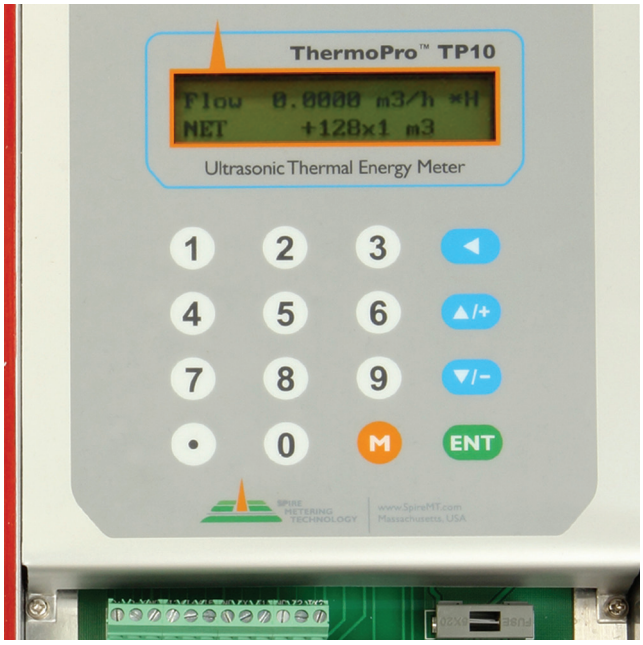
ThermoPro™ Series TP10

HEAT

Ultrasonic Thermal Energy Meter For Permanent Installation

Applications

The TP10 thermal energy measurement meter is an ideal choice for a wide range of applications in HVAC, energy production, energy transfer, building management, university facility management, district heating and cooling, geothermal and solar hot water system monitoring, and all other liquid-based thermal energy production/transferring applications.



Some examples are:

- Chilled water sub-metering
- Hot water sub-metering
- Condensate and heating water circuits
- Boiler feed water
- Glycol / Water mixture
- Thermal storage
- Geothermal system
- Solar hot-water system
- Chemical feed / Ammonia feed
- Power plants
- District energy management and billing
- LEED / Green building verification, green credit applications
- Energy consulting
- Facility management in shopping malls, campuses, industrial parks, hospitals, commercial buildings, government buildings, airports and more

Features And Benefits

- Non-intrusive thermal energy / BTU measurement
- Clamp-on ultrasonic technology
- Easy and economical installation. No pipe work required
- No moving parts to wear and tear. No maintenance required
- Industrial grade temperature sensors and ultrasonic sensors for improved robustness
- Paired PT100 RTD sensors and ultrasonic transducers for improved accuracy
- NIST-traceable factory calibration
- Suitable for pure liquids and liquids with some particles. No dependency on conductivity
- Suitable for all commonly used pipes
- Bi-directional flow measurement
- Seamless integration of temperature and flow so to deliver a complete energy metering solution
- High-performance. Abundant input/output features, such as 4-20mA, relay, alarm, task scheduler, batch controller and more
- Totalizers for flow, energy, daily energy and monthly energy
- Large data logger for recording multiple variables (optional)
- Communication: RS485/MODBUS. Optional GPRS, GSM, RF wireless
- Compatible with uGalaxy telemetry system for centralized energy distribution management

SPIRE METERING TECHNOLOGY

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ThermoPro™ Series TP10

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A member of the ThermoPro Series, the TP10 Ultrasonic Thermal Energy Meter (also called BTU Meter) is the first member of the 3rd generation ultrasonic thermal energy meters from Spire Metering. Compared with its predecessors, the 3rd generation meters offer better performance and a richer feature set.

The TP10 ultrasonic energy meter is designed to be installed at a fixed location for long-term flow measurement on a closed pipe carrying liquid. The unit uses a pair of clamp-on ultrasonic transducers to measure the flow from the outside of a pipe non-intrusively. It also uses a pair of PT100 RTD sensors to measure the temperatures in the supply and return lines. This information, together with the liquid material information, is used to calculate the thermal energy transferred to a heat-exchanger or generated by an energy production system.

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Signal Quality Tracking

The TP10 energy meter 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 itself to its optimized condition. This mechanism leads the system to be easily adaptable to pipe material variations and liquid property changes.

Transducer Pairing and Wetted Calibration

As QUALITY is of crucial importance, all ultrasonic transducers and temperature sensors are carefully paired, inspected and calibrated in order to guarantee high accuracy for both flow and temperature measurement.

The flowmeter portion of the system is again wet-calibrated by installing the transducers on a flow loop in the factory and running the flow at different flowrate points. This wetted calibration process further assures the system accuracy and reliability.

Versatile Interfaces

TP10 provides versatile input/output interfaces, such as digital and relay outputs, batch control, alarm, energy and flow totalizing and 4-20mA output, which can be easily used by a host computer, PLC or a flow controller for process monitoring and control. Additionally, the built-in isolated RS-485 port and the optional GPRS/GSM module make remote flow and energy monitoring easy and reliable.

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.

The temperature sensor PT100SM is also surface-mount type, which can be simply attached to the outer surface of the pipe.

Economical to Operate. Economical to Own

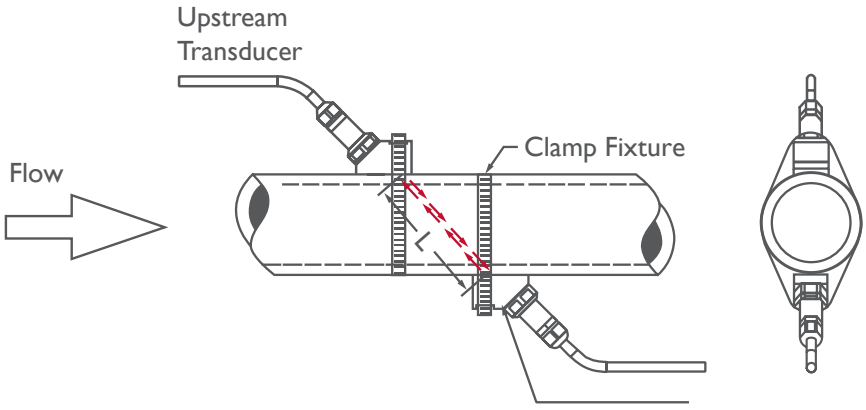
The ultrasonic transducers are made from crystal, and there are no moving parts to wear and tear. The whole meter system is completely solid state, and therefore the TP10 is both a robust and reliable system. No maintenance is required and no downtime cost is incurred.

Measurement Principle

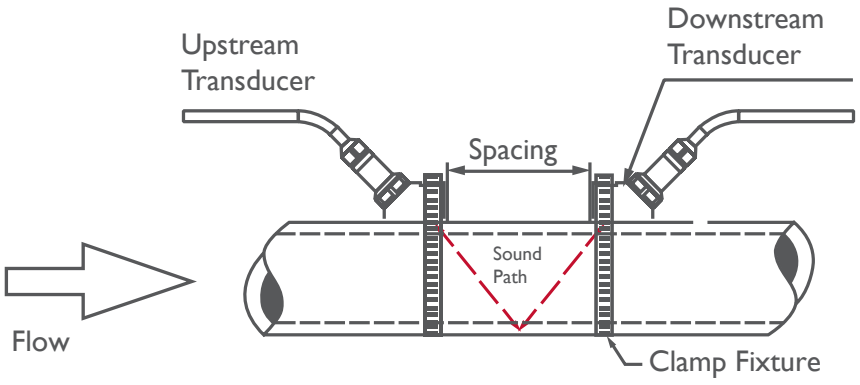
The TP10 energy measurement system can be functionally divided into 3 subsystems: the flow subsystem, the temperature subsystem and the thermal energy calculation subsystem.

The flow subsystem measures the flowrate in the pipe based on the transit-time flow measurement principle. It utilizes a pair of ultrasonic sensors (A and B in figure below) that function as both ultrasonic transmitter and receiver. The sensors are clamped on the outside of the 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 a sound pulse 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 opposite sides of the 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



Z-method



V-method

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.

The temperature subsystem measures the temperature of the liquid in the supply line and the return line of a heat exchanging circuit. The electronics of the TP10 system can accommodate a pair of PT100 RTD sensors, either surface mount type or insertion type. For easy installation, the PT100SM surface mount RTD is better. For better accuracy, PT100IN insertion RTD is better.

The thermal energy calculation subsystem utilizes the flowrate data, temperature data and the liquid density information to calculate the thermal energy delivered to the heat exchanging device. There are two methods for thermal energy calculation:

(1) $Qt = V \times (T2 - T1) \times Ct$

(2) $Qt = V \times \rho \times (TC2 - TC1)$

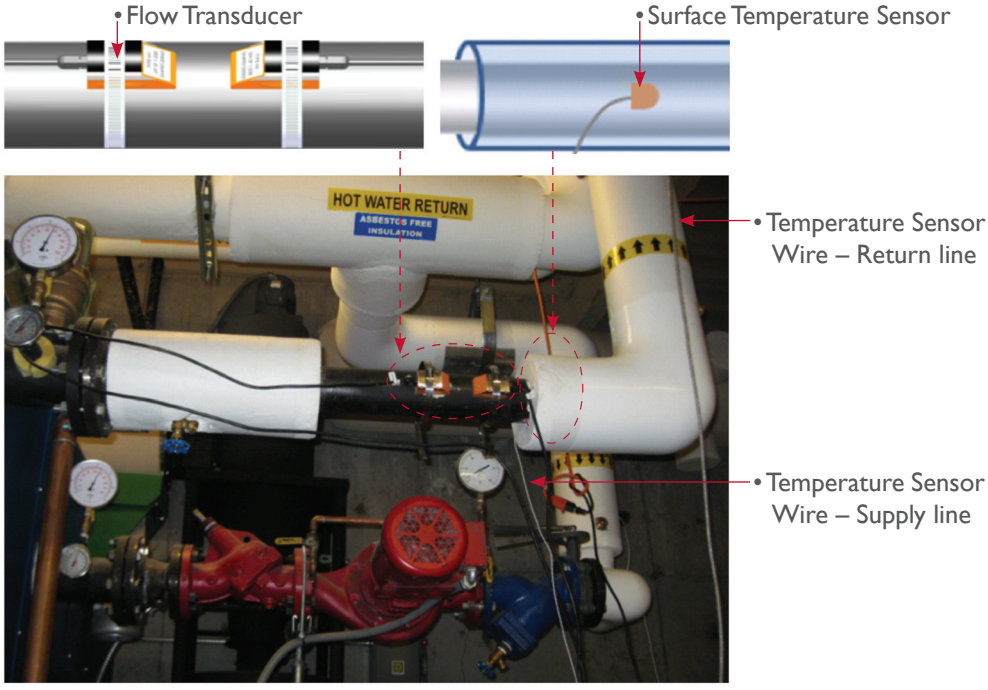
for water only. Temperature must be in range 0-150°C (302°F)

Where Qt is the thermal energy (or caloric) consumed, V is the volumetric flow rate, T1 and T2 are the temperatures at the return line and the supply line, respectively. Ct is the specific heat (or the thermal capacity coefficient) of the fluid, which can be manually entered into the TP10 through the keypad. For water, Ct is normally about 0.0041868GJ/m3°C.

ρ is the density of water at the supply temperature. TC1 and TC2 are the thermal capacities of the water corresponding to temperature T1 and T2, which are calculated by the TP10 system according to international standards.

Typical Transducer Installation

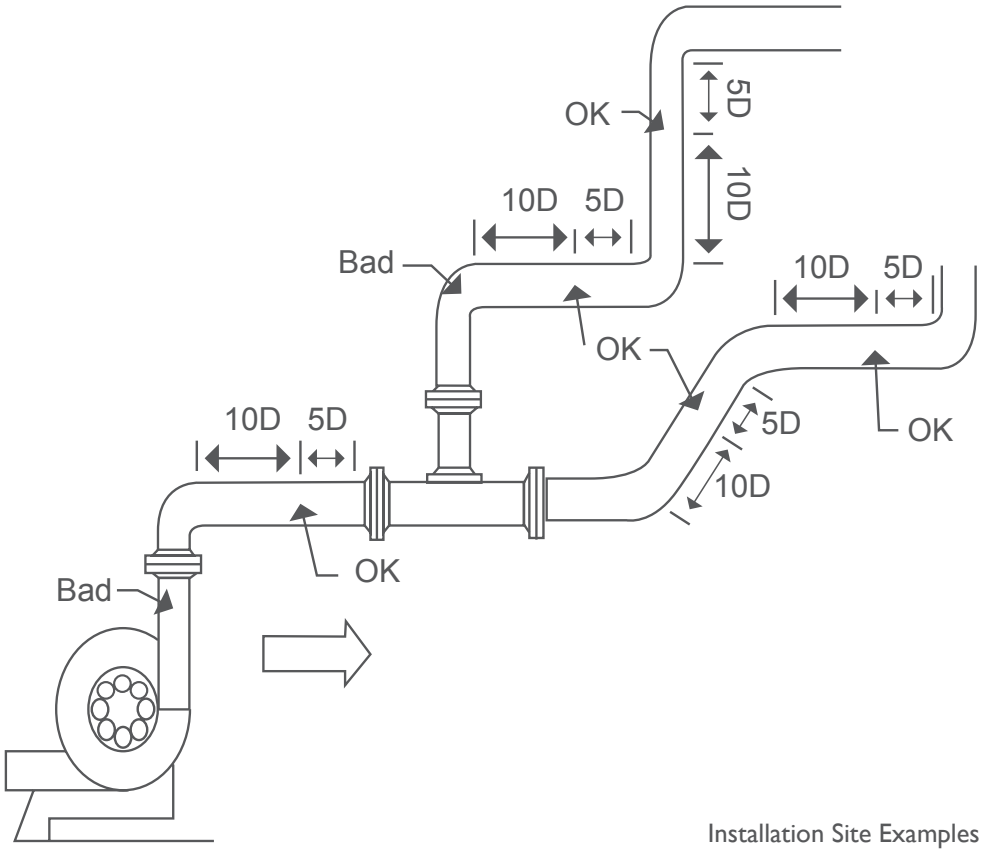
The following figure illustrates how the ultrasonic transducers and temperature sensors are installed on a chiller circuit. The ultrasonic transducers are clamped on the outside of the supply line with metal strip fixtures. The two transducers are on the same side of the pipe, referred to as the V-method installation. The temperature sensors shown here are surface-mount type, PT100SM. They are attached to the pipes, one on the supply, another on the return. Both sensors should be wrapped in thermal insulation material so that the temperature near the sensor is close to the temperature inside of the pipe.



Transducer Mounting Site Selection

The site of the ultrasonic 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 length: 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 gap 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.



Installation Site Examples

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Specifications: Main Unit

Fluid- Velocity	± 10 m/s (± 32 ft/s)
Fluid Temperature	0 – 150°C (0 – 300°F)
Accuracy - Velocity	±1% of reading ± 0.008m/s (± 0.03ft/s) in velocity *
Accuracy – Temperature	For Delta T: <0.1C with matched RTD sensor pair For T: <1°C (33.8 °F) Sensor Type: PT100. 4-wire
Repeatability	0.2%
Response Time	0.5s. Configurable between 0.5s and 99s
Display/Keypad	LCD with backlight. 2 x 20 letters. 4 x 4 tactile-feedback membrane keypad. Displays instantaneous energy rate, energy total, flow rate, flow total, velocity, time, temperature, analog outputs/inputs
Units	English (U.S.) or metric. BTU, KWH, GJ, etc.
Physical Quantity	Energy rate, total energy, volumetric flow rate, total flow, velocity, analog inputs
Totalizers	Positive totalizer, negative totalizer, net totalizer, daily totalizer, monthly totalizer, yearly totalizer, manual totalizer
Security	Keypad can be locked with password
Outputs	
• Current Output	0/4-20mA isolated output for energy rate, flowrate, velocity or sound speed. Impedance 0-1k. Accuracy 0.1%
• Digital Output	Optically isolated Open Collector Transistor output (OCT). Up to 0.5A load. Can be programmed as: • Pulse signal for flow/energy totalization • ON/OFF signal for special event such as overflow, no flow, reverse flow, leakage alarming, etc. • 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/energy totalization • ON/OFF signal for special event such as overflow, no flow, reverse flow, leakage alarming, etc. • START/STOP signal for batch control Can be used to drive pulse counter, external relay, alarm, PLC counter, or, to control pump, valve, lights
• Sound Alarm	One sound alarm, programmable to specific event such as overflow, no flow, reverse flow, leakage alarming

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Inputs	One 4-20mA input for temperature, pressure or liquid level transmitter	
Recording	Automatically records the daily total of the last 512 days and the monthly total of the last 128 months SD data logger (Optional) for recording energy, temperature, velocity, flow, status, etc	
Communication Interface	Isolated RS-485 with power surge protection. Supports the MODBUS protocol. Optional RF / GPRS / GSM module for wireless networking, remote monitoring and remote control	
Software	Optional StufManager PC software for real-time data acquisition and remote meter control	
Telemetry	uGalaxy_GPRS and uGalaxy_GSM wireless telemetry systems are available upon request **	
Enclosure	Standard (TP10-x-A)	Enhanced (TP10-x-B)
• Protection	IP65	IP66 (NEMA 4X)
• Dimensions	280mm x 190mm x 54mm (11" x 7.5" x 2.1")	305mm x 254mm x 102mm (12" x 10" x 4")
• Features	Weather-proof. Aluminum, power coded.	Weather-proof. Polycarbonate. High-impact, UV resistant. UL-50/c-UL Listed.
Weight	5kg (10lbs)	7.5kg (15lbs)
Environment Temp	60°C (140°F)	60°C (140°F)
Power sources	12-24 VDC, 90-260 VAC 50/60 Hz <2W @12VDC	12-24 VDC, 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.

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How To Order The Main Unit:

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

TP10 - □-□-□-□-□-□-□-□-□-□

Type	ID
Clamp-on (See page 12 for transducer configuration)	C

Enclosure	ID
Standard IP65	A
Enhanced IP66	B
Other, please specify	C

Temperature Sensor	ID
None	0
Surface Mount PT100SM	1
Insertion PT100IN	2

Temperature Sensor Wire Length	ID
None	A
3m (10ft)	B
10m (30ft)	C

Power Supply	ID
110VAC & 12-24VDC	1
220VAC & 12-24VDC	2

Data Logger	ID
None	N
2GB SD data logger (for recording flow, temperature, and energy)	Y

Wireless	ID
None	0
GSM	1
GPRS	2
Radio	3
Other, please specify	4

Attention

You must order both flow transmitter (main unit) and Transducer pair to make a complete flowmeter system.

Attention

485-USB or 485-Ethernet adapter is required for PC software use.

ID	**External Adapter***
A	None
B	485-USB (to connect to a PC)
C	485-Ethernet (to connect to an Ethernet network)
D	Other, please specify

ID	**PC Software**
0	None
1	StufManager for real-time data acquisition
2	uGalaxy Telemetry System

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Specifications: Clamp-On Transducer

Model	Picture	Description
Type: HFx PN#: TWC-X (x=1-5)	 (shape may vary)	**Standard temperature, FITTED** Temperature range 0˚F - 140˚F (-20˚C - 60˚C). Compact 2MHz transducer. Fit to one pipe size only TWC-HF1: for ½" (DN15) pipe TWC-HF2: for ¾" (DN20) pipe TWC-HF3: for 1" (DN25) pipe TWC-HF4: for 1 ¼" (DN32) pipe TWC-HF5: for 1 ½" (DN40) pipe
Type: HF0 PN#: TWC-6		**Standard temperature, clamp-on, 2MHz** Temperature 0˚F - 176˚F (-20˚C - 80˚C) Clamp-on 2MHz transducer TWC-HF0: for ¾" - 2" (DN20-DN50) pipes
Type: M1 PN#: TWC-7		**Standard temperature, clamp-on, 1MHz** Temperature 0˚F - 176˚F (-20˚C - 80˚C) Clamp-on 1MHz transducer (magnetic) For medium size pipes 2" - 28" (DN50-DN700mm)
Type: LF PN#: TWC-8		**Standard temperature, clamp-on, 0.5MHz** Temperature 0˚F - 176˚F (-20˚C - 80˚C) Clamp-on 0.5MHz transducer. For large size pipes 12" - 120" (DN300- DN3000mm)
Type: HF0HT PN#: TWC-9		**High temperature, clamp-on** High temperature 32˚F - 300˚F (0˚C - 150˚C) Clamp-on 2MHz transducer For ¾" - 2" (DN20-DN50) pipes
Type: M1HT PN#: TWC-10		**High temperature, clamp-on** High temperature 32˚F - 300˚F (0˚C - 150˚C) Clamp-on 1MHz transducer For medium size pipes 2" - 28" (DN50-DN700mm)
Type: PT100SM PN#: TWT-PT100SM		**Temperature sensor** RTD, PT100, surface-mount. 4-wires 0˚F - 300˚F (-20˚C - 150˚C) Metal protection.
Type: PT100IN PN#: TWT-PT100IN		**Temperature sensor** RTD, PT100, insertion. 4-wires 0˚F - 300˚F (-20˚C - 150˚C) Industrial grade

Notes:

- TP10 main unit works not only with the above clamp-on transducers, but also with wetted transducers, such as insertion type and flow-cell type transducers. Wetted transducers provide better accuracy and excellent long-term stability. Please contact solutions@spiremt.com for more information.

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How To Order The Flow Transducer:

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

TWC - □-□□□□-□-□-□-□-□

Flow Transducer Type	ID
Standard temperature, FITTED:	
HF1 - 2MHz, for pipe size ½"	1
HF2 - 2MHz, for pipe size ¾"	2
HF3 - 2MHz, for pipe size 1"	3
HF4 - 2MHz, for pipe size 1 ¼"	4
HF5 - 2MHz, for pipe size 1 ½"	5
Standard temperature, clamp-on, 2MHz:	
HF0 - 2MHz, for pipe sizes ¾" - 2"	6
Standard temperature, clamp-on, 1MHz:	
M1 - 1MHz, for pipe size 2" - 28"	7
Standard temperature, clamp-on, 0.5MHz:	
LF - 0.5MHz, for pipe size 12" - 120"	8
High temperature, clamp-on:	
HF0HT - 2MHz, for pipe size ¾" - 2"	9
M1HT - 1MHz, for pipe size 2" - 28"	10

Pipe Size

Please write nominal pipe size. **Please reference example shown on the right.*

***Note**

When indicating nominal pipe size please reference the following:

For 1/2 inch → 0.50
For DN15 → 0015
For 1.5 inch → 01.5

Pipe Size Unit	ID
Inch	I
Millimeter	M

Pipe Type	ID
Copper	A
Rigid Tubing	B
ANSI Plastic	C
ANSI Metal	D
Stainless Steel	E
Other, please specify	F

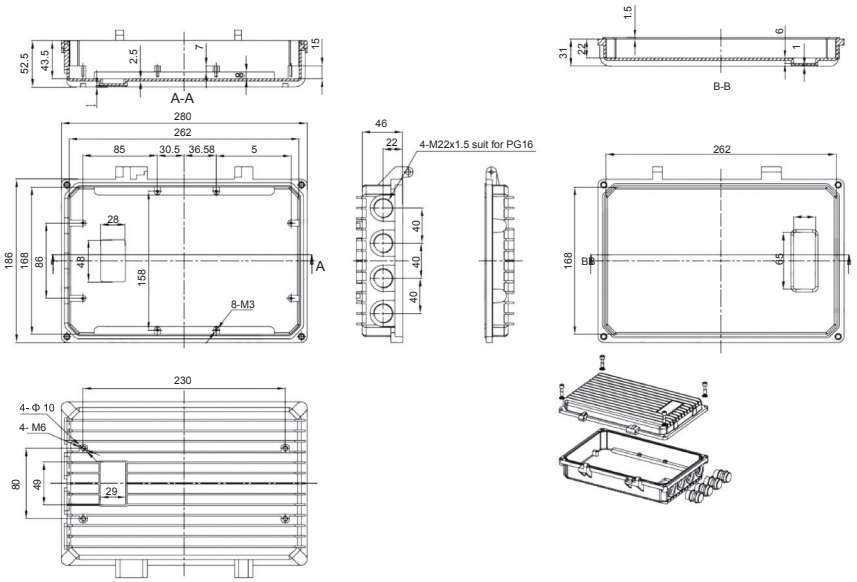
Cable Length	ID
5m (15ft)	1
15m (50ft)	2
50m (150ft)	3
Other, please specify	4

ID	Clamp Fixture
0	None
1	½" - 2" (DN15-50)
2	2" - 4" (DN50-100)
3	5" - 8" (DN125-200)
4	10" - 12" (DN250-300)
5	14" - 16" (DN350-400)
6	18" - 20" (DN450-500)
7	Other, please specify

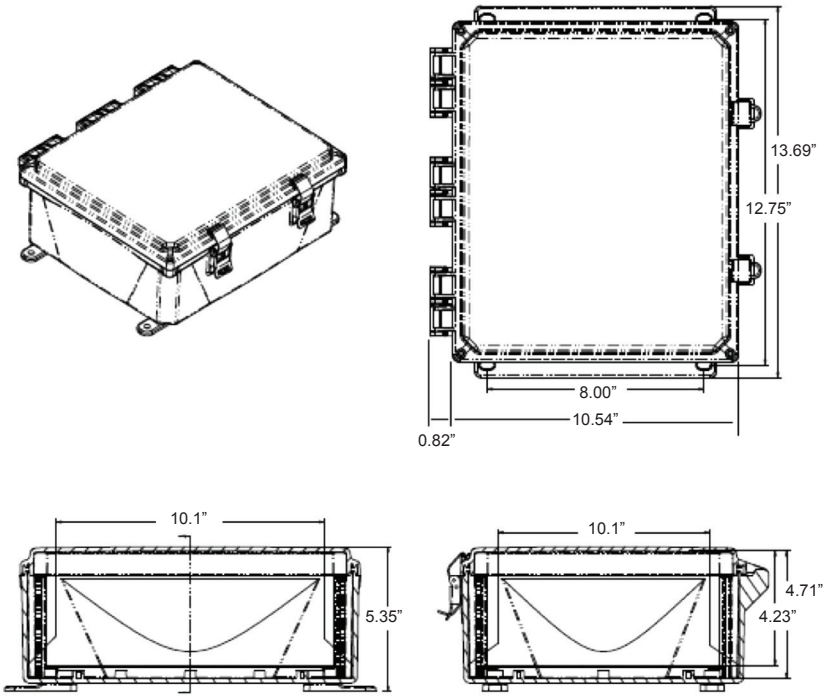
ID	Liquid Temperature
A	32° - 176°F (0° - 80°C)
B	32° - 300°F (0° - 150°C)
C	Other, please specify

Dimensions

Standard Enclosure (TP10-x-A)



Enhanced Enclosure (TP10-x-B)



Application Examples

Example 1: Chiller System

Company A has a chiller pipe, 8" size, carbon steel, schedule 40. They want to monitor the thermal energy production of this chiller circuit with non-intrusive technology. There is a 10 feet straight pipe after an elbow. The main unit will be installed in a control room which is 15 feet away from the transducer location.

In this application, the customer needs to use the following parts:

Main unit with temperature sensors:
TP10-1-A-2-B-1-N-0
Clamp-on Flow Transducer (pair):
TWC-7-8I-D-1-A-3

Example 2: Solar Hot Water System

Company B 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 160°F (71.1°C) 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.

The operator of this system wants to use a cell phone to check the flow and energy so to monitor the system status anywhere he/she goes. Also, 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 TP10 clamp-on thermal energy meter with GSM wireless option. The customer needs to order the following:
Main unit with temperature sensors:
TP10-2-A-2-B-1-Y-1
Clamp-on Flow Transducer (pair):
TWC-6-2I-A-1-A-1

Memo

About Spire Metering Technology

Formerly Shenitech, 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.