ATE1-TCHE-127 TEC Modules

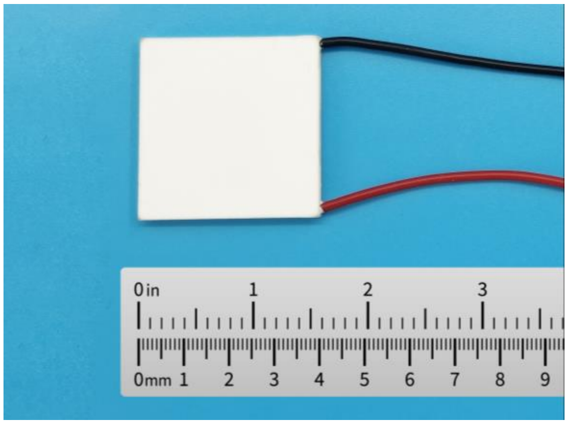

Figure 1. The Photo of Actual ATE1-TCHE-127

WHAT'S NEW

1. **Enhanced Thermal Efficiency:** Achieve high thermal efficiency through a significant Delta T (temperature difference) capability.
2. **Exceptional Longevity:** Enjoy extended product life thanks to remarkable thermal shock resilience.

FEATURES

- **Long Operational Life:** This product is built to last, offering a minimum of 50,000 operational cycles with a sequence of 1 minute at full power, 1 minute off, and 1 minute at full power. It can also endure at least 20,000 cycles when exposed to full power, transitioning from 20°C to 80°C, and returning to 20°C.
- **High Voltage Tolerance:** The product is designed to handle a maximum input voltage of 18.1V, ensuring reliability in various electrical applications.
- **Variable Input Current:** With a capacity ranging from 3A to 8.5A, this product accommodates a wide range of input currents, making it versatile for diverse electrical setups.
- **Environmentally Friendly:** It's important to note that this product is 100% Lead (Pb)-free and fully compliant with RoHS standards, contributing to a safer and more sustainable future.

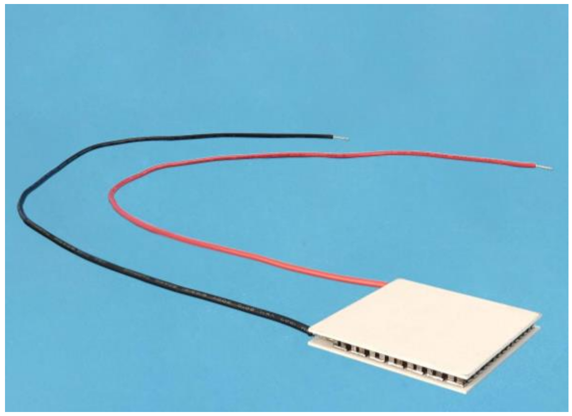

Figure 2. 3D View of Actual ATE1-TCHE-127

APPLICATIONS

PCR (Polymerase Chain Reaction) machines, thermal cyclers, chillers, thermal imaging, environmental chambers, etc.

INTRODUCTION

TEC modules are often categorized by the number of Peltier element pairs in the modules. The most popular series is the modules having 127 Peltier pairs. The TEC module presented herewith belongs to one of the 3 types of TECs in this series. This 127 series has 3 types, of TECs divided by their delta T and allowable thermal cycle times,as shown in Table 1.

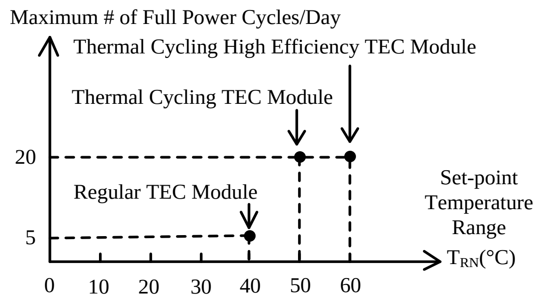

Figure 3.

Table 1.

127 Series	V_{MAX} (V)	I_{MAX} (A)	Q_{MAX} (W)	DT_{MAX} (°C)
Regular	15.4	3 ~ 18	20 ~ 170	63 ~ 68
Thermal Cycling	16.2~18.1	4 ~ 12.1	32 ~ 128.7	72 ~ 79
Thermal Cycling High Efficiency	18.1	3 ~ 8.5	28 ~ 80	83

HOW TO USE TECS PROPERLY

TEC modules comprise three essential components: thermally conductive but electrically insulating plates, Peltier pellets, and electrical conduction tracks, illustrated in both Figure 4 and Figure 5.

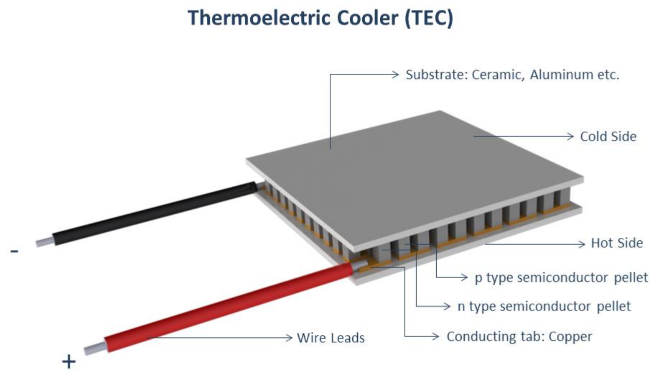

Figure 4.

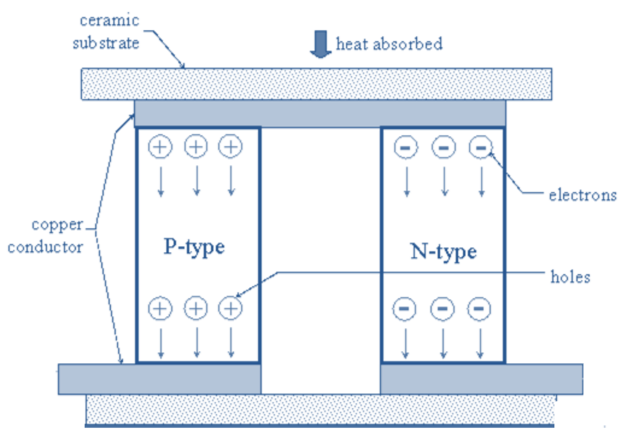

Figure 5.

The two TEC plates serve as robust substrates for sandwiching together Peltier pellets, which are constructed from semiconductor materials and come in two types: n and p. Understanding the unique attributes of these pellets is paramount. They boast impressive resistance to compressive forces, capable of withstanding pressures of up to 150lb/in^2 (10.55kg/cm^2). However, they are susceptible to shear forces, as illustrated in Figure 5. Even minimal shear force can initiate cracks in the pellets, leading to heightened electrical resistance or, in extreme scenarios, pellet breakage, potentially resulting in the failure of the entire TEC module.

As the resistance of these pellets increases, more heat is generated when electric current passes through them. This, in turn, counters the cooling effect and diminishes overall cooling efficiency.

The ATE1-TCHE-127 series TECs come with highly flat bare ceramic surfaces on both sides. They can be mounted onto flat metal surfaces by inserting thin layers of thermally conductive filler materials, the so-called thermal pads, or adding a thin layer of thermal paste. When mounting, make sure that proper pressure is applied constantly to keep good thermal contacting between the metal and the TEC plates, minimizing thermal resistance between them.

The TECs can withstand strong orthogonal forces applied to the surface, but very vulnerable to tangent forces, especially shocking tangent forces. A small shocking tangent force can cause the Peltier elements to crack inside. The crack may not cause operational problem initially, but it will grow with time, causing the TEC resistance to increase slowly and the TEC will stop operating.

The ATE1-TCHE-127 TECs come with 2 insulated lead wires. The positive wire is coated red, and the negative wire is coated black. The mechanical dimensions are shown in Figure 21 and Table 2.

This TEC module can be controlled by our TEC controllers to build highly stable and efficient temperature regulating systems. The ATE1-TCHE-127 series TECs can be used with our thermistors as well to achieve precise and stable temperature sensing.

For applications in moisture environments, the sealed version is recommended to achieve a longer life span and high reliability for the system.

For high end applications where good and reliable thermal contacts are needed between the TEC and the target object surfaces, the TEC ceramic surface can be metalized so that the TEC and the target object surfaces can be soldered together.

TYPICAL CHARACTERISTICS

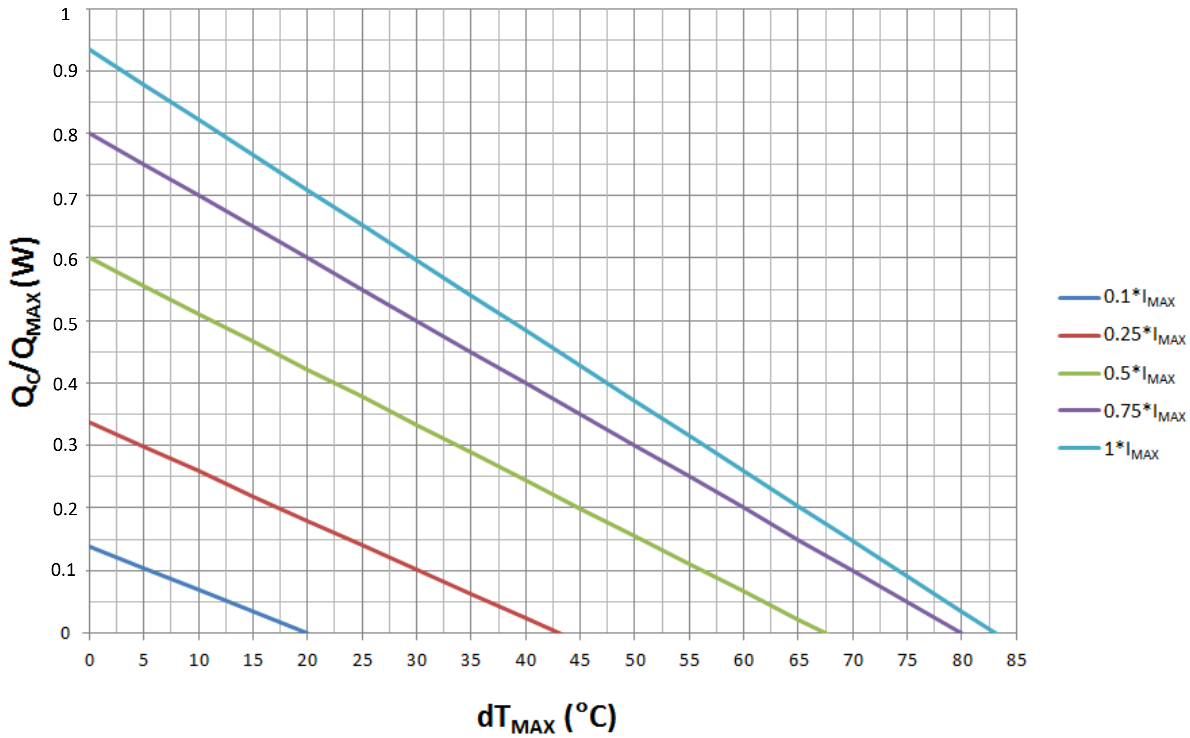

Figure 6. Q_C/Q_{MAX} vs. dT_{MAX}

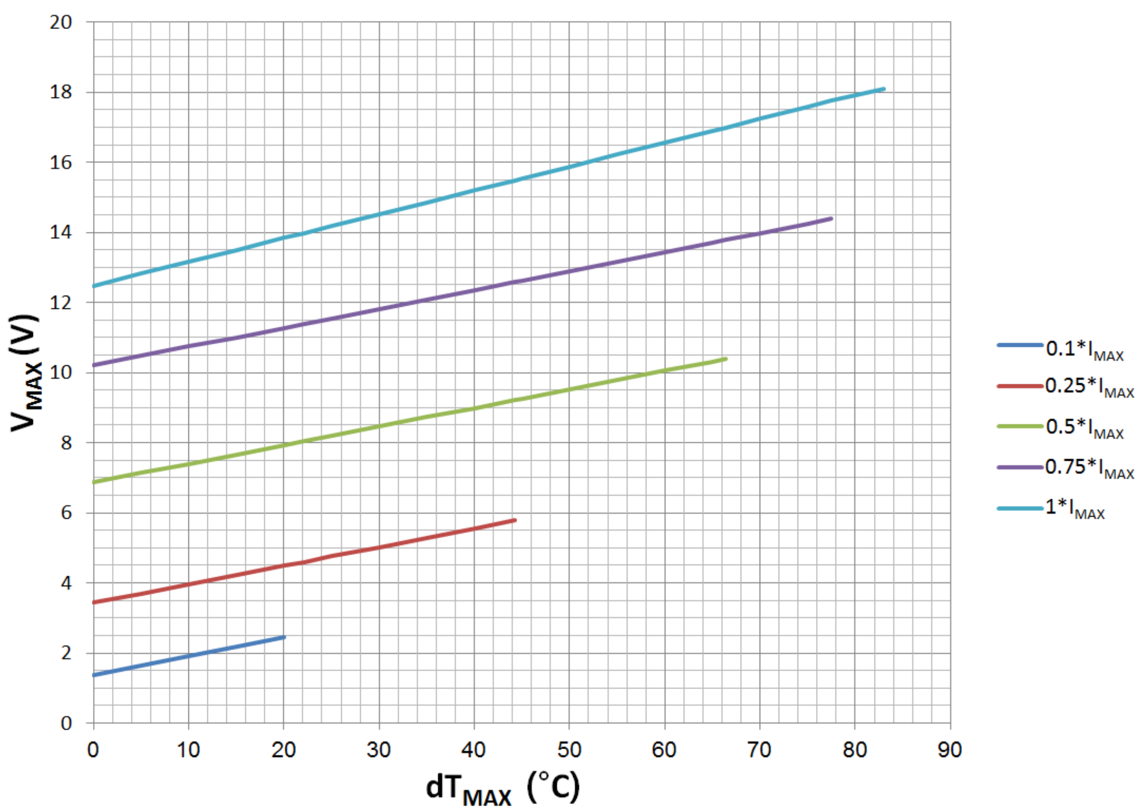

Figure 7. V_{MAX} vs. dT_{MAX}

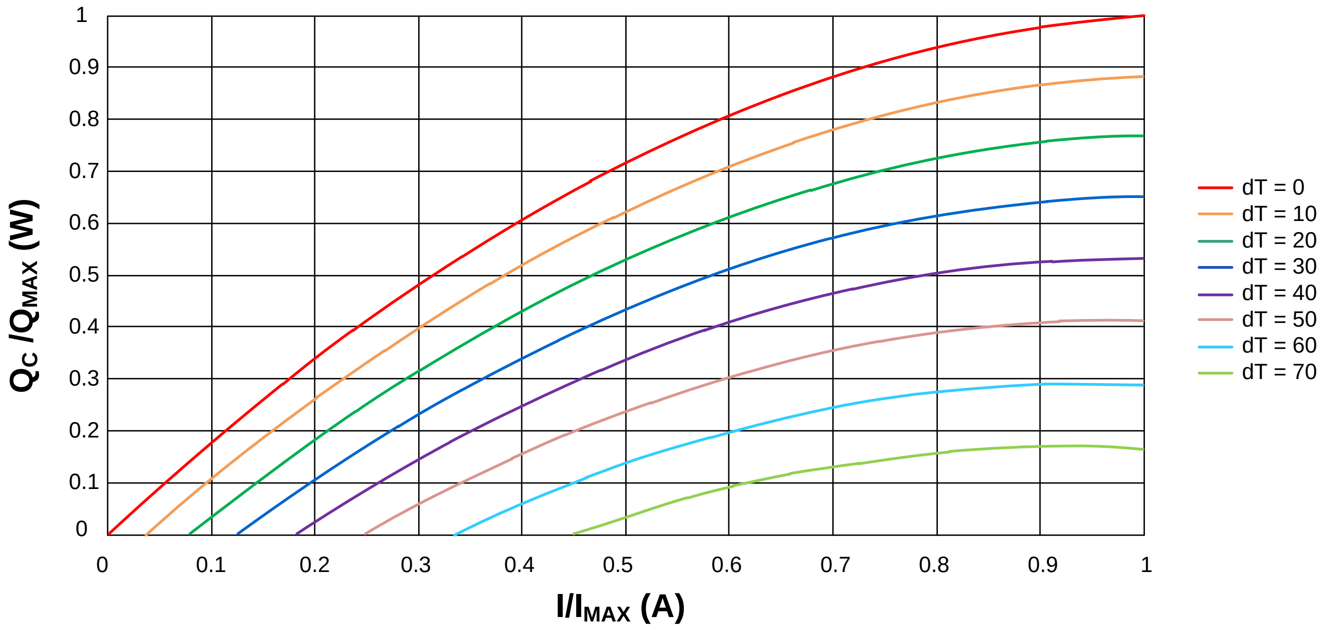

Figure 8. Q_C/Q_{MAX} vs. I/I_{MAX}

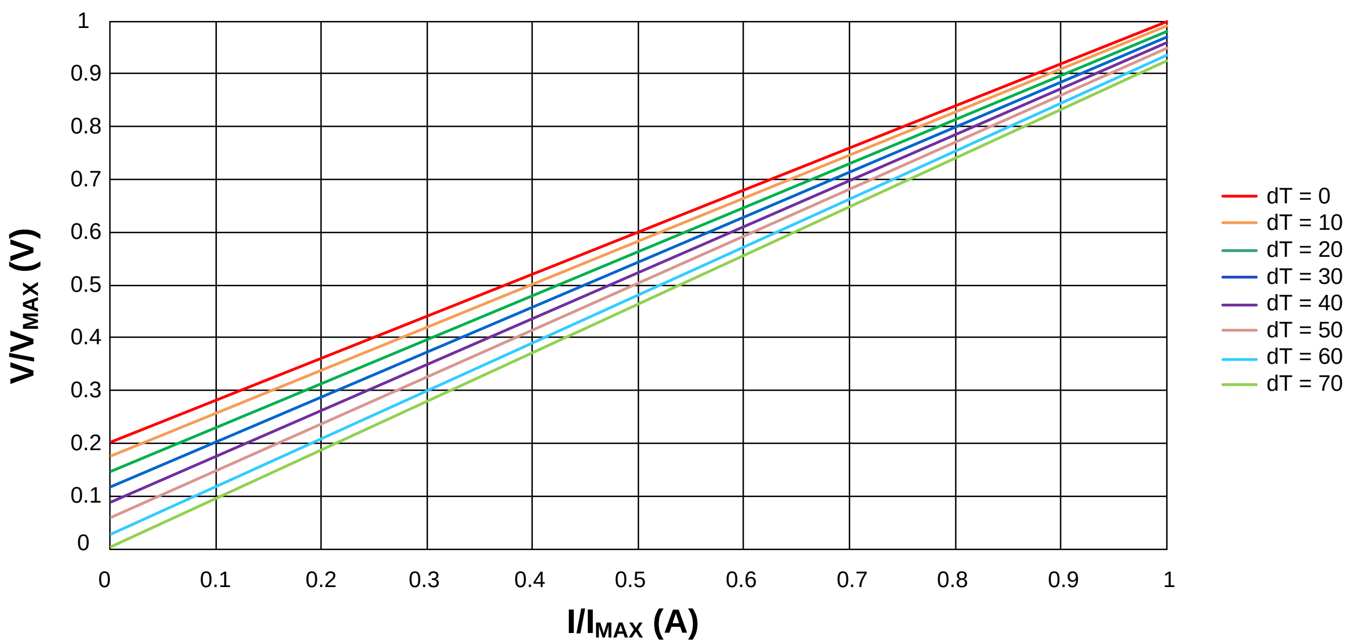

Figure 9. V/V_{MAX} vs. I/I_{MAX}

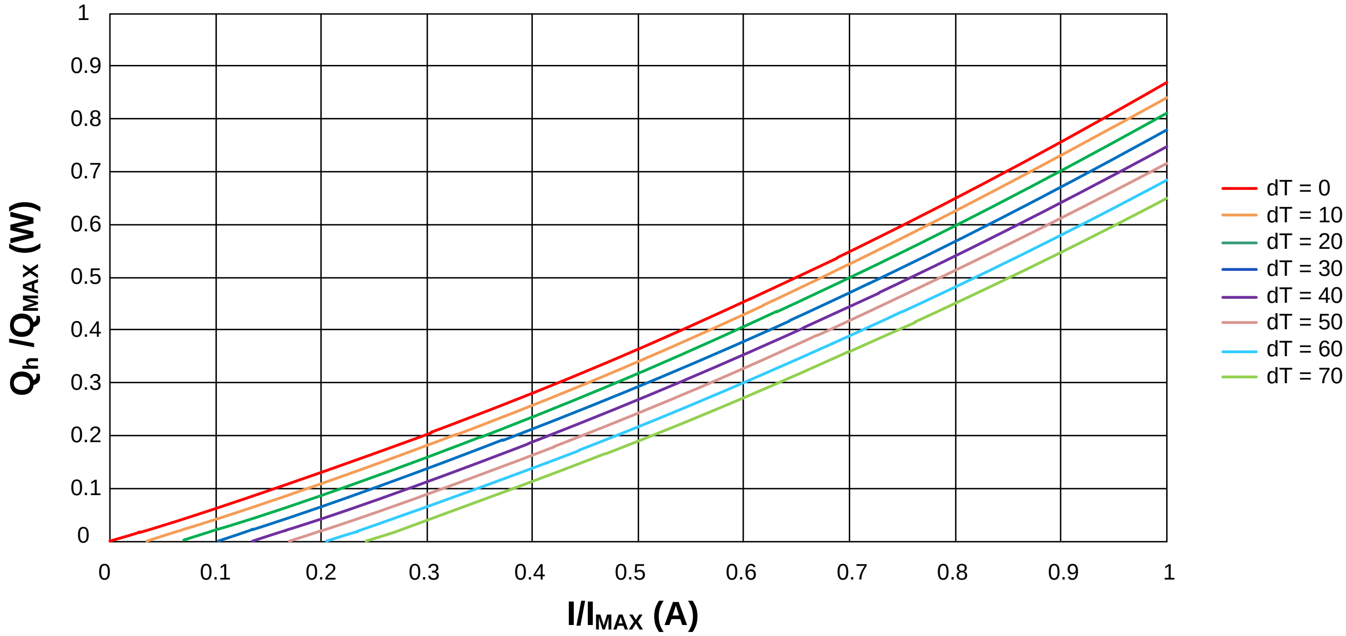

Figure 10. Q_h/Q_{MAX} vs. I/I_{MAX}

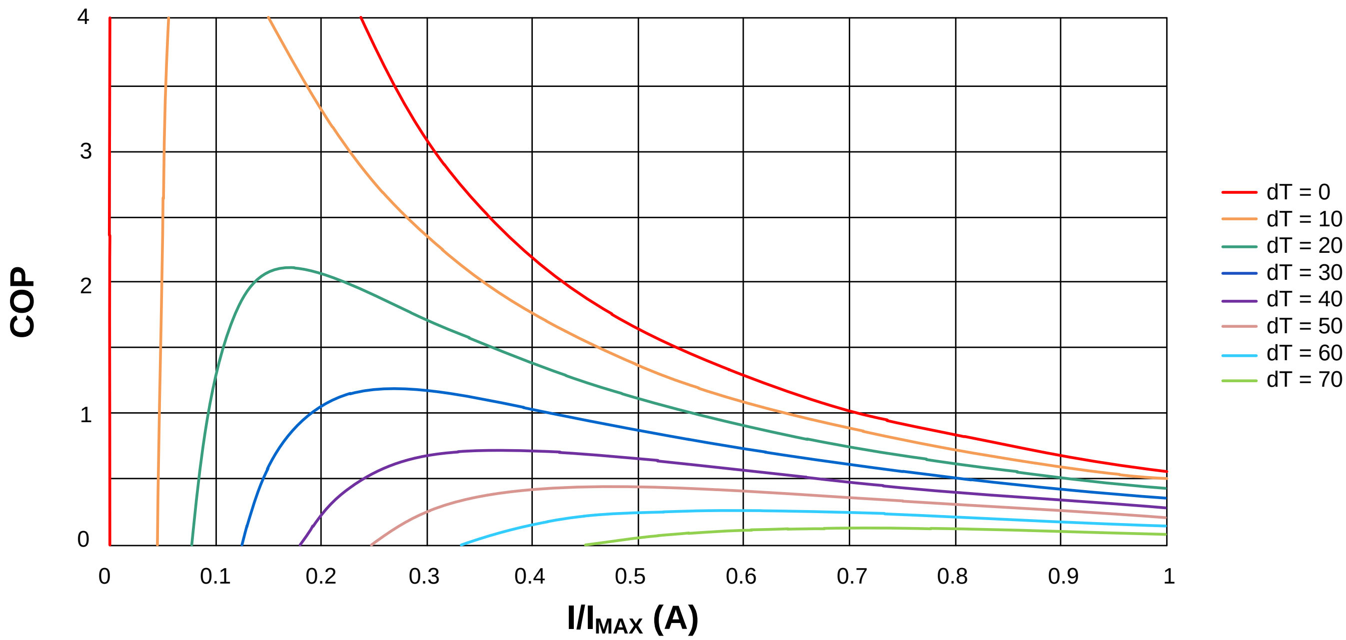

Figure 11. COP vs. I/I_{MAX}

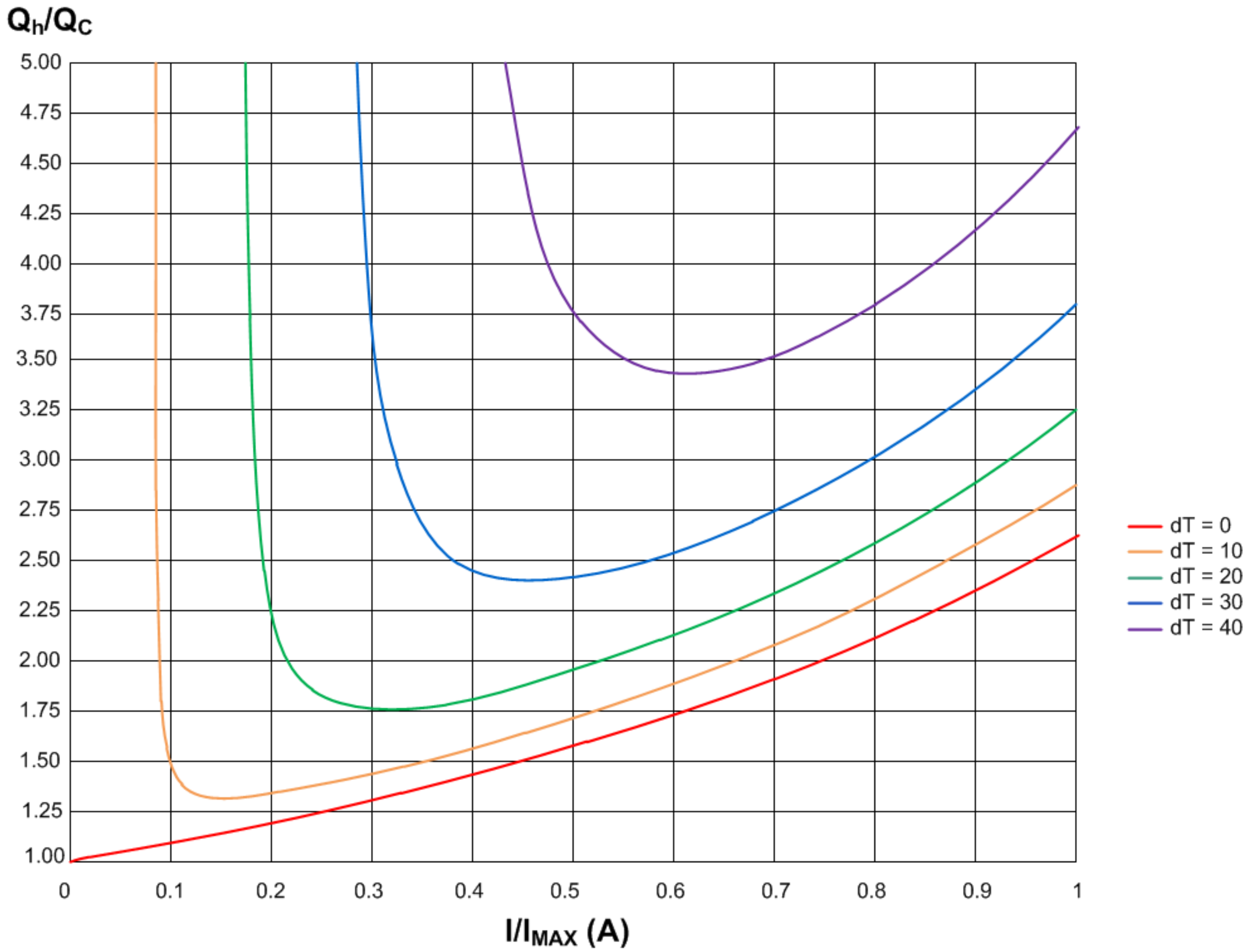

Figure 12. Q_h/Q_c vs. I/I_{MAX}

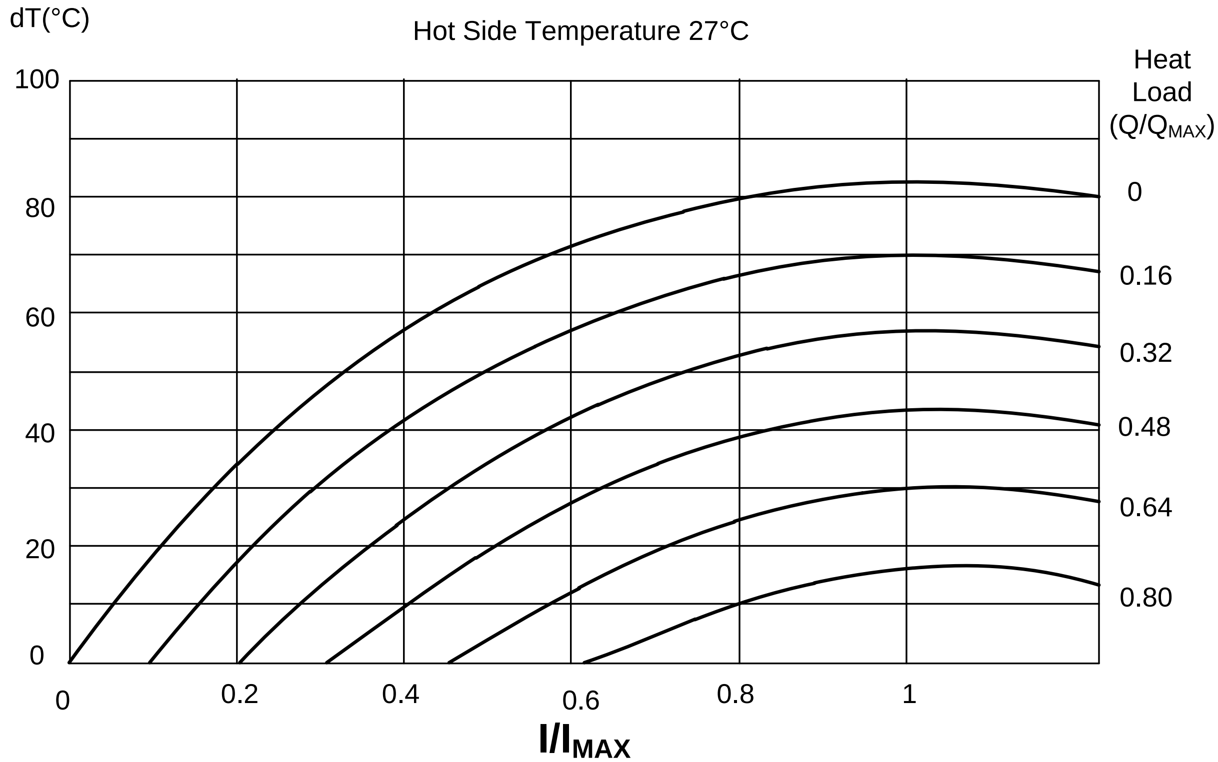

Figure 13. dT vs. I/I_{MAX}

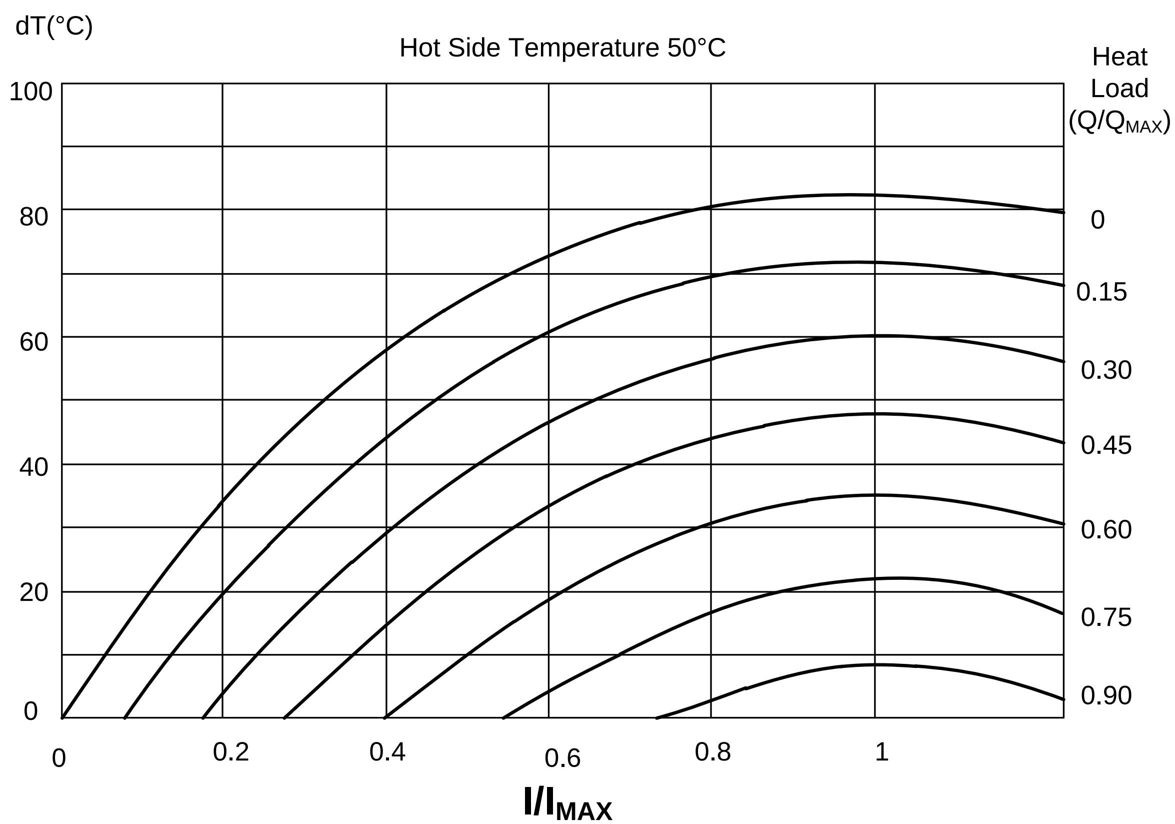

Figure 14. dT vs. I/I_{MAX}

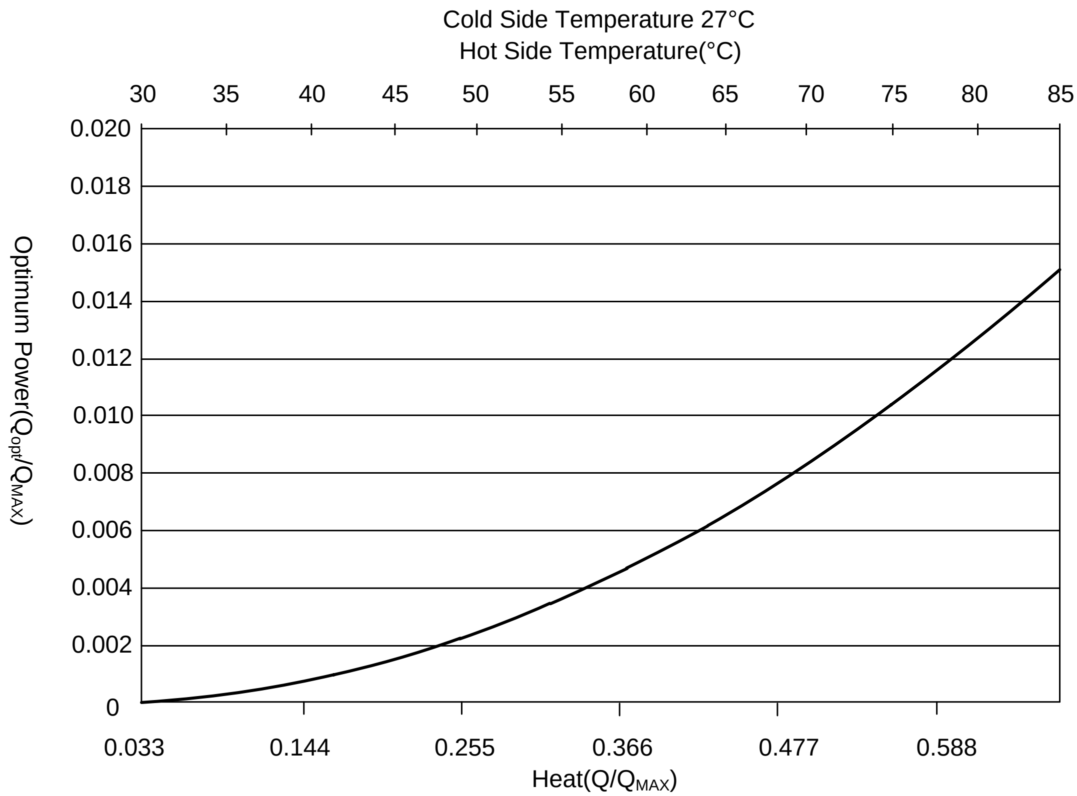

Figure 15. Q/Q_{MAX} vs. Q_{opt}/Q_{MAX}

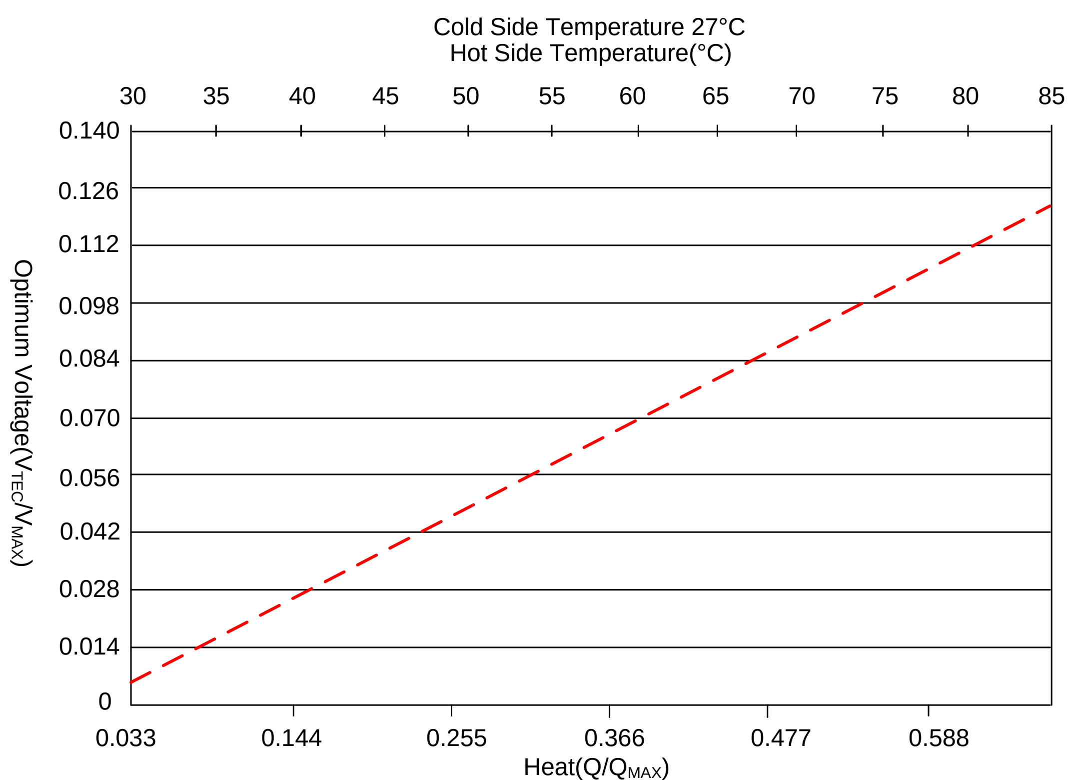

Figure 16. Q/Q_{MAX} vs. V_{TEC}/V_{MAX}

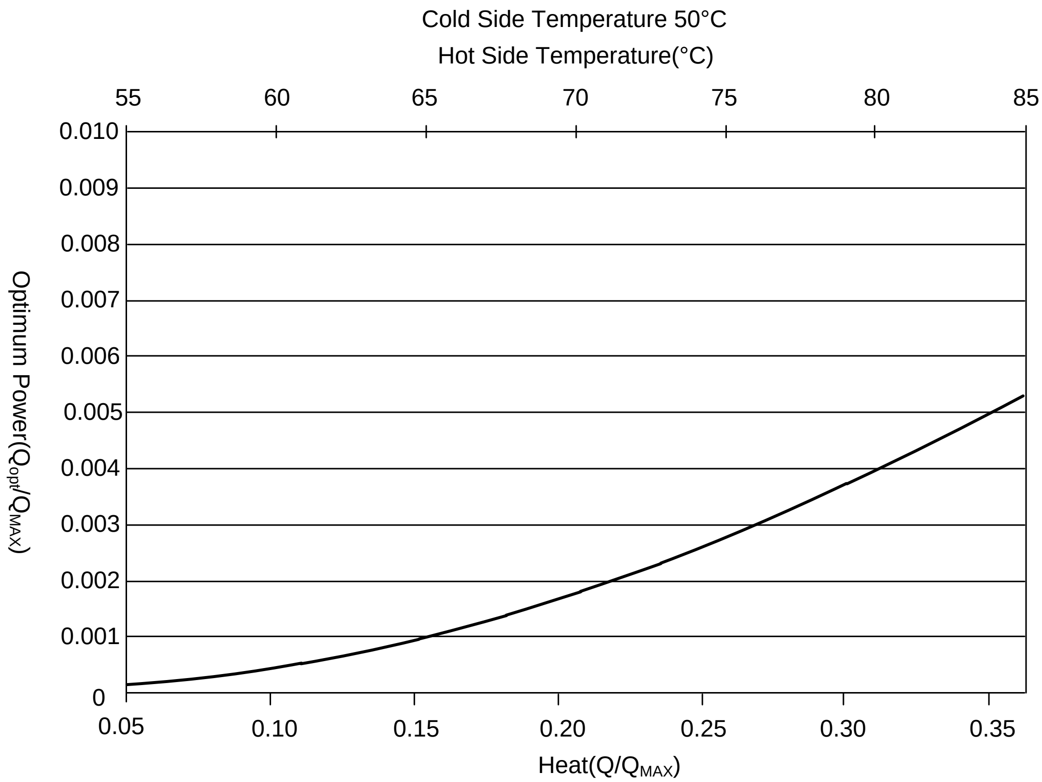

Figure 17. Q/Q_{MAX} vs. Q_{opt}/Q_{MAX}

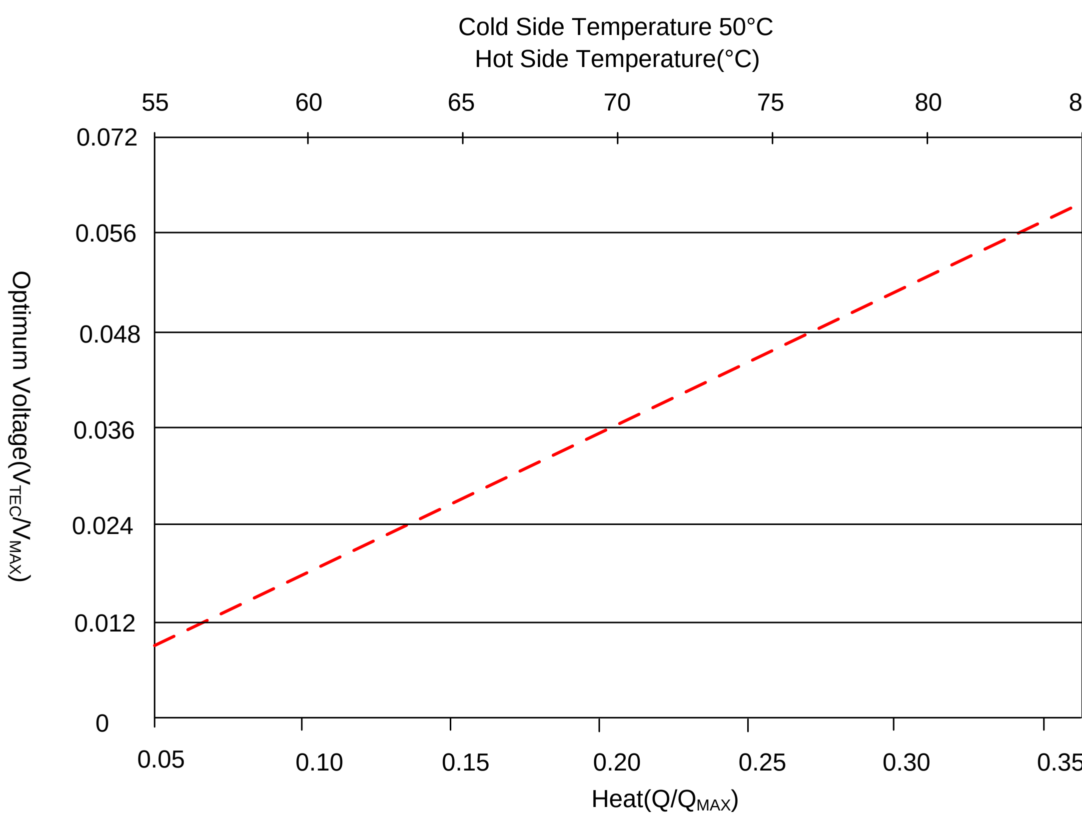

Figure 18. Q/Q_{MAX} vs. V_{TEC}/V_{MAX}

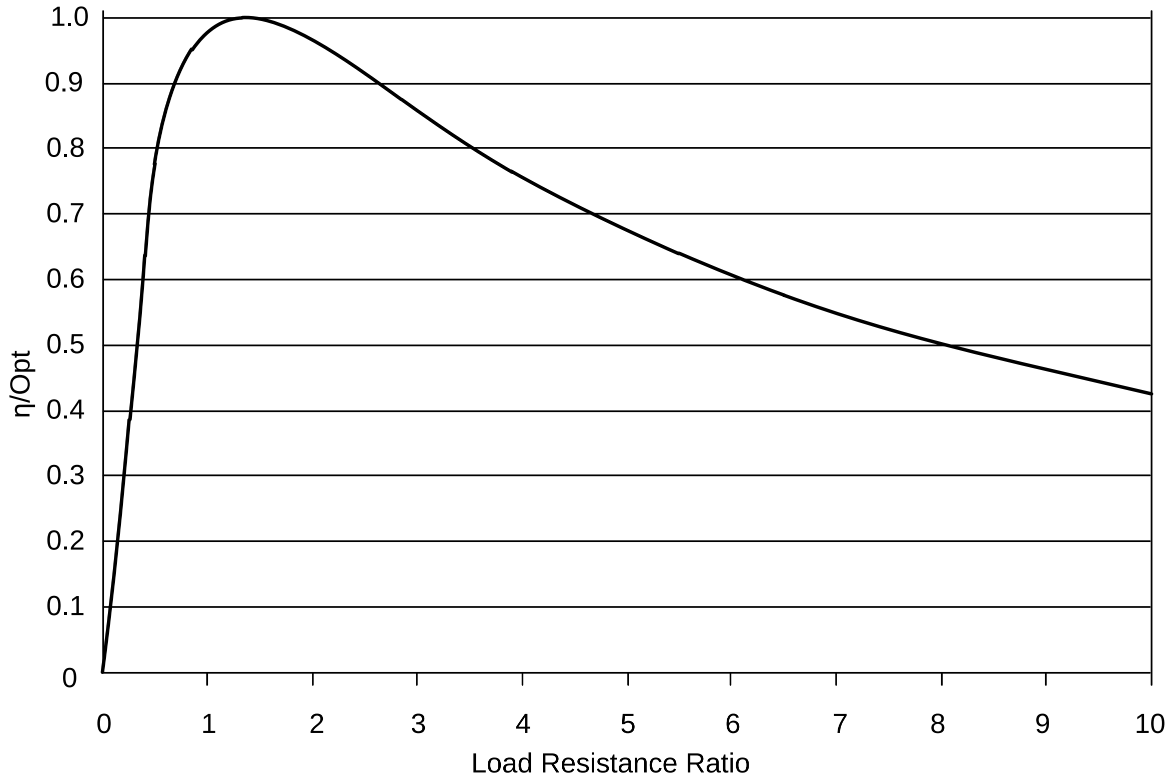

Figure 19. Load Resistance Ratio vs. η/Opt

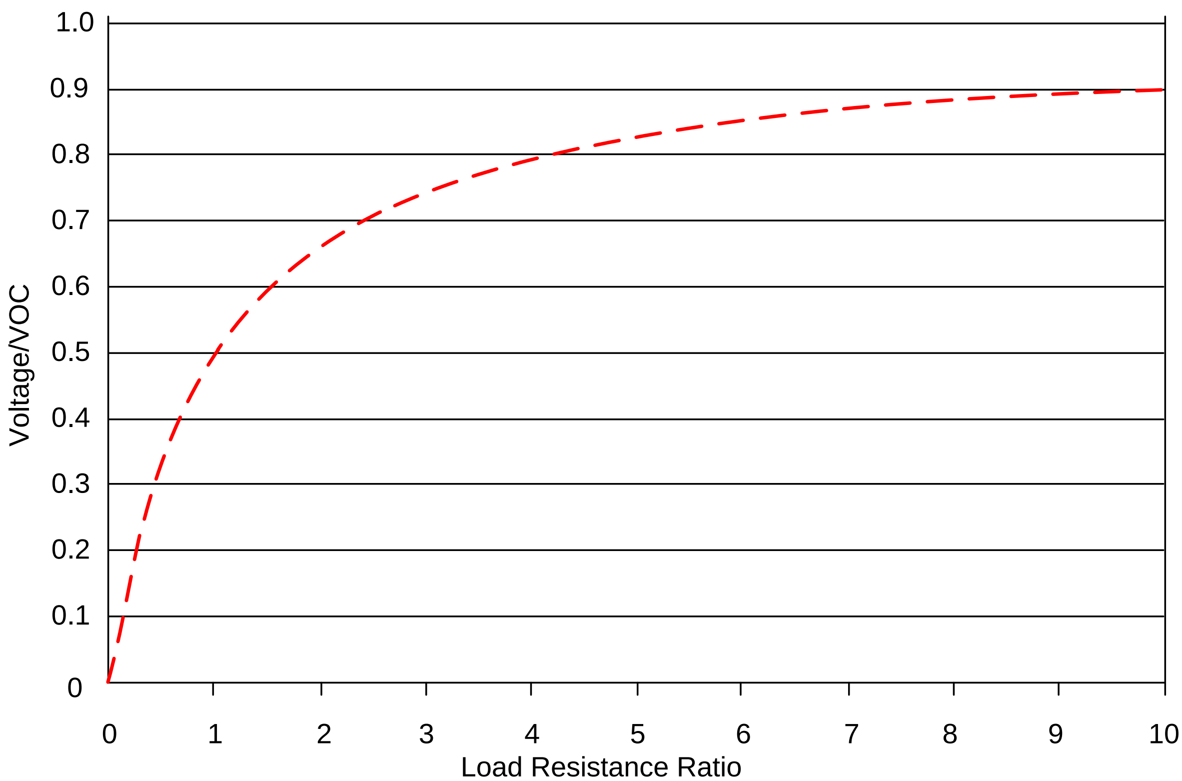

Figure 20. Load Resistance Ratio vs. Voltage/VOC

SPECIFICATIONS

Table 2. Specifications

Part #	I_{MAX} (A)	V_{MAX} (V)	Q_{MAX} (W)	DT_{MAX}* (°C)	Dimension (mm)				Note	Buy Now
					L_c	L_h	W	H		
ATE1-TCHE-127-3A	3.0	18.1	28	83	29.7	-	29.7	3.8	Non-sealed	* *
ATE1-TCHE-127-4A	4.0	18.1	38	83	29.7	-	29.7	3.8	Non-sealed	* *
ATE1-TCHE-127-4B	4.0	18.1	38	83	39.7	-	39.7	4.5	Non-sealed	* *
ATE1-TCHE-127-6A	6.0	18.1	57	83	39.7	-	39.7	4.0	Non-sealed	* *
ATE1-TCHE-127-8R5A	8.5	18.1	80	83	39.7	-	39.7	3.8	Non-sealed	* *

* DT_{MAX}: DT stands for Differential Temperature between TEC's 2 plates.

APPLICATION INFORMATION

As shown in Table 2, the DT_{MAX}, the maximum temperature difference between the 2 TEC plates, is 83°C. This is the normal value for a single stage TEC module. When needing a higher DT_{MAX}, 2 or 3 stage TECs must be utilized. Contact us for details.

TEC modules can be used for stabilizing laser chip temperature as well as the wavelength and the working lasing mode, resulting in less or no mode hopping and stable output power.

Inversely, when applying a temperature difference between the TEC 2 plates, electricity can be generated. Thus, the TECs can be called TEGs (thermoelectric Generators).

When designing a thermal system by using TECs, one should choose the TEC module in the following way:

1. To achieve maximum efficiency, it is essential to minimize the thermal resistance between the TEC plate surface and the heat sink surface and also between the TEC plate and the target object surface. The best way to minimize the thermal resistance is to mount the TEC modules' plates to the heat-sink and to the thermal load by soldering them together. This requires metalizing the TEC plate surfaces first. The 2nd best way is to apply a thin layer of thermal paste between the TEC plates and the heat-sink and the target object surfaces. Constant pressure is needed between the TEC plates, the heat-sink and the target object surfaces. Thermal pad material, or the so called thermal filler pads, can be used to replace the thermal paste. But this may increase the thermal resistance between the TEC plates and the heat-sink and the target object surfaces. Therefore, thermal paste is recommended to be applied between the TEC plates and the heat-sink. The 3rd best way is to use thermally conductive epoxy, to glue the TEC surface, the heat-sink and the target object surfaces together. This approach is the least reliable because the epoxy may lose its adherence power over time.
2. To achieve high COP, Coefficient of Performance, which is defined as:

   COP = thermal power / electric power,

   the ratio between the TEC's output thermal power and the input electric power. Apparently, a high COP leads to low power system consumption, thus, high efficiency. The key to achieve high COP is to design the system with a low maximum temperature difference between the 2 TEC plates (the hot side and the cold side), DT. When the operating DT can be kept to be ≤ 30°C, the COP can be as high as 2, which is a very good result.
3. When the required maximum temperature difference is low, such as < 30°C, a large TEC module can be used to drive a small thermal load, resulting in a low DT, thus high COP and efficiency.
4. It is not hard to design and integrated into a TEC system, but does require some understanding of heat transfer and a good grasp of your applications.

MECHANICAL DIMENSIONS

The mechanical dimensions of the ATE1-TCHE-127 series TECs are shown below. The ATE1-TCHE-127 series TECs come in a square shape, small size, and is light weight.

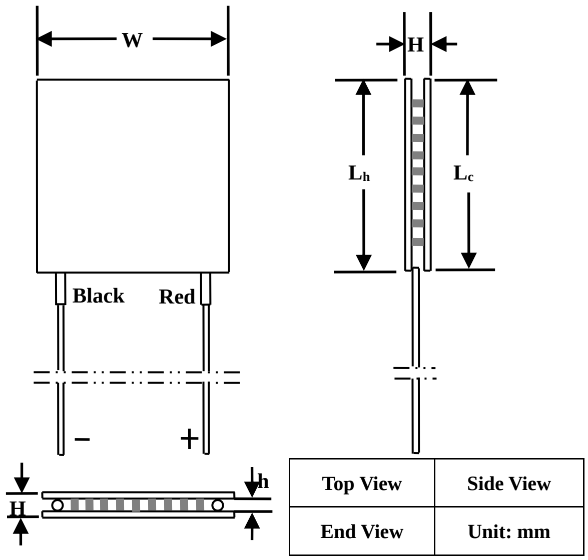

Figure 21. Mechanical Dimensions of Non-sealed ATE1-TCHE-127

Note: As Figure 21 shows, when the red lead wire is on the right, then the top surface is the cold side of the TEC.

CAUTIONS

1. Never apply electricity to TEC modules without having heat sinks attached properly.
2. Always keep the current less than I_{MAX}, to avoid thermal run-away disaster.

NOTICE

1. It is important to carefully read and follow the warnings, cautions, and product-specific notes provided with electronic components. These instructions are designed to ensure the safe and proper use of the component and to prevent damage to the component or surrounding equipment. Failure to follow these instructions could result in malfunction or failure of the component, damage to surrounding equipment, or even injury or harm to individuals. Always take the necessary precautions and seek professional assistance if unsure about proper use or handling of electronic components.
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