Guide

Table of Contents

Introduction

Please note that this symbol is used to highlight aspects of particular importance with respect to the operation and safety of the instrument.

The 500 Series flow meters are designed to suit a wide range of applications within many sectors including agriculture, industrial and mining, manufacturing and water treatment. There are two base-models, the I Series which is intended for low power remote applications including agricultural irrigation, and the M Series which suits industrial applications. A range of options are available for I and M Series flowmeters, including option cards that provide additional communications and control signal interfaces.

Please ensure that you are conversant with the operation, installation and precautions contained within this manual before installation or operation of the communications interface.

The 500 Series Electromagnetic Flowmeters have remote serial communications capability using Modbus protocol. The physical interface to the flowmeter is provided by a plug-in option card.

The Modbus implementation uses a sub-set of Modbus function codes in Modbus RTU and Modbus ASCII formats. All communication settings are modified using the flowmeter LCD interface. The flowmeter includes internal access codes that provide security to registers.

Model Numbering and Optional Accessories

Please refer to the document entitled “500 Series Electromagnetic Flowmeter Operation and Configuration Manual” for details of model numbering.

Recommended Parameters for Modbus Masters

Maximum number of retries	5
Maximum no reply timeout	30 seconds
Inter-character gap	5 milliseconds

Codes and Terminology

The following list of codes, abbreviations and terms may be used in the software coding of these structures:

UI16	Unsigned 16 bit integer
UI32	Unsigned 32 bit integer
F32	IEEE754 single precision floating point 32 bit value
EC	Electrode Check – impedance checking between flow electrodes
PNF	Pipe Not Full – pipe is not full of water
YTD	Year To Date
HO	High order – upper 8 bits of a 16 bit word
LO	Low order – lower 8 bits of a 16 bit word

MODBUS Protocol

Register Addressing

Based on the Modbus register address format, Modbus standard function codes can be used to read digital IO and data structures using standard Modbus function codes according to the following table:

Registers	Content	Data Accessed	Registers Used
00xxx	Memory Registers	Current Values	See detail descriptions in this document
01xxx		Calibration data	
03xxx		Configuration data	

Integer and Floating Point Values

Note that the Modbus protocol specifies that the order of bytes is sent as low order first. For example, when sending a value of 0x1234, the first byte sent is 0x12 followed by the value 0x34.

32 Bit Values

Note that the Modbus registers for 32 bit integer and floating point values are aligned on even register numbers and must be read and written in a single function call. For example to read the Meter ID, call function code 03, start register 03028 and read two register values. Note that an attempt to read register 03029 will result in an exception response.

Note that the above differs from the I300 registers where it is possible to individually access the Modbus registers for the High word and the Low Word content of 32 bit variables.

Floating Point

All floating-point variables (denoted as type F32) are IEEE754 Floating Point format (single precision 32 bit). For example, to read registers 00100 and 00101: flow velocity which has a value of 51.392. The Modbus registers return 0x424d and 0x9225 from addresses 0100 and 0101. This data corresponds to 0x25924d42 (low byte first) which is the same as 51.3297.

MODBUS Function Codes

Standard Function Codes

Function Code	Description	Uses for 500 Series
03	Read multiple registers	Read current values, calibration data, basic calibration data and confguration data.
16	Write registers - multiple	Write current values, calibration data, basic calibration data and confguration data. Initiate a scan.
65-68	User commands	See following section

Extended Function Codes

Function Code	Description	Uses for 500 Series
65	Set Date and Time	Change the date/time.
66	Test Mode	Reserved, factory usage only.
67	Reset Totalisers	Clears totals, as per flags sent as command parameters.
68	Security Access	Enter passcode to gain level 0, 1 or 2 access and to log out.

Function Code 65: Set Date and Time

This function requires level 1 access. Range checking on each of the fields is provided as follows:

Field	Lower Limit	Upper Limit
Year	0	99
Month	1	12
Day	1	31
Hour	0	23
Minute	0	59
Second	0	59

An illegal data value response will be returned to the Master if the values are not within limits..

Example: Set date and time of slave 2E to 1-1-2008 12:00:00 in RTU mode.

Command

ADDR	FUNC	Y	M	D	H	M	S	
2E	41	08	01	01	0C	00	00	CRC

Response

ADDR	FUNC	LEN	Y	M	D	H	M	S	
2E	41	06	08	01	01	0C	00	00	CRC

Function Code 67: Reset Totalisers

This function uses bit fields to determine which totals to reset: sending a command with the corresponding bit set high will reset the total, as shown in the table below. Although it is possible to reset any combination of totals, the most common usage is to reset all totals by writing a value of 0xFFFF.

Bit	Total to Reset
1	Forward Total
2	Reverse Total
3	Combined Total
4	Peak Forward Total
5	Off Peak Forward Total
6	Peak Reverse Total
7	Off Peak Reverse Total
8	Forward YTD Total
9	Reverse YTD Total
10	Combined YTD
11-16	Reserved

Example: Reset the forward, reverse and combined totals only for slave address 04 in RTU mode.

Command

ADDR	FUNC	HO	LO	
04	43	00	07	CRC

Response

ADDR	FUNC	LEN	HO	LO	
04	43	2	00	07	CRC

Function Code 68: Communications Access

Communications access is granted by submitting a pass-code using this function. The pass-code must match that of registers in the Configuration Data:

Register pwdC0: Level 0 access code

Register pwdC1: Level 1 access code: implies Level 0 also granted.

Register pwdC2: Level 2 access code: implies Levels 1 and 0 also granted.

Example: Gain access to Level 0 in RTU mode. Register pwdC0 contains 0x1234 (i.e. the pass code is '1234'):

Command

ADDR	FUNC	a	b	
04	44	12	34	CRC

Response

ADDR	FUNC	LEN	a	b	
04	44	2	12	34	CRC

If entry is not granted then an exception code 07 will be returned to the Master.

MODBUS Exception Responses

Exception Code	Description	Uses for 500 Series
01	Illegal Function	The received function code is not a valid
02	Illegal Data Address	The address in the data field is not valid
03	Illegal Data Value	The value in the data field is outside limits
07	NAK	Access denied – operation cannot be performed

Real Time Flow Measurements

The 500 Series Flowmeter will typically be configured to operate in a power save mode whereby it is in a low power sleep mode but wakes up periodically to perform a flow measurement. Depending upon the smoothing function, there is a short delay of approximately 10-20 seconds after which time the real-time flow rate registers are updated. Other Registers update continuously.

A real-time flow measurement occurs whenever Register 42 is read by the Host Device.

The Sequence of events to perform a flow measurement is as follows:

- RTU Host polls I500 unit and reads register number 42. (initial returned value will be 0)
- The unit will immediately commence diagnostics and scanning
- After approx 10-20 seconds the registers will be updated and register 42 will reset to 1
- Unit will stay powered up and in “Real Time Mode” for the “On Period”
- Re reading Register 42 will cause the unit to remain powered up for the “On time”
- If Register 42 is repeatedly read (eg every 10 seconds or so) the unit will stay in Live Mode.

Flow Control Functions

The real time flow measurements can be used in Gate Control Applications whereby a Gate position (Valve, Penstock etc) may need to be adjusted according to a pre set flow rate, or a volumetric delivery requirement as follows:

- RTU unit Polls I500 unit and reads all registers of interest (including Register 42)
- After approx 10 seconds (when register 42 has value 1) – read the “live” flow rate register.
- Perform Gate adjustment (close, open etc)
- Wait for flow conditions to settle then read “live” flow rate again
- Adjust Gate position
- Confirm flow rate etc

When the Host RTU device has closed the connection, the I500 will revert to its normal sleep / wake mode.

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MODBUS Registers

Register 00000+: Current Values

Address (decimal)	R	W	Type	Description
00001	✓	×	UI16	Number of power resets
00002	✓	×	UI16	Number of days since last reset
00003	✓	×	UI16	Number of hours since last reset
00004	✓	×	UI16	Flow tube diameter
00005	✓	×	UI16	Flow tube factor 1
00006	✓	×	UI16	Flow tube zero
00007	✓	×	UI16	ADC reference voltage
00008	✓	×	UI16	ADC zero offset higher-word
00009	✓	×	UI16	ADC zero offset lower-word
00010	✓	×	UI16	ADC span higher-word
00011	✓	×	UI16	ADC span lower-word
00012	✓	×	UI16	On time (seconds)
00013	✓	×	UI16	Off time (seconds)
00014	✓	×	UI16	Zero-flow off-time (seconds)
00015	✓	×	UI16	Low flow cut-off (mm/sec)
00016	✓	✓	UI16	Pipe Not Full Check and Gate Shut/Open function status Bit 0 – Gate Control Function (1 = enabled) Bit 1 – PNF Detection Function (1 = enabled)
00017	✓	×	UI16	Smoothing
00018	✓	×	UI16	Display unit 1
00019	✓	×	UI16	Display unit 2
00020	✓	×	UI16	Totalisers unit
00021	✓	×	UI16	Full-scale 4-20 milliamp
00022	✓	×	UI16	Frequency scale
00023	✓	×	UI16	Litres-per-pulse-scale
00024	✓	×	UI16	Pipe not full detection status/Gate Control/Electrode Check status Bit 0 – PNF Status (read only) 1 = pipe full. Bit 1 – Gate Control (RW) 1 = open, 0 = shut Bit 2 – EC status (read only) 1 = EC Ok, 0 = EC Fault
00025	✓	×	UI16	Current day
00026	✓	×	UI16	Current month
00027	✓	×	UI16	Current year
00028	✓	×	UI16	Current hour
00029	✓	×	UI16	Current minute
00030	✓	×	UI16	Real time flow (litres/sec)
00031	✓	×	UI16	Battery voltage
00032	✓	×	UI16	Solar panel voltage
00033	✓	×	UI16	Peak forward totaliser higher-word
00034	✓	×	UI16	Peak forward totaliser lower-word
00035	✓	×	UI16	Off-peak forward totaliser higher-word
00036	✓	×	UI16	Off-peak forward totaliser lower-word
00037	✓	✓	UI16	Site ID number lower word only (read only) – see configuration data for write.
00038	✓	×	UI16	Reserved

00039	✓	×	UI16	Reserved
00040	✓	×	UI16	Reserved
00041	✓	×	UI16	Flow velocity [mm/s]
00042	✓	×	UI16	Real time status (1= scan in progress). Reading this register initiates reading if a scan was not in progress.

Access to all registers at address 50 and above require an additional offset of +1.

Address (decimal)	**R**	**W**	**Type**	**Description**
00050	✓	×	UI16	Reserved
00051	✓	×	UI16	Reserved
00052	✓	×	UI16	Logic Status of Digital Inputs DI0 = bit 0, DI1 = bit 1
00053	✓	×	UI16	Scan Status. Reading the register initiates a flow scan. 0-Scanning stopped or stopping 1 - Flow scanning is starting 2 - Flow scanning is udpating (data available)
00054	✓	×	UI16	Logic status of System Faults - refer to table below
00055	✓	×	UI16	Logic status of Self Test function - refer to table below
00056	✓	×	UI16	Serial Number Six byte field (hexadecimal)
00059	✓	×	UI16	Reserved
00060	✓	×	UI16	Reserved
00061	✓	×	UI16	Reserved
00062	✓	×	UI32	Firmware Version ID code, ASCII encoded, example 0x414c3132 == AL1.2
00064	✓	×	Timestamp	Current date and time
00067	✓	×	Timestamp	Reserved
00070	✓	×	Timestamp	Reserved
00073	✓	×	UI16	Logic Status of Digital Outputs: DO0 = bit 0 (LSB).. DO3 = bit 3
00074	✓	×	F32	Frequency output value for Digital Output 0
00076	✓	×	F32	Pulse output value for Digital Output 0
00078	✓	×	F32	Frequency output value for Digital Output 1
00080	✓	×	F32	Pulse output value for Digital Output 1
00082	✓	×	F32	Analog output 0 [milliAmps]
00084	✓	×	F32	Analog output 1 [milliAmps]
00086	✓	×	UI16	Logic status of Alarms – see table below.
00087	✓	×	UI16	Passcode access level: 0 = access denied, 1 = read only, 2 = write config, 3 = full access
00090	✓	×	UI16	Option Card slot 0 – see table below
00091	✓	×	UI16	Option Card slot 1 – see table below
00092	✓	×	UI16	Option Card slot 2 – see table below
00093	✓	×	UI16	Modem power status, 1 = ON, 0 = OFF
00094	✓	×	Timestamp	Last time that modem power switched
00100+	✓	×		Channel Data: see detailed description below

System Fault Logic Table

00054	Item
Bit 0	Coil Inductance Low
Bit 1	Coil Inductance High
Bit 2	Coil Resistance Low
Bit 3	Coil Resistance High
Bit 4	Signal Range Fault
Bit 5	Electrode Check Fault
Bit 6	Settling Time Fault
Bit 7	Signal Noise Fault
Bit 8	Reserved
Bit 9	Low Battery
Bit 10	Solar current fault
Bit 11	Reserved
Bit 12	High (internal) temperature
Bits 13-15	Reserved

Self Test Logic Table

00055	Item
Bit 0	A/D Converter check
Bit 1	Serial Number check
Bit 2	Configuration Data check
Bit 3	SD Card check
Bit 4	Real Time Clock check
Bit 5	Power Supply cehck
Bit 6	Coil Current check
Bit 7	Reserved

Alarm Status Logic Table

00086	Item
Bit 0	Reserved
Bit 1	Low Battery alarm
Bit 2	Pipe Not Full alarm
Bit 3	System Fault
Bit 4	Low Flow
Bit 5	High Flow
Bit 6	Forward Flow
Bit 7	Reverse Flow

Units Type Tables

Units' codes are used for the LCD display and channel scaling for the LCD display. The units' codes for flow rate/totals and time are listed below:

Code	Flow Unit
0	Megalitres 'ML'
1	Cubic metres 'M3'
2	Kilolitres 'KL'
3	Litres 'L'
4	Cubic feet 'FT3'
5	Imperial Gallons 'IG'
6	Imperial mega-gallons 'IMG'
7	US gallons 'USG'
8	US mega-gallons 'UMG'
9	Acre Feet 'AFT'
10	Special Factor 'SPL'

Code	Time Unit
0	Seconds 'SEC'
1	Minutes 'MIN'
2	Hours 'HR'
3	Days 'DAY'
4	Special Factor 'SPL'

Option Card Code Table

Code	Option Card Type
0	Reserved
1	Reserved
2	Isolated Serial Card
3	Reserved
4	Reserved
5	Modem Interface Card
6	Dual Analog Output Card (4-20mA)
7	Digital IO Expansion Card
31	Empty Slot

Channel Data Table

Address (decimal)	Data type	Item	Value	Units
00100	F32	Flow Velocity	Last scanned value	m/s
00102	F32	Flow Velocity	Last logged value	m/s
00104	F32	Flow Rate	Last scanned value	L/s
00106	F32	Flow Rate	Last logged value	L/s
00108	F32	Mass Flow	Last scanned value	Kg/s
00110	F32	Mass Flow	Last logged value	Kg/s
00112	F32	Electrode Check	Last scanned value	
00114	F32	Electrode Check	Last logged value	
00116	F32	Forward Total	Last scanned value	Kilolitres
00118	F32	Forward Total	Last logged value	Kilolitres
00120	F32	Reverse Total	Last scanned value	Kilolitres
00122	F32	Reverse Total	Last logged value	Kilolitres
00124	F32	Nett Total	Last scanned value	Kilolitres
00126	F32	Nett Total	Last logged value	Kilolitres
00128	F32	Peak Forward Total	Last scanned value	Kilolitres
00130	F32	Peak Forward Total	Last logged value	Kilolitres
00132	F32	Off Peak Forward Total	Last scanned value	Kilolitres
00134	F32	Off Peak Forward Total	Last logged value	Kilolitres
00136	F32	Peak Reverse Total	Last scanned value	Kilolitres
00138	F32	Peak Reverse Total	Last logged value	Kilolitres
00140	F32	Off Peak Reverse Total	Last scanned value	Kilolitres
00142	F32	Off Peak Reverse Total	Last logged value	Kilolitres
00144	F32	Forward YTD Total	Last scanned value	Kilolitres
00146	F32	Forward YTD Total	Last logged value	Kilolitres
00148	F32	Reverse YTD Total	Last scanned value	Kilolitres
00150	F32	Reverse YTD Total	Last logged value	Kilolitres
00152	F32	Nett YTD Total	Last scanned value	Kilolitres
00154	F32	Nett YTD Total	Last logged value	Kilolitres
00156	F32	Coil Current	Last scanned value	Amps
00158	F32	Coil Current	Last logged value	Amps
00160	F32	Battery Voltage	Last scanned value	Volts
00162	F32	Battery Voltage	Last logged value	Volts
00164	F32	Solar Current	Last scanned value	Amps
00166	F32	Solar Current	Last logged value	Amps
00168	F32	Solar Voltage	Last scanned value	Volts
00170	F32	Solar Voltage	Last logged value	Volts
00172	F32	Temperature	Last scanned value	Degrees Celsius
00174	F32	Temperature	Last logged value	Degrees Celsius
00176	F32	Coil Resistance	Last scanned value	Ohm
00178	F32	Coil Resistance	Last logged value	Ohm
00180	F32	Reserved	N/A	
00182	F32	Reserved	N/A	
00184	F32	Coil Voltage	Last scanned value	Volts
00186	F32	Coil Voltage	Last logged value	Volts

Raw Channels Detail

Address (decimal)	Item
00300	F32 Input Negative
00302	F32 Input Positive
00304	F32 Guard Negative
00306	F32 Guard Positive
00308	F32 Input Differential
00310	F32 Filtered Input Diff
00312	F32 1.5Vrail
00314	F32 2.5V rail
00316	F32 Coil Current
00318	F32 Coil Voltage
00320	F32 Battery Voltage
00322	F32 Solar Current
00324	F32 Solar Voltage
00326	F32 Temperature
00328	F32 Flow Voltage
00330	F32 Compensated Flow Voltage
00332	F32 Adjusted Flow Voltage

Register 01000+: Calibration Data

Address (decimal)	R	W	Type	Description
01001	✓	×	UI16	Reserved
01001	✓	×	UI16	Reserved
01002	✓	×	UI16	Pipe size units: 0 = mm, 1 = inches
01003	✓	×	UI16	Mains frequency: 0=50Hz , 1=60Hz, 2 = 50/60
01004	✓	×	UI16	Coil current in mA
01005	✓	×	UI16	Nominal pipe diameter (0 to 2000mm)
01006	✓	×	F32	TF Select 3-4: Flow Tube factor 4 is used when the flow voltage is below this value.
01008	✓	×	F32	Tube Factor (TF) 4. Determined by wet calibration. (0.00 to 6000.00).
01010	✓	×	F32	Tube Factor (TF) 3. Determined by wet calibration. (0.00 to 6000.00)
01012	✓	×	F32	Tube Zero. Determined by wet calibration (-30.000 - 30.000)
01014	✓	×	F32	Reserved
01016	✓	×	F32	Density: [kg/litre] For calculation of mass flow (0.1000-5.0000)
01018	✓	×	F32	Coil excitation frequency. (0.0033 to 16.00Hz)
01020	✓	×	F32	Reserved
01022	✓	×	F32	Reserved
01024	✓	×	F32	Offset trim for 4-20 D/A converter on Analog option board 0
01026	✓	×	F32	Span trim for 4-20 D/A converter on Analog option board 0

01028	✓	×	F32	Offset trim for 4-20 D/A converter on Analog option board 1
01030	✓	×	F32	Span trim for 4-20 D/A converter on Analog option board 1
01032	✓	×	UI16	Index for model (emflux) replacement
01033	✓	×	Timestamp	Date/time of factory calibration
01036	✓	×	Timestamp	Date/time of last verifier connection
01039	✓	×	F32	TF Select 2-3. Tube factor 3 is used when the flow voltage is below this value.
01041	✓	×	F32	TF Select 1-2. Tube factor 2 is used when the flow voltage is below this value.
01043	✓	×	F32	Tube Factor (TF) 2. Determined by wet calibration. (0.00 to 6000.00)
01045	✓	×	F32	Tube Factor (TF) 1. Determined by wet calibration. (0.00 to 6000.00)
01047	✓	×	UI32	Meter ID
01049	✓	×	F32	Flow full scale for frequency output scaling & alarming.

Register 03000+ Configuration Data

Address (decimal)	R	W	Type	Description
03000	✓	×	UI16	Reserved
03001	✓	×	UI16	Reserved
03002	✓	×	UI16	Modbus Address [0..247]
03003	✓	×	UI16	Simulation Mode: 0-disabled, 1-flow simulation (totalisers disabled), 2-DC coil current.
03004	✓	×	UI16	LCD backlight timeout value [seconds]. Default value = 10.
03005	✓	×	UI16	LCD screen blanking timeout value [seconds]. Default value = 60.
03006	✓	×	UI16	Reserved
03007	✓	×	UI16	Empty pipe detection. 1= enabled, 0 = disabled.
03008	✓	×	UI16	Reserved
03009	✓	×	UI16	Smoothing algorithm constant [seconds]. Range is 0 to 100.
03010	✓	×	UI16	On time for flow sampling [seconds]
03011	✓	×	UI16	Off time for flow sampling [seconds]
03012	✓	×	UI16	Data logging period [seconds]
03013	✓	×	UI16	Number (ratio) of flow measurement scans per diagnostics scan.
03014	✓	×	UI16	Off time when there is no flow detected [seconds].
03015	✓	×	UI16	Display units type for flow rate. Refer to Units Type table above.
03016	✓	×	UI16	Display units type for time period. Refer to Units Type table above.
03017	✓	×	UI16	Display units type for all totalisers. . Refer to Units Type table above.
03018	✓	×	UI16	Number of power on resets
03019	✓	×	Timestamp	Off peak start time: HH:MM fields only apply.
03022	✓	×	Timestamp	Off peak stop time: HH:MM fields only apply.
03025	✓	×	Timestamp	Day/month all totalisers are latched
03028	✓	×	Reserved	
03030	✓	×	F32	Units special factor for flow rate
03032	✓	×	F32	Totalisers units special factor
03034	✓	×	F32	Time special factor for flow rate
03036	✓	×	F32	Reserved
03038	✓	×	F32	Flow full scale [%] below which flow is forced to zero. Rang is 0.00 to 10.00
03040	✓	×	F32	Simulated flow rate for outputs and display (simulation mode 1) or DC Coil Current (simulation mode 2).
03042	✓	×	UI16	Modem On Duration. Minutes that modem is powered on per Modem Interval Period.
03043	✓	×	UI16	Modem Interval Period. Minutes between switching on the modem power.
03044	✓	×	F32	PNF detector threshold.
03046	✓	×	F32	Electrode check threshold.
03048	✓	×	F32	Zero flow cutoff. Flow rate below which the flow is forced to zero.
03050	✓	×	UI16	LCD Contrast

03051	✓	×	Timestamp	Modem Start Time. The time of day (24 hour format) when the Modem On Duration and Modem Interval Period start to apply.
03054	✓	×	Timestamp	Modem End Time. The time of day when the Modem On Duration and Modem Interval Period cease to apply, thereafter the modem power output is off.
03057	✓	×	UI32	Site ID number lower and upper word only (read/write) – see configuration data for write.
03100	✓	×	UI16	User interface access code - level 0
03101	✓	×	UI16	User interface access code - level 1
03102	✓	×	UI16	User interface access code - level 2
03103	✓	×	UI16	Communications access code - level 0*
03104	✓	×	UI16	Communications access code - level 1#
03105	✓	×	UI16	Communications access code - level 2^
03200+	✓	×	Alarms	There are four alarm variables. See detailed description below
03400+	✓	×	Analog Outputs	There are two analog output variables. See detailed description below
03500+	✓	×	Digital Outputs	There are four Digital Output variables. See detailed description below

* Requires communications access level 0 to read this value.
# Requires communications access level 1 to read this value.
^ Requires communications access level 2 to read this value.

Registers 03200+ Alarms

Address (decimal)	Item
03200	Alarm 0 – see detail below
03206	Alarm 1 – see detail below
03212	Alarm 2 – see detail below
03218	Alarm 3 – see detail below

Alarm Detail

Address (decimal)	Type	Description
032xx+0	Bool	Enable logging alarm records
+ 1	UI16	Alarm Cause: see table below
+ 2	F32	Reserved
+ 4	F32	Reserved

Alarm Causes

Cause	Item
0	Alarm disabled
1	Low Battery
2	Pipe Not Full
3	System Fault
4	Low Flow
5	High Flow
6	Forward Flow
7	Reverse Flow

Register 03400+ Analog Outputs

Address (decimal)	Item
03400	Analog output 1 configuration – see detail below
03410	Analog output 2 configuration – see detail below

Analog Outputs Detail

Address (decimal)	Type	Description
034xx+0	UI16	0 = disabled, 1 = forward acting, 2 = reverse acting, 3 = bidirectional
+ 1	UI16	Channel: flow channel number to use as the signal
+ 2	F32	Rise time in seconds
+ 4	F32	Calibration factor for 'zero' output = channel value where output is either 4mA or 12mA depending on mode.
+ 6	F32	Calibration factor for full scale output (ie gain) = channel value where output is 20mA

Analog Outputs Mode

Value	Channel
0	Disabled
1	Forward acting
2	Reverse acting
3	Bi-directional

Analog Output Channel

Value	Channel
0	Velocity
1	Flow rate
2	Mass flow

Register 03500+ Digital Outputs

Address (decimal)	Item
03500	Digital output 0 configuration – see detail below
03506	Digital output 1 configuration – see detail below
03512	Digital output 2 configuration – see detail below
03518	Digital output 3 configuration – see detail below

Digital Output Settings Detail

Address (decimal)	Type	Description
035xx+0	UI16	Output Type: see table below.
+ 1	UI16	Maximum Frequency: the frequency at 'Flow Full Scale'
+ 2	UI16	Channel: see table below
+ 3	UI16	Pulse Scale: sets the number of totaliser units per pulse
+ 4	UI16	Pulse Width: the output pulse width in milliseconds.

Digital Output Channel

Value	Channel
0	Frequency
1	Pulse
2	Alarm
4	Disabled
5	Inactive

Frequency and Pulse Output Channel Types

Value	Channel	Frequency	Pulse
0	Velocity	✓	x
1	Flow rate	✓	x
2	Mass flow	✓	x
3	Forward total	x	✓
4	Reverse total	x	✓
5	Combined (nett) total	x	✓