

DIFFERENTIAL VOLTAGE SENSOR 0210i -10 .. +10 V User's Guide



Figure 1. The Differential Voltage sensor -10 .. +10 V



CENTRE FOR MICROCOMPUTER APPLICATIONS

<http://www.cma-science.nl>

Description

The Differential Voltage sensor 0210i is designed for exploring the basic principles of electricity. With a wide input voltage range of ± 10 V this sensor can be used to measure voltages in AC and DC circuits.

The sensor has differential inputs, which means that measurements can be done directly across circuit elements without the constraints of common grounding. It can be used to measure positive potentials, as well as negative potentials. It has two banana (4-mm) plugs for easy connection.

The Differential Voltage Sensor should be connected parallel to a circuit element. It measures the potential difference between the V_{+} - red plug and the V_{-} - black plug. The measured voltage goes through an amplifier unit and the output of the sensor is adjusted to the range of ± 7 V, which can be measured by an interface.

The sensor is provided with over-voltage protection and voltages up to ± 50 V (related to ground) will not damage the sensor. It never can be used for higher voltages or 220V.

The sensor is excellent to sample AC-signals at relative high frequencies (< 100 kHz).

The sensor is equipped with a BT plug and can be connected to the following CMA interfaces: €Lab, CoachLab II/II⁺ and ULAB. Furthermore the sensor can be used with Texas Instruments CBL™, CBL2™ and Vernier LabPro.

Sensor specifications

The Differential Voltage sensor has a memory chip (EEPROM) with information about the sensor. Through a simple protocol (I²C) the sensor transfers its data: name, quantity, unit and calibration to the interface¹.

Examples of experiments

The Differential Voltage sensor can be used in various experiments such as:

- charging and discharging capacitors,
- characteristics of a light bulb and a diode,
- measurements of internal resonance and EMF,
- measurements in series and parallel electrical circuits.

Together with a Current Sensor it can be used to explore the relationship between the current and the voltage in electrical circuits - the Ohm's Law.

¹ This is valid for the following interfaces: CMA €Lab, BT inputs of CoachLab II/II⁺ and ULAB, TI CBL™ and CBL2™, and Vernier LabPro.

Calibration

The output of the Differential Voltage sensor is linear with respect to the input voltage. To collect data you can:

1. Use the calibration supplied by the sensor EEPROM memory.
2. Use the calibration supplied in the standard sensor library of the Coach program.
3. Calibrate the sensor using known voltages (a standard, simple 2-point calibration can be done). User calibration can be performed in the Coach software.

The name of the Differential Voltage sensor in the sensor library of the Coach program is **Voltage sensor (differential) (0210i) (CMA) (-10 ..10 V)**.

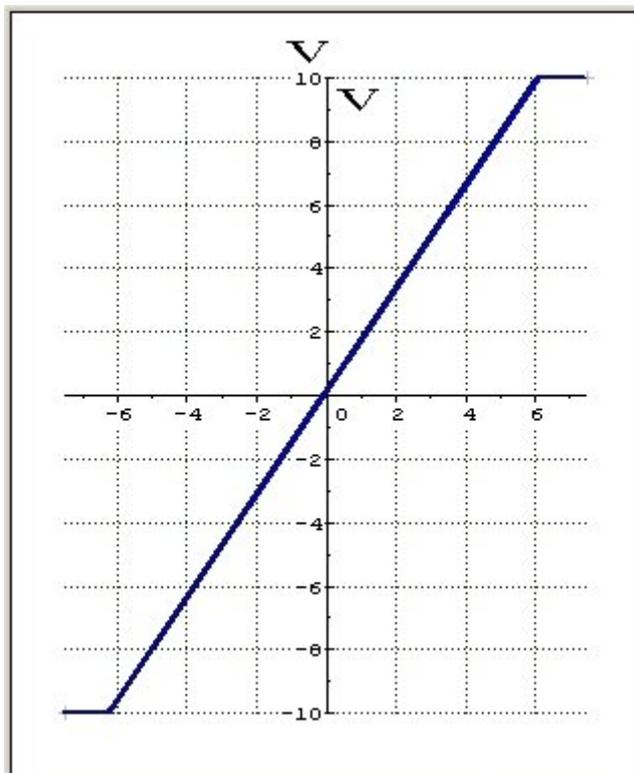


Figure 2.

Default calibration graph of the Differential Voltage Sensor (used in the Coach sensor library and in the sensor memory).

$$V_{in} (V) = 1.616 * V_{out} (V) - 0.0081$$

where $V_{in} = V_{+} - V_{-}$.

Default linear calibration coefficients:

$$a=1.616; b=-0.0081$$

Technical data

Differential input voltage range Common-mode input voltage range	± 10 V (voltage between input terminals) ± 50 V (voltage related to ground)
Output voltage range	± 7 V
Gain	0.619 x
Resolution using 12 bits A/D converter	7.9 mV
Calibration function	$V_{in} (V) = 1.616 * V_{out} (V) - 0.0081$ where $V_{in} = V_+ - V_-$
Input impedance to ground	each terminal 1 M Ω
Input offset voltage error	typical ± 8 mV
Common-mode input voltage error	typical 0.03 mV/V (0 – 500 Hz)
Non-linearity	< 0.001 %
Slew rate	10 V/ μ s (maximum output voltage variation)
Bandwidth (small signal)	1.2 MHz (-3dB)
Supply voltage Supply current	5 V DC typical 19 mA
Maximum differential input voltage Maximum common-mode input voltage	± 50 V (max. voltage between input terminals) ± 50 V (max. voltage related to ground)
Sensor information for Auto-ID and calibration	256 byte serial EEPROM
Connection	Right-hand BT (British Telecom) connector

Warranty:

The 0210i Differential Voltage sensor 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.
