



# ASSOCIATION of UNIVERSITIES for RESEARCH in ASTRONOMY, INC.

UNDER COOPERATIVE AGREEMENT WITH THE NATIONAL SCIENCE FOUNDATION  
 OPERATING THE  
 NATIONAL OPTICAL ASTRONOMY OBSERVATORY  
 NATIONAL SOLAR OBSERVATORY  
 GEMINI OBSERVATORY  
 LARGE SYNOPTIC SURVEY TELESCOPE  
 DOING BUSINESS FOR

**PURCHASE ORDER  
 N740700-H**

July 28, 2016  
 Page 1 of 1

LSST, INC. - SOAR CONSORTIUM, INC. - WIYN CONSORTIUM, INC.

**Vendor:** ALPS CONTROLS INC  
 217 W 8TH AVE #1  
 HOMESTEAD, PA 15120

ALPS

Please Reference the above Purchase Order Number on all shipping documents, packing lists, invoices and other correspondence.

Attn: Online

Terms applicable to this order are available at:  
<http://auracas.aura-astronomy.org/terms>  
 For a hard copy, contact the buyer listed below.

**Invoice To:** AURA, Inc.  
 Attn: Accounting  
 P.O. Box 26732  
 Tucson, AZ 85726  
 520 318-8000

**Ship To:** AURA Gemini Observatory  
 670 N. A'ohoku Place  
 Hilo, HI 96720

<b>INVOICE TERMS</b> Mastercard	<b>TAX CODE</b> 3	<b>REQUISITION #</b> 0740700	<b>F.O.B.</b> Ship Point	<b>SHIP-VIA</b> BestWay
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REQUESTER	LINE NO.	DESCRIPTION	REQUIRED DATE	QUANTITY	UNIT	UNIT PRICE	EXTENDED PRICE
KAREWICZ, STAN	1	Immersion Temperature Sensors with T1K Transmitter, Part Number: BA/T1K[0 TO 100F]-I-2in-SS-BB2	08/16/2016	1.00	EA	150.36 \$	150.36
KAREWICZ, STAN	2	2in Thermowell, Part Number: BA/2inM304	08/16/2016	1.00	EA	38.40 \$	38.40
Karewicz	3	Shipping	08/16/2016	1.00	ea	16.24 \$	16.24

Receipt Number PP-392670

AURA Internal Account Distribution

G-02552-000-100	205.00
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**Total: \$ 205.00**

DIRECT QUESTIONS CONCERNING THIS ORDER TO:

Tito Agbayani

(808) 974-2506

APPROVED BY:

AURA CAS Procurement



### Features & Options

- Probe Lengths: 2", 4" and 8" (fit standard BAPI Thermowell lengths)
- Series 304 Stainless Steel Probes
- Double Encapsulated Sensors
- 3 Optional Watertight Enclosures
- Wide Selection of Temperature Sensing Elements

Immersion Units are available in 2", 4" and 8" probe lengths. This unit is provided with a 1/4" stainless steel probe and a 1/2" NPT double-ended stainless steel fitting.

The sensors are potted inside the probe with a thermally conductive compound. All units have etched Teflon leadwires and double encapsulated sensors to create a watertight package that can withstand high humidity and condensation. Immersion Probes are available with a watertight BAPI-Box, BAPI-Box 2 or a Weatherproof enclosure.

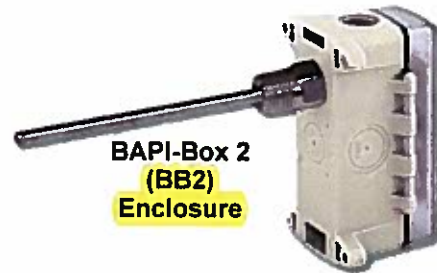
No Box (NB)  
(Standard)



BAPI-Box  
(BB)  
Enclosure



BAPI-Box 2  
(BB2)  
Enclosure



Weatherproof  
(WP)  
Enclosure



### Blü-Test Bluetooth® Wireless Temp & Humidity Measurement Probe

Commissioning just got easier with BAPI's Bluetooth® temp and humidity probe. No need to carry an extra meter because the Blü-Test communicates to your Bluetooth-enabled Smart Phone or Tablet. The free App even lets you log the data.

*For more info on the Blü-Test, see the Accessories section.*



\*All Passive Thermistors 20KΩ and smaller are CE compliant.

### Specifications

#### Environmental Operation Range:

Temperature Sensor: -40 to 105 °C  
Temperature Transmitter: -20 to 70 °C  
Humidity: 0 to 100%, non-condensing

#### Enclosure Material:

WP Model: Cast Aluminum  
BB & BB2: UV-resist. polycarb., UL94, V-0

#### Enclosure Rating:

WP Model: NEMA 3R  
BB & BB2: IP66, NEMA 4

#### Encl. Dimensions: H x W x D

BAPI-Box (BB) 5 x 4.1 x 2.5" (127 x 104 x 63.5mm)  
BAPI-Box 2 (BB2) 4.9 x 2.8 x 2.35" (125 x 71.6 x 60mm)  
Weatherproof (WP) 4.5 x 2.75 x 2.2" (114 x 70 x 55mm)

(For enclosure dimension drawings, turn to the end of the section.)

**For detailed specifications on the Sensors & Transmitters, see the "Sensors" section.**





# Immersion Probes w/ stainless steel fitting

# A47

Rev. 02/25/15

Temperature Sensors

Ordering Information		Immersion Probes, Double Threaded - Temperature		
<b>BA/</b>	Sensor Type (Required) Use the designator number (shown to the left in bold) to indicate the sensor			
#	<b>1.8K</b>	<b>THERMISTORS</b> 1.8K Ω @ 25 °C	<b>RTDs</b> 1K[375] 1K Ω Platinum @ 0 °C, 3.75 Ω/°C temp. coeff.	
	<b>2.2K</b>	2.2K Ω @ 25 °C	1K[Ni] 1K Ω Nickel @ 21°C, 5 Ω/°C temp. coeff.	
	<b>3K</b>	3K Ω @ 25 °C	1K 1K Ω Platinum @ 0 °C, 3.85 Ω/°C temp. coeff.	
	<b>3.25K</b>	3.25K Ω @ 25 °C (T30 type)	2K 2K Ω Silicon @ 20 °C, 8 Ω/°C temp. coeff.	
	<b>3.3K</b>	3.3K Ω @ 25 °C		
	<b>10K-2</b>	10K Ω @ 25 °C		
	<b>10K-3</b>	10K Ω @ 25 °C		
	<b>10K-3[11K]</b>	5,238 Ω @ 25 °C	<b>SEMICONDUCTORS</b>	
	<b>20K</b>	20K Ω @ 25 °C	334 LM334 Semiconductor	
	<b>47K</b>	47K Ω @ 25 °C	592 AD592 Semiconductor, 273 μA @ 0 °C	
	<b>50K</b>	50K Ω @ 25 °C	592-10K AD592 Semicond. with 10 kΩ shunt resistor, 2.73 V @ 0 °C	
	<b>100K</b>	100K Ω @ 25 °C		
		<b>TEMPERATURE TRANSMITTERS</b> Must include a "range" figure. Requires an enclosure.		
		<b>T1K[range]</b>	1K Platinum RTD, 1,000 Ω @ 0 °C with 4 to 20 mA Output	
		<b>T1KM[range]</b>	1K Platinum RTD, 1,000 Ω @ 0 °C with MATCHED* 4 to 20 mA Output	
	<b>T10K[range]</b>	10K Thermistor, 10,000 Ω @ 25 °C with 4 to 20 mA Output**		
	<b>T10K5[range]</b>	10K Thermistor, 10,000 Ω @ 25 °C with 0-5 VDC Output**		
	<b>T10K10[range]</b>	10K Thermistor, 10,000 Ω @ 25 °C with 0-10 VDC Output**		
	<b>TEMPERATURE TRANSMITTER RANGES</b>			
	Custom temperature transmitter ranges are available. Common ranges are listed below			
	30 TO 81F	-1 TO 27C	32 TO 212F 0 TO 100C	
	0 TO 100F	-18 TO 38C	40 TO 240F 4 TO 116C	
	20 TO 120F	-7 TO 49C	50 TO 250F 10 TO 121C	
	32 TO 134F	0 TO 57C		
	<b>Note: Temperature Transmitter Units require a WP, BB or BB2 enclosure</b>			
	<b>Configuration (Required)</b>			
	<b>-I-2"-SS</b>	2" Immersion length of 1/4" Diameter, Stainless Steel Probe, 3.5" probe (use 2" BAPI Well)		
	<b>-I-4"-SS</b>	4" Immersion length of 1/4" Diameter, Stainless Steel Probe, 5.5" probe (use 4" BAPI Well)		
	<b>-I-8"-SS</b>	8" Immersion length of 1/4" Diameter, Stainless Steel Probe, 8.5" probe (use 8" BAPI Well)		
		<b>Optional Enclosure Enclosure required for transmitters</b>		
	<b>-WP</b>	Weatherproof Enclosure - NEMA 3R rated metal enclosure		
	<b>-WPO</b>	Weatherproof Encl. - NEMA 3R rated, Outside Mount (probe out the bottom)		
	<b>-BB</b>	BAPI-Box Enclosure - IP66 rated, UV-resistant polycarbonate		
	<b>-BBO</b>	BAPI-Box Encl. - IP66 rated, Outside Mount (probe out the bottom)		
	<b>-BB2</b>	BAPI-Box 2 Enclosure - IP66 rated, UV-resistant polycarbonate		
	<b>-BB2O</b>	BAPI-Box 2 Encl. - IP66 rated, Outside Mount (probe out the bottom)		
		<b>Optional Terminal Block An enclosure is required</b>		
	<b>-TS</b>	Terminal Strip Connection (BB or BB2 required for units with a Thermistor, RTD or Semiconductor)***		
<b>EXAMPLE</b>				
BA/	10K-2	-I-2"-SS	-WP	
Example Part Number: BA/10K-2-I-8"-SS-WP				
<b>Your Part Number:</b>				

Call BAPI if you have questions about the above ordering grid or the configuration of the product you are ordering.

\*Transmitters with matched outputs require a Class A sensor.

\*\*Range is limited to -40 to 185°F (-40 to 85°C)

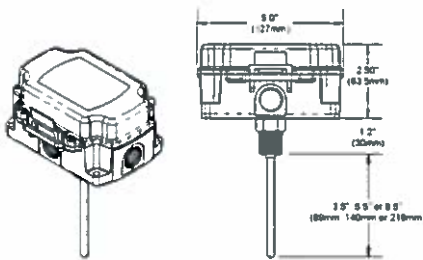
\*\*\*TS option is not available with the 592-10K Semiconductor sensor or the T10K transmitters



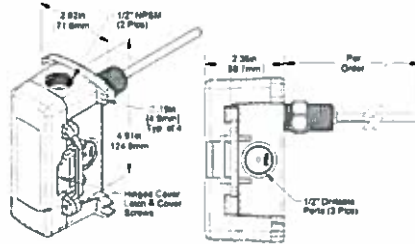
#### Overview

The BA/T#-Ix-SS Double Threaded Stainless Steel (SS) Immersion Transmitter is made for thermowell mounting and temperature measurement in water pipes, water tanks or cooling tower sump applications. Direct probe insertion into a Threadolet is possible without a thermowell. However, this is not recommended as it cannot be removed after the pipe is pressurized. The rigid probe and threads are made of Stainless Steel and made in different lengths for a custom thermowell fit. The 4 to 20mA transmitter can be ordered with 100Ω (385), 1KΩ (385) RTDs or 10KΩ type 2 thermistor sensors. A 0 to 5VDC or 0 to 10VDC transmitter is also available with the 10KΩ type 2 thermistor sensor. Special high accuracy RTD matched transmitters (M) are available which match the sensor to the transmitter for improved accuracy. Enclosure mounting styles come in plastic or metal for both NEMA 3R and NEMA 4 applications and are all plenum rated.

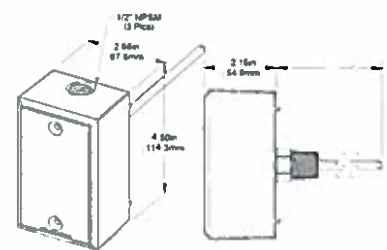
#### Identification



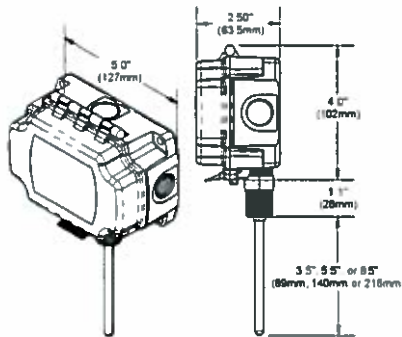
**Fig 1:** Double Threaded Immersion Sensor in a BAPI-Box (BB) Enclosure



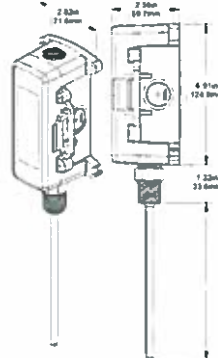
**Fig 2:** Double Threaded Immersion Sensor in a BAPI-Box 2 (BB2) Enclosure



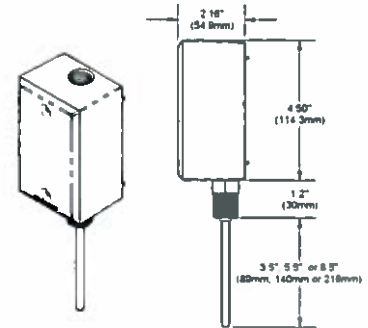
**Fig 3:** Double Threaded Immersion Sensor in a Weatherproof (WP) Enclosure



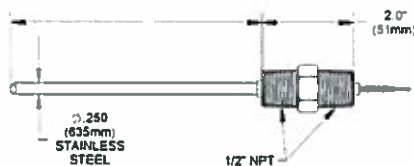
**Fig 4:** Double Threaded Immersion Sensor in a BAPI-Box (BBO) Enclosure with "Outside Mount" Configuration.



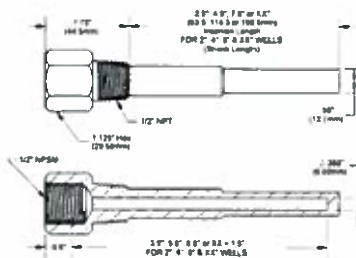
**Fig 5:** Double Threaded Immersion Sensor in a BAPI-Box 2 (BB2O) Enclosure with "Outside Mount" Configuration.



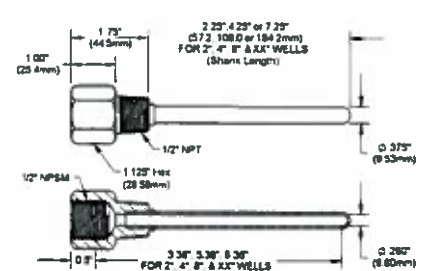
**Fig 6:** Double Threaded Immersion Sensor in a Weatherproof (WPO) Enclosure with "Outside Mount" Configuration.



**Fig 7:** Double Threaded Stainless Steel Immersion Probe Only



**Fig 8:** Machined Bar Stock Thermowell



**Fig 9:** Two Part Welded Thermowell

Specifications subject to change without notice.

#### Mounting

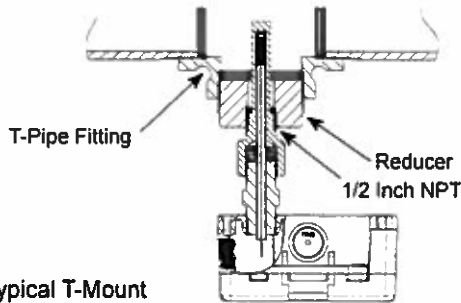


Fig 10: Typical T-Mount

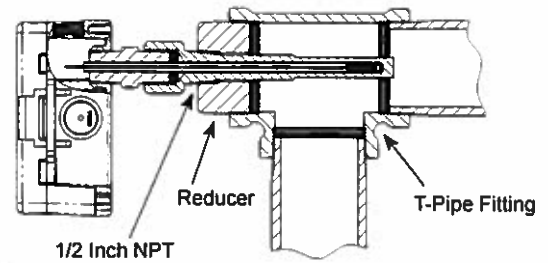


Fig 11: Typical Corner Mount

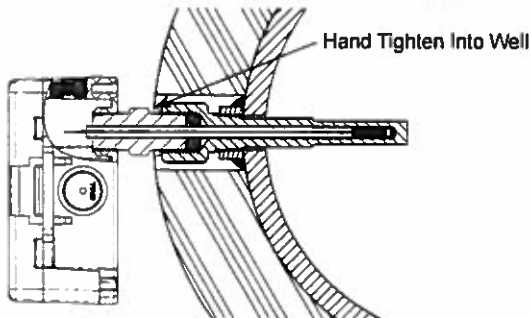


Fig 12: Typical Sensor Inserted

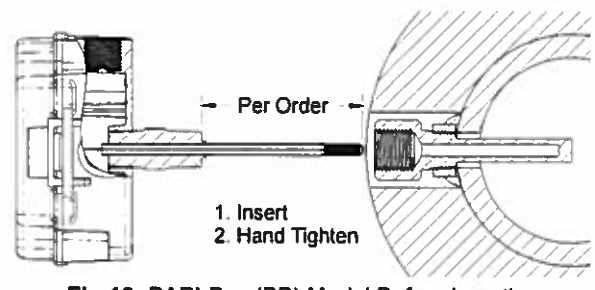


Fig 13: BAPI-Box (BB) Model Before Insertion

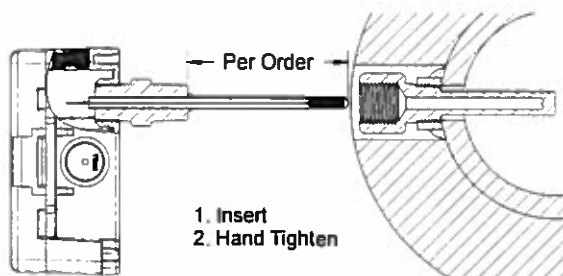


Fig 14: BAPI-Box 2 (BB2) Model Before Insertion

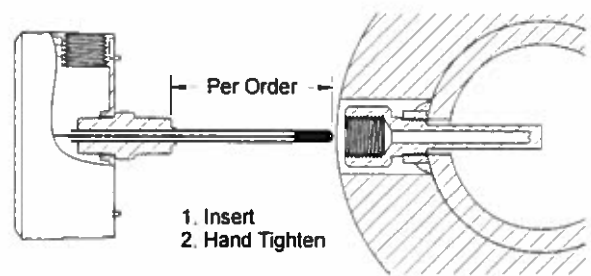


Fig 15: Weatherproof (WP) Sensor Before Insertion

**Application:** Figure 12 shows a typical thermowell and immersion probe installed into a pipe. In a properly insulated pipe with liquid or steam, the temperature is essentially the same across the entire cross section of the pipe. Usually thermowells are sized to extend to the center of the pipe; however, shorter thermowells will give proper temperature readings if properly insulated. The shorter thermowells are used in pipes with high flow velocities. See Application notes "Thermowells Explained" on our web site BAPIHVAC.com.

**Thermowell Installer:** Typically a Pipe Fitter drills a 3/4-inch hole into the pipe where the thermowell is needed. A customer provided fitting, called a Threadolet or Weldolet, is welded to the pipe over the hole. The Threadolet has a 1/2" NPT thread in the center. Thread sealant such as Teflon tape or pipe dope is applied to the 1/2" NPT threads of the thermowell. The thermowell is then inserted into the Threadolet and tightened. Estimates on insertion depths can be seen in our Application note "Thermowells Explained" on our web site BAPIHVAC.com

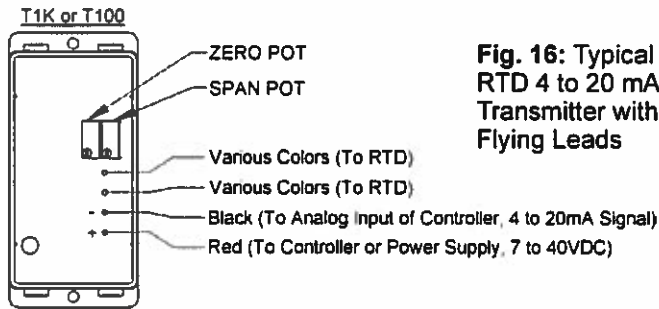
**Sensor Installation:** Insert the immersion sensor into the well. Hand tighten the immersion sensor snugly without too much torque. The probe is tight fitting to the bottom and wall of the thermowell offering an accurate temperature reading.

Direct probe insertion into the pipe without a thermowell is possible. However, this is not recommended as it cannot be removed after the pipe is pressurized. Apply a minimum of five turns of Teflon tap to the SS probe side threads. Insert the SS probe and 1/2" NPT threads into the Threadolet and tighten with a wrench to achieve a water tight seal. The probe should not touch the far side of the water pipe or probe failure may occur.

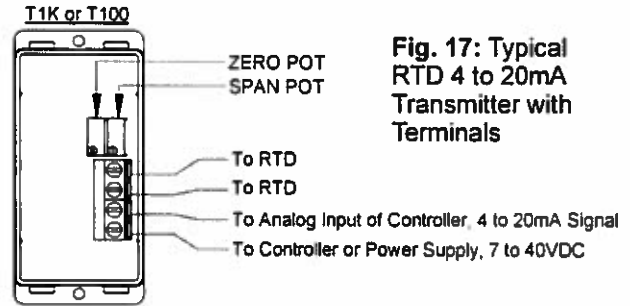
Specifications subject to change without notice.

### Wiring & Termination

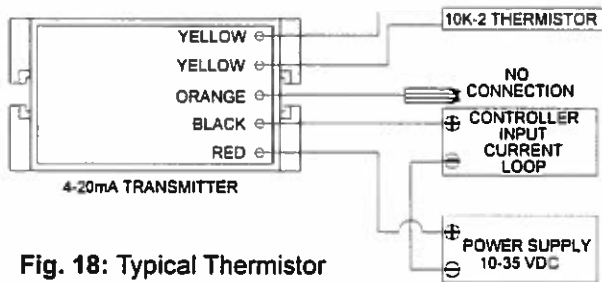
BAPI recommends using twisted pair of at least 22AWG and sealant filled connectors for all wire connections. Larger gauge wire may be required for long runs. All wiring must comply with the National Electric Code (NEC) and local codes. Do NOT run this device's wiring in the same conduit as high or low voltage AC power wiring. BAPI's tests show that inaccurate signal levels are possible when AC power wiring is present in the same conduit as the sensor wires.



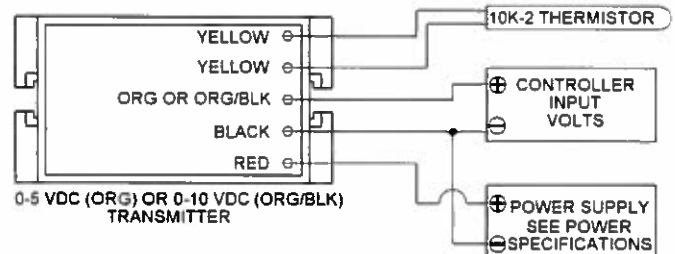
**Fig. 16:** Typical RTD 4 to 20 mA Transmitter with Flying Leads



**Fig. 17:** Typical RTD 4 to 20mA Transmitter with Terminals



**Fig. 18:** Typical Thermistor 4 to 20mA Transmitter



**Fig. 19:** Typical Thermistor Voltage Transmitter

### Diagnostics

#### Possible Problems:

- Unit will not operate.

#### Possible Solutions:

- Measure the power supply voltage by placing a voltmeter across the transmitter's (+) and (-) terminal. Make sure that it matches the drawings above and power requirements in the specifications.
- Check if the RTD wires are physically open or shorted together and are terminated to the transmitter.
- Measure the physical temperature at the temperature sensor's location using an accurate temperature standard. Disconnect the temperature sensor wires and measure the temperature sensor's resistance with an ohmmeter. Compare the temperature sensor's resistance to the appropriate temperature sensor table on the BAPI web site.

- The reading is incorrect in the controller.

- Determine if the input is set up correctly in the controllers and BAS software.

- For a 4-20mA current transmitter measure the transmitter current by placing an ammeter in series with the controller input. The current should read according to the "4-20mA Temperature Equation" shown below.

- For a voltage transmitter, measure the signal with a volt meter (Orange or Orange/Black to Black). The signal should read according to the "Voltage Temperature Equation" shown below.

#### Voltage Temperature Equation

$$T = T_{Low} + \frac{(V \times T_{Span})}{V_{Span}}$$

T	= Temperature at sensor
T <sub>Low</sub>	= Low temperature of span
T <sub>High</sub>	= High temperature of span
T <sub>Span</sub>	= T <sub>High</sub> - T <sub>Low</sub>
V <sub>Low</sub>	= Low transmitter voltage usually=(0, 1 or 2v)
V <sub>High</sub>	= High transmitter voltage usually=(5 or 10v)
V <sub>Span</sub>	= V <sub>High</sub> - V <sub>Low</sub>
V	= Signal reading in volts

#### 4-20mA Temperature Equation

$$T = T_{Low} + \frac{(A - 4) \times T_{Span}}{16}$$

T	= Temperature at sensor
T <sub>Low</sub>	= Low temperature of span
T <sub>High</sub>	= High temperature of span
T <sub>Span</sub>	= T <sub>High</sub> - T <sub>Low</sub>
A	= Signal reading in mA

Specifications subject to change without notice.



# Double Threaded Stainless Steel Immersion Transmitters

## BA/T# -Ix-SS Temperature Transmitter

### Installation & Operating Instructions

0919\_Ins\_ImrnDblThread\_Active

rev. 06/30/15

#### Specifications

##### RTD Transmitter

Power Required: 7 to 40VDC  
 Transmitter Output: 4 to 20mA, 850Ω@24VDC  
 Output Wiring: 2 wire loop  
 Output Limits: <1mA (short), <22.35mA (open)  
 Span: Min. 30°F (17°C), Max 1000°F, (555°C)  
 Zero: Min. -148°F (-100°C), Max 900°F (482°C)  
 Zero & Span Adjust: 10% of span  
 Accuracy: ±0.065% of span  
 Linearity: ±0.125% of span  
 Power Output Shift: ±0.009% of span  
 RTD Sensor: 2 wire Platinum (Pt), 385 curve  
 Transmitter Ambient: -4 to 158°F (-20 to 70°C)  
 0 to 95% RH, Non-condensing

##### Thermistor Transmitter

Supply Voltage:  
 10 to 35 VDC (0 to 5 VDC or 4 to 20 mA Outputs)  
 15 to 35 VDC (0 to 10 VDC Output)  
 12 to 24 VAC (0 to 5 VDC Outputs)  
 15 to 24 VAC (0 to 10 VDC Output)  
 Transmitter Output: 4 to 20mA, 700Ω@24VDC  
 0 to 5 & 0 to 10VDC, 10KΩ min  
 Output Wiring: 2 & 3 wire (See wiring detail on pg. 3)  
 Transmitter Limits: -40 to 185°F, (-40 to 85°C)  
 Accuracy: ±1.015°C, from (0 to 65°C)  
 Linearity: ±0.065°C, from (0 to 65°C)  
 Resolution: Span/1024  
 Thermistor Sensor: 10K-2 Thermistor, 10KΩ @77°F  
 Transmitter Ambient: 32 to 158°F, (0° to 70°C)  
 0 to 95% RH, Noncondensing

**Thermistor:** 10K-2, Thermal Resistor (Bare Sensor)  
 Accuracy (Std): ±0.36°F, (±0.2°C)  
 Accuracy (High): ±0.18°F, (±0.1°C), [XP] option  
 Stability: < 0.036°F/Year, (<0.02°C/Year)  
 Heat Dissipation: 2.7 mW/°C  
 Probe Range: -40° to 221°F (-40° to 105°C)  
 Wire Colors:  
 Standard: Yellow/Yellow (no polarity)  
 High Acc. [XP]: Yellow/Yellow (no polarity)

**RTD:** Resistance Temp Device (Bare Sensor)  
 Platinum (Pt): 100Ω and 1KΩ @0°C, 385 curve,  
 Pt Accuracy (Std): 0.12% @Ref, or ±0.55°F, (±0.3°C)  
 Pt Accuracy (High): 0.06% @Ref, or ±0.277°F,  
 (±0.15°C), [A]option  
 Pt Stability: ±0.25°F, (±0.14°C)  
 Pt Self Heating: 0.4 °C/mW @0°C  
 Pt Probe Range: -40° to 221°F, (-40 to 105°C)  
 Wire Colors: General color code (other colors possible)  
 1KΩ, Class B Orange/Orange (no polarity)  
 1KΩ, Class A Orange/White (no polarity)  
 100Ω, Class B Red/Red (no polarity)  
 100Ω, Class A Red/Red-w/black stripe (no polarity)

**Sensitivity:** Approximate @ 32°F (0°C)  
 Thermistor: Non-linear - (See www.bapihvac.com, click "Sensor Specs")  
 RTD (Pt): 3.85Ω/°C for 1KΩ RTD  
 0.385Ω/°C for 100Ω RTD  
**Lead Wire:** 22awg stranded  
**Insulation:** Etched Teflon, Plenum rated  
**Probe Rigid:** 316 Stainless Steel, 0.25" OD  
**Probe Length:** 2', 4', 8' or custom per order  
**Mounting:** 1/2" NPT, 316 Stainless Steel Double Threaded Fitting

**Enclosure Types:** (Part number designator in bold)  
 Weatherproof: **-WP**, w/ two 1/2" FNPT entries, (Bell box)  
 BAPI-Box: **-BB**, w/ four 1/2" NPSM & one 1/2" drill-out  
 BAPI-Box 2: **-BB2**, w/ three 1/2" NPSM & three 1/2" drill-outs  
**Enclosure Ratings:** (Part number designator in bold)  
 No Box: **-NB**, No Rating, (Probe Only)  
 Weatherproof: **-WP**, NEMA 3R, IP14  
 BAPI-Box: **-BB**, NEMA 4, IP66, UV Rated  
 BAPI-Box 2: **-BB2**, NEMA 4, IP66, UV Rated

**Enclosure Material:** (Part number designator in bold)  
 Weatherproof: **-WP**, Cast Aluminum, UV rated  
 BAPI-Box: **-BB**, Polycarbonate, UL94V-0, UV rated  
 BAPI-Box 2: **-BB2**, Polycarbonate, UL94V-0, UV rated  
**Ambient (Enclosure):** 0 to 100% RH, Non-condensing  
 Weatherproof **-WP**, -40°F to 212°F, (-40° to 100°C)  
 BAPI-Box **-BB**, -40°F to 185°F, (-40° to 85°C)  
 BAPI-Box 2 **-BB2**, -40°F to 185°F, (-40° to 85°C)  
**Agency:** RoHS  
 PT= DIN43760, IEC Pub 751-1983,  
 JIS C1604-1989

Specifications subject to change without notice.