

30 golden rules for Peltier Technology

- 1.) The number of solid-state pairs as well as packet density of Peltier module determines the size of the module.
- 2.) On every solid-state pair drops approx. 0.12 Volt. A high number of solid-state pairs increases maximum possible voltage and the current can be thereby decreased.
- 3.) High current influence the life time of the module, because it extends microtears of solid-state material with the time.
- 4.) High current conduct higher thermal warming and therefore it lowers efficiency.
- 5.) The relation of cooling power (Q_c) to the used current can be seen mathematically as an exponential approach to the maximum value. Consequently a lot of electric energy must be engaged for the last 30% of the maximum chill achievement.
- 6.) The heat dissipation on warm side of the Peltier module is the sum of the cooling power and the engaged electric energy (working energy).
- 7.) The efficiency of Peltier module is the relation of thermal transfer to the engaged electric energy.
- 8.) Very high efficiency of cooling with Peltier is realized by operation around approx. 50% of voltage / current maximum value.
- 9.) The information of maximum cooling power Q_c of Peltier module is based on temperature difference between both sides (0 Kelvin), a maximum provided current / voltage and an ambient temperature of 300K (27°C). The real cooling power is lower and can be estimated with the help of a performance diagram.
- 10.) Standard modules reach under vacuum condition and 300K (27°C) ambient temperature a maximum temperature difference of approx. 70 Kelvin.
- 11.) High-quality modules can reach values of about 72 Kelvin and more, while low-cost modules reach scarcely about 60 Kelvin.
- 12.) Special modules like multistage cascades generate a difference in temperature up to 120K. Disadvantage is low thermal pumping and the high price.
- 13.) A good heat dissipation on warm side of Peltier module improves the cooling power, efficiency and maximum temperature difference ΔT .
- 14.) The heat dissipation to the surroundings depends on the capability of the heat sink. A higher active surface of the heat sink (dimension as well number of fins) improves the thermal resistance.
- 15.) Big fans with high air flow improve the thermal resistance of the heat sink.

Temperaturmanagement



- 16.) Direct blowing on heat sinks body is most efficient, because the highest heat is always given on the ground of the body.
- 17.) Liquid heat sinks mostly have even higher thermal qualities, nevertheless they are substantially more cost-intensive.
- 18.) Between Peltier module and heat sink should be applied a good thermal interface material (thermal pads, thermal paste or thermal adhesive) for increasing the thermal transmission
- 19.) A very good thermal transmission between materials is reachable with a thin layer of thermal grease, because it can adapt itself to the microscopic unevenness.
- 20.) PCM (phase change material) show especially high filling factor. It moisten in the surfaces even better than normal thermal grease and also have the advantage that it doesn't dry up.
- 21.) High contact pressure also improves the thermal transmission, but at assembly it is very important that shearing force is prevented.
- 22.) Contact pressure to Peltier module should be between 3-8 kg / cm².
- 23.) Only small modules till maximum 12x12mm can be coated optionally with a metallization. They can be soldered in the manufacturing process directly on the heat sink.
- 24.) The maximum short-term operation temperature should be always 20-30°C below the solder temperature of the plumb (139°C; 183°C and 232°C).
- 25.) A longer-term use of a Peltier module >120°C leads to a diffusion process of the copper into solid-state material and consequently to a decrease of performance.
- 26.) For protection against moisture is a sealing mandatory. But due to heat recovery performance is approx. 4% lower.
- 27.) For condensation protection sealing with silicone is best choice because it can adapt to frequent temperature changes very well.
- 28.) Sealing with epoxy has the advantage that no outgassing is noticeable. The operating temperature shouldn't be higher than 80°C and not frequently changed.
- 29.) Frequent and high temperature changes lead to tensions between materials (caused by different length expansions of materials) and therefore it lowers life time.
- 30.) An analogue controlling as well as short-term pulses produce less mechanical stress than ordinary two-point controlling systems.

Änderungen und Irrtümer vorbehalten. Angaben in Millimeter (mm) / Specifications subject to change without notice. Dimensions in Millimeter (mm)

