WaterMaster
Electromagnetic flowmeter

Measurement made easy
For more information

Further publications for the WaterMaster electromagnetic flowmeter are available for free download from:

www.abb.com/measurement

or by scanning this code:

<table>
<thead>
<tr>
<th>Search for or click on</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Sheet</td>
<td>DS/WM-EN</td>
</tr>
<tr>
<td>WaterMaster</td>
<td>Electromagnetic flowmeter</td>
</tr>
<tr>
<td>Programming Guide</td>
<td>IM/WMP</td>
</tr>
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<td>Electromagnetic flowmeter</td>
</tr>
<tr>
<td>WaterMaster</td>
<td>Electromagnetic flowmeter</td>
</tr>
<tr>
<td>User Guide Supplement – PROFIBUS FEX100-DP Parameter Tables</td>
<td>IM/WMPBST-EN</td>
</tr>
<tr>
<td>WaterMaster</td>
<td>Electromagnetic flowmeter</td>
</tr>
<tr>
<td>Setup Guide</td>
<td>IM/WM/VM</td>
</tr>
<tr>
<td>VeriMaster</td>
<td>Software tools</td>
</tr>
</tbody>
</table>
1 Safety

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of the Technical Publications Department.

1.1 Electrical Safety

This equipment complies with the requirements of CEI/IEC 61010-1:2001-2 ‘Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use’ and complies with NIST and OSHA. If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

1.2 Symbols

One or more of the following symbols may appear on the equipment labelling:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>!</td>
<td>Warning – Refer to the manual for instructions</td>
</tr>
<tr>
<td>Caution</td>
<td>Direct current supply only</td>
</tr>
<tr>
<td>Protective earth (ground) terminal</td>
<td>Alternating current supply only</td>
</tr>
<tr>
<td>Earth (ground) terminal</td>
<td>Both direct and alternating current supply</td>
</tr>
<tr>
<td></td>
<td>The equipment is protected through double insulation</td>
</tr>
</tbody>
</table>
1.3 Health & Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

- The safety requirements of this equipment, any associated equipment and the local environment must be taken into consideration during installation.
- Install and use this equipment and any associated equipment in accordance with the relevant national and local standards.
- The relevant sections of these instructions must be read carefully before proceeding.
- Warning labels on containers and packages must be observed.
- Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and / or temperature.
- Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
- When disposing of chemicals ensure that no two chemicals are mixed.
- Product liability – advice and assistance provided without charge is given in good faith but without liability.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.
2 Introduction

WaterMaster™ is a range of high performance electromagnetic flowmeters for the measurement of electrically conductive fluids and systems are normally supplied factory-configured and calibrated.

This User Guide provides installation, connection, security, start-up and basic setup details. For programming and configuration information refer to the Programming Guide – IM/WMP.

Warning.

- System configuration must be carried out only by users or personnel with approved access rights (user privileges).
- Read all relevant sections of this guide before configuring the system or modifying system parameters.
- Install and use associated equipment in accordance with the relevant national and local standards.

This User Guide should be used in conjunction with the following publications:

- Programming Guide – IM/WMP

For Profibus DP variants (FEX100-DP)

- User Guide Supplement, PROFIBUS FEX100-DP Parameter Tables – IM/WMPBST–EN

For Modbus variants (FEX100-MB)

- User Guide Supplement, MODBUS RS485 Physical Layer COI/FEX100/MOD–EN
- User Guide Supplement, MODBUS Tables COI/FEX100/MOD/TBL–EN

2.1 Quality Control

The UKAS Calibration Laboratory No. 0255 is just one of the ten flow calibration plants operated by the Company and is indicative of our dedication to quality and accuracy.

Fig. 2.1 UKAS Calibration Laboratory No. 0255
3 Mechanical Installation

3.1 Unpacking

Caution. Visually inspect equipment for damage before installing. Do not install damaged or faulty equipment.

Fig. 3.1 Unpacking

3.2 Installation Conditions

Caution. Do NOT exceed the maximum working pressure marked on the equipment.

Fig. 3.2 Spillage

Fig. 3.3 Vibration
Fig. 3.4 Localized Heat

Fig. 3.5 Siting

Fig. 3.6 Straight Pipe Requirements

Fig. 3.7 Fluid Level
Fig. 3.8 Within Temperature Limits

Fig. 3.9 Shade

Fig. 3.10 Above Ground
Fig. 3.11 Temperature Difference

Fig. 3.12 Within Environmental Rating

Sensor Submersion: Continuous
Transmitter Submersion:
1 m (3.3 ft) <12 hours
Accrued time

IP68 (NEMA 6)
IP67 (NEMA 4X)

Fig. 3.13 Underground

Note. For further details when burying flow sensors contact the ABB Service Organization.
Fig. 3.14 Cable Routing

Fig. 3.15 Gasket Fitting

Fit Gaskets
Gaskets Same Size as Pipe

Fig. 3.16 Separation of Sensors

Fig. 3.17 Access to Transmitter

Position to enable access to display and communication connector

Min. $-20 \degree C\ (\sim -4 \degree F)$
Max. $70 \degree C\ (158 \degree F)$

0.7 m (2.3 ft) Min.
3.3 Dimensions

3.3.1 Transmitter Dimensions

Dimensions in mm (in).

Fig. 3.18 Integral Transmitter Dimensions (Standard Gland Shown)

Fig. 3.19 Remote Transmitter Dimensions (Standard Gland Shown)

Note. Fix remote transmitter to a secure surface using 3 M5 screws (not supplied).
3.3.2 Sensor Dimensions

Note. Lay length – all sensors conform to ISO13359.

DN 10 to 32 Full Bore

Fig. 3.20 DN10 to 32 (3/8 to 1 3/4 NB) Full-bore

<table>
<thead>
<tr>
<th>Meter Size</th>
<th>Dimensions mm (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN NPS/NB</td>
<td>A*</td>
</tr>
<tr>
<td>10 3/8</td>
<td>93 (3.7)</td>
</tr>
<tr>
<td>15 1/2</td>
<td>95 (3.7)</td>
</tr>
<tr>
<td>20 3/4</td>
<td>111 (4.4)</td>
</tr>
<tr>
<td>25 1</td>
<td>120 (4.7)</td>
</tr>
<tr>
<td>32 1 3/4</td>
<td>137 (5.4)</td>
</tr>
</tbody>
</table>

*Dimensions are approximate and vary depending on flange type

Table 3.1 DN10 to 32 (3/8 to 1 3/4 NB) Full-bore
**Fig. 3.21 DN40 to 200 (1½ to 8 NB) Full-bore**

<table>
<thead>
<tr>
<th>DN</th>
<th>NPS/NB</th>
<th>A*</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>1½</td>
<td>150 (5.9)</td>
<td>200 (7.9)</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
<td>165 (6.5)</td>
<td>200 (7.9)</td>
</tr>
<tr>
<td>65</td>
<td>2.5</td>
<td>185 (7.2)</td>
<td>200 (7.9)</td>
</tr>
<tr>
<td>80</td>
<td>3</td>
<td>200 (7.9)</td>
<td>200 (7.9)</td>
</tr>
<tr>
<td>100</td>
<td>4</td>
<td>230 (9.1)</td>
<td>250 (9.8)</td>
</tr>
<tr>
<td>125</td>
<td>5</td>
<td>250 (9.9)</td>
<td>250 (9.8)</td>
</tr>
<tr>
<td>150</td>
<td>6</td>
<td>280 (11.0)</td>
<td>300 (11.8)</td>
</tr>
<tr>
<td>200</td>
<td>8</td>
<td>345 (13.6)</td>
<td>350 (13.8)</td>
</tr>
</tbody>
</table>

*Dimensions are approximate and vary depending on flange type*

*Table 3.2 DN40 to 200 (1½ to 8 NB) Full-bore*
DN 250 to 2200 Full Bore

Fig. 3.22 DN 250 to 600 (10 to 24 NB) Full Bore

Fig. 3.23 DN 700 to 2200 (28 to 84 NB) Full Bore
<table>
<thead>
<tr>
<th>DN</th>
<th>NPS/NB</th>
<th>A</th>
<th>B (&lt;=PN25)</th>
<th>B (PN25, PN40, ASME, CL300)</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>10</td>
<td>405 (15.99)</td>
<td>450 (17.7)**</td>
<td>488 (19.2)</td>
</tr>
<tr>
<td>300</td>
<td>12</td>
<td>460 (18.1)</td>
<td>500 (19.7)**</td>
<td>538 (21.2)</td>
</tr>
<tr>
<td>350</td>
<td>14</td>
<td>535 (21.1)</td>
<td>550 (21.7)**</td>
<td>568 (22.3)</td>
</tr>
<tr>
<td>400</td>
<td>16</td>
<td>600 (23.6)</td>
<td>600 (23.6)**</td>
<td>618 (24.3)</td>
</tr>
<tr>
<td>450</td>
<td>18</td>
<td>640 (25.2)</td>
<td>698 (27.5)**</td>
<td>698 (27.5)</td>
</tr>
<tr>
<td>500</td>
<td>20</td>
<td>715 (28.1)</td>
<td>768 (30.2)**</td>
<td>768 (30.2)</td>
</tr>
<tr>
<td>600</td>
<td>24</td>
<td>840 (33.1)</td>
<td>918 (36.1)**</td>
<td>918 (36.1)</td>
</tr>
<tr>
<td>700</td>
<td>27/28*</td>
<td>927 (36.5)</td>
<td>700 (27.6)***</td>
<td>–</td>
</tr>
<tr>
<td>760</td>
<td>30</td>
<td>985 (38.8)</td>
<td>762 (30)***</td>
<td>–</td>
</tr>
<tr>
<td>800</td>
<td>32</td>
<td>1060 (41.7)</td>
<td>800 (31.5)***</td>
<td>–</td>
</tr>
<tr>
<td>900</td>
<td>36</td>
<td>1170 (46.1)</td>
<td>900 (35.4)***</td>
<td>–</td>
</tr>
<tr>
<td>1000</td>
<td>39/40*</td>
<td>1290 (50.8)</td>
<td>1000 (39.4)***</td>
<td>–</td>
</tr>
<tr>
<td>1050</td>
<td>42</td>
<td>1405 (55.3)</td>
<td>1067 (42)***</td>
<td>–</td>
</tr>
<tr>
<td>1100</td>
<td>44</td>
<td>1405 (55.3)</td>
<td>1067 (42)***</td>
<td>–</td>
</tr>
<tr>
<td>1200</td>
<td>48</td>
<td>1511 (59.5)</td>
<td>1200 (47.2)***</td>
<td>–</td>
</tr>
<tr>
<td>1400</td>
<td>54</td>
<td>1745 (68.7)</td>
<td>1400 (55.1)***</td>
<td>–</td>
</tr>
<tr>
<td>1500</td>
<td>60</td>
<td>1855 (73.0)</td>
<td>1524 (59)**</td>
<td>–</td>
</tr>
<tr>
<td>1600</td>
<td>66</td>
<td>2032 (80.0)</td>
<td>1600 (63)***</td>
<td>–</td>
</tr>
<tr>
<td>1800</td>
<td>72</td>
<td>2197 (86.5)</td>
<td>2250 (88.6)***</td>
<td>–</td>
</tr>
<tr>
<td>2000</td>
<td>78</td>
<td>2362 (93.0)</td>
<td>2500 (98.4)***</td>
<td>–</td>
</tr>
<tr>
<td>2200</td>
<td>84</td>
<td>2534 (100.0)</td>
<td>2750 (110)***</td>
<td>–</td>
</tr>
</tbody>
</table>

* Size is dependent on flange specification

Typical tolerances:
** +0/–10 mm (0.40 in)  *** +0/–20 mm (1.0 in)

Table 3.3 DN250 to 2200 (10 to 84 NB) full-bore
4 Electrical Installation

4.1 Grounding

**Caution.** For safety reasons and optimum performance, the flowmeter, pipelines and medium must be correctly bonded and grounded according to regulations.

**Note.**
- The flow sensor must not be connected to a ground spike.
- For bonding connections use $\geq 4\text{mm}^2$ ($< 10\text{AWG}$) cable.

![Optional fluid contact ring for lined pipes](image)

*Fig. 4.1 All Metal Pipe (Including Lined Metal Pipe)*

![Optional fluid contact ring for lined pipes](image)

*Fig. 4.2 Metal Pipe with Flange Adaptor*
Fig. 4.3 Flanged Metal Pipe to Plastic Pipe

Fig. 4.4 Metal Pipe with Plastic Make-up Insert

Fig. 4.5 All-plastic Pipe

Refer to Section 4.2, page 17
4.2 Remote Transmitter / Sensor Arrangement

Caution. Do NOT ground cathodically protected systems.

Note. For bonding connections use ≥ 4mm² (< 10AWG) cable.

Fig. 4.6 Pipelines with Cathodic Protection

Fig. 4.7 Remote Transmitter in Roadside Cabinet
4.3 Transmitter Terminal Connections

**Warning.** Isolate the transmitter from power supplies before removing the cover.

![Fig. 4.8 Accessing the Transmitter Terminals](image)

Referring to Fig. 4.8:

1. Slacken (but do not remove) the four transmitter cover screws (A).
2. Remove the transmitter cover.
3. Check that the power indicator LED (B) on the backplane is **not** lit.

**Warning.** If the power indicator LED (B) is lit, the transmitter is still powered up. Before continuing, isolate the transmitter power supply.

4. If screws (C) are not visible, access them by gently pulling the rotation lock (D) back and rotating the cartridge (E) until the cartridge screw access holes align with the cartridge screw heads.
5. Slacken the three cartridge screws and lift the cartridge (F) away from the housing.
Fig. 4.9 Cable Gland / Conduit Entry (Remote Transmitter Shown)
4.4 Cable Preparation (Remote Systems Only)

**Caution.** Maintain Environmental Protection at all times – See Section 4.5.2, page 22.

To prepare the cable for connection at the transmitter and sensor terminal blocks:

1. Remove the outer cable insulation and Mylar® wrap.
2. Ensure the drain wire is sleeved.
3. Cut the cable connection wires to the lengths shown in Figs 4.10 and 4.11, page 21.

4.5 Transmitter / Sensor Cable Connections

**Caution.**

- Make connections only as shown.
- Twist the screen wire of D1 / TFE + D2 with the outer screen drain wire and sleeve them.
- For standard (non-cathodically protected) systems, connect the drain wire to the earth screw.
- For cathodically protected systems, connect the drain wire to terminal SCR, ensuring no braid or wires touch the exposed copper areas within the transmitter sensor cable wiring area.
- If an earth screw is not available at the transmitter enclosure, connect the drain wire to terminal SCR.
- Ensure the seal and mating surfaces are clean to maintain environmental rating.
- Conduit connections must provide cable entry sealing.
- Ensure cable glands are tightened after wiring. Do not overtighten the plastic cable glands to avoid destroying their sealing properties. Initially, tighten finger-tight, then a further $\frac{1}{2}$ to $\frac{3}{4}$ turn using a suitable spanner or wrench.
- Fit blanking plugs where required.
4.5.1 Sensor Cable Terminal Connections and Recommended Cable Lengths

**For Cathodically Protected Systems (or if the transmitter enclosure does not have an earth screw) connect the drain wire to terminal SCR.

**Drain Wire (Twisted with Screen Wire from D1/TFE – Orange and D2 – Yellow)

Cut cables to 70 mm (2.75 in)

Cut cables to 60 mm (2.35 in)

**For Cathodically Protected Systems connect the drain wire to terminal SCR.

Fig. 4.10 Sensor Cable Connections at Transmitter Terminal Block – Standard System

Fig. 4.11 Sensor Cable Connections at Sensor Terminal Block – Standard System
4.5.2 Environmental Protection

Fig. 4.12 Potting the Sensor Terminal Box

Warning.

- Potting materials are toxic. Read the manufacturers’ instructions carefully before preparing the potting material and use suitable safety precautions.
- Power up and check all connections before potting.
- The remote sensor terminal box connections must be potted immediately on completion to prevent the ingress of moisture.
- Do not overfill or allow the potting material to come into contact with 'O' rings or grooves.
- Do not let potting material enter conduit (if used).
4.6 Output Connections

**Caution.**
- Refer to page 36 for 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 WaterMaster connections.

### 4.6.1 Frequency Outputs

**Fig. 4.13 Frequency Output Connections**

**Note.** Outputs 1 and 2 are polarity sensitive. The common (negative) connection for these outputs is designated 'COM'.
4.6.2 Alarm Outputs

Terminal connection IDs are HART, PROFIBUS & MODBUS-variant dependent

Fig. 4.14 Alarm Output Connections

4.6.3 Current Output (4 to 20 mA) – HART (FEX100) Variant

Refer to IM/WMP for HART®-Protocol communication details

Fig. 4.15 Current Output (4 to 20 mA) – HART (FEX100) Variant
4.6.4 RS485 Communications – PROFIBUS (FEX100–DP) and MODBUS (FEX100–MB) Variants

Fig. 4.16 WaterMaster RS485 Backplane Connections to PROFIBUS Network

4.6.5 Test Point Access

Note. A typical DVM probe can access (fit) the PCB’s test holes.

*These 2 test points are connected on the HART FEX100 backplane only (they are present on the PROFIBUS FEX100–DP and MODBUS FEX100–MB backplanes but are not connected)

Fig. 4.17 Transmitter PCB Board Test Point Access
4.7 Power Supply Connections

Warning.
- Electrical installation and earthing (grounding) must be in accordance with relevant national and local standards.
- Power must be connected via a suitable isolator and fused in accordance with relevant standards.
- When changing fuses F1 or F2, isolate the power supply and wait 20 s before opening the enclosure.
- Replace fuses with the correct part, see Fig 4.18 (AC power) and 4.19, page 27 (DC power).

4.7.1 AC Power Supply

*AC Fuse F1 250 mA Type T (see table below for suppliers)

<table>
<thead>
<tr>
<th>*Fuse Supplier</th>
<th>Fuse Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB</td>
<td>B20411</td>
</tr>
<tr>
<td>Bussmann</td>
<td>BK/ETF 250 mA</td>
</tr>
<tr>
<td>Wickmann</td>
<td>19372 K250mA</td>
</tr>
</tbody>
</table>

>4 mm² (<10 AWG) Copper Wire

**Can be used as a Protective Earth (PE) if required by national standards

Fig. 4.18 AC Power Supply Connections
4.7.2 DC (and Low Voltage AC) Power Supply

![Diagram of DC (and Low Voltage AC) Power Supply Connections]

*DC Fuse F2 2 A Type T (see table below for suppliers)

- Power Supply Indicator LED
- **Red**
- **Black**
- Green / Yellow
- *Fuse Supplier* | *Fuse Part Number*
--- | ---
ABB | B20412
Bussmann | BK/ETFZM
Wickmann | 19372 K2A

DC (or Low Voltage AC) Power via suitable Isolator and Fuse

- >4 mm² (<10 AWG) Copper Wire
- Screws

---

*Fuse Supplier* | *Fuse Part Number*
--- | ---
ABB Limited | B20412
ABB Ltd. | B20412
Bussmann | BK/ETFZM
Wickmann | 19372 K2A

**Transmitter Label (DC)**

Fig. 4.19 DC (and Low Voltage AC) Power Supply Connections
4.7.3 Configuration DIP Switches

Three configuration DIP switches are mounted on the transmitter backplane board. These are factory set as follows:

- Remote transmitter – all OFF
- Integral transmitter – SW3 ON

For MID-compliant flowmeters set the read-only / MID protection switch to 'ON' to ensure the meter is secure from tampering.

For HART software versions prior to 01.02.XX, this switch (set after commissioning) prevents login via the keypad or bus at any security level.

From HART software version 01.03.XX onwards and for all PROFIBUS software versions, on MID meters, all metrological-related parameters are locked and inaccessible at the Service level. Standard and Advanced user level parameters can still be modified via the HMI or bus.

![Configuration DIP Switches](image)

**Fig. 4.20 Configuration DIP Switches**

4.8 Refitting the Cartridge and Cover

**Warning.** Ensure the transmitter is isolated from power supplies before refitting the cover.

**Caution.**

- The communications bus type is HART FEX100 if not specified on the cartridge label. An example of the PROFIBUS FEX100-DP variant cartridge label is shown on the right.
- The cartridge communications type must match the the communications type of the transmitter backplane pcb.
- To avoid damaging the cartridge during refitting, do not overtighten the cartridge screws.
Referring to Fig. 4.21:

1. Confirm that the cartridge to be fitted is of the correct power supply and for the correct communications bus type (HART, PROFIBUS or Modbus) by checking the label on the side of the cartridge:
   - AC cartridges have one black label on the cartridge side.
   - DC (and low voltage AC) cartridges have two red DC labels – one on the cartridge side and one on the cartridge rear plate.

2. Align the three cartridge screws with the cartridge housing pillars and tighten the screws carefully until the cartridge is held in position.

3. If necessary, rotate the cartridge to the required orientation before refitting the cover – see Fig. 4.8, page 18 for details.

4. For high integrity / security installations, set DIP switch SW1 to the 'ON' (Read-only) position – see Fig. 4.20, page 28.

5. Align the transmitter cover with the housing and tighten the four cover screws carefully.

6. For high integrity / security installations or where MID is required, fit anti-tamper seals to the security fixtures.

---

**Fig. 4.21 Refitting the Cartridge and Cover**
5 Start-up and Operation

Note. This section describes the options available at the 'Easy Setup' menu. Refer to the Programming Manual (IM/WMP) for comprehensive details of all end-user menus and operating levels.

5.1 Navigating the Menus and Parameters
The four keys below the display are used to navigate through the menus and to execute all system commands and selections.

![Figure 5.1 Display and Keys](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Screen title at the current level / parameter</td>
</tr>
<tr>
<td>B</td>
<td>Main level icon</td>
</tr>
<tr>
<td>C</td>
<td>Menu level title</td>
</tr>
<tr>
<td>D</td>
<td>Prompt executed by pressing the key</td>
</tr>
<tr>
<td>E</td>
<td>Prompt executed by pressing the key</td>
</tr>
<tr>
<td>F</td>
<td>Left key – used for parameter navigation and to enter editable parameters</td>
</tr>
<tr>
<td>G</td>
<td>Up / Down keys – used to scroll through menu options and to increase / decrease values in editable parameters</td>
</tr>
<tr>
<td>H</td>
<td>Right key – used to accept / select parameter values / selections and exit sub-levels</td>
</tr>
</tbody>
</table>
5.2 Start-up Screens

At start-up, the type of screen displayed indicates the status of the system. There are four common start-up screen types as follows:

### System Start-up

At system start-up, a progress bar is displayed for the duration of the start-up period. After this period, one of the four following screens is displayed according to the current status of the system.

### No Sensor Connected

If no sensor is detected during start-up, an auto-recovery routine is run to look for the sensor. If no sensor is detected, this routine continues until it is stopped manually.

If ‘Offline’ is selected during auto-recovery (by pressing the key) the transmitter ceases to operate as a flowmeter and the following conditions apply at the transmitter:

- Plant and transmitter data can be configured.
- Sensor data cannot be configured.

**Note.** If this screen is displayed on an integral transmitter, check that DIP switch SW3 is in the 'ON' position (refer to Fig. 4.20, page 28).

### Dual Sensor Memory

Integral and retrofit systems have the sensor memory mounted on the transmitter backplane board.

If two sensor memory types (integral and remote) are detected at start-up, the warning ‘DUAL SENSOR MEMORY’ is displayed.

To correct this condition, set DIP switch SW3 to the 'OFF' position (refer to Fig. 4.20, page 28).
If the sensor data stored in the transmitter memory does not match the data of the connected sensor, the warning 'INSTALLATION CHANGED' is displayed.

The changed item(s) (transmitter or sensor) can be identified and data copied as follows:

**Transmitter**

Selecting this option copies plant and stack data from the sensor memory to the transmitter memory and loads the totalizer from the sensor memory.

It is used to make the following changes:
- Remote or integral cartridge change
- Remote Tx change
- New installation

**Sensor**

Selecting this option copies data from the transmitter memory to the sensor and loads the totalizer from the sensor memory.

It is used to make the following changes:
- Integral backplane change
- Sensor change
- Integral transmitter change

**Process Display (Operator Page)**

When the 'Process Display' (Operator Page) is displayed, normal operation is assumed.

To access menus at a permitted access level, press the key to display the 'Access Level' screen – see Section 5.3, page 33.
5.3 Security Levels and Password Access

At power-up, the 'Start-up Display' and 'Process Display' screens are activated in sequence.

**Note.**
- Passwords at 'Standard' and 'Advanced' level can be set and changed by end-users.
- Access to the 'Service' level is reserved for factory-only personnel and not available to end-users.
- To navigate from the 'Operator Page(s)' directly back to the menus, accept the default access level selection at the 'Access Level' screen and press the key.

---

**Example legend only**

Operator Pages (Process Display)

When the start-up routine is completed, and if no changes have occurred since last start-up, the 'Process Display' (Operator Page) screen is displayed.

Press the key to display the 'Access Level' screen where the level of user access is selected.

Access Level

Passwords are required for 'Standard' and 'Advanced' level access. Passwords are not required for 'Read Only' access.

Select the permitted level of access and press the key to display the 'Enter Password' screen (the 'Enter Password' screen is bypassed if 'Read Only' is selected).

Enter Password

Enter the password and press the key to display menus available at the permitted access level.

**Note.** If a time-out occurs (5 minutes of no activity), enter the password again to access the menus.
5.3.1 Default Passwords
The WaterMaster transmitter is supplied with default passwords for access to 'Standard' and 'Advanced' level menus.

The two passwords are:
- 'Standard' access password: 2 or blank
- 'Advanced' access password: 3 or blank

Passwords can contain up to 5 characters and are not case sensitive.

To prevent unauthorized access ABB recommend the default passwords are changed on commissioning.

**Note.** When allocating passwords, record a copy of each password and store in a safe location. It is not possible to interrogate the transmitter to 'recover' passwords once they have been set.

5.3.2 Entering Passwords
To select password characters and enter passwords:

1. Scroll to the 'Access Level' screen and select the required access level. Press the key to display the 'Enter Password' screen.
2. Use the and keys to scroll to and highlight the first password character to be selected.
3. Press the key to select the highlighted character (add it to the password set).
4. Use the and keys to highlight the next password character to be selected.
5. Repeat steps 2 to 4 until all characters have been added to the password.
6. Press the key to accept the password and display menus available at the requested access level.
5.4 Easy Setup

The 'Easy Setup' level is used to set the system up quickly and contains a series of options for users with 'Standard' and 'Advanced' access permission. Users with 'Read Only' access cannot make selections at this level.

To navigate the 'Easy Setup' parameters:
- Enter 'Easy Setup' by pressing the ☐ key at the 'Select' prompt.
- View and edit a parameter by pressing the ☐ key at the 'Edit' prompt.
- Scroll parameter options by pressing the ▲ and ▼ keys (press and retain contact to scroll multiple options consecutively).
- Edit parameters by pressing the ◄ key at the 'Next' prompt to enter the text field and press the ▲ and ▼ keys to increase or decrease the value. Press the ☐ key at the 'OK' prompt to accept the new value.
- Accept a highlighted parameter by pressing the ☐ key at the 'OK' prompt.
- Exit the current parameter without changing the setting by pressing the ◄ key at the 'Cancel' prompt.
- Move to the next parameter by pressing the ◄ key at the 'Next' prompt.
- Exit 'Easy Setup' level by pressing the ☐ key at the 'Exit' prompt on the 'Easy Setup' main level screen.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
<th>[Default] Note</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>English, Deutsch, Français, Español, Italiano, Polski, Portuguese</td>
<td>[English] Selectable</td>
<td></td>
</tr>
<tr>
<td>Q (Flowrate) Unit</td>
<td>m³/s, m³/min, m³/h, m³/d, ft³/s, ft³/min, ft³/h, ft³/d, ugal/s, ugal/min, ugal/h, ugal/d, Mugal/d, igal/s, igal/min, igal/h, igal/d, bls/s, bls/min, bls/h, bls/d, hl/h, ml/s, ml/min, l/s, l/min, l/h, ml/d,</td>
<td>[m³/h] Selectable</td>
<td></td>
</tr>
<tr>
<td>Qmax</td>
<td>Dependant on sensor size</td>
<td>[Factory set]</td>
<td></td>
</tr>
<tr>
<td>Volume &amp; Pulse Unit</td>
<td>m³, l, ml, ft³, hl, igal, ugal, bls, Ml, Mugal</td>
<td>Selectable*</td>
<td></td>
</tr>
<tr>
<td>Pulse Width</td>
<td>0.09 to 2000.00 ms</td>
<td>[0.09 ms] Editable</td>
<td></td>
</tr>
<tr>
<td>Pulses / Unit</td>
<td>0.000010 to 10,000,000 pulses / unit</td>
<td>[1.0] Editable</td>
<td>(Only shown when Pulse Mode is Pulse / Unit)</td>
</tr>
<tr>
<td>Fullscale Frequency</td>
<td>0.250000 to 10,000,000 Hz</td>
<td>[5,000.000] Editable</td>
<td>(Only shown when Pulse Mode is Fullscale Frequency)</td>
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<tr>
<td>Damping</td>
<td>0.02 to 60 s</td>
<td>[3.00 s] Editable</td>
<td></td>
</tr>
<tr>
<td>Mains Frequency</td>
<td>50 or 60 Hz</td>
<td>[50 Hz] Selectable</td>
<td></td>
</tr>
</tbody>
</table>

* For OIML and MID flowmeters, only m³ must be used.
## 6 WaterMaster Flow Performance

### 6.1 WaterMaster flow performance – m³/h

<table>
<thead>
<tr>
<th>DN</th>
<th>Q4 (m³/h)</th>
<th>Q3 (m³/h)</th>
<th>Q0.4% (m³/h)</th>
<th>Q2 (m³/h)</th>
<th>Q1 (m³/h)</th>
<th>Q0.2% (m³/h)</th>
<th>Q2 (m³/h)</th>
<th>Q1 (m³/h)</th>
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</thead>
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<tr>
<td>10</td>
<td>3.1</td>
<td>2.5</td>
<td>0.167</td>
<td>0.013</td>
<td>0.008</td>
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<td>0.02</td>
<td>0.012</td>
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<td>15</td>
<td>7.88</td>
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<td>0.42</td>
<td>0.032</td>
<td>0.02</td>
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<td>0.05</td>
<td>0.03</td>
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<td>0.032</td>
<td>1.25</td>
<td>0.08</td>
<td>0.05</td>
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<td>25</td>
<td>20</td>
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<td>1.1</td>
<td>0.08</td>
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<td>25</td>
<td>1.67</td>
<td>0.13</td>
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<td>0.20</td>
<td>0.13</td>
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<td>6</td>
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<td>16</td>
<td>1.3</td>
<td>0.8</td>
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<tr>
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<td>313</td>
<td>250</td>
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<td>1.3</td>
<td>0.79</td>
<td>25</td>
<td>2</td>
<td>1.25</td>
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<tr>
<td>125*</td>
<td>313</td>
<td>250</td>
<td>16.7</td>
<td>1.3</td>
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<td>25</td>
<td>2</td>
<td>1.25</td>
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<tr>
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<td>630</td>
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<td>2.0</td>
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<td>5</td>
<td>3.2</td>
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<td>1,000</td>
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<td>1600</td>
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<td>1600</td>
<td>102</td>
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<td>1600</td>
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<td>100</td>
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<tr>
<td>900</td>
<td>31,250</td>
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<td>160</td>
<td>100</td>
<td>2500</td>
<td>250</td>
<td>156</td>
</tr>
<tr>
<td>DN (in)</td>
<td>Q4 (m³/h)</td>
<td>Q3 (m³/h)</td>
<td>Q0.4% (m³/h)</td>
<td>Q2 (m³/h)</td>
<td>Q1 (m³/h)</td>
<td>Q0.2% (m³/h)</td>
<td>Q2 (m³/h)</td>
<td>Q1 (m³/h)</td>
</tr>
<tr>
<td>--------</td>
<td>-----------</td>
<td>-----------</td>
<td>--------------</td>
<td>-----------</td>
<td>-----------</td>
<td>--------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>1000</td>
<td>31,250</td>
<td>25,000</td>
<td>2500</td>
<td>160</td>
<td>100</td>
<td>2500</td>
<td>250</td>
<td>156</td>
</tr>
<tr>
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<td>31,250</td>
<td>25,000</td>
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<td>160</td>
<td>100</td>
<td>2500</td>
<td>250</td>
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<td>50,000</td>
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<td>256</td>
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</tr>
<tr>
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<td>6300</td>
<td>403</td>
<td>252</td>
<td>6300</td>
<td>630</td>
<td>394</td>
</tr>
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<td>60 in</td>
<td>78,750</td>
<td>63,000</td>
<td>6300</td>
<td>403</td>
<td>252</td>
<td>6300</td>
<td>630</td>
<td>394</td>
</tr>
<tr>
<td>1600</td>
<td>78,750</td>
<td>63,000</td>
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<td>252</td>
<td>6300</td>
<td>630</td>
<td>394</td>
</tr>
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<td>125,000</td>
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<td>10000</td>
<td>640</td>
<td>400</td>
<td>10000</td>
<td>1000</td>
<td>625</td>
</tr>
<tr>
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<td>125,000</td>
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<td>10000</td>
<td>640</td>
<td>400</td>
<td>10000</td>
<td>1000</td>
<td>625</td>
</tr>
<tr>
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<td>200,000</td>
<td>160,000</td>
<td>16000</td>
<td>1024</td>
<td>640</td>
<td>16000</td>
<td>1600</td>
<td>1000</td>
</tr>
</tbody>
</table>

* OIML R49 Certificate of Conformance to Class 1 and Class 2, with OIML R49 and MID versions available.

**Note.** OIML R49–1 allow Class 1 only for meters with \( Q_3 \geq 100 \text{ m}^3/\text{h} \). Meters outside this range have been tested and conform to Class 1.
### 6.2 WaterMaster flow performance – gal/min

<table>
<thead>
<tr>
<th>NPS/NB (DN)</th>
<th>Q4 (gal/min)</th>
<th>Q3 (gal/min)</th>
<th>Q4.0 % Class 2 (gal/min)</th>
<th>Q2 (gal/min)</th>
<th>Q1 (gal/min)</th>
<th>Q4.2 % Class 1 (gal/min)</th>
<th>Q2 (gal/min)</th>
<th>Q1 (gal/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 (10)</td>
<td>13.8</td>
<td>11</td>
<td>0.73</td>
<td>0.06</td>
<td>0.035</td>
<td>1.38</td>
<td>0.09</td>
<td>0.053</td>
</tr>
<tr>
<td>1/2 (15)</td>
<td>34.7</td>
<td>27.7</td>
<td>1.85</td>
<td>0.14</td>
<td>0.09</td>
<td>3.48</td>
<td>0.22</td>
<td>0.14</td>
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<td>3/4 (20)</td>
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<td>44</td>
<td>2.94</td>
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<td>0.14</td>
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<td>0.35</td>
<td>0.22</td>
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<tr>
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<td>0.22</td>
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<td>0.57</td>
<td>0.35</td>
</tr>
<tr>
<td>1 1/4 (32)</td>
<td>137.6</td>
<td>110</td>
<td>7.3</td>
<td>0.57</td>
<td>0.35</td>
<td>13.2</td>
<td>0.88</td>
<td>0.57</td>
</tr>
<tr>
<td>1 1/2 (40)</td>
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<td>0.56</td>
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<td>0.88</td>
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<td>1.41</td>
<td>0.88</td>
<td>34.7</td>
<td>2.22</td>
<td>1.39</td>
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<td>2 1/2 (65)</td>
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<td>1.40</td>
<td>55.0</td>
<td>3.52</td>
<td>2.20</td>
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<tr>
<td>3 (80)</td>
<td>881</td>
<td>704</td>
<td>47.0</td>
<td>3.58</td>
<td>2.24</td>
<td>70.4</td>
<td>5.64</td>
<td>3.52</td>
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<tr>
<td>4 (100)</td>
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<td>1,101</td>
<td>73.4</td>
<td>6.59</td>
<td>3.49</td>
<td>110</td>
<td>8.81</td>
<td>5.50</td>
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<td>5 (125)</td>
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<td>1,101</td>
<td>73.4</td>
<td>5.59</td>
<td>3.49</td>
<td>110</td>
<td>8.81</td>
<td>5.50</td>
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<td>8 (200)</td>
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<td>11,007</td>
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<td>34.9</td>
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<td>55.0</td>
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<td>16 (400)</td>
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<td>17,611</td>
<td>1,174</td>
<td>89.5</td>
<td>55.9</td>
<td>1,761</td>
<td>141</td>
<td>88.1</td>
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<td>27,738</td>
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<td>2,774</td>
<td>222</td>
<td>139</td>
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<td>27,738</td>
<td>1,849</td>
<td>141</td>
<td>88.1</td>
<td>2,774</td>
<td>222</td>
<td>139</td>
</tr>
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<td>24 (600)</td>
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<td>4,403</td>
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<td>27/28* (700)</td>
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<td>282</td>
<td>7,045</td>
<td>704</td>
<td>440</td>
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<tr>
<td>30 (760)</td>
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<td>282</td>
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<td>704</td>
<td>440</td>
</tr>
<tr>
<td>32 (800)</td>
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<td>70,446</td>
<td>7,045</td>
<td>451</td>
<td>282</td>
<td>7,045</td>
<td>704</td>
<td>440</td>
</tr>
<tr>
<td>36 (900)</td>
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<td>110,072</td>
<td>11,007</td>
<td>704</td>
<td>440</td>
<td>11,007</td>
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<td>688</td>
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<td>42 (1050)</td>
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<td>48 (1200)</td>
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<td>17,611</td>
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<td>17,611</td>
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<td>54 (1400)</td>
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<td>277,381</td>
<td>27,738</td>
<td>1,775</td>
<td>1,110</td>
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<td>60 (1500)</td>
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<td>44,029</td>
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<td>70,446</td>
<td>7,045</td>
<td>4,403</td>
</tr>
</tbody>
</table>

*Size is dependent on flange specification
7 Specification – Sensor

**Functional specification**

**Pressure limitations**
- As per flange rating – non approved
- PN16 for OIML R49 Approved

**Temperature limitations**
- Ambient temperature: –20 to 70 °C (–4 to 158 °F)
- Remote transmitter: –20 to 60 °C (–4 to 140 °F)
- Integral transmitter: –20 to 60 °C (–4 to 140 °F)
- Process temperature: –6 to 70 °C (21 to 158 °F) – non approved
- 0.1 to 50 °C (32.2 to 122 °F) – OIML R49 T50 Approved

**Environmental protection**
- Rating:
  - IP68 (NEMA 6) to 10m (33 ft) depth (not DN10 to DN32)
  - IP67 (NEMA 4X) – DN10 to DN32

**Buriable (sensor only)**
- FEW (DN10 to 32): No
- FEV and FEF: Yes

**Conductivity**
- >5μS cm⁻¹

**Transmitter mounting**
- Integral or remote

**Electrical connections**
- 20 mm glands
- 1/2 in NPT
- 20 mm armored glands

**Sensor cable**
- ABB WaterMaster cable available in two forms – standard and armored
- Maximum length 200 m (660 ft)
Physical Specification

Wetted parts

Lining material / potable water approvals

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Size Range</th>
<th>Liner</th>
<th>WRAS</th>
<th>ACS</th>
<th>NSF-61</th>
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<td>FEF</td>
<td>DN250 – 2200</td>
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<td>PTFE</td>
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</tbody>
</table>

Electrode material

Stainless steel 316 L
Hastelloy® C-22 (Hastelloy C4 on DN10 to DN32)
(Other electrode materials available on request)

Potential equalizing rings

Optional (recommended at least 1 for insulated bore upstream and downstream pipes)

Lining protection plates

Not required

Installation conditions (recommended)

Upstream ≥ 5D
Downstream ≥ 0D (FEV, FEF and FEW [DN10 to 32])

Pressure loss

<0.25 bar at Q3 (DN40 to 200 [1¼ to 8 NB])
Negligible at Q3 (DN10 to 32 [1½ to 1¼ NB],
DN250 to 2200 [10 to 84 NB])
Non-wetted parts

Flange material

- Carbon steel (DN20 to DN2200 [3/4 to 84 NB])
- Stainless steel (DN10 to DN15 [3/8 to 1/2 NB])

Housing material

- Carbon steel: FEV and FEF (DN40 to 200 [1 1/2 to 8 NB] and DN700 to 2200 [28 to 84 NB])
- Plastic: FEF (DN250 to 600 [10 to 24 NB])
- Aluminium: FEW (DN10 to DN32 [3/8 to 1 1/4 NB])

Terminal box material
- Polycarbonate

Cable gland material
- Plastic or brass
Functional Specification

Power supply
- Mains 85 to 265 V AC @ <7 VA
- Low voltage 24 V AC +10 %/–30 % @ <7 VA
- DC 24 V ±30 % @ <0.4 A
Supply voltage fluctuations within the specified range have no effect on accuracy.

Digital Outputs (3 off)
- Rating 30 V @ 220 mA, open collector, galvanically isolated
- Maximum output frequency 5250 Hz
- 1 off dedicated to Alarm/Logic, programmable function
- 2 off configurable to either Pulse/Frequency or Alarm/Logic function

Current output – HART FEX100 Variant
- 4 to 20 mA or 4 to 12/20 mA, galvanically isolated
- Maximum loop resistance 750 Ω
- HART protocol Version 5.7 (HART registered)
- Signal levels compliant with NAMUR NE 43 (3.8 to 20.5 mA)
- Low alarm 3.6 mA, High alarm, 21.8 mA
- Additional accuracy
  - ±0.1 % of reading
  - Temperature coefficient typically <±20 ppm/°C

RS485 Communications – PROFIBUS FEX100-DP Variant
- Registered name FEX100-DP
- RS485 (9.6 kbps to 1.5 Mbps), galvanically isolated
- DPV0, DPV1
- PA Profile 3.01
- Standard ids: 9700, 9740, 9741
- FEX100-DP specific ident: 3431
- 3 Concurrent MS2 master connections

RS485 Communications – MODBUS FEX100-MB variant
- MODBUS RTU protocol
- RS485 (9.6kbps to 115.2kbps), galvanically isolated

Electrical connections
- 20 mm glands, 1/2 in NPT, 20 mm armored glands

Temperature limitations
- Ambient temperature –20 to 60 °C (–4 to 140 °F)
- Temperature coefficient Typically <±10 ppm/°C @ Vel ≥0.5 mls

Environmental protection
- Humidity: 0 to 100 %
- Rating: IP67 (NEMA 4X) to 1 m (3.3 ft) depth

Tamper-Proof Security
- Write access prevented by internal switch combined with external security seals for MID applications

Languages
- English, French, German, Italian, Spanish, Polish
Infrared service port
USB adapter (accessory), USB 1.1. and 2.0 compatible
Driver software for Windows 2000, XP, 7 (32 bit) and Vista

Housing material
Powder-coated aluminium with glass window

Hazardous approvals (HART variant only)
FM & FMc Class 1 Div 2
(FM listing NI / 1 / 2 / ABCD / T4, S / II, III / 2 / FG /T4,
Ta=60C; Type 4X, IP67 – for transmitter and integral mounting
Ta=70C, Type 6P, IP68 – for remote sensor type, IP67 on DN10 to 32)
(FMc listing NI / 1 / 2 / ABCD / T4, DIP / II, III / 2 / FG /T4,
Ta=60C; Type 4X, IP67 – for transmitter and integral mounting
Ta=70C, Type 6P, IP68 – for remote sensor type, IP67 on DN10 to 32)

FET, FEV, FEW and FEF DN700 to 2200 (27/28* to 84) only
*Size is dependent on flange specification

Declaration of Conformance
Copies of CE and PED certification will be available on request.
WaterMaster has OIML R49 Certificate of Conformity to accuracy class 1 and 2 (FEV DN40 to 200). Copies of accuracy certification are available on request.
WaterMaster (FEV DN40 to 200) has been type examined under directive MID 2004/22/EC, Annex MI-001. Copies of this certificate are available on request.

DS/WM–EN Rev. J
Acknowledgments

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