ROME
MEMORIAL HOSPITAL
*Total commitment. Total care.*

# Cogeneration System Monitoring Plan (NYSERDA Task 7)

September, 2010

IPD #10-6412

IPD: Engineering
INTEGRATED PROJECT DELIVERY

**Project Summary**

Rome Memorial Hospital (RMH) is planning to install a partial distributed generation, combined heat and power (DG-CHP) system. The goals include:

1. Reduce operating costs.
2. Reduce volatility associated with fluctuating natural gas and electric prices.
3. Simplistic design and operation.
4. Reduced carbon footprint.
5. Highly reliable (to avoid utility company penalties).
6. Require minimal maintenance efforts and costs.

To achieve the above, RMH plans to design, build and operate a nominal 260kW micro-turbine based Combined Heat and Power (CHP) plant to supplement its thermal and electrical loads. The plant will be located in the Hospital's 'Old Boiler Room'. The proposed system is sized/arranged to operate at peak thermal and electrical performance and at full capacity 24hrs/day, 365days/year.

As with most Hospitals, RMH has many potential thermal hosts including hot water heating, hot water reheating, domestic hot water heating, steam humidification and chilled water cooling. Of these systems, the hot water reheat system(s) provide the most significant year-around thermal load, which is driving the size of the proposed DG-CHP system. The electricity generated as a result of providing the reheat energy is always needed, as it accounts for less than 30% of the facility's total demand.

The design of the DG-CHP system comprises four Capstone model C65ICHP micro-turbines with integral heat recovery modules. All four units are planned to operate simultaneously producing AC power. Each turbine can produce 205F hot water via their on-board heat recovery heat exchangers. This heat will be piped to the Hospitals existing terminal reheat systems for which there are consistent, year-around base loads. The micro-turbines will operate in parallel with the grid, but are sized for a small fraction of the facilities demand; therefore, there will be no potential to export power at the point of service entry.

**Mechanical Sequence of Operation**

Refer to the attached schematic showing how the system is intended to be arranged.

The operation is intended to be simple and straight forward. The proposed DG-CHP system will be driven by thermal demand, which, based on the systems it's planned to be connected to, will require all micro-turbines to operate continuously and at full capacity.

Each microturbine will be provided with a constant volume (40gpm) circulating pump, all of which deliver hot water from the microturbines integral heat exchangers to a 400 gallon thermal storage tank. A temperature sensor will be located near the bottom of the tank and set to 200F. The microturbines will respond (ramp) to maintain this set point. The storage tank acts as a thermal flywheel and as an interface between the microturbines that generate hot water (source) and the existing Hospital reheat systems that use the hot water (sink). On the sink side, circulating pumps are energized whenever their associated reheat systems hot water supply set points are less than 5F above set point. Each reheat system is equipped with a steam-to-hot water heat exchanger; the CHP system is connected to the return water side of each heat exchanger so as to be the first stage of heat. Should the supply water temperature sensor not be satisfied by the amount of heat supplied by the CHP system, the existing steam control valves modulate to supplement the CHP system and ultimately maintain the desired setpoints (which are reset between 140F and 200F by the Hospitals existing automatic temperature control system).

In the event excess micro-turbine heat is available, the system's thermal storage tank will assist in absorbing it; should excess heat be available once the thermal storage absorption is maxed out, the microturbines will begin to bypass exhaust around their heat exchangers. As a last resort, microturbines will ramp down to maintain a minimum of 80% exhaust flow thru their associated heat exchangers at all times. Based on accumulated data, this will be an unlikely occurrence.

**Electrical Sequence of Operation**

The building service entrance and the microturbines operate at 480/277 volts ac, three phase, wye configuration.

Two modes of operation are possible:

1. Normal operation:
   The micro-turbines are operating in parallel to the utility grid through a connection at the equipment system distribution panel which serves equipment loads throughout the hospital. The minimum demand on the equipment system is in excess of the 260 KW capacity of the micro-turbine bank; therefore the facility demand on the utility grid will be reduced by 260 KW 24hrs/day, 365 days/yr.

2. Utility failure (black start):
   The digital power controller in the micro turbine senses a utility outage (voltage drop) and the units go into shutdown mode. The onsite emergency power system senses the voltage drop and energizes the generator, within 10 seconds the emergency power system is on line serving critical loads throughout the building. With the emergency power system operational, the micro-turbines are energized and operate in parallel with the generator to serve the equipment loads throughout the building via the equipment automatic transfer switch and associated distribution panel.

**Monitoring Plan Compliance**

*Requirement:* The monitoring plan shall account for total site electric power and fuel use to compare with the baseline energy data in order to quantify the economic and efficiency impacts of the new CHP system.

*Approach:* The Hospitals automatic temperature control contractor (Pasco) is currently monitoring electric demand and use at the service entrance and the Hospitals gas service provider, National Grid will be replacing the site gas meter with one that provides a signal that Pasco can tie in to. Pasco will be collecting this information in 15 min intervals and providing it to NYSERDA each day for two years.

*Requirement:* Sufficient data shall be collected in order to calculate the annual overall efficiency of the CHP system based on the higher heating value (HHV) of the fuel input. Sufficient data shall be collected in order to calculate hourly electric, fuel and recovered-and-beneficially used thermal energy load profiles of the CHP system each day throughout the year.

*Approach*: From an energy-in standpoint, the common gas line feeding the microturbines will be equipped with a natural gas thermal mass flow meter (refer to attached Sage cut sheet). From an energy-out standpoint, each microturbine is integrally equipped with a hot water supply and return temperature sensor that Pasco will receive a signal from and use in conjunction with the flow rate from each microturbines constant volume circulating pump to calculate the recovered-and-beneficially used thermal energy at each microturbine. The electricity provided by the microturbines to the Hospitals distribution system will be obtained by Pasco installing a power meter at the new electric panel to measure the total power output from all microturbines. The power consumed by the parasitic loads

(pumps and gas boosters) will be measured during commissioning (as will the aforementioned constant volume pump flow rate) and applied whenever they are in use. An energy calculation will be performed, subtracting the recovered-and-beneficially used thermal energy, the electricity provided to the Hospital and parasitic loads from the high heating value of the natural gas being consumed to arrive at the remaining wasted energy (stack heat). Additionally Pasco will be providing a pair of temperature sensors, an Onicon F-1100 turbine insertion flow meter and an Onicon BTU meter in the hot water piping on the microturbine side of the thermal storage tank as a check against the data collected at each microturbine. Pasco will be collecting all of this information in 15 min intervals and providing it to NYSERDA each day for two years.

*Requirement:* Monitoring parameters for each prime mover of the CHP system shall include but not be limited to: power output, heat recovered-and-beneficially-used, fuel use and run hours.

*Approach*: As stated above, each microturbine will be monitored for these items, as well as run hours, as provided to the Pasco system by each microturbine.

*Requirement:* CHP emissions shall be monitored during CHP System commissioning in order to validate the manufacturer's performance specifications (to be reported in the CHP System Installation Report described under Task 0).

*Approach*: The Hospital has purchased a complete package from Capstone including start-up and commissioning as well as a 9-year full service contract. As part of the start-up and commissioning, Capstone will be performing emissions testing on each microturbine and will be providing IPD:Engineering a report that is in compliance with NYSERDA Task 0. IPD:E will forward this information to NYSERDA at the appropriate time.

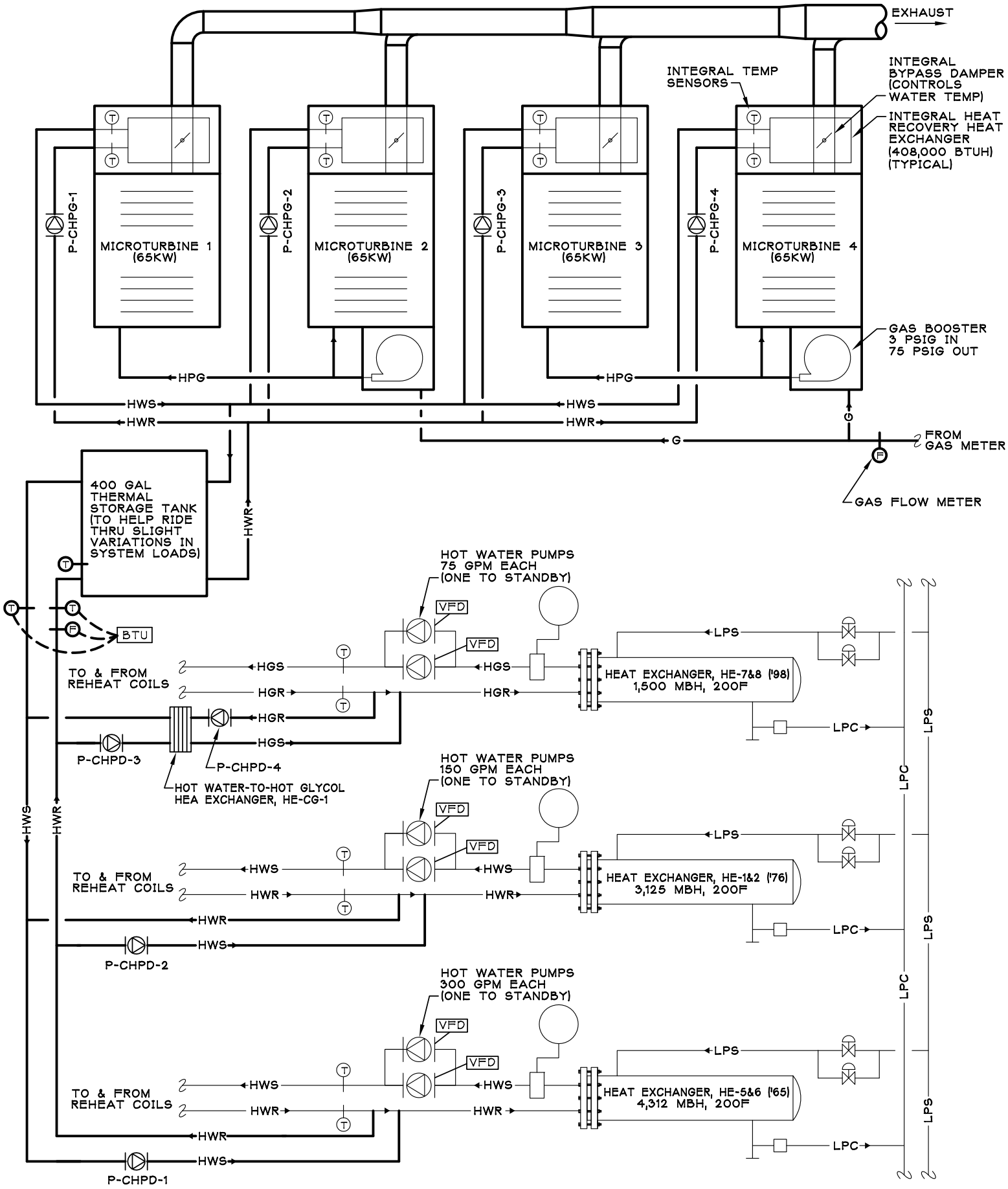
Monitoring equipment: See attached.

Calibration of equipment: Pasco will be calibrating each piece of monitoring equipment per the manufacturer's directions.

Data warehousing: Pasco will be providing a hard drive capable of storing two years worth of required data and will be providing the Hospital with a mean to back-up this data on a regular basis (CD-RW).

Timely QA/QC: Pasco will be retained by the Hospital via a service contract to perform QA/QC on a quarterly basis for at least 2 years (potentially indefinitely). Additionally, as stated above, the Hospital has purchased a service contract from Capstone to maintain each microturbine for a period of 9 years.

Data reporting format: Pasco intends to provide NYSERDA all of the above mentioned data each day for a period of two years in a format consistent with NYSERDA's monitoring and data collection standard.




# MECHANICAL SYSTEMS SCHEMATIC

To measure natural gas flow to each microturbine.

# "SAGE PRIME™" INDUSTRIAL & ENVIRONMENT THERMAL MASS FLOW METER

## "SAGE PRIME™" HIGH PERFORMANCE, COST EFFECTIVE THERMAL MASS FLOW METER FOR GASES

Sage Prime is the latest addition to our family of high performance Thermal Mass Flow Meters. It features a bright new graphical display of Flow Rate, Total and Temperature, robust industrial enclosure, and easy to access power and output terminals. Sage Prime has a new dual-compartment windowed enclosure featuring a very high contrast photo-emissive OLED display. The rear compartment, which is separated from the electronics, has large, easy-to-access and well marked terminals, for ease of customer wiring. It is powered by 24 VDC (12 VDC optional, or 115/230 VAC). The power dissipation is under 2.5 watts (e.g. under 100 ma at 24 VDC).

The Sage Prime Flow Meter is offered in the Integral Style (standard) or Remote Style (with lead length compensation up to 1000 feet) with explosion proof Junction Box with your choice of Probe or Flow Body depending on your pipe size. It has a 4-20 ma output as well as a Pulsed Output of Totalized Flow (solid state [sourcing] transistor drive). In addition, Sage Prime supports full Modbus® compliant RS485 RTU communications (IEEE 32 Bit Floating Point).

## THERMAL MASS FLOW METERS

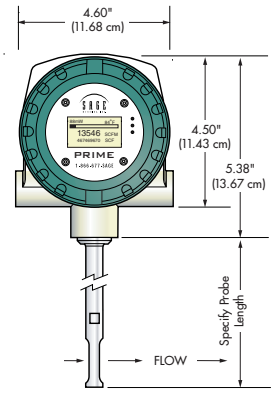
Sage Metering is your source for monitoring, measuring and controlling the gas mass flow in your industrial process or environmental application. Our high performance, NIST Traceable, thermal mass flow meters will help increase productivity, reduce energy costs, maximize product yields, and/ or help reduce environmental insult. With over 120 years of combined experience in delivering quality in-line and insertion thermal mass flow meters for a wide variety of industrial and environmental monitoring needs, the Sage Metering management team is dedicated to providing you with the performance and customer support that you deserve.

Sage Thermal Mass Flow Meters are designed for high performance mass flow measurement of flow rate and consumption of gases such as natural gas, air, oxygen, digester gas, landfill gas, biogas and other gases and gas mixes.

Sage Metering has distinguished itself by offering a higher standard – our mass flow meter output is unaffected by even large process temperature variations, and our digital electronics is impervious to external analog noise. Fast response, high resolution, and ultra sensitivity are features that are at the heart of every Sage Thermal Mass Flow Meter. See Sage Metering product brochure (Rev. 0808) for additional information and product benefits, or contact us at 866-677-7243 for application assistance.


*Dual-Sided Industrial Enclosure, with large, easy-to-access terminals in rear compartment*

*Features a very high contrast display of Gas Flow Rate, Total and Temperature, visible even in bright sunlight*




Note: DC Enclosure depth is 4.35" (11.05 cm)
AC Enclosure depth is 5.35" (13.59 cm)

## HOW DOES THERMAL MASS FLOW MEASUREMENT BENEFIT YOU?

- Direct Mass Flow – No need for separate temperature or pressure transmitters
- High Accuracy and Repeatability – Precision measurement and optimal control of your process
- Turndown of up to 100 to 1 and resolution as much as 1000 to 1
- Low-End Sensitivity – Detects leaks, and measures as low as 5 SFPM!
- Negligible Pressure Drop – Will not impede the flow nor waste energy
- No Moving Parts – Eliminates costly bearing replacements, and prevents undetected accuracy shifts
- Dirt Insensitive – Provides sustained performance
- Low cost of ownership

## WHAT ARE THE BENEFITS THAT SAGE PRIME THERMAL MASS FLOW METERS OFFER YOU?

- Powerful state-of-the-art microprocessor technology designed for high performance mass flow measurement, at a low cost-of-ownership
- Rugged, user-friendly packaging with easy terminal access
- Proprietary digital sensor drive circuit provides enhanced signal stability and is unaffected by process temperature and pressure changes
- Low power dissipation, under 2.5 Watts (e.g. under 100 ma at 24 VDC)
- High contrast photo-emissive OLED display with numerical Flow Rate, Total and Temperature, as well as Graphical Flow Indicator
- Displays calibration milliwatts (mw) for ongoing diagnostics
- Remote Style has Lead-Length Compensation. Remote electronics up to 1000 ft from probe, and the Junction Box has no electronics
- Modbus® compliant RS485 RTU communications (IEEE 754)
- Ease of installation, and convenient mounting hardware
- Flow conditioning built in to In-line flow meters (1/2" and up)
- Option for Solar Energy use (12VDC Models)

**Flow Control Magazine**
**2006 Innovations Awards**
**WINNER**

**Sage Metering, Inc.** / 8 Harris Court / Bldg D-1 / Monterey, CA 93940 / 866-677-SAGE (7243) / 831-242-2030 / Fax 831-655-4965 / www.sagemetering.com

Rev. 11-0908

# SAGE PRIME™ MASS FLOW METER SPECIFICATIONS

Sage Prime™ is a thermal dispersion type of Flow Meter, utilizing the constant temperature difference method of measuring Gas Mass Flow Rate. It contains two reference grade platinum RTD sensors clad in a protective 316 SS sheath. It features direct Mass Flow for gases, wide rangeability, low pressure drop, very low end sensitivity, and no moving parts.

The Prime is microprocessor based, does not have any potentiometers, and has Modbus® RS485 RTU communications. It is powered by 24 VDC (12 VDC optional, or 115/230 VAC). The power dissipation is under 2.5 watts (e.g. under 100 ma at 24 VDC) for the DC version. The power and output terminals are in a separate compartment for ease of installation. Sage Prime is CE approved[1].

The enclosure has a dual compartment for ease of wiring. The display is a high contrast photoemissive OLED display, and it displays Mass Flow Rate, Totalized Flow and Temperature as well as a graphical representation of Flow Rate in a horizontal bar graph format. In addition, the calibration milliwatts (mw) is continuously displayed, providing ongoing diagnostics. Outputs include a 4-20 ma signal proportional to Mass Flow Rate, and Pulsed Outputs of Totalized Flow (24VDC solid state [sourcing] transistor drive), as well as Modbus® compliant RS485 RTU communications (IEEE 32 Bit Floating Point).

The Flow Element (Integral and Remote, Insertion Style) consists of a 1/2" OD probe (3/4" optional) with lengths up to 36" long (typically 15" long) suitable for insertion into the center of pipes from 1-1/2" to 24". Mounting hardware choices (such as Isolation Valve Assemblies, Compression Fittings, and Flange Mounts) are optionally available.

The Flow Element (Integral and Remote, In-line Style) consists of a choice of 316 Stainless Steel Schedule 40 Flow Bodies sized from 1/4" x 6" long to 4" x 12" long. Male NPT ends are standard, with flanged ends, tube, or butt weld optionally available. Note 3" and 4" Flow Bodies have flanged ends as standard.

Calibration is NIST traceable, and covers a wide variety of gas calibrations. Sage Prime™ can measure gas flow up to 450ºF (-40ºF to 200ºF standard, up to 450ºF optional on Remote, Insertion Styles) at pressures up to 500 PSIG (1000 PSIG, optional).

Calibration Self Check: Flow Meter has built in diagnostics—a display of the calibration milliwatts (mw) can be used to check the sensor's operation by being compared to the original reported "zero flow" value noted on last few lines of meter's Certificate of Conformance.

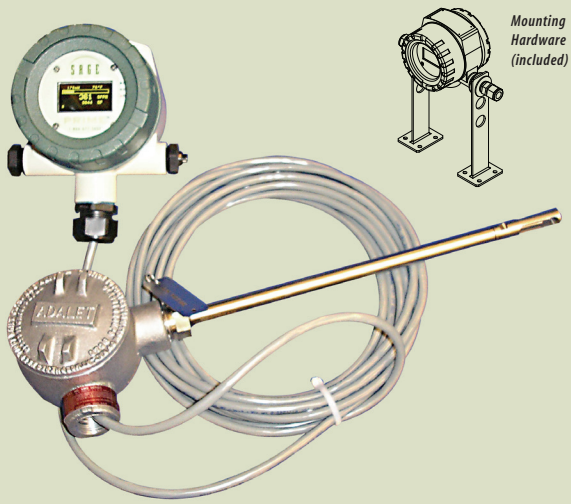
Accuracy is +/– 0.5% of Full Scale +/– 1% of reading with a turn-down of 100 to 1 and resolution as much as 1000 to 1. Higher accuracy available with lower turndown (contact Sage). Repeatability of 0.2%. The Flow Meter is Sage Metering, Inc. SIP Series (Integral Style) or SRP (Remote Style), with the trade name Sage Prime™.

## INTEGRAL


*Optional Programmable Dongle*[2]

### SIP Series

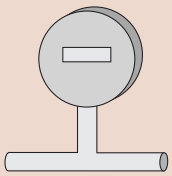
## REMOTE




*Mounting Hardware (included)*

### SRP Series[3,4]

### IN-LINE



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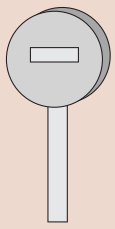

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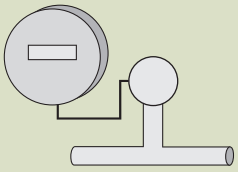

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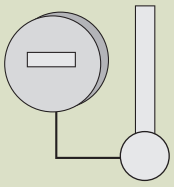


**1** *Sage Prime™ is now CE Compliant (see www.sagemetering.com/Products/Product Approvals. Contact Sage for other approvals)*

**2** *Sage Prime™ Field Programmable (patent pending) "Dongle" for field modifications or resetting of totalizer now available (contact Sage for details)*

**3** *Remote Mounting Brackets included (see drawing inset).*

**4** *On the Remote Styles, the Flow Element's Junction Box is Explosion Proof (Class 1, Div 1, Groups B, C, D), and does not have any electronics – only a wiring terminal block. The Flow Element will be connected to the Electronics Enclosure by 25 feet of lead-length compensated cable. The cable (6-conductor) can be lengthened or shortened without affecting accuracy (max loop resistance 10 ohms; over 1000 feet).*

**Sage Metering, Inc.** / 8 Harris Court / Bldg D-1 / Monterey, CA 93940 / 866-677-SAGE (7243) / 831-242-2030 / Fax 831-655-4965 / www.sagemetering.com

For use at thermal storage tank.

# 1000 OHM PLATINUM RTD RANGEABLE TEMPERATURE TRANSMITTER

## *TT809 SERIES*

### DESCRIPTION

The **Model TT809** is a **1000Ω Platinum RTD Rangeable Temperature Transmitter**. Zero setting can range anywhere from -50° to 212°F (-45° to 100°C) and span from 30° to 320°F (17° to 180°C). The **Model TT809** comes factory calibrated, and once installed, it can be field calibrated with a high precision DVM and decade box. The **Model TT809** is easily calibrated by adjusting the zero pot to match the calibration reference.

The gasketed cast-metal housing provides excellent weather resistance. The screw terminal connections on the transmitter circuit, 1/2" NPT threaded connection, and adjustable mounting brackets simplify installation. Several varieties of precision 1000Ω platinum RTD probes are easily mated with the transmitter housing.

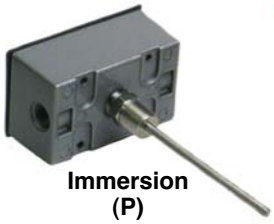
MINCO

OSA
(O)

TT-809-A
Transmitter only
(W)

Duct
(E)

Averaging
(V)



Immersion
(P)

Mated Probe Selection

WS-6

### FEATURES

- ***Switch-set rangeable with zero and span***
- ***One-point field calibration***
- ***Non-polar loop connections***
- ***Weatherproof sensor interface housing***
- ***Non-interacting zero/span adjustment***

### SPECIFICATIONS

| | |
|---|---|
| **Sensing element** | 1000Ω platinum RTD, two-wire<br>0.00375 Ω/Ω/°C TCR<br>0.00385 Ω/Ω/°C TCR |
| **Sensor accuracy** | ±0.12% |
| **Transmitter accuracy** | ±0.1% of span |
| **Transmitter linearity** | ±0.1% of span |
| **Rangeability** | |
| **Zero** | -50° to 212°F (-45° to 100°C) |
| **Span** | 30° to 320°F (17° to 180°C) |
| **Output** | 4-20 mA, two-wire |
| **Maximum load** | (Supply voltage - 9.4) / 0.02A |
| **Supply voltage** | 9.4-35 VDC |
| **Operating temperature** | -40° to 185°F (-40° to 85°C) |

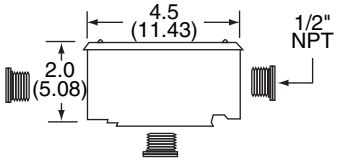
| | |
|---|---|
| **Connections** | Screw terminals; non-polar, for connections either way; 4" (10 cm) 22 AWG leads |
| **Probe** | |
| **Immersion** | Stainless steel, 1/4" (6.35 mm), 2" to 48" long |
| **Averaging** | Copper, 3/16" (4.76 mm), 12', 24', and 50' only |
| **Enclosure** | Cast aluminum moisture-resistant 1/2" FNPT and gasketed cover, suitable for outdoor use, UL #459L |
| **Dimensions** | 4.5"L x 2.75"W x 2.25"D (11.43 x 6.99 x 5.72 cm) |
| **Warranty** | 1 year |

# 1000 OHM PLATINUM RTD RANGEABLE TEMPERATURE TRANSMITTER

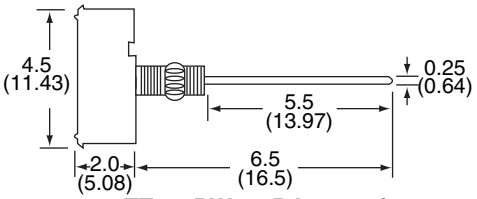
## *TT809 SERIES*

## DIMENSIONS

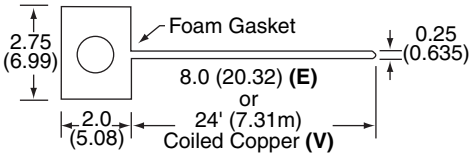
in
(cm)



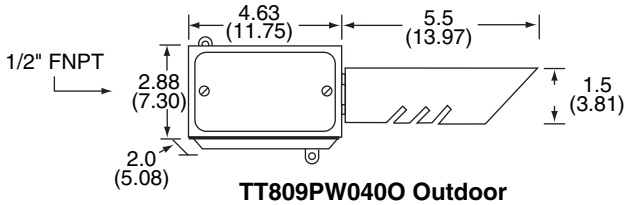

**TT809PW000W Enclosure Only**




**TT809PW055P Immersion**

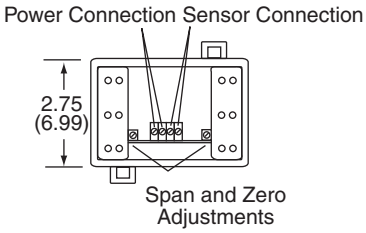


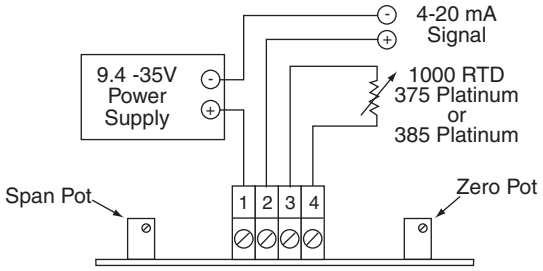

**TT809PW080E Duct**
**TT809PW288V Averaging**




**TT809PW040O Outdoor**

## WIRING




The Model **TT809** has range switch adjustments and non-interacting zero and span pots. The weatherproof box is standard and provides easy accessibility for installation and service.

**TT809**
**Temperature Transmitter**

## ORDERING INFORMATION

| MODEL | DESCRIPTION |
|---|---|
| TT809 | Assembly probe for two-wire RTDs |
| PW | 1000Ω 0.0375 Ω/Ω/°C platinum curve, 6" leads |
| LLL | Length LLL in 0.1" increments 040 = 4.0", 120 = 12.0", 0.000 for "W" without sensors |
| E | Duct mount, weather-resistant box, LLL typically = 8.0" |
| V | Duct averaging, weather-resistant box, LLL must be = 144", 288", or 600" |
| O | Outside air, weather-resistant box with weather shield, LLL = 4.0" |
| P | Immersion, weather-resistant box, LLL typically = 5.5" for 6" well insertion |
| W | Wall mount, weather-resistant box, LLL typically 4.0" or 000 for no probe" |
| 1 | 4-20 mA DC output |
| BI | Range codes 30°/130°F (-1°/54°C) |
| S | Range codes 0°/100°F (-18°/38°C) |
| H | Range codes 40°/90°F (4°/32°C) |
| N | Range codes 32°/122°F (0°/50°C) |
| EN | Range codes -20°/140°F (-29°/60°C) |
| 1 | No calibration data, sensor, or transmitter |
| 2 | Sensor/transmitter matched at 0°C with NIST |
| 3 | Sensor/transmitter matched at 0°, 100°, and 260°C with NIST |

**NOTE:** Call Kele for additional temperature sensor options.

**Sample order:**

**TT809PW080E1S1** Transmitter with 8" duct probe, 375 curve platinum RTD, ranged for 0°/100°F

**TT809PW055P1BI2** Transmitter with 5.5" immersion probe, 375 curve RTD, with NIST at 0°C, ranged for 30°/130°F

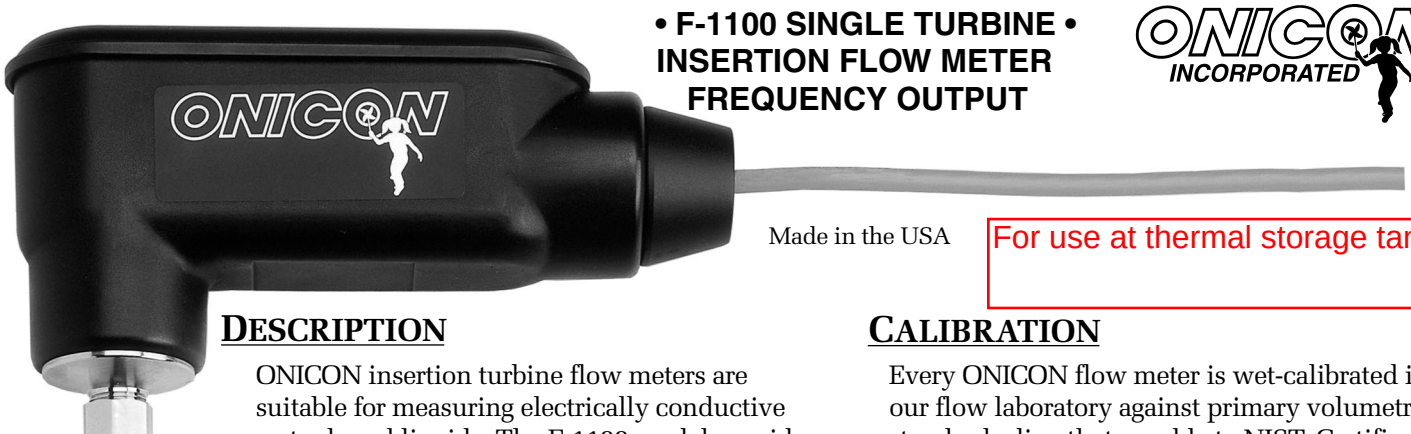
**TT809PW000W1N1** Transmitter only for two-wire 1000Ω, 375 curve RTD, ranged for 32°/122°F

### RELATED PRODUCTS

| | | | |
|---|---|---|---|
| **WB-6** | **Brass well** | **AS2PA080E000XX1** | **1000Ω duct probe** |
| **WS-6** | **Stainless steel well** | **AS2PA050P000XX1** | **1000Ω immersion probe** |
| **ST-AV91H** | **1000Ω averaging probe** | **AS2PA040O000XX1** | **1000Ω OSA probe** |

# • F-1100 SINGLE TURBINE • INSERTION FLOW METER FREQUENCY OUTPUT

ONICON INCORPORATED




Made in the USA

For use at thermal storage tank.

## DESCRIPTION

ONICON insertion turbine flow meters are suitable for measuring electrically conductive water-based liquids. The F-1100 model provides a high-resolution frequency output for connection to an ONICON Display or BTU Meter.

## APPLICATIONS

- Chilled water, hot water, condenser water, and water/glycol/brine for HVAC
- Process water and water mixtures
- Domestic water

## GENERAL SPECIFICATIONS

**ACCURACY**
± 0.5% OF READING at calibrated velocity
± 1% OF READING from 3 to 30 ft/s (10:1 range)
± 2% OF READING from 0.4 to 20 ft/s (50:1 range)

**SENSING METHOD**
Electronic impedance sensing
(non-magnetic and non-photoelectric)

**PIPE SIZE RANGE**
1¼" through 72" nominal

**SUPPLY VOLTAGE**
24±4 V AC/DC at 30 mA

**LIQUID TEMPERATURE RANGE**
Standard: 180˚ F continuous, 200˚ F peak
High Temp: 280˚ F continuous, 300˚ F peak
Meters operating above 250˚ F require
316 stainless steel construction option

**AMBIENT TEMPERATURE RANGE**
-5 to 160˚ F (-20 to 70˚ C)

**OPERATING PRESSURE**
400 PSI maximum

**PRESSURE DROP**
Less than 1 PSI at 20 ft/s in 1½" pipe,
decreasing in larger pipes and lower velocities

**OUTPUT SIGNAL PROVIDED:**

**FREQUENCY OUTPUT**
0-15 V peak pulse, typically less than 300 Hz

(continued on back)

## CALIBRATION

Every ONICON flow meter is wet-calibrated in our flow laboratory against primary volumetric standards directly traceable to NIST. Certification of calibration is included with every meter.

## FEATURES

**Unmatched Price vs. Performance** - Custom calibrated, highly accurate instrumentation at very competitive prices.

**Excellent Long-term Reliability** - Patented electronic sensing is resistant to scale and particulate matter. Low mass turbines with engineered jewel bearing systems provide a mechanical system that virtually does not wear.

**Industry Leading Two-year "No-fault" Warranty** - Reduces start-up costs with extended coverage to include accidental installation damage (miswiring, etc.). Certain exclusions apply; see our complete warranty statement for details.

**Simplified Hot Tap Insertion Design** - Standard on every insertion flow meter. Allows for insertion and removal by hand without system shutdown.

OPERATING RANGE FOR COMMON PIPE SIZES
0.17 TO 20 ft/s
± 2% accuracy begins at 0.4 ft/s

| Pipe Size (Inches) | Flow Rate (GPM) |
|---|---|
| 1¼ | 0.8 - 95 |
| 1½ | 1 - 130 |
| 2 | 2 - 210 |
| 2½ | 2.5 - 230 |
| 3 | 4 - 460 |
| 4 | 8 - 800 |
| 6 | 15 - 1800 |
| 8 | 26 - 3100 |
| 10 | 42 - 4900 |
| 12 | 60 - 7050 |
| 14 | 72 - 8600 |
| 16 | 98 - 11,400 |
| 18 | 120 - 14,600 |
| 20 | 150 - 18,100 |
| 24 | 230 - 26,500 |
| 30 | 360 - 41,900 |
| 36 | 510 - 60,900 |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## F-1100 SPECIFICATIONS cont.

**MATERIAL**

Wetted metal components

Standard: Electroless nickel plated brass

Optional: 316 stainless steel

**ELECTRONICS ENCLOSURE**

Standard: Weathertight aluminum enclosure

Optional: Submersible enclosure

**ELECTRICAL CONNECTIONS**

3-wire for frequency output

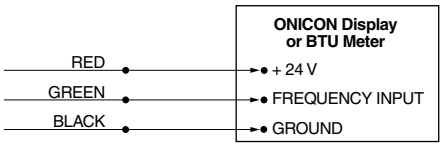
Standard: 10' of cable with ½" NPT conduit connection

Optional: Indoor DIN connector with 10' of plenum rated cable

## F-1100 Wiring Information

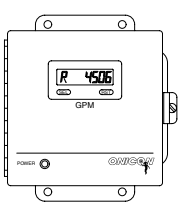
| WIRE COLOR CODE | | NOTES |
|---|---|---|
| RED | (+) 24 V AC/DC supply voltage, 30 mA | Connect to power supply positive |
| BLACK | (–) Common ground (Common with pipe ground) | Connect to power supply negative |
| GREEN | (+) Frequency output signal: 0-15 V peak pulse | Signal for ONICON Display or BTU meter |

## F-1100 Wiring Diagram

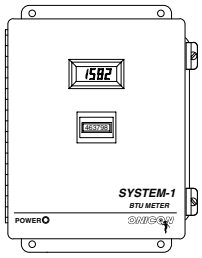



*Note: Black wire is common with the pipe ground (typically earth ground).*

## ALSO AVAILABLE




Display Modules

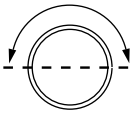


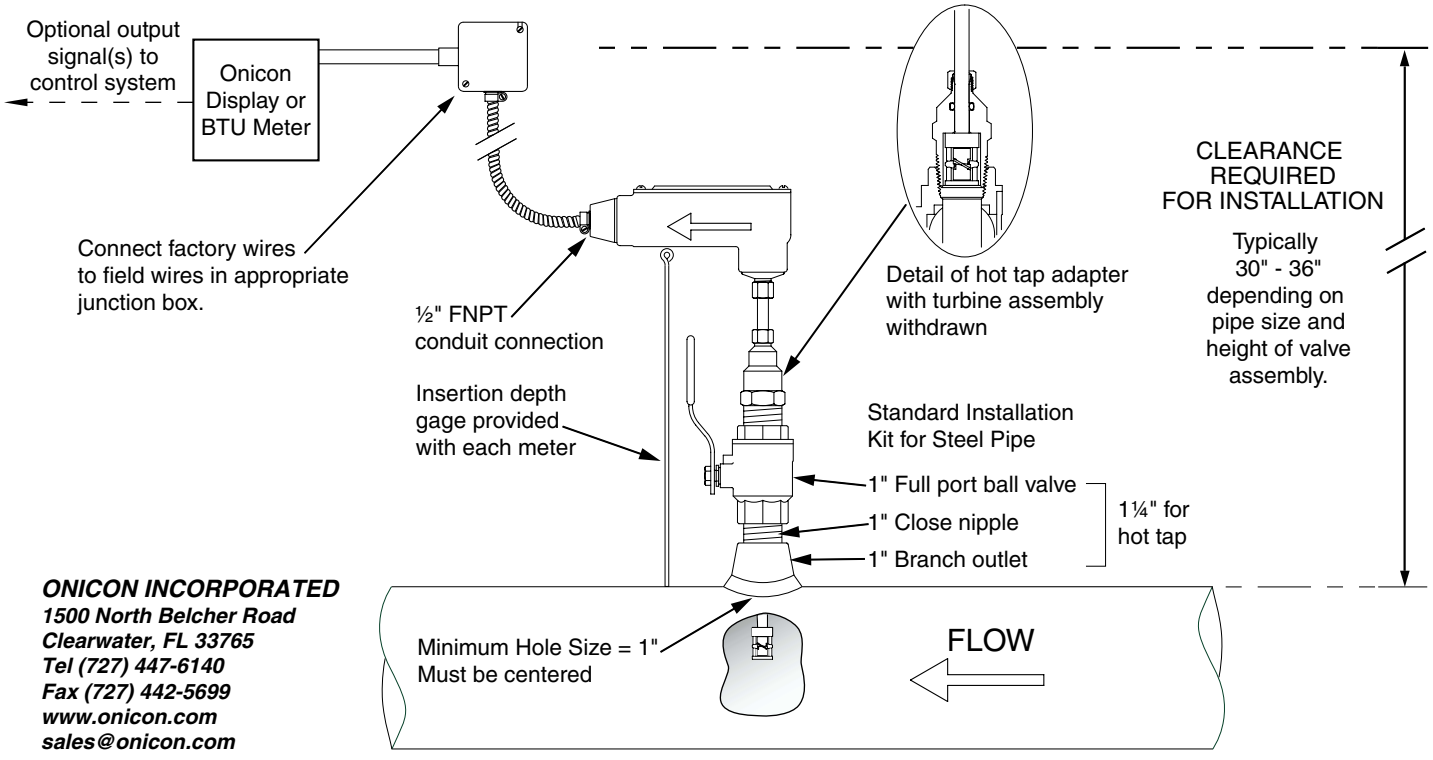

BTU Measurement Systems

## Typical Meter Installation

**(New construction or scheduled shutdown)**

- Acceptable to install in vertical pipe
- Position meter anywhere in upper 180˚ for horizontal pipe



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Note: Installation kits vary based on pipe material and application. For installations in pressurized (live) systems, use "Hot tap" 1¼ inch installation kit and drill hole using a 1 inch wet tap drill.

For use at thermal storage tank.

# • SYSTEM-10-BAC BTU METER •
## BACnet MS/TP COMPATIBLE


## FEATURES

**BACnet Compatible Serial Communications** - Provides complete energy, flow and temperature data to the control system through a single BACnet MS/TP network connection, reducing installation costs.

**Simple Installation and Commissioning** - Factory programmed and ready for use upon delivery. All process data and programming functions are accessible via front panel display and keypad.

**Single Source Responsibility** - One manufacturer is responsible for every aspect of the energy measurement process, ensuring component compatibility and overall system accuracy.

**N.I.S.T. Traceable Calibration with Certification** - Each Btu measurement system is individually calibrated using application specific flow and temperature data and is provided with calibration certifications.

**Precision Solid State Temperature Sensors** - Custom calibrated and matched to an accuracy better than ±0.15˚ F over calibrated range.

**Highly Accurate Flow Meters** - Insertion turbine and inline turbine flow meters are accurate to within ±0.5% of rate at the calibrated typical flow rate and within ±2% of rate over an extended 50:1 turndown range (0.4 - 20 ft/s).

**Complete Installation Package** - All mechanical installation hardware, color coded interconnecting cabling and installation instructions are provided to ensure error-free installation and accurate system performance.

## DESCRIPTION

The System-10 BTU Meter provides highly accurate thermal energy measurement in chilled water, hot water and condenser water systems based on signal inputs from two matched temperature sensors (included) and any of ONICON's insertion or inline flow meters (ordered separately). The System-10-BAC provides energy, flow and temperature data on a local alphanumeric display and to the network via the BACnet communications MS/TP driver. An optional auxiliary input is also available to totalize pulses from another device and communicate the total directly to the network.

## APPLICATIONS

Chilled water, hot water and condenser water systems for:

- Commercial office tenant billing
- Central plant monitoring
- University campus monitoring
- Institutional energy cost allocation
- Performance/efficiency evaluations
- Performance contracting energy monitoring

## ORDERING INFORMATION

The System-10 BTU Meter is sold complete with temperature sensors and standard thermowells. Flow Meters are purchased separately.

| ITEM # | DESCRIPTION |
|---|---|
| SYSTEM-10-BAC | System-10 BTU Meter, BACnet compatible |
| SYSTEM-10-OPT1 | Add for 6" and larger pipes |
| SYSTEM-10-OPT2 | Add for 2.5" - 3" copper tube |
| SYSTEM-10-OPT3 | Add for 4" copper tube |
| SYSTEM-10-OPT4 | Upgrade to outdoor thermowells (pair) |
| SYSTEM-10-OPT5 | Upgrade to hot tap thermowells (pair) |
| SYSTEM-10-OPT8 | High temperature sensors (over 200˚ F) |
| SYSTEM-10-OPT9 | Add one analog output |
| SYSTEM-10-OPT11 | Auxiliary pulse input |
| **Choose from the following flow meters & installation kits:** | |
| F-1100 | Single Turbine Insertion Flow Meter (1¼"-72") |
| F-1200 | Dual Turbine Insertion Flow Meter (2½"-72") |
| FB-1200 | Bi-Directional Insertion Flow Meter (2½"-72") |
| F-1300 | Inline Turbine Flow Meter (¾" - 1") |
| F-STD-INSTL1 | Std. install kit for 1¼" - 72" steel pipe |
| F-HTAP-INSTL2 | Hot tap install kit for 1¼' - 72" steel pipe |
| (refer to catalog for additional options and install kits) | |

UL LISTED
PROCESS CONTROL EQUIPMENT
3GF5


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# SYSTEM-10-BAC BTU METER SPECIFICATIONS

**CALIBRATION**

Flow meter and temperature sensors are individually calibrated, followed by a complete system calibration.
Field commissioning is also available.

**ACCURACY**

Differential temperature accuracy ±0.15˚ F over calibrated range
Computing nonlinearity within ±0.05%

**PROGRAMMING**

Factory programmed for specific application
Field programmable via front panel interface

**MEMORY**

Non-volatile EEPROM memory retains all program parameters and totalized values in the event of power loss.

**DISPLAY**

Alphanumeric LCD displays total energy, total flow, energy rate, flow rate, supply temperature and return temperature
Alpha: 16 character, 0.2" high; Numeric: 6 digit, 0.4" high

**OUTPUT SIGNALS**

BACnet Points List (MS/TP)

| Name | BACnet Object Type | Units |
|---|---|---|
| Total Energy | Analog Value | Btu, kW-hrs or ton-hrs |
| Energy Rate | Analog Input | Btu/hr, kW or tons |
| Total Flow | Analog Value | gallons, liters or meters³ |
| Flow Rate | Analog Input | gpm, gph, mgd, l/s, l/m, l/hr or m³/hr |
| Supply Temperature | Analog Input | ˚F or ˚C |
| Return Temperature | Analog Input | ˚F or ˚C |
| Delta T | Analog Input | ˚F or ˚C |
| Energy Total Reset | Binary Value | Not applicable |
| Flow Total Reset | Binary Value | Not applicable |
| Auxiliary Input Total | Analog Value | Pulse Accumulator |
| Auxiliary Input Reset | Binary Value | Not applicable |

Baud Rate: 76800, 38400, 19200 or 9600 bps
Isolated solid state dry contact for energy total
Contact rating: 100 mA, 50V
Contact duration: 0.5, 1, 2, or 6 sec
Optional Analog Output(s) (4-20 mA, 0-10 V or 0-5 V):
One or four analog output(s) available for flow rate, energy rate, supply/return temps, or delta-T.

**LIQUID FLOW SIGNAL INPUT**

0-15 V pulse output from any ONICON flow meter.

**TEMPERATURE SENSORS**

Solid state sensors are custom calibrated using N.I.S.T. traceable temperature standards.
Current based signal (mA) is unaffected by wire length.

**TEMPERATURE RANGE**

Liquid temperature range: 32˚ to 200˚ F
Optional liquid temperature range: 122˚ to 302˚ F
Ambient temperature range: 40˚ to 120˚ F

**MECHANICAL**

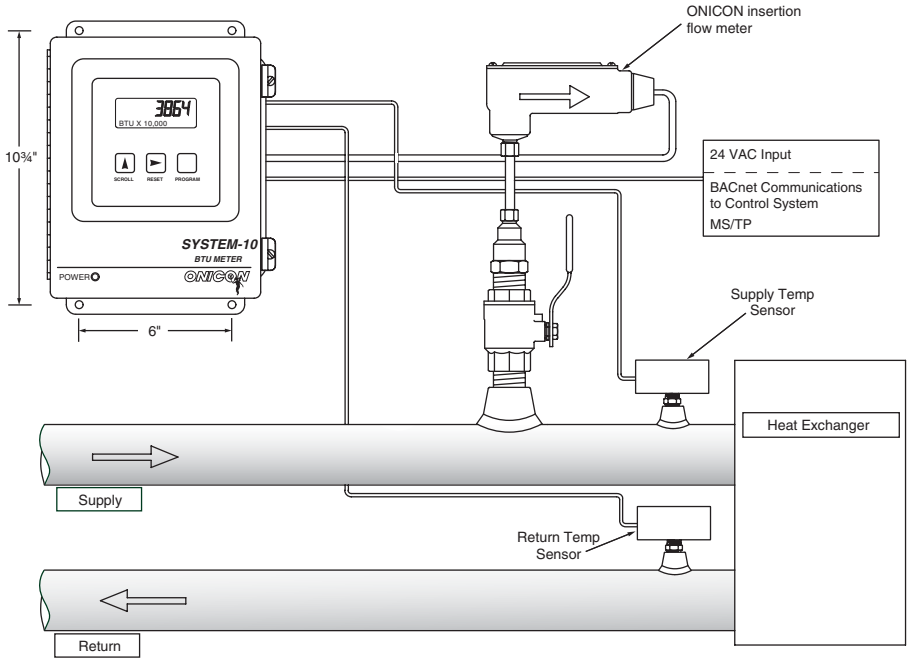
ELECTRONICS ENCLOSURE:
Standard: Steel NEMA 13, wall mount, 8"x10"x4"
Optional: NEMA 4 (Not UL listed)
Approximate weight: 12 lbs.
TEMPERATURE THERMOWELLS:
Standard: ½" NPT brass thermowells (length varies with pipe size) with junction box
Note: 6" pipes and larger require SS thermowell option
Optional:
- ½" NPT stainless steel thermowells
- Outdoor junction box with thermal isolation
- Hot tap thermowells with isolation valves are available in plated brass or stainless steel

**ELECTRICAL**

INPUT POWER*:
Standard: 24 VAC 50/60 Hz, 300 mA
Optional: 120 VAC 50/60 Hz, 200 mA
230 VAC, 50 Hz, 150 mA
*Based on Btu meters configured for network connection without the optional analog outputs
INTERNAL SUPPLY:
Provides 24 VDC at 200 mA to electronics and flow meter
WIRING:
Temperature signals: Use 18 - 22 ga twisted shielded pair
Flow signals: Use 18 - 22 ga shielded - see flow meter specification sheet for number of conductors

NOTE: Specifications are subject to change without notice.

## TYPICAL SYSTEM-10-BAC INSTALLATION





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