DIFFERENTIAL VOLTAGE SENSOR -500 .. +500 mV

Description D0212i

Figure 1. The Differential Voltage Sensor - 500 .. +500 mV

Short description

The Differential Voltage Sensor (0212i) is designed for measuring voltages in between -500 and +500 mV. The sensor is a small signal amplifier with a wide frequency range, which can be used to measure small 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 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 $\pm$7.5V, which can be measured by an interface.
The sensor is provided with over-voltage protection and voltages up to $\pm$50V (related to ground) will not damage the sensor. It never can be used for higher voltages or 220V.
The sensor is equipped with a BT plug and can be connected to the following CMA interfaces:

- CoachLab II
- **U**LAB

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.

Intelligent sensor[1]

The Differential Voltage Sensor is an intelligent sensor. The sensor has a memory chip with information about the sensor. Through a simple protocol (I^2C) the sensor communicates with **U**LAB and transfers its data (name, quantity, unit and calibration) to the datalogger. **U**LAB automatically displays the calibrated values in the right unit on its screen. Also **U**LAB communicates the information to the Coach software.
The sensor is delivered with a standard calibration.

Examples of experiments

The Differential Voltage Sensor is specifically designed for accurate measurements of low voltages. It 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

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[1] At this moment only for CMA **U**LAB datalogger, in the future also for LabPro and the CBL2.

current and the voltage in electrical circuits - the Ohm's Law.

Calibration

The output of the Differential Voltage Sensor is linear with respect to the input voltage. The amplifier allows measuring positive and negative values of voltage.
To collect data you can:

1. Use the calibration supplied in the standard sensor library of the Coach program.
2. Use the calibration supplied by the sensor EEPROM memory (only for the **U**LAB datalogger).

or

3. Calibrate the sensor using known voltages (a standard, simple 2-points calibration can be done). User calibration can be performed in Coach software (for details see 'Guide to Coach 5').

Changing of the default calibration in EEPROM of the sensor

In the near future a special simple program will be available to enable a user to replace the default calibration in EEPROM by a calibration done by the user. This will be done while the sensor is connected to **U**LAB. In this way the sensor can have its own, precise calibration.

The name of the Differential Voltage Sensor in the sensor library of the Coach program is **Voltage sensor (differential) (0212i) (CMA) (-500 .. 500 mV)**.

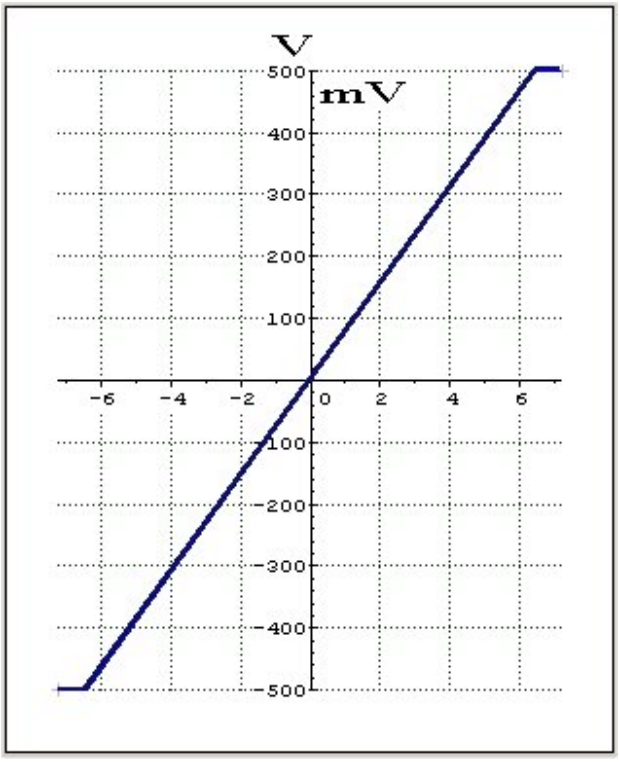
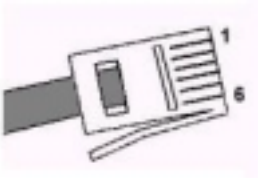


Figure 2.
Default calibration graph of the Differential Voltage Sensor (used in the standard Coach library and sensor memory).
V_{in} (mV) = 78.125 * V_{out} (V) – 0.47
where $V_{in} = V_+ - V_-$

Default linear calibration coefficients:
a=78.125; b=-0.47

Technical data

Differential input voltage range Common-mode input voltage range	± 500 mV (voltage between input terminals) ± 50 V (voltage related to ground)
Output voltage range	± 7 V
Gain	12.8 x
Resolution using 12 bits A/D converter	0.38 mV
Calibration function	V_{in} (mV) = 78.125 * V_{out} (V) – 0.47 where $V_{in} = V_+ - V_-$
Input impedance to ground	each terminal 400 kΩ
Input offset voltage error	typical ± 0.3 mV
Common-mode input voltage error	typical 0.15 mV/V (0 – 500 Hz)
Non-linearity	< 0.001 %
Slew rate	3 V/μs (maximum output voltage variation)
Bandwidth (small signal)	120 kHz (-3dB)
Supply voltage Supply current	5 V DC typical 23 mA
Sensor information for Auto-ID and calibration	256 byte serial EEPROM via I^2C-bus
Connection: BT (British Telecom) plug 	pin 1: V_{out} pin 2: ground pin 3: I^2C data pin 4: I^2C clock pin 5: supply voltage (+5 V) pin 6: n.c.

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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