Low g Accelerometer BT10i

User's Guide

CENTRE FOR MICROCOMPUTER APPLICATIONS

https://www.cma-science.nl

Short description

The CMA Low g Accelerometer BT10i measures acceleration in the range between – 4.8 g[1] (-47.0 m/s^2) to 4.8 g (47.0 m/s^2). The sensing element of the sensor is mounted inside the round box and the arrow on the label of this box marks the direction in which acceleration is measured. If the sensor is at rest and oriented with the arrow pointing down its acceleration value is - 1.0 g (-9.8 m/s^2). When the arrow points up the measured acceleration value is 1.0 g (9.8 m/s^2). When the axis arrow is held horizontally the measured acceleration value is zero.

The range of accelerations measured by the Low g Accelerometer lay in the range 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.
DO NOT drop the sensor directly onto a solid surface or use it in collisions, accelerations above ± 4.8 g will damage the sensor.

The Low g Accelerometer is delivered with two pieces of Velcro tape, which can be used to mount the round box of the Accelerometer on a moving object.

The Low g Accelerometer can be directly connected to analog BT inputs of the CMA interfaces. The sensor cable BT - IEEE1394 needed to connect the sensor to an interface is not supplied with the sensor and has to be purchased separately (CMA Article BTsc_1).

Sensor recognition

The Low g Accelerometer has a memory chip (EEPROM) with information about the sensor: its name, measured quantity, unit and calibration. Through a simple protocol this information is read by the CMA interfaces and the sensor is automatically recognized when it is connected to these interfaces. If your Low g Accelerometer is not automatically detected by an interface you have to manually set up your sensor by selecting it from the Coach Sensor Library.

Calibration

The CMA Low g Accelerometer BT10i is supplied calibrated. The output of the Accelerometer is linear with respect to the acceleration. The supplied calibration function is: $a(m/s^2) = 31.4103 * V_{out}(V) – 78.5256$.
The Coach program allows selecting the calibration supplied by the sensor memory (EEPROM) or the calibration stored in the Sensor Library. For better accuracy the pre-defined calibration can be shifted.
For even more accurate measurements a new user calibration can be performed using the acceleration due to gravity. To calibrate the sensor:

- Position the accelerometer with the arrow pointing down for the first

[1] 1 g is the acceleration due to gravity at the earth's surface and is equal to 9.8 m/s^2.

calibration point. Define this as -9.8 m/s^2 or -1.0 g.

- Rotate the Accelerometer so the arrow points up and use the reading for the second calibration point. Define this as 9.8 m/s^2 or 1.0 g.

The accelerometer will read 0.0 m/s^2 or 0.0 g when it is held horizontally.

Suggested experiments

The Accelerometer can be used for a wide variety of experiments, both inside and outside the classroom. The Accelerometer should be mounted in the appropriate orientation for an experiment (so that its axis is in the direction of interest).

- Measuring acceleration of a dynamics cart on a track.
- Measuring the tilt of an object (for example a vertical balk placed on the table). Angles can be measured to the nearest degree.
- Measuring acceleration as you swing the Accelerometer as a pendulum bob.
- Measuring accelerations during body movements: put the Accelerometer under your belt buckle, and jump up and down, land both with your knees flexed and with your knees held more stiff.
- If you have the CMA VinciLab data-logger you might measure acceleration on elevators, on amusement park rides, on playground apparatus, on remote-control toy cars, in a car, etc.
- To measure acceleration in two or three directions mount two or three Accelerometers at right directions.

Interpretation of Accelerometer measurements

An accelerometer is an electromechanical device that measures acceleration forces. Such forces may be static, like the constant force of gravity, or, as is the case with many mobile devices, dynamic to sense movement or vibrations.

Also the CMA Low g Accelerometer is sensitive to both, movement acceleration and the Earth's gravitational field and interpreting its measurements is complex.

The accelerometer does not measure gravity; it actually measures "non-gravitational" acceleration - the component of "total acceleration minus gravity" along its input axis. This is the acceleration it experiences relative to free fall.

The basic principle of operation behind the accelerometer is the displacement of a small proof mass, which is attached to the case with a spring that deflects in proportion to the force applied to the proof mass. When the device is in rest the constant gravity force is acting on the proof mass. The only measured acceleration is on this moment the acceleration due to gravity. As acceleration is applied to the device, consistent with Newton's second law of motion (F = m*a) an additional force proportional to the applied acceleration develops. The accelerometer output is proportional to the net acting force and respectively to the acceleration of the proof mass.

Accelerometers are used in many modern devices such as:

- In laptops to protect hard drives from damage.

- In cars to determine the trigger point for release airbag system or to trigger belt tensioners.
- In mobile phones to determine the orientation of the screen and to adjust the screen resolution and mode.
- In gaming consoles e.g. the Nintendo Wii use accelerometers in the hand controllers.

Technical Specifications

Sensor kind	Analog, generates an output voltage between 0 - 5 V
Measuring range	- 4.8 g .. 4.8 g (-47.0 m/s^2 .. 47.0 m/s^2)
Resolution	± 0.004 g
Accuracy	0.05 g
Frequency Response	0 - 100 Hz
Calibration function	a (m/s^2) = 31.4103*V_{out}(V) – 78.5256 (stored in the sensor EEPROM memory) a (g) = 3.2051*V_{out}(V) – 8.0128
Connection	IEEE1394 connector for BT-IEEE1394 sensor cable. Sensor cable is not delivered with the sensor.

Warranty:

The Low g Accelerometer BT10i is warranted to be free from defects in materials and workmanship for a period of 24 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.*

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