Voltage sensor
(Product No. 3162)
Range: **±1 V**
Resolution: 1 mV

Voltage sensor
(Product No. 3161)
Range: **0 to 10 V**
Resolution: 10 mV

Voltage sensor
(Product No. 3160-12)
Range: **±12 V**
Resolution: 10 mV

Voltage sensor
(Product No. 3160)
Range: **±20 V**
Resolution: 10 mV

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DS 021 No 6

Contents

Introduction

The *Smart Q* Voltage sensors are used to measure the potential difference between the ends of an electrical component. This range of Voltage sensors can be used to measure both DC and low-voltage AC circuits.

! SAFETY: Never use high voltages or household AC

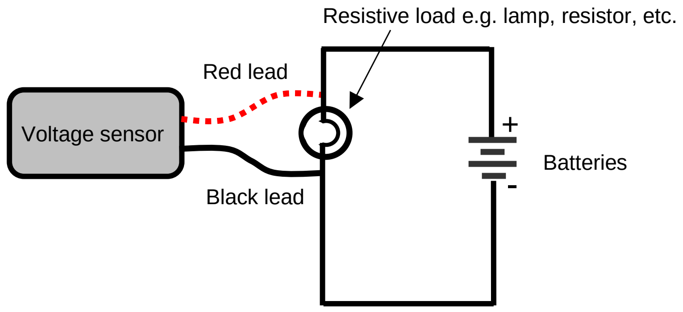
Smart Q Voltage sensors are equipped with a micro controller that greatly improves the sensor accuracy, precision and consistency. They are supplied calibrated and the stored calibration (in volts) is automatically loaded when the Voltage sensor is connected.

Connecting

- Push one end of the sensor cable (supplied with the EasySense logger) into the hooded socket on the sensor housing with the locating arrow on the cable facing upwards.
- Connect the other end of the sensor cable to an input socket on the EasySense logger.
- The EasySense logger will detect that the Voltage sensor is connected and display values.

Practical information

Voltage, referred to as potential difference or electromotive force (e.m.f.) is the electrical potential energy between two points in a circuit and is the driving force pushing the electricity around a circuit.



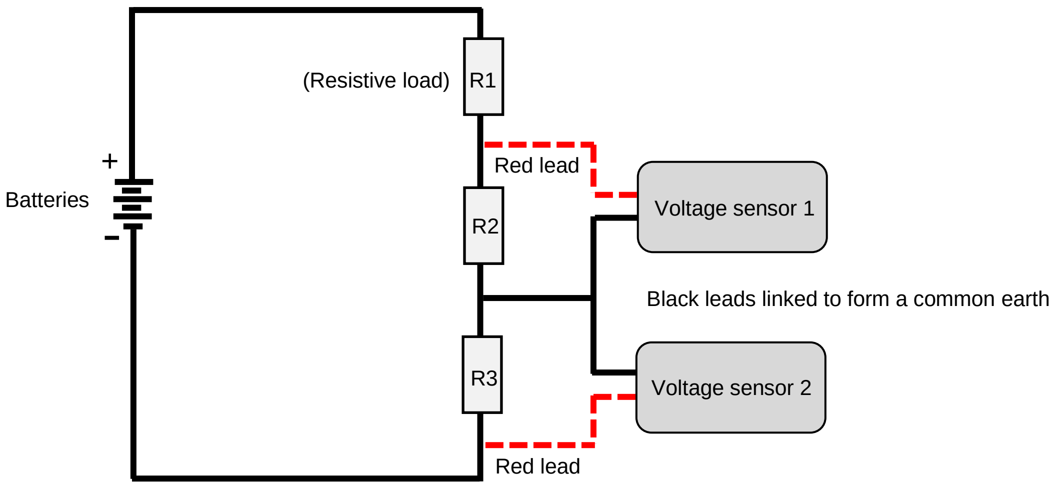
- The Voltage sensor is used to measure the potential difference between the ends of an electrical component and is therefore connected across (i.e. in parallel) the component.
- Make sure you observe the correct polarity i.e. connect the black lead from the Voltage sensor to the negative terminal of the cells.

- Product No 3160 (±20V), 3160-12 (±12V) and 3162 (±1V) can be used to measure both negative and positive potentials.

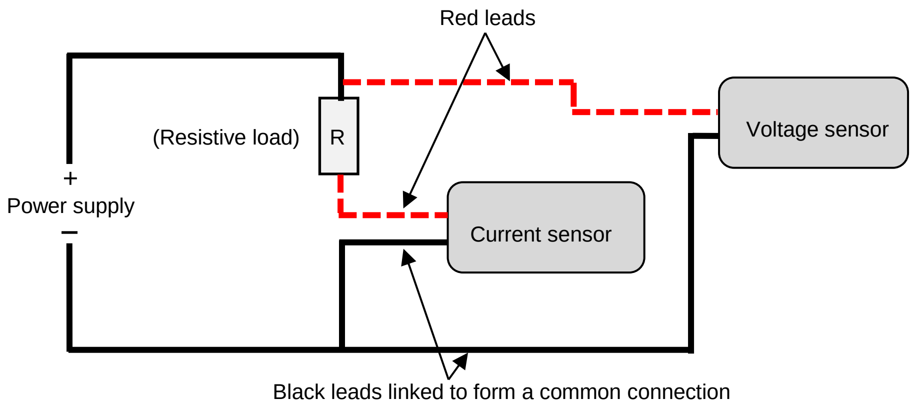
  The range for Product No 3161 (0 – 10V) was selected so that only positive potentials are displayed. It has the same resolution as the 3160 and 3160-12 sensors

- For reasons of accuracy, if two Voltage sensors are being used in a circuit, ensure they share a common earth (the same black lead).

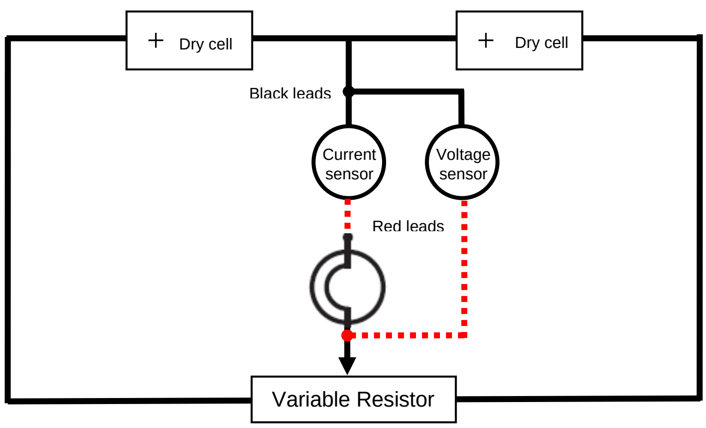
An example of using two Voltage sensors in the same circuit



Note: *In this circuit the reading from Voltage sensor (2) will be negative. To correct to a positive value use the Tare pre or post log function and set the tare value to -1 (see page 4).*



- If the Voltage sensor is used in a circuit with a Current sensor the black leads of both should be linked to form a common connection.

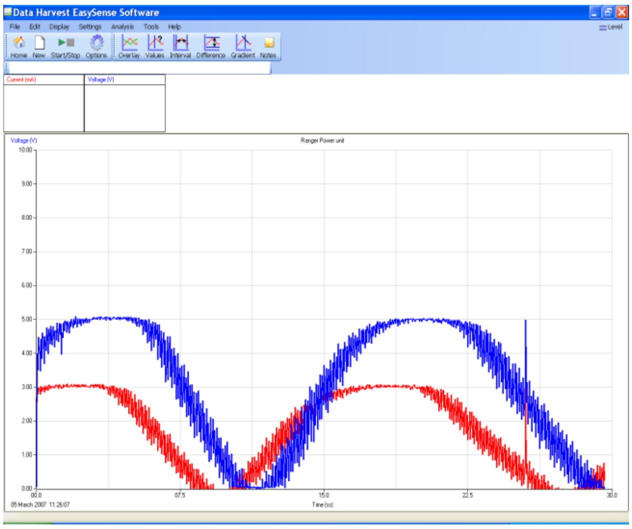


- If a Voltage sensor is connected to an EasySense logger, without being part of a complete circuit, then data collected may appear 'noisy'. To measure voltage accurately you need high impedance (resistance), the Voltage sensor is a high impedance device and will pick up any electrical 'noise'.

  Note: *To demonstrate zero impedance, short out a Voltage sensor by connecting its black & red plugs together*.

- Batteries are the first choice as the source of energy. An alternative to batteries is to use a fully isolated mains power supply with a regulated DC output (smoothed and fully rectified).

  Be aware that some power supplies are ½ wave rectified producing an average rather than true DC. The Voltage sensor will 'pick up' the fluctuations in voltage and current from this type of power supply.



EasyLog of the voltage and current supplied by a ½ wave rectified power unit - the voltage was fixed at 4.5V

Specifications

Product Number	**3162**	**3161**	**3160-12**	**3160**
Range	±1 V	0 to 10 V	±12 V	±20 V
Resolution	1 mV	10 mV	10 mV	10 mV
Protection to maximum voltage	±10 V	±27 V	±27 V	±27 V
Impedance	1 MΩ	1 MΩ	1 MΩ	1 MΩ

Subtracting an offset

If you want to change the sign of a number or subtract an offset from a sensor's reading (i.e. when the reading isn't exact zero) use the Tare pre or post-log function.

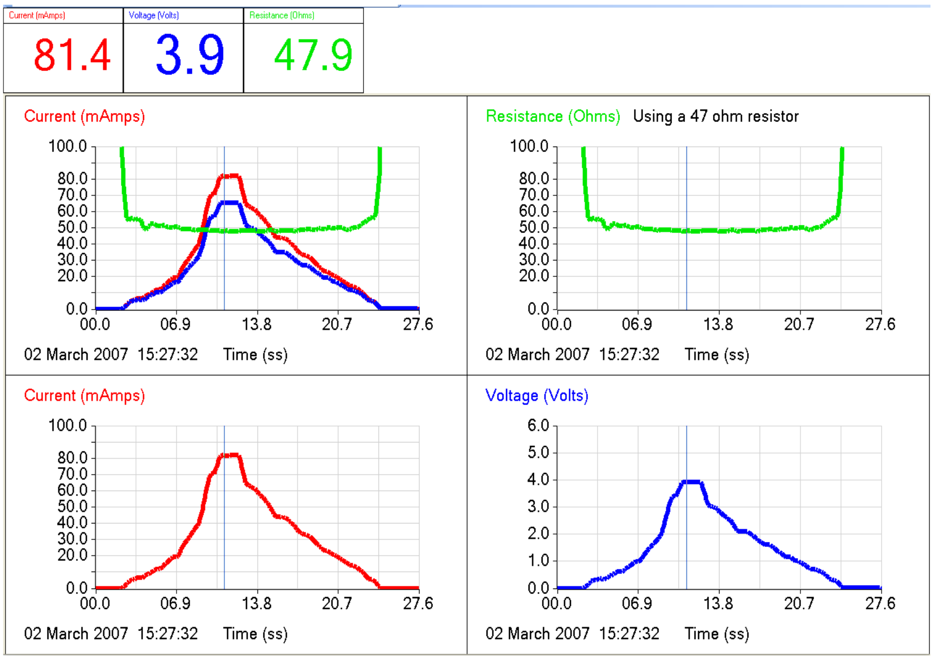
Note: *Use the Pre-log function for the tare to be applied to the data as logging progresses or the Post-log function to apply the tare to data that has already been recorded.*

- If subtracting an offset, first select **Test Mode** from the Tools menu to find the tare value.
- Select **Pre** or **Post-log function** from the Tools menu.
- Select a **Preset** function, with **General** from the drop-down list and then **Tare** from the second list, Next. Select the Voltage sensor as the Channel, Next. Enter a name for the corrected data set e.g. Voltage (adj.) and enter the **tare value**. Click on Finish.

Calculating Resistance or Power

A pre or post-log function can be used to calculate Resistance or Power from Current and Voltage data.

- Select **Pre** or **Post-log function** from the Tools menu.
- Select a **Preset** function, with **Electricity** from the drop-down list and then **Calculate Resistance** or **Calculate Power** from the second list, Next.
- Select the Voltage and Current channel to use, Next.
- Enter the appropriate multiplier using the information supplied in the white panel. Click on Finish.



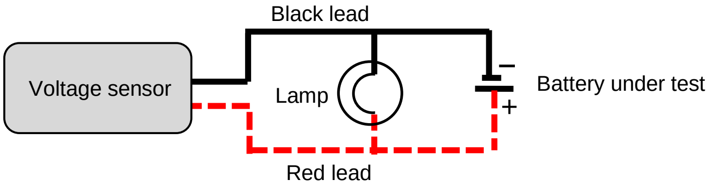
Graph showing the result from an electrical resistance investigation

Investigations

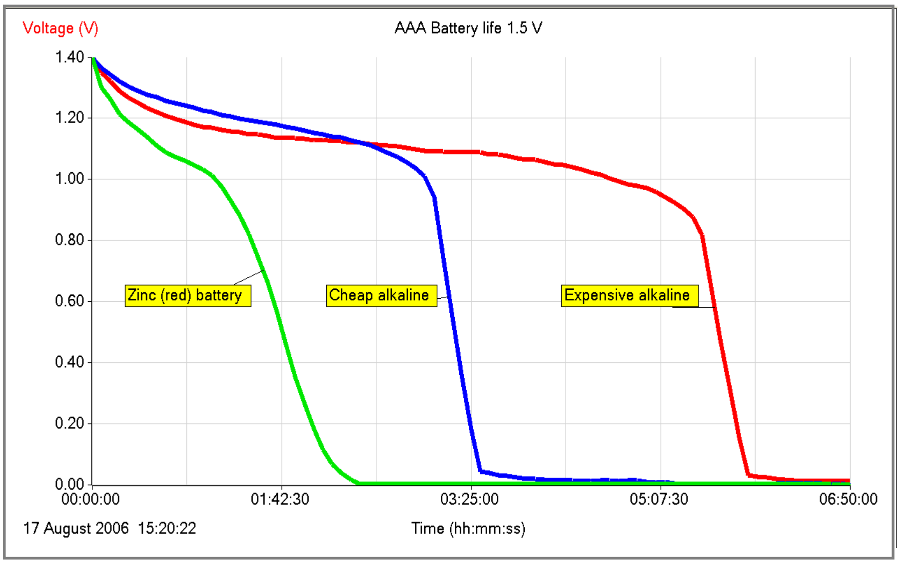
- *Battery life*
- *Series and parallel circuits*
- *Ohm's law*
- *Alternative power investigations e.g. solar cells*
- *Heat and electric Voltage*
- *Faraday's induction of voltage in a coil, induction of Voltage in a conductor*
- *Electrical component characteristics*
- *Investigating a thermistor, light dependent resistor*
- *Power*
- *Voltage / Current relationships*
- *To measure the voltage from a homemade sensor*
- *Time constant, charge and energy stored in a capacitor*

Which battery is the best buy?

In this investigation the difference between the outputs from different types of battery are tested (e.g. alkaline, zinc, etc.).



- Assemble the apparatus as shown with the Voltage sensor connected to the EasySense data logger.
- Select **EasyLog** and record until the lamp goes out. Use the battery that you think will last the longest first. The length of time this will take will depend on the size of the battery selected e.g. for a 1.5 V AAA battery it took between 2 – 6 hours.
- Select **Overlay** and repeat using another type of battery.



This example shows three single AAA batteries and a 2.5 volt bulb. Sensor settings was used to alter the minimum & maximum limits.

The results could be used to calculate which battery is better value for money.

Extension Ideas: -

- Compare difference sized batteries with the same voltage, i.e. AAA, AA, C, D size 1.5V batteries.
- Use a Light Level sensor to record the brightness of the lamps as the power from the battery is used up.

Magnetic induction

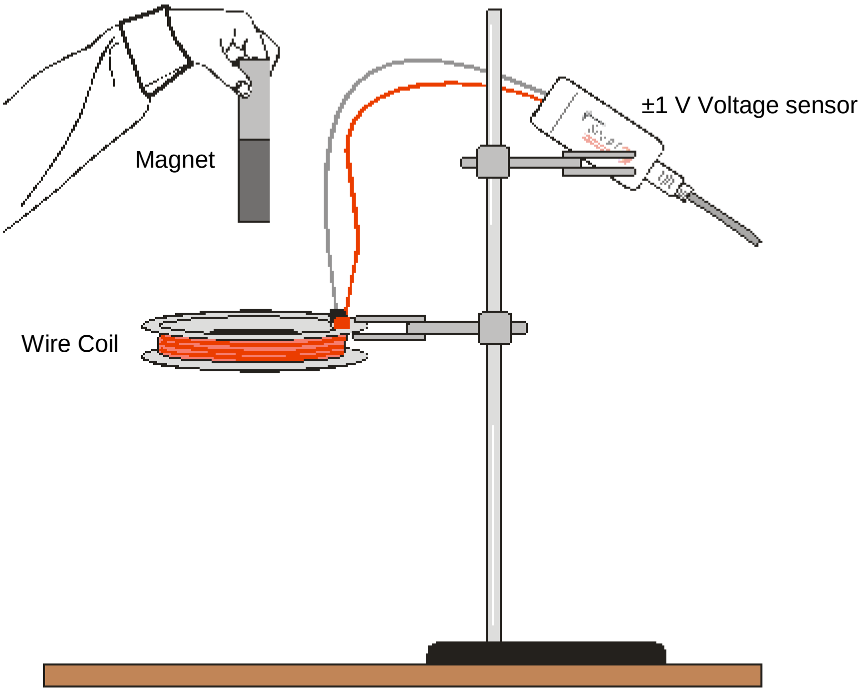
This investigation measures the voltage induced by a magnet falling through a wire coil.

Note: *This investigation is only suitable for an EasySense logger capable of fast logging.*

Use the ±1 V Voltage sensor (Product No. 3162) and the Wire Coil (Product No. 3173).

Note: *You can use the ±12 or 20 V sensors but the resolution and therefore the graph will not be as good. The trigger level with these sensors should be set to volts e.g. rises above* ***0.4 V.***

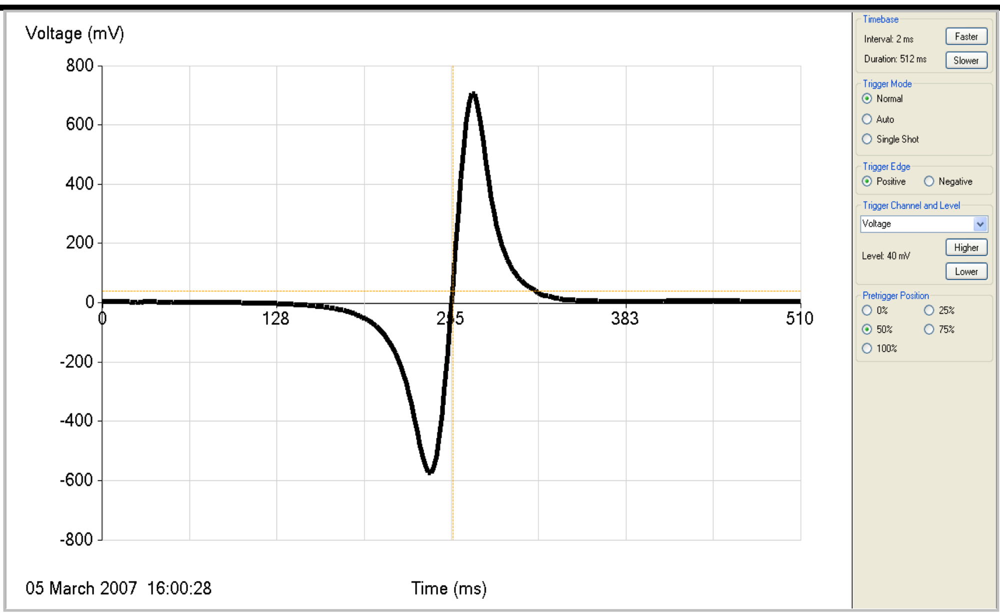
If you are using your own wire coil connect a 0.01μf ceramic capacitor across the coil terminals to reduce e.m.f. noise.



1. Assemble the apparatus as shown with the Voltage sensor connected to the EasySense logger.
2. Open the EasySense program and select either **Scope** or **Graph** from the Home page. Set the options for recording the data (see suggestions in the table).

Scope	
Interval	1ms, **2 ms**, 5 ms
Trigger mode	Normal or Single shot
Suggested trigger level	Positive 40 mV with a 50% pre-trigger

Graph	
Total recording time	**500 ms**, 1 s, 2 s
Interval between samples	**500 us**, 1 ms, 2 ms
Suggested trigger level	Rises above 40 mV with a 50% pre-trigger



In this graph Scope was used to collect data with a 2 ms interval, normal trigger mode, positive edge, at a level of 40 mV with a 50% pre-trigger.

3. Click on **Start**.
4. Mark one end of the magnet and drop this end through the coil.

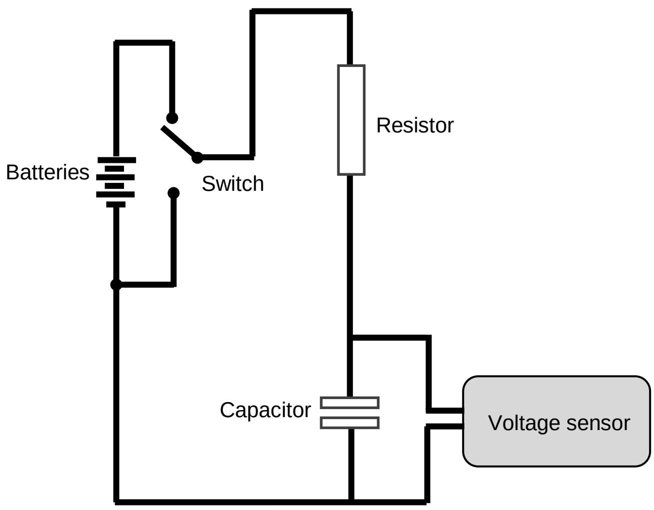
Extension Ideas

- What happens when the magnet is dropped through unmarked end first?
- Try using longer or shorter magnets or dropping from different heights.
- Join two magnets together, firstly with poles attracting, secondly with poles opposing.
- Suspend the magnet horizontally from a coiled up elastic band so it can spin clockwise and anticlockwise close to the Wire coil – to create the dynamo effect.

Capacitor discharge and charge

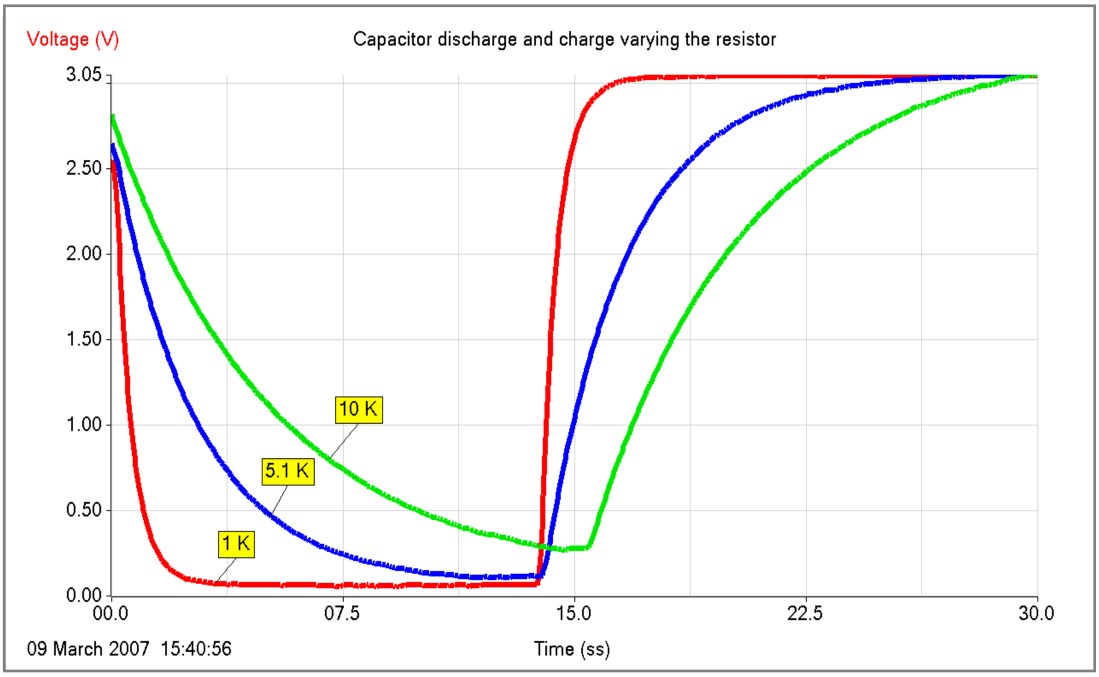
This investigation measures the voltage across a capacitor as it discharges and charges.

Note: *To select the appropriate capacitor and resistor, use the formula T = CR, where T = time in seconds, C = capacitor value in farads, R = resistor value in ohms.*



1. Assemble the apparatus as shown with the Voltage sensor connected to the EasySense logger.
2. Open the EasySense program and select **Meters** from the Home page. Fully charge the capacitor (until the value stops rising) and measure the potential difference. This value will be used to set a level for the trigger.
3. Click on Stop and select the **Home** page.
4. Select **Graph** and in the logging wizard select a time span of 30 seconds and a trigger for when the value falls just below the potential difference level measured in step 2.
5. Select **Test Mode** from the Tools menu, short out the capacitor - wait until it is fully discharged (value stops falling).
6. Fully charge the capacitor (until the value stops rising).
7. Click on **Start,** move the switch to allow it to **discharge** for about 15 seconds and then switch over again to charge for the rest of the recording time.
8. Change the resistor to a different size. Select **Overlay** and repeat.

In the example shown a 470 μF capacitor was used with a 1 K, 5.1 K, 10 K resistor. The use of a trigger means each data set starts at the same value.



Limited warranty

For information about the terms of the product warranty, see the Data Harvest website at: https://data-harvest.co.uk/warranty.

Note: Data Harvest products are designed for **educational** use and are not intended for use in industrial, medical or commercial applications.

WEEE (**W**aste **E**lectrical and **E**lectronic **E**quipment) Legislation

Data Harvest Group Ltd is fully compliant with WEEE legislation and is pleased to provide a disposal service for any of our products when their life expires. Simply return them to us clearly identified as 'life expired' and we will dispose of them for you.