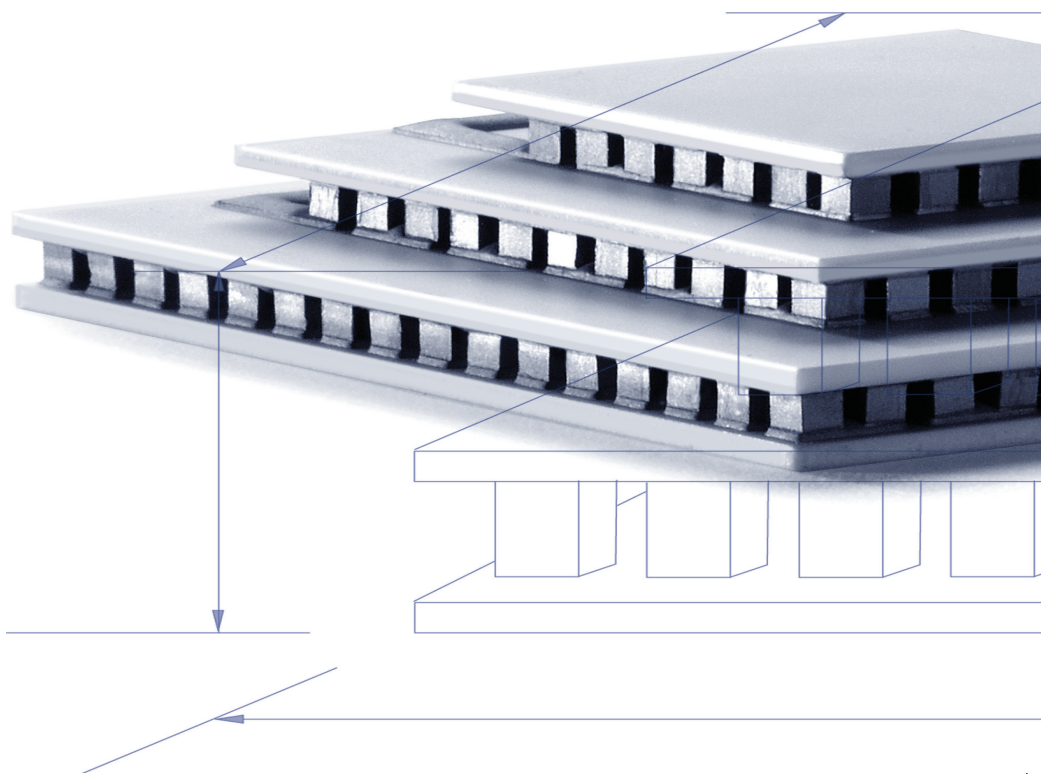




热电致冷器
Thermoelectric
Modules

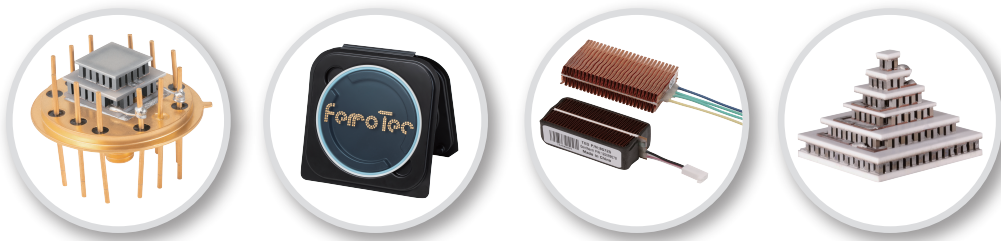


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202412



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Hangzhou Advanced Thermal Technology Co., Ltd.



Thermoelectric Solutions for Precision Thermal Management

精确热电解决方案

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尊敬的用户：

感谢您对Ferrotec致冷器的关注。Ferrotec成立于1980年末，是致冷器和致冷单元的专业制造商。长期以来，Ferrotec不断研发高品质并具有价格竞争优势的产品来满足当今全球业务的需求。

从消费品到精密温度控制系统等广泛的应用领域，Ferrotec被公认为是最值得信赖的供应商之一。通过全球销售网络，我们能够为客户提供灵活、专业、有效和快捷的热电解决方案。

通过与客户紧密合作，Ferrotec还可提供定制化的致冷器或致冷单元。从产品的设计到未来的应用，Ferrotec都能够提供有力的技术支持和服务。

Dear Customer,
Thank you for your interest in Ferrotec thermoelectric products. Ferrotec, a manufacturer of thermoelectric modules and assemblies, was founded in the late 1980's and has continuously developed high quality products at competitive prices to serve the needs of Today's businesses worldwide.

Ferrotec is recognized as one of the most reliable providers in a wide variety of market segments, with applications ranging from consumer products to precise temperature control systems. Our flexibility and expertise enable us to offer effective product solutions with short delivery times through our global sales channels.

Working closely with our customers as partners, Ferrotec also specializes in the development and manufacture of custom modules and assemblies. We are committed to providing strong technical support and service throughout your product design process and beyond.

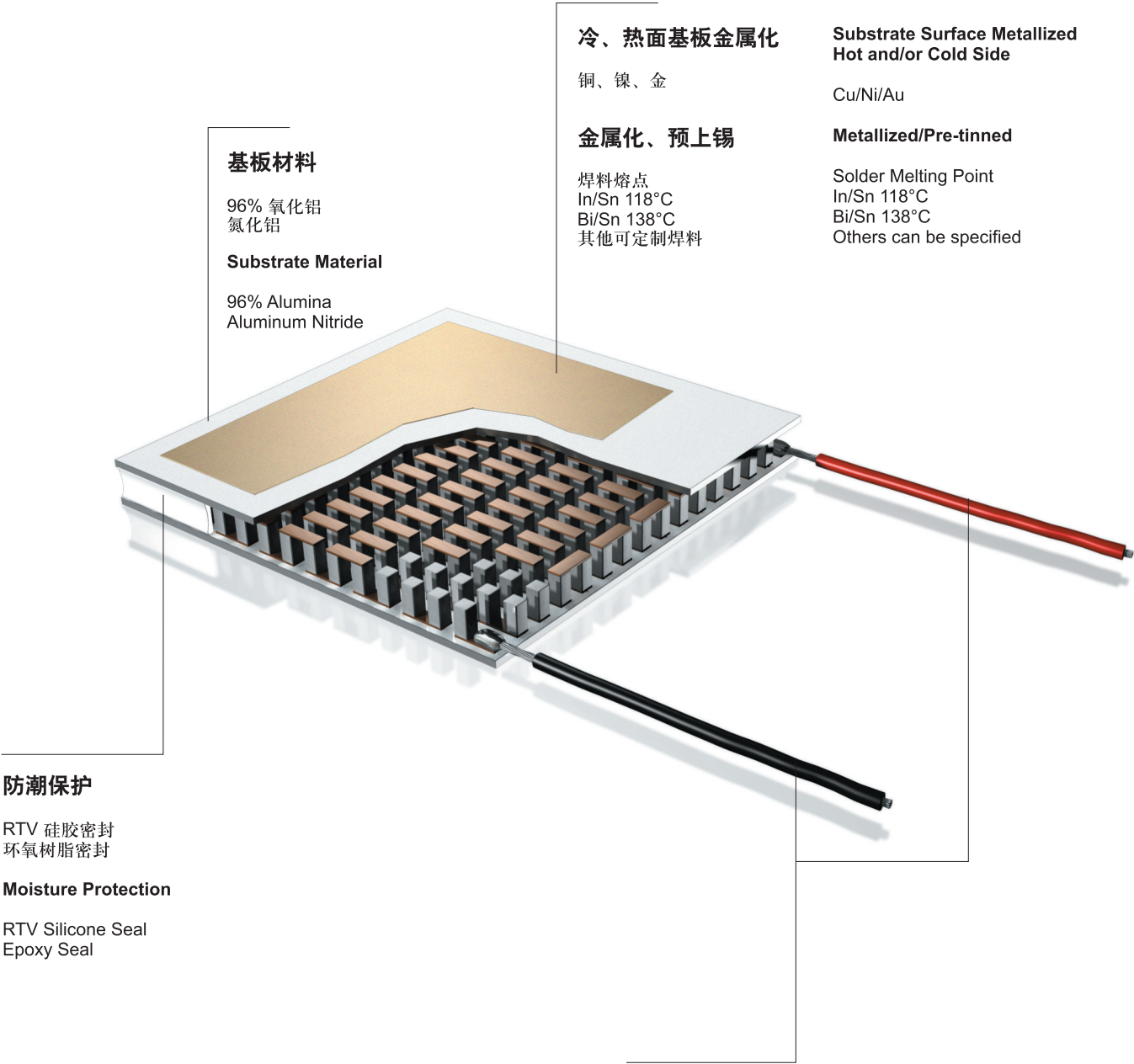


Ferrotec已通过ISO9001、ISO14001和ISO/TS16949认证，您完全可以信赖Ferrotec提供的所有产品。

With ISO 9001, ISO 14001 and ISO/TS 16949 accreditations, you can be assured of high quality with all Ferrotec products.

外型特征/选项

Features and Options at a Glance



防潮保护

RTV 硅胶密封
环氧树脂密封

Moisture Protection

RTV Silicone Seal
Epoxy Seal

导线

标准: Teflon®
可选: 裸线或PVC绝缘线
长度: 客户指定

Wires

Standard:
Teflon®

Options: PVC, Bare,...
Length: As required/specified

Teflon® 是DuPont de Nemours
注册商标

Teflon® is a registered trademark
of DuPont de Nemours Co.



技术介绍
Technical Introduction

热电致冷模块(TEM)，又称热电致冷器或热电致冷装置，是由许多微小而有效的热泵组成的半导体器件。通过施加一个低压直流电源，热量将从TEM的一面转移到另一面。从而产生TEM一面变热另一面变冷的现象。值得一提的是，由于该现象完全可逆，所以，当直流电源极性改变时，会使热量向相反的方向转移。因此TEM可被应用于既需要制冷又需要制热的特定场合。通常，致冷器是由两对或以上的碲化(Bi2Te3)半导体元件串联而成。这些串联的热电元件被紧凑地排列和固定在绝缘的两块金属化陶瓷基板之间，并为致冷器提供了平整、平行的安装表面。

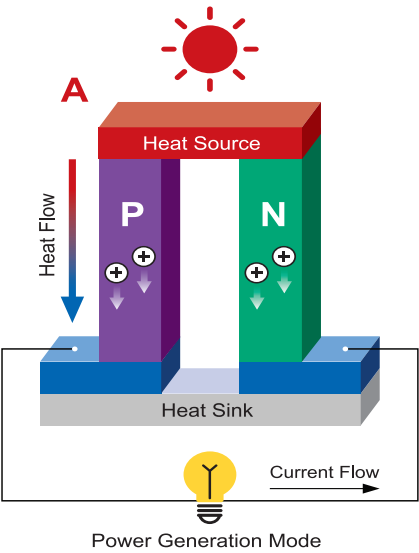
热电致冷器件由n型和p型两种Bi₂Te₃材料组成。这种结构使得电流在n型和p型材料间交替流动时，热量从致冷器的一端转移到另一端。n型材料存在着多余的自由电子而P型材料电子不足。n型材料中多余的电子和p型材料中的“空穴”就相当于载体。当载体移动时，热量随之穿过热电元件。

热流量，即被TEM传递的热量，与直流电源电流的大小成正比。通过调节输入电流的大小(从0到最大)，可以实现对TEM热流量及温度变化的精确控制。

A thermoelectric module (TEM), also called a thermoelectric cooler or device, is a semiconductor based electronic component that functions as a compact and efficient heat pump. By applying a low voltage DC power source to a TEM, heat will be moved through the module from one side to the other. One module face, therefore, will be cooled while the opposite face simultaneously is heated. It is important to note that this phenomenon is fully reversible whereby a change in the polarity of the applied DC voltage will cause heat to be moved in the opposite direction. Consequently, a TEM may be used for both cooling and heating in a given application. A TEM generally consists of two or more semiconductor elements, usually made of bismuth telluride (Bi₂Te₃), that are connected electrically in series and thermally in parallel. These thermoelectric elements and their interconnects typically are mounted between two thin metallized ceramic substrates, which provide structural integrity, insulate the elements electrically from external mounting surfaces, and provide flat and parallel contact surfaces.

Both n-type and p-type Bi₂Te₃ materials are used in a TEM. This arrangement causes heat to move through the cooler in one direction only while the electrical current moves back and forth alternately between the top and bottom substrates through each n-type and p-type element. The n-type material is doped to have an excess of electrons while the p-type material is doped to have a deficiency of electrons. The extra electrons in the n-material and the "holes" resulting from the deficiency of electrons in the p-material serve as carriers. These carriers move the heat energy through the thermoelectric material.

Heat flux - the heat actively pumped through the TEM - is proportional to the magnitude of the applied DC electric current. By regulating the input current from zero to maximum, one can adjust and precisely control the heat flow and module temperature differential.



通过并列安装可提高TEM的热转换能力，或通过叠加安装能增大其温差。

由于没有运动部件，TEM非常可靠，勿需维护。与机械制冷相比，TEM具有体积小、重量轻、噪音低等优点。当然，TEM并非适用于所有制冷场合，有时用简易的冷却装置如散热器更加合适。有些情况下，TEM明显优于其它制冷方式，甚至成为唯一的解决方案。TEM属主动型制冷器件，可将冷却对象冷却至环境温度以下，而只靠散热器是无法实现的。TEM的固态结构能确保其具有高可靠性，尤其适用于安装后不易拆卸的系统。TEM制冷系统具有运行噪音低，电子干扰小等优点。

要选择合适的TEM，首先需对被应用的系统进行全面评估。通常情况下，可直接选用标准系列产品。在某些给定条件下，需要对TEM进行特殊设计，以满足制冷功率、电气、机械及其它方面的要求。尽管Ferrotec推荐选用标准型致冷器，但也可为客户定制。我们将竭诚提供技术支持，完全满足您对TEM的特殊设计要求。

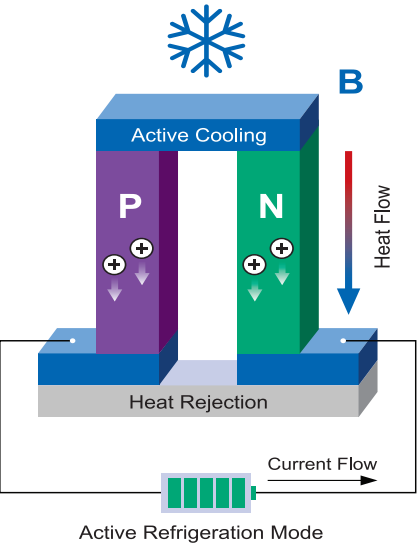
大多数制冷系统都是动态的，其性能取决于相关参数。如何选择更合适的规格参数，请联系我们的销售部门或驻地代表寻求帮助。

TEMs can be mounted in parallel to increase the heat transfer capacity, or they can be stacked in multistage cascades to increase the temperature differential.

TEMs have no moving parts, so they are reliable and virtually maintenance free. They are also smaller, lighter and quieter than comparable mechanical cooling systems. However, TEMs are not ideal for every cooling application, and there are situations in which a simple passive cooling device, such as a heat sink, is more appropriate. There are also situations in which thermoelectric cooling is the only suitable solution, or for which it presents significant advantages over other cooling methods. TEMs can provide active cooling, which means they cool below ambient temperature, which is not possible with heat sinks alone. Their solid-state construction ensures high reliability, which is an advantage when they are to be used in a system that is not easily accessible after installation. Operation is acoustically silent and electrical interference is negligible.

Selection of the proper TEM for a specific application requires an evaluation of the total system in which the TEM will be used. For most applications it should be possible to use a standard TEM configuration, while in certain cases a special design may be needed to meet stringent heat pumping, electrical, mechanical, or other design requirements. Although we encourage the use of a standard TEM whenever possible, Ferrotec specializes in the development and manufacture of custom TEMs. We will be pleased to provide technical analysis to define a unique TEM design that meets your requirements precisely.

Most cooling systems are dynamic in nature, and overall system performance is a function of several interrelated parameters. If there is any uncertainty about which TEM would be most suitable for a particular application, we recommend that you contact our sales team or your local representative for assistance.



技术介绍

Technical Introduction

图表中对应各曲线的温差标识：

- ΔT = 0°C

ΔT = 10°C

ΔT = 20°C

ΔT = 30°C

ΔT = 40°C

ΔT = 50°C

ΔT = 60°C

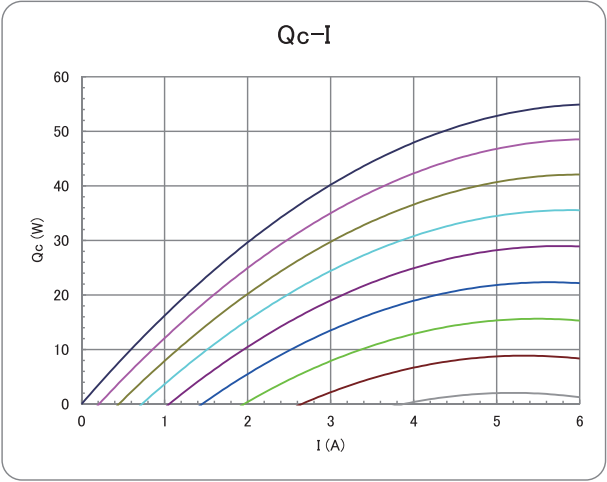
ΔT = 70°C

ΔT = 80°C

ΔT = 90°C

每种应用都对应一组特定参数。其性能参数可用四张曲线图加以描述。

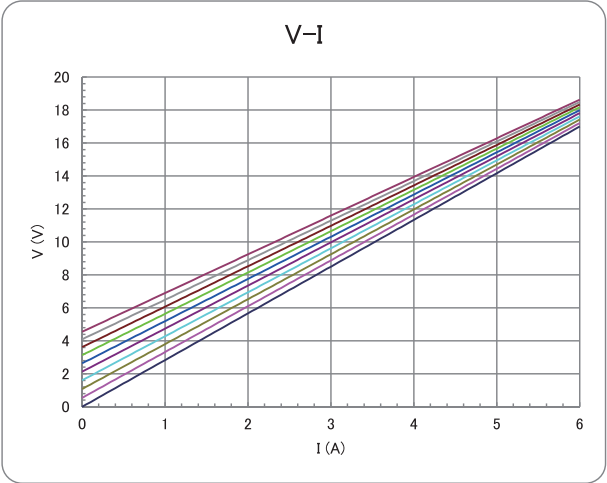
Each application will have its own set of parameters that will impact the temperature of the TEM hot side (Th). Performance data is presented graphically and there are four important attribute graphs explaining the TEM performance.



Qc vs. I

该图显示了在热面温度一定时,不同温差的输入电流与制冷功率的关系。该曲线有助于用户确认致冷器是否有足够的制冷能力来满足应用要求。

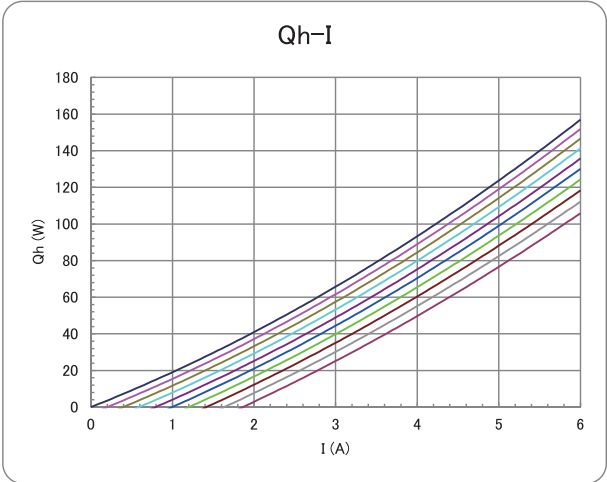
This graph shows the TEM's heat pumping capacity (Qc) in watts at a fixed level of Th as a function of input current (I) at various differential temperatures across the TEM (ΔT). This data allows the user to determine whether the module under consideration has sufficient heat removal capacity to meet the application requirements.



V vs. I

图V vs. I描述了不同温差下,电压与电流的对应关系。当选择了一款适合的TEM,从图Qc vs. I 中确定合适的工作电流和温差,从而在该图中查得所需电源。

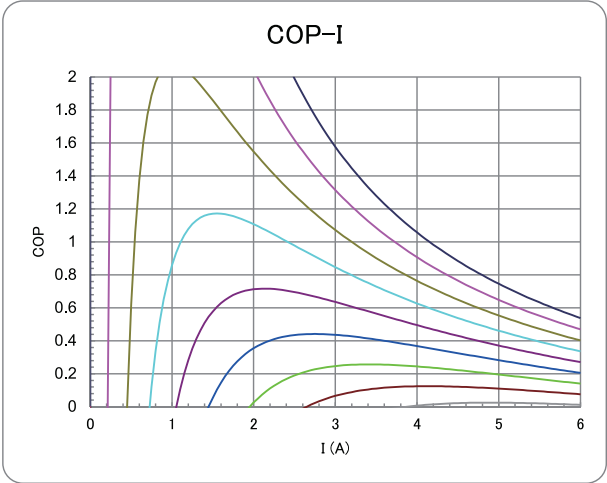
A graph of V vs. I depicts the voltage necessary to produce the current needed at various differential temperatures. If you have selected an appropriate TEM established the correct operating current from the Qc vs. I graph, and figured out the ΔT value, you can use this chart to determine the power supply requirements.



Qh vs. I

上图表明了热面温度一定时,热面散热功率和输入电流的关系。Qh单位为瓦特。Qh=Qc(制冷功率)+IxV(输入电功率)。

The graph Qh vs. I above shows the expelled heat (Qh) in watts, from the hot side of the TEM as a function of current level at a specific Th level. The quantity Qh is the sum of Qc (cooling capacity) and I x V (electrical power in).



COP vs. I

该图表显示了COP、ΔT与输入电流的关系。COP系数为制冷功率与输入电功率的比值。该曲线可帮助用户确定COP(制冷效率),从而实现制冷能力的最大化,热面散热量的最小化。

This important graph relates the coefficient of performance (COP) and ΔT to input current. The COP is equal to the heat pumped divided by the input power. This graph enables the user to determine the coefficient of performance (efficiency) to maximize the cooling capacity and minimize the heat rejected to the heat sink.

在选择TEM前,设计者应回答下列题:
Before starting the actual TEM selection process, the designer should be able to answer the following questions:

• 被冷却对象需要保持的温度及控温精度?
• At what temperature must the cooled object be maintained and to what Precision?

• 需从被冷却对象转移多少热量?
• How much heat must be removed from the cooled object?

• 预期的环境温度范围是多少?运行过程中温度是否有明显变化?
• What is the expected ambient temperature range? Will the temperature change significantly during operation?

• 散热器(热面)的热阻值多大?接触面采用何种材料?
• What is the thermal resistance of the heat sink (hot side) and what is the interface material to be used?

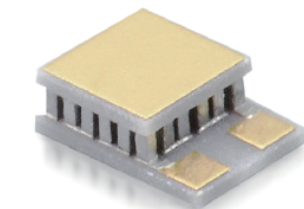
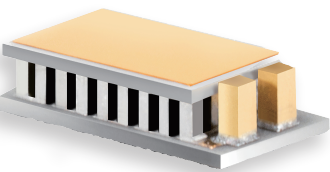
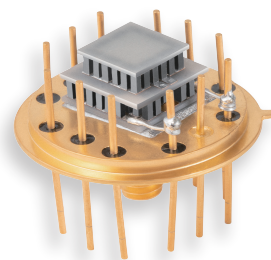
• 致冷器的安装尺寸大小?
• What is the allowable footprint and height of the module?

• 采用何种直流电源?对电压和电流有何种限制?
• What DC power is available? What voltage and current restrictions exist?

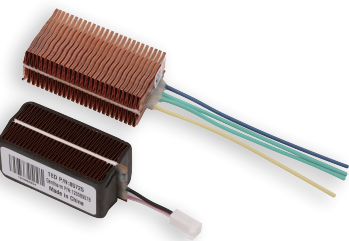
• 运行中散热器预计达到多少温度?该温度是否是变化的?
• What is the expected temperature of the heat sink during operation? Is this temperature steady or variable?

• TEMs将怎样安装?
• How will the TEMs be mounted?

通信领域 TEC
Communication Field TEC



车用领域 TEC
Automotive Field TEC



Thermoelectric Solutions for
Precision Thermal Management
精确热电解决方案

高性能
High Performance

通信领域TEC是Ferrotec为满足苛刻高温环境及器件小型化发展趋势，采用高性能热电材料和先进制作工艺所开发出的产品。典型应用于光通讯行业的激光发射器、光接收器、泵浦激光器等产品。可供选择的规格如下：

The Field of communication TEC series is developed for rigorous high ambient temperature and components miniaturization.The TECs use high performance semiconductor material and special assembly technology. These modules are typically used in optical communication industry such as laser transmitter, optical receiver, pump laser etc. These TECs are also available with different configurations.

25G BOX

TEM Model No.	Imax (A)	Vmax (V)	ΔT_{max} (°C)	Qcmax (W)	SIZE(mm)			
					W	L1	L2	H
20134/015/011MN/C01	1.1	2.08	76	1.22	2	2.4	2.85	0.9
20035/009/012AN/CO3	1.2	1.25	76	0.8	1.8	3	3.6	1.25

100G

TEM Model No.	Imax (A)	Vmax (V)	ΔT_{max} (°C)	Qcmax (W)	SIZE(mm)			
					W	L1	L2	H
28034/027/020MN	2	3.75	76	4	2.9	4.4	5.1	0.9
28134/037/012MN	1.2	5.14	76	3.29	2.9	4.5	5.1	1

Pump Laser

TEM Model No.	Imax (A)	Vmax (V)	ΔT_{max} (°C)	Qcmax (W)	SIZE(mm)			
					W	L1	L2	H
20031/023/020M	2	3.4	78	3.7	6.05	8.18		1.65
20021/029/018M	1.8	4	78	3.9	6.05	10.2		1.65
20031/035/025M	2.5	4.8	78	6.5	6.05	12.2		1.65

TO 系列

TEM Model No.	Imax (A)	Vmax (V)	ΔT_{max} (°C)	Qcmax (W)	SIZE(mm)			
					W	L1	L2	H
20034/009/012AN/C01	1.2	1.25	76	0.8	1.6	2.6	3	0.95
20033/014/010MN/C01	1	1.94	76	1.04	1.6	2.6	3	0.9
20033/018/010MN/C01	1	2.5	76	1.33	1.44	3.1	3.5	0.9
28133/015/011MN/C02	1.1	2.1	76	1.23	1.8	2.05	2.6	0.8
28133/018/010MN/C01	1	2.5	76	1.33	2.06	2.1	2.7	0.8

Tunable Laser

TEM Model No.	Imax (A)	Vmax (V)	ΔT_{max} (°C)	Qcmax (W)	SIZE(mm)			
					W	L1	L2	H
20016/042/009AN	0.9	5.75	80	2.8	3.1	7.1	8	1.3
20018/036/010AN	1	4.96	78	2.7	4.4	7.8	8.8	1.55

高性能
High Performance

TED是Ferrotec为满足简单、节能和精准温控的市场需求，采用高性能热电材料和先进制作工艺所开发出的产品。主要应用于汽车行业的座椅。

TED is Ferrotec's application of high-performance thermoelectric materials and advanced manufacturing processes to meet the market demand for simplicity, energy efficiency and precise temperature control Developed by the product. Mainly used in the automotive industry seat.

TED

TEM Model No.	Imax (A)	Vmax (V)	ΔT_{max} (°C)	Qcmax (W)	齿数	SIZE(mm)			
						W	L1	L2	H
TU20031/130/090M/C10	9.0	17.8			42	59	30.2		22.20
TU20031/130/090M/C13	9.0	17.8			42	59	30.2		
TU20031/130/090M/C14	9.0	17.8			29	59	32.2		

All TEMs are
RoHS
compliant

高性能

High Performance

生命科学领域系列产品采用高性能材料与特殊的生产工艺相结合，热循环达上百万次，DT=20℃工作20万小时，主要应用于PCR与生化、发光、凝血仪等

The series of products in the field of life science adopt the combination of high-performance materials and special production technology, heat cycle up to millions of times, DT=20℃ working for 200,000 hours, mainly used in PCR and biochemistry, luminescence, blood coagulation instrument and so on.

凝血仪、流式细胞仪等

TEM Model No.	Imax (A)	Vmax (V)	ΔT_{max} (°C)	Qcmax (W)	SIZE(mm)			
					W	L1	L2	H
72013/031/040BS	4.0	4.4	78	8.1	15.1	15.1		3.10
20005/035/040BS	4.0	4.8	78	11.5	15.1	29.8		4.00
20085/035/040BS	4.0	5	78	10	20	30		3.95
20028/071/025BS	2.5	10.1	78	13	15.1	15.1		3.05
72015/071/025BS	4.0	10.1	78	21	22.4	22.4		3.15
72011/071/060BS	6.0	10.1	78	28.7	22.4	22.4		2.68
72003-071-060BS	8.5	10.1	78	45	29.7	29.7		3.80
72013/127/040BS	4.0	18.1	78	38	29.7	29.7		3.90
72013/127/050BS	5.0	18.1	78	48	29.7	29.7		3.80

生化分析仪、化学发光分析仪等

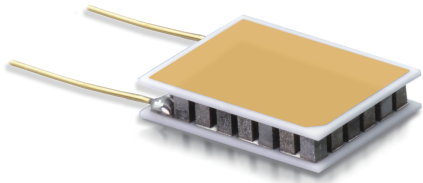
TEM Model No.	Imax (A)	Vmax (V)	ΔT_{max} (°C)	Qcmax (W)	SIZE(mm)			
					W	L1	L2	H
72003/127/050BS	5.0	18.1	78	47.5	39.7	39.7		3.80
72001/127/060BS	6.0	18.1	78	57	39.7	39.7		3.50
72003/241/040BS/C01	4.0	34.3	78	72	39.7	39.7		3.85
72001/241/060BS	6.0	34.3	78	108	55	55		3.50
72003/241/085BS	8.5	34.3	78	162	55	55		3.80

PCR、恒温金属浴等

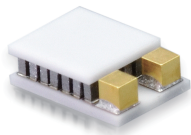
TEM Model No.	Imax (A)	Vmax (V)	ΔT_{max} (°C)	Qcmax (W)	SIZE(mm)			
					W	L1	L2	H
72003/127/085BS	8.5	18.1	78	80	39.7	39.7		3.80
72001/127/100BS	10.0	18.1	78	95	39.7	39.7		3.60
72001/127/110BS	11.0	18.1	78	104	39.7	39.7		3.50
72008/127/120BS	12.0	18.1	78	114	39.7	39.7		3.30
72058/127/150BS	15.0	18.1	78	142	39.7	39.7		3.30
72031/133/070BS	7.0	18.9	78	69	29	40	38	3.40
72008/198/120BS	12.0	28.2	78	177.8	36	47		3.20
72021/157/080BS	8.0	22.4	78	94	16.7	76.6		3.50
72038/131/150BS	15.0	18.6	78	146	20	70		3.25
72011/129/150BS	15.0	18.3	83	142	34.5	79.5		3.50
72008/165/170B	17.0	23.5	83	209	52.8	70		3.35

All TEMs are
RoHS
compliant

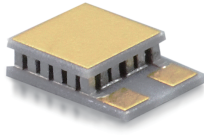
微型致冷器
Miniature Modules



超微型致冷器
Micro Modules



金锡制冷器
AuSn TEC



Thermoelectric Solutions for
Precision Thermal Management
精确热电解决方案

高性能

微型致冷器是Ferrotec为满足苛刻高温环境及器件小型化发展趋势，采用高性能热电材料和先进制作工艺所开发出的产品。典型应用于光通讯行业的激光发射器、光接收器、泵浦激光器等产品。可供选择的规格如下：

The Miniature Modules series is developed for rigorous high ambient temperature and components miniaturization. The TECs use high performance semiconductor material and special assembly technology. These modules are typically used in optical communication industry such as laser transmitter, optical receiver, pump laser etc. These TECs are also available with different configurations.

TEM Model No.	I _{max} (A)	V _{max} (V)	ΔT _{max} (°C)	Q _{cmax} (W)	SIZE(mm)			
					W	L1	L2	H
20003/007/012M	1.2	1.0	80	0.7	4.0	4.0		2.20
20023/017/012M	1.2	2.5	80	1.6	6.1	6.1		1.95
20033/018/012M	1.2	2.7	80	1.7	6.1	6.1	7.2	1.95
20031/023/018M	1.8	3.4	80	3.3	6.1	8.2		1.65
20021/029/018M	1.8	4.3	80	4.2	6.1	10.2		1.65
20021/065/018M	1.8	9.6	80	9.4	12.1	11.2		1.65
20001/031/020M	2.0	4.6	80	5.0	8.0	8.0		1.65
20031/035/020M	2.0	5.2	80	5.6	6.1	12.2		1.65

高性能

High Performance

超微型致冷器产品主要应用于通讯行业。

The Micro Module series is especially developed for the demands of telecom applications.

TEM Model No.	I _{max} (A)	V _{max} (V)	ΔT _{max} (°C)	Q _{cmax} (W)	SIZE(mm)			
					W	L1	L2	H
20016/008/010M	1.0	1.1	76	0.6	2.3	2.3	3.3	1.13
20036/012/010M	1.0	1.7	76	0.9	3.4	2.3	3.3	1.13
200B6/018/010M	1.0	2.5	76	1.4	3.4	3.4	4.4	1.13
20036/024/010M	1.0	3.3	76	1.8	3.4	4.5	5.5	1.13
20015/008/015A	1.5	1.1	76	0.9	2.3	2.3	3.3	0.98
20035/012/015A	1.5	1.7	76	1.4	3.4	2.3	3.3	0.98
200B5/018/015A	1.5	2.5	76	2.0	3.4	3.4	4.4	0.98
20035/024/015A	1.5	3.3	76	2.7	3.4	4.5	5.5	0.98
20034/008/009AN	0.9	1.2	76	0.6	1.8	1.8	2.4	0.9

高性能

High Performance

金锡制冷器Ferrotec为满足不断提升使用环境温度的应用趋势，采用高性能的材料和先进工艺开发的新一代高温应用产品，典型应用于光通信行业的激光发射器与和其他行业的大功率的小型激光器。

AuSn TEC is developed for high temperature application, it is made of high performance material and advanced process technology, typically used in optical telecommunication such as the laser transceiver, pumper laser and other high power mini laser.

TEM Model No.	I _{max} (A)	V _{max} (V)	ΔT _{max} (°C)	Q _{cmax} (W)	SIZE(mm)			
					W	L1	L2	H
28036/018/012MN	1.2	2.4	76	1.6	3.7	3.2	3.95	1.03
28031/023/020M	2.0	3.4	80	3.7	6.1	8.2		1.65

高性能

单级产品适用于制冷能力要求很高或者较高的和高效率要求的场合，广泛应用于工业和实验室设备，标准产品高度可以达到±0.025mm的精度；20系列产品可以根据客户要求进行各种不同的配置：

The Single Stage Module series is suitable for a wide range of applications which require medium or high pumping capacity combined with excellent efficiency, especially where temperature needs precisely stabilized. Typically applications include optical, industrial and laboratory equipment. Standard substrates are lapped with ±0.025mm tolerance. On request, these TEMs are available with different configurations, other dimensions and electrical specifications.

TEM Model No.	I _{max} (A)	V _{max} (V)	ΔT _{max} (°C)	Q _{cmax} (W)	SIZE(mm)			
					W	L1	L2	H
20013/017/030B	3.0	2.4	83	3.8	11.5	11.5		2.90
20013/023/030B	3.0	3.3	83	5.1	7.4	22.4		2.90
20005/017/040B	4.0	2.4	83	5.1	15.1	15.1		3.10
20013/031/040B	4.0	4.4	83	9.2	15.1	15.1		2.90
20005/035/040B	4.0	5.0	83	10	15.1	29.8		3.95
20015/063/040B	4.0	9.0	83	19	20.1	39.7		3.95
20013/071/040B	4.0	10.1	83	21	22.4	22.4		2.90
20003/031/085B	8.5	4.4	83	20	20.0	20.0		3.75

TEM Model No.	I _{max} (A)	V _{max} (V)	ΔT _{max} (°C)	Q _{cmax} (W)	SIZE(mm)			
					W	L1	L2	H
72005/071/040B	4.0	10.1	83	21	29.8	29.8		4.00
72001/071/060B	6.0	10.1	83	32	29.8	29.8		3.50
72011/127/060B	6.0	18.1	83	57	29.7	29.7		3.50
720C1/127/060B	6.0	18.1	83	57	34.5	34.5		3.50
72001/127/060B	6.0	18.1	83	57	39.7	39.7		3.50
72031/133/070B	7.0	18.9	83	69	29.0	40.0		3.40
72001/071/085B	8.5	10.1	83	45	29.8	29.8		3.50
72001/127/085B	8.5	18.1	83	80	39.7	39.7		3.50
72001/097/090B	9.0	13.8	83	65	29.8	29.8		3.40
72011/063/100B	10.0	9.0	83	47	20.1	39.7		3.50
72001/127/100B	10.0	18.1	83	95	39.7	39.7		3.50
72001/127/110B	11.0	18.1	83	104	39.7	39.7		3.50
72041/071/150B	15.0	10.1	83	79	40.1	40.1		3.50

TEM Model No.	I _{max} (A)	V _{max} (V)	ΔT _{max} (°C)	Q _{cmax} (W)	SIZE(mm)			
					W	L1	L2	H
72001/241/060B	6.0	34.3	83	108	55.0	55.0		3.50
72003/241/085B	8.5	34.3	83	153	55.0	55.0		3.80
72008/391/085B	8.5	55.5	83	248	55.0	55.0		3.20
72008/199/100B	10.0	28.3	83	148	40.0	40.0		3.30
72008/199/120B	12.0	28.3	83	178	40.0	40.0		3.30
72011/129/150B	15.0	18.3	83	144	79.5	34.5		3.50
72008/131/150B	15.0	18.6	83	146	30.0	60.0		3.30
72018/242/160B	16.0	34.4	83	288	55.0	55.0	58.0	3.30

单级致冷器
Single-Stage Modules



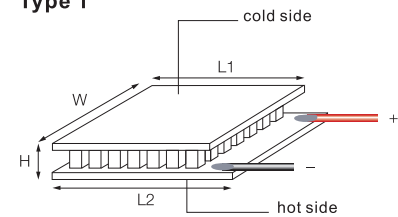
大功率制冷器
High Power Modules



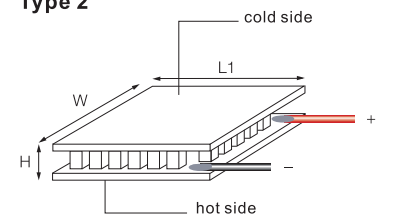
长寿命致冷器
Thermal Cycling Modules



Type 1



Type 2



Thermoelectric Solutions for
Precision Thermal Management
精确热电解决方案

高性能

长寿命致冷器系列产品采用高性能材料与特殊的生产工艺相结合，在热循环过程中提供更长寿命与更佳效率，主要应用于PCR与分析仪。

The long Life Module Series has been specifically designed for fast and very fast thermal cycling applications. Life time is significantly greater than a standard module under the same thermal cycling conditions. Typical application areas include PCR cyclers and analyzers. These TEMs are also available with different configurations.

(Th=50°C)								
TEM Model No.	Imax (A)	Vmax (V)	ΔTmax (°C)	Qcmax (W)	SIZE(mm)			
					W	L1	L2	H
72013/127/030B	3.0	18.1	83	28	29.7	29.7		3.80
72013/127/040B	4.0	18.1	83	38	29.7	29.7		3.80
7200A/127/040B	4.0	18.1	83	38	39.7	39.7		4.50
72005/071/060B	6.0	10.1	83	32	29.8	29.8		4.00
72005/127/060B	6.0	18.1	83	57	39.7	39.7		4.00
72005/128/060B	6.0	18.2	83	57	39.7	39.7	42.8	4.00
72003/071/085B	8.5	10.1	83	45	29.8	29.8		3.80
72003/127/085B	8.5	18.1	83	80	39.7	39.7		3.80
7200A/031/090B	9.0	4.4	83	21	29.8	29.8		4.50
7201A/032/100B	10.0	4.5	83	24	25.4	25.4	28.7	4.50
7200A/031/150B	15.0	4.4	83	35	29.8	29.8		4.50
72013/032/150B	15.0	4.5	83	36	25.4	25.4	28.7	3.80
72058/199/160B	16.0	28.3	83	237	40.0	58.0		3.30

Type 1的porch结构(引线外置)特征，能使热量分布更均匀。L2比L1的长度要稍长一些。

Type 1 TEMs feature a “porch” for more accurate heat distribution. This makes the L2 dimensions slightly longer than the L1 dimension.

T_{hot}=50°C时，致冷器的参数：

Imax	最大输入电流 (A)	条件：当Qc=0 且 ΔTmax
Vmax	最大输入电压 (V)	条件：当Qc=0 且 Imax
ΔTmax	最大温度差 (°C)	条件：当Qc=0 且 Imax
Qcmax	最大制冷量 (W)	条件：当Imax 且 ΔT=0
T _{hot}	致冷器热面工作温度	

The following terms are used in the tables at T_{hot} = 50°C:

Imax	Maximum input current in amperes at Qc = 0 and ΔTmax
Vmax	Maximum DC input voltage in volts at Qc = 0 and Imax
ΔTmax	Maximum temperature differential in °C at Qc = 0 and Imax
Qcmax	Maximum heat pumping capacity in watts at Imax and ΔT= 0
T_{hot}	Temperature of TEM hot side during operation

单孔致冷器系列适用于中等制冷功率的场合，典型应用于工业、电器设备以及实验室和光电子设备等领域。标准产品的高度公差为0.025mm。可供选择的规格如下。

The Center-Hole TEM series is suitable for various cooling and heating applications which generally require medium pumping capacity. Typical application areas include industrial and electrical equipment as well as laboratory and opto-electronics. Standard substrates are lapped with 0.025 mm tolerance.

(Th=50°C)								
TEM Model No.	Imax (A)	Vmax (V)	ΔTmax (°C)	Qcmax (W)	SIZE(mm)			
					W	L1	D	H
Square Type								
20083/023/030B	3.0	3.3	83	5.1	15.1	15.1	5.0	2.90
20063/023/030B	3.0	3.3	83	5.1	15.1	15.1	6.7	2.90
20043/023/030B	3.0	3.3	83	5.1	18.0	18.0	8.0	2.90
20083/023/040B	4.0	3.3	83	6.8	15.1	15.1	5.0	2.90
20063/023/040B	4.0	3.3	83	6.8	15.1	15.1	6.7	2.90
20043/023/040B	4.0	3.3	83	6.8	18.0	18.0	8.0	2.90
20045/125/060B	6.0	17.8	83	56	39.7	39.7	4.7	3.55

TEM Model No.	Imax (A)	Vmax (V)	ΔTmax (°C)	Qcmax (W)	SIZE(mm)		
					DO	DI	H
Round Type							
20065/014/060B	6.0	2.0	83	6.3	26	14	3.1

专为5.66mm的CAN型激光二极管设计的多孔致冷器系列。因加大了致冷器和激光二极管之间的接触面，制冷更快速，温度更均匀。优化的接触面设计，使得激光二极管的性能更为稳定。该标准系列产品适用于φ3.5-9.0mm的激光二极管。如有其它特殊设计要求，请联系Ferrotec。

The Multi-Hole TEM series has been specifically designed for 5.6mm CAN type laser diodes. The increased contact area between the TEM and laser diode package enables more uniform cooling with the target temperature being achieved more rapidly. The optimized thermal contact area results in very stable thermal performance for laser diodes. The standard series is available for laser diodes with diameters ranging from φ 3.5-9.0 mm. For other specific laser diode sizes or design requirements please contact Ferrotec.

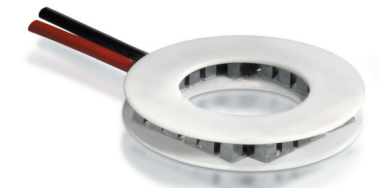
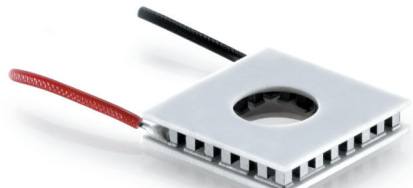
(Th=50°C)							
TEM Model No.	Imax (A)	Vmax (V)	ΔTmax (°C)	Qcmax (W)	SIZE(mm)		
					W	L	H
20073/023/012M	1.2	3.3	80	2.1	8.65	8.65	1.95

Ferrotec 95系列软性基板产品系列是FERROTC特别开发的能够根据客户要求进行了灵活设计，制作各种形状的TE产品；可以实现诸如热敏电阻内置，外表面金属化以便于客户的焊接安装，铜质散热器可以直接焊接在TE产品上；此外还可以提供高性能的聚合物基板的产品。

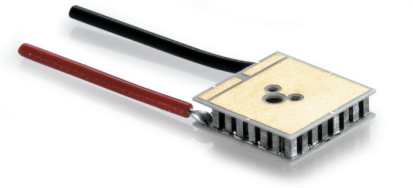
The Thin-Film Substrate TEM series was specially developed to offer greater design flexibility to users. Ferrotec Thin-Film Substrate modules can be rapidly prototyped in nearly any shape.Features such as internal thermistors or custom external metallization patterns can be easily added. Coppers heat sinks can be soldered directly on the substrate.The high performance polymer substrate is also available in many sizes.

* Only available on request

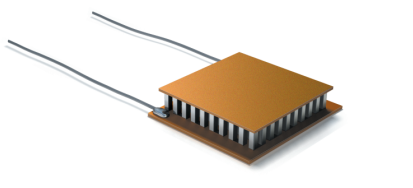
单孔致冷器
Center-Hole Modules



多孔致冷器
Multi-Hole Modules

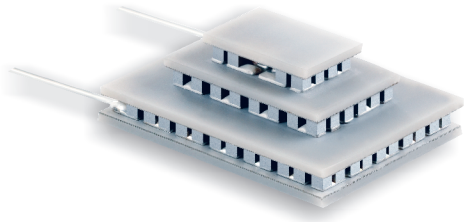


软性基板致冷器
Thin-Film Substrate Modules



多级致冷器

Multi-Stage Modules



客户定制致冷器

Customized Modules



Thermoelectric Solutions for Precision Thermal Management
精确热电解决方案

高性能

多级致冷器系列产品是为大温差应用而设计的。这类致冷器适用于需要中小制冷功率、大温差的情况。典型应用于 IR-检测，CCD 阵列和光电等领域。不同层叠方式的设计可满足深度制冷的需求。这类致冷器能获得比标准单级致冷器更大的温差。

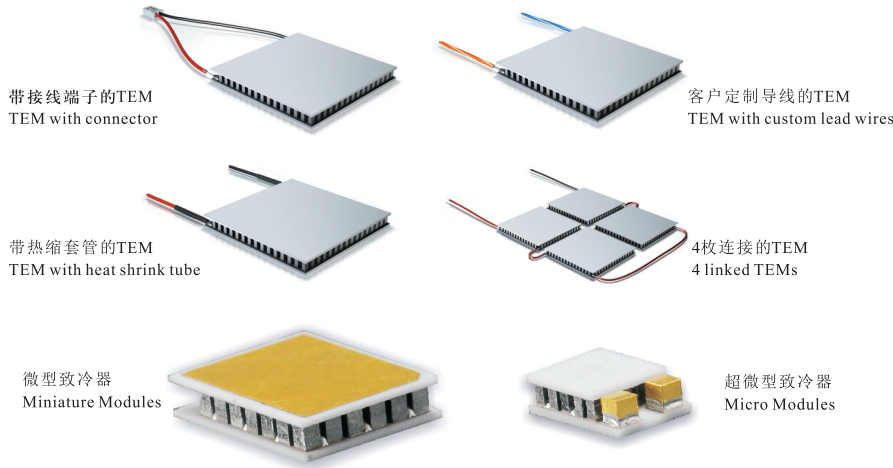
The Multi-Stage TEM series is designed to provide significantly higher ΔT . These TEMs are suitable for low temperature applications where a small or medium cooling capacity is required. Typical application areas include IR-detectors, CCD arrays and electro-optics. These items are also available with different configurations in cascade designs to meet a range of deep cooling applications. They provide higher temperature differentials than obtainable with standard single stage TEMs.

(Th=50°C)

TEM Model No.	Imax (A)	Vmax (V)	ΔTmax (°C)	Qcmax (W)	SIZE(mm)						
					W1	W2	W3	L1	L2	L3	H
2020/190/016BN	1.6	17.2	104	11	14.8	29.8		29.8	29.8		7.75
2020/038/048M	4.8	4.1	105	4.0	11.5	15.1		11.5	15.1		5.40
2020/110/050A	5.0	12.4	114	9.7	14.0	14.0		27.0	27.0		2.65
2020/088/055B	5.5	11.1	105	13	15.2	29.8		15.2	29.8		7.00
2020/147/055BN	5.5	9.2	95	23	25.0	30.0		25.0	30.0		4.74
2020/324/060BS	6.0	28.2	98	69	40.0	40.0		40.0	40.0		5.60
2020/185/065B	6.5	17.9	100	37	29.8	39.7		29.8	39.7		6.65
2020/197/070B	7.0	17.8	91	43	29.8	39.7		29.8	39.7		4.65
2020/157/070B	7.0	17.3	106	24	20.0	39.7		20.0	39.7		6.65
2020/197/080B	8.0	17.8	91	52	29.8	39.7		29.8	39.7		6.00
2020/094/230B	23.0	8.2	88	74	45.2	45.2		54.1	54.1		7.30
2030/099/043MN	4.3	8.1	117	6.1	8.6	12.7	21.7	13.0	19.4	28.3	10.40
2030/119/045B	4.5	8.6	111	9.7	15.2	20.0	29.8	15.2	20.0	29.8	9.10
2030/228/045B	4.5	16.4	111	18	20.0	29.8	39.7	20.0	29.8	39.7	9.50
2030/106/047MN	4.7	9.3	123	7.0	8.6	13.0	21.7	13.0	21.9	28.3	8.42
2030/106/055A	5.5	9.6	111	8.7	8.6	13.0	21.7	13.0	21.9	28.3	6.75
2030/228/060B	6.0	18.3	111	22	20.0	29.8	39.7	20.0	29.8	39.7	8.55

Ferrotec可以根据客户的要求，设计生产不同尺寸，不同形状，不同基板材料，不同密封形式的TEC产品，具体请与FerroTec联系。

FerroTec can provide various size, shape, substrate and sealing according to customer requirements. Detail please contact with Ferrotec for helping.



环氧树脂用于高湿环境中的TEM密封保护。尽管RTV硅胶密封已经具备有效防潮功能，但是在一些防潮要求非常严格的使用条件下，环氧树脂密封却能提供更好的密封保护。为了开发出最有效的密封树脂，Ferrotec对多种型号的树脂进行了精心试验和筛选。脆性是树脂用于TEM密封时普遍存在的问题。随着时间的推移，树脂的脆性导致树脂和基板分离，最终导致密封失效。Ferrotec的密封树脂在固化后既具有和基板牢固的结合力，又保持了良好的弹性，因此，能克服上述的弱点。在更具挑战性的热循环试验中，Ferrotec树脂密封同样表现出了优异的防潮性能。这种树脂的电阻值很高，在兆欧级范围。树脂密封产品的最高使用温度推荐为80℃。Ferrotec的密封树脂可用于几乎所有型号的TEM产品。环氧树脂对冷却性能的影响取决于组件的设计。

Epoxy sealing is offered for protecting TEMs used in high humidity environments. Although RTV silicone sealing has been demonstrated to be an effective moisture barrier, our epoxy sealant offers greater moisture resistance for those applications requiring the highest protection. Ferrotec has carefully screened and tested many epoxy types to develop the most effective solution for TEMs. Brittleness is a common problem with some epoxies used to seal TEMs, and it can lead to separation from the substrate over time and cause loss of seal. Ferrotec epoxy sealant forms a strong bond with the substrate and remains flexible after curing, therefore avoiding this common problem. This epoxy has also demonstrated very good resistance to humidity under aggressive thermal cycling testing. The maximum recommended operating temperature for the epoxy sealant is 80C.Ferrotec epoxy sealant can be

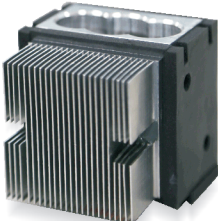
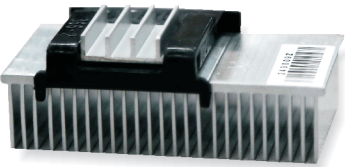
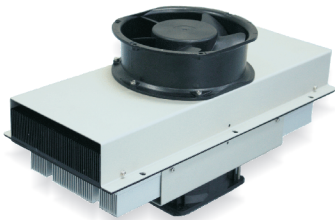
Ferrotec可提供电子级的RTV硅胶全密封型致冷器，可有效防止致冷器在低于露点温度运行时的结露问题。如果湿气长期存在于致冷器内，将会导致其性能降低。RTV硅胶在封装后富有弹性并能长期保持，这一特性尤其适用于热循环条件苛刻的环境。RTV硅胶密封的产品，其有效使用的环境温度为-60℃~+200℃。RTV硅胶密封对冷却性能的影响取决于组件设计。

Ferrotec offers an electronics-grade silicone as an option for perimeter sealing TEMs. This RTV Silicone Seal is an effective barrier against condensation when operating TEMs below the dew point. Continual moisture contact within the TEM can lead to performance degradation. The RTV Silicone Seal is flexible after setting and retains its elasticity over time, this property is particularly useful in rigorous, temperature cycling applications. Ferrotec RTV Silicone Seal is effective over a temperature range of -60C to +200C. The impact of the RTV Silicone Seal on cooling performance is depending on the design of the assembly.



致冷单元

TEM Standard Assembly:



FerroTec 可以提供各种类型的制冷单元，包括风冷，液冷和直接接触等不同形式的。适用于各种制冷和加热场合的应用，典型应用有小型冰箱，小型加热制冷箱，测试台，除湿器，科学仪器及其他。

- 特点:
- 1.采用FerroTec自制的具有全球业内领先的性能和可靠性TEC;
 - 2.优异的防潮密封设计，防止湿气的进入装置;
 - 3.优化的散热设计，制冷性能达到高效;
 - 4.隔离式的结构设计，提高TEC的抗震性和抗冲击性;
 - 5.选用优质的风扇，保证可靠的持续的散热性能。

- Ferrotec can provide variable TE assemblies, include the air cooling, liquid cooling and direct contact cooling, used in all kind of the cooling and heating applications, such as the compact refrigerators, cooled/heated compact cases, testing stand, dehumidifiers, scientific instruments and others
- Features:
1. Take the Ferrotec designed and manufactured TEC which have the leading performance and reliability in the industry;
 2. Excellent humidity-proof design to prevent the moisture into the assembly;
 3. Optimized thermal design to ensure the whole assembly working in High efficiency ;
 4. Isolated TEC from vibration and mechanical shock, increased the reliability;
 5. Take the high reliable fan to ensure the performance and reliability.

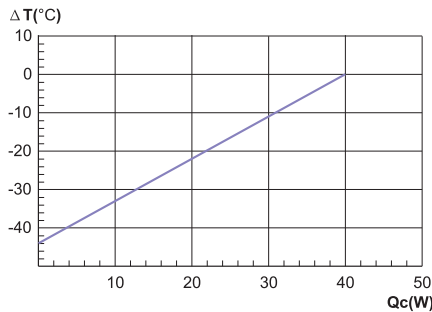
温差 $\Delta T = T_c - T_a$ (°C)

环境温度 T_a = Ambient temperature

致冷单元冷面温度

T_c = The temperature of the TEM
Standard Assembly surface

性能曲线 Performance



参数表 Specification

(Th=50°C)

TEM Model No.	V (V)	I (A)	I _{max} (A)	Q _c max (W)	SIZE(mm) W x L x H	Dim. Cooling Plate (mm) W x L
FTA951	12(DC)	5.8	7.0	39	122×100×102	80×80

V = 额定电压 (V)

I = 额定电流 (A)

I_{max} = 最大电流 (A)

Q_c = 制冷功率 (W)

直流风扇的额定电压/电流= DC12 V/0, 24 A

环境温度: T_a = 25C,

冷面温度: T_c = 25C

温差(T_a = T_h = T_c): ΔT = 0C

V = Rated Voltage (V)

I = Rated Current (A)

I_{max} = Maximum Current (A)

Q_c = Heat Pumping Capacity (W)

DC Fan Rated Voltage/Current=DC12V/0,24A

Ambient Temp.: T_a = 25C,

Cooling Block Temp: T_c = 25C

Temp. Differential (T_a = T_h = T_c): ΔT = 0C

上述性能表中反映的是平均参数值。测试是在冷块与外界绝热的情况下进行，尺寸不含侧面接线座的尺寸。可根据需要索取机械结构图纸。标准配置包含冷块的隔热绝缘圈。

The figures seen in the above performance table chart reflect average values. Testing was performed with the cooling plate surrounded by insulation. The dimensions do not include the side terminal. Mechanical drawing available on request. The standard configuration includes a heat insulation package.

致冷器编号规则

TEM Numbering System

产品系列号

Product Line

95-Series*
Center Hole Modules
Multi Hole Modules
Thin Film Substrate Modules

20-Series*
Miniature Modules
Micro Modules
Single Stage Modules
Multi Stage Modules

72-Series*
Single Stage Modules
Thermal Cycling Modules

28-Series*
Miniature modules
Micro modules

* 200C Max. peak process temperature;
we generally recommend lower
temperatures for sustained operation.

外型

- 0 标准型致冷器
- 1 未设定
- 2 二级致冷器
- 3 三级致冷器

Shape

- 0 Standard Module
- 1 Undesignated
- 2 2-Stage Module
- 3 3-Stage Module

分类代码

Classification Number

最大电流 $\times 0.1$ A

Maximum Current 0.1 Ampere Increments

选项

- N 用ALN 基板制成
- P 用软性基板制成

Options

- N Made by ALN substrate
- P Made by Thin Film substrate

选项

- S RTV 硅胶密封
- X 环氧树脂密封

Options

- S RTV Silicone Seal
- X Epoxy Seal

Dice 高度

Height of Dice

对数

Number of Couples

基本参数

A 标准型陶瓷表面
常规产品的高度公差为 ± 0.25 mm
微型致冷器高度公差为 ± 0.15 mm

B 研磨型瓷表面
单级致冷器高度公差 ± 0.025 mm
多级致冷器高度公差 ± 0.10 mm

H 热面可上锡的金属化陶瓷基板

C 冷面可上锡的金属化陶瓷基板

M 冷、热面均可上锡的金属化陶瓷基板

Substrate Specification

A Standard type, plain ceramic surface
General Modules - height tolerance = ± 0.25 mm
Miniature Modules - height tolerance = ± 0.15 mm

B Lapped type, plain ceramic surface
Single-Stage Modules - height tolerance = ± 0.025 mm
Multi-Stage Modules - height tolerance = ± 0.10 mm

H Solderable metallized ceramic
on hot side external surface

C Solderable metallized ceramic
on cold side external surface

M Solderable metallized ceramic on both
hot and cold side external surfaces

All TEMs are
RoHS
compliant

All TEMs are
RoHS
compliant

为了帮助您选择更合适的TEM，我们列出以下问题。由于TEM的性能很大程度上取决于系统中所有元器件，所以简要提供您的应用要求能够帮助我们为您选择最佳和最有效的解决方案。

In order to help you optimize the selection of a TEM we have provided the following list of questions. Since the performance of a TEM is strongly dependant on all system components, summarizing your application requirements will help us to provide a complete and effective solution for you.

名称/Name
职位/Position
部门/Title
公司/Company
地址/Street/Address
城市/City
州/省/State/Province
国家/Country
电话/Phone
邮件/E-Mail



(仅制冷, 制冷及加热, 发电)请描述:
(cooling only, cooling and heating,
power generation), please describe:

- ☐ 总热负载(主动+被动)
Total Heat Load (active + passive)
- ☐ 最大环境温度/Max. Ambient Temperature
- ☐ 目标冷却温度/Targeted Cold Temperature
- ☐ 目标热面温度/Targeted Hot Temperature
- ☐ 要求的制冷速率/Rate of cooling required
- ☐ 要求的加热速率/Rate of heating required

外形尺寸 Overall Dimensional Envelope
 宽/Width: _____
 深/Depth: _____
 高/Height: _____
 重/Weight: _____

散热器类型/Heat Sink Type: _____
 风扇尺寸及流量
 Fan Size and Flow Rate (CFM): _____
 散热器热阻
 Heat Sink Thermal Resistance ($^{\circ}\text{C}/\text{W}$): _____

部件类型(形容被冷却的部件, 如: 散热器、液冷板、冷却板):
Component Type (describe component being cooled, e.g., heat sink, liquid plate, solid plate)

部件尺寸/Component Dimensions
(in mm or inches): _____

散热器热阻/Heat Sink Thermal Resistance
(°C/W): _____

特殊环境描述, 如高湿度、真空等
Describe any special exposure requirements
e.g., high humidity, vacuum
热面/Hot Side: _____
冷面/Cold Side: _____
特殊机械环境描述, 如高振动, 重力场等
Describe any special mechanical
requirements, high vibrations, G-forces, etc. _____

输入功率/total Power in: _____
电压(目标, 最大)/Voltage (target, maximum): _____
电流(目标, 最大)/Current (target, maximum): _____

级数/Stage: _____
 长度/Length: _____
 宽度/Width: _____
 高/Height: _____
 其它/Other: _____

类型(96%氧化铝、氮化铝)
Type (96% alumina, AlN): _____
厚度/Thickness: _____
热面切割/Hot Side Sectioning: _____
其它/Other: _____

- ☐ 特氟龙绝缘线(标准线)
Teflon Insulated Multistrand (standard)
- ☐ 特殊导线长度/Special Lead Length
- ☐ 上锡导线/Tinned solid Wire
- ☐ 布置(特殊)/Posts (specify)
- ☐ 特殊接线端子(特殊)/Special Terminals (specify)

- ☐ 陶瓷/Bare Ceramic
- ☐ 金属化/Metallized:
 - ☐ 铜/Copper
 - ☐ 铜/Copper ☐ 镍/Nickel ☐ 金/Gold
- ☐ 特定金层厚度/Specific gold thickness
- ☐ 单面金属化/One side metallization only
- ☐ 特定金属化模式/Specific metallization pattern

预上锡选择/Pre-Tinning Options

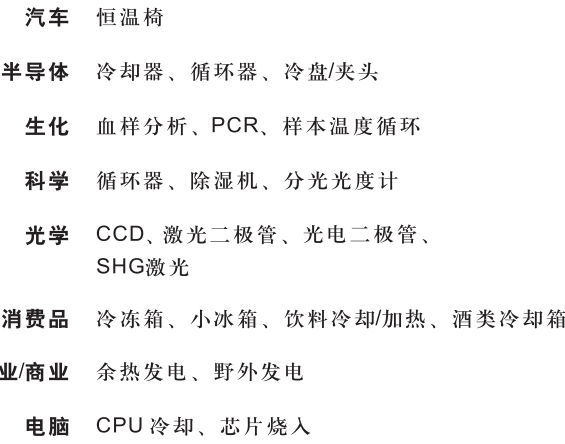
☐ 热面/Hot Side ☐ 冷面/Cold Side

☐ 双面/Both Sides

☐ 118°C InSn

☐ 138°C BiSn

☐ 157°C In

[illegible]

- For example:
 - Automotive**
 - Heated and cooled seats
 - Semiconductor**
 - Chiller
 - Circulator
 - Cooling plate / chuck
 - Biomedical**
 - Blood analyzer
 - PCR
 - Specimen temperature cycling
 - Scientific**
 - Circulator
 - Dehumidifier
 - Spectrophotometer

- Charged couple device (CCD) cooling
- Infrared detectors
- Laser diode cooling
- Photo diode cooling
- SHG laser cooling
- Computer**
 - CPU Cooling
 - Chip-set burn-in
- Consumer**
 - Cooler box
 - Mini refrigerator
 - Beverage cooler / heater
 - Wine cooler
- Industrial / Commercial**
 - Waste heat power generation
 - Remote power generation