ABB MEASUREMENT & ANALYTICS | OPERATING INSTRUCTION | OI/FET400-EN REV. H

AquaMaster4

Electromagnetic flowmeter transmitter



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

Measurement made easy

Harness the power of electromagnetic flowmeters

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 end-user details for AquaMaster4 integral and remote transmitters.

For more information

Further publications for AquaMaster4 are available for free download from:
https://new.abb.com/products/measurement-products/flow/electromagnetic-flowmeters/water-waste-water/aquamaster-few400-electromagnetic-flowmeter

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1 Health, safety and cybersecurity

Document symbols

Symbols that appear in this document are explained below:

DANGER – SERIOUS DAMAGE TO HEALTH
This symbol in conjunction with the signal word 'DANGER' indicates an imminent electrical hazard. Failure to observe this safety information will result in death or severe injury.

WARNING – BODILY INJURY
This symbol in conjunction with the signal word 'WARNING' indicates a potential electrical hazard. Failure to observe this safety information will result in death or severe injury.

CAUTION – MINOR INJURIES
This symbol in conjunction with the signal word 'CAUTION' indicates a potentially dangerous situation. Failure to observe this safety information may result in minor or moderate injury. The symbol may also be used for property damage warnings.

IMPORTANT (NOTE)
This symbol indicates operator tips, particularly useful information or important information about the product or its further uses. The signal word 'IMPORTANT (NOTE)' does not indicate a dangerous or harmful situation.

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

Cybersecurity

IMPORTANT (NOTE)
This product is designed to be connected to and communicate information and data via a digital communication network interface. It is the user's sole responsibility to provide and continuously ensure a secure connection between the product and the user's network or any other network (as the case may be). Users shall establish and maintain any and all appropriate measures (such as, but not limited to, the installation of firewalls, the application of authentication measures, the encryption of data, the installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized accesses, interference, intrusions, leakages and/or theft of data or information.

Disclaimer

ABB 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. ABB strives to maintain cybersecurity for its products and services. By visiting the web page indicated below, you will find notifications about newly found software vulnerabilities and options to download the latest software. It is recommended that you visit this web page regularly:
www.abb.com/cybersecurity

Defense in depth strategy

ABB follows "Defense in Depth" strategy to achieve layered structures of security. Products are built with security measures that are difficult to breach from unknown sources. ABB adopts "Defense in Depth" throughout product life cycles and required measures are put in place. Below is the multi-layer security model adopted by AquaMaster4 Mobile Comms (FEW450/FET450).

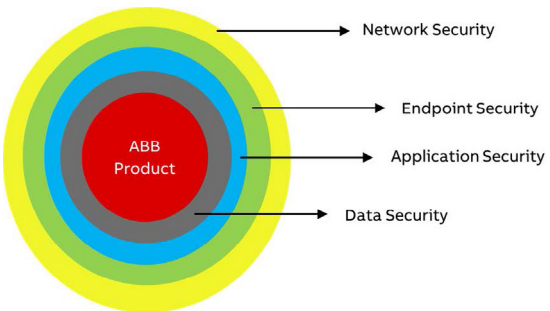


Figure 1 AuaMaster4 multi-layer security model

Data security

Securing data is a key element and AquaMaster4 Mobile Comms (FEW450/FET450) uses encryption mechanisms to secure data. Standard cryptographic mechanisms are being stored and

processed by the product. Authentication and authorization controls are in place to access the data.

Examples:

1 Authentication to access device NV memory.

2 Data Transmission over Cellular network is encrypted to secure data loss.

Application security

It is important to secure applications that are developed for the AquaMaster4 Mobile Comms (FEW450/FET450). ABB follows the Secure Development Life Cycle (SDLC) approach during development. This ensures all security practices are followed during development. The principle of least privilege is incorporated for account management. Our device security and assurance center, make sure that the product is comprehensively tested for vulnerabilities and robustness before releasing the product to the market.

Examples:

1 Input validation mechanisms to prevent unauthorized login.

2 Allow only trusted users to access the devices.

Endpoint security

Securing the product is a crucial step to restrict unauthorized access. AquaMaster4 Mobile Comms (FEW450/FET450) adopts:

- Regular patch management via firmware updates
- User authentication & authorization
- Least functionality philosophy – disable all unnecessary ports and protocols

Network security

Network security involves various measures to protect the confidentiality, integrity and availability of data as it travels across. The AquaMaster4 Mobile Comms (FEW450/FET450) uses standard ABB reference architecture to place the product based on the customer environment. Measures are considered to mitigate the risks associated with accessing various network segments. As per the reference architecture it is recommended to place the product at level 0.

Examples:

1 Allocating static IP address and restricting data traffic to only trusted network

2 Use customer network and disable other network interactions.

System hardening policy

AquaMaster4 Mobile Comms (FEW450/FET450) are secured by hardening accessible entries to the product. This will ensure the product is secured from unauthorized users. Below are the recommendations on system hardening for the product:

Any third-party software used within the AquaMaster4 Mobile Comms (FEW450/FET450) follows regular patch management procedures. By updating third party software, ABB protects the product from a potential vulnerability.

Application layer protocols are required to enable communication and data exchange between soft-ware applications on different network devices. These protocols specify the rules and standards that enable applications to communicate easily across a network. The AquaMaster4 Mobile Comms (FEW450/FET450) use industry standard protocols for processing the data.

ABB recommends certain system hardening steps as part of commissioning and engineering instructions. Commissioning engineers can ensure hardening steps are implemented during the product com-missioning, therefore it is recommended to contact your ABB service organization for all types of com-missioning.

As part of the maintenance activities, ABB service engineers would recommend users on corrections/customization based on the outcome of the periodic checks: please contact your ABB service organization.

ABB is committed to protect the product during the entire life cycle. ABB established vulnerability management process which will ensure all vulnerabilities are tracked and closed on a systematic manner. AquaMaster4 Mobile Comms (FEW450/FET450) webpage consists of the procedural recommendations of a vulnerability management. It is recommended that the customers follow the procedure for reporting all vulnerabilities related to the product.

ABB recommends below best practices which will ensure the product is secure.

Do's:

1 Follow ABB recommended user management tips to protect user accounts

2 Allow system patch recommendations from ABB community

Don'ts:

1 Don't change the default security configurations of a product

2 Don't install untrusted firmware to the product. Always connect with ABB service engineer when in doubt

Software downloads

By visiting the web page indicated below, you will find options to download the latest software. It is recommended that you visit this web page regularly:
AquaMaster4 software downloads

...1 Health, safety and 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 hand shake.

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 is a secure protocol based on TLS1.2 with digital certificate based mutual authentication. AquaMaster4 FEX45X device supports TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 and TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256 cipher suites, which is generally considered insecure as per industry standards.

The FTP protocol runs on 4G variant of the transmitter is a 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.

The MQTTS protocol runs on a 4G variant of the transmitter which is a secure protocol based on TLS 1.2 with digital certificate based mutual authentication. AquaMaster4 FEX45X device supports TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 and TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256 cipher suites, which is generally considered insecure as per industry standards.

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

AquaMaster4 (FE45X) device supports RSA-2048 (factory enabled) and RSA1024 which is a insecure asymmetric algorithm that can be used in FTPS protocol. Users should take appropriate measures to mitigate any associated security vulnerabilities.

Intended use

This flowmeter is intended for the following uses:

- To transmit fluid media with electrical conductivity.
- To measure and compute 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.

AquaMaster4 Mobile Comms (FEW450/FET450) has additionally been designed to securely transmit operational data to authorized back end system via its designated wireless communication interface (e.g. Cellular LTE, NB IoT) as well as short -range wireless communication such as NFC for configuring/operating in connected environments. The device is intended to be installed, operated and maintained by competent personnel ensuring system integrity and compliance with ETSI EN 303 645 and RED 18031-1, the unit shall be installed and operated under secure physical and logical conditions ensuring that only authorized personnel can access the device configuration and communication interfaces, maintaining the product's security & integrity in its operational environment.

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.
- Sharing or publishing credentials.
- Neglecting to apply firmware/software updates.
- Deploying the device in unsecured environments - may compromised the security, integrity and availability of device in connected networks.
- Use without activating and maintaining its required access controls for applications, as this risks non-compliance with EN 18031-1.

Potential safety hazard

AquaMaster4 transmitter – electrical

WARNING – BODILY INJURY
To ensure safe use when operating this equipment, the following points must be observed:

- Up to 240 V AC may be present. Be sure to isolate the supply before removing the terminal cover.
- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.

Safety advice concerning the use of the equipment described in this manual or any relevant Material Safety Data Sheets (where applicable) can be obtained from the Company, together with servicing and spares information.

Safety standards

This product has been designed to satisfy the requirements of IEC61010-1:2010 3rd edition 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use'.

If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

Battery hazard, handling, shipping and recycling/disposal

WARNING – DANGER
AquaMaster4 is available with choice of power options including lithium thionyl chloride battery power. This warning covers the health and safety issues regarding the product with such batteries. The following warnings must be observed:

- Only batteries approved by ABB that comply with the safety requirements of IEC60086-4 (see list under **...5 Installation** on page <?>), or contained in the latest documentation from ABB may be fitted. Fitting of other types is not recommended by ABB.
- Do not use spiral wound lithium thionyl chloride batteries. These pose a very high fire and explosion hazard leading to a high risk for the users. NEVER FIT THIS TYPE.
- Fitting of battery technologies other than lithium thionyl chloride is NOT permitted.
- Some forms of D batteries do not conform the 'D' battery standard and may result in intermittent connection and incorrect product operation.
- Incorrect use or operation of batteries may result in potentially serious hazards to personnel.
- DO NOT expose batteries to fire or temperatures above 85 °C (185 °F) and DO NOT crush or puncture – they may leak, explode or rupture violently.
- DO NOT ship or transport the AquaMaster4 with lithium batteries fitted unless the following instruction is complied with:

Transporting lithium batteries or product containing lithium batteries:

- These are classified in 'category UN3091 – Class 9' of the UN list of hazardous materials. The transport of such battery packs must conform to the prevailing rules that are specific to the means of transport used, both in terms of packing, identification and accompanying documents. The carrier must always be informed of the contents. A warning label 'Hazardous Label for Class 9 – Miscellaneous Hazardous Goods' must be attached to the packing and remain visible on the outside of the package.
- DO NOT dispose of depleted or partially depleted batteries. They MUST be recycled in accordance with local regulations (for example, sent to a specialist recycling centre that handles such batteries). The batteries must be packed, labeled and transported in accordance with the regulations. Ensure the battery cannot be short circuited.
- Recycling in Europe must be in accordance with 91/157/EEC and 93/86/EEC Directives.
- Damaged, leaking or overheated batteries require urgent specialist handling and treatment. Immediately evacuate all personnel from the area and seek professional assistance.

...1 Health, safety and cybersecurity

Waste Electrical and Electronic Equipment (WEEE)

WEEE EU Directive 2012/19/EU covers disposal and recycling of electronic equipment at the end of life for reasons of environmental protection.



For industrial installations, portable equipment is included. This means that when the AquaMaster4 transmitter is used with a remote insertion sensor, it is included in directive's scope and has the WEEE symbol (left) on its data label. Therefore, at the end of life, contact the supplier for specialist waste recycling. It must not be disposed of as municipal waste.

Permanent Industrial installations are not designated within this directive for recycling. At the point of supply the intended use is not always known, so the WEEE symbol is included on all remote forms of the AquaMaster4 transmitter.

Product recycling and disposal (Europe only)



Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August 2005. To conform to European local and national regulations (EU Directive 2012/19/EU), European electrical equipment users can now return old or end-of-life equipment to the manufacturer for disposal at no charge to the user. ABB is committed to ensuring that the risk of any environmental damage or pollution caused by any of its products is minimized as far as possible.

IMPORTANT (NOTE)
For return for recycling, please contact the equipment manufacturer or supplier for instructions on how to return end-of-life equipment for proper disposal.

End-of-life battery disposal

The transmitter contains lithium batteries that must be removed and disposed of responsibly in accordance with local environmental regulations.

Information on ROHS Directive 2011/65/EU and 2015/863

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.

Product symbols

Symbols that may appear on this product are shown below:



Risk of electric shock.



This symbol, when noted on a product, indicates a potential hazard which could cause serious personal injury and/or death. The user should reference this instruction manual for operation and/or safety information.



Protective earth (ground) terminal.



Functional earth (ground) terminal.

Direct current supply only.

Alternating current supply only.

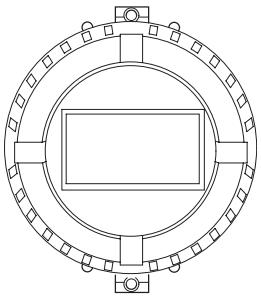


This symbol, when noted on a product enclosure or barrier, indicates that a risk of electrical shock and/or electrocution exists and indicates that only individuals qualified to work with hazardous voltages should open the enclosure or remove the barrier.

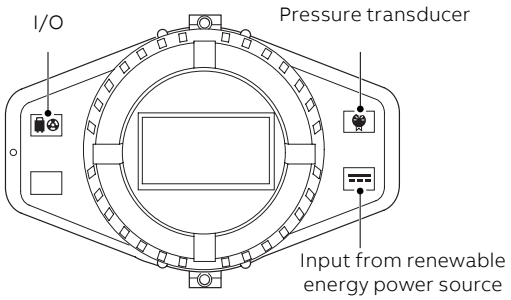


Recycle separately from general waste under the WEEE directive.

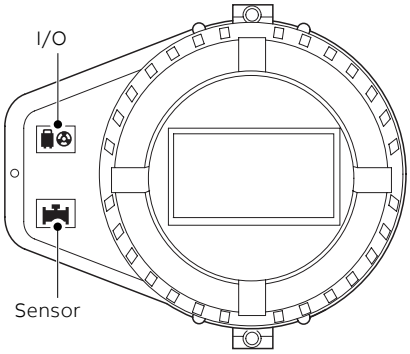
2 Transmitter overview



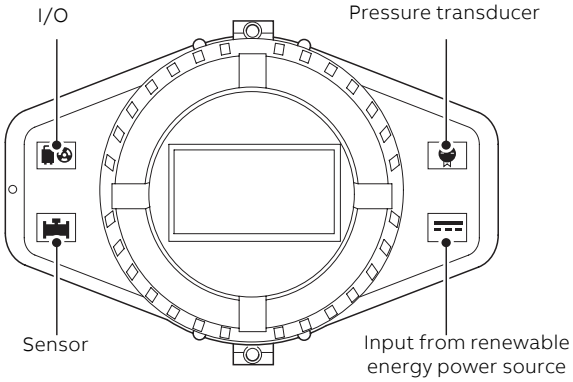
Integral
Internal battery-powered only
No output(s)



Integral
Internal battery/renewable-powered
Pulse/Modbus/Sensus™ output(s) and pressure

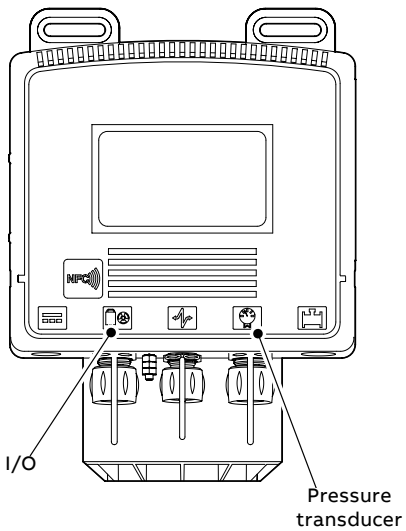


Integral/Remote – Pipe/Wall mount
Internal battery/AC-powered
Pulse/Modbus/Senus output(s)

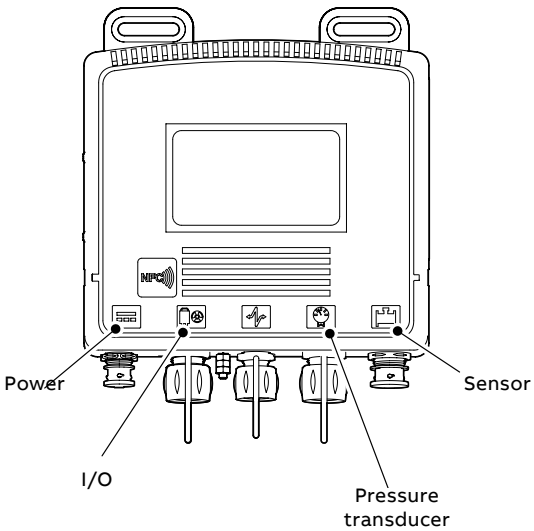


Integral/Remote – Pipe/Wall mount
Internal battery/AC/renewable-powered
Pulse/Modbus/Senus output(s) and pressure

Figure 2 AquaMaster4 (FET41X/43X) configuration options



Integral
Internal battery
4G/nB-IoT/Pulse/Modbus and pressure



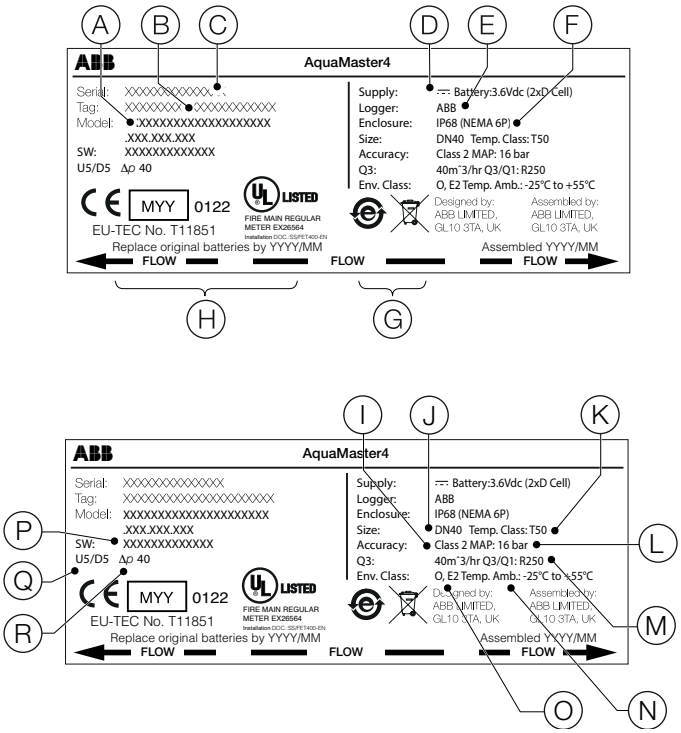
Remote – Wall mount
External battery/AC/renewable-powered
4G/nB-IoT/Pulse/Modbus and pressure

Figure 3 AquaMaster4 (FET45X) configuration options

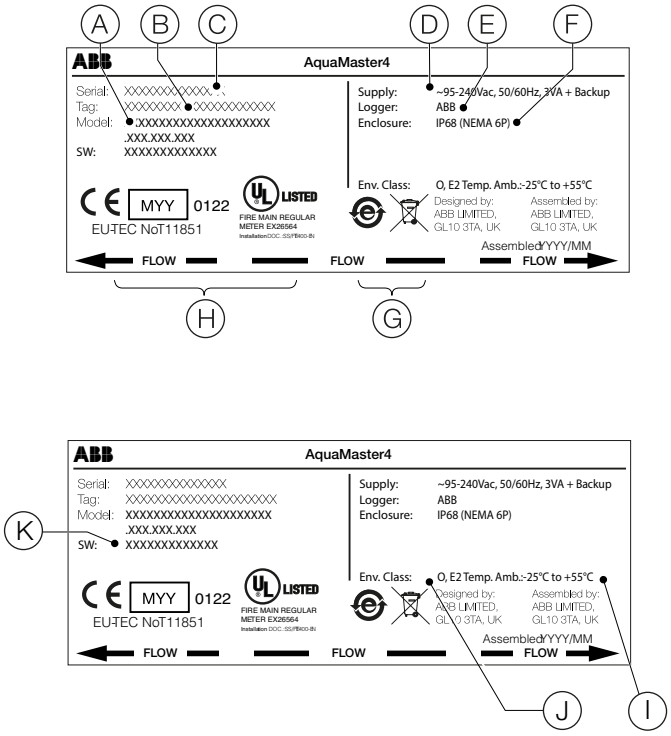
3 Product identification labels

Nameplate – FET41X/43X

Integral transmitter



Remote-mount transmitter



- (A) Model type/number
- (B) Transmitter-specific tag
- (C) ABB-defined product serial number
- (D) Min./Max. voltage rating
- (E) Logger (shown if available)
- (F) Enclosure ingress protection rating
- (G) Transmitter disposal categories
- (H) Applicable certification
- (I) OIML R49 class
- (J) Sensor size
- (K) Temperature class
- (L) Maximum admissable pressure
- (M) Highest flow rate within rated operating conditions
- (N) Ambient temperature
- (O) Environmental and electromagnetic class
- (P) Software number*
- (Q) Installation sensitivity class
- (R) Pressure loss class

Figure 4 Name plate – integral transmitter (example)

- (A) Model type/number
- (B) Transmitter-specific tag
- (C) ABB-defined product serial number
- (D) Min./Max. voltage rating
- (E) Logger (shown if available)
- (F) Enclosure ingress protection rating
- (G) Transmitter disposal categories
- (H) Applicable certification
- (I) Ambient temperature
- (J) Environmental and electromagnetic class
- (K) Software number*

Figure 5 Name plate – remote-mount transmitter (example)

Note: For some configurations of the product, only some of the items listed will be printed on the labels.

*Refer to page 10 "Software versions" and respective part numbers

Software version.

Table 1 shows the various software part codes and corresponding version numbers for FEX43X/FEX41X only.

Table 1 Software part code and version number

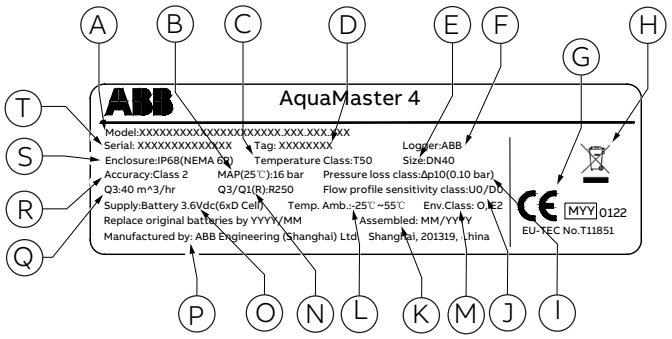
Software Part code	Version number
3KXF208402U0113	03. XX. XX
3KXF208402U0313	02. XX. XX
3KXF208402U0513	02. XX. XX
3KXF004494U0113, 3KXF004476U0113 & 3KXF004410U0113	01. XX. XX

Note: Update of software is possible in the same version and not across version. Example 02.01.00 can be upgraded to 02.02.00 and not 03.02.00.

…3 Product identification labels

Nameplate – FET45X

Integral transmitter

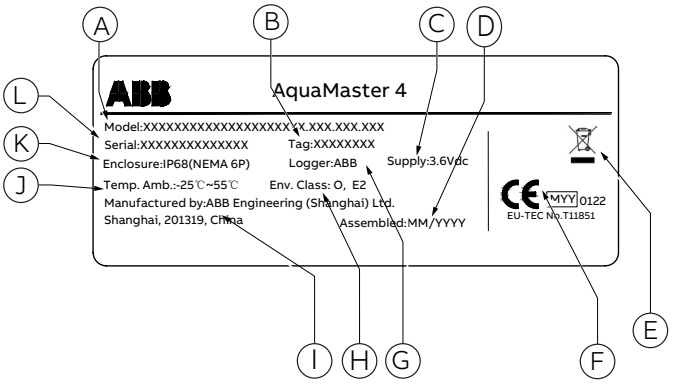


- (A) Model type/number
- (B) Maximum admissable pressure
- (C) Temperature class
- (D) Transmitter-specific tag
- (E) Sensor size
- (F) Logger (shown if available)
- (G) Applicable certification
- (H) Transmitter disposal categories
- (I) Pressure loss class
- (J) Installation sensitivity class
- (K) Date
- (L) Ambient temperature
- (M) Environmental and electromagnetic class
- (N) Q3/Q1 (R)
- (O) Min./Max. voltage rating
- (P) Manufacturer
- (Q) Highest flow rate within rated operating conditions
- (R) OIML R49 class
- (S) Enclosure ingress protection rating
- (T) ABB-defined product serial number

Figure 6 Name plate – integral transmitter (example)

Note: For some product configurations, not all of the items listed will be printed on the labels.

Remote Transmitter



- (A) Model type/number
- (B) Transmitter-specific tag
- (C) Min./Max. voltage rating
- (D) Date
- (E) Disposal categories
- (F) Applicable certification
- (G) Logger (shown if available)
- (H) Environmental and electromagnetic class
- (I) Manufacturer
- (J) Ambient temperature
- (K) Enclosure ingress protection rating
- (L) ABB-defined product serial number

Figure 7 Name plate – remote transmitter (example)

4 Transport and storage

Inspection

Check the transmitter immediately after unpacking for possible damage that may have occurred from improper transport. Details of any damage that has occurred in transit must be recorded on the transport documents. All claims for damages must be submitted to the shipper without delay and before installation.

Transport

WARNING – BODILY INJURY
Life-threatening danger due to suspended loads. In the case of suspended loads, a danger of the load falling exists.

Remaining under suspended loads is prohibited.

WARNING – RISK OF INJURY DUE TO FLOWMETER SLIPPING.
The flowmeter's center of gravity may be higher than the harness suspension points.

- Ensure that the flowmeter does not slip or turn during transport.
- Support the flowmeter laterally during transport.

Storing the flowmeter/transmitter

Bear the following points in mind when storing transmitters:

- Store the transmitter in its original packaging in a dry and dust-free location.
- Observe the permitted ambient conditions for transport and storage.
- Do not store the transmitter in direct sunlight.

Storage temperature
–20 to 60 °C (–4 to 140 °F).

The ambient conditions for the transport and storage of the transmitter correspond to the ambient conditions for operation of the transmitter.

Adhere to the transmitter data sheet (DS/FET400/OIML-EN).

5 Installation

Installation conditions – FET 410/430

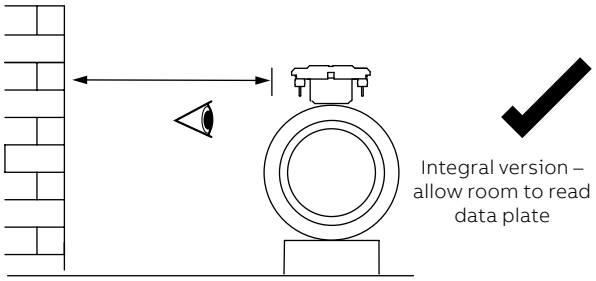


Figure 8 Siting

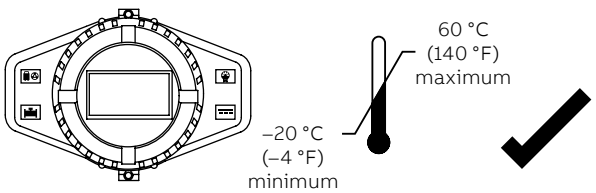


Figure 9 Within temperature limits

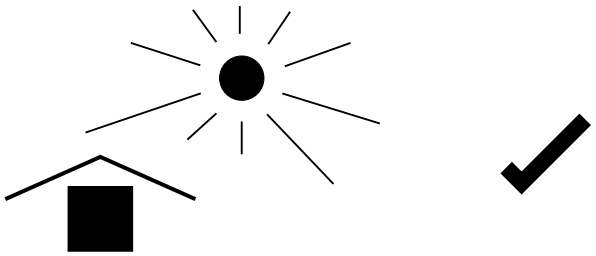


Figure 10 Shade

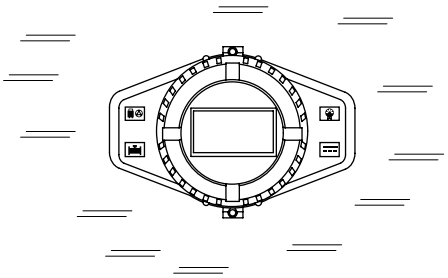


Figure 11 Vibration

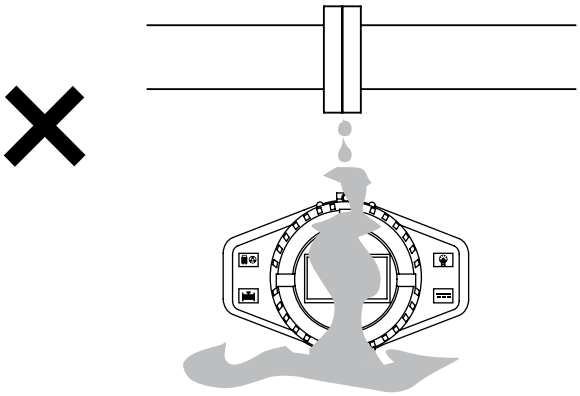
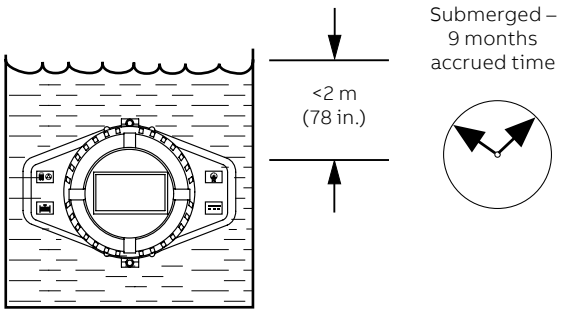


Figure 12 Spillage



IP68 (NEMA 6P)
ENCLOSURE 6P

Figure 13 Within environmental rating

Installation conditions – FET 410/430

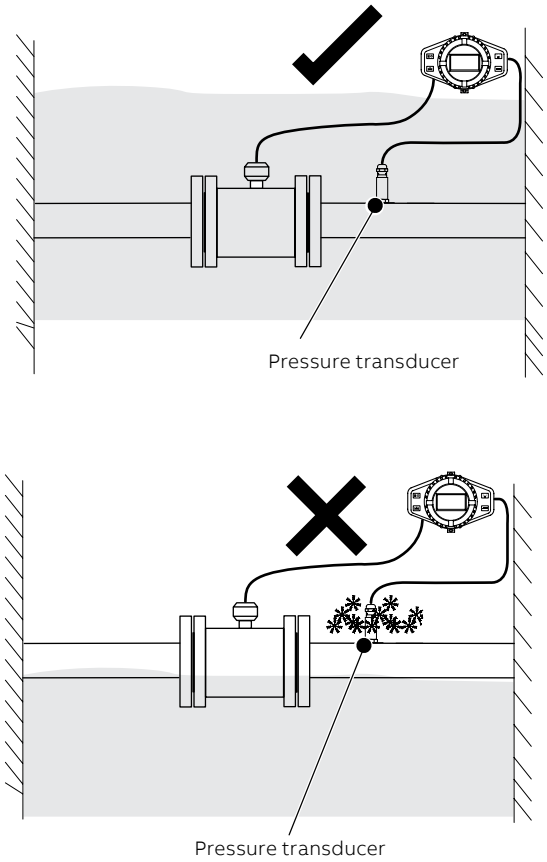


Figure 14 Pressure transducer – protect from frost

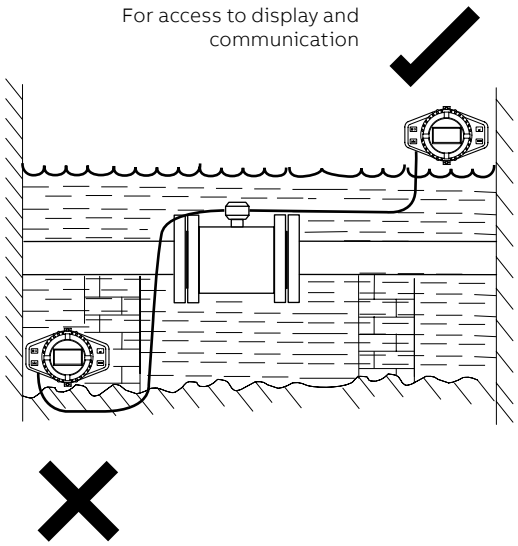


Figure 15 Access to transmitter

…5 Installation

Installation conditions – FET 450

General Requirements:
The following points much be observed during installation.

1 Physical Security

The AquaMaster4 Mobile Comms (FEW450/FET450) and associated com-munication components shall be installed in a secure location such as:
- Locked meter chambers
- Fenced compounds
- Below-ground valve boxes

2 Interface Protection

The NFC interface or the electronic interface must be protected using one or more of the following site access control measures:
- Keyed or coded locks
- Site access logging
- Controlled key management systems
- Tamper-evident seals
- Anti-tamper bolts
- CCTV surveillance

3 Password and Logical Security

- Default passwords must be changed before or during the commis-sioning of the device.
- Strong, unique passwords shall be enforced following industry guidelines.
- Passwords shall never be shared or stored in plain text and should be changed periodically as deemed necessary.

4 Device Isolation

- The AquaMaster4 Mobile Comms (FEW450/FET450) unit shall not be connected to unsecured networks or exposed to public wireless in-terfaces without proper segmentation and firewalling.
- Physical isolation from other non-secure devices is recommended to minimize attack surfaces.

These measures ensure that only authorized personnel can access AquaMaster4 Mobile Comms (FEW450/FET450) configuration and communication interfaces, maintaining the product's security integrity in its operational environment.

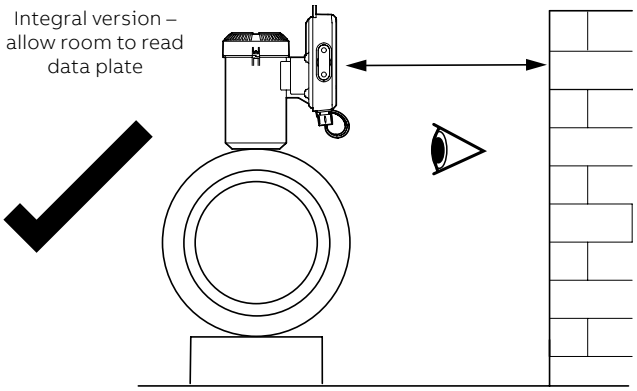


Figure 16 Siting

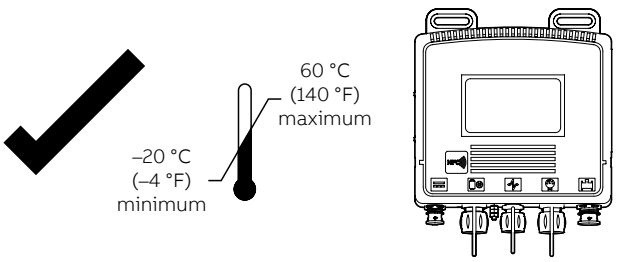


Figure 17 Within temperature limits

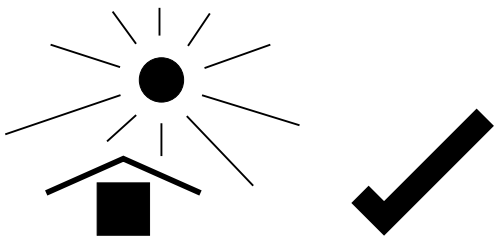


Figure 18 Shade

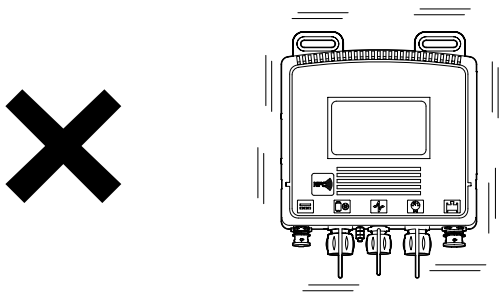


Figure 19 Vibration

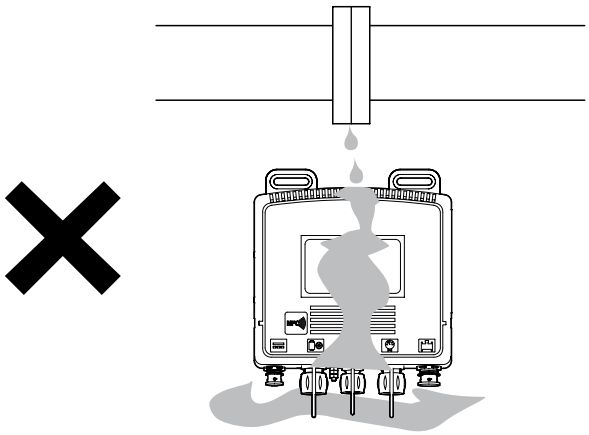


Figure 20 Spillage

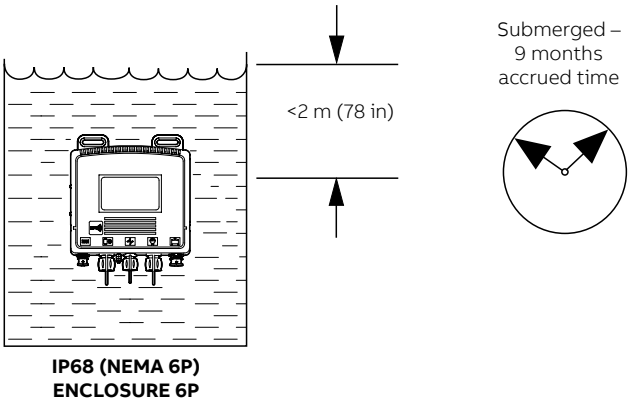
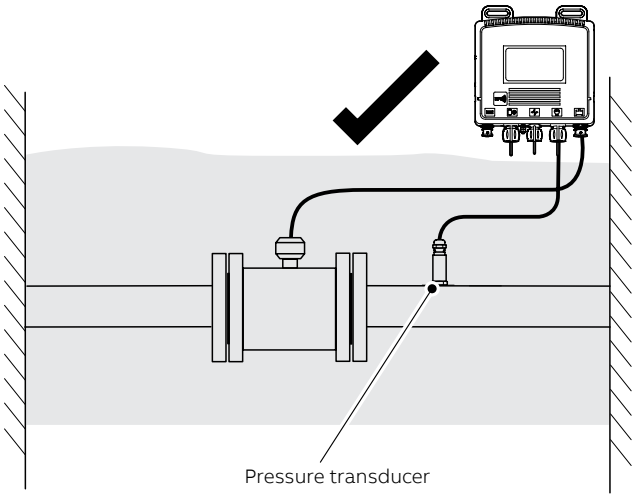


Figure 21 Within environmental rating



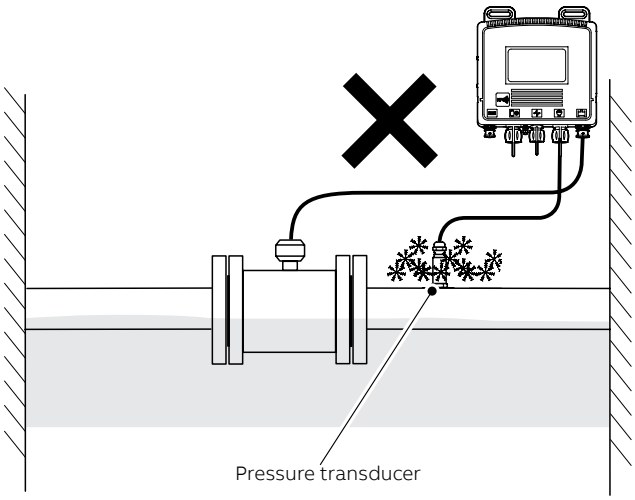


Figure 22 Pressure transducer – protect from frost

...5 Installation

Installation conditions – FET 450

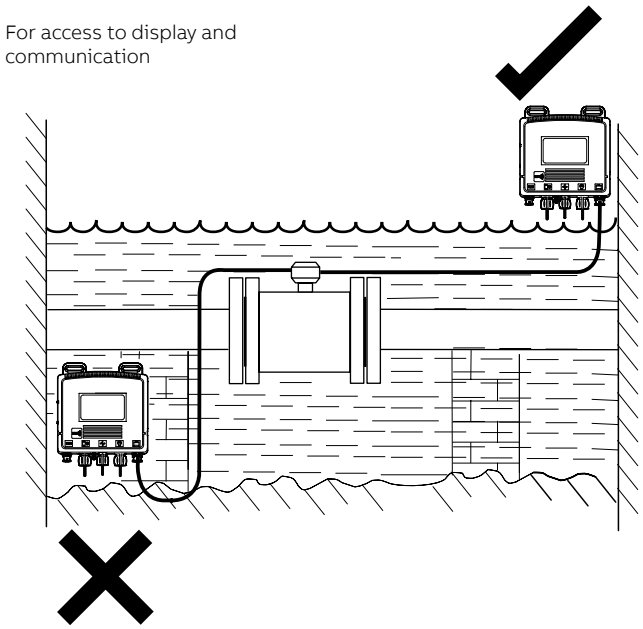


Figure 23 Access to transmitter

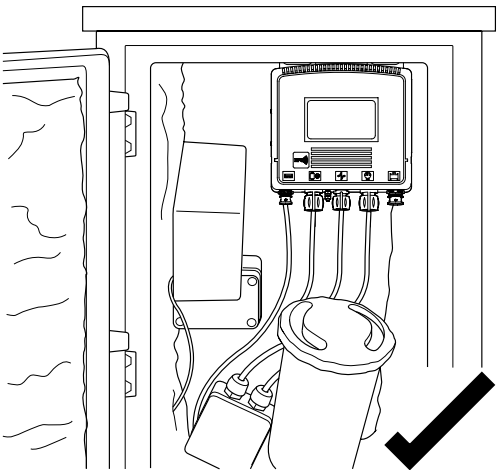


Figure 24 Installed in locked meter chamber

#

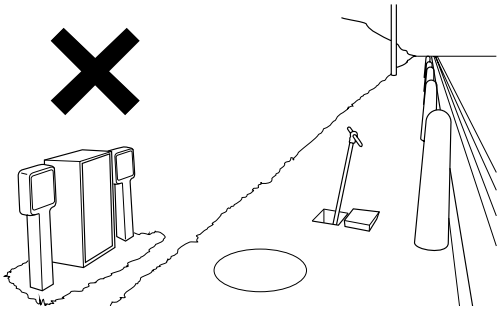
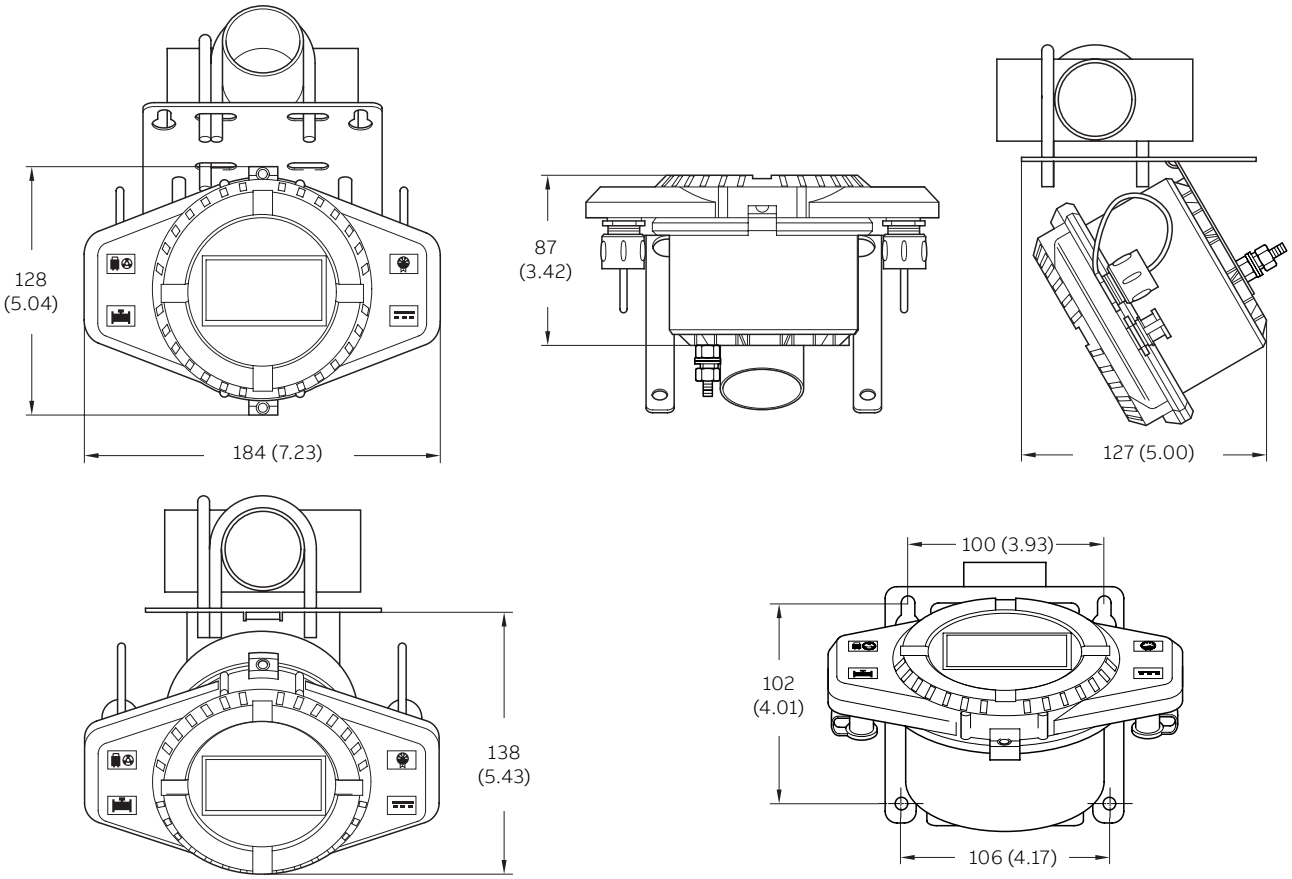


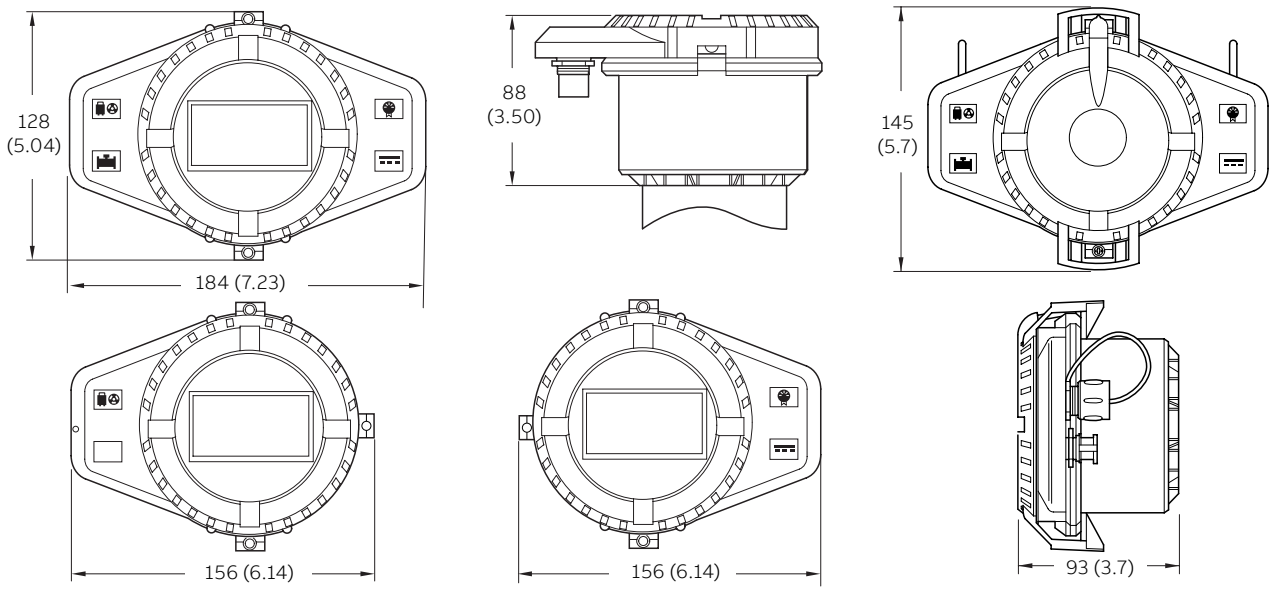
Figure 25 Installed in public street

Dimensions – FET410/430

Dimensions in mm (in.)



Wall-/Pipe-mount remote transmitter



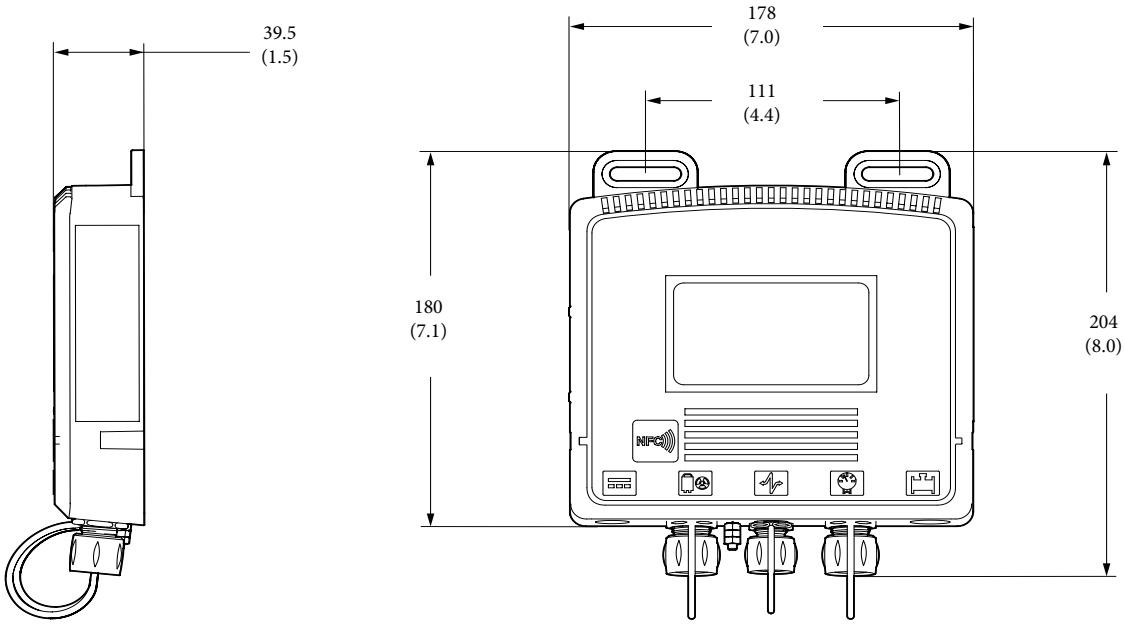
Integral transmitter **Transmitter with NFC aerial cover**

Figure 26 AquaMaster4 transmitter dimensions

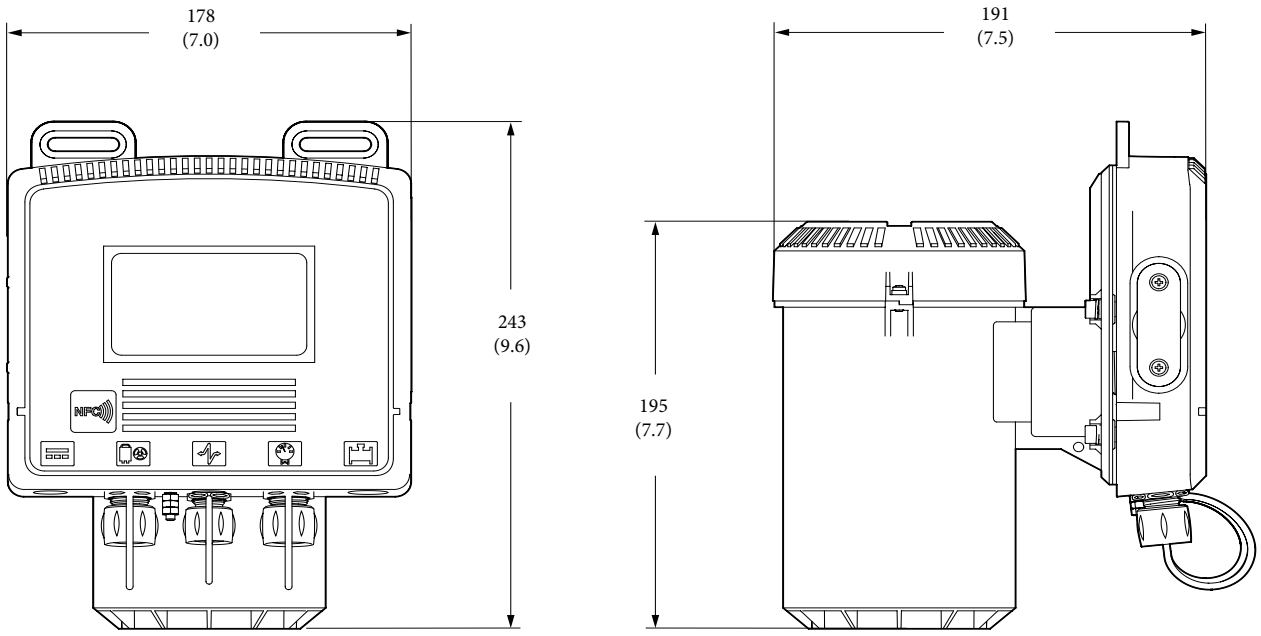
…5 Installation

Dimensions – FET450

Dimensions in mm (in)

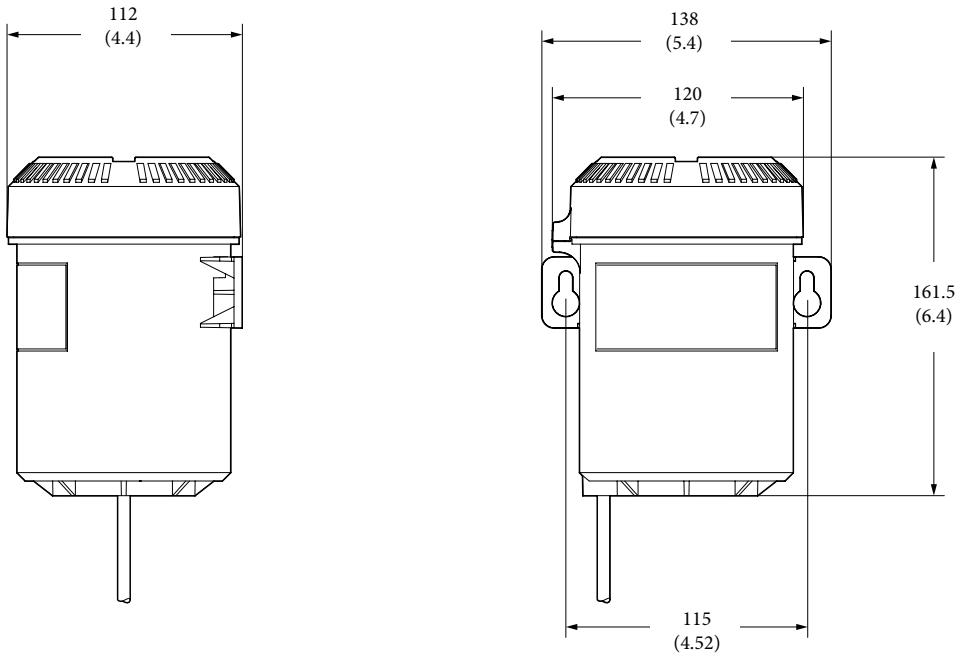


Wall/Pipe mount transmitter

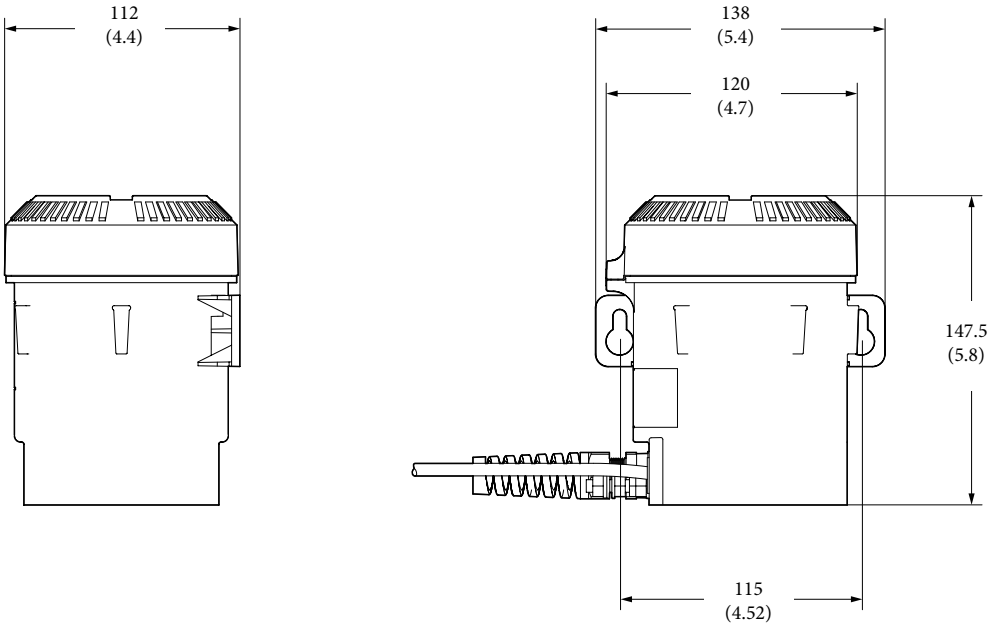


Integral transmitter

Dimensions – Power supply unit for FET452



Battery power supply unit (PSU)



Mains / renewable power supply unit (PSU)

...5 Installation

Antenna installation - FET45X

Before deciding on an antenna mounting location, check that the local signal strength for the chosen mobile phone network is satisfactory. Use the transmitter and Velox app to establish the signal strength (refer to **page 55**).
The minimum signal strength for the remote communication is -37 dB corresponding to 26% as stated above. The recommended signal strength is -73 dB or 52%.

If a transmitter is not available, a standard mobile phone on the same network, positioned as close as possible to the intended location, gives a good indication of local signal strength.

> **IMPORTANT (NOTE)**
> The signal strength mentioned above are applicable for both internal or external antenna of the transmitter.

The following must also be observed when deciding on the antenna mounting location:

- For best results, mount the antenna as high above local ground level as possible.
- If the antenna must be mounted below ground, achieve optimum results by ensuring:
  - there is a strong mobile phone network signal at ground level
  - the antenna, mounted 50 mm (2 in.) below the chamber cover, is plastic
- Ensure the antenna does not become submerged underwater.
- Metallic enclosures seriously degrade the signal. If an enclosure is used it must be non-metallic.
- Do not mount the antenna closer than 50 mm (2 in.) to any solid wall or surface
- Do not mount the antenna beneath a solid surface (for example, metal cover, floor / ceiling).

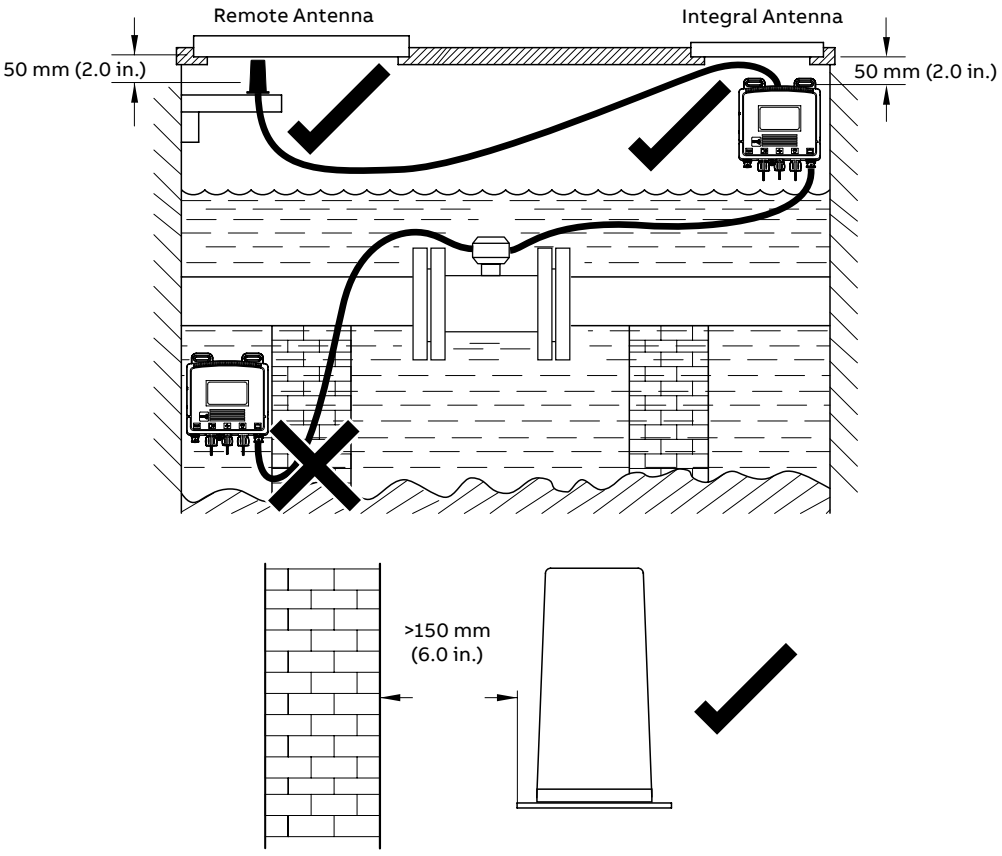


Figure 27 3G/4G or NB-IoT antenna installatio

Connecting a remote antenna

Referring to Figure 25:

5 Remove the cap (1) from the antenna connector.

6 Install the antenna adaptor (2) in the antenna connector.

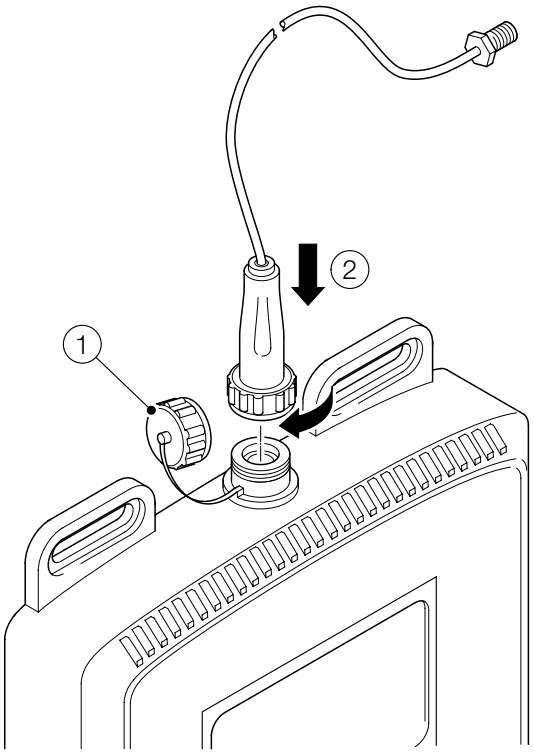


Figure 28 Installing the antenna adaptor

CAUTION – RADIO FREQUENCY (RF) TRANSMITTER EXPOSURE

- It is recommended to maintain a minimum of 20 cm distance between the transmitter and personnel during operation or maintenance while the device is powered on. Radio Frequency exposure can cause harm. Make sure that antenna for FEX45X is not co-located with antenna from other devices or devices that work on radio frequency.

Referring to Figure 26:

7 Install the remote antenna in the mounting hole.

8 Connect the SMA connector to the antenna adaptor (1).

9 Use 3M tape (2) to wrap the connection between the SMA connector and the antenna adaptor.

10 Torque the mounting screw (3) of the antenna to 4.0 Nm (41 kgf.cm).

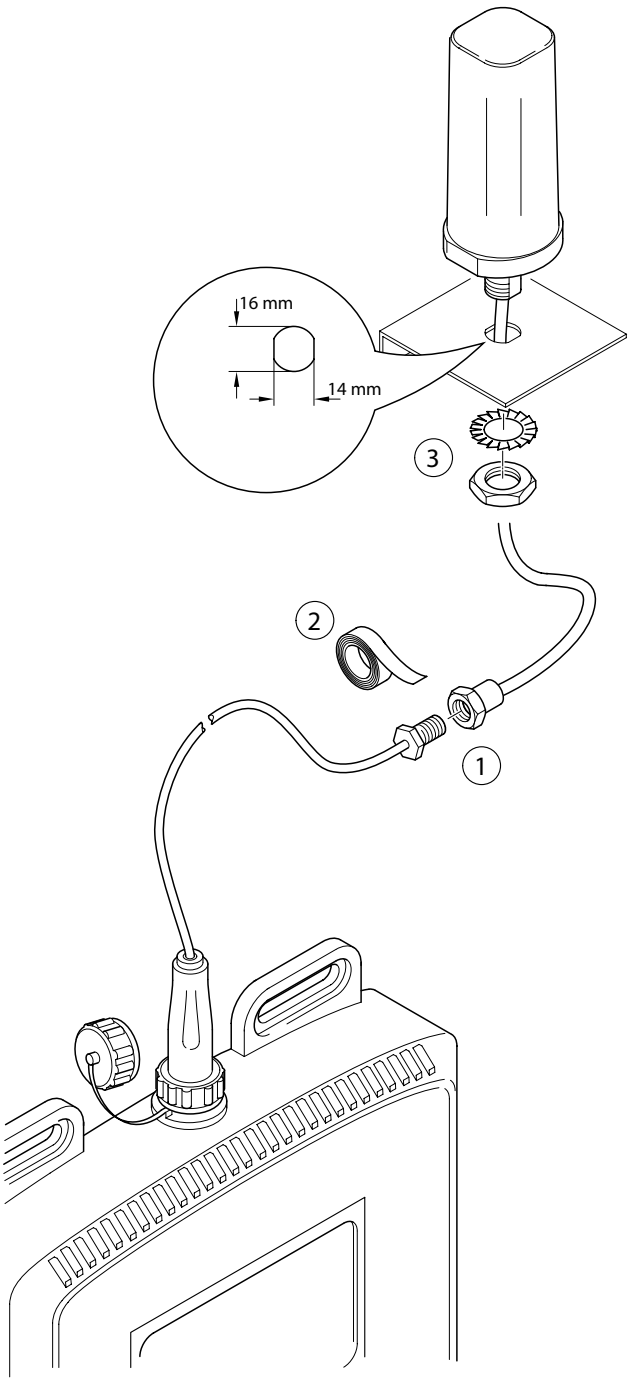


Figure 29 Installing the remote antenna

…5 Installation

Installing the SIM card – FET45X

CAUTION – DAMAGE TO THE TRANSMITTER

- Only use a standard SIM card, with dimensions of 25 mm × 15 mm.
  Do not attempt to use a Micro SIM, Nano SIM or an empty SIM card adaptor. Use of these items will damage the slot.

1. Remove the two fixing screws (A).
2. Remove the SIM cover (B).
3. Insert the SIM card (D) into the slot (C) with the chip facing down.
4. Push the SIM card (D) with your finger until you hear a click.
5. Put the SIM cover (B) in position.
6. Install the fixing screws (A).
7. Torque the fixing screws (A) to 0.25 Nm.

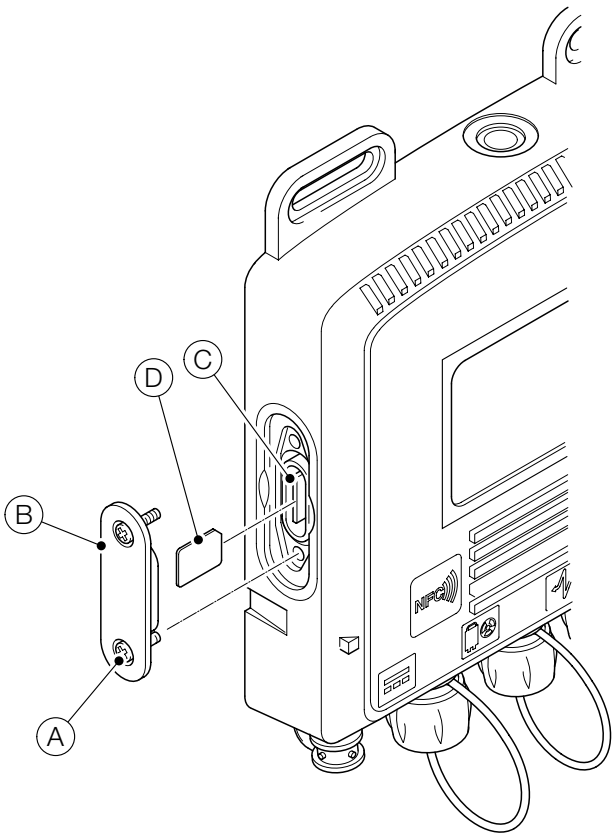


Figure 30 Installing the SIM card

Grounding – FET410/430

IMPORTANT (NOTE)
The grounding arrangements shown in Figure 28 to Figure 30 are applicable to both cathodic and non-cathodic protected installations.

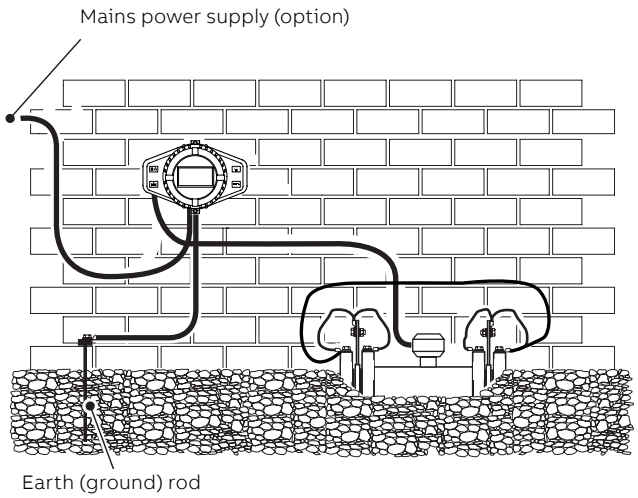


Figure 31 AquaMaster4 transmitter mounted in a chamber – flanged sensor

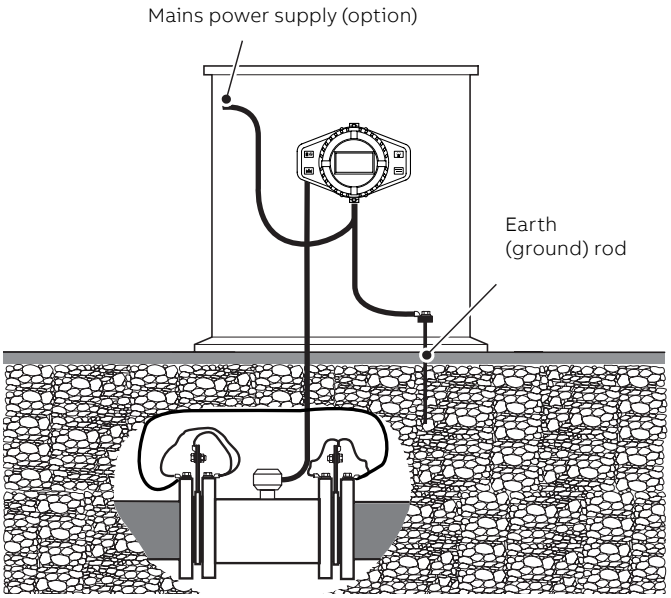


Figure 32 AquaMaster4 transmitter mounted in a cabinet – flanged sensor

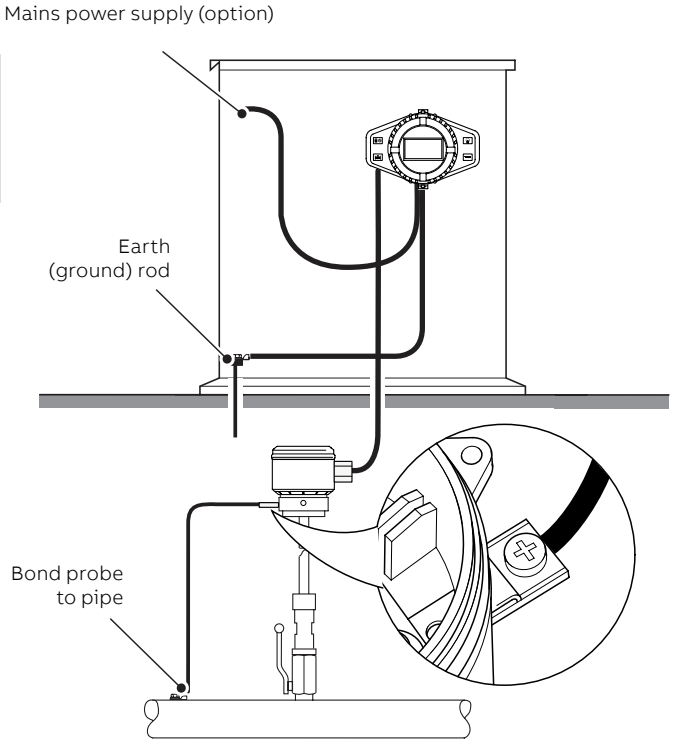


Figure 33 AquaMaster4 transmitter mounted in a cabinet – remote insertion sensor

IMPORTANT (NOTE)
The grounding arrangements shown in Figure 31 are applicable ONLY to:
- cathodic protected installations
- installations where E2 and E3 are different to E1

CAUTION – DAMAGE TO EQUIPMENT
Incorrect installation will result in fault currents flowing through the meter resulting in unstable readings.

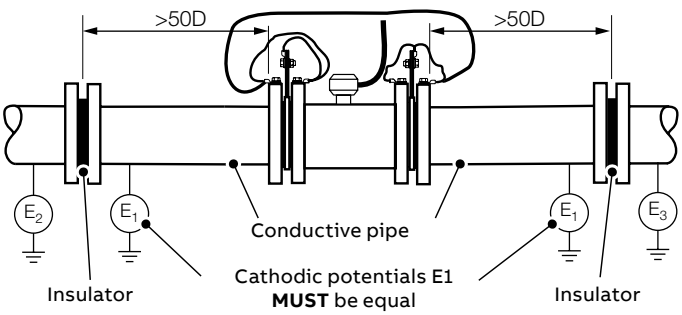


Figure 34 Cathodic protected installations with different cathodic potential generator

…5 Installation

Grounding – FET450

IMPORTANT (NOTE)
The grounding arrangements shown in Figure 32 to Figure 34 are applicable to both cathodic and non-cathodic protected installations.

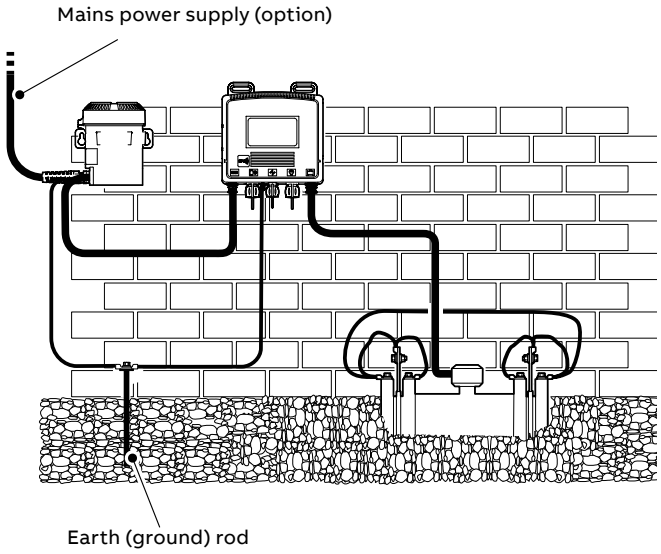


Figure 35 AquaMaster4 transmitter mounted in a chamber – flanged sensor

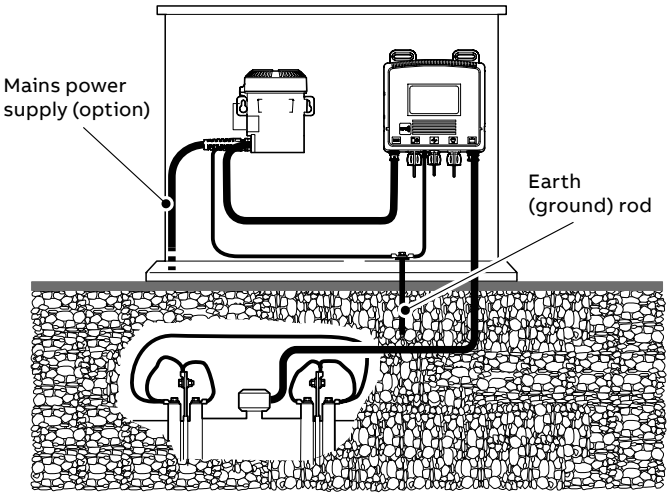


Figure 36 AquaMaster4 transmitter mounted in a cabinet – flanged sensor

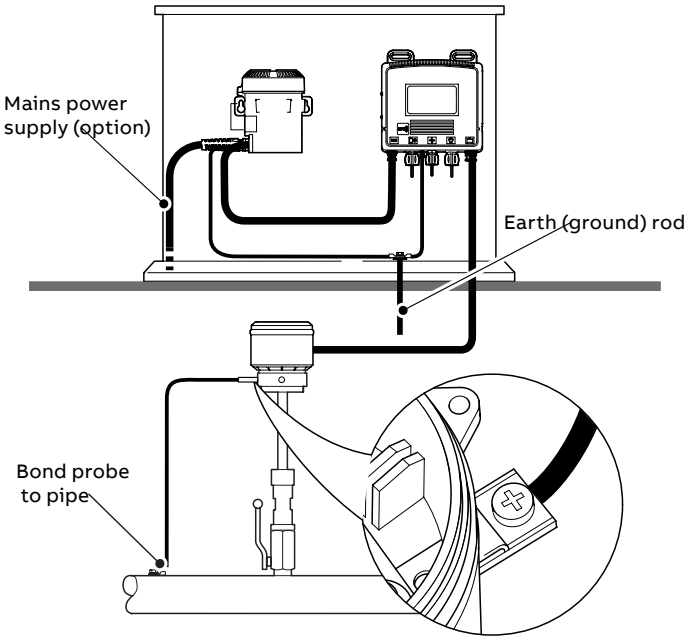


Figure 37 AquaMaster4 transmitter mounted in a cabinet – insertion sensor

IMPORTANT (NOTE)
The grounding arrangements shown in Figure 35 are applicable ONLY to:
- cathodic protected installations
- installations where E2 and E3 are different to E1

CAUTION – DAMAGE TO EQUIPMENT
Incorrect installation will result in fault currents flowing through the meter resulting in unstable readings.

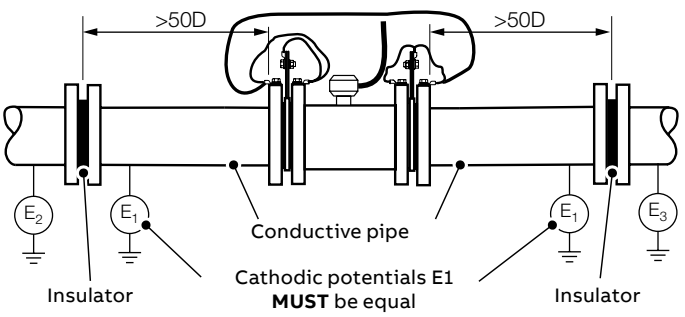


Figure 38 Cathodic protected installations with different cathodic potential generator

Connections

DANGER – SERIOUS DAMAGE TO HEALTH

- The mains/line-powered transmitter option is not fitted with a switch – an isolator such as a switch or circuit breaker conforming to local safety standards must be fitted to the final installation. It must be fitted in close proximity to the transmitter, within easy reach of the operator and marked clearly as the isolator for the transmitter.
- Remove all power from supply, relay, any powered control circuits and high common mode voltages before accessing or making any connections.
- All connections to secondary circuits must have insulation to required local safety standards. After installation, there must be no access to live parts. Use screened cable for signal inputs and relay connections. Route signal leads and power cables separately, preferably in an earthed (grounded) flexible metal conduit.

WARNING – BODILY INJURY

- If the transmitter is used in a manner not specified by the Company, the protection provided by the equipment may be impaired.
- Replacement of the internal battery must be carried out by an approved technician only.
- The transmitter conforms to Installation Category II of IEC 61010.
- All equipment connected to the transmitter's terminals must comply with local safety standards (IEC 60950, IEC61010-1).

Power supply connections

AquaMaster4 is available with three power options – battery, AC with internal back-up and renewable with internal back-up. Refer to Table 1 to identify valid combinations between transmitter electronics and enclosure. **NEVER** mix and match between different power options.

Table 1 Mix and match compatibility between transmitter enclosure and transmitter electronics

		Transmitter electronics power option		
		B (Battery)	K (AC + internal back-up)	R (Renewable+ internal back-up)
Transmitter enclosure power option	B/L (Battery)	Yes	No	No
	K (AC + int'l back-up)	No	Yes	No
	R (Renewable+ int'l back-up)	No	No	Yes

See **Transmitter overview** on page 9 for power supply options by transmitter type.

WARNING – BODILY INJURY

- Disconnect the supply from any cables that are terminated on the transmitter.
- Electrical installation and earthing (grounding) must be in accordance with relevant national and local standards.
- The external earthing (grounding) boss must be connected to an earthing (grounding) rod or to a local electrical earth.

IMPORTANT (NOTE)

Power supply connections/earthing arrangements are identical for cathodically-protected remote transmitter systems. For cathodically-protected integral transmitter systems, follow cathodic installation practices.

Mains power supply (remote transmitter)

Mains power requirements:

- 95 to 240 V AC, 50/60 Hz @ <3 VA
- Cable length 3 m (9.8 ft.)
- Protected by a fused isolator, rating – mains, anti-surge 3 A

Make connections as shown in Figure 36. Connect the external earth (ground) boss to the local electrical earth or earth rod if no electrical earth is available. Use a suitable wire with a cross sectional area rated for >3 A.

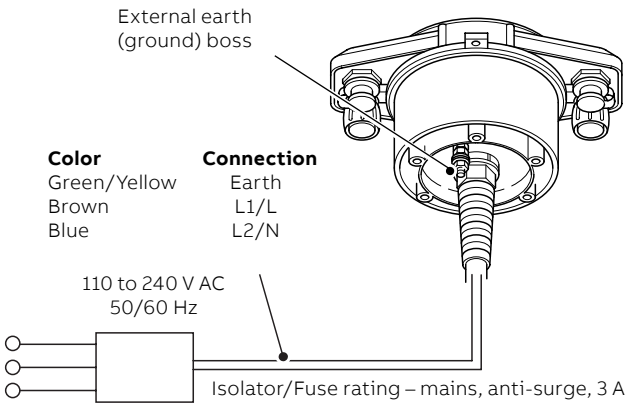
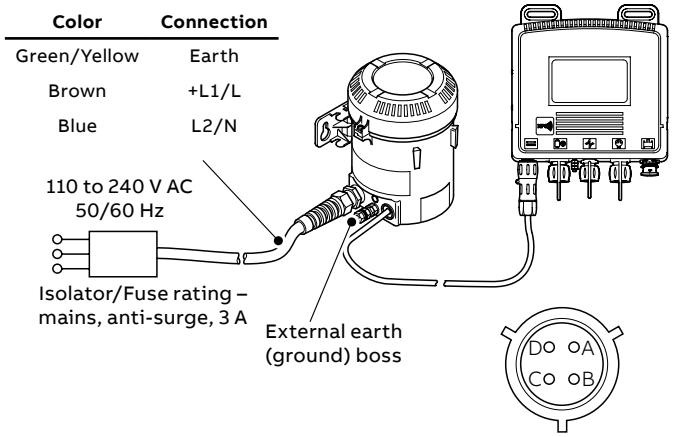


Figure 39 Connecting a mains power supply (remote transmitter FET41X/43X)

…5 Installation

…Connections



Pin	Connection
D	0 V/–V
A	+V
B	RXD
C	TXD

Figure 40 Connecting a mains power supply for an external power supply unit for FET452

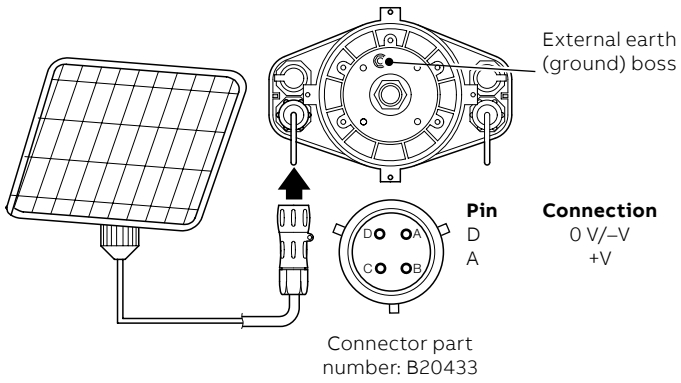


Figure 41 Connecting a renewable energy supply (FET43X)

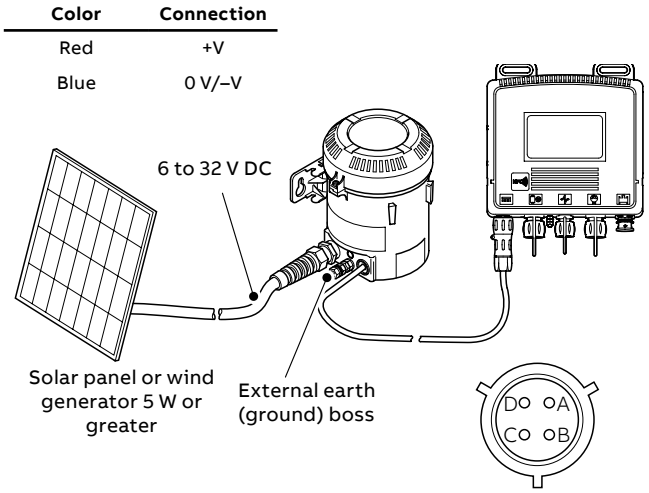
Renewable energy supply

IMPORTANT (NOTE)

- Before making connections, check the Data label to confirm power supply requirements.
- External earth (ground) boss **must** be connected to earth (ground) rod or a local electrical earth.
- Renewable energy generators do not operate at maximum capacity. Wind turbines are affected by low wind speeds and solar panels by coatings of dust, wildlife droppings and short daylight periods in winter.
  For these reasons, in some installations, generators with a capacity greater then the specified 5 W minimum should be used. Contact ABB for a technical note, giving guidance on the selection of suitably sized generators for AquaMaster4.

Renewable energy supply requirements:

- Input 12 V (nominal)
- V in: max. 32 V DC, min. 6 V DC
- Solar panel or wind generator 5 W or greater



Pin	Connection
D	0 V/–V
A	+V
B	RXD
C	TXD

Figure 42 Connecting a renewable energy supply to external power supply unit (FET452)

Battery power supply

IMPORTANT (NOTE)

- The external earthing (grounding) boss must be connected to an earthing (grounding) rod.
- Observe all warnings in **Battery hazard, handling, shipping and recycling/disposal on page 7**.
- Never remove the transmitter lid assembly when the water level around the flowmeter is close to the enclosure.
- Only use 3.6 V lithium thionyl chloride D batteries recommended by ABB.
  Recommended/preferred batteries are:
  - SAFT LS33600
  - Eve ER34615
  - GB Cell ER34615
  - cT-energy ER34615
  - OmniCel ER34615
  - GEBC ER34615
  - LiYa ER34615
  - Fanzo ER34615H

  The above batteries comply with the safety requirements of IEC60086-4 and have a maximum peak discharge current of less than 500mA.

Connect the external earth (ground) boss to the local electrical earth, cabinet earth, or earth rod if no electrical earth is available. Use a suitable wire with a cross sectional area rated for >3 A.

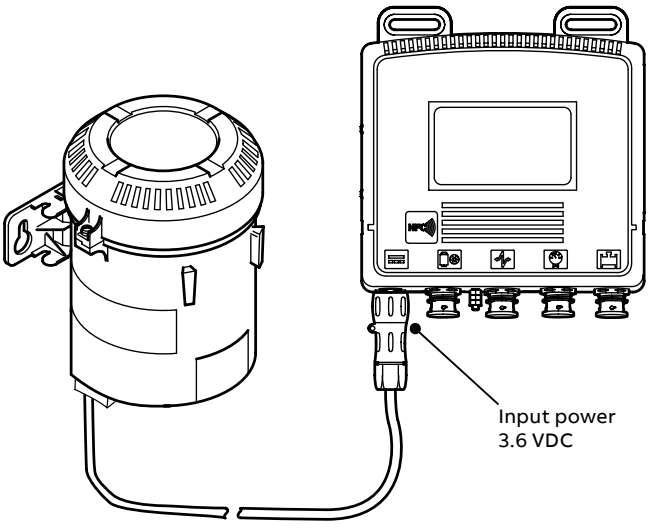


Figure 43 Connecting a battery powered Transmitter to Power supply unit

IMPORTANT (NOTE)

- The input power for all devices is 3.6 V DC

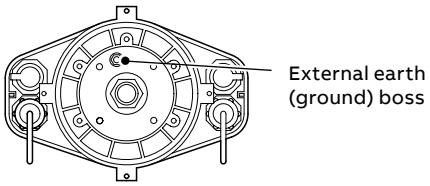


Figure 44 External earth (ground) boss (FET43X)

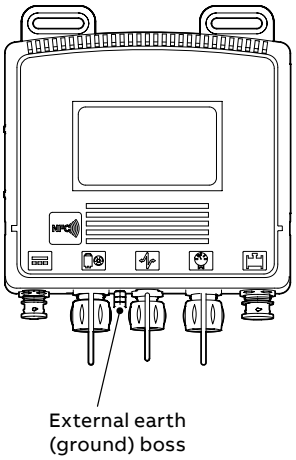


Figure 45 External earth (ground) boss for FET45X

IMPORTANT (NOTE)

- Depending on industry specific requirements, additional external earthing may be required in specific applications. When an external earthing (grounding) boss is provided on the device it is recommended to connect the boss to an earthing (grounding) rod.

...5 Installation

Installing internal batteries – FET41X/43X

IMPORTANT (NOTE)

- Observe all warnings in Health, safety and security. See page page 4.
- Never remove the transmitter lid assembly when the water level around the flowmeter is close to the enclosure.
- Only use 3.6 V lithium thionyl chloride D batteries recommended by ABB - see list in **Installation on page <?>**.
- If fitting batteries for the first time, perform steps 2, 3 and 8 to 14 of the procedure below.
- Always fit batteries as new pairs.
- The transmitter assembly is not attached to the housing by a restraining cord/cable. After removal, place it in a clean dry accessible location.
- On small flanged sensors, the transmitter should be 90 ° to the pipe to avoid connectors impacting the flanges.

Referring to Figure 42:

1 If tamper detection seals or locking screw(s) are fitted remove them – see page 40 and page 41 (not applicable if fitting the batteries for the first time).
2 Rotate transmitter assembly (A) anticlockwise to disengage it from transmitter housing (B).
3 Carefully lift transmitter assembly (A) away from transmitter housing (B) avoiding strain/damage to any attached internal wiring (C).
4 Carefully disconnect battery connection plug (D).
5 Carefully disconnect sensor connection plug (E).
6 Remove existing batteries (F) and discard safely – refer to page 7.
7 Remove O-ring (G) from the recess in the transmitter housing and ensure transmitter/housing mating sealing faces are clean. If contaminated, clean recess and sealing faces and fit a new O-ring using supplied grease type (ABB kit no. 3K220).
8 Remove and discard any silica gel bags (not illustrated).
9 Insert new batteries (H) of the correct type into the holders, ensuring the correct polarity ((I) = positive [+]).
10 Place new silica gel bags from spares kit (not illustrated) in the housing.
11 Carefully connect sensor connection cable plug (E) avoiding strain/damage to the cable loom.
12 Carefully connect battery connection plug (D) avoiding strain/damage to the cable loom.
13 Fit transmitter assembly (A) onto transmitter housing (B) and rotate clockwise until the tamper seal openings in the housing and transmitter assembly align fully.
14 If required fit tamper seals or refit locking screw(s) – see page 40 and page 41.

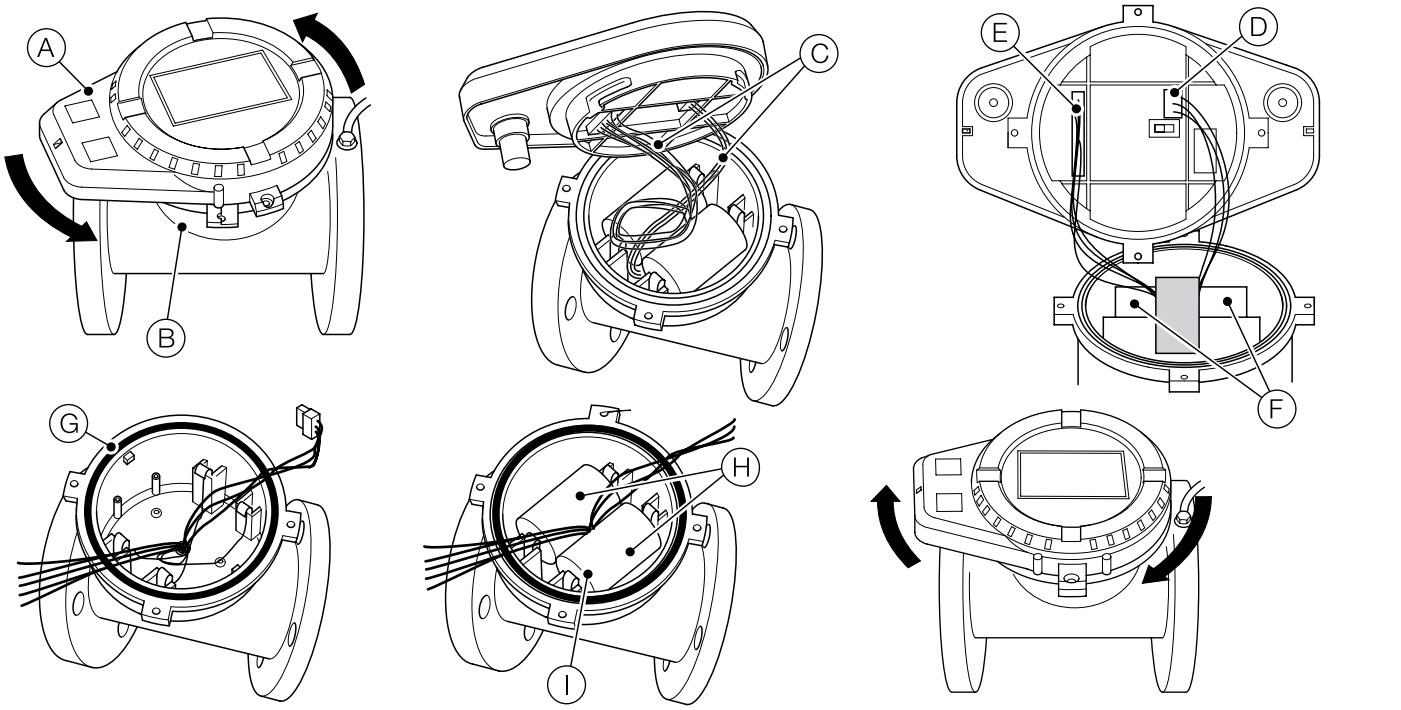


Figure 46 Fitting internal batteries (FET41X/43X)

Installing internal batteries – FET45X

Referring to Figure 43:

1. Use the Velox app to disable mobile communication. (Enable **Advanced Access Level Enable** in **User Access Right Settings** and navigate to **Advanced Settings – Cellular 4G > Operation mode.** Click the edit icon and select **Disabled** and tap the phone to the device).
2. Remove and retain the screw (A) from the lid (B) .
3. Turn the lid (B) counterclockwise and remove it from the housing (E).
4. Carefully disconnect the plug (G) from the battery holder (C).
5. Carefully lift the battery holder (C) from the housing (E). Be careful not to stretch the attached wires.
6. Remove the batteries (D) and (F) from the battery holder (C). Discard the batteries in accordance with local regulations.
7. Remove and discard any silica gel bags from the housing (E).
8. Remove the O-ring from the recess in the housing (E).
9. If necessary, clean the recess and sealing faces and fit a new O-ring using the supplied grease (ABB kit no. 3K220).
10. Install the new batteries (D) and (F) into the battery holder (C).
11. Place new silica gel bags from spares kit in the housing (E).
12. Carefully insert the battery holder (C) into the housing (E).
13. Carefully connect the plug (G) to the battery holder (C).
14. Put the lid (B) onto the housing (E).
15. Turn the lid (B) clockwise.
16. Refit the screw (A).
17. Use the Velox app to enable the mobile communication. Enable **Advanced Access Level Enable** in **User Access Right Settings** and navigate to **Advance Setting - Cellular 4G> Operation mode**. Click the edit icon and select **Enabled** and tap the phone to the device.
18. Ensure the device is in **Advanced Access Level Enable** in **User Access Right Settings**. Navigate to **Advance Setting - Power Management**. Edit **D- Cell Capacity (Ah)** and enter the amp-hour rating of the battery. Edit **Number of D- Cell** and enter the number of cells that are fitted. Edit **Confirm Battery Replacement** and select **On** and tap the phone to the device.

IMPORTANT (NOTE)

If installing batteries for the first time, perform steps 1 - 5, 10, 12 - 18 of this procedure.

If replacing existing batteries, follow all the instructions.

Always install batteries as new pairs.

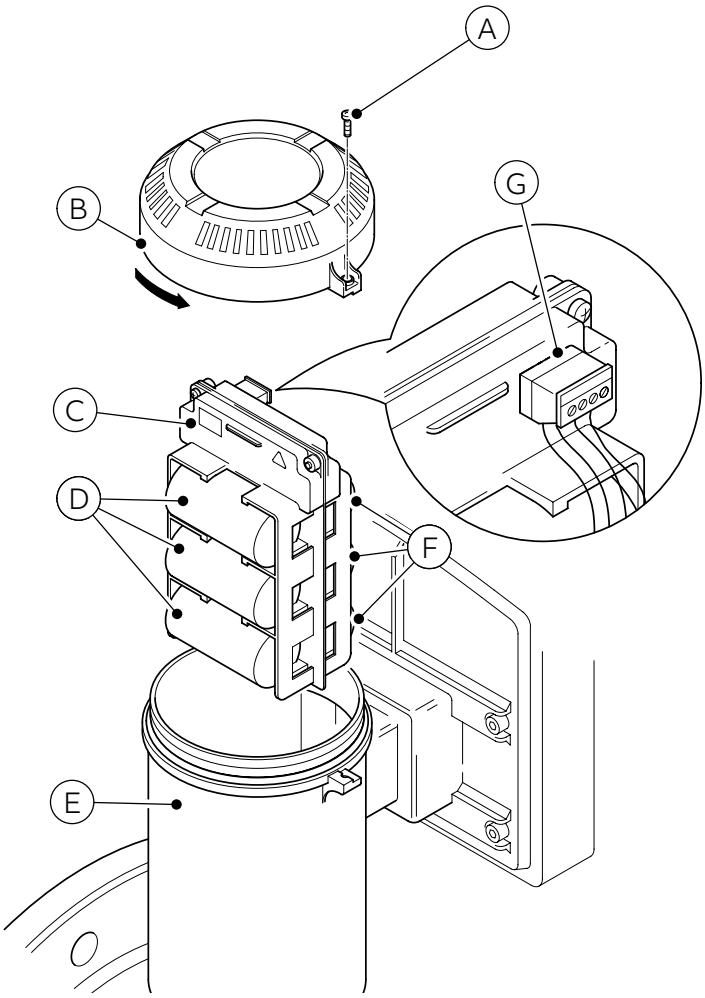


Figure 47 Fitting batteries inside the PSU for FEX45X

IMPORTANT (NOTE)

Always install new batteries into the device before you follow step 18. The device battery life is calculated based on input data as per step 18 using new batteries.

...5 Installation

AquaMaster4 remote sensor connections

1 Connect the ground cable Ⓒ to the top cover of the transmitter.

2 Fit the top cover to the transmitter.

3 Remove the cap Ⓑ on sensor connector Ⓐ.

4 Carefully push sensor plug Ⓓ into the socket and rotate until it engages.

> **IMPORTANT (NOTE)**
> If the sensor cable is terminated with fly leads, connection is via a sensor cable adapter box (part number WABC2035 available separately).

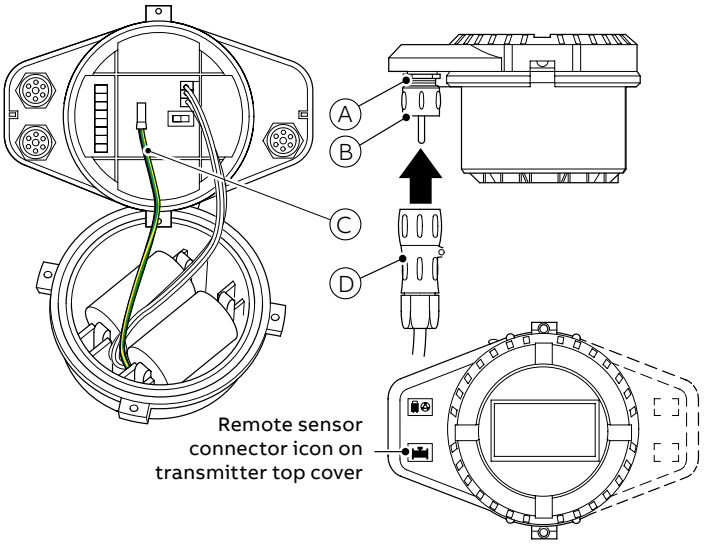


Figure 48 Remote sensor connections (FEW412/432)

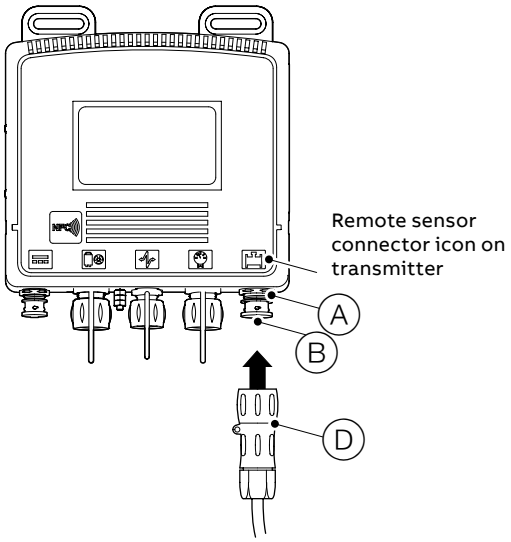


Figure 49 Remote sensor connections (FEW452)

Integral sensor connections

Pre-wired sensor connections to the connector plug are shown in Figure 46.

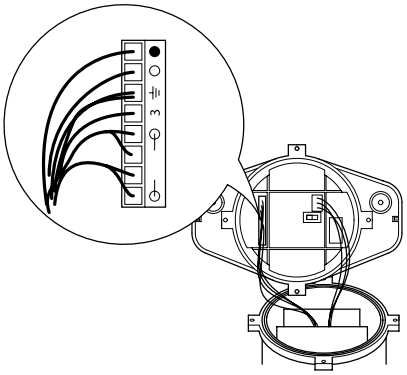


Figure 50 Integral sensor connections (pre-wired)

Input/Output connections

CAUTION – DAMAGE TO EQUIPMENT

- Refer to the Specification, **Specification** on page 72 for input/output ratings.
- Inductive loads must be suppressed or clamped to limit voltage swings.
- Operation of outputs is programmable.
- External isolators are not normally required as the pulse and alarm circuit is electrically-separated from all other AquaMaster4 connections.
- Capacitive loads must be inrush current limited.
- Fully-floating pulse outputs may be subject to static damage, for example connecting to a floating datalogger, unless 'COM' is operated within its galvanic isolation range (±35 V) from earth.

Input/Output connection socket

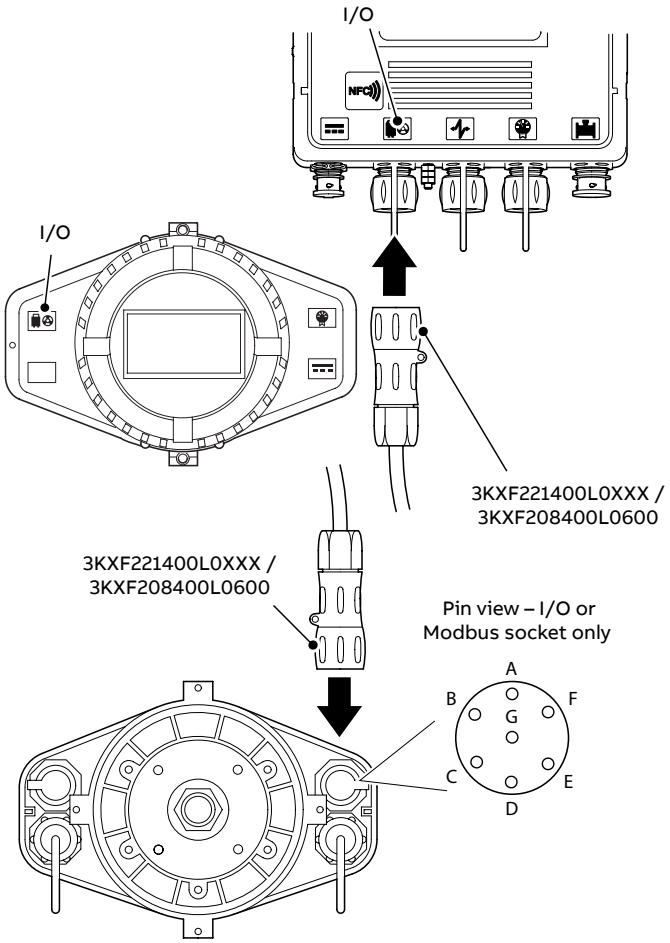


Figure 51 Input/Output connection socket (rear view)

Table 2 Connector input/output connections (Sensus + pulse/pulse*)

Pin	Signal	Function	Color (output cable)
A	DATA	Sensus Encoder	Violet
B	DATA CLOCK	Sensus Encoder	Blue
C	O/P COM	Output common	Yellow
D	O/P2	Reverse pulses	Red
E	O/P3	Alarm output	Brown
F	O/P1	Forward pulses	Orange
G	0V	Sensus Encoder	Screen

*For pulse only connection, use pins C, D and F.

...5 Installation

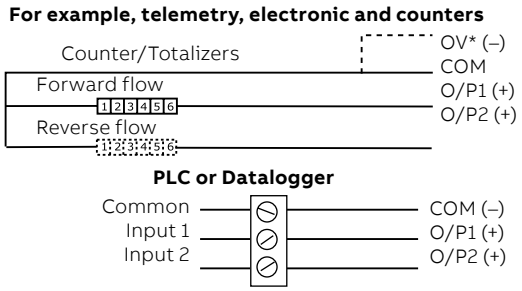
Table 3 Connector input/output connections (Modbus + Pulse / Modbus*)

Pin	Signal	Function	Color (output cable)
A	D0	Data D0	Violet
B	D1	Data D1	Blue
C	O/P COM	Output common	Yellow
D	O/P2	Reverse pulses	Red
E	O/P3	Alarm output	Brown
F	O/P1	Forward pulses	Orange
G	0V	Signal ground	Screen

* Refer to COI/FET400/MODBUS-EN for Modbus only

Pulse outputs

IMPORTANT (NOTE)
Outputs 1 and 2 are polarity-sensitive. The common connection for these outputs is designated 'COM' and is the negative connection.



*Optional link for grounding floating output – see **Note** above.

Figure 52 Pulse output connections

Alarm interface

IMPORTANT (NOTE)
Output 3 is not polarity-sensitive. The common connection for these outputs is designated 'COM'.

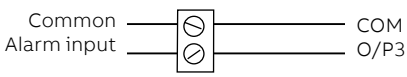


Figure 53 Alarm output connections

MODBUS connection

This section describes the AquaMaster4 MODBUS serial data communications option and must be used in conjuction with Communication Supplement COI/FET400/MODBUS.

Detailed specifications and recommendations for using and implementing MODBUS communications are contained in the following external publications – refer to www.modbus.org:

- "MODBUS over Serial Line – Specification and Implementation Guide V1.02" – For hardware, cabling, grounding and shielding
- "MODBUS Application Specification V1.1b"

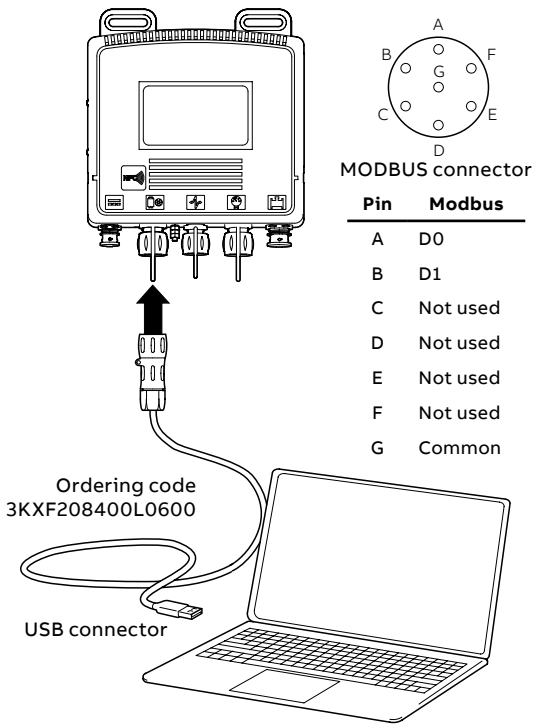


Figure 54 MODBUS connection

IMPORTANT (NOTE)
A USB Comms lead driver is required when using WEBC2100 – download from www.ftdichip.com/FTDrivers.htm

The Modbus protocol is an unsecured protocol, as such the intended application should be assessed to ensure that these protocols are suitable before

implementation.

Pressure transducer (optional)
Optional pressure transducers are available for a range of pressures and cable lengths.

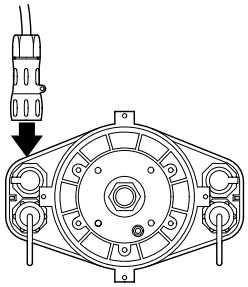


Figure 55 Optional pressure transducer connector (FET432)

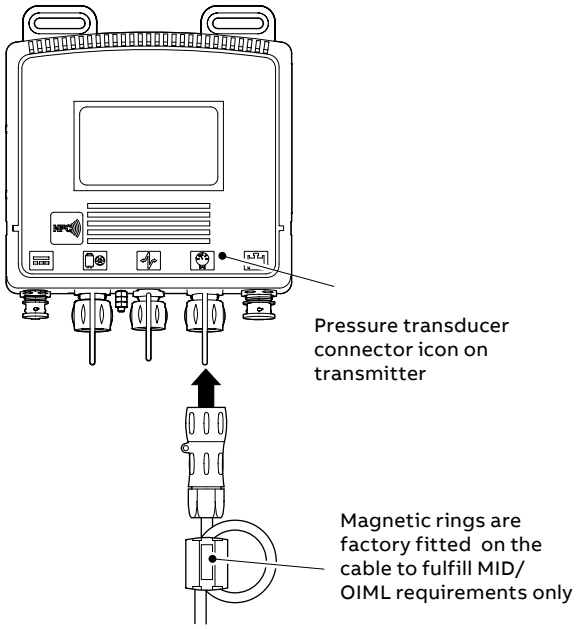


Figure 56 Optional pressure transducer connections (FEX45X)

CAUTION – DAMAGE TO EQUIPMENT
- Use only the pressure transducer supplied with the transmitter – other types may not function.
- ABB pressure transducers require setting of the transmitter's pressure span and zero factors.
- Factory fitted magnetic rings for pressure transducer are mandatory to fulfill MID/OIML requirements for FEX45X device only.

Transmitter protective cover

An optional protective cover can be fitted over the transmitter front panel for locations where damage could occur.

Fitting the transmitter protective cover
Referring to Figure 53.

1. Stretch retaining strap (A) (included with cover (B)) over transmitter face (C).
2. Position optional protective cover (B) over transmitter face (C) and clip it into the fitted position (D).

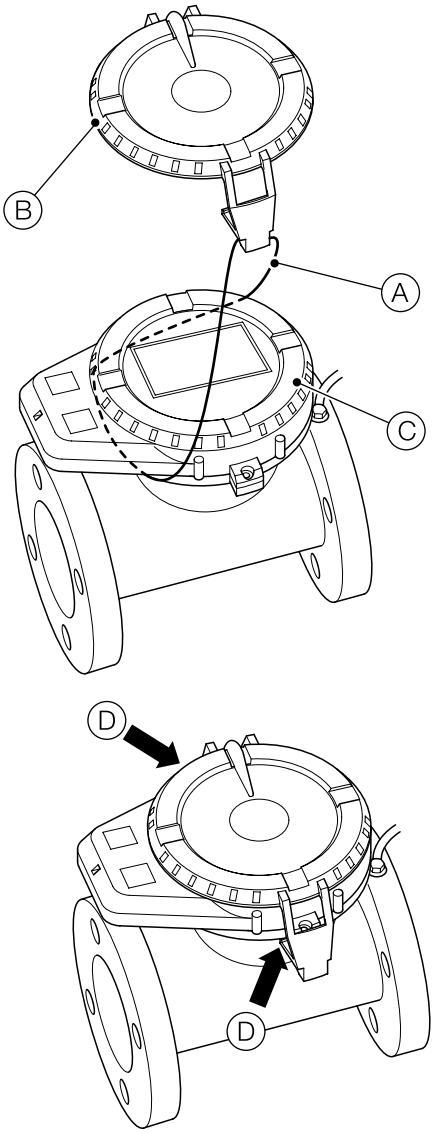


Figure 57 Fitting the transmitter protective cover (FET41X/43X)

...5 Installation

Near Field Communication (NFC)

AquaMaster4 has a smart contactless Near Field Communications (NFC) interface located on its front face where the ABB logo is just above the LCD for FEX 41X/43X. For FEX45X, it is located on the front face where the NFC logo is marked below the LCD. This enables users to interact directly with the transmitter locally using the ABB Velox phone productivity app and other compatible ABB desktop/phone productivity apps.

NFC wall-mount coupler
In some installations the transmitter may be relatively inaccessible, for example, below ground level in a chamber. In such locations an optional remote configuration/reading interface connected to an NFC wall-mount coupler can be fitted to make remote reading or access for configuration via smartphone easier.

This interface clips over the front face of the transmitter and connects to an NFC wall-mount coupler (mounted in an accessible location) using a short connecting cable.

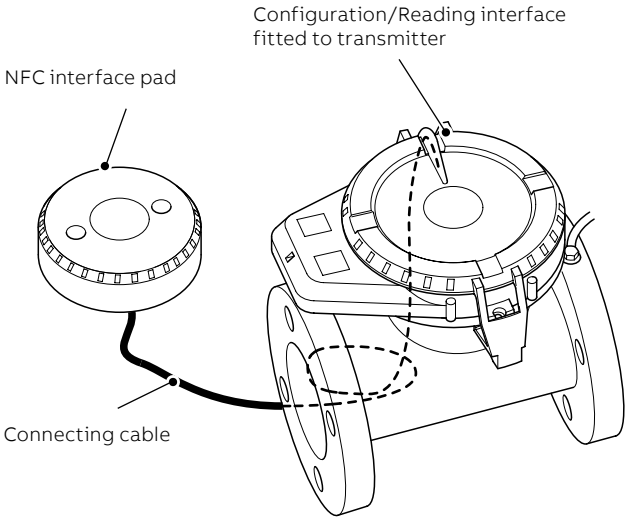


Figure 58 Remote configuration/reading interface and NFC wall-mount coupler (FET41X/43X)

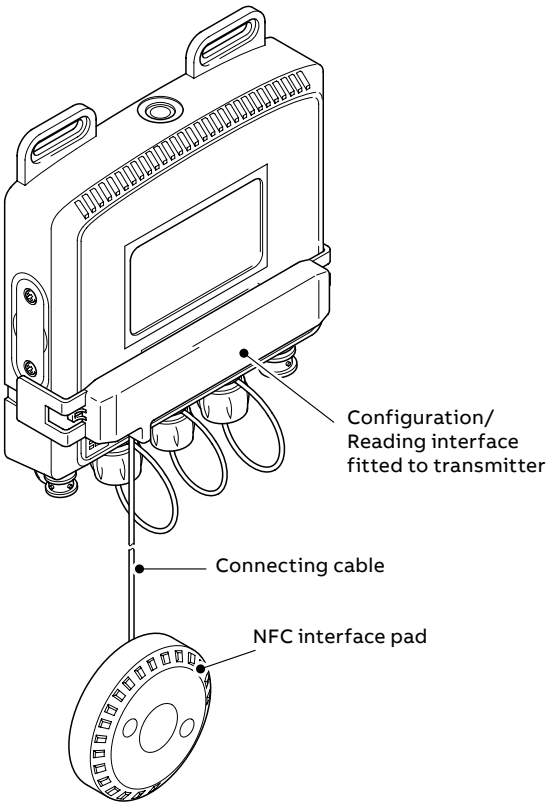


Figure 59 Remote configuration/reading interface and NFC wall-mount coupler (FET45X)

Note:
The NFC interface pad is also available with a USB connector.

Fitting the configuration/reading interface and connecting the NFC wall-mount coupler

Referring to Figure 53 on page 35,

1 Stretch retaining strap (A) (included with cover (B)) over transmitter face (C).

Referring to Figure 56 and Figure 57:

2 Clip the configuration/reading interface (A) over the front of the transmitter (B), ensuring correct orientation.

3 Route connection cable (C) to the required location for the wall-mount coupler.

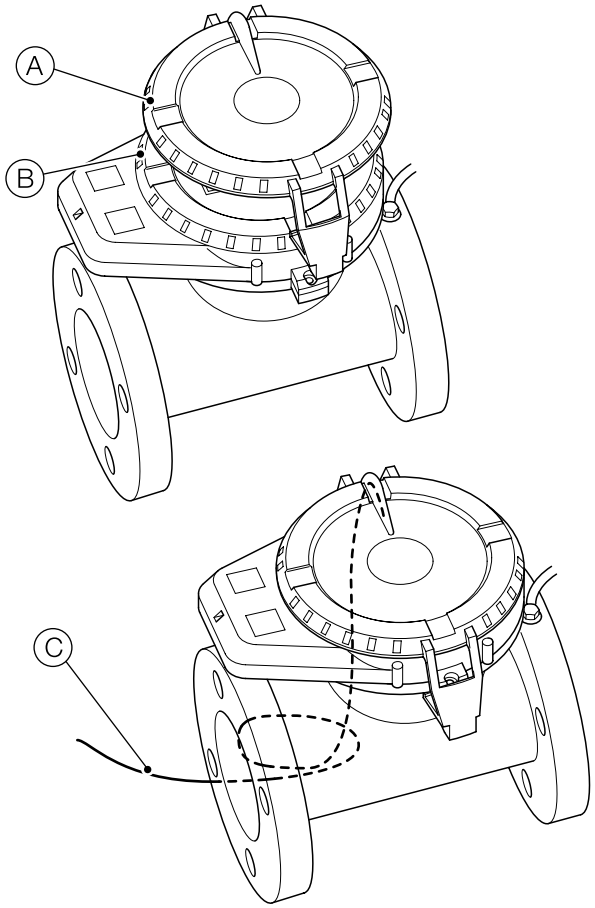


Figure 60 Fitting the configuration/reading interface (FET41X/43X)

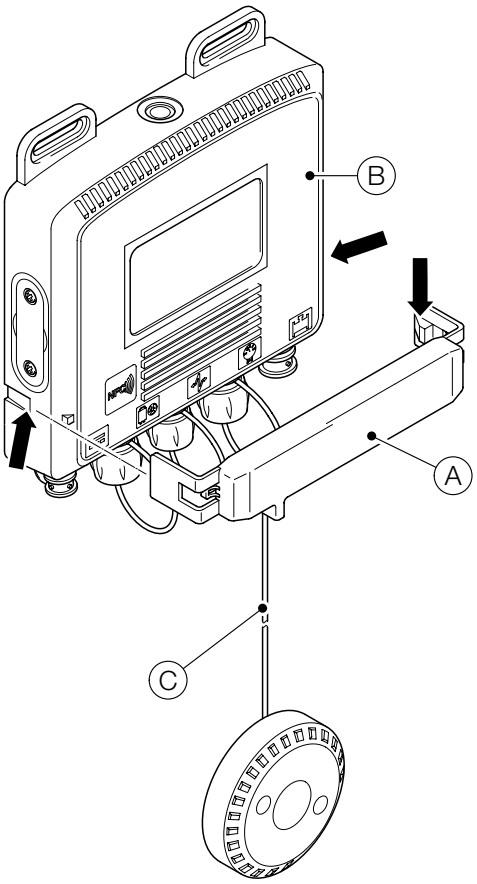


Figure 61 Fitting the configuration/reading interface (FET45XX

...5 Installation

Referring to Figure 58:

4 The fitted cable can be shortened if required – do not extend this cable.

5 Loosen cable clamp screws (A), pass free end of cable (B) through to terminal connections (C), make cable connections and re-tighten cable clamp screws (A).

6 Power up and check connections between the 2 interfaces before proceeding with step 7.

7 Seal the wall-mount coupler connections (C) with sealant (supplied) to seal against water ingress. Allow the sealant to cure.

WARNING – BODILY INJURY

- Potting materials can be toxic. Read the manufacturers' instructions carefully before preparing the potting material and use suitable safety precautions when required.
- Do not overfill or allow the potting material to come into contact with seals or grooves.
- Do not let potting material enter conduit (if used).

8 Fix/mount wall-mount coupler in the required location/ position using 2 screws.

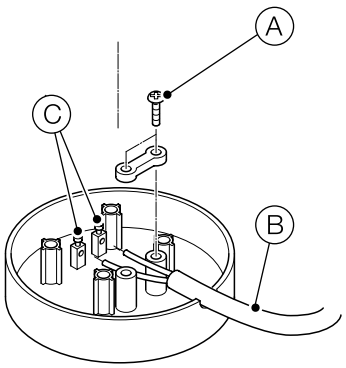


Figure 62 Connecting and sealing the NFC wall-mount coupler

6 Commissioning

Safety instruction

WARNING – INTEGRAL FLOWMETERS
Risk of burns due to hot measuring media.
The sensor surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature! Before starting work on the flowmeter, make sure that it has cooled sufficiently.

If there is a chance that safe operation is no longer possible, take the flowmeter out of operation and secure it against unintended startup.

Checks prior to commissioning

The following points must be checked before commissioning the flowmeter:

- The wiring must have been completed as described in **Installation on page 23 and 24**.
- The sensor must be cross bonded to up and downstream pipes correctly.
- The ambient conditions must meet the requirements set out in the technical data.
- The power supply must meet the requirements printed on the identification plate.
- The sensor and transmitter must be correctly assigned – see page 8 for label information.

IMPORTANT (NOTE)
The Flow Settings > Mains Noise Rejection Frequency (Hz) setting must match the mains frequency in the country of installation. Refer to **Configuration** from page 50.

MID/Anti-tamper seals

For flowmeters ordered with the option for compliance with EU Measuring Instrument Directive (MID), it is a legal requirement that, after installation, the flowmeter is sealed to prevent unauthorized changes to the meter settings and configuration.

Both the sensor and transmitter must be ordered with the MID option for the flowmeter to be MID compliant

A read-only switch is used to prevent login through any communication means and modification of any parameters on the AquaMaster4 – see Figure 59. For MID and OIML systems, the switch is for write protection for legally relevant parameters.

For MID and OIML systems this switch must be set to the MID read-only position and a compliance seal fitted as shown in Figure 59. Suitable tamper detection seals must be used (such as the factory-fitted seals, see Figure 59) so that in the event of unauthorized tampering, it is clearly visible that the fitted legal metrology seal has been broken.

IMPORTANT (NOTE)
On earlier hardware versions, this switch polarity was reversed, refer to the fitted label regarding the lock position

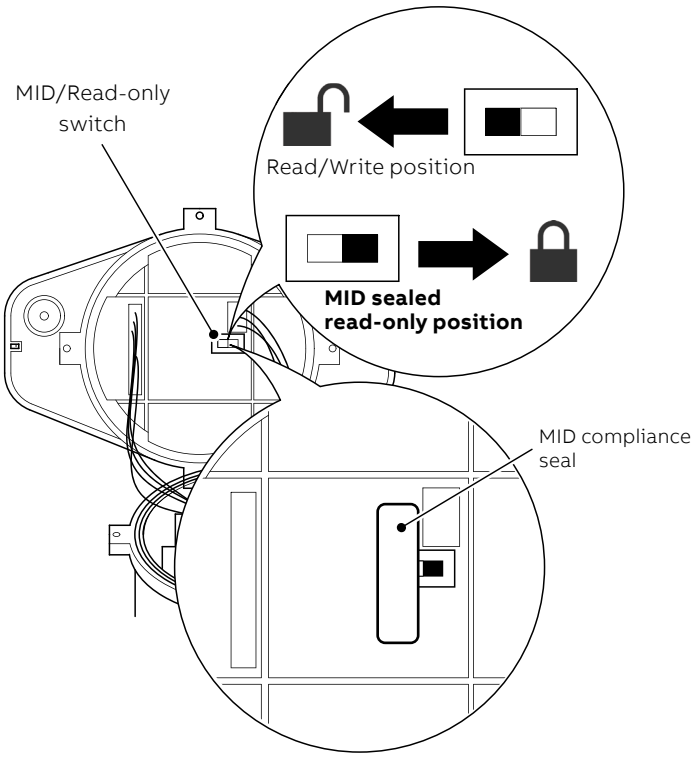


Figure 63 Read-only switch and compliance seal (FET41X/43X)

...6 Commissioning

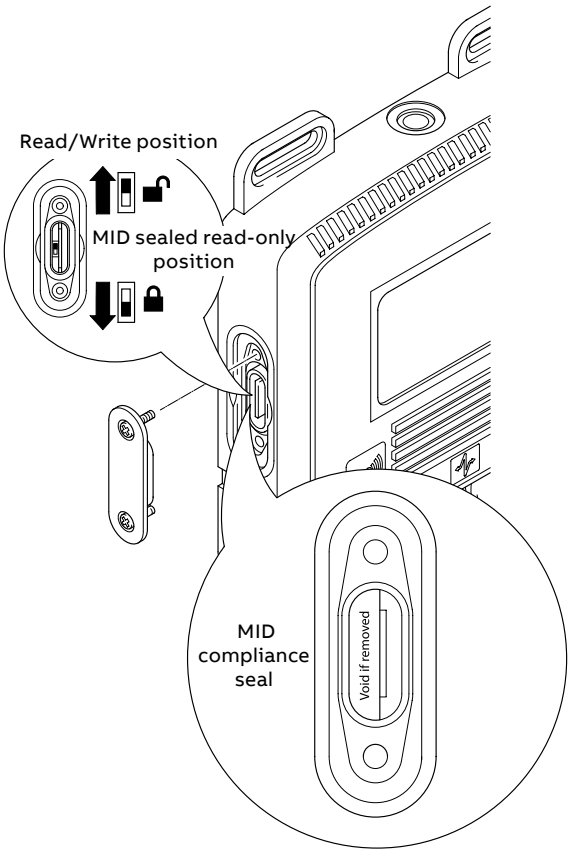


Figure 64 Read-only switch and compliance seal (FET45X

Integral transmitter – tamper-detection seals/locking screws

Locations for tamper-detection seals/locking screws on integral transmitters are shown in Figure 61.

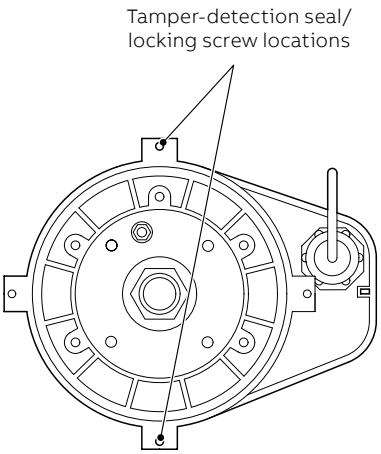


Figure 65 Integral transmitter (FEW431) – tamper detection seal/locking screw locations (rear view)

Remote transmitter – tamper-detection seals/locking screws

> **IMPORTANT (NOTE)**
> It is a legal requirement for MID-compliant flowmeters to fit tamper-detection seals at installation to the case and remote sensor connector.

Locations for tamper-detection seals are shown in Figure 62.

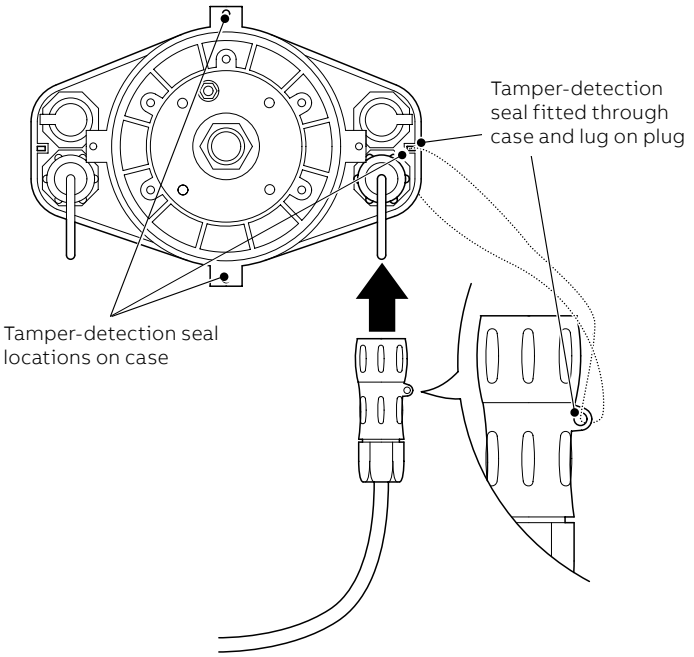


Figure 66 Remote transmitter (FET432) tamper-detection seal locations (rear view)

Locations for locking screws are shown in Figure 63.

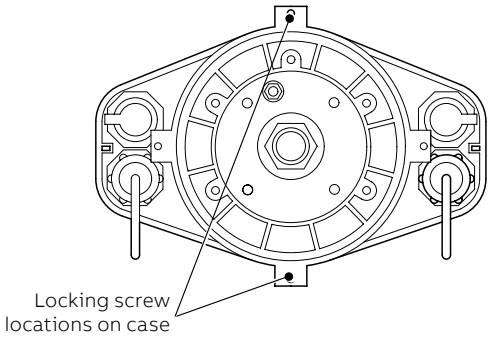


Figure 67 Remote transmitter (FET432) security screw locations (rear view)

Fitting the tamper-detection seal (FEX45X)

It is a legal requirement for MID compliant flowmeters to fit a tamper detection seal to the remote sensor connector.

Referring to Figure 64:

1 Pass the wire of the seal through both the hole in the locking-ring and the hole in the cable connector.

2 Close the seal.

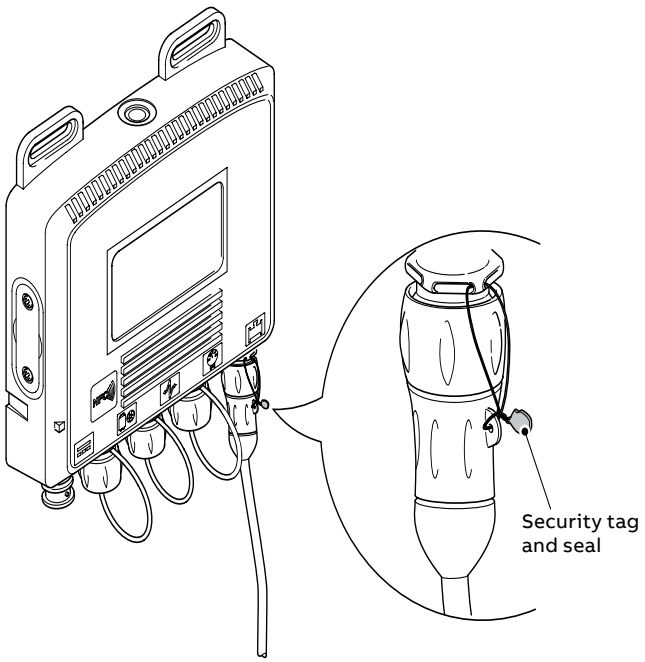


Figure 68 Fitting the tamper-detection seal

Establish cellular 4G communication - FTPS/FTP

It is necessary to establish the cellular communication of transmitter before putting into operation. This procedure describes how to establish cellular 4G based communication between the transmitter and the server (refer to **Cellular 4G settings*** on page 61).

1 Insert the SIM card (page 24) and set the Time Zone and Day Light Savings according to location of installation (refer to **Device Information** on page 55). Ensure that “Data Option” is enabled in the SIM and enough balance is maintained.

2 Configure the Time Zone and Day light Savings for the device according to the installation location of the device through the Velox interface app under **Device Information** and tap the phone against the device to update the parameters.

Item	Description
Time Zone	Set the UTC time for the device
Daylight Savings On/Off	On/Off
Daylight Saving Start Time (m.w.d-hhmmss)	4.1.0.-02:00:00 (First week of April on Sunday at 02:00 hrs
Daylight Saving End Time (m.w.d-hhmmss)	10.5.0.-02:00:00 (Last week of October on Sunday at 02:00 hrs
Daylight Savings Time Shift/Bias (mins)	e.g 60

3 Enable **Advanced Access Level Enable** in **User Access Right Settings** and navigate to **Advanced Settings – Cellular 4G > Operation mode**.

4 Click the edit icon and select **Disabled** and tap the phone to the device to disable Cellular 4G communication.

5 Configure the below parameters for FTPS/FTP server through Velox interface app under **Advance Settings – Cellular 4G** and tap the phone to the device to update the parameters.

Item	Description
FTPS/FTP server host name	IP address: xxx.xxx.xxx.xxx Domain name: xxx.com
FTPS/FTP server port number	e.g. 21
FTPS/FTP server username	e.g. Test
FTPS/FTP server user password	e.g. 123456
FTPS/FTP server working directory (optional)	e.g. /test
TLS On/Off	On/Off
TLS Authentication Mode	None/Verify server cert only/ Mutual authentication
TLS Cipher Suite*	TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256/TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256**
Device folder name style	The default selection is **Meter tag** with option to select Transmitter/ Sensor ID. Ensure the **Meter tag** is defined (refer to **Device Information** on page 55)
Data report mode	Summary report
FTPS/FTP file type	JSON/CSV

Note: If **TLS Authenticate Mode** is set to **None** skip step 5.
If If **TLS Authenticate Mode** is set to **Verify Server Cert only** skip step 5a and 5c to 5k.

* Not Mandatory
** Recommended

...6 Commissioning

6 Configure parameters for SSL/TLS through Velox. The purpose of configuring SSL/TLS parameters is to realize digital certificate based mutual authentication between the FTPS/FTP server and the device. (Not applicable for FTP protocol)

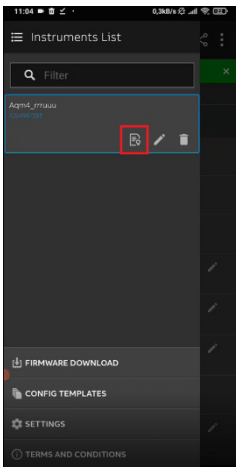
a Prepare the **CSR subject name** file (in .txt format) and save it in the phone, the csr_info file should contain a comma-separated list of OID (Object Identifier) types and values as below with a fixed prefix "subject _name":

Field	Description	Example
C	Country	China
CN	Common name	AquaMaster 4
L	Locality	Shanghai
O	Organization	ABB
OU	Organizational unit	Service
R	Email address	xxxx@cn.abb.com
ST	State	Shanghai

The content in the csr_info.txt file according to the example shall be:

subject_name=C=China, CN=AquaMaster4,L=Shanghai,O=ABB,OU=Service, R=xxxxx@cn.abb.com,ST=Shanghai

b Navigate to the sidebar and select **Certificate**:



c Select **Import CSR Subject Name** and navigate to the file prepared as per step 1 and select the csr_info.txt file for **CSR File** generation.

d Press START and hover the phone to the transmitter and allow the Velox app to download the **CSR SUBJECT NAME** into the transmitter.

e Once the **CSR Subject Name** is downloaded into the transmitter the Success message is shown on the screen of Velox app (Clear the notification by tapping **OK**).

f Select **Export CSR File** and hover the phone to export .csr file to generate the device certificate.

g Now the .csr file is downloaded to the phone and can be shared with your CA (Certificate Authority).
Note:
Both certificate generation by CA(Certificate Authority) and self-signed are supported. However, certificate signed by CA is highly recommended which will give better security protection on the 4G communication.

h Copy the client certificate and server root certificate into phone internal storage.

i Select **Import Device Public-Key Certificate > Select Device Public-Key Certificate**.

j Navigate to the transmitter's certificate in .crt format and select the respective file.

k Hover the phone to the transmitter and select **Start** to download the certificate. After download completion, the success message is shown on the screen of the Velox app (clear the notification by tapping **OK**).

l Select **Import Trust Anchor** (known a root certificate as well).

m Press **Select Trust Anchor** to select server trust anchor in .der format from phone internal storage memory.

n Click on **Start** and hover the phone to download the file to the transmitter after successful importing the SSL/TLS configuration is completed.

7 If necessary, configure the parameters for NTP server through Velox app. If not configured, the device will sync with the network time of the cellular provider.

Item	Description
NTP server address	xxx.xxx.xxx.xxx
NTP server port number	e.g. 123

8 If necessary, configure the parameters for the DNS server through Velox app. These parameters are only necessary if domain name is applied when configuring FTPS/FTP server host name (refer item 4 of this section).

Item	Description
DNS primary server address	The initial choice for DNS server
DNS secondary server address	The back-up choice for DNS server

9 If necessary, configure the parameters for APN through Velox app. These parameters are only necessary if APN is required by the SIM card operator.

Item	Description
APN	The access point name
APN username	The username of APN
APN user password	The user password of APN
APN mode	Whether APN is enabled or disabled
APN authentication method	The authentication method of APN

10 Navigate to **Advanced Settings – Cellular 4G > Operation mode**.

11 Click the edit icon and select **Enabled** and hover the phone to the transmitter to enable Cellular 4G communication.

12 Reboot the transmitter through Velox by selecting **On** in **Firmware Information > Reboot System** and tap the phone to device.

13 Wait and hover the phone to the transmitter to confirm if local calendar date/time is successfully synchronized by network time.

14 Trigger data report by selecting **On** in **Cellular 4G Settings > Trigger data report** and hover the phone to the transmitter.

15 Check the data report on the server.

Establish Cellular Communication – MQTTS/ MQTT + SparkPlug B

It is necessary to establish the cellular communication of transmitter before putting into operation. This procedure describes how to establish cellular 4G based communication between the transmitter and the server (refer to **Cellular 4G settings** on Page 59).

1 Insert the SIM card (refer to **Installing the SIM card – FET45X** on page 22) and set the Time Zone according to location of installation (refer to **Device Information** on page 53). Make sure that “Data Option” is enabled in the SIM and enough balance is maintained. Disable cellular 4G functionality through Velox.

2 Configure the Time Zone and Day light Savings for the device according to the installation location of the device through the Velox interface app under **Device Information** and tap the phone against the device to update the parameters.

Item	Description
Time Zone	Set the UTC time for the device
Daylight Savings On/Off	On/Off
Daylight Saving Start Time (m.w.d-hhmmss)	4.1.0.-02:00:00 (First week of April on Sunday at 02:00 hrs
Daylight Saving End Time (m.w.d-hhmmss)	10.5.0.-02:00:00 (Last week of October on Sunday at 02:00 hrs
Daylight Savings Time Shift/Bias (mins)	e.g 60

3 Enable **Advanced Access Level Enable** in **User Access Right Settings** and navigate to **Advanced Settings – Cellular 4G > Operation mode**.

4 Click the edit icon and select **Disabled** and tap the phone to the device to disable Cellular 4G communication.

5 Configure the below parameters for MQTTS/MQTT server through Velox interface app under **Advance Settings – Cellular 4G** and tap the phone to the device to update the parameters.

Item	Description
MQTTS/MQTT server host name	IP address: xxx.xxx.xxx.xxx Domain name: xxx.com
MQTTS/MQTT server port number	e.g. 21
MQTTS/MQTT server username	e.g. Test
MQTTS/MQTT server user password	e.g. 123456
MQTTS/MQTT keep alive	e.g. 60 seconds
SparkPlug B - group ID	e.g. group ID
SparkPlug B - group ID	e.g. nodeID
SparkPlug B - group ID	e.g. deviceID
MQTT client ID	The default selection is Meter tag with option to select Transmitter/ Sensor ID
Data report mode	Summary/Detail/Both
MQTT report content	Select from Totalizer/Flowrate/ pressure/maintenance info
TLS On/Off	On/Off
TLS Authentication Mode	None/Verify server cert only/ Mutual authentication
TLS Cipher Suite*	TLS_ECDHE_RSA_WITH_ AES_128_CBC_SHA256/TLS_ ECDHE_RSA_WITH_AES_128_ GCM_SHA256**

Note: If **TLS Authenticate Mode** is set to **None** skip step 5. If If **TLS Authenticate Mode** is set to **Verify Server Cert only** skip step 5a and 5c to 5k.

6 Configure parameters for SSL/TLS through Velox. The purpose of configuring SSL/TLS parameters is to realize digital certificate based mutual authentication between the FTPS/FTP server and he device. (Not applicable for MQTT protocol)

a Prepare the **CSR subject name** file (in .txt format) and save it in the phone, the csr_info file should contain a comma-separated list of OID (Object Identifier) types and values as below:

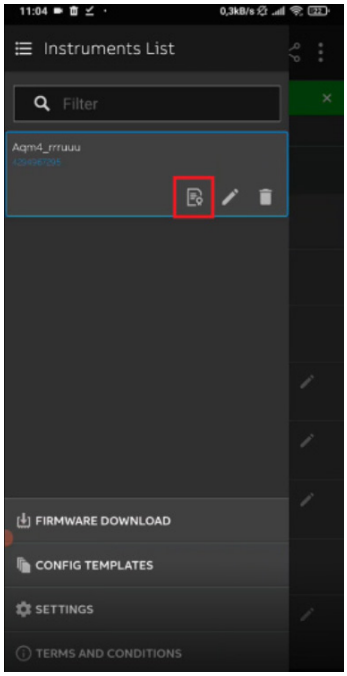
Field	Item	Description
C	Country	China
CN	Common name	AquaMaster 4
L	Locality	Shanghai
O	Organization	ABB
OU	Organizational unit	service
R	E-mail address	xxxx@cn.abb.com
ST	State	Shanghai

The content in the csr_info.txt file according to the example shall be:
subject_name=C=China, CN=AquaMaster4, L=Shanghai, O=ABB, OU=Service, R=xxxx@cn.abb.com, ST=Shanghai

* Not Mandatory
** Recommended

...6 Commissioning

b Prepare the **CSR subject name** file (in .txt format) and save it in the phone, the csr_info file should contain a comma-separated list of OID (Object Identifier) types and values as below:



c Select **Import CSR Subject Name** and navigate to the file prepared as per step 1 and select the csr_info.txt file for **CSR File** generation.

d Press **START** and hover the phone to the transmitter and allow the Velox app to download the **CSR SUBJECT NAME** into the transmitter.

e Once the **CSR Subject Name** is downloaded into the transmitter the Success message is shown on the screen of Velox app (Clear the notification by tapping **OK**).

f Select **Export CSR File** and hover the phone to export .csr file to generate the device certificate.

g Now the .csr file is downloaded to the phone and can be shared with your CA (Certificate Authority).

Note: Both certificate generation by CA (Certificate Authority) and self-signed are supported. However, a certificate signed by CA is highly recommended as it will give better security protection on the 4G communication.

h Copy the client certificate and server root certificate into phone internal storage.

i Select **Import Device Public-Key Certificate > Select Device Public-Key Certificate**.

j Navigate to the transmitter's certificate in .crt format and select the respective file.

k Hover the phone to the transmitter and select **Start** to download the certificate. After download completion, the success message is shown on the screen of the Velox app (clear the notification by tapping **OK**).

l Select **Import Trust Anchor** (known a root certificate as well**).**

m Press **Select Trust Anchor** to select server trust anchor in .der format from phone internal storage memory.

n Click on **Start** and hover the phone to download the file to the transmitter after successful importing the SSL/TLS configuration is completed.

7 If necessary, configure the parameters for NTP server through the Velox app. If not configured, the device will sync with the network time of the cellular provider.

Item	Description
NTP server address	xxx.xxx.xxx.xxx
NTP server port number	e.g. 123

8 If necessary, configure the parameters for the DNS server through the Velox app. These parameters are only necessary if the domain name is applied when configuring MQTTS/ MQTT server host name (refer to step **4** on page 41).

Item	Description
DNS primary server address	The initial choice for DNS server
DNS secondary server address	The back-up choice for DNS server

9 If necessary, configure the parameters for APN through Velox app. These parameters are only necessary if APN is required by the SIM card operator.

Item	Description
APN	The access point name
APN username	The username of APN
APN user password	The user password of APN
APN mode	Whether APN is enabled or disabled
APN authentication method	The authentication method of APN

10 Navigate to **Advanced Settings – Cellular 4G > Operation mode**.

11 Click the edit icon and select **Enabled** and hover the phone to the transmitter to enable Cellular 4G communication.

12 Reboot the transmitter through Velox by selecting **On** in **Firmware Information > Reboot System** and tap the phone to device.

13 Wait and hover the phone to the transmitter to confirm if local calendar date/time is successfully synchronized by network time.

14 Trigger data report by selecting **On** in **Cellular 4G Settings > Trigger data report** and hover the phone to the transmitter.

15 Check if MQTT Broker is receiving the messages.

Establish cellular NB-IoT communication

It is necessary to establish the cellular communication of transmitter before putting into operation. This procedure describes how to establish cellular NB based communication between the transmitter and the server (refer to **Cellular NB settings*** on page 61).

1 Insert the SIM card (page 24). Make sure that “Data Option” is enabled in the SIM and enough balance is maintainedDisable cellular NB functionality through Velox.

2 Enable **Advanced Access Level Enable** in **User Access Right Settings** and navigate to **Advanced Settings – Cellular NB > Operation mode**.

3 Click the edit icon and select **Disabled** and tap the phone to the device to disable Cellular NB communication.

4 Configure the below parameters for IoT platform through Velox interface app under **Advance Settings – Cellular NB** and tap the phone to the device to update the parameters.

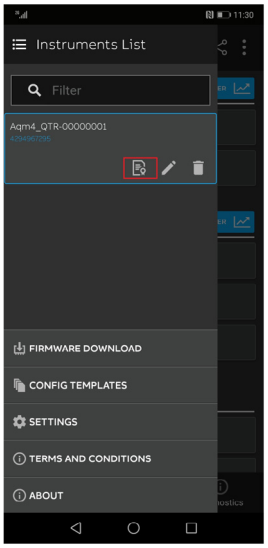
Item	Description
IoT platform host name	e.g. IP address: 180.101.147.115
IoT platform port number	e.g. 5684

5 Read IMEI number through Velox app **Cellular NB Settings > Device Name**. This is the unique identifier of the transmitter on IoT platform, which will be used when registering the transmitter on the IoT platform.

a Generate PSK (pre-shared keys) through Velox app.
Note:
A PSK is generated inside the transmitter and shown in the screen only and could not be extracted or pasted. The registration of transmitter on the IoT platform is based on the PSK and IMEI number.

IMPORTANT (NOTE)
There is a label with an IMEI number from the device and factory generated PSK (pre-shared keys) tagged on the transmitter that needs to be modified during commissioning of the device in the field. You must make a note of the modified PSK as it is required for registering the device to the IoT platform and for trouble shooting in the future.

b Navigate to the sidebar and select **Certificate**:



c Select **Generate PSK**.

d Press **Start** and hover the phone to the transmitter to generate a new PSK.
Once PSK generation is done, the PSK will be shown in a dialog for user to capture to use for registering the transmitter into IoT platform.
Note:
In consideration of cyber security, after generating and reading the PSK through Velox, it is strongly recommended

- To register the transmitter on IoT platform with the PSK and IMEI number.
- Close the dialog box with PSK information in Velox as soon as possible to minimize the possibility of revealing the PSK.

6 Navigate to **Advanced Settings – Cellular NB > Operation mode**.

7 Click the edit icon and select **Enabled** and hover the phone to the transmitter to enable Cellular NB communication.

8 Reboot the transmitter through Velox by selecting **On** in **Firmware Information > Reboot System** and tap the phone to device

9 Wait and hover the phone to the transmitter to confirm if local calendar date/time is successfully synchronized by network time.

10 Trigger data report by selecting **On** in **Cellular NB Settings > Trigger data report** and hover the phone to the transmitter.

11 Check the data report on the server.

7 Operation

Start-up

WARNING – BODILY INJURY

- Observe all battery and other warnings in Section 1, page 5.
- Operation at temperature extremes significantly shortens the battery capacity and life – see **Specification** on page 72.

To start the AquaMaster4 for the first time connect the battery connector (Ⓓ on page 16)/apply mains or renewable power.

Operating display

The LCD is configurable, but by default it displays the volumetric flow rate and totalizer in selected units, which are programmable. For volume totals, the display cycles between forward, reverse and net totals by default, with the direction indicated by the **Σ±** symbols above the volume total. Volume accuracy is shown to 0, 1, 2, 3 or 4 significant digits with a box around the sgnificant digits to indicate them. Further accuracy is available if the flowmeter is read via the Velox app.

The LCD display shows the configured display values, such as flow totals, flowrate and alarm icons.

The sensor fault alarm icon has two states:

- When blinking it indicates a failure to meet OIML R49 self checking Type P (Permanent) self checking. For further causes see **Diagnostics** on page 63.
- When static it indicates a fault with the sensor, its installation or connection.

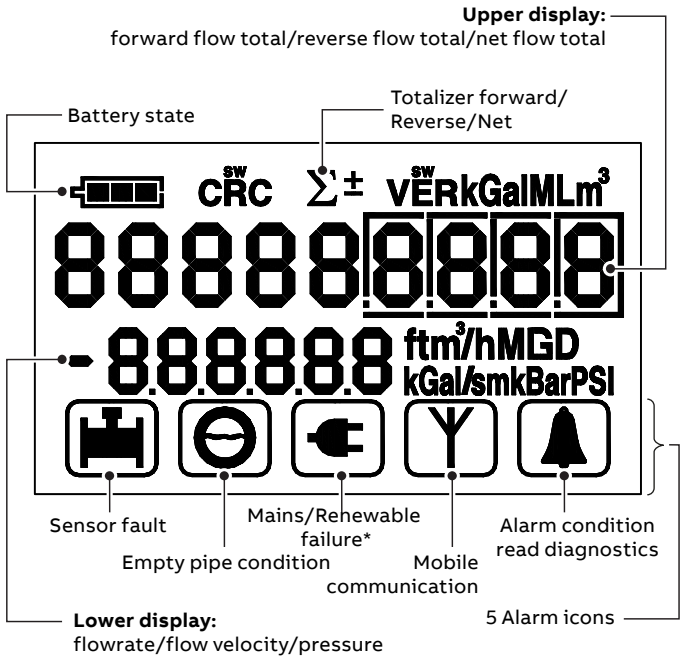


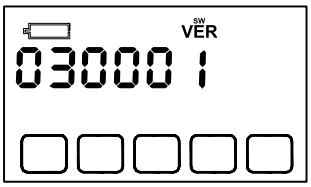
Figure 69 AquaMaster4 display information

If an alarm, fault or power issue occurs, warning icons are displayed on the bottom line.

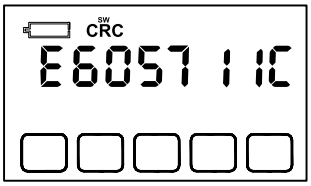
The antenna/Mobile Communication icon has 4 states:

1. When static, it indicates the cellular engine is either connecting or disconnecting from the cellular network.
2. When off, it indicates the cellular engine is in sleep mode.
3. When blinking, slowly it indicates the device is connecting to the cellular network
4. When blinking fast, it indicates the device is communicating/ transmitting data to the server.

For MID/OIML certified systems, a verification sequence is cycled every 10 minutes to check software integrity and that all segments of the LCD display are functioning. The sequence starts with all segments disabled followed by all segments enabled as shown in Figure 65. The flow meter firmware version is then displayed…



…followed by the result of a cyclic redundancy checksum on the currently running flow meter firmware…



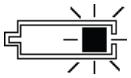
…followed by the lower significant digits of the totalizer value with increased resolution to aid in-situ meter performance verification.

Note: An empty battery state indicator, during verification sequence, for checking the flowmeter firmware version and cyclic redundancy checksum, does not indicate the state of the battery.

*Only for FEW450

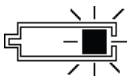
The battery state indicator has 3 segments that indicate the following conditions:

Table 4 Battery icon – status indicators (FEX41X/43X)

Icon state	Battery only	Mains + backup and renewable
	Both batteries in good condition	Backup battery fully charged
	Both batteries in use	Backup battery ⅔rds full
	One battery empty (red wire connection)	Backup battery ⅓rd full
	Replace both batteries	
	No power left no flow measurement	Backup battery empty*

*Backup energy is recharged over a period of time when mains power is restored.

Table 5 Battery icon - status indicators (FEX45X)

Icon state	Battery only	External Back up for Mains/Renewable
	Battery full	External battery full
	Battery ⅔ full	External battery ⅔ full
	Battery ⅓ full	External battery ⅓ full
	Replace batteries	Replace batteries
	No power left no flow measurement	External backup battery empty

WARNING – BODILY INJURY
Batteries must be disposed of in accordance with regulations – refer to page 5.

...7 Operation

Factory-configuration/calibration

AquaMaster4 flowmeters are factory-configured and calibrated. If changes to the configuration are required, these are made via an Android® phone productivity app using a local communications interface (NFC) app for connectivity.

The NFC interface is located on the AquaMaster4 front face where the ABB logo is (just above the LCD) or on the wall-mount coupler (if used). The interface enables direct interaction with AquaMaster4 locally using the ABB Velox phone productivity app (or other compatible ABB phone productivity apps).

> **IMPORTANT (NOTE)**
> Before attempting to exchange data, launch the Velox phone productivity app and enable the NFC option on your phone (configuration device). On an Android device this is normally found in the Settings...> menu).

The Velox phone productivity app enables:

- process values (PV); flow rate, totalizer values to be read
- logger data to be retrieved
- configuration settings to be read or changed
- diagnostic conditions to be read
- firmware updates to be download into the transmitter

Obtain and install the ABB Velox phone productivity app from Google Playstore or ABB portal. The Velox phone productivity app exchanges data with the AquaMaster4 when a configuration device is placed on the AquaMaster4's NFC interface (or the user end of the AquaMaster4 Passive NFC Coupler if this is connected to the transmitter) – see Figure 66 and Figure 67.
Each time data is captured from a transmitter a new file is written; historical data is retained.

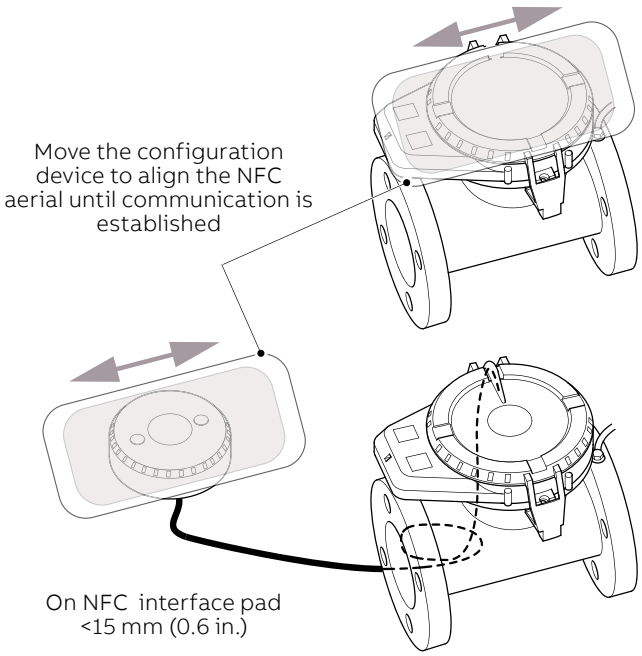


Figure 70 Capturing data to configuration device via NFC

Security and password access

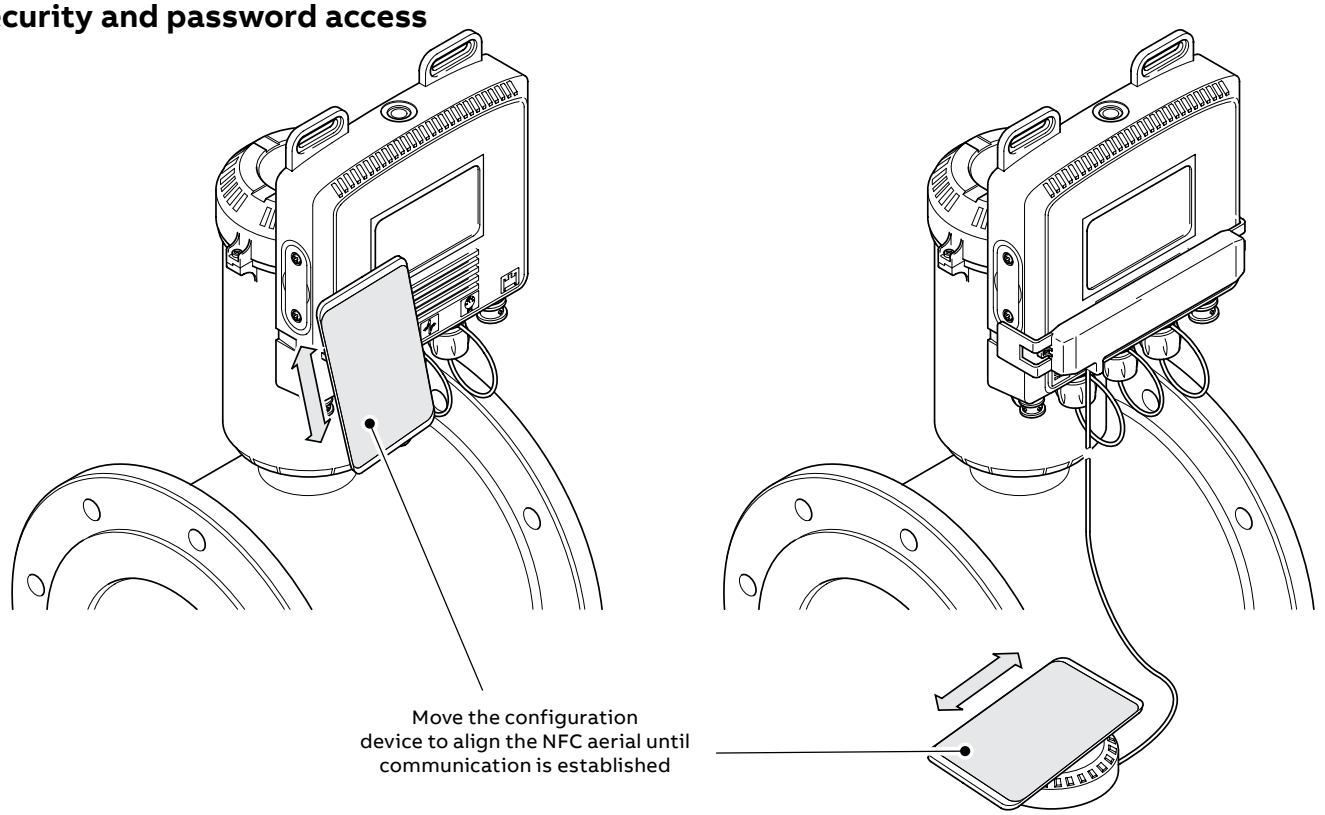


Figure 68 Capturing data to configuration device via NFC (FEX45X)

Access to the transmitter via the NFC interface requires the use of an authentication password. The NFC interface supports two access accounts for FEX410/430 series and five access accounts for FEX450 series product, each with a separate password. There is one user account in FEX410/430 series and three user account for FEX450 series for normal use and an account to reset the user account passwords.

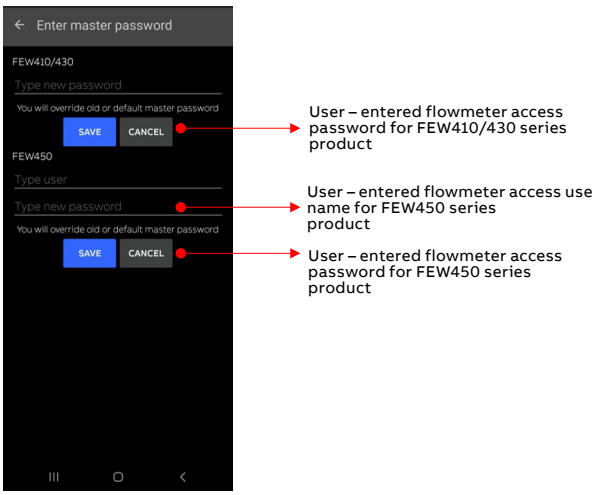
While authenticating the password in the Velox phone productivity app for NFC users, the user name needs to be entered for FEX45X as it supports 3 user accounts. The user name for 3 accounts would be "1" , "2" or "3".

Enter the account authentication password in the Velox phone productivity app before bringing the configuration device into contact with the transmitter. Data exchange will not be successful if an incorrect password is used.

IMPORTANT (NOTE)
Password and PIN details are entered via the Setting option in the Instrument List pane – refer to page 53 for navigation details.

User account 1 to 3 - standard level privileges

Factory default password: **am2k**



These are the main user account for general access to the transmitter and has a user-settable password.
Process values, user configuration settings, transmitter diagnostics conditions and logger data are accessible with the standard level privileges provided by the User account.

All configuration changes made to an FEX45X device are recorded and maintained in the audit log, the date and time are stamped with the identity of the user account used to make the configuration changes. Such information can be exported from the Audit Log Retrieve feature (refer to page 62 on how to retrieve the log).

These are the only items that users generally require and are expected to know during normal flow meter use. Advanced settings and factory-specific configuration (not needed to for normal flowmeter configuration and control) are accessible only with high levels of access privilege. Temporary elevated access privileges can be obtained only with a meter specific one-time use command generated by ABB technical support and service teams.

IMPORTANT (NOTES)

- It is strongly recommended that the account's factory default authentication password is changed from the factory default on commissioning the flowmeter.
- When changing a password, record it somewhere secure, especially if each flowmeter has a unique password. If a password is lost or unknown, it must be reset to the factory default password using a single-use hash code that is specific to the applicable meter. This will reset the flowmeter to the factory default settings and allow access to it.

Contact your ABB technical support or service engineer for help if you need access to advanced settings or factory configuration. (Note, more data is exchanged via the NFC connection with higher levels of access so it takes longer to read from the flowmeter when these privileges are being granted.)

IMPORTANT (NOTE)
The command code/single-use hash code is specific to the applicable meter and generated by ABB technical support/service teams only. Contact your regular ABB technical support or service engineer for help if you need to reset the user account password.

...7 Operation

Data transmission via cellular 4G (FEX45X)

Additional transmitter configuration is required before normal operation.

Note:
Below are the additional configurations to be done for normal operation along with those as per **Establish cellular 4G communication** on page 41.

1 Enable **Advanced Access Level Enable** in **User Access Right Settings** and navigate to **Advanced Settings – Cellular 4G > Operation mode**.

2 Click the edit icon and select **Disabled** and tap the phone to the device to disable Cellular 4G communication.

3 Configure the below parameters through Velox interface app under **Advance Settings – Cellular 4G** and tap the phone to the device to update the parameters.

Item	Description
Report Mode	Daily/Weekly
Data report interval - Daily	1 hour/6 hour/12 hour/1 day/15 minutes/30 minutes/2 hours/4 hours/8 hours
Data Report Mode	Summary Report/Detail Report/ Both*
Weekday Selection (Only if Report Mode is Weekly)	Monday/Tuesday/Wednesday/ Thursday/Friday/Saturday/ Sunday (multiple selection)
Data Report Time Base	e.g. 0 (to set the base time for sending report at 00:00 h), the value should be in seconds.
Report Packet Interval**	Off/15 minutes/30 minutes/ 1hour/2 hours/4 hours/6 hours/8 hours/12 hours/24 hours
Alarm Report Interval (min)	Eg. 10
Alarm report on raise condition	Off/On
Alarm report on clear condition	Off/On
Downlink Time Window (s)*	2 - 120
Report Content	Totalizer/Flowrate/Pressure/ Maintenance info (multiple selection)

* Only available with devices supported by MQTT protocol

** Report Packet interval enables the device to send report in packets/group. For example, sending Summary Report for every 15 mins once a day needs the Report Packet Interval to be set as 15 minutes and Data report interval as 24 hours.

5 In case of Detail report for FTPS/FTP device or Detail Report metrics for an MQTTS/MQTT SparkPlug B device, **Logging interval & Retrieved record interval** needs to configure under **Process Logger Settings**.

6 Transmitter supports optional SIM card configurations in **Advance Settings – Cellular 4G**.

- SIM card pin: The transmitter supports to set PIN for un-authorized access by setting the PIN in **Advance Settings – Cellular 4G > SIM card pin.**
- Lock SIM card: Select **On** in **Advance Settings – Cellular 4G > Lock SIM card** to lock the SIM card with the PIN as per above.
- Unlock SIM Card: Select **On** in **Advance Settings – Cellular 4G > Unlock SIM card** to unlock the SIM card with the PIN as per above.
- SIM card PUK: If the PIN is lost, the transmitter allow customer to enter PUK (Personal Unblocking Key) for the SIM card with the reset PIN code under **Advance Settings – Cellular 4G > SIM card puk**.

7 Navigate to **Advanced Settings – Cellular 4G > Operation mode**.

8 Click the edit icon and select **Enabled** and hover the phone to the transmitter to enable Cellular 4G communication.

9 Reboot the transmitter through Velox by selecting **On** in **Firmware Information > Reboot system** and hover the phone to device and the transmitter is now ready for normal operation.

Note:
Renewal for SSL/TLS keys and certificates is easy and similar to the steps in **Chapter 6. Commissioning, Establish Cellular Communication.....** on page 39 to 43). Every time when a new signed CSR file is exported, the internal 4G private key will be renewed meaning the previous internal 4G private key is erased and cannot be used. The renewed and signed device public-key certificate should be imported into the device to make sure that the interval 4G private key and the device public-key certificate are used in pair. Similarly, importing the trust anchor will renew the trust anchor with the previous one.

Data transmission via cellular NB (FEX45X)

Additional transmitter configuration is required before normal operation.

Note:

Below are the additional configuration to be done for normal operation along with those as per **Establish cellular NB-IoT communication** on page 42.

1 Enable **Advanced Access Level Enable** in **User Access Right Settings** and navigate to **Advanced Settings – Cellular NB > Operation mode**.

2 Click the edit icon and select **Disabled** and tap the phone to the device to disable Cellular NB communication.

3 Configure the below parameters through Velox interface app under **Advance Settings – Cellular NB** and tap the phone to the device to update the parameters.

Item	Description
Data report time base	e.g. 0 (to set the base time for sending report at 00:00 h), the value should be in seconds.
Data report interval	1 hour / 6 hour / 12 hour / 1 day
Data report mode	summary report
Alarm report on raise condition	Off / On
Alarm report on clear condition	Off / On

4 In case of Detail report, **Logging interval & Retrieved record interval** needs to configure under Process Logger Settings.

5 Navigate to **Advanced Settings – Cellular NB > Operation mode**.

6 Click the edit icon and select **Enabled** and hover the phone to the transmitter to enable Cellular NB communication.

7 Reboot the transmitter through Velox by selecting **On** in **Firmware Information > Reboot system** and hover the phone to device and the transmitter is now ready for normal operation.

Data report for FEX45X

The measured data from the device will be transferred by the transmitter periodically based on the configuration. Below are examples of different types of data report.

Note:

In case of NB Transmitter, the file type is JSON only.

Summary report

The summary report contains summary information for measured data in a period based on configured data report interval.


```
{
    "date": "2020.03.24",
    "time": "22:15:00",
    "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": "100%"
}
```


Figure 69 Example of summary report in JSON format

	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	2019.09.20	14:40:55	m3	3.51	2.11	1.4	m3/h	2.001	2.001	2.001	OK	100%	100%

Figure 70 Example of summary report in CSV format

...7 Operation

Detail report

The detail report contains detailed information for measured data in a period based on configured data report interval and the record interval is as per configuration done in **Retrieved record interval in Process Logger Settings**.


```
{
    "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%"
        }
    ]
}
```

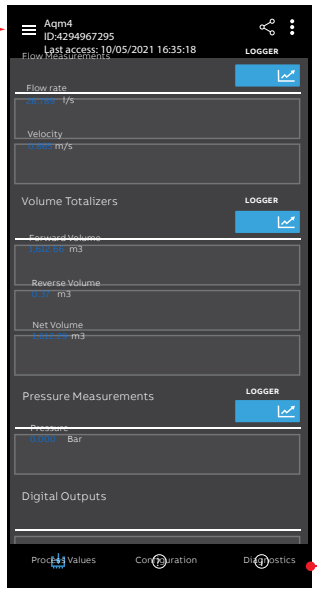

Figure 71 Example of detail report in JSON format

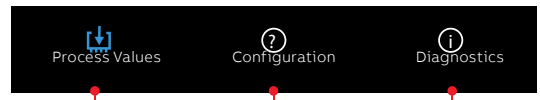
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Date	Time	Totalizer Unit	Totalizer Forward	Totalizer Reverse	Totalizer Net	Flow Rate Unit	Flow Rate Value	Pressure Unit	Pressure Value	Alarm Status	Battery Life	Signal Quality
2	2021.04.19	4:40:00	ft3	3510086.906	745.7515494	3509341.154	imp-gal/day	0	bar	0	OK	100%	100%
3	2021.04.19	4:40:15	ft3	3510086.906	745.7515494	3509341.154	imp-gal/day	0	bar	0	OK	100%	100%
4	2021.04.19	4:40:30	ft3	3510086.906	745.7515494	3509341.154	imp-gal/day	0	bar	0	OK	100%	100%

Figure 72 Example of detail report in CSV format

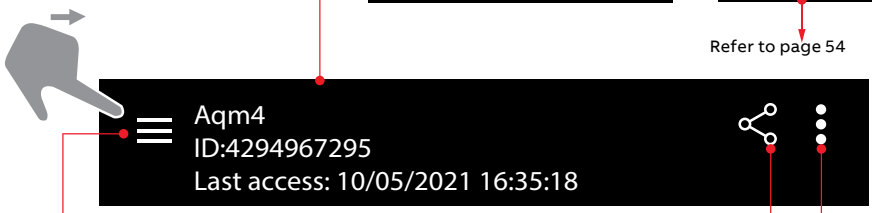
Velox user interface app

Velox
phone productivity
app



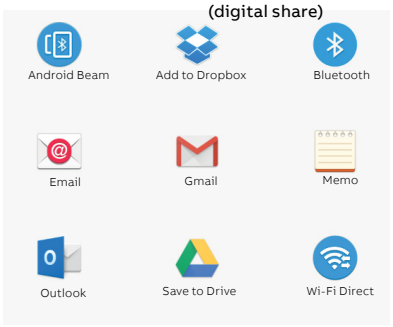


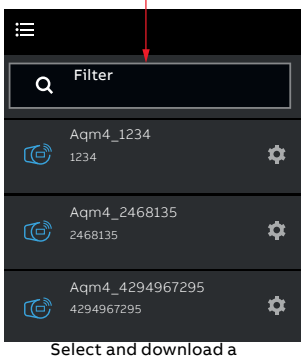
Refer to page 54 | Refer to page 55 | Refer to page 63



Context menu

Share data icon
(digital share)

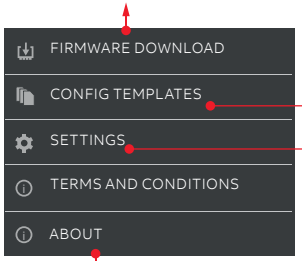


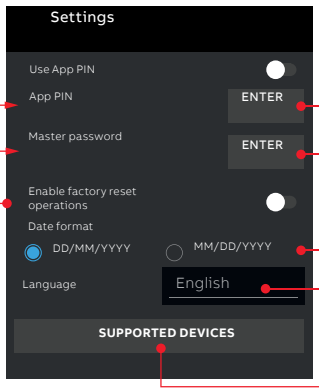


List of captured
AQM4 flowmeters

Select and download a
compatible firmware file

List of configuration
templates
(settings), resident
in the phone
productivity app –
these enable
flowmeter settings
to be changed





User-set PIN
(prompted at launch)

User-entered flowmeter
access password

Desired date format

Language displayed on the phone
productivity app –
user-selectable (FEX41X/43X only)

List of supported flowmeters –
enables new flowmeters to be added
and existing flowmeters to be
deleted

Enter/Edit/Save
passwords and PIN

When enabled, the user can make use of the user access password reset action (located on Configuration tab-page/User Access Rights). When these operations are enabled, the user can read the transmitter ID and password, reset PIN values and invoke the user access password reset action.
Note: Easy way to save configuration templates: The ABB Velox app lets users save configuration templates. It is the user's responsibility to share these templates via secure means.

Software version and
associated software details

Figure 73 Overview - Velox interface

...7 Operation

Process values

This window displays operating values for the selected flowmeter:

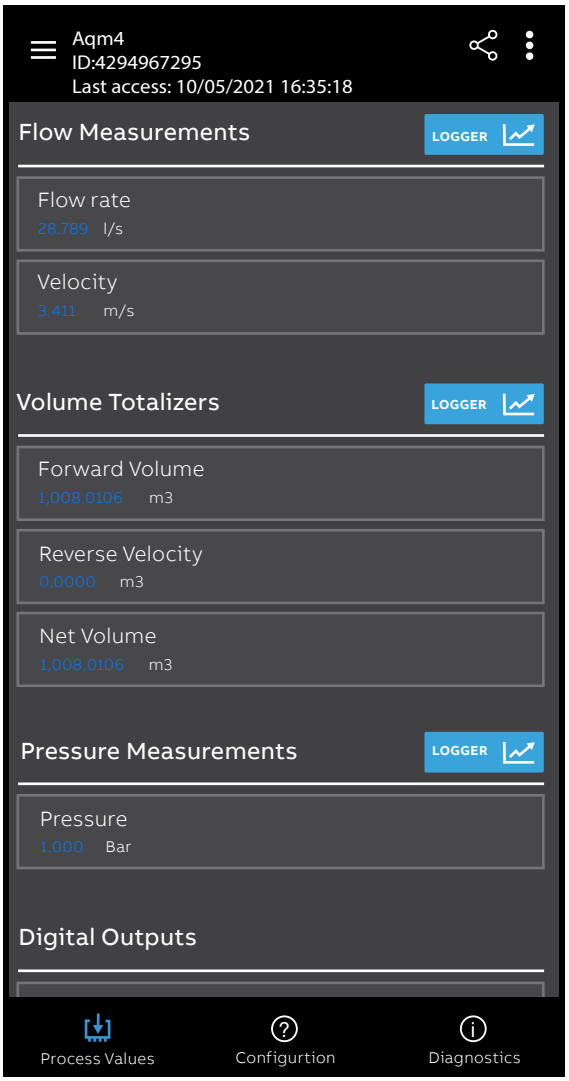


Figure 74 Process Values window

Logger data

If the (optional) logger functionality was ordered, logger data is acquired by pressing the **LOGGER** button when the Process Values window is displayed. The log type and a date/time range must be specified.

Data acquisition is started by pressing the **GET LOGGER DATA** button and holding the phone within NFC range of the associated transmitter.

Logger menu options comprise:

Menu	Function
Get ... Log	A drop-down menu used to select one of the following log types: Get Flow and Pressure Log Get Flow Log Get Pressure Log (pressure transducer option required) Get Totalizer Log
Date (from)	A user-set calendar used to enter the date to start logging
Date (to)	A user-set calendar used to enter the date to cease logging
Time (from)	A user-set clock used to enter the time to start logging
Time (to)	A user-set calendar used to enter the time to cease logging

Acquired data is displayed on a chart (see below) and can be shared via Bluetooth/email or saved to a drive – see page 53:

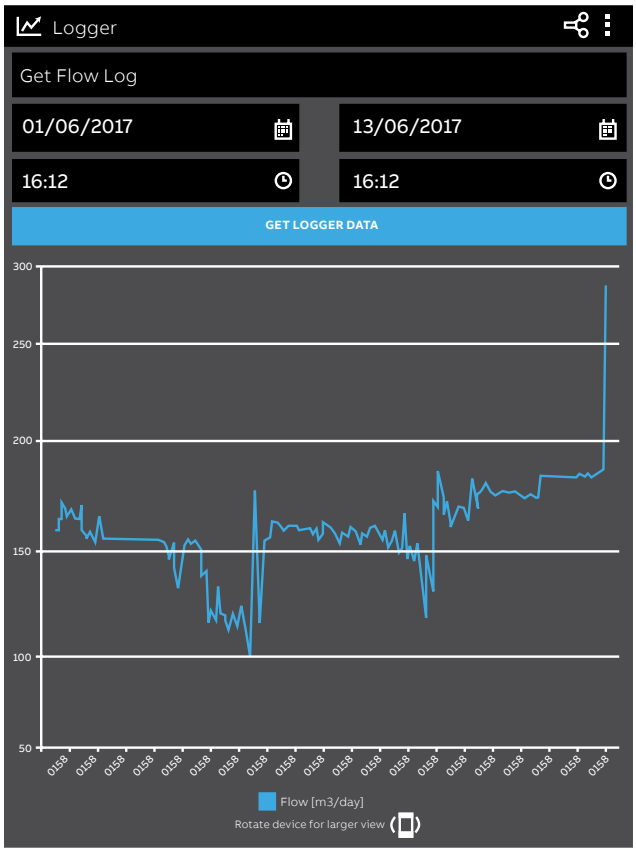


Figure 75 Example of logger data displayed on a chart

Configuration

IMPORTANT (NOTE)

- Access rights are transmitter-specific. Protected read-only fields cannot be overwritten via Velox even if read/write access is displayed on the phone (at Configuration level).
- **Pressure Settings** and **Logger Settings** menus are enabled only if the transmitter was ordered with these options. Menus are not displayed if an option is not ordered.
- To edit values in the device, make changes in the Velox app and put your phone in NFC range.

This window displays a list of Configuration menus.
Menus with a icon can be edited by the end-user. All other menus are factory presets and cannot be modified by the end-user.

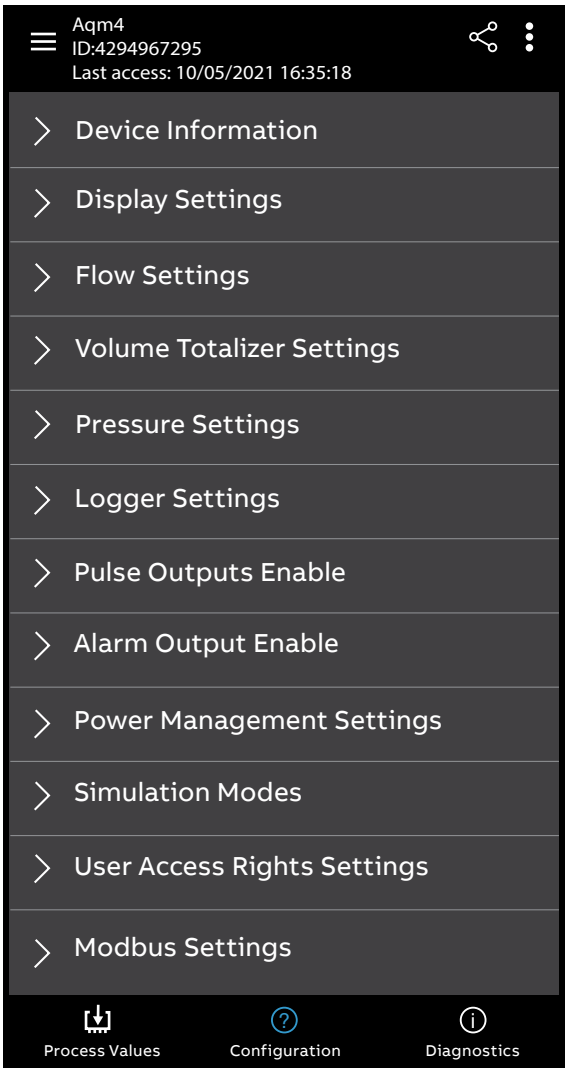


Figure 76 Configuration window

The **Configuration** tab allows users to intuitively go through the easy setup menu and make changes. Changes made are clearly highlighted.



Figure 77 Easy and intuitive configuration menu

…7 Operation

…Configuration

Device Information	Description	Note
Transmitter unique ID	Transmitter-specific	Read-only
Transmitter serial number	Transmitter-specific	Read-only
Transmitter date of manufacture	Date and time of transmitter manufacture	Read-only
Sensor unique ID	Sensor-specific	Read-only
Sensor serial number	Sensor-specific	Read-only
Sensor date of manufacture	Date and time of sensor manufacture	Read-only
Transmitter build type	Factory set. Options: Integral sensor/Remote sensor	Read-only
Meter tag	Used to enter a unique tag for the meter	Editable
Meter owner	Used to enter the owner of the meter	Editable
Transmitter location	Used to enter the location of the transmitter	Editable
Sensor location	Used to enter the location of the sensor	Editable
Sensor type	Type of sensor. Types: Full bore/Probe	Read-only
Calibration accuracy	Options: Normal/Class 1/Class 2/MID Class 1/MID Class 2	Read-only
Sensor certificate number	Sensor-specific	Read-only
MID switch state	The position of the MID lock switch. Options: Locked/Unlocked/Not fitted	Read-only
Lining material	The lining material of the meter	Read-only
Electrode material	The electrode material of the meter	Read-only
Flange material	The flange material of the meter	Read-only
Calendar date/time	Used to set the device date (format DD/MM/YYYY) and time (format hr/min/sec). A prompt is displayed if the set date/time differs from the device.	Editable
Time zone*	Time zone adjustment configurations. Options: UTC-12:00 | UTC-11:00 | UTC-10:00 | UTC-9:30 | UTC-0:00 | UTC-8:00 | UTC-7:00 | UTC-6:00 | UTC-5:00 | UTC-4:00 | UTC-3:30 | UTC-3:00 | UTC-2:00 | UTC-1:00 | UTC | UTC+1:00 | UTC+2:00 | UTC+3:00 | UTC+3:30 | UTC+4:00 | UTC+4:30 | UTC+5:00 | UTC+5:30 | UTC+5:45 | UTC+6:00 | UTC+6:30 | UTC+7:00 | UTC+8:00 | UTC+8:45 | UTC+9:00 | UTC+9:30 | UTC+10:00 | UTC+10:30 | UTC+11:00 | UTC+12:00 | UTC+12:45 | UTC+13:00 | UTC+14:00	Editable
Daylight saving*	Used to set daylight saving mode. Options: On | Off	Editable
Daylight Saving Start Time (m.w.d-hhmmss)*	Used to set the start of Day light saving in (month,week,day - Time)	Editable
Daylight Saving End Time (m.w.d-hhmmss)*	Used to set the end of Day light saving in (month,week,day - Time)	Editable
Daylight Saving Time Shift/ Bias(mins)*	Used to set the time shift due to Day light saving in minutes	Editable
Sensor and Connection Type	The status of the connector sensor. Options: Integral sensor/VKG sensor connected/VKG sensor disconnected	Read-only
Transmitter firmware checksum#	The checksum of the firmware in the transmitter (FEX41X/43X)	Read-only
Top Line User Decimal	Used to set the decimal place for the totalizer	Editable
Geo Co-ordinates* - Latitude (°)	Used to set the latitude of the device	Read-only
Geo Co-ordinates* - Longitude (°)	Used to set the Longitude of the device	Read-only

Display Settings	Description	Note
Velocity	Used to select if the velocity is displayed on the transmitter	Editable
Flow rate	Used to select if the flow value is displayed on the transmitter	Editable
Pressure	If the option is ordered, used to select if pressure is displayed on the transmitter	Editable
Forward Totalizer	Used to select if the forward flow total is displayed on the transmitter	Editable
Reverse Totalizer	Used to select if the reverse flow total is displayed on the transmitter	Editable
Net Totalizer	Used to select if the net total flow is displayed on the transmitter	Editable
Display Test	Used to test the display of the transmitter	Editable
Top line leading zeros	Used to set the leading zeros for the totalizer	Editable

Process Logger Settings*	Description	Note
Logging interval	Used to enter interval time between logging of process values	Editable
Retrieved record interval	Used to enter interval time between data capture when retrieving process values	Editable

*Available with FEX45X only
#Available with FEX41X/FEX43X only

Flow Settings	Description	Note
Velocity units	Used to select the unit for velocity displayed on the transmitter	Editable
Flow rate units#	Used to select the unit for flow displayed on the transmitter. Custom units | l/s | l/min | l/hr | Ml/day | m3/s | m3/min | m3/hr | m3/day | gal/s | gal/min | gal/hr | Mgal/day | ft3/s | ft3/min | ft3/hr | us-gal/s | us-gal/min | us-gal/hr | us-Mgal/day.	Editable
Custom flow rate units name	Used to enter the name for custom flow units (if required) displayed on the transmitter. Ensure Custom units is selected in the Flow Units parameter before entering a name here.	Editable
Custom flow rate units scaling factor (from m3/s)	Used to enter a value to be used as the scaling factor for custom flow units. Ensure Custom units is selected in the Flow Units parameter before entering this value.	Editable
Probe On Off	Displayed only if an insertion sensor is connected	Read-only
Meter Bore (mm)	The bore size of the sensor/probe pipe connected to the transmitter	Read-only
Meter Bore (mm) (Probe)	Displayed only if an insertion sensor (probetype) is connected to the transmitter	Editable
Probe Profile Factor Fp	Displayed only if an insertion sensor (probetype) is connected to the transmitter	Editable
Probe Insertion Factor Fi	Displayed only if an insertion sensor (probetype) is connected to the transmitter	Editable
Filter Response Time (seconds)	Flowmeter time constant, default 3 s	Editable
Mains Noise Rejection Frequency (Hz)	Selectable between 60 and 50 Hz. Note: see page 37 before setting this option.	Editable
Max nominal flow rate Q3	The Q3 flow rate of the meter	Read-only
Flow rate low trip %	Used to enter low flow rate trip in %	Editable
Flow rate high trip %	Used to enter high flow rate trip in %	Editable
User flow direction	Used to set flow direction	Editable
User cut-off (%)	Used to set user cut-off flow rate in %	Editable
Flow (%)	Displays the flow in %	Read-only
Alarm hysteresis (%)	Used to set alarm hysteresis in % for alarm	Editable

For a MID / OIML system, the flow units will be factory set to m^3/h and cannot be changed by the user while the "lock" switch is engaged. If the lock switch is disengaged to change the flow units, they will revert to m^3/h as soon as the lock switch is re-engaged.

Volume Totalizer Settings	Description	Note
Volume Units**	Used to select the unit for volume displayed on the transmitter. Options: Custom Units | l | m3 | imp-gal | ft3 | us-gal | Ml | us-Mgal | imp-Mgal | ml | hl | kgal | acre-feet.	Editable
Custom Volume Units Name	Used to enter the name for custom volume units displayed on the transmitter. Ensure (Custom Units) is selected in the Volume Units parameter before entering a name at this parameter.	Editable
Custom Volume Units Scaling Factor (from m3)	Used to enter a value to be used as the scaling factor for custom volume units. Ensure (Custom Units) is selected in the Volume Units parameter before entering a value here.	Editable
Reset Totalizers	Reset forward, reverse and net totalizers to zero	Editable
Net Totalizer Range***	0-Used to select totalizer range -max .. 0 .. +max (Overflow from +max to 0, underflow from 0 to +max) 1-Used to select totalizer range 0 .. +max (Overflow from +max to 0, underflow from 0 to +max)	Editable

Pressure Settings		Note
Pressure Units	Used to select the unit for pressure displayed on the transmitter. Options: Custom units | Bar | mBar | kPa | mmHg | mH2O | psi | ftH2O | Pa	Editable
Transducer Height Offset (mm)	The height difference between the pressure transducer and the top of the flow pipe	Editable
Pressure Transducer Output (mV/V)	Read from the tag of the transducer span factor and enter it	Editable
Pres. Transducer Zero Offset (mV/V)	Read from the tag of the transducer zero factor and enter it	Editable
Transducer linearity correction (%)	Display the linearity of transducer in %	Editable
Transducer full scale pressure (Bar)	Display the pressure limit of the transducer	Editable
Pressure display type	Used to select the display pressure type. Options: Gauge/Absolute	Editable
Pressure response time (seconds)	Used to set the response time for pressure output	Editable
Pressure Low Trip(%)*	Used to enter Low pressure trip in %	Read-only
Pressure High Trip(%)*	Used to enter High pressure trip in %	Read-only
Pressure Low - Low Trip(%)*	Used to enter Low - Low pressure trip in %	Read-only
Pressure High - High Trip(%)*	Used to enter High - High pressure trip in %	Read-only
Pressure Alarm Hysteresis(%)*	Used to enter the Hysteresis %	Read-only

* Available with FEX45X only

** For a MID and OIML system, the volume units will be factory set to m^3 and cannot be changed by the user while the "lock" switch is engaged. If the lock switch is disengaged to change the volume units, they will revert to m^3 as soon as the lock switch is re-engaged.

*** The displayed totalizer value is limited to 9 digits for a positive value and 8 digits for a negative value. Therefore the limits +max and -max depend on the decimal point position in the displayed totaliser value. An example for totalizer value with 2 decimal places: +max is 9999999.99 and -max is -999999.99.

...7 Operation

...Configuration

Logger Settings#	Description	Note
Flow and pressure logging interval (seconds)	Used to enter an interval time between logging of flow and pressure values.	Readable level 3 Writable level 4
Flow and pressure retrieved record interval (seconds)	Used to enter an interval time between data capture when retrieving flow and pressure values	Editable
Totalizer Logging Hour	Hour of day totals are recorded	Editable
Clear Logging Data	Erases all logging data	Editable
Earliest Logger Data/Time	Informs start date/time of log	

Pulse Output Settings	Description	Note
Pulse Outputs Configuration	Used to enable/disable pulse outputs. Options: Disabled/Enabled	Editable, default: Disabled
Pulses Per Unit Volume	Used to enter a value (the quantity) of pulses per unit volume. Ensure Enabled is selected at the Pulse Outputs Configuration parameter before entering a value at this parameter.	Editable
Pulse Width (ms)	Used to enter the pulse duration (in ms)	Editable
Max Available Pulse Frequency (Hz)***	Maximum frequency for a given pulse width	Read-only

*** Use of high pulse output frequencies and long pulse widths will significantly shorten battery life. Ideally F≤ 5 Hz with width ≤ 2 ms.

Alarm Output Settings	Description	Note
Clear All Alarms	Erases all alarm state	Editable
Alarm Output Configuration	Used to enable / disable alarm output. Options: Disabled | Always on | Normally off | Normally on	Editable, default: Disabled
Totalizer Rollover	0 (Off), 1 (On)	Read-only
Totalizer Reset	0 (Off), 1 (On)	Read-only
Flow Sensor Communications	0 (Off), 1 (On)	Read-only
High Flow Alarm	0 (Off), 1 (On)	Read-only
Low Flow Alarm	0 (Off), 1 (On)	Read-only
High Pressure Alarm*	0 (Off), 1 (On)	Read-only
Low Pressure Alarm*	0 (Off), 1 (On)	Read-only
High-high Pressure Alarm*	0 (Off), 1 (On)	Read-only
Low-low Pressure Alarm*	0 (Off), 1 (On)	Read-only
Empty Pipe	0 (Off), 1 (On)	Read-only
Pulse output saturated	0 (Off), 1 (On)	Read-only
Battery Power Low Warning	0 (Off), 1 (On)	Read-only

Power Management Settings	Description	Note
System power type	Battery | Mains | Renewable (Factory-set)	Read-only
Current power source	Mains, AC power, Internal battery supply	Read-only
Measurement interval (seconds)	15 s – factory setting	Read-only
Internal supply voltage (V)	Current on-board power supply voltage in voltage	Read-only
Battery life (%)*	Used to indicate the remaining battery life	Read-only
D - Cell Battery Capacity (Ah)*	The capacity of a single D - Cell Battery	Read-only
Number of D - Cell*	Number of D - Cells inserted in the PSU	Read-only

Simulation modes	Description	Note
Flow Simulation Mode	Used to select the simulation mode. Options: Off | Velocity (mm/s) | Flow (system units)	Editable
Flow Simulation Value**	Used to set a value for flow simulation.	Editable
Pulse Output Simulation Configuration	Used to select the simulation mode for pulse outputs. Options: Off | Forward (DO1) | Reverse (DO2)	Editable
Pulse Output Simulation Frequency	Range 0 to 50 Hz	Editable
Pressure Simulation Mode	Options: Off/On	Editable
Pressure Simulation Value	Used to set a value for pressure simulation	Editable

#Logger Settings availble with FEX41X/43X only
* Available with FEX45X only
**Totalizer changes while a simulation mode is enabled, are not saved in non-volatile memory, and are reversed when the simulation mode is disabled

User Access Rights Settings	Description	Note
Current Access Level***	The current level of access	Default at Level 3
Transmitter Unique ID		Read-only
Elevated Access PIN		Read-only
Change User Access Password***	Used to enter a different/new access password	Editable
Confirm User Access Password*** Change	Used to re-enter/confirm the access password set at the Change User Access Password menu	Editable
Elevated Access Request	Transmitter unique ID (see above) and Elevated Access PIN. Enter into 'Hasher',' result of 'Hasher' is a string; enter the value in this field.	Editable
Lock Switch Function	Indicator MID settings	Read-only
Advanced Access Level Enable	Enables/Disable advanced level access	Editable
User Password Reset PIN		Read-only
Current User**	The current user	Read-only
Current User Access Level**	The current level of Access for the current user	Read-only
User Password Reset Request	Transmitter unique ID (see above) and User Password Reset PIN. Enter into 'Hasher',' result of 'Hasher' is a string; enter the value in this field.	Editable
Activate User**	The current active user operating/configuring the device	Read-only
User New Password**	Used to enter a different/new access password for the current user	Editable
User New Password Confirmation**	Used to re-enter/confirm the access password set at the User New Password	Editable
User Elevated Access Request**	Transmitter unique ID (see above) and Elevated Access PIN. Enter into 'Hasher','result of 'Hasher' is a string; enter the value in this field.	Editable

Sensus Settings *	Note
Sensus Serial Number	Editable
Sensus Totalizer Source: 0 Totalizer Fwd 1 Totalizer Rev 2 Totalizer Net	Editable
Include Subfields: 0 No Subfields in Sensus read message 1 Mult/units Subfields included in Sensus read message	Editable
Reading multiplier: -3 x 0.001 -2 x 0.01 -1 x 0.1 0 x 1 1 x 10 2 x 100 3 x 1000	Editable
Reading Digits: 6 Reading has 6 digits (range 000000 to 999999) 7 Reading has 7 digits (range 0000000 to 9999999) 8 Reading has 8 digits (range 00000000 to 99999999)	Editable

* Applicable only to flowmeters ordered with Sensus AMR enabled.
** Available with FEX45X only
*** Available with FEX43X/41X only

...7 Operation

...Configuration

Reader Output Totalizer Values	Description
Display value	
[1 2 3 4 5 6 7 8 9]	Display value to 0 DPs
[2 3 4 5 6 7 8 9.1]	Display value to 1 DPs
[3 4 5 6 7 8 9.1 2]	Display value to 2 DPs
[4 5 6 7 8 9.1 2 3]	Display value to 3 DPs
[5 6 7 8 9.1 2 3 4]	Display value to 4 DPs
Reading value	
[2 3 4 5 6 7 8 9]	mult = 0, digits = 8
[3 4 5 6 7 8 9]	mult = 0, digits = 7
[4 5 6 7 8 9]	mult = 0, digits = 6
[1 2 3 4 5 6 7 8]	mult = 1, digits = 8
[2 3 4 5 6 7 8]	mult = 1, digits = 7
[3 4 5 6 7 8]	mult = 1, digits = 6
[7 1 2 3 4 5 6 7]	mult = 2, digits = 8
[1 2 3 4 5 6 7]	mult = 2, digits = 7
[2 3 4 5 6 7]	mult = 2, digits = 6
[8 7 1 2 3 4 5 6]	mult = 3, digits = 8
[7 1 2 3 4 5 6]	mult = 3, digits = 7
[1 2 3 4 5 6]	mult = 3, digits = 6
[3 4 5 6 7 8 9 1]	mult = -1, digits = 8
[4 5 6 7 8 9 1]	mult = -1, digits = 8
[5 6 7 8 9 1]	mult = -1, digits = 8
[4 5 6 7 8 9 1 2]	mult = -2, digits = 8
[5 6 7 8 9 1 2]	mult = -2, digits = 7
[6 7 8 9 1 2]	mult = -2, digits = 6
[5 6 7 8 9 1 2 3]	mult = -3, digits = 8
[6 7 8 9 1 2 3]	mult = -3, digits = 7
[7 8 9 1 2 3]	mult = -3, digits = 6

Note: The meter has an internal totaliser range of 000000000000.0000 to 999999999999.9999 which allows it to scale up and down depending on the reading multiplier. The reading value depends on the multiplier and the number of digits that are configured.

Modbus Settings	Note
Modbus Device Address	Editable
Modbus Port Settings 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	Editable
Modbus Most Significant Register First Format 0 off 1 on	Editable

***** Applicable only to flowmeters ordered with Modbus enabled

Cellular 4G settings*	Description	Note
Network Operator	Operator name of the network that the device has registered to	Read-only
Signal Quality (%)	Cellular signal quality in percentage	Read-only
Super Cap Voltage (V)	Current voltage of internal super cap	Read-only
Access Technology	Current selected cellular access technology. Options: GSM | UTRAN | UTRAN_HSDPA | UTRAN_ HSUPA | UTRAN_HSDPA_HSUPA | E-UTRAN | CDMA	Read-only
Roaming Indicator	Indicator for roaming status. Options: Off/On	Read-only
Report Mode (Daily/Weekly)	Current report mode selected. Options: Daily |Weekly	Read-only
Weekday Selection	Current selected days during which the report/data being sent in Weekly mode Options: Sunday | Monday | Tuesday | Wednesday | Thursday | Friday| Saturday	Read-only
Data Report Interval	Time interval for data report in Daily Mode	Read-only
Data Report Base Time	Time base for device to send data report in a day in seconds. Range: 0 ~ 86399 seconds (i.e. within 1 day)	Read-only
Data Report Mode	The type of data report to be sent. Options : Summary report| Detail report|Both	Read-only
File Format##	Current file format for data transfer. Options: JSON | CSV	Read-only
FTP Server Host Name##	Remote FTP/FTPS Server host name in IP address or domain name format.	Read-only
FTP Server Port##	Remote FTP/FTPS server port number	Read-only
FTP User Name##	Current user name for accessing remote FTP/FTPS Server	Read-only
FTP Working Directory##	Current working directory on remote FTP/FTPS server	Read-only
MQTT Server Host Name#	Remote MQTT/MQTTS Server host name in IP address or domain name format.	Read-only
MQTT Server Port#	Remote MQTT/MQTTS server port number	Read-only
MQTT User Name#	Current user name for accessing remote MQTT/MQTTS Server	Read-only
MQTT Keep Alive#	Current keep alive interval for MQTT in seconds.	Read-only
MQTT SPB Group ID#	Current group_id for Sparkplug B topic namespace.	Read-only
MQTT SPB Node ID#	Current node_id for Sparkplug B topic namespace.	Read-only
MQTT SPB Device ID#	Current device_id for Sparkplug B topic namespace.	Read-only
MQTT Device Name#	Used for MQTT client ID from transmitor ID, sensor ID or Meter tag.	Read-only
Report Content Selection	Current MQTT report content selection.	Read-only
TLS On Off***	TLS is enabled or not . Options: On|Off	Read-only
TLS Authentication Mode	Current TLS authentication method. Options: None|Verify server cert only|Mutual authentication	Read-only
DNS Primary Server Address	IP address of primary DNS server	Read-only
DNS Secondary Server Address	IP address of secondary DNS server	Read-only
NTP Server Host Name	Remote NTP Server host name in IP address or domain name format	Read-only
NTP Server Port	Remote NTP Server port number	Read-only
Diagnosis Format	Device Diagnosis Format. Options: AquaMaster4 format|AquaMaster3 format	Read-only
Report Packet Interval	Time interval for sending report in packets. Options: Not Used |15 mins |30 mins |1 hour |2 hours |4 hours|6 hours |12 hours |24 hours	Read-only
Trigger Data Report	Manually trigger a data report	Editable
Sync Network Time	Manually trigger the synchronization to network time	Editable
Last Report Time	Display the last data report sent time	Read-only
Module IMEI Number	Display the module IMEI number	Read-only

*Only available with FEX45X transmitter
*** Disable TLS to switch to FTP or MQTT protocol. & Select "None" for enabling FTP or MQTT protocol
# Available with device supporting MQTTS/MQTT protocol only
Available with device supporting FTPS/FTP protocol only

…7 Operation

…Configuration

Cellular NB settings*	Description	Note
Battery Life	Battery life indication	Read-only
Signal quality	Cellular signal quality in percentage	Read-only
Local battery voltage	Current voltage of cellular interface buffer battery	Read-only
Data report timebase	Time base for data report with in one day in seconds. Range: 0 ~ 86399 seconds (i.e. within 1 day)	Read-only
Data report interval	Time interval for data report. Options: 1 hour | 6 hours | 12 hours | 24 hours	Read-only
Server IP	IP address of IoT Platform to connect	Read-only
Server port	Port number of IoT Platform to connect.	Read-only
Band	Current cellular band configuration. Options: Band 1 | Band 3 | Band 5 | Band 8 | Band 20 | Band 28	Read-only
Power class	Current cellular power class configuration. Options: 23dBm | 20dBm | 14dBm	Read-only
Band	Manually trigger a data report	Editable

*Only available with FEX45X transmitter

Firmware Information	Description	Note
Flowmeter Firmware Part Code**	3KXF208402U0113	
Flowmeter Firmware Version**	The version of firmware installed on the transmitter	
Flowmeter Firmware Date**	The firmware date on the transmitter	
Bootloader Firmware Version**	ID of the bootloader firmware	
UAM Firmware Version**	ID of the update application manager firmware	
MCU0 Application Version - 3KXF065016G0013*	The version of firmware installed on the transmitter	Read-only
MCU0 Boot1 Version - 3KXF065018G0013*	The version of firmware installed on the transmitter	Read-only
MCU1 Application Version - 3KXF065019G0013*	The version of firmware installed on the transmitter	Read-only
MCU1 Boot1 Version - 3KXF065021G0013*	The version of firmware installed on the transmitter	Read-only
Err3 Range Error List		
MCU0 Range Error List*		
System diagnostic Message		
MCU0 Diagnostic Message		Read-only
Firmware Revision*	The version of firmware installed on the transmitter	Read-only
Reboot System	Use to reboot the system	Editable

*Only available with FEX45X transmitter
**Only available with FEX41X/43X transmitter

8 Diagnostics

Diagnostic error messages are displayed by pressing the Diagnostics tab:

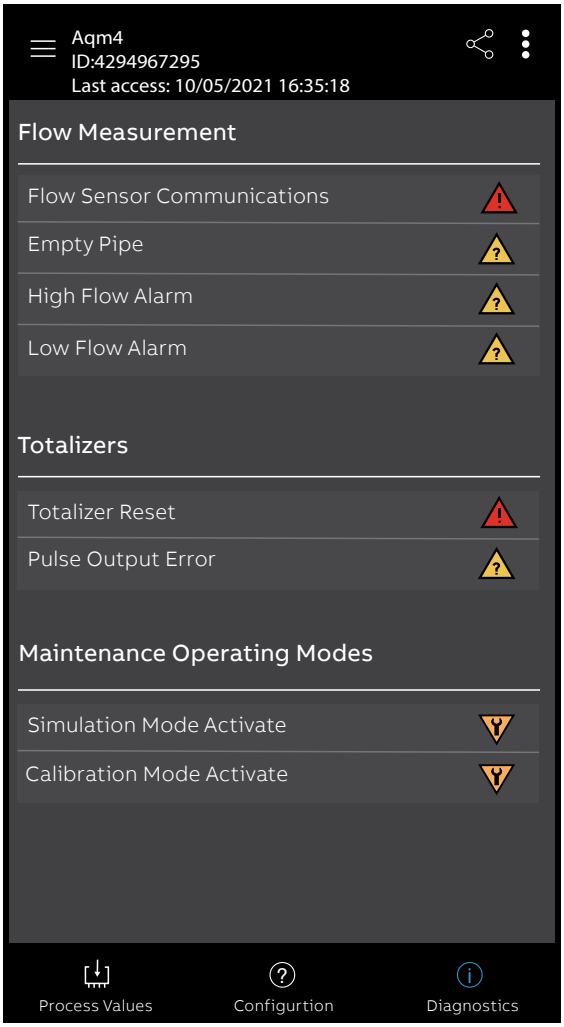


Figure 78 Example Diagnostics window

Messages displayed are for the last flowmeter selected from the Instruments List – see page 53.

The following icons indicate the diagnostic status:

Table 6 Diagnostic icons

Icon	Status	Icon	Status
	Failure		Out of specification
	Check function		Maintenance required

Diagnostic error messages

Flow Measurement

Table 7 Flow Measurement – diagnostic messages

Icon	Message	Corrective action
	Flow Sensor Communications	Remote sensor is not plugged in, or not connected. If connected, this error indicates a connection problem, with no sensor data connection. Check the sensor terminal box wiring.
	Empty Pipe	The pipe is not full of water. Check the pipe. An empty pipe is indicated when either, or both measuring electrodes have resistances which exceed the resistance trip level. Check each electrode SigA & SigB Impedance. If one electrode resistance is far higher than the other, it could indicate a wiring fault. For very low conductivity application (< 20 uS/cm) the electrode trip level may need to be increased to prevent unwanted empty pipe alarms.
	High Flow Alarm	The flowrate has exceed the upper flowrate alarm trip level. Ensure this alarm threshold is set correctly. Disable this alarm if not required.
	Low Flow Alarm	The flowrate is lower than the low flowrate alarm trip level. Ensure this alarm threshold is set correctly. Disable this alarm if not required.

Totalizers

Table 8 Totalizers – diagnostic messages

Icon	Message	Corrective action
	Totalizer Reset	A user has reset the totalizers.
	Pulse Output Saturation Warning	The pulse output has saturated at the maximum output frequency. An external counter will under read compared to the true volume. Reduce the Pulses per unit volume on the Pulse Output Setting menu to lower the output frequency.

Maintenance Operating Modes

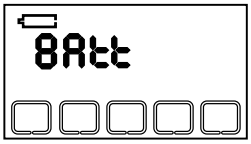
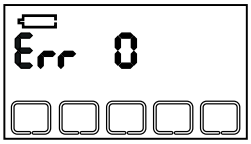
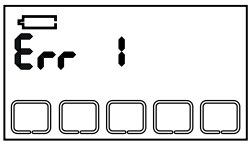
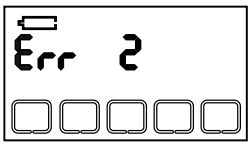
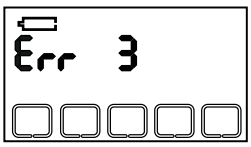
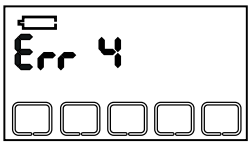
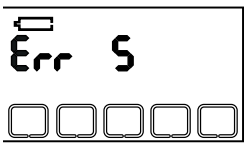
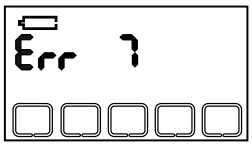
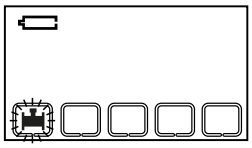
Table 9 Maintenance Operating Modes – diagnostic messages

Icon	Message	Corrective action
	Simulation Mode Active	The user has put the flowmeter into simulation mode. The displays and outputs are set based on the entered simulated input value. This error is cleared by turning off simulation mode.
	Calibration Mode Active	The user has put the flowmeter into calibration mode. This error is cleared by turning off calibration mode.

...8 Diagnostics

Other errors/required action

Table 10 Other errors/required action

Error displayed	Corrective action
	Not enough power to operate flowmeter optimally. Connect the flowmeter to power source (battery/AC mains/renewable).
	Flowmeter has stopped working due to no power. Connect the flowmeter to power source (battery/AC mains/renewable) and wait for 5 mins for the flowmeter to recover.
	Remote sensor not connected. Connect a remote ABB sensor or, if already connected, check wiring. This error condition is shown briefly after product restart only. To check the condition has cleared, reset the flowmeter using Velox and check for this error display.
	Contact ABB Service.
	Some configuration settings are out-of-range. Contact ABB Service.
	Contact ABB Service.
	Application program CRC check failed. Reset the transmitter using Velox. If this alarm occurs again contact ABB Service.
	Self check for pairing of sensor & Transmitter failed. This indicates the factory fitted MID approved flowmeter (Sensor and Transmitter) has failed the pairing. This could be for multiple reasons. Check that the serial number of the Sensor and Transmitter match. If the intention is to change the pair, break the MID seal, clear the process logger and then power on the flowmeter after you connect the sensor and transmitter. Note: Module D approval for the change in pair is invalid and need to be approved. Contact ABB Service
	Self check to OIML R49 Type P (Permanent) failed. This indicates the flowmeter has failed continuous self checking. This can be for multiple reasons. Check that the MID switch is in the lock position Use the Velox diagnostics screen for further information on the cause of the self check failure.

9 Legacy support

AquaMaster4 is compatible with legacy AquaMaster remote sensors.

WARNING – BODILY INJURY
Isolate the legacy transmitter from power supplies before performing this procedure.

IMPORTANT (NOTE)
For AquaMaster4 450 transmitters ensure that it is backward compatible (Ensure optional code NFL is selected while ordering).
Be aware that there are differences in protocol for data transfer between AquaMaster 3 and AquaMaster 4 450 transmitter (refer Datasheet or page 59, 60 for more details).
The Data exchange format are different between AquaMaster 3 and AquaMaster 4 450 transmitters (refer Datasheet or page 59, 60 for more details).

1 Refer to the installation requirements/instructions on page 14 to 15 and install the AquaMaster4 transmitter in a suitable location.

2 Remove the grounding connection from the AquaMaster3 transmitter and connect it to AquaMaster4 – see page 25 and page 26.

3 Make power supply connections (internal batteries/mains/renewable) as shown on page 27 and page 28.

4 Disconnect the remote sensor connections from AquaMaster3 and make connections to AquaMaster4 as shown on page 32, Figure 44 or Figure 45.

5 Open the Velox phone productivity app and perform a system reboot: (Configuration > Firmware Information > Reboot System). Once AquaMaster4 has rebooted, all flowmeter-specific parameters are read automatically. No further inputs are required to operate the legacy sensor with the new AquaMaster4.

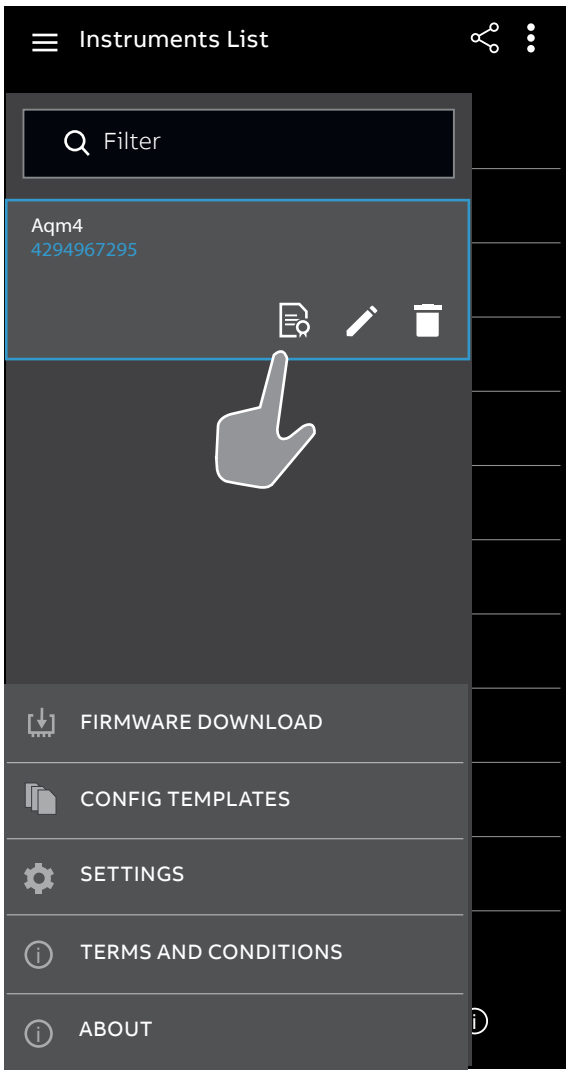
6 Configuration changes can be made as detailed from page <?> to page 59.

10 Maintenance

Audit logger - Exporting the audit log

AquaMaster4 (FEX45X) devices can record events such as configuration changes, diagnostics, regular alarms, and critical alarms. This procedure describes how to export this information as an audit log using the Velox app.

1 Enable **Advanced Access Level Enable** in **User Access Rights Settings**.
2 Select the certificate symbol.



3 Select **Audit Logger**.

4 Select **Get Standard Audit Log** or **Get Critical Audit Log** and enter the required time range for the log, then select **Get Logger Data**.

5 Hover the phone over the transmitter to collect the data, and wait until the data is fetched.

6 Choose either to **Share** or **Save on the device**.

...10 Maintenance

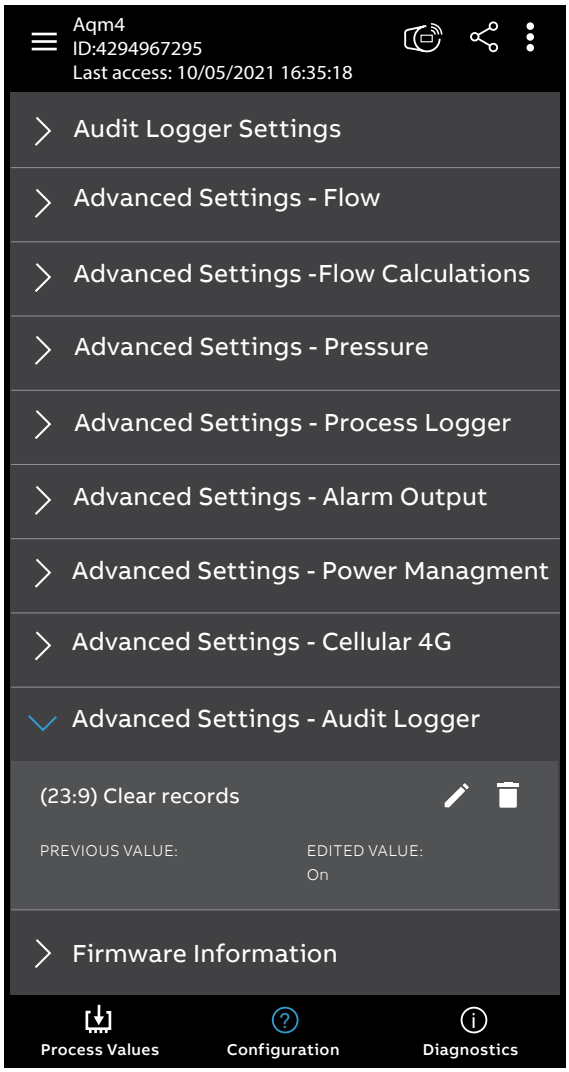
...Audit logger - Exporting the audit log

IMPORTANT (NOTE)
There are two kinds of audit events: Standard and Critical. The transmitter has the capability to store 3000 regular events and 1000 critical events. For the regular event log, it will roll over if the regular log is full. For the critical event log, the critical operations will be blocked if the critical log is full, unless it is cleared explicitly.
An alarm in the diagnostics tab indicates whether the critical log is almost full (over 900 events recorded).
The following operations are considered critical actions, which will be recorded in the critical log:

- Reset of totalizer
- Change of totalizer unit
- Firmware update

Clearing the audit log

1 Enable **Advanced Access Level Enable** in **User Access Rights Settings**, then navigate to **Advanced Settings - Audit Logger > Clear records**.



2 Select the type of records to be cleared.

3 Hover the phone to the device to clear the audit log records.

Firmware upgrade via NFC

AquaMaster 4 transmitters can be upgraded to the latest firmware through Near Field Communication (NFC) using Velox interface app. This procedure describes how to update the firmware for the transmitter through NFC.

Requirements

- AquaMaster 4 device
- USB to NFC coupler (FEX45X only), or
- Remote configuration/reading interface and NFC wall-mount coupler
- Android phone with Velox interface app
- Suitable firmware update image for device (depending on the device type).

The firmware update image is available from the **Download > Software** tab of the AquaMaster4 product page, or contact your local ABB service person.
Verify the firmware package using corresponding signature to make sure the firmware package to deploy is valid using the SHA512 cryptographic hash function.

Upgrade the firmware

1 Copy the firmware image to your phone internal storage.

2 Open the Velox interface app on your phone.

3 Tap the phone to the device to sync the parameters.

4 Move the phone away from the device and navigate to the sidebar, then select **Firmware Download**.

5 Tap **Select Firmware**. The Velox interface app navigates into the phone memory.

6 Browse through the memory and select the firmware update that you copied in step 1.

7 Tap **Start**, then hover the phone to the device to start the firmware download (the Velox interface app will transfer the firmware update image to the device).
Once the firmware image is transferred completely to the device, the Velox interface app will display **Download finished**.

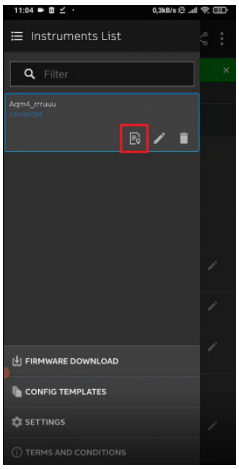
8 Tap **Close** to exit the firmware download page.
The device will reboot automatically to upgrade the new firmware.

Communication Logger (FEX45X)

AquaMaster4 (FEX45X) devices can record all events of communication the device has done with the remote server, known as Communication Logger, which can be retrieved via NFC using the Velox app.

1 Enable **Advanced Access Level Enable** in **User Access Right Settings**.

2 Navigate to the sidebar, and select the certificate.



3 Select **Communication Logger**.

4 Tap **Start** and hover the phone to the transmitter, and wait for the Velox app to fetch all records of the communication log.

5 Select either **Share** or **Save**.

6 The communication logger contains a timestamp of the communication status and the state of the communication. The details of different communication status are as seen in the below table along with a sample of the communication logger:

Sample of communication logger

Timestamp	State
05/05/2025 13:08	Response Failed
05/05/2025 12:36	Report OK
05/05/2025 10:40	Response Failed
05/05/2025 10:07	Report OK
05/05/2025 7:38	Response Failed
05/05/2025 7:06	Report OK
05/05/2025 5:07	Response Failed
05/05/2025 4:35	Report OK
05/05/2025 3:06	Response Failed
05/05/2025 2:36	Report OK
05/05/2025 0:35	Response Failed
05/05/2025 0:03	Report OK
04/05/2025 23:33	Response Failed
04/05/2025 23:01	Report OK
04/05/2025 22:31	Report OK
04/05/2025 22:01	Report OK

...10 Communication Logger (FEX45X)

Different states of communication:

Communication Status/State	Description
Get Server Parameter Error	Retrieval of server details from memory failed
Connect Server Error	Connection to server failed
Report OK	Report sent successfully
Report Error	Report sent failed
Response Failed	Device failed to process remote request
Subscribe Error	Device failed to subscribe to MQTT topic
Birth Error	Device failed to publish MQTT message
APN Active Error	Device failed to activate APN
List Error	Device failed to list the request files in Request folder of FTPS/FTP
Get Time offset Error	Device was not able to get the Time zone of the device.
Module Power On Error	Cellular Engine failed to power on
Module Disable Echo Error	Cellular Engine failure
Module Baud rate Switch Error	Cellular Engine failure.
Sim Card Error	SIM Card detection failed or corrupted
Network Register Error	Cellular engine failed to register network
Get Network Time Error	Device failed to sync cellular time
APN Config Error	Cellular engine failed to configure the APN settings
Network Operator Auto Select Error	Cellular engine failed to auto-connect to network operator
Network Operator List Error	Cellular engine failed to list the available network operators
Network Operator Set Error	Cellular engine failed to select the configured operator
Network Operator Get Error	Cellular engine failed to get current operator info.
DNS Config Error	Cellular engine failed to configure the DNS server
Report Time not reached	The current device time has not exceeded the last reported timestamp.

11 Digital Signature for reports

Communication Logger (FEX45X)

AquaMaster4 (FEX45X) devices with Legal Metrology approval such as OIML, MID etc. include additional Digtial Signature (ECDSA -256: Elliptic Curve Digital Signature) to authenticate the data/report being sent over cellular/mobile communication.

All flowmeters have a factory generated key pair of ECDSA -256 and the public key can be seen in **Advanced Settings – Cellular 4G -> (22:62) Generate Signature Public Key**. The device calculates the SHA256 hash value for the data being sent over cellular with the internal ECDSA-256 private key and can be authenticated using the Public Key.

FTP/FTPS protocol:
A sample for summary report with digital signature in Json file format from a device with FTP/FTPS protocol is shown below:


```
{
        "date": "2024.12.20",
        "time": "10:33:00",
        "totalizerUnit":        "CUSTOM_UNITS",
        "totalizerForward":     "58474.492276863568",
        "totalizerReverse":     "0",
        "totalizerNet": "58474.492276863568",
        "flowRateUnit": "CUSTOM_UNITS",
        "flowRateMax":  "0.014734070748090744",
        "flowRateMin":  "0.014726216904819012",
        "flowRateAvg":  "0.014729584567248821",
        "alarmStatus":  "Not OK",
        "batteryLife":  "99%",
        "signalQuality":        "67%",
        "signatureData":
        "03450220045ab7693dd390b197b20193aa1d1270ad0447bb68d6048f1086a98a009d9496022100a9454b8cd7366b94dc643e9872659e2
fc0ef11e58040a3b902d898a66d5940bc"
}
```


The procedure below describes how to use the key-pair and validate/authenticate the data:

- **Format the Public key**: Export/Copy the public key of the digital signature from Velox as described above and remove all the hyphen in hex format:

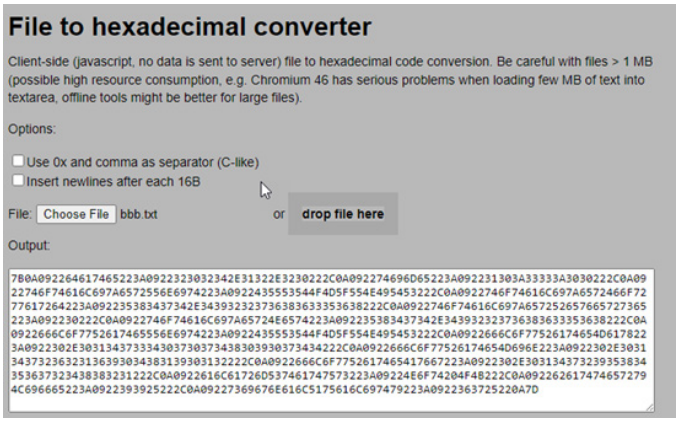
```
Data from Velox config:
04-D0-57-3C-B0-20-2B-E2-8A-67-4B-DD-DE-36-52-
A6-73-76-58-0A-45-21-49-0E-3B-51-9D-35-74-68-9C-2C-78-9C-2D-58-12-A0-3A-E4-54-
B0-FA-6D-A7-02-B1-E4-3E-99-49-ED-F0-09-C4-A8-EA-8B-7F-AE-1E-EC-22-1E-6F

Data after format:
04D0573CB0202BE28A674BDDDE3652A67376580A4521490E3B519D3574689C2C789C2D5812A03AE
454B0FA6DA702B1E43E9949EDF009C4A8EA8B7FAE1EEC221E6F
```

- **Format the file/data to be authenticated**: Remove the signature at the end of the report:


```
{
        "date": "2024.12.20",
        "time": "10:33:00",
        "totalizerUnit":        "CUSTOM_UNITS",
        "totalizerForward":     "58474.492276863568",
        "totalizerReverse":     "0",
        "totalizerNet": "58474.492276863568",
        "flowRateUnit": "CUSTOM_UNITS",
        "flowRateMax":  "0.014734070748090744",
        "flowRateMin":  "0.014726216904819012",
        "flowRateAvg":  "0.014729584567248821",
        "alarmStatus":  "Not OK",
        "batteryLife":  "99%",
        "signalQuality":        "67%"
}
```


- **Conversion:** Convert the file saved from the previous step into hex format.



- **Signature Verification:** Use the public key, signature and the data report stored in Hex format to authenticate using algorithm **SECG secp256r1 / X9.62 prime256v1 / NIST P-256**.

For MQTTS/MQTT protocol

AquaMaster4 (FEX45X) devices with MQTTS/MQTT protocol transmit data thru' one or more MQTT messages. The report (detail/summary) content is composed by concatenating the raw values of all messages and converting them to hex format:

A sample for detail report with 60 seconds of retrieval interval will have the data shown below in table and the MQTT messages:

FullName	Metric_type	Alias	Time	Note
MeterData/ VolumeUnits	UINT8	0x0701	tn-1 to tn	Included if Volume mask is open
MeterData/ TotalizerForward	DOUBLE	0x0702	tn-1 to tn	
MeterData/ TotalizerReverse	DOUBLE	0x0703	tn-1 to tn	
MeterData/ TotalizerNet	DOUBLE	0x0704	tn-1 to tn	
MeterData/ FlowRateUnits	UINT8	0x0602	tn-1 to tn	Included if flowrate mask is open
MeterData/ FlowRateValue	FLOAT	0xFF02	tn-1 to tn	
MeterData/ PressureUnits	UINT8	0x0802	tn-1 to tn	Included if pressure mask is open
MeterData/ PressureValue	FLOAT	0x0801	tn-1 to tn	
MeterData/ AlarmStatus	STRING	0xFF04	tn-1 to tn	Included if maintain mask is open

...11 Digital Signature for reports

...For MQTTS/MQTT protocol

MQTT first message:



MQTT second message:



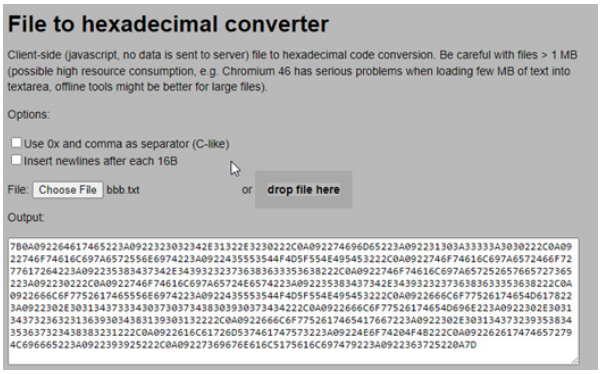
Concatenated message from the above two MQTT messages:



A sample for the summary report will have the data shown below in the table and the MQTT messages:

FullName	Metric_type	Alias	Time	Note
MeterData/ VolumeUnits	UINT8	0x0701	tn	Included if Volume mask is open
MeterData/ TotalizerForward	DOUBLE	0x0702	tn	
MeterData/ TotalizerReverse	DOUBLE	0x0703	tn	
MeterData/ TotalizerNet	DOUBLE	0x0704	tn	
MeterData/ FlowRateMax	FLOAT	0xFF05	tn-1 to tn	Included if summary historical data option is selected and flowrate mask is open.
MeterData/ FlowRateMin	FLOAT	0xFF06	tn-1 to tn	
MeterData/ FlowRateAvg	FLOAT	0xFF07	tn-1 to tn	
MeterData/ PressureMax	FLOAT	0xFF08	tn-1 to tn	Included if summary historical data option is selected and pressure mask is open.
MeterData/ PressureMin	FLOAT	0xFF09	tn-1 to tn	
MeterData/ PressureAvg	FLOAT	0xFF0A	tn-1 to tn	

- **Conversion**: Convert the MQTT messages into hex format



- **Signature acquisition**: The signature key for MQTTs/MQTT report is published through a separate metric called MeterData/Signature along with the data report message. This metric is a string type which is the hexadecimal value of the Signature. Sample signature of detailed report below:



- **Signature Verification**: Use the public key, signature and the data report stored in Hex format to authenticate using algorithm **SECG secp256r1 / X9.62 prime256v1 / NIST P-256**.

ECDSA-256 Key-Pair Generation:
All flowmeters (FEX45X) have a factory set key-pair of ECDSA-256, which could be regenerated as per below if needed.

a Enable **Advanced Access Level Enable** in User **Access Right Settings.**

b Navigate to **Advanced Settings – Cellular 4G**, and configure the below parameters together:

– Set **(22:42) Unlock Key Pair Generation** to **90** to unlock report key pair generation.
– Set **(22:62) Generate Signature Key Pair for Report** to **On**.

c Hover the phone over the transmitter, the generated public key will be shown in hex format in **(22:62) Generated Signature Public Key.**

12 Spares/Accessories

Ordering code	Description
3KXF0044 38U0100	Display protective cover without NFC
3KXF0044 55U0100	Display protective cover with NFC, 5 m cable (approx. 15 ft.)
3KXF004455U0200	Display protective cover with NFC, 20 m cable (approx. 66 ft.)
3KXF004482U0100	Sensus cable, 5 m (approx. 15 ft.)
3KXF004482U0300	Sensus cable, 20 m (approx. 66 ft.)
3KXF208400L1000	AM4 pulse output cable 1 m (approx. 3 ft.)
3KXF221400L0100	FEW4 sensor/pulse/Modbus cable, 5 m (approx. 15 ft.)
3KXF221400L0200	FEW4 sensor/pulse/Modbus cable, 10 m (approx. 30 ft.)
3KXF221400L0300	FEW4 sensor/pulse/Modbus cable, 20 m (approx. 66 ft.)
3KXF221400L0400	FEW4 sensor/pulse/Modbus cable, 30 m (approx. 98 ft.)
3KXF221400L0500	FEW4 sensor/pulse/Modbus cable, 50 m (approx. 164 ft.)
3KXF221400L0600	FEW4 sensor cable, 100 m (approx. 328 ft.) junction box/Mil
3KXF221400L0700	FEW4 sensor cable, 150 m (approx. 492 ft.) junction box/Mil
3KXF208400L2100	AM4 pressure transducer 20 bar 10 m cable (approx. 30 ft.)
3KXF208400L2200	AM4 pressure transducer 20 bar 20 m cable (approx. 66 ft.)
3KXF208400L2500	AM4 pressure transducer 40 bar 10 m cable (approx. 30 ft.)
3KXF208400L2600	AM4 pressure transducer 40 bar 20 m cable (approx. 66 ft.)
3KXF208400L0600	AM4 RS485 lead Mil connectors Modbus
3KXF208400L2700	AM4 transmitter seal kit
3KXF208400L2800	AM4 battery connector kit
3KXF208400L3000	AM4 anti-tamper security kit

13 Recycling and disposal

Disassembly

WARNING
Risk of injury due to process conditions
The process conditions, e.g. high pressures and temperatures, toxic and aggressive measuring media, can give rise to hazards when dismantling the flowmeter.

- If necessary, wear suitable personal protective equipment during disassembly.
- Before disassembly, ensure that the process conditions do not pose any safety risks.
- Depressurize and empty the flowmeter/piping, allow to cool and purge if necessary.

IMPORTANT (NOTE)
It is recommended to erase private data from the FEX45X before disposal of the device. Refer to **Erasing private data** on page 72.

...13 Recycling and disposal

Erasing private data

It is recommended that you erase private data from FEX45X before disposal of the device.

1 Enable **Advanced Access Level Enable** in **User Access Rights Settings**, then navigate to **Advanced Settings - Device**.

2 Enter **0** in the field **Erase private data**.

3 Enter **0** in the field **Erase private data confirmation**.

4 Hover the phone over the device to erase the date.

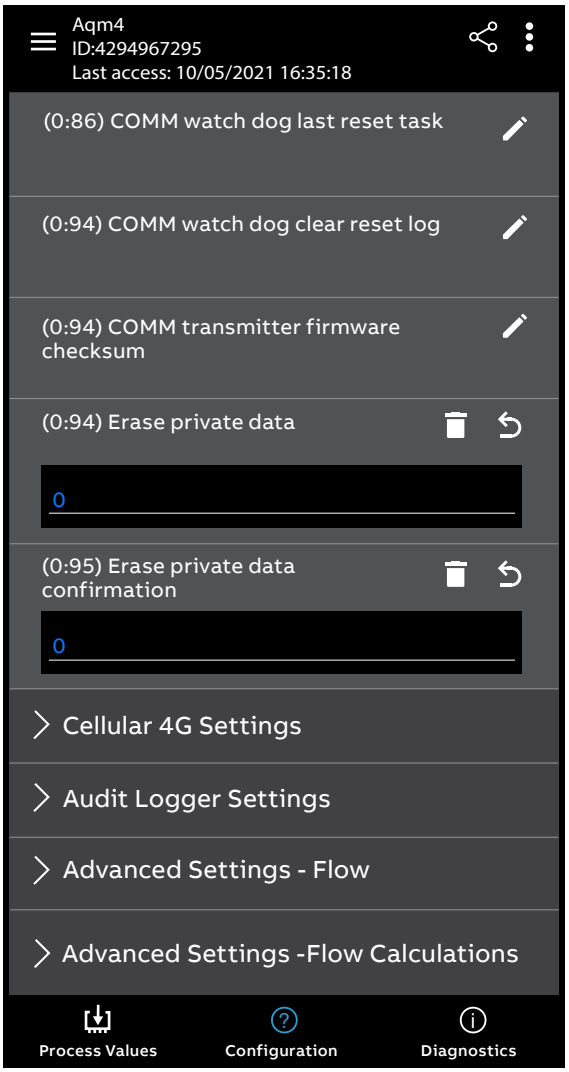


Table 11 Private information stored in the device that is erased during the procedure

Item	Description
Hash code of NFC PSK with user account number (number: 3)	The encryption key fo r the specific user account when an NFC device (e.g. Velox on a smartphone) starts a secure communication with the transmitter
Narrow-band PSK	Used for the TLS handshake between the transmitter and NBIoT platform
4G device private key	Used for the TLS handshake between the transmitter and the server
4G FTPS/FTP or MQTTS/MQTT user password	FTPS/FTP MQTTS/MQTT user password by the server
4G SIM card PIN code	PIN code for locked SIM card
4G APN user password	User password of APN by 4G SIM card

Disposal

This product and its packaging are manufactured from materials that can be recycled by specialist recycling companies.
Note the following points when disposing of the product:

- This product is not subject to WEEE Directive 2012/19/EU or relevant national laws (for example, ElektroG in Germany).
- The product must be surrendered to a specialist recycling company. Do not use municipal garbage collection points.
- According to WEEE Directive 2012/19/EU, only products used in private applications may be disposed of at municipal garbage collection points.
- If it is not possible to dispose of old equipment properly, ABB Service can take receipt of and dispose of returns. Contact your local ABB Sales or Service representatives for a quotation.



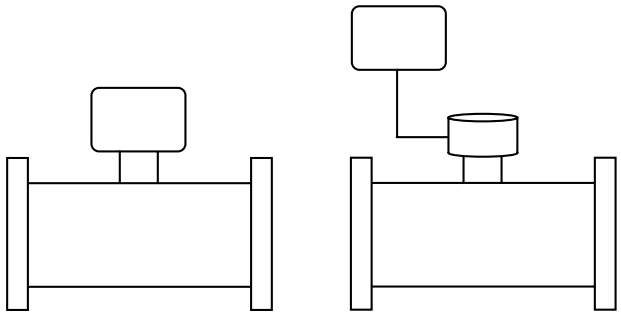
IMPORTANT (NOTE)
Products that are marked with this symbol may not be disposed of through municipal garbage collection points.

Note:
Refer to **Battery hazard, handling, shipping and recycling/ disposal** on page 7.

14 Specification

FEX41X/43X

Mounting on flow sensor



Integral with sensor

Remote with up to 150 m (492 ft.) cable

Power supply



Battery AC mains Solar Wind

Battery power

2 lithium thionyl chloride 'D' batteries.

Note. The following batteries work with the product:

- SAFT LS33600 *
- Eve ER34615 *
- GB Battery ER34615
- cT-energy ER34615
- OmniCel ER34615
- GEBC ER34615
- LiYa ER34615
- Fanzo ER34615H

* Preferred

Nominal battery life

Sensor style	Size	Integral-mount transmitter	Remote-mount transmitter
Reduced bore	DN40 to 80	10.5 years	8 years
	DN100 to 300	7 years	5.5 years
	DN350 to 600	6 years	5 years
Octagonal bore	DN40 to 200	10.5 years	8 years
Full bore	DN250 to 600	6 years	5 years
	DN700 to 2400	2.5 years	2 years
Probe	300 to 1000 mm	10.5 years	8 years

Test conditions:

- acquisition = 15 seconds
- pulse output = 2 Hz @ 5 ms
- alarm output on = 25 %
- logger rate = 1 minute
- with pressure
- integral verification self check = 15 minutes
- ambient temperature = 20 °C

Sensor style	Size	Integral-mount transmitter	Remote-mount transmitter

Battery capacity and life are significantly shortened:

- when the operating environment temperature ranges between –20 and 0 °C or 50 and 70 °C (–4° and 32 °F or 122 and 158 °F)
- when data acquisition is less than 15 seconds
- when pulse output width > 5 ms and output frequency is set high
- with extended NFC interface use
- Class 2/Class 1 calibration to OIML R49 options (RCM and RCN in ordering code)

Mains supply (option – remote only)

- 95 to 240 V AC, 50/60 Hz, 3 VA
- Mains connection cable: approx. 3 m (9.8 ft.)

Internal backup power time for:

- DN40 to 200: 16 days
- DN250 to 600: 6 days
- DN700 to 2400: 3 days

Renewable power (option)

- Solar or wind
- Input voltage: 6 to 32 V DC @ 5 W
- Max. current: 200 mA

Internal backup time for:

- DN40 to 200: 48 days
- DN250 to 600: 18 days
- DN700 to 2400: 9 days

Note. Renewable energy generators do not operate at maximum capacity. For example, low wind speeds, dirty solar panels and shorter daylight periods all reduce capacity. Consequently, some installations may require generators with a capacity greater than the specified 5 W minimum.

Inputs

- IP68 connectors, mains cable (remote only)
- Sensor cable (remote only). ABB sensor cable supplied as standard. SWA cable available (via adapter box) on application
- Pressure transducer connection (option)

Configuration/User interface

ABB Velox Interface app on a compatible smartphone. Operating systems of a smartphone are Android (Oreo or newer). Functions of Velox Interface include configuration, diagnostics, logger data retrieval and transmitter flash update.

...14 Specification

Outputs

- Pulse/Alarm
- RS485 Modbus
- Sensus protocol

Pulse outputs (option)

- Passive Output 1: forward pulses
- Passive Output 2: reverse pulses
- +35 V @ 20 mA solid state, unipolar
- Isolated with one common, shared with alarm output Max ±50 V to earth
- 50 Hz max., programable pulse width, default 2 ms *

* Increasing pulse width beyond 2 ms at frequencies greater than 10 Hz reduces battery life

Modbus interface (option)

- Modbus RTU over 2-wire EIA-485
- Supported baud rates: 9600 and 19200
- Max. devices on bus segment: 32
- Max. response time, 1 registered read: 60 ms
- Max. response time, 1 registered write: 600 ms

Alarm outputs (option)

- Indicates any problem with measurement, power supply or flowrate alarm
- Bi-directional, solid state
- +35 V @ 50 mA
- Isolated with one common, shared with pulse outputs

Automatic meter reading (AMR)

3-wire Sensus compatible

Logger

Logger function	Flow and pressure	Forward, reverse, and net flow totals
No. of records	45871	3120
Logging interval *	15 seconds 30 seconds 1 minute 5 minutes 15 minutes (selectable)	24 hours (fixed)
Logger capacity	31 days @ 1 minute 477 days @ 15 minutes	8 years

* Based on a default 15 second measurement rate when operating on battery or renewable power

Retrieval of logger data file via smartphone – see **Operation on page <56>.**

Logger data file format

- .csv for easy import into databases/spreadsheets
- Time-stamped records with flow, pressure and totalizers in user-configured units of measurement

Response time (programmable)

>0.1 second (mains-powered)

15 seconds (battery-powered + external renewable energy)

Environmental and operating conditions

Ingress rating

IP68 (NEMA 6P), <2m (6 ft.)

Submerged

9 months accrued time

Humidity

0 to 100 %

Temperature ranges

Storage: –20 to 60 °C (–4 to 140 °F)

Ambient: –25 to 60 °C (–13 to 140 °F)

Environmental classification

O, M1 and E2

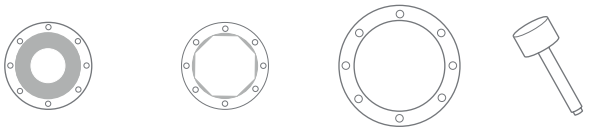
Transmitter vibration

IEC 60068-2-6 (2007)

Vibration level 2g

Options

Compatible sensor styles



Reduced bore DN40 to 600	Octagonal bore DN40 to 200	Full bore DN250 to 2400	Probe 300 to 1000 mm

External pressure transducer (option)

10, 20 and 40 bar absolute

Backward compatibility (option)

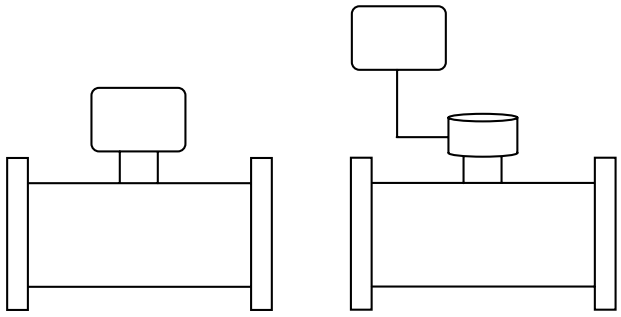
- Full compatibility with legacy AquaMaster remote sensors. Plugs directly into AquaMaster 4 with no specific configuration required.

MID/Tamper detection (option)

- Switch selectable inside the tamper-evident, seal-protected enclosure
- Prevents changes to meter configuration that affect the meter/output accuracy

FEX45X

Mounting on flow sensor



Integral with sensor

Remote with up to 150 m (492 ft.) cable

Power supply



Battery AC mains Solar Wind

Battery power

6/4 lithium thionyl chloride 'D' batteries.

Note. The following batteries work with the product:

- SAFT LS33600 *
- Eve ER34615 *
- GB Battery ER34615
- cT-energy ER34615
- OmniCel ER34615
- GEBC ER34615
- LiYa ER34615
- Fanzo ER34615H

* Preferred

Nominal external battery Power Supply Unit (PSU) only:

FTPS/FTP

Sensor style	Size	Integral	Remote
Reduced bore	DN40 to 80	8.5 years	7 years
	DN100 to 300	7 years	6.5 years
	DN350 to 600	7 years	6 years
Octagonal bore	DN40 to 200	8.5 years	7 years
Full bore	DN250 to 600	7 years	6 years
	DN700 to 2400	4 years	4 years

MQTTS/MQTT with Sparkplug B

Sensor style	Size	Integral	Remote
Reduced bore	DN40 to 80	11 years	9 years
	DN100 to 300	9 years	7.5 years
	DN350 to 600	8.5 years	7.5 years
Octagonal bore	DN40 to 200	11 years	9 years
Full bore	DN250 to 600	8.5 years	7.5 years
	DN700 to 2400	4.5 years	4 years

Test conditions:

- acquisition = 15 seconds
- pulse output = 2 Hz @ 5 ms
- alarm output on = 25 %
- logger rate = 1 minute
- with pressure
- integral verification self check = 15 minutes
- ambient temperature = 20 °C
- mobile communication transmission interval of:
  - 6 h for Detailed Report through 4G over FTPS/FTP/MQTTS/MQTT with Sparkplug B, or
  - 2 h for Summary Report through NB - IoT over LwM2M

Battery capacity and life are significantly shortened:

- when the operating environment temperature ranges between –20 and 0 °C or 50 and 70 °C (–4° and 32 °F or 122 and 158 °F)
- when data acquisition is less than 15 seconds
- when pulse output width > 5 ms and output frequency is set high
- with extended NFC interface use
- Class 2/Class 1 calibration to OIML R49 options

(RCM and RCN in ordering code)

Mains supply (option – remote only)

- 95 to 240 V AC, 50/60 Hz, 3 VA
- Mains connection cable: approx. 3 m (9.8 ft)

Renewable power (option)

- Solar or wind
- Input voltage: 6 to 32 V DC @ 5 W
- Max. current: 200 mA

Internal backup time for:

- DN40 to 200: 5 days
- DN250 to 600: 3 days
- DN700 to 2400: 1 day

Note. Renewable energy generators do not operate at maximum capacity. For example, low wind speeds, dirty solar panels and shorter daylight periods all reduce capacity. Consequently, some installations may require generators with a capacity greater than the specified 5 W minimum.

...14 Specification

... FEX45X

Nominal external backup power time for Mains and Renewable power supply unit:
FTPS/FTP

Sensor style	Size	Integral-mount transmitter	Remote-mount transmitter
Reduced bore	DN40 to 80	5.5 years	5 years
	DN100 to 300	5 years	4 years
	DN350 to 600	4.5 years	4 years
Octagonal bore	DN40 to 200	5.5 years	5 years
Full bore	DN250 to 600	4.5 years	4 years
	DN700 to 2400	2.5 years	2.5 years

MQTTS/MQTT with Sparkplug B

Sensor style	Size	Integral-mount transmitter	Remote-mount transmitter
Reduced bore	DN40 to 80	6.5 years	5 years
	DN100 to 300	5.5 years	4.5 years
	DN350 to 600	5 years	4.5 years
Octagonal bore	DN40 to 200	6.5 years	5.5 years
Full bore	DN250 to 600	5 years	4.5 years
	DN700 to 2400	3 years	3 years

Note. Test conditions are the same as for battery-operated transmitter with 4 batteries only.

Battery change-over backup time
- Approximately 2 minutes

Antenna
- Internal
- External (option)

Note. Mobile communications do not operate if the internal antenna is under water . The general advice is to mount the antenna as high as possible, always outside of any metal enclosures and not under the surface of the ground.

Inputs
- IP68 connectors, mains cable (remote only)
- Sensor cable (remote only). ABB sensor cable supplied as standard. SWA cable available (via adapter box) on application
- Pressure transducer connection (option)

Configuration/User interface
ABB Velox Interface app on a compatible smartphone. Operating systems of a smartphone are Android (Kit Kat or newer). Functions of Velox Interface include configuration, diagnostics, logger data retrieval and transmitter flash update.

Outputs
- Pulse/Alarm
- RS485 Modbus
- Mobile communications (4G fall back to 3G / NB - IoT)

Pulse outputs (option)
- Passive Output 1: forward pulses
- Passive Output 2: reverse pulses
- +35 V @ 20 mA solid state, unipolar
- Isolated with one common, shared with alarm output Max ±50 V to earth
- 50 Hz max., programable pulse width, default 2 ms *

* Increasing pulse width beyond 2 ms at frequencies greater than 10 Hz reduces battery life

Modbus interface (option)
- Modbus RTU over 2-wire EIA-485
- Supported baud rates: 9600 and 19200
- Max. devices on bus segment: 32
- Max. response time, 1 registered read: 60 ms
- Max. response time, 1 registered write: 600 ms

Alarm outputs (option)
- Indicates any problem with measurement, power supply or flowrate alarm
- Bi-directional, solid state
- +35 V @ 50 mA
- Isolated with one common, shared with pulse outputs

Mobile communications – 4G/3G
- 4G LTE Cat1 with fall back to 3G (HSPA / HSPA+)
- Data exchange via FTPS/FTP or MQTTS/MQTT Sparkplug B (V 3.0.0) protocol
- Data exchange format configurable to CSV/Json for devices with FTPS/FTP protocol only
- Data exchange interval can be configured to 15 minutes/30 minutes/1 hour/2 hours/4 hours/6 hours/8 hours/12 hours or 24 hours

Mobile communications – NB – IoT
- NB – IoT over China Telecom
- Data exchange via LwM2M DTLS
- Data exchange format Json (JavaScript Object Notation) for China Telecom
- Data exchange interval 1 hour, 6 hours, 12 hours or 24 hours configurable

Logger

Logger function	Flow, pressure, forward, reverse, and net flow totals
No. of records	45792
Logging interval *	15 seconds 30 seconds 1 minute 5 minutes 15 minutes (selectable)
Logger capacity	31 days @ 1 minute 477 days @ 15 minutes

* Based on a default 15 second measurement rate when operating on battery or renewable power

Retrieval of logger data file via smartphone – see **Operation on page <54>**.

Logger data file format

- .csv for easy import into databases/spreadsheets
- Time-stamped records with flow, pressure and totalizers in user-configured units of measurement

Audit logger

- Time-stamped records for all events, such as configuration changes, diagnostics, regular alarms, and critical alarms (firmware update, change of totalizer, rollover of totalizer, reset of totalizer).
- Stored as standard (3000 records) and critical (1000 records) events in separate database.
- Available as .csv for easy import into databases/ spreadsheets.

Response time (programmable)

>0.1 second (mains-powered)
15 seconds (battery-powered + external renewable energy)

Report types in mobile communications

- Summary report with configurable content: Totalizer (fwd., reverse and net), flow rate (max.,min. and avg), Pressure , Maintenance info such as, alarm status (OK/ Not OK), signal quality, and battery life.
- Detail report with configurable content: Totalizer (fwd, reverse, and net), flow rate (max.,min. and avg), pressure log, Maintenance info such as alarm status (OK/Not OK) signal quality, battery life.
- Diagnostic alarm report

Remote requests through mobile communications

- Summary report, detail report, and audit log report
- Firmware update
- Configuration changes
- Device Certificate update

Environmental and operating conditions

Ingress rating

IP68 (NEMA 6P), <2m (6 ft.), for 360 hours (Tested according to IEC 60529)

Humidity

0 to 100 %

Temperature ranges

Storage: –20 to 60 °C (–4 to 140 °F)
Ambient: –25 to 60 °C (–13 to 140 °F)

Environmental classification

O, M1 and E2 for internal antenna devices & E1 for external antenna devices

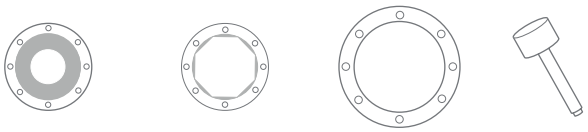
Transmitter vibration

IEC 60068-2-6 (2007)

Vibration level 2g

Options

Compatible sensor styles



External pressure transducer (option)

10, 20 and 40 bar absolute

Backward compatibility (option)

- Full compatibility with legacy AquaMaster remote sensors. Plugs directly into AquaMaster 4 with no specific configuration required. Note: The transmitter is not compatible with legacy telemetry applications and software applications

Read-only switch

- Switch selectable inside the SIM card chamber
- Prevents changes to meter configuration that affect the meter/output accuracy

15 Appendix

Declarations of conformity

IMPORTANT (NOTE)
All documentation, declarations of conformity, and certificates are available in ABB's download area: www.abb.com/flow.

The FCC Supplier's Declaration of Conformity can be found here.

FCC Supplier's Declaration of Conformity:
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1 This device may not cause harmful interference

2 This device must accept any interference, including interference that may cause undesired operation

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Caution: Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

ISED (Canada Regulatory Information:
This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1) L'appareil ne doit pas produire de brouillage;

2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

CAUTION – RADIO FREQUENCY (RF) TRANSMITTER EXPOSURE:
To satisfy FCC/IC RF exposure requirements, , this equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet émetteur ne doit pas être colocalisé ou fonctionner en conjonction avec une autre antenne ou émetteur. Cet équipement doit être installé et utilisé avec une distance minimale de 20 centimètres entre le radiateur et votre corps.

Acknowledgements

- Sensus is a registered trademark of Sensus USA, Inc.
- Windows is a registered trademark of Microsoft Corporation USA
- Android is a registered trademark of Google Inc.

ABB Measurement & Analytics

For your local ABB contact, visit:
www.abb.com/contacts

For more product information, visit:
www.abb.com/measurement

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