FT-302 Force Transducer

Technical Note

FT-302

Overview

The FT-302 is a high-sensitivity dual-range research grade force transducer designed to measure forces in the 0.005 to 10 gram and 0 to 100 gram ranges. The FT-302 uses a reflective photomicrosensor to measure minute deflections of the beam under load. The deflection of the beam is less than a few hundred microns, making the sensor very isometric. In addition, its unique optical technology makes it resistant to drift and offers intrinsically low noise characteristics. The FT-302's on-board amplifiers reduce gain and adjustment requirements on connected recording amplifiers. The transducer is highly resistant to mechanical damage; its body is machined from aluminum and mounts to a standard ring stand or, with the handle removed, clamp mounts. The cable that connects the FT-302 to the recording amplifier is detachable, allowing for multiple cables to be configured for the user's choice of amplifiers. The FT-302 uses a transducer input on an iWorx data acquisition system, or an amplifier such as the ETH-256 or ETH-401.

How to Use the FT-302

To use the transducer, firmly secure it to a ring stand or other support. The long axis of the transducer should be parallel to the work surface, the attachment hooks should be pointing downward toward the work surface, and the cable connector should be facing up. While alignment of the sensor with the work surface is not critical, linearity and sensitivity will decrease if the transducer is tipped more than 30-40°.

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1) Connect the cables first to the data acquisition system or amplifier and then to the transducer.

2) After a 5 minute warm-up period, check the output of the transducer on your recorder. Zero the transducer output in LabScribe. If your data acquisition system does not have enough range to zero the transducer, use the zero adjustment knob on the transducer.

3) Once zeroed, calibrate the transducer. Typically this involves the use of two weights that are appropriate to the range in which you are recording.

Calibration of the FT-302 Force Transducer

1) Type "No Weight" in the **Mark** box. Click **Record**, and press the Enter key to attach the comment to the recording. Record for ten seconds with no weight hanging from the arm or hook of the transducer.

2) Type "5 grams" in the **Mark** box. Hang a 5 gram weight on the arm or hook of the transducer. Press the Enter key on the keyboard. Record for ten more seconds.

3) Click **Stop** to halt the recording.

Select **Save As** in the **File** menu, and name the file. Choose a destination on the computer in which to save the file. Click on the **Save** button to save the data file.

Unit Conversion

1) Scroll to the beginning of data when no weight was attached to the force transducer.

2) Use the **Display Time** icons on the LabScribe toolbar to adjust the display time of the **Main window** to show the complete calibration data on the **Main window**.

3) Click the **Double Cursor** icon so that two vertical cursors appear on the **Main window**. Place one cursor on the flat section of data collected when no weight was attached to the force transducer, and the second cursor on the flat section of data collected when the 5 gram weight was attached to the transducer.

4) Click on the arrow next to the title of the force transducer channel to open the channel menu.

5) Select **Units** from the channel menu and **Simple** from the **Units** submenu.

6) In the **Simple Units Calibration** window, select **2 point calibration** from the pull-down menu in the upper-left corner of the window.

7) Put a check mark in the box next to **Apply units to all blocks**. Notice that the voltages from the positions of the cursors are automatically entered into the value equations.

8) Enter "Zero" in the corresponding box to the right of the voltage recorded when no weight was attached to the transducer. Enter "5" in the box to the right of the corresponding voltage recorded when the 5 gram weight was hung on the hook of the transducer.

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9) Enter the name of the units, grams, in the box below the weights. Click on the **OK** button in the lower right corner of the window to activate the units conversion.

In the 10 gram range, the FT-302 will deliver approximately 75 mV/gram at X1 gain and approximately one tenth of that in the 100 gram range. From the graphs in the technical data section of this manual you can see that the sensor is actually linear to about 14 g in the 10 g range and about 140 g in the 100 g range. This upper limit will vary from transducer to transducer but will never be less than 10/100 g. The FT-302 is now ready for use.

Experiments

LabScribe experiments using the FT-302 Force Transducer include:
- **Experiment AM-2: Skeletal Muscle, Summation,** (found in the **Animal Muscle** category of the LabScribe **Settings** menu as **SkeletalMuscle-Summation-Tetanus**)
- **Experiment AM-3: Heart Muscle** (found in the **Animal Muscle** category of the LabScribe **Settings** menu as **HeartMuscle**)
- **Experiment AM-7: Crayfish Heart** (found in the **Animal Muscle** category of the LabScribe **Settings** menu as **CrayfishHeart**)
- **Experiment AM-8:** *Mytilus* **Anterior Byssal Retractor Muscle** (found in the **Animal Muscle** category of the LabScribe **Settings** menu as **ByssalMuscle**)
- **Experiment AM-9: Crayfish Gut Pharmacology** (found in the **Animal Muscle** category of the LabScribe **Settings** menu as **CrayfishGutPharmacology**)
- **Experiment AM-10: Summation, Tetanus, and Fatigue in an Intact Nerve-Muscle Prep** (found in the **Animal Muscle** category of the LabScribe **Settings** menu as **FrogNerveMuscle**)
- **Experiment AM-11: Earthworm Smooth Muscle Contractions** (found in the **Animal Muscle** category of the LabScribe **Settings** menu as **EarthwormSmoothMuscle**)

Technical Data and Specifications

How It Works

The FT-302 uses a reflective photomicrosensor to optically measure the distance of the blade from the sensor. The beam is positioned so that it stays within the initial linear region of the graph. As a result, beam movement at the 10 g point of attachment is limited to less than 500 µm and movement at the 100 g attachment point is approximately half that. Since the sensing technology is optical, there is no thermal drift. The sensor requires an amplifier/conditioner with an excitation voltage of ±5 V. Full-scale voltage output swing for either range is approximately ±1 V, so amplification requirements for the conditioner are minimal. Since the FT-302 has no integral cable, detachable cables are used to connect to amplifiers and

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conditioners in the lab. This means the FT-302 can be fitted with a variety of cables and is suited for a wide range of applications, including most smooth and striated muscle experiments.

Linearity and Drift

The drift for the FT-302 is 35mg/Hour in the 0-10g range and 350mg/Hour in the 100g range. Typical performance/calibration curves are displayed below.
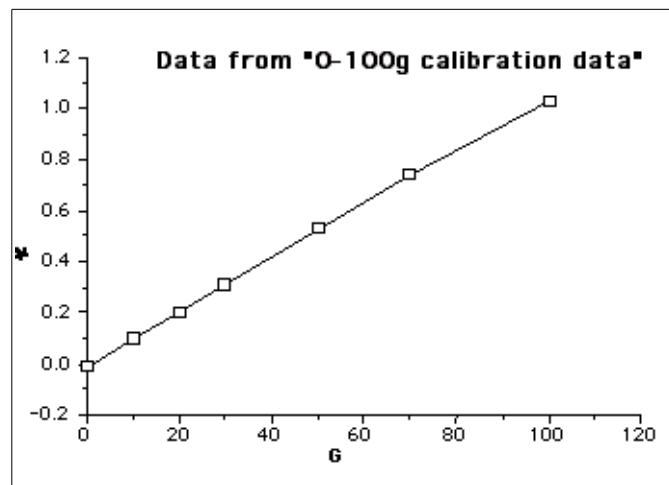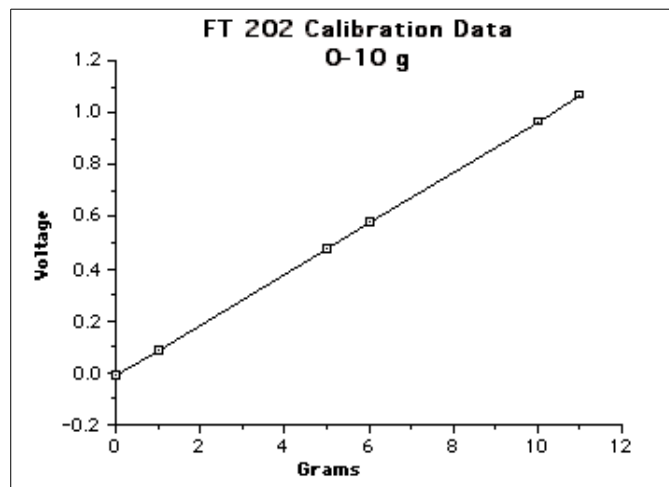

Amplifier Requirements

The FT-302 requires a standard bridge style amplifier input. The amplifier should supply power at approximately ±5 V and have a differential input. The output impedance of the FT-302 is low, so it does not require high input impedance. The connector used on the FT-302 is a standard DIN8. The connections are detailed below.

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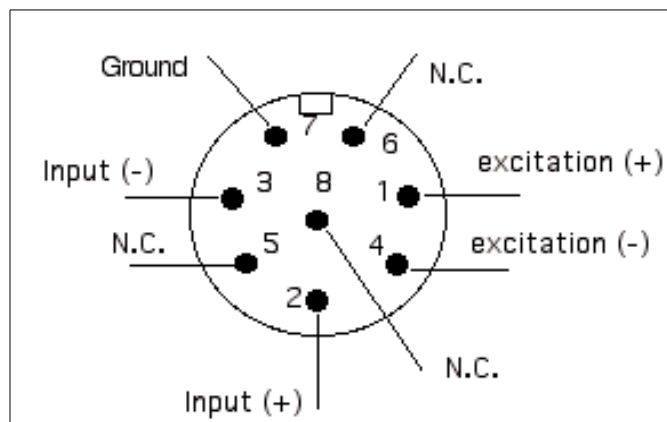
FT-302 connector pin-out (solder side)

SPECIFICATIONS	
Sensitivity	>60 mV/g (0-10 g)
Drift	<30 mg/hr (0-10 g) thermally compensated
Noise	3.0 mg max (0-10 g)
Excitation voltage	±5 V
Dimensions	2.85 cm W x 7.6 cm L x 1.5 cm H
Handle length	6.45 cm
Part number	FT-302

Care

Cleaning

Clean the FT-302 with a moistened cloth. Never immerse it in liquid. When cleaning the attachment hooks, it is unlikely that you will damage the sensor by pushing the hooks up into the body or pulling on them within reason. The hooks cannot be removed.

Storage

The FT-302 can be stored in its shipping container or left in the rack where it is used. We recommend that the sensor be left powered whenever possible to avoid the warm up period when it is switched on cold.

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