Tech Note

FT-302 Force Transducer

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. 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 recording amplifiers to which it may be connected.

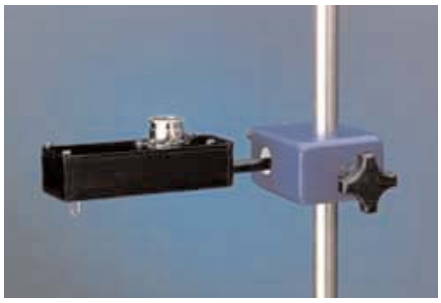

Figure 1: FT-302 Force Transducer

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 requires a transducer conditioning amplifier such as the ETH-256 or ETH-401.

How it Works

The FT-302 uses an reflective photo microsensor 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 10g point of attachment is limited to less than 500µm and movement at the 100g attachment point is approximately half that. Since the sensing technology is optical, there is no thermal drift resulting from a strain-guage. The sensor requires an amplifier/conditioner with an excitation voltage of ±4V. Full-scale voltage output swing for either range is approximately ±1V, 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 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.

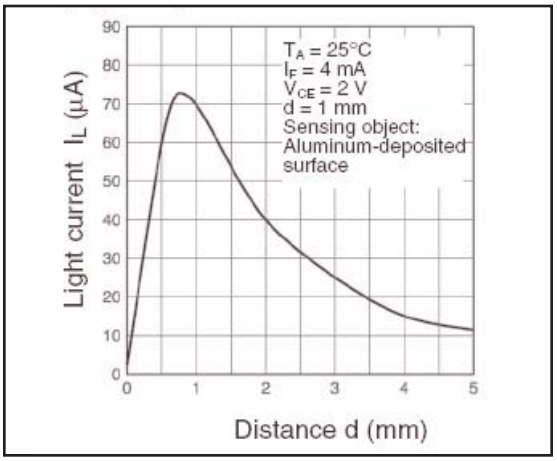

Figure 2: Sensing Distance Characteristics

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Using 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°.

Connect the cables first to the amplifier and to the transducer.

After a 5 minute warm-up period, check the output of the transducer on your recorder. If your recorder has an offset or baseline adjust, zero the transducer output. If your recorder does not have enough range to zero the transducer or if no offset adjust is present, use the zero adjustment know on the transducer. Once zeroed, calibrate the transducer per the recorder manufacturer's instructions. Typically this involves the use of two weights that are appropriate to the range in which you are recording.

In the 10g range, the FT-302 will deliver approximately 75 mV/gram at x1 gain and approximately one tenth of that in the 100g range. From the graphs in the technical data section of this manual you can see that the sensor is actually linear to about 14g in the 10 g range and about 140g in the 100g range. This upper limit will vary from transducer to transducer but will never be less than 10/100g. The FT-302 is now ready for use.

Technical Data

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.

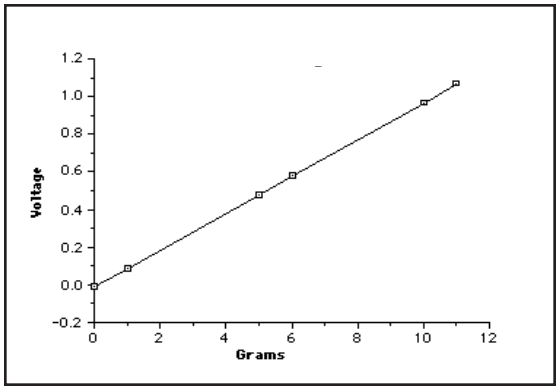

Figure 3: Calibration Data 0 - 10 grams.

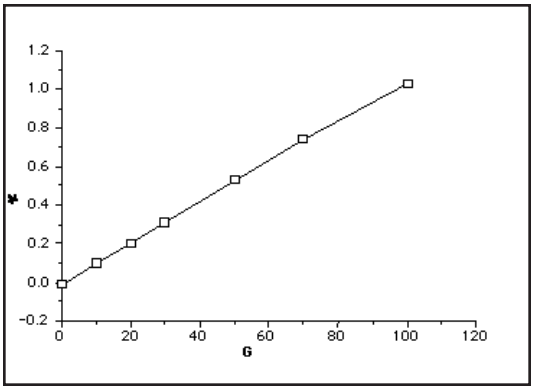

Figure 4: Calibration Data - 0 - 100 grams.

Amplifier Requirements

The FT-302 requires a standard bridge style amplifier input. The amplifier should supply power at approximately ±4V and have a differential input. The output impedance of the FT-302 is low. 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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Connector Pinout

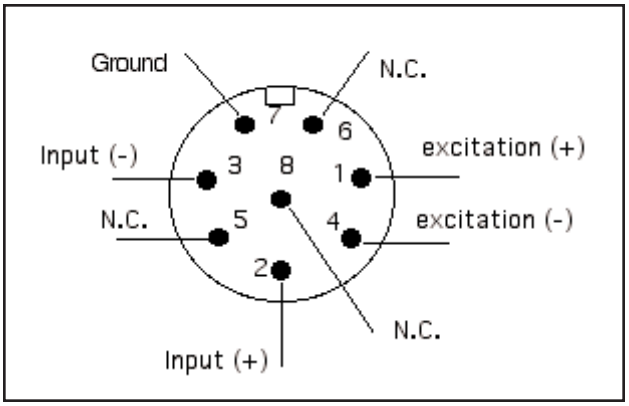

Figure 5: Connector viewed from solder side.

Care

Cleaning

Clean the FT-302 with a moistened cloth. Never immerse it in liquid. When cleaning the attachment hooks, however, 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.

Mechanical Shock

While the sensor is durable, dropping it or otherwise shocking it will produce changes in offset and overall range. The transducer zero can be adjusted by using the "Transducer Zero" knob. Range and sensitivity are adjusted at the factory using the beam adjustment screw and are not user adjustable. Transducers with intolerable changes in range sensitivity or linearity caused by mechanical shock should be returned to the factory for realignment.

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