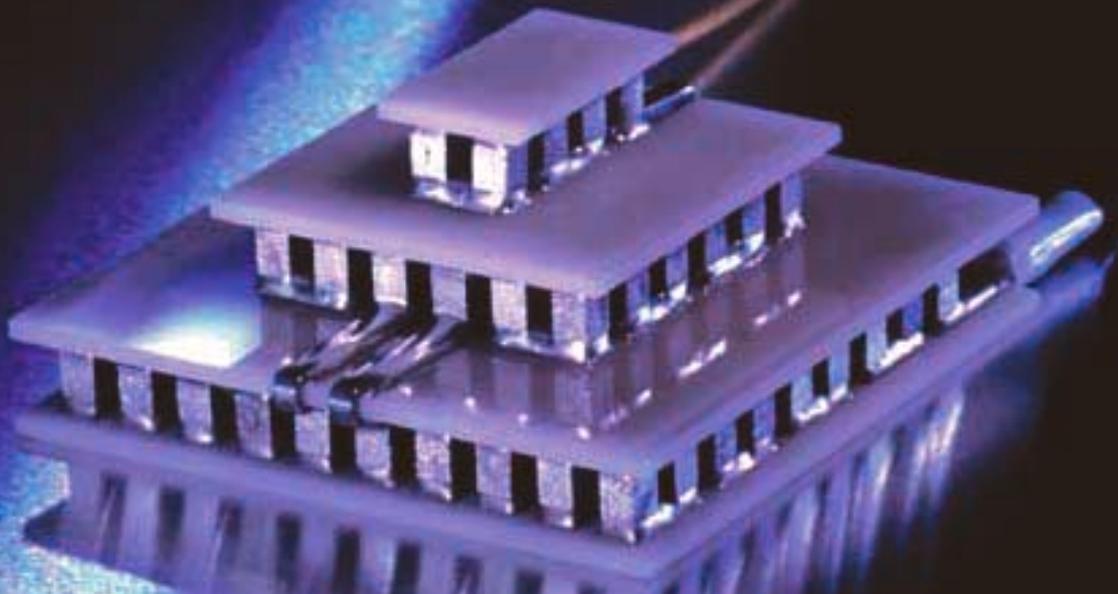
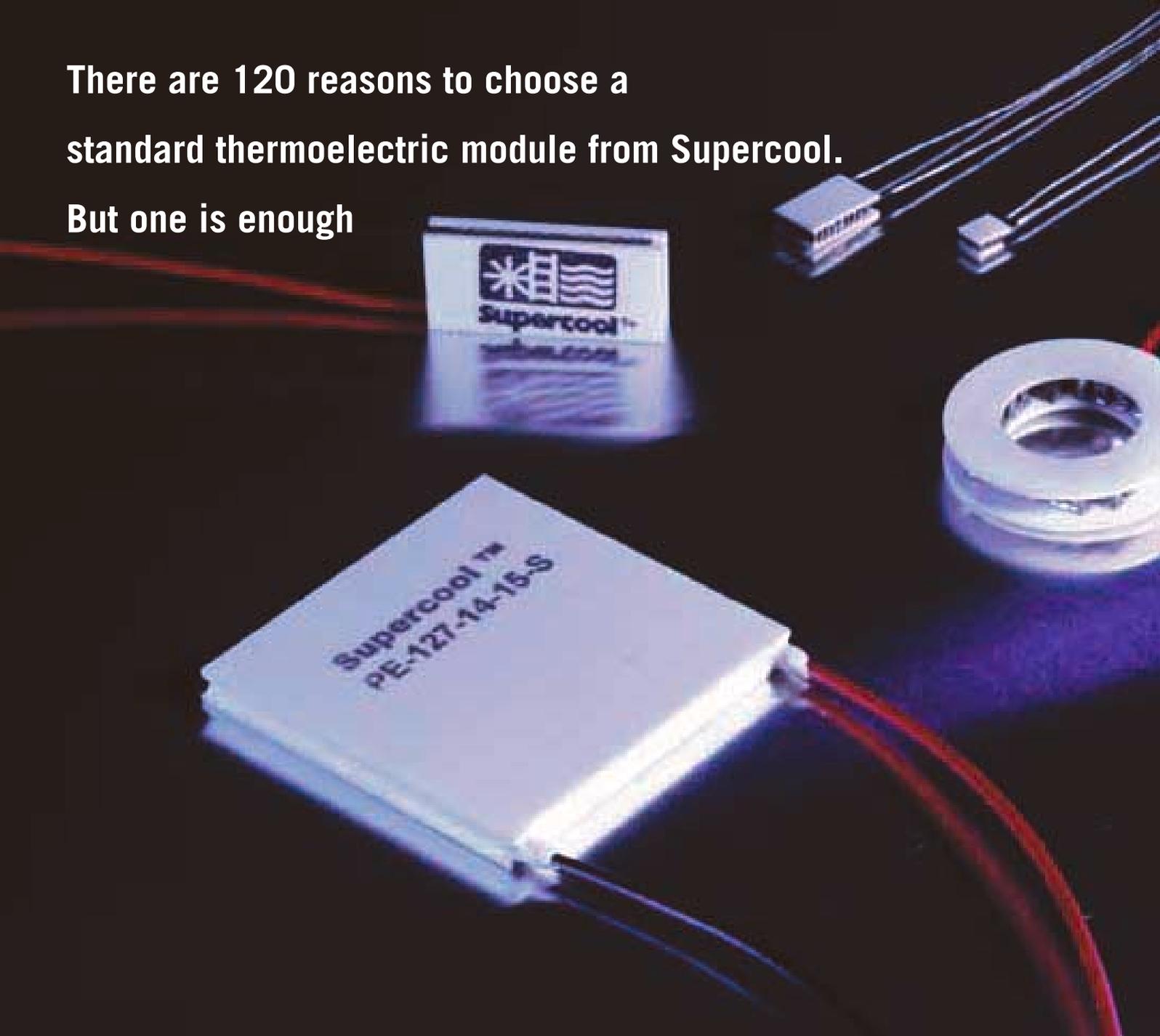


# Thermoelectric modules



# There are 120 reasons to choose a standard thermoelectric module from Supercool. But one is enough



We Scandinavians don't tend to sing our own praises. So when we say we supply the best thermoelectric modules on the market, it's no idle boast.

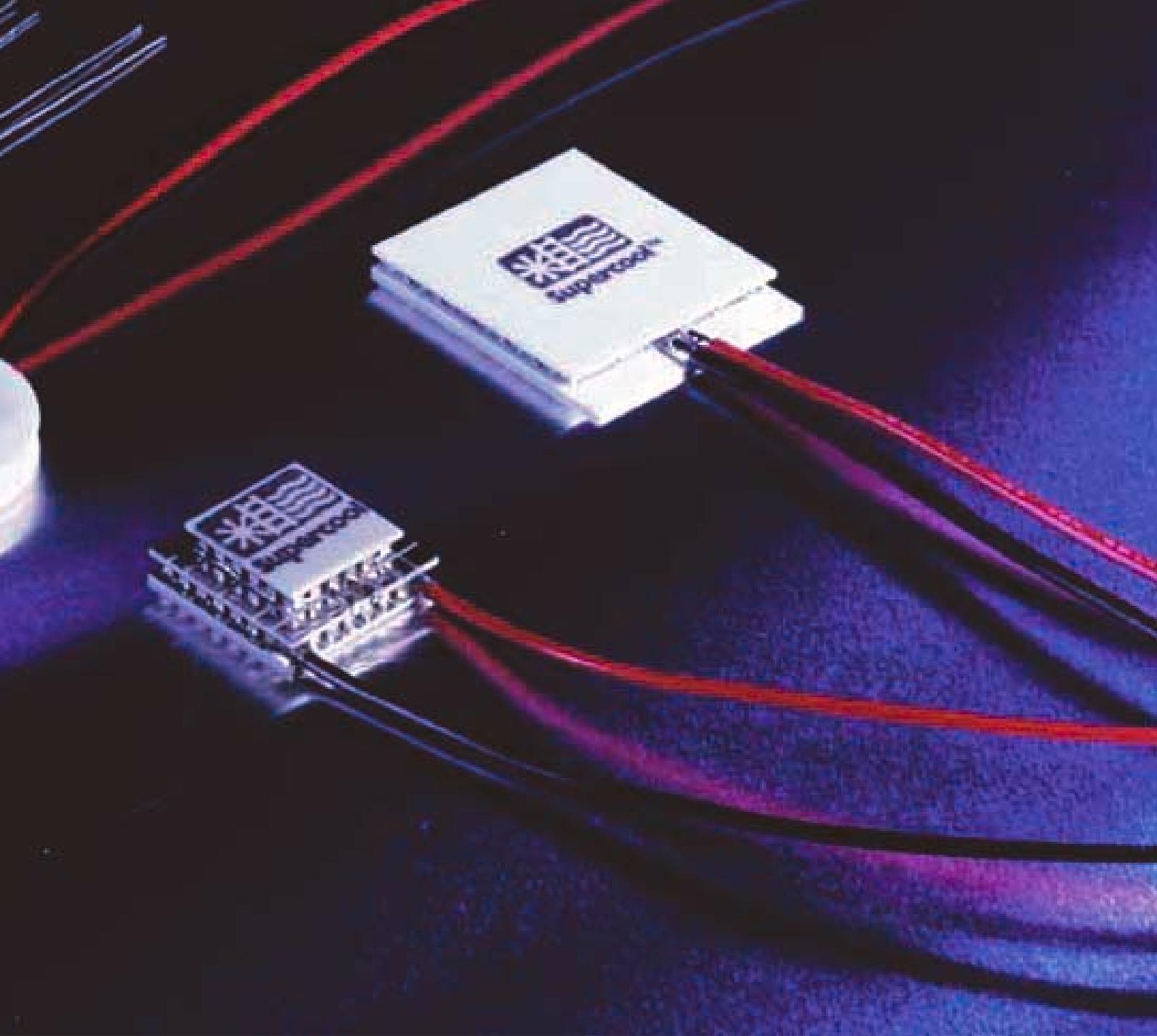
Thanks to unrivaled material characteristics, our modules deliver truly outstanding performance (max.  $\Delta T$  up to 75°C). To illustrate our point, we'd like you to consider the following. If power consumption is constant, then a standard

refrigerator running on our TE-modules will be about 3-4°C cooler than if you use the vast majority of competing products.

## **Whatever your application, we have the modules**

With over 120 standard TEMs available off-the-shelf, Supercool supplies one of the market's widest selections. Our

Custom design	4-5	<b>High performance modules</b>		Multistage modules	8
Supercool worldwide	5	Standard modules	6	<b>High temperature modules</b>	9
		Miniature modules	7	<b>Power modules</b>	9
		Center hole modules	8		



range includes modules of every conceivable size – from the tiniest miniature modules to high-power density TEMs delivering cooling power up to 340 W. In addition, silicon and epoxy sealing, metallization as well as other options are all available on request.

#### **Temperature controllers to ensure top performance**

Specially designed for thermoelectric applications, our temperature controllers guarantee not only reliable performance but also the temperature stability of your system. For more information, order our ‘Thermoelectric solutions’ catalog.

**Medium performance modules** 10  
Technical information 10-11

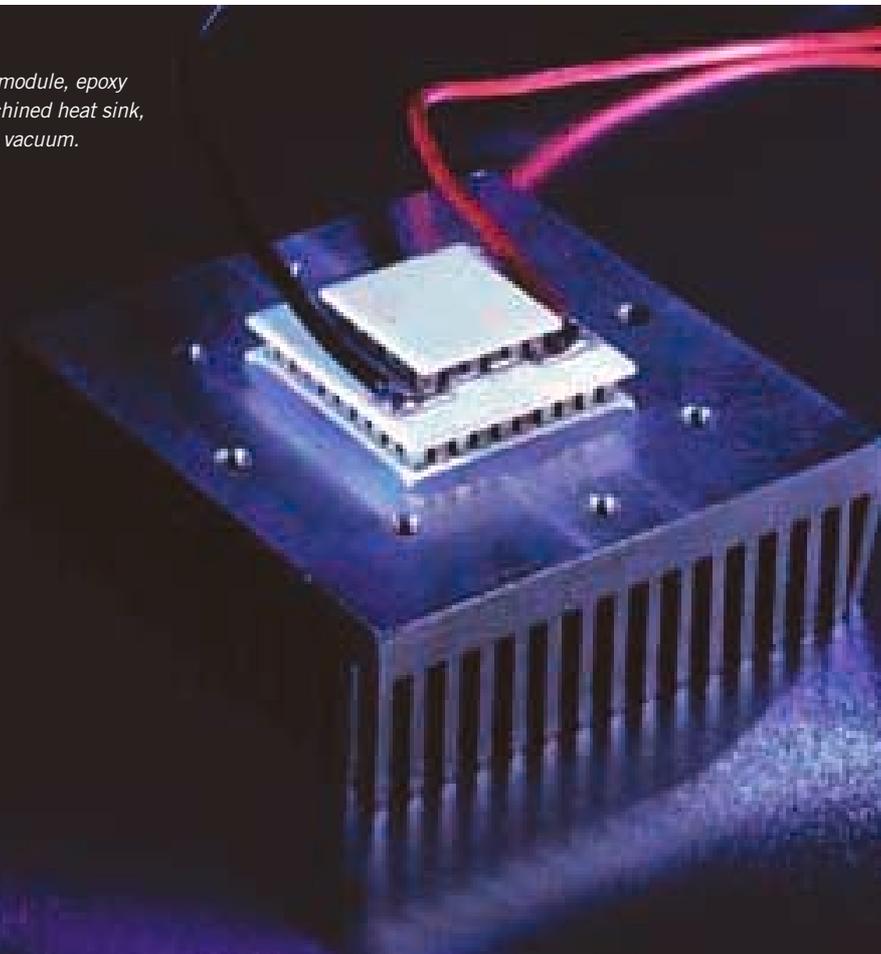
For more information on the market's leading thermoelectric assemblies, order our TE solutions catalog.



*Examples of custom-designed TE modules:  
a gold metallized micro-TEM, a kit of 3 sealed TEMs with wire  
harness, and a 5-stage module optimized for best  $\Delta T$ .*



*This 2-stage TE module, epoxy  
bonded to a machined heat sink,  
cools a CCD in a vacuum.*



## Custom design – finding a solution quickly

Although we provide more than 120 standard modules, we're fully aware that a standard product will not always meet your needs. That's why we pride ourselves on being able to customize solutions quickly and cost-efficiently. All you have to do is ask.

### **Making sure you get the best**

We'll help you conduct thermal studies to define your demands. Supercool's design engineers will then work closely with your personnel to implement the solution. Our flexible production process enables us to meet your requirements – without you having to invest a fortune in either prototypes or large-volume production.

### **Modules alone won't do the job**

We provide not only modules, but also wire harnesses, packaging such as epoxy bonding to heat sinks and much more. To make the most of the market's finest TEMs, be sure to challenge our designers. And if your project calls for it, we can test-run systems in our climatic chamber.

Naturally, we also offer complete thermoelectric solutions, including assemblies, temperature controllers and power supplies.

## A Supercool product has to work all over the world

Today it's widely accepted that thermoelectrics enjoy virtually limitless potential. That's why our solutions see action all over the world. They withstand shocks and vibrations. They manage thermal cycling and provide absolute accuracy. Yet they never lose their cool.

### **Typical applications:**

- CCDs
- Lasers
- Sensors
- Analytical instruments
- Liquid chillers
- Thermal cycling
- Point-of-sale refrigerators
- Automotive applications.

### **Supercool in reality...**

Though we have operations in Sweden and the United States, it's only through our international network of partners and representatives that we can offer you a global service. Their

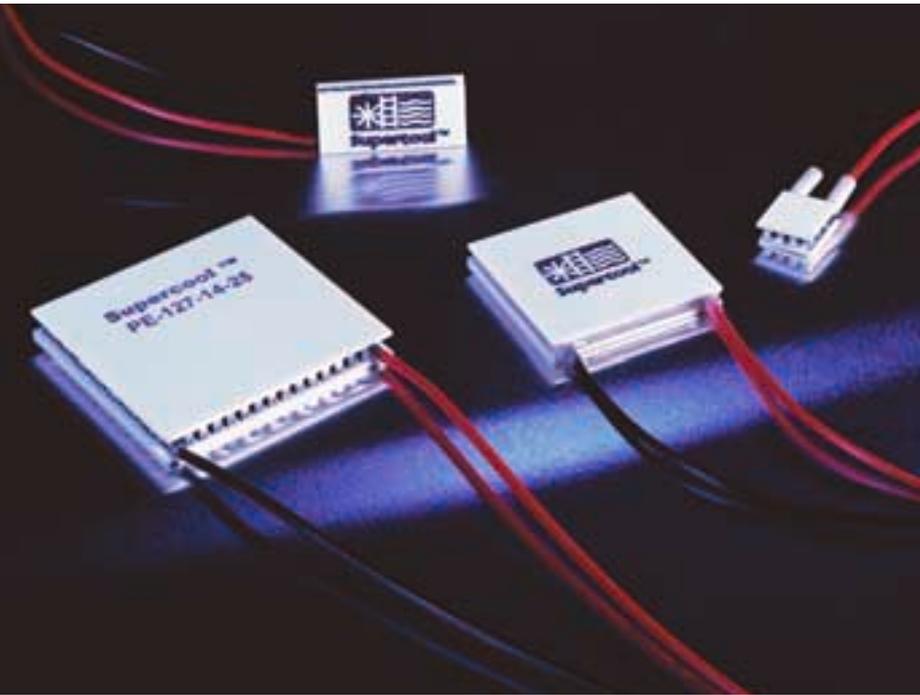
commitment to quality, service and integrity has established Supercool as a global supplier of thermoelectric solutions. You're never far from Supercool – wherever you are.

### **...and in virtual reality**

[www.supercool.com](http://www.supercool.com) is much more than simply a shopwindow for us. This is where you go for the latest news as well as tips and advice on how to best manage your thermal challenges.

### **Cool by nature**

Environmental legislation is getting ever tougher. But once you opt for thermoelectrics you need never worry that you've chosen a cooling system that has a negative impact on the environment. That's because electricity triggers the cooling process; there are no CFCs and no need for refills.



**Standard modules**

Supercool's thermoelectric modules for industrial and commercial applications deliver the market's best cooling performance. By using one or more TEMs, you can design a cooling system with effects ranging from just a few Watts all the way up to several hundred Watts. With max. voltage from 0.9 V up to 30 V DC and an array of pellet geometries, there's every chance of finding just the right module for your application. In the event that our standard range doesn't meet all your requirements, we offer a choice of other dimensions and pellet geometries. Max.  $\Delta T$  up to 75°C (at  $T_{hot} = 25^\circ C$ ). To optimize service life, maximum warm side temperature is 80°C.

**Sealed versions**

We also provide a selection of off-the-shelf standard TEMs with perimeter sealing.

*Silicon moisture sealing:* A cost-effective moisture sealing method suitable for most applications. Add -S after product code

(PE-071-14-15-S)

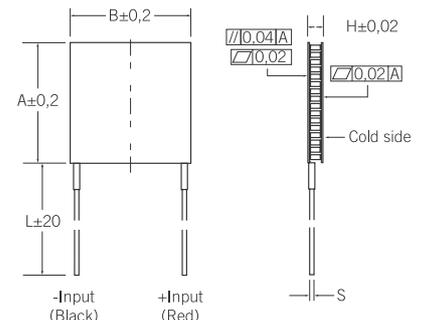
*Epoxy moisture sealing:* Moisture and vapor sealing using special epoxy resin with low thermal conductivity. Add -E after product code (PE-127-10-13-E)

Sealed modules (-S or -E) available from stock are given in the table below.

All high performance modules are available in a sealed version on request.

Product No.	I <sub>max</sub> (A)	U <sub>max</sub> (V)	P <sub>c,max</sub> (W)	ΔT <sub>max</sub> (°C)	R <sub>AC</sub> (ohm)	(mm)				S AWG #	Available Sealing <sup>1</sup>
						A	B	H	L		
<b>Standard modules</b>											
PE-007-14-15	6.0	0.9	3.3	74	0.12	10	10	3.9	200	22	
PE-017-10-15	3.4	2.1	4.5	74	0.49	10	10	3.8	200	24	
PE-017-14-15	6	2.1	7.6	74	0.29	15	15	3.9	200	22	
PE-031-08-15	2.2	3.8	5.1	74	1.57	13	13	3.8	200	24	
PE-031-10-08	6	3.8	13.8	72	0.52	15	15	3.1	200	22	
PE-031-10-13	3.9	3.8	9.3	74	0.93	15	15	3.6	200	24	S
PE-031-10-15	3.4	3.8	8.1	74	1.03	15	15	3.8	200	24	S
PE-031-14-15	6	3.8	14.5	74	0.48	20	20	3.9	200	22	
PE-063-08-15	2.2	7.8	10.4	74	3.20	25	12	3.8	150	24	
PE-063-10-15	3.4	7.8	16.5	74	2.03	30	15	3.8	200	24	
PE-071-10-08	6	8.8	31.6	72	1.17	20	20	3.1	200	22	
PE-071-10-13	3.9	8.8	21.2	74	1.98	20	20	3.6	200	24	S
PE-071-10-15	3.4	8.8	18.5	74	2.18	20	20	3.8	200	24	
PE-071-14-11	8.5	8.8	45.8	72	0.83	30	30	3.8	200	20	
PE-071-14-15	6	8.8	33.2	74	1.27	30	30	3.9	200	22	S
PE-071-14-25	3.9	8.8	21.6	75	1.88	30	30	4.8	200	22	
PE-071-20-15	13.1	8.8	71.9	74	0.55	47	47	4.6	200	20	
PE-127-08-15	2.2	15.7	20.9	74	6.2	25	25	3.8	200	24	
PE-127-08-25	1.3	15.7	12.6	75	11.0	25	25	4.8	200	24	S
PE-127-10-08	6	15.7	57.1	72	2.23	30	30	3.1	200	22	S
PE-127-10-13	3.9	15.7	37.9	74	3.46	30	30	3.6	200	24	S, E
PE-127-10-15	3.4	15.7	33.2	74	4.02	30	30	3.8	200	24	
PE-127-10-25	2	15.7	19.7	75	6.7	30	30	4.8	200	24	
PE-127-14-11	8.5	15.7	82.1	72	1.54	40	40	3.8	300	20	S, E
PE-127-14-15	6	15.7	59.4	74	2.23	40	40	3.9	300	22	S, E
PE-127-14-25	3.9	15.7	38.6	75	3.36	40	40	4.8	350	22	S, E
PE-127-20-15	13.1	15.7	128.7	74	1.08	62	62	4.6	200	20	
PE-127-20-25	8	15.7	78.7	75	1.68	62	62	5.6	200	20	
PE-131-10-13	3.9	16.2	39.1	74	3.65	40	23	3.6	200	24	S
PE-161-12-10	6.7	20.0	83.9	72	2.44	40	40	3.3	350	22	S
PE-161-12-13	5	20.0	62.3	74	3.34	40	40	3.7	350	22	S
PE-161-12-15	4.4	20.0	54.6	74	3.87	40	40	3.9	350	22	S
PE-241-10-13	3.9	30.0	71.8	74	6.6	40	40	3.6	200	24	
PE-241-10-25	2	30.0	37.3	75	12.7	40	40	4.8	300	24	S
PE-241-14-15	6	30.0	112.7	74	4.21	55	55	3.9	200	22	

1) S = Silicon sealed version available. E = Epoxy sealed version available. Note! Max ΔT is reduced by 2-3°C for S-type and 1-2°C for E-type.



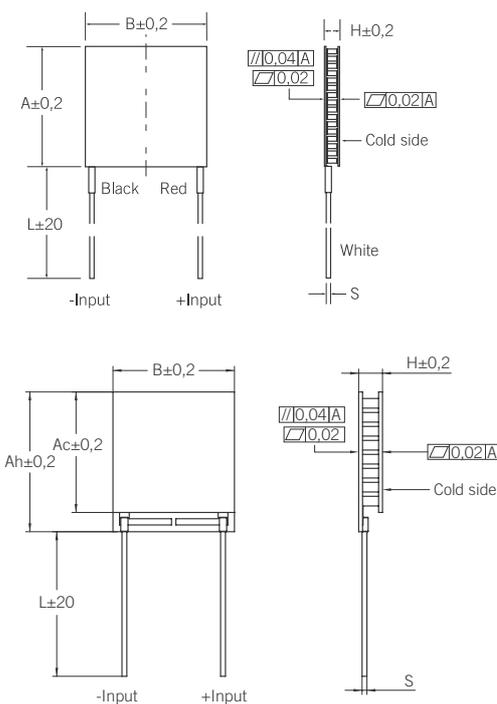
- Lead wires are approved acc. to UL 1569.
- R<sub>AC</sub> tolerance = ±10%
- Tolerance of I<sub>max</sub>, U<sub>max</sub>, Q<sub>max</sub> = ± 5%



**Miniature modules**

This range has been specially developed for low-effect applications where space is limited, such as optical components, sensors and lasers typically found in the opto-electronics and telecom industries. Our superior TE-material makes it possible to achieve  $\Delta T$  up to  $74^{\circ}\text{C}$  (at  $T_{\text{hot}} = 25^{\circ}\text{C}$ ). Standard sizes range from  $2.5 \times 2.5 \text{ mm}$  up to  $13.2 \times 13.2 \text{ mm}$ .

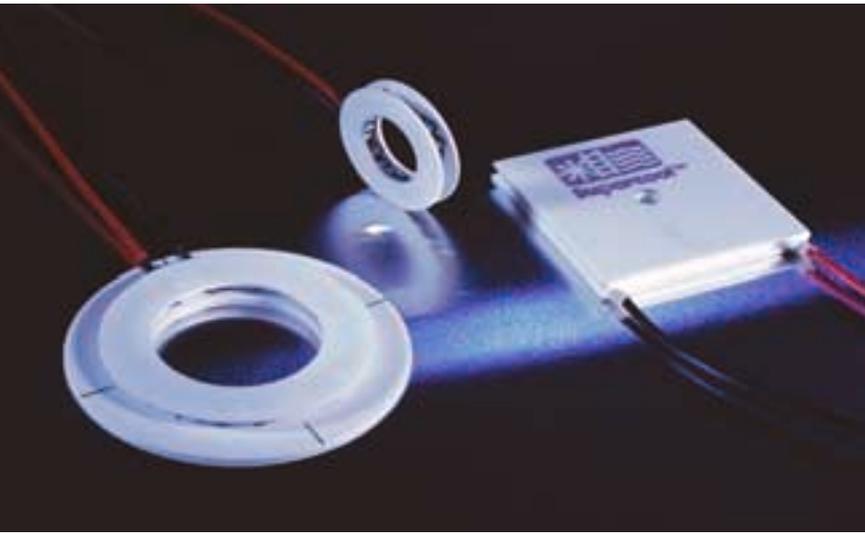
Standard internal solder temperature is  $138^{\circ}\text{C}$  ( $T_{\text{h max}} 80^{\circ}\text{C}$ ). Optionally we can offer  $183^{\circ}\text{C}$  and  $232^{\circ}\text{C}$  internal solder – both with an operating temperature of up to  $150^{\circ}\text{C}$ . Gold metallization and pretinning ( $95, 138$  or  $183^{\circ}\text{C}$ ) are other options. We also provide miniature TEMs on request.



Product No.	$I_{\text{max}}$ (A)	$U_{\text{max}}$ (V)	$P_{\text{c max}}$ (W)	$\Delta T_{\text{max}}$ ( $^{\circ}\text{C}$ )	$R_{\text{AC}}$ (ohm)	(mm)					S mm/mm <sup>2</sup>
						A / Ac	Ah	B	H	L	
<b>Miniature modules</b>											
PE-008-03-09	0.5	1.0	0.3	71	1.82	2.5	3.5	2.5	2.05	50	0.25 <sup>1</sup>
PE-018-03-09	0.5	2.2	0.6	71	4.29	3.5	4.5	3.5	2.05	50	0.25 <sup>1</sup>
PE-032-03-09	0.5	3.9	1.1	71	7.62	5.0	6.0	5.0	2.05	50	0.25 <sup>1</sup>
PE-007-06-11	1.5	0.9	0.8	72	0.42	4.0		4.0	2.7	50	0.25 <sup>1</sup>
PE-017-06-11	1.5	2.1	2.0	72	1.12	6.0		6.0	2.7	50	0.25 <sup>1</sup>
PE-018-06-11	1.5	2.2	2.1	72	1.22	6.0	7.2	6.0	2.7	50	0.25 <sup>1</sup>
PE-023-06-11	1.5	2.8	2.6	72	1.53	8.2		6.0	1.95	50	0.25 <sup>1</sup>
PE-029-06-11	1.5	3.6	3.3	72	1.87	10.2		6.0	2.7	50	0.25 <sup>1</sup>
PE-031-06-11	1.5	3.8	3.6	72	2.03	8.0		8.0	2.7	50	0.25 <sup>1</sup>
PE-068-06-11	1.5	8.3	7.8	72	4.35	13.2		13.2	2.7	50	0.25 <sup>1</sup>
PE-007-05-15	0.8	0.9	0.4	74	0.88	4.0		4.0	3.0	50	0.07 <sup>2</sup>
PE-011-05-15	0.8	1.4	0.7	74	1.45	4.0		6.0	3.0	50	0.07 <sup>2</sup>
PE-017-05-15	0.8	2.1	1.1	74	2.15	6.0		6.0	3.0	50	0.07 <sup>2</sup>
PE-031-05-15	0.8	3.8	2.0	74	4.11	8.0		8.0	3.0	50	0.07 <sup>2</sup>
PE-065-05-15	0.8	8.1	4.2	74	8.2	11.0		12.0	3.0	100	0.07 <sup>2</sup>
PE-007-07-10	2.4	0.9	1.3	72	0.34	6.0		6.0	2.5	50	0.14 <sup>2</sup>
PE-011-07-10	2.4	1.4	1.9	72	0.53	6.0		8.0	2.5	50	0.14 <sup>2</sup>
PE-017-07-10	2.4	2.1	2.9	72	0.82	8.0		8.0	2.5	50	0.14 <sup>2</sup>
PE-031-07-10	2.4	3.8	5.3	72	1.49	10.0		10.0	2.5	50	0.14 <sup>2</sup>
PE-065-07-10	2.4	8.1	11.1	72	3.12	14.0		15.0	2.5	50	0.14 <sup>2</sup>

- $R_{\text{AC}}$  tolerance =  $\pm 10\%$
- Tolerance of  $I_{\text{max}}, U_{\text{max}}, Q_{\text{max}} = \pm 5\%$

1) Bare wire, Ni over Cu, diameter in mm  
 2) Teflon insulated wire. Cross section in mm<sup>2</sup>



**Center hole modules**

Center hole modules are used when light, wires or other hardware need to be transferred through the module.

We only stock a limited number of modules of this type. Let us know about the challenges of your application, and we'll make sure you get just the right module. In principle, all modules can be supplied with a center hole.

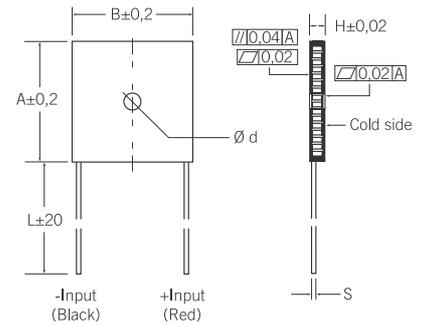
Operating temperature is max. 80°C.

Product No.	I <sub>max</sub> (A)	U <sub>max</sub> (V)	P <sub>c max</sub> (W)	ΔT <sub>max</sub> (°C)	R <sub>AC</sub> (ohm)	(mm)				S AWG #
						A, B, D	d	H	L	
<b>Center hole modules</b>										
PE-119-10-13HS <sup>1)</sup>	3.9	14.7	35.5	71	3.37	30	4.7	3.6	200	24
PE-125-14-11HS <sup>1)</sup>	8.5	15.6	81.5	70	1.46	40	4.7	3.8	300	20
PE-125-14-15HS <sup>1)</sup>	6	15.5	58.5	72	2.16	40	4.7	3.9	300	22
PE-014-14-25RH <sup>2)</sup>	3.9	1.7	4.3	75	0.37	26	14	4.7	200	22
PE-032-14-15RH <sup>2)</sup>	6	4.0	15	74	0.54	55 <sup>3)</sup>	27	3.9	200	22
PE-038-10-13RH <sup>2)</sup>	3.9	4.7	11.4	74	1.05	24	10	3.6	200	24

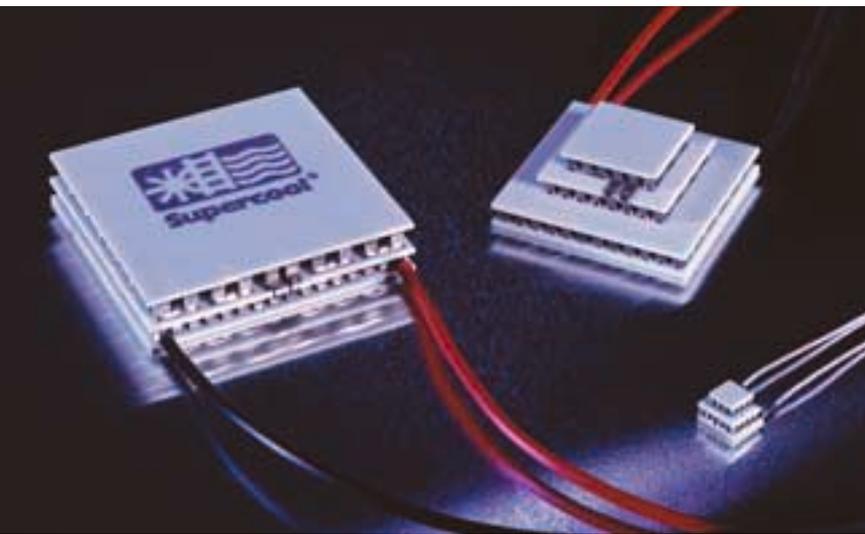
<sup>1)</sup> S = Silicon sealed versions.

<sup>2)</sup> Round design. D = outer diameter and d = inner diameter.

<sup>3)</sup> Outer diameter on warm side = 55 mm. Outer diameter on cold side = 44 mm.



- Lead wires are approved acc. to UL 1569.
- R<sub>AC</sub> tolerance = ±10%
- Tolerance of I<sub>max</sub>, U<sub>max</sub>, Q<sub>max</sub> = ±5%



**Multistage modules**

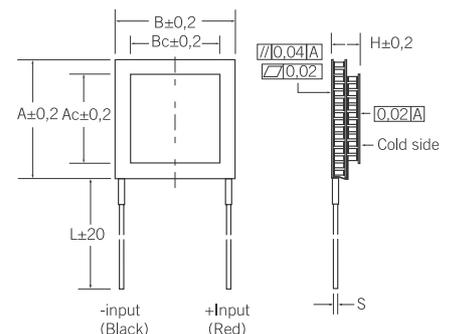
Thanks to superior material characteristics we can offer a range of truly outstanding multistage TEMs. If your system has to generate a ΔT above 50°C, you normally need a multistage module. Typical applications include CCD arrays, IR detectors and analytical instruments.

If you can't find the right TEM for your application, feel free to put our designers to the test.

Operating temperature is max. 80°C.

Product No.	I <sub>max</sub> (A)	U <sub>max</sub> (V)	P <sub>c max</sub> (W)	ΔT <sub>max</sub> (°C)	R <sub>AC</sub> (ohm)	(mm)					S AWG #	
						Ac	Bc	A	B	H		L
<b>Multistage modules</b>												
PE-010-0606-1111	1.1	0.9	0.35	92	0.64	3.2	3.2	3.9	3.9	4.2	50	0.07 <sup>1)</sup>
PE-024-0606-1111	1.1	2.2	0.81	92	1.47	4.1	4.1	6.1	6.1	4.6	50	0.07 <sup>1)</sup>
PE-049-1010-1515	2.1	3.8	3.4	87	1.53	11.5	11.5	15	15	6.6	200	24
PE-049-1414-1515	4	3.8	3.7	87	0.83	15	15	20	20	7.2	200	22
PE-107-1010-1212	3	9.2	9.2	89	2.72	22.6	22.6	22.6	22.6	6.25	200	24
PE-190-1010-1212	2.8	15.7	16.4	87	4.78	30	30	30	30	6.5	200	24
PE-192-1420-1118	6.7	15.6	39.9	87	2.15	40	40	40	40	8.1	300	20
PE-192-1420-1525	4.4	16.0	27.3	88	3.03	40	40	40	40	8.1	300	22
PE3-070-20-25	6.5	6.5	3.0	118	0.93	14	8	36	36	16	200	22
PE3-119-14-15	3.9	8.0	7.5	100	2.09	15	15	30	30	10.4	200	22
PE3-119-20-15	8	8.2	14.9	100	0.97	22	22	44	44	12.9	200	20
PE3-231-10-15	1.9	15.5	6.9	104	7.22	15	15	30	30	9.5	200	24
PE4-115-14-15	3.5	7.6	2.6	122	1.95	14.5	4.5	33	24	13.8	200	22
PE4-129-10-15	1.8	8.2	1.9	115	3.83	8	8	23	23	12.5	200	24
PE5-257-10-15	1.5	14.5	2.0	123	7.9	8	8	30	30	15.4	200	24

1) Teflon insulated wire. Cross section in mm<sup>2</sup>

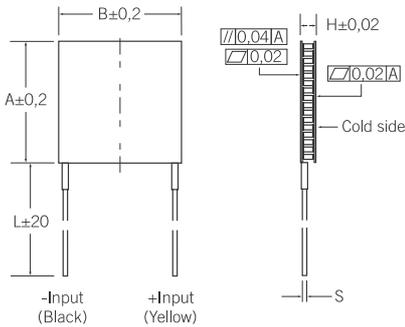
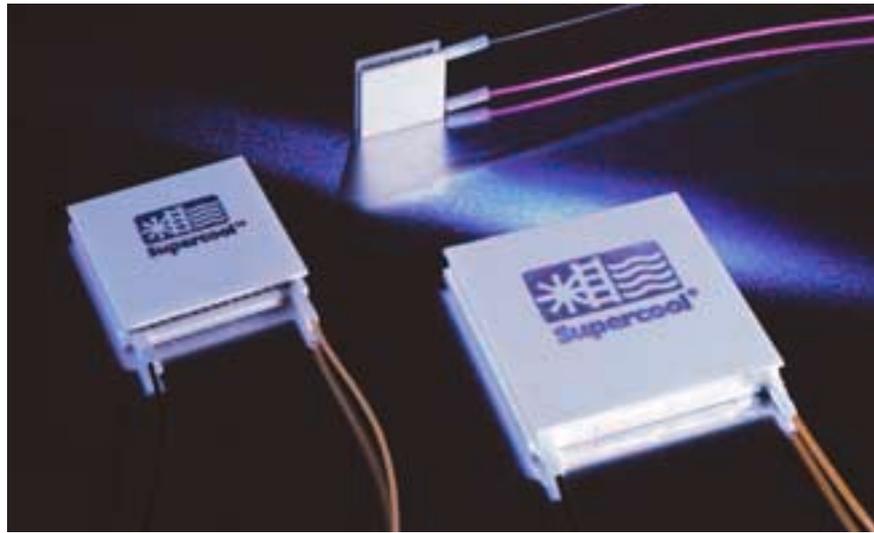


- Lead wires are approved acc. to UL 1569.
- R<sub>AC</sub> tolerance = ±10%
- Tolerance of I<sub>max</sub>, U<sub>max</sub>, Q<sub>max</sub> = ± 5%

**High temperature modules**

Supercool's high temperature modules deliver not only long-term operation up to 150°C, but also outstanding cooling performance (Max.  $\Delta T = 73^\circ\text{C}$  at  $T_{\text{hot}} = 25^\circ\text{C}$ ).

Although we boast a modest standard range, we can, in principle, supply all modules as high temperature modules should your application call for high volumes.



- High temperature modules feature Teflon (PTFE) insulated lead wires.
- $R_{AC}$  tolerance =  $\pm 10\%$
- Tolerance of  $I_{\text{max}}$   $U_{\text{max}}$   $Q_{\text{max}}$  =  $\pm 5\%$

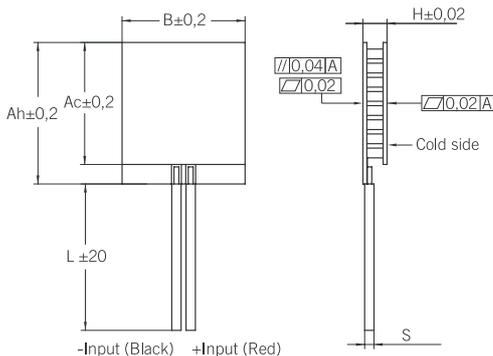
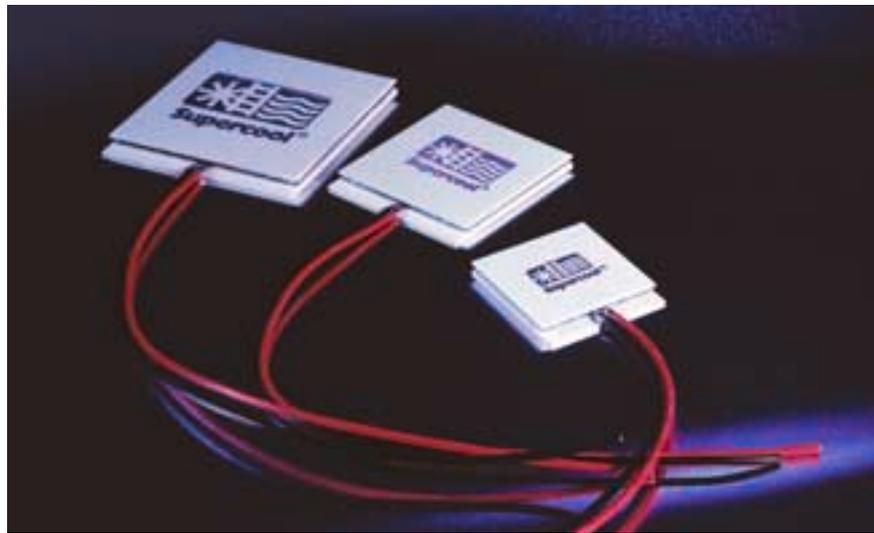
Product No.	$I_{\text{max}}$ (A)	$U_{\text{max}}$ (V)	$P_{\text{c,max}}$ (W)	$\Delta T_{\text{max}}$ ( $^\circ\text{C}$ )	$R_{AC}$ (ohm)	(mm)				S mm <sup>2</sup>
						A	B	H	L	
<b>High temperature modules</b>										
PF-031-10-13	3.9	3.8	8.0	73	0.91	15	15	3.6	200	0.20
PF-071-10-13	3.9	8.8	20.9	73	1.97	20	20	3.6	200	0.20
PF-071-14-15	6	8.8	32.8	73	1.32	30	30	3.9	200	0.35
PF-127-10-13	3.9	15.7	37.4	73	3.47	30	30	3.6	200	0.20
PF-127-10-20	2.6	15.7	24.9	74	5.7	30	30	4.3	200	0.20
PF-127-14-11	8.5	15.7	81.0	71	1.52	40	40	3.8	300	0.50
PF-127-14-15	6	15.7	58.6	73	2.19	40	40	3.9	300	0.35
PF-127-14-25	3.9	15.7	38.1	74	3.42	40	40	4.8	350	0.35
PF-127-14-11-S <sup>1)</sup>	8.5	15.7	77.6	69	1.52	40	40	3.8	300	0.50
PF-127-14-15-S <sup>1)</sup>	6	15.7	56.1	71	2.19	40	40	3.9	300	0.35
PF-127-14-25-S <sup>1)</sup>	3.9	15.7	36.6	72	3.42	40	40	4.8	350	0.35

<sup>1)</sup> S = Silicon sealed versions.

**Power modules**

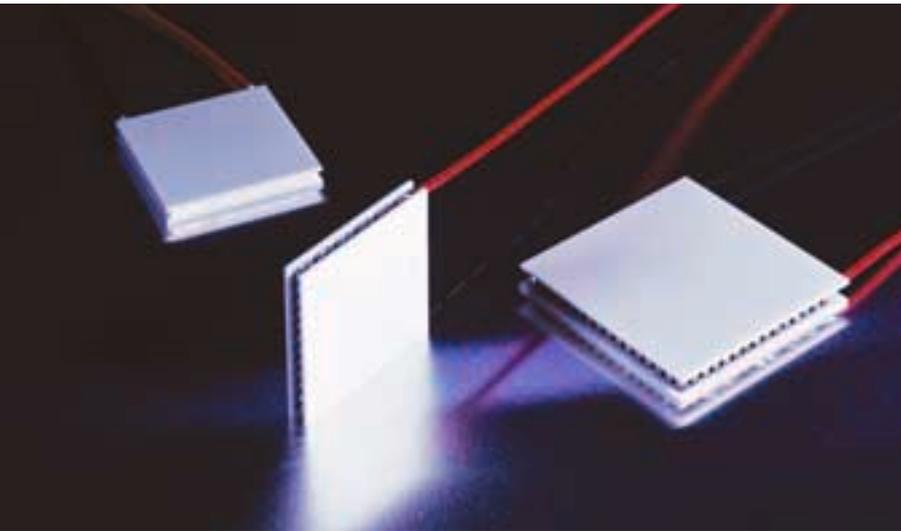
Power modules are for applications where you need to pump a great amount of heat onto a small surface. We offer power density of up to 14 W/cm<sup>2</sup>. These TEMs also provide outstanding thermal cycling properties and can be used for applications such as lasers, PCR cycling and thermal testing of micro-processors.

By powering the TEMs to around half of  $U_{\text{max}}$  you can use these modules to achieve exceptionally high efficiency (COP). The porch style offers a strong lead attachment. Operating temperature is max. 120°C.



- Power modules feature Teflon (PTFE) insulated lead wires.
- $R_{AC}$  tolerance =  $\pm 10\%$
- Tolerance of  $I_{\text{max}}$   $U_{\text{max}}$   $Q_{\text{max}}$  =  $\pm 5\%$

Product No.	$I_{\text{max}}$ (A)	$U_{\text{max}}$ (V)	$P_{\text{c,max}}$ (W)	$\Delta T_{\text{max}}$ ( $^\circ\text{C}$ )	$R_{AC}$ (ohm)	(mm)					S mm <sup>2</sup>
						Ac	Ah	B	H	L	
<b>Power modules</b>											
PC-128-10-05	9	15.8	88.2	68	1.38	30	34	30	2.5	200	0.50
PC-072-14-06	15.4	8.9	85.1	68	0.45	30	34	30	3.3	200	0.75
PC-128-14-06	15.4	15.8	151.4	68	0.82	40	44	40	3.3	300	0.75
PC-128-20-08	24	15.8	235.5	70	0.55	55	59	55	4.0	200	0.75
PC-200-14-06	15.4	25.0	236.5	68	1.28	40	44	40	3.3	200	0.75
PC-200-14-11	8.5	24.9	127.5	71	2.36	40	44	40	3.8	200	0.50
PC-288-10-05	9	35.8	198.4	68	3.11	40	44	40	2.5	200	0.50
PC-288-10-08	6	35.8	127.6	71	4.83	40	44	40	3.1	200	0.50
PC-288-14-06	15.4	35.8	340.5	68	1.84	52	56	52	3.3	200	0.75
PC-288-14-11	8.5	35.8	182.6	71	3.39	52	56	52	3.8	200	0.5



**Medium performance modules**

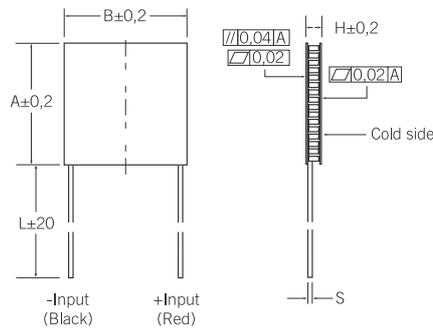
Kristall, our new range of medium performance thermoelectric modules, is specially designed for high volume applications. A novel manufacturing technique allows us to offer dependable performance – at an attractive price. Max.  $\Delta T$  of up to 72°C at  $T_h = 25^\circ\text{C}$ .

The Kristall range is based on a patented method for growing thermoelectric material that delivers not only competitive cooling properties but also cost-effective production. Thanks to an advanced nickel diffusion barrier process, these modules can be used long-term at temperatures up to 90°C. Options are silicon or epoxy sealing and lapping.



Plate and bar ingots – special materials technology

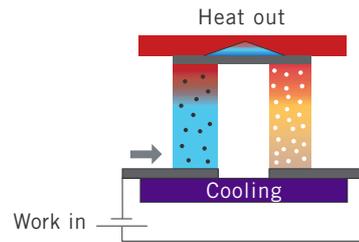
- Lead wires are PVC insulated.
- Max temperature = 105°C
- $R_{AC}$  tolerance =  $\pm 10\%$
- Tolerance of  $I_{max}$ ,  $U_{max}$ ,  $Q_{max}$  =  $\pm 5\%$



Product No.	$I_{max}$ (A)	$U_{max}$ (V)	$P_{c max}$ (W)	$\Delta T_{max}$ (°C)	$R_{AC}$ (ohm)	(mm)				S AWG #
						A	B	H	L	
<b>Medium performance modules</b>										
PM-071-10-13	3.9	8.8	18.2	71	2.0	20	20	3.6	200	24
PM-071-14-15	6.0	8.6	29	71	1.30	30	30	3.9	200	22
PM-127-10-13	3.9	15.4	32.5	71	3.50	30	30	3.6	200	24
PM-127-14-11	8.5	15.4	73	69	1.50	40	40	3.8	200	20
PM-127-14-15	6.0	15.4	51.6	71	2.20	40	40	3.9	200	22
PM-127-14-25	3.9	15.4	32.5	72	3.4	40	40	4.8	200	22

Silicon sealed and Epoxy sealed version are available. Note ! Max  $\Delta T$  is reduced by 2-3°C for S-type and 1-2°C for E-type

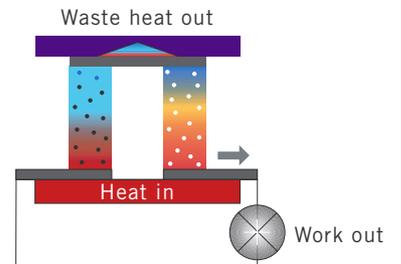
**Thermoelectrics and how it works**



**Heat Pump (Refrigerator) Peltier (1834)**

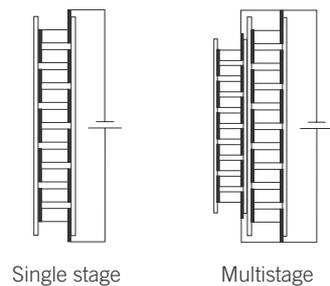
The Thermoelectric Peltier effect is the most direct way to utilize electricity to pump heat. Electrical current (work input) forces the matter to approach a higher energy state (black dots) and heat is absorbed (cooling).

The energy is released (heating) as the matter approaches a lower energy state (white dots). The net cooling or heating effect is proportional to the electric current and Peltier coefficient.



**Power Generator Seebeck (1822)**

Thermoelectric material can also be used for electric power generation. Some of the heat input is converted to electric current (work), as the higher energy matter (black dots) releases energy and cools to a lower energy state (white dots). The net work is proportional to the temperature difference and Seebeck coefficient.



**Thermoelectric modules**

The material used at working temperatures up to 150°C is normally bismuth telluride, doped to obtain p (positive) and n (negative) semi-conducting properties.

A number of pn-couples, thermally parallel and electrically in series, are sandwiched between ceramic plates.

The maximum temperature differential ( $\Delta T_{max}$ ) between the cold and the warm side of a Supercool single stage module is up to 75°C at warm side temperatures of 25°C or  $\Delta T = 85^\circ\text{C}$  at a warm side temperature of 50°C. By increasing the number of stages in a multistage arrangement, you also increase maximum  $\Delta T$ .

**Installation**

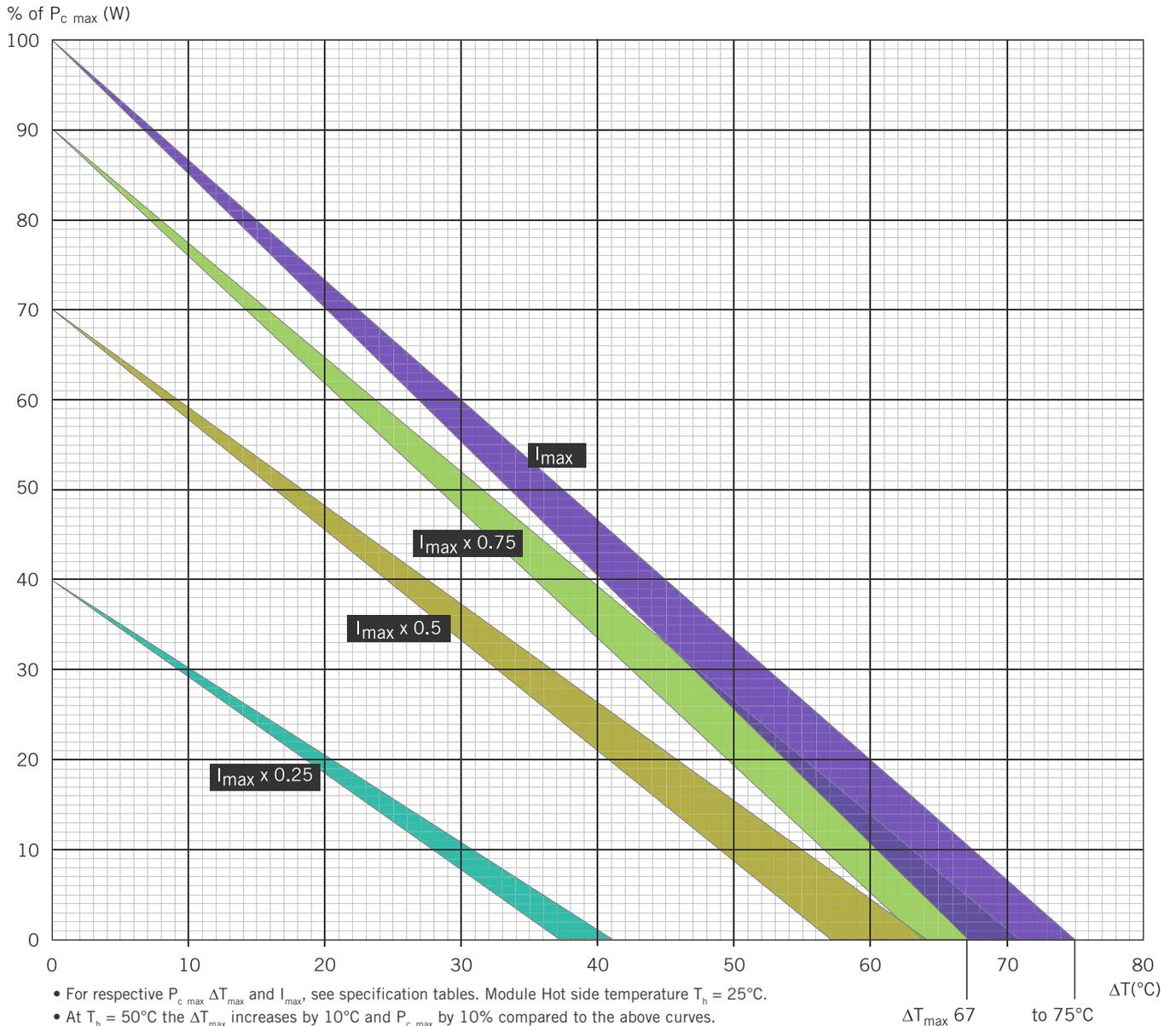
- Recommended mounting methods are clamping using thermal grease, bonding with thermal epoxy, or soldering with metallized ceramics (option).
- TE modules should not be subjected to significant shear forces.
- Surface flatness of heat sinks should be 0.05 mm/100 mm or better.
- Soldering is not recommended for TE modules whose size is 18 x 18 mm or larger.
- Maximum clamping pressure is 1000 kPa for miniatures and 1500 kPa for other modules.

**Operation**

- Storage and operation in a condensing environment is only recommended if you use sealed modules.
- Generally TE modules are operated at 40-80% of  $U_{max}$ .
- Be sure to handle TE modules carefully during transportation and in production.
- When regulating in ON/OFF mode, make sure cycle time is 60 sec. or more.
- If you use your own PWM-controller, make sure switching frequency is 5 kHz or more.

For more information, please contact Supercool.

**Cooling power ( $P_c$ ) versus Temperature difference ( $\Delta T$ ) for single stage modules.**



- For respective  $P_{c\ max}$ ,  $\Delta T_{max}$  and  $I_{max}$  see specification tables. Module Hot side temperature  $T_h = 25^\circ C$ .
- At  $T_h = 50^\circ C$  the  $\Delta T_{max}$  increases by  $10^\circ C$  and  $P_{c\ max}$  by 10% compared to the above curves.
- For multistage modules, as well as for more detailed specifications for any module, please call for individual performance graphs.
- $U_{max}$  and  $I_{max}$  are specified at  $\Delta T = \Delta T_{max}$
- $\Delta T =$  Hot side temperature ( $T_h$ ) less Cold side temperature ( $T_c$ ).

# Supercool on the Internet

To find out more about Supercool, our products and solutions, visit us at [www.supercool.com](http://www.supercool.com).

We've also posted a complete list of representatives on our website, including contact details.



## The widest range of standard solutions

Robust, efficient and compact, our thermoelectric solutions have been put to the test in scores of applications. Our experience and know-how create the foundations for an unrivaled selection of standard products.

We provide everything you need to get your thermoelectric system up and running, including assemblies, temperature controllers and power supplies.

*For more information, order our 'Thermoelectric solutions' catalog.*



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