DIFFERENTIAL VOLTAGE SENSOR
BT32i

USER'S GUIDE

CENTRE FOR MICROCOMPUTER APPLICATIONS

http://www.cma-science.nl

Short description

The Differential Voltage sensor BT32i is designed for measuring voltages in the range between -500 and 500 mV. The sensor is a 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, 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 ±7.5V. The sensor is provided with over-voltage protection and voltages up to ±50V (related to ground) will not damage the sensor. It never can be used for higher voltages.

The Differential Voltage sensor 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 Current sensor BT32i is supplied calibrated. The output of the sensor is linear with respect to the input voltage. The supplied calibration function is:

$$V_{in}\ (mV) = 78.125 * V_{out}\ (V) - 0.47 \text{ where } V_{in} = V_+ - V_-$$

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 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.

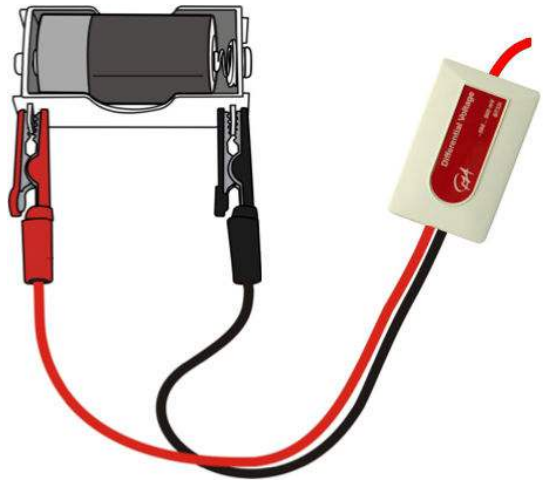

Figure 1. Measuring a battery voltage.

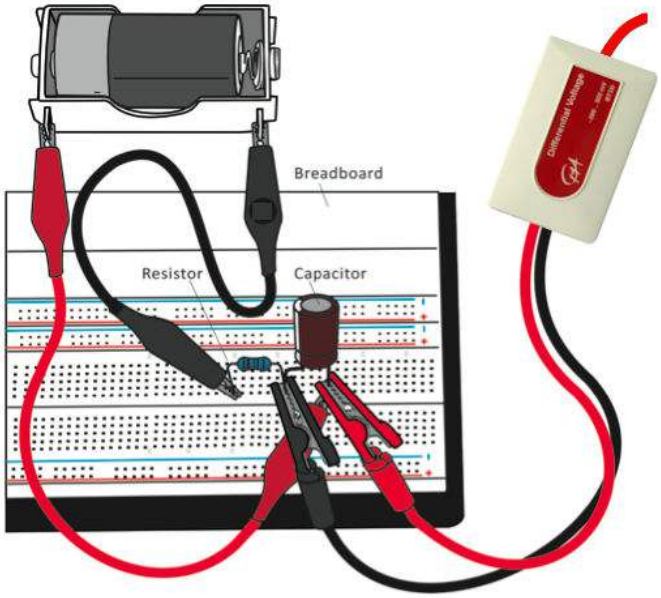

Figure 2. Measuring the voltage during discharging of a capacitor.

Technical Specifications

Sensor kind	Analog, generates an output voltage between -7.5 and 7.5 V
Measurement range	± 500 mV (voltage between input terminals)
Resolution	0.38 mV
Gain	12.8 x
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)
Maximum common input voltage	± 50 V (max. voltage related to ground)
Supply voltage	5 V DC
Supply current	typical 23 mA
Connection	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 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.*

Rev. 20/11/2014