Force Transducers

Written by staff of ADInstruments.

Introduction

Force transducers convert displacement signals into electrical signals. Force transducers can be used in a variety of experiments, especially those involving muscle contractions. This document covers the basic operating principles of ADInstruments force transducers, including setup, calibration, and software settings.

Required Equipment

A computer system
Chart 5.0 or higher
Force transducers:
- [MLT500/A] 0-500 gram force transducer
- [MLT050/A] 0-50 gram force transducer
- [MLT0210/A] 0-25 gram sensitive force transducer

Bridge Pod [ML301]
PowerLab with available Pod Port
- PowerLab 2/25
- PowerLab 4/25
- PowerLab 4/25T

Calibration weights*
- 1 g weight
- 10 g weight

*The weights listed here are suggested values for basic experiments. For more information, refer to the Calibration section of this Application Note.

Basics of operation

Choosing the right transducer

Choose a force transducer that is best suited for the experiment you wish to perform. A high-range force transducer [MLT500/A] is a good general-purpose transducer, and is especially ideal for isolated whole-muscle experiments. A small-range force transducer [MLT0210/A] is best used for organ bath or isolated tissue experiments where sensitivity is important. A high-range force transducer will be able to detect small forces, but the signal must be amplified significantly, at the expense of increased noise.

Connecting equipment

Force transducers require a special amplifier: a Wheatstone bridge circuit. The transducers discussed in this document require the ADInstruments Bridge Pod [ML301].

1. Connect the force transducer to the back of the Bridge Pod.

2. Connect the Bridge Pod to an available Pod Port Input on the PowerLab. It is acceptable to plug in the Bridge Pod to a PowerLab that is turned on. **Note:** A PowerLab input can accept either a BNC connector or a Pod connector (8-pin DIN). Do not attempt to use both the BNC and 8-pin DIN connectors simultaneously on a single input.

Zeroing

1. Select "Bridge Pod" from the Channel function pop-up menu in the channel corresponding to the input that you connected the Bridge Pod.

2. A dialog box will appear (Figure 1).

3. In the left-hand window, you should see the input signal from the force transducer.

4. Turn the knob on the front of the Bridge Pod until the waveform is zeroed.

5. Click OK.

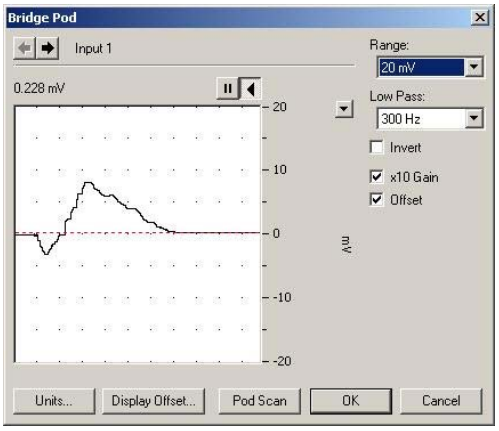

Figure 1. This Bridge Pod dialog box shows a signal that has been zeroed.

Calibration and range adjustment

To perform a calibration, you will need two weights of known mass. One gram and ten gram weights are suggested, but you should choose weights based on an approximation of the range of forces you intend to record. For small forces, use small masses. For large forces, use larger masses. The heaviest calibration weight should exceed the maximum expected force.

1. With the heavier of the two calibration weights attached to the force transducer, click Start.

2. With the weight freely hanging, ensure a stable recording is made in Chart. Adjust the Range in the Channel function pop-up menu so the deflection is about 1/2 of the channel height.

3. While still recording, remove the first calibration weight and hang the second calibration weight to the force transducer. When you get a stable recording, click Stop.

4. Select the part of the Chart trace that contains data from both weights.

5. From the Channel function pop-up menu, select "Units Conversion."

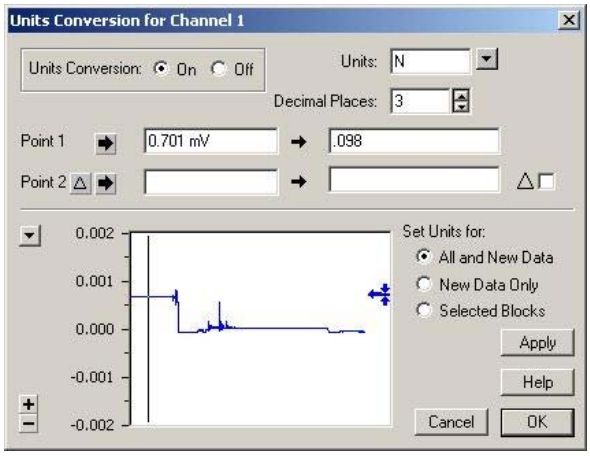

Figure 2. The Units Conversion dialog box, showing values input for Point 1.

6. In the data display panel of the Units Conversion dialog box, click the mouse on a point of the data trace that corresponds to the recording from the first calibration weight (Figure 2).

7. Click the arrow button for "Point 1." The voltage value is automatically entered into the text box. Enter the known value (grams or Newtons) for the first weight into the adjacent text box (See Appendix 1 for more details).

8. Repeat this procedure for the second weight, entering the values into the Point 2 text box.

9. Choose a unit from the Units list. If your unit of choice is not listed, you can choose Define Unit and enter your own unit abbreviation.

10. Click OK to close the dialog box.

11. The output from the force transducer will now be displayed in your unit of choice, rather than in volts.

Saving your settings

Once you have calibrated your force transducer, you can save the settings as a Chart settings file for future use.

1. From the File menu, select Save As…

2. Choose Chart Settings File from the Save as… drop-down list.

3. Name the file, choose a save loaction and click Save.

4. The channel settings will be saved in an empty Chart Settings file.

Troubleshooting

Signal is off-scale; Out of Range message appears in the Chart View

- Select a higher range from the Range menu so that the signal takes up 1/3 to 1/2 of the window height.

Signal is noisy

- Apply a low-pass filter in the Bridge Pod dialog box (Figure 1).
- Your force transducer may not be sensitive enough to detect the signal of interest. Try a force transducer that has a smaller operating range.

Unable to zero the Bridge Pod

- Make sure the Offset button is checked in the Bridge Pod dialog box (Figure 1).

Appendix: Typical unit conversions

The table below gives some typical converted values between gram weight and Newtons. To convert other masses to force, use the following equation:

$$\text{Force } (N) = \frac{\text{mass } (g)}{1000} \times 9.81$$

Mass (g)	Force (N)
1	0.0098
2	0.0196
5	0.049
10	0.0981
20	0.1961
50	0.4903
100	0.9807
200	1.9613
500	4.9035

Table 1. Conversions between grams and Newtons

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