einstein™
imagine • explore • learn

Voltage Sensor

-30V to 30V TRMS

Product Number: ENVLT102

Overview

The Voltage sensor measures voltage between -30 to 30 V using the highly accurate True Root Mean Square (TRMS) method. This differential sensor is capable of measuring both direct and alternating voltage and it is ideal for use in a wide range of Physics and Chemistry experiments.

The Voltage sensor has floating inputs, meaning you can connect any number of voltage sensors to a circuit without shorting them.

The sensor has two durable banana plugs for easy connection.

The Voltage sensor can be connected to all types of einstein™ Tablets, einstein™LabMate™, and einstein™LabMate™+.

Typical experiments

Electricity and Magnetic Fields

- EMF and internal resistance
- V-I characteristics of a wire, a light bulb and a diode
- Resistance of a wire – Ohm's Law
- Series and parallel circuits
- Charging and discharging a capacitor
- Investigating the transformer
- Specific heat

How it works

Electric current flows along the wires running through the sensor. When measuring alternating voltage, the sensor measures this voltage, squares the values and then uses the square root of the results to determine the true measurement. This True Root Mean Square (TRMS) reading is considered the most accurate way of measuring voltage.

Sensor specification

Instantaneous range	±30 V
Effective (TRMS) range (DC)	0 to 30 V
Effective (TRMS) range (Sine wave):	0 to 21 V
Input Voltage	AC or DC
Accuracy – Instantaneous	±1.5 % over entire range
Accuracy - Effective (TRMS)	±3 % over entire range
Resolution Instantaneous	14.6 mV
Resolution Effective (TRMS)	7.3 mV
Minimum Sample Rate	1,000 samples per second (TRMS mode)
Input Resistance	5 MΩ
Bandwidth - Instantaneous	0-10 KHz
Bandwidth – Effective (TRMS)	20 Hz to 10 KHz
Protection	Up to 220 V
Common mode signal	Max ±40 V

Note: sensor cables sold separately

Technical Notes

- **Warning** – extreme caution should be taken when experimenting with electricity. These experiments should only be conducted in the presence of a teacher or supervisor
- **Warning** – Keep all liquids away from any electricity experiments
- **Warning** - This sensor is designed for up to 25 volts, never use for higher voltages
- **Warning** - This sensor is not designed to measure line voltage. Never connect this sensor to a wall socket
- For more accurate measurements connect the sensor's negative input (black) to the power source's negative input (ground)
- The Voltage sensor is equipped with built-in protection, the sensor from voltages of up to 220 V

Calibration

MiLAB™Desktop Set Zero Calibration

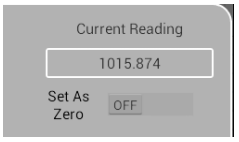
In the Current Reading column, click Set 

to set the current value as the zero or base value. Reset 

cancels this action

MiLAB™ Set Zero Calibration

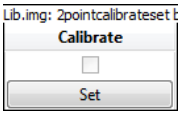
Under Current Reading column flip the Set As Zero switch to set the current value as the zero or base value.



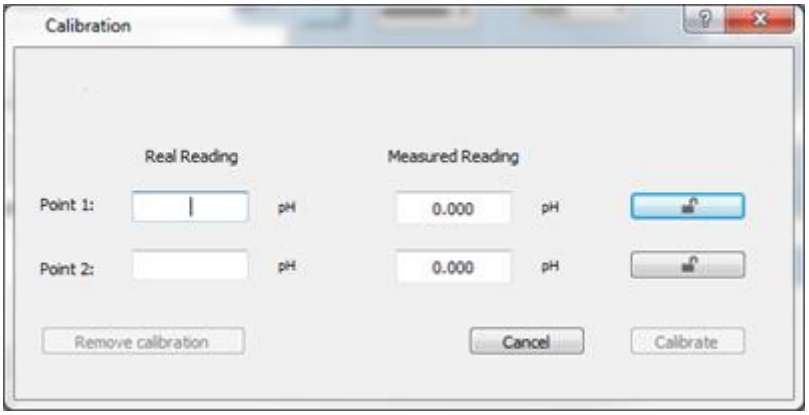
Calibrating in MiLAB™Desktop

Two Point Calibration

1. Go to the Full Setup window and in the Calibrate column click Set



2. The Calibration window will appear



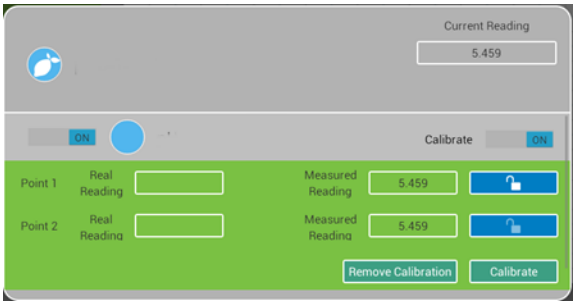
3. Prepare something that has a known value (e.g. a solution with a known pH of 7). Enter this known value in the Point 1, Real Reading field
4. Measure the substance and, wait for the readings to stabilize. Enter the known value as the Point 1 Measured Reading field and click the lock button 
5. Prepare a second substance with a known value. Enter this known value in the Point 2, Real Reading field
6. Measure the substance and, wait for the readings to stabilize. Enter the known value as the Real Reading on the first line and click the lock button 
7. Click Calibrate

Calibrating in MiLAB

Two Point Calibration

1. Tap the Settings button next to the sensor's name

2. Flip the Calibrate switch to On

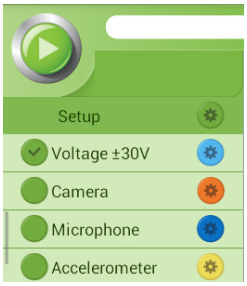


3. Prepare something that has a known value (e.g. a solution with a known pH of 7). Enter this known value in the Point 1, Real Reading field
4. Measure the substance and, wait for the readings to stabilize. Enter the known value as the Point 1 Measured Reading field and click the lock button
5. Prepare a second substance with a known value. Enter this known value in the Point 2, Real Reading field
6. Measure the substance and, wait for the readings to stabilize. Enter the known value as the Point 2 Measured Reading field and click the lock button
7. Click Calibrate.

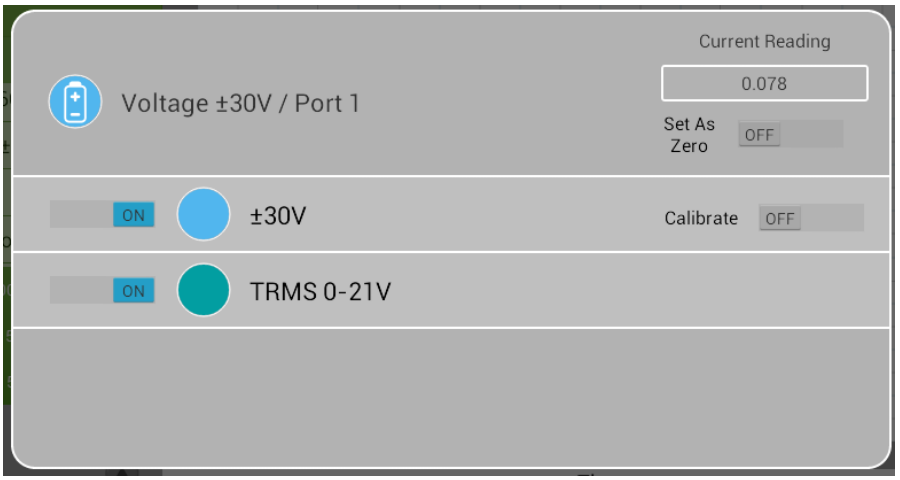
Data logging and analysis

MiLAB™

1. Take your einstein™ Tablet OR pair your einstein™LabMate with your Android or iOS tablet via Bluetooth
2. Insert the sensor cable into one of the sensor ports
3. Launch MiLAB
4. MiLAB will automatically detect the sensor and show it in the Launcher View



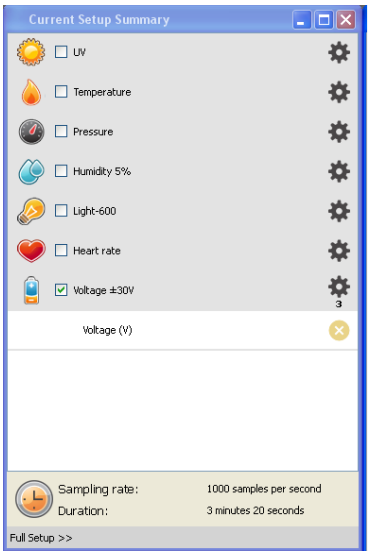
5. Check the icon next to the sensor ( ) to enable it for logging
6. Tap the Setup button to select what mode (Voltage, TRMS or both) to work in



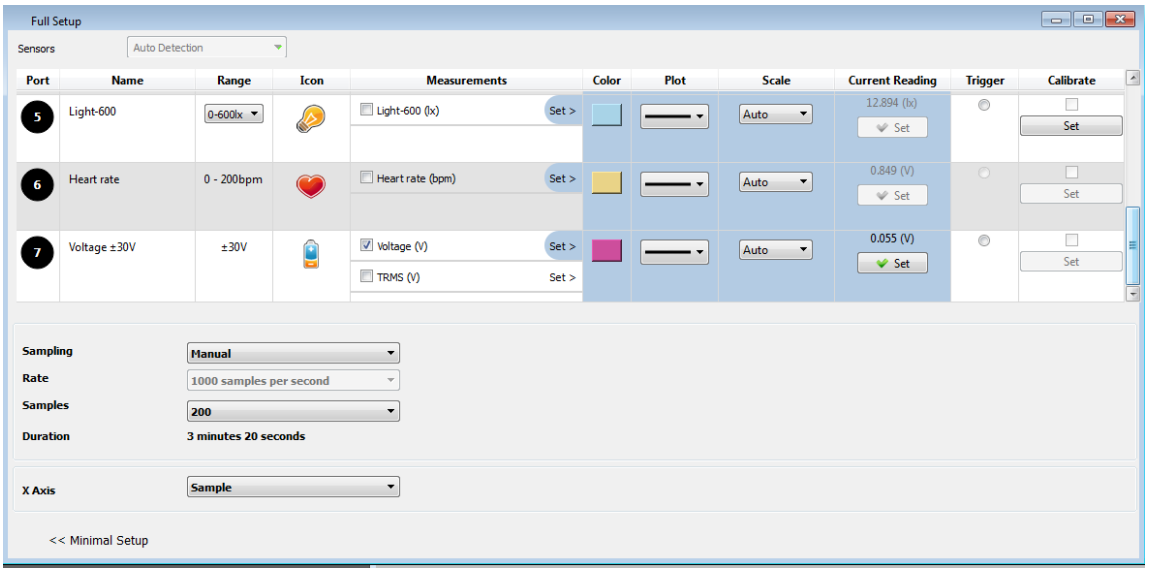
7. Note that the sensor can work in two modes – Voltage and TRMS. The sensor can work in either mode or both modes simultaneously. If working simultaneously, the graph will display two plot lines, one for Voltage and one for TRMS. As long as TRMS is selected the Sample rate will be set at a minimum of 1000 samples per second.

MiLAB™Desktop

1. Pair your einstein™LabMate™ with your PC, MAC, or Linux machine via Bluetooth, or connect it via the USB cable (found in the einstein™LabMate™ box).
2. Insert the sensor cable into one of the sensor ports
3. Launch MiLAB
4. MiLAB will automatically detect the sensor and show it in the Current Setup Summary window



5. Click Full Setup, located at the bottom of the Current Setup Summary window to program the data logger's sample rate, number of samples, units of measurement, whether you're measuring voltage, TRMS or both and other options.



6. Note that the sensor can work in two modes – Voltage and TRMS. The sensor can work in either mode or both modes simultaneously. If working simultaneously, the graph will display two plot lines, one for Voltage and one for TRMS. As long as TRMS is selected the Sample rate will be set at a minimum of 1000 samples per second.
7. Click the Run button ( )on the main toolbar of the Launcher View to start logging

Example of using the Voltage Sensor

Comparing a Voltage Reading to a TRMS Reading

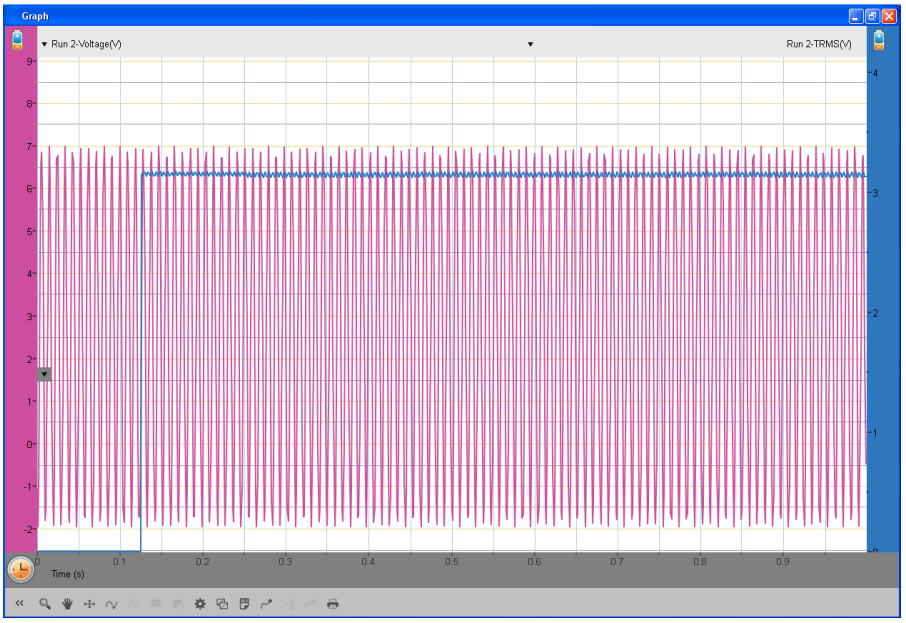
In this experiment we will compare the readings between a regular Voltage sensor and one using true root mean square (TRMS) to calculate the results. For this experiment you will need:

- A function generator
- An einstein™ Tablet+, or a tablet computer/desktop PC with a LabMate
- A Voltage sensor

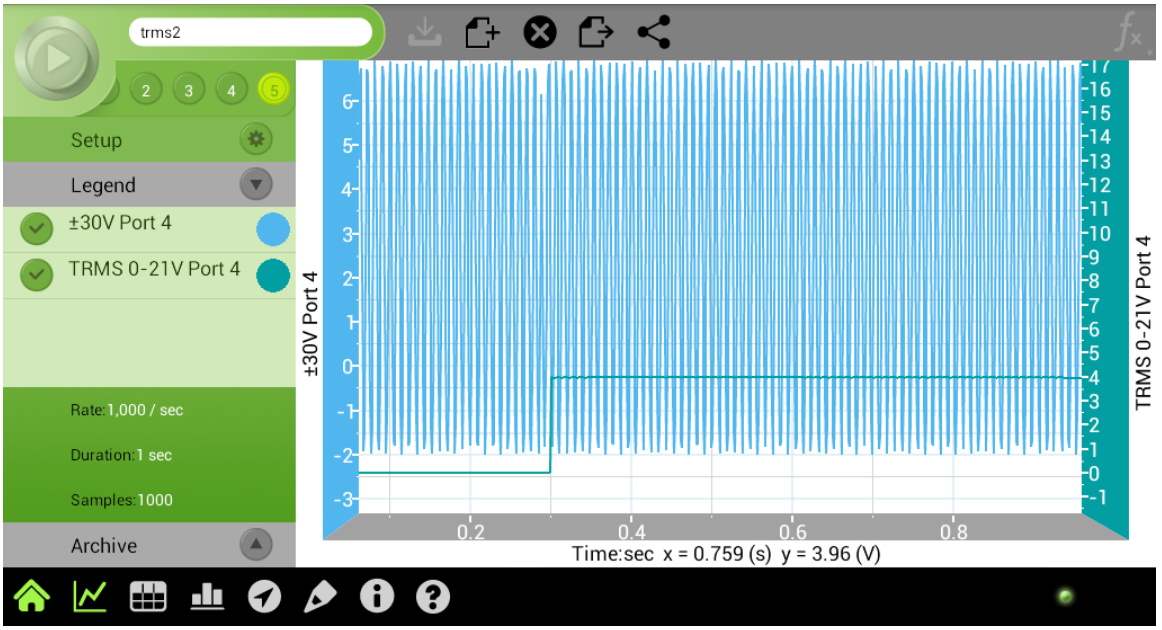
Experiment Procedure

1. Attach the Voltage sensor to the function generator
2. Attach the Voltage sensor to either an einstein™LabMate or einstein™Tablet
3. Set the function generator to a sinus wave to 100Hz
4. Open MiLAB™
5. Go to either Settings or Full Setup
6. Make sure that both Voltage and TRMS are selected
7. Set the Sample Rate to 1000 samples per second
8. Set the Duration to 1 second or Number of Samples to 1000
9. Click or Tap Run
10. Compare the two readings

Sample graphs of this experiment:



Typical graph of this experiment in MiLAB™ for Desktops. Red represents the Voltage reading, blue the TRMS reading.



Typical graph of this experiment in MiLAB Mobile. Blue represents the Voltage reading, green the TRMS reading.

Troubleshooting

If the Voltage sensor isn't automatically recognized by MultiLab/ MiLAB, please contact Fourier Education's technical support.

Technical support

For technical support, you can contact the Fourier Education's technical support team at:
Web: www.einsteinworld.com/support

Email: support@fourieredu.com
Phone (in the US): (877) 266-4066

Copyright and Warranty

All standard Fourier Systems sensors carry a one (1) year warranty, which states that for a period of twelve months after the date of delivery to you, it will be substantially free from significant defects in materials and workmanship.
This warranty does not cover breakage of the product caused by misuse or abuse.
This warranty does not cover Fourier Systems consumables such as electrodes, batteries, EKG stickers, cuvettes and storage solutions or buffers.