

# MicroStrain by HBK Technical Note

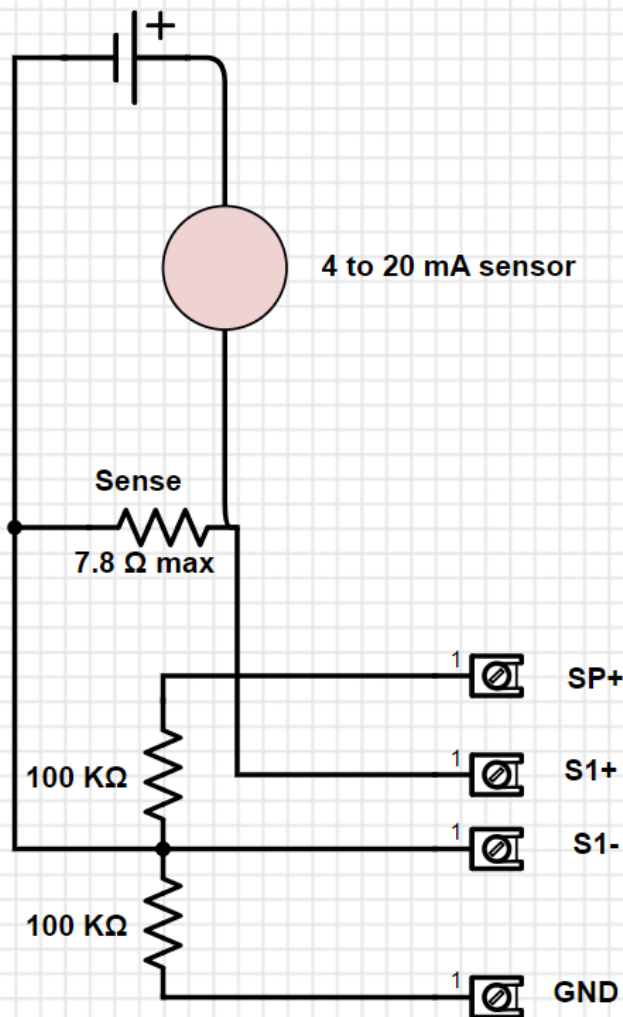
## V-Link-200® Wireless Voltage Node

Connecting and calibrating a 4 to 20 mA sensor on one of the four differential channels

This example is using a 0 - 100 PSI, 4 to 20 mA sensor

### Connections

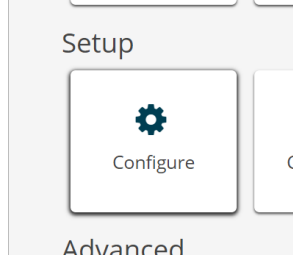
- Place qty 2 100 K $\Omega$  resistors between SP+, S#- and GND as shown
- Place sense resistor, 7.8 $\Omega$  max ( $156\text{mV} \div 20 \text{ mA}$ , between S#+ and S#-
  - Measure the sense resistor prior to installing with ohm meter to get precise value
  - 5.1  $\Omega$  for this example
- Connect 4 to 20 mA sensor to power supply and sense resistor as shown




## Calibration

**DO NOT POWER THE 4 to 20 mA SENSOR AT THIS TIME**

**Select the Configure tile**



**Select the  $\pm 156$  mV range**

Input Range 

Channel(s)	Input Range
Differential (ch1)	<input type="text" value="±156 mV"/>
Differential (ch2)	<input type="text" value="±156 mV"/>
Differential (ch3)	<input type="text" value="±156 mV"/>
Differential (ch4)	<input type="text" value="±156 mV"/>
Single-ended (ch5)	<input type="text" value="0 to 5.12 V"/>

**Short together S#+ and S#-  
Verify Mid for the Target and click the Auto Balance button**

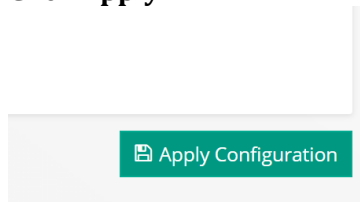
Hardware Offset

Channel(s)	Offset	Balance Target
Differential (ch1)	<input type="text" value="626"/>	<input type="text" value="Mid (50%)"/> <input type="button" value="Auto Balance"/>

Auto balance complete  
(achieved: 49.97%)

**The achieved balance should be very close to 50%**

**Click Apply**



**Select the Calibration tab**

**Select the channels Cal Tools button and click on Manual**

Hardware Calibration

### Linear Calibration ?

Channel(s)	Cal Tools	Unit
Differential (ch1)	Cal Tools	Raw Millivolts
Differential (ch2)	Strain	None
Differential (ch3)	mV/V	None
Differential (ch4)	Manual	None
Differential (ch5)	Tare	None
Single-ended (ch5)	Cal Tools	Raw Volts

**To output mV**

Selecting Raw Millivolts should populate the Slope and offset as shown, if not populate the slope and offset using the table below. Click Accept Calibration button

Manual Calibration

Node: 63784, Channel: ch1 - Differential (ch1)

$$output = (slope \times bits) + offset$$

Unit:

Slope:  mV/bit

Offset:  mV

Effective Range: -156.25 to 163.75 mV

Accept Calibration Cancel

Input Range	[Gain]	Slope	Offset
±156 mV	[16]	0.0012207031	-156.25
±78.1 mV	[32]	0.0006103516	-78.13
±39.0 mV	[64]	0.0003051758	-39.06
±19.5 mV	[128]	0.0001525879	-19.53
±9.76 mV	[256]	0.0000762939	-9.77
±4.88 mV	[512]	0.0000381470	-4.88
±2.44 mV	[1024]	0.0000190735	-2.44
±1.22 mV	[2048]	0.0000095367	-1.22

**Table 5 - Raw Voltage Output**

Click the Apply Configuration button

Apply Configuration

## With short still in place

go back to the Cal Tools and select Tare

Linear Calibration ?

Channel(s)		Unit
Differential (ch1)	Cal Tools	Raw Millivolts
Differential (ch2)	Strain	None
Differential (ch3)	mV/V	None
Differential (ch4)	Manual	None
Differential (ch5)	Tare	None
Single-ended (ch5)	Cal Tools	Raw Volts

Click the sample now button several times, while observing the Current Measurement.

Current Measurement: -0.1038 mV Sample Now

Current Load:  Raw Millivolts

Once a steady number is seen there, click the Apply Offset button

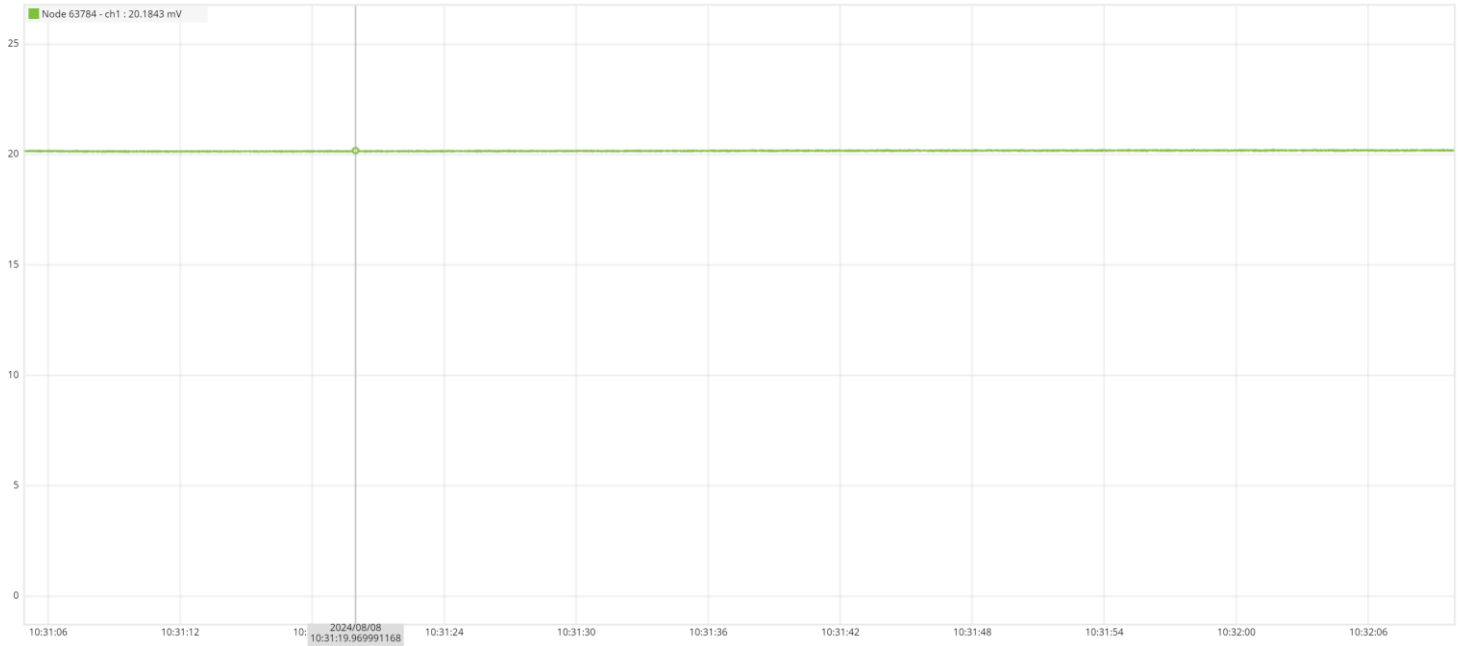
Apply Offset

Revert

## Remove the short

Close the calibration and configuration screens

Power up the 4 to mA sensor and collect data. With no load on the 4 to 20 mA sensor there should be ~20.4 mV (4 mA x sense resistor  $\Omega$ )



If able, apply the max load to the 4 to 20 mA sensor and observe if the max mV is ~102 mV (20 mA x sense resistor  $\Omega$ )

**Note: If the signal is negative and positive was expected, either swap the leads on S#+ and S#- and recalibrate, or swap the signs on the slope and offsets.**

### To output mA

Take the Slope and Offset values from the table above and  $\div$  the value by the measured sense resistor

**Slope**

$$0.0012207031 \div 5.1 = 0.0002393535$$

**Offset**

$$-156.25 \div 5.1 = 30.6372549019$$

In the Manuel Cal tool, select Milliampere and enter the calculated mA slope and offset

Manual Calibration

×

Node: 63784, Channel: ch1 - Differential (ch1)

*output = (slope x bits) + offset*

Unit:

Slope:  mA/bit

Offset:  mA

Effective Range: -30.6373 to 32.1078 mA

Accept Calibration

Cancel

## Accept Calibration and Apply Configuration

Power up the 4 to 20 mA sensor with no load, output should be 4 mA

Go to the Tare tool

Enter Current Load of 4 Milliampere

Click the Sample Now button several times to get a steady Current Measurement value

Click Apply Offset

×

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Node: 63784, Channel: ch1 - Differential (ch1)

Original Calibration:  $\text{mA} = (-2.3935\text{e-}4 \times \text{bits}) + 30.6373$

Current Measurement: 3.9522 mA ↻ Sample Now

Current Load:

Applied Calibration:  $\text{mA} = (-2.3935\text{e-}4 \times \text{bits}) + 30.6373$

Offset: 30.685 mA ( +4.7800e-2 ) Apply Offset

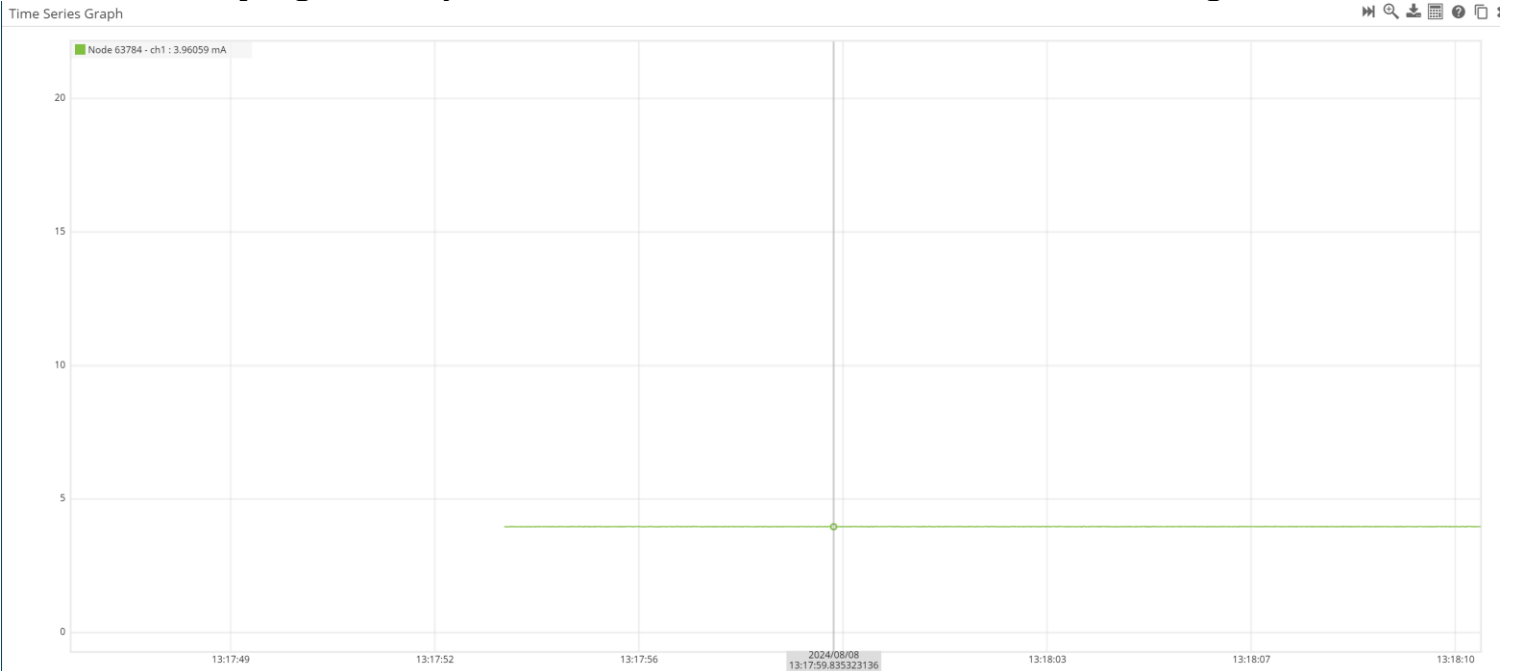
Effective Range: 30.685 to -32.06 mA ↻ Revert

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Close

Close Tare and Configuration screen

Set the node sampling and verify that with no load on the 4 to 20 mA sensor that the signal is ~4 mA



If able, apply the max load to the 4 to 20 mA sensor and observe if the max mA is ~20 mA

**To output engineering unit**

Calculate the engineering unit slope

		min	max	
Slope		0	100	psi
0.001220703	mV/Bit	20.4	102	mV
				100 PSI range
				81.6 mV range
	mV Range ÷ PSI Range		1.22549	PSI/mV
	PSI/mV x mV/Bit		0.001496	PSI/bit

**Manual enter the Unit and slope, can leave the offset as 0 as the next step is to Tare**

Manual Calibration ×

Node: 63784, Channel: ch1 - Differential (ch1)

$$output = (slope \times bits) + offset$$

Unit:

Slope:  PSI/bit

Offset:  PSI

Effective Range: 0 to 392.1569 PSI

**Accept Calibration and Apply Configuration**

**Go to the Tare screen**

**With no load on the 4 to 20 mA sensor**

**Leave the Current Load at 0**

**Click the Sample Now button several times to get a steady Current Measurement**

## Click the apply Offset button

Tare Offset ×

Node: 63784, Channel: ch1 - Differential (ch1)

Original Calibration:  $\text{PSI} = (1.4960\text{e-}3 \times \text{bits}) + 0$

Current Measurement: 166.6544 PSI ↻ Sample Now

Current Load:  Pound Per Square Inch

Applied Calibration:  $\text{PSI} = (1.4960\text{e-}3 \times \text{bits}) + 0$

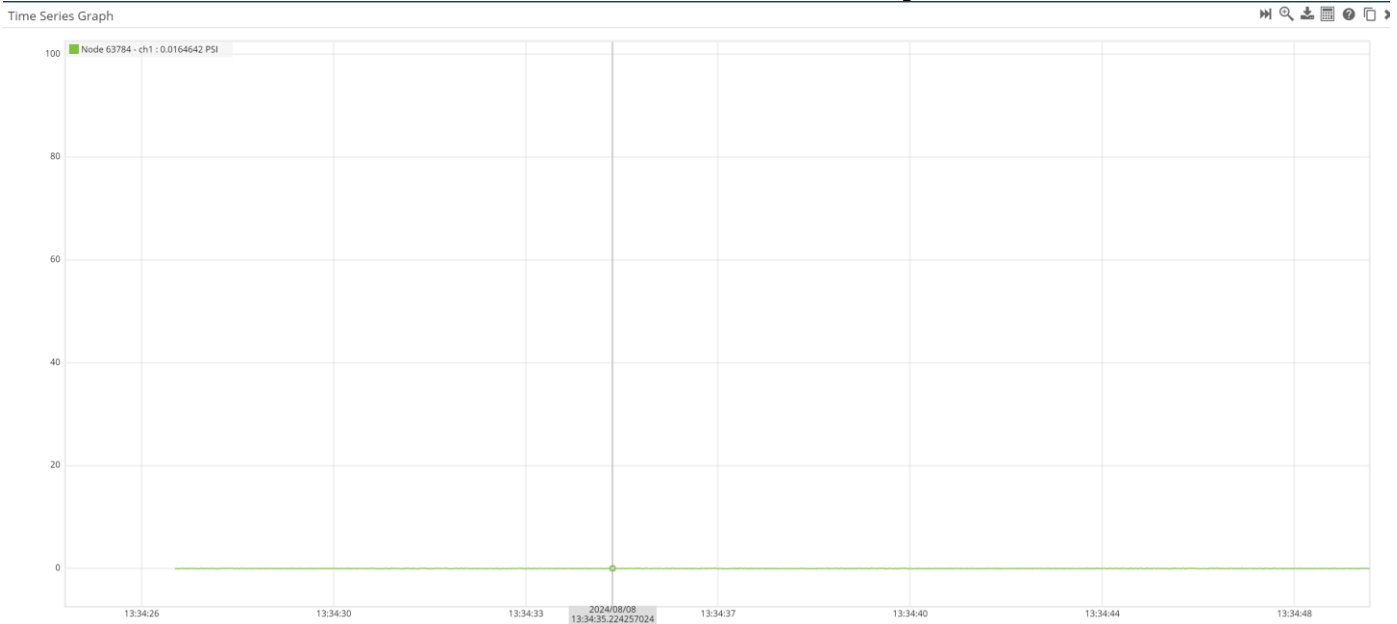
Offset: -166.6544 PSI (-166.6544) Apply Offset

Effective Range: -166.6544 to 225.5025 PSI Revert

Close

## Close the Tare and Configuration screen

## Collect data with no load on the 4 to 20 mA sensor, for this example should be ~0 PSI



If able, apply the max load to the 4 to 20 mA sensor and observe if the max engineering unit matches the sensor rating.