8401-0010
Wireless Sensor Networks Technical Note
LORD Corporation, MicroStrain Sensing Systems

Using a Load Cell with V-Link®-LXRS™

Overview

MicroStrain's V-Link®-LXRS™ 8 Channel Wireless Analog Sensor 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®-LXRS™, calibrating the load cell, and operating the system. Familiarity with the V-Link®-LXRS™, Node Commander® software and load cell operation is assumed. This technical note is also applicable to **SG®-Link-LXRS™** operations.

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**: Futek Load Cell Cable Leads*

- To connect to the V-Link®-LXRS™, 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®-LXRS™ terminal block connector.
- It is also strongly recommended that you solder the shielding of the cable to the Black lead as shown in Figure 1. This will reduce noise in the system.
- Connect the 4 leads of the load cell to the V-Link®-LXRS™ as shown in Table 2 and Figure 2.
- For this example we are connecting to differential input channel 1 of the V-Link®-LXRS™.

Load Cell Lead	Load Cell Lead Function	V-Link Function	V-Link Pin
Red	+Excitation	SP+	1
Black	-Excitation	GND	4
Green	+Signal	S1-	3
White	-Signal	S1+	2

***Table 2**: Load Cell Cable Connection to V-Link®-LXRS™*

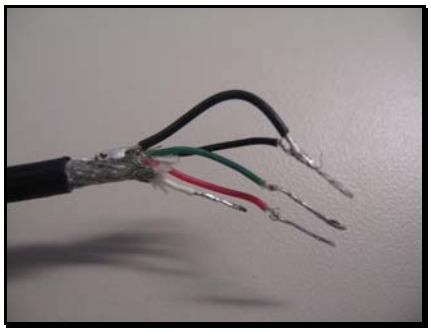
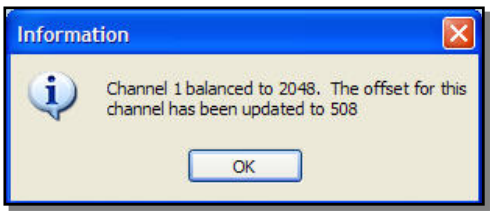


***Figure 1:** Shielding and 4 Leads of Load Cell*

***Figure 2:** Leads Connected to V-Link®-LXRS™*

Node Commander® software

- Power-up the V-Link®-LXRS™ and launch Node Commander® software.
- Establish communication with the V-Link®-LXRS™ as normal.
- Right-click the node and a drop-down menu will appear.
- Click Configure.
- Click Configure Node and the Configuration screen will appear.
- Click the Channels tab.
- Enable the channel to which you connected the load cell (Channel 1 in our example).
- Continue to the Channel 1 Configuration screen by clicking the … button.
- Select the Midscale bullet under the Auto-Balance button.
- Click the Auto-Balance button.
- A pop-up window will appear similar to the example to the right.



The key information within the window is the 2048 bits and the 508 offset. We are looking for a value of approximately 2048 (+/- 50) bits. This is "mid-scale" on the V-Link®-LXRS™ 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®-LXRS™ 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.
- Click the Streaming tab.
- Uncheck the Continuous Streaming checkbox.
- Enter a value of 15000 Sweeps (~20 seconds).
- Click Apply and click OK to close the Configuration screen.
- Right-click the node and a drop-down menu will appear.
- Click Sample.
- Click Stream.
- Click Start and the node will start streaming the load cell data on Channel 1.
- Exercise the load cell by hand to check you are getting proper output as shown.
- 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®-LXRS™.
- Now re-run the auto-balance procedure and stream to verify proper operation.

Calibrations

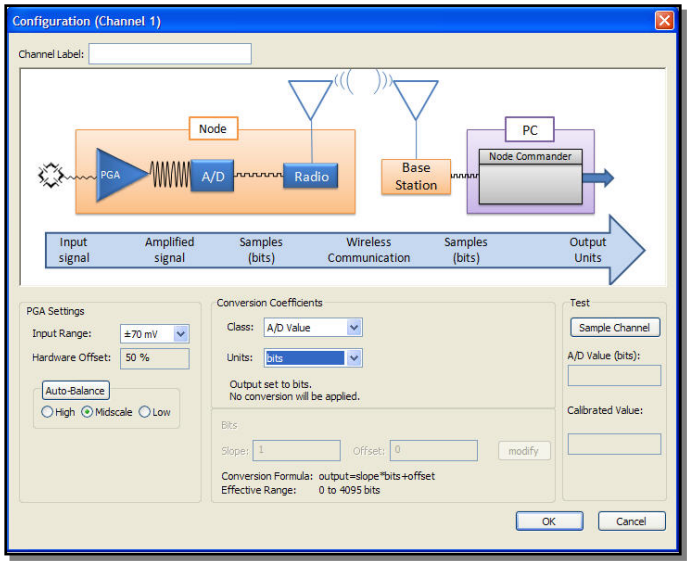
We actually have several options to calibrate the load cell with the V-Link®-LXRS™:

- The "poor man calibration" – Hang several weights off the load cell and read the output of the V-Link®-LXRS™. 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®-LXRS™ or the V-Link®-LXRS™ 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 mount the load cell to a sturdy structure that will support the weights you apply to the load cell, as shown here.

- Launch Node Commander® software.
- Establish communication with the V-Link®-LXRS™ 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 Coefficients frame as shown.
- Click OK to close the Channel 1 Configuration screen.



- Proceed by streaming the node and observing the bit output using various weights. In our example shown in Figure 3, 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 Calculating a Linear Slope with Microsoft Excel for a step-by-step instruction.

Bits	Lbs
2033	0
2069	5
2108	10
2213	25

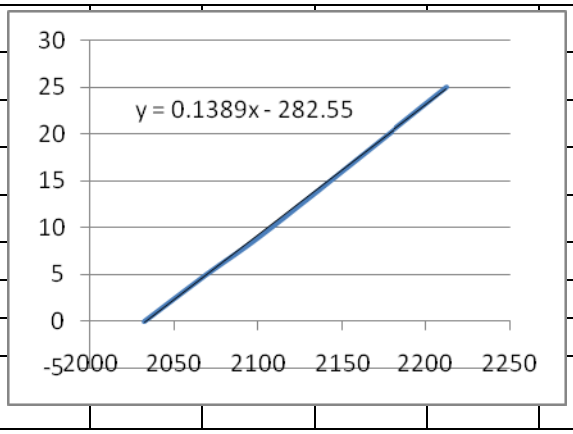
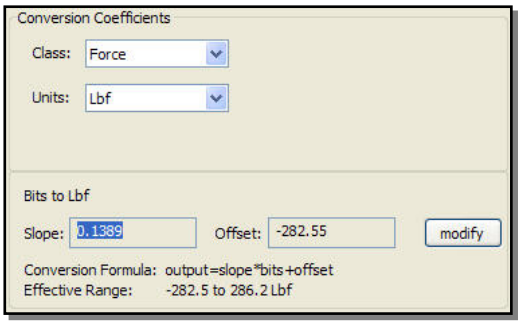


Figure 3: *Calculating a Slope*

- 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 Coefficients frame.
- 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.
- 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.

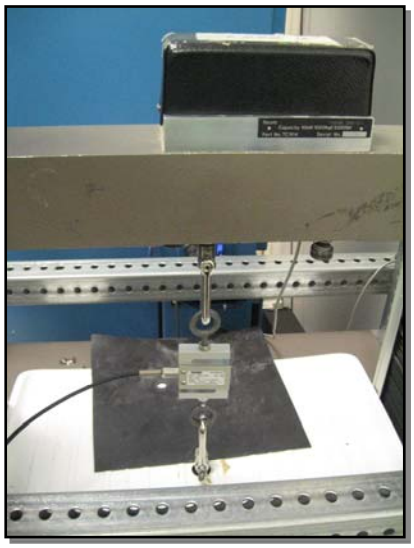
- Modify the Offset by increasing or decreasing the value to zero the output.
- Hang different weights on the load cell to verify calibration throughout its range.

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 569 (+/-2.5 mV user selectable gain) (see note) = 3.0345339 V
  - 3.0345339 V / (3 V/4096 Bits) (see note) = 4145 Bits
  - 200 Lbs / 4145 Bits = 0.048250 (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. Select a gain that most closely matches the full scale output of 4096 bits.
- Return to the Channel 1 Configuration screen.
- Select Force under Class and Lbf under Units in the Conversion Coefficients frame.
- Click the Modify button and enter 0.048250 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 a tensometer as shown, applying precision loads, and noting the corresponding bit values.
- Proceed by streaming the node and observing the bit output using various weights. In our example shown in Figure 4, 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

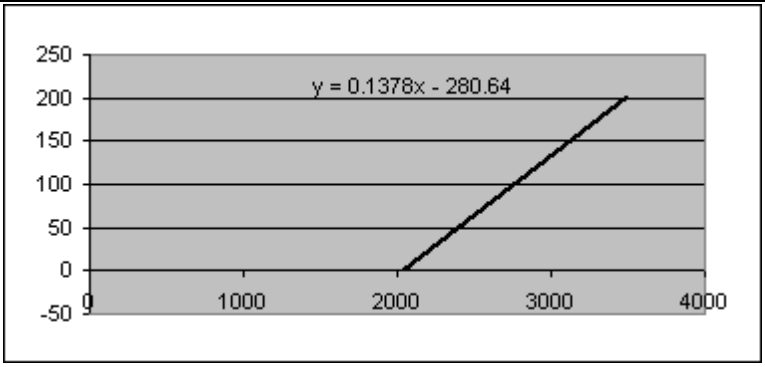


Figure 4: *Calculating a Slope*

- 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 Coefficients 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.

LORD Corporation
MicroStrain Sensing Systems
459 Hurricane Lane, Unit 102
Williston, VT 05495 USA
ph: 800-449-3878
fax: 802-863-4093
www.microstrain.com
support@microstrain.com

8401-0010