Impeller
Data Industrial®

Series 380 Btu System

380CS/HS Meter

Badger Meter

SEN-UM-01628-EN-05 (May 2015)

Distributed By
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User Manual

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INTRODUCTION

The Series 380 Btu System from Badger Meter® provides a low cost solution for metering cold or hot systems. The 380CS/HS can accurately measure flow and temperature differential to compute energy. Utilizing BACnet™ or Modbus® RS-485 communications protocols or a scaled pulse output, the Btu System can interface with many existing control systems.

The rugged design incorporates an impeller flow sensor and two temperature probes. One temperature probe is conveniently mounted directly in the flow sensor tee. The second temperature probe is placed on either the supply or the return line depending on installation requirements. These minimal connections help simplify installation and save time.

The main advantage of the Series 380 Btu System is the cost savings over other systems offered on the market today. The integration of flow and temperature sensors, along with metering components provide a single solution for metering. With this system, it will be possible to meter energy where metering had not cost effective.

Commissioning of this meter can be completed in the field via a computer connection. Setup includes energy measurement units, measurement method, communications protocol, pulse output option, fluid density and specific heat parameters.

Cold Service (380CS)

Designed for operating in fluid temperatures of -4…140° F (-20…60°C). See "Specifications" on page 7.

Hot Service (380HS)

Designed for operating in fluid temperatures of 40…260° F (4…125° C). See "Specifications" on page 7..

Series 380

The 380 combines an electronics package with a PEEK sensor probe inserted in a 3/4", 1", 1-1/4", 1-1/2" and 2" proprietary cast bronze pipe tee with threaded NPT connections.

Ordering System Matrix

Example: 380 | 0 | 07 | 0 | 0 | 0 | - | 1 | 2 | 0 | 0

TYPE	CS - Cold Service	0
	HS - Hot Service	1
SIZE	0.75"	07
	1"	10
	1.25"	12
	1.5"	15
	2"	20
ELECTRONIC HOUSING	Polycarbonate	0
OUTPUT	Scaled Pulse and RS-485 (Modbus and BACnet)	0
DISPLAY	N/A	0
O-RING	EPDM (CS - Cold Service)	1
	Aflas® (HS - Hot Service)	2
SHAFT	Tungsten Carbide (STANDARD)	2
IMPELLER	Stainless Steel	0
BEARING	Torlon® (CS - Cold Service)	0
	Ketron® (HS - Hot Service)	2

Figure 1: Ordering system matrix

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MECHANICAL INSTALLATION

General

The accuracy of flow measurement for all flow measuring devices is highly dependent on proper location of the sensor in the piping system. Irregular flow velocity profiles caused by valves, fittings, pipe bends, etc. can lead to inaccurate overall flow rate indications, even though local flow velocity measurement may be accurate. A sensor located in the pipe can be affected by air bubbles, floating debris, or sediment may not achieve full accuracy and could be damaged. Badger Meter flow sensors are designed to operate reliably under adverse conditions, but the following recommendations should be followed to ensure maximum system accuracy.

1. Choose a location along the pipe where 10 pipe diameters upstream and 5 pipe diameters downstream of the sensor provide no flow disturbances. Pipe bends, valves, other fittings, pipe enlargements and reductions should not be present in this length of pipe.
2. The recommended location for the sensor around the circumference of a horizontal pipe is on top of the pipe. The sensor should never be located at the bottom of the pipe, as sediment may collect there. Locations away from the top-center on a pipe cause the impeller friction to increase, which may affect performance at low flow rates. Any circumferential location is correct for installation in vertical pipes. Rising flow is preferred to reduce effects of any trapped air.

Installing the Sensor Tee

1. Position the tee for unrestricted pipe flow for at least 10 pipe diameters upstream and 5 pipe diameters downstream of the tee.
2. Apply pipe compound over the first 3 or 4 threads of the mating pipe.
3. Thread the pipe into the sensor tee until hand tight.
4. Tighten the pipe an additional 1-1/2 turns, using a wrench.

ELECTRICAL INSTALLATION

1. The Series 380 requires an isolated 12-24 V AC/DC power supply. To avoid ground fault conditions, the 380 power should not be shared with other devices. This is especially true when the RS-485 network connections are being utilized, where damage to the product or system could result.
   The power connections are labeled 1 and 2 and are not polarity sensitive.
2. The RS-485 requires three connections: RS-485+, RS-485- and REF.
   The connections are labeled 1 (+), 2 (-) and 3 (GND). RS-485 is a high-speed connection and should be wired to meet TIA-EIA-485-A standards.
   This is especially true if a long cable run is involved or multiple devices are to be networked.

The pulse output is a simple solid state switch.
   The connections are labeled "PULSE OUTPUT 1" and "PULSE OUTPUT 2". The switch is not polarity sensitive, however, be careful that the maximum voltage and current ratings are not exceeded. See *"Specifications" on page 7* for details.

NOTE: The pulse and RS-485 may be used simultaneously.

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COMMISSIONING

All setup and commissioning of the Series 380 is done using a USB to Mini USB cable and the Badger Meter Series 380 commissioning software.

Figure 2 shows the main setup screen. Flow and Energy rates and totals can be selected or a custom unit can be put in with the correct conversion factor.

For the temperature sensors the user can select the units along with the calculation mode, i.e., T1>T2, Absolute, or T1<T2. The Diff Zero parameter is the difference between T1 and T2 that will still read 0 energy rate.

If the Scaled Pulse Output is going to be used, the user can select what the pulse is representing (Energy or Flow), along with Units/Pulse and the pulse width. If the Scaled Pulse Output is not going to be used, this output can be set to OFF.

Figure 3 shows the communication parameters tab. The user can select BACnet or Modbus along with the network address. If using BACnet, the Device Name, Device ID BACnet BitRate and the Max Master number should be entered for the appropriate network for which the 380 is being connected.

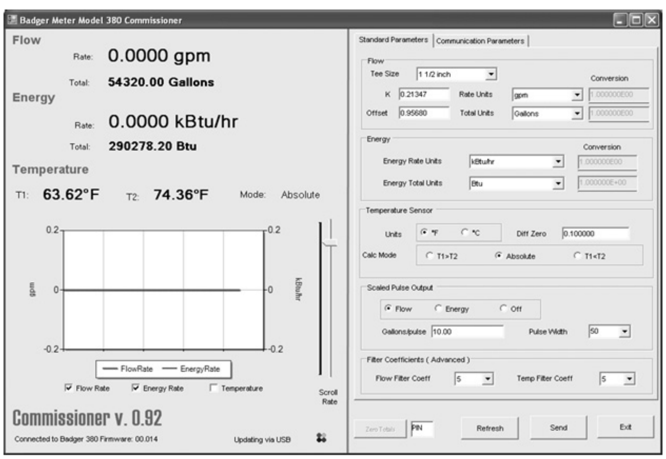

Figure 2: Main setup screen

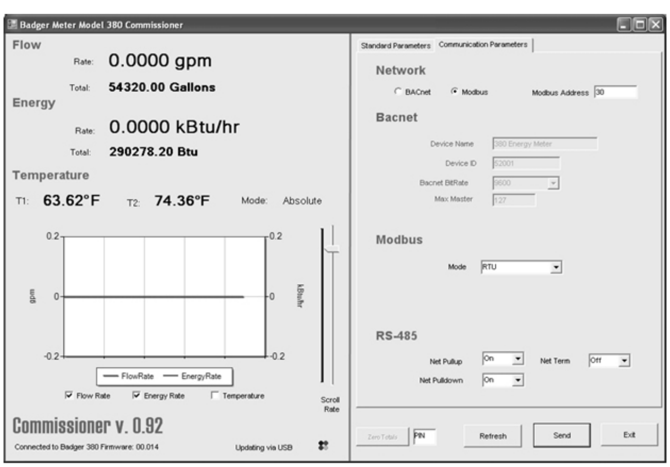

Figure 3: Communication parameters

RS-485 Network Configurations

The RS-485 Section can be configured in two ways:

- Modbus
- BACnet

The following sections explain each in detail.

RS-485 Network Configurations—Modbus

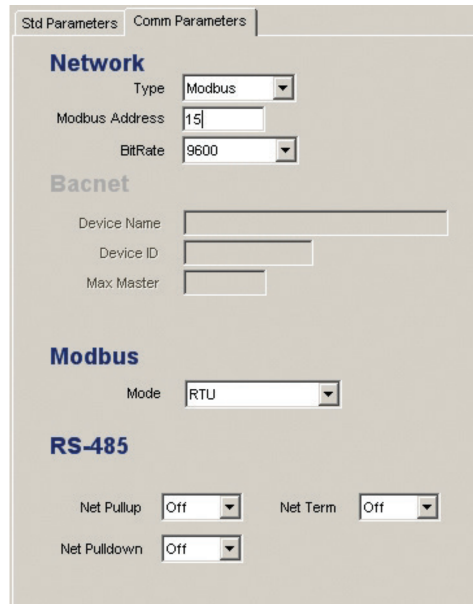

Figure 4: Comm parameters—modbus

Select **Modbus**, to access the Modbus pull-down menus.

Select the **Address**, **Bit Rate** (Baud Rate) and **Mode** (RTU or ASCII).

The Series 380 uses IEEE 754 Float Data Located in "Read Holding Registers."

The Series 380 Data Format is "Float 32" where the Data is stored across two "Read Holding Registers".

In the case of sensor mounted in the 380 body, the upper byte is stored in register 40001 and the lower byte is stored in the register 40002.

For example, a temperature of 53.36° F when converted to IEEE 754 is "425570A4." In the case of the Series 380, Register # 40001 = 70A4 Hex and Register # 40002 = 4255 Hex. See *Table 1 on page 6* for additional information.

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Modbus Register Map

Series 380 Register Map			
Register Name	Address	Data Type	Read/Write
Sensor Temperature	40001 + 40002	IEEE 754 Float	Read Only
Remote Sensor	40003 + 40004	IEEE 754 Float	Read Only
Flow Rate	40005 + 40006	IEEE 754 Float	Read Only
Flow Total	40009 + 40010	IEEE 754 Float	Read Only
Energy Rate	40007 + 40008	IEEE 754 Float	Read Only
Energy Total	40011 + 40012	IEEE 754 Float	Read Only
Energy Calc Mode	40013 + 40014	IEEE 754 Float	Read Only
Flow Filter	40015 + 40016	IEEE 754 Float	Read Only
Temp Coef	40017 + 40018	IEEE 754 Float	Read Only
Specific Heat	40019 + 40020	IEEE 754 Float	Read Only
Fluid Density	40021 + 40022	IEEE 754 Float	Read Only

Table 1: 380 register map

RS-485 Network Configuration—BACnet

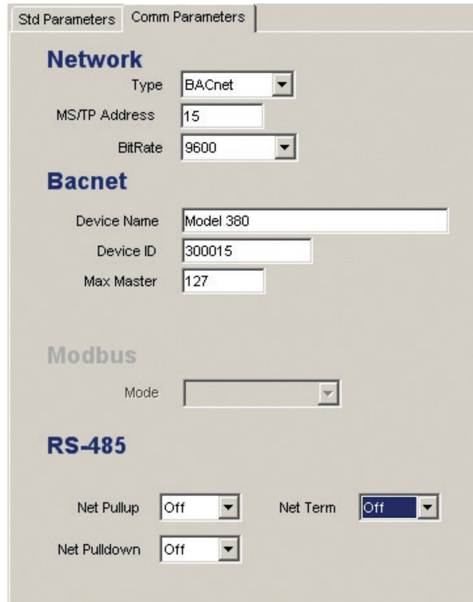

Figure 5: Comm parameters—BACnet

Select **BACnet** to access the BACnet pull-down menus.

Select the **Bit Rate** (BAUD rate) to match other devices on the network.

BACnet Device Name can be set to help identify this device and location.

BACnet Device ID (Incidence #) is a unique number that identifies this device on the network. Typically, the first part of the number is the same as the network #, and the last two characters are the same as the address.

NOTE: The numbering sequence is not a requirement, but can help in system planning.

Series 380 BACnet Object Map

Description	ID	Name	Units
Analog Input	AN1	TempIn	ºC, ºF
Analog Input	AN2	TempOut	ºC, ºF
Analog Value	AV1	VolFlow	gpm, gph, lpm, lps, lph, ft^3/s, ft^3/m, ft^3/h, m^3/s, m^3/min, m^3/h, custom
Analog Value	AV2	EnergyFlow	kBtu/min, kBtu/h, kW, MW, HP, Tons, custom
Analog Value	AV3	TotalVol	gallons, galx100, galx1000, liters, ft^3, m^3, custom
Analog Value	AV4	TotEnergy	Btu, kBtu, MBtu, kWh, MWh, kJ, MJ, custom
Analog Value	AV5	TempMode	dimensionless
Analog Value	AV6	FFilterCoef	dimensionless
Analog Value	AV7	TFiltCoef	dimensionless
Analog Value	AV8	SpHtCapac	Btu/lb-F
Analog Value	AV9	Density	lb/gallon
Analog Value	AV10	SerialNum	dimensionless

Table 2: 380 BACnet object map

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BACnet Protocol Implementation Conformance Statement

BACnet Standardized Device Profile

Device Profile	Tested
BACnet Smart Actuator (B-SA)	✓

Supported BIBBs

Supported BIBBs	BIBB Name	Tested
DS-RP-B	ReadProperty - B	✓
DS-WP-B	WriteProperty - B	✓
DM-DDB-B	Dynamic Device Binding - B (Who-Is, I-Am)	✓

Standard Object Types Supported

Object Type	Creatable	Deletable	Tested
Analog Input	No	No	✓
Analog Value	No	No	✓
Device	No	No	✓

Data Link Layer Options

Data Link	Options	Tested
MS/TP Slave	baud rates: 9600, 19200, 38400, 76800 bps	✓

Segmentation Capability

Segmentation Type	Supported	Window Size (MS/TP product limited to 1)	Tested
Able to transmit segmented messages	No		N/A

Device Address Binding

Static Binding Supported	Tested
No	N/A

Character Sets

Character Sets supported	Tested
ANSI X3.4	✓

Figure 6: BACnet Device Profile

SPECIFICATIONS

Mass	Less than 13 lb	
Electrical Input	Power	12…35V DC, 12…28V AC
	Communication	Modbus RTU, BACnet MSTP
Electrical Output	Scaled Pulse	Open drain, 0.01…100 Hz max.
Materials	Housing	Polycarbonate
	Flow Sensor	PEEK
	Potting Material	Polyurethane
	Tee Material	Brass
Sensor Body Sizes	Tee Sizes	3/4 in., 1 in., 1-1/4 in., 1-1/2 and 2 in.
Environmental	Fluid Temperature	Chilled: –4…140° F (–20…60° C) Hot: 40…260° F (4…125° C)
	Ambient Temperature	–4…149° F (–20…65° C)
Accuracy	± 2% of flow rate within flow range	
	± 0.5% repeatability	
	RTD meets IEC751 Class B	
Flow Range	1…15 ft/sec	
	Diameter	**380 Btu Meter Flow Range**
	0.75 in. (19 mm)	1.65…24.69 gpm (6 lpm)
	1 in. (25 mm)	2.70…40.48 gpm (10 lpm)
	1.25 in. (32 mm)	4.66…69.93 gpm (17 lpm)
	1.5 in. (38 mm)	6.35…95.18 gpm (24 lpm)
	2 in. (50 mm)	10.49…157.34 gpm (40 lpm)
	This chart is based on ASME/ANSI B336.10 *Welded and Seamless Wrought Steel Pipe* and ASME/ANSI B3619 *Stainless Steel Pipe*.	

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Legacy Document Number: 880102-0001

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