PELTIER MODULE. KIT 66

Thermoelectric coolers, thermoelectric heaters, heat pumps, thermoelectric effect devices - these all refer to the Peltier Effect. In 1834 Jean Peltier discovered that the passage of an electric current through the junction of two dissimilar conductors cools or heats the junction depending on the direction of the current. The modern Peltier junction is made out of semiconductor material. In the Peltier Module supplied in this Kit, 127 p-n junctions are connected electrically in series but thermally in parallel. The p- & n- doped elements are soldered to copper connecting strips. Ceramic faceplates electrically insulate these connecting strips from external surfaces. Bismuth telluride is the semiconductor material used.

When a current is passed through the module a water drop placed on one side will boil or freeze depending on the direction of the current. The effect is fully reversible; pass the current the other way & the opposite surfaces will heat & cool. It is important to understand that a Peltier Module is not a heat sponge which absorbs heat. It is a heat pump. Heat which is pumped out of the cold surface is deposited on the hot side of the module where it must be dissipated in some way. If not, the hot side will heat up to the point where it will stop functioning as a cooling device and actually begin to heat the cold surface.

Heat Sinking. A heat sink **must** be considered as an integral part of any Peltier cooling system. All performance characteristics of Peltier devices vary as a function of the heat sink temperature. An ideal heatsink would be capable of absorbing an infinite amount of heat without rising in temperature. In practice we must choose a heatsink which will absorb the total waste heat from the module and not rise in temperature above a tolerable level. In general, a heat sink temperature rise in the range 5 to 15 ^{o}C above ambient is reasonable.

Heatsinks are rated in ^{o}C/Watt. This is a measure of how many degrees the heatsink will rise above ambient when 1 watt of heat is pumped onto its surface. For example, a heatsink rated at 0.17 ^{o}C/Watt will rise 17^{o} C above ambient when 100 watts of heat is pumped into the sink.

Natural conduction heatsinks (0.5 to 5 ^{o}C/W) may only just be suitable for some uses of Peltier modules. Forced convection (0.02 to 0.5 ^{o}C/W) and liquid cooled (0.005 to 0.15 ^{o}C/W) must be used to obtain the maximum efficiency from a module.

Using the Module. The module should **not** be used as it is supplied. The best idea is to bolt metal plates on both sides of the module to protect the ceramic surfaces. Make sure to use heat insulating washers. Modules should not be used as mechanical supporting members of any assembly. This will put unnecessary strain on the solder joints within the module.

Alot of care must go into the construction of the assembly. Metal surfaces in contact with the ceramic plates should be ground flat, cleaned of grit and heatsink conducting paste used to make an efficient contact.

NOTE : HEAT MUST BE REMOVED FROM THE HOT SIDE BY A HEAT SINK OR COOLING FAN. IF NOT THEN THE MODULE WILL OVERHEAT & MELT.

Operating Voltage: maximum 13.5V. Potential may be applied either way. The only difference is the sides which heat up and cool down.

Rating: maximum 4.4 amps
Power: maximum 36 watts
Temperature difference: maximum 59 ^{o}C at an ambient temperature of 30 ^{o}C and with no load.
Number of p-n junctions: 127
Footprint: 4 cm x 4 cm
Thickness: 4mm
Weight: 28 grams
Module Factory Number: TEC1-12704

There are thousands of uses for heat pumps today especially in situations where heating or cooling must be present in very small spaces - called spot cooling. The other benefits of heat pumps are that there is no refrigerant, no fumes, no mechanical vibration & no noise. Also the amount of heating or cooling can be precisely controlled.

This module will allow you to experiment with this modern device. You should use a main powered power supply with the capacity to deliver up to 10 amps and where the voltage can be easily adjusted. Remember to watch out that your heat-sinking on the hot side is sufficient for the application.

Power Generation.
So far we have only discussed the Peltier Effect. However, you can use the module to generate power (Seebeck Effect.) At open circuit the module behaves as a simple thermocouple. If a temperature gradient is maintained across the device a potential develops across its terminals. If you maintain the temperature difference and connect the terminals to an electrical load then power is generated. You can experiment with your Peltier module to generate power in this way.

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