

# LORD MicroStrain<sup>®</sup>

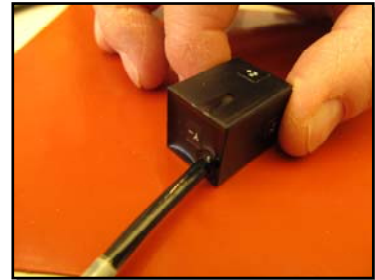
## SENSING SYSTEMS

### Technical Note

## Using the 50g, 100g, 200g or 500g Triaxial Accelerometer Cube

### Overview

LORD MicroStrain<sup>®</sup> provides optional +/-50g, +/-100g, +/-200g and +/-500g Triaxial Accelerometer Cubes for use with its [V-Link<sup>®</sup>-LXRS<sup>®</sup>](#) 8 Channel Wireless Analog Sensor Node. The accelerometer cubes have a 6 foot signal cable which allows them to be placed on their own in hard to locate or remote positions. The system allows the user to measure acceleration, vibration and shock and transmit it wirelessly to a host computer. This technical note provides a step-by-step instruction to configure and operate the system and assumes the user is familiar with the V-Link<sup>®</sup>-LXRS<sup>®</sup> and Node Commander<sup>®</sup> software.



### Specifications

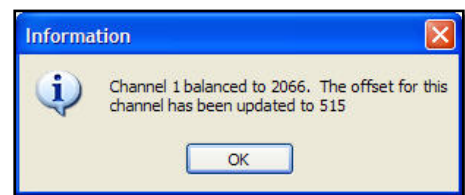
Cube	LORD Part Number	Accelerometer Manufacturer	Model	Range
50g	6402-0310	Measurement Specialties	<a href="#">3031-50</a>	+/-50g
100g	6402-0110	Measurement Specialties	<a href="#">3031-100</a>	+/-100g
200g	6402-0210	Measurement Specialties	<a href="#">3038-200</a>	+/-200g
500g	6402-0410	Measurement Specialties	<a href="#">3038-500</a>	+/-500g

- The cube is manufactured with 3 individual accelerometers mounted on 3 interconnected circuit boards.
- The circuit board array is inserted into the cube made of with DAP (Glass-fibre Filled Diallyl Phthalate) and potted in place with Loctite<sup>®</sup> E-60NC Hysol Epoxy Potting Compound.
- The cube and its signal cable are temperature rated from -30C to +70C.
- The signal cable wiring shield is attached to the black ground lead at the circuit board array and has a wiring clamp provided for strain relief.
- The cube carries no threaded or smooth holes for mounting. Suggested mounting methods include strapping, gluing, insertion in a holding fixture, etc.
- The cube has a 6 foot, 8-lead, shielded signal cable which provides pigtailed to be attached to the terminal connectors on the V-Link<sup>®</sup>-LXRS<sup>®</sup>.
- The signal cable carries a shrink-wrap label that indicates the serial numbers of the 3 installed accelerometers.
- A wiring diagram for connecting the cube to the V-Link<sup>®</sup>-LXRS<sup>®</sup> may be found at: <http://files.microstrain.com/3007-0011.pdf>. Ensure that the cube is wired to the V-Link<sup>®</sup>-LXRS<sup>®</sup> following the wiring diagram, i.e., Channel 1 is the X-axis, Channel 2 is the Y-axis and Channel 3 is the Z-axis.
- Each cube comes with a Certificate of Calibration as shown in the example at: [Cert of Cal](#).
- Cube dimensions and axes orientation may be found at: <http://files.microstrain.com/3007-0011.pdf>

### Configure Channel 1

- The Certificate of Calibration that accompanies each cube contains its X, Y and Z-axis accelerometer calibration.
- **Note:** These calibrations are taken from the actual Measurement Specialties factory calibrations; LORD MicroStrain<sup>®</sup> does not calibrate the accelerometers.
- In our example Certificate of Calibration noted above, we find an X-axis sensitivity of 0.777 mV/g, a Y-axis sensitivity of 0.693 mV/g, and a Z-axis sensitivity of 0.796 mV/g.

- These values are used to calculate the Slope and Offset needed in Node Commander® to scale the V-Link®-LXRS® output into engineering units, i.e., acceleration (g).
- An on-line spreadsheet is available to make these calculations and may be found at: [Spreadsheet](#).
- Open the spreadsheet.
- We will perform the calculations for the X-axis (Channel 1) first.
- Enter the **Full range of sensor**; in our example we have a +/-50g accelerometer which has a full scale range of **100g**.
- Enter the **Sensitivity**; in our example we have an X-axis sensitivity of **0.777 mV/g**.
- Enter the **Volts sensor calibrated at**; in our example the accelerometer was calibrated at **5 VDC**.
- The spreadsheet now automatically calculates an **Optimal hardware gain**; in our example the gain is **64**.
- Refer to the V-Link®-LXRS® gain table on the spreadsheet to select an appropriate gain.
- As you see, 64 is not available as a gain on the V-Link®-LXRS®. By entering 75 (+/-20 mV [75]), you will get higher resolution, but a slightly lessened measurement range, i.e., +/-42.9g. See cells named *Using Mid-scale Balance (~2048 bits)*.
- By entering 30 (+/-50 mV [30]), you will get lower resolution, but an increased measurement range, i.e., +/-107.25g.
- Therefore, a gain of 75 best fits the range of our example +/-50g accelerometer.
- Let's move to Node Commander® now...
- Establish communication as normal between the V-Link®-LXRS™ and Node Commander®.
- Right-click the node and a drop-down menu appears.
- Click Configure.
- Click Configure Node and the Node Configuration window appears.
- Click the Channels tab.
- Enable channels 1, 2 and 3 and disable channels 4 thru 8.
- Click Apply.
- Click the Channel 1 Configure button (...) and the Channel 1 Configuration window appears.
- In the PGA Settings frame using the Input Range drop-down, select the range that was used in the calculations above; in our example, we are using +/-20 mV [75].
- Place the cube on its side on a level surface so that the cable is parallel to the level surface.  
**Important:** Ensure that the **Z+** side is up.
- Select the Midscale radio button and click Auto-Balance.
- An information window will appear indicating that Channel was balanced. The balance should be ~2048 (+/-30) and the offset should be ~512 (+/-20). Note the value to which the channel was balanced; in our example we see 2066.
- Click OK and the information window will disappear.
- Return to the spreadsheet...
- Enter the **Auto-balance Bit Value from Node Commander**; in our example we have an auto-balance value of 2066.
- The spreadsheet now automatically calculates a **Slope** and **Offset**; in our example the Slope is 0.0209473 and our Offset is -43.2771.
- Return to Node Commander®...
- In the Conversion Coefficients frame, select Acceleration in the Class drop-down.
- Select G in the Units drop-down.
- In the Bits to G frame, click the Modify button.
- Enter the Slope from the calculations above; in our example, we are using 0.0209473.
- Enter an Offset value of -43.2771.
- Click Lock.
- Click OK and the Channel 1 Configuration window disappears.



Full range of sensor	100	Engineer unit (EU)
Sensitivity	0.777	mV/EU
Volts sensor calibrated at	5.0	V
Sensitivity @ 3V	0.466	mV/EU
Full range sensor voltage	46.620	mV @ Max EU
Optimal hardware gain	64	3000mv / Max Sensor V
User set hardware gain	75	Gain
mV/EU	34.965	Gain * Sensitivity
EU/mV	0.0286000	1 / (mV/EU)
Slope (EU/bit)	0.0209473	(EU/mv)*(3000mv/4096bits)
Auto-balance Bit Value from Node Commander	2066	
Offset (EU)	-43.2771	Slope * Midpoint
Voltage at max sensor output	3496.500	mV (Max sensor V * Gain)
Full range of node in EU	85.8	Slope * 4096 bits
	Max Node Output	Min Node Output
Using High-scale Balance (~3072 bits)	21.45	-64.35
Using Mid-scale Balance (~2048 bits)	42.90	-42.90
Using Low-scale Balance (~1024 bits)	64.35	-21.45

**Worksheet Showing Channel 1 Example**

### Configure Channel 2

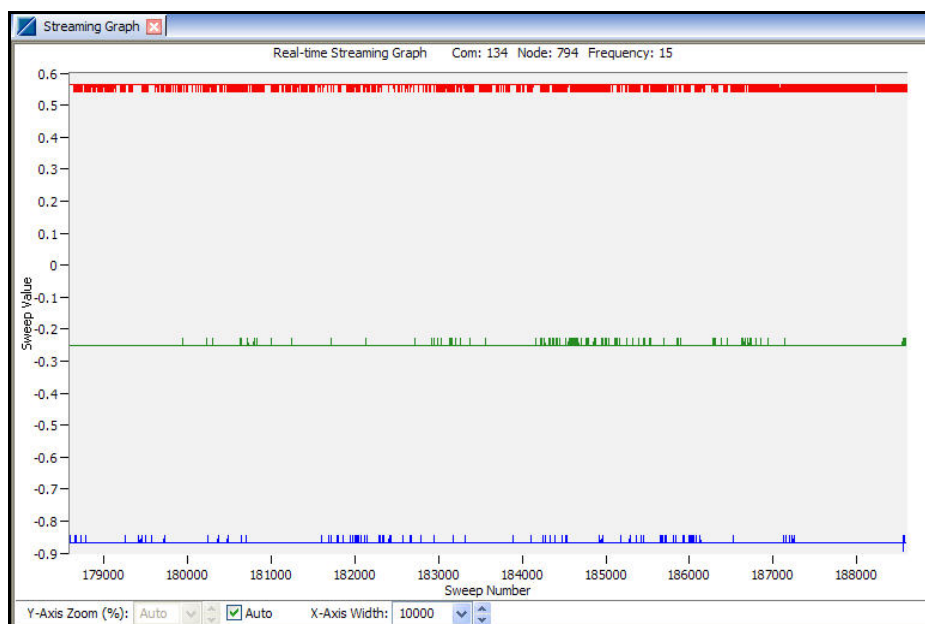
- Using the Y-axis 0.693 mV/g sensitivity value from our example Certificate of Calibration, configure Channel 2 using the exact method described for Channel 1.

### Configure Channel 3

- Using the Z-axis 0.796 mV/g sensitivity value from our example Certificate of Calibration, configure Channel 3 using the exact method described for Channel 1 **with the following important change**: Place the cube on its side on a level surface so that the cable is parallel to the level surface with the **X+** side up.
- After configuring all 3 channels, close the Node Configuration window by clicking OK.

### Operation

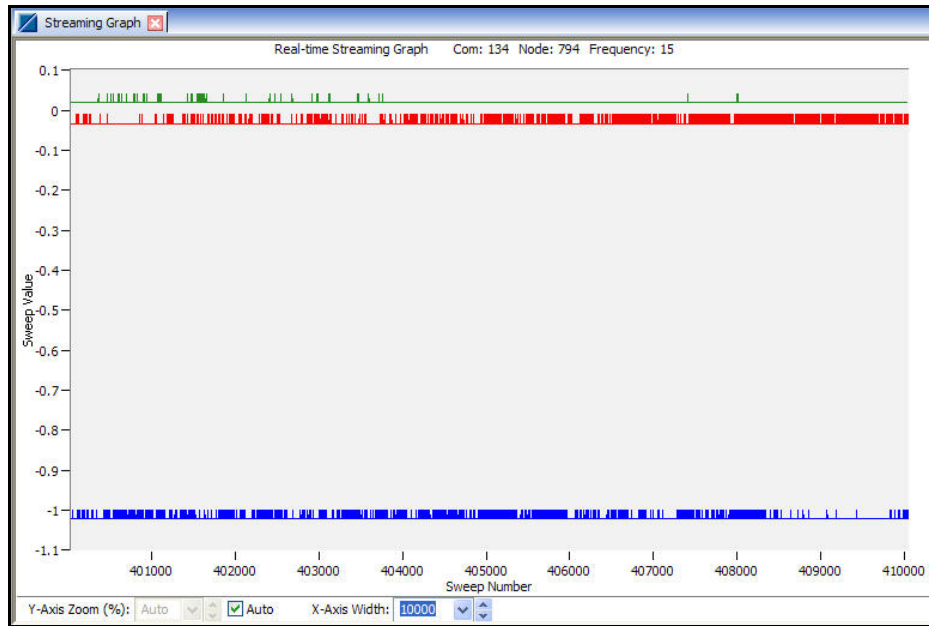
- Again, change the position of the cube. Place the cube on its side on a level surface so that the cable is parallel to the level surface with the **Z+** side up.
- Set up a continuous streaming session and stream the V-Link®-LXRS®.
- The Streaming Graph will appear and you will observe that the **X-axis (Channel 1)** is reading at or near 0g, the **Y-axis (Channel 2)** is reading at or near 0g, and the **Z-axis (Channel 3)** is reading at or near -1g.



**Streaming Graph Before Fine Tuning**

## Fine Tuning

- To fine tune the outputs to the theoretical 0, 0, -1, the offset may be adjusted as further explained.
- In our example we see Channel 1 streaming at approximately -0.23g, Channel 2 streaming at approximately +0.55g, and Channel 3 streaming at approximately -0.87g.
- Stop streaming and go to the Channel 1 Configuration screen.
- Click Modify.
- The Offset value is -43.2771; add 0.23 to this Offset resulting in -43.0471; enter -43.0471 as the new Offset.
- Click Lock and go to the Channel 2 Configuration screen.
- Click Modify.
- The Offset value is -48.1235; subtract 0.55 from this Offset resulting in -48.6735; enter -48.6735 as the new Offset.
- Click Lock and go to the Channel 3 Configuration screen.
- Click Modify.
- The Offset value is -48.0296; subtract 0.13 from this Offset resulting in -48.1596; enter -48.1596 as the new Offset.
- Note: Fine tuning to achieve 0, 0, -1 may take several iterations. Achieving a 'perfect' 0, 0, -1 is highly unlikely given the sensor noise characteristics of these MEMS accelerometers.



**Streaming Graph After Fine Tuning**

## Support

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

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