

**SYSTEM-30 BTU MEASUREMENT SYSTEM**  
**MODBUS RTU Version**  
**Installation and Operation Guide**



For Software Version FB5.20 or higher.



## Safety Information

This meter was calibrated at the factory before shipment.

To ensure correct use of the meter, please read this manual thoroughly.

Regarding This Manual:

- This manual should be passed on to the end user.
- Before use, read this manual thoroughly to comprehend its contents.
- The contents of this manual may be changed without prior notice.
- All rights reserved. No part of this manual may be reproduced in any form without ONICON's written permission.
- ONICON makes no warranty of any kind with regard to this material, including, but not limited to, implied warranties of merchantability and suitability for a particular purpose.
- All reasonable effort has been made to ensure the accuracy of the contents of this manual. However, if any errors are found, please inform ONICON.
- ONICON assumes no responsibilities for this product except as stated in the warranty.
- If the customer or any third party is harmed by the use of this product, ONICON assumes no responsibility for any such harm owing to any defects in the product which were not predictable, or for any indirect damages.

Safety Precautions:

The following general safety precautions must be observed during all phases of installation, operation, service, and repair of this product. Failure to comply with these precautions or with specific WARNINGS given elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. ONICON Incorporated assumes no liability for the customer's failure to comply with these requirements. If this product is used in a manner not specified in this manual, the protection provided by this product may be impaired.

The following symbols are used in this manual:



### WARNING

Messages identified as WARNING contain information regarding the personal safety of individuals involved in the installation, operation or service of this product.



### CAUTION

Messages identified as CAUTION contain information regarding potential damage to the product or other ancillary products.



### IMPORTANT NOTE

Messages identified as IMPORTANT NOTE contain information critical to the proper operation of the product.



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## SECTION 1.0: INTRODUCTION



### WARNING

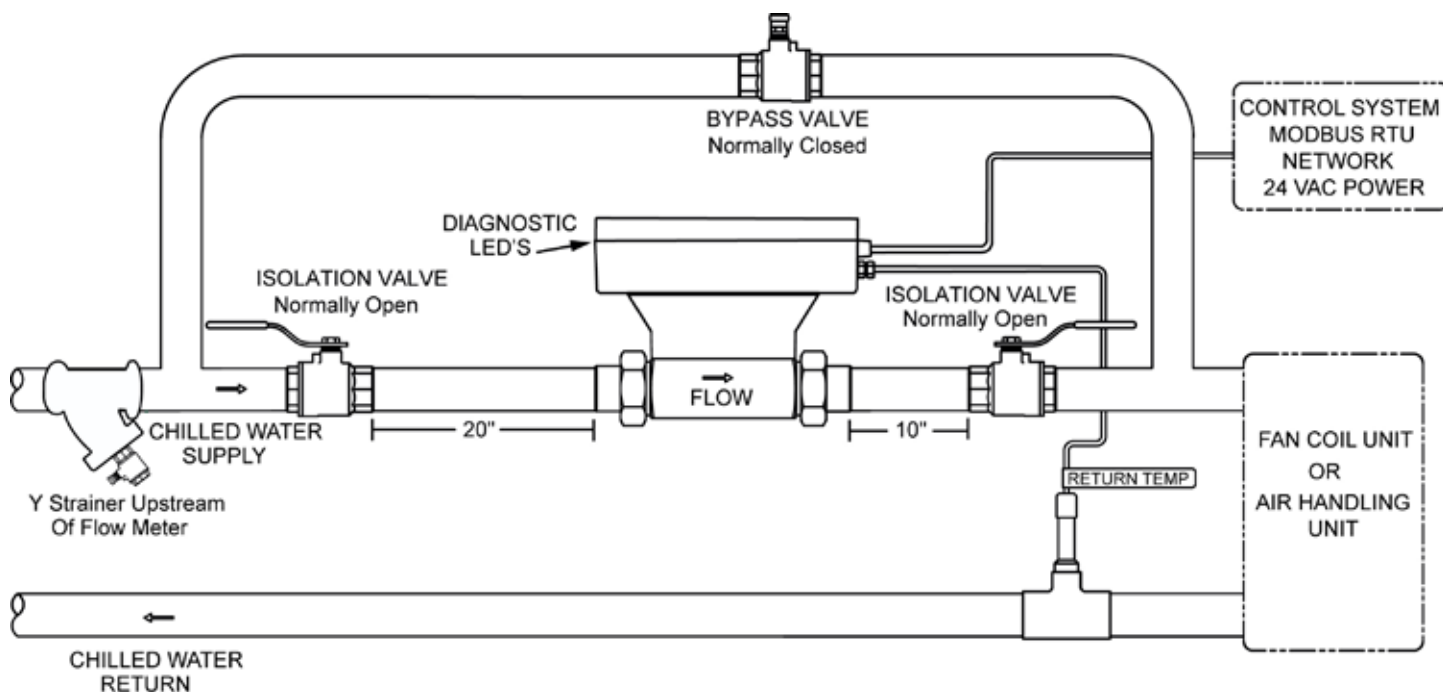
Only qualified service personnel should attempt to install or service this equipment. Serious injury may result from the improper installation or use of this equipment.

### 1.1 PURPOSE OF THIS GUIDE

The purpose of this guide is to provide installation and commissioning procedures and basic operating and servicing instructions for the ONICON SYSTEM-30 BTU MEASUREMENT SYSTEM.

### 1.2 TYPICAL SYSTEM-30 BTU MEASUREMENT SYSTEM

ONICON'S System-30 is a true heat (Btu) computer, which accepts data from several sensors, performs a series of computations with that data, and transmits the results as an indication of the amount of heat (Btu's) being transferred or as a totalized amount.



## 1.3 STANDARD FEATURES AND SPECIFICATIONS

Single mode Btu calculations, in either the heating or cooling mode, are totalized and reported.

Two-pipe dual mode Btu calculations in both the heating mode and the cooling mode are totalized and reported separately.

### GENERAL SPECIFICATIONS

#### **CALIBRATION**

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

#### **ACCURACY**

Differential temperature accuracy  $\pm 0.15^{\circ}$  F over calibrated range  
Computing non-linearity within  $\pm 0.05\%$   
Flow sensor accuracy:  
 $\pm 0.5\%$  of reading at calibrated velocity  
 $\pm 1\%$  of reading from 3 to 30 ft/s (10:1 range)  
 $\pm 2\%$  of reading from 0.4 to 20 ft/s (50:1 range)

#### **TEMPERATURE SENSORS**

Solid state sensors are custom calibrated using N.I.S.T. traceable temperature standards.

#### **PROGRAMMING**

Factory programmed for each specific application.

#### **MEMORY**

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

#### **OUTPUT SIGNALS**

Isolated solid state dry contacts for mode 1 and mode 2 energy total:  
Contact rating: 100 mA, 50 VDC maximum  
Contact duration: 0.5, 1, 2 or 6 second selectable

#### **NETWORK INTERFACE**

MODBUS RTU Protocol  
RS485, 2-wire (half duplex)

#### **MODBUS HOLDING REGISTERS**

Total Energy: (Btu, ton-hr(s), kw-hr)  
Energy Rate: (Btu/hr, tons, kw)  
Total Flow: (gallons, liters, cubic meters)  
Flow Rate: (gpm, l/s, l/m, m<sup>3</sup>/hr)  
Supply Temperature ( $^{\circ}$ F,  $^{\circ}$ C)  
Return Temperature ( $^{\circ}$ F,  $^{\circ}$ C)  
Mode (Heating-Cooling) Indicator

#### **BAUD RATE**

9600 default  
Optional: 1200, 2400, 4800, 19200, 38400, 57600, and 115200 bps

#### **OPTIONAL LOCAL DISPLAY**

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

#### **MAINTENANCE**

ONICON recommends periodic inspection and recalibration. No other periodic maintenance is required.

#### **TEMPERATURE RANGE**

Liquid temperature range:  $32^{\circ}$ F to  $200^{\circ}$ F  
Ambient temperature range:  $40^{\circ}$ F to  $120^{\circ}$ F

#### **MECHANICAL**

OVERALL DIMENSION:  
9.25" L x 5" W x 6.5" H  
TEMPERATURE THERMOWELL:  
Brass thermowell ( $\frac{1}{2}$ " sweat or  $\frac{1}{4}$ " NPT)

#### **ELECTRICAL**

This equipment is intended for INSTALLATION CATEGORY (OVERVOLTAGE CATEGORY) II applications.

INPUT VOLTAGE: 24 V  $\pm 10\%$  AC 50/60 Hz or 24 V  $\pm 4$  DC

INPUT CURRENT: 200 mA maximum

TERMINALS CONNECTIONS: Use 18-22 ga. copper wire. Do not exceed 4.5 in-lb (0.5 Nm) of torque when tightening.

#### **WIRING:**

CONDUIT: Use PVC jacketed copper cable with a wire gauge suitable for the length of run and required maximum current carrying capacity. The installation must comply with all local, state and federal codes.

PLENUM AREA: (without conduit) Use plenum rated copper cable with a wire gauge suitable for the length of run and required maximum current carrying capacity. The installation must comply with all local, state and federal building codes.

Note: Specifications are subject to change without notice.

## **1.4 WORKING ENVIRONMENT**

The SYSTEM-30 was designed for installation and use in typical commercial and residential environments that are free of corrosive liquids and fumes, direct liquid exposure, heavy condensation, and temperature extremes and vibrations.

The operating ambient air temperature range is 40° F to 120° F.

The electrical power should be relatively clean, free of high frequency noise, large voltage transients, and protected from power surges and brown outs.

## **1.5 WARRANTY & SERIAL NUMBER**

### **Warranty**

ONICON's 2-year "No-fault" warranty reduces start-up costs with extended coverage that includes coverage for incidental damage during installation. Certain exclusions apply. See our complete warranty statement for details.

### **Serial Number**

The serial number of your SYSTEM-30 is located on the side of the enclosure. Serial numbers are unique identifiers that you should have available when contacting ONICON for assistance regarding your system.

## **SECTION 2.0: UNPACKING**

The SYSTEM-30 generally ships in one package unless optional hardware or equipment is ordered. If any items are damaged, notify the shipping company (all products are shipped insured) and the ONICON Customer Service Department.

### **2.1 CHECKING THAT YOU HAVE RECEIVED EVERYTHING**

#### **Standard Documentation**

Enclosed with each SYSTEM-30 is a comprehensive documentation package that includes the following items:

The SYSTEM-30 BTU MEASUREMENT SYSTEM Installation and  
Operation Guide  
The System-30 Calibration Data Sheet  
MODBUS Memory Map and Product Brochure

Please notify ONICON immediately if any items are missing.

#### **The Main Unit**

Remove the System-30 from the shipping carton and inspect it for physical damage.

#### **Temperature Sensors**

One temperature sensor is built into the body of the meter, and the other is connected to the main unit via a permanently attached cable. Inspect the free sensor and cable for external damage.

#### **Temperature Thermowell**

A standard thermowell with installation hardware is packed with the main unit.

#### **Mounting Hardware**

The System-30 is supplied with two tail pieces to facilitate connection to the piping system. A compression fitting with retaining nut makes up one end of each tail piece. The other end will either be a sweat fitting for copper or a threaded nipple with NPT threads.

## **SECTION 3.0: INSTALLATION**

The SYSTEM-30 BTU MEASUREMENT SYSTEM should be installed by experienced plumbers and others with related knowledge and experience in the heating, cooling, and fluid metering fields. ONICON will be happy to assist with technical recommendations and to provide guidance by telephone and/or email. On-site field engineering, installation and/or service is also available at an additional cost.

The installer should use good trade practices and adhere to all state and local building or other applicable codes.



### **CAUTION**

ONICON strongly recommends the use of a valved bypass and strainer in conjunction with the installation of the System-30 to facilitate servicing and to protect the turbine assembly during start-up.

### **3.1 SITE SELECTION**

Careful attention to site selection for system components will help installers with initial installation, reduce start-up problems, and make future maintenance easier. For example, do not install the System-30 or its temperature sensor where it will be difficult for personnel to perform periodic maintenance and calibration. When selecting a site for mounting the system components, consider the criteria under Section 1.4, WORKING ENVIRONMENT as well as the following:

#### **The Main Unit**

Choose the location (supply or return) with the longest straight, unobstructed run. Ideally, the location chosen should allow for at least 20 diameters of unobstructed straight run upstream of the meter and at least 10 diameters of unobstructed straight run downstream. If both the supply and return have adequate straight run conditions, locate the meter in the supply.

The location must be accessible to facilitate service and recalibration.

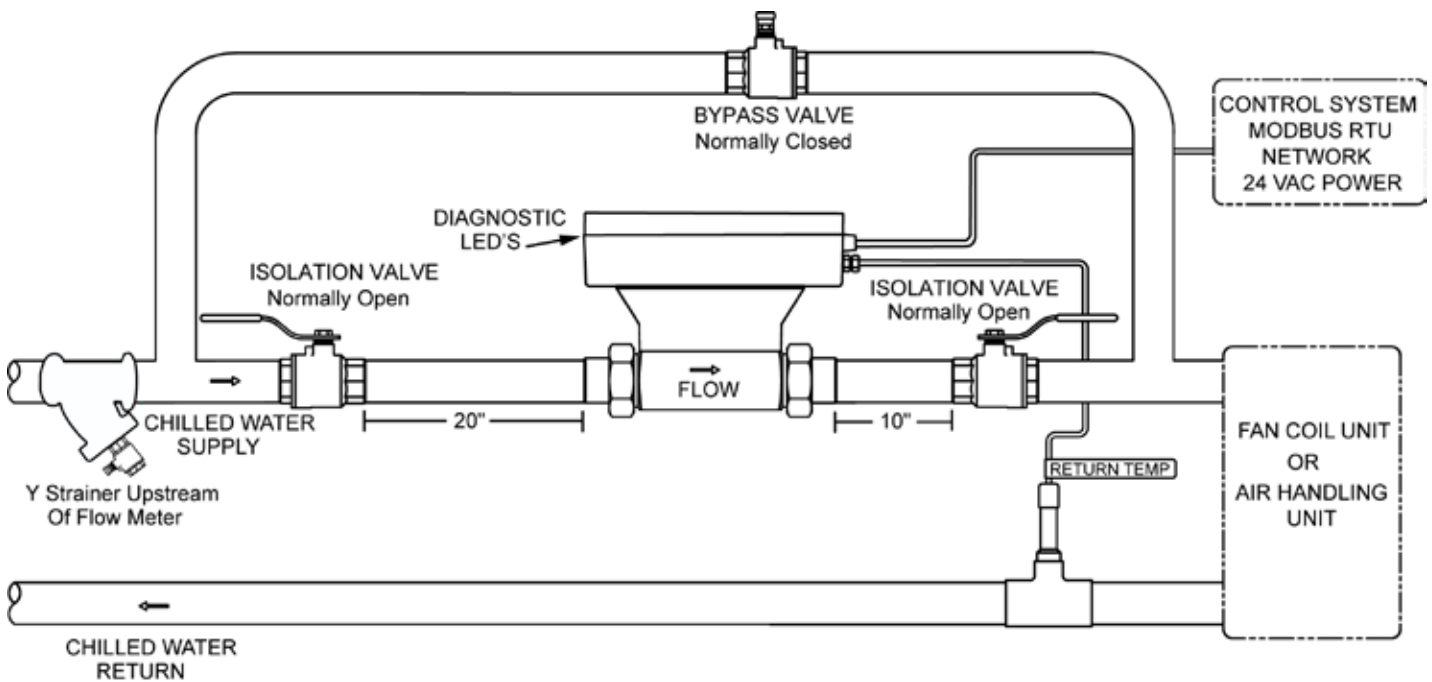
#### **The Temperature Sensor**

The temperature sensor should be located in an accessible location. This will facilitate any on-site service.

Place the temperature sensor away from sources of electrical noise that might interfere with the temperature sensor signal.

## 3.2 MECHANICAL INSTALLATION

### 3.2.1 Main Unit Installation



Find an easily accessible location where wire connections can be made and the diagnostic LED's can be viewed from floor level. The location where the main unit is mounted should be free from vibration. Clean the external surface of the pipe at the installation site so that it is free of debris, foreign matter, solids, leak inhibitors, and chemically aggressive substances. Next, locate the tail pieces that were shipped with the main unit and install these on the pipe making certain that the compression nuts are correctly oriented. Wherever appropriate, use pipe dope on threaded connections to ensure a leak free seal. **DO NOT USE TEFLON TAPE.**

Insert the main unit between the two open ends of the pipe and secure in place using the compression fittings. **MAKE CERTAIN THAT THE FLOW DIRECTION ARROW ON THE BODY OF THE MAIN UNIT IS POINTING IN THE DIRECTION OF FLOW.**



#### CAUTION

Before you attempt to use the Btu measurement system, isolate the main unit, open the bypass and flush the entire system so that it is free of flux, solder, pipe and tube cuttings and any other free moving particles.

### 3.2.2 Thermowell Installation

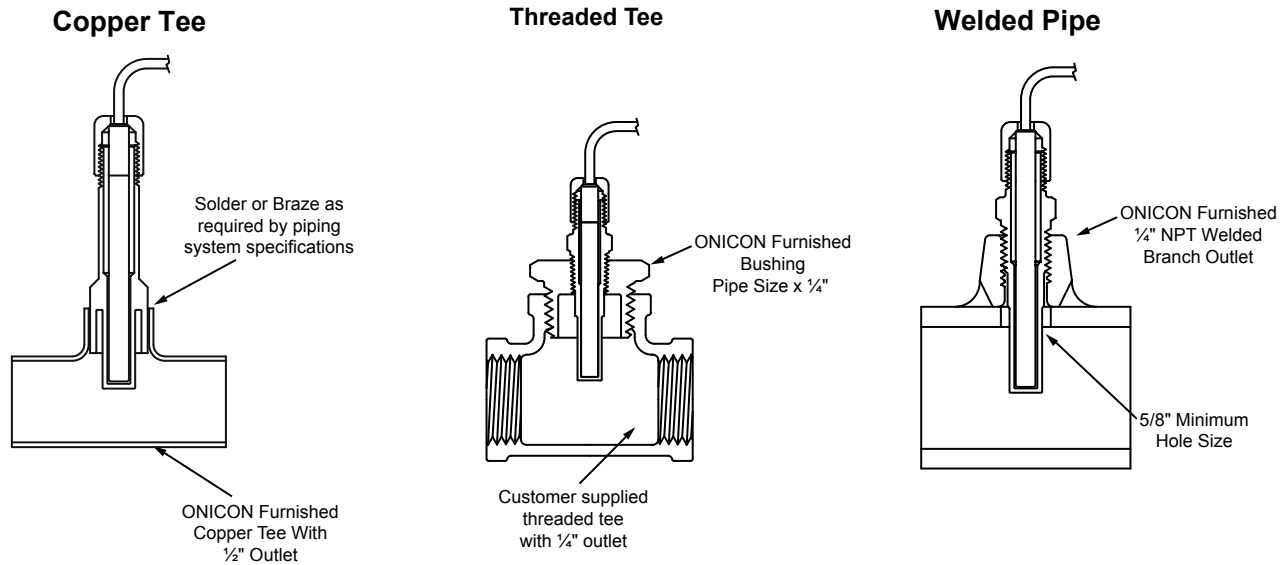


#### IMPORTANT NOTE

It is important that no dirt or other foreign material be allowed into the thermowell as this could affect the thermal response of the system.

#### Standard Thermowell

The most common installation methods are shown below. Consult ONICON for special applications.



### 3.2.3 Temperature Sensor Installation

The temperature sensor is factory matched and permanently attached to the Btu measurement system. Sensors from different Btu meters cannot be used without being returned to ONICON for recalibration.

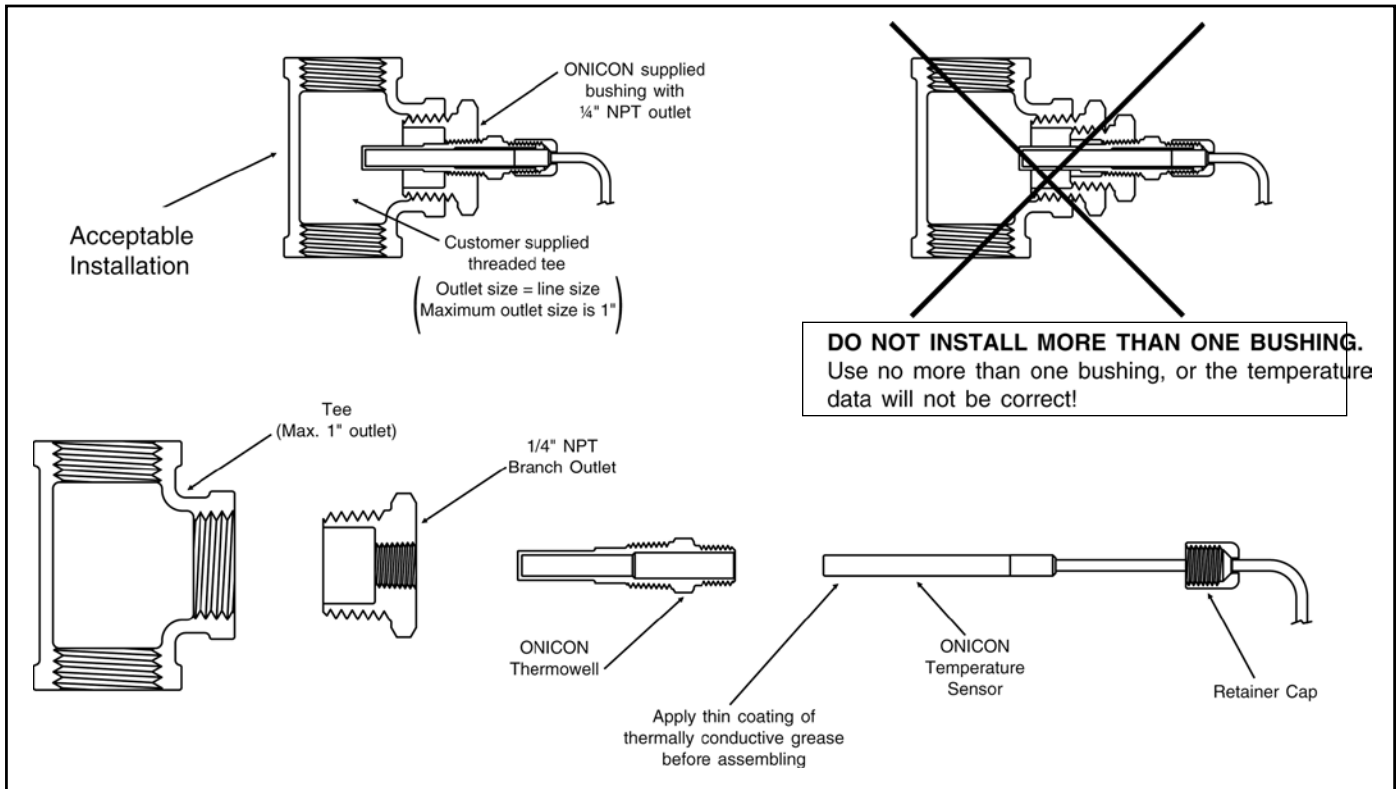
Apply a thin coat of thermally conductive grease to the temperature sensor, and gently insert it into the thermowell until it contacts the bottom of the cavity. Gently tighten the retainer cap. **DO NOT OVER TIGHTEN.** The thermowell completely seals the plumbing system without the retainer cap. The only purpose of the cap is to keep the sensor from losing contact with the bottom of the thermowell cavity.



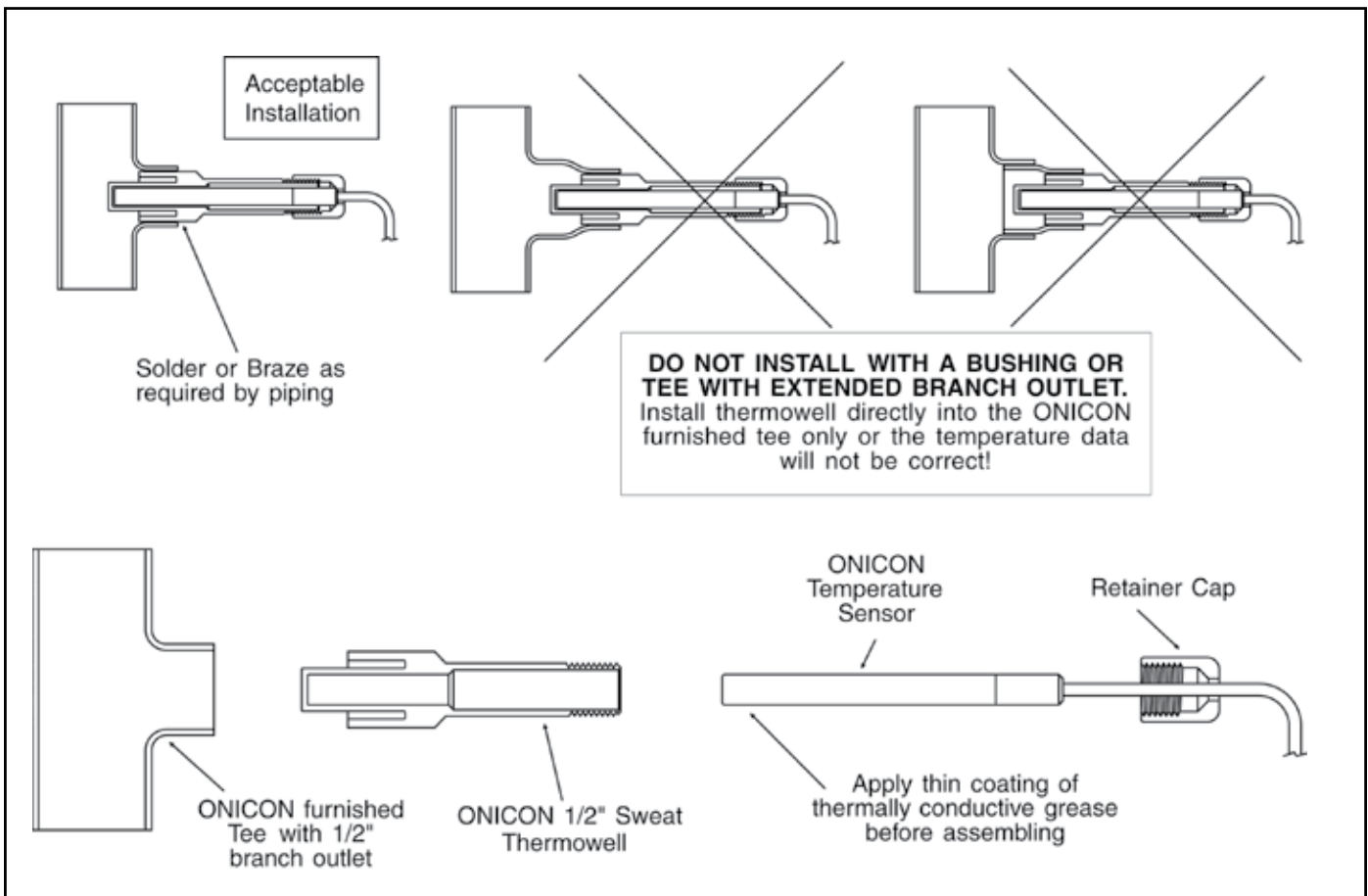
#### CAUTION

Cable length is specified at time of order. This is three wire shielded plenum rated cable. Altering the cable length will affect calibration. Do not change the cable length without consulting ONICON.

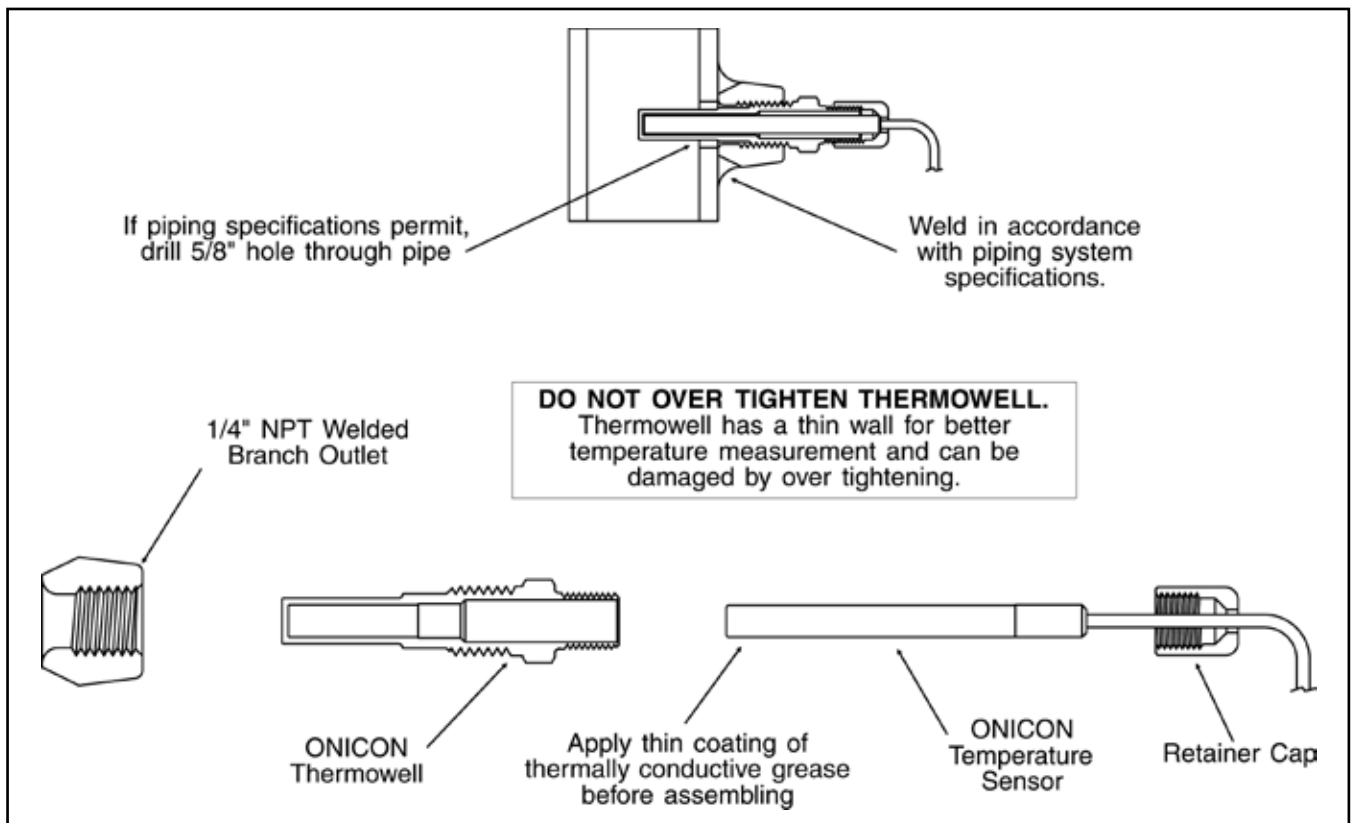
## THERMOWELL INSTALLATION IN THREADED PIPE TEES



## THERMOWELL INSTALLATION IN COPPER TEE



## THERMOWELL INSTALLATION IN WELDED PIPE



### 3.3 ELECTRICAL INSTALLATION

All user supplied conduit fittings, junction boxes, etc. are to be installed as required by legal codes.

#### IMPORTANT NOTE

**i** The System-30-MOD BTU Meter is designed with one internal (Temp1) and one remote (Temp 2) temperature sensor. If the meter body is located in the supply pipe, then the internal temperature sensor will indicate the supply temperature and the remote sensor will indicate the return temperature. This relationship will reverse if the meter body is located in the return pipe. The location of the meter will also affect the logic used to determine mode 1 and mode 2 operations for dual mode applications. Single mode energy measurements are absolute measurements and are not effected by polarity of the delta T.

#### 3.3.1 Single Mode (4 Pipe) Vs. Dual Mode (2 Pipe) Operation

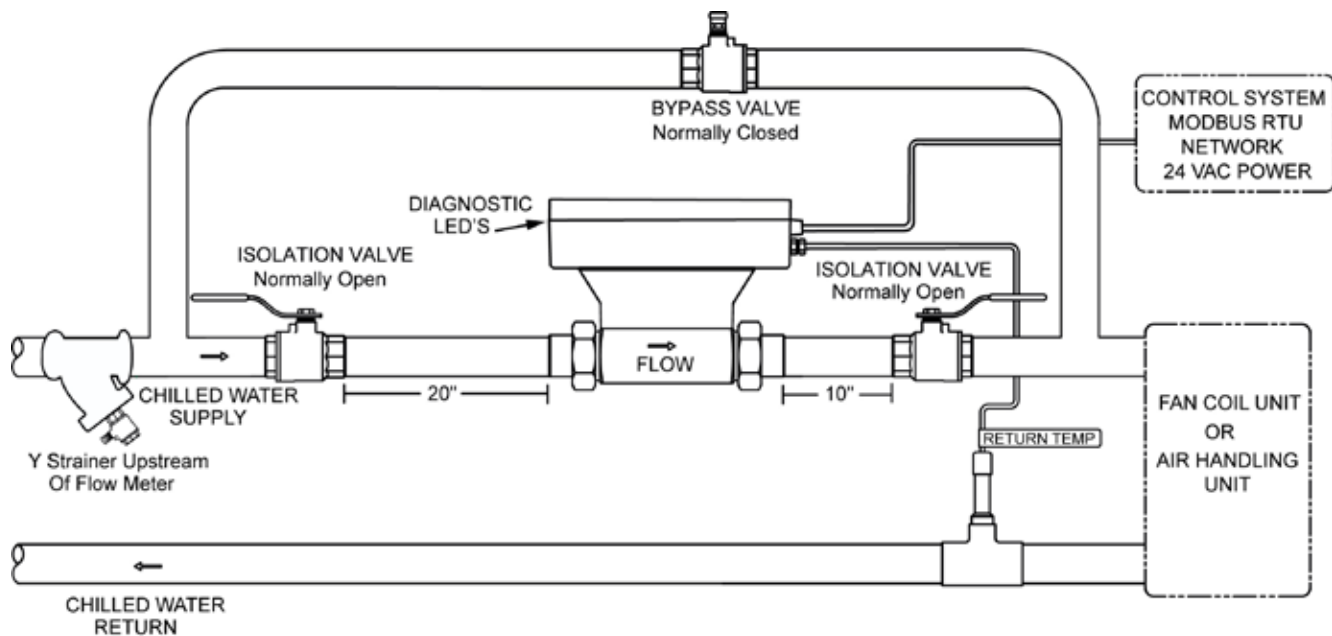
ONICON System-30 BTU Meters may be configured for single or dual mode applications. Single and dual modes are references to the piping system and not the meter itself. Single mode (4 pipes) applications are those that always have the same relationship between the supply and return pipe temperatures. In dual mode (2 pipes) applications the polarity of the temperature differential (delta T) reverses, often on a seasonal basis.

It is often desirable to totalize the amount of energy transferred in each mode in separate registers. For these applications, ONICON Btu meters may be configured for dual mode operation. In this configuration, the meter will measure and totalize energy in separate registers based on the polarity of the delta T.

The drawings and tables below and on the following page illustrate the relationship between meter location, temperature sensor and mode of operation.

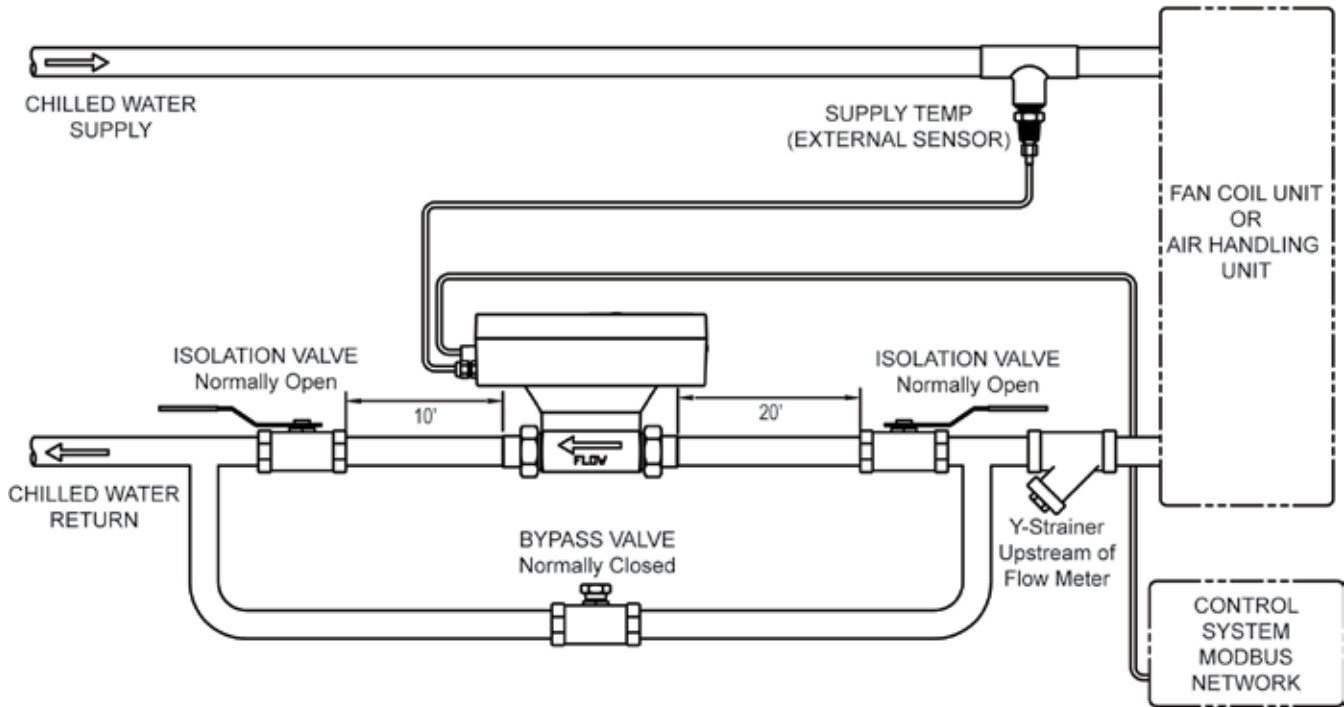
**Temperature Sensor/Mode of Operation Relationship with Meter in Supply Line**

Supply Temp	Temperature 1 Sensor (Internal Sensor)
Return Temp	Temperature 2 Sensor (External Sensor)
Mode 1 Total	Heating (Supply Temp > Return Temp)
Mode 2 Total	Cooling (Supply Temp < Return Temp)



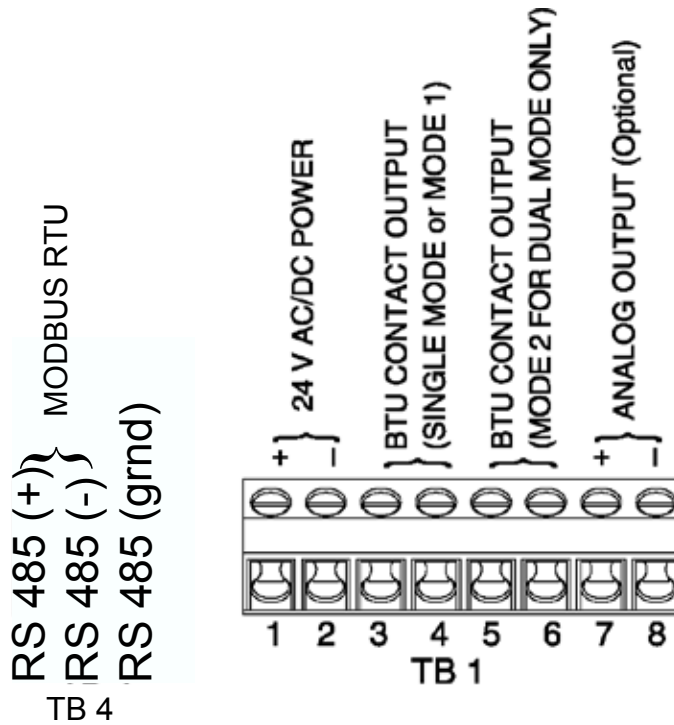
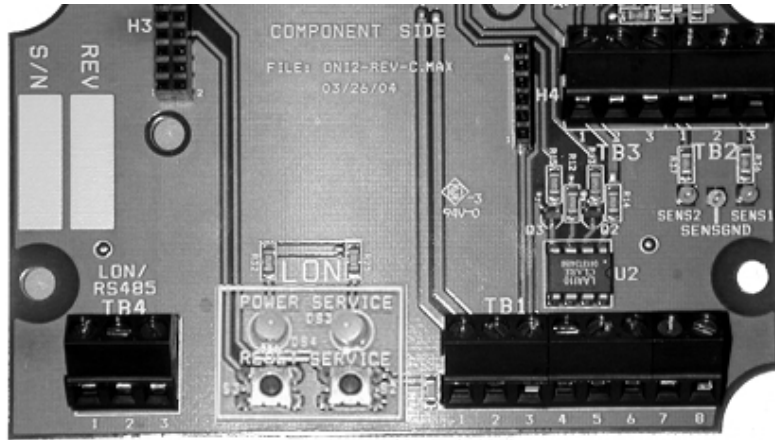
### Temperature Sensor/ Mode of Operation Relationship with Meter in Return Line

Supply Temp	Temperature 2 (External Sensor)
Return Temp	Temperature 1 (Internal Sensor)
Mode 1 Total	Cooling (Supply Temp < Return Temp)
Mode 2 Total	Heating (Supply Temp > Return Temp)



### 3.3.2 Electrical Wiring

Connect all Btu meter signal outputs to terminal strip TB1 and TB4 as shown below. Then connect the 24 V AC/DC input power to terminal strip TB1. The standard SYSTEM-30 is configured for 24 VAC 50/60 Hz operation or 24 VDC operation. Do not connect the 24 V AC/DC source until all other signal connections have been made and verified.



#### CAUTION



Only qualified service personnel should make connections between the System-30-MOD BTU Meter and the user's external equipment. ONICON assumes no responsibility for damage caused to the external equipment as a result of an improper installation.

## **SECTION 4.0: START UP AND COMMISSIONING**

### **4.1 DISPLAY AND USER INTERFACE (If display ordered)**

The System-30 may be ordered with an optional display and user interface.

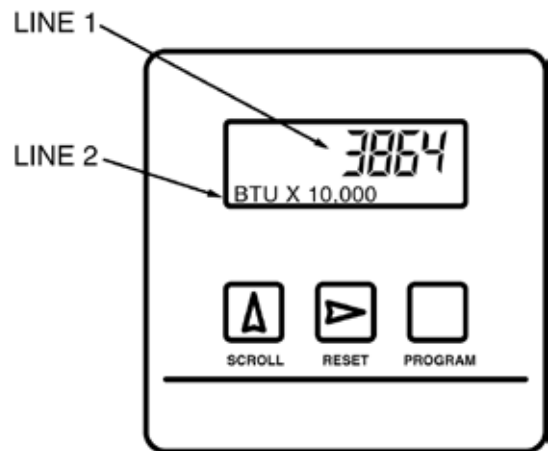
The display consists of 2 lines of alphanumeric characters. Line 1 indicates the current value, while line 2 identifies the engineering units and multiplier values that apply to the current value displayed on line 1. In the example shown, the current value is 3864, the engineering units are Btu's and the multiplier is 10,000. This would be read as 38,640,000 Btu's.

The user interface consists of 3 pushbutton switches. These 3 switches allow the user to operate the display and program the meter.

When operating in the run mode, the scroll button advances the display from one parameter to the next. A total of up to 8 different operating parameters may be available for display depending on whether the meter is being used in a single mode or dual mode application.

When operating in the run mode, the reset button (if enabled) allows the user to reset volume and energy totals.

The program button is not functional in the run mode.



### **4.2 PROCESSOR START-UP**

When power is applied to the Btu meter, alphanumeric characters appear on the two lines of the display, indicating the meter is operating. Press and release the SCROLL button on the front panel. Observe the display cycle to the next display page.

Select the SUPPLY TEMP page. Note the displayed temperature. Confirm that it is in the expected range. Now select the RETURN TEMP page. Again note the displayed temperature. Confirm that it is also in the correct range.

Select the FLOW RATE page. Note the displayed flow rate. Confirm that the flow rate value is in the correct range.

Successively pressing the SCROLL button will cycle the display through the run mode pages summarized in the tables on the next page.

## Single Mode Operation

SINGLE MODE BTU METERS – RUN MODE DISPLAY PAGES		
PAGE No.	DISPLAY NAME	SELECTABLE UNITS
1	ENERGY TOTAL	BTU, TONHR or KWHR
2	VOLUME TOTAL	GAL, LITER, METERS <sup>3</sup>
3	ENERGY RATE	BTU / HR, TONS, KW
4	VOLUME RATE	GPM, GPH, MGD, L/SEC, L/MIN, L/HR, METERS <sup>3</sup> /HR
5	INTRN TEMP	DEG F, DEG C
6	EXTRN TEMP	DEG F, DEG C

## Dual Mode Btu Meters

DUAL MODE BTU METERS – RUN MODE DISPLAY PAGES		
PAGE No.	DISPLAY NAME	SELECTABLE UNITS
1	MODE 1 ENERGY TOTAL	BTU, TONHR or KWHR
2	MODE 1 VOLUME TOTAL	GAL, LITER, METERS <sup>3</sup>
3	MODE 2 ENERGY TOTAL	BTU or TONHR
4	MODE 2 VOLUME TOTAL	GAL, LITER, METERS <sup>3</sup>
5	ENERGY RATE	BTU / HR, TONS or KW
6	VOLUME RATE	GPM, GPH, MGD, L/SEC, L/MIN, L/HR, METERS <sup>3</sup> /HR
7	INTRN TEMP	DEG F, DEG C
8	EXTRN TEMP	DEG F, DEG C

The operating mode, measurement units and multipliers are programmed into the Btu meter at the factory. These settings may be re-programmed in the field. Please contact ONICON technical support personnel for assistance, if changes are required.

### 4.3 DISPLAY AND PULSE OUTPUT UNITS AND MULTIPLIERS

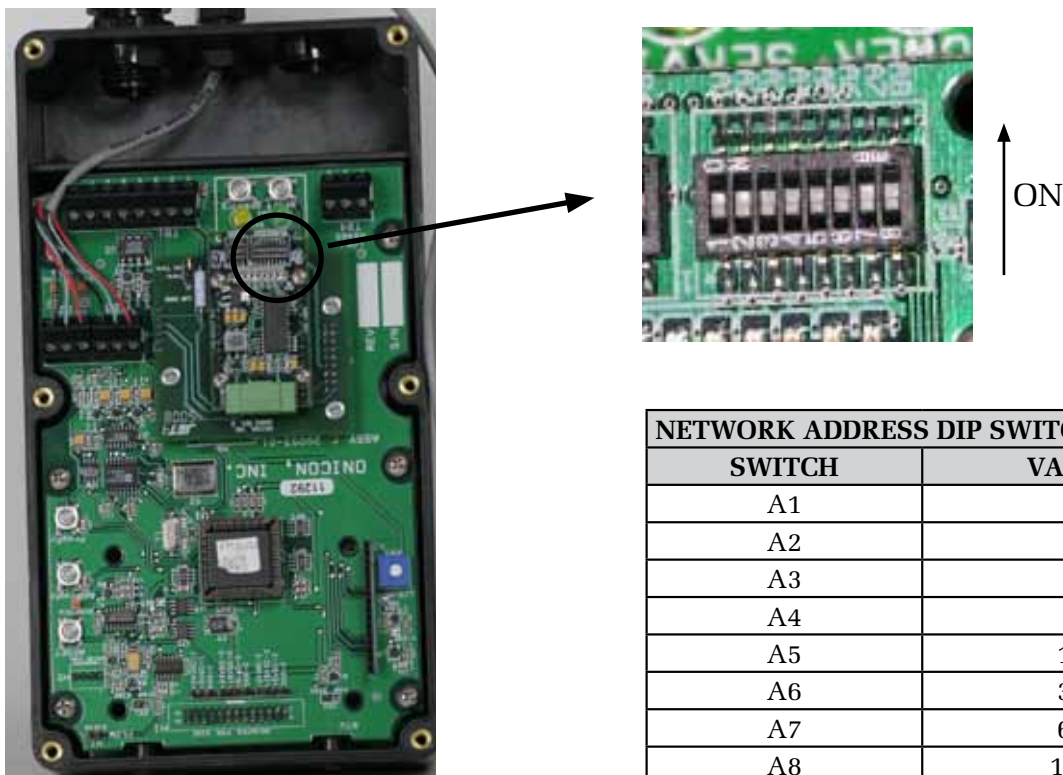
The units and multipliers are programmed prior to delivery. Contact ONICON's technical support personnel for assistance in changing units or multipliers.

## 4.4 MODBUS RTU NETWORK ADDRESSING

The MODBUS RTU network address may be set to any address from 1-247.

### 4.4.1 Changing the Network Address

Every ONICON Btu meter is individually programmed at the factory with application specific data provided by the customer during the ordering process, and this may include network addressing information. If address information was provided, the Btu meter will be programmed with that number. If no address is provided, ONICON Btu meters are programmed with a default address of 017. The address is set using the DIP switches shown below and on the following pages.



NETWORK ADDRESS DIP SWITCH VALUES	
SWITCH	VALUE
A1	1
A2	2
A3	4
A4	8
A5	16
A6	32
A7	64
A8	128

DEVICE ADDRESS	DIP SWITCH SETTINGS							
	1	2	3	4	5	6	7	8
1	ON							
2		ON						
3	ON	ON						
4			ON					
5	ON		ON					
6		ON	ON					
7	ON	ON	ON					
8				ON				
9	ON			ON				
10		ON		ON				
11	ON	ON		ON				
12			ON	ON				
13	ON		ON	ON				
14		ON	ON	ON				
15	ON	ON	ON	ON				
16					ON			
17	ON				ON			
18		ON			ON			
19	ON	ON			ON			
20			ON		ON			
21	ON		ON		ON			
22		ON	ON		ON			
23	ON	ON	ON		ON			
24				ON	ON			
25	ON			ON	ON			
26		ON		ON	ON			
27	ON	ON		ON	ON			
28			ON	ON	ON			
29	ON		ON	ON	ON			
30		ON	ON	ON	ON			
31	ON	ON	ON	ON	ON			
32						ON		
33	ON					ON		
34		ON				ON		
35	ON	ON				ON		
36			ON			ON		
37	ON		ON			ON		
38		ON	ON			ON		
39	ON	ON	ON			ON		
40				ON		ON		
41	ON			ON		ON		
42		ON		ON		ON		
43	ON	ON		ON		ON		

	1	2	3	4	5	6	7	8
44			ON	ON		ON		
45	ON		ON	ON		ON		
46		ON	ON	ON		ON		
47	ON	ON	ON	ON		ON		
48					ON	ON		
49	ON				ON	ON		
50		ON			ON	ON		
51	ON	ON			ON	ON		
52			ON		ON	ON		
53	ON		ON		ON	ON		
54		ON	ON		ON	ON		
55	ON	ON	ON		ON	ON		
56				ON	ON	ON		
57	ON			ON	ON	ON		
58		ON		ON	ON	ON		
59	ON	ON		ON	ON	ON		
60			ON	ON	ON	ON		
61	ON		ON	ON	ON	ON		
62		ON	ON	ON	ON	ON		
63	ON	ON	ON	ON	ON	ON		
64							ON	
65	ON						ON	
66		ON					ON	
67	ON	ON					ON	
68			ON				ON	
69	ON		ON				ON	
70		ON	ON				ON	
71	ON	ON	ON				ON	
72				ON			ON	
73	ON			ON			ON	
74		ON		ON			ON	
75	ON	ON		ON			ON	
76			ON	ON			ON	
77	ON		ON	ON			ON	
78		ON	ON	ON			ON	
79	ON	ON	ON	ON			ON	
80					ON		ON	
81	ON				ON		ON	
82		ON			ON		ON	
83	ON	ON			ON		ON	
84			ON		ON		ON	
85	ON		ON		ON		ON	
86		ON	ON		ON		ON	
87	ON	ON	ON		ON		ON	

	1	2	3	4	5	6	7	8
88				ON	ON		ON	
89	ON			ON	ON		ON	
90		ON		ON	ON		ON	
91	ON	ON		ON	ON		ON	
92			ON	ON	ON		ON	
93	ON		ON	ON	ON		ON	
94		ON	ON	ON	ON		ON	
95	ON	ON	ON	ON	ON		ON	
96						ON	ON	
97	ON					ON	ON	
98		ON				ON	ON	
99	ON	ON				ON	ON	
100			ON			ON	ON	
101	ON		ON			ON	ON	
102		ON	ON			ON	ON	
103	ON	ON	ON			ON	ON	
104				ON		ON	ON	
105	ON			ON		ON	ON	
106		ON		ON		ON	ON	
107	ON	ON		ON		ON	ON	
108			ON	ON		ON	ON	
109	ON		ON	ON		ON	ON	
110		ON	ON	ON		ON	ON	
111	ON	ON	ON	ON		ON	ON	
112					ON	ON	ON	
113	ON				ON	ON	ON	
114		ON			ON	ON	ON	
115	ON	ON			ON	ON	ON	
116			ON		ON	ON	ON	
117	ON		ON		ON	ON	ON	
118		ON	ON		ON	ON	ON	
119	ON	ON	ON		ON	ON	ON	
120				ON	ON	ON	ON	
121	ON			ON	ON	ON	ON	
122		ON		ON	ON	ON	ON	
123	ON	ON		ON	ON	ON	ON	
124			ON	ON	ON	ON	ON	
125	ON		ON	ON	ON	ON	ON	
126		ON	ON	ON	ON	ON	ON	
127	ON	ON	ON	ON	ON	ON	ON	
128								ON
129	ON							ON
130		ON						ON
131	ON	ON						ON

	1	2	3	4	5	6	7	8
132			ON					ON
133	ON		ON					ON
134		ON	ON					ON
135	ON	ON	ON					ON
136				ON				ON
137	ON			ON				ON
138		ON		ON				ON
139	ON	ON		ON				ON
140			ON	ON				ON
141	ON		ON	ON				ON
142		ON	ON	ON				ON
143	ON	ON	ON	ON				ON
144					ON			ON
145	ON				ON			ON
146		ON			ON			ON
147	ON	ON			ON			ON
148			ON		ON			ON
149	ON		ON		ON			ON
150		ON	ON		ON			ON
151	ON	ON	ON		ON			ON
152				ON	ON			ON
153	ON			ON	ON			ON
154		ON		ON	ON			ON
155	ON	ON		ON	ON			ON
156			ON	ON	ON			ON
157	ON		ON	ON	ON			ON
158		ON	ON	ON	ON			ON
159	ON	ON	ON	ON	ON			ON
160						ON		ON
161	ON					ON		ON
162		ON				ON		ON
163	ON	ON				ON		ON
164			ON			ON		ON
165	ON		ON			ON		ON
166		ON	ON			ON		ON
167	ON	ON	ON			ON		ON
168				ON		ON		ON
169	ON			ON		ON		ON
170		ON		ON		ON		ON
171	ON	ON		ON		ON		ON
172			ON	ON		ON		ON
173	ON		ON	ON		ON		ON
174		ON	ON	ON		ON		ON
175	ON	ON	ON	ON		ON		ON

	1	2	3	4	5	6	7	8
176					ON	ON		ON
177	ON				ON	ON		ON
178		ON			ON	ON		ON
179	ON	ON			ON	ON		ON
180			ON		ON	ON		ON
181	ON		ON		ON	ON		ON
182		ON	ON		ON	ON		ON
183	ON	ON	ON		ON	ON		ON
184				ON	ON	ON		ON
185	ON			ON	ON	ON		ON
186		ON		ON	ON	ON		ON
187	ON	ON		ON	ON	ON		ON
188			ON	ON	ON	ON		ON
189	ON		ON	ON	ON	ON		ON
190		ON	ON	ON	ON	ON		ON
191	ON	ON	ON	ON	ON	ON		ON
192							ON	ON
193	ON						ON	ON
194		ON					ON	ON
195	ON	ON					ON	ON
196			ON				ON	ON
197	ON		ON				ON	ON
198		ON	ON				ON	ON
199	ON	ON	ON				ON	ON
200				ON			ON	ON
201	ON			ON			ON	ON
202		ON		ON			ON	ON
203	ON	ON		ON			ON	ON
204			ON	ON			ON	ON
205	ON		ON	ON			ON	ON
206		ON	ON	ON			ON	ON
207	ON	ON	ON	ON			ON	ON
208					ON		ON	ON
209	ON				ON		ON	ON
210		ON			ON		ON	ON
211	ON	ON			ON		ON	ON
212			ON		ON		ON	ON
213	ON		ON		ON		ON	ON
214		ON	ON		ON		ON	ON
215	ON	ON	ON		ON		ON	ON
216				ON	ON		ON	ON
217	ON			ON	ON		ON	ON
218		ON		ON	ON		ON	ON
219	ON	ON		ON	ON		ON	ON

	1	2	3	4	5	6	7	8
220			ON	ON	ON		ON	ON
221	ON		ON	ON	ON		ON	ON
222		ON	ON	ON	ON		ON	ON
223	ON	ON	ON	ON	ON		ON	ON
224						ON	ON	ON
225	ON					ON	ON	ON
226		ON				ON	ON	ON
227	ON	ON				ON	ON	ON
228			ON			ON	ON	ON
229	ON		ON			ON	ON	ON
230		ON	ON			ON	ON	ON
231	ON	ON	ON			ON	ON	ON
232				ON		ON	ON	ON
233	ON			ON		ON	ON	ON
234		ON		ON		ON	ON	ON
235	ON	ON		ON		ON	ON	ON
236			ON	ON		ON	ON	ON
237	ON		ON	ON		ON	ON	ON
238		ON	ON	ON		ON	ON	ON
239	ON	ON	ON	ON		ON	ON	ON
240					ON	ON	ON	ON
241	ON				ON	ON	ON	ON
242		ON			ON	ON	ON	ON
243	ON	ON			ON	ON	ON	ON
244			ON		ON	ON	ON	ON
245	ON		ON		ON	ON	ON	ON
246		ON	ON		ON	ON	ON	ON
247	ON	ON	ON		ON	ON	ON	ON

## 4.5 BAUD RATE

Every ONICON Btu meter is individually programmed at the factory with application specific data provided by the customer during the process of ordering the meter. This normally includes the Baud rate setting. If the Baud rate was provided, the Btu meter will be configured to operate at the specified rate. The available Baud rate settings are listed in the table below.

If the Baud rate setting was not provided to ONICON, the Btu meter will be configured to 9600.

The Baud rate setting can be manually changed in the field. The drawing and table below show the Baud rate dipswitch settings.



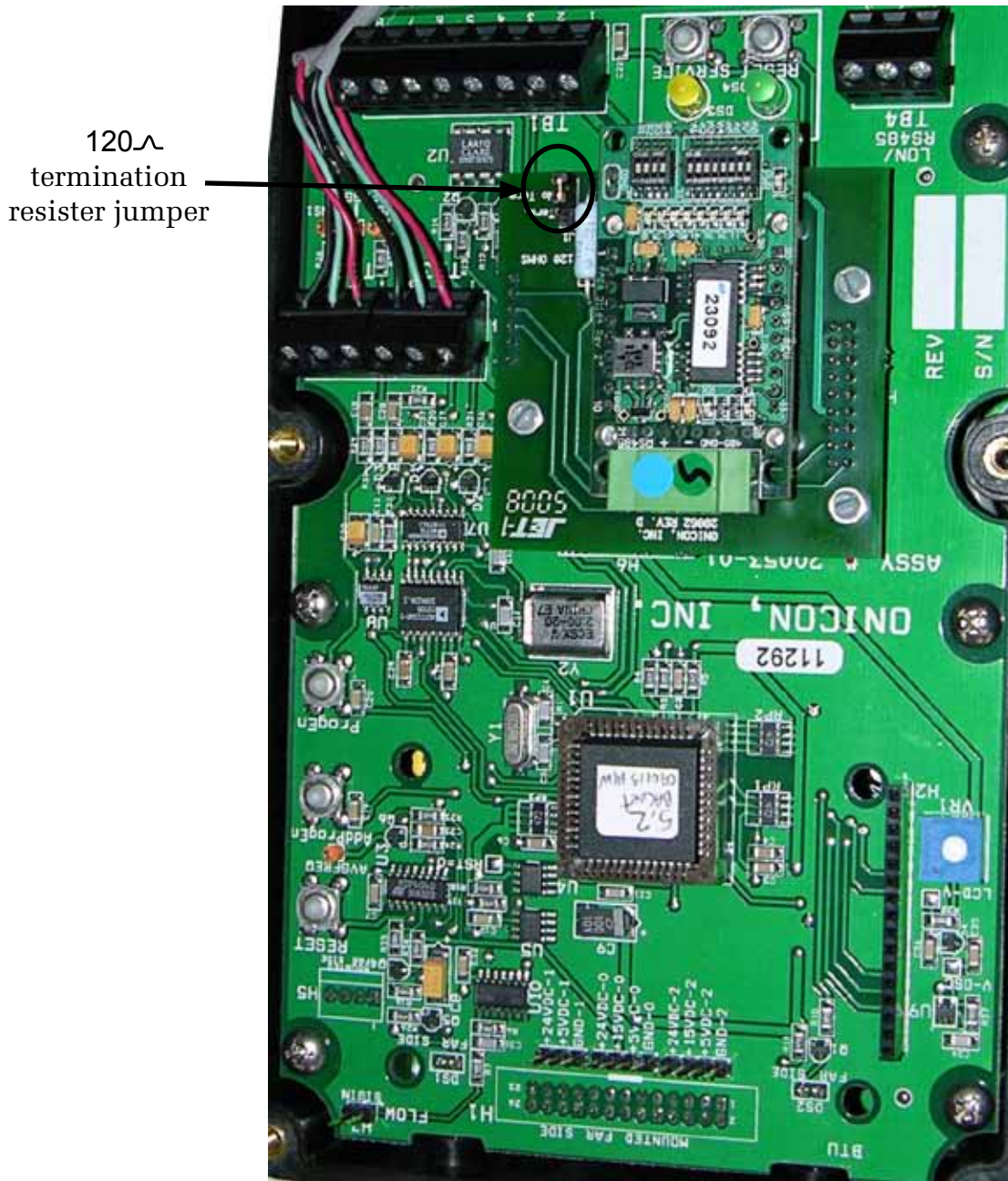
BAUD Rate	B1	B2	B3	B4
9600	OFF	OFF	OFF	OFF
1200	ON	OFF	OFF	OFF
2400	ON	ON	OFF	OFF
4800	ON	OFF	ON	OFF
9600	ON	ON	ON	OFF
19200	ON	OFF	OFF	ON
38400	ON	ON	OFF	ON
57600	ON	OFF	ON	ON
115200	ON	ON	ON	ON



Baud Rate Dipswitches

## 4.6 BIASING AND TERMINATION

The ONICON System-30-MOD BTU Meter does not provide biasing voltage to the RS-485 network. A jumper selectable 120 ohm resistor is provided as shown below. The termination resistor should only be used when the meter is installed at the end of the line.



## 4.7 MODBUS MEMORY MAP

ONICON Btu meters equipped with MODBUS RTU serial communications provide volume and energy rate data, temperature data, totalized volume and totalized energy data in a variety of engineering units. For example, supply and return temperatures are available in both degrees F and degrees C. You select the engineering units you wish to use by mapping to the appropriate registers.

### 4.7.1 MODBUS RTU Register Format and Networking Information

1. All registers are 16 bit MODBUS Holding Registers
2. MODBUS Holding Registers are used in 4 different ways.
  - A. As an analog value: In some cases these values are scaled by multiplying the register contents by a fixed multiplier.
  - B. As a status indicator where the register value can only be "1" or "2".
  - C. As a mode indicator where the value indicates current operating mode such as; "1" = single, "2" = dual, or "3" = bi-directional.
  - D. As a control register where the host can write a value to reset total(s).
3. Registers 40001 through 40068 are unsigned integer registers (0 to 65,535) except for 40024 and 40025. These are 16 bit signed integer values (-32,768 to +32,767). Registers 41003 through 41064 are 32 bit single precision floating point values. 41001, 41002 and 41065 through 41069 are unsigned integer registers.
4. MODBUS function codes supported:

CODE	DESCRIPTION
03	Read Holding Registers
06	Preset Single Registers
16	Preset Multiple Registers
17	Report Slave ID

5. Connection information: RS485, 2-wire (half duplex)
6. Data: 8 bits, 1 stop bit
7. Flow control (handshaking): None
8. Parity: None
9. Device address range: 1 – 247 (default address 017)
10. Termination: selectable, 120 ohms or none (default - none)

#### 4.7.2 MODBUS Memory Map

### Available Engineering Units

Engineering Units	Abbreviation
<b>Energy Rate</b>	
Btu per hour	Btu/Hr
Btu per hour x 1,000	kBtu/Hr
Btu per hour x 1,000,000	MBtu/Hr
Watts x 1,000	kW
Watts x 10,000	kW x 10
Tons	Tons
<b>Volume Rate (Flow)</b>	
Gallons per minute	GPM
Gallons per minute x 10	GPM x 10
Gallons per hour	GPH
Million gallons per day	MGD
Liters per second	L/S
Liters per minute	L/M
Liters per hour	L/Hr
Cubic meters per hour	M <sup>3</sup> /Hr
Cubic meters per hour x 10	M <sup>3</sup> /Hr x 10
<b>Mass Rate (Mass flow) – Only available with F-2000 Flow Meter</b>	
Pounds per hour	Lb/Hr
Pounds per hour x 10	Lb/Hr x 10
Kilograms per hour	kg/Hr
Kilograms per hour x 10	kg/Hr x 10
<b>Temperature</b>	
Degrees Fahrenheit	°F
Degrees Celsius	°C

Engineering Units	Abbreviation
<b>Energy Total</b>	
Btu x 1,000	kBtu
Btu x 1,000,000	MBtu
Btu x 1,000,000,000	GBtu
Ton-hours	TonHr
Ton-hours x 1,000	kTonHr
Watt-hours x 1,000	kWHr
Watt-hours x 1,000,000	MWHr
Watt-hours x 1,000,000,000	GWHR
<b>Volume Total</b>	
Gallons x 1,000	kGal
Gallons x 1,000,000	MGal
Gallons x 1,000,000,000	GGal
Liters x 1,000	kLiters
Liters x 1,000,000	MLiters
Liters x 1,000,000,000	GLiters
Cubic Meters	M <sup>3</sup>
Cubic Meters x 1,000	kM <sup>3</sup>
<b>Mass Total - Only available with F-2000 Flow Meter</b>	
Pounds x 1,000	kLbs
Pounds x 1,000,000	MLbs
Kilograms x 1,000	Kkg
Kilograms x 1,000,000	Mkg

Register Address	Description	Register Range	Data Range	Over Range	Read/Write	Comment
40001	Meter Operating Mode Indicator		1 – 3	Not applicable	Read Only	1 – indicates single mode 2 – indicates dual mode 3 – indicates bi-directional mode
40002	Mode Status Indicator		1 – 2	Not applicable	Read Only	1 - indicates heating mode or forward direction 2 - indicates cooling mode or reverse direction
40003	Energy Rate – Btu/Hr	0 – 65535	0 - 65534	65535	Read Only	
40004	Energy Rate – kBtu/Hr	0 – 65535	0 - 65534	65535	Read Only	
40005	Energy Rate – MBtu/Hr	0 – 65535	0 - 65534	65535	Read Only	
40006	Energy Rate – kW	0 – 65535	0 - 65534	65535	Read Only	
40007	Energy Rate – kW x 10	0 – 65535	0 - 65534	65535	Read Only	
40008	Energy Rate – Tons	0 – 65535	0 - 65534	65535	Read Only	
40009	Volume Rate – GPM	0 – 65535	0 – 65534	65535	Read Only	
40010	Volume Rate – GPM x 10	0 – 65535	0 – 65534	65535	Read Only	
40011	Volume Rate – GPH	0 – 65535	0 – 65534	65535	Read Only	
40012	Volume Rate – MGD	0 – 65535	0 – 65534	65535	Read Only	
40013	Volume Rate – L/S	0 – 65535	0 – 65534	65535	Read Only	
40014	Volume Rate – L/M	0 – 65535	0 – 65534	65535	Read Only	
40015	Volume Rate – L/Hr	0 – 65535	0 – 65534	65535	Read Only	
40016	Volume Rate – M <sup>3</sup> /Hr	0 – 65535	0 – 65534	65535	Read Only	
40017	Volume Rate – M <sup>3</sup> /Hr x 10	0 – 65535	0 – 65534	65535	Read Only	
40018	Mass Rate – Lb/Hr	0 – 65535	0 – 65534	65535	Read Only	Mass units are only available when using F-2000 Vortex Meter.
40019	Mass Rate – Lb/Hr x 10	0 – 65535	0 – 65534	65535	Read Only	
40020	Mass Rate – kg/Hr	0 – 65535	0 – 65534	65535	Read Only	
40021	Mass Rate – kg/Hr x 10	0 – 65535	0 – 65534	65535	Read Only	
40022	Supply Temperature – °F	0 – 65535	0 - 655.35	Not applicable	Read Only	Multiply by 0.01 to read temperature to 2 decimal places.
40023	Return Temperature – °F	0 – 65535	0 - 655.35	Not applicable	Read Only	
40024	Supply Temperature – °C	-32768 to +32767	-327.68 to +327.67	Not applicable	Read Only	
40025	Return Temperature – °C	-32768 to +32767	-327.68 to +327.67	Not applicable	Read Only	
40026	Energy Total Mode 1 - kBtu	0 – 65535	0 – 999		Read Only	Low Order
40027	Energy Total Mode 1 - MBtu	0 – 65535	0 – 999		Read Only	Middle Order
40028	Energy Total Mode 1 - GBtu	0 – 65535	0 – 65534	65535	Read Only	High Order
40029	Energy Total Mode 2 – kBtu	0 – 65535	0 – 999		Read Only	Low Order

Register Address	Description	Register Range	Data Range	Over Range	Read/Write	Comment
40030	Energy Total Mode 2 – MBtu	0 – 65535	0 – 999		Read Only	Middle Order
40031	Energy Total Mode 2 – GBtu	0 – 65535	0 – 65534	65535	Read Only	High Order
40032	Energy Total Mode 1 – TonHr	0 – 65535	0 – 999		Read Only	Low Order
40033	Energy Total Mode 1 – kTonHr	0 – 65535	0 – 65534	65535	Read Only	High Order
40034	Energy Total Mode 2 – TonHr	0 – 65535	0 – 999		Read Only	Low Order
40035	Energy Total Mode 2 – kTonHr	0 – 65535	0 – 65534	65535	Read Only	High Order
40036	Energy Total Mode 1 – kWhr	0 – 65535	0 – 999		Read Only	Low Order
40037	Energy Total Mode 1 – MWhr	0 – 65535	0 – 999		Read Only	Middle Order
40038	Energy Total Mode 1 – GWhr	0 – 65535	0 – 65534	65535	Read Only	High Order
40039	Energy Total Mode 2 – kWhr	0 – 65535	0 – 999		Read Only	Low Order
40040	Energy Total Mode 2 – MWhr	0 – 65535	0 – 999		Read Only	Middle Order
40041	Energy Total Mode 2 – GWhr	0 – 65535	0 – 65534	65535	Read Only	High Order
40042	Volume Total Mode 1 - kGal	0 – 65535	0 – 999		Read Only	Low Order
40043	Volume Total Mode 1 - MGal	0 – 65535	0 – 999		Read Only	Middle Order
40044	Volume Total Mode 1 – GGal	0 – 65535	0 – 65534	65535	Read Only	High Order
40045	Volume Total Mode 2 – kGal	0 – 65535	0 – 999		Read Only	Low Order
40046	Volume Total Mode 2 – MGal	0 – 65535	0 – 999		Read Only	Middle Order
40047	Volume Total Mode 2 – GGal	0 – 65535	0 – 65534	65535	Read Only	High Order
40048	Volume Total Mode 1 – kLiters	0 – 65535	0 – 999		Read Only	Low Order
40049	Volume Total Mode 1 – MLiters	0 – 65535	0 – 999		Read Only	Middle Order
40050	Volume Total Mode 1 – GLiters	0 – 65535	0 – 65534	65535	Read Only	High Order
40051	Volume Total Mode 2 – kLiters	0 – 65535	0 – 999		Read Only	Low Order
40052	Volume Total Mode 2 - MLiters	0 – 65535	0 – 999		Read Only	Middle Order
40053	Volume Total Mode 2 – GLiters	0 – 65535	0 – 65534	65535	Read Only	High Order
40054	Volume Total Mode 1 –M <sup>3</sup>	0 – 65535	0 – 999		Read Only	Low Order
40055	Volume Total Mode 1 – kM <sup>3</sup>	0 – 65535	0 – 65534	65535	Read Only	High Order
40056	Volume Total Mode 2 –M <sup>3</sup>	0 – 65535	0 – 999		Read Only	Low Order
40057	Volume Total Mode 2 – kM <sup>3</sup>	0 – 65535	0 – 65534	65535	Read Only	High Order
40058	Mass Total – kLbs	0 – 65535	0 – 999		Read Only	Mass units are only available when using F-2000 Vortex Meter.
40059	Mass Total – MLbs	0 – 65535	0 – 65534	65535	Read Only	
40060	Mass Total – Kkgs	0 – 65535	0 – 999		Read Only	
40061	Mass Total – Mkgs	0 – 65535	0 – 65534	65535	Read Only	
40062	Auxiliary Input Total	0 – 65535	0 – 999		Read Only	Low Order
40063	Auxiliary Input Total (x1000)	0 – 65535	0 – 65534	65535	Read Only	High Order
40064	Zero Mode 1 Energy Total	0 – 1	0 – 1	Not applicable	Read/Write	Write a value of 1 to registers to reset totals. Re-write a value of zero to registers once the totals reset.
40065	Zero Mode 1 Volume Total	0 – 1	0 – 1	Not applicable	Read/Write	
40066	Zero Mode 2 Energy Total	0 – 1	0 – 1	Not applicable	Read/Write	
40067	Zero Mode 2 Volume Total	0 – 1	0 – 1	Not applicable	Read/Write	
40068	Zero Auxiliary Input Total	0 – 1	0 – 1	Not applicable	Read/Write	

Register Address	Description	Register Range	Data Range	Over Range	Read/Write	Comment
41001	Meter Operating Mode Indicator		1 – 3	Not applicable	Read Only	1 – indicates single mode 2 – indicates dual mode 3 – indicates bi-directional mode
41002	Mode Status Indicator		1 – 2	Not applicable	Read Only	1 - indicates heating mode or forward direction 2 - indicates cooling mode or reverse direction
Register Address	Description	Register Type		Read/Write	Comment	
41003	Energy Rate – Btu/Hr	Floating point register (1 of 2)		Read Only		
41004	Energy Rate – Btu/Hr	Floating point register (2 of 2)		Read Only		
41005	Energy Rate – kW	Floating point register (1 of 2)		Read Only		
41006	Energy Rate – kW	Floating point register (2 of 2)		Read Only		
41007	Energy Rate – Tons	Floating point register (1 of 2)		Read Only		
41008	Energy Rate – Tons	Floating point register (2 of 2)		Read Only		
41009	Volume Rate – GPM	Floating point register (1 of 2)		Read Only		
41010	Volume Rate – GPM	Floating point register (2 of 2)		Read Only		
41011	Volume Rate – GPH	Floating point register (1 of 2)		Read Only		
41012	Volume Rate – GPH	Floating point register (2 of 2)		Read Only		
41013	Volume Rate – MGD	Floating point register (1 of 2)		Read Only		
41014	Volume Rate – MGD	Floating point register (2 of 2)		Read Only		
41015	Volume Rate – L/S	Floating point register (1 of 2)		Read Only		
41016	Volume Rate – L/S	Floating point register (2 of 2)		Read Only		
41017	Volume Rate – L/M	Floating point register (1 of 2)		Read Only		
41018	Volume Rate – L/M	Floating point register (2 of 2)		Read Only		
41019	Volume Rate – L/Hr	Floating point register (1 of 2)		Read Only		
41020	Volume Rate – L/Hr	Floating point register (2 of 2)		Read Only		
41021	Volume Rate – M <sup>3</sup> /Hr	Floating point register (1 of 2)		Read Only		
41022	Volume Rate – M <sup>3</sup> /Hr	Floating point register (2 of 2)		Read Only		
41023	Mass Rate – Lb/Hr	Floating point register (1 of 2)		Read Only	Mass units are only available when using F-2000 Vortex meter	
41024	Mass Rate – Lb/Hr	Floating point register (2 of 2)		Read Only		
41025	Mass Rate – Kg/Hr	Floating point register (1 of 2)		Read Only		
41026	Mass Rate – Kg/Hr	Floating point register (2 of 2)		Read Only		
41027	Supply Temperature – °F	Floating point register (1 of 2)		Read Only		
41028	Supply Temperature – °F	Floating point register (2 of 2)		Read Only		
41029	Return Temperature – °F	Floating point register (1 of 2)		Read Only		
41030	Return Temperature – °F	Floating point register (2 of 2)		Read Only		
41031	Supply Temperature – °C	Floating point register (1 of 2)		Read Only		
41032	Supply Temperature – °C	Floating point register (2 of 2)		Read Only		
41033	Return Temperature – °C	Floating point register (1 of 2)		Read Only		
41034	Return Temperature – °C	Floating point register (2 of 2)		Read Only		

Register Address	Description	Register Type			Read/Write	Comment
41035	Energy Total Mode 1 –Btu	Floating point register (1 of 2)			Read Only	
41036	Energy Total Mode 1 –Btu	Floating point register (2 of 2)			Read Only	
41037	Energy Total Mode 2 –Btu	Floating point register (1 of 2)			Read Only	
41038	Energy Total Mode 2 –Btu	Floating point register (2 of 2)			Read Only	
41039	Energy Total Mode 1 – TonHr	Floating point register (1 of 2)			Read Only	
41040	Energy Total Mode 1 – TonHr	Floating point register (2 of 2)			Read Only	
41041	Energy Total Mode 2 – TonHr	Floating point register (1 of 2)			Read Only	
41042	Energy Total Mode 2 – TonHr	Floating point register (2 of 2)			Read Only	
41043	Energy Total Mode 1 – kWhr	Floating point register (1 of 2)			Read Only	
41044	Energy Total Mode 1 – kWhr	Floating point register (2 of 2)			Read Only	
41045	Energy Total Mode 2 – kWhr	Floating point register (1 of 2)			Read Only	
41046	Energy Total Mode 2 – kWhr	Floating point register (2 of 2)			Read Only	
41047	Volume Total Mode 1 –Gal	Floating point register (1 of 2)			Read Only	
41048	Volume Total Mode 1 –Gal	Floating point register (2 of 2)			Read Only	
41049	Volume Total Mode 2 –Gal	Floating point register (1 of 2)			Read Only	
41050	Volume Total Mode 2 –Gal	Floating point register (2 of 2)			Read Only	
41051	Volume Total Mode 1 – Liters	Floating point register (1 of 2)			Read Only	
41052	Volume Total Mode 1 – Liters	Floating point register (2 of 2)			Read Only	
41053	Volume Total Mode 2 – Liters	Floating point register (1 of 2)			Read Only	
41054	Volume Total Mode 2 – Liters	Floating point register (2 of 2)			Read Only	
41055	Volume Total Mode 1 – M <sup>3</sup>	Floating point register (1 of 2)			Read Only	
41056	Volume Total Mode 1 – M <sup>3</sup>	Floating point register (2 of 2)			Read Only	
41057	Volume Total Mode 2 – M <sup>3</sup>	Floating point register (1 of 2)			Read Only	
41058	Volume Total Mode 2 – M <sup>3</sup>	Floating point register (2 of 2)			Read Only	
41059	Mass Total –Lbs	Floating point register (1 of 2)			Read Only	Mass units are only available when using F-2000 Vortex meter
41060	Mass Total –Lbs	Floating point register (2 of 2)			Read Only	
41061	Mass Total –kg	Floating point register (1 of 2)			Read Only	
41062	Mass Total –kg	Floating point register (2 of 2)			Read Only	
41063	Auxiliary Input Total	Floating point register (1 of 2)			Read Only	
41064	Auxiliary Input Total	Floating point register (2 of 2)			Read Only	
Register Address	Description	Register Range	Data Range	Over Range	Read/Write	Comment
41065	Zero Mode 1 Energy Total	0 – 1	0 – 1	Not applicable	Read/Write	Write a value of 1 to registers to reset totals. Re-write a value of zero to the register once the totals reset.
41066	Zero Mode 1 Volume Total	0 – 1	0 – 1	Not applicable	Read/Write	
41067	Zero Mode 2 Energy Total	0 – 1	0 – 1	Not applicable	Read/Write	
41068	Zero Mode 2 Volume Total	0 – 1	0 – 1	Not applicable	Read/Write	
41069	Zero Auxiliary Input Total	0 – 1	0 – 1	Not applicable	Read/Write	

### 4.7.3 Totalization, Resetting Tools, and Over-range & Rollover

#### A. Integer Register Totalization

Holding registers 40026 through 40061 are integer registers that provide totalized energy, volume and mass flow data in a variety of engineering units. The registers are organized into pairs or groups of 3.

The first (low order) register is limited to a range of 0 – 999. This register rolls over to zero when the total value reaches 1,000. If the registers are in a group of 3, the second register (middle order) is also limited to a range of 0 – 999. This register also rolls over when the register value reaches 1,000.

The second, or in the case of groups of 3, third, (high order) register is scaled such that the smallest incremental value indicated is 1,000 times greater than the preceding register. An example of this is shown below.

Example - A group of 3 registers

<u>Register</u>	<u>Engineering units &amp; Scaling</u>	<u>Current Value</u>
40026	kBtu (Btu x 1,000)	00500
40027	MBtu (Btu x 1,000,000)	00015
40028	GBtu (Btu x 1,000,000,000)	00111

Low order + middle order + high order = Btu Total = 111,015,500,000

or

kBtu Total = 111,015,500

Registers 40062 and 40063 provide totalization for the optional auxiliary pulse input option of the System-30 BTU Meter. There are no engineering units associated with these registers.

#### B. Floating Point Totalization

Registers 41003 through 41064 provide energy, volume and mass flow data in 32 bit single precision floating point format. The registers are organized into pairs. Each pair must be concatenated according to IEEE 754.

Word order: Most significant value first, least significant value second. Byte order within each word: Most significant byte first. Bit order within each byte: Most significant bit first.

Registers 41063 and 41064 provide totalization for the optional auxiliary pulse input option of the System-30 BTU Meter. There are no engineering units associated with these registers.

#### C. Resetting Totals

Registers 40064 through 40068 or 41065 through 41069 are integer registers that provide a mechanism to reset totals. Each reset register is associated with a group of totalizing registers and will reset all of the

engineering units at the same time. Both integer and floating point registers will be reset at the same time regardless of which set of reset registers are used.

To reset the totals associated with the register write a value of 1 to the register. Once the totals are reset, re-write a value of 0 to the register.



#### **IMPORTANT NOTE**

ONICON Btu meters contain internal registers for totalization. These registers will also be reset by this action.

#### **D. Over-range & Rollover Conditions for Totals**

All low order and middle order registers are designed to rollover to 0 when their totals exceed 999. The maximum value that can be totalized in high order registers is 65,534. A value of 65,535 is considered an over-range condition.



#### **CAUTION**

ONICON Btu meters contain internal registers for totalization. These registers will eventually roll over to zero if the totals are not reset on a periodic basis. The associated MODBUS registers will also rollover to zero when this occurs. The engineering units and multipliers programmed in to the Btu meter affect the point at which the totals roll over. The factory assigned engineering units and multipliers applied to the Btu meter display were chosen to eliminate the possibility of an over-range condition in the MODBUS registers before the Btu meter registers roll over. Changing the engineering units or multipliers at the Btu meter will affect the rollover point. Contact ONICON prior to making any changes.

## 4.8 DIAGNOSTICS

The ONICON System-30 BTU MEASUREMENT SYSTEM uses a microprocessor to calculate energy. Factory programmed settings provide energy total outputs in accordance with the customer's application data. An optional isolated analog output for energy rate, flow rate or delta T may also be available. Refer to the Btu meter calibration sheet for a complete listing of factory settings. These settings cannot be changed in the field. Contact ONICON factory service personnel if changes to the calibration are required.

The System-30 is equipped with diagnostic indicator lights that confirm the operation of the microprocessor and its input circuitry.

Please contact the ONICON factory service personnel if either of the diagnostic lights indicate a potential problem with the operation of the BTU MEASUREMENT SYSTEM.



### 4.8.1 Diagnostic Lights

#### Energy

Located on the end of main unit opposite the cable connection is a red LED labeled Btu. This LED will flash as energy is transferred.

#### Liquid Flow

Located on the end of main unit opposite the cable connection is a red LED labeled FLOW. This LED will flash at a rate that is proportional to the liquid flow rate. An unlit LED indicates no flow signal.

## 4.9 COMMISSIONING

Please read all installation instructions carefully before proceeding. Wiring diagrams are located in the appendix. A worksheet for checking off these steps and recording measured values is located on the following page.

1.	Confirm main unit location and adequate straight pipe run to achieve desired results.	Is the main unit located in the correct location as required by the plans?  Compare actual straight pipe upstream and downstream of the main unit location to the recommended distances identified in this installation manual.
In order to proceed with the following steps, the System-30 must be operating and connected to the control system. There must also be flow in pipes. Flow signal readings should be taken while holding the flow rate constant if possible. Otherwise, take the various output readings as quickly as possible.		
2.	Confirm correct supply voltage.	Verify that the correct supply voltage is available at the System-30 signal cable connections. The System-30 BTU MEASUREMENT SYSTEM operates from 24 V AC/DC.
3.	With the HVAC system active, verify that the diagnostic LED's for flow and Btu are both flashing.	The LED's are located on the exterior of the main unit on the end opposite from the cables.
The following steps require a multimeter with the ability to measure DC voltage as well as DC frequency in Hertz. Remove the six screws that secure the cover to the main unit and carefully lift the cover off.		
4.	Check temperature readings for T1, T2 and the differential temperature.	Set multimeter for 2 to 4 volt range.  TB2: Measure DC volts between test point sensor 1 and sensor ground terminals TB3: Measure DC volts between test point sensor 2 and sensor ground terminals Delta T: Measure DC volts between test point sensor 1 and sensor 2 terminals  The relationship between voltage and temperature is 10 mV/degree F. Multiply the reading in volts by 100 to obtain degrees F. Compare the calculated temperatures to expected values and to the values shown on the network.
5.	Check flow signal.	Set multimeter for DC Hertz, voltage range > 15 volts. The average frequency test point for flow is located next to the reset button.  $\text{GPM} = \frac{\text{Frequency in Hz} \times 60}{\text{Meter Factor in ppg}}$ (refer to calibration tag for meter factor)  Compare the calculated flow rate to expected values and to the values shown on the network.
6.	Check Energy Total Output (Btu Output Mode 1 and/or Mode 2).	Set multimeter for volts DC.  Mode 1: Measure voltage between TB1 terminals 3 and 4 Mode 2: Measure voltage between TB1 terminals 5 and 6  Confirm that the voltage changes state (low to high or high to low) each time the controls system register records a new energy total.
End of standard commissioning. Please contact ONICON at (727) 447-6140 with any questions.		

#### 4.9.1 Commissioning Worksheet

Please read all installation instructions carefully prior to proceeding with these steps. Wiring diagrams are located in the appendix. Use the following worksheet for checking off the commissioning steps and recording measured values:

STEP	TEST / MEASUREMENT	S/N:	S/N:	S/N:	S/N:
1.	Meter location				
2.	Supply voltage verified				
3.	Verify diagnostic LED's are flashing				
4.	Note and record temperature readings for T1, T2 & delta T				
5.	Note and record flow rate				
6.	Confirm contact closure output operation for Mode 1 & Mode 2				

#### TROUBLESHOOTING GUIDE FOR ONICON SYSTEM-30 BTU MEASUREMENT SYSTEMS

NOTE: Also refer to the COMMISSIONING GUIDE located on the preceding pages.

REPORTED PROBLEM:	POSSIBLE SOLUTIONS:
No Flow Signal/ Energy Signal (While hydronic system is active)	<ul style="list-style-type: none"> <li>• Verify 24 VAC/VDC supply voltage to the System-30.</li> <li>• Verify correct wiring to the System-30 (see wiring diagram).</li> <li>• Check turbine for clogging due to debris.</li> <li>• If none of the above, re-confirm that flow is really present in the line.</li> <li>• NOTE: Flow meter function cannot be verified by blowing on the turbine. The sensing system requires a conductive liquid to operate.</li> </ul>
Displayed flow rate too high or too low	<ul style="list-style-type: none"> <li>• Verify that System-30 isolation valves are fully open and bypass valve is fully closed (if bypass is used).</li> <li>• Check turbine for debris.</li> <li>• Verify supply voltages.</li> </ul>
Displayed temperature too high or too low vs. expected values	<ul style="list-style-type: none"> <li>• Verify that thermowell is inserted into the flow stream and that the temperature sensor is completely inserted into the thermowells.</li> </ul>

Data not available at the control system (device offline)	<ul style="list-style-type: none"> <li>• Verify that the network address is correct and there are no address conflicts.</li> <li>• Verify that the receive LED is flashing on the MODBUS board. If the receive LED is not flashing, look for an open connection in the network cable. See Appendix to locate the receive (Rx) LED.</li> <li>• Verify that the Baud rate selected matches the network Baud rate. (See section 4.5.)</li> <li>• Verify that the polarity of the network connections is correct.</li> <li>• If the meter is at the end-of-line, add the 120 ohm termination resistor across the network terminals.</li> <li>• Press and release switch S-1 to reset the Btu meter.</li> </ul>
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For technical assistance, contact ONICON at (727) 447-6140.

## APPENDIX A – DRAWINGS

A-1 TYPICAL SYSTEM INSTALLATION

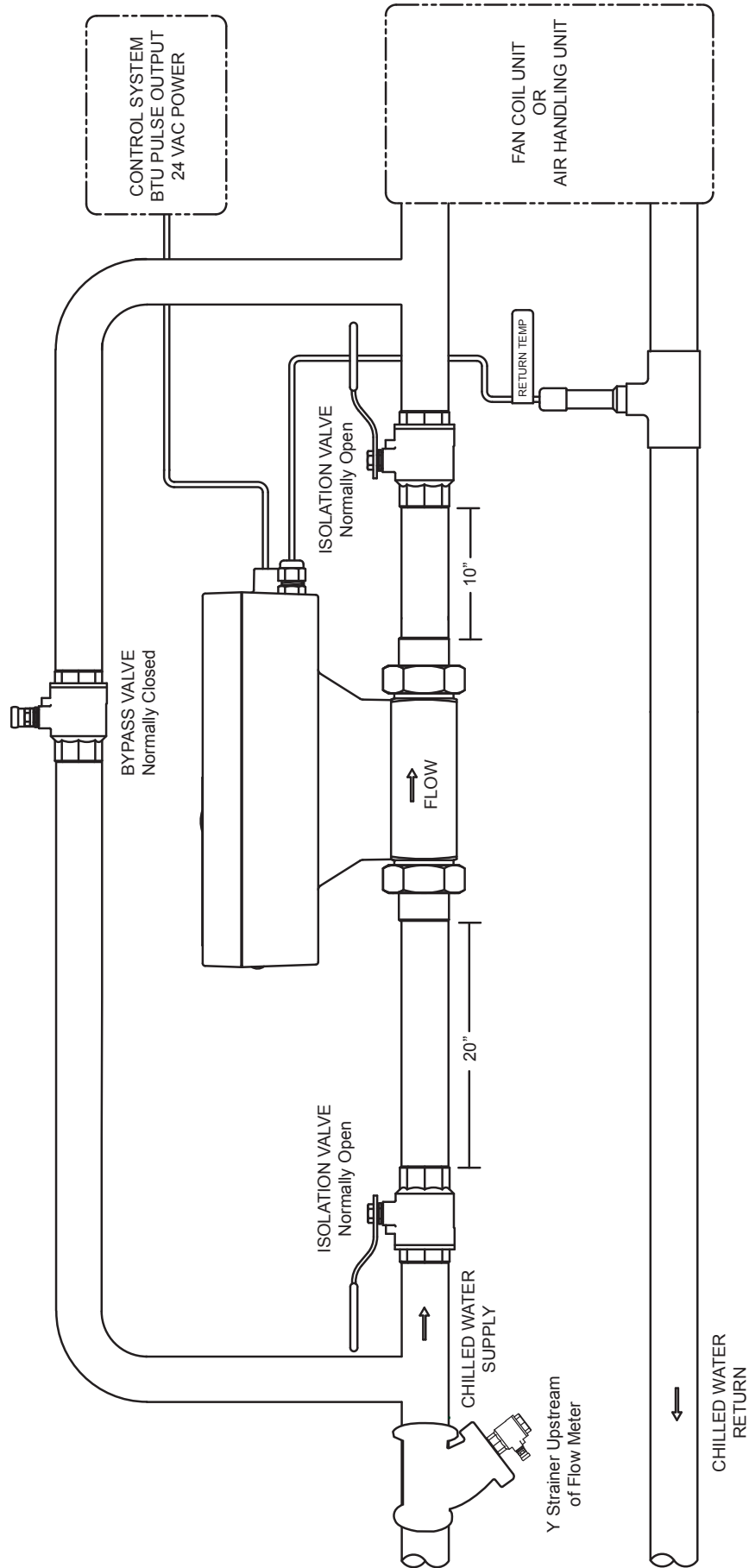
A-2 / A-3 THERMOWELL INSTALLATION

A-4 WIRING DIAGRAM with SIGNAL CONNECTION BOARD

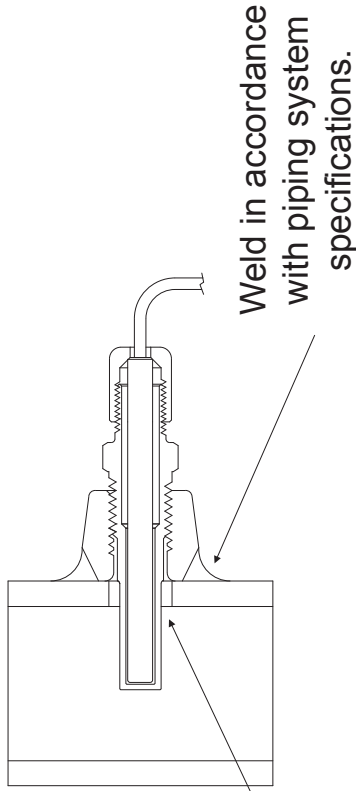
A-5 WIRING DIAGRAM FOR DIN CONNECTOR

A-6 MODBUS BOARD

**SYSTEM-30 BTU MEASUREMENT SYSTEM WITH INTEGRAL  
FLOW METER & TEMPERATURE SENSORS**



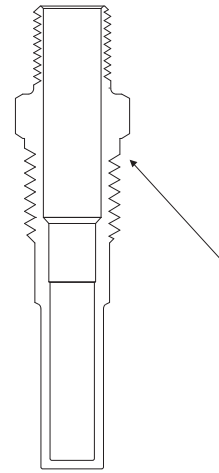
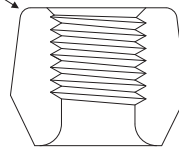
# THERMOWELL INSTALLATION IN WELDED PIPE



If piping specifications permit, drill 5/8" hole through pipe

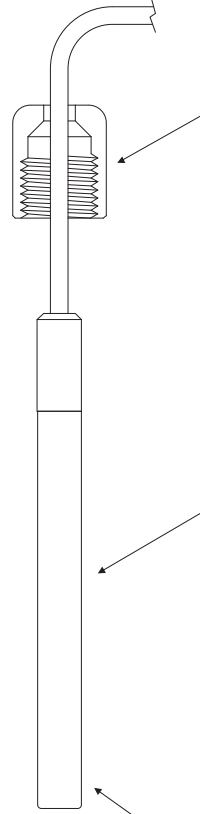
**DO NOT OVER-TIGHTEN THERMOWELL.**  
Thermowell has a thin wall for better temperature measurement and can be damaged by over-tightening.

1/4" NPT welded branch outlet



**ONICON Thermowell**

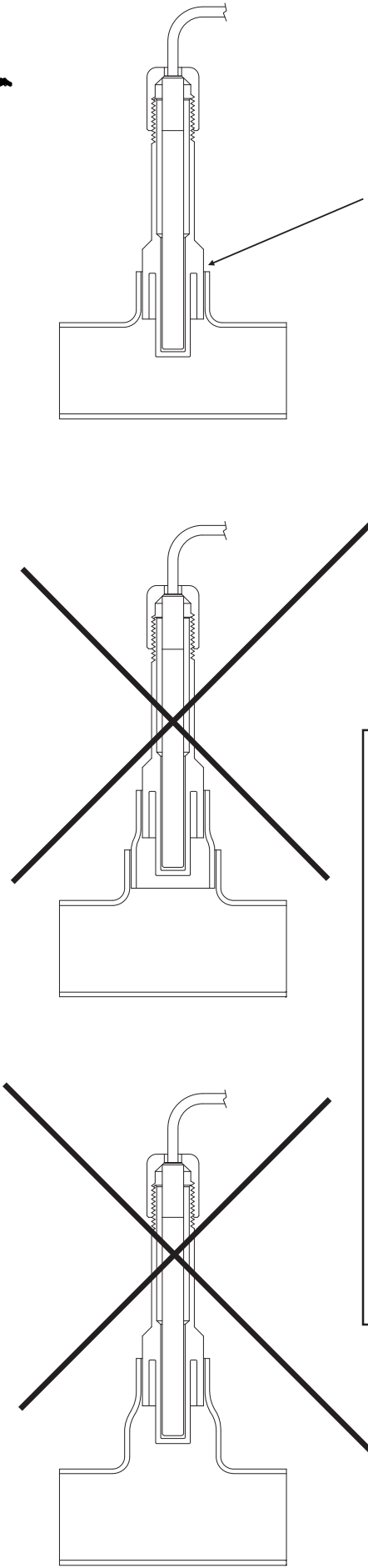
Apply thin coating of thermally conductive grease before assembling.



**ONICON Temperature Sensor**

**Retainer Cap**

**ALTERNATE THERMOWELL INSTALLATION  
IN COPPER TEES**



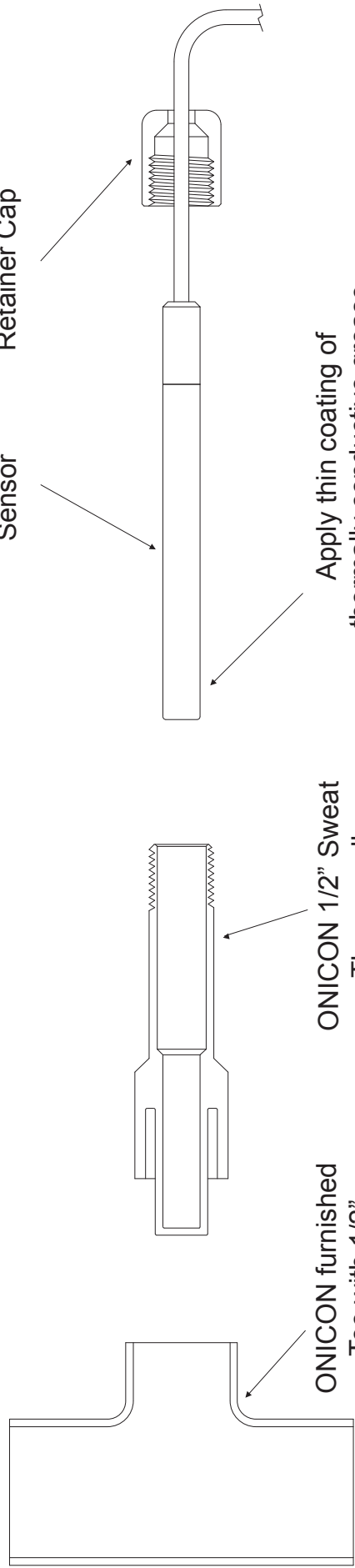
**DO NOT INSTALL WITH A BUSHING OR TEE WITH EXTENDED BRANCH OUTLET.**  
Install thermowell directly into the ONICON furnished tee only or the temperature data will not be correct!

Solder or braze as required by piping

ONICON Temperature Sensor

Retainer Cap

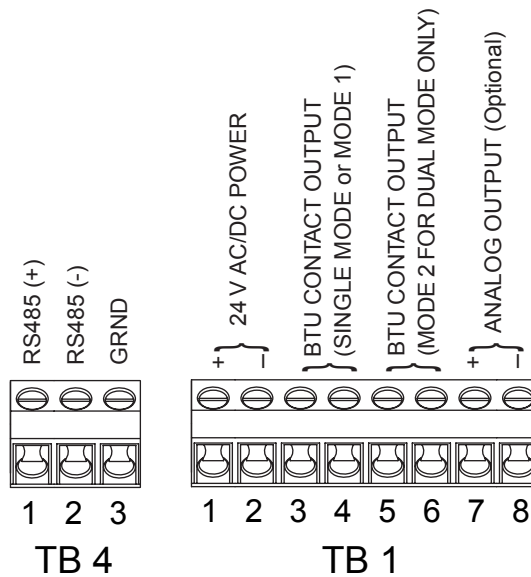
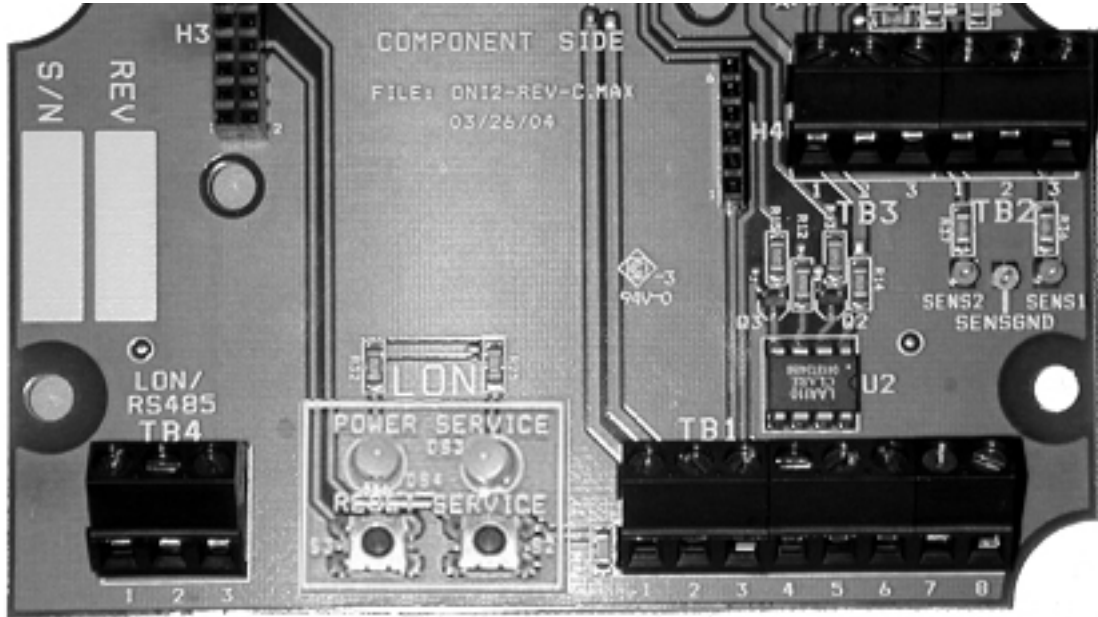
Apply thin coating of thermally conductive grease before assembling



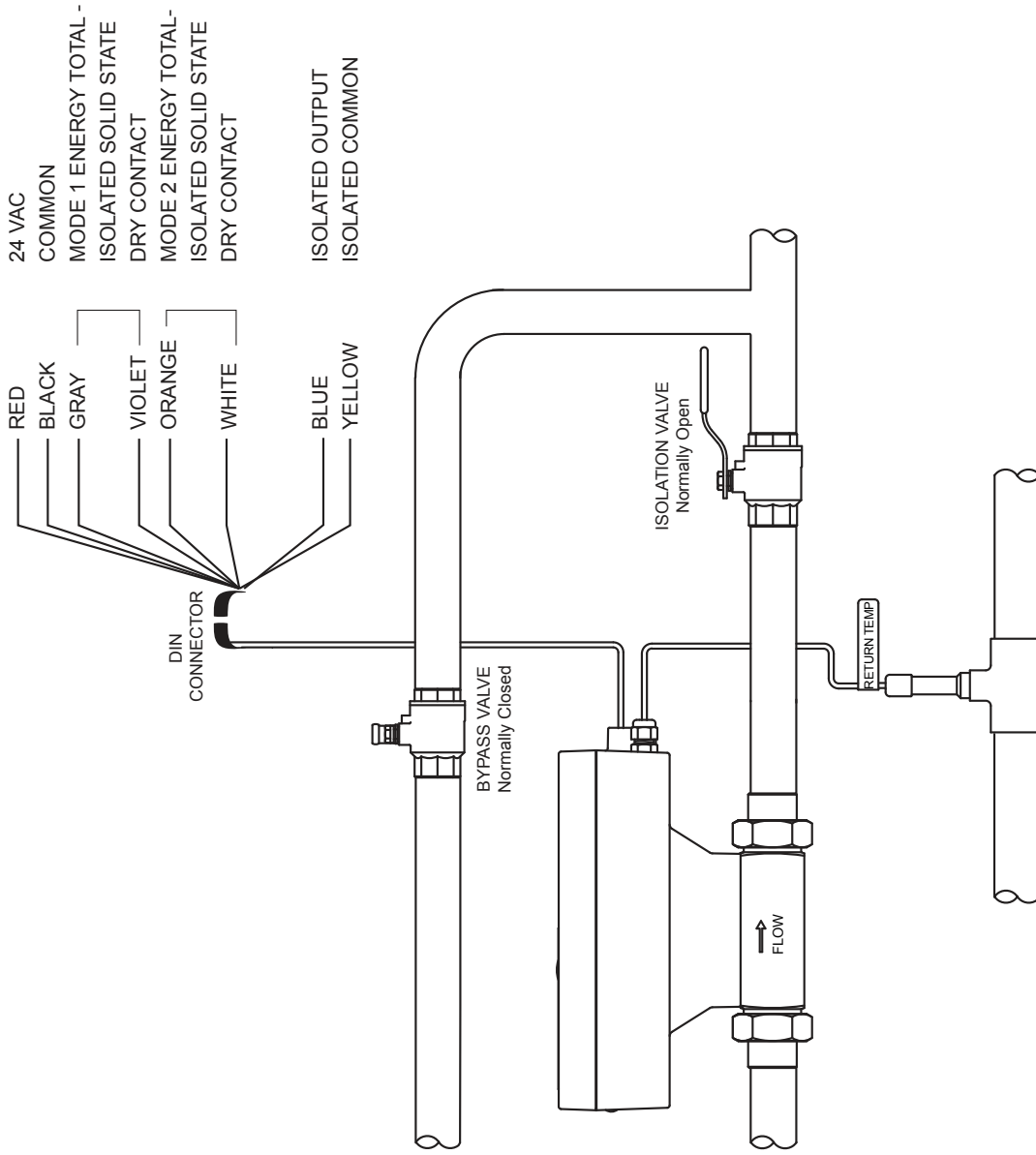
ONICON 1/2" Sweat Thermowell

ONICON furnished Tee with 1/2" branch outlet

# WIRING DIAGRAM WITH SIGNAL CONNECTION BOARD



# SYSTEM-30 WITH DIN CONNECTOR WIRING DIAGRAM



**SYSTEM-30 BOARD**

