FORCE SENSOR 0663I

WITH TWO RANGES

±5 N AND ±50 N

User's Guide

Figure 1. The Force sensor with two ranges ±5 N and ±50 N

CENTRE FOR MICROCOMPUTER APPLICATIONS

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Description

The Force sensor with two ranges 0663i is a general-purpose device for measuring forces. It can be used as a replacement for a hand-held spring scale, can be mounted on a ring stand or on a dynamics cart to study collisions. It measures both pulls and pushes.
The force sensor uses strain gage technology to measure force, based on the bending of a beam. Strain gages attached to both sides of the beam change resistance as the beam bends. The strain gages 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. The switch allows selecting either of two ranges: ±5 N or ± 50 N.
A maximal force of 80 N can be applied to the sensor, for forces above 80 N the sensor can be damaged permanently.
The sensor is equipped with a BT-plug and can be connected to the interfaces **U**LAB, CoachLab, CoachLab II/II+. Furthermore the sensor can be used in combination with other interfaces, like Texas Instruments CBL™, CBL2™ and Vernier LabPro without the need of an adapter.

Several accessories are included with the Force sensor, which are shown in figure 2:

- A *thumb screw* to mount the sensor on a ring standard;
- A *utility handle* to mount the sensor to various clamps;
- A *bumper* to use for collision experiments, or any time you want to measure pushing forces.
- A *hook* to use to measure pulling forces.

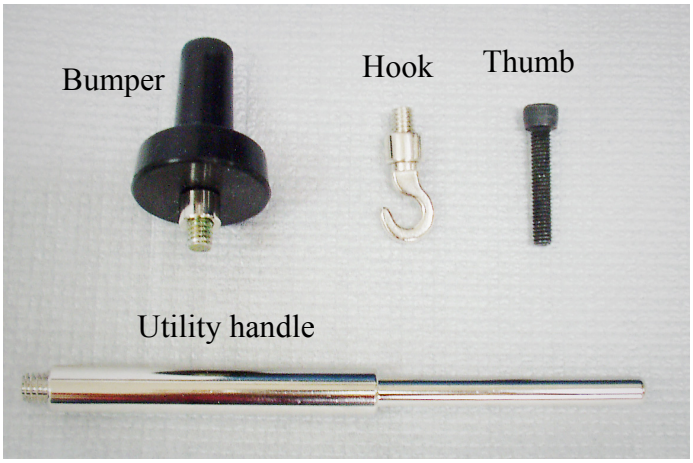

Figure 2. Accessories of the Force sensor

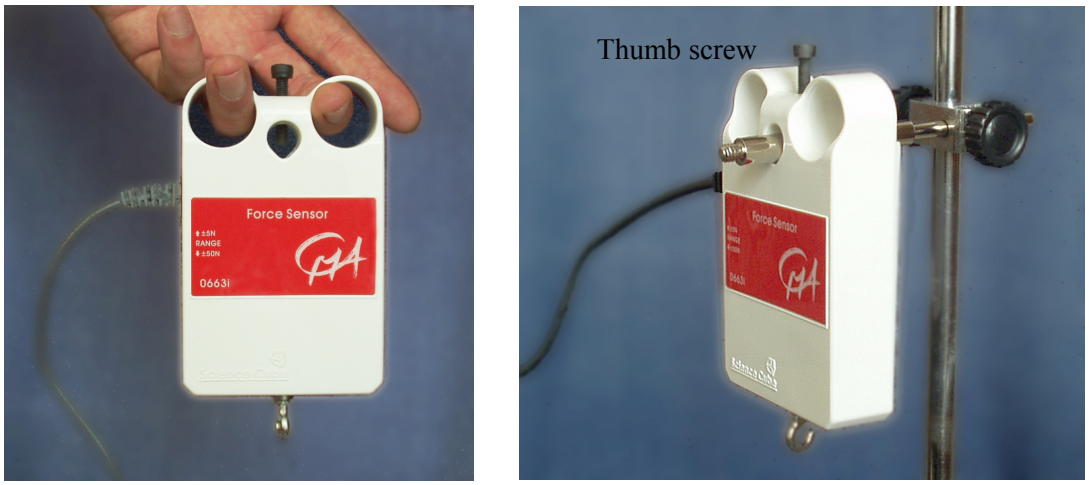

Figure 3. The Force sensor can be hold by hand or mounted on a ring stand.

Sensor specifications

The Force sensor has a memory chip (EEPROM) with information about the sensor. Through a simple protocol (I^2C) the sensor transfers its data: name, quantity, unit and calibration to the interface[1].

Examples of experiments

The Force sensor with two ranges can be used in a variety of experiments, including:
- Measuring of forces and impulse during collisions,
- Studying simple harmonic motion,
- Measuring of centripetal or frictional forces,
- Studying Hook's law.

Calibration

The output of the force sensor is linear with respect to the applied force. To collect data you can:
1. Use the calibration supplied by the sensor EPROM memory.
2. Use the calibration supplied in the standard sensor library of the Coach program. The names of the Force sensor in the sensor library of Coach are:
   Force sensor with two ranges (0663i) (CMA) (–5..5 N), and
   Force sensor with two ranges (0663i) (CMA) (–50..50 N).
3. Calibrate the force sensor. The calibration can be performed in the Coach software. You can e.g. perform a standard two-point calibration using two different weights.

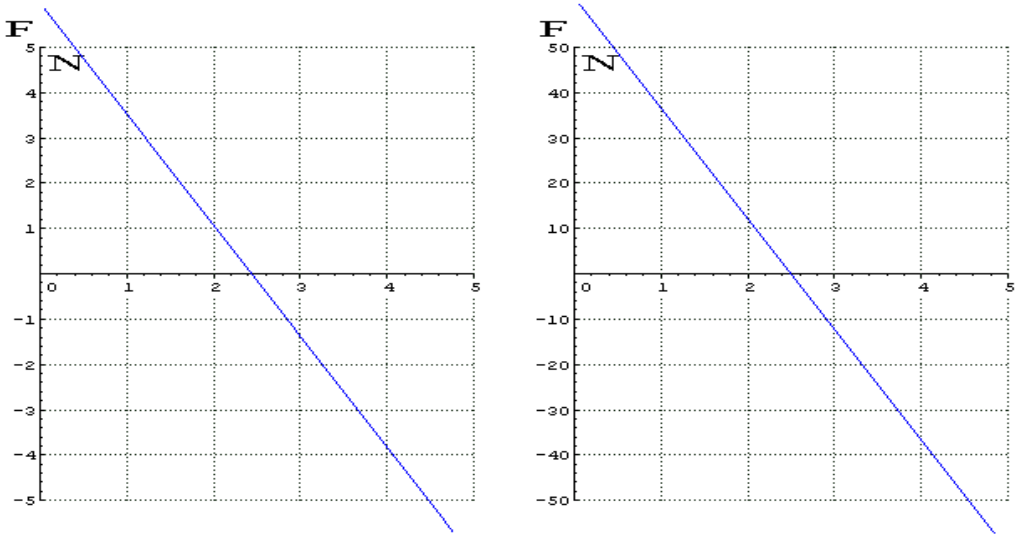

Figure 4. Default calibrations of the Force sensor with two ranges
(used in the standard Coach library and sensor memory):
±5 N range (left): F (N) = –2.45 * V_{out} (V) + 5.98 calibration coefficients: a = –2.45; b = 5.98.
±50 N range (right): F (N) = –24.4 * V_{out} (V) + 61.0 calibration coefficients: a = –24.4; b = 61.0

[1] This is valid for the following interfaces: CMA €Lab**,** BT inputs of CoachLab II/II$^+$ and **U**LAB, TI CBL™and CBL2™, and Vernier LabPro.

- In the range ±5 N the sensor is so sensitive that the weight of the connection element of the sensor influences the calibration in the vertical direction (even more effect when the hook or bumper is mounted). Calibrate the sensor in this range in the horizontal position to avoid this effect.
- Because the sensor generates the output voltage of 2.5 V for the force of 0 N it can happen that the sensor does not indicate exactly 0. This applies especially for the ±5 N range, at which the sensor signal is internally amplified.
- Use the 'Shift calibration' option or the 'Set to zero' option in Coach to adjust the zero point of the sensor. These options are also useful to adjust the zero level when something is attached to the sensor, for example in experiments to study oscillations of a spring attached to the sensor (the sensor oscillates around the value of 0 N).

Technical data

Switch position	±5 N	±50 N
Force range	10 N	100 N
Output voltage	0 – 5 V	0 – 5 V
Calibration function	F (N) = –2.45 * V_{out} (V) + 5.98	F (N) = –24.4 * V_{out} (V) + 61.0
	Offset can differ slightly for different samples of this sensor.	
Resolution using 12 bit A/D converter	0.003 N (theoretical)	0.03 N (theoretical)
Accuracy	±0.01 N (due to noise)	±0.05 N (due to noise)
Maximum force	80 N (For forces above this value the sensor can be damaged permanently)	
Dimensions (hxwxd)	116 x 75 x 25 mm³	
Sensor information for Auto-ID and calibration	256 byte EPROM	
Connection	Right-hand BT (British Telecom) connector	

Warranty:

The 0663i Force sensor with two ranges is warranted to be free from defects in materials and workmanship for a period of 12 months from the date of purchase provided that it has been used under normal laboratory conditions. This warranty does not apply if the sensor has been damaged by accident or misuse.

Note: *This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.*
