Wireless Analog Input Sensor Nodes

Using Differential Inputs for a Resistance Thermocouple Device (RTD)

OVERVIEW

Wireless sensor nodes with analog differential inputs, such as the V-Link® -LXRS® and SG-Link®-LXRS (all models), can be used to acquire temperature data with a Resistance Thermocouple Device (RTD). This is accomplished by installing a current source circuit on the node's differential sensing inputs and configuring the node with the conversion values specific to each RTD. This technical note uses a PT100 RTD as an example to provide step-by-step instruction of the RTD installation and the configuration procedure, and it includes a link and instructions for a simple conversion value calculator.

HOW TO CONNECT THE RTD

1. *Use two same value resistors to create a current source*, as shown in the diagram below. Measure and record the actual resistance before installation as this will be used in the conversion value calculations. In this example we used a PT100 type RTD which works best with two 10K ohm resistors. The resistor value optimizes the RTD output measurement range to the node input requirements, and it will vary depending on the type of RTD used.
2. *For a 2-wire RTD, ensure the RTD leads are the same length* to mitigate the effects of lead resistance and achieve the best measurement accuracy.
3. *Attach the RTD* to the node differential inputs. The example below shows integration of a 2-wire and a 4-wire PT100 RTD.

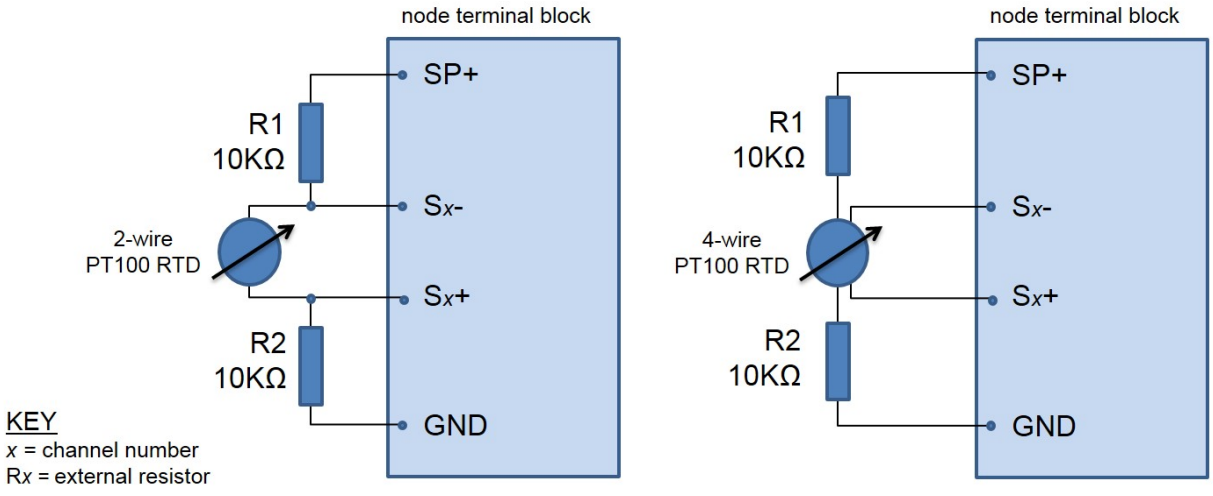


Figure 1 - RTD Connections

DETERMINING THE RTD CONVERSION VALUE

In order to correctly translate the RTD measurements into temperature readings, conversion values need to be determined for each RTD. The conversion values include the slope and offset that characterize the linear relationship between the sensor voltage output and the corresponding temperature reading.

The LORD MicroStrain®Node Commander® software program, along with a slope and offset calculator (written in Microsoft® Excel), can be used to determine these conversion values. Both are available by clicking these links;

Node Commander (select appropriate bit version for download)
RTD Calculator (link downloads Excel file; this calculator is specific to the PT100)

The process is described below using the PT100 as an example.

1. Open the calculator and enter the values for the measured or precision resistor in the R1 and R2 fields, as shown below.
2. Select the node A-to-D (analog-to-digital) converter resolution. This is a specification of the node and may depend on when it was manufactured (for example, an older V-Link® -LXRS® may be 12-bit, while a newer one will be 16-bit).
3. Enter the desired Input Voltage Range. This sets the amplification of the signal within the node. For the PT100, +/- 50mV is recommended.
4. Once the values are entered, press Enter, and the slope value will be automatically calculated and displayed in the blue boxes for conversions to both Celsius and Fahrenheit.

user-entered system parameters

R1	4971 Ω	
R2	4977 Ω	
A to D converter	16 Bit	65536
Input Voltage range	±50mV	30
Input Voltage	28.0817	mV

LXRS V-Link		Bits	18404	
mV Range	Gain	Slope	0.001526	mV/bit
±70mV	21			
±50mV	30			
±20mV	75			
±10mV	147			
±5mV	291			
±2.5mV	569			
±1mV	1214			
±600nV	2222			
±350nV	3799			
±100nV	13074			

Denotes User enterable information

calculated slope conversion values for PT100 RTD

mA @ -50	0.299153	3000 mV/(R1+R2+Rt)
mA @ 200	0.296330	
mV @ -50	24.024985	mA x Rt
mV @ 200	52.106710	
ΔmV -50 to 200°C	28.081725	mV
mv/Bit @ +/-50mV(30)	0.001526	mV/Bit
temp(°C) per mV	8.902587	°C/mV
temp(°F) per mV	16.024656	°F/mV

Slope:	°C/Bit	°F/Bit
temp per Bit	0.0135840	0.0244512

Bit value of Auto-Balance	16451		
Offset:		°C	°F
Offset to enter		-488.61	-667.38

Denotes values to enter into Node Commander

CONFIGURING THE NODE

The RTD conversion values must be entered into the node to perform the conversion. Additionally, the zero load offset of the node circuitry must be tared out in the scale range appropriate for the application. The following steps describe how this is done for the PT100 in Node Commander.

1. Open Node Commander and establish communication with the gateway and node, as described in the node user manual or quick-start guide.
2. Right-click on the node name and select Configure > Configure Node (*Figure 2 - Node Configure Menu*).
3. Check the channel the RTD is connected to, and then select the corresponding Configure icon.

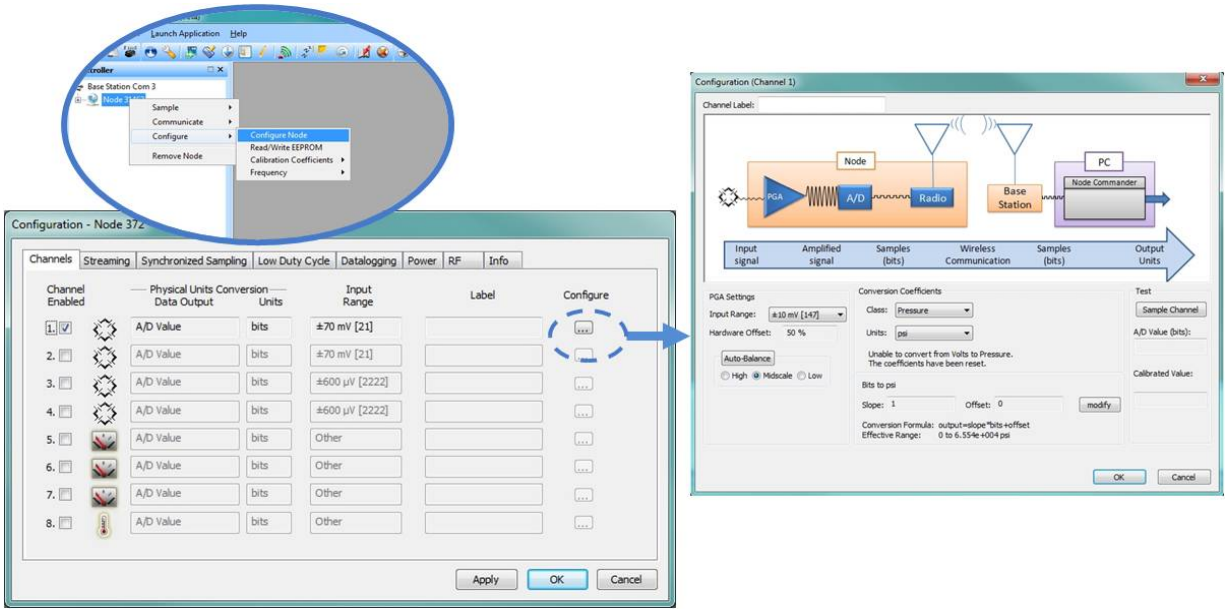


Figure 2 - Node Configure Menu

4. Short together the Sx- and Sx+ inputs of the node (where the RTD is connected). This provides the node with a zero-load condition.
5. Select the Input Range that was used in the conversion value calculation. In this example it was +/- 50mV (*Figure 3 - Node Auto Balance*).
6. Select the scale range (High, Moderate or Low) from below the Auto-Balance button. For most RTD applications Low will be the appropriate selection because it is a positive-going signal. Moderate would be used for positive and negative-going signal applications and High for negative-going signals.
7. Select the Auto- Balance button to tare the node input. A conformation window will appear. In the example with the PT100, the node input was balanced to 16454.

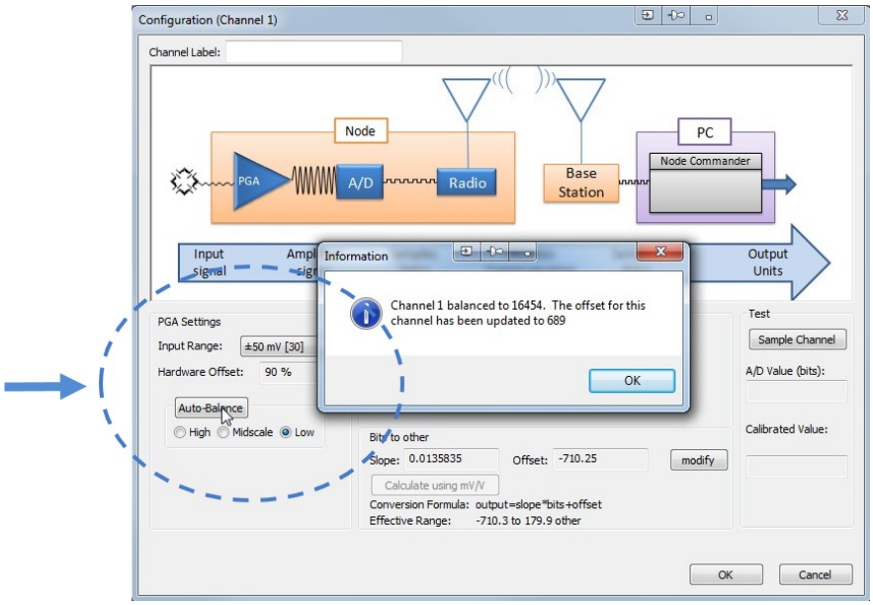
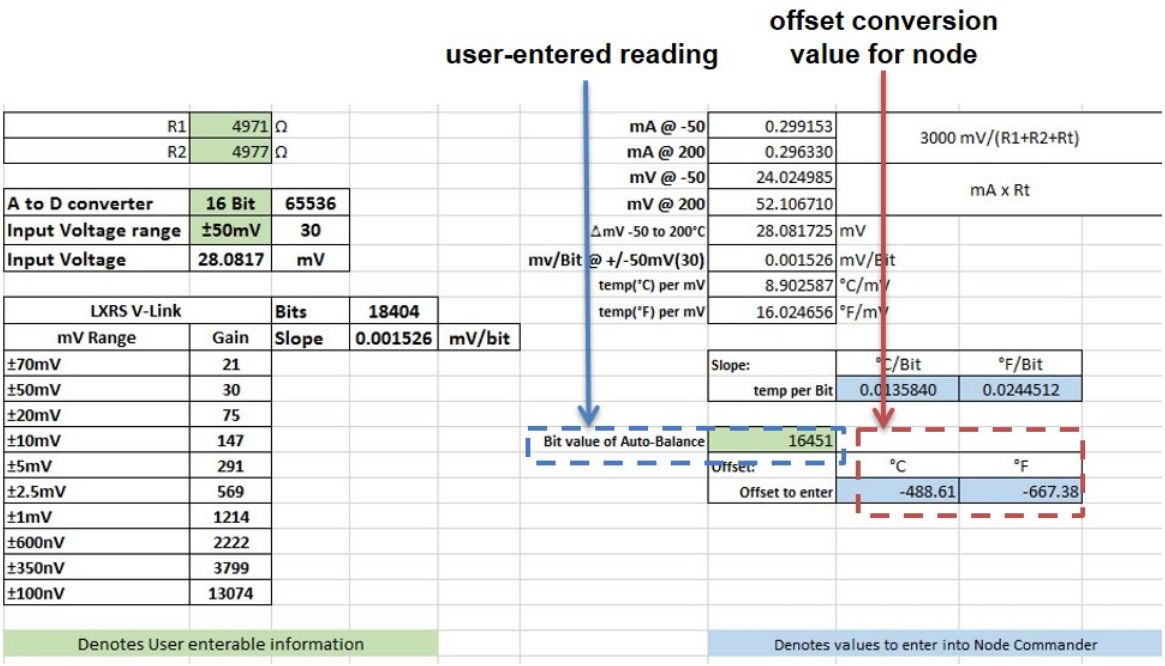


Figure 3 - Node Auto Balance

8. Enter the reported value into the input the RTD calculator in the "Bit value of Auto-Balance" field. Press Enter, and the offset will be recalculated automatically.



9. Back in the Node Commander configuration menu, select the Conversion Coefficients Class (type of measurement - Temperature), desired units (Celsius or Fahrenheit).
10. Select the Modify button to allow editing of the Slope and Offset fields.
11. Enter the calculated slope and offset values from the RTD calculator, and then select Lock to save the values (*Figure 4 - Entering Conversion Values*),.

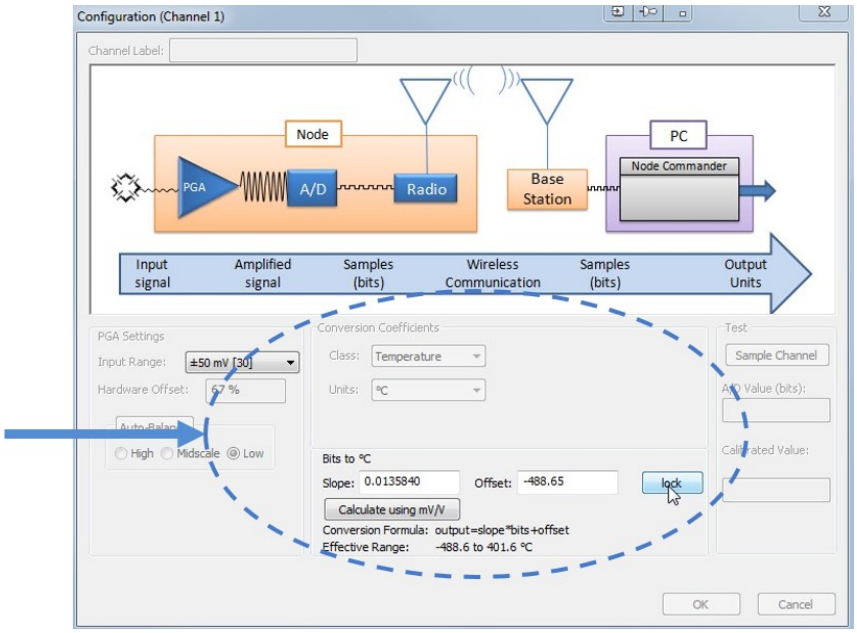


Figure 4 - Entering Conversion Values

12. Select OK twice to exit the configuration menus.
13. Remove the short from the node input. The node and RTD are now ready for data acquisition.

NOTES

RTD's are not linear over the entire measurement range. To compensate for this non-linearity, a smaller range than what the device is capable of should be used. In this example, a range of -50 °C to 200 °C (-58 °F to 392 °F) was used.

LORD MicroStrain Technical Support is available to assist if with any variations to the temperature range, RTD type, or other parameters than what was used in this example (see contact information in document footer).

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