



股票简称：富信科技

股票代码：688662

微型热电制冷器件

Micro Thermoelectric Modules



广东富信科技股份有限公司

Guangdong Fuxin Technology Co., Ltd

广东富信热电器件科技有限公司

Guangdong Fuxin Thermoelectric Module Technology Co., Ltd

广东富信科技股份有限公司创建于2003年，是一家专注于半导体热电技术及应用产品研发、制造和销售的国家级高新技术企业，具备覆铜陶瓷基板、热电材料、热电器件、热电系统、热电整机应用产品全产业链技术解决方案，并于2021年4月在科创板上市。

公司目前建筑面积6万多平方米，具备年产热电器件2000万片、热电系统620万套、热电整机产品165万台的生产能力，并拥有包括热电材料制备等多项自主核心技术、全自动化制造工艺以及SAP ERP、MES、PLM、SRM、WMS、QMS等IT化管理系统，质量体系通过GB/T 19001-2016/ISO 9001:2015质量管理体系、IATF16949 汽车行业质量管理体系、GB/T 24001-2016/ISO 14001:2015环境管理体系、GB/T 45001-2020/ISO 45001:2018 职业健康安全管理体系、IECQ QC080000:2017有害物质过程管理体系认证。

2021年公司投资9600万人民币成立控股子公司——广东富信热电器件科技有限公司，聚焦光通讯、汽车、生物医疗、工业等领域专用热电器件（TEC）的研发、制造和销售，并依托公司技术研发和质量优势，在国内率先实现光通讯Micro TEC的技术突破及产品的批量化交付。未来公司将继续加大在高性能高可靠性热电器件的研发投入，以不断的技术进步和持续的质量改善，致力于为客户提供“更优设计、更高可靠、更低功耗、更低成本”的产品及专业化的技术支持和服务，为客户持续创造价值。

Guangdong Fuxin Technology Co., Ltd. was founded in 2003 and is a national high-tech enterprise specializing in the research and development, manufacturing, and sales of semiconductor thermoelectric technology and application products. It has a full industry chain technology solution for copper clad ceramic substrates, thermoelectric materials, thermoelectric devices, thermoelectric systems, and thermoelectric application products. It was listed on the Science and Technology Innovation Board in April 2021.

The company currently has a construction area of over 60000 square meters, with an annual production capacity of 20 million thermoelectric modules, 6.2 million sets of thermoelectric systems, and 1.65 million sets of thermoelectric application products. It also has multiple independent core technologies, including thermoelectric material preparation, fully automated manufacturing processes, and IT management systems such as SAP ERP, MES, PLM, SRM, WMS, and QMS. The quality system has passed the GB/T 19001-2016/ISO 9001:2015 quality management system, IATF16949 Automotive Industry Quality Management System, GB/T 24001-2016/ISO 14001:2015 Environmental Management System, GB/T 45001-2020/ISO 45001:2018 Occupational Health and Safety Management System, IECQ QC080000:2017 Hazardous Substance Process Management System Certification.

In 2021, the company invested 96 million yuan to establish a holding subsidiary - Guangdong Fuxin Thermoelectric Module Technology Co., Ltd., focusing on the research, development, manufacturing and sales of special thermoelectric modules (TEC) in optical communication, automobile, biomedical, industry and other fields, and relying on the company's advantages in technology R&D and quality management, taking the lead in realizing the technological breakthrough of optical communication Micro TEC and the batch delivery of products in China. In the future, the company will continue to increase investment in the research and development of high-performance and reliable thermoelectric modules, with continuous technological progress and quality improvement, committed to providing customers with "better design, higher reliability, lower power consumption, and lower cost" products and professional technical support and services, and continuously creating value for customers.



■ 技术优势 Technical Advantages

➤ 全制造流程自主核心技术 Full Manufacturing Process Independent Core Technology

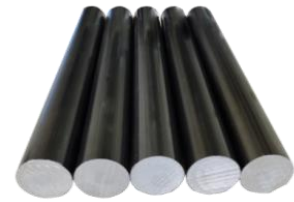
富信公司掌握包括碲化铋热电材料制备技术在内的Micro TEC全制造流程自主核心技术。核心原材料自制、全制程无任何委外工序，从而有效保障了供应链的安全及产品质量的可控性。

Fuxin has mastered the independent core technology of the full manufacturing process of Micro TEC, including the preparation technology of bismuth telluride thermoelectric materials. The core raw materials are self-made and there are no outsourced processes throughout the entire process, effectively ensuring the safety of the supply chain and the controllability of product quality.

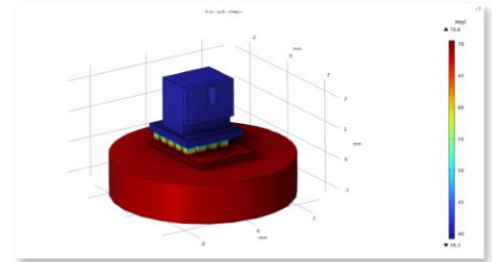
➤ Micro TEC仿真设计能力 Micro TEC Simulation Design Capability

公司拥有仿真软件和专业化的设计团队，可以根据客户的需求对TEC进行仿真设计，从而能够为客户提供最佳的技术解决方案。

Fuxin has simulation software and a professional design team, which can simulate and design TECs according to customer needs, thus providing customers with the best technical solutions.



碲化铋热电材料
Bismuth Telluride Material



Micro TEC仿真设计示例图
Micro TEC simulation design example diagram

➤ 研发及可靠性问题分析能力 R&D and Reliability Analysis Capabilities

公司拥有省级企业技术中心和省级工程技术研究中心，多名行业资深技术专家以及SEM、EDS等研发装备，此外设有完备的热电器件可靠性实验室，可以按照GR-468-CORE和MIL-STD-883测试标准对热电器件进行高低温储存、恒温恒湿、温度循环、温度冲击、启停循环、冷热循环、振动、机械冲击、剪切力等可靠性试验。

Fuxin has a provincial-level enterprise technology center and a provincial-level engineering technology research center, several industry senior technical experts, as well as research and development equipment such as SEM and EDS. In addition, Fuxin has a complete thermoelectric module reliability laboratory, which can carry out reliability tests on thermoelectric modules such as high and low temperature storage, constant temperature and humidity, temperature cycle, temperature shock, on-off cycle, cold and heat cycle, vibration, mechanical shock, shear force, etc. according to GR-468-CORE and MIL-STD-883 test standards.

■ 制造优势 Manufacturing Advantages

公司有超过20年TEC制造经验，拥有超过3000平方米无尘车间以及多条高精度全自动化生产线，具备年产500万片Micro TEC生产能力，并可实现晶粒尺寸小于0.2*0.2mm的Micro TEC全自动化精密组装和检测。

Fuxin has over 20 years of experience in TEC manufacturing, with over 3000 square meters of dust-free workshops and multiple high-precision fully automated production lines. It has an annual production capacity of 5 million Micro TECs and can achieve fully automated precision assembly and testing of Micro TECs with grain sizes less than 0.2 * 0.2mm.



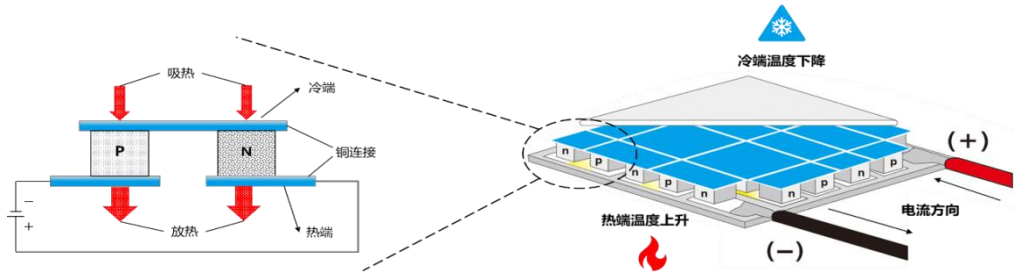
TEC可靠性实验室 TEC Reliability Laboratory



■ 管理优势 Management Advantages

公司通过了IATF16949 汽车行业质量管理体系认证，以及多家光通讯行业头部客户供应商体系认证。此外公司拥有SAP ERP、MES、PLM、QMS、WMS、SRM、OA等IT化管理系统，对产品开发管理、PCN变更管理、订单管理、生产计划管理、供应链管理、生产管控、质量管理、工艺管理、设备管理、仓储管理、交付管理、财务管理、成本管理等进行全面IT化管控，保证了产品质量的稳定可靠性、可追溯性以及产品交付的时效性。

Fuxin has passed the IATF16949 quality management system certification in the automotive industry and the supplier system certification of several leading customers in the Optical communication industry. In addition, the company has IT management systems such as SAP ERP, MES, PLM, QMS, WMS, SRM, OA, etc. It comprehensively controls product development management, PCN change management, order management, production plan management, supply chain management, production control, quality management, process management, equipment management, warehousing management, delivery management, financial management, cost management, etc., ensuring the stability and reliability of product quality and timeliness of product delivery.



热电制冷器件 (TEC) 是利用半导体材料的帕尔贴 (Peltier) 效应实现固态制冷或加热的一种功能器件, 广泛应用于通信、医疗实验、汽车、工业、消费电子、航天国防等领域。

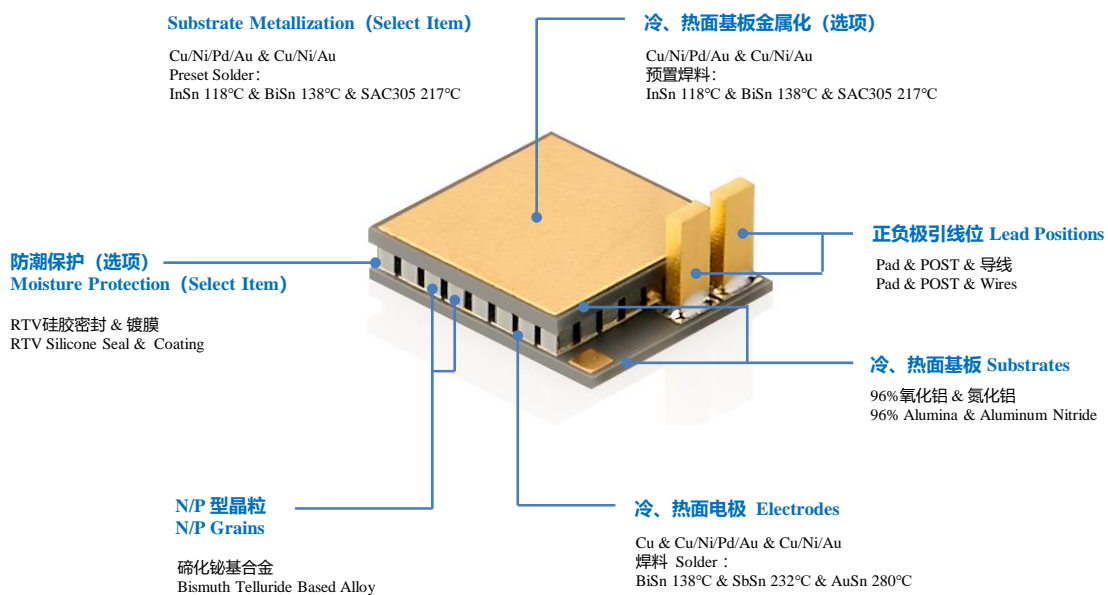
帕尔贴效应是一种当直流电通过两种不同导电材料构成的回路时, 结点上产生吸热或放热的现象。如上图所示, 将一只p型半导体晶粒和一只n型半导体晶粒通过铜连接片连接成电偶对, 当电流从n型半导体流向p型半导体时, 二者接头处温度降低并从外界吸收热量, 形成冷端; 反之, 电流从p型半导体流向n型半导体时, 二者接头处温度升高并放出热量, 形成热端, 且单位时间内吸收或者放出的热量与电流强度成正比。将若干对电偶对串联起来并固定在两片导热绝缘基板之间就形成一个单级热电制冷器件。当给TEC通入直流电时, 热量就从TEC的一面转移到另一面, 从而产生制冷和加热的现象。

TEC具有体积小、重量轻、无振动、无噪音、可靠性高、绿色环保等特点, 特别是同时具有制冷和加热两种功能, 且通过调节输入电流, 就可以实现对温度的精确控制, 控温精度甚至可以达到 0.01°C , 因此非常适合光通讯等领域需要在狭小空间对物体进行精确温度控制的场合。

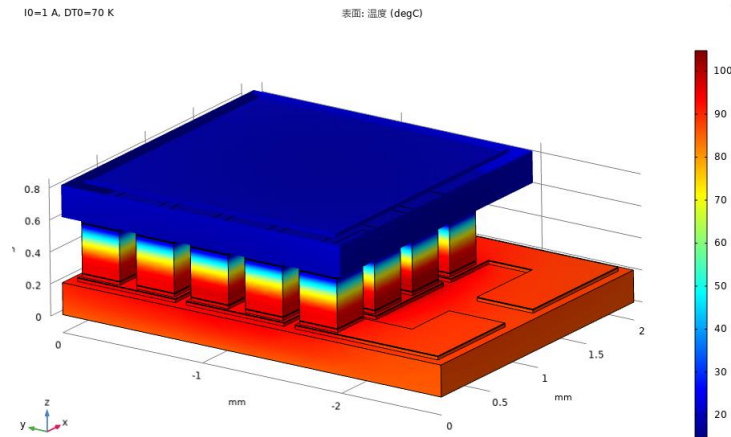
Thermoelectric modules (TEC) is a functional device that uses the Peltier effect of semiconductor materials to realize solid-state cooling or heating. It is widely used in communication, medical experiments, automotive, industry, consumer electronics, aerospace, national defense and other fields.

Peltier Effect is a phenomenon that when direct current passes through a circuit composed of two different conductive materials, heat will be absorbed or released at the node. As shown in the above figure, connect a p-type semiconductor grain and an n-type semiconductor grain into a galvanic couple pair through a copper connector. When the current direction flows from the n-type semiconductor to the p-type semiconductor, the temperature at the joint of the two decreases and absorbs heat from the outside, forming a cold end; on the contrary, when the current direction flows from p-type semiconductor to n-type semiconductor, the temperature at the joint of the two increases and releases heat, forming a hot end, and the heat absorbed or released per unit time is proportional to the current intensity. A single-stage TEC is formed by connecting several pairs of galvanic couples in series and fixing them between two heat-conducting insulating substrates. When a direct current is applied to the TEC, the heat is transferred from one side of the TEC to the other, resulting in the phenomenon of cooling and heating.

TEC has the characteristics of small size, light weight, no vibration, no noise, high reliability, green environmental protection, etc., especially it has two functions of cooling and heating at the same time. By adjusting the input current, it can achieve accurate control of temperature, and the temperature control accuracy can even reach 0.01°C . Therefore, it is very suitable for Optical communication and other fields that need accurate temperature control of objects in a narrow space.



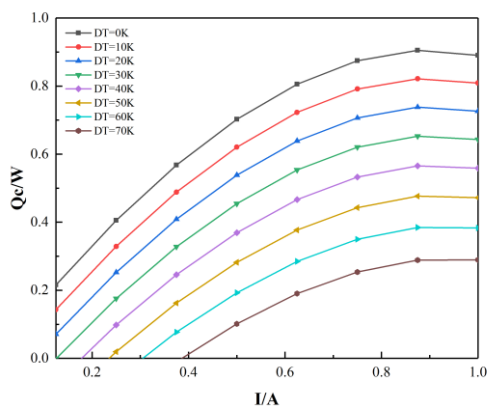
微型热电制冷器件 (Micro TEC) 结构示例图
Example structure diagram of Micro TEC



Micro TEC热仿真设计示例图
 Example diagram of Micro TEC thermal simulation design

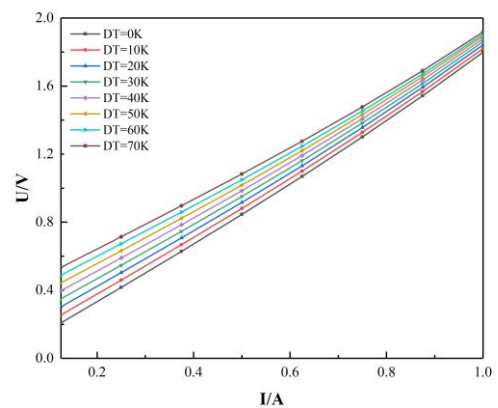
TEC的设计可以使用仿真软件进行, 并获得如下性能曲线:

TEC can be designed using simulation software, and the following performance curves can be obtained:



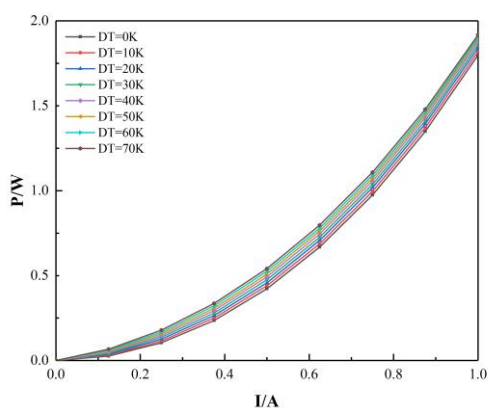
Qc-I: 表示在热面温度一定时, 不同温差下制冷功率与输入电流之间的关系。该曲线可以评价TEC是否有足够的制冷能力来满足应用需求。

Qc-I: Indicates the relationship between refrigeration power and input current under different temperature differences when the hot surface temperature is constant. This curve can evaluate whether TEC has enough refrigeration capacity to meet the application needs.



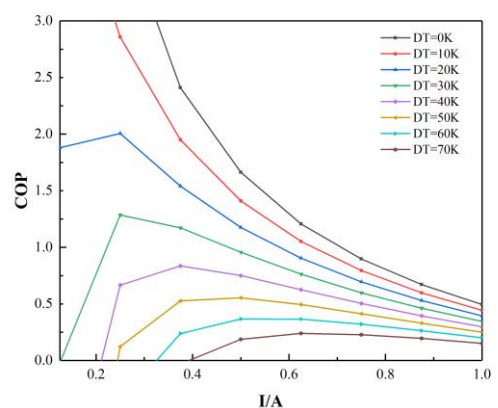
U-I: 表示不同温差下, 输入电压与输入电流之间的对应关系。当温差与电流确定后, 该曲线可以帮助用户选择合适的电源。

V-I: Indicates the corresponding relationship between input voltage and input current under different temperature differences. When the temperature difference and current are determined, the curve can help users choose the appropriate power supply.



P-I: 表示在热面温度一定时, 不同温差下输入功率与输入电流之间的对应关系。该曲线可以确定TEC在一定工况下的功耗。

Qh-I: Indicates the corresponding relationship between input power and input current under different temperature differences when the hot surface temperature is constant. This curve can determine the power consumption of TEC under certain working conditions.



COP-I: 表示不同温差下, COP系数与输入电流之间的对应关系。COP系数为制冷功率与输入电功率的比值。该曲线有助于用户确定TEC的转换效率。

COP-I: Indicates the corresponding relationship between COP coefficient and input current under different temperature differences. COP coefficient is the ratio of refrigerating power to input electric power. This curve helps the user to determine the conversion efficiency of TEC.

公司产品采用高性能热电材料及全自动化工艺制造，具有尺寸小巧，转化效率高，可靠性高等特点。典型应用于光通讯光模块、车载激光雷达、气体探测、红外探测等领域。

The Micro TEC are manufactured using high-performance thermoelectric materials and fully automated processes, featuring small size, high conversion efficiency, and high reliability. Typical applications include Optical communication Optical module, vehicle mounted laser radar, gas detection, infrared detection and other fields.

■ 超微型热电制冷器件 Subminiature TEC

典型应用于光通讯接入网10G PON以及气体探测、车载激光雷达等领域。产品支持金锡焊料和工温工况。

It is typically used in 10G PON of Optical communication access network, gas detection, laser radar and other fields. The product supports gold tin solder and industrial temperature conditions.



(Th=50°C)

Models	Size (mm)				ΔT_{max} (°C)	Q_c_{max} (W)	U_{max} (V)	I_{max} (A)
	W	Lc	Lh	H				
TEM1-007010A-NM-3B	1.25	2.10	2.65	0.80	80	0.6	0.9	1.0
TEM1-014009A-NM-3B	1.38	2.60	3.20	0.90	80	1.1	2.0	0.9
TEM1-010010B-NM-3B	1.52	2.00	2.60	0.80	80	0.8	1.3	1.0
TEM1-008012A-NM-3B	1.60	1.60	2.20	0.90	80	0.7	1.0	1.2
TEM1-012012A-NM-3B	1.60	2.40	3.00	0.80	80	1.2	1.6	1.2
TEM1-010012A-NM-3B	1.80	2.00	2.60	0.80	80	1.0	1.5	1.0
TEM1-015010A-NM-3B	1.80	2.00	2.60	0.80	80	1.2	1.9	1.0
TEM1-012012B-NM-3B	2.00	2.00	2.70	0.80	80	1.2	1.7	1.2
TEM1-018010B-NM-3B	2.00	2.00	2.70	0.80	80	1.6	2.6	1.0

■ 微型热电制冷器件 Micro TEC

典型应用于光通讯传输网10G DWDM光模块、100G LR4/ER4/ZR4光模块、相干模块、数据中心400G/800G光模块以及车载激光雷达等。产品支持金锡焊料和非气密性封装。

Typical applications include 10G DWDM Optical module, 100G LR4/ER4/ZR4 Optical module, coherence module, data center 400G/800G Optical module in Optical communication transmission network and vehicle mounted laser radar. The product supports gold tin solder and non airtight packaging.



(Th=50°C)

Models	Size (mm)				ΔT_{max} (°C)	Q_c_{max} (W)	U_{max} (V)	I_{max} (A)
	W	Lc	Lh	H				
TEM1-025015A-NM-3P	2.30	4.10	4.85	0.90	80	1.8	3.8	1.5
TEM1-020016C-NM-3P	2.80	4.35	5.10	0.90	80	2.5	2.6	1.6
TEM1-020007A-NM-3P	2.80	4.35	5.10	0.90	80	1.2	2.6	0.7
TEM1-027010A-NN-3P	2.90	4.50	5.20	1.00	80	2.3	1.1	1.1
TEM1-024010C-NM-3B	2.95	3.05	3.65	0.75	80	2.1	3.7	1.0
TEM1-027016A-NM-3P	3.00	4.20	4.90	1.00	80	2.3	3.5	1.6
TEM1-028010B-NM-2P	3.10	3.60	4.50	1.00	80	2.5	4.0	1.0
TEM1-030013A-NC-2P	3.10	5.10	5.85	1.00	80	3.0	3.9	1.3
TEM1-015014A-OM-3B	3.20	2.68	3.60	0.95	80	1.7	1.9	1.4

(Th=50°C)

Models	Size (mm)				ΔT_{\max} (°C)	$Q_c \max$ (W)	U_{\max} (V)	I_{\max} (A)
	W	Lc	Lh	H				
TEM1-020012A-NM-3P	3.35	5.45	6.15	0.75	80	2.5	3.1	1.2
TEM1-024020B-NM-3B	3.60	5.00	6.00	0.95	80	4.0	3.7	2.0
TEM1-032016A-NM-3B	3.80	3.90	4.60	0.97	80	4.5	4.9	1.6
TEM1-031010A-NM-2V	4.00	4.10	4.10	0.90	80	3.2	4.5	1.0
TEM1-028014A-NM-3P	4.00	4.40	5.10	1.20	80	3.0	3.6	1.4
TEM1-024020A-NMH-3B	4.00	5.00	5.80	1.20	80	3.1	3.5	1.5
TEM1-030028A-NM-2B	4.00	7.50	8.50	0.90	80	6.7	3.9	2.8
TEM1-030027A-NM-2P	4.10	6.00	6.70	0.90	80	6.5	3.8	2.2
TEM1-045014A-NM-2P	4.15	9.70	10.50	0.90	80	5.7	6.5	1.4
TEM1-032018A-NM-2P	4.50	4.80	5.60	0.90	80	5.0	4.6	1.8
TEM1-022009A-NMH-3P	5.00	2.80	3.50	1.78	80	1.6	2.8	0.9
TEM1-054018A-NM-3V	5.30	12.50	12.50	1.30	80	8.6	8.3	1.8
TEM1-020025A-NM-3B	6.50	4.40	5.50	0.75	80	2.5	3.1	2.5
TEM1-037007A-NM-3P	7.82	2.70	3.40	1.40	80	2.1	5.4	0.7
TEM1-090027A-NN-2P	8.20	10.10	11.30	1.10	80	19.4	11.6	2.7

■ 小型热电制冷器件 Mini TEC

典型应用于光通讯EDFA泵浦激光器及工业红外探测器等。

Typical applications are EDFA pumped lasers in Optical communication and industrial infrared detectors.



(Th=50°C)

Models	Size (mm)				ΔT_{\max} (°C)	$Q_c \max$ (W)	U_{\max} (V)	I_{\max} (A)
	W	Lc	Lh	H				
TES1-063034A-NM-2P	6.00	15.50	16.50	1.65	80	15.8	8.1	3.1
TES1-038027A-NM-2W	6.05	12.20	12.20	1.65	80	8.1	4.9	2.7
TES1-024022A-NM-2W	6.20	8.20	9.20	1.70	80	4.2	3.1	2.2
TES1-047022A-NM-2W	7.00	17.00	17.00	1.65	80	10.4	6.1	2.8
TES1-042058A-MM-3B	7.80	12.80	14.80	1.30	80	19.3	5.4	5.8
TES1-052052A-MM-3B	7.80	12.80	14.80	1.30	80	22.2	6.7	5.2
TES1-030028B-ON-2B	9.10	6.10	7.30	1.35	80	7.4	4.6	2.8
TES1-071015A-ON-2W	11.00	12.00	12.00	1.95	80	8.4	9.2	1.5
TES1-031040A-OM-2W	17.98	18.47	18.47	2.81	80	11.5	4.7	4.2
TEC1-089050A-OH-2W	21.40	23.40	23.40	3.40	80	32.4	11.5	4.6

※ 如上述产品型号不能满足您的需求，我们可根据您的需求为您专门定制。 If the above product model cannot meet your needs, we can customize it specifically according to your needs.



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