

AquaMaster4

Electromagnetic flowmeter transmitter



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

Measurement made easy

—
AquaMaster 4
Harness the power
of electromagnetic
flowmeters

Introduction

This interface document is a supplement to the operating instructions of the AquaMaster4 FET400. All safety instructions it includes are valid and must be observed.

These instructions offer additional information required for the remote data exchange on FTPS/FTP for AquaMaster4 (FEX450) through cellular interface (4G). The document provides information regarding the communication protocol, structure of fields for different types of messages, available data types and parameters that support for integration to any SCADA and data visualization or human-machine interaction.

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	3	8	Firmware update	15
	Safety precautions	3		Single device update	15
	Cybersecurity	3		Single device update file naming convention	15
	Disclaimer	3		Single device update file content	15
	Communication protocol specific	3		Multiple device update.	16
	Intended use	3		Multiple device update package naming.	16
	Improper use.	3	9	Object list.	17
	Information on ROHS Directive 2011/65/EU (RoHS II) and 2015/863 (RoHS III)	4		Configuration lookup table	17
	ABB, Industrial Automation, Measurement & Analytics, fully supports the objectives of the ROHS directive. All in-scope products placed on the market by ABB are compliant to directives 2011/65/EU and 2015/863.	4	10	Diagnostics description.	27
	Communications protocol security	4		Diagnostics lookup table	27
2	Remote communication	4			
	Supported communication protocols.	4			
	FTPS/FTP	4			
	Connecting flowmeter to server.	4			
3	Remote functionality	5			
	Working principle	5			
	Network topology	5			
	Working folder structure	5			
	Routine data exchange.	6			
	Alarm report.	7			
4	Process data report.	8			
	Process data report process	8			
	Process data report file naming convention.	8			
	Process data report file content.	8			
	Detailed report	8			
	Alarm report process	10			
	Alarm report file naming.	10			
	Alarm report file content.	10			
6	Remote configuration exchange	11			
	Flowmeter configuration	11			
	Remote configuration	11			
	Remote configuration file naming convention.	11			
	Request file	11			
	Response file	11			
	Remote configuration file content.	11			
	Request file content	11			
	Response file content	12			
	Remote logger data retrieval	12			
7	Remote audit log retrieve	13			
	Remote audit log retrieve file naming convention	13			
	Request file	13			
	Response file	13			
	Request file content	13			
	Response file content	13			

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

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

Cybersecurity

NOTICE

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.

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www.abb.com/cybersecurity

Communication protocol specific

The DOAP over NFC is a secure protocol defined by ABB between the Velox Interface App and the transmitter, based upon a secret device identification PIN handshake.

The Modbus protocol is an unsecured protocol, as such the network security risk for the intended application should be assessed to ensure that these protocols are suitable before implementation.

The FTPS protocol runs on 4G variant of the transmitter. It is a secure protocol based on TLS1.2 with digital certificate based mutual authentication.

The FTP protocol runs on 4G variant of the transmitter. It is an in-secure protocol. Users should take appropriate measures to mitigate any associated security vulnerabilities.

The LwM2M/CoAP over DTLS-PSK protocol runs on NB variant of the transmitter is an unsecured protocol, as such the intended application should be assessed to ensure that these protocols are suitable before implementation.

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.

...1 Health, safety and security

Information on ROHS Directive 2011/65/EU (RoHS II) and 2015/863 (RoHS III)

ABB, Industrial Automation, Measurement & Analytics, fully supports the objectives of the ROHS directive. All in-scope products placed on the market by ABB are compliant to directives 2011/65/EU and 2015/863.

Communications protocol security

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

2 Remote communication

AquaMaster4 (FEX45X) provides a set of functionalities through Cellular interface to the end user including: **Routine Process Data Report, Alarm Auto-report, Remote Configuration Exchange, Remote Audit Log Retrieve and Remote Firmware Upgrade also known as Firmware Over-The-Air (FOTA)**. This document explains these functionalities in detail as a guide for integration of these functionalities to SCADA and data visualization or human-machine interaction.

Supported communication protocols

FTPS/FTP

FTPS also known as FTP-SSL, and FTP Secure which is an extension to the commonly used File Transfer Protocol (FTP) that adds support for the Transport Layer Security (TLS). AquaMaster4 FEX45X runs on secure protocol based on TLS 1.2 with digital certification based mutual authentication (refer to the Operating Instruction – OI/FET400).

FTP (File Transfer Protocol) is a standard communication protocol used for the transfer of files from a server to a client or client to a server on a computer network. FTP is built on a client-server model architecture using separate control and data connections between the client and the server.

Connecting flowmeter to server

To use the Cellular/Remote Interface available in AquaMaster4 FEX45X the communication between flowmeter and the server/IoT platform should have been established successfully (refer to Operation Instruction – OI/FET400 for the configuration and troubleshooting). Regarding the server/IoT platform configuration/settings, refer to the documents of your server/IoT Platform solution or contact your IT supplier.

3 Remote functionality

This section describes the detailed information about how to interact with the device through FTPS/FTP over Cellular 4G. To use the features mentioned below, a FTPS/FTP Server shall be setup and registered with the AquaMaster4 (FEX45X) device as explained in the previous section.

Working principle

Network topology

The Network topology of AquaMaster4 (FEX45X) Cellular 4G telemetry system is shown in Figure 1 below:

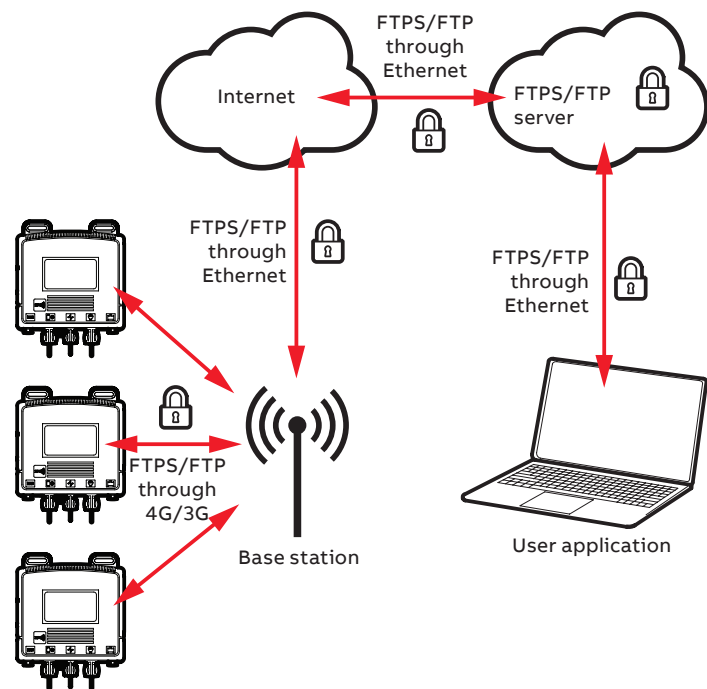


Figure 1 AquaMaster4 telemetry system topology

There are 3 main components in the system: the AquaMaster4 (FEX45X), the FTPS/FTP Server deployed on cloud platform/ physical machine and the terminal equipment with application. The FTP or FTP over TLS (also called as FTPS) is used for the data exchange between the FTP/FTPS Server and the AquaMaster4 (FEX45X) as well the data exchange between FTPS /FTP Server and user application such as SCADA or data visualization application. The AquaMaster4 (FEX45X) and user application/SCADA play the role of FTPS/FTP Client, they use the FTPS/FTP Server as a transfer station for data exchange in an routing/ad-hoc approach.

Working folder structure

AquaMaster 4 (FEX45X) which is an FTPS/FTP client as explained above creates a working folder the first time it communicates with the FTPS/FTP servers for itself.

Root working directory

One of the mandatory parameters that needs to be configured during commissioning of AquaMaster 4 (FEX45X0) is the FTPS/FTP working directory. This parameter defines the root working directory on the FTPS/FTP Server for the telemetry system. The root working directory/FTPS/FTP working directory in the FTPS/FTP Server can be shared among multiple devices and purpose thus avoid additional cost.

Folder hierarchy

The working folder is structured in 3-level hierarchy as shown in Figure 2 below:

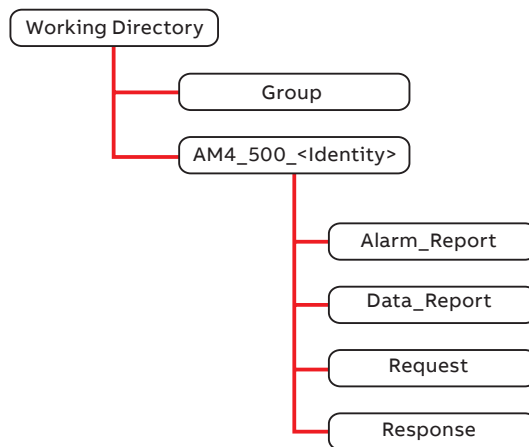


Figure 2 Working folder structure on FTPS/FTP Server

The Working Directory is the Root Working Directory of the telemetry system on the FTPS/FTP Server. Under the Working Directory, there is a dedicate folder called Group. The Group folder is used to apply change to all the AquaMaster4 devices which belong to the same Working Directory on the FTPS/FTP Server.

NOTICE

Currently, only firmware update to multi-device is supported by Group folder.

...3 Remote functionality

...Working principle

The other folder/folders under Working Directory is Device Dedicate Folder which follows a naming rule: AM4_500_<Identity>. Each device has its own Device Dedicate Folder and they are distinguished by Identity in its folder name. The identity is determined by the device configuration which has three options: Meter tag, Transmitter unique ID or Sensor unique ID. For each of the Device Dedicate Folder, a set of Functional Sub-Folders are provided as below:

Sub-folder Name	Functionality
Alarm_Report	Alarm report sent by the device
Data_Report	Routine process data report sent by the device
Request	Pending requests from user/user application
Response	Responses to the requests from the user/user application

NOTICE

The folder structure will be created by the device automatically for the very first time it connects to the FTPS/FTP Server, but could be created by the user as well.

The details about how to use the functional sub-folders will be explained in detail in the following sections.

Data exchange mode

AquaMaster4 has two modes to wake up from sleep, to switch on cellular communication and to have a durable battery life.

Routine data exchange

AquaMaster4 (FEX45X) stays in sleep mode and will wake up to switch on the cellular communication to interact with the FTPS/FTP Server depending upon the interval configured in parameter data report interval during commissioning for routine data exchange. During the routine data exchange cycle the device follows as shown in Figure 3:

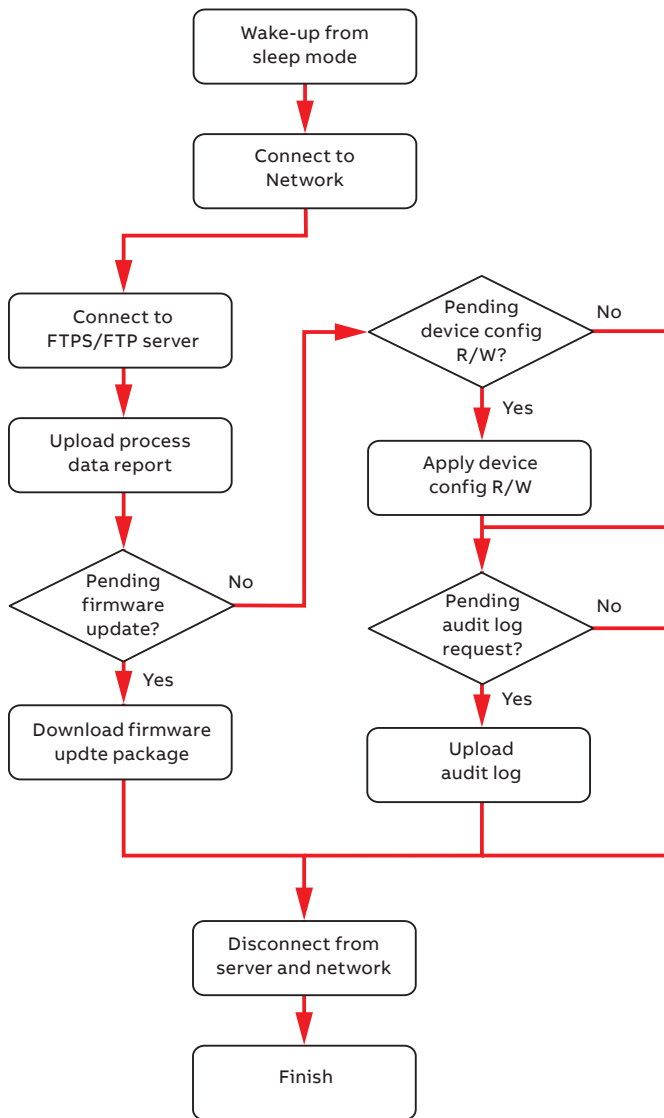


Figure 3 Routine data exchange workflow

Routine data exchange covers Process Data Report, Remote Configuration Read/Write, Remote Audit Log Retrieve and Remote Firmware Update.

The schedule of the data exchange is configured through a set of parameters within the device as described in the table below:

Parameter	Description
Data Report Time Base	The time offset in seconds from 00:00:00 within one day as reference for routine data exchange
Data Report Interval	The time interval between 2 data report time. Possible values: 1 hour 6 hours 12 hours 24 hours
Time Zone	UTC time zone selection
Daylight-saving	Enable/Disable daylight-saving

An example of the data exchange schedule is as below:

Configuration	Routine data exchange time
Data Report Time Base = 1 hour (3600 s)	01:00:00 UTC+8
Data Report Interval = 6 hours	07:00:00 UTC+8
Time Zone = UTC+8	13:00:00 UTC+8
Daylight-saving = Off	19:00:00 UTC+8

The relationship between Time Base & Time Interval and routine data exchange time is also shown in Figure 4 below:

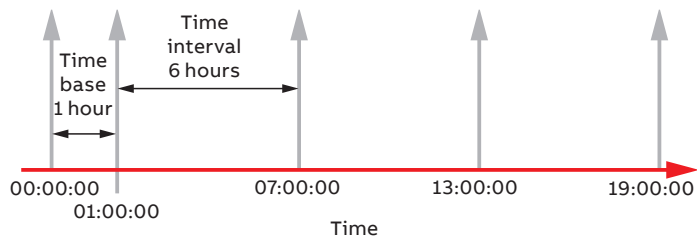


Figure 4 How to configure routine data exchange time

Alarm report

Besides the routine data exchange, the device wakes up from sleep for event-driven alarm report. The alarm report is generated and uploaded to the server when there is an alarm raised or cleared according to user configuration.

The workflow for alarm report is shown in Figure 5:

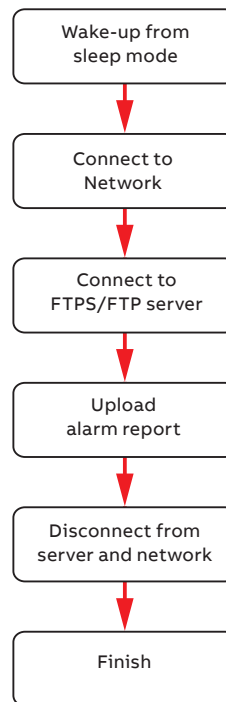


Figure 5 Alarm report workflow

The alarm report on alarm raises and alarm clear can be set separately from parameters:

Parameter	Description
Alarm report on raise condition	On Off
Alarm report on clear condition	On Off

4 Process data report

The Process Data Report contains process data acquired by the device during normal operation and is uploaded to the remote FTPS/FTP Server following the routine data exchange process described in Routine data exchange section.

Process data report process

The Process Data Report is uploaded to the **Data_Report** sub-folder under **Device Dedicate Folder** following the routine data exchange process described in Routine data exchange.

Process data report file naming convention

The process data report file naming convention remains same irrespective of the type of Process Data Report, **Detailed report** or **Summary report** (refer to the Data Sheet – DS/FET400 for details). AquaMaster4 (FEX45X) can generate both reports either in CSV or JSON format depending upon the parameter FTP file type (refer to the Operating Instruction – OI/FET400). The file naming rule is as below:

Complete file name	AM4_500_<Device Identifier>_<Report Type>_<Timestamp>_<CRC-16>.<ext>
Device Identifier	Options: Meter Tag Transmitter unique ID Sensor unique ID
Report Type	DetailedReport SummaryReport
Timestamp	The time of process data report generated in YYYYMMDDHHMMSS format
CRC-16	The CRC-16 checksum of the file content
Ext	Options: csv json

Process data report file content

As mentioned in previous section, there are two types of Process Data Report that the device can upload to FTPS/FTP Server according to device configuration.

Detailed report

The content of Detailed Report file is provided as a process data log. The interval of the log sent to the FTPS/FTP is defined in parameter **Retrieved long interval data** and can be selected during device configuration which is **15s, 30s, 1min, 5mins and 15mins**. Each of the record provides data fields:

Data field	Description
Date	Date of the measurement happen in YYYY.MM.DD format
Time	Time of the measurement happen in hh:mm:ss format
Totalizer Unit	Unit of flow totalizer
Totalizer Forward	Forward volume of flow totalizer
Totalizer Reverse	Reverse volume of flow totalizer
Totalizer Net	Net volume of flow totalizer
Flowrate Unit	Unit of flow rate
Flowrate Value	Flow rate in user unit
Pressure Unit	Unit of pressure (only available for pressure enabled device)
Pressure Value	Pressure in user unit (only available for pressure enabled device)
Alarm Status	OK - there is no alarm raised Not OK - there is any alarm raised
Battery Life	Battery-life in percentage when data report is generated
Signal Quality	Wireless signal quality in percentage when data report is generated

Sample report file – CSV

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Date	Time	Totalizer Unit	Totalizer Forward	Totalizer Reverse	Totalizer Net	Flow Rate Unit	Flow Rate Value	Pressure Unit	Pressure Value	Alarm Status	Battery Life	Signal Quality
2	2021.04.19	4:40:00 R3	3510086.906	745.7515494	3509341.154	imp-gal/day	0 bar	0	OK	100%	100%		
3	2021.04.19	4:40:15 R3	3510086.906	745.7515494	3509341.154	imp-gal/day	0 bar	0	OK	100%	100%		
4	2021.04.19	4:40:30 R3	3510086.906	745.7515494	3509341.154	imp-gal/day	0 bar	0	OK	100%	100%		
5	2021.04.19	4:40:45 R3	3510086.906	745.7515494	3509341.154	imp-gal/day	0 bar	0	OK	100%	100%		
6	2021.04.19	4:41:00 R3	3510086.906	745.7515494	3509341.154	imp-gal/day	0 bar	0	OK	100%	100%		
7	2021.04.19	4:41:15 R3	3510086.906	745.7515494	3509341.154	imp-gal/day	0 bar	0	OK	100%	100%		
8	2021.04.19	4:41:30 R3	3510086.906	745.7515494	3509341.154	imp-gal/day	0 bar	0	OK	100%	100%		
9	2021.04.19	4:41:45 R3	3510086.906	745.7515494	3509341.154	imp-gal/day	0 bar	0	OK	100%	100%		
10	2021.04.19	4:42:00 R3	3510086.906	745.7515494	3509341.154	imp-gal/day	0 bar	0	OK	100%	100%		
11	2021.04.19	4:42:15 R3	3510086.906	745.7515494	3509341.154	imp-gal/day	0 bar	0	OK	100%	100%		

Sample report file – JSON

```
{
  "detailReportList":
  [
    {
      "date": "2021.04.08",
      "time": "09:00:00",
      "totalizerUnit": "m3",
      "totalizerForward": 0,
      "totalizerReverse": 0,
      "totalizerNet": 0,
      "flowRateUnit": "ltr/sec",
      "flowRateValue": 0,
      "pressureUnit": "bar",
      "pressureValue": 0,
      "alarmStatus": "OK",
      "batteryLife": "100%",
      "signalQuality": "100%"
    },
    {
      "date": "2021.04.08",
      "time": "09:00:15",
      "totalizerUnit": "m3",
      "totalizerForward": 0,
      "totalizerReverse": 0,
      "totalizerNet": 0,
      "flowRateUnit": "ltr/sec",
      "flowRateValue": 0,
      "pressureUnit": "bar",
      "pressureValue": 0,
      "alarmStatus": "OK",
      "batteryLife": "100%",
      "signalQuality": "100%"
    }
  ]
}
```


Summary report

The content of Summary Report file is provided as a record of the instance during which the report was generated. Each of the record provides data fields:

Data field	Description
Date	Date of this report generated in YYYY.MM.DD format
Time	Time of this report generated in hh:mm:ss format
Totalizer Unit	Unit of flow totalizer
Totalizer Forward	Current forward volume of flow totalizer when this report generated
Totalizer Reverse	Current reverse volume of flow totalizer when this report generated
Totalizer Net	Current net volume of flow totalizer when this report generated
Flowrate Unit	Unit of flow rate
Flowrate Max	Maximal flow rate since last routine data exchange
Flowrate Min	Minimal flow rate since last routine data exchange
Flowrate Avg	Average flow rate since last routine data exchange
Alarm Status	OK - there is no alarm raised Not OK – there is any alarm raised
Battery Life	Battery-life in percentage when data report is generated
Signal Quality	Wireless signal quality in percentage when data report is generated

Sample report file – CSV

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Date	Time	Totalizer Unit	Totalizer Forward	Totalizer Reverse	Totalizer Net	Flow Rate Unit	Flow Rate Max	Flow Rate Min	Flow Rate Avg	Alarm Status	Battery Life	Signal Quality
2	2021.06.20	14:40:55	m3	395	211	1.4	m3/h	2.001	2.001	2.001	OK	100%	100%

Sample report file – JSON

```
{
  "date": "2021.06.03",
  "time": "02:55:00",
  "totalizerUnit": "m3",
  "totalizerForward": "395.403",
  "totalizerReverse": "0.168",
  "totalizerNet": "395.235",
  "flowRateUnit": "m3/h",
  "flowRateMax": "2.001",
  "flowRateMin": "1.801",
  "flowRateAvg": "1.901",
  "alarmStatus": "OK",
  "batteryLife": "100%",
  "signalQuality": "64%"
}
```


6 Remote configuration exchange

Flowmeter configuration

AquaMaster4 (FEX45X) supports remote configuration which is used to change configuration parameters or to get device configuration remotely. As mentioned in previous sections, the remote configuration exchange is effective during the routine data exchange process.

Remote configuration

The remote configuration is achieved through a set of actions as stated below.

- The user/user application should create the configuration exchange request file following the request file naming and content structure rule defined for configuration exchange.
- The user/user application to save the configuration exchange request file under the **Request** sub-folder.
- The device will check all pending request under its **Request** folder each time it wakes up for the routine data exchange, apply the configuration changes/read the desired settings and upload the feedback into its **Response** sub-folder with the result.
- The user/user application can poll the **Response** sub-folder of the device to know the status of request and get the data it requested if any.

Remote configuration file naming convention

Request file

Complete file name	AM4_500_<Device Identifier>_RequestDataExchange_<Timestamp>_<CRC-16>.<ext>
Device Identifier	Options: Meter Tag Transmitter unique ID Sensor unique ID
Report Type	RequestDataExchange as indication for data exchange request
Timestamp	The time of request file generated in <code>yyyymmddHHMMSS</code> format
CRC-16	The CRC-16 checksum of the file content
Ext	Options: csv json

Response file

Complete file name	AM4_500_<Device Identifier>_ResponseDataExchange_<Timestamp>_<CRC-16>.<ext>
Device Identifier	Options: Meter Tag Transmitter unique ID Sensor unique ID
Report Type	ResponseDataExchange as indication for data exchange response
Timestamp	The time of request file generated in <code>yyyymmddHHMMSS</code> format
CRC-16	The CRC-16 checksum of the file content
Ext	Options: csv json

Remote configuration file content

Request file content

The configuration request file is defined as a list of requests, each of the request within the request file describes to read or write a specific parameter/configuration with a value:

Data field	Description
Command	Read or write device configuration. Options: Read Write
Sub System Index*	Subsystem index of the configuration to access
Object Index*	Object index of the configuration to access
Data Length*	Length of the data to write, only valid for Write command, not applicable for Read
Data*	Data in hex byte array to write, only valid for Write command, not applicable for Read

*Refer to "Configuration lookup table" from page 17.

Sample report file – CSV

	A	B	C	D	E
1	Cmd	Subsystem Index	Object Index	Data Length	Data
2	Read	1	2	NA	NA
3	Write	20	2	1	12

Sample report file – JSON

```
{
  "requestList": [
    {
      "command": "Read",
      "subsystemIndex": "1",
      "objectIndex": "2",
      "dataLength": null,
      "data": null
    },
    {
      "command": "Write",
      "subsystemIndex": "20",
      "objectIndex": "2",
      "dataLength": "1",
      "data": "12"
    }
  ]
}
```

...6 Remote configuration exchange

...Remote configuration file content

Response file content

Data field	Description
Command	Read or write device configuration. Options: Read Write
Error Code	Result of this configuration exchange
Sub System Index*	Subsystem index of the configuration to access
Object Index*	Object index of the configuration to access
Data Length*	Length of the data from device, only valid for Read command, null for Write
Data*	Data in hex byte array from device, only valid for Read command, null for Write

*Refer to "Configuration lookup table" from page 17.

Sample report file – CSV

	A	B	C	D	E	F
1	Cmd	Error Code	Subsystem Index	Object Index	Data Length	Data
2	Read	Success	1	2	11	20 00 00 40 00 12 02 00 08 00 02
3	Write	Success	10	1	NA	NA

Sample report file – JSON

```
{
  "responseList": [
    {
      "command": "Read",
      "errorCode": "Success",
      "subsystem Index": "1",
      "objectIndex": "2",
      "dataLength": "11",
      "data": "20,00,00,40,00,12,02,00,08,00,02"
    },
    {
      "command": "Write",
      "errorCode": "Success",
      "subsystem Index": "10",
      "objectIndex": "1",
      "dataLength": null,
      "data": null
    }
  ]
}
```

Remote logger data retrieval

Remote data retrieval from the logger in AquaMaster4 (FEX45X) is done similarly to remote configuration (remote configuration file naming convention and file content).

The sequence of commands to be sent should be:

- enable **Advance Access** level for the device,
- optionally change the interval of retrieval,
- the last command is for interval of logger data retrieval.

For logger data retrieval, the Subsystem Index is 22 and Object Index is 49 and the Data to be sent is the UNIX Time stamp for the start and end in UNIT32 – Little Endian Hex format.

Example : 2021.9.1 00:00:00 = 1632329311 = 5F 5E 4B 61

Sample data retrieval file – CSV

	A	B	C	D	E
1	Cmd	Subsystem Index	Object Index	Data Length	Data
2	Write	14	11	1	1
3	Write	10	2	1	300
4	Write	22	49	8	5F 5E 4B 61 8F 88 4B 61

7 Remote audit log retrieve

AquaMaster4 (FEX45X) device has a built-in audit logger which records all the internal diagnostics, configuration change (through Cellular 4G, NFC, Modbus) and critical events like firmware update, reset of flow totalizer, etc. The Remote Audit Log Retrieve feature provide the capability to acquire audit log content remotely for traceability.

The Remote Audit Log Retrieve feature is achieved through the **Request** folder and **Response** folder under **Device Dedicate Folder**.

- The user/user application generates audit log retrieve request file following the file name and content rule for audit log retrieve purpose.
- The user/user application saves the constructed audit log retrieve request file under the **Request** sub-folder of the device to read.
- The device will check the pending request under its **Request** sub-folder each time it wakes up for the routine data exchange, read the desired audit log events and upload the feedback into its **Response** sub-folder with the result.
- The user/user application can poll the **Response** sub-folder of the device to obtain the audit log.

Remote audit log retrieve file naming convention

Request file

Complete file name	AM4_500_<Device Identifier>_RequestAuditLogger_<Timestamp>_<CRC-16>.<ext>
Device Identifier	Options: Meter Tag Transmitter unique ID Sensor unique ID
Report Type	RequestAuditLogger as indication for audit log retrieve request
Timestamp	The time of request file generated in yyyymmddHHMMSS format
CRC-16	The CRC-16 checksum of the file content
Ext	Options: csv json

Response file

Complete file name	AM4_500_<Device Identifier>_ResponseAuditLogger_<Timestamp>_<CRC-16>.<ext>
Device Identifier	Options: Meter Tag Transmitter unique ID Sensor unique ID
Report Type	ResponseAuditLogger as indication for audit log retrieve response
Timestamp	The time of request file generated in yyyymmddHHMMSS format
CRC-16	The CRC-16 checksum of the file content
Ext	Options: csv json

NOTICE

The response file re-uses the same timestamp with the correlated request file for matching purpose.

Remote audit log retrieve file content

Request file content

The audit log retrieve request file is defined as a simple log extract request with necessary information mentioned below:

Data field	Description
category	Category of audit log to retrieve. Options: Regular Critical
Start Time	Start of retrieve time range in YYYYMMDDHHMMSS format
End Time	End of retrieve time range in YYYYMMDDHHMMSS format

Sample report file – CSV

	A	B	C
1	Category	Start Time	End Time
2	Regular	20200608103200	20200608103200

Sample report file – JSON

```
{
  "readAuditLogger":
  {
    "category": "Regular",
    "startTime": "20200608103200",
    "endTime": "20200608103200"
  }
}
```

Response file content

The content of Audit Log Retrieve response is the requested audit log content with a time stamp. For each log, the data structure may vary depending on the type of the audit log record. All the supported event types are listed as below with corresponding data structure:

Device configuration change record

Data field	Description
Timestamp	The time of event happens in YYYYMMDDHHMMSS format
Indicator	W – indicate this is a configuration change record
Interface	The communication interface used for the configuration change: NFC0~3 : NFC user 0 to user 3 4G : Cellular 4G MOB : Modbus-RTU"
Sub System Index*	Subsystem index of the configuration
Object Index*	Object index of the configuration
CRC-16	The CRC-16 checksum of this audit log record

*Refer to "Configuration lookup table" from page 17.

...7 Remote audit log retrieve

...Remote audit log retrieve file content

Diagnosics record

Data field	Description
Timestamp	The time of event happens in YYYYMMDDHHMMSS format
Indicator	Diagnosis – indicate this is a diagnostics record
Diagnostics	The diagnostics in hex byte array, see attached Diagnostics Lookup Table for detailed explanation on each bit.
CRC-16	The CRC-16 checksum of this audit log record

Firmware update record

Data field	Description
Timestamp	The time of event happens in YYYYMMDDHHMMSS format
Indicator	FirmwareUpdated – indicate this is a diagnostics record
Firmware identifier	Used to identify which firmware of the device is updated: AC : Communication Application BC : Communication Bootloader AM : Measurement Application BM : Measurement Bootloader
Original firmware version	Firmware version in XX.YY.ZZ format
New firmware version	Firmware version in XX.YY.ZZ format
CRC-16	The CRC-16 checksum of this audit log record

Sample audit log response file – CSV

	A	B
1	Category	Content
2	Regular	20210407044825,Diagnosis,00000000000000000000,8f27
3	Regular	20210407045800,W,NFC0,014,003,8d7c
4	Regular	20210407045805,W,NFC0,022,009,64be
5	Regular	20210407051056,Diagnosis,00000040000000000000,09b6

Sample audit log response file – JSON

```
{
  "regularAuditLogger": [
    "20210407044825,Diagnosis,00000000000000000000,8f27",
    "20210407045800,W,NFC0,014,003,8d7c",
    "20210407045805,W,NFC0,022,009,64be",
    "20210407051056,Diagnosis,00000040000000000000,09b6"
  ],
  "errorCode": "Success"
}
```

8 Firmware update

AquaMaster4 (FEX45X) supports remote firmware update (FOTA) through cellular 4G. There are two possible methods for the firmware Update: **Single device update**, **Multiple device update**.

Single device update

The single device Update feature is achieved through the **Request** folder and **Response** folder under **Device Dedicate Folder**, below are the steps for firmware update.

- 1 Navigate to the **Download > Software** tab of the [AquaMaster4 product page](#).
- 2 User verifies the firmware package using corresponding signature to make sure the firmware package to deploy is valid using the SHA512 cryptographic hash function..
- 3 User uploads the firmware update package to the **Request** sub-folder of the device to update on the **FTPS/FTP Server**.
- 4 Device will download the firmware package and apply it when it wakes up for routine data exchange and provide update result to its **Response** folder.
- 5 User can poll and check the **Response** folder of the device to get the result of the firmware update operation.

NOTICE

The firmware release package is signed by ABB and shall be only downloaded from secured ABB official webpage mentioned in step 1 above.

Single device update file naming convention

Firmware package

Complete file name	AM4_500_<Device Identifier>_<Firmware Image Type>_<version>.bin
Device Identifier	Options: Meter Tag Transmitter unique ID Sensor unique ID
Firmware Image Type	Identify which part of the firmware to update: COMM_Application – Communication MCU Application firmware COMM_Bootloader – Communication MCU Bootloader firmware MEAS_Application – Measurement MCU Application firmware MEAS_Bootloader – Measurement MCU Bootloader firmware"
Version	The firmware version number in XXYYZZ format

Firmware download response

Complete file name	AM4_500_<Device Identifier>_FirmwareDownload_<timestamp>.<ext>
Device Identifier	Options: Meter Tag Transmitter unique ID Sensor unique ID
Timestamp	The timestamp when firmware image downloaded in yyyymmddHHMMSS format
ext	Options: csv json

Firmware update response

Complete file name	AM4_500_<Device Identifier>_FirmwareUpdate_<timestamp>.<ext>
Device Identifier	Options: Meter Tag Transmitter unique ID Sensor unique ID
Timestamp	The timestamp when firmware updated in yyyymmddHHMMSS format
ext	Options: csv json

Single device update file content

Firmware package: The firmware package for update downloaded as indicated above

Firmware download response

Data field	Description
Firmware Type	The type of downloaded firmware package: A0 : Communication Application B0 : Communication Bootloader A1 : Measurement Application B1 : Measurement Bootloader"
Error Code	Indicate the firmware download & verification result: Success Packet Index Error Erase Flash Failed Image Too Large Get Firmware Lock Failed

Firmware update response

Data field	Description
Firmware Type	The type of downloaded firmware package: A0 : Communication Application B0 : Communication Bootloader A1 : Measurement Application B1 : Measurement Bootloader"
Previous Firmware Version	Previous firmware version in XX.YY.ZZ format
Current Firmware Version	Current firmware version in XX.YY.ZZ format
Error Code	Indicate the firmware update result: 00 : Upgrade Success Not 0 : Upgrade Failed"

...8 Firmware update

...Single device update

Sample firmware download response file – CSV

	A	B
1	Firmware Type	Error Code
2	A1	Success

Sample firmware download file – JSON

```
{
  "firmwareType": "A1",
  "errorCode": "Success"
}
```

Sample firmware update response file – CSV

	A	B	C	D
1	Firmware Type	Previous Firmware Version	Current Firmware Version	Error Code
2	Read	00.05.00	00.06.00	00

Sample firmware update file – JSON

```
{
  "firmwareType": "A1",
  "previousFirmwareVersion": "00.06.00",
  "currentFirmwareVersion": "00.06.00",
  "errorCode": "00"
}
```

Multiple device update

The multiple device update follows the same procedure of single device update. The only difference is the folder under which the firmware update image is placed. As described earlier, there is a folder named **Group** under **Working Directory** for multiple device update. The device firmware update package shall be named according to below rule and placed in the folder **Group**.

Multiple device update package naming

Complete file name	AM4_500_Group_<Firmware Image Type>_<version>.bin
Firmware image type	Identify which part of the firmware to update: COMM_Application – Communication MCU Application firmware COMM_Bootloader – Communication MCU Bootloader firmware MEAS_Application – Measurement MCU Application firmware MEAS_Bootloader – Measurement MCU Bootloader firmware
Version	The firmware version number in XYZZZ format

The firmware download and firmware update response are placed by the devices to their individual **Response** folder under **Device Dedicate Folder** after the firmware download and update is successful. The user/user application can poll to confirm the status.

9 Object list

Configuration lookup table

Category	Configuration item	Subsystem index	Object index	Access level	Type	Description
Device information	Transmitter unique ID	0	6	Read-only	UNSIGNED32	
	Transmitter serial number	0	35	Read-only	STRING	String length: 33 bytes
	Transmitter date of manufacture	0	13	Read-only	DATETIME	
	Sensor unique ID	0	7	Read-only	UNSIGNED32	
	Sensor serial number	0	36	Read-only	STRING	String length: 33 bytes
	Sensor date of manufacture	0	14	Read-only	DATETIME	
	Transmitter build type	0	17	Read-only	ENUM8	0 – Integral Sensor 1 – Remote Sensor
	Meter tag	0	5	Read/Write	STRING	String length: up to 33 bytes
	Meter owner	0	12	Read/Write	STRING	String length: up to 33 bytes
	Transmitter location	0	33	Read-only	STRING	String length: up to 33 bytes
	Sensor location	0	8	Read/Write	STRING	String length: up to 33 bytes
	Sensor type	0	15	Read-only	ENUM8	0 – Full Bore 1 – Virtual Full Bore (VKG only) 2 – Reduced Bore (VKG only) 3 – Probe
	Calibration accuracy	0	16	Read-only	ENUM8	0 – Normal 1 – Class 1 2 – Class 2 3 – MID Class 1 4 – MID Class 2
	Sensor certificate number	0	47	Read-only	STRING	String length: up to 33 bytes
	MID switch state	0	49	Read-only	ENUM8	0 – Unlocked 1 – Locked 255 – Switch not fitted
Lining material	0	50	Read-only	ENUM8	0 – Special device 2 – PFA 3 – PTFE 4 – FEP 5 – ABR 6 – Soft elastomer 7 – Polyurethane 8 – High temp elastomer 9 – Polypropylene 10 – PES 11 – Polyethylene 12 – PPS 13 – Viton® 26 – Peek device 27 – Hard rubber device 28 – Linatex device	
Electrode material	0	51	Read-only	ENUM8	0 – Special device 1 – NA 14 – Stainless steel 18 – Titanium 19 – Hastelloy® B 20 – Hastelloy C 21 – Platinum iridium 22 – Tantalum 24 – Super austenitic stainless steel device	
Flange material	0	52	Read-only	ENUM8	0 – Special device 1 – NA 14 – Stainless steel 15 – Carbon steel 16 – Brass 25 – Wafer device	
Calendar date / time		17	9	Read/Write	DATETIME	

...9 Object list

...Configuration lookup table

Category	Configuration item	Subsystem index	Object index	Access level	Type	Description
	Time zone	17	7	Read/Write	ENUM8	0 – UTC-12:00 1 – UTC-11:00 2 – UTC-10:00 3 – UTC-09:30 4 – UTC-09:00 5 – UTC-08:00 6 – UTC-07:00 7 – UTC-06:00 8 – UTC-05:00 9 – UTC-04:00 10 – UTC-03:30 11 – UTC-03:00 12 – UTC-02:00 13 – UTC-01:00 14 – UTC 15 – UTC+01:00 16 – UTC+02:00 17 – UTC+03:00 18 – UTC+03:30 19 – UTC+04:00 20 – UTC+04:30 21 – UTC+05:00 22 – UTC+05:30 23 – UTC+05:45 24 – UTC+06:00 25 – UTC+06:30 26 – UTC+07:00 27 – UTC+08:00 28 – UTC+08:45 29 – UTC+09:00 30 – UTC+09:30 31 – UTC+10:00 32 – UTC+10:30 33 – UTC+11:00 34 – UTC+12:00 35 – UTC+12:45 36 – UTC+13:00 37 – UTC+14:00
	Daylight saving	17	8	Read/Write	BOOL	0 – Off 1 – On
	Sensor and Connection Type	0	58	Read-only	ENUM8	0 – Integral Sensor 1 – VKG Sensor Connected 2 – VKG Sensor Disconnected 3 – VKL Sensor Connected 4 – VKL Sensor Disconnected
	Top Line User Decimal	0	59	Read/Write	UNSIGNED8	Range: 0~4
Display settings	Velocity	9	1	Read/Write	UNSIGNED8: Bit 0	0 – Off 1 – On
	Flow rate	9	1	Read/Write	UNSIGNED8: Bit 1	0 – Off 1 – On
	Pressure	9	1	Read/Write	UNSIGNED8: Bit 2	0 – Off 1 – On
	Forward Totalizer	9	1	Read/Write	UNSIGNED8: Bit 3	0 – Off 1 – On
	Reverse Totalizer	9	1	Read/Write	UNSIGNED8: Bit 4	0 – Off 1 – On
	Net Totalizer	9	1	Read/Write	UNSIGNED8: Bit 5	0 – Off 1 – On
	Display Test	9	2	Read/Write	UNSIGNED16	0 – Off 1 – On
	Top line leading zeros	9	3	Read/Write	UNSIGNED16	0 – Off 1 – On

Category	Configuration item	Subsystem index	Object index	Access level	Type	Description
Process logger settings	Logging interval	10	1	Read/Write	ENUM16	15 – 15 s 30 – 30 s 60 – 1 min 300 – 5 mins 900 – 15 mins
	Retrieved record interval	10	2	Read/Write	ENUM16	15 – 15 s 30 – 30 s 60 – 1 min 300 5 mins 900 – 15mins
Flow settings	Velocity units	6	1	Read/Write	ENUM8	1 – m/s 2 – ft/s 3 – ft/min
	Flow rate units	6	2	Read/Write	ENUM8	0 – Custom units 1 – l/s 2 – l/min 3 – l/hr 4 – Ml/day 5 – m3/s 6 – m3/min 7 – m3/hr 8 – m3/day 9 – imp-gal/s 10 – imp-gal/min 11 – imp-gal/hr 12 – imp-Mgal/day 13 – ft3/s 14 – ft3/min 15 – ft3/hr 16 – us-gal/s 17 – us-gal/min 18 – us-gal/hr 19 – us-Mgal/day
	Custom flow rate units name	6	42	Read/Write	STRING	String length up to 11 bytes
	Custom flow rate units scaling factor (from m3/s)	6	8	Read/Write	FLOAT	Range: 0~3.39E+38
	Probe On Off	6	31	Read-only	ENUM8	0 – Probe Off 1 – Probe On
	Meter Bore (mm)	6	6	Read-only	FLOAT	Range: 1.0~5000.0
	Meter Bore (mm) (Probe)	6	5	Read/Write	FLOAT	Range: 1.0~5000.0
	Probe Profile Factor Fp	6	29	Read/Write	FLOAT	
	Probe Insertion Factor Fi	6	28	Read/Write	FLOAT	
	Filter Response Time (seconds)	5	11	Read/Write	FLOAT	Range: 0.0~1000.0
	Mains Noise Rejection Frequency (Hz)	5	32	Read/Write	ENUM8	0 – 60 Hz 1 – 50 Hz
	Max nominal flow rate Q3	6	7	Read-only	FLOAT	
	Flow rate low trip %	6	9	Read/Write	FLOAT	
	Flow rate high trip %	6	10	Read/Write	FLOAT	
	User flow direction	6	30	Read/Write	ENUM8	0 – Flow Normal 1 – Flow Backwards 2 – Flow Forward Only 3 – Flow Reverse Only
User cut-off (%)	6	34	Read/Write	UNSIGNED8		
Flow (%)	6	40	Read-only	FLOAT		
Alarm hysteresis (%)	6	44	Read/Write	FLOAT		

...9 Object list

...Configuration lookup table

Category	Configuration item	Subsystem index	Object index	Access level	Type	Description
Volume totalizer settings	Volume Units	7	1	Read/Write	ENUM8	0 – Custom units 1 – l 2 – m3 3 – imp-gal 4 – ft3 5 – us-gal 6 – Ml 7 – us-Mgal 8 – imp-Mgal 9 – ml 10 – hl 11 – kgal 12 – acre-feet
	Custom Volume Units Name	7	7	Read/Write	STRING	String length: up to 11 bytes
	Custom Volume Units Scaling Factor (from m3)	7	6	Read/Write	FLOAT	Range: 0~3.39E+38
	Reset Totalizers	7	5	Read/Write	ENUM8	Write 0 to trigger action
Pressure settings	Pressure Units	8	2	Read/Write	ENUM8	0 – Custom units 1 – Bar 2 – mBar 3 – kPa 4 – mmHg 5 – mH2O 6 – psi 7 – ftH2O 8 – Pa
	Transducer Height Offset (mm)	8	5	Read/Write	SIGNED16	
	Pressure Transducer Output (mV/V)	8	7	Read-only	FLOAT	Range: 0.0~1000.0
	Pres. Transducer Zero Offset (mV/V)	8	8	Read-only	FLOAT	
	Transducer linearity correction (%)	8	25	Read-only	FLOAT	Range: -100.0~100.0
	Transducer full scale pressure (Bar)	8	9	Read-only	FLOAT	Range: 0~3.39E+38
	Pressure display type	8	11	Read/Write	ENUM8	0 – Absolute 1 – Gauge
	Pressure response time (seconds)	5	53	Read/Write	FLOAT	Range: 0.0~1000.0
Pulse outputs settings	Pulse Outputs Configuration	2	5	Read/Write	ENUM8	0 – Disabled 1 – Enabled 3 – DO3 Single Line Enabled
	Pulses Per Unit Volume	2	1	Read/Write	FLOAT	
	Pulse Width (ms)	2	2	Read/Write	UNSIGNED8	Range: 1~250
	Max Available Pulse Frequency (Hz)	2	14	Read-only	FLOAT	
Alarm output settings	Clear All Alarms	1	3	Read/Write	ENUM8	Write 0 to trigger action
	Alarm Output Configuration	2	6	Read/Write	ENUM8	0 – Disabled 1 – Always on 2 – Normally off 3 – Normally on
	Totalizer Rollover	1	5	Read-only	BITARRAY:13	0 – No 1 – Yes
	Totalizer Reset	1	5	Read-only	BITARRAY:1	0 – No 1 – Yes
	Flow Sensor Communications	1	5	Read-only	BITARRAY:2	0 – No 1 – Yes
	High Flow Alarm	1	5	Read-only	BITARRAY:3	0 – No 1 – Yes
	Low Flow Alarm	1	5	Read-only	BITARRAY:5	0 – No 1 – Yes
	Empty Pipe	1	5	Read-only	BITARRAY:7	0 – No 1 – Yes
	Pulse output saturated	1	5	Read-only	BITARRAY:8	0 – No 1 – Yes
	Battery Power Low Warning	1	5	Read-only	BITARRAY:35	0 – No 1 – Yes

Category	Configuration item	Subsystem index	Object index	Access level	Type	Description
Power management settings	System power type	12	7	Read-only	ENUM8	0 – Battery 1 – Mains 2 – Renewable
	Current power source	12	3	Read-only	ENUM8	0 – Internal Backup Battery 1 – Battery Cell 2 – Mains AC Power 3 – External DC Power
	Measurement interval (seconds)	12	1	Read-only	UNSIGNED8	Range: 0~60
	Internal supply voltage (V)	12	4	Read-only	FLOAT	
Simulation modes	Flow rate simulation mode	6	3	Read/Write	ENUM8	0 – Off 1 – Velocity (mm/s) 2 – Flow (system units)
	Flow rate simulation value	6	4	Read/Write	FLOAT	
	Pulse output simulation configuration	2	7	Read/Write	ENUM8	0 – Off 1 – Forward (DO1) 2 – Reverse (DO2)
	Pulse output simulation frequency (Hz)	2	8	Read/Write	FLOAT	
	Pressure simulation mode	8	3	Read/Write	BOOL	0 – Off 1 – On
	Pressure simulation value	8	4	Read/Write	FLOAT	Range: 100.0~30000.0
User access rights settings	Current Access Level	14	8	Read-only	UNSIGNED8	
	Transmitter Unique ID	14	5	Read-only	UNSIGNED32	
	Elevated Access PIN	14	6	Read-only	UNSIGNED32	
	Change User Access Password	14	1	Read/Write	STRING	String length: up to 49 bytes
	Confirm User Access Password Change	14	2	Read/Write	STRING	String length: up to 49 bytes
	Elevated Access Request	14	3	Read/Write	STRING	String length: 19 bytes
	Lock Switch Function	14	10	Read-only	ENUM8	0 – Off 1 – All Settings Read-Only 2 – MID Settings Read-Only
	Advanced Access Level Enable	14	11	Read/Write	BOOL	0 – Off 1 – On
	User Password Reset PIN	14	12	Read-only	UNSIGNED32	
User Password Reset Request	14	4	Read/Write	BYTEARRAY	Length: 66 bytes	
Modbus settings	Modbus Slave Address	20	1	Read-only	UNSIGNED8	Range: 1~247
	Modbus Port Settings	20	2	Read-only	ENUM8	18 – 9600Bd 7-bit no parity 19 – 9600Bd 7-bit odd parity 20 – 9600Bd 7-bit even parity 21 – 9600Bd 8-bit no parity 22 – 9600Bd 8-bit odd parity 23 – 9600Bd 8-bit even parity 24 – 19200Bd 7-bit no parity 25 – 19200Bd 7-bit odd parity 26 – 19200Bd 7-bit even parity 27 – 19200Bd 8-bit no parity 28 – 19200Bd 8-bit odd parity 29 – 19200Bd 8-bit even parity
	Modbus Big-endian Mode	20	3	Read-only	BOOL	0 – Off 1 – On

...9 Object list

...Configuration lookup table

Category	Configuration item	Subsystem index	Object index	Access level	Type	Description
Cellular 4G settings	Network operator	22	6	Read-only	STRING	String length: up to 80 bytes
	Signal quality	22	1	Read-only	UNSIGNED8	Range: 0~100
	Local battery voltage	22	48	Read-only	FLOAT	
	Access technology	22	34	Read-only	ENUM8	0 – Auto 2 – UTRAN 4 – UTRAN w/ HSDPA 5 – UTRAN w/ HSUPA 6 – UTRAN w/ HSDPA n HSUPA 7 – E-UTRAN 100 CDMA
	Roaming indicator	22	33	Read-only	BOOL	0 – Off 1 – On
	Data report timebase	22	9	Read-only	UNSIGNED32	
	Data report interval	22	10	Read-only	ENUM8	0 – 1 hour 1 – 6 hours 2 – 12 hours 3 – 24 hours
	Data report mode	22	8	Read-only	ENUM8	0 – Summary report 1 – Detail report
	File format	22	19	Read-only	ENUM8	0 – JSON 1 – CSV
	FTPS/FTP server host name	22	14	Read-only	STRING	String length: up to 100 bytes
	FTPS/FTP server port	22	15	Read-only	UNSIGNED16	
	FTPS/FTP user name	22	16	Read-only	STRING	String length: up to 48 bytes
	FTPS/FTP working directory	22	18	Read-only	STRING	String length: up to 255 bytes
	TLS on off	22	20	Read-only	BOOL	0 – Off 1 – On
	TLS auth mode	22	27	Read-only	ENUM8	0 – None 1 – Verify server cert only 2 – Mutual authentication
	DNS primary server address	22	12	Read-only	BYTEARRAY	Length: 4 bytes
	DNS secondary server address	22	13	Read-only	BYTEARRAY	Length: 4 bytes
	NTP server host name	22	39	Read-only	STRING	String length: up to 100 bytes
	NTP server port	22	40	Read-only	UNSIGNED16	
	Trigger data report	22	11	Write-only	ENUM8	Write 0 to trigger action
Sync network time	22	7	Write-only	ENUM8	Write 0 to trigger action	
Last sent report time	22	32	Read-only	DATETIME		
Firmware information	MCU0 Application Version	0	70	Read-only	STRING	String length: 9 bytes
	MCU0 Boot0 Version	0	76	Read-only	STRING	String length: 9 bytes
	MCU0 Boot1 Version	0	80	Read-only	STRING	String length: 9 bytes
	MCU1 Application Version	0	1	Read-only	STRING	String length: 9 bytes
	MCU1 Boot0 Version	0	18	Read-only	STRING	String length: 9 bytes
	MCU1 Boot1 Version	0	22	Read-only	STRING	String length: 9 bytes
	Err3 Range Error List	0	54	Read-only	STRING	String length: 255 bytes
	System Diagnostic Message	1	6	Read-only	STRING	String length: 128 bytes
	Reboot System	0	38	Read/Write	ENUM8	Write 0 to trigger action

Category	Configuration item	Subsystem index	Object index	Access level	Type	Description
Advanced settings - Audit Logger	(23:7) Regular records time range	23	7	Read-only	DATETIMERANGE	
	(23:8) Critical records time range	23	8	Read-only	DATETIMERANGE	
	(23:16) First power-on time	23	16	Read-only	DATETIME	
	(23:9) Clear records	23	9	Write-only	ENUM8	0 – All 1 – Regular 2 – Critical
Advanced settings - Cellular 4G	(22:31) Operation mode	22	31	Read/Write	ENUM8	0 – Enabled 1 – Disabled 3 – Battery retain
	(22:9) Data report timebase	22	9	Read/Write	UNSIGNED32	
	(22:10) Data report interval	22	10	Read/Write	ENUM8	0 – 1 hour 1 – 6 hours 2 – 12 hours 3 – 24 hours
	(22:8) Data report mode	22	8	Read/Write	ENUM8	0 – Summary report 1 – Detail report
	(22:19) File format	22	19	Read/Write	ENUM8	0 – JSON 1 – CSV
	(22:14) FTPS/FTP server host name	22	14	Read/Write	STRING	String length: up to 100 bytes
	(22:15) FTPS/FTP server port	22	15	Read/Write	UNSIGNED16	
	(22:16) FTPS/FTP user name	22	16	Read/Write	STRING	String length: up to 48 bytes
	(22:17) FTPS/FTP user password	22	17	Write-only	STRING	String length up to 48 bytes
	(22:18) FTPS/FTP working directory	22	18	Read/Write	STRING	String length up to 255 bytes
	(22:20) TLS on off	22	20	Read/Write	BOOL	0 – Off 1 – On
	(22:27) TLS auth mode	22	27	Read/Write	ENUM8	0 – None 1 – Verify server cert only 2 – Mutual authentication
	(22:12) DNS primary server address	22	12	Read/Write	BYTEARRAY	Length: 4 bytes
	(22:13) DNS secondary server address	22	13	Read/Write	BYTEARRAY	Length: 4 bytes
	(22:39) NTP server host name	22	39	Read/Write	STRING	String length: up to 100 bytes
	(22:40) NTP server port	22	40	Read/Write	UNSIGNED16	
	(22:50) Device folder name style	22	50	Read/Write	ENUM8	0 – Meter tag 1 – Transmitter id 2 – Sensor id
	(22:2) SIM card pin	22	2	Write-only	STRING	String length: 5 bytes
	(22:3) Lock SIM card	22	3	Write-only	ENUM8	Write 0 to trigger action
	(22:4) Unlock SIM Card	22	4	Write-only	ENUM8	Write 0 to trigger action
	(22:5) SIM card puk	22	5	Write-only	STRING	String length: 13 bytes
	(22:7) Sync network time	22	7	Read/Write	ENUM8	Write 0 to trigger action
	(22:43) Access point name	22	43	Read/Write	STRING	String length: up to 60 bytes
	(22:44) Access point user name	22	44	Read/Write	STRING	String length: up to 60 bytes
	(22:45) Access point user password	22	45	Read/Write	STRING	String length: up to 60 bytes
	(22:46) Access point mode	22	46	Read/Write	ENUM8	0 – Auto 1 – APN only 2 – APN with username 3 – APN with username and password
	(22:47) Access point auth method	22	47	Read/Write	ENUM8	0 – None 1 – PAP 2 – CHAP 3 – PAP or CHAP
	(22:51) Clear communication logger	22	51	Write-only	ENUM8	Write 0 to trigger action
	(22:60) Alarm report on raise condition	22	60	Read/Write	ENUM8	0 – Off 1 – On
	(22:61) Alarm report on clear condition	22	61	Read/Write	ENUM8	0 – Off 1 – On

...9 Object list

...Configuration lookup table

Category	Configuration item	Subsystem index	Object index	Access level	Type	Description
Advanced settings - Device	(0:73) MCU0 application part code	0	73	Read/Write	STRING	String length: up to 33 bytes
	(0:4) MCU1 application part code	0	4	Read-only	STRING	String length: up to 33 bytes
	(0:9) Device type ID	0	9	Read-only	UNSIGNED16	
	(0:74) MCU0 start-up count	0	74	Read-only	UNSIGNED32	
	(0:10) MCU1 start-up count	0	10	Read-only	UNSIGNED32	
	(0:26) Transmitter type	0	26	Read-only	STRING	String length: up to 33 bytes
	(0:27) Manufacturer	0	27	Read-only	STRING	String length: up to 33 bytes
	(0:28) Address line 1	0	28	Read-only	STRING	String length: up to 33 bytes
	(0:29) Address line 2	0	29	Read-only	STRING	String length: up to 33 bytes
	(0:30) Address line 3	0	30	Read-only	STRING	String length: up to 33 bytes
	(0:31) Address line 4	0	31	Read-only	STRING	String length: up to 33 bytes
	(0:33) Transmitter location	0	33	Read/Write	STRING	String length: up to 33 bytes
	(0:34) Transmitter user calibration date	0	34	Read/Write	DATETIME	
	(0:37) Sensor user calibration date	0	37	Read/Write	DATETIME	
	(0:39) Sensor firmware version	0	39	Read-only	UNSIGNED32	
	(0:40) Sensor hardware version	0	40	Read-only	UNSIGNED32	
	(0:41) Sensor type number	0	41	Read-only	UNSIGNED16	
	(0:42) Transmitter hardware version	0	42	Read-only	UNSIGNED16	
	(0:84) MCU0 watchdog reset count	0	84	Read-only	UNSIGNED16	
	(0:86) MCU0 watchdog last reset task	0	86	Read-only	STRING	String length: up to 33 bytes
	(0:87) MCU0 watchdog clear reset log	0	87	Read-only	ENUM8	Write 0 to trigger action
	(0:43) MCU1 watchdog reset count	0	43	Read-only	UNSIGNED16	
	(0:45) MCU1 watchdog last reset task	0	45	Read-only	STRING	String length: up to 33 bytes
	(0:46) MCU1 watchdog Clear Reset Log	0	46	Read/Write	ENUM8	Write 0 to trigger action
	(0:56) MID approved transmitter	0	56	Read-only	ENUM8	0 – No 1 – Yes
	(0:60) MID totalizer decimals mains	0	60	Read-only	UNSIGNED8	Range: 0~4
	(0:61) MID totalizer decimals battery	0	61	Read-only	UNSIGNED8	Range: 0~4
	(0:98) Enable fault recovery	0	98	Read/Write	BOOL	0 – Off 1 – On
	(0:100) Service interval	0	100	Read/Write	UNSIGNED16	Range: 0~9999
	(0:101) Remaining service interval	0	101	Read-only	UNSIGNED16	Range: 0~9999
	(0:102) Reset service interval	0	102	Write-only	ENUM8	Write 0 to trigger action
	(0:94) Erase private data	0	94	Read/Write	ENUM8	0 – Off 1 – On
	(0:95) Erase private data confirmation	0	95	Read/Write	ENUM8	0 – Off 1 – On

Category	Configuration item	Subsystem index	Object index	Access level	Type	Description
Advanced settings - Flow	(5:4) Coil drive mode internal	5	4	Read-only	UNSIGNED8	
	(5:5) Empty pipe trip (kOhms)	5	5	Read/Write	UNSIGNED16	Range: 0~1000
	(5:10) Coil current (mA)	5	10	Read-only	FLOAT	
	(5:13) Sensor coil inductance (mH)	5	13	Read-only	FLOAT	
	(5:15) Sensor inductance shift (%)	5	15	Read-only	FLOAT	
	(5:19) Electrode A resistance (Ohms)	5	19	Read-only	FLOAT	
	(5:20) Electrode B resistance (Ohms)	5	20	Read-only	FLOAT	
	(5:21) Sensor coil + cable R (Ohms)	5	21	Read-only	FLOAT	
	(5:23) Self validation period (s)	5	23	Read-only	UNSIGNED16	Range: 5~65535
	(5:24) Sensor coil isolation R (Ohms)	5	24	Read-only	FLOAT	
	(5:25) Electrode A voltage (V)	5	25	Read-only	FLOAT	
	(5:26) Electrode B voltage (V)	5	26	Read-only	FLOAT	
	(5:29) Diff. electrode V (V)	5	29	Read-only	FLOAT	
	(5:31) Coil drive mode	5	31	Read-only	UNSIGNED8	Range: 1~8
	(5:40) Tx span check vel. (m/s)	5	40	Read-only	FLOAT	
(5:43) Debug output mode	5	43	Read/Write	UNSIGNED8	0 – Disabled 1 – RS232 2 – RS485	
(5:51) Tx span shift (%)	5	51	Read-only	FLOAT		
(5:52) Sensor isolation trip (Ohms)	5	52	Read-only	FLOAT	Range: 0.0~10E+6	
Advanced settings - Flow Calculations	(6:13) Sensor span trim 30mA	6	13	Read-only	FLOAT	
	(6:14) Sensor span 50mA	6	14	Read-only	FLOAT	
	(6:15) Sensor zero 50mA	6	15	Read-only	FLOAT	
	(6:16) Sensor zero 30mA	6	16	Read-only	FLOAT	
	(6:17) Sensor reverse wired	6	17	Read-only	ENUM8	0 – No 1 – Yes
	(6:18) Fact. flow sensor span (VKG)	6	18	Read-only	FLOAT	
	(6:19) Fact. flow sensor trim (VKG)	6	19	Read-only	FLOAT	
	(6:20) Sensor zero low I (VKG)	6	20	Read-only	SIGNED16	
	(6:21) Flow sensor B-H coef A (VKG)	6	21	Read-only	FLOAT	
	(6:22) Flow sensor B-H coef B (VKG)	6	22	Read-only	FLOAT	
	(6:23) Reynolds Sc	6	23	Read-only	SIGNED8	
	(6:24) Reynolds Sv	6	24	Read-only	SIGNED8	
	(6:25) User span	6	25	Read/Write	FLOAT	
	(6:26) User zero VKG	6	26	Read/Write	SIGNED16	
	(6:27) User zero VKL	6	27	Read/Write	FLOAT	
	(6:35) Nominal transmitter velocity	6	35	Read-only	FLOAT	
	(6:36) Nominal user sensor velocity	6	36	Read-only	FLOAT	
(6:45) Sensor span Trim 60Hz (%)	6	45	Read-only	FLOAT		
(6:46) Sensor zero Trim 60Hz (mm/s)	6	46	Read-only	FLOAT		
Advanced settings - Pressure	(8:7) Pres. transducer output (mV/V)	8	7	Read/Write	FLOAT	Range: 0.0~1000.0
	(8:8) Pres. transducer zero offset (mV/V)	8	8	Read/Write	FLOAT	
	(8:25) Transducer linearity correction (%)	8	25	Read/Write	FLOAT	Range: -100.0~100.0
	(8:9) Transducer fullscale pressure (Bar)	8	9	Read/Write	FLOAT	Range: 0.0~3.39E+38
	(8:10) Pressure transducer type	8	10	Read/Write	ENUM8	0 – Absolute 1 – Gauge
	(8:16) Pres. bridge supply voltage (V)	8	16	Read-only	FLOAT	
	(8:17) Pres. reading (mV)	8	17	Read-only	FLOAT	
(8:22) Pres. bridge resistance (Ohms)	8	22	Read-only	FLOAT		
Advanced settings - Process Logger	(10:5) Available records time range	10	5	Read/Write	DATETIMERANGE	
	(10:11) Clear process logger records	10	11	Read/Write	ENUM8	Write 0 to trigger action

...9 Object list

...Configuration lookup table

Category	Configuration item	Subsystem index	Object index	Access level	Type	Description
Advanced settings - Alarm Output	(1:4) General persistence time (secs)	1	4	Read/Write	UNSIGNED8	Range: 0~180
	Totalizer Rollover	1	5	Read/Write	BITARRAY:13	0 – Off 1 – On
	Totalizer Reset	1	5	Read/Write	BITARRAY:1	0 – Off 1 – On
	Flow Sensor Communications	1	5	Read/Write	BITARRAY:2	0 – Off 1 – On
	High Flow Alarm	1	5	Read/Write	BITARRAY:3	0 – Off 1 – On
	Low Flow Alarm	1	5	Read/Write	BITARRAY:5	0 – Off 1 – On
	Empty Pipe	1	5	Read/Write	BITARRAY:7	0 – Off 1 – On
	Pulse output saturated	1	5	Read/Write	BITARRAY:8	0 – Off 1 – On
	Battery Power Low Warning	1	5	Read/Write	BITARRAY:35	0 – Off 1 – On
Advanced settings - Power Management	(12:1) Measurement interval (seconds)	12	1	Read/Write	UNSIGNED8	Range: 0~60
	(12:10) High Coil Current Override	12	10	Read-only	BOOL	0 – Off 1 – On
Advanced settings - Modbus	(20:1) Modbus Slave Address	20	1	Read/Write	UNSIGNED8	Range: 1~247
	(20:2) Modbus Port Settings	20	2	Read/Write	ENUM8	18 – 9600Bd 7-bit no parity 19 – 9600Bd 7-bit odd parity 20 – 9600Bd 7-bit even parity 21 – 9600Bd 8-bit no parity 22 – 9600Bd 8-bit odd parity 23 – 9600Bd 8-bit even parity 24 – 19200Bd 7-bit no parity 25 – 19200Bd 7-bit odd parity 26 – 19200Bd 7-bit even parity 27 – 19200Bd 8-bit no parity 28 – 19200Bd 8-bit odd parity 29 – 19200Bd 8-bit even parity
	(20:3) Modbus Big-endian Mode	20	3	Read/Write	BOOL	0 – Off 1 – On

10 Diagnostics description

Diagnostics lookup table

Alarm byte	Alarm bit	Alarm description
Byte 0	Bit0	Flowmeter OK
	Bit1	OUT OF SPEC - Totalizer Reset
	Bit2	FAILURE - Flow Sensor Communications
	Bit3	OUT OF SPEC - High Flow Alarm
	Bit4	<Not Used>
	Bit5	OUT OF SPEC - Low Flow Alarm
	Bit6	<Not Used>
	Bit7	OUT OF SPEC - Empty Pipe
Byte 1	Bit0	MAINTENANCE - Pulse Output Saturated
	Bit1	CHECK - Simulation Mode Active
	Bit2	CHECK - Calibration Mode Active
	Bit3	CHECK - Pulse Outputs Simulation Mode Active
	Bit4	CHECK - Flow Measurement Simulation Mode Active
	Bit5	CHECK - Totalizer Rollover
	Bit6	CHECK - Coil Drive Current Calibration
	Bit7	<Not Used>
Byte 2	Bit0	CHECK - MCU1 Data Object(s) Not Initialized
	Bit1	OUT OF SPEC - MID Compliant Behaviour Not Enforced
	Bit2	FAILURE - Coil Open Circuit Fault
	Bit3	FAILURE - Coil Short Circuit Fault
	Bit4	<Not Used>
	Bit5	<Not Used>
	Bit6	<Not Used>
	Bit7	OUT OF SPEC - Electrode Voltage Warning
Byte 3	Bit0	<Not Used>
	Bit1	<Not Used>
	Bit2	<Not Used>
	Bit3	OUT OF SPEC - Excessive Electrode Ramp Warning
	Bit4	FAILURE - ADC Saturation Warning
	Bit5	OUT OF SPEC - Low Coil Current Warning
	Bit6	OUT OF SPEC - Flow Verification Warning
	Bit7	FAILURE - MCU1 NV Memory Write Error
Byte 4	Bit0	FAILURE - MCU1 NV Memory Read Error
	Bit1	<Not Used>
	Bit2	<Not Used>
	Bit3	CHECK - MCU1 Battery Power Low Warning
	Bit4	FAILURE - Battery Power Critical Warning
	Bit5	<Not Used>
	Bit6	FAILURE - Internal Power Critical Warning
	Bit7	FAILURE - Transmitter Not formatted Error
Byte 5	Bit0	FAILURE - Sensor Not Formatted Error
	Bit1	CHECK - Pressure Sensor Disconnected
	Bit2	<Not Used>
	Bit3	OUT OF SPEC - Coil Isolation Resistance Low
	Bit4	CHECK - Reverse Flow Warning
	Bit5	CHECK - Internal Power Warning
	Bit6	OUT OF SPEC - Sensor Inductance Warning
	Bit7	OUT OF SPEC - OIML R49 Alarm
Byte 6	Bit0	FAILURE - MCU1 Firmware CRC Alarm
	Bit1	OUT OF SPEC - Sensor H Fingerprint Warning
	Bit2	OUT OF SPEC - Transmitter Gain Fingerprint Warning
	Bit3	<Not Used>

...10 Object list

...Diagnostics lookup table

Alarm byte	Alarm bit	Alarm description
Byte 8	Bit0	CHECK - MCU0 Data Object(s) Not Initialized
	Bit1	FAILURE - MCU0 NV Memory Write Error
	Bit2	FAILURE - MCU0 NV Memory Read Error
	Bit3	CHECK - Default Password Warning
	Bit4	CHECK - Mains Power Off Warning
	Bit5	CHECK - Renewable Power Low Warning
	Bit6	CHECK - Battery Power Low Warning
	Bit7	CHECK - Real Time Clock Not Set
Byte 9	Bit0	FAILURE - Battery Power Critical Warning
	Bit1	FAILURE - MCU0 Firmware CRC Alarm
	Bit2	FAILURE - MCU1 Start Up Failure
	Bit3	<Not Used>
	Bit4	FAILURE - Sim Card Insert Error
	Bit5	OUT OF SPEC - DB Battery Power Low Warning
	Bit6	FAILURE - Process Logger Flash Operation Failed
	Bit7	FAILURE - Process Logger Flash Corrupted
Byte 10	Bit0	MAINTENANCE - Audit Logger Critical Events Full Warning
	Bit1	OUT OF SPEC - Insecure Protocol Used
	Bit2	CHECK - Cellular Handshake Failed
	Bit3	FAILURE - HSM Handshake Failed
	Bit4	MAINTENANCE - Trust Anchor Expired Warning
	Bit5	MAINTENANCE - Device Cert Expired Warning
	Bit6	<Not Used>
	Bit7	FAILURE - Recover from failure(Start Timestamp, Stop Timestamp)
Byte 11	Bit0	MAINTENANCE - SRV500 Service Required in 30 Days
	Bit1	MAINTENANCE - SRV500 Service Required in 15 Days

Acknowledgements

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Notes

Notes

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