



EnduroFlow™ Series EF40

Ultrasonic Transit-Time Flowmeter For Permanent Installation

Applications

- Water/Wastewater
- Hot/Chilled Water/Mixture of Water and Glycol in HVAC systems
- Chemical Liquids and Solvents
- Petroleum Products
- Oil/Crude Oil/Fuel Oil/Diesel/Lubricant Oil/Hydraulic Oil
- Water management in buildings, metropolitans, water/wastewater treatment plants, irrigation systems, and more
- Flow monitoring and control in desalination plants, steel plants, power plants, machining plants, pump stations
- Liquid process control in chemical plants and industrial automation
- Oil/fuel/chemicals and other liquid transfer
- Retrofit capability, to upgrade or augment existing systems
- Automated batching and scheduling
- Efficiency monitoring and improvement of liquid-based heating/cooling systems, including solar/geothermal systems
- Beverage, food and pharmaceutical processors where non-contact is essential
- Remote flow monitoring network and leakage detection
- Thermal energy measurement, BTU consumption metering, Green building audit, facility and building energy management and district heating/cooling



Features And Benefits

- No moving parts to wear and tear. No maintenance required
- NIST-traceable factory calibration
- Multi-frequency system. Able to work reliably in a wide pipe size range
- Able to measure thermal energy and temperature with BTU measurement option
- Suitable for pure liquids and liquids with some particles. No dependency on conductivity
- Suitable for all commonly used pipes
- Compatible with various types of transducers:
 - Clamp-on transducer: non-contact, non-invasive, easy and economical installation, no pipe working
 - Insertion transducer: robust, excellent long-term stability, hot-tapping installation, no need to shut down the flow
 - Flow-cell transducer: most accurate and robust. Plug and play. Excellent long-term performance
- Large storage data logger for recording flow, temperature, status, and more
- Communication: RS485/MODBUS. Optional BACnet, GPRS, RF wireless
- IP65 protection



Spire Metering Technology LLC, 249 Cedar Hill Street, Marlborough, MA 01752, USA

Tel +1 978 263-7100 / 888 738-0188 (toll-free) **Fax** +1 978 418-9170 **sales@spiremt.com** **www.SpireMT.com**



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A member of the EnduroFlow™ Series, the EF40 Ultrasonic Flowmeter is the first member of the 4th generation ultrasonic flow meters from Spire Metering. Compared with its predecessors, the 4th generation flowmeters feature advanced multi-frequency flow measurement technology, thus, offering wider pipe size coverage, better accuracy and richer features.

The EF40 ultrasonic flowmeter is designed to be installed at a fixed location for long-term flow measurement on a closed pipe, carrying pure liquids or liquids with some suspended particles. EF40 can be equipped with clamp-on or wetted (insertion or flow-cell) type transducers to meet various application challenges.

Signal Quality Tracking

EF40 flowmeter utilizes cutting-edge technologies such as advanced transducer design, low voltage transmission, digital signal processing, self adaptation, and more, to achieve high performance. Its proprietary quality tracking mechanism analyzes the quality of the received signal and automatically tunes the meter system to its optimized condition. This mechanism leads the system to be easily adaptable to pipe material variations and liquid property changes.

Multi-frequency

EF40 main unit can be programmed to operate at 0.5MHz, 1MHz or 2MHz frequency. Together with transducers of compatible frequency, EF40 is able to measure flow on pipes from DN20 (3/4") up to DN3000 (120") with various pipe materials.

Transducer Pairing and Wetted Calibration

As QUALITY is of crucial importance, all transducers are carefully paired, and all flowmeters are wet-calibrated on the flow loop in the factory to further ensure the system accuracy and reliability.

Thermal Energy Measurement

With a pair of RTD temperature probes and a thermal energy module, EF40 can measure the thermal energy (BTU) as well as the temperature of the supply and return lines of a heating / cooling circuit.

EF40 provides versatile input/output interfaces, such as digital and relay outputs, batch control, alarm and flow/energy totalizing, 4-20mA output, RS485/Modbus and optional BACnet output, which can be easily used by a host computer, BMS, PLC or a flow controller for process monitoring and control.

Non-intrusive. Non-obstructive

With clamp-on transducers, the installation becomes very simple and easy. No pipe work is required and there is no risk of leaking or contamination. With wetted transducers, there is no obstruction to the flow, thus, there is no pressure drop.

Economical to Operate, Economical to Own

The ultrasonic transducers are made from crystal. There are no moving parts to wear and tear. The whole meter system is completely solid state. Therefore, EF40 is a robust and reliable system. It does not require maintenance or downtime which eliminates any potential incurred costs.



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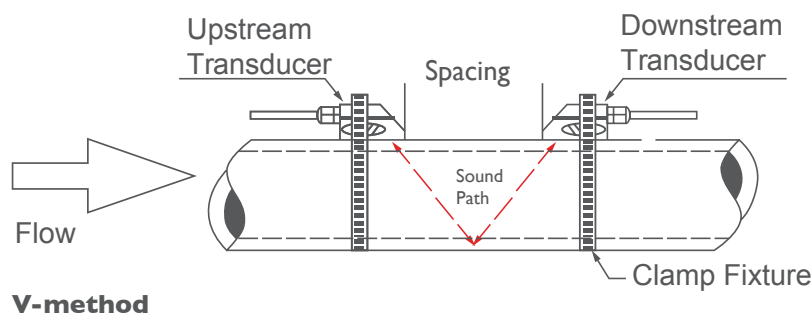
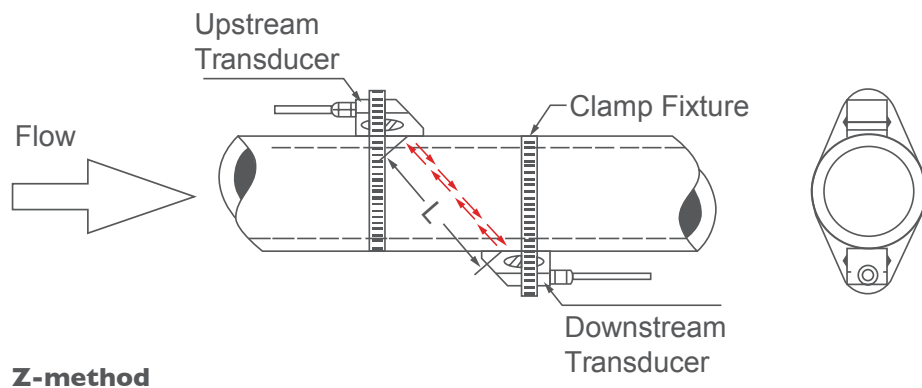
Ultrasonic Transit-Time Flowmeter For Permanent Installation

Measurement Principle

The EnduroFlow™ Series flowmeters are based on the transit-time measurement principle. The system utilizes a pair of sensors (A and B in figure below) that function as both ultrasonic transmitter and receiver. The sensors are installed on the pipe wall, either clamped on the outside of the pipe or inserted into pipe at a specific distance from each other, and the flow meter operates by alternately transmitting and receiving a coded burst of sound energy between the two sensors and measuring the transit time it takes for sound to travel between the two sensors. The difference in the transit time is directly related to the velocity of the liquid in the pipe. The flowrate is then calculated based on the transit-time difference, the geometry of the pipe and the fluid dynamics formula.

The sensors are commonly mounted with the Z-method or the V-method. With the Z-method, the two sensors are installed on the opposite side of a pipe. This method offers shorter sound path, thus, better signal strength. It is often used for large size pipes where signal strength is more important. With the V-method, the two sensors are installed on the same side of the pipe. The sound path is doubled, and as a result, the measurement accuracy is better. This method is often used for small and medium size pipes.

For insertion and flow-cell type transducers, however, only the Z-method is used.





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Typical Transducer Installation

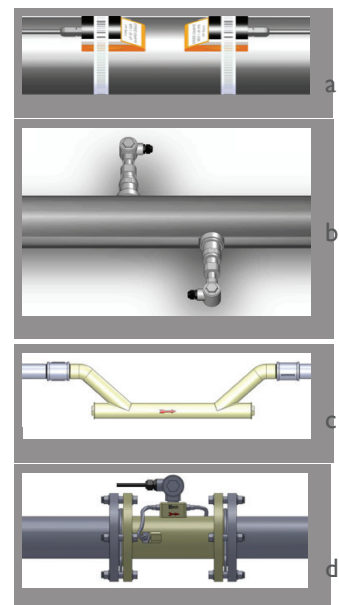
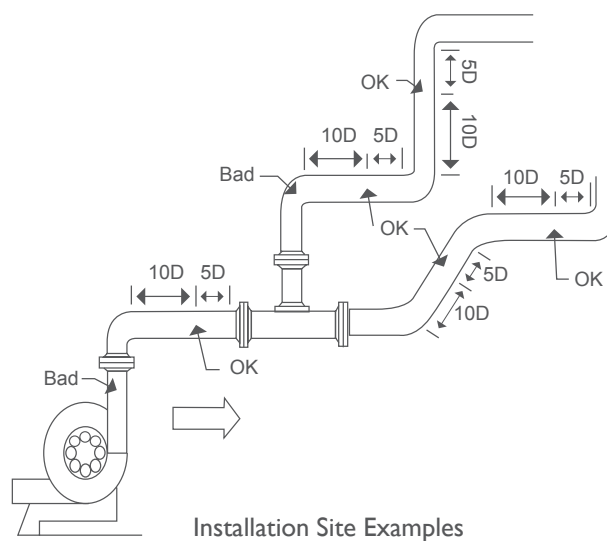
The four figures below illustrate how the transducers are installed on a pipe. The clamp-on transducer (figure a) is mounted on the outside of a pipe with a mounting fixture using the V-method. The insertion transducer (figure b) is hot-tapped or cold tapped onto the pipe using the Z-method. The flow-cell (spool-piece) transducer comes in two

varieties: for size DN40 (1 1/2") or smaller, PI-type transducer (figure c) is used, where its pipe joint could be threaded or flanged. For size DN50 (2") or larger, the transducer is a standard spool-piece with two ultrasonic sensors installed using the Z-method (figure d) where it is normally connected to a pipe line using a flange connection.

Transducer Mounting Site Selection

The site of the transducer installation is very important. Here are some recommendations for selecting the right site:

- In order to achieve good accuracy, it is recommended to have 15D straight-pipe run: upstream 10D and downstream 5D, where D is pipe diameter.
- If there is a valve upstream and the valve is not fully open, it could generate flow disturbance. A longer upstream straight pipe is recommended.
- If there is a pump upstream, we recommend to have 25D straight pipe run.
- If the pipe is vertical, make sure the flow is going upward, not downward. Downward flow could have air gaps if the flow is free fall.
- If the pipe is horizontal, make sure the pipe is full! The transducers should be installed on the side of the pipe, not on the top or bottom of the pipe.





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Specifications: Flow Transmitter (Main Unit)

Flow Velocity	± 10 m/s (± 32 ft/s). Bi-directional
Accuracy	±1% of reading ±0.008m/s (±0.03ft/s) in velocity*
Repeatability	0.2%
Response Time	3s. Configurable between 3s and 99s
Display/Keypad	LCD with backlight. 2 x 20 letters. 4 x 4 tactile-feedback membrane keypad. Displays instantaneous flow rate, flow total (positive, negative and net), velocity, time, temperature, energy, analog outputs/inputs
Units	English (U.S.) or metric
Physical Quantity	Volumetric flow rate, total flow, velocity, analog inputs, temperature, energy rate, energy total
Totalizers	Positive totalizer, negative totalizer, net totalizer, daily totalizer, monthly totalizer, yearly totalizer, manual totalizer, energy totalizer
Security	Keypad can be locked with password
Outputs	
• Current Output	0/4-20mA isolated output for flowrate, velocity or sound speed. Impedance 0-1k. Accuracy 0.1%
• Digital Output	Optically isolated OCT (Open Collector Transistor) output. Up to 0.5A load. Can be programmed as: • Pulse signal for flow totalization • ON/OFF signal for special event such as overflow, no flow, reverse flow, leakage alarming, and more • START/STOP signal for batch control Can be used to drive pulse counter, external relay, alarm, PLC counter
• Relay Output	1A@125VAC or 2A@30VDC. Can be programmed as: • Pulse signal for flow totalization • ON/OFF signal for special event such as overflow, no flow, reverse flow, leakage alarming, and more • START/STOP signal for batch control Can be used to drive pulse counter, external relay, alarm, PLC counter, or, to control pump, valve, light
• Sound Alarm	One sound alarm, programmable to specific event such as overflow, no flow, reverse flow, leakage alarm
Inputs	One 4-20mA input for temperature, pressure or liquid level transmitter Two temperature channels for accommodating two PT100 4-wire temperature sensors. This function is only available upon request
Recording	Automatically records the daily total of the last 64 days, the monthly total of the last 64 months and the yearly total of the last 5 years
Communication Interface	Isolated RS-485 with power surge protection. Supports the MODBUS protocol Optional RF/GPRS module for wireless networking, remote monitoring and remote control Optional BACnet/MSTP adapter for BMS



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Software	Optional StufManager PC software for real-time data acquisition and remote meter control (applicable for RS485 output only)
Telemetry**	uGalaxy_GPRS wireless telemetry systems are available upon request
Enclosure	
• Protection	IP65
• Dimensions	280mm x 220mm x 90mm (11" x 8.66" x 3.54")
• Features	Weather-proof Aluminum, powder coated
Weight	3kg (6.62lbs)
Environment Temp	60°C (140°F)
Power sources	12-24VDC, 90-260 VAC 50/60 Hz <2W @12VDC

Notes:

* Under reference condition and velocity should be above 0.5ft/s.

Flowrate is calculated by multiplying velocity with the inner cross-section area of the pipe.

** For wireless telemetry system solution, please contact solutions@spiremt.com.

How To Order Flow Transmitter (Main Unit)

EF40 - ☐

Please select BTU option

BTU Option*	ID
Without (default)	N
With BTU	Y

Note:

* BTU Option is needed for thermal energy measurement.
If this option is chosen, you should also order one pair of RTD probes, either PT100SM or PT100IN.

Required Accessories

Power Supply Cable	Model No.
USA Standard Plug	WA-PWC-1
British Standard Plug	WA-PWC-2

Optional Accessories

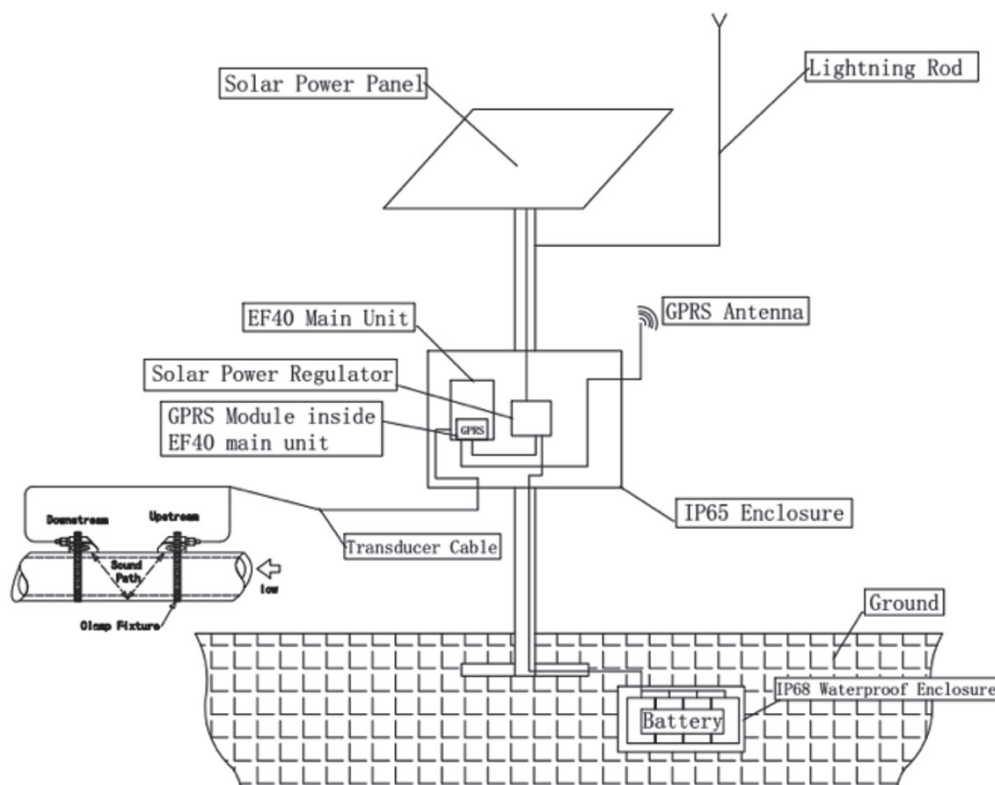
External Adapter	Model No.
485-USB (to connect to a PC)	WA-485USB
485-BACnet / MSTP (to connect to a BACnet Gateway)	WA-BACMSTP
485-GPRS (wireless module)	WA-EP228
Disc Antenna	WA-EPANT
PC Software (485-USB or 485-Ethernet adapter required for PC software use)	Model No.
StufManager (for real-time data acquisition)	SW-STMGR
uGalaxy Telemetry System	Please contact us
Temperature Sensor (in pair)	Model No.
Surface Mount PT100SM with 5m (15ft) or 10m (30ft) wire	PT100SM-5/10
Insertion PT100IN with 5m (15ft) or 10m (30ft) wire	PT100IN-5/10



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Equipment Schematic



Equipment List

A	Solar Power System (including support column, lightning rod, attaching bolts, 24V solar power regulator (maximum current 5A), monocrystalline silicon solar panels (50W, 12V) -- minimum of one panel, or two at most.
B	IP65 Enclosure for EF40 main unit (Dimension 400mm*300mm*150mm)
C	EF40 main unit (including ancillary equipment, Maximum Power 1.5W).
D	GPRS module (including GPRS antenna)
E	12 V / 30A lead-acid rechargeable battery (IP68 waterproof enclosure, buried depth:1.5 m)
F	1mm ² shielded wire.

Features


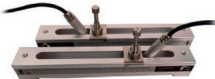



- Long service life: The warranty for the monocrystalline silicon solar panel and its accessories is 15 -20 years.
- High performance
- Maintenance free
- Uninterruptible Power Supply
- Non-interference / non-fluctuation DC Power Supply
- Not affected by the geographical environment



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Specifications: Clamp-On Transducer

Model	Picture	Description
Type: RS2/RS2C PN#: TWC-RS2 / TWC-RS2C20/25/32		Clamp-on WITH mounting rail, 2MHz Temperature 32°F~300°F (0°C~150°C) TWC-RS2: 2MHz transducer WITH mounting rail for pipe sizes DN20-50 (¾" – 2"). For copper pipes of DN20-32 (¾" – 1 ¼") and metal pipes of DN20-25 (¾" – 1"), please consider transducer TWC-RS2C20/25/32 TWC-RS2C20: 2MHz transducer WITH mounting rail fitted for DN20 (¾") copper pipe TWC-RS2C25: 2MHz transducer WITH mounting rail fitted for DN25 (1") copper pipe or DN20 (¾") ANSI pipe TWC-RS2C32: 2MHz transducer WITHOUT mounting rail fitted for DN32 (1 ¼") copper pipe or DN25 (1") ANSI pipe
Type: RM PN#: TWC-RM		Clamp-on WITH mounting rail, 1MHz Temperature 32°F~300°F (0°C~150°C) TWC-RM: 1MHz transducer WITH mounting rail for pipe size DN65-700 (2 ½"-28")
Type: M1 PN#: TWC-M1		Clamp-on WITHOUT mounting rail, 1MHz Temperature 0°F~176°F (-20°C~80°C) TWC-M1: 1MHz transducer WITHOUT mounting rail for pipe size DN65-700 (2 ½"-28")
Type: RL PN#: TWC-RL		Clamp-on WITH mounting rail, 0.5MHz Temperature 0°F~176°F (-20°C~80°C) TWC-RL: 0.5MHz transducer WITH mounting rail for pipe sizes DN300-3000 (12"-120")
Type: LF PN#: TWC-LF		Clamp-on WITHOUT mounting rail, 0.5MHz Temperature 0°F~176°F (-20°C~80°C) TWC-LF: 0.5MHz transducer WITHOUT mounting rail for pipe sizes DN300-3000 (12"-120")



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How To Order Clamp-on Transducer:

Please select one option **(ID)** from each category.

TWC -

Transducer Type	ID
Clamp-on, 2MHz for small size pipes	
2MHz transducer WITH mounting rail for pipe sizes DN20-50 (¾" – 2"). For copper pipes of DN20-32 (¾" – 1 ¼") and metal pipes of DN20-25 (¾" – 1"), please consider RS2C20/25/32	RS2
2MHz transducer WITH mounting rail fitted for DN20 (¾") copper pipe	RS2C20
2MHz transducer WITH mounting rail fitted for DN25 (1") copper pipe or DN20 (¾") ANSI pipe	RS2C25
2MHz transducer WITH mounting rail fitted for DN32 (1 ¼") copper pipe or DN25 (1") ANSI pipe	RS2C32
Clamp-on, 1MHz for medium size pipes	
1MHz transducer WITH mounting rail for pipe sizes DN65-700 (2 ½"-28")	RM
1MHz transducer WITHOUT mounting rail for pipe sizes DN65-700 (2 ½"-28")	M1
Clamp-on, 0.5MHz for large size pipes	
0.5MHz transducer WITH mounting rail for pipe sizes DN300-3000 (12"-120")	RL
0.5MHz transducer WITHOUT mounting rail for pipe sizes DN300-3000 (12"-120")	LF

Required Accessories (choose one from each category)



Transducer Cable	Model No.
5m (15ft) shielded transducer cable (in pair)	TW-CBL-5M
15m (50ft) shielded transducer cable (in pair)	TW-CBL-15M
50m (150ft) shielded transducer cable (in pair)	TW-CBL-50M
100m (300ft) shielded transducer cable (in pair)	TW-CBL-100M
Clamp Fixture	Model No.
Metal clamp for DN20-50 (¾"-2") pipe	TW-CLP-1
Metal clamp for DN50-100 (2"-4") pipe	TW-CLP-2
Metal clamp for DN125-200 (5"-8") pipe	TW-CLP-3
Metal clamp for DN250-300 (10"-12") pipe	TW-CLP-4
Metal clamp for DN350-400 (14"-16") pipe	TW-CLP-5
Metal clamp for DN450-500 (18"-20") pipe	TW-CLP-6

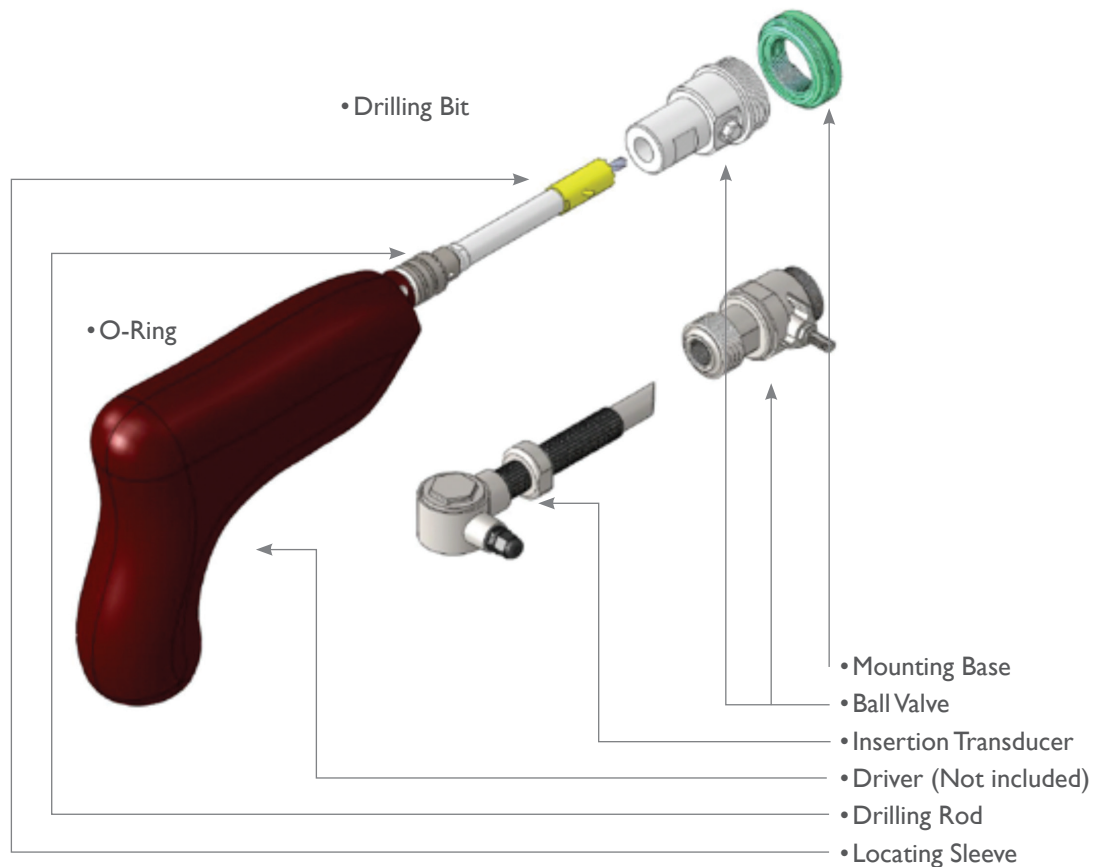


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Specifications: Insertion Transducer

Model	Picture	Description
Type: INS PN#: TWI-V		Insertion transducer, vertical type, 1MHz. For pipe size 3" - 40" (DN80-1000) Temperature range 32°F - 300°F (0°C - 150°C).
Type: INS PN#: TWI-I		Insertion transducer, inclined type, 1MHz. For pipe size 3" - 40" (DN80-1000) Temperature range 32°F - 300°F (0°C - 150°C). (Not recommended)
Type: PN#: TWI-HTK		Hot-tapping tool kit for insertion transducer installation





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How To Order Insertion Transducer

Please select one option (ID) from each category.

TWI - - - -

Type

	ID
Vertical	V
Inclined	I

Pipe Size

	ID
3"- 40" (DN80-DN1000)	1
40" -120" (DN1000-DN3000)	2

Pipe Material

	ID
Steel	1
Plastic	2
Concrete	3
Other, please specify	4

Pressure

	ID
0.6MPa (87psig)	A
1MPa (145psig)	B
1.6MPa (232psig)	C
2.5MPa (362psig)	D

Required Accessories

Cable Length	Model No.
5m (15ft)	TW-CBL-5M
15m (50ft)	TW-CBL-15M
50m (150ft)	TW-CBL-50M
100m (300ft)	TW-CBL-100M
Hot-tapping Tool Kit	TW-HTT



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Specifications: Flow-Cell Transducer

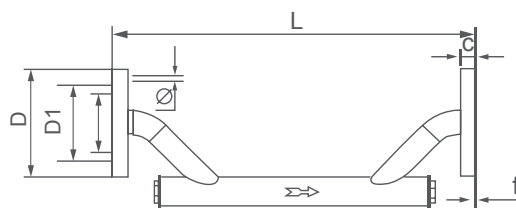
Flow Cell	Pipe Size Range	Temperature Range	Flow Vel. Range	Pipe Joint
PI-type	$\frac{3}{8}$ " ~ 1 $\frac{1}{2}$ " (DN10~40)	32°F ~ 266°F (0°C ~ 130°C)	±15ft/s (±5m/s)	Thread/Flange
Standard-type	2" ~ 40" (DN50~1000)	32°F ~ 266°F (0°C ~ 130°C)	±24ft/s (±8m/s)	Flange

Unit: mm

PI Type Flow-cell Transducer

Max Pressure Rating: 2.5MPa (362psig)

Nominal Size DN		Length L	Flange Dimension (DIN)					Flange Thickness C
mm	in		D	D1	D-Φ	D2	f	
10	$\frac{3}{8}$ "	300	90	60	4-14	41	2	14
15	$\frac{1}{2}$ "	320	95	65	4-14	46	2	14
20	$\frac{3}{4}$ "	360	105	75	4-14	56	2	16
25	1"	390	115	85	4-14	65	3	16
32	1 $\frac{1}{4}$ "	450	140	100	4-18	76	3	18
40	1 $\frac{1}{2}$ "	500	150	110	4-18	84	3	18



Notes :

- The above flange is DIN type. ANSI flange is available upon request.
- Threaded pipe joint, BSP or NPT, is available upon request.



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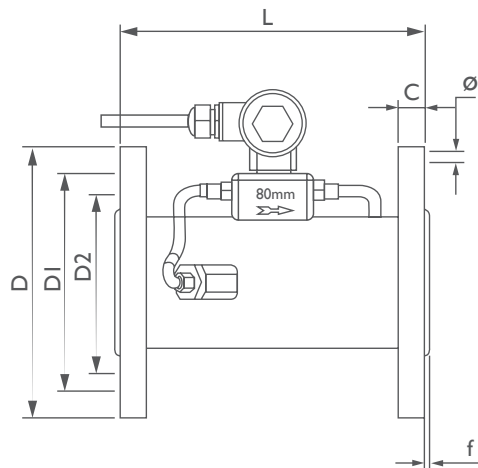
Ultrasonic Transit-Time Flowmeter For Permanent Installation

Unit: mm

Max Pressure Rating: 1.6MPa (232psig)

Standard Type Flow-cell Transducer

Nominal Size DN		length L	Flange Dimension (DIN)			Sealing Face		Thickness C
mm	in		D	D1	Φ X n	D2	f	
50	2"	200	165	125	18x4	99	3	20
65	2 ½"	200	185	145	18x4	118	3	20
80	3"	225	200	160	18x4	132	3	20
100	4"	250	220	180	18x8	156	3	22
125	5"	250	250	210	18x8	184	3	22
150	6"	300	280	240	22x8	211	3	24
200	8"	350	340	295	22x12	266	3	24
250	10"	450	405	355	26x12	319	3	26



Notes :

- The above flange is DIN type.

We also offer ANSI RF150 flange as the pipe joint upon request.



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How To Order Flow-Cell Transducer

Please select one option (ID) from each category.

TWF - - - -

Flow-cell Size		ID			ID
3/8"	(DN10)	01	2 1/2"	(DN65)	08
1/2"	(DN15)	02	3"	(DN80)	09
3/4"	(DN20)	03	4"	(DN100)	10
1"	(DN25)	04	5"	(DN125)	11
1 1/4"	(DN32)	05	6"	(DN150)	12
1 1/2"	(DN40)	06	8"	(DN200)	13
2"	(DN50)	07	10"	(DN250)	14

Pipe Joint	ID
BSP Threading (only available for size <DN50/2")	A
NPT Threading (only available for size <DN50/2")	B
DIN Flange	C
ANSI 150# Flange	D

Flow-cell Material	ID
Carbon Steel (default)	1
Stainless Steel	2
Other, please specify	3

Pressure	ID
1.6MPa (232psig) (for sizes from DN50/2" to DN250/10")	A
2.5MPa (362psig) (for sizes <DN50/2")	B

Required Accessories

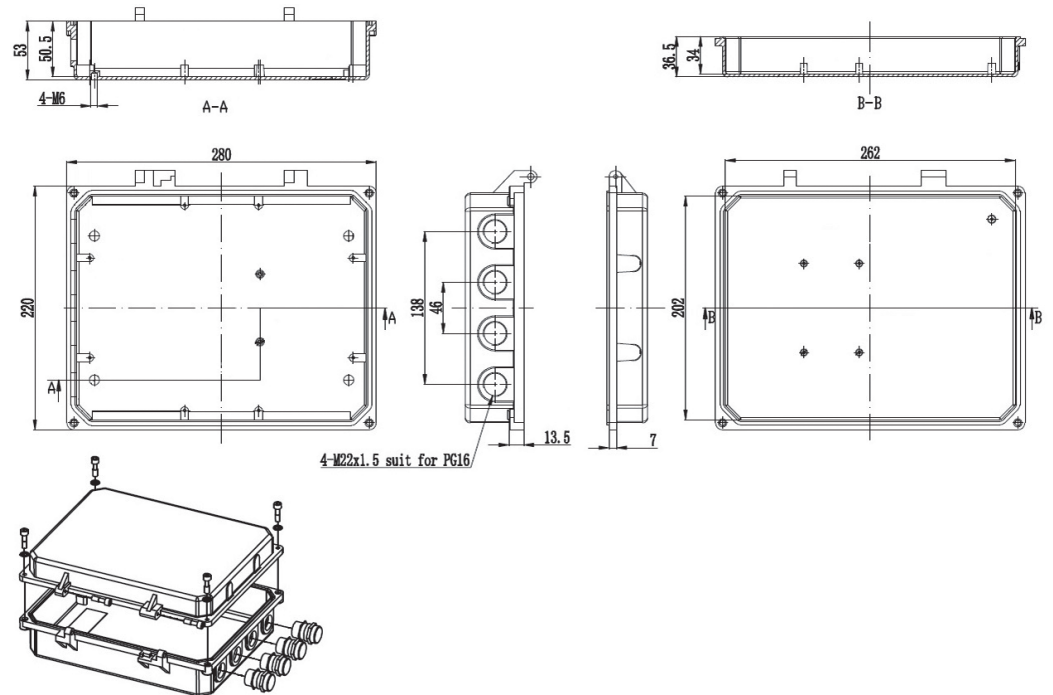
Cable Length	Model No.
5m (15ft)	TW-CBL-5M
15m (50ft)	TW-CBL-15M
50m (150ft)	TW-CBL-50M
100m (300ft)	TW-CBL-100M



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Dimensions



Application Examples

Example 1: Chiller System

Company A has a chiller pipe, 12" size, carbon steel, schedule 40. They want to monitor the flowrate in the pipe with clamp-on technology. There is a 10ft straight pipe run after an elbow and the flow transmitter (main unit) will be installed in a control room which is 15ft away from the transducer location.

In this application, they need to order the following parts:

Flow transmitter:

EF40-N-N-0, 1unit

Clamp-on Transducer:

TWC-RL, 1 pair

Transducer Cable:

TW-CBL-5M

Clamp Fixture:

TW-CLP-4

Example 2: Geothermal System

Company B has a geothermal hot water system. They need to measure how much hot water has been generated each day. The main pipe is a 4" copper pipe with the water temperature being around 160°F. They want to use a non-intrusive method to measure the flow, and the flow data needs to be logged every 5 minutes for 3 months.

In this application, the customer needs to use the EF40 clamp-on flowmeter with data logger option. The following parts should be ordered:

Flow transmitter:

EF40-N-Y-0, 1unit

Clamp-on Transducer:

TWC-RM, 1 pair

Transducer Cable:

TW-CBL-5M

Clamp Fixture:

TW-CLP-2



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Application Examples

Example 3: Clamp-on BTU Measurement for Solar Hot Water System

Company C has a solar hot water system. They need to measure how much hot water and how much thermal energy have been generated each day. The main pipe is a 2" copper pipe. The water temperature is around 180°F on the supply line. They want to use non-intrusive method to measure the flow and energy.

The flow and energy data need to be logged every 5 minutes for 3 months. Besides, the operator of this system wants to use a cell phone to check the flow and energy to monitor the system status anywhere he/she goes. In case the flow is over or below a certain flowrate, which could indicate a pump failure, the operator wants to receive an alarm message from the meter immediately.

In this application, the customer needs to use the EF40 clamp-on flow meter with data logger, BTU measurement and GPRS wireless options. The following parts should be ordered:

Main unit with BTU module:

EF40-Y-Y-0, 1unit

Clamp-on Flow Transducer:

TWC-RS2HT, 1 pair

Surface mount temperature sensors:

PT100SM-5, 1 pair

GPRS wireless Module:

WA-EP228, 1 unit

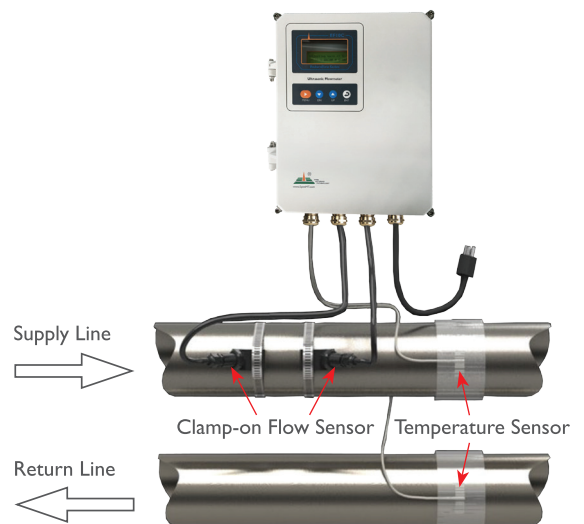
Transducer Cable:

TW-CBL-5M

Clamp Fixture:

TW-CLP-1

uGalaxy Telemetry system software



Non-intrusive Thermal Energy (BTU) Measurement
of a Heating / Cooling System

About Spire Metering Technology

Spire Metering is a global leader in flow and energy management solutions. Through continuous innovation, we transform cutting-edge technologies into affordable, reliable solutions for accurate flow and energy measurement. Spire Metering offers water, heat, electricity and gas meters as well as AMR/AMI solutions. To find out how we can help today, please tell us about your application.