LogIT

Data logging for STEM

Example experiments using uLog

Energy Harvesting power on board a yacht

Overview:
Energy Harvesting is the process by which energy is obtained from external sources such as Solar, Wind and kinetic energy (movement). By investigating induced EMF using a magnet and coil, the movement of a yacht might be used to generate electricity (Kinetic energy). This generated electricity could be used for a small GPS in the event of power failure on board and as a backup for long distance passages.

Aim:
To investigate induced EMF and to suggest designs for a power supply system for a long distance yacht using the motion of the ocean as the generator. Suggest what this power may be suitable for.

Equipment required: LogIT uLog pH adapter (set units to +/- 1250 mV)
BNC to 4mm (or equivalent) connection leads
Coil of wire (pre-made or use a cardboard tube and copper wire)
Strong magnet
Ruler or similar to mount the magnet
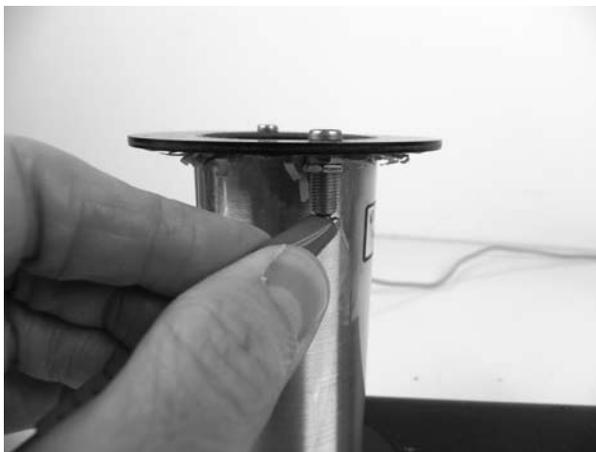Modelling clay, sticky tape or similar

Hazards:
Always check your local regulations or the school advisory service for guidance on the use of laboratory equipment. Students should be supervised at all times.

Suggested Method:
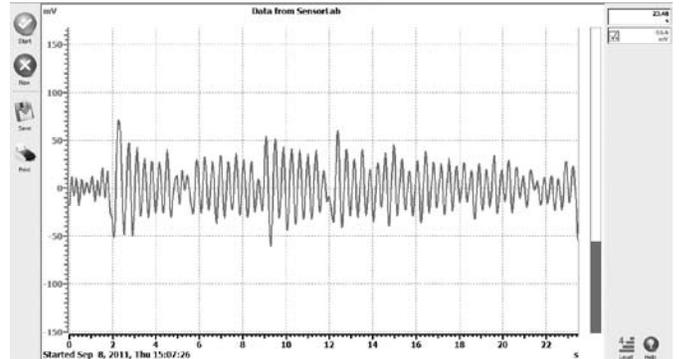1. Connect the uLog sensor to the computer.

2. Connect the coil to the mV adapter using the connection leads and connect to the uLog sensor.

Energy Harvesting power on board a yacht - continued

3. In the software, select the 'mv' range and then press the uLog button to start logging. Dip the magnet in and out of the coil and observe what happens to the voltage on the graph.

4. You now need to come up with a design which allows the magnet to dip in and out of the coil as the yacht moves on the ocean. For this example, we tried a long flexible ruler and an elastic band, suspending the magnet on the end which caused the magnet to move vertically inside the coil as shown.
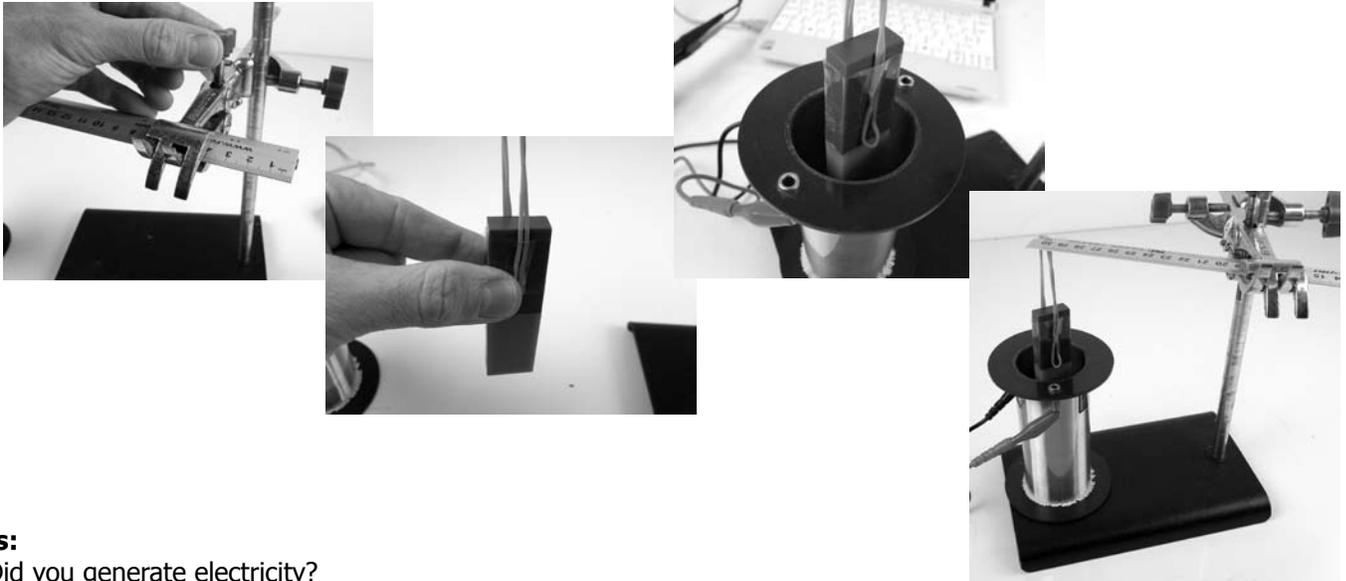
Results:
    Did you generate electricity?
    What type of electricity has been produced?
    What needs to be done with this voltage before it can be used as an electrical generator?
    Is the amount of electricity good or do you think improvements need to be done?

Going further:
    Is the current produced enough to charge batteries for a hand held GPS? If not, why not?
    How would you improve your design?
    This example only really captures the vertical movement of the yacht, what would you do to capture all movement such as the lateral movement as well?
    You may like to look at 'Energy Harvesting' and how it is used in remote areas of the world and on large vehicles such as trains.

Looking at vibrations

Overview:
When engineers design structures, it is very important that the behaviour of the design is thoroughly investigated. This is to prevent the structure not being fit for it's designed purpose and possibly failing. Using electronic sensors, you can look at how structures react when they are being used. Here we will look at the vibrations which occur when a gym bench is walked accross using a force sensor.

Aim:
To investigate oscillations through a structure such as a gym bench.

Equipment required: LogIT uLog sensor adapter
LogIT Force sensor and a gym bench
Mass to place on the force sensor (we used 200g)
Modelling clay

Hazards:
Always check your local regulations or the school advisory service for guidance on the use of laboratory equipment. Students should be supervised at all times.

Method:
1. Connect the uLog sensor adapter to the computer and connect the force sensor to the uLog sensor adapter.

2. Place a small amount of modelling clay to the bottom of the mass and place the mass on the force sensor as shown.
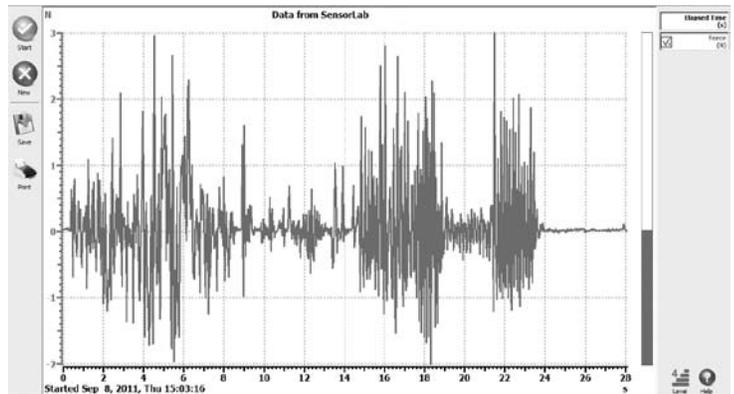
Looking at vibrations - continued

3. With the mass on the force sensor, press the zero button to set the force reading to zero again.

4. Position the force sensor either on the edge of a gym bench or on the bottom rung (if it has one), press the uLog button to start logging and then walk across the bench.

Results:
    Does the graph follow the movements of the force sensor?
    What do the results show?
    Is the bench designed well? If so, how can you tell from the data?

Going further:
    How would you improve your experiment?
    What else could you test? For example, would different gym shoes yield different data patterns?

    This experiment measures transverse waves. These travel up and down. How could you adapt your experiment to measure longitudinal waves which travel froward and backward's?
    Transverse and longitudinal waves make up seismic activity within the earths crust causing earthquakes. How could you design a self contained seismic monitoring station using this sensor? What would you like to include?

Clothing for keeping warm

Overview:
Latent heat is the heat absorbed or released by a substance as it changes state ie. liquid to gas at a constant temperature and pressure. The latent heat needed for evaporation is taken from the liquid itself which subsequently cools and as a result cools its surroundings. This is why we feel cold when we get out of the sea or a swimming pool. The water evaporating reduces the temperature on the surface of the skin which feels cold. This resource is designed to show this cooling in action, and to allow the design of beach or swim clothing which might reduce this effect.

Aim:
To investigate the cooling effect of a liquid evaporating and to see how this can be used in the design of comfortable clothing to minimise the effect.

Equipment required: uLog Temperature sensor
Clamp stand or similar
Paper towels, pipettes drip tray or mat
Different materials for clothing eg. felt, T-shirt material etc
Tap water
Electric fan or similar

Hazards:
Always check your local regulations or the school advisory service for guidance on the use of laboratory equipment. Students should be supervised at all times.

Method:

1. Connect the uLog temperature sensor to the computer and mount it on the clamp stand as shown.
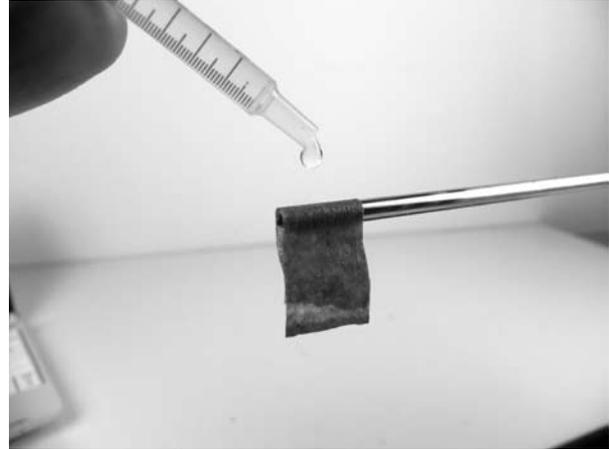

2. Place the fan close to the probe and place a small folded piece of paper towel (about 1 x 4cm) on the tip as shown.
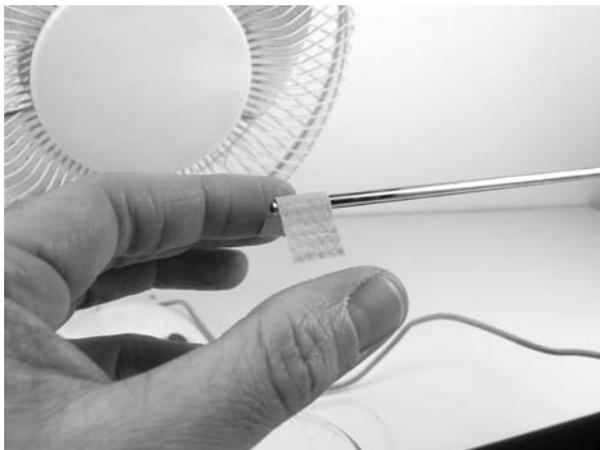
Clothing for keeping warm - continued

3. Start logging by pressing the uLog button, then saturate the paper using the dropper and start the fan.

4. Once the temperature no longer falls, stop logging, reset the experiment performing steps 2 and 3 only this time, once the paper has been saturated, place a material sample over the paper as shown. For clarity we have used transparent bubble wrap.
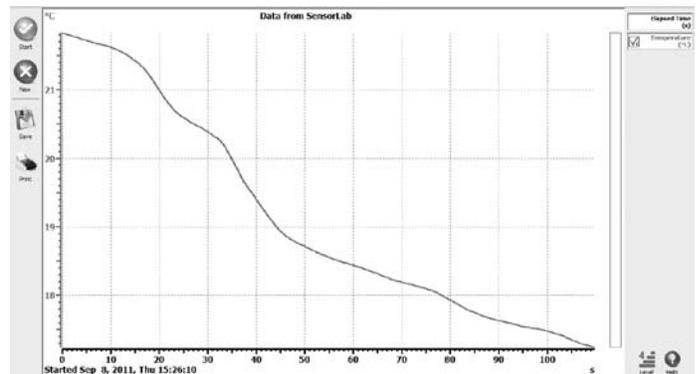
Note: You can produce separate graphs, but for easier analysis you can overlay each set of readings by simply pressing the uLog button each time you are ready to start, with a new material. Don't forget to allow the probe to reach normal room temperature each time by drying the tip using another paper towel.

Results:
What do the graphs tell you about heat loss?
How does the fan effect this heat loss? Why does this happen?

Going further:
From your data, which material might be the best solution for preventing heat loss?
Why might this material not be the most suitable for designing beach clothing?
What factors do you think are the most important for designing this type of specialist clothing?

Investigate 'breathable' material. Why is this a good type of material for this application? Think about drying and keeping warm at the same time.

Calculating the speed of sound

Overview:
The speed of sound in dry air at 20 °C (68 °F) is 343.2 metres per second. This investigation demonstrates a simple method by which this can be calculated using a uLog Ranger.
The uLog Ultrasonic Ranger works by sending an ultrasonic pulse at a target and waiting for the return echo - the time taken to receive the echo, given the speed of sound, equates to twice the distance between the Ranger and the target.
The Ranger can display distance (default) or echo time**.**

Aim:
Using the uLog Ranger, calculate the speed of sound in air and check how accurate the results are using a uLog Temperature sensor to compensate for the temperature of air.

Equipment required: uLog Ranger
uLog Temperature sensor
Computer
Measuring tape (optional)
Spreadsheet or calculator

Hazards:
Do not place your ear close to the Ranger.
Always check your local regulations or the school advisory service for guidance on the use of laboratory equipment.
Students should be supervised at all times.

Method:
1. Connect the uLog ranger to the computer and start the SensorLab software.


2. Position the uLog Ranger a set distance from a solid object such as a wall. (The larger the target the better).

Calculating the speed of sound - continued

3. Note the distance recorded by the Ranger and convert to metres (1000mm = 1m). Now, change the scale to 'Echo time in uS' and note the time for the echo. Convert to seconds (1s = 1,000,000 uS) and calculate the speed of sound using the following equation:

Speed of sound (m/s) = Distance for echo to travel (m) / Echo time (s)
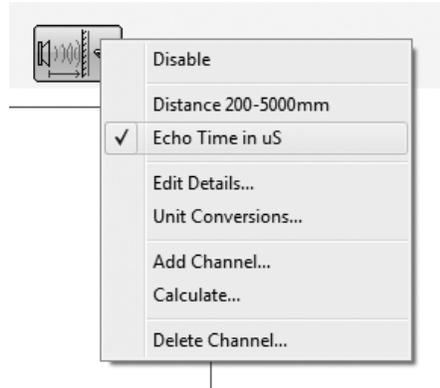
If the calculated speed of sound is half what it should be, don't forget that you need to divide the time for echo by 2. This is because the echo time is the time taken for the sound to travel from the Ranger, to the wall and back again. We are only interested in the time to the wall.

4. To test how accurate the measured speed of sound is, we need the temperature of the air. Connect a uLog temperature sensor and record the temperature of the air in the room in °C.
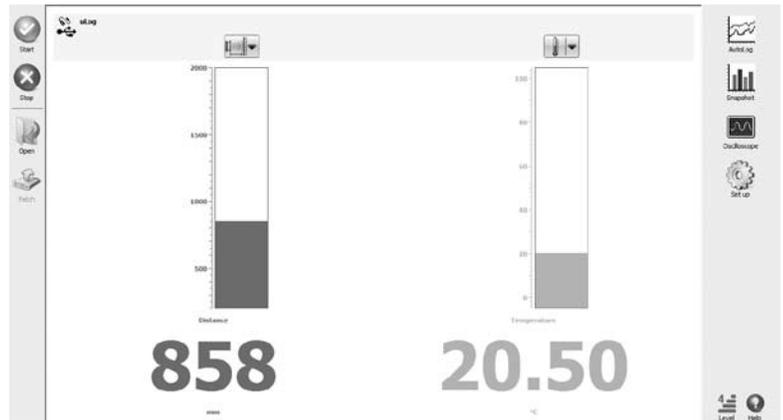
Substitute '∂' (room temperature in °C) into the following equation to calculate the true speed of sound.

Speed of sound (m/s) = 331.3 x √(1 + (∂ /273.15))

Results:
How accurate are your results?
How did you make sure that the experiment was as accurate as it could be? (Think about how the Ranger works).
Could you have improved your experiment?

Going further:
Why might the speed of sound be important for musicians and sound engineers at concerts?
If you were designing a concert hall, why might you be interested in sound echoes?
Investigate the speed of sound in solid objects. How does this differ from the speed in air?

Designing a car engine mount

Overview:
When an engine is mounted in a car, engine mounts are used to prevent vibrations being passed to the chassis. They are usually made of strong rubber and reduce the vibration of the engine and subsequently reduce the noise of the engine. This makes it more pleasant and quiet for the passengers riding in the car. This investigation simulates the problem by using a tuning fork as the engine, the base of a clamp stand as the chassis and a uLog sound sensor as the ears of a passenger.

Aim:
To measure the amount of sound a tuning fork makes connected directly to the base of a clamp stand and to subsequently investigate different isolating materials to reduce this sound. Then, suggest ideas for which material would make the best engine mount.

Equipment required: LogIT uLog sound sensor
Tuning fork (256Hz was used for this example)
Computer
Different materials eg foam rubber, thick cardboard, felt etc
Clamp stand
Rubber bung or similar to strike the tuning fork

Hazards:
Always check your local regulations or the school advisory service for guidance on the use of laboratory equipment. Students should be supervised at all times.

Method:

1. Connect the uLog sensor to the computer and start the SensorLab software.

2. Mount the uLog sound sensor onto the upright of the clamp stand as shown. Depending on the clamp stand used, you may need to lower or raise the sensor. Position a piece of card in front of the sensor to simulate the bulkhead of the car. You may also want to place the base on a book or similar.

Designing a car engine mount - continued

3. Unlike the other investigations that simply use the logging defaults, you will need to setup the software to capture the sound quickly. To do this, perform the following steps:
- Select 'Setup' from the first screen in SensorLab
- Select 'Fast with trigger (one sensor only)' and click 'Next'
- Select 'Scope (Quiet)' from the drop down menu and then click 'Next'
- Select '0.2 seconds' from the drop down menu or use the slider, then click 'Next'

SensorLab is ready to go, when ready click 'Start' to take the first readings.

4. Strike the tuning fork on the rubber bung (to prevent damage) and place the base of the fork onto the metal base of the clamp stand as shown. Click 'Start' in the software to take the first set of readings.
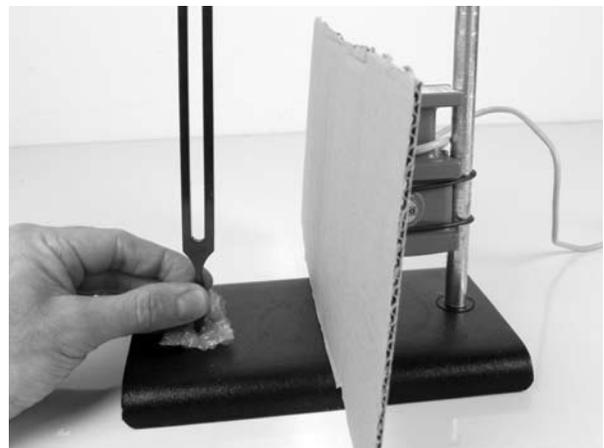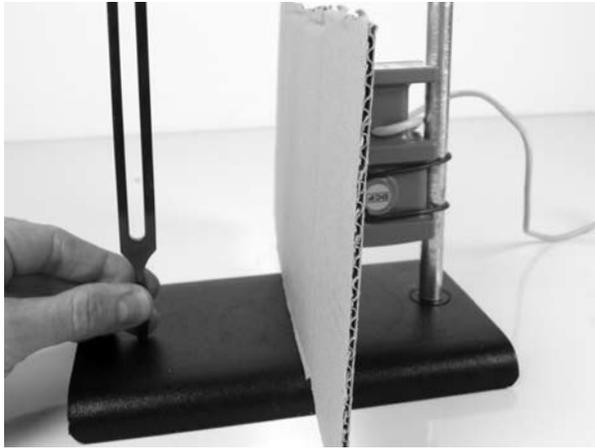
5. When ready, place a test material (engine mount) onto the base and repeat the experiment. To overlay onto the existing data, simply press 'o' on the computers keyboard after striking the tuning fork. If you make a mistake, you can delete a set of readings by using the right mouse button and select 'Delete channel' option in the menu.
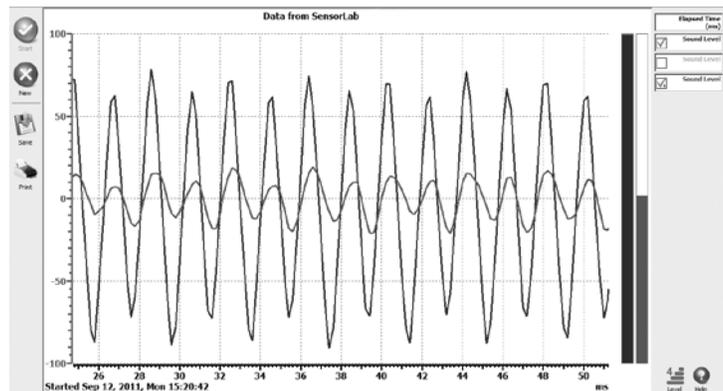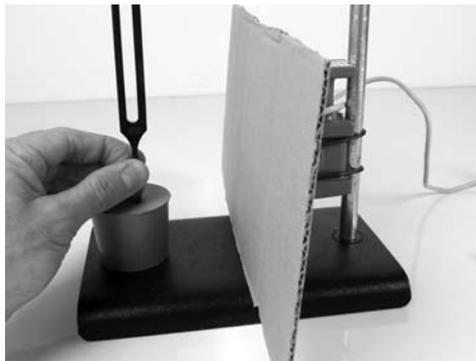
Results:
When you have tested a range of insulating materials, have you been surprised by what you have found?
Is there a common link between the best insulating materials?
How could you improve the experiment? For example, could you design a chamber which simulates the separation of the engine bay to the passengers sitting inside?

Going further:
The test setup shown is simply a starting point. You may like to improve the investigation by building a more car like testing chamber, maybe even adding some rubber wheels. What effect might this have?
How might tiles used in the ceiling's of offices help?
Are there cars that do not have rubber isolating engine mounts? What might the advantage be of these? If you are stuck, have a look at racing car designs.

No datalogger required, just your regular computer!

For the best sensors you need the best datalogger - your computer!

You choose what suits you best, from a regular desktop or notebook PC to a compact netbook or a slim tablet and all of your favorite programs already there can be used to analyse, report, share or email your experiment data. No batteries are required as each sensor takes its power from the computer - easy to manage and no hidden running costs.

You have a wide choice of computers as the comprehensive datalogging software supplied with every uLog sensor is Multiplatform and so compatible with Windows (inc XP, Vista and 7), Mac (OS X 10.4 & above) and Linux (most popular distributions) - it only needs to be installed once to work with every uLog sensor. So you can either use your existing computer or share the sensor with others - the software is exactly the same to use on Windows, Mac or Linux and a low cost unlimited user site license upgrade is also available if you want to install it on every computer.

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uLog
USB TO STANDARD LogIT SENSOR ADAPTER

- Enables most standard LogIT Microsense sensors to plug in and be used alongside other uLog sensors

Note adapter does not support scope display for Sound Wave sensor etc - uLog Sound Sensor does

uLog LogIT sensor adapter
D104200   **£49**

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uLog
LIGHT GATE SET (pair)

- Timing
- Acceleration
- Speed
- Tachometer

- Master & Slave included in set (Master can be used on its own)

uLog Light Gate set (pair)
D104035   **£99**

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uLog
pH PROBE

NEW!

- Replaceable pH electrode (D104045)
- Rate of Reaction
- Titration
- Environmental
- Food tech etc

- Range: 0 - 14 pH

uLog pH Probe
D104040   **£80**

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uLog
TEMPERATURE PROBE

- General Air & Liquid temperature
- Food technology
- Cooling curves

- Range: -10°C to +110°C

uLog Temperature probe
D104010   **£45**

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uLog
LIGHT LEVEL SENSOR

- General Light
- Environment
- Solar investigations
- Rate of reaction
- AC Lighting - scope display

- Range: 0 - 100,000 LUX

uLog Light Sensor
D104015   **£55**

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uLog
ULTRASONIC RANGER SENSOR

- Distance
- Time graphs
- Dynamics
- Speed of sound
- Simple Harmonic Motion

- Range: 200 - 5000mm

uLog Ranger Sensor
D104030   **£125**

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uLog
pH•Ion•mV adapter

NEW!

- Use with pH electrodes
- Use with Ion selective electrodes
- Measure +/-1250mV
- BNC socket connection

uLog pH•ION•mV adapter
D104050   **£60**

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uLog
SOUND SENSOR

- Sound Levels
- Reflection of sound
- Effectiveness of insulation
- Wave analysis - scope display
- Noise Pollution
- Speed of sound
- Range: 50 - 100 dBA

uLog Sound Sensor
D104020   **£65**

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uLog
SENSORLAB FOR uLog SINGLE TO SITE LICENSE UPGRADE CD PACK

- Upgrades single user software supplied to a site license

uLog single to site license
D104305   **£59**

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uLog accessories
3m USB extension cable
BNC to 4mm adapter

- The 3m extension cable extends the uLog sensor cable by 3 metres - you can use up to two together

- The BNC to 4mm adapter allows you to use standard 4mm leads with the uLog pH•ION•mV adapter

3m USB extension cable
D104300   **£8.95**

BNC to 4mm adapter
D100072   **£8.50**

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uLog
Ion selective electrodes

- Use with the uLog pH•ION•mV adapter. (sold individually)

Available electrodes include:
D100142i Ammonium
D100141i Bromide
D100143i Calcium
D100144i Chloride
D100145i Flouride
D100146i Nitrate
D100147i Sulphide

Ion Selective Electrodes
D10014x (as above)   **£249**

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uLog
pH electrode

NEW!

- Specially designed to plug straight into the uLog pH•ION•mV adapter
- No wires
- Wired compatible version available (D100112)

uLog pH electrode
D104045   **£45**

Every uLog Sensor includes Datalogging Software for Windows, Mac OS X & Linux!