FORCE SENSOR

Description D036

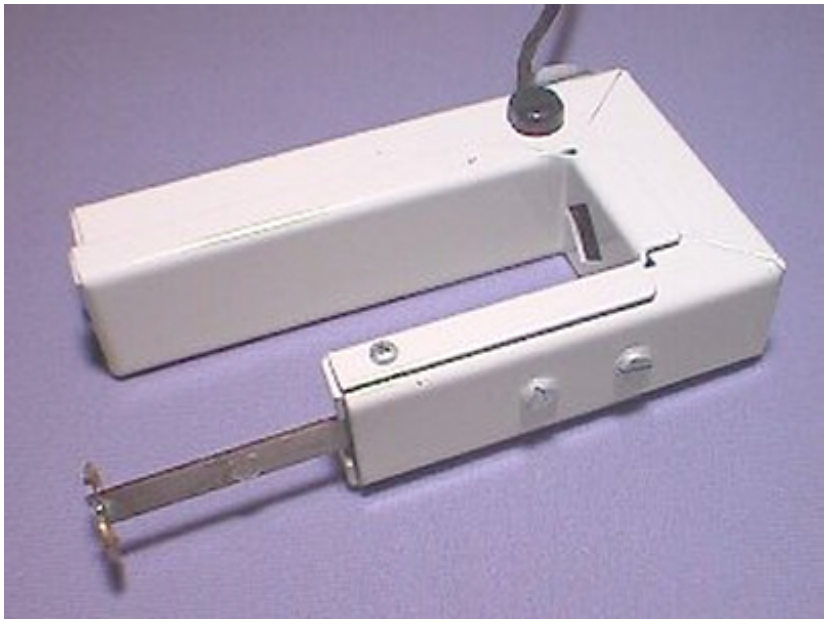


Figure 1. Force Sensor

Short description

The force sensor offers the opportunity to measure forces in various circumstances. The sensor consists of a metal case, out of the case comes a flat metal beam. The force sensor measures forces between -20 up to 20N. The range can be changed by adjusting a screw. The sensor can be mounted on a ring stand or used as a replacement for a hand-held spring scale. Strain gauges are installed on the metal beam. They are part of an electrical circuit. Bending the beam changes the resistance of the strain gauges. This results in a potential difference, from the sensor, that changes linearly with the applied force.
The force sensor is delivered with a BT-plug and can be connected to the following interfaces:

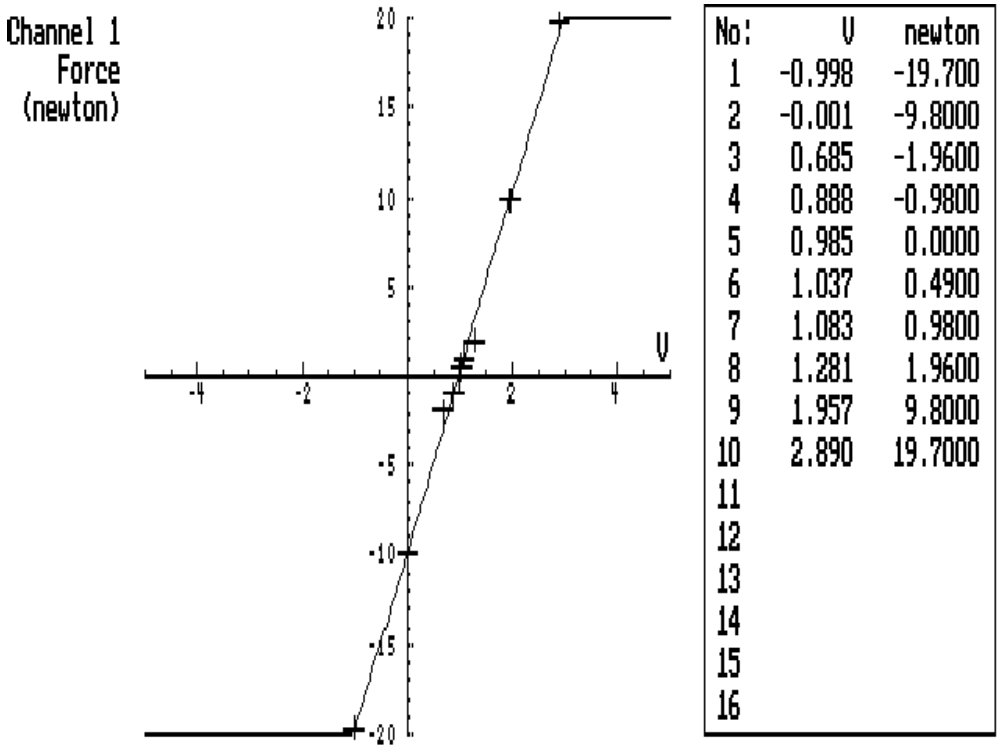
- UIA/UIB through Measuring console (via 0520 adapter)
- CoachLab
- CoachLab II
- SMI (via 0520 adapter)
- Texas Instruments CBL™ data-logger.

There is an adapter (art. 0520) to connect sensors with BT-plugs to 4-mm inputs.

Suggestion for experiments

- Measurements of forces and impulse during collisions.
- Studying simple harmonic motion.
- Measurements of centripetal forces.
- Measurements of frictional forces.

Calibration



No:	V	newton
1	-0.998	-19.700
2	-0.001	-9.8000
3	0.685	-1.9600
4	0.888	-0.9800
5	0.985	0.0000
6	1.037	0.4900
7	1.083	0.9800
8	1.281	1.9600
9	1.957	9.8000
10	2.890	19.7000
11		
12		
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15		
16		

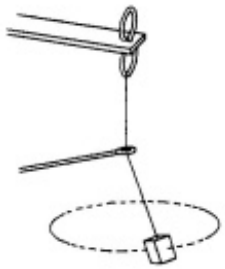
Figure 2. Calibration of the force sensor

The name of the position sensor in the sensor library of Coach 5 program is **Force sensor (036&bt) (CMA).**

Using the force sensor

Direction of the force

The sensor registers the force in the direction perpendicular to the plane of the beam. The sensor is not sensitive for any component of the applied force in the plane of the beam. For instance, to measure the tension in a rope connected to a rotating mass, you have to lead the rope through a smooth small ring and position this ring straight under the hook of the sensor



Example of the use of the force sensor.

Oscillations

The flat beam, used to measure the forces, has a resonant frequency of about 150 Hz. When the beam is used for collisions, the beam will oscillate with this frequency after the collision. If a mass is connected to the beam, the frequency will decrease.

Bending of the beam and maximum load

The beam will bend when a force is applied, approximately 0.25 mm/N.

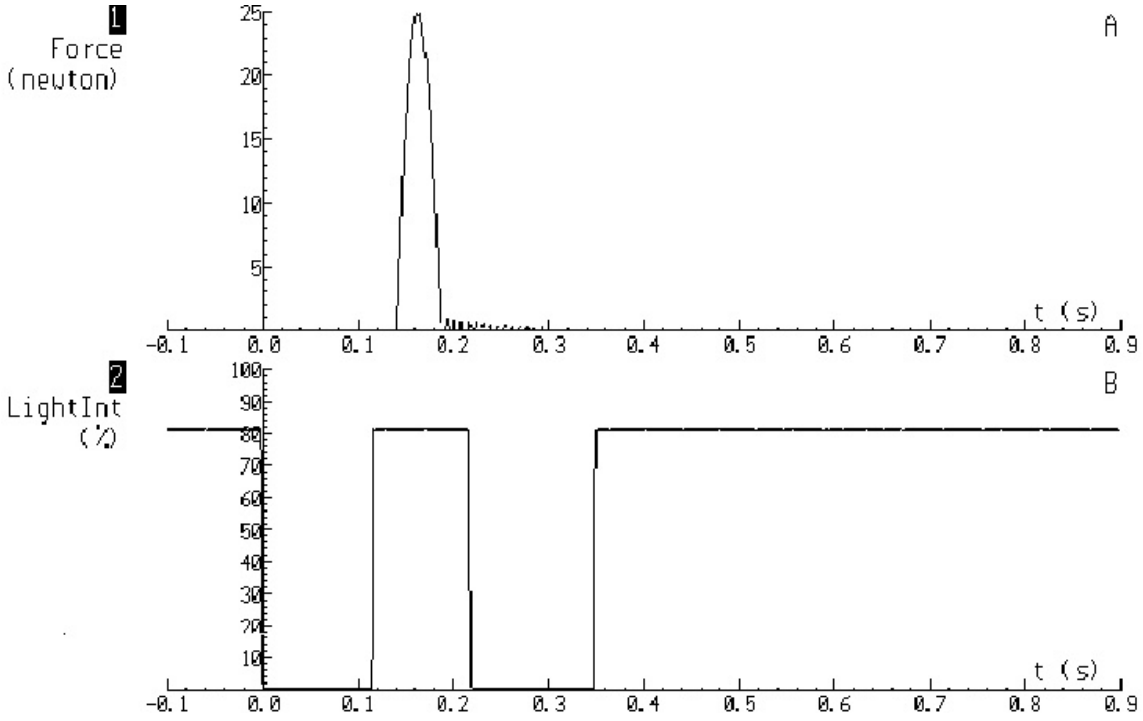


Figure 3. Results from the collision of a trolley with the force sensor. Using the light gate time, measured on channel 2, the change of velocity and therefore the change of linear momentum can be calculated.

Technical data

Sensitivity	0.1 V/N (Standard adjustment at delivery) Adjustable between 0.065 V/N and 0.2 V/N. You can adjust the sensitivity by the small screw, furthest from the screw for mounting the sensor, behind an opening in the case. Rotating the adjustment screw clockwise increases the sensitivity. Adjustment of the sensitivity influences the offset unless this is set at 0 V.
Output voltage	-1 to +2V
Force range	-20 to +20 N (at standard adjustment)
Resolution using 12 bit 5V A/D converter	0.01 N (at standard adjustment)
Current	max. 10 mA
Offset	1 V (Standard adjustment at delivery) Adjustable between -2.8 V and + 2.8 V. You can adjust the offset by the small screw, close to the screw for mounting the sensor, behind an opening in the case. Rotating the screw clockwise decreases the offset.
Accuracy	± 0.05 N due to noise in the signal. The flat beam can oscillate with a frequency of 150 Hz. It bends 0.25 mm per Newton applied force.
Use	The sensor registers the force in the direction perpendicular to the flat beam. Connection hooks are attached to each side of the beam. The sensor is not sensitive to the component of a force in the plane of the beam.
Maximal force	30 N without permanent damage.
Dimensions	Length = 15 cm; Width = 4 cm; Height = 10 cm
Connection	 BT (British Telecom) plug

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