

Technical Notes

Thermal Generator

(Peltier/Seebeck Element)

Associated Equipment

The following equipment from djb microtech can be used with the Thermal Generator:

- Solar Motor L1-1020.00
- Smiley Green Man LED Board L1-1030.00
- Digital Temperature Probe C3-1010.20.00

Specification

The specification of the Peltier/Seebeck Element is:

- dimensions 30x30x4.7 mm
- maximum cooling performance 17 W
 - maximum temperature difference between faces 67 °C
 - maximum voltage 8V dc
 - maximum current 3.5 A
 - maximum working temperature 70 - 80 °C
 - internal resistance 1R8.

Theory

The Peltier/Seebeck Element can be used in two ways:

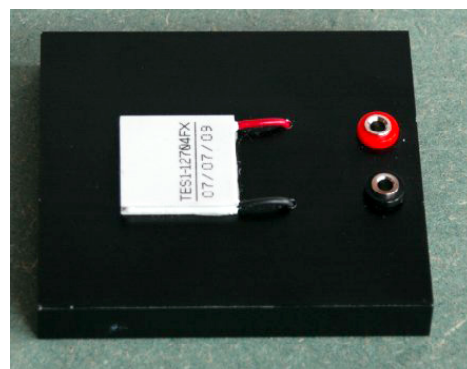
When used as a Seebeck element the device can produce a voltage if one face is warmed and the other cooled.

When used as a Peltier element a temperature gradient is produced across the element if a voltage is applied to it. The unit can be used for heating or cooling.

Investigations

Listed below are the outlines of some possible investigations to try with your Peltier/Seebeck Element.

- Using three D cells, connect 4.5V to the element. Place a digital temperature probe on the top surface of the element and monitor the temperature to see by how much it cools. Note that the bottom surface becomes hot and this heat is removed by the metal heat sink.
- Theoretically it is possible to reverse the polarity of the supply to the Peltier element. This results in the heating of the top surface where there is no metal heat sink to remove this heat. This could result in the destruction of the element. It is not recommended that you let your students try this experiment. If you demonstrate it then ensure that the power is supplied for a few seconds only and switch off as soon as it becomes too hot to touch the element.
- Place a polythene bag of crushed ice on top of the Seebeck element and measure the voltage produced. Connect the Solar motor - you may have to kick start it.
- Place a small aluminium beaker filled with boiling water on the Seebeck element and measure the voltage produced - note that it is negative. Now connect the solar motor and it should work well. Connect the Smiley Green Man LED board - note that the leads will need to be reversed to this board because the output from the Seebeck element is negative.
- Devise a method for determining the approximate efficiency of the Peltier element.



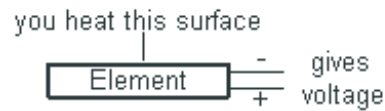
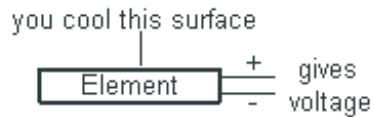
Caution

If your students are using the Peltier/Seebeck element then it is recommended that they use up to four D-type cells instead of a power supply. In this way the rating of the element will not be exceeded. Accidentally turning up a power supply could destroy the element.

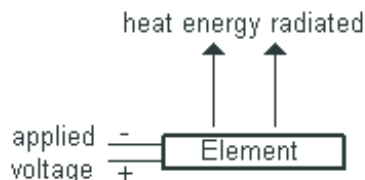
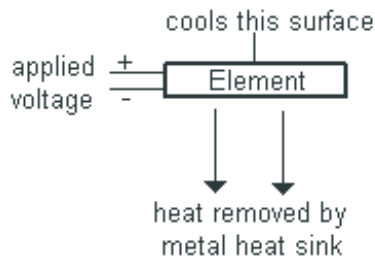
Overheating the element will destroy it.

Summary of use of Peltier/Seebeck Element

Seebeck Effect



Peltier Effect



If you are demonstrating this aspect of the Peltier Effect take great care to apply the voltage for a short time as there is no metal heat sink on the top surface to remove the heat. Switch the power off as soon as the element becomes too hot to touch.

Additional Thoughts

Often the Peltier elements are used in a stack. Consider the case when a voltage is applied, with the correct polarity, to make the top surface of the bottom element in the stack cold. Now the element above in the stack will have its bottom surface cold and if a voltage is now applied to this element then its top surface will become even colder .. and so on up the stack. In this way very cold temperatures can be reached.

Ask your students to find out practical applications of the Peltier/Seebeck element. A quick visit to the internet highlights the following areas:

- fridges
- cooling microprocessors in your PC
- air conditioning
- water cooling
- heat pumps
- blood flow measurement

The Seebeck element produces 'carbon free' electricity. Ask your students why this device will never become a significant green energy source.

The Technical Notes are available as a coloured pdf in the Teachers section of our website.