

Application Note 141: Tri-Axial Accelerometer Calibration

Tri-axial accelerometers are high-level output transducers requiring no additional amplification since the amplifier is built into the transducer. They connect directly to the data acquisition unit to provide three outputs, each simultaneously measuring acceleration in the X, Y, and Z direction. The 5 g accelerometer is well suited for measuring slow movements, whereas the 50 g accelerometer is made to measure quick movements. With the proper equipment and proper scaling parameters listed below, precise acceleration measurements can be obtained.

Equipment

- Data Acquisition System
 - Biopac Student Lab System [MP36](#) (or older MP35 or MP30)
 - *AcqKnowledge* [MP36R](#)
- Tri-axial Accelerometer—connects to MP36, MP35, MP30 or MP36R
 - Output ± 5 g (400 mV/g) – [SS26LB](#) (or older [SS26L](#) or [SS26LA](#))
 - Output ± 50 g (40 mV/g) – [SS34L](#) (or older [SS27L](#))

Hardware Setup

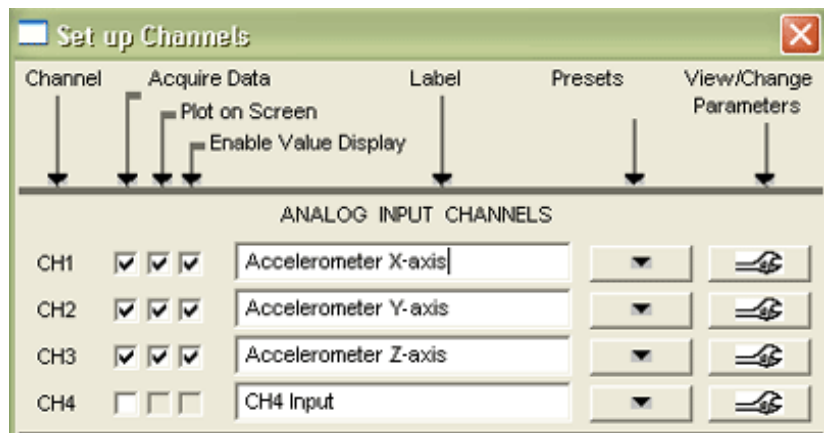
1. Connect the transducer directly to CH inputs on the MP3X data acquisition unit.
 - Tri-axial accelerometers require 3 output connectors, 1 each for the X-, Y-, and Z-axis. Each output connector must be connected to one input channel on the MP3X unit. For example, the X-axis to channel 1, the Y-axis to channel 2, and the Z-axis to channel 3.

Software Setup

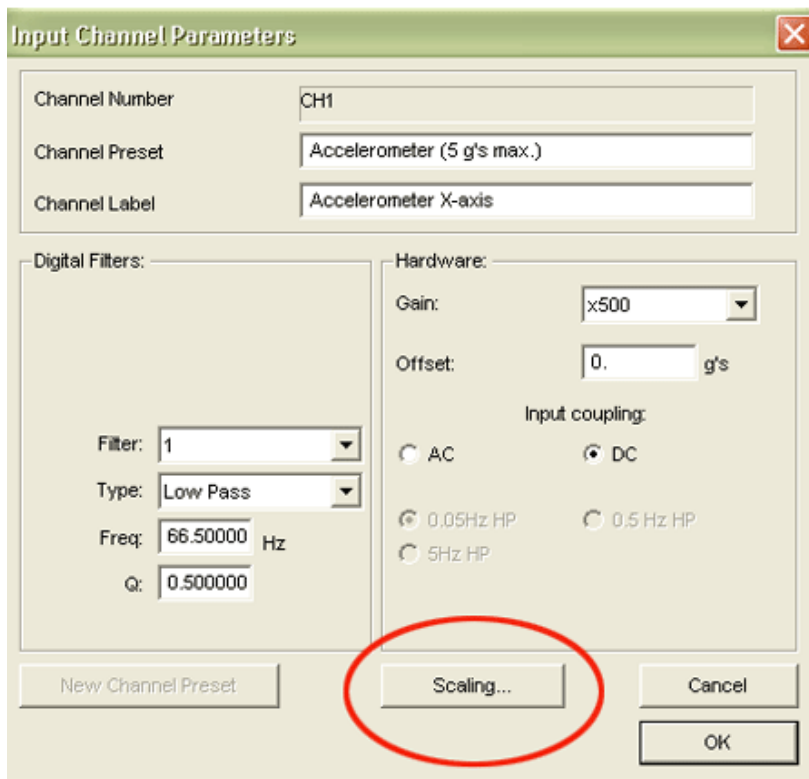
Shown with Biopac Student Lab *PRO*, similar with *AcqKnowledge*

1. Click MP menu > Set up Channels.
2. Enable 3 analog channels, one for each axis, and label accordingly (as shown below).
3. Click the Presets button next to CH1 (Accelerometer X-axis) > Select preset for "Accelerometer 5 g's max." or "Accelerometer 50 g's max." Repeat for each axis.

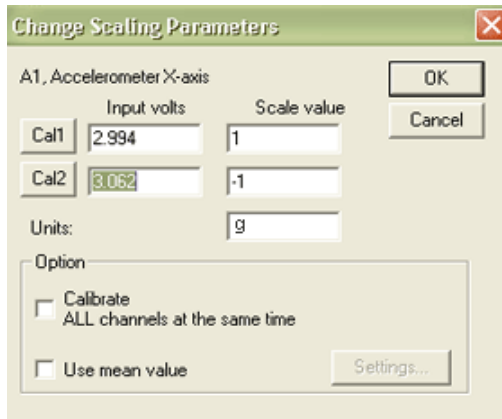
You will calibrate the accelerometer by rotating each channel through 180 degrees and taking a calibration reading at each axis point (see pictures).



4. **X-axis Scaling**
 - a. Click View/Change Parameters button in the CH1 (Accelerometer X-axis) row. In the Input Channel Parameters dialog that opens (see below), click "Scaling" to generate the Change Scaling Parameters dialog.



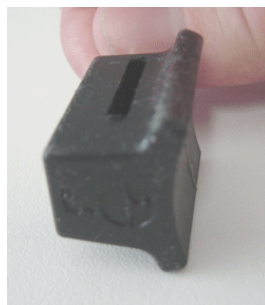
- b. Enter the "Scale values" Cal1 = 1 and Cal2 = -1, and enter the Units label "g" (as shown below).



- c. Rest the accelerometer on a flat surface in the sideways position and then click Cal1.



X-axis Cal1



X-axis Cal2

- d. Rotate the accelerometer 180 degrees, rest it on a flat surface in the flipped position, and then click Cal2.

5. Y-axis Scaling

- a. Click View/Change Parameters button in the CH2 (Accelerometer Y-axis) row and click "Scaling" to generate the Change Scaling Parameters dialog.
- b. Enter the "Scale values" Cal1 = 1 and Cal2 = -1, and enter the Units label "g."

- c. Rest the accelerometer on a flat surface in the wide upright position and then click Cal1.



Y-axis Cal1



Y-axis Cal2

- d. Rotate the accelerometer 180 degrees, rest it on a flat surface in the flipped position, and then click Cal2.

6. Z-axis Scaling

- a. Click View/Change Parameters button in the CH3 (Accelerometer Z-axis) row and click "Scaling" to generate the Change Scaling Parameters dialog.
- b. Enter the "Scale values" Cal1 = 1 and Cal2 = -1, and enter the Units label "g."
- c. Rest the accelerometer on a flat surface in the tall upright (cord up) position and then click Cal1.



Z-axis Cal1



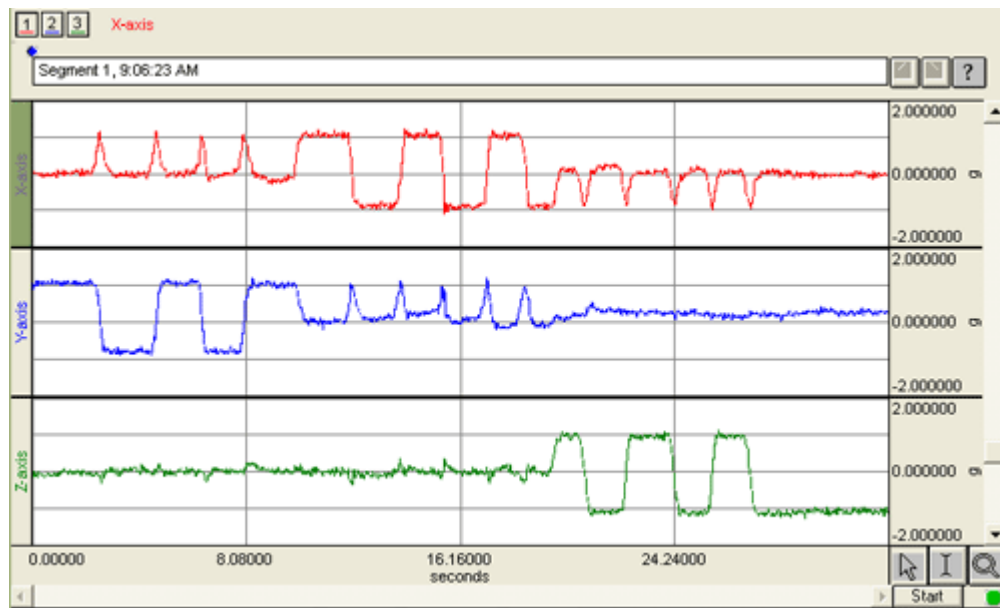
Z-axis Cal2

- d. Rotate the accelerometer 180 degrees, rest it on a flat surface in the flipped (cord down) position, and then click Cal2.

Calibration Validation

To visually confirm that calibration is correct, repeat the calibration procedure of rotating the accelerometer 180 degrees through each axis.

1. Set up acquisition parameters.
 - o A sample rate of 50 samples/second was used in this example.
2. Click "Start" to begin acquiring data.
3. Rotate the accelerometer 180 degrees through each axis.
4. Click "Stop" to end data acquisition.
5. Set the vertical scale to 1 and the midpoint to 0 for all channels.
6. Check the data to confirm the scaling:
 - o Each channel should show the signal moving from 1 g to -1 g as the accelerometer axis is rotated.



Accelerometer being rotated through each axis:

- Channel 1 (top) is the X-axis
- Channel 2 (middle) is the Y-axis
- Channel 3 (bottom) is the Z-axis

When calibration is confirmed, the tri-axial accelerometer is ready to measure movement.