



# ThermoPro™ Series TP10

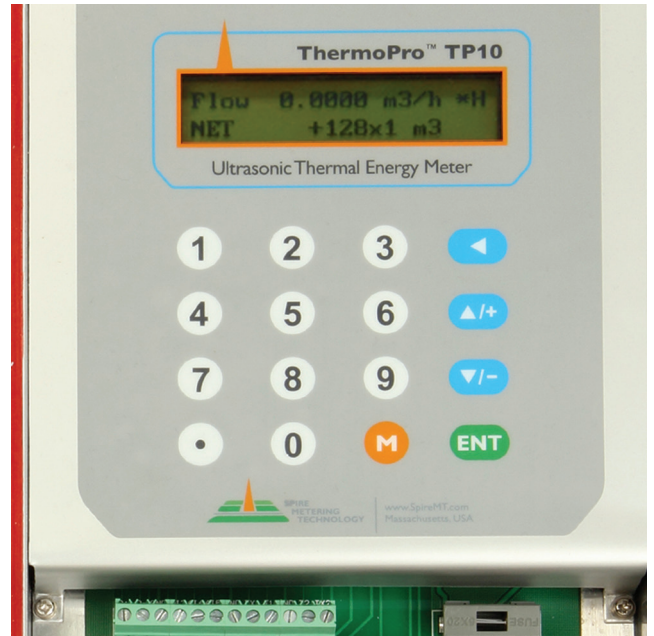
Ultrasonic Thermal Energy Meter For Permanent Installation

## 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

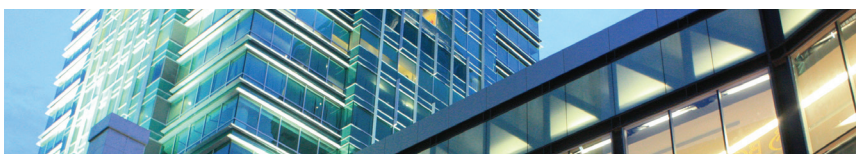


- Energy consulting
- Facility management in shopping malls, campuses, industrial parks, hospitals, commercial buildings, government buildings, airports and more

## 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 pipe materials
- Bi-directional flow measurement
- Seamless integration of temperature and flow 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: RS-485/MODBUS. Optional GPRS or BACnet
- Compatible with uGalaxy telemetry system for centralized energy distribution management

DS-TP10-170807\_Rev10



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A member of the ThermoPro Series, the TP10 Ultrasonic Thermal Energy Meter (also known as a BTU Meter) is the first member of the 3rd generation of 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 system 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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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 or BACnet module make remote flow and energy monitoring easy and reliable.

### 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. The 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.

### 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.

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

### Economical to Own and Operate

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.



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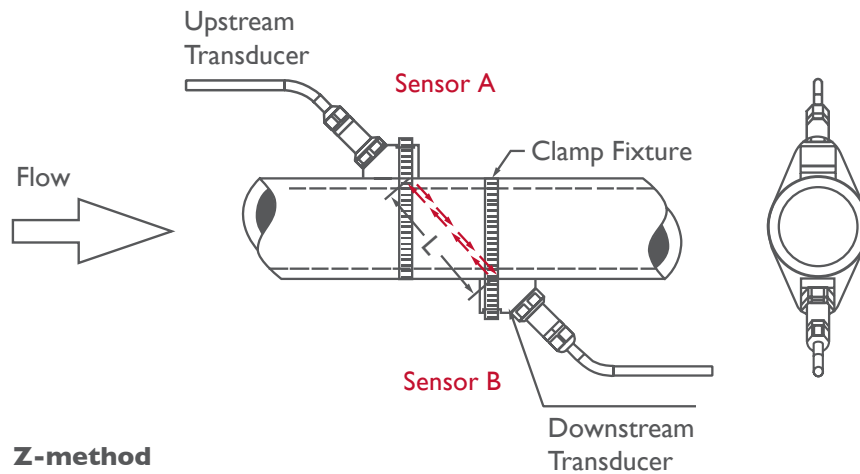
## Measurement Principle

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

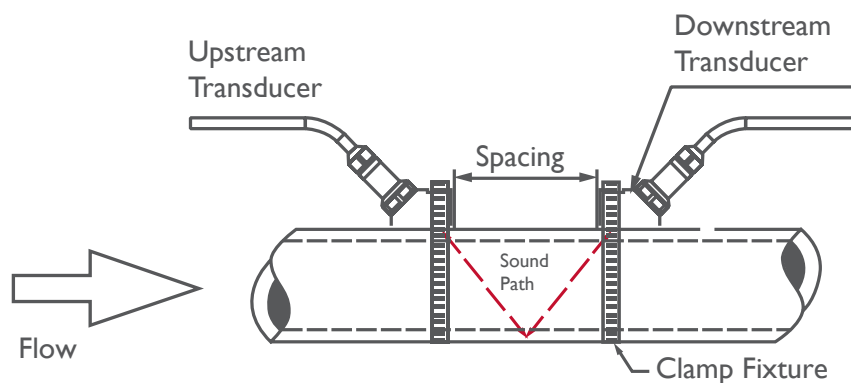
The flow subsystem measures the flowrate in the pipe based on the transit-time flow measurement principle. It utilizes a pair of ultrasonic sensors (A and B in figure below) that function as both an ultrasonic transmitter and receiver. The sensors are clamped on the outside of the pipe at a specific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



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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 higher 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:

$$(1) Q_t = V \times (T_2 - T_1) \times C_t$$

$$(2) Q_t = V \times \rho \times (TC_2 - TC_1)$$

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

Where  $Q_t$  is the thermal energy (or caloric) consumed,  $V$  is the volumetric flow rate,  $T_1$  and  $T_2$  are the temperatures at the return line and the supply line, respectively.  $C_t$  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,  $C_t$  is normally about 0.0041868GJ/m<sup>3</sup>°C.

$\rho$  is the density of water at the supply temperature.  $TC_1$  and  $TC_2$  are the thermal capacities of the water corresponding to temperature  $T_1$  and  $T_2$ , which are calculated by the TP10 system according to international standards.

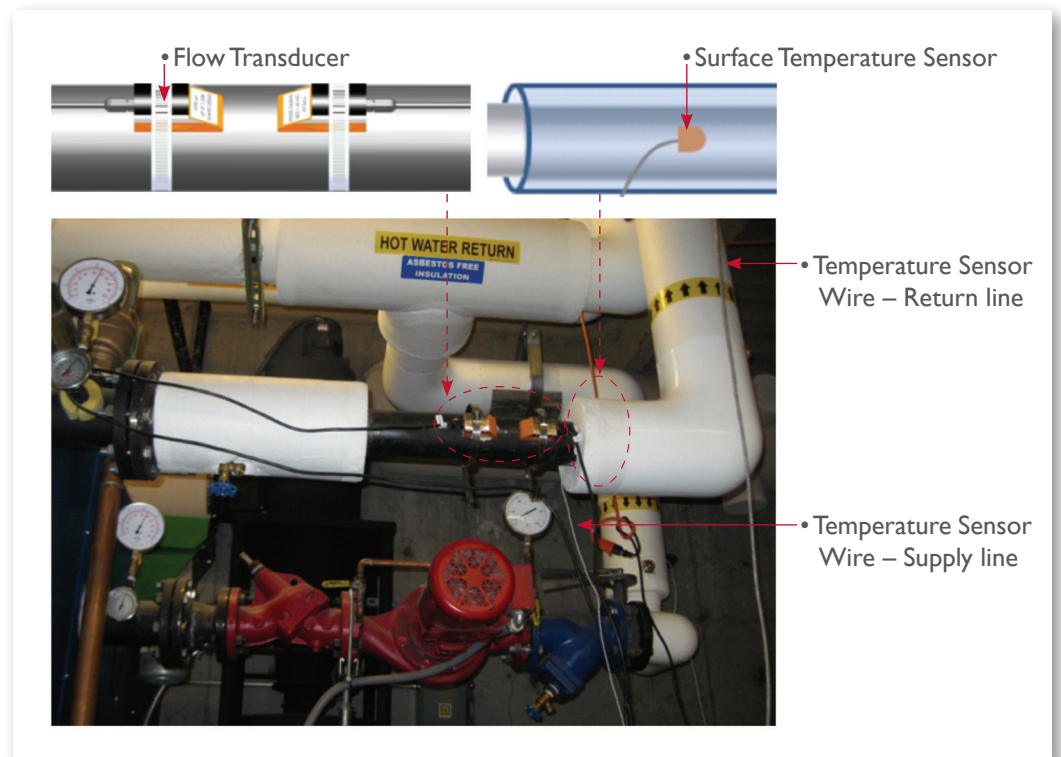


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## Typical Transducer Installation

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 of the pipe exterior (where the sensor is installed) is close to the temperature inside of the pipe.

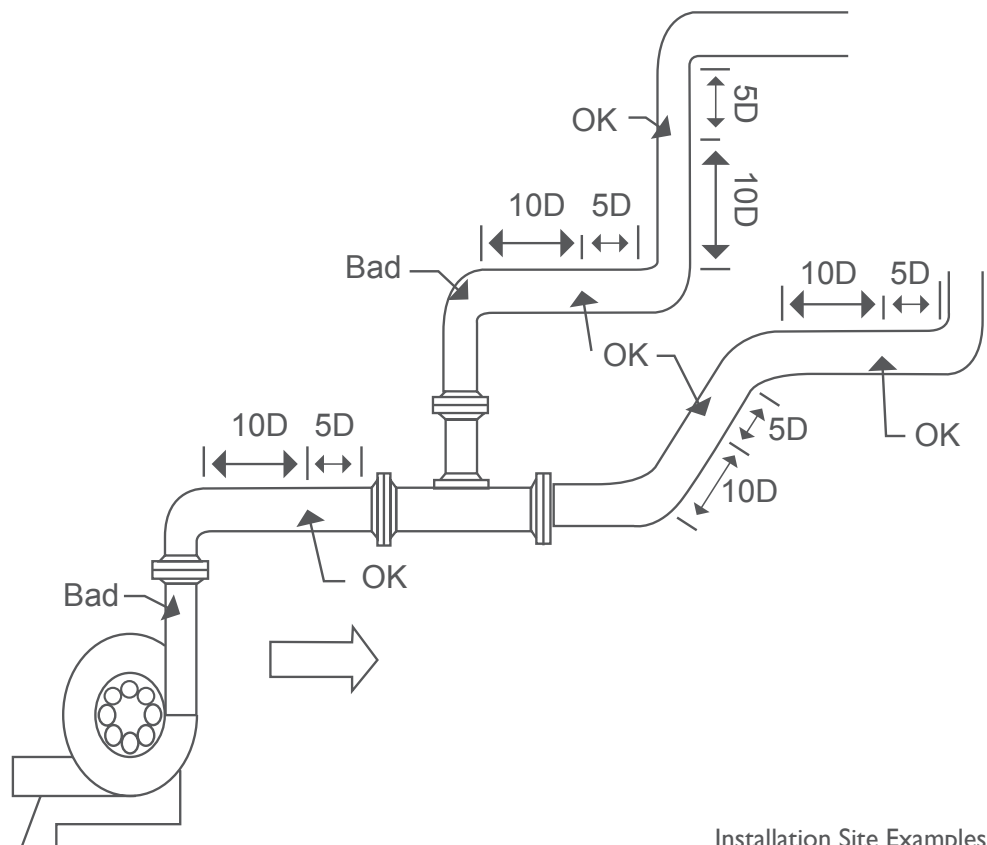




## Transducer Mounting Site Selection

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 in a 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

|                               |   |
|-------------------------------|---|
| <b>Fluid- Velocity</b>        | ± 12 m/s (± 40 ft/s)  |
| <b>Fluid Temperature</b>      | -20~150°C (0~300°F)   |
| <b>Accuracy - Velocity</b>    | ±1% of reading ± 0.008m/s (± 0.03ft/s) in velocity *  |
| <b>Accuracy – Temperature</b> | For Delta T: <0.1°C (0.15°F) with matched RTD sensor pair<br>For T: <1°C (1.8 °F)<br>Sensor Type: PT100. 4-wire   |
| <b>Repeatability</b>          | 0.2%  |
| <b>Response Time</b>          | 0.5s. Configurable between 0.5s and 99s   |
| <b>Display/Keypad</b>         | LCD with backlight. 2 x 20 letters. 4 x 4 tactile-feedback membrane keypad.<br>Displays instantaneous energy rate, energy total, flow rate, flow total, velocity, time, temperature, analog outputs/inputs  |
| <b>Units</b>                  | English (U.S.) or metric. BTU, KWH, GJ  |
| <b>Physical Quantity</b>      | Energy rate, total energy, volumetric flow rate, total flow, velocity, analog inputs  |
| <b>Totalizers</b>             | Positive totalizer, negative totalizer, net totalizer, daily totalizer, monthly totalizer, yearly totalizer, manual totalizer   |
| <b>Security</b>               | Keypad can be locked with password  |
| <b>Outputs</b>                |   |
| • Current Output              | 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:<br>• Pulse signal for flow/energy totalization<br>• ON/OFF signal for special event such as overflow, no flow, reverse flow, leakage alarm<br>• START/STOP signal for batch control<br>Can be used to drive pulse counter, external relay, alarm, PLC counter |
| • Relay Output                | 1A@125VAC or 2A@30VDC. Can be programmed as:<br>• Pulse signal for flow/energy totalization<br>• ON/OFF signal for special event such as overflow, no flow, reverse flow, leakage alarm<br>• START/STOP signal for batch control<br>Can be used to drive a pulse counter, external relay, alarm, PLC counter, control pump, valve, or lights                    |
| • Sound Alarm                 | One sound alarm, programmable to specific event such as overflow, no flow, reverse flow, leakage alarm  |





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

**Notes:**

- \* Under reference condition and velocity should be above 0.15m/s (0.5ft/s).  
Flowrate is calculated by multiplying velocity with the inner cross-section area of the pipe.
- \*\* For uGalaxy Telemetry System solution, please contact [solutions@spiremt.com](mailto:solutions@spiremt.com).



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## How To Order The Main Unit:

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

TP10 -  -1

| Enclosure             | ID |
|-----------------------|----|
| Standard IP65         | A  |
| Enhanced IP66         | B  |
| Stainless Steel, IP65 | C  |



### Attention

In addition to the main unit, you must order a temperature sensor pair and a ultrasonic transducer pair to make a complete BTU measurement system.

### Required Accessories

| Power Supply Cable     | Model No. |
|------------------------|-----------|
| American 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 (Must select the Enhanced IP66 Enclosure option & Telemetry System) | WA-YR228          |
| 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      |
| Data Logger  | Model No.         |
| 2GB SD data logger (for recording flow, temperature, and energy)             | WA-SD             |



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## Specifications: Transducers and Sensors

| Model                             | Picture | Description  |
|-----------------------------------|---------|--|
| Type: RM1<br>PN#: TWC-RM1         |         | <b>Standard temperature, clamp-on WITH mounting rail, 1MHz</b><br>Temperature 32°F~300°F (0°C~150°C)<br>TWC-RM1: 1MHz transducer WITH mounting rail for pipe size DN65-700 (2 1/2"-28")                    |
| Type: S1HT<br>PN#: TWC-S1HT       |         | <b>High temperature, clamp-on WITHOUT mounting rail, 1MHz</b><br>High temperature 32°F~300°F (0°C~150°C)<br>TWC-S1HT: 1MHz high temp transducer WITHOUT mounting rail for pipe sizes DN40-100 (1 1/2" -4") |
| Type: PT100SM<br>PN#: TWT-PT100SM |         | <b>Temperature sensor</b><br>RTD, PT100, surface-mount. 4-wires<br>0°F~300°F (-20°C~150°C)<br>Metal protection   |
| Type: PT100IN<br>PN#: TWT-PT100IN |         | <b>Temperature sensor</b><br>RTD, PT100, insertion. 4-wires<br>0°F~300°F (-20°C~150°C)<br>Industrial grade   |

**Note:**

- 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. In particular, for pipe sizes smaller than DN40 (1 1/2"), we recommend to use flow-cell transducer. Please contact [solutions@spiremt.com](mailto:solutions@spiremt.com) for more information.



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## How To Order Clamp-on Transducer:

Please select one option (ID) from each category.

TWC -

| Transducer Type  | ID   |
|--|------|
| 1MHz transducer WITH mounting rail for pipe sizes DN65-700 (2 ½"-28")              | RM1  |
| 1MHz high temp transducer WITHOUT mounting rail for pipe sizes DN40-100 (1 ½" -4") | S1HT |

### 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"-1½") 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    |

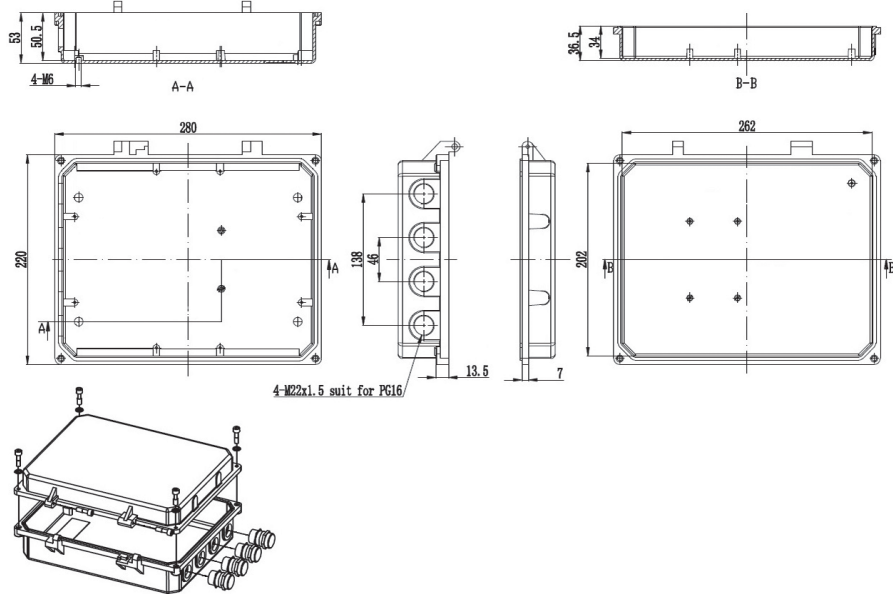


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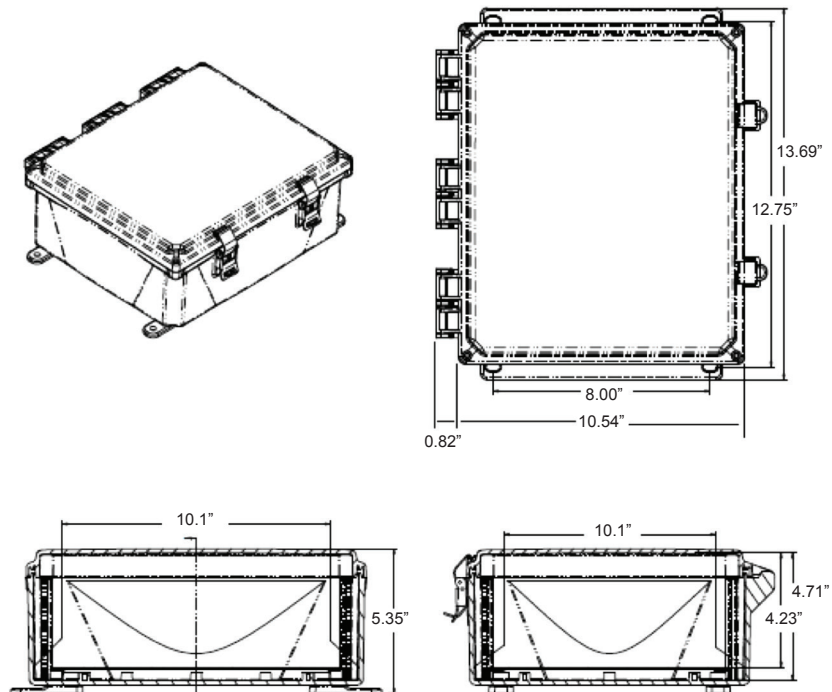
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## Dimensions

### Standard Enclosure (TP10-A)



### Enhanced Enclosure (TP10-B)





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## Application Examples

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### 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 foot 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-A-1  
PT100SM-5  
WA-PWC-1

Clamp-on Flow Transducer (pair):

TWC-RM1  
TW-CBL-5M

### 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 a 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 in order to monitor the system status anywhere they go. Also, in case the flow is above 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 GPRS wireless option. The customer needs to order the following parts:

Main unit with temperature sensors:

TP10-C-1  
PT100SM-5  
WA-PWC-1  
WA-YR280  
WA-SD

Clamp-on Flow Transducer (pair):

TWC-S1HT  
TWC-CBL-5M  
TWC-CLP-2



# ThermoPro™ Series TP10

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## Memo

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# ThermoPro™ Series TP10

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## Memo

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## About Spire Metering Technology

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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.