AquaProbe FEA200

Insertion-type electromagnetic flow sensor with AquaMaster3 transmitter

Measurement made easy
Maximum performance, minimum hassle

Suitable for permanent or temporary installation
• total user flexibility

Proven accuracy over wide operating flow range in both forward and reverse flow directions
• enables accurate measurement

Battery / Renewable power operation
• optional 10-year battery life
• no external power supply required
• facilitates installation in remote location
• ability to connect a solar panel or wind turbine

AC powered with supercapacitor backup
• continuous measurement even during power-down

Optional built-in multi-speed, multi-channel, dual-variable logger
• high precision, high resolution datalogging

'Hot tap' capability
• enables installation with no interruption to water supply

'Fit and Flow™'
• simplifies installation

3-Year material defect warranty (AquaProbe sensor)

AquaProbe FEA200

AquaProbe FEA200 extends the capability of the ABB AquaProbe flowmeter by bringing together the proven AquaProbe flow sensor with the innovative AquaMaster3 transmitter.

AquaProbe has been designed, in close consultation with the water industry, as an economic and accurate alternative to full-bore metering. It comprises an electromagnetic sensing head mounted on the end of a support rod. The sensing head can be installed in existing pipelines without the need for the major excavations or alterations to pipework associated with full-bore meters. It can be fitted without interrupting the water supply and can be removed easily for periodic calibration or inspection.

AquaProbe is designed for installation in existing pipelines by means of a small valved tapping. It is normally installed with the sensing head on the pipe centreline, but may be located at the critical position (the mean velocity position) a distance of $\frac{1}{8}$ of the pipe diameter away from the wall.

It provides an accurate local measurement of the water velocity and, provided the flow profile is developed fully, a good flow volume measurement.

If the profile is not fully developed, a traverse of the pipe can be performed, enabling an accurate flow volume measurement to be obtained in non-ideal networks.

Key features include the wide flow range with the minimum measured velocity (well below that detected by insertion turbine or DP devices), no moving parts resulting in increased reliability and reduced maintenance.

The AquaProbe is ideal for permanent installation to monitor potable or clean water flow. Also through the provision of multiple tappings on the supply pipelines, AquaProbe can be used as a portable survey tool to assist in the building of an accurate network model, locate leaks and check the operation of installed full-bore meters.

The high sensitivity of AquaProbe enables it to traverse the pipe to establish the flow profile and so identify hydraulic problems in complex systems or ensure maximum accuracy from an AquaProbe that has been installed in a non-ideal location.

Figure 1   AquaProbe flow sensor

Based on ABB-proven technology, AquaProbe is supported by the expertise of ABB, the world's leading flow meter manufacturer with many pioneering advances in water flow metering over the last decade – for example, AquaMag™, WaterMaster™, AquaProbe™ and CalMaster™.

ABB operate nationally- and internationally-accredited flow calibration facilities in the UK, Germany, USA, Australia, China and India. We also offer comprehensive, locally based before- and after-sales service.

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…AquaProbe FEA200

AquaProbe FEA200 power options

Mains power with super capacitor back-up

- Mains-only option supplied with a built-in rechargeable super capacitor backup power source
- The super capacitor can operate for up to 5 days without power (depending on operating conditions)
- The super capacitor has recharge cycles greater than 10,000 and, with mains power, offers continuous SMS operation
- In the event of mains interruption, continuous measurement is maintained and alarms reported via SMS protocols for up to 5 days without power
- No batteries to replace

Battery power for remote locations

- Up to 10-year* battery life
- Option of an external lithium battery pack for high temperature locations
- Option of manganese alkaline battery pack*
- Site-replaceable battery pack
- The battery can be replaced without loss of logger contents, enabling smooth switchover

AquaProbe FEA200 is the ideal solution for locations where there is no external power. AquaProbe FEA200's extended battery life is achieved through new technology design.

*Operation at extremes of temperature can shorten battery capacity and life significantly.

Solar and wind power

Utilizes a simple DC (6 to 12 V) connection from sources as small as a 5 W solar panel or wind generator. Wind generators and solar panels are not supplied by ABB.

- No external rechargeable batteries required
- No external regulators
- Very simple installation
- Super capacitor backup

It is now possible to access sun and wind energy power sources. The internal super capacitor can power the transmitter at night or for up to 3 weeks during power interruptions (dependent on operational conditions).

Figure 2   AquaMaster3 with solar panel

Logger facility

AquaProbe FEA200 can contain an optional multi-speed multichannel, dualvariable logger. The ability of the logger to run at two speeds simultaneously enables the user to investigate, in precise detail, the flow and pressure activity during a period of interest. The logger logs both flow and pressure via a direct digital transfer of data, ensuring optimum accuracy and measurement resolution. Figure 3 illustrates actual district network measurements showing extra detail captured utilizing the twin loggers.

Traditional techniques of counting pulses over a short logging interval leads to 'quantization' effects corresponding to whole numbers of pulses on logger graphs that is shown on Figure 3. AquaProbe FEA200 eliminates such effects, averaging digitally over the selected logging interval. Such high resolution data facilitates step testing, leak detection and water network analysis.
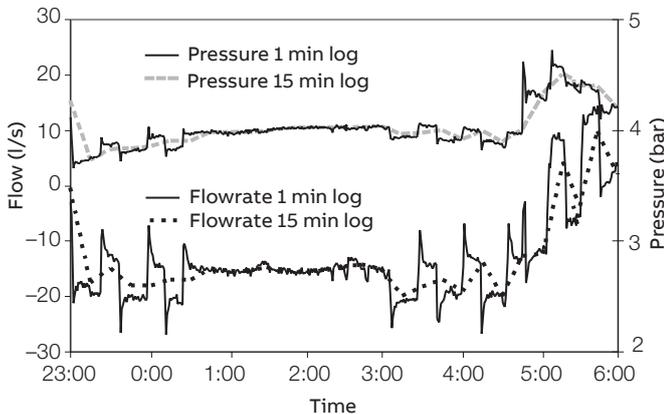

Figure 3   Dual high-speed integral logger

The FEA200 internal loggers feature an advanced automatic time synchronization function that ensures operation on synchronized time boundaries irrespective of the logging interval set. This ensures all flow and pressure data, when combined with data from other meters, is synchronized precisely.

For revenue applications, not only is the logged flow and pressure information available, there are also totalizer and tariff loggers that log all volume totals (forward, reverse, net) and tariff reading totals daily, at midnight. The in-built memory keeps all records for 2 years (732 days). The readings stored are the precise register volumes and are not inferred by integration of pulses or other similar techniques.

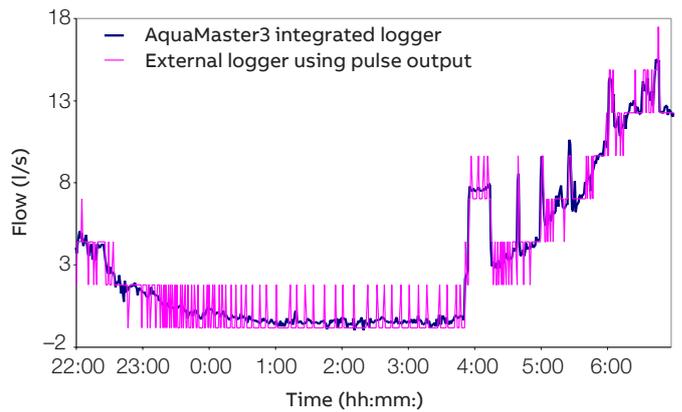Access to the loggers and logger configuration is security-protected by user-defined passwords.

Figure 4   Elimination of pulse quantization with AquaMaster3

AquaMaster3 transmitter

The AquaMaster3 transmitter provides a comprehensive display of all flow data, including forward and reverse flow totals, flow rate, pressure and time / date. If all the data is not required, the transmitter is configured easily to display only the required values, ensuring simple reading with no superfluous data. The two standard pulse outputs (forward and reverse flow direction) are compatible with the wide range of dataloggers used in the water industry, worldwide.

The transmitter is fully submersible, enabling it to be mounted locally in chambers that are liable to flooding or up to 200 m (656 ft) remote from the flow sensor to facilitate ease of reading.

- Comprehensive display
- Submersible for use in flooded chambers IP68 (NEMA6P)
- Resettable or secure totals
- 5 mm (0.2 in.) high displays for totals
  (exceeds ISO 4064 requirements)
- Total security
- Two user-security levels
- Anti-tamper switch and seals
- Three outputs
  (forward & reverse pulse, pulses & direction and alarm)
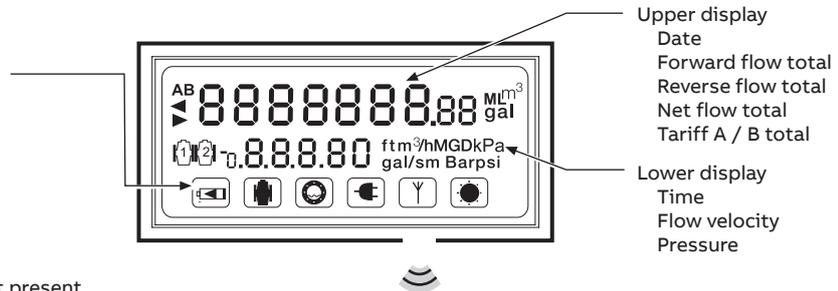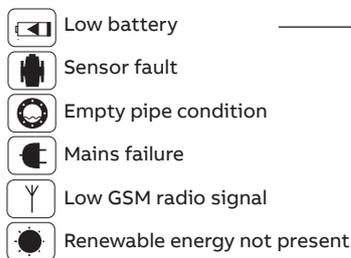

Pictorial warning annunciators

Low battery	
Sensor fault	
Empty pipe condition	
Mains failure	
Low GSM radio signal	
Renewable energy not present	

Upper display
  Date
  Forward flow total
  Reverse flow total
  Net flow total
  Tariff A / B total

Lower display
  Time
  Flow velocity
  Pressure

Figure 5   AquaMaster3 display

Support software

AquaMaster3 is available with a variety of industry standard third party software (Technolog™ [PMAC], Primayer™, Capula™ and AutoChart™) for download, management, analysis and display of data; either directly from the RS232 port or via telemetry.

ABB also supply ABB LogMaster, simple-to-use PC software, that provides local communication to the AquaMaster3 and enables full control and downloading of the onboard datalogger. A file-save facility enables data to be exported in CSV format for charting in Microsoft Excel™ or similar spreadsheets. It supports Vodafone Radiopad™ remote connection for full remote operation.

AquaMaster3 also has on-bard remote communication ability with an optional GSM / SMS radio to support remote configuration, diagnostics and logger retrieval. Local hard-wired connections are available via RS232, RS485 Modbus and ScanReader.

ABB also supply ScrewDriver, enhanced PC software that provides users with all-round improved profile analysis, setup, downloading and display options when used with AquaMaster3.

Easy, low cost installation

No matter what the location or installation requirements, AquaProbe provides a cost-effective solution. The flow sensor is fully submersible, enabling installation in flooded chambers.

The AquaProbe is installed by means of a small valve tapping on the water supply pipeline, normally with the sensing head on the pipe center line. It may be located at the critical position (the mean velocity position) a distance of $1/8$ of the pipe diameter away from the wall.

AquaProbe provides an accurate local measurement of the water velocity and, provided the installation instructions have been carefully followed, a good flow volume measurement.

Fit weld-on boss

Fit suitable valve and drill into pipe using 'Hot Tap' technique

'Fit and Flow'

- No need to match flow sensor and transmitter
- Fast, reliable installation
- Foolproof, no errors
- Flow sensor stores all calibration factors, site settings, serial numbers and totalizer values
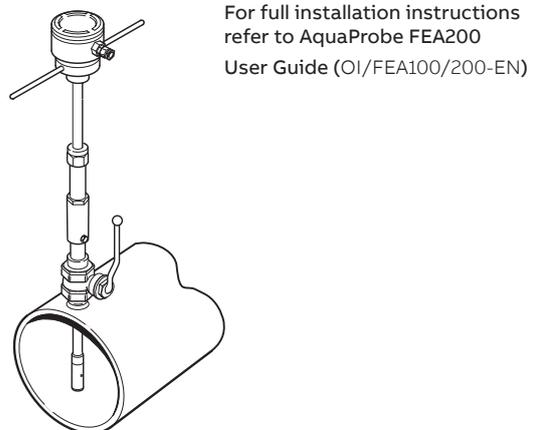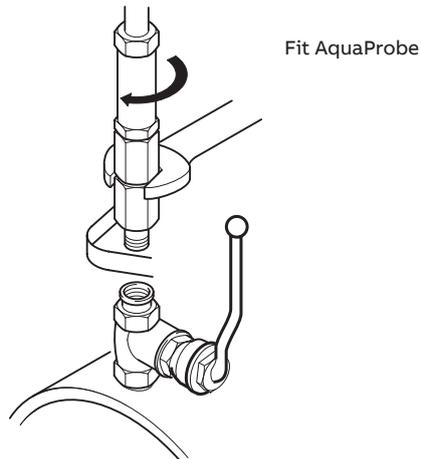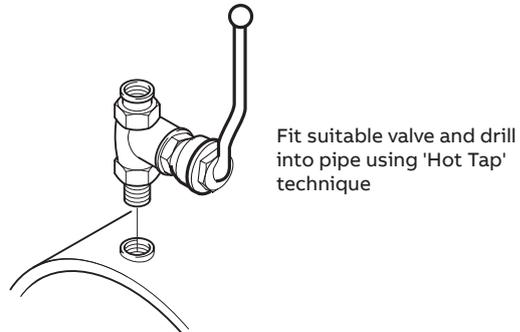- Totalizer volume values backed-up in flow sensor for total security

Fit AquaProbe

For full installation instructions refer to AquaProbe FEA200 **User Guide (**OI/FEA100/200-EN**)**

Figure 6   Typical installation (metal pipe)

Technical specification

AquaProbe flow sensor

Maximum insertion length
- 300 mm (12 in.)
- 500 mm (20 in.)
- 700 mm (25 in.)
- 1000 mm (40 in.)

Pipe sizes
200 to 8000 mm (8 to 320 in.) nominal bore

Protection
IP68/NEMA6P (Indefinite submersion down to 10 m [30 ft.])

Weight
<3.5 kg (7.7 lb)

Accuracy

Velocity
±2 % of Rate or ±2 mm/s (±0.08 in./s) whichever is the greater

Volume
Refer to ISO 7145-1982 (BS 1042 section 2.2) for details

Flow condition
Fully developed profile in accordance with ISO 7145-1982 (BS1042 section 2.2.)

Max. pressure
20 bar (295 psi)

Pressure equipment directive 97/23/EC
This product is applicable in networks for the supply, distribution and discharge of water and associated equipment and is therefore exempt

Conductivity
>50 µS/cm

Connections
- 1 in. BSP
- 1 in. NPT
- 1.5 in. BSP

Maximum flow
The maximum velocity depends upon the actual insertion length. Typical insertion lengths are 0.125 and 0.5 x pipe diameter.

The graph (Figure 7) is a guide* to the maximum allowable velocity for different insertion lengths.
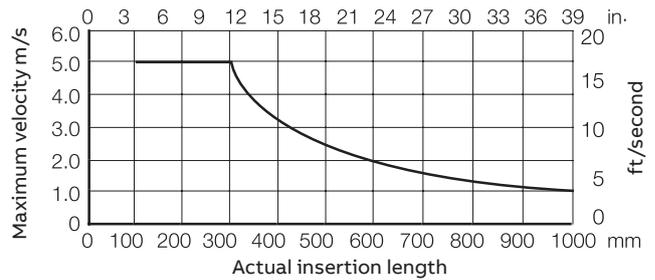

Figure 7   Maximum allowable velocity for different insertion lengths

Warranty
All AquaProbe sensors come with a factory-standard 3-year material defect warranty.

Wetted materials

Body
Stainless steel

Flow sensor
Suitable for potable water (WRAS listed)
Electrodes – stainless steel 316L

Seals
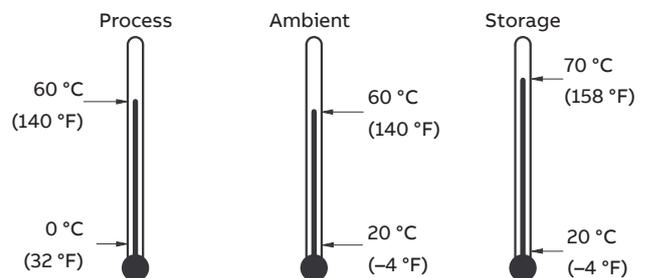Suitable for potable water (WRAS listed)

Temperature ranges

Figure 8   Temperature ranges

Pressure tapping provision
$^1/_8$ in BSP

*The graph is intended as a guide only. Factors that influence the maximum insertion length into the pipe include: flow sensor mounting components, for example, standoffs, bushes and valves; other influences include pipeline vibration, fluid vibration and pump noise.

AquaMaster3 transmitter

Housing
> IP68 (NEMA 6P)
> Stainless steel housing in a Thermoplastic outer cover with window, encapsulated with polyurethane-based resin.

Electrical connections
> IP68 plug & socket, mains cable (option)

Mains supply (option)
> 85 to 285 V AC @ <3 VA
> Power requirement: <3 W
> Connection cable: <3 m (9.8 ft.)
> Mains power failure backup time: 5 days

Renewable power (option)
> Solar or wind
> Input voltage range:
> - 6 to 22 V DC*
>
> Maximum input current:
> - 200 mA
>
> Backup power time:
> - up to 3 weeks (dependant on operating conditions)

Probe cable length
> 5, 10, 20, 30, 50, 80, 100, 150 m
> (16, 33, 65, 98, 164, 263, 329, 492 ft)

External battery pack
> IP68 (NEMA 6P)
> Battery life (manganese alkaline)
> @ 0 to 45 °C (32 to 113 °F):
> - 5 years (typical)
>
> Battery life (lithium)
> @ 0 to 60 °C (32 to 140 °F):
> - 10 years (typical)
>
> **Note**. Battery life is shorter with GSM, depending on how frequently it is used and for what period. For example, used once per day for SMS automated reporting of data logged at 15 minute intervals, the life of a battery pack would typically be reduced by 20 %.

Pulse and alarm outputs
> 3 bi-directional solid state switches with common isolation ±35 V DC 50 mA
> Output 1
> - Forward only, or forward plus reverse pulses
>
> Output 2
> - Reverse pulses, or direction indicator
>
> Output 3
> - Alarm indicates any problem with measurement or with power
>
> Pulse output
> - 50 Hz maximum, 50 % nominal duty cycle

Communications
> **Serial data communications**
> Local Port RS232**
> RS485 MODBUS
> MODBUS RTU slave
> - Baud rates: 1200, 2400, 4800, 9600 or 19200
> - RS485: 2-wire + ground signalling low power shut-off mode after 10 s of inactivity
>
> **Encoder interface / scancoder / scanreader (non-logging versions only)**
> Function – remote reading of totalizer and serial number.
> - Connections
>   - 2-wire for inductive pads (max. cable length 80 m [260 ft])
>   - 3-wire for AMR
> - Compatible readers
>   - Severn Trent Services Smart reader
>   - ABB or Elster SR100 and SR50
>   - Logicon Versaprobe
>   - Itron ERT
> - Compatible inductive pads
>   - Starpad
>   - ABB

*Renewable energy generators do not operate at maximum capacity, for example, low wind speed, coating of the solar panel or short daylight periods. As a consequence some installations will require generators with a capacity greater than the specified 5 W minimum.

**On battery and renewable energy versions, frequent use of the RS232 port considerably reduces battery standby life.

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...Technical specification

Telemetry applications (option)

GSM / SMS modem
Frequency bands
- Quad band: 850 / 900 / 1800 / 1900 MHz

Functions
- SMS auto report of flow and optionally, pressure logger data (typically 1 s or 1 min. average)
- SMS report frequency: typically daily
- SMS alarm reporting at time of event, for example power loss, limited to 1 per day
- SMS flowmeter configuration
- SMS flowmeter diagnosis
- SMS total / tariff auto report

GSM antenna (option)
Quad band operation
- 850 / 900 / 1800 / 1900 MHz

Antenna mounting
- Integral with transmitter or remote.

Antenna environmental
- IP66 (NEMA4) waterproof for accidental submersion

Note. The GSM does not operate with integral antenna under water.
General advice is to mount the antenna as high as possible, always outside of any metal enclosure and not under the surface of the ground.

Pressure system – external transducer (option)

Pressure range
16 bar Abs.

Connection
Standard quick-fit male flow sensor connector via an adapter cable

Operating temperature range
–20 °C (ambient) to 70 °C (–4 to 158 °F)
Protect the sample and transducer from freezing

Accuracy (typical)
±0.4 % of range

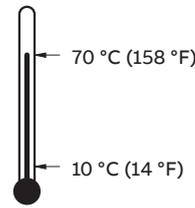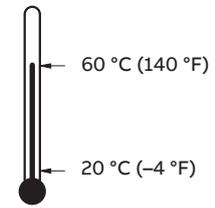### Thermal error band (typically 100 °C [212 °F])
±1.5 % span

Cable length
5, 10, 20, 30, 50, 80, 100 or 150 m
(16, 33, 65, 98, 164, 263, 329 or 492 ft)

Temperature ranges

Operation outside ambient temperature limits of 0 to 45 °C (32 to 113 °F) reduces battery capacity and shortens battery life.

Response time (programmable)

Minimum
1 s (mains-powered)
15 s (battery-powered + external renewable energy)

### Device languages
English
French
German
Spanish
Italian
Dutch

Logger details (option)

	Logger		
	1	**2**	**3**
Logger Function	**Flow & Pressure**	**Flow & Pressure**	**Forward, Reverse, Tariffs & Net Flow Totals**
No. of Records	8831	11361	732
Logging Interval	15 to 65500 s (adjustable)		24 hour (fixed)
Typical Capacity	3 months 7 days (approx.) @15 minutes	@ 1 minute	2 year

Software compatibility

Software	Direct RS232	SMS (Text)
ABB LogMaster	✓	✗
Technolog (PMAC)	✓	✗
Primayer Primeware	✓	✗
OSI PI Database or Capula	✓	✗
Mobile phone text	✗	✓
AutoChart	✗	✓
Areal (Topkapi)	✗	✓
ABB Logger Server (AMI)	✗	✓
EcoTech	✗	✓
QTech	✗	✓
HydroComp	✗	✓
ABB AC800	✗	✓
Primayer Xilog	✗	✓
Zeepaard	✗	✓

Limits of upstream disturbance
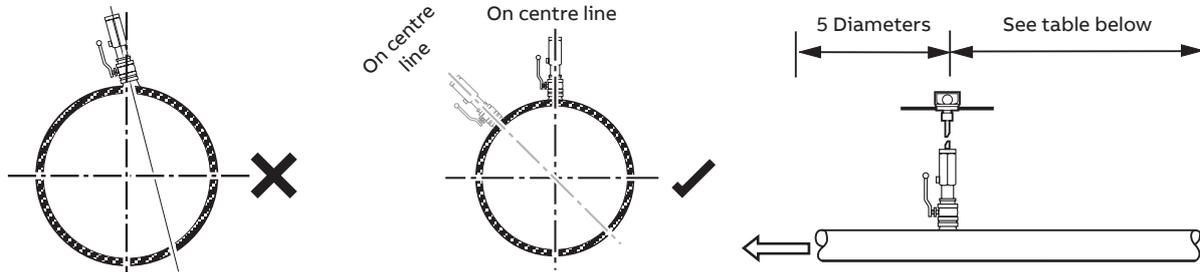
Type of disturbance upstream from the measuring cross-section	Minimum upstream straight length*	
	For a measurement at the point of mean axial velocity	For a measurement on the axis of the conduit
90° Elbow or a T-bend	50	25
Several 90° Coplanar Bends	50	25
Several 90° Non-coplanar Bends	80	50
Total Angle Convergent 18 to 36°	30	10
Total Angle Divergent 14 to 28°	55	25
Fully Opened Butterfly Valve	45	25
Fully Opened Plug Valve	30	15

*Expressed in multiples of the diameter of the conduit.

Downstream from the measurement cross-section, the straight length must be at least equal to five duct diameters whatever the type of disturbance.

Note. This Table is an extract from ISO7145 (BS 1042): Section 2.2: 1982 and is reproduced with the permission of BSI. Complete copies of the standard can be obtained by post from BSI Publications, Linford Wood, Milton Keynes, MK14 6LE**.**
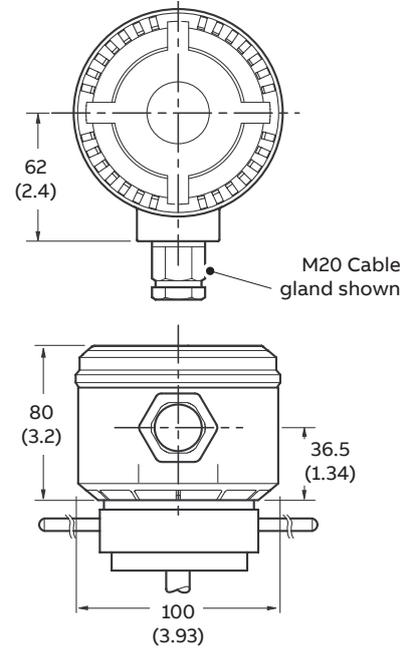
—

Overall dimensions
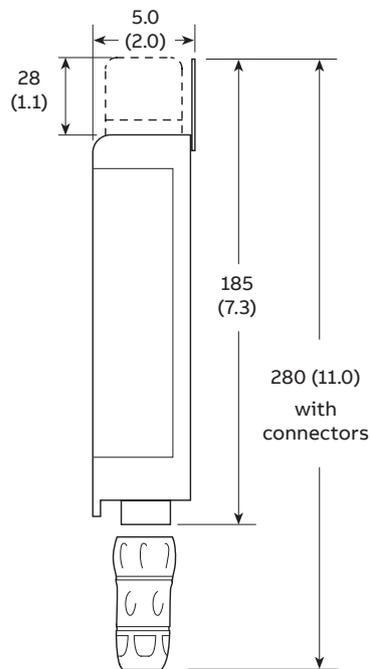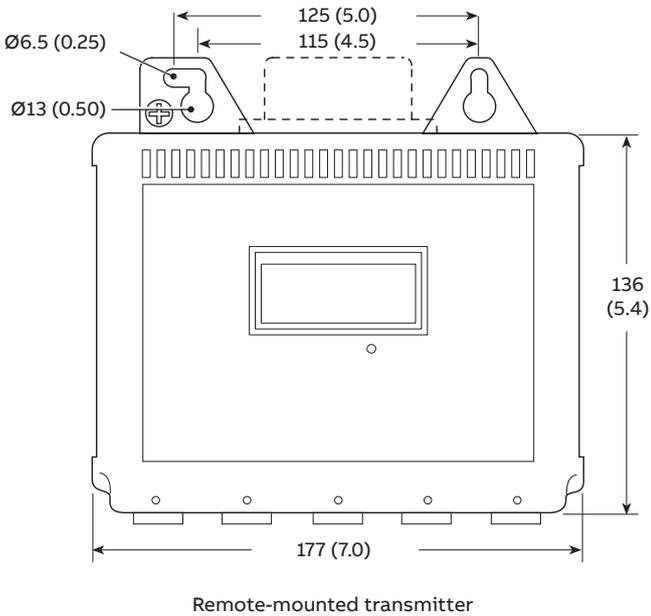
Flow sensor
Dimensions in mm (in.)

320 (12.6)

800, 1000,
1200 or 1400
(31.5, 39.4,
47.25 or 55)

1 in. BSP
1½ in. BSP
1 in. NPT
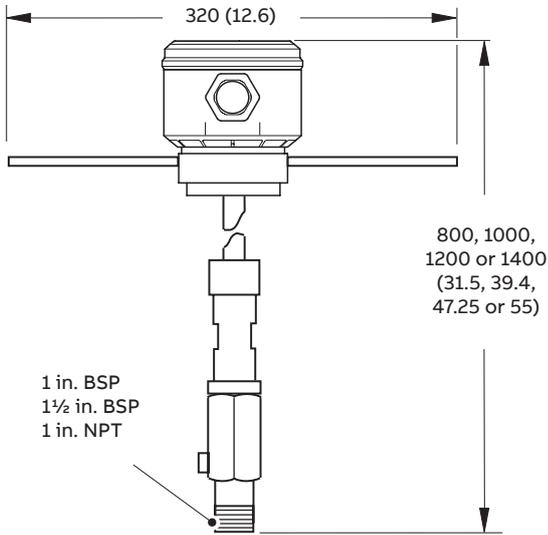
Terminal box – flow sensor-mounted
Dimensions in mm (in.)

62
(2.4)

M20 Cable
gland shown

80
(3.2)

36.5
(1.34)

100
(3.93)

AquaMaster3 transmitter
Dimensions in mm (in.)

Ø6.5 (0.25)

Ø13 (0.50)

125 (5.0)

115 (4.5)

136
(5.4)

177 (7.0)

Remote-mounted transmitter

5.0
(2.0)

28
(1.1)

185
(7.3)

280 (11.0)
with
connectors

—

Ordering information

Variant digit number	1 ... 6	7 ... 9	10	11	12	13	14,15	16	17	18	19	20	21	22	23	24	25	26	27	Options
AquaProbe (with AquaMaster3)	FEA221	XXX	G	1	X	X	XX	X	1	X	1	A	X	A	X	G	X	X	X	XXX
AquaProbe (flow sensor only)	FEA281																			

Length
300 mm (12 in.)	300
500 mm (20 in.)	500
700 mm (28 in.)	700
1000 mm (40 in.)	001

Electrode material
Stainless steel	S

Grounding accessories
Without	0

Process connection
1 in. BSP coupling ($^1/_8$ in. pressure tap)	N1
1½ in. BSP coupling ($^1/_8$ in. pressure tap)	N2
1 in. NPT coupling ($^1/_8$ in. pressure tap)	N3

Process connection material
Stainless steel seal carrier	J
Brass seal carrier	K

Calibration type
Standard factory calibration	A

Signal cable length and type
5 m (16 ft.)	1
10 m (32 ft.)	2
20 m (65 ft.)	3
30 m (98 ft.)	4
50 m (164 ft.)	5
80 m (262 ft.)	6
100 m (328 ft.)	7
150 m (492 ft.)	8
Others	9

Protection class
Sensor IP68 TX IP68 – cable fitted and potted	6

Power supply
Battery	5
AC+ backup	7
External renewable energy	8

Input and output signal types
Without (sensor only)	O
ScanReader	S
MODBUS	M
Mobile communication (GSM / SMS)	H
Sensor only	Y

Note. Pulse outputs and RS232 are always present

Configuration type
None (sensor only)	0
Standard	1

—
...Ordering information

Variant digit number	1 ... 6	7 ... 9	10	11	12	13	14,15	16	17	18	19	20	21	22	23	24	25	26	27	Options
AquaProbe (with AquaMaster3)	**FEA221**	XXX	G	1	X	X	XX	X	1	X	1	A	X	A	X	G	X	X	X	XXX
AquaProbe (flow sensor only)	**FEA281**																			

Accessories	
1.5 in. Ball valve	AB
RS232 Communication lead	AC
Manganese alkaline battery pack	AD
Lithium high-temperature pack	AE
Logger and protocols	
ABB Logger Server (AMI)	LP1
Capula	LP2
Technolog (PMAC)	LP3
Primayer (Primeware)	LP4
QTech	LP6
Areal (Topkapi)	LP7
EcoTech	LP8
AutoChart	LP9
HydroComp	LPA
ABB Generic (for example, LogMaster)	LPB
ABB AC800M	LPC
Primayer Xilog	LPD
Zeepaard	LPE
No logger	LPO
Mobile Communications	
Quad band antenna – integral	G3
Quad band antenna – remote, 1 m (3 ft)	G6
Quad band antenna – remote, 5 m (15 ft)	G7
Documentation language	
German	M1
Italian	M2
Spanish	M3
French	M4
English (default)	M5
Pressure options	
Remote, no transducer	PT2
Remote, with ABS transducer, 5 m (15 ft) cable	PT4
Remote, with ABS transducer, 10 m (30 ft) cable	PT5
Remote, with ABS transducer, 20 m (60 ft) cable	PT6
10 Bar (145 psi)	PS1
16 Bar (232 psi)	PS2
20 Bar (300 psi)	PS3

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