



TEC module

Water Cooler

Cool/Heat Car Seat Cushion

Cool/Heat Sleep Pad

Personal Mini Cooler

Thermoelectric cooling unit

Redwood Wine Cooler

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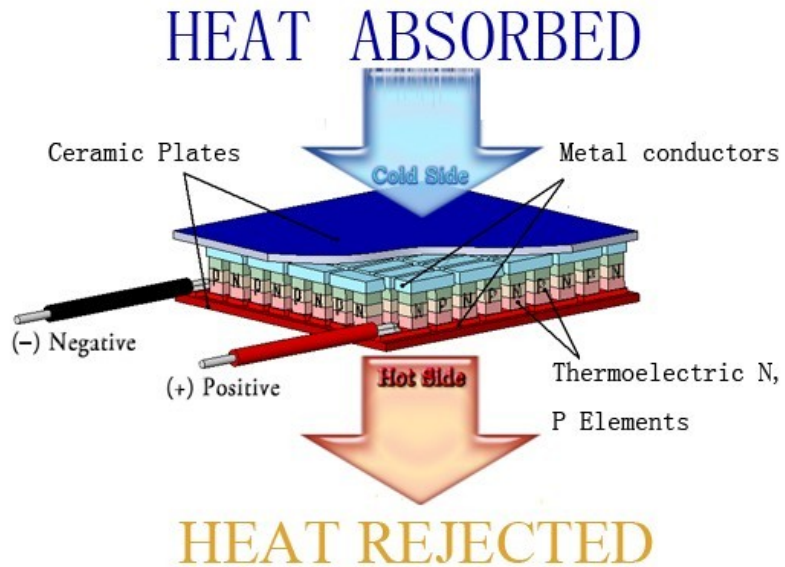
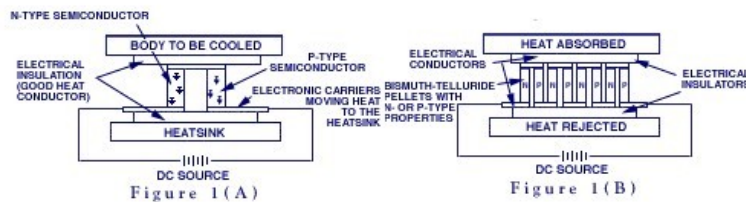
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An Introduction To Thermoelectric cooling module

Thermoelectric technology is an active thermal management technique based on the Peltier effect. It was discovered by J.C.A Peltier in 1834, this phenomenon involves the heating or cooling of the junction of two thermoelectric materials (bismuth and telluride) by passing current through the junction. During operation, direct current flows through the TEC module causing heat to be transferred from one side to the other. Creating a cold and hot side. If the direction of the current is reversed, the cold and hot sides are changed. Its cooling power also can be adjusted by changing its operating current. A typical single stage cooler (Figure. 1) consists of two ceramic plates with p and n-type semiconductor material (bismuth ,telluride) between the ceramic plates. The elements of semiconductor material are connected electrically in series and thermally in parallel.



Thermoelectric cooling module,Peltier device,TEC modules can be considered as a type of solid-state thermal energy pump, and due to its actual weight, size and the rate of reaction, it is very suitable to be used as part of the inbuilt cooling systems (due to limitation of space). With advantages such as quiet operation, shatter proof, shock resistance, longer useful life and easy maintenance, modern thermoelectric cooling module,peltier device,TEC modules have a wide range application in the fields of military equipments, aviation, aerospace, medical treatment, epidemic prevention, experimental apparatus, consumer products (water cooler, car cooler, hotel refrigerator, wine cooler, personal mini cooler, cool & heat sleep pad, etc).

Today, because of its low weight, small size or capacity and low cost, thermoelectric cooling is widely used in medical, pharmaceutical equipment, aviation, aerospace, military, spectroscopy systems, and commercial products (such as hot& cold water dispenser, portable refrigerators, carcooler and so on)

Parameters	
I	Operating Current to the TEC module (in Amps)
I_{max}	Operating Current that make the maximum temperature difference ΔT_{max} (in Amps)
Q_c	Amount of heat that can be absorbed at the cold side face of the TEC (in Watts)
Q_{max}	Maximum amount of heat that can be absorbed at the cold side. This occurs at $I = I_{max}$ and when $\Delta T = 0$ (in Watts)
T_{hot}	Temperature of the hot side face when the TEC module operating (in °C)
T_{cold}	Temperature of the cold side face when the TEC module operating (in °C)
ΔT	Difference in temperature between the hot side (T_h) and the cold side (T_c). $\Delta T = T_h - T_c$ (in °C)
ΔT_{max}	Maximum difference in temperature a TEC module can achieve between the hot side (T_h) and the cold side (T_c). This occurs (Maximum cooling capacity) at $I = I_{max}$ and $Q_c = 0$. (in °C)
U_{max}	Voltage supply at $I = I_{max}$ (in Volts)
ϵ	TEC module cooling efficiency (%)
α	Seebeck coefficient of thermoelectric material (V/°C)
σ	Electrical coefficient of thermoelectric material (1/cm · ohm)
κ	Thermo conductivity of thermoelectric material (W/CM · °C)
N	Number of thermoelectric element
I_{ϵ_{max}}	Current attached when the hot side and cold side temperature of TEC module is a specified value and it requires getting the Maximum efficiency (in Amps)

Introduction of application Formulae to TEC module

$$Q_c = 2N[\alpha(T_c + 273) - L I^2 / 2 \sigma S - \kappa S / L \alpha (T_h - T_c)]$$

$$\Delta T = [I \alpha (T_c + 273) - L I^2 / 2 \sigma S] / (\kappa S / L + I \alpha)$$

$$U = 2 N [I L / \sigma S + \alpha (T_h - T_c)]$$

$$\epsilon = Q_c / U I$$

$$Q_h = Q_c + I U$$

$$\Delta T_{max} = T_h + 273 + \kappa / \sigma \alpha^2 \times [1 - \sqrt{2 \sigma \alpha^2 / \kappa \times (T_h + 273) + 1}]$$

$$I_{max} = \kappa S / L \alpha \times [\sqrt{2 \sigma \alpha^2 / \kappa \times (T_h + 273) + 1} - 1]$$

$$I_{\epsilon_{max}} = \alpha \sigma S (T_h - T_c) / L (\sqrt{1 + 0.5 \sigma \alpha^2 (546 + T_h - T_c) / \kappa} - 1)$$

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Thermoelectric cooling module, TEC module, peltier device, thermoelectric modules, thermoelectric cooling, high power thermoelectric cooling module, center hole thermoelectric cooling module, center hole TEC module, high power TEC modules, thermoelectric cooler, peltier module, thermoelectric water cooler, Micro thermoelectric cooling module, Micro-TEC module, multi stage thermoelectric cooling module, Multi stage TEC module, TE cooling, two stage thermoelectric cooling module, high performance thermoelectric cooling module, thermoelectric heat/cool sleep pad, TEC modules, heat/cool matters, TEC warm/cool pad, cool/heat car seat cushion, TE cooling car seat pad, thermoelectric warm/cool pad, thermoelectric cooling water dispenser

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