
DIFFERENTIAL VOLTAGE SENSOR BT31i

USER'S GUIDE



CENTRE FOR MICROCOMPUTER APPLICATIONS

<https://cma-science.nl>

Short description

The Differential Voltage sensor BT31i is designed for measuring voltages in the range between -12 and +12 V. With a wide input voltage range 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, 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 ±7.0 V. 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. The sensor is excellent to sample AC-signals at relative high frequencies (< 100 kHz).

The Differential Voltage sensor BT31i 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 Differential Voltage sensor 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 Voltage sensor 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 Differential Voltage Sensor BT31i is supplied calibrated. The output of the sensor is linear with respect to the input voltage. The supplied calibration function is:

$$V_{in} (V) = 1.616 * V_{out} (V) - 0.0081 \text{ where } V_{in} = V_{+} - V_{-}$$

The Coach program allows selecting the calibration supplied by the sensor memory (EEPROM) or the calibration stored in the Coach Sensor Library. For better accuracy the pre-defined calibration can be shifted.

For even more accurate measurements a new user calibration (a standard, simple 2-point calibration) can be performed in Coach using known voltages.

Practical information

CAUTION: NEVER use high voltages or household AC.

- The Voltage sensor is used to measure the potential difference between the ends of an electrical component and is therefore connected across (i.e. in parallel) the component.
- Make sure you observe the correct polarity i.e. connect the black lead from the Voltage Sensor to the negative terminal of the cells, otherwise the sensor will give readings with the wrong sign.
- The Voltage Sensor(s) can be used in conjunction with a Current sensor(s) anywhere in a circuit.

Suggested 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 electric elements such as a light bulb or 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.

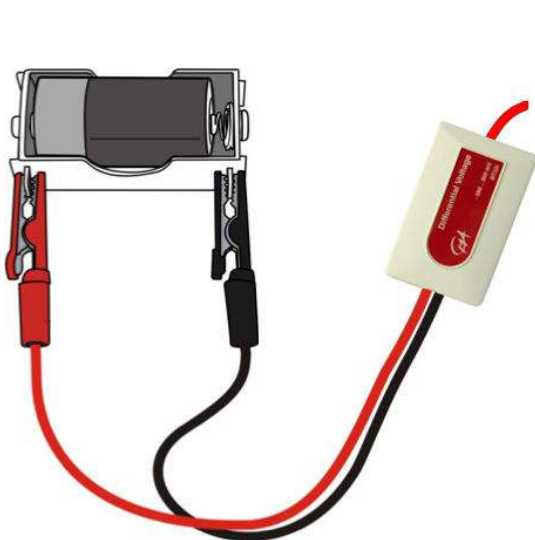


Figure 1. Measuring a battery voltage.

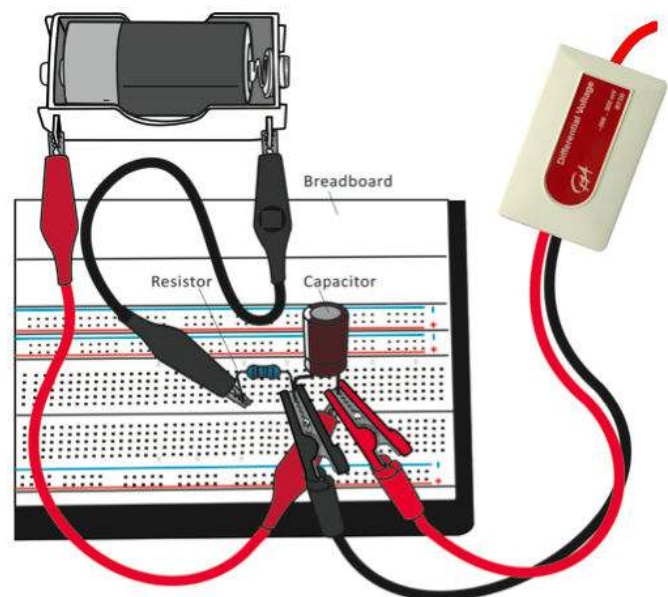


Figure 2. Measuring the voltage during discharging of a capacitor.

Technical Specifications

<i>Sensor kind</i>	Analog, generates an output voltage between -7 .. +7 V
<i>Measurement range</i>	-12 .. +12 V (voltage between input terminals)
<i>Gain</i>	0.619 x
<i>Calibration function</i>	$V_{in} (V) = 1.616 * V_{out} (V) - 0.0081$ where $V_{in} = V_+ - V_-$
<i>Input impedance to ground</i>	each terminal 1 M Ω
<i>Input offset voltage error</i>	typical ± 8 mV
<i>Common mode input voltage error</i>	typical 0.03 mV/V (0 – 500 Hz)
<i>Non-linearity</i>	< 0.001 %
<i>Slew rate</i>	10 V/ μ s (maximum output voltage variation)
<i>Bandwidth (small signal)</i>	1.2 MHz (-3dB)
<i>Maximum common input voltage</i>	± 50 V (max. voltage related to ground)
<i>Supply voltage</i>	5 V DC
<i>Supply current</i>	typical 19 mA
<i>Connection</i>	IEEE1394 connector for BT-IEEE1394 sensor cable. Sensor cable is not delivered with the sensor.

Warranty:

The Differential Voltage sensor BT32i 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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