Connecting and Calibrating a Load Cell with V-Link®

V-Link® and Futek LSB300 Load Cell

(Applies to V-Link®, SG-Link®, SG-Link® OEM, HS-Link®)

Overview

MicroStrain's V-Link® Wireless Voltage Node has 4 differential input channels (strain channels) designed to support strain gauges, load cells, etc.

Futek's LSB300 Series is an S Beam Load Cell designed for use in platforms, silos and scales; for purposes of this discussion, we are using the 200 lbs capacity, full bridge model FSH02077.

This technical note presents a step-by-step approach to connecting the load cell to the V-Link®, calibrating the load cell, and operating the system. It is assumed that the user is familiar with MicroStrain's V-Link® and Node Commander® software as well as load cell operation.

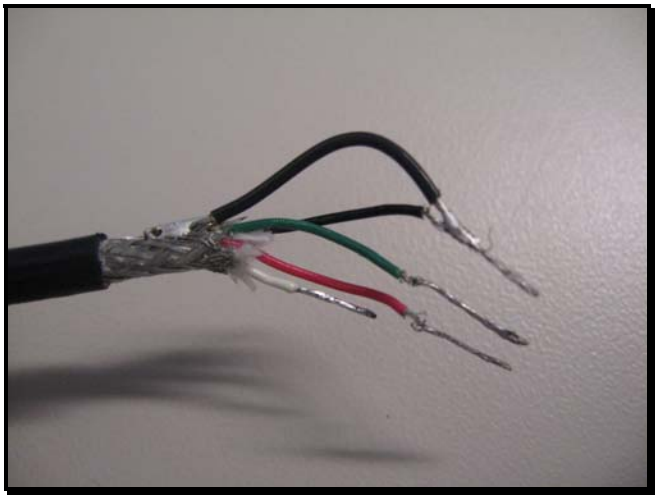
Wiring Connection

The Futek load cell presents a 5 foot, polyurethane sheathed, shielded, connection cable with 6 flying leads. Table 1 describes the individual leads' purpose and nomenclature:

1	Red	+EXC	+Excitation
2	Black	-EXC	-Excitation
3	Green	+SIG	+Signal
4	White	-SIG	-Signal
5	Orange	+SEN	+Sense
6	Blue	-SEN	-Sense
Shield	Silver	Grounded	Shield

Table 1

- To connect to the V-Link®, we need only deal with the Red, Black, Green, and White leads.
- Cut back the Orange and Blue leads and secure them to prevent shorting.
- Strip back each of the 4 remaining leads approximately ½".
- Tin (with solder) each of the 4 leads to insure a good grip in the V-Link®'s terminal block connector.
- It is also strongly recommended that you solder the shielding of the cable to the Black lead as shown in Picture 1. This will reduce noise in the system.

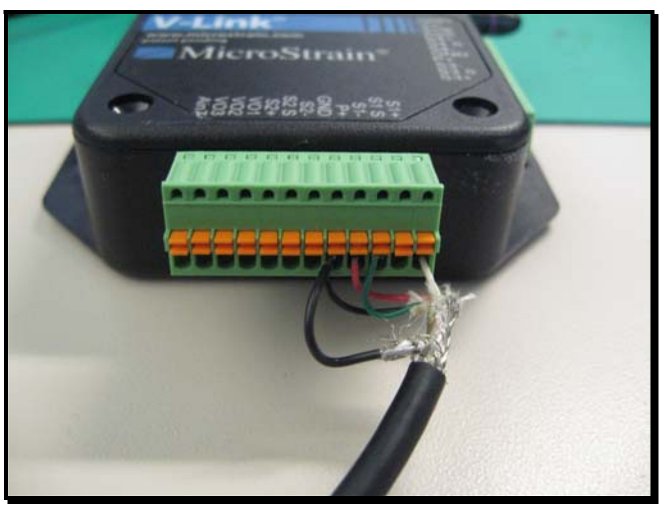


Picture 1

- Connect the 4 leads of the load cell to the V-Link® as shown in Table 2 and Picture 2.
- For this example we are connecting to differential input channel 1 of the V-Link®.

Lead Color Code	Lead Function	V-Link Function	V-Link Pin
Red	+Excitation	Sensor Power Out	16
Black	-Excitation	Ground	17
Green	+Signal	Sensor 1-	15
White	-Signal	Sensor 1+	13

Table 2

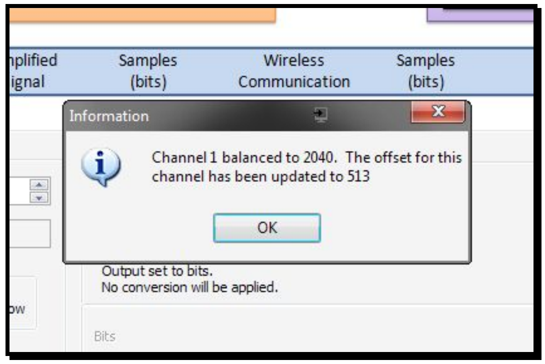


Picture 2

Node Commander® software

- Power-up the V-Link® and launch Node Commander® software.
- Establish communication with the V-Link® as normal.
- Proceed to the Configuration screen and enable the channel to which you connected the load cell (channel 1 in this case).
- Continue to the Channel 1 Configuration screen.

- Select the Midscale bullet under the Auto-Balance button.
- Click the Auto-Balance button.
- A pop-up window will appear similar to the example shown in Picture 3.

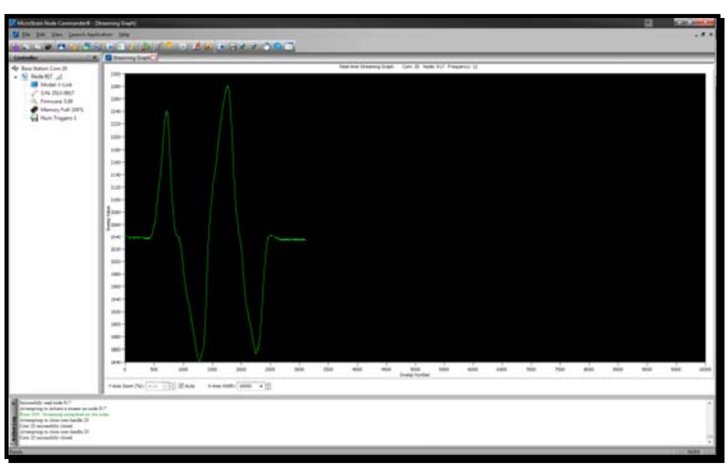


Picture 3

The key information within the window is the 2040 bits and the 513 offset. We are looking for a value of approximately 2048 (+/- 50) bits. This is "mid-scale" on the V-Link®'s 0 – 4096 bit measurement range. Low-scale balancing will yield approximately 1024 bits; high-scale will be approximately 3072 bits. You should use mid-scale balancing if you are expecting equal amounts of positive and negative output from the load cell. Low-scale is used if you are expecting more positive and high-scale if more negative data.

The offset is used to get the measurement range to align with the expected load cell output. The value for mid-scale should be approximately 512 (+/- 10) for a balanced bridge situation. If these numbers are off, the wiring of the load cell to the V-Link® is likely not sound. Correct the wiring and re-run the auto-balancing to verify.

- Click OK to close the pop-up window.
- Click OK to close the Channel 1 Configuration screen.
- Click Apply and click OK to close the Configuration screen and return to main screen of Node Commander.
- Stream the node and exercise the load cell by hand to check you are getting proper output as shown in Picture 4.



Picture 4

- If the data is opposite to what you would expect, i.e., it goes negative when you were expecting positive, switch the Green and White leads to the V-Link®.
- Now re-run the auto-balance procedure and stream to verify proper operation.

Calibrations

We actually have several options to calibrate the load cell with the V-Link®:

- The "poor man calibration" – Hang several weights off the load cell and read the output of the V-Link®. A limiting factor for this option is the number and accuracy of the weights available.
- Use the factory calibration of the load cell. Futek calibrates the load cell and provides a sensitivity coefficient that allows us to calculate a slope and offset. A limiting factor for this option is that the factory calibration does not take into account the load cell connections to the V-Link® or the V-Link® electronics.
- Utilize a calibrated tensometer to apply at least ten loads over the entire range of the load cell. Not everyone has a large expensive testing apparatus, but this will give the most accurate results.

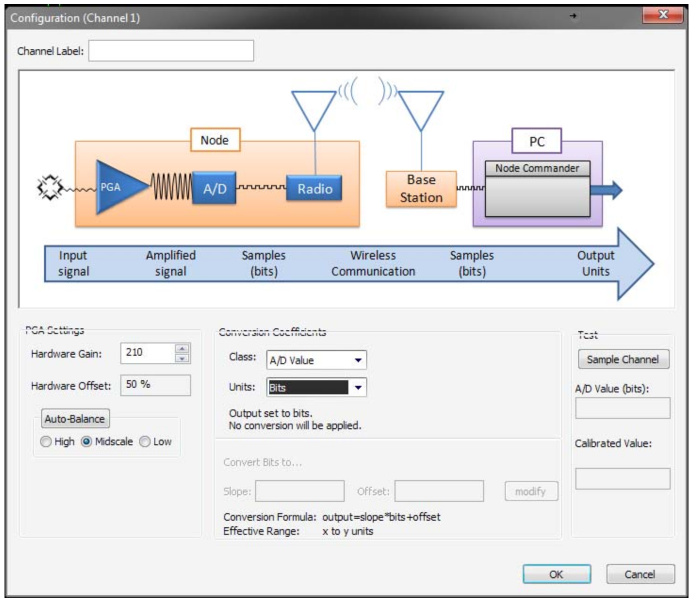
Poor man calibration

- Securely hang the load cell to a sturdy structure that will support the weights you apply to the load cell, as shown in Picture 5.

Picture 5

- Launch Node Commander® software.
- Establish communication with the V-Link® as normal.
- Proceed to the Configuration screen.
- Continue to the Channel 1 Configuration screen.
- Select A/D Value under Class and Bits under Units in the Conversion Class frame as shown in Picture 6.

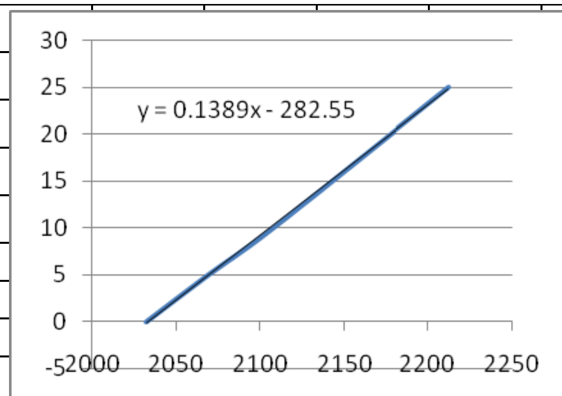
- Click OK to close the Channel 1 Configuration screen.



Picture 6

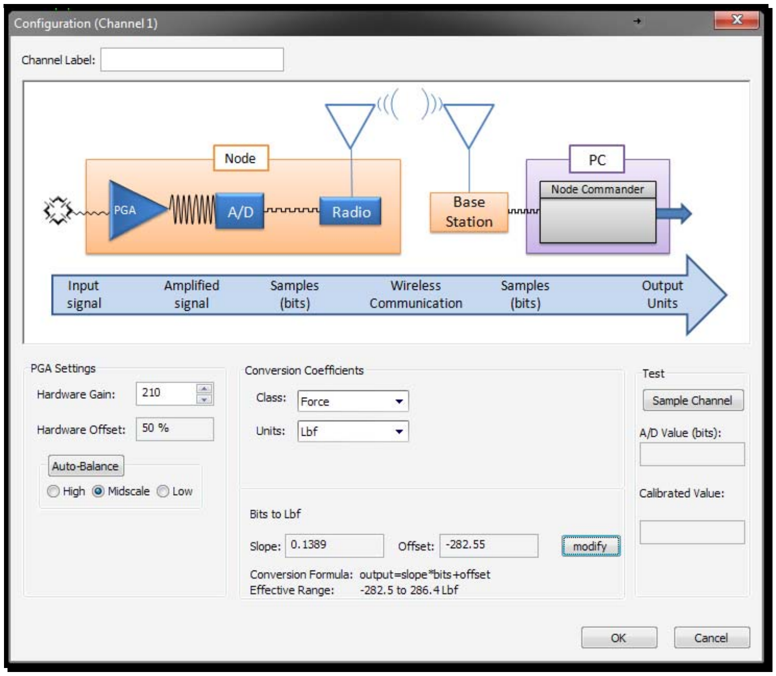
- Proceed by streaming the node and observing the bit output using various weights. In our example shown in Picture 7, we are demonstrating four weights, i.e., 0 (no weight), 5 lbs, 10 lbs and 25 lbs.
- After making weight measurements, calculate a slope from the data using the formula *y=mx+b*. Please see our technical note for a step-by-step using Microsoft Excel.

Bits	Lbs
2033	0
2069	5
2108	10
2213	25



Picture 7

- In our example we see a slope of 0.1389 and an offset of -282.55.
- Return to the Channel 1 Configuration screen.
- Select Force under Class and Lbf under Units in the Conversion Class frame as shown in Picture 8.
- Click the Modify button and enter 0.1389 in Slope and -282.55 in Offset.
- Click Lock to apply the Slope and Offset.
- Click OK to close the Channel 1 Configuration screen.



Picture 8

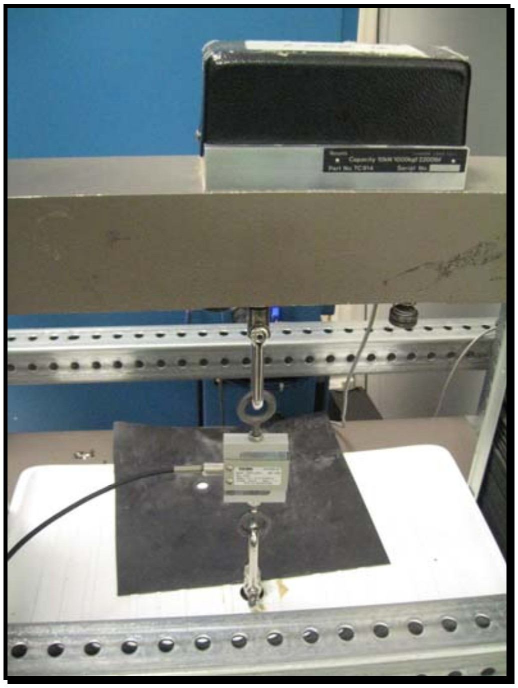
- Proceed to again stream the node with no weight on the load cell.
- Observe the value in the stream graph.
- If the stream is not at zero, return to the Channel 1 Configuration screen.
- Modify the Offset by increasing or decreasing the value to zero the output.
- Hang different weights on the load cell to verify calibration throughout its range.

Using Factory Calibration of Load Cell

- The load cell in this example has been calibrated at the factory in the tension direction.
- It has a calibration sheet indicating an output sensitivity of 1.7777 mV/V @ 200 Lbs.
- With this information we can calculate the slope as follows:
  - 1.7777 mV/V x 3 V(excitation voltage) = 5.3331 mV for full range of 200 Lbs
  - 5.3331 mV x 210 (user selectable gain) = 1.119951 V
  - 1.119951 V x (3 V/4096 Bits) (see note) = 1529.106432 Bits
  - 200 Lbs / 1529.106432 Bits = 0.130795 (slope)
- Note: The V-Link® has a 12-bit A/D converter with a 3 volt excitation, resulting in 4096 Bits / 3 Volts = 0.000732 Bits/Volt.
- Return to the Channel 1 Configuration screen.
- Select Force under Class and Lbf under Units in the Conversion Class frame.
- Click the Modify button and enter 0.130795 in Slope and 0 in Offset.
- Click Lock to apply the Slope and Offset.
- Click OK to close the Channel 1 Configuration screen.
- Stream the node with no weight on the load cell.
- Observe the value in the stream graph.
- If the stream is not at zero, return to the Channel 1 Configuration screen.
- Modify the Offset by increasing or decreasing the value to zero the output.
- Hang different weights on the load cell to verify calibration throughout its range.

Using a Calibrated Tensometer

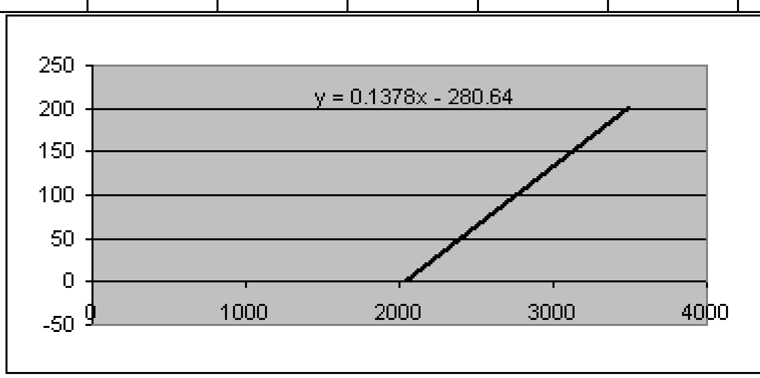
- The procedure is very similar to the "poor man calibration". Instead of hanging weights from the load cell, we are mounting the load cell into the tensometer as shown in Picture 9, applying precision loads, and noting the corresponding bit values.



Picture 9

- Proceed by streaming the node and observing the bit output using various weights. In our example shown in Picture 10, we are demonstrating 11 loads, i.e., 0 (no load), 21 lbs, 39 lbs, and so forth.
- After making weight measurements, calculate a slope from the data using the formula $y=mx+b$. Please see our technical note for a step-by-step using Microsoft Excel.

Bits	Lbs
2036	0
2191	21
2324	39
2475	61
2617	80
2760	100
2908	120
3056	141
3201	161
3348	181
3495	200



Picture 10

- In our example we see a slope of 0.1378 and an offset of -280.64.
- Return to the Channel 1 Configuration screen.
- Select Force under Class and Lbf under Units in the Conversion Class frame.
- Click the Modify button and enter 0.1378 in Slope and -280.64 in Offset.
- Click Lock to apply the Slope and Offset.
- Click OK to close the Channel 1 Configuration screen.
- Proceed to again stream the node with no load on the load cell.
- Observe the value in the stream graph.
- If the stream is not at zero, return to the Channel 1 Configuration screen.
- Modify the Offset by increasing or decreasing the value to zero the output.
- Apply different loads on the load cell to verify calibration throughout its range.
- Note: You should apply at least ten loads (even more is better) over the entire range of the load cell rating to increase the accuracy of the calibration.

Support

MicroStrain support engineers are always available to expand on this subject and support you in any way we can.