

# Dual-Range Force Sensor

(Order Code DFS-BTA)

The Dual-Range Force Sensor is a general-purpose device for measuring pushing and pulling forces. It can be used as a replacement for a hand-held spring scale or mounted on a ring stand. It can also be mounted on a dynamics cart to study collisions. Forces as small as 0.01 N and as large as 50 N can be measured. The Dual-Range Force Sensor can be used for a variety of experiments, including

- Studying force and impulse during collisions
- Studying simple harmonic motion
- Monitoring frictional force
- Studying Hooke's law
- Monitoring the thrust of model rocket engines
- Measuring the force on a dynamics cart
- Measuring the force required to lift a known mass using simple machines

**Note:** Vernier products are designed for educational use. Our products are not designed nor are they recommended for any industrial, medical, or commercial process such as life support, patient diagnosis, control of a manufacturing process, or industrial testing of any kind.

## What's Included

- Dual-Range Force Sensor
- Hook attachment for measuring pulling forces
- Bumper attachment for measuring pushing forces
- Nylon thumb screw
- Accessory Rod that can be used as a handle or mount



Bumper attached



Accessory rod and hook attached

## Compatible Software and Interfaces

See [www.vernier.com/manuals/dfs-bta](http://www.vernier.com/manuals/dfs-bta) for a list of interfaces and software compatible with the Dual-Range Force Sensor.

## Assembly

The Dual-Range Force Sensor is designed to be mounted on a ring stand, cart, track, or force table in several different ways. Use a 13 mm rod extended through the hole in the Dual-Range Force Sensor. Tighten the included thumb screw.

## Getting Started

1. Plug the sensor into the interface (LabQuest 3, LabQuest Mini, etc.).
2. Connect the interface to your device.
  - If using USB, connect to the USB port on your computer.
  - If using Bluetooth® wireless technology, click your interface type and then select your device.
3. Prepare for data collection:
  - Vernier Graphical Analysis®: Launch the app, if necessary, and click Sensor Data Collection.
  - LabQuest® App: Choose New from the File menu.

The software will identify the sensor and load a default data-collection setup. You are now ready to collect data.

## Need Additional Information?

Visit the following link:

[www.vernier.com/start-lq-sensor](http://www.vernier.com/start-lq-sensor)

## Using the Product

Connect the sensor following the steps in the Getting Started section of this user manual.

Note that the Dual-Range Force Sensor measures forces in only one dimension.

## Videos

View videos related to this product at [www.vernier.com/dfs-bta](http://www.vernier.com/dfs-bta)

## Calibration

You should not have to perform a new calibration when using the Dual-Range Force Sensor in the classroom. The sensor is sensitive enough to measure the weight of the sensor hook. To minimize this effect, simply place the sensor in the orientation in which it will be used (horizontal or vertical) and choose zero in the software. Much like pressing “Tare” on a scale, zeroing will define the current situation as 0 N of force.



*Mounted for vertical data collection*

If you want to improve the calibration, it is easy to recalibrate. Follow the same two point calibration procedure used in calibrating most Vernier sensors. One of the points is usually with no force applied.

- Remove all force from the sensor and place it in the vertical orientation.
- Select the calibration option in the program you are using.
- Enter 0 as the first known force.
- Apply a known force to the sensor. The easiest way to do this is to hang a labeled mass from the hook on the end of the sensor. Enter the weight of the mass (**Note:** 1 kg applies a force of 9.8 N).

For calibration in the  $\pm 10$  N range, we recommend using 300 g of mass (2.94 N) for the second calibration point. For calibration in the  $\pm 50$  N range, we recommend using a 1 kg mass (9.8 N) for the second calibration point. Be careful not to exceed the selected range setting during calibration. If you plan to use the Dual-Range Force Sensor in a different orientation (horizontal vs. vertical) than calibrated, simply zero the sensor after calibrating to account for the change.

The default calibration for the Dual-Range Force Sensor is linear (Force) = (slope) (output voltage) + (intercept), with the following values for the slope and intercept:

$\pm 10$  N range – slope =  $-4.9$  N/V, intercept = 12.25 N

$\pm 50$  N range – slope =  $-24.5$  N/V, intercept = 61.25 N

## Specifications

As with any instrument, there is a trade-off between accuracy and the range of forces that can be measured. In general, you should use the  $\pm 10$  N range if you can. If the forces exceed 10 N, you need to use the  $\pm 50$  N range. In normal use, the resolution with the two different switch settings will be

Accuracy	$\pm 0.2$ N (when calibrated)	
Range	Resolution	Default Calibration Values
$\pm 10$ N	0.01 N	N: slope = $-4.9$ , intercept = 12.25 lbs: slope = $-1.1016$ , intercept = 2.7539
$\pm 50$ N	0.05 N	N: slope = $-24.5$ , intercept = 61.25 lbs: slope = $-5.5083$ , intercept = 13.77

## How the Sensor Works

The Dual-Range Force Sensor uses strain gauge technology to measure force based on the bending of a beam. Strain gauges attached to both sides of the beam change resistance as the beam bends. The strain gauges are used in a bridge circuit such that a small change in resistance will result in a change in voltage. This voltage change is proportional to the change in force. A switch allows you to select either of two ranges:  $\pm 10$  N or  $\pm 50$  N.

## Troubleshooting

For troubleshooting and FAQs, see [www.vernier.com/til/1429](http://www.vernier.com/til/1429)

## Repair Information

If you have watched the related product video(s), followed the troubleshooting steps, and are still having trouble with your Dual-Range Force Sensor, contact Vernier Technical Support at [support@vernier.com](mailto:support@vernier.com) or call 888-837-6437. Support specialists will work with you to determine if the unit needs to be sent in for repair. At that time, a Return Merchandise Authorization (RMA) number will be issued and instructions will be communicated on how to return the unit for repair.

## Accessories/Replacements

Item	Order Code
Clay-Holder Bumpers with Clay	CLAY-BUMPERS
Bumper and Launcher Kit	BLK
Reflex Hammer Accessory Kit	RFX-ACC
Adapter for Pasco Cart	PCA-DFS
Force Table Adapter	FTA-DFS
Air Track Adapter	ATA-DFS
Springs Set	SPRINGS
Analog Extension Cable	EXT-BTA
Replacement Rod for Dual-Range Force Sensor, Photogate, or WDSS, 5 in	ACC-ROD
Dual Range Force Sensor Replacement Parts Kit	DFS-RPK

## Warranty

Warranty information for this product can be found on the Support tab at [www.vernier.com/dfs-bta](http://www.vernier.com/dfs-bta)

General warranty information can be found at [www.vernier.com/warranty](http://www.vernier.com/warranty)



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