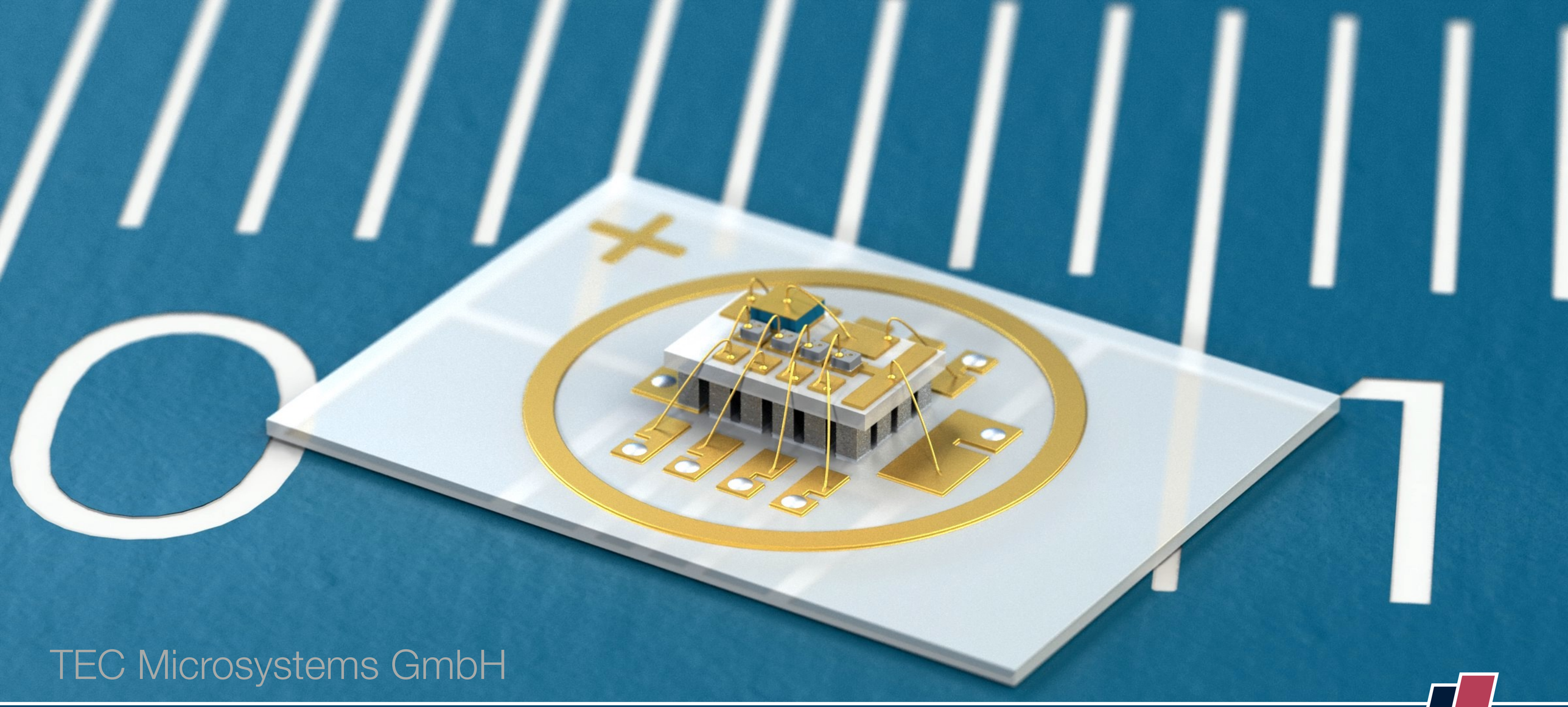


TEC Microsystems GmbH

THERMOELECTRIC TECHNOLOGIES AND PRODUCTS

We create TECs

more than 15 Years on Thermoelectric Market

TEC Microsystems GmbH

About TEC Microsystems GmbH

ADVANCED THERMOELECTRIC TECHNOLOGIES AND PRODUCTS

Founded in 2007, the Hi-Tech company TEC Microsystems GmbH is based in the prominent Technology Park Berlin Adlershof, Germany. Thermoelectric technologies are our core competence based on almost a decade of analysis, innovative development, product design and numerous successful projects in this field.
Specialized in miniature thermoelectric modules (Peltier elements), TEC Microsystems GmbH is a driver of innovation and technological progress including state-of-the-art analysis techniques. Our worldwide customers operate in key industries like opto-electronics, telecom, micro-electronics, space, medical equipment/health care, security systems, small scale energy harvesting and fundamental research. All thermoelectric modules and related products are designed and developed in our ISO 9001:2015 certified facility in Berlin, Germany.

ISO 9001 BUREAU VERITAS Certification

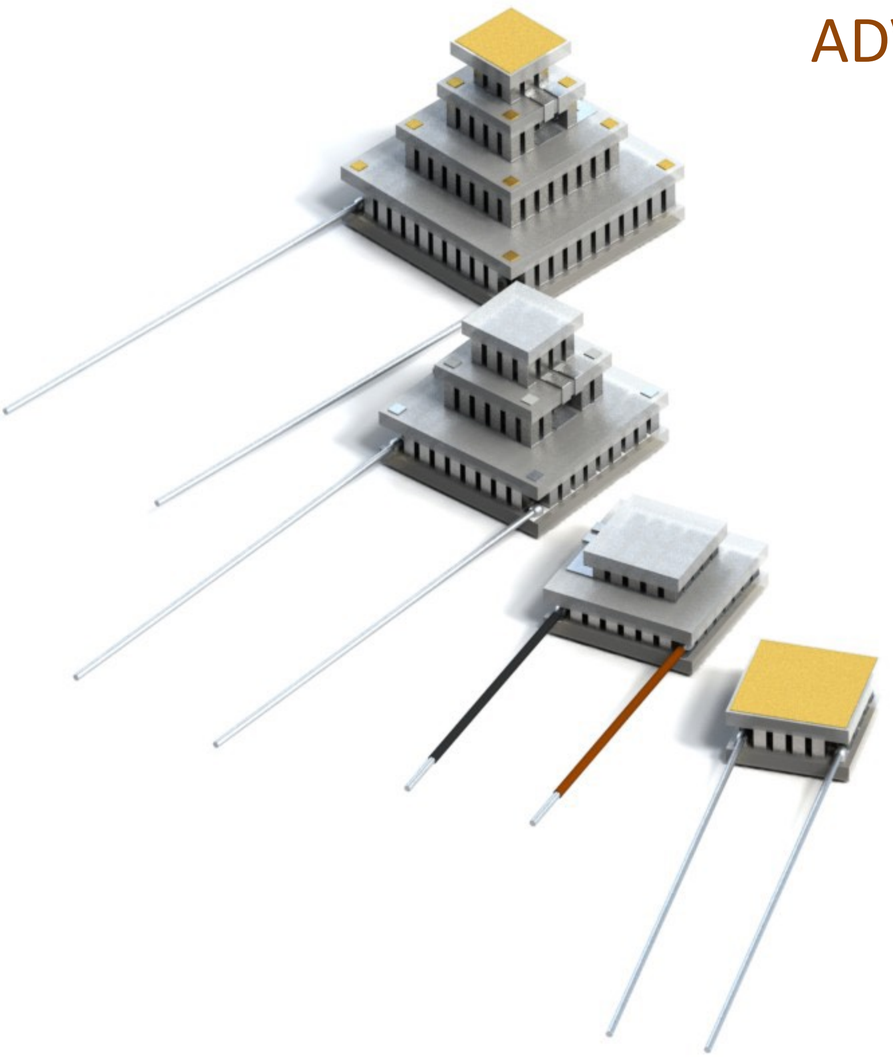
Developed in Germany

OpTecBB

Berlin Adlershof

DTG Deutsche Thermoelektrik-Gesellschaft e.V.

Miniature Thermoelectric Coolers



ADVANCED THERMOELECTRIC COOLING SOLUTIONS

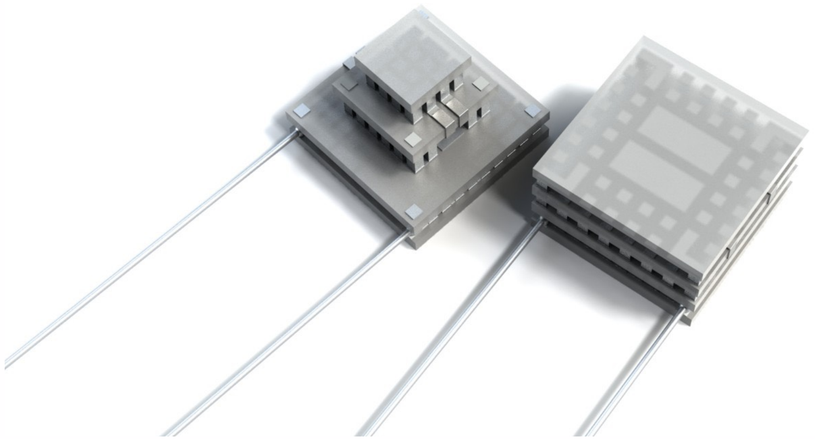
- LD and Superluminescent Diodes
- X-Ray and IR- Sensing Applications
- Photodetectors
- Avalanche Photodiodes (APD)
- Focal Plane Arrays (FPA)
- Charge Couple Devices (CCD)

- More than 5000 TEC types
- Advanced HD Assembly Technology
- High-quality Materials
- Sn-Sb assembly Solder (T_{melt}=230ºC)
- 100% Quality Control
- RoHS compliant by default

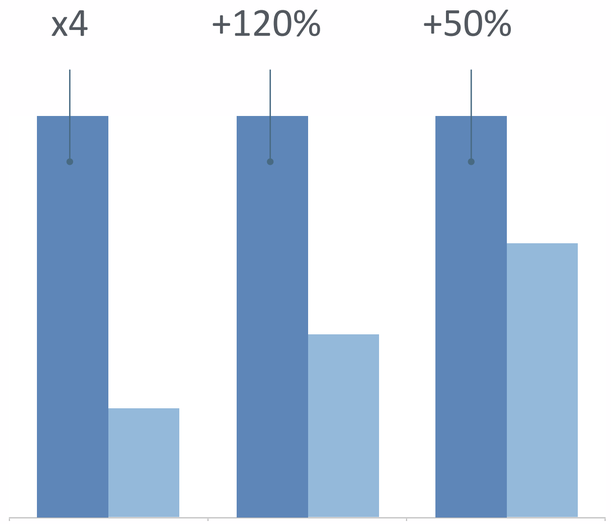
We work directly with engineering teams of our customers and provide advanced thermoelectric solutions optimized for exact application requirements. Our key advantages are in ultra-fast application analysis, world widest range of thermoelectric coolers and great flexibility with TECs manufacturing options. All thermoelectric modules and related products are designed and developed in our ISO 9001:2015 certified facility in Berlin, Germany.

Miniature Thermoelectric Coolers

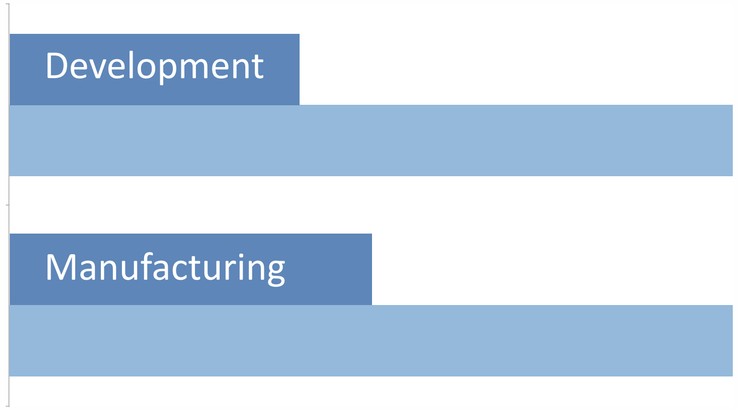
TEC MICROSYSTEMS TE COOLERS KEY FEATURES AND BENEFITS



More than 5000 developed TEC types



On average x2.5 faster TEC Development

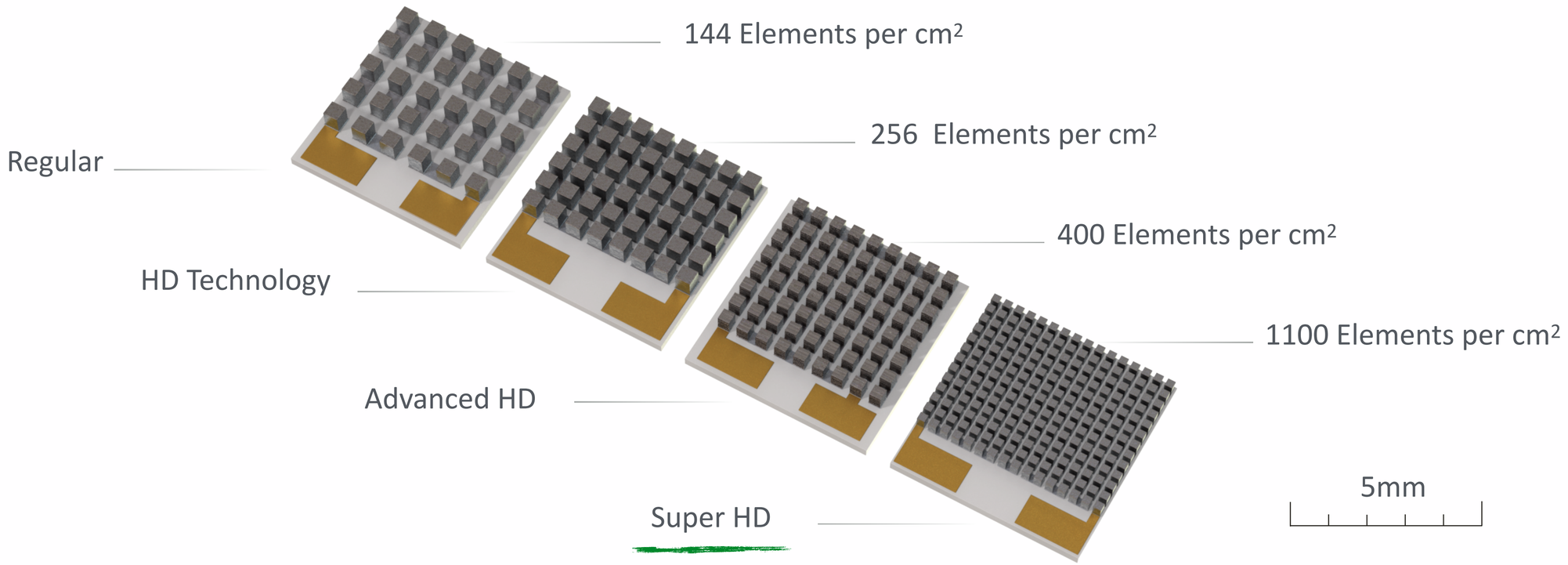


On average x2 faster TEC Manufacturing

TEC Microsystems Other sources

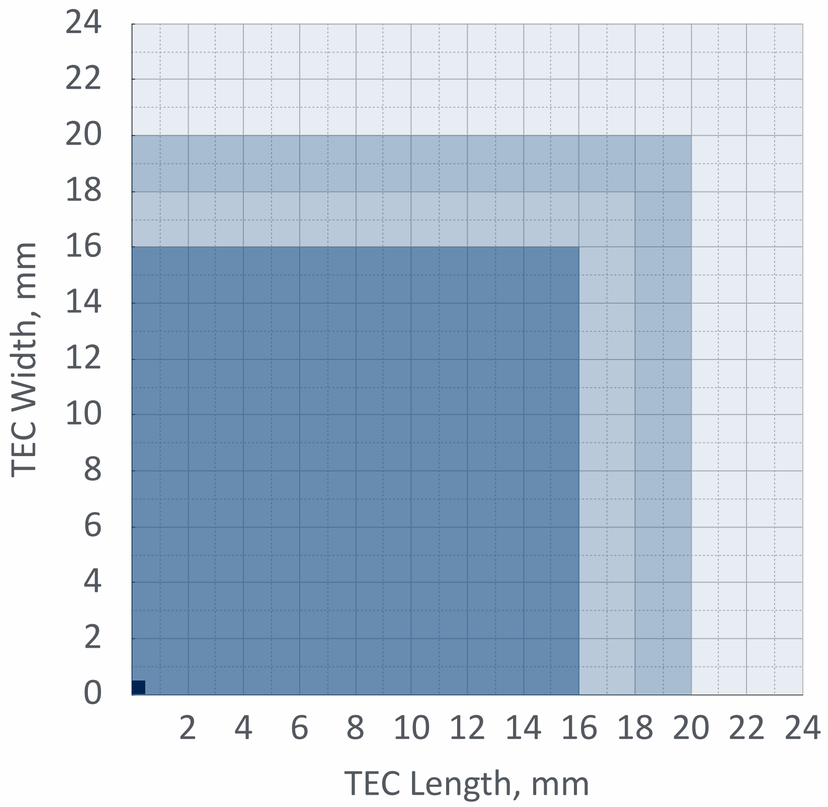
Miniature Thermoelectric Coolers

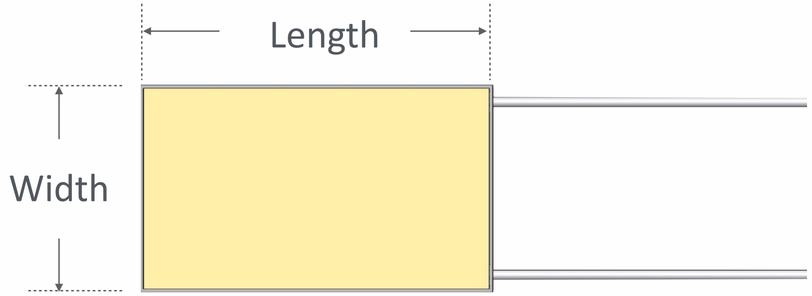
ADVANCED HD PELLETS PLACEMENT TECHNOLOGIES FOR TE MODULES



Miniature Thermoelectric Coolers

MINIATURE THERMOELECTRIC COOLERS DIMENSIONS RANGE

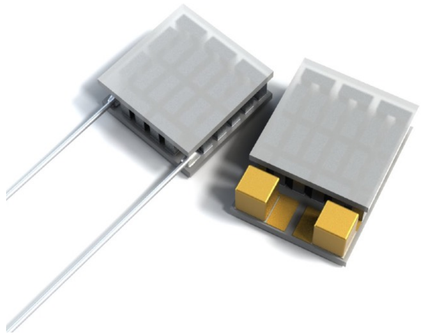




Dimensions, mm	Width	Length
Min possible	0.5	0.5
Most Common	< 16	< 16
Available	20	20
Max possible	24	24

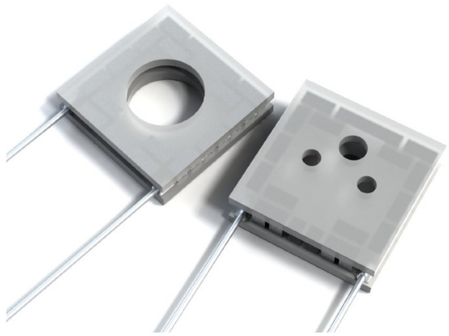
Miniature Thermoelectric Coolers

SINGLE-STAGE TECs



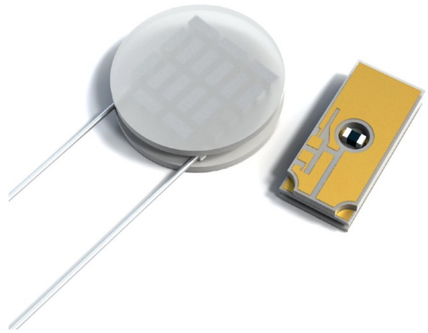
Cold side:	up to 18 x 18mm^2
Height:	from 0.8mm
dTmax:	68 - 75K (@300K T_{amb})
Qmax:	up to 50W
Technology:	regular, HD
Solutions:	>3000

TECs WITH HOLES



TE Coolers with central holes or multiple holes. Optimal for external cooling of un-cooled laser diodes on TO-46, TO-56 and TO-9 headers.

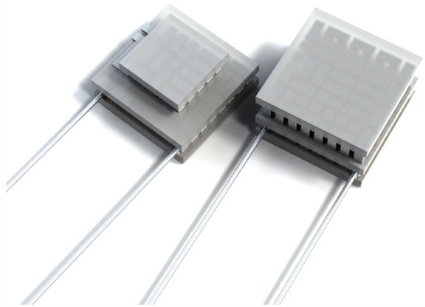
CUSTOM SHAPES



Modification of standard TEC shape in accordance to Customer requirements. Customized thermoelectric cooler developments.

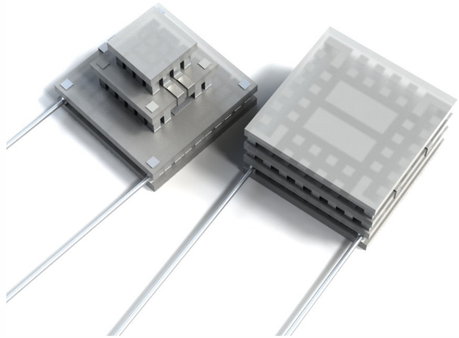
Miniature Thermoelectric Coolers

2-STAGE TECs



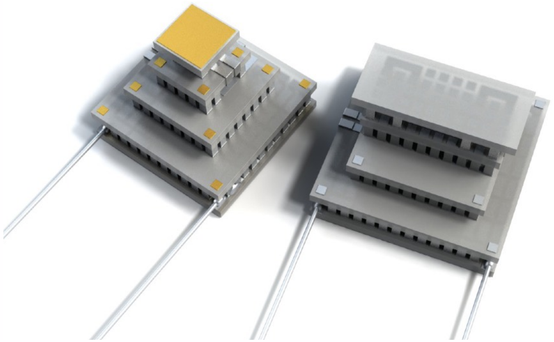
Cold side:	up to 18 x 18mm^2
Height:	from 1.6mm
dTmax, K:	80 - 100 (@300K T_{amb})
Qmax, W:	up to 27W
Technology:	regular, HD
Solutions:	>250

3-STAGE TECs



Cold side:	up to 17 x 17mm^2
Height:	from 2.2mm
dTmax, K:	100 - 110 (@300K T_{amb})
Qmax, W:	up to 12W
Technology:	regular, HD
Solutions:	>300

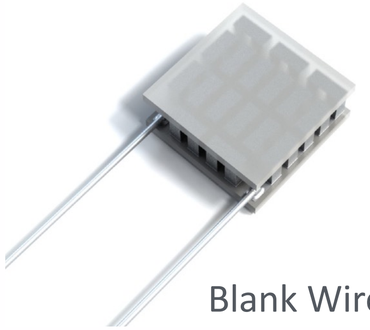
4-STAGE TECs



Cold side:	up to 4.0 x 4.0mm^2
Height:	from 2.9mm
dTmax, K:	110 - 130 (@300K T_{amb})
Qmax, W:	up to 2W
Technology:	regular, HD
Solutions:	>150

Miniature Thermoelectric Coolers

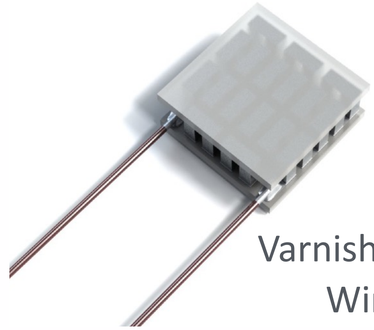
THERMOELECTRIC COOLER TERMINAL CONNECTIONS



Blank Wires

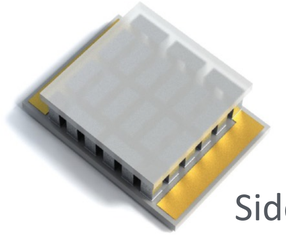
Insulated Wires

Insulated Color-Coded



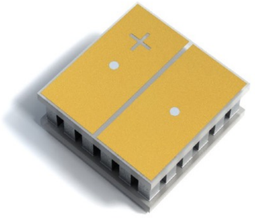
Varnished Wires

Front WB Pads



Side WB Pads

WB Posts

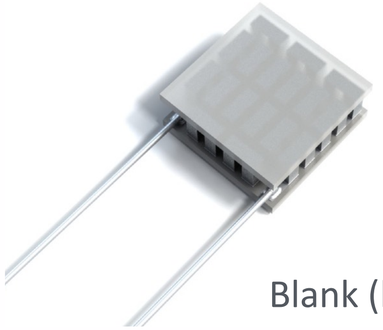


Flip-Chip

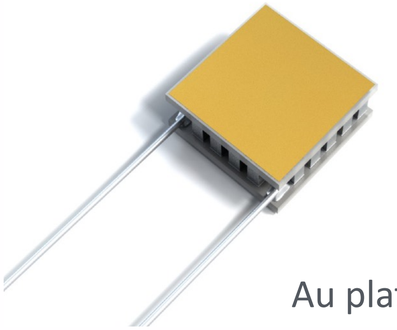
Miniature Thermoelectric Coolers

THERMOELECTRIC COOLERS CERAMICS SURFACE

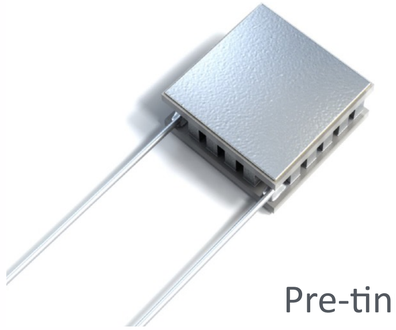
Standard Surface Solutions
(available by default)



Blank (bare)

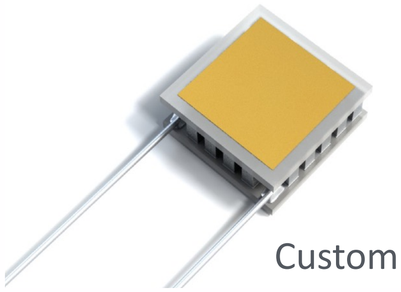


Au plated

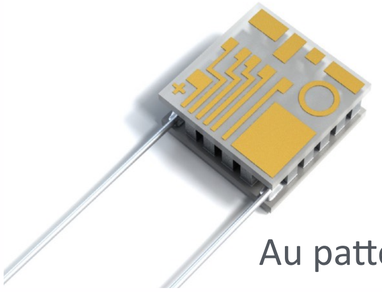


Pre-tinned

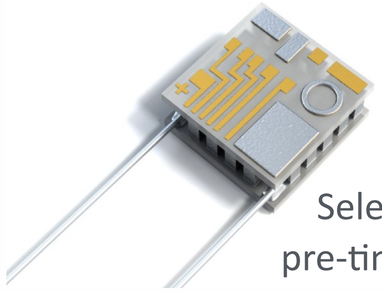
Advanced Surface Solutions
(provided by request)



Custom gap



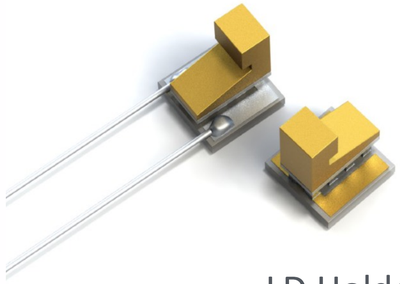
Au patterns



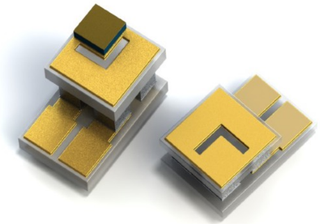
Selective
pre-tinning

Miniature Thermoelectric Coolers

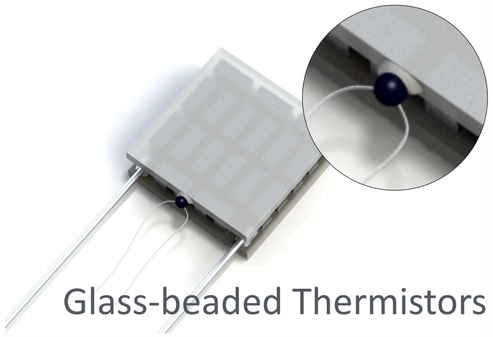
ADVANCED VALUE-ADDED SERVICES FOR TEC COOLERS



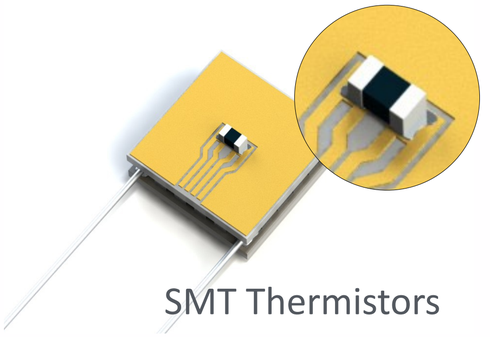
LD Holders



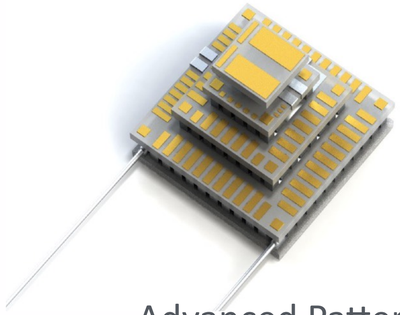
Leadless Thermistors



Glass-beaded Thermistors



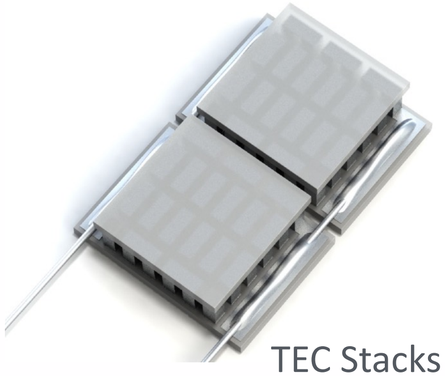
SMT Thermistors



Advanced Patterns

Moisture Protection

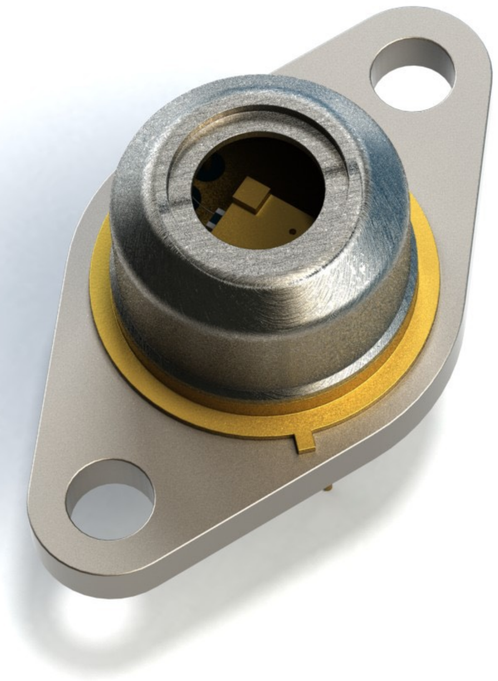
Custom TEC Shapes



TEC Stacks

Custom CNC Machining Services

CNC MACHINING FOR PROTOTYPING AND CUSTOMIZATION

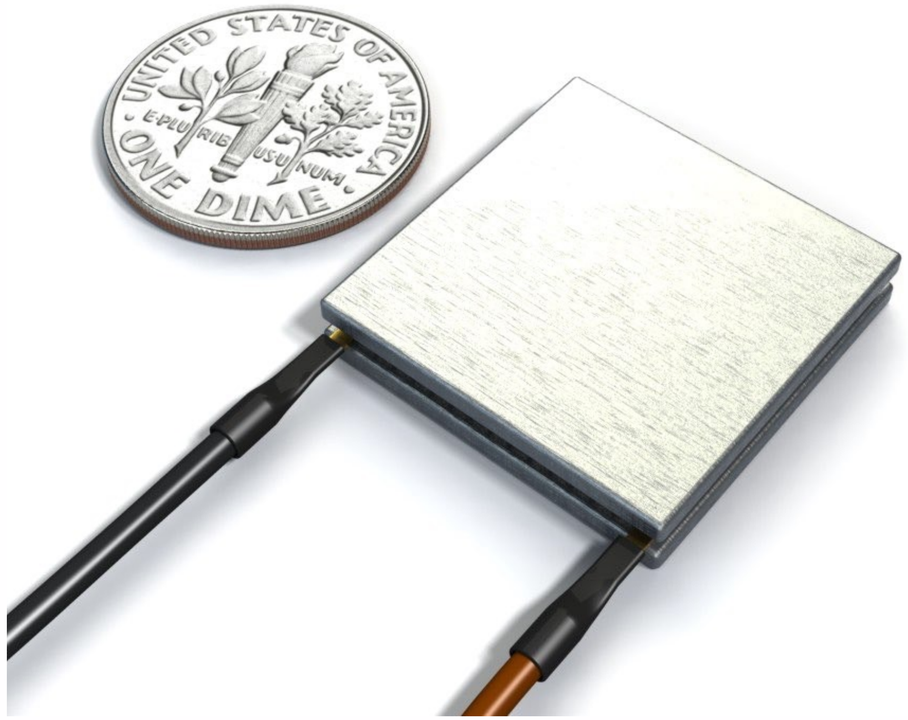


- Precision CNC Machining
- Customized Metal Parts
- Machining from CuW, Kovar, Copper, Aluminium and CRS
- Mounting blocks, adapters, caps

- Galvanic Ni and Au Plating service
- Optimization for Application
- Assembly and Integrating services
- One-Stop-Shop for Customer designs

Special TE on Aluminium Plates

SPECIAL THERMOELECTRIC COOLERS WITH ALUMINIUM PLATES



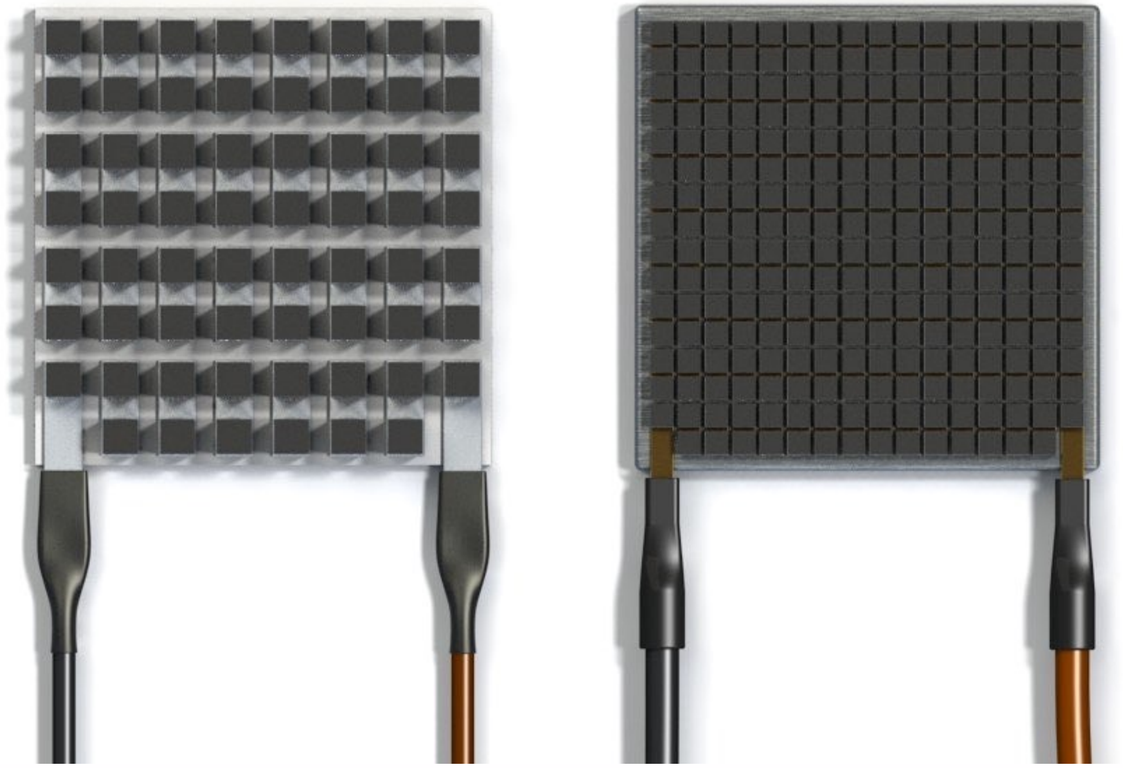
- Pure Aluminium instead of Al_2O_3 Ceramics on top and bottom sides
- HD Pellets Placement Technology
- Increased TEC Cooling Power
- Advanced TEC endurance
- No CTE mismatch with Al heatsinks
- >30W/cm^2 Cooling Power Density
- Perfect for Cycling Applications
- High-quality Materials
- Sn-Sb assembly Solder (T_{melt}=230ºC)
- 100% Quality Control
- RoHS compliant by default

Thermoelectric coolers with aluminium plates instead of ceramics are the game changer in the applications with heavy heatload. Aluminium plates instead of classical ceramics solutions increase TEC endurance and reduce manufacturing costs. Aluminium TECs have the ideal CTE matching with standard heatsinks. Large cooling capacity and assembly technology with a special elastic adhesive inside make these TECs perfect for cycling applications.

1MA10 Series “Aluminium” TECs

1MA10 SERIES - LIGHT METAL TECs FOR HEAVY HEATLOAD APPLICATIONS

Typical TEC with standard technology	"Classical" 20x20mm² TE Cooler	Aluminium TEC 1MA10 Series	Alternative Solution from TEC Microsystems
Standard Al_2O_3 Ceramics Plate			Advanced Solution Pure Aluminium Plate
Regular pellets placement			Advanced HD pellets placement Technology
Cooling Capacity Qmax 30 - 40W			Cooling Capacity Qmax = **115W**

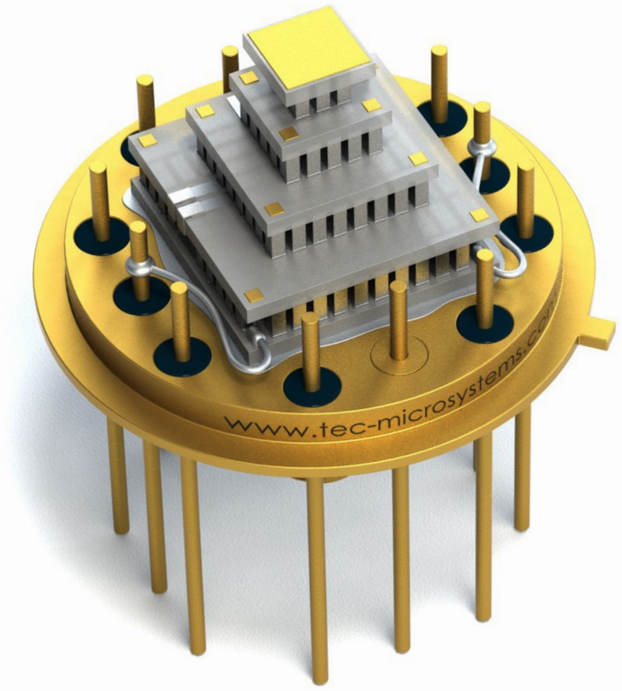


10mm

* - both TECs are shown with top plate (cold side) removed

Thermoelectric Sub-Assemblies

TE COOLER + HEADER = THERMOELECTRIC SUB-ASSEMBLY



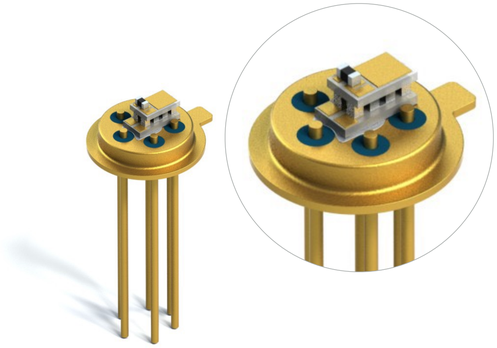
- Minimized Risks and Expenses
- Significant Time Saving for Projects
- Single Source for TECs and Headers
- Perfect Solution for R&D
- Optimization for Application

- More than 5000 TEC types
- High-Quality Glass-To-Metal Headers
- High-Temperature TEC Soldering
- 100% Quality Control
- RoHS compliant by default

The term “thermoelectric sub-assembly” means a thermoelectric cooler mounted into standard or customized package. Thermoelectric sub-assembly is a perfect solution for fast and easy integrating into final application. There is a range of industry standard headers and packages, that are usually used with thermoelectric coolers.

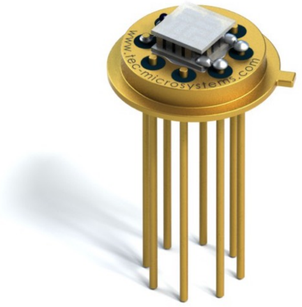
Thermoelectric Sub-Assemblies

TO-46 ASSEMBLIES



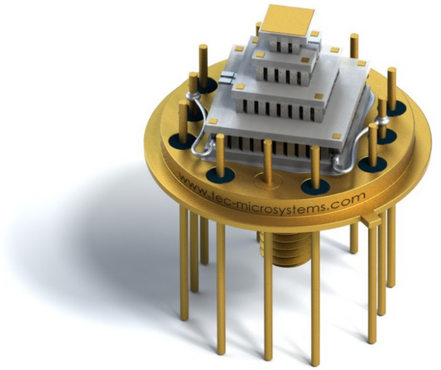
Header type:	TO-style
Number of pins:	4 - 6
Material:	Kovar
Space for TEC:	1.2 x 1.9mm^2
TEC types:	single- stage only
Solutions:	15

TO-39 ASSEMBLIES



Header type:	TO-style
Number of pins:	3 - 10
Material:	Kovar
Space for TEC:	3.2 x 3.2mm^2
TEC types:	single- and multistage
Solutions:	160

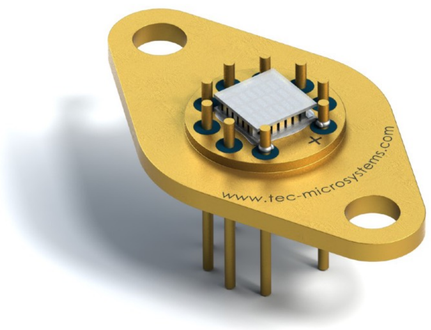
TO-8 ASSEMBLIES



Header type:	TO-style
Number of pins:	6 - 20
Material:	Kovar or CRS
Space for TEC:	8.2 x 8.2mm^2
TEC types:	single- and multistage
Solutions:	990

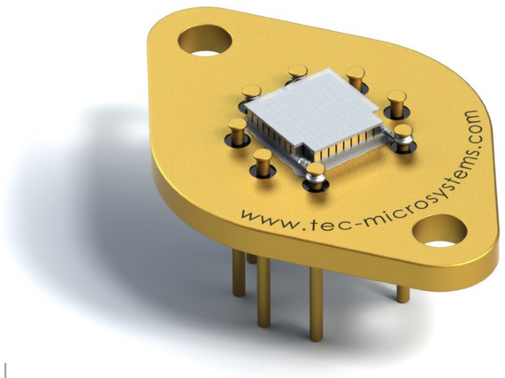
Thermoelectric Sub-Assemblies

TO-66 ASSEMBLIES



Header type:	TO-style
Number of pins:	6 - 10
Material:	Kovar or CRS
Space for TEC:	4.2 x 4.2mm²
TEC types:	single- and multistage
Solutions:	321

TO-3 ASSEMBLIES



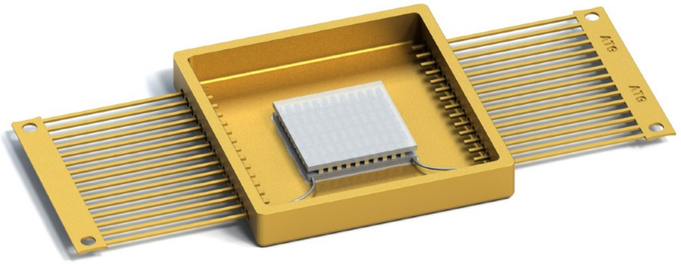
Header type:	TO-style
Number of pins:	6 - 9
Material:	Kovar or CRS
Space for TEC:	8.2 x 8.2mm²
TEC types:	single- and multistage
Solutions:	990

TO-822 ASSEMBLIES

Header type:	TO-style
Number of pins:	12 - 14
Material:	Kovar or CRS
Space for TEC:	12.0 x 12.0mm²
TEC types:	single- and multistage
Solutions:	1480

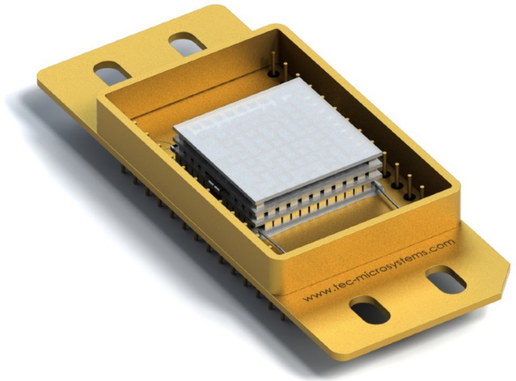
Thermoelectric Sub-Assemblies

FLATPACK TYPES



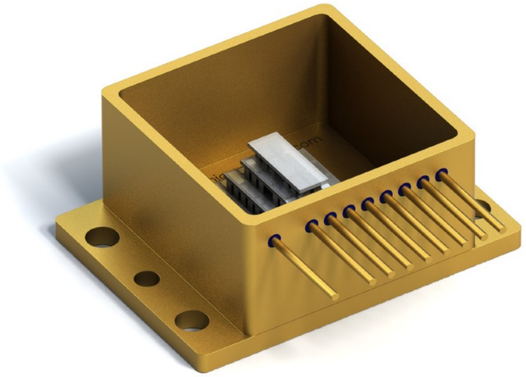
Header type:	Flatpack
Number of pins:	10 - 72
Material:	Kovar or CRS
Space for TEC:	up to 25 x 45 mm²
TEC types:	single- and multistage
Solutions:	depends on size

DUAL-IN-LINE (DIL)



Header type:	DIL (Dual-in-Line)
Number of pins:	up to 72
Material:	Kovar or CRS
Space for TEC:	up to 45.0 x 45.0mm²
TEC types:	single- and multistage
Solutions:	up to 5000 types

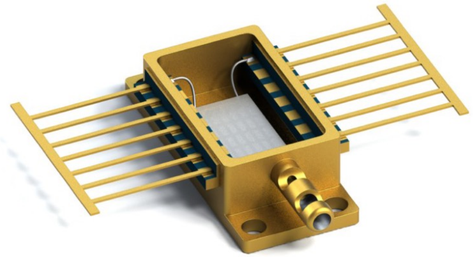
HIGH HEAT LOAD (HHL)



Header type:	High heat load
Number of pins:	9
Material:	Kovar / CuW
Space for TEC:	28.0 x 28.0mm²
TEC types:	single- and multistage
Solutions:	up to 5000 types

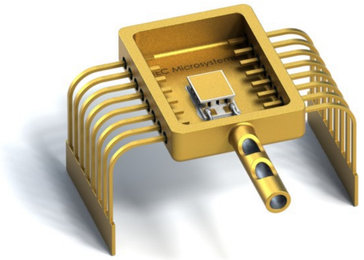
Thermoelectric Sub-Assemblies

“BUTTERFLY” 14PIN



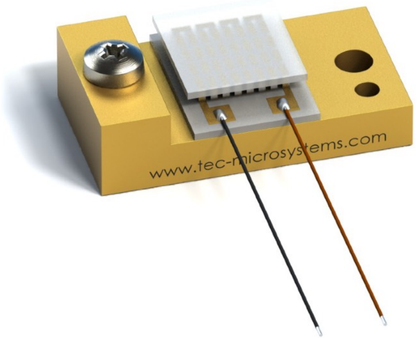
Header type:	DWDM “Butterfly”
Number of pins:	14
Material:	Kovar/ CuW
Space for TEC:	14.0 x 9.0mm^2
TEC types:	single- and multistage
Solutions:	1330

CUSTOMIZED TYPES



Modification of standard headers and packages in accordance to Customer requirements. Customized thermoelectric coolers, headers and packages development.

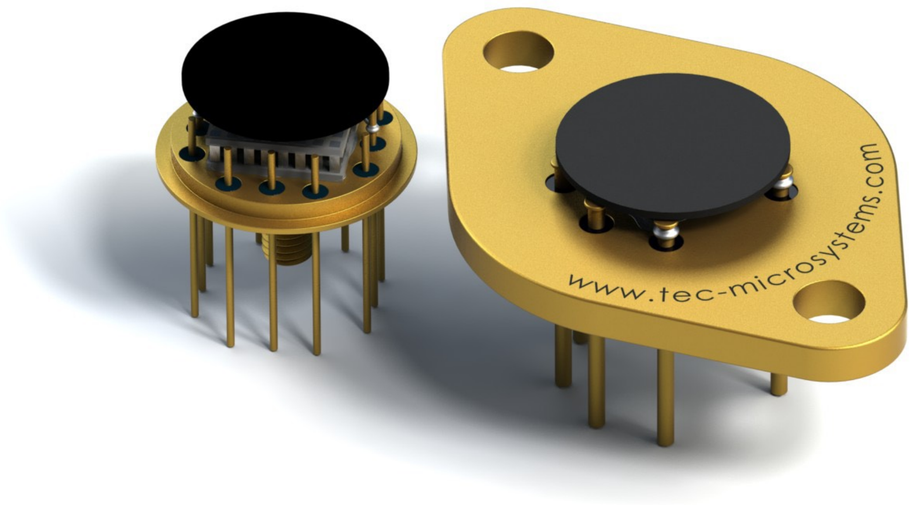
MOUNTING SERVICES



TEC Microsystems GmbH provides mounting services - TEC integrating into Customer packages and headers. Flux-free soldering technique with 100% quality control and TEC testing.

TTRS “Blackbody” Sub-Assemblies

THERMOELECTRIC THERMAL REFERENCE SOURCES (TTRS)

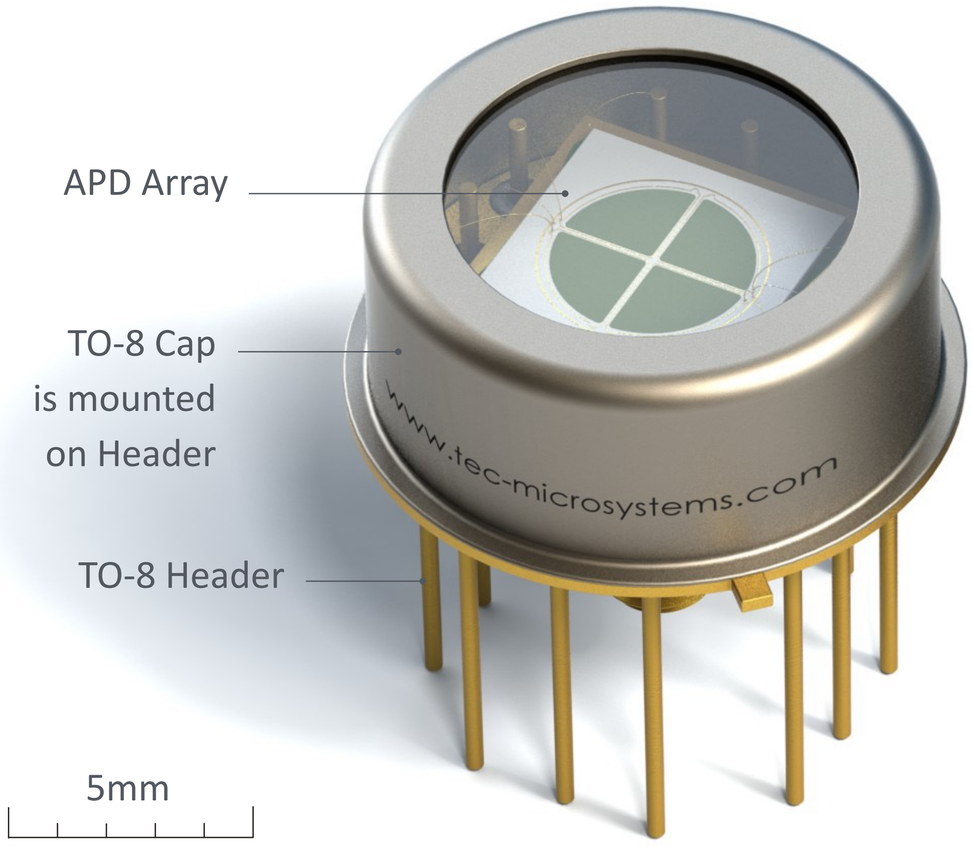


- Imaging Applications
- Threat Warning
- Guidance Systems
- Radiometer
- Surveillance
- Process Control

- TTRS Emitter Emissivity > 95%
- Large Uniform Emitter Surfaces
- High Slew Rates
- Wide Operating Temperature Range
- Accurate Temperature Sensing Device

Thermoelectric Thermal Reference Source (TTRS) sub-assemblies provide a temperature-controllable, uniform-temperature, high-emissivity surface used in calibrating infrared (IR) detector arrays and FLIR systems. Most TTRS sub-assemblies are provided as open devices consisting of a thermoelectric cooler, emitting surface and temperature sensor. The header cap with IR window and hermetic sealing can be provided for customized solutions.
TTRS controllers are available as well.

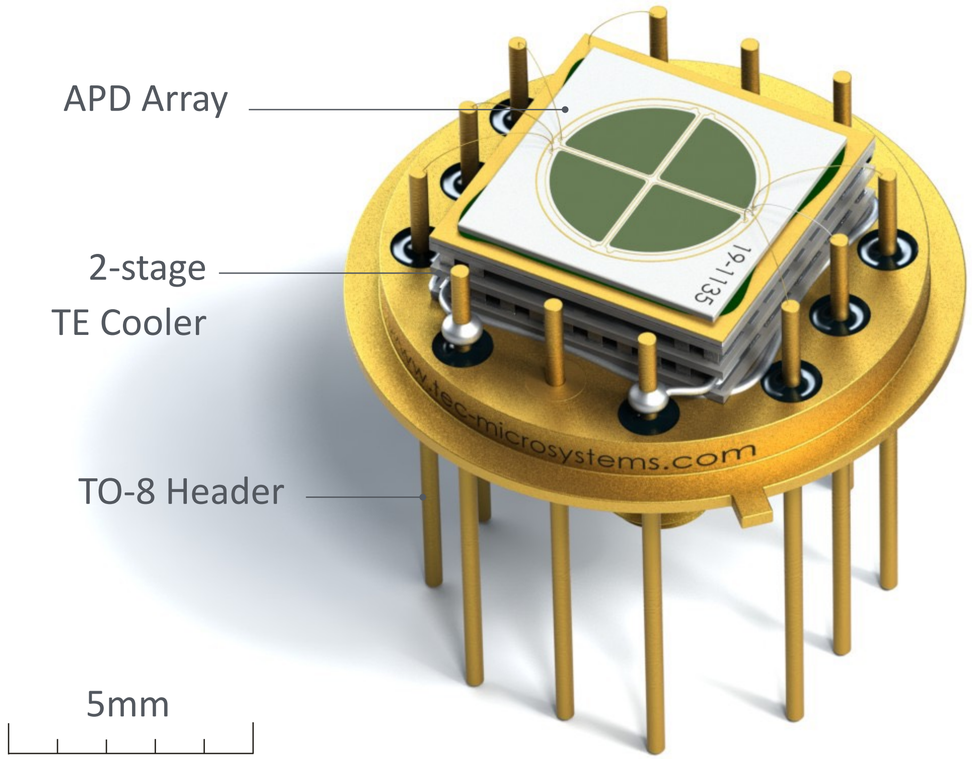
“Header-free” TE Cooling Solutions



Classical APD Assembly with TE Cooler
on TO-8 Header

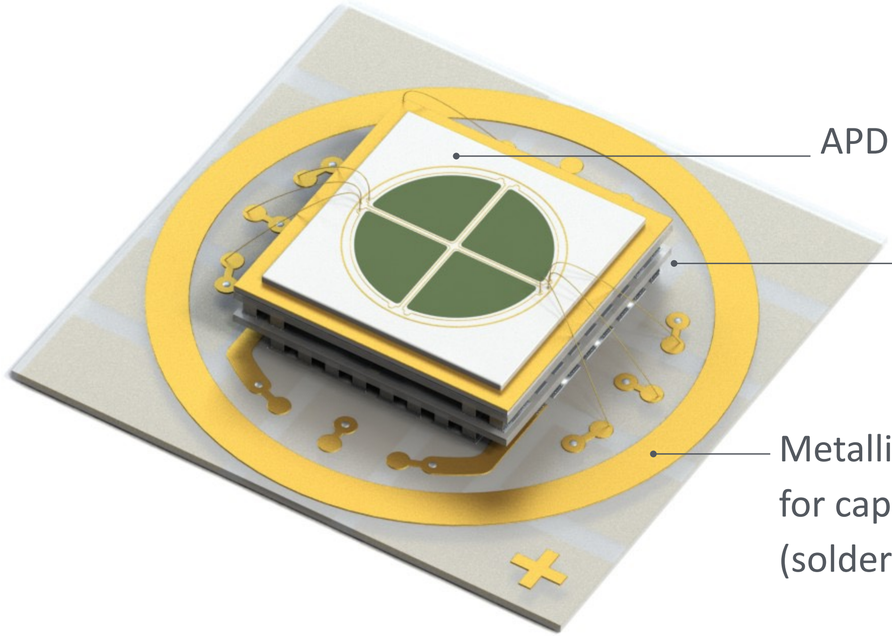
“Header-Free” Alternative TEC Solution
for direct mounting on PCB (Example)

Example of “Header-free” TEC for APD



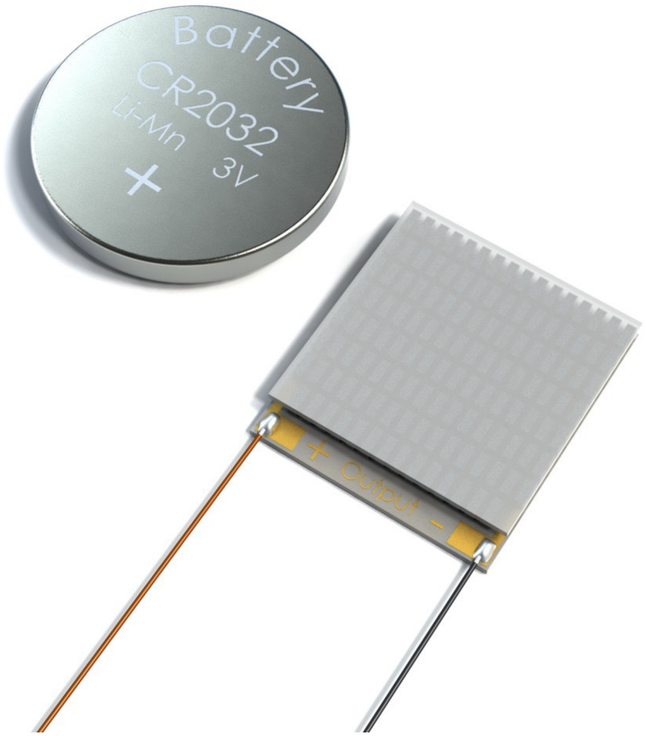
Classical APD Assembly with TE Cooler
on TO-8 Header (cap removed)

“Header-Free” Alternative TEC Solution
for direct mounting on PCB (Example)



Miniature Thermoelectric Generators

THERMOELECTRIC SOLUTIONS FOR SMALL SCALE ENERGY HARVESTING



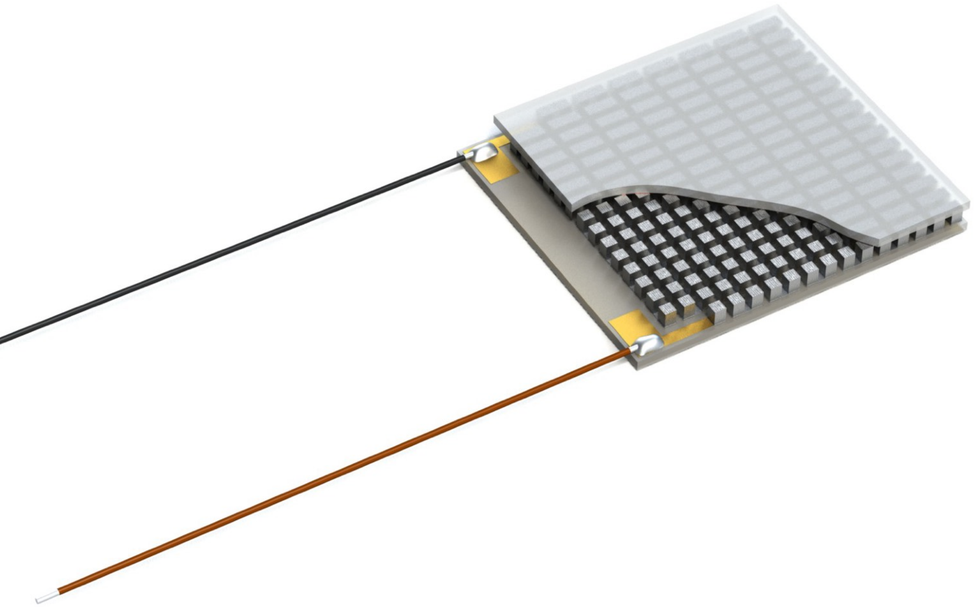
- Smart Home
- Aviation and Train Monitor
- Industrial Process Control
- Automotive Industry
- Security Systems
- Wearable Devices

- More than 500 standard TEG types
- Bulk TE Technology with 400uV/K
- Ultra-miniature TEG sizes
- Maintenance-free
- Long Lifetime
- Best Price-Performance Ratio

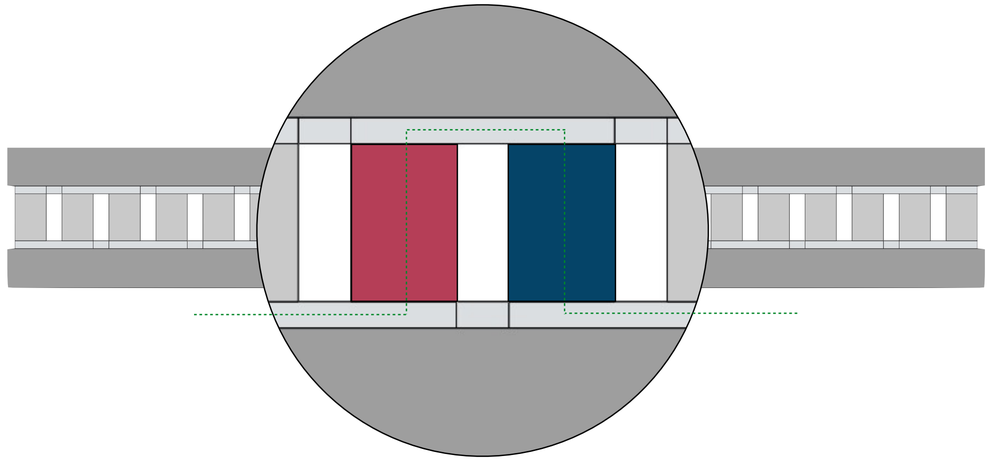
Thermoelectric harvesting is considered a key component for many future technological applications, like wireless sensor networks, multi-purpose self-organising autonomous (micro-)systems and many others. The key advantages of thermoelectric micro-generators: small sizes, simple scalability; no moving parts, very long operational lifetime – tens of years without maintenance. And the most unique property – the possibility to convert heat into electricity starting from very low temperature differences of just a few degrees.

Miniature Thermoelectric Generators

BULK THERMOELECTRIC MATERIAL TECHNOLOGY FOR TE GENERATORS



Bulk BiTe material P-N Couple inside TEG

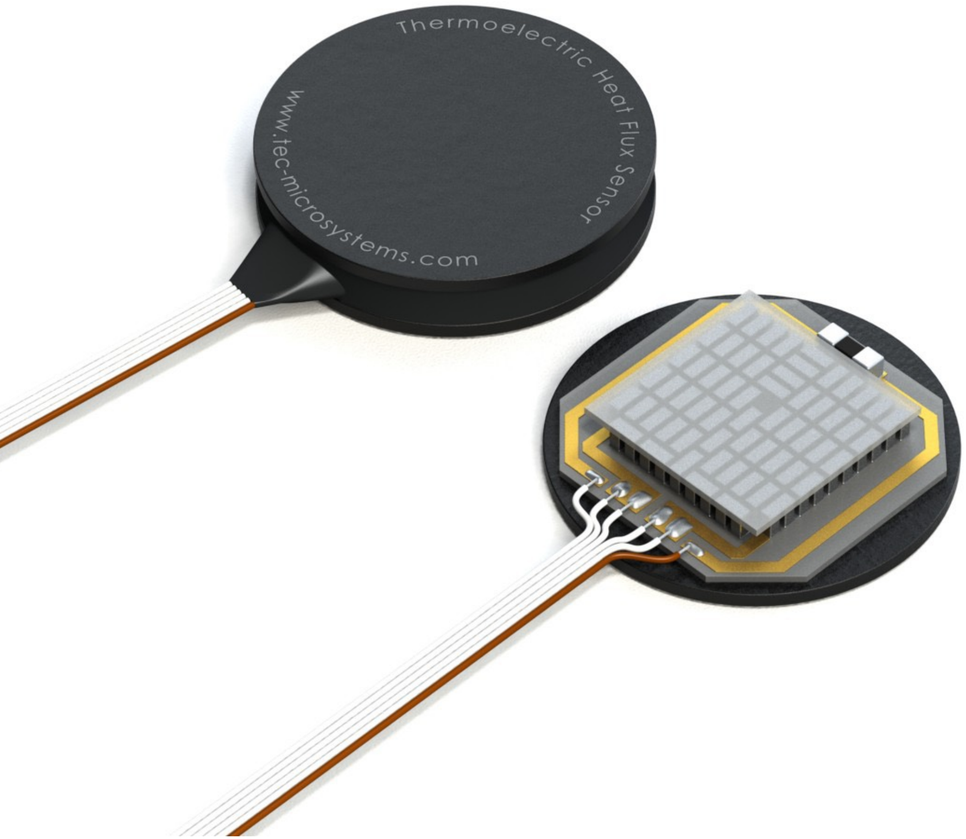


$\alpha = 400uV/K$

Every couple gives around 400uV/K. This value is specified for TEGs provided by TEC Microsystems.
As a reference - thin-film technology TEGs have 250uV/K.

Thermoelectric Heat Flux Sensors

HEAT FLUX SENSORS WITH ULTRA-HIGH SENSITIVITY LEVEL



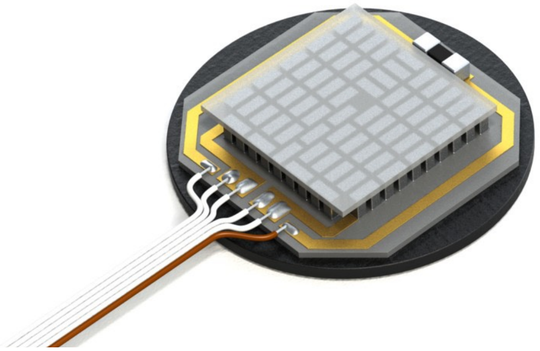
- Ultra-High Sensitivity
- Miniature Dimensions
- Self-Calibration (Patented)
- Built-In Temperature Sensor
- FET Cable and Connector
- Wide Range of Types

- Scientific Analysis And Research
- Agriculture
- Climatology
- Building Engineering
- Solar Industry
- Safety and Security Applications

The advantage of thermoelectric module (TEM) over differential thermocouple is in much higher Seebeck effect (electromotive force), exactly because of semiconductor usage. For example, in usual Copper-Constantan thermocouple the electromotive (EMF) is 38uV/K, while one BiTe P-N pellet pair inside a thermoelectric module provides EMF 400uV/K - ten times higher. This key advantage makes thermoelectric modules very promising to use as heat flux sensors.

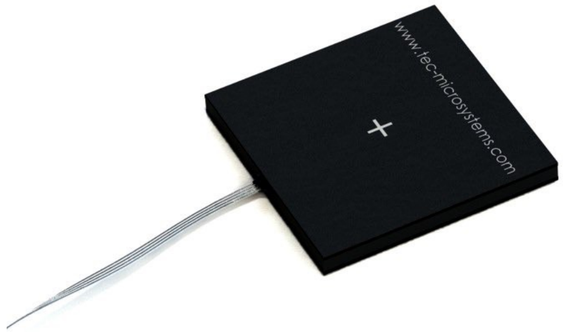
Thermoelectric Heat Flux Sensors

HTx SERIES



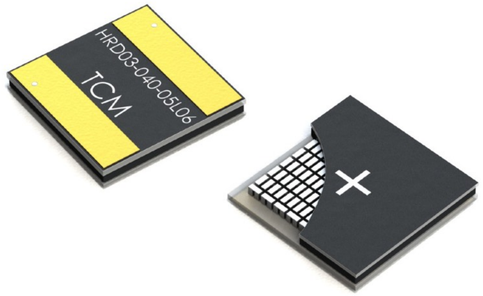
Thermoelectric heat flux sensors with integrated temperature sensor Pt1000. Round shape. Self-calibrating patented method. 180cm FET cable with or without connector.

HFx SERIES



Standard solutions, quad shape, ultra-thin heat flux sensors w/o temperature sensors integrated. Self-calibrating patented method. 180cm FET cable with or without connector.

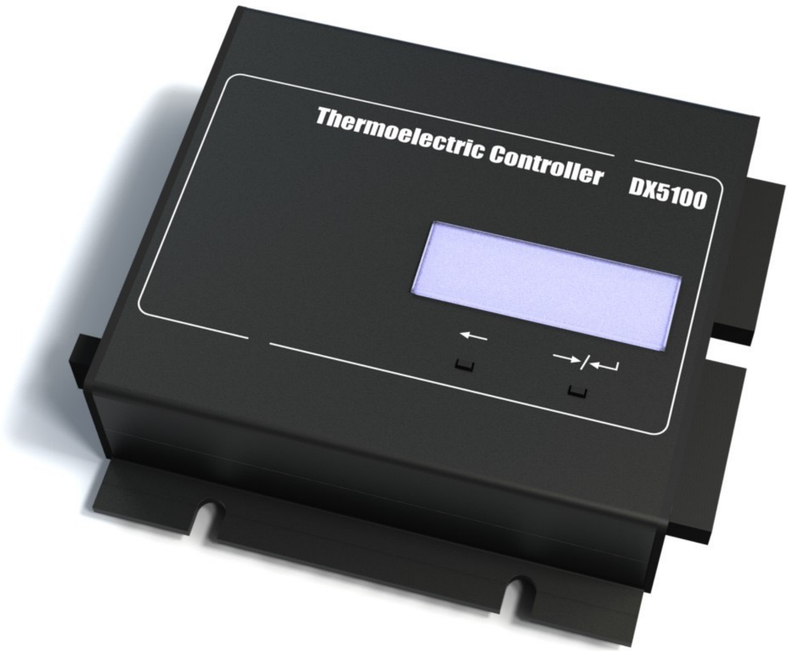
HRx SERIES



SMD style miniature heat flux sensors for radiation heat flux measurements. Self-calibrating patented method. Suitable for flip-chip mounting, up to 260ºC processing temperature.

Programmable TEC Controllers

DX5100 PRECISE PROGRAMMABLE TEC CONTROLLERS WITH PID AUTO-TUNE



- Bi-Directional Regulation
- Supports NTC and PTC Thermistors
- Two Channels 32W (4Ax8V) each
- PID Temperature Regulation Mode
- PID Auto-Tune Function
- Constant Voltage Operation Mode
- Programmable Controllers
- PC Controlled and Stand-alone
- Network connectivity (up to 128 channels at once in array)
- USB and RS-485 interfaces
- Complete LabView Integration

Thermoelectric Controllers of the DX5100 family represent a range of precision-programmed devices (standard and OEM versions) for management of thermoelectric coolers (TECs, Peltier modules). DX5100 Controllers have a bi-directional (heating and cooling) PID regulation with PID Auto-Tune function. Besides the PID regulation additional modes of operation are realized in the Controller: DC voltage mode, T-regulation and programming of an object temperature behaviour with time.

Programmable TEC Controllers

DX5100 OEM

3A x 8V; 4A x 8V; 12A x 8V

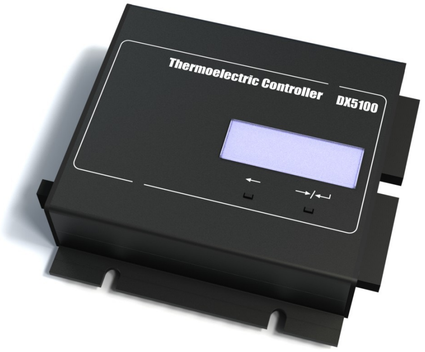
Compact modular DX5100 OEM TEC Controllers for integrating with PID temperature regulation and PID Auto-Tune for thermoelectric coolers management and efficient operating. Several configurations are available.

DX5100 FRAME

3A x 8V; 4A x 8V; 12A x 8V

DX5100 Frame TEC Controllers with metal housing for installation into industry standard racks. PID temperature regulation and PID Auto-Tune for thermoelectric coolers management and efficient operating.

DX5100 TABLETOP

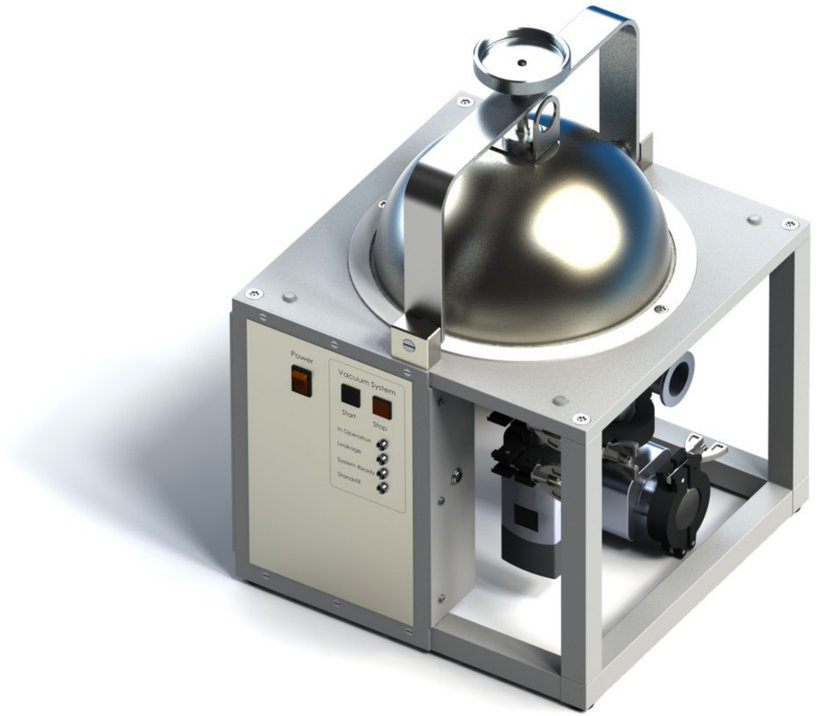


2X 4A x 8V

All-in-one table-top TEC driver with 2x independent 4A x 8V output channels. Ideal solution for laboratory experiments and R&D. Precise programmable TEC driver with PID Auto-Tune.

Special Analysis and R&D Equipment

LABORATORY R&D INSTRUMENTS FOR DEEP TE MODULES ANALYSIS

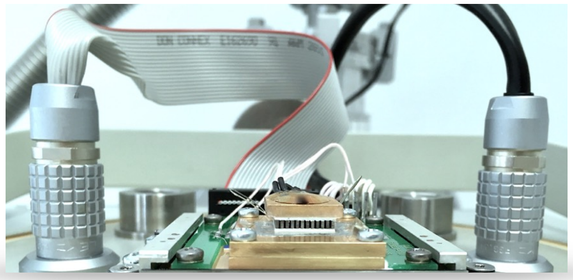


- Detailed “Deep” TEM Analysis
- TE Coolers Qualification Tests
- TE Coolers Acceptance Tests
- TEC Operating Mode Analysis
- Power Consumption Research
- Testing in Vacuum and Dry Air
- Comparison Analysis of TEC vendor Estimations/Datasheet Values
- Detailed TEC analysis at Specified Operating Conditions
- Advanced Comparison Analysis of Multiple TEC sources

Hi-end professional R&D systems for comprehensive analysis of TE Modules and TE Materials. It allows to measure all TEC key performance parameters and power consumption under specified conditions. Expert laboratory R&D systems that provide automatic measuring and full specifications of TE modules and materials in one measuring cycle. Perfect for acceptance, qualification and research testing of single- and multistage TE modules.

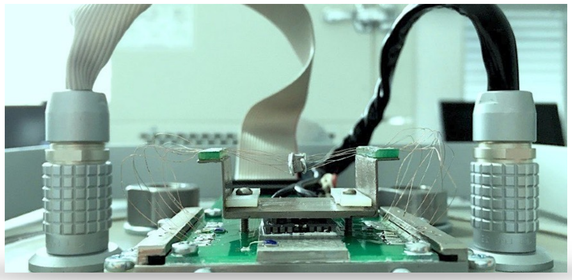
Special Analysis and R&D Equipment

DX8020 TEC EXPERT



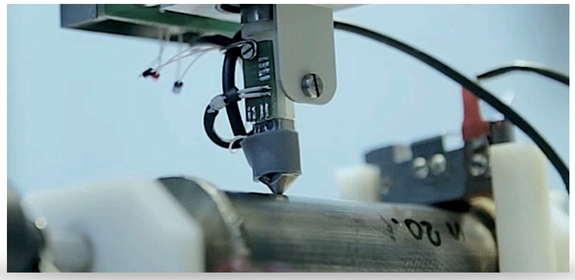
DX8020 provides automatic capability to measure full specifications of a TE module at one measuring cycle in given ambient conditions.
DX8020 is intended for acceptance, qualification and research testing of TE modules.

DX8080 TEM EXPERT



DX8080 provides detailed analysis of thermoelectric (TE) properties of BiTe material, P/N-type in pellets: Seebeck coefficient, electrical conductivity, Figure-of-Merit Z and thermal conductivity in a given temperature interval.

DX8070 INGOTS TESTER



DX8070 provides incoming control of BiTe material in ingots and disks. It measures the Seebeck coefficient and electrical conductivity of BiTe material ingots taking into account the polarity. Must-have instrument for TEM and BiTe material manufacturers.

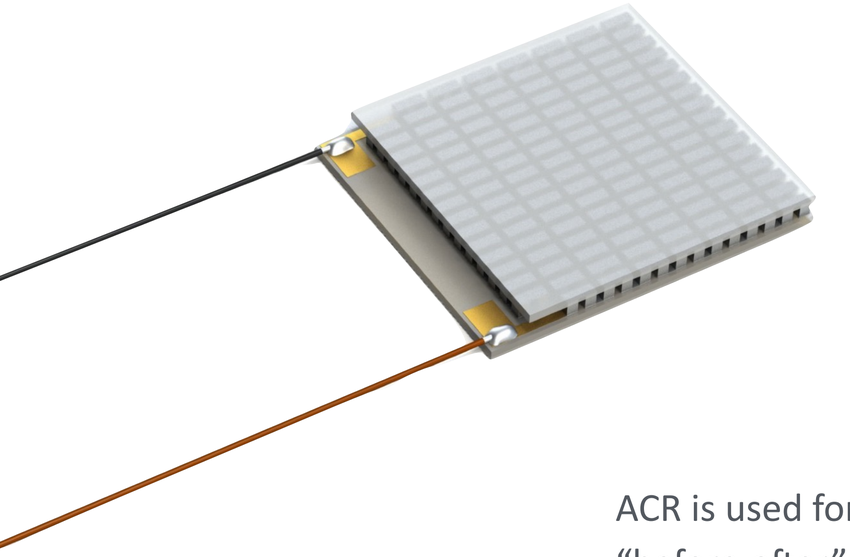
TE Modules Express Analysis & Testing

Z-METERs FOR THERMOELECTRIC MODULES EXPRESS QUALITY CONTROL

- Simple and quick TE Module Testing
- Suitable for mounted TEMs
- Perfect For “Before-After” Testing
- Express Testing of TE Modules with Terminal Wires and WB Contacts
- ACR Resistance Measurement
- Figure-of-Merit Measurement
- Time Constant Measurement
- Results Normalization for Required Ambient Temperature

Thermoelectric Modules (TEMs) are solid state devices with very long maintenance-free lifetime. Modern thermoelectric modules provide more than 25 years of continuous operating at normal conditions. However mounting procedures and/or improper handling may increase the risks of TEM damages. Z-Meters are the best solution for thermoelectric modules express quality control and performance testing.

Z-Meter Measuring Concept



Shows TEC current Conditions	TEC performance, material and quality	Dynamical characteristics TEC “cooling rate”
ACR (AC Resistance)	**Z** (Figure-of-Merit)	**τ** (Time Constant)
ACR is used for comparison on “before-after” basis. An ACR change by more than 5% after impact is accepted as criteria of failure by Telcordia GR-468	Z shows TEC material quality and performance level. Used for analysis of degradation, performance drops and similar issues.	Time Constant shows the time required by TEM from turning on to a stabilized operating mode. Used as a criteria for assembly and proper mounting tests.

Z-Meters for TEMs express QC

DX4085 Z-METER TESTER

Autonomous device, no connection to PC required. Combines three devices in one: portable Z-Meter for TEC parameters measurement, voltmeter and digital thermometer for ambient and operating temperature tests.

DX4090 Z-METER

Universal device for thermoelectric coolers quality control and R&D. It has two measuring interfaces - inner clips and external clips. The device is ideal for express control of small and medium size batches, R&D projects, income, in-process and outcome TEC control.

DX4095 Z-METER MINI

Pocket size device as small as typical USB flash drive. It has the same measuring functionality as a standard Peltier Z-Meter and is designed mainly for single thermoelectric coolers testing, R&D, trial batch check and laboratory usage. Ideal for occasional testing.

Z-Meters for TEMs express QC

DX4190 Z-METER TESTER (10x TECs AT ONCE)

The Z-Meter DX4190 is the must-have device for TE Modules manufacturers or consumers with large volumes.
The DX4190 allows to implement 100% quality control in all stages of mass production with no compromises. The device measures directly three TE Module key parameters (ACR, Figure-of-Merit and Time Constant) for up to 10 thermoelectric modules simultaneously.
The DX4190 Z-Meter can be used with separate (not mounted) TEMs by manufacturers or consumers at income/outcome control, or for TE modules quality control and performance testing in the end-product with integrated TEM.

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