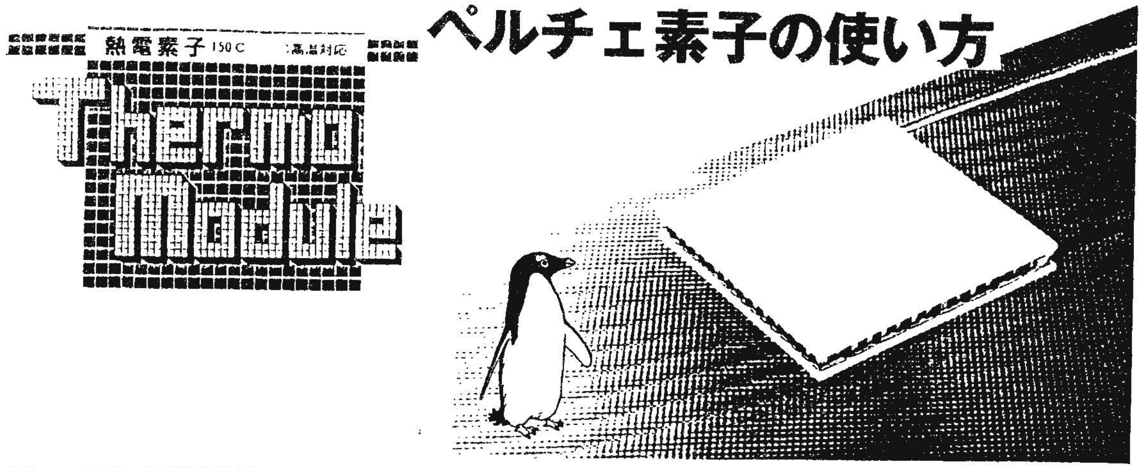
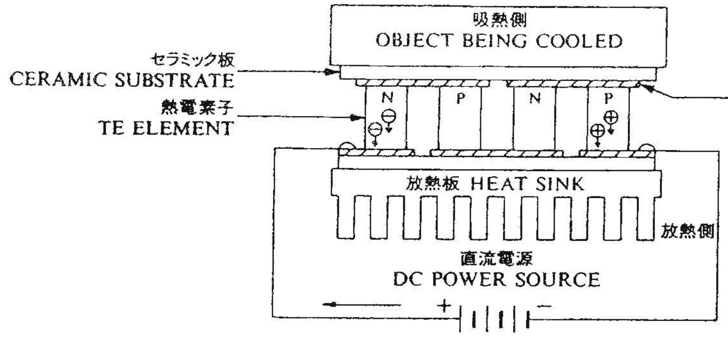
ペルチェ素子の使い方



INTRODUCTION



電子冷却概略図
Typical Thermoelectric Cooler

概略図は、典型的なサーモ・モジュールを応用した冷却用、応用例であり、電流を流した時の熱の移動を示しています。ほとんどのサーモ・モジュールは、N型・P型が対になった半導体素子によって組み立てられており、熱放出量は、流した電流値に比例し、直流電流入力を"0~最大値"まで変化させることにより熱放出量と温度の制御が可能です。

この製品の応用分野は広く、一般的には、保温保冷庫から半導体プロセス用恒温槽、オプトエレクトロニクスにおける光通信用レーザーダイオード等に利用されております。又、環境破壊対策としての脱フロン時代をむかえ、更にその要求は高まりつつあります。

1.4 The Seebeck, Peltier, and Thomson Effects, together with several other phenomena, form the basis of functional thermoelectric devices. Without going into too much detail, we will examine some of these fundamental thermoelectric effects.

1.4.1 *SEEBECK EFFECT:* To illustrate the Seebeck Effect let us look at a simple thermocouple circuit as shown in FIGURE (1-1). The thermocouple conductors are two dissimilar metals denoted as Material x and Material y.

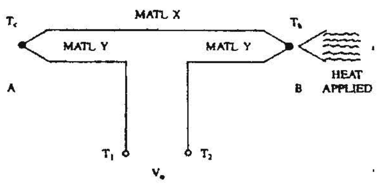


FIGURE (1-1)

In a typical temperature measurement application, thermocouple A is used as a "reference" and is maintained at a relatively cool temperature of T_c. Thermocouple B is used to measure the temperature of interest (T_h) which, in this example, is higher than temperature T_c. With heat applied to thermocouple B, a voltage will appear across terminals T1 and T2. This voltage (V_o), known as the Seebeck emf, can be expressed as:

$$V_o = \alpha_{xy} \times (T_h - T_c)$$

where: V_o is the output voltage in volts
α_{xy} is the differential Seebeck coefficient between the two materials, x and y, in volts/°K
T_h, T_c are the hot and cold thermocouple temperatures, respectively, in °K

1.4.2 *PELTIER EFFECT:* If we modify our thermocouple circuit to obtain the configuration shown in FIGURE (1-2), it will be possible to observe an opposite phenomenon known as the Peltier Effect.

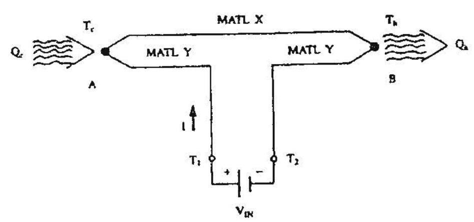


FIGURE (1-2)

If a voltage (V_{in}) is applied to terminals T1 and T2 an electrical current (I) will flow in the circuit. As a result of the current flow, a slight cooling effect (Q_c) will occur at thermocouple junction A where heat is absorbed and a heating effect (Q_h) will occur at junction B where heat is expelled. Note that this effect is fully reversible whereby a change in the direction of electric current flow will reverse the direction of heat flow. The Peltier effect can be expressed mathematically as:

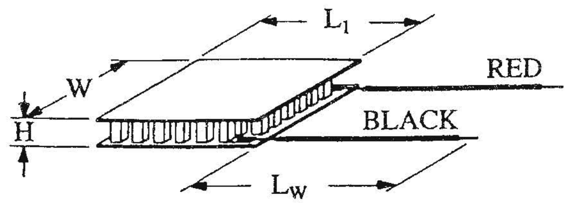
$$Q_c \text{ or } Q_h = \pi_{xy} \times I$$

where: π_{xy} is the differential Peltier coefficient between the two materials, x and y, in volts
I is the electric current flow in amperes
Q_c, Q_h is the rate of cooling and heating, respectively, in watts

Joule heating, having a magnitude of I^2R (where R is the electrical resistance), also occurs in the conductors as a result of current flow. This Joule heating effect acts in opposition to the Peltier effect and causes a net reduction of the available cooling.

1.4.3 *THOMSON EFFECT:* When an electric current is passed through a conductor having a temperature gradient over its length, heat will be either absorbed by or expelled from the conductor. Whether heat is absorbed or expelled depends upon the direction of both the electric current and temperature gradient. This phenomenon, known as the Thomson Effect, is of interest in respect to the principles involved but plays a relatively small role in the operation of practical thermoelectric devices. By using average Seebeck coefficient values when modeling thermoelectric device performance, the Thomson Effect essentially is incorporated into the mathematical model.

TECHNICAL DATA SHEET



L_1 = 39.7mm
W = 39.7mm
H = [illegible] mm
Lw = 135mm

THERMOELECTRIC COOLING MODULE
127-Couples, 6.0 Amperes

12V用<4~16.8V> 6Amax

最大吸熱量57W 外形:4cm×4cm

最大使用温度 150℃

※これは6Aタイプの代表値です。4A,9Aタイプも値は違いますが同じような特性の曲線になります。

仕様 GENERAL SPECIFICATIONS	高温側温度 Hot Side Temperature (Th)				単位 Units
	25°C	35°C	50°C	80°C	
温度差 Temperature Differential (DT) at Qc=0	65	68	72	76	°C
吸熱量 Heat Pumping Capacity (Qc) at DT=0	51	54	57	62	watts
最大電流値 Maximum or Optimum Current (Imax)	6.0	6.0	6.0	6.0	amperes
入力電圧 Input Voltage (Vin) at Imax and DT=30	14.9	15.7	16.8	19.2	volts