BAPI-Stat Advanced Diagnostics

Installation & Operating Instructions

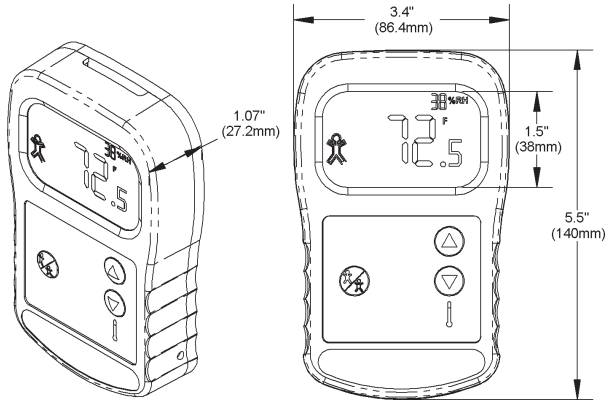

Fig: 1 3 button BAPI-Stat

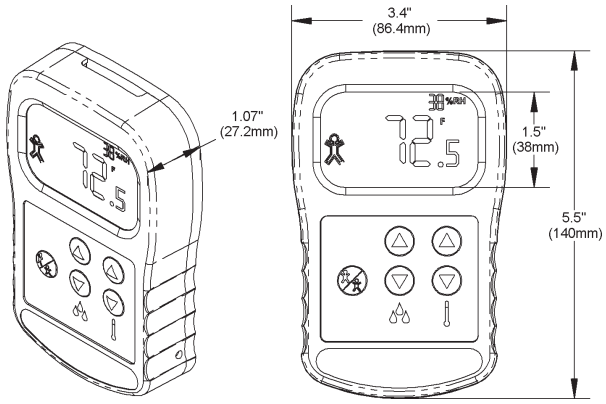

Fig: 2 5 button BAPI-Stat

Termination

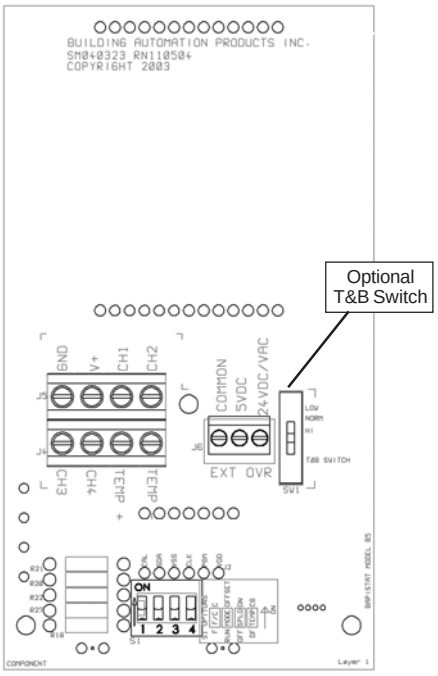

Fig: 3

Terminal Descriptions

GND ..... To GND(Common) of controller

V+ ..... From power of controller or power supply (See specifications on last page.)

J6 - Common ..... Display Occupancy Mode

J6 - 5VDC ..... Display Occupancy Mode

J6 - 24VDC/VAC ..... Display Occupancy Mode

Consult unit label for output configuration.

CHANNEL	Output Variable				Output Type			
	Temperature Output	Humidity Output	Temperature Setpoint Output	Humidity Setpoint Output	Voltage Output	Current Output	Resistive Output	-592
CH1	X		X	X	X	X		
CH2		X	X	X	X	X		
CH3			X	X	X		X	
CH4			X	X	X		X	
TEMP+	X						X	V+
TEMP-	X						X	V-

Table: 1

NOTE: The GND(Common) terminal is common between the Power, CH1, CH2, CH3, CH4. "TEMP-" can be connected to GND(Common) by placing the "TEMP" switch (S1-Position 4) in the "CG" position.

Diagnostics

Possible Advanced Diagnostic Solutions:

- Determine that the input is set up correctly in the controller's and building automation software.
- Check wiring for proper termination
- Check for corrosion at either the controller or the sensor. Clean off the corrosion, re-strip the interconnecting wire and reapply the connection. In extreme cases, replace the controller, interconnecting wire and/or sensor.
- Label the terminals that the interconnecting wires are connected to at the sensor and the controller. Disconnect the interconnecting wires from the controller and the sensor. With the interconnecting wires separated at both ends measure the resistance from wire-to-wire with a multimeter. The meter should read greater than 10 Meg-ohms, open or OL depending on your meter. Short the interconnecting wires at one end. Go to the other end and measure the resistance from wire-to-wire with a multimeter. The meter should read less than 10 ohms (22 gauge or larger, 250 feet or less). If either test fails, replace the wire.

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Diagnostics continued...

PROBLEM: UNIT DOES NOT OPERATE

Possible Solutions:

- Check power for proper polarity.
- Disconnect the power wires at the controller. Measure controller output for proper power (see specifications on last page), if the voltage is outside the limits, troubleshoot controller. Reconnect power wires to controller when finished. If the measured voltage is above specification limits, you may have damaged the BAPI-Stat, contact your BAPI representative.
- Disconnect the power wires at the sensor. Measure the wires for the same voltage as at controller. If the voltage is different from that measured at the controller troubleshoot wire. Reconnect power wires to sensor when finished.
- Measure the power at the sensor with the power connected for proper power (see specifications on last page), if the voltage is outside the limits, call your BAPI representative.

PROBLEM: TEMPERATURE READING IS INCORRECT

Possible Solutions:

- Check offset for proper adjustment. (See the User Calibration Adjustment section of this document)
- Determine that the temperature output signal wires are connected to the correct controller input terminals and are not loose.
- Check that the wires at the sensor are connected to the proper sensor terminals.
- Make sure that the test and balance switch is in the correct position.
- Make sure that the sensor element leads are not touching
- If the unit has a **direct sensor (resistance) output**, then disconnect the temperature sensor wires (Temp+/Temp-) and measure the temperature sensor's resistance across the sensor output pins with an ohmmeter. Compare the temperature sensor's resistance to the appropriate temperature sensor table on the BAPI web site. If the measured resistance is different from the temperature table by more than 5%, call BAPI technical support. Find BAPI's web site at www.bapihvac.com; click on the button labeled SENSORS on the left of the screen and then click on the type of sensor you have. If the measured resistance does not match the table, call your BAPI representative. Don't forget to reconnect the wires.
- If the unit has a **direct sensor (resistance) output**, check the Common Ground/Differential Ground switch for proper setting. S1, position 4
- If the unit has a **voltage or current output**, then measure the physical temperature at the BAPI-Stat's location using an accurate temperature standard. Compare the measured temperature to the calculated temperature described in the following paragraphs. If the measured temperature does not match the calculated temperature, call your BAPI representative.

CALCULATED TEMPERATURE FORMULAS

VOLTAGE OUTPUT CHANNEL 1:

Read your temperature output range from the label. Trange = Tmax - Tmin. Measure the voltage from the GND terminal to the Channel 1 terminal, Vtemp. Calculate the BAPI-Stat's temperature from the following formulas:

[5VDC output] Tstat = ((Vtemp/5)*Trange)+Tmin

[10VDC output Tstat = ((Vtemp/10)*Trange)+Tmin

EXAMPLE

Your label says; *CH1:0 TO 10V @ 50 TO 90°F*
Tmin = 50°F, Tmax = 90°F & Trange = 40°F
You measure a voltage of 5.523 volts on the channel 1 terminal. What is the calculated temperature?

The formula for the calculated temperature is: Tstat = ((Vtemp/10)*Trange)+Tmin

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Diagnostics continued...

Solve this formula in three steps to determine the calculated temperature:

Step 1: Determine the value of innermost parentheses; Vtemp/10 = 5.523/10 = 0.5523
Step 2: Determine the value of the next parentheses; (Vtemp/10)*Trange = 0.5523*40 = 22.092
Step 3: Solve the whole equation; ((Vtemp/10)*Trange)+Tmin = 22.092+50 = 72.092°F
So the calculated temperature of the unit is 72.092°F. If this does not match the measured temperature, call your BAPI representative.

CURRENT OUTPUT CHANNEL 1:

Read your temperature output range from the label. Trange = Tmax - Tmin. Measure the current signal by placing an ammeter (200mA range) in series with the channel 1 output and the controller's input, Itemp. Determine the calculated temperature using the following formula:

Tstat = (((Itemp-4mA)/16)*Trange)+Tmin

EXAMPLE

Your label says; *CH1: 4 TO 20mA @ 7 TO 35°C*
Tmin = 7°C, Tmax = 35°C & Trange = 28°C

You measure a current of 6.63mA coming out of the channel 1 terminal. What is the calculated temperature?

The formula for the calculated temperature is: Tstat = (((Itemp-4mA)/16)*Trange)+Tmin
Solve this formula in four steps to determine the calculated temperature:

Step 1: Determine the value of innermost parentheses; Itemp-4mA = 6.63-4 = 2.63
Step 2: Determine the value of the next parentheses; (Itemp-4mA)/16 = 2.63/16 = 0.164375
Step 3: Determine the value of the next parentheses; (((Itemp-4mA)/16)*Trange) = 0.164375*28 = 4.6025
Step 4: Solve the whole equation; (((Itemp-4mA)/16)*Trange)+Tmin = 4.6026+7 = 11.6026°C
So the calculated temperate of the unit is 11.6026°C. If this does not match the measured temperature, call your BAPI representative.

PROBLEM: HUMIDITY READING IS INCORRECT

Possible Solutions:

- Check offset for proper adjustment. (See the User Calibration Adjustment section of this document)
- Determine that the humidity output signal wires are connected to the correct controller input terminals and are not loose.
- Check that the wires at the sensor are connected to the proper sensor terminals.
- If the unit has a **voltage or current output** for humidity, then measure the physical humidity at the BAPI-Stat's location using an accurate humidity standard. Compare the measured humidity to the calculated humidity described in the following paragraphs. If the measured humidity does not match the calculated humidity, call your BAPI representative.

CALCULATED HUMIDITY FORMULAS

VOLTAGE OUTPUT CHANNEL 2:

Read your humidity output range from the label. Hrange = Hmax - Hmin. Measure the voltage from the GND terminal to the Channel 2 terminal, Vrh. Determine the calculated humidity from the following formulas:

[5VDC output] RHstat = ((Vrh/5)*Hrange)+Hmin

[10VDC output] RHstat = ((Vrh/10)*Hrange)+Hmin

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Diagnostics continued...

EXAMPLE
Your label says; *CH2: 0 TO 5V @ 0 TO 100%RH*
Hmin = 0%, Tmax = 100% & Trange = 100%

You measure a voltage of 3.523 volts on the channel 2 terminal. What is the calculated humidity?

The formula for the calculated humidity is: RHstat = ((Vrh/5)*Hrange)+Hmin
Solve this formula in three steps to determine calculated humidity:

Step 1: Determine the value of innermost parentheses; Vrh/5 = 3.523/5 = 0.7046
Step 2: Determine the value of the next parentheses; (Vtemp/10)*Hrange = 0.7046*100 = 70.46
Step 3: Solve the whole equation; ((Vrh/5)*Hrange)+Hmin = 70.46+0 = 70.46%
So the calculated humidity of the unit is 70.46%. If this does not match the measured humidity, call your BAPI representative.

CURRENT OUTPUT CHANNEL 2:
Read your humidity output range from the label. Hrange = Hmax - Hmin. Measure the current signal by placing an ammeter in series with the channel 2 output and the controller's input, Irh. Determine the correct output from the following formula:
RHstat = (((Irh-4mA)/16)*Hrange)+Hmin

EXAMPLE
Your label says; *CH2: 4 TO 20MA @ 35 TO 70%*
Tmin = 35%, Tmax = 70% & Trange = 35%

You measure a current of 7.45mA coming out of the channel 2 terminal. What is the calculated relative humidity?

The formula you need to use is; RHstat = (((Irh-4mA)/16)*Hrange)+Hmin
Solve this formula in four steps to determine the calculated relative humidity:

Step 1: Determine the value of innermost parentheses; Irh-4mA = 7.45-4 = 3.45
Step 2: Determine the value of the next parentheses; (Irh-4mA)/16 = 3.45/16 = 0.215625
Step 3: Determine the value of the next parentheses; (((Irh-4mA)/16)*Hrange) = 0.215625*35 = 7.546875
Step 4: Solve the whole equation; (((Irh-4mA)/16)*Hrange)+Hmin = 7.546875+35 = 42.546875%RH
So the calculated humidity of the unit is 42.546875%. If this does not match the measured humidity, call your BAPI representative.

PROBLEM: TEMPERATURE SETPOINT IS INCORRECT

Possible Solutions:
- Determine that the temperature setpoint output signal wires are connected to the correct controller input terminals and are not loose.
- Check that the wires at the sensor are connected to the proper sensor terminals.
- Check whether the unit's actual setpoint output voltage, current or resistance is the same as the calculated voltage, current or resistance using the following formulas and examples. If the actual setpoint output voltage, current or resistance does not match the calculated setpoint voltage, current or resistance, call your BAPI representative.

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Diagnostics continued...

CALCULATED SETPOINT FORMULAS

SETPOINT VOLTAGE OUTPUT ON CHANNEL 1, 2, 3, 4:

Read your temperature setpoint output range from the label. Tspr = Tspmax - Tspmin. Measure the voltage from the GND terminal to the temperature setpoint channel terminal, Vtsp. Determine the calculated setpoint output voltage from the following formulas:
[5VDC output] Vout = ((Tsp-Tspmin)/Tspr)*5
[10VDC output] Vout = ((Tsp-Tspmin)/Tspr)*10
If the measured voltage does not match the formula, call your BAPI representative. If the measured voltage matches the calculated voltage, troubleshoot your controller.

EXAMPLE:
Your label says; *CH3: STPT 0 TO 5 V @ 50 TO 90°F*
Tspmin = 50, Tspmax = 90 & Tspr = 40

You push one of the setpoint buttons and read 71 on the LCD. What is the calculated setpoint output voltage?

The formula you need to use is: Vout = ((Tsp-Tspmin)/Tspr)*5
Solve this formula in three steps to determine the BAPI-Stat's calculated setpoint output voltage.

Step 1: Determine the value of innermost parentheses: Tsp-Tspmin = 71-50 = 21
Step 2: Determine the value of the next parentheses: (Tsp-Tspmin)/Tspr = 21/40 = 0.525
Step 3: Solve the whole equation: ((Tsp-Tspmin)/Tspr)*5 = 0.525*5 = 2.625 V
So the calculated setpoint output voltage of the unit is 2.625V. If this does not match the setpoint output voltage on Channel 3, call your BAPI representative.

SETPOINT CURRENT OUTPUT ON CHANNEL 1 OR 2:

Read your temperature setpoint output range from the label. Tspr = Tspmax - Tspmin. Measure the current signal by placing an ammeter in series with the channel 1 or 2 output and the controller's input, Itsp. Determine the calculated setpoint output current using the following formula:
Iout = (((Tsp-Tspmin)/Tspr)*16mA)+4mA
If the measured current does not match the calculated current, call your BAPI representative. If the measured current matches the calculated current, troubleshoot your controller.

EXAMPLE:
Your label says; *CH2: STPT 4 TO 20 MA @ 60 TO 80°F*
Tspmin = 60, Tspmax = 80 & Tspr = 20

You push one of the setpoint buttons and read 67 on the LCD. What is the calculated output current?

The formula you need to use is: Iout = (((Tsp-Tspmin)/Tspr)*16mA)+4mA
Solve this formula in four steps to determine the BAPI-Stat's calculated output current on Channel 2 .

Step 1: Determine the value of the innermost parentheses: Tsp-Tspmin = 67-60 = 7
Step 2: Determine the value of the next parentheses: (Tsp-Tspmin)/Tspr = 7/20 = 0.35
Step 3: Determine the value of the next parentheses: ((Tsp-Tspmin)/Tspr)*16mA = 0.35*16mA = 5.6mA
Step 4: Solve the whole equation: (((Tsp-Tspmin)/Tspr)*16mA)+4mA= 5.6mA+4mA = 9.6mA
So the calculated setpoint output current of the unit is 9.6mA. If this does not match the setpoint output current on Channel 2, call your BAPI representative.

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Diagnostics continued...

SETPOINT RESISTANCE OUTPUT ON CHANNEL 3 OR 4:

Read your temperature setpoint output range from the label. Ttspr = Tspmax - Tspmin and Rtspr = Rtspmax - Rtspmin. Disconnect the temperature setpoint wire from channel 3 or 4 and measure the temperature setpoint resistance from GND to the temperature setpoint terminal, Rtsp. Determine the calculated setpoint output using the following formula:
Rtsp = (((Tsp-Tspmin)/Ttspr)*Rtspr)+Rtspmin
If the measured resistance does not match the calculated setpoint resistance, call your BAPI representative. If the measured resistance matches the calculated resistance, troubleshoot your controller.

EXAMPLE:

Your label says; *CH3: STPT 889 TO 111 OHMS @ 50 TO 90°F*
Tspmin = 50, Tspmax = 90, Ttspr = 40, Rtspmin = 889, Rtspmax = 111 & Rtspr= -778

You push one of the setpoint buttons and read 81 on the LCD. What is the calculated setpoint output resistance?

The formula you need to use is: Rtsp = (((Tsp-Tspmin)/Tspr)*Rtspr)+Rtspmin
Solve this formula in four steps to determine the BAPI-Stat's calculated setpoint output resistance.

Step 1: Determine the value of the innermost parentheses: Tsp-Tspmin = 81-50 = 31
Step 2: Determine the value of the next parentheses: (Tsp-Tspmin)/Tspr = 31/40 = 0.775
Step 3: Determine the value of the next parentheses: ((Tsp-Tspmin)/Tspr)*Rtspr = 0.775*(-778) = -602.95
Step 4: Solve the whole equation; (((Tsp-Tspmin)/Tspr)*Rtspr)+Rtspmin = -602.95 + 889 = 286.05 Ohms
So the calculated setpoint output resistance is 286.05 Ohms. If this does not match the setpoint output resistance on Channel 3, call your BAPI representative.

PROBLEM: HUMIDITY SETPOINT IS INCORRECT

Possible Solutions:

- Determine that the Humidity setpoint output signal wires are connected to the correct controller input terminals and are not loose.
- Check that the wires at the sensor are connected to the proper sensor terminals.
- Check whether the unit's actual humidity setpoint output voltage, current or resistance is the same as the calculated voltage, current or resistance using the following formulas and examples. If the actual humidity setpoint output voltage, current or resistance does not match the calculated humidity setpoint voltage, current or resistance, call your BAPI representative.

CALCULATED HUMIDITY SETPOINT FORMULAS

HUMIDITY SETPOINT VOLTAGE OUTPUT ON CHANNEL 1, 2, 3, 4:

Read your humidity setpoint output range from the label. RHspr = RHspmax - RHspmin. Measure the voltage from the GND terminal to the humidity setpoint channel terminal, Vrhsp. Determine the calculated humidity setpoint output voltage using the following formulas:
[5VDC output] Vout = ((RHsp-RHspmin)/RHspr)*5
[10VDC output] Vout = ((RHsp-RHspmin)/RHspr)*10
If the measured voltage does not match the calculated voltage, call your BAPI representative. If the measured voltage matches the calculated voltage, troubleshoot your controller.

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Diagnostics continued...

EXAMPLE: (for determining the calculated humidity setpoint output voltage)
Your label says; *CH3: STPT 0 TO 10 V @ 0 TO 100%*
RHspmin = 0, RHspmax = 100 & RHspr = 100

You push one of the setpoint buttons and read 35% on the LCD. What is the calculated humidity setpoint output voltage?

The formula you need to use is: Vout = ((RHsp-RHspmin)/RHspr)*10
Solve this formula in three steps to determine the BAPI-Stat's calculated humidity setpoint output voltage.

Step 1: Determine the value of innermost parentheses: RHsp-RHspmin = 35-0 = 35
Step 2: Determine the value of the next parentheses: (RHsp-RHspmin)/RHspr = 35/100 = 0.35
Step 3: Solve the whole equation: ((RHsp-RHspmin)/RHspr)*5 = 0.35*5 = 1.75 V
So the calculated humidity setpoint output voltage of the unit is 1.75V. If this does not match the humidity setpoint output voltage on Channel 3, call your BAPI representative.

HUMIDITY SETPOINT CURRENT OUTPUT ON CHANNEL 1 OR 2:
Measure the humidity setpoint current output by placing an ammeter in series with the channel 1 or 2 output and the controller's input, Irhsp. Determine the calculated setpoint current output from the following formula:
Iout = (((RHsp-RHspmin)/RHspr)*16mA)+4mA
If the measured current does not match the calculated current, call your BAPI representative. If the measured current matches the calculated current, troubleshoot your controller.

EXAMPLE:
Your label says; *CH1: STPT 4 TO 20 MA @ 35 TO 70%*
RHspmin = 35, RHspmax = 70 & RHspr = 35

You push one of the setpoint buttons and read 40% on the LCD. What is the calculated humidity setpoint output current?

The formula you need to use is: Iout = (((HRsp-HRspmin)/HRspr)*16mA)+4mA
Solve this formula in four steps to determine the BAPI-Stat's calculated humidity setpoint output current.

Step 1: Determine the value of the innermost parentheses; HRsp-HRspmin = 40-35 = 5
Step 2: Determine the value of the next parentheses; (HRsp-HRspmin)/HRspr = 5/35 = 0.143
Step 3: Determine the value of the next parentheses; ((HRsp-HRspmin)/HRspr)*16mA = 0.143*16mA = 2.3mA
Step 4: Solve the whole equation; (((HRsp-HRspmin)/HRspr)*16mA)+4mA= 2.3mA+4mA = 6.3mA
So the calculated humidity setpoint output current of the unit is 6.3mA. If this does not match the humidity setpoint output current on Channel 1, call your BAPI representative.

HUMIDITY SETPOINT RESISTANCE OUTPUT ON CHANNEL 3 OR 4:
Read your humidity setpoint output range from the label. Rrhspr = Rrhspmax - Rrhspmin. Disconnect the humidity setpoint wire from channel 3 or 4 and measure the humidity setpoint resistance from GND to the humidity setpoint terminal, Rrhsp. Determine the calculated humidity setpoint resistance from the following formula:
Rrhsp = (((RHsp-RHspmin)/RHspr)*Rrhspr)+Rrhspmin
If the measured resistance does not match the calculated resistance, call your BAPI representative. If the measured resistance matches the calculated resistance, troubleshoot your controller.

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Diagnostics continued...

EXAMPLE: (for Humidity Setpoint Resistance Output on channel 3 or 4)
Your label says; *CH3: STPT 0 TO 100K @ 0 TO 100%*
HRspmin = 0, HRspmax = 100, HRspr = 100, Rhrspmin = 0, Rhrspmax = 100K & Rrhspr = 100K

You push one of the setpoint buttons and read 37% on the LCD. What is the calculated humidity setpoint output resistance?

The formula you need to use is; Rhrsp = (((HRsp-HRspmin)/HRspr)*Rhrspr)+Rhrspmin
Solve this formula in four steps to determine the BAPI-Stat's humidity setpoint output resistance.

Step 1: Determine the value of innermost parentheses: RHsp-RHspmin = 37-0 = 37
Step 2: Determine the value of the next parentheses: (RHsp-RHspmin)/RHspr = 37/100 = 0.37
Step 3: Determine the value of the next parentheses: ((RHsp-RHspmin)/RHspr)*Rrhspr = 0.37*100K = 37K
Step 4: Solve the whole equation: (((RHsp-RHspmin)/RHspr)*Rrhspr)+Rrhspmin = 37K+0 = 37K Ohms
So the calculated humidity setpoint output resistance of the unit is 37K Ohms. If this does not match the humidity setpoint output resistance on Channel 3, call your BAPI representative.

OVERRIDE IS NOT WORKING CORRECTLY

Possible Solutions:

- Check for proper override resistance or voltage output as described in the following paragraphs. Depending upon how the unit is configured, the override signal is available as a resistance, voltage or dry contact on channels 3 and 4, or as a dry contact in parallel with the direct sensor output (TEMP+ & TEMP-). The override signal is a momentary signal and is present when the override button is pressed and for approximately three seconds after the button is released. Check for the proper override output signal as described below. Refer to the unit's label to determine which configuration you have. If the measurement does not match the description below, call your BAPI representative. If the measurement matches the description below, troubleshoot your controller.

OVERRIDE AS A RESISTANCE ON CHANNELS 3 or 4

- If the override is in parallel with a setpoint, the resistance will measure less than 100 Ohms when the override button is pressed (or for three seconds after the button is released). When the override button is not pressed, the resistance will measure the normal setpoint resistance.
- If the override is not in parallel with a setpoint, the resistance will measure less than 100 Ohms when the override button is pressed (or for three seconds after the button is released) and greater than 10K Ohms when the override button is not pressed.

OVERRIDE AS A VOLTAGE ON CHANNELS 3 or 4

- The voltage will measure 0 VDC when the override button is pressed (or for three seconds after the button is released) and will measure 5 VDC when the button is not pressed.

OVERRIDE AS A DRY CONTACT ON CHANNELS 4

- The resistance will measure less than 10 Ohms when the override button is pressed (or for three seconds after the button is released) and greater than 10K Ohms when the override button is not pressed.

OVERRIDE AS A DRY CONTACT IN PARALLEL WITH THE DIRECT SENSOR (TEMP+ & TEMP-)

- The resistance will measure less than 10 Ohms when the override button is pressed (or for three seconds after the button is released). When the override button is not pressed, the resistance will measure the normal temperature sensor resistance.

Specifications

Power: 10 to 35 VDC (15 to 24 VDC Recommended) for 4 to 20 mA or 0 to 5 VDC Outputs
15 to 35 VDC (15 to 24 VDC Recommended) for 0 to 10 VDC Output
12 to 28 VAC (Requires a separate pair of shielded wires) for 4 to 20 mA or 0 to 5 VDC Outputs
15 VAC to 28 VAC (Requires a separate pair of shielded wires) 0 to 10 VDC Output

Power Consumption: 60 mA maximum DC: 4 to 20 mA or 0 to 5 VDC Outputs
10 mA maximum DC: 0 to 10 VDC Output
1.44 VA maximum AC; 4 to 20 mA or 0 to 5 VDC Outputs
0.2 VA maximum AC: AC: 0 to 10 VDC Output

Sensing Elements: Temperature - Thermistor or RTD
Humidity - Capacitive Polymer, ±1.8%RH

Mounting: 2” by 4” J-box or drywall mount - screws provided

Environmental Specifications: Temperature: 32 to 122ºF (0 to 50ºC)
Humidity: 0 to 95%, non-condensing

Wiring: 2 to 5 pair of 16 to 22 AWG

Material: ABS Plastic

Material Rating: UL 94, V-0

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