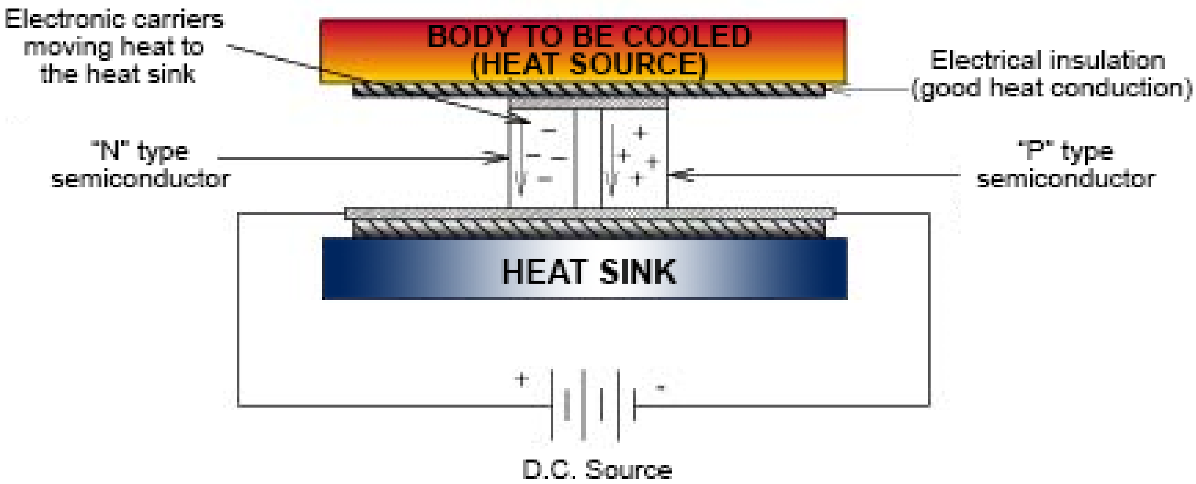
TEC MODULES

Thermoelectric devices are semiconductor heater or refrigeration units which use the Peltier effect to create a heat flux between the two surfaces of the module. Named after French physicist Athanase Peltier, the Peltier Effect shows that a temperature differential is created when DC current is applied across two dissimilar materials with a P-N junction characteristics. The Peltier Effect is one of the three thermoelectric effects, the other two are known as the Seebeck Effect and Thomson Effect.

The typical thermoelectric module is manufactured using two thin ceramic wafers with a series of P and N doped bismuth-telluride semiconductor material elements sandwiched between them. The ceramic material on both sides of the module adds rigidity and the necessary electrical insulation. The N element type material has an excess of electrons, while the P element type material has a deficit of electrons. One P element and one N element make up a couple junction that creates the thermoelectric effect.



When a DC current is applied to the circuit, a thermoelectric module can work as a cooler or heater depending on the direction of current. A thermoelectric cooler (TEC), or solid state heat pump, transfers heat from one side of the device to the other side against the temperature gradient.

There are many products using thermoelectric coolers, including small refrigeration systems, CCD cameras, laser diodes, and portable picnic coolers. In addition to the aforementioned, they are also used in thermal management of electronic devices, such as microprocessors, memory modules, etc.

There are a set of equations that define the performance of a TEC. For example if one wants to maintain a cold temperature (T_C) at a certain level for a specific amount of current (less than I_{MAX}) to extract a specific amount Q_C (less than Q_{MAX}) from the cold side, the hot side temperature (T_h) can be found from the Q_C equation. Subsequent equations for Q_h,V and COP can be used to find the values of Q_h,V and COP. The correlations are as follows:

EQUATIONS:

Heat pumped (cold side): $\dot{Q}_c = 2N[S_{AB}IT_c - 2N\frac{k\rho}{R}(T_h - T_c)] - \frac{1}{2}I^2R$

Heat rejected (hot side): $\dot{Q}_h = 2N[S_{AB}IT_h - 2N\frac{k\rho}{R}(T_h - T_c)] + \frac{1}{2}I^2R$

Voltage across the TEC module: $V = 2N[S_{AB}(T_h - T_c)] + IR$

Coefficient of performance (COP): $COP = \frac{\dot{Q}_c}{VI} = \frac{2N[S_{AB}IT_c - 2N\frac{k\rho}{R}(T_h - T_c)] - \frac{1}{2}I^2R}{VI}$

WHERE:

N is the number of couples

I is the input current to TEC module (A)

V is the voltage across TEC module (V)

S_{AB} is the Seebeck coefficient of Bi_2Te_3 material ($^V/_K$)

R is module electrical resistance (Ω)

k is the thermal conductivity of Bi_2Te_3 material (W/m•K)

ρ is the electrical resistivity of Bi_2Te_3 material (Ω•m)

T_h is hot side temperature (K)

T_C is cold side temperature (K)

NOTES

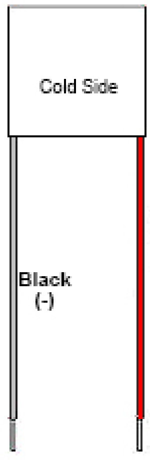
S_{AB}, k and ρ are thermoelectric material properties that vary with temperature. Typical values are:

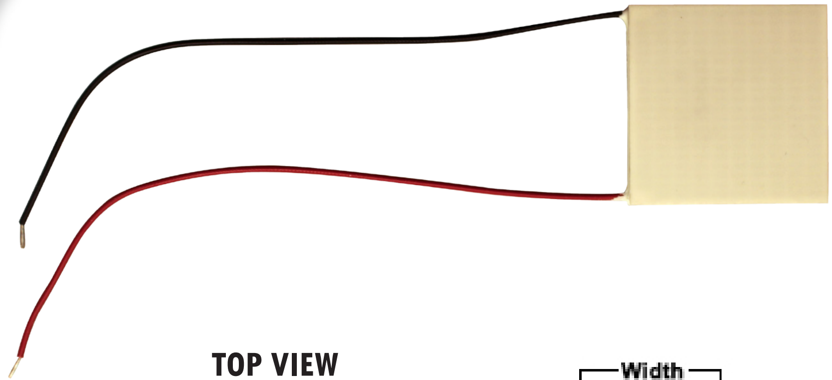
S_{AB} = 200 x 10^{-6} V/K

k = 1.5 W/mK (at 300 K)

ρ = 10 x 10^{-6} Ω•m

- Cold side is identified as seen on right
- Positive wire: red
- Negative wire: black
- Use thermal grease on both cold and hot surfaces for contact with heat sink and device
- For maximum reliability a non-condensing environment is recommended
- Lead wire: #20 AWG, solid tinned copper
- Sealed by silicone rubber RTV, for protection against moisture
- Ceramic plates = (96% Al_2 0_2, white)





TEC Modules

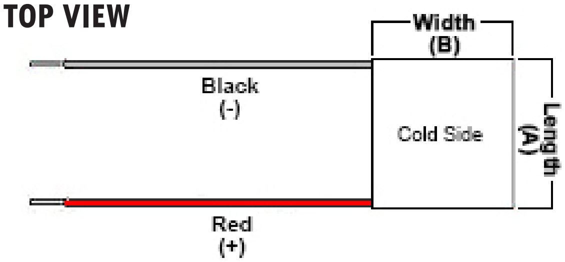
FEATURES & BENEFITS

- Medium to small form factors (10x10 to 50x50 mm)
- Thin form factor (3.3 to 4.7 mm)
- Cooling power, Q_{max}, from 2 to 133W
- Customizable shapes to suit different applications

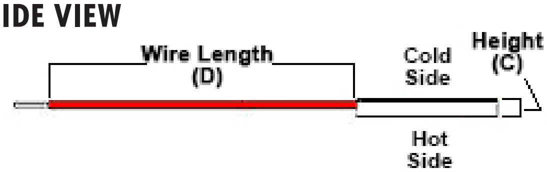
APPLICATIONS

- Thermal management
- Laboratory testing
- Laser diode
- Refrigerators
- Telecom equipment
- Biomedical equipment

TOP VIEW



SIDE VIEW



PRODUCT SPECIFICATIONS

Part Number	I_{max} amps	V_{max} (volts)	Q_{max} (watts)	ΔT_{max} (T_h=300K)	Internal Resistance	Modules Dimensions (mm)				Weight	N (Couples)
						Length	Width	Height	Wire Length		
ATS-TEC40-45-001	4	15.4V	36.8W	68°C	3.02Ω±10%	40	40	4.5	300	26.8g	127
ATS-TEC40-47-002	4	15.4V	36.8W	68°C	3.02Ω±10%	40	40	4.7	100	28.6g	127
ATS-TEC40-40-003	5	15.4V	46.5W	68°C	2.51Ω±10%	40	40	4.0	100	23.8g	127
ATS-TEC40-39-004	6	15.4V	53.0W	68°C	2.05Ω±10%	40	40	3.9	100	23.3g	127
ATS-TEC40-35-005	8	15.4V	68.8W	68°C	1.51Ω±10%	40	40	3.5	100	22.9g	127
ATS-TEC40-33-006	10	15.4V	88.9W	68°C	1.12Ω±10%	40	40	3.3	100	22.6g	127
ATS-TEC50-40-007	12	15.4V	106.7W	68°C	0.91Ω±10%	50	50	4.0	100	51.4g	127
ATS-TEC50-38-008	15	15.4V	133.3W	68°C	0.75Ω±10%	50	50	3.8	100	40.2g	127
ATS-TEC40-42-010	3	24.1V	41.6W	68°C	6.82Ω±10%	40	40	4.2	100	27.5g	127
ATS-TEC10-47-012	4	0.8V	2.0W	68°C	0.16Ω±10%	10	10	4.7	100	4.3g	7
ATS-TEC30-47-013	4	8.5V	21.0W	68°C	1.73Ω±10%	30	30	4.7	100	16.3g	71
ATS-TEC23-36-014	3	8.5V	14.9W	68°C	2.05Ω±10%	23	23	3.6	100	7.4g	71
ATS-TEC40-47-015	3	15.4V	26.7W	68°C	3.42Ω±10%	40	40	4.7	140	28.5g	127
ATS-TEC50-38-016	7	29.4V	118.5W	68°C	3.36Ω±10%	50	50	3.8	140	38.4g	241
ATS-TEC30-36-017	3	15.4V	26.7W	68°C	3.42Ω±10%	30	30	3.6	100	13.5g	127
ATS-TEC40-35-018	8	24.1V	111.5W	68°C	2.35Ω±10%	40	40	3.5	100	25g	199
ATS-TEC40-37-019	6	15.4V	53.3W	68°C	1.98Ω±10%	40	40	3.7	100	24.5g	124
ATS-TEC30-33-020	4	15.4V	35.6W	68°C	3.08Ω±10%	30	30	3.5	100	12.2g	127

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Advanced Thermal Solutions:

ATS-TEC10-47-012 ATS-TEC23-36-014 ATS-TEC30-33-020 ATS-TEC30-36-017 ATS-TEC30-47-013 ATS-TEC40-33-006 ATS-TEC40-45-001 ATS-TEC40-47-002 ATS-TEC40-47-015 ATS-TEC50-38-008 ATS-TEC50-38-016 ATS-TEC50-40-007 ATS-TEC40-35-005 ATS-TEC40-35-018 ATS-TEC40-37-019 ATS-TEC40-39-004 ATS-TEC40-40-003 ATS-TEC40-42-010