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THE MAGAZINE FOR COMPUTER APPLICATIONS

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RESOURCE PAGES



A Guide to online information about:

Peltier Thermoelectric Coolers

by [Bob Paddock](#)

At one time or other most of us have designed a circuit that was not stable during some type of temperature change. So to test it, we get out the Cold Spray and Heat Gun. What we usually end up with is a wet, foggy circuit. What we really need is our own personal environmental chamber, but few of us can afford one. Using Peltier Effect thermoelectric coolers, we can build our own environmental chamber. See *Closed Loop Temperature Regulation Using H-Bridge Motor Controller of a Thermoelectric Cooler*.

First I'll cover the manufacturers of Peltier devices, then I'll cover some of their applications. The applications range from useful OEM products to the truly absurd.

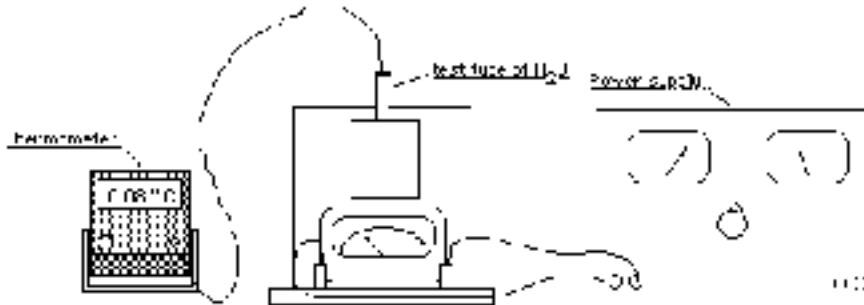
Before we can talk about the Peltier device, a device that gets hot on one side and cold on the other based on the direction of current flow, it would be a good idea to brush up on the fundamentals of temperature and thermodynamics.

[About Temperature](#)

The document [About Temperature](#) was prepared for the middle school math teachers who are taking part in [Project Skymath](#). This document

covers:

- What is temperature?
- The development of thermometers and temperature scales
- Heat and thermodynamics
- The kinetic theory
- Thermal radiation
- 3 K - The temperature of the universe



University of Oregon physics demonstration [Thermodynamics: Thermal Properties of Matter Peltier App. -- super cooled water.](#)

DOE-HDBK-1012/1-92	DOE Fundamentals Handbook, Thermodynamics, Heat Transfer, and Fluid Flow, Volume 1 of 3 (138 pages) PDF (2994 KB)
DOE-HDBK-1012/2-92	DOE Fundamentals Handbook, Thermodynamics, Heat Transfer, and Fluid Flow, Volume 2 of 3 (80 pages) PDF (1193 KB)
DOE-HDBK-1012/3-92	DOE Fundamentals Handbook, Thermodynamics, Heat Transfer, and Fluid Flow, Volume 3 of 3 (82 pages) PDF (1214 KB)

By the year 2000, the culture of the DOE community will be based on standards. Technical standards will formally integrate part of all DOE facility, program, and project activities. The DOE will be recognized as a participant in the use and development of technical standards. The Technical Standards Program will be a benchmark for efficiency, value, and support for the DOE customer.

In support of the Department's Standards Program and in partnership

with all stakeholders, the mission is to enhance DOE's transition to a standards-based culture by providing information, co-ordinating activities, and promoting the use of consensus standards, and when needed, the development of DOE technical standards.

[Online Approved DOE Technical Standards](#)

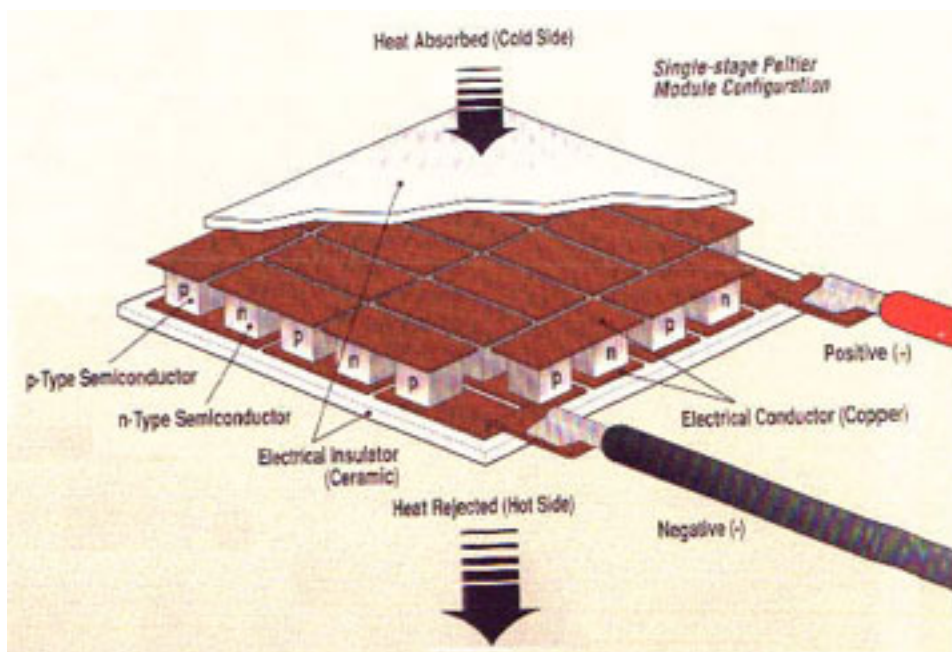
[The few standards that are listed here are the ones relevant to this section, check above link for the complete listing.]

A thermoelectric cooler is a special type of semiconductor that functions as a heat pump. By applying a low-voltage, high-current, DC power source, heat will be moved in the direction of the current (+ to -). The heat is pumped from one side of the module to the other, so that one face will be cold while the opposite face will be heated, and the effect is reversible. This is also known as the Peltier Effect.

Manufactures of Peltier devices, listed alphabetically:

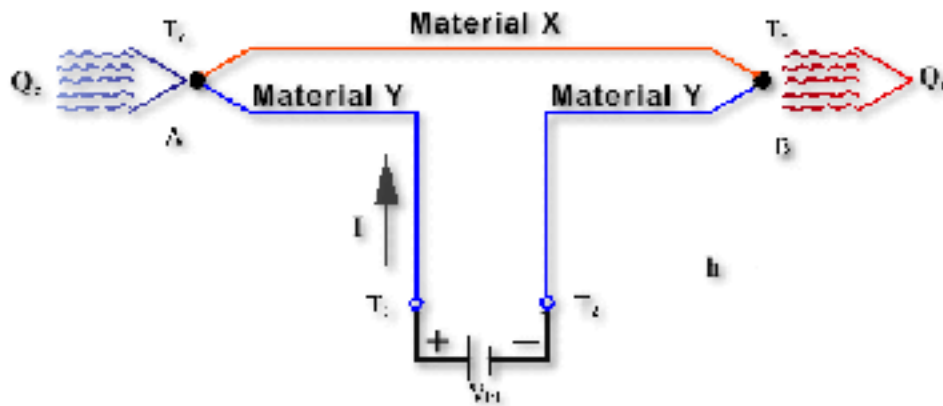
[Alpha & Omega Computer, Inc.](#)

[Frequently asked questions about Peltier Effect:](#)

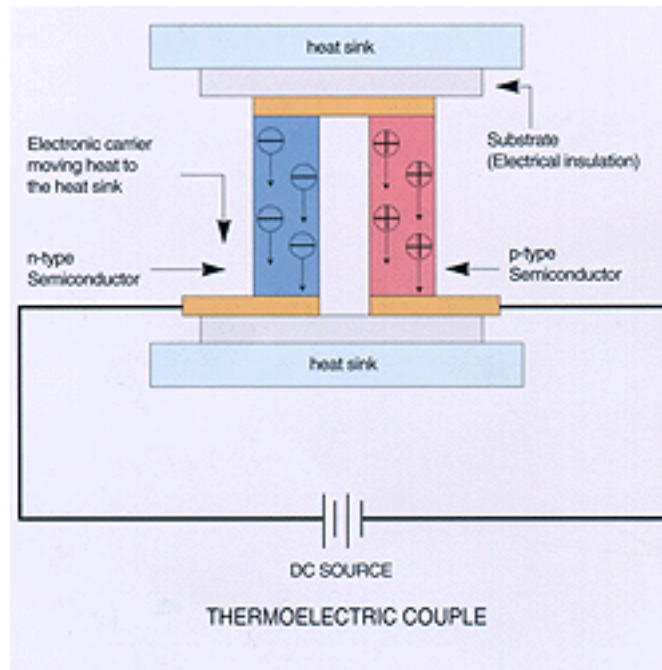


[Ferrotec Corporation](#) is a leading manufacturer of small, wafer-like heat pumps called thermoelectric modules and their related assemblies. These products are used to cool or control the temperature in a wide variety of products by utilizing the Peltier Effect.

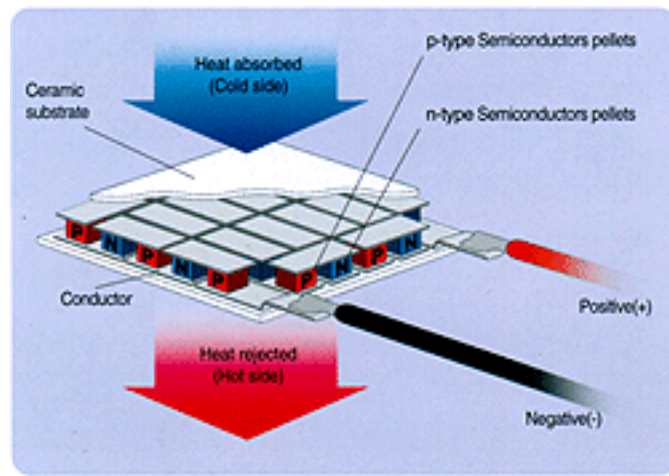
[Introduction to Thermoelectric Cooling.](#)



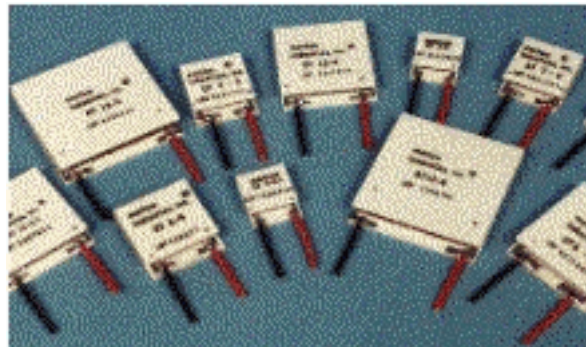
[INB Products, Inc.](http://www.inbproducts.com) is a worldwide supplier of Thermoelectric modules. Their Peltier products are used in many industries, such as military, commercial, industrial, and consumer.



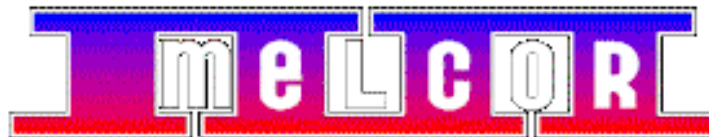
Peltier Effect is the phenomenon used in the thermoelectric refrigeration, with the rate of reversible heat absorption. When current passes through the junction of the two different types of conductors, it results in a temperature change.



Seebeck effect is the phenomenon underlying the conversion of the thermal energy into electrical power. Two dissimilar conductors at different temperatures create a voltage that generates electricity.



[Marlow Industries](#) offers a more detailed [FAQ about the Peltier Effect](#). Marlow Industries, Inc., is the world leader in quality thermoelectric cooling technology.



[Melcor Thermal Solutions](#) is one of the main manufacturers of thermoelectric coolers.

[Thermoelectric Handbook](#)
[Commonly Asked Questions About Thermoelectrics](#)

[Thermoelectric Cooler Controller Schematic](#) by Greg Billock and Chuan Xie. This circuit is useful for controlling TECs such as those sold by Melcor.



[Supercool Thermoelectrics](#) is a leading OEM supplier of thermoelectric refrigeration equipment. They are certified by the pharmaceutical, laboratory, electronic, marine, refrigeration, and automotive industries.

[OEM Applications](#) include:

- AA = Air to air system
- AL = Air to liquid system
- DA = Direct to air system
- DL = Direct to liquid system
- LA = Liquid to air system
- LL = Liquid to liquid system

[Thermoelectrics and how it works](#) has some educational graphics that are worth a look.

[TE Technology](#) designs and manufactures thermoelectric (Peltier) coolers, temperature controllers and test equipment.

[Tellurex](#) is the world leader in the manufacture of high-performance thermoelectric (Peltier) modules, used in both cooling and heat/cool applications. A result of years of material research and development, the ZMAX® module—produced exclusively by Tellurex—is recognized throughout the world as the technological benchmark in thermoelectric cooling and heating.

Their [26-page FAQ](#) probably answers any question that you may have.

Applications and techniques

[Alpha Omega Instruments Corp.](#)



Power Puncher Thermoelectric Cooler Controller

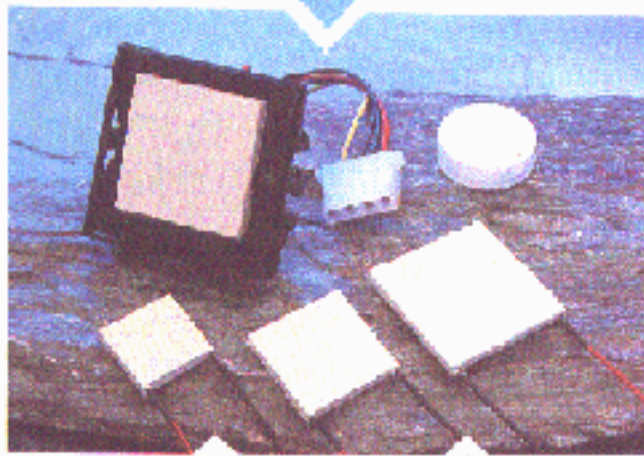
The Power Puncher is a rugged, full-capacity thermoelectric cooler controller that packs a wallop of up to 120 W (15 V @ 8 A). It features a linear, DC current source together with proportional and integral (P/I) temperature control. And, unlike hybrid controller chips that require users to purchase and install heat sinks, printed circuit boards, various electrical components, power supplies, and so on, the Power Puncher is a Plug and Play device.



The [Series 800](#) features a user-friendly front control panel. The control panel contains four switches that allow access to the instrument's control settings. In addition, there are two LED digital displays that simultaneously display both actual temperature and set point temperature. The Series 800 thermoelectric cooler controller features proportional, integral, and derivative (PID) control that provides exceptionally tight control over a wide temperature range. The auto-tuning feature helps to ensure maximum performance over a broad spectrum of operating conditions. Auto-tuning sets the critical PID terms to match the conditions of the application and provides fast response while minimizing overshoot and undershoot. From the user's perspective, the need to make frequent manual adjustments has been virtually eliminated.



The [Series P-1 Thermoelectric Cooler \(TEC\)](#) controller board is a high-performance linear analog controller designed to be used with a wide variety of thermoelectric coolers. The controller features an optically coupled MOSFET analog driver together with proportional and integral (P/I) temperature control.



[The unique combination of T.E.C. chip, advanced design heat sink, and a quiet, powerful fan acts efficiently to pump the CPU's heat output away from the CPU.](#)



The [Ice Probe](#), from [Advanced Thermoelectric Products](#), is a one piece water cooler probe—an easy to install unit that works without compressors, carcinogenic oils, or ozone-depleting gases that may be harmful to the environment. (It is also 90% recyclable.)

[Advanced Thermoelectric Products](#)

The Basics

[Advanced Thermoelectric Products: Fundamental Thermoelectrics.](#)



[Can cooler](#): This can cooler is provided with a thermoelectric refrigeration module to achieve a small, compact, light and noiseless cooling solution. The thermoelectric module exploits Peltier Effect by doped bismuth telluride, to pump heat.

[Cascaded Peltier Liquid Cooler](#)

If one Peltier can get things really cold, two should get things colder.

Right? Well...

[Liquid Cooled CPU Experiments.](#)

[Chemical Engineering, Science & Technology Timeline](#)

[Compiled by Luis Klemas](#)

[CK500 - Peltier Junction Experimenters Kit](#)

This experimenter's kit comes with a 127-element thermo-electric device sandwiched between two large heat sinks. We have also included a PID (proportional integral differential) power control circuit board. From <http://electronickits.com/>.


Coolers



40Qt. Thermoelectric Cooler 3
Product Number #68-5642-807

- New internal light and auto thermostat control allow quick access to contents and provides a consistent cooler temp.
- LED indicator shows when Auto-thermostatic control is operational
- Door shelf and new internal light
- Can be used horizontally or vertically
- Shelf divider has 3 different positions
- Engineered to open in tight spaces
- Door converts to open left or right

[I've seen smaller versions of this device at local stores, but didn't find any in my web searching.]

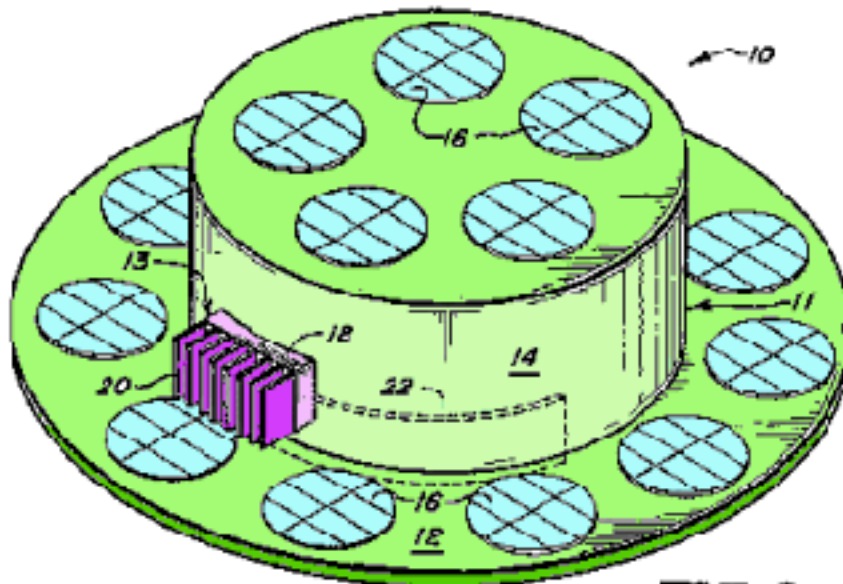


FIG. 1

'Cranium Cooler' [US Patent 4,551,857 / Issued 1985](http://www.uspto.gov/patent/publications/4551857.pdf)
from
<http://www.totallyabsurd.com/>.

[CRC Handbook of Thermoelectrics](#) by [Rowe; D.M.](#)

Description:

Thermoelectrics is the science and technology associated with thermoelectric converters, that is, the generation of electrical power by the Seebeck Effect and refrigeration by the Peltier Effect.



[Dage TC-1 Thermoelectric Cooler](#)

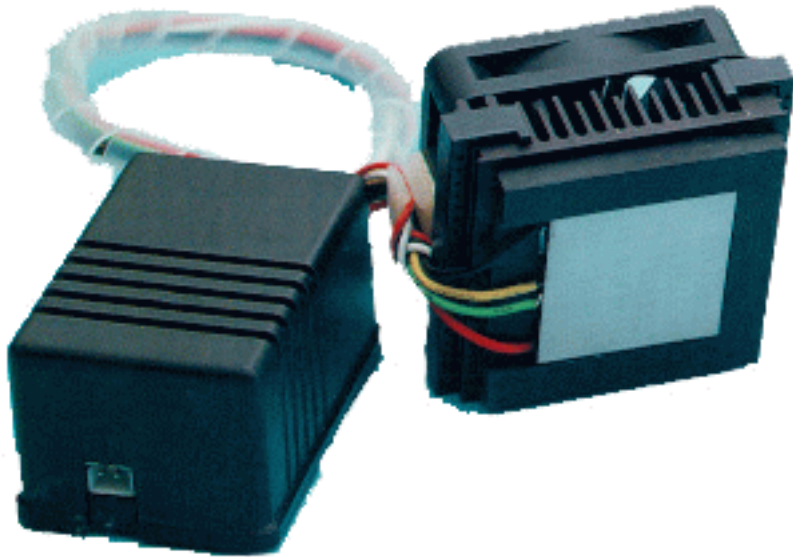
The TC-1 Thermoelectric Cooler is a two-stage Peltier type cooler that lowers the sensor temperature a full 55°C. Eliminating the dark current allows the user to extend integration times and improves both the signal to noise ratio and increases the dynamic range up to 10 bits. The clean,

constant power supply optimizes the cooling efficiency without adding more noise to the system. The TC-1 cooling unit is permanently affixed to the CCD camera head. It can be added to some CCD cameras.

Design Ideas: June 8, 1995
[Temperature controller drives Peltier cooler](#)

Dr Trevor Preston,
Cambridge, UK

DesTech DESTeCH Solutions Inc.
TEL:886-2-28832998 FAX:886-2-28829138



[DT-P54A Pentium Peltier Thermoelectric CPU Cooler](#)



[Ecofan Stovetop Fan](#)

The Caframo Ecofan is a heat-powered fan designed to circulate the warm air created by a wood stove. This fan does not use any batteries or wall cords. The Caframo Ecofan has a thermoelectric module that acts as a small generator to power the fan's motor. When this generator module experiences a heat differential between its top and bottom surfaces, it pumps out electricity. The bottom surface of the module is heated by the base of the fan, while the top of the module is kept cooler by the fan's top cooling fins.

Electronics Cooling

[ElectronicsCooling](#) is the premier magazine dedicated to engineers responsible for thermal management in the electronics industry. The magazine's mission is to disseminate practical information that relates to cooling today's electronics.

[The Heatsink Guide: Peltier coolers](#)

covers some of the down sides of Peltier Coolers such as the dangers of Peltiers, and how long will they last.



[Mike's Water Cooled CPU Project](#) has many useful construction tips involving water jackets and heat exchangers.

Steve J. Noll put together his [Peltier Device \(Thermoelectric Heater/Cooler\) Info](#) page. I wish I had found it earlier in my search of Peltier info, he had all the hard work done for me.

[Over clocking to Extreme! The Water-Cool News.](#)

Only for all of you radical overclockers.



The days of having to leave the comfort of your recliner to go to the kitchen are over. [Oasis](#) is the first ever recliner to feature a beverage cooler built right into the arm of the chair. The thermoelectric refrigeration unit holds up to six 12-ounce cans.

[Unitrode Corporation](#) has several unique application notes dealing with H-Bridges.

[TI has announced plans to acquire Unitrode Corporation.](#)

Closed Loop Temperature Regulation Using the UC3638 H-Bridge Motor Controller and Thermoelectric Cooler

[Class-D Amplifier for Thermoelectric Devices DN-76](#)

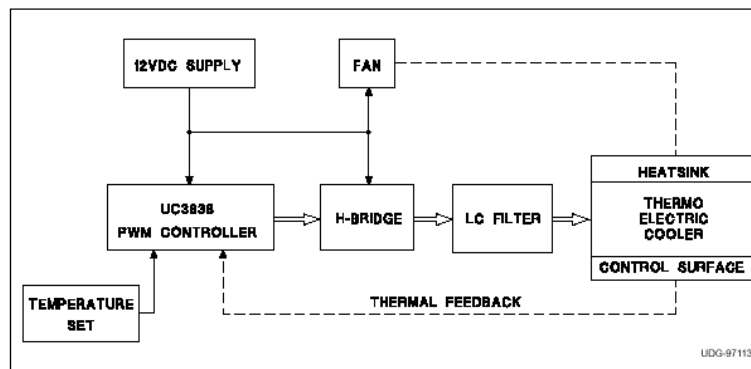
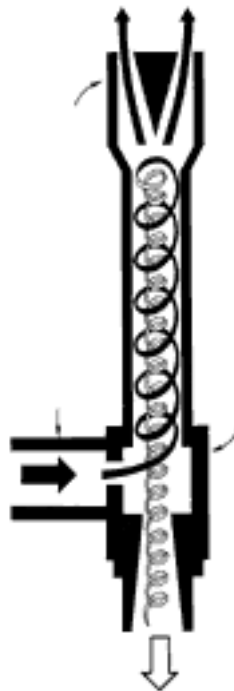


Figure 1. Temperature controller block diagram.
02/99

Have you ever wanted to test an IC over temperature, but couldn't put

the entire application circuit in the oven? Maybe you needed to access critical circuit nodes for troubleshooting, or observe the effects of temperature on only one component. Freeze sprays and hair dryers may be good for benchtop troubleshooting, but the temperature (and temperature slew rate) is highly uncontrolled and may actually damage the part. Forced-air systems that direct temperature controlled air to a specific area are available, but they are large, cumbersome, and expensive. What is needed is a portable, low-cost, temperature forcing system.

One solution is to use a thermoelectric cooler. Thermoelectric coolers employ the Peltier Effect, acting as small, solid state heat pumps when a DC current is passed through them. They are relatively small, flat devices which transfer heat from one side to the other. The direction of heat transfer can be reversed, for heating or cooling, by simply reversing the direction of the current. The amount of heat transfer is controlled by the magnitude of the current. A temperature difference achieved using a single element, if proper heat sinking is provided on one side of the device. Larger temperature gradients can be produced by stacking multiple elements. They can be used effectively as part of a closed loop temperature regulation system.



Vortex Tube Phenomenon

While the Vortex Tube has nothing at all to do with the Peltier Effect, I thought it was an interesting method of cooling. A real-world implementation of Maxwell's Demon, where ambient temperature goes in the middle of the Vortex Tube, and hot air comes out one end, while cold air comes out the other.

The vortex tube was discovered in 1930 by French physicist Georges Ranque. [Vortec](#) was the first company to develop this phenomenon into practical, effective cooling solutions for industrial applications.

All product names and logos contained herein are the trademarks

of their respective holders.

If you would like to add any information on this topic or request a specific topic to be covered, contact [Bob Paddock](#).

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