ACCELEROMETER (±5 g)

Description D0385bt

Figure 1. The Accelerometer

Short description

The Accelerometer (±5 g) can be used for a wide variety of experiments and demonstrations, both inside the classroom and outside. Some suggested activities in the classroom are:

- Measure the acceleration of dynamics cars as they roll down inclines.
- Measure the acceleration of dynamics carts as a force is applied to them. If you have a Force sensor (art. 036bt or art. 0362bt), monitor the force at the same time and demonstrate Newton's second law.
- Mount the Accelerometer on a mass that is hanging from a spring. Start it in simple harmonic motion and monitor the acceleration. If you have a Force sensor (art. 036bt or art. 0362bt), measure the force at the same time and study the relationship between acceleration and force.
- Use the Accelerometer to measure the tilt of an object (for example a vertical balk placed on the table).
  Angles can be measured to the nearest degree.
- Measure acceleration as you swing the Accelerometer as a pendulum bob.
- Body movements: put the Accelerometer under your belt buckle, and jump up and down. Measure the acceleration as you land, both with your knees flexed and with your knees held more stiff.

If you have the CBL data-logger you might try to measure acceleration:

- on elevators
- on amusement park rides
- in a car.

How the Accelerometer works

The Accelerometer senses acceleration using an integrated circuit (IC) of a type originally designed to control release of air bags in an automobile. This IC is micro-machined with very thin "fingers" carved in silicon. These fingers flex when accelerated. They are arranged and connected like the plates of a capacitor. As the finger flex, the capacitance changes, and a circuit included in the IC monitors capacitance, converting it into voltage. An external op-amp circuit amplifies and filters the outputs from the IC.

The Accelerometer is delivered with BT plug and can be connected to the following interfaces:

- CoachLab and CoachLab II
- ULab
- UIA/UIB through Measuring Console (via 0520 adapter)
- SMI (via 0520 adapter)
- Texas Instruments CBL™ and CBL2™ dataloggers

- Vernier LabPro™.

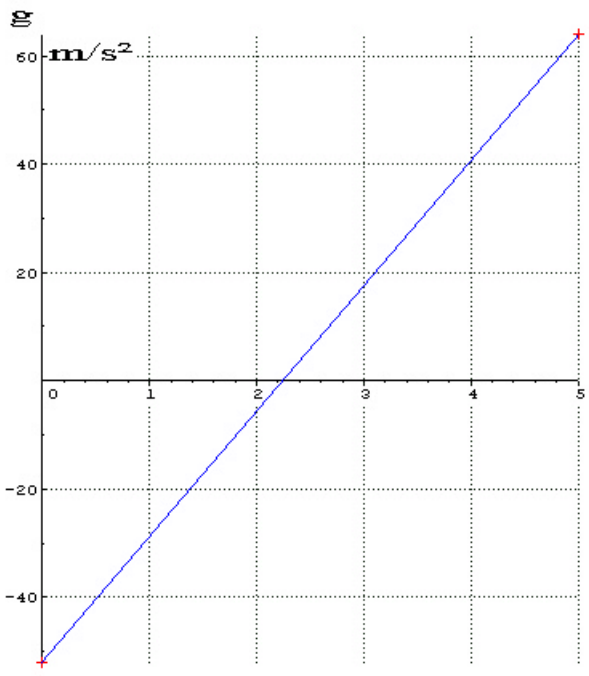
There is an adapter (art 0520) to connect sensors with BT plugs to 4-mm inputs.

The Accelerometer measures acceleration along the line marked by the arrow on the label, in m/s^2 of g (1 g is the acceleration due to gravity at the earth's surface or 9.8 m/s^2).
The measurement range of sensor is –5 g (-49 m/s^2) to +5 g (+49 m/s^2). This is a range of accelerations which human body could experience without damage. Many collisions will produce much larger accelerations. In fact, dropping the Accelerometer on a hard surface from even a few centimeters can produce acceleration of a hundred g's. The Accelerometer will not be damaged by accelerations up to 1000 g's.

The offset voltage (voltage output at 0 m/s^2) will drift somewhat with temperature. Performing a calibration prior to the experiment will provide the best results. The calibration in Coach 5 (or Coach 5 Junior) software is explained below.

Calibration

Calibration may be done using the acceleration due to gravity.
To calibrate the sensor for measuring acceleration in the horizontal direction, position the accelerometer with the arrows pointing down for the first calibration point. Define this as -9.8 m/s^2 or -1g.
Rotate the Accelerometer so the arrows point up and use the reading for the second calibration point. Define this as 9.8 m/s^2 or +1g.
The accelerometer will then read 0 with no acceleration when held horizontally.
If you want to calibrate for measuring acceleration in the vertical direction, follow the procedure above, but define the first calibration point as 0 m/s^2 or 0g and the second point as 19.6 m/s^2 or 2 g.



Calibration graph of the Accelerometer.

The name of the accelerometer in the sensor library of Coach 5 program is **Low g accelerometer (385) (CMA).**

Using multiple Accelerometers

Two Accelerometer mounted at the right angles allow you to study acceleration in a plane. This works well, for example, in an automobile.

You can mount three Accelerometers at right angles to study acceleration in every direction (park rides, bungee jumping). Calibrate each Accelerometer for measuring horizontal acceleration. Mount them at right angles.

During the measurements in Coach Junior (Coach 5) it is possible to display in diagram components and resultant of the acceleration.

Technical data

Resolution using 12 bits 5V AD converter	(As shipped) is about 0.5 m/s^2 . The resolution is limited by the noise inherent in the accelerometer sensor.
Output voltage	0 - 5 V
Acceleration range	-5 g (-49 m/s^2) to +5 g (+49 m/s^2) The Accelerometer will not be damaged by accelerations up to 1000 g
Accuracy	± 0.5 m/s^2 (± 0.05g)
Frequency response	0 - 100 Hz
Connection	 BT (British Telecom) plug

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