Peltier Module Installation Notes

1. Important Installation Notes

Peltier modules contain a relatively fragile thermoelectric material and ceramics (as shown in Figure 1), they require careful handling and strict compliance with the installation rules. Failure to meet these rules may result in reducing Peltier module performance, lower life time or complete breakdown.

When installing Peltier modules, pay attention for the following recommendations:

1. Impacts, dropping of the module on a hard surface etc. may cause irreparable damage to the module.

2. The mounting surfaces (between which modules are to be clamped) should be flat to within 0.025 mm (0.001 inch).

3. Module surfaces must have a good thermal contact with the cooled object and heat-eliminating surface.

4. Avoid excessive mechanical loading of the module for the modules are relatively strong in compression and weak in shear.

5. Do not use acuminate tool to position the modules to avoid break the thermoelectric material.

6. The force on the wire cannot be in the direction of up and down or left and right besides the Lead-Out direction.

7. Accurately spot the hot side and cold side of the module.

The "hot" and "cold" sides of standard Peltier modules may be identified by the position of the wire leads. Wires are attached to the hot side of the module, which is the module face that is in contact with the heat sink. For modules having insulated wire leads, when the red and black leads are connected to the respective positive and negative terminals of a DC power supply, heat will be pumped from the module's cold side, through the module, and into the heat sink. Note that for Peltier modules having bare wire leads, the positive connection is on the right side and the negative connection is on the left when the leads are facing toward the viewer and the substrate with the leads attached presented on the bottom.

Figure 1 The structure of the Peltier modules

2. System Assembly

Several methods for installing Peltier modules have been developed, including: mechanical lamping, epoxy bonding, and direct solder bonding. The individual requirements of the application will determine which method is most appropriate, however, mechanical clamping is by far the most common.

Mechanical Clamping Method:

The following is a list of guidelines for using mechanical clamping:

1. Lap or grind all the mounting surfaces flat to within 0.025 mm (0.001 inch).

2. Clean the mounting and module surfaces to ensure all burrs, chips, etc have been removed.

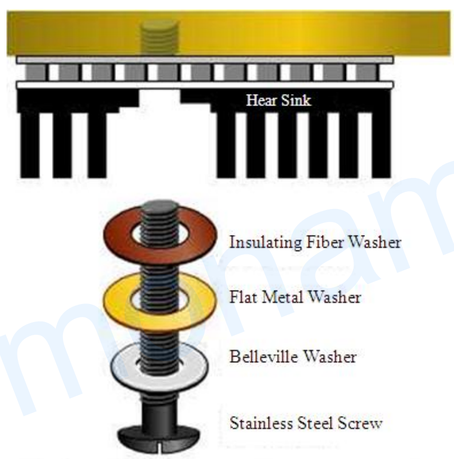
3. If more than one module is to be used in the assembly, all modules should be within 0.025 mm (0.001 inch) in height/thickness.

4. Coat the hot side of the module with a thin layer of thermal grease, then place it on the heat sink. Applying firm but even downward pressure, move the module in clockwise/counter clockwise motions. Do this until a slight resistance is felt and excess thermal grease is squeezed out.

5. Coat the cold side of the module with a thin film of thermal grease. Repeat the process described in step 4.

6. Apply a light load in line with center of module by using clamp or weights, and locate bolt holes in your assembly such that they are at opposite sides of the center of the module between 1.6 mm to 12.7 mm (0.063 to 0.5 inches) from the sides of the module as Figure 2.

7. Bolt the object to be cooled and heat sink together using stainless steel fasteners with washers or split type lock-washers. Insure an even pressure across the module surface when tightening the screws. The recommended compression for a TEC assembly is 70~130 Kg per sq. inch of module surface.



Typical Fastener Components

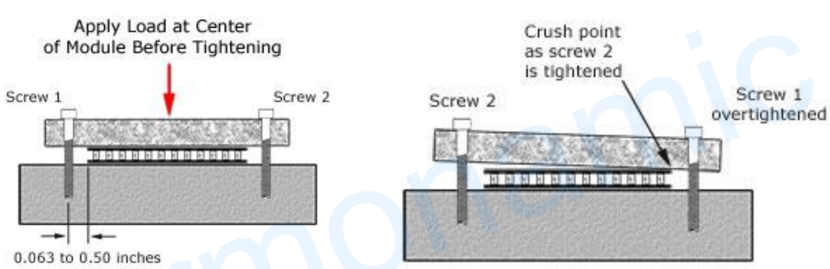


Figure 2 Diagram of mechanical lamping installation

Calculation of Peltier module clamping force

Torque (T) of the torque wrench may be calculated with the following formula:

T (torque) = $(2.8 \times 10^{-4} \times p \times d)/n$, (kg × m)

where: p is required clamping force (kg)

d is screw diameter (mm)

n is number of screws (2-4) used for module installation.

Example: Installation of a 40 × 40 mm module (e.g. TEC1-12708) requires a total hold-down force of 210 to 240 kg.

Soldering Method:

Peltier modules that have metallized external faces may be soldered into an assembly provided that reasonable care is taken to prevent module overheating. Soldering to a rigid structural member of an assembly should be performed on one or two side of the module in order to avoid excessive mechanical stress on the module. Note that with a module's hot side soldered to a rigid body, however, a component or small electronic circuit may be soldered to the module's cold side provided that the component or circuit is not rigidly coupled to the external structure. Good temperature control must be maintained within the soldering system in order to prevent damage to the Peltier module due to overheating. Thermonamic`s Peltier modules are rated for continuous operation at relatively high temperatures (100 or 270℃) so they are suitable in most applications where soldering is desirable. Naturally these relative temperatures should not be exceeded in the process. Since the coefficients of expansion of the module ceramics, heat sink and cooled object vary, we do not recommend soldering modules larger than 15 × 15 mm. Soldering should not be considered in any thermal cycling application. For module mounting with solder, the following steps should be observed:

1. Machine or grind flat the mounting surface on which the module(s) will be located. Although surface flatness is not highly critical with the soldering method, it is always desirable for mounting surfaces to be as flat as possible. Obviously, the heat sink surface must be a solderable material such as copper or copper plated material.

2. Clean and degrease the heat sink surface and remove any heavy oxidation. Make sure that there are no burrs, chips, or other foreign material in the module mounting area.

3. Pre tin the heat sink surface in the module mounting area with the appropriate solder. The selected solder must have a melting point that is less than or equal to the rated maximum operating temperature of the TE device being installed. When tinning the heat sink with solder, the heat sink's temperature should be just high enough so that the solder will melt but in no case should the temperature be raised more than the maximum value specified for the TE device.

4. Apply soldering flux to the Peltier module's hot side and place the module on the pre tinned area of the heat sink. Allow the module to "float" in the solder pool and apply a back and forth turning motion on the module to facilitate solder tinning of the module surface. A tendency for the module to drag on the solder surface rather than to

float is an indication that there is an insufficient amount of solder. In this event, remove the module and add more solder to the heat sink.

5. After several seconds the module surface should be tinned satisfactorily. Clamp or weight the module in the desired position, remove the heat sink from the heat source, and allow the assembly to cool. When sufficiently cooled, degrease the assembly to remove flux residue.

3. Supply Voltage Considerations

Peltier module operating mode - the required maximum cooling capacity and efficiency- predetermine the voltage rating to be supplied per one module. It is highly important to remember that the supplied voltage per Peltier module should not exceed the maximum voltage (Umax) specified for this particular type of Peltier module.

For example, in the case of the Peltier module with 127 couple pellets series such as frost, snowball, and ice series with the Umax being equal to appr. 16 volts, we recommend to feed the Peltier modules with 12 volts, which is around 75% of their specified Umax. We consider this way of choosing Peltier module voltage to be optimal to provide large cooling capacity (Qc) at high-rated efficiency of a Peltier module. Coefficient of performance (COP) is a measure of the efficiency of a Peltier module and is defined as Peltier module cooling capacity (Qc) divided by the electric input power (P). When the high performance Peltier modules are supplied with over 12 volts, the increase in Peltier module cooling capacity is negligible and COP of a Peltier module drops.

To provide high COP of a thermoelectric system that operates on a relatively low ΔT (ΔT << ΔTmax), it is recommended to mount several Peltier modules into the system to supply each of the Peltier modules with a lower voltage of around 6 to 9 volts. If the need arises to increase specific cooling capacity of frost, snowball, or ice cooling modules, the Peltier modules should be supplied with over 12 volts with the generated heat being effectively dissipated from the Peltier module hot side.

The same principle of voltage optimization to supply Peltier modules with 75% of their Umax is applied to all the modules, although their Umax may be different from the one mentioned above. At the same time, heat dissipation from the hot side and power supply characteristics should necessarily be taken into consideration in each particular case.

When calculating electrical parameters of a Peltier module working point, it should be noted that once the Peltier module is in its running mode, the input current goes down 20 - 35 %. According to the Seebeck effect, the increase in temperature differential between the hot and cold sides of the module results in greater thermal EMF. This leads to smaller voltage drop and, consequently, reduction in current running across the Peltier module.