

Using a G-Link[®]-LXRS[™] as a Dual Axis Tilt Sensor



Overview

MicroStrain's G-Link[®]-LXRS[™] wireless accelerometer node contains a tri-axial accelerometer array that can be utilized to produce a dual axis tilt sensor. The G-Link[®]-LXRS[™] is calibrated at the factory and the calibration coefficients necessary to output accelerations are written to non-volatile memory. By further scaling the accelerations with the appropriate formulas, the G-Link[®]-LXRS[™] can be made to produce both pitch and roll. MicroStrain provides a simple software sample that demonstrates this capability. This technical note provides details on this use of the G-Link[®]-LXRS[™] and the demonstration software. Familiarity with the G-Link[®]-LXRS[™] and Node Commander[®] is assumed.

Accelerometer Designation

Channel 1 of the G-Link[®]-LXRS[™] outputs the X axis accelerometer, channel 2 is the Y axis accelerometer and channel 3 is the Z axis accelerometer.

Bits and Coefficients to g

The G-Link[®]-LXRS[™] outputs 'bits' to the base station and into the host software. These 'bits' can be combined with the on-board calibration coefficients to produce 'g' (unit of acceleration). The formula is discussed in detail in the Calibration Coefficients section (starting on page 48) of the [Wireless Sensor Networks LXRS Data Communications Protocol](#) manual. The coefficients are referred to as Gain (or Slope) and Offset. Each accelerometer channel has a Gain (or Slope) and an Offset. The formula is as follows:

$$\text{Acceleration} = (\text{Slope} * \text{Bits}) + \text{Offset}$$

Retrieving Calibration Coefficients

The simplest way to get the Slope and Offset for each channel is to use Node Commander[®] software. You will use these noted values in our example below and in the software sample.

- Launch Node Commander[®] software.
- Establish communication with the G-Link[®]-LXRS[™] as normal.
- Note the comm port of the base station, e.g. Base Station Com 33.
- Note the node address, e.g., Node 449.
- Right-click the Node and a drop-down menu appears.
- Click Configure.
- Click Calibration Coefficients.
- Click Configure and the Calibration Coefficients window appears.
- Note the Slope and Offset of Channels 1, 2 and 3, e.g. Channel 1 Slope = 0.00147059 and Offset = -2.74559. Note all 3 channels.

Example

If our current bits output on Channel 1 was 2048, here's how the *Bits and Coefficients to g* formula works:

$$0.266 \text{ g} = (0.00147059 \text{ Slope} * 2048 \text{ Bits}) + -2.74559$$

g to Tilt

The G-Link[®]-LXRS[™] uses a variation of the ADXL103/ADXL203 accelerometer. Page 15 of the [accelerometer data sheet](#) shows us how to get tilt:

Pitch = ASIN(A_x / 1g)
where Pitch is in radians
where ASIN is arcsine
where A_x is the acceleration in g on channel 1

Roll = ASIN(A_y / 1g)
where Roll is in radians
where ASIN is arcsine
where A_y is the acceleration in g on channel 2

Pitch and Roll can be further processed into degrees as follows:

$$\begin{aligned} \text{Pitch in degrees} &= \text{Pitch in radians} * 57.2958 \\ \text{Roll in degrees} &= \text{Roll in radians} * 57.2958 \end{aligned}$$

Demonstration Software

A demonstration of this use of the G-Link[®]-LXRS[™] has been implemented in software. The software requires the Microsoft Visual Studio 2010 VB.NET IDE and is provided as an uncompiled project. The project may be downloaded [here](#).

Before using the demonstration software, use Node Commander[®] software to:

- configure the G-Link[®]-LXRS[™] and base station on the same frequency
- set the G-Link[®]-LXRS[™]
 - with channels 1, 2 and 3 active
 - Low Duty Cycle set to 1 Hz sampling rate
 - Low Duty Cycle set to Unlimited Sampling

Launch the demonstration software, enter your Comm Port, Node Address and 6 Calibration Coefficients, and click Run.

Support

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

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