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.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Red</td>
<td>+EXC +Excitation</td>
</tr>
<tr>
<td>2</td>
<td>Black</td>
<td>-EXC -Excitation</td>
</tr>
<tr>
<td>3</td>
<td>Green</td>
<td>+SIG +Signal</td>
</tr>
<tr>
<td>4</td>
<td>White</td>
<td>-SIG -Signal</td>
</tr>
<tr>
<td>5</td>
<td>Orange</td>
<td>+SEN +Sense</td>
</tr>
<tr>
<td>6</td>
<td>Blue</td>
<td>-SEN -Sense</td>
</tr>
<tr>
<td>Shield</td>
<td>Silver</td>
<td>Grounded Shield</td>
</tr>
</tbody>
</table>

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™.
<table>
<thead>
<tr>
<th>Load Cell Lead</th>
<th>Load Cell Lead Function</th>
<th>V-Link Function</th>
<th>V-Link Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>+Excitation</td>
<td>SP+</td>
<td>1</td>
</tr>
<tr>
<td>Black</td>
<td>-Excitation</td>
<td>GND</td>
<td>4</td>
</tr>
<tr>
<td>Green</td>
<td>+Signal</td>
<td>S1-</td>
<td>3</td>
</tr>
<tr>
<td>White</td>
<td>-Signal</td>
<td>S1+</td>
<td>2</td>
</tr>
</tbody>
</table>

*Table 2: Load Cell Cable Connection 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 Mid-scale 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.

<table>
<thead>
<tr>
<th>Bits</th>
<th>Lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2033</td>
<td>0</td>
</tr>
<tr>
<td>2069</td>
<td>5</td>
</tr>
<tr>
<td>2108</td>
<td>10</td>
</tr>
<tr>
<td>2213</td>
<td>25</td>
</tr>
</tbody>
</table>

![Figure 3: Calculating a Slope](image)

• 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:
  - \(1.7777 \text{ mV/V} \times 3 \text{ V (excitation voltage)} = 5.3331 \text{ mV for full range of 200 Lbs}\)
  - \(5.3331 \text{ mV} \times 569 (+/-2.5 \text{ mV user selectable gain}) \text{ (see note)} = 3.0345339 \text{ V}\)
  - \(3.0345339 \text{ V} / (3 \text{ V}/4096 \text{ Bits}) \text{ (see note)} = 4145 \text{ Bits}\)
  - \(200 \text{ Lbs} / 4145 \text{ Bits} = 0.048250 \text{ (slope)}\)

**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.
- 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.

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**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.

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