CERTIFIED
ISO 9001

INTERTEK
CERTIFICATION

Thermoelectric Coolers (TECs)

MELCOR

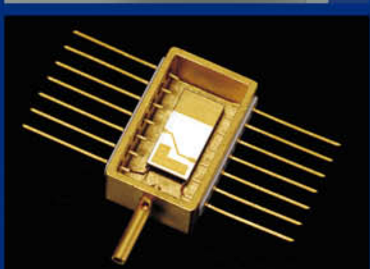
Heat Sinks

THERMAL

Thermal Design Software & Services

SOLUTIONS

Solid State Air Conditioners



Custom Assemblies & Packaging

Temperature Controllers
& Power Supplies

Fans & Thermal
Compounds

MELCOR®

The Standard in Thermoelectrics

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Contents

A Brief Introduction to Thermoelectrics

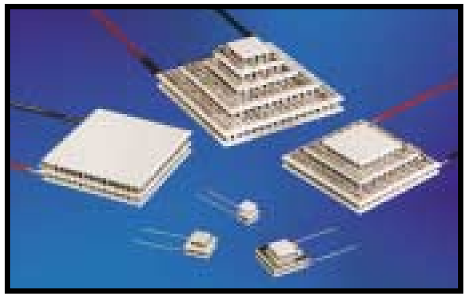
Thermoelectric coolers (TECs) are solid-state heat pumps that utilize the Peltier effect. During operation, DC current flows through the TEC, resulting in heat being transferred from one side of the TEC to the other, creating a cold and hot side. A single-stage TEC can achieve temperature differences up to 70˚C, or can transfer heat at a rate of 138W. To achieve greater temperature differences (up to 131˚C) select a multistage (cascade) TEC. To increase the amount of heat transferred, the TEC's modular design allows the use of multiple TECs mounted side-by-side.

Benefits of MELCOR TECs

The special combination of benefits attained by TECs makes them the only effective solution for certain applications:

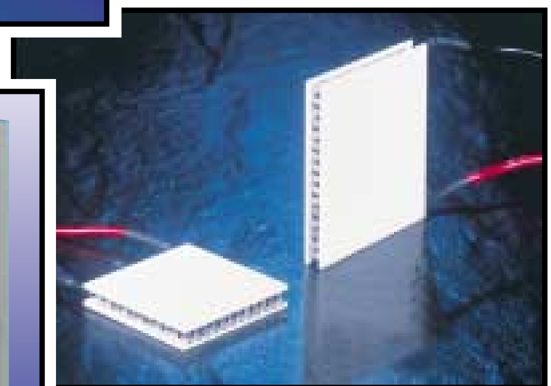
- Precision temperature control capability
- Quick and economical cooling to below ambient
- Reduced space, size and weight
- Reliable solid-state operation – no sound or vibration (lifetimes of more than 200,000 hours!)
- Virtually no electrical noise
- DC operation
- Heating or cooling by changing direction of current flow
- More than 280 standard types available, from sub-miniature, low capacity to compact, high-capacity
- Multistage cascades to below -100˚C, standard or designed to specifications
- Patented ThermaTEC™ cools at +225˚C!

See the following pages for details on MELCOR's TECs!



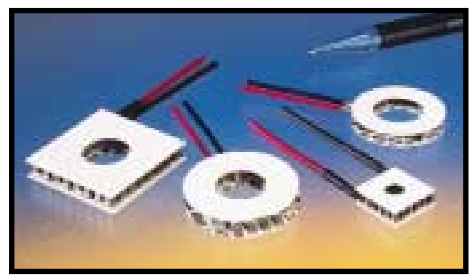
Multistage (Cascades)

PolarTEC™



CP Series

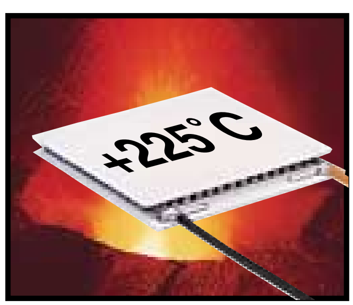
External Mount Air Conditioners



Center Hole

Value-added capabilities

Laser Chillers

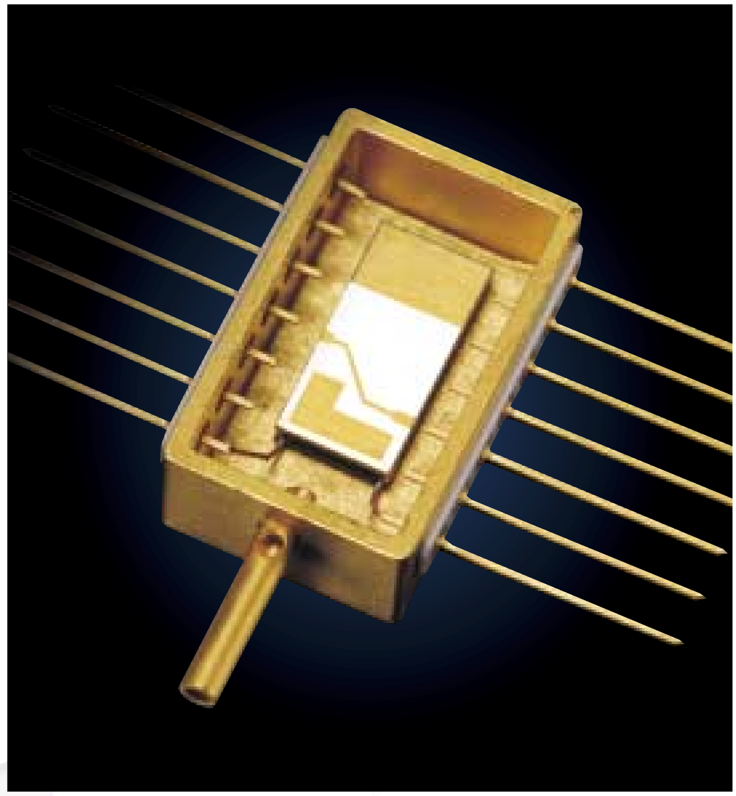


ThermaTEC™

OptoTEC™

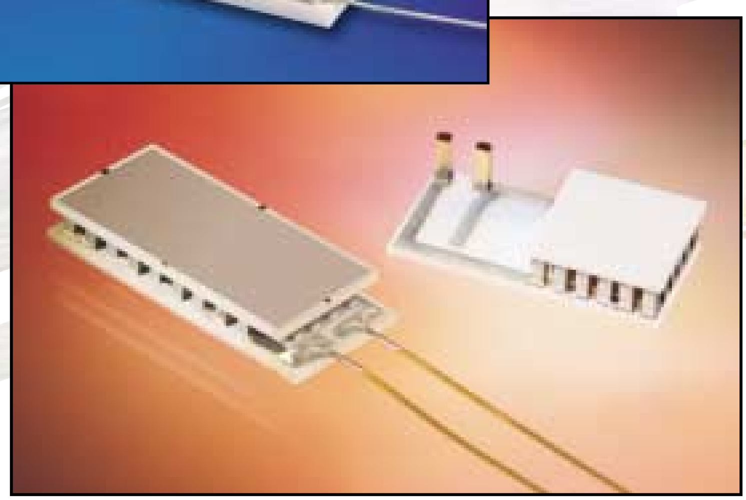
Telecom/Fiber Optics

Melcor's telecom team provides assistance from the initial design through qualification testing, and further throughout the lifetime of the product. From testing and screening to the widest range of assembly solders available, Melcor supports the telecom market with world-class engineering and customer service.



Advantages

- Customization capabilities include performance, size, metallization patterns
- Ceramic options include Al_2O_3, and AIN and BeO
- Pb-free construction, including the highest temperature solder for thermoelectrics at 271˚C
- Range of mounting solders from 93˚C to 232˚C
- Wire bondable posts available in place of lead wires
- Qualification testing and screening to Telcordia (Bellcore) or special requirements



Applications

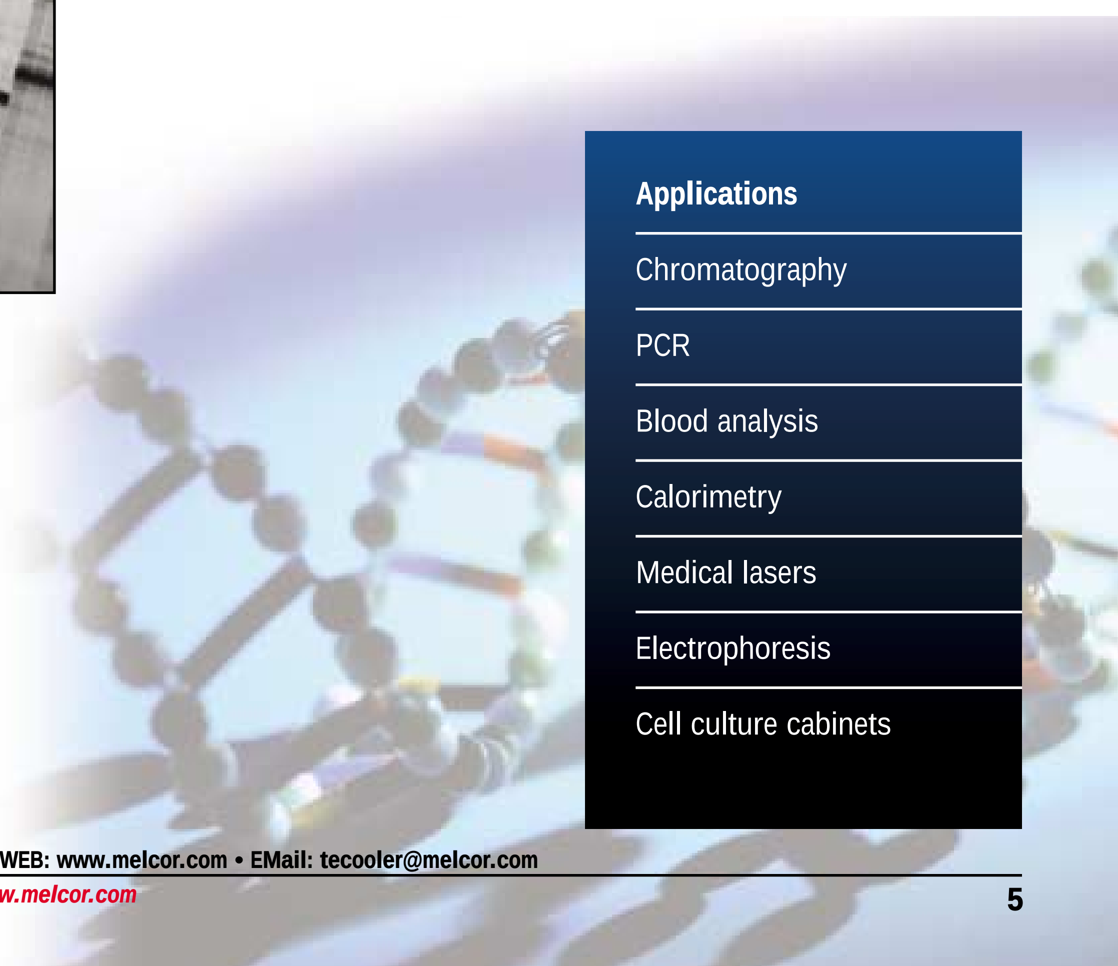
- Transmission lasers
- Pump (amplifier) lasers
- Mux/DeMux
- Enclosure cooling for wireless stations
- Component testing
- Transceivers

Medical/Scientific Instruments

From developing the most reliable thermoelectrics for temperature cycling applications such as DNA Research – PCR (Polymarase Chain Reaction), to manufacturing of complex value-added assemblies, Melcor provides products for many technical applications and instruments used in the advancement of the frontiers of science.

Advantages

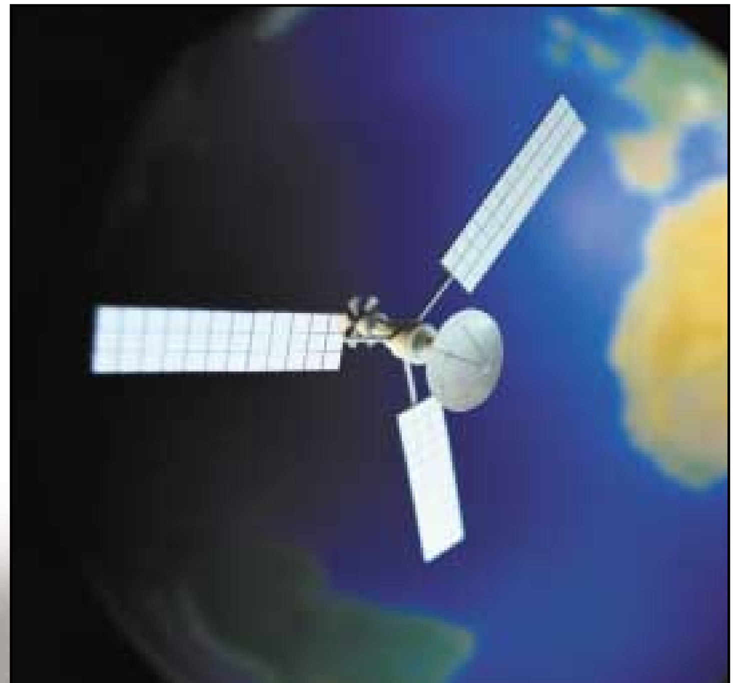
- The most reliable thermoelectrics available for thermal cycling
- Customization abilities to fit product-driven demands
- Value-added assembly capabilities
- High-power density thermoelectrics available



Applications
Chromatography
PCR
Blood analysis
Calorimetry
Medical lasers
Electrophoresis
Cell culture cabinets

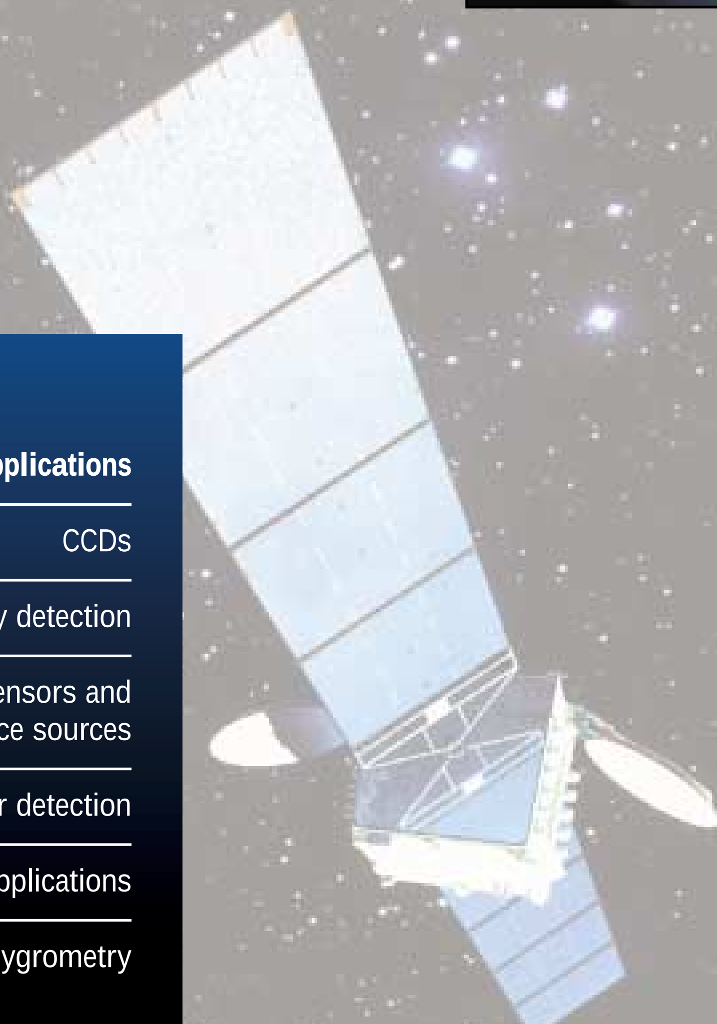
Military/Photonics

Applications for military and aerospace, as well as for various kinds of detectors, are key markets for thermoelectrics. Our products are used for applications including IR sources, dewpoint hygrometry, and the cooling of CCDs. Melcor's flexible thermoelectric design capabilities allow us to build hundreds of different multistage thermoelectrics to fit any application need.



Advantages

- Flexible multistage design that matches high cost-efficiency with reliability and performance
- Testing capabilities per Telcordia and MIL-STD requirements
- Rugged thermoelectrics for high reliability



Applications

- CCDs
- X/Gamma-ray detection
- IR sensors and reference sources
- Laser detection
- Space applications
- Hygrometry

Applications in manufacturing, consumer goods, and electronic enclosure cooling are the responsibility of Melcor's commercial market team. Melcor's available products include high-power density thermoelectrics, value-added assemblies, and low-cost thermoelectrics for high-volume products.

Advantages

- Cost-effective devices and assemblies
- Rapid customization and prototyping
- High reliability, efficiency, power density
- Complete assembly and test capabilities
- Largest range of products and capabilities

Applications

- Semiconductor manufacturing and testing
- Consumer goods (portable refrigerators, water coolers)
- Automotive applications
- Enclosure air-conditioning
- Liquid chillers

Value Added Capabilities

MELCOR has implemented a major expansion of its thermoelectric (TE) special-assembly production facilities. The addition of several flexible production lines enables us to continue to meet the increasing needs of our customers for thermoelectric assemblies designed and built to exacting specifications.

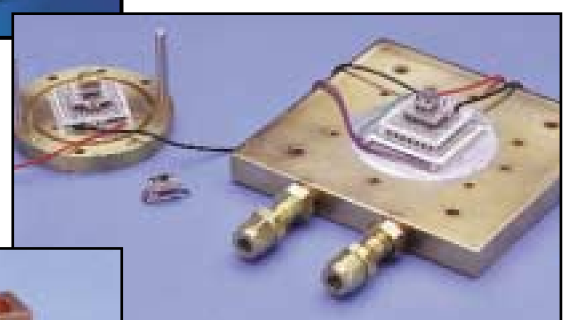
Typical TE assembly and mounting applications:

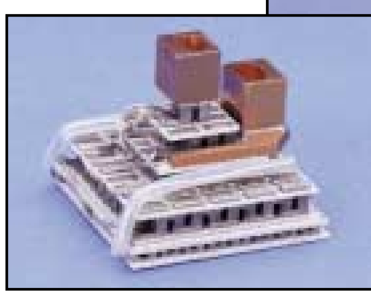
- **Laser Diodes**
- **Infrared Detectors**
- **CCD Cameras**
- **Complete Assemblies for Thermal Cyclers and Reagent Stabilization**
- **Blood Analyzers, Medical Lasers**
- **Dewpoint Hygrometers**
- **Electronic Enclosures**
- **CPU Cooling and Burn-in Test Equipment**

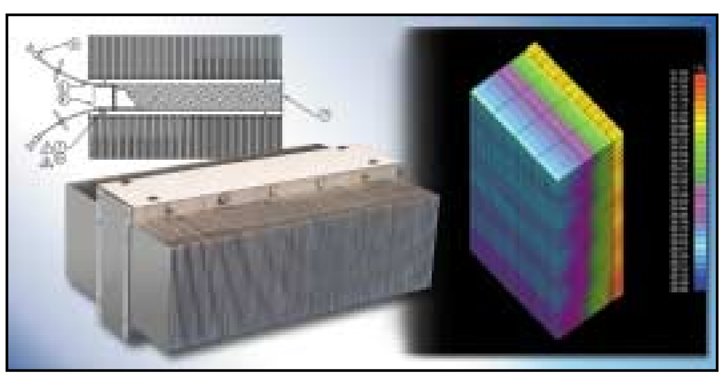
MELCOR provides cost effective custom packaging, testing and thermoelectric cooler design. Over 40 years of experience and documented processes ensure that our products are manufactured to exacting specifications and fully tested. Contact us for a quotation of your special design and packaging, and take the worry and expense out of your operations.

In addition to our Thermal Solutions product line, we work closely with leading thermal products manufacturers worldwide to provide integrated solutions for our customers.

Challenge MELCOR to offer the highest quality, cost effective solution for your thermoelectric needs from prototype through production quantities.







"I'm curious, exactly what is a thermoelectric module?"

A thermoelectric module is a small solid-state device that can operate as a heat pump or as an electrical power generator. When used to generate electricity, the module is called a thermoelectric generator (TEG). When used as a heat pump, the module utilizes the Peltier effect to move heat and is called a thermoelectric cooler (TEC). MELCOR is a world leader in TEC manufacturing. (Our products are also well-suited for some TEG applications. However, we address only TECs in this literature.)

"It sounds familiar, but…what is the Peltier effect?"

The Peltier effect was discovered in 1834. When current passes through the junction of the two different types of conductors it results in a temperature change. However, the practical application of this concept required the development of semiconductors that are good conductors of electricity but poor conductors of heat – the perfect balance for TEC performance. Today, bismuth telluride is primarily used as the semiconductor material, heavily doped to create either an excess (n-type) or a deficiency (p-type) of electrons.

"How does a TEC work?"

Very simply, a TEC consists of a number of p- and n-type pairs (couples) connected electrically in series and sandwiched between two ceramic plates (see drawing). When connected to a DC power source, current causes heat to move from one side of the TEC to the other. Naturally, this creates a hot side and a cold side on the TEC. A typical application exposes the cold side of the TEC to the object or substance to be cooled and the hot side to a heatsink which dissipates the heat to the environment. A heat exchanger with forced air or liquid may be required. (As clever as TECs are, they can't eat heat – only move it!)

"What happens if I reverse the direction of the current?"

If the current is reversed, the heat is moved in the opposite direction. In other words, what was the hot face will become the cold face and vice-versa.

"How much heat can it pump? Could I cool my house with it?"

The maximum amount of heat the largest single TEC can pump is about 138W. So, you wouldn't cool your house with it! However, our modular design enables you to use several TECs per application, allowing you to move more heat.

"So, I can use more than just one?"

Sure! They can be used side-by-side to increase the amount of heat pumped, or they can be stacked on top of another to increase the temperature difference across the TEC. When stacked, they are called "cascades," or multistage TECs. When the temperature difference between the hot and cold faces doesn't need to be more than about 60˚C, single-stage TECs can normally do the job. If the temperature difference needs to be greater than 60˚C, cascades should be considered. Some cascades are listed in the Multistage Specification table. Many others are also available.

"When should I use a TEC? Is a TEC as good as a compressor?"

TECs are absolutely perfect for some applications and completely unsuitable for others. Depending on the application, a TEC can be much, much better than a compressor or no match at all! TECs are very small, very light, and completely silent. With no moving parts, they are extraordinarily reliable. TECs generate little, if any, electrical noise and can provide precision temperature control when used with an appropriate controller. They can be operated in a vacuum or weightless environment, and in any physical orientation. On the other hand, TECs tend to lose their competitive advantage when cooling loads exceed 200 W. Under some special circumstances, however, TECs are used to pump loads of tens of kilowatts.

"Is it hard to design-in a TEC?"

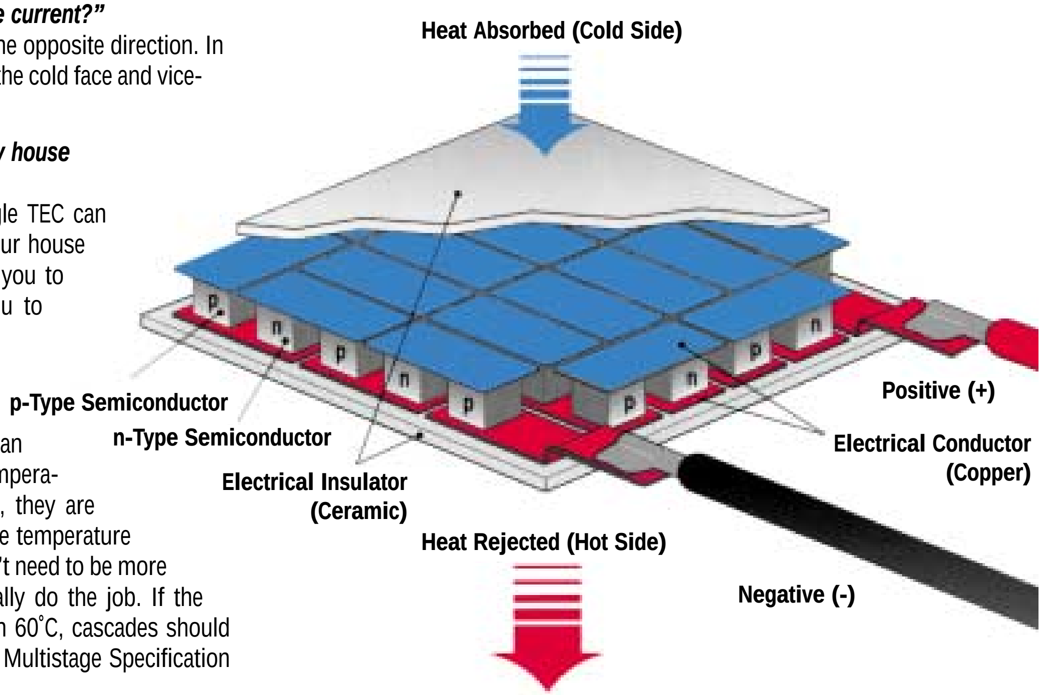
Not really. It does require some understanding of heat transfer and a good grasp of your application. In addition to the information in this catalog, MELCOR has developed a thermoelectric selection/design software program AZTEC™ (A to Z Thermoelectric Cooling) that is a FREE download from our website: **www.melcor.com**. Our experienced engineers are available to help you.

"Do I need special equipment or training to install a TEC?"

Proper installation is extremely important but not very difficult. MELCOR provides detailed, illustrated assembly instructions. And, we can build custom subassemblies for specific applications.

"What about temperature control and power supplies?"

TECs are DC devices. The amount of the heat through the TEC is directly proportional to the power supplied. Temperature is controlled through manual or automatic means. The automatic controller can range from a simple on-off thermostat to a complex computer-controlled feedback circuit. Such control systems are available from a variety of qualified manufacturers.

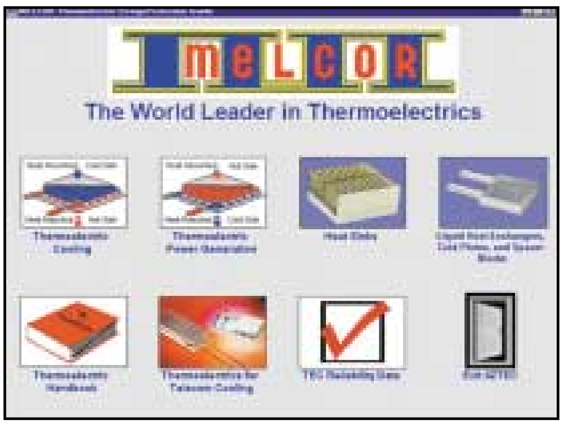


Cutaway drawing shows the construction of a single-stage TEC. During operation, DC current flows through the p- and n-type couples causing heat to move from the cold side to the hot side of the TEC. In many applications, some type of heat exchanger will be used on the hot side of the TEC to move heat away from the unit.

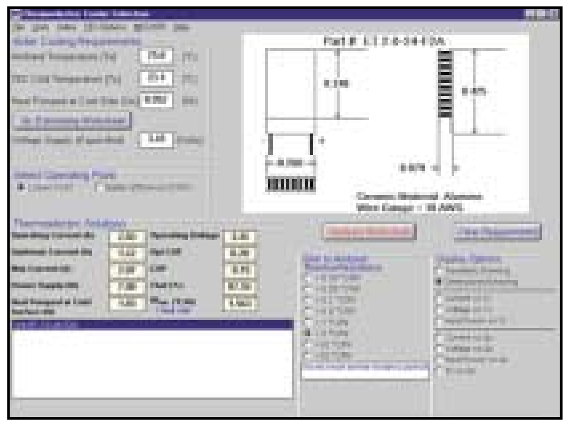
AZTEC™ Thermoelectric Design Software

Leave it to a world leading manufacturer of thermoelectric cooling products to provide a handy, Windows-based software program that takes the engineer through every step of thermoelectric design from A to Z.

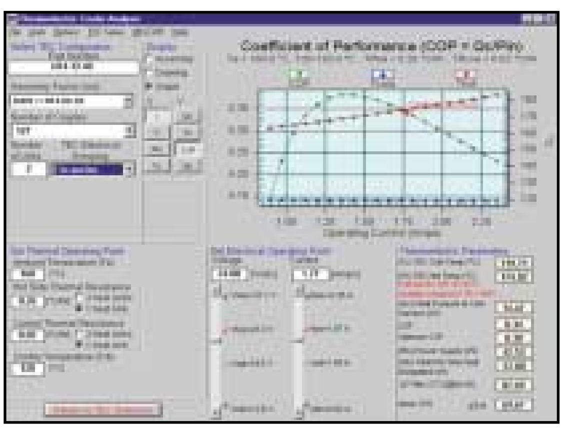
AZTEC is an easy-to-use program that runs in most Windows versions. Available as a FREE download from our website, it includes thermal load estimating for both passive and active components, as well as for enclosures.



The main menu screen lets you choose from among Thermoelectric Cooling, Thermoelectric Power Generation, additional thermal components and reliability information.



AZTEC can recommend a thermoelectric cooler (TEC) for your application based on the design parameters that you input, as well as offer alternative possibilities.

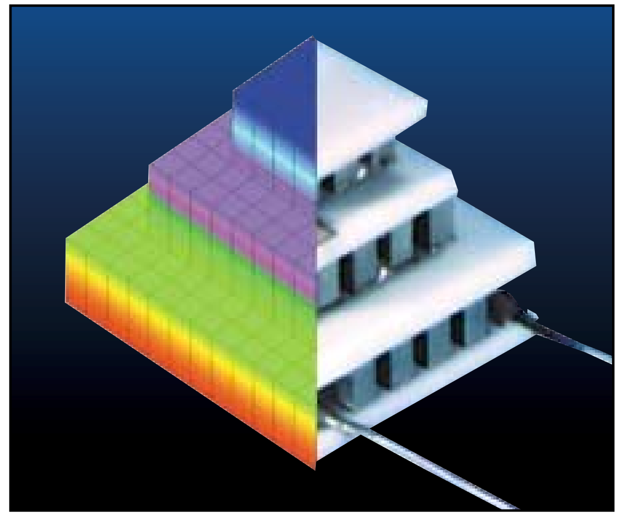


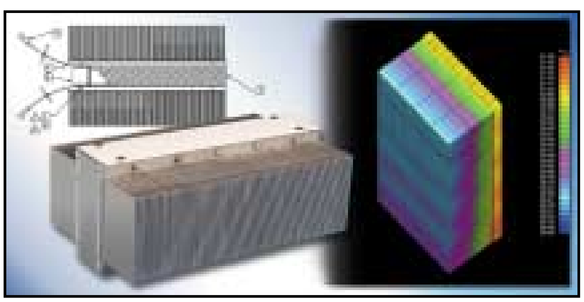
Use AZTEC to model the performance of any standard thermoelectric cooler in our inventory, using your operating conditions.

TAS – Thermal Analysis System

Melcor, a leader in thermoelectric devices has teamed up with Harvard Thermal, a leader in the thermal modeling software industry, to offer our customers a fast, easy, and accurate solution for the thermal modeling of assemblies that incorporate thermoelectric coolers.

The Windows-based Harvard/Melcor Thermal Analysis Software (TAS) is an intuitive software solution for today's complex thermal management problems. It is the first three-dimensional simulation application of a TE Cooler available in a general-purpose thermal modeling tool.

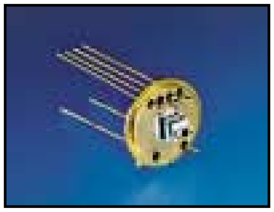


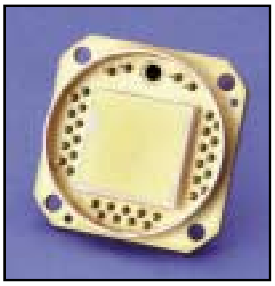


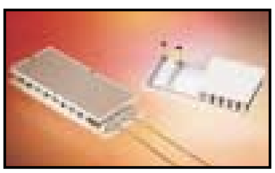
Software Highlights:

- TAS accurately simulates the device behavior over its entire operating range in both heating and cooling modes
- Unique combination of finite element modeling with a finite difference solver
- Offers true 3-D modeling capability and the ability to add convection, radiation, fluid flow, heat loads and temperature boundaries
- Easily handles temperature and time dependent properties
- Thermostat function can be used to control voltage or current to the device
- Other features include stacking TE coolers (multistage) and solving for steady state and transient conditions

Download FREE demo from our website
www.melcor.com







OptoTEC™ SERIES

Internal Solder Temp.			Model		Th = 25˚C					Th = 75˚C						Dimensions					
							∆Tmax					∆Tmax									
138	232	271		Imax	Qmax	Vmax	OT	ET	HOT	Qmax	Vmax	OT	ET	HOT	N	A	B	C	D_1	D_2	E
OT	ET	-	0.8-18-F0	0.8	0.97	2.1	67	67	-	1.19	2.5	84	84	-	18	4.9	4.9	6.5	2.4	2.8	-
OT	ET	-	0.8-32-F0	0.8	1.72	3.8	67	67	-	2.11	4.5	84	84	-	32	6.5	6.5	8.1	2.4	2.8	-
OT	ET	-	0.8-66-F0	0.8	3.56	7.9	67	67	-	4.36	9.2	84	84	-	66	9.8	8.9	11.4	2.4	2.8	-
OT	ET	-	1.2-7-F1A	1.2	0.57	0.8	67	67	-	0.67	1.0	84	84	-	7	4.0	4.0	4.0	2.7	3.0	-
OT	ET	-	1.2-17-F1A	1.2	1.38	2.0	67	67	-	1.63	2.4	84	84	-	17	6.6	6.6	6.6	2.7	3.0	-
OT	ET	HOT	1.2-18-F2A	1.2	1.46	2.1	67	67	64	1.72	2.5	84	84	81	18	6.0	6.2	7.2	2.7	3.0	-
OT	ET	HOT	1.2-24-F2A	1.2	1.97	2.7	67	67	64	2.30	3.4	84	84	81	24	6.6	8.8	10.8	2.5	2.7	-
OT	ET	HOT	1.2-30-F2A	1.2	2.43	3.6	67	67	64	2.87	4.2	84	84	81	30	6.2	10.3	12.3	2.3	2.5	-
OT	ET	-	1.2-31-F1A	1.2	2.51	3.7	67	67	-	2.97	4.3	84	84	-	31	8.8	8.8	8.8	2.7	3.0	-
OT	ET	HOT	1.2-31-F2A	1.2	2.51	3.7	67	67	64	2.97	4.3	84	84	81	31	8.8	8.8	11.0	2.7	2.9	-
OT	ET	-	1.2-62-F3	1.2	5.01	7.5	67	67	-	5.94	8.7	84	84	-	62	12.2	11.2	13.2	2.7	2.9	2.0
OT	ET	HOT	1.2-65-F2A	1.2	5.34	7.8	67	67	64	6.22	9.1	84	84	81	65	13.2	12.1	13.2	2.7	3.0	-
OT	ET	-	1.2-68-F1A	1.2	5.59	8.2	67	67	-	6.51	9.5	84	84	-	68	13.2	13.2	13.2	2.7	3.0	-
OT	ET	-	1.5-7-F1A	1.5	0.71	0.8	67	67	-	0.80	1.0	84	84	-	7	4.0	4.0	4.0	2.4	2.8	-
OT	ET	-	1.5-17-F1A	1.5	1.72	2.0	67	67	-	1.95	2.4	84	84	-	17	6.6	6.6	6.6	2.4	2.8	-
OT	ET	HOT	1.5-18-F2A	1.5	1.82	2.1	67	67	64	2.07	2.5	84	84	81	18	6.0	6.2	7.2	2.4	2.8	-
OT	ET	HOT	1.5-24-F2A	1.5	2.42	2.7	67	67	64	2.76	3.4	84	84	81	24	6.6	8.8	10.8	2.2	2.4	-
OT	ET	HOT	1.5-30-F2A	1.5	3.03	3.6	67	67	64	3.45	4.2	84	84	81	30	6.2	10.3	12.3	2.1	2.2	-
OT	ET	-	1.5-31-F1	1.5	3.13	3.7	67	67	-	3.56	4.3	84	84	-	31	8.1	8.1	8.1	2.4	2.8	-
OT	ET	-	1.5-31-F1A	1.5	3.13	3.7	67	67	-	3.56	4.3	84	84	-	31	8.8	8.8	8.8	2.4	2.8	-
OT	ET	HOT	1.5-31-F2A	1.5	3.13	3.7	67	67	64	3.56	4.3	84	84	81	31	8.8	8.8	11.0	2.4	2.8	-
OT	ET	-	1.5-62-F3	1.5	6.27	7.5	67	67	-	7.12	8.7	84	84	-	62	12.2	11.2	13.2	2.4	2.8	2.0
OT	ET	HOT	1.5-65-F2A	1.5	6.57	7.8	67	67	64	7.47	9.1	84	84	81	65	13.2	12.1	13.2	2.4	2.8	-
OT	ET	-	1.5-68-F1A	1.5	6.87	8.2	67	67	-	7.81	9.5	84	84	-	68	13.2	13.2	13.2	2.4	2.8	-

Please see page 13 for more model numbers and specifications.

OptoTEC™

MELCOR's OptoTEC™ Series of modules and assemblies focuses on your electro-optic cooling requirements with laser-like precision. No one offers a broader or better range of solutions for cooling laser diodes, IR detectors, CCDs or other electro-optic systems.

Your competitive advantage is in your design. Our advantage is providing the cooler that makes your product work effectively, efficiently and reliably. That's why it pays to partner with Melcor, the original manufacturer of commercial thermoelectric (TEC) coolers. We offer a wide range of products and capabilities that enhance your design possibilities. We've recently tripled our telecom cooler manufacturing capacity to support your future growth. Use the power of our vast experience to secure the total solution for your telecom application.

- Pb-free construction solders up to 271˚C; pre-tinning available for packaging temperatures ranging from 93˚C to 232˚C
- Aluminum Nitride, Alumina or Beryllia
- Custom sizes, power densities and ceramic patterns
- Wire bondable posts, metallized pads and wires
- Package mounting, assembly, integral temperature sensors and ruggedizing
- Qualification and screening to Telcordia (Bellcore), MIL-STD and special requirements
- 200% expansion of telecom cooler manufacturing facility

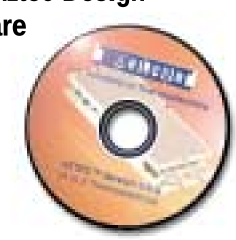
Wire Standards:

Module Type	Wire Gauge (AWG)
0.8-ALL	32
1.2-ALL	30
1.5-ALL	30
1.9-ALL	30
2.0-ALL	30
2OT0.6-ALL	32
2OT1.4-ALL	30
3OT-ALL	30

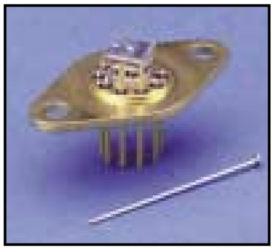
For all OptoTEC Series modules, wire is solid, uninsulated and 50mm (2.0 in.) long.

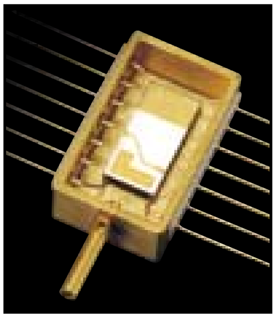
Insulated wire available on request.

Download our FREE Aztec Design Software



OptoTEC™ SERIES

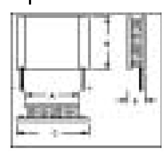




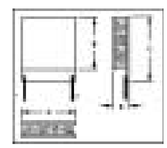
Internal Solder Temp.			Model	Imax	Th = 25˚C					Th = 75˚C					N	Dimensions					
							ΔTmax					ΔTmax									
138	232	271		Imax	Qmax	Vmax	OT	ET	HOT	Qmax	Vmax	OT	ET	HOT	N	A	B	C	D₁	D₂	E
OT	ET	-	1.9-23-F1N†	1.9	3.02	2.7	65	65	-	3.47	3.2	81	81	-	23	6.0	8.2	6.0	-	1.65	-
OT	ET	-	1.9-35-F1N†	1.9	4.60	4.2	65	65	-	5.28	4.9	81	81	-	35	6.0	12.2	6.0	-	1.65	-
OT	ET	-	2.0-7-F1A	2.0	0.95	0.8	67	67	-	1.09	1.0	84	84	-	7	4.0	4.0	4.0	2.2	2.5	-
OT	ET	-	2.0-17-F1A	2.0	2.30	2.0	67	67	-	2.65	2.4	84	84	-	17	6.6	6.6	6.6	2.2	2.5	-
OT	ET	HOT	2.0-18-F2A	2.0	2.43	2.1	67	67	64	2.80	2.5	84	84	81	18	6.0	6.2	7.2	2.2	2.5	-
OT	ET	HOT	2.0-24-F2A	2.0	3.23	2.7	67	67	64	3.74	3.4	84	84	81	24	6.6	8.8	10.8	2.0	2.2	-
OT	ET	HOT	2.0-30-F2A	2.0	4.04	3.6	67	67	64	4.67	4.2	84	84	81	30	6.2	10.3	12.3	1.8	2.0	-
OT	ET	-	2.0-31-F1	2.0	4.18	3.7	67	67	-	4.83	4.3	84	84	-	31	8.1	8.1	8.1	2.2	2.5	-
OT	ET	-	2.0-31-F1A	2.0	4.18	3.7	67	67	-	4.83	4.3	84	84	-	31	8.8	8.8	8.8	2.2	2.5	-
OT	ET	HOT	2.0-31-F2A	2.0	4.18	3.7	67	67	64	4.83	4.3	84	84	81	31	8.8	8.8	11.0	2.2	2.5	-
OT	ET	-	2.0-62-F3	2.0	8.36	7.5	67	67	-	9.66	8.7	84	84	-	62	12.2	11.2	13.2	2.2	2.5	2.0
OT	ET	HOT	2.0-65-F2A	2.0	8.76	7.8	67	67	64	10.13	9.1	84	84	81	65	13.2	12.1	13.2	2.2	2.5	-
OT	ET	-	2.0-68-F1A	2.0	9.16	8.2	67	67	-	10.59	9.5	84	84	-	68	13.2	13.2	13.2	2.2	2.5	-
			2 OT 0.6-83-F9 0.65	1.19	7.96	92	-	-	1.37	8.71	120	-	-	83	4.9	4.9	9.8	4.4	4.6	9.8	
			2 OT 1.4-24-F9 1.40	1.03	1.96	83	-	-	1.15	2.45	109	-	-	24	4.1	4.1	6.1	4.3	4.5	6.1	
			2 OT 1.4-10-F9 1.45	0.42	0.84	86	-	-	0.47	0.97	113	-	-	10	3.2	3.2	3.9	3.8	3.9	3.9	
			3 OT 1.3-46-F9 1.30	0.65	3.40	109	-	-	0.81	4.54	139	-	-	46	4.1	4.4	8.8	5.8	5.9	8.8	
			3 OT 1.3-26-F9 1.33	0.35	1.94	110	-	-	0.43	2.56	140	-	-	26	2.5	2.5	6.6	5.2	5.4	6.6	

† Al_2O_3 is the standard ceramic on all parts shown except for the items indicated, which have AlN.

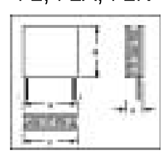
OptoTEC – F0



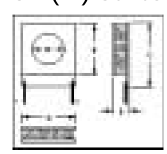
OptoTEC – F2, F2A



OptoTEC – F1, F1A, F1N



OptoTEC – F3 SH (-2) Series



Definitions:

Imax Input current resulting in greatest ΔT (ΔTmax)[Amps]

Qmax Maximum amount of heat that can be absorbed at cold face (occurs at I = Imax, ΔT = 0°)[watts]

Th Temperature of the TEC hot face during operation [°C]

ΔTmax Maximum temperature difference a TEC can achieve (occurs at I = Imax, Q_C = 0)[°C]

Vmax Voltage at ΔTmax

A, B, C TEC footprint dimensions

D_1 Non-metallized thickness

D_2 Metallized (Au plated) thickness before pre-tinning

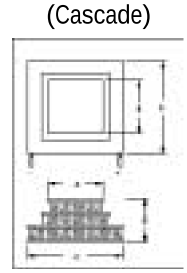
Interfacing and Options:

See chart on page 24.

Notes:

1) Qmax rated value at ΔT = 0°, Imax and Vmax, Th = 25°C.
2) Thickness for non-metallized versions only.

OptoTEC – F9 Typical Multistage (Cascade)



Model Number Nomenclature

__ __T_____ – _____ – F__ _____ – H__ – C__

TEC construction solder:
OT = 138˚C
ET = 232˚C
HOT= 271˚C
(Patented)

Imax = Input current resulting in greatest ΔT (Amps)

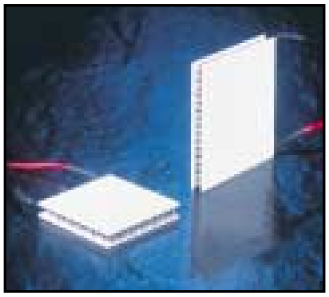
N = Number of thermocouples (p- and n-type pairs)

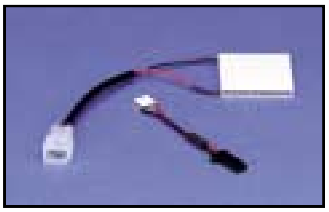
Configuration:
F0 = side-porch style ceramics
F1 or F1A = non-porch style ceramics
F2 or F2A = porch style ceramics

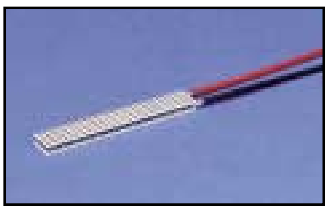
Ceramic material: (see note † above)
Blank = Aluminum Oxide (Al_2O_3, Alumina)
N = Aluminum Nitride (AlN)
B = Beryllium Oxide (BeO, Beryllia)

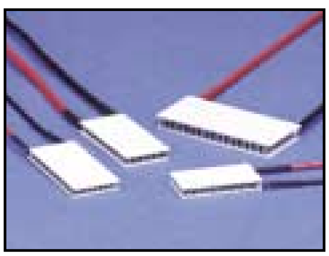
Hot and Cold side finishing options:
G = Au metallization
1 = Bare ceramic
2 = Pretinned with 118˚C InSn solder
3 = Pretinned with 138˚C BiSn solder (available only for ET and HOT thermoelectrics)
4 = Pretinned with 183˚C SnPb solder (available only for ET and HOT thermoelectrics)
5 = Pretinned with 93˚C InSnCd solder

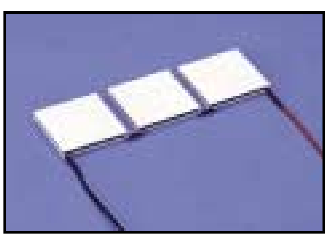
CP Series TECs











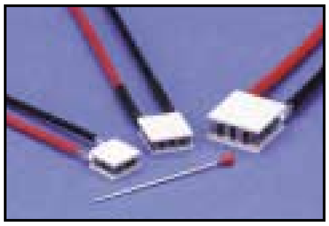
CP Series Specifications

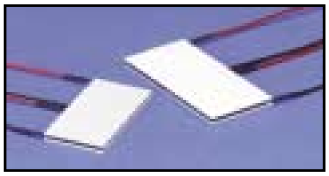
Catalog Number	Imax (Amps)	Th = 25˚C			N	Dimensions (mm)			
		Qmax[1] (Watts)	Vmax (Volts)	ΔTmax (˚C)		A	B	C	D[2]
CP0.8-7-06L	2.1	1.0	0.85	67	7	6	6	6	3.4
CP0.8-17-06L	2.1	2.4	2.06	67	17	9	9	9	3.4
CP0.8-31-06L	2.1	4.4	3.75	67	31	12	12	12	3.4
CP0.8-63-06L	2.1	9.0	7.62	67	63	12	25	12	3.4
CP0.8-71-06L	2.1	10.1	8.60	67	71	18	18	18	3.4
CP0.8-127-06L	2.1	18.1	15.40	67	127	25	25	25	3.4
‡ CP0.8-254-06L	2.1/4.2	36.2	30.8/15.4	67	254	50	25	50	3.4
CP0.8-127-05L	2.6	22.4	15.40	67	127	25	25	25	3.1
‡ CP0.8-254-05L	2.6/5.2	44.8	30.8/15.4	67	254	50	25	50	3.1
CP1.0-7-08L	2.5	1.2	0.85	67	7	8	8	8	4.0
CP1.0-17-08L	2.5	2.9	2.06	67	17	12	12	12	4.0
CP1.0-31-08L	2.5	5.3	3.75	67	31	15	15	15	4.0
CP1.0-63-08L	2.5	10.6	7.62	67	63	15	30	15	4.0
CP1.0-71-08L	2.5	12.0	8.60	67	71	23	23	23	4.0
CP1.0-127-08L	2.5	21.4	15.40	67	127	30	30	30	4.0
‡ CP1.0-254-08L	2.5/5.0	42.8	30.8/15.4	67	254	60	30	60	4.0
CP1.0-7-06L	3.0	1.4	0.85	67	7	8	8	8	3.6
CP1.0-17-06L	3.0	3.4	2.06	67	17	12	12	12	3.6
CP1.0-31-06L	3.0	6.3	3.75	67	31	15	15	15	3.6
CP1.0-63-06L	3.0	12.7	7.62	67	63	15	30	15	3.6
CP1.0-71-06L	3.0	14.4	8.60	67	71	23	23	23	3.6
CP1.0-127-06L	3.0	25.7	15.40	67	127	30	30	30	3.6
‡ CP1.0-254-06L	3.0/6.0	51.4	30.8/15.4	67	254	60	30	60	3.6
CP1.0-7-05L	3.9	1.8	0.85	67	7	8	8	8	3.2
CP1.0-17-05L	3.9	4.5	2.06	67	17	12	12	12	3.2
CP1.0-31-05L	3.9	8.2	3.75	67	31	15	15	15	3.2
CP1.0-63-05L	3.9	16.6	7.62	67	63	15	30	15	3.2
CP1.0-71-05L	3.9	18.7	8.60	67	71	23	23	23	3.2
CP1.0-127-05L	3.9	33.4	15.40	67	127	30	30	30	3.2
‡ CP1.0-254-05L	3.9/7.8	66.8	30.8/15.4	67	254	60	30	60	3.2
CP1.4-11-10L	3.9	2.9	1.33	68	11	10	15	10	4.7
CP1.4-17-10L	3.9	4.5	2.06	68	17	15	15	15	4.7
CP1.4-31-10L	3.9	8.2	3.75	68	31	20	20	20	4.7
CP1.4-35-10L	3.9	9.2	4.24	68	35	15	30	15	4.7
CP1.4-51-10L	3.9	13.4	6.18	68	51	9.5	62	9.5	4.7
CP1.4-71-10L	3.9	18.7	8.60	68	71	30	30	30	4.7
CP1.4-127-10L	3.9	33.4	15.40	68	127	40	40	40	4.7
CP1.4-11-06L	6.0	4.4	1.33	67	11	10	15	10	3.8
CP1.4-17-06L	6.0	6.9	2.06	67	17	15	15	15	3.8
CP1.4-31-06L	6.0	12.5	3.75	67	31	20	20	20	3.8
CP1.4-35-06L	6.0	14.2	4.24	67	35	15	30	15	3.8
CP1.4-51-06L	6.0	20.6	6.18	67	51	9.5	62	9.5	3.8
CP1.4-71-06L	6.0	28.7	8.60	67	71	30	30	30	3.8
CP1.4-127-06L	6.0	51.4	15.40	67	127	40	40	40	3.8

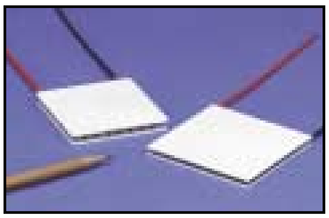
More specifications on following page.

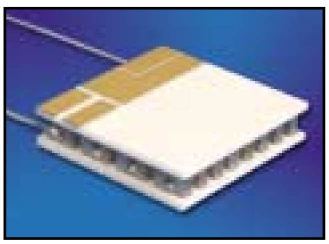
CP Series

- For higher current, larger heat pumping applications
- Low-Cost, High-Performance
- The standard for consumer product and industrial cooling
- Ideal for instrumentation, laboratory apparatus, consumer appliances
- Excellent for applications from commercial to military









CP Series Specifications

Catalog Number	Imax (Amps)	Th = 25˚C			N	Dimensions (mm)			
		Qmax[1] (Watts)	Vmax (Volts)	ΔTmax (˚C)		A	B	C	D[2]
CP1.4-11-045L	8.5	6.0	1.33	65	11	10	15	10	3.3
CP1.4-17-045L	8.5	9.2	2.06	65	17	15	15	15	3.3
CP1.4-31-045L	8.5	16.8	3.75	65	31	20	20	20	3.3
CP1.4-35-045L	8.5	19.0	4.24	65	35	15	30	15	3.3
CP1.4-51-045L	8.5	28.9	6.18	65	51	9.5	62	9.5	3.3
CP1.4-71-045L	8.5	38.5	8.60	65	71	30	30	30	3.3
CP1.4-127-045L	8.5	72.0	15.40	65	127	40	40	40	3.3
CP2-17-10L	9.0	10.3	2.06	68	17	22	22	22	5.6
CP2-31-10L	9.0	18.8	3.75	68	31	30	30	30	5.6
CP2-49-10L	9.0	29.7	5.93	68	49	36	36	36	5.6
CP2-71-10L	9.0	43.1	8.60	68	71	44	44	44	5.6
CP2-127-10L	9.0	77.1	15.40	68	127	62	62	62	5.6
CP2-17-06L	14.0	16.0	2.06	67	17	22	22	22	4.6
CP2-31-06L	14.0	29.3	3.75	67	31	30	30	30	4.6
CP2-49-06L	14.0	46.2	5.93	67	49	36	36	36	4.6
CP2-71-06L	14.0	67.0	8.60	67	71	44	44	44	4.6
CP2-127-06L	14.0	120.0	15.40	67	127	62	62	62	4.6
CP2.8-31-06L	24.0	50.2	3.75	67	31	40	40	40	5.0
CP5-31-10L	39.0	81.5	3.75	68	31	55	55	55	5.8
CP5-31-06L	60.0	125.0	3.75	67	31	55	55	55	4.9

Interfacing and Options:

Both hot and cold faces non-metallized flat, Type L. Both faces metallized and tinned, Type TT. Hybrid, hot face tinned, cold faced non-metallized, Type TL. Hot face non-metallized, cold face tinned, Type LT. Two face soldering (Type TT) in sizes larger than 12 x 12 mm is not recommended. Consult MELCOR for details. See chart on page 24.

Example: CP1.0-127-05TL
Hot face tinned with 118˚C solder
Cold face non-metallized

Notes:

1) Qmax rated value at ΔT = 0°, Imax and Vmax, Th = 25°C.

2) Thickness for Type L only.

Definitions:

Imax	Input current resulting in greatest ΔT (ΔTmax)[amps]
N	Number of thermocouples (p- and n-type pairs)
Qmax	Maximum amount of heat that can be absorbed at cold face (occurs at I = Imax, ΔT = 0°)[watts]
Th	Temperature of the TEC hot face during operation [°C]
ΔTmax	Maximum temperature difference a TEC can achieve (occurs at I = Imax, Q_C = 0)[°C]
Vmax	Voltage at ΔTmax

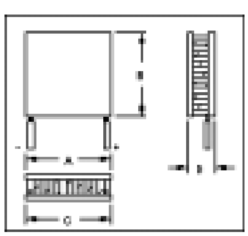
Wire Standards:

Module Type	Wire Gauge (AWG)
CP0.8-ALL	26
CP1.0-ALL	24
CP1.4-ALL	18
CP2-ALL	18
CP2.8-ALL	16
CP5-_ _-10	14 (Teflon™)
CP5-_ _-06	12 (Teflon™)
‡ CP_ _-254-_ _	Contact Melcor

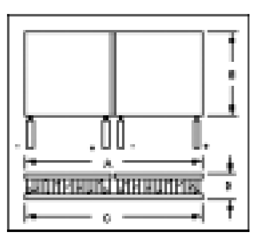
For all CP Series modules, wire is stranded, 114 mm (4.5 in.) long and PVC insulated, except CP5.

‡ These modules have four leads and can be wired in series or parallel. The Specifications table indicates maximum values for V and I when "Wired in Series/Wired in Parallel".

CP Series



‡CP_ _-254- _ _



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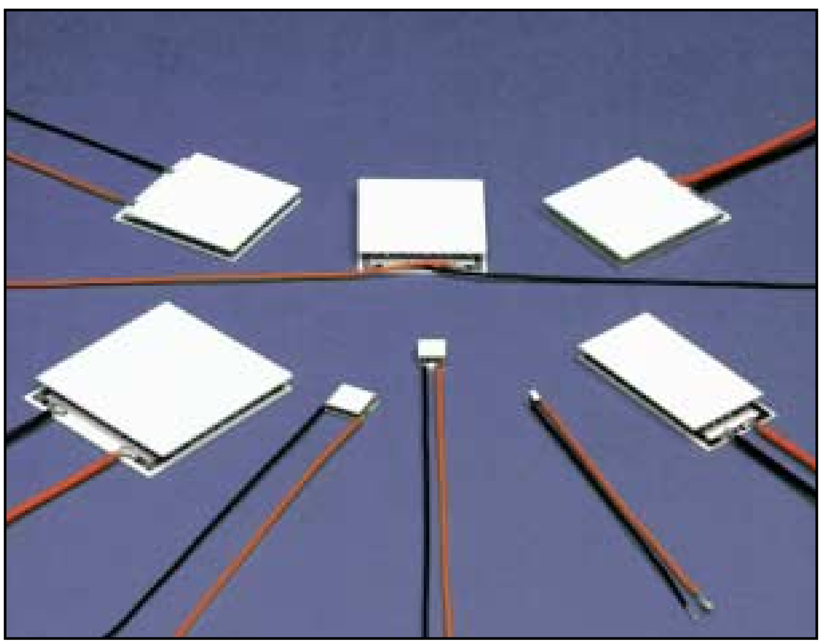
ThermaTEC™

- Unique patented technology works at +225˚C
- Affordable
- Full range of size, power and cooling capacities
- Superior cycling capacity
- Solid-state reliability
- Strong, porch-style lead attachment
- Generate power from waste heat!
- MELCOR Quality

High-Temperature Cooling:

MELCOR's new ThermaTEC™ keeps on cooling at temperatures that would cook other TECs: +225˚C. And only ThermaTEC offers MELCOR reliability, and at a reasonable cost. For cooling, heating or power generation, ThermaTEC is the ultimate high-temp TEC.



The ThermaTEC™ series is designed for high temperature applications and packaging (+225˚C). These rugged TECs were designed to withstand the demands of repeated cycling over a large temperature range. The *patented* technology offers the greatest operational flexibility. ThermaTEC can also be used for power generation; converting waste heat into electrical energy. The possibilities are endless.

U.S. Patent 5,817,188

Download our FREE Aztec Design Software

ThermaTEC™ SERIES

Catalog Number	Th = 25°C				Th = 125°C				Th = 200°C				N	Dimensions (mm)			
	Imax (Amps)	Qmax(1) (Watts)	Vmax (Volts)	ΔTmax (°C)	Imax (Amps)	Qmax(1) (Watts)	Vmax (Volts)	ΔTmax (°C)	Imax (Amps)	Qmax (Watts)	Vmax (Volts)	ΔTmax (°C)		A	B	C	D(2)
HOT1.2-18-F2A	1.2	1.46	2.1	64	1.2	1.79	2.9	91	1.1	1.77	3.2	90	18	6.0	6.2	7.2	2.7
HOT1.2-24-F2A	1.2	1.97	2.7	64	1.2	2.39	3.9	91	1.1	2.36	4.3	90	24	6.6	8.8	10.8	2.5
HOT1.2-30-F2A	1.2	2.43	3.6	64	1.2	2.98	4.8	91	1.1	2.95	5.4	90	30	6.2	10.3	12.3	2.3
HOT1.2-31-F2A	1.2	2.51	3.7	64	1.2	3.08	5.0	91	1.1	3.05	5.6	90	31	8.8	8.8	11.0	2.7
HOT1.2-65-F2A	1.2	5.34	7.8	64	1.2	6.47	10.5	91	1.1	6.39	11.7	90	65	13.2	12.1	13.2	2.7
HOT1.5-18-F2A	1.5	1.82	2.1	64	1.4	2.15	2.9	91	1.3	2.12	3.2	90	18	6.0	6.2	7.2	2.4
HOT1.5-24-F2A	1.5	2.42	2.7	64	1.4	2.86	3.9	91	1.3	2.83	4.3	90	24	6.6	8.8	10.8	2.2
HOT1.5-30-F2A	1.5	3.03	3.6	64	1.4	3.58	4.8	91	1.3	3.54	5.4	90	30	6.2	10.3	12.3	2.1
HOT1.5-31-F2A	1.5	3.13	3.7	64	1.4	3.70	5.0	91	1.3	3.66	5.6	90	31	8.8	8.8	11.0	2.4
HOT1.5-65-F2A	1.5	6.57	7.8	64	1.4	7.76	10.5	91	1.3	7.67	11.7	90	65	13.2	12.1	13.2	2.4
HOT2.0-18-F2A	2.0	2.43	2.1	64	1.8	2.69	2.9	91	1.6	2.65	3.2	90	18	6.0	6.2	7.2	2.2
HOT2.0-24-F2A	2.0	3.32	2.7	64	1.8	3.58	3.9	91	1.6	3.54	4.3	90	24	6.6	8.8	10.8	2.0
HOT2.0-30-F2A	2.0	4.04	3.6	64	1.8	4.48	4.8	91	1.6	4.42	5.4	90	30	6.2	10.3	12.3	1.8
HOT2.0-31-F2A	2.0	4.18	3.7	64	1.8	4.63	5.0	91	1.6	4.57	5.6	90	31	8.8	8.8	11.0	2.2
HOT2.0-65-F2A	2.0	8.76	7.8	64	1.8	9.70	10.5	91	1.6	9.58	11.7	90	65	13.2	12.1	13.2	2.2
HT2-12-30	2.3	20	14.4	63	2.2	24	20.5	90	2.1	24	22.8	89	127	30	30	34	3.6
HT3-12-30	2.8	24	14.4	63	2.8	30	20.5	90	2.6	29	22.8	89	127	30	30	34	3.2
HT4-6-21x43	3.7	16	7.2	64	3.7	19	10.1	91	3.4	19	11.3	90	63	21	38	43	4.1
HT4-7-30	3.7	18	8.1	64	3.7	22	11.4	91	3.4	22	12.7	90	71	30	30	34	4.1
HT4-12-40	3.7	32	14.4	64	3.7	39	20.5	91	3.4	39	22.8	90	127	40	40	44	4.1
HT4-12-30	3.9	33	14.4	63	3.8	41	20.5	90	3.6	41	22.8	89	127	30	30	34	3.2
HT6-6-21x43	6.0	26	7.2	63	5.9	31	10.1	90	5.5	31	11.3	89	63	21	38	43	3.8
HT6-7-30	6.0	29	8.1	63	5.9	35	11.4	90	5.5	35	12.7	89	71	30	30	34	3.8
HT6-12-40	6.0	51	14.4	63	5.9	63	20.5	90	5.5	62	22.8	89	127	40	40	44	3.6
HT8-12-30	8.2	70	14.5	63	7.7	82	20.5	88	7.1	81	22.8	87	127	30	30	34	2.6
HT8-7-30	8.5	39	8.1	63	8.3	49	11.4	89	7.7	49	12.7	88	71	30	30	34	3.3
HT8-12-40	8.5	72	14.4	63	8.3	88	20.5	89	7.7	87	22.8	88	127	40	40	44	3.3
HT9-3-25	9.6	20	3.6	66	9.5	25	5.0	93	8.9	25	5.6	92	31	25	25	29	4.9

Interfacing and Options: Both hot and cold faces non-metallized. See chart on page 24. HT = ThermaTEC options, HOT = OptoTEC options.

Notes: 1) Qmax rated value at ΔT = 0°, Imax and Vmax, Th = 25°C. 2) Thickness for non-metallized versions only.

Wire Standards:

Imax at 25°C (Amps)	Wire Gauge (AWG)
≤ 2.0	30
> 2.0 and < 3.7	24
3.7	18
3.9	24
≥ 6.0	18 or 20

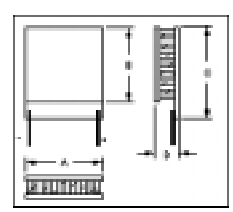
For all HT Series modules, wire is 152 mm (6.0 in.) long and Teflon™ insulated.

For all HOT modules, the wire is solid, uninsulated and 50mm (2.0 in.) long.

Definitions:

- Imax — Input current resulting in greatest ΔT (ΔTmax)[amps]
- N — Number of thermocouples (p- and n- type pairs)
- Qmax — Maximum amount of heat that can be absorbed at cold face (occurs at I = Imax, ΔT = 0°)[watts]
- Th — Temperature of the TEC hot face during operation [°C]
- ΔTmax — Maximum temperature difference a TEC can achieve (occurs at I = Imax, Q_C = 0)[°C]
- Vmax — Voltage at ΔTmax

ThermaTEC, HT, HOT



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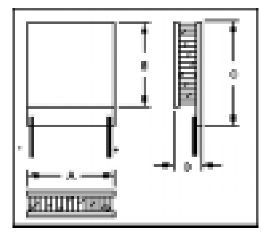
PolarTEC™ SERIES

Catalog Number	Th = 25°C				N	Dimensions (mm)			
	Imax (Amps)	Qmax[1] (Watts)	Vmax[1] (Volts)	ΔTmax (°C)		A	B	C	D[2]
PT2-12-30	2.3	20	14.4	65	127	30	30	34	3.6
PT3-12-30	2.8	24	14.4	65	127	30	30	34	3.2
PT4-7-30	3.7	18	8.1	67	71	30	30	34	4.1
PT4-12-30	3.9	33	14.4	65	127	30	30	34	3.2
PT4-12-40	3.7	32	14.4	67	127	40	40	44	4.1
PT6-7-30	6.0	29	8.1	65	71	30	30	34	3.8
PT6-12-40	6.0	52	14.4	65	127	40	40	44	3.8
PT8-7-30	8.5	40	8.1	64	71	30	30	34	3.3
PT8-12-40	8.5	72	14.4	64	127	40	40	44	3.3

PolarTEC™

- Low cost
- Designed for high volume commercial applications
- Full range of size, power and cooling capacities
- Solid-state reliability
- Strong, porch-style lead attachment available
- MELCOR Quality

PolarTEC



Low-Cost Cooling:

PolarTEC™ modules offer reliable, low-cost cooling for consumer and other high volume applications where cost is critical. The series features strong, porch-style lead attachments and MELCOR's proven quality.

Wire Standards:

Module Type	Wire Gauge (AWG)
PT2-ALL	24
PT3-ALL	24
PT4-7-30	18
PT4-12-30	24
PT4-12-40	18
PT6-ALL	18
PT8-ALL	18

For all PT Series modules, wire is stranded, 152 mm (6.0 in.) long and PVC insulated.

Interfacing and Options:

Both hot and cold faces non-metallized. See chart on page 24.

Notes:

1) Qmax rated value at ΔT = 0°, Imax and Vmax, Th = 25°C.
2) Thickness for non-metallized versions only.

Definitions:

Imax	Input current resulting in greatest ΔT (ΔTmax)[amps]
N	Number of thermocouples (PTx-7-x=71, PTx-12-x=127)
Qmax	Maximum amount of heat that can be absorbed at cold face (occurs at I = Imax, ΔT = 0°)[watts]
Th	Temperature of the TEC hot face during operation [°C]
ΔTmax	Maximum temperature difference a TEC can achieve (occurs at I = Imax, Q_C = 0)[°C]
Vmax	Voltage at ΔTmax

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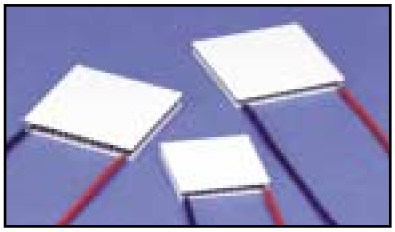
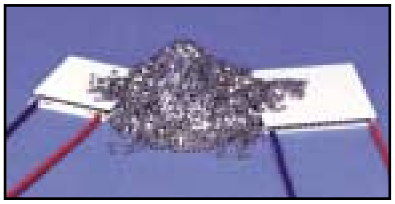
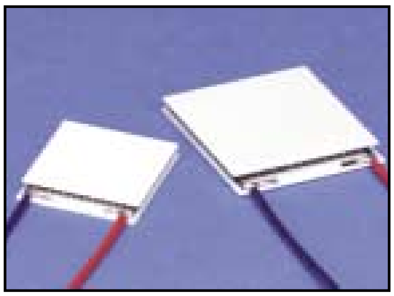




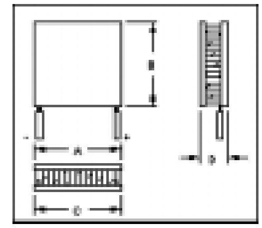


UltraTEC™

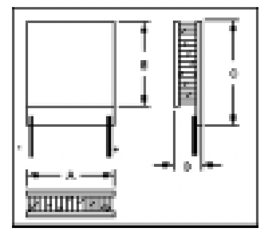
UltraTEC™ is the ultimate in thermoelectric cooling technology. Using high performance material technology, it offers the highest performance and efficiencies.

- High performance and power using the latest thermoelectric material technology
- Increased temperature differences (ΔT) or increased heat pumping density
- Increased efficiency
- Most popular sizes and capacities
- Solid-state reliability
- MELCOR Quality

F1 (no porch)



F2 (porch)



Interfacing and Options:

F2 (porch) style available in non-metallized finish only.
F1 style options listed on page 24.

Definitions:

Imax	Input current resulting in greatest ΔT (ΔTmax)[amps]
N	Number of thermocouples (p- and n-type pairs)
Qmax	Maximum amount of heat that can be absorbed at cold face (occurs at I = Imax, ΔT = 0°)[watts]
Th	Temperature of the TEC hot face during operation [°C]
ΔTmax	Maximum temperature difference a TEC can achieve (occurs at I = Imax, Q_C = 0)[°C]
Vmax	Voltage at ΔTmax

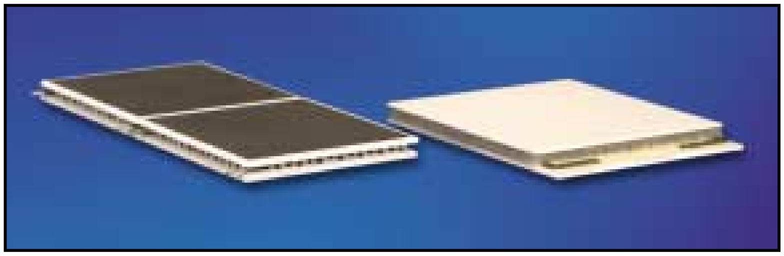
UltraTEC Series Specifications

Catalog Number	Th = 50˚C				Th = 25˚C				N	Dimensions (mm)				Wire Gauge (AWG)
	Imax (Amps)	Qmax[1] (Watts)	Vmax (Volts)	ΔTmax (˚C)	Imax (Amps)	Qmax (Watts)	Vmax (Volts)	ΔTmax (˚C)		A	B	C	D[2]	
UT4-12-30-F1	3.8	37	16.1	78	3.9	33	14.4	68	127	30	30	30	3.2	24
UT4-12-30-F2	3.8	37	16.1	78	3.9	33	14.4	68	127	30	30	34	3.2	24
UT4-7-30-F1	3.7	21	9.0	79	3.8	18	8.1	70	71	30	30	30	4.7	18
UT4-12-40-F1	3.7	37	16.1	79	3.8	33	14.4	70	127	40	40	40	4.7	18
UT6-7-30-F1	5.7	32	9.0	79	6.0	29	8.1	70	71	30	30	30	3.8	18
UT6-12-40-F1	5.7	56	16.1	79	6.0	52	14.4	70	127	40	40	40	3.8	18
UT6-12-40-F2	5.7	56	16.1	79	6.0	52	14.4	70	127	40	40	44	3.8	18
UT8-12-25-F2	7.9	75	16.2	79	7.9	69	14.4	69	127	25	24	27	1.9	24
UT8-12-30-F2	7.9	75	16.2	79	7.9	69	14.4	69	127	30	30	34	2.6	20
UT8-12-40-F1	8.0	78	16.1	77	8.5	72	14.4	67	127	40	40	40	3.3	18
UT11-12-30-F2	10.9	105	16.2	79	11.0	95	14.4	69	127	30	30	34	2.4	22
UT15-7-30-F2	14.5	77	9.1	79	14.6	70	8.0	69	71	30	30	34	2.8	20
UT15-12-40-F2	14.5	138	16.2	79	14.6	126	14.4	69	127	40	40	44	2.8	20

For all UT Series modules, wire is 152mm (6.0 in.) long.

Notes:
1) Qmax rated value at ΔT = 0°, Imax and Vmax, Th at indicated value.
2) Thickness for non-metallized versions only.

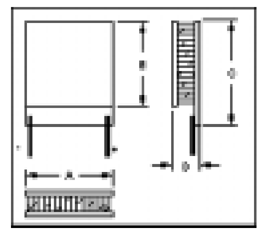
High Power Density Series



Melcor's High Power thermoelectrics perform cooling previously only possible with much larger or multiple thermoelectrics.

- High heat-pumping capacity within small areas
- High efficiency in most applications when replacing lower-power thermoelectrics
- Solid-state reliability
- Available in regular temperature as well as high temperature (ThermaTEC)
- Strong, porch-style lead attachment
- Melcor Quality

High Power Density



High Power Density Series Specifications

Catalog Number	Th = 25˚C				N	Dimensions (mm)			
	Imax (Amps)	Qmax[1] (Watts)	Vmax (Volts)	∆Tmax (˚C)		A	B	C	D[2]
UT8-12-25-F2	7.9	69	14.4	69	127	25	24	27	1.9
UT8-12-30-F2	7.9	69	14.4	69	127	30	30	34	2.6
UT11-12-30-F2	11.0	95	14.4	69	127	30	30	34	2.4
UT15-7-30-F2	14.6	70	8.0	69	71	30	30	34	2.8
UT15-12-40-F2	14.6	126	14.4	69	127	40	40	44	2.8
HT8-12-30	8.2	70	14.5	66	127	30	30	34	2.6

Wire Standards:

Module Type	Wire Gauge (AWG)
UT8-12-25	24
UT8-12-30	20
UT11-12-30	22
UT15-7-30	20
UT15-12-40	20
HT8-12-30	20

For all High Power Density Series, wire is 152mm (6.0 in.) long.

Interfacing and Options:

Both hot and cold faces non-metallized. See chart on page 24.

Notes:

1) For all High Density Series modules, wire is 152mm (6.0 in.) long.
2) Density Series modules, wire is 152mm (6.0 in.) long.

Definitions:

Imax	Input current resulting in greatest ∆T (∆Tmax)[amps]
N	Number of thermocouples (p- and n-type pairs)
Qmax	Maximum amount of heat that can be absorbed at cold face (occurs at I = Imax, ∆T = 0°)[watts]
Th	Temperature of the TEC hot face during operation [°C]
∆Tmax	Maximum temperature difference a TEC can achieve (occurs at I = Imax, Q_C = 0)[°C]
Vmax	Voltage at ∆Tmax

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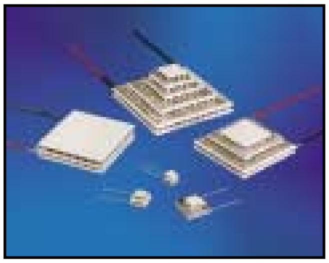
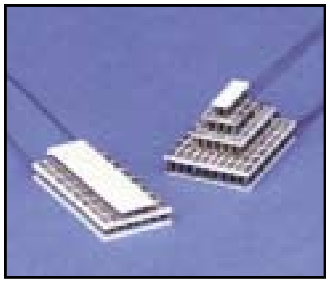
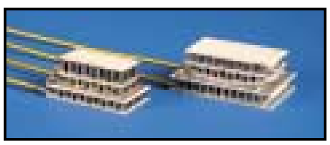
Multistage Series TECs

Multistage (Cascade) Series Specifications







Catalog Number	Imax (Amps)	Th = 25˚C			Dimensions (mm)				
		Qmax[1] (Watts)	Vmax (Volts)	ΔTmax (˚C)	A	B	C	D	E[2]
2 OT 1.4-10-F9	1.45	0.42	0.84	86	3.2	3.2	3.9	3.9	3.8
2 OT 1.4-24-F9	1.40	1.03	1.96	83	4.1	4.1	6.1	6.1	4.2
2 OT 0.6-83-F9	0.65	1.19	7.96	92	4.9	4.9	9.8	9.8	4.2
2 CP 040 080-7-2	2.0	0.41	0.8	91	3.5	3.5	8	8	7.4
2 CP 040 065-31-17	2.1	3.11	3.8	81	11.5	11.5	15	15	6.6
2 CP 055 065-31-17	4.0	6.04	3.8	81	15	15	20	20	7.2
2 CP 085 100-31-20	5.9	9.74	3.8	77	23	26	30	30	10.7
2 CP 055 065-71-31	4.3	12.65	8.6	85	20	20	30	30	7.2
2 SC 040 050-127-63	2.8	16.05	15.5	83	30	30	30	30	6.5
2 CP 085 065-71-31	10.3	30.22	8.6	85	30	30	44	44	8.9
2 SC 055 045-127-63	6.0	34.51	15.5	83	40	40	40	40	7.5
2 SC 085 065-127-70	9.5	59.25	15.5	81	62	62	62	62	8.9
3 OT 1.3-26-F9	1.33	0.35	1.94	110	2.5	2.5	6.6	6.6	5.2
3 OT 1.3-46-F9	1.30	0.65	3.40	109	4.1	4.4	8.8	8.8	5.8
3 CP 040 065-31-17-7	1.8	1.52	3.8	96	8	8	15	15	9.5
3 CP 040 065-127-71-31	1.8	6.48	15.4	96	15	15	30	30	9.5
3 CP 055 065-71-31-17	3.5	6.53	7.7	97	15	15	30	30	10.4
3 CP 055 065-127-71-31	3.5	12.58	15.4	96	20	20	40	40	10.4
3 CP 085 065-71-31-17	8.4	15.60	7.7	97	22	22	44	44	12.9
4 CP 040 080-31-17-7-2	1.5	0.47	3.8	114	3.5	3.5	15	15	14.0
4 CP 040 080-64-26-11-6	1.4	1.08	6.8	110	4	11	16	23.6	14.0
4 CP 040 065-71-31-17-7	1.7	1.66	7.9	110	8	8	23	23	12.5
4 CP 055 065-69-29-11-6	3.4	2.68	7.5	112	4.5	14.5	24	33	13.8
4 CP 040 080-127-71-31-17	1.3	2.87	14.6	107	11.5	11.5	30	30	14.0
4 CP 055 065-127-71-31-17	3.1	6.84	14.6	107	15	15	40	40	13.8
5 CP 040 065-127-71-31-17-7	1.6	1.74	14.5	118	8	8	30	30	15.4
5 CP 055 065-127-71-31-17-7	3.0	3.37	14.5	118	10	10	40	40	16.9
6 CP 040 065-127-71-31-17-7-2	1.5	0.63	14.5	131	3.5	3.5	30	30	18.3
6 CP 055 065-127-71-31-17-7-2	3.0	1.22	14.5	131	5	5	40	40	20.1

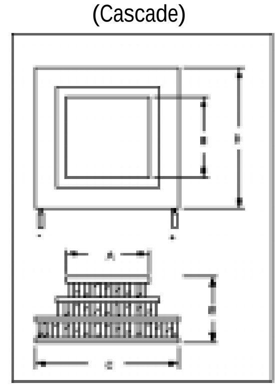
Wire Standards:

Contact MELCOR.

Multistage

- Ideal for requirements with large temperature differentials (ΔT) up to 131˚C
- Standard designs meet most multistage requirements
- **Custom designs available to meet any multistage application**

Typical Multistage (Cascade)



Interfacing and Options:

Both hot and cold faces non-metallized flat, Type L. Both faces metallized and tinned, Type TT. Hybrid, hot face tinned, cold faced non-metallized, Type TL. Hot face non-metallized, cold face tinned, Type LT. Two face soldering (Type TT) in sizes larger than 12 x 12 mm is not recommended. Consult MELCOR for details. See chart on page 24.

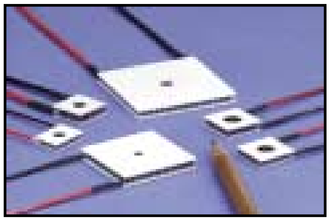
Notes:

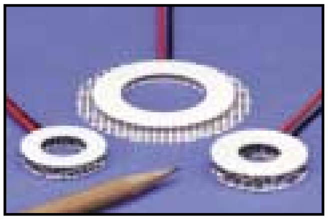
1) Qmax rated value at ΔT = 0°, Imax and Vmax, Th = 25°C.
2) Thickness for non-metallized versions only.

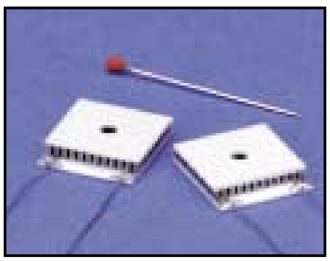
Definitions:

Imax	Input current resulting in greatest ΔT (ΔTmax)[amps]
Qmax	Maximum amount of heat that can be absorbed at cold face (occurs at I = Imax, ΔT = 0°)[watts]
Th	Temperature of the TEC hot face during operation [°C]
ΔTmax	Maximum temperature difference a TEC can achieve (occurs at I = Imax, Q_C = 0)[°C]
Vmax	Voltage at ΔTmax

Center Hole Series TECs







Center Hole (Annular) Series Specifications

Catalog Number	Imax (Amps)	Th = 25˚C			N	Dimensions (mm)				
		Qmax[(1)] (Watts)	Vmax (Volts)	∆Tmax (˚C)		A	B	C	D[(2)]	E
OT 1.2-62-F3	1.20	5.01	7.52	67	62	12.3	11.3	13.4	2.7	2.0
OT 1.5-62-F3	1.50	6.27	7.52	67	62	12.3	11.3	13.4	2.4	2.0
OT 2.0-62-F3	2.00	8.36	7.52	67	62	12.3	11.3	13.4	2.2	2.0
SH 0.8 -28 -05	2.6	4.9	3.9	67	28	14.7	10.3	14.7	3.1	4.4
SH 1.0 -23 -06	3.0	4.7	2.8	67	23	15	15	15	3.6	7.2
SH 1.0 -95 -06	3.0	19.3	11.5	67	95	30	30	30	3.6	14.5
SH 1.0-125-06	3.0	25.3	15.2	67	125	30	30	30	3.6	3.6
SH 1.0 -23 -05	3.9	6.0	2.8	67	23	15	15	15	3.2	7.2
SH 1.0 -95 -05	3.9	25.1	11.5	67	95	30	30	30	3.2	14.5
SH 1.0-125-05	3.9	32.9	15.2	67	125	30	30	30	3.2	3.6
SH 1.4 -15 -10	3.9	3.9	1.8	68	15	14	14	14	4.7	5.1
SH 1.4 -69 -10	3.9	18.1	8.4	68	69	30	30	30	4.7	3.6
SH 1.4 -125 -10	3.9	32.9	15.2	68	125	40	40	40	4.7	4.7
SH 1.4 -15 -06	6.0	6.1	1.8	67	15	14	14	14	3.8	5.1
SH 1.4 -69 -06	6.0	27.9	8.4	67	69	30	30	30	3.8	3.6
SH 1.4 -125 -06	6.0	50.7	15.2	67	125	40	40	40	3.8	4.7
SH 1.4 -15 -045	8.5	8.1	1.8	65	15	14	14	14	3.3	5.1
SH 1.4 -69 -045	8.5	37.3	8.4	65	69	30	30	30	3.3	3.6
SH 1.4 -125 -045	8.5	67.7	15.2	65	125	40	40	40	3.3	4.7
SH 2 -20 -10	9.0	12.2	2.4	68	20	30	30	30	5.6	13
SH 2 -20 -06	14.0	18.9	2.4	67	20	30	30	30	4.6	13
RH 1.4 -14 -10	3.9	3.7	1.7	68	14	26	26	26	4.7	14
RH 1.4 -32 -10	3.9	8.4	3.9	68	32	44	55	55	4.7	27
RH 1.4 -14 -06	6.0	5.7	1.7	67	14	26	26	26	3.8	14
RH 1.4 -32 -06	6.0	12.9	3.9	67	32	44	55	55	3.8	27
RH 1.4 -14 -045	8.5	7.6	1.7	65	14	26	26	26	3.3	14
RH 1.4 -32 -045	8.5	17.3	3.9	65	32	44	55	55	3.3	27
RH 2 -10 -10	9.0	6.1	1.2	68	10	29	29	29	5.6	13
RH 2 -10 -06	14.0	9.4	1.2	67	10	29	29	29	4.6	13

Wire Standards:

Module Type	Wire Gauge (AWG)
OT-ALL	30
SH0.8-ALL	26
SH1.0-ALL	24
SH1.4-ALL	18
SH2-ALL	18
RH1.4-ALL	18
RH2-ALL	18

For all OptoTEC Series modules, wire is solid, uninsulated and 50mm (2.0 in.) long.

For all SH and RH Series modules, wire is stranded, 114 mm (4.5 in.) long and PVC insulated.

Download our FREE Aztec Design Software

Center Hole

- Features center hole for transmission of light, wires, probes or other hardware through the TEC
- Round or square configurations available

Interfacing and Options:

Both hot and cold faces non-metallized flat, Type L. Both faces metallized and tinned, Type TT. Hybrid, hot face tinned, cold faced non-metallized, Type TL. Hot face non-metallized, cold face tinned, Type LT. Two face soldering (Type TT) in sizes larger than 12 x 12 mm is not recommended. Consult MELCOR for details. See chart on page 24. SH, RH = Center Hole options; OT = OptoTEC options.

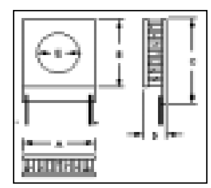
Notes:

1) Qmax rated value at ∆T = 0°, Imax and Vmax, Th = 25°C.
2) Thickness for non-metallized versions only.

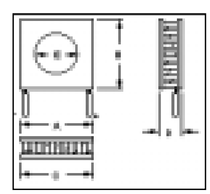
Definitions:

Imax	Input current resulting in greatest ∆T (∆Tmax)[amps]
N	Number of thermocouples (p- and n-type pairs)
Qmax	Maximum amount of heat that can be absorbed at cold face (occurs at I = Imax, ∆T = 0°)[watts]
Th	Temperature of the TEC hot face during operation [°C]
∆Tmax	Maximum temperature difference a TEC can achieve (occurs at I = Imax, Q_C = 0)[°C]
Vmax	Voltage at ∆Tmax

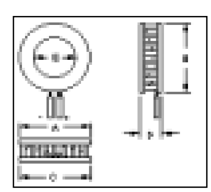
OptoTEC – F3

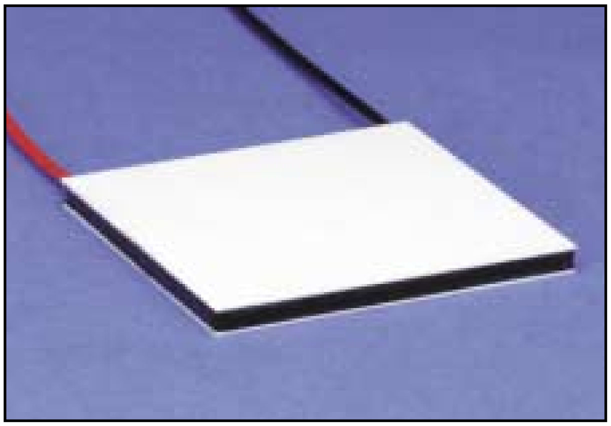


SH Series

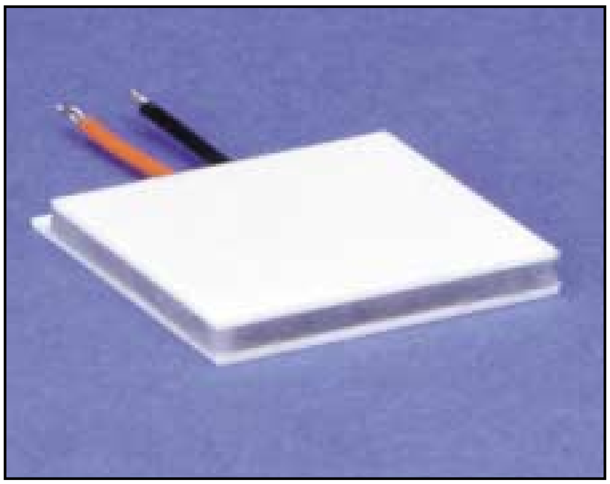


RH Series

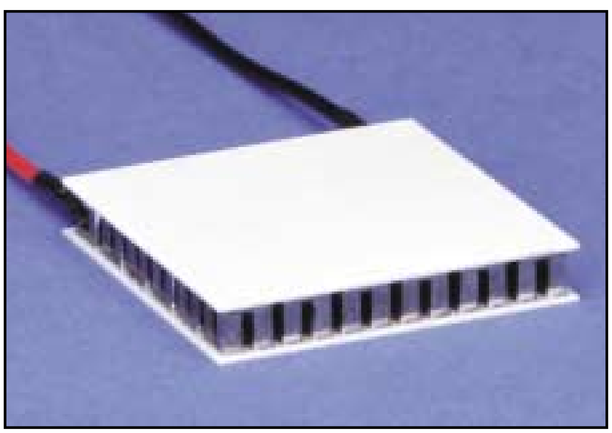




Epoxy Sealing (EP)



Silicone (RTV)



Conformal Coating (EC)

SEALED THERMOELECTRIC COOLERS

When used in conjunction with recommended assembly sealing techniques, these moisture protection options help prevent water or gases from contacting the TE elements and conductors.

Epoxy Sealing (EP) – A low-density (lightweight), syntactic foam epoxy resin for electronic encapsulation and perimeter sealing. When cured the material is completely uni-cellular and therefore the moisture absorption is negligible. The material exhibits a low dielectric constant, low coefficient of thermal expansion and low cure shrinkage. It contains microballoons to reduce thermal conductance. Usable temperature range is -40 to +130˚C.

Silicone (RTV) – A perimeter seal that retains elastomeric properties over a wide temperature range. The non-corrosive material exhibits excellent electrical properties and UV, chemical and weather resistance. Usable temperature range is -60 to +204˚C.

Conformal Coating (EC) – Conformal coating is a transparent, general purpose dip epoxide surface coating that is used for coating electronic components for corrosion protection and high insulation resistance. Not a perimeter seal. Can be used in conjunction with RTV. Usable temperature range is -55 to +150˚C.

TEC Options & Services

Finish Options	CP Series	OptoTEC OT	OptoTEC ET	OptoTEC HOT	ThermaTEC HT	PolarTEC PT	UltraTEC UT	Multistage	Center Hole SH/RH
Metallized Hot and/or Cold face	M/M	HG/CG	HG/CG	HG/CG	–	–	H0/C0▲	M/M	M/M
Non-Metallized Hot and/or Cold face	L/L	H1/C1	H1/C1	H1/C1	√	√	H1/C1	L/L	L/L
Pre-tinning Hot and/or Cold face with 118˚C InSn Solder	T/T	H2/C2	H2/C2	H2/C2	–	–	H2/C2▲	T/T	T/T
Pre-tinning Hot and/or Cold face with 138˚C BiSn Solder	–	-	H3/C3	H3/C3	–	–	–	–	–
Pre-tinning Hot and/or Cold face with 183˚C PbSn Solder	–	-	H4/C4	H4/C4	–	–	–	–	–
Pre-tinning Hot and/or Cold face with 93˚C InSnCd Solder	T93/T93	H5/C5	H5/C5	H5/C5	–	–	H5/C5▲	T93/T93	T93/T93

▲ F1 style only.

Examples: CP 1.0-127-05TL = Pre-tinned Hot Face (118˚C InSn), Non-Metallized Cold Face
OT 1.2-18-F2-H2/C5 = Pre-tinned Hot Face (118˚C InSn), Pre-tinned Cold Face (93˚C InSnCd)

Thickness Tolerance Options	CP Series	OptoTEC	ThermaTEC	PolarTEC	UltraTEC	Multistage	Center Hole Series
+/- 0.001” (0.025mm)	-1	-T1	-T1	-T1	-T1	–	-1
+/- 0.0005” (0.013mm)	-2†	-T2	-T2	-T2	-T2	–	-2†

NOTE: Call MELCOR for thickness options of Multistage.

Examples: CP 1.0-127-05L-2 = thickness is 3.2mm +/- 0.013
OT 1.2-18-F2-T1 = thickness is 2.7mm +/- 0.025

Moisture Protection Options	CP Series	OptoTEC	ThermaTEC	PolarTEC	UltraTEC	Multistage	Center Hole Series
RTV perimeter seal, Color: Translucent	-RTV	-RTV	-RTV	-RTV	-RTV	-RTV†	-RTV†
Epoxy perimeter seal, Color: Black	-EP	-EP	-EP	-EP	-EP	-EP†	-EP†
Conformal coating, two applications, Color: Clear	-EC	-EC	-EC	-EC	-EC	-EC	-EC

Examples: CP 1.0-127-05L-RTV = RTV silicone perimeter seal
OT 1.2-18-F2-EC = Conformal epoxide coating of internal circuit

Wire Options	CP Series	OptoTEC	ThermaTEC	PolarTEC	UltraTEC	Multistage	Center Hole Series	Custom wire-bondable posts
Custom lead length # in inches, (S denotes special requirement)	- W# -	- W# -	- W# -	- W# -	- W# -	- W# -	- W# -	√ *
Custom wire colors	√	√	√	√	√	√	√	√ *
Custom wire types (Teflon, Solid, Bare, etc.)	√	√	√	√	√	√	√	√ *

Examples: CP 1.0-127-05L-W8 = Wire length is 8” (203mm)
OT 1.2-18-F2-W4 = Wire length is 4” (102mm)

† Does not apply to all devices in series, consult MELCOR.

* Usually requires customized ceramic.

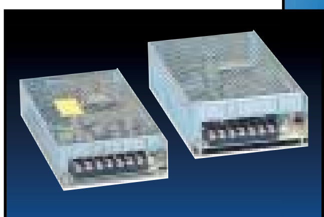
Contact MELCOR for your specification needs!

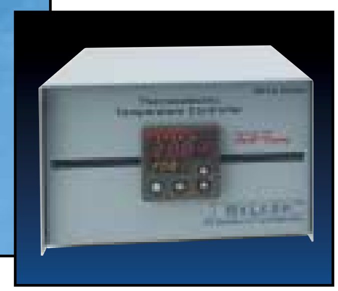
Services

• TEC Burn-in • Custom Module Design • Serialization • Telecom Screening • Custom Testing • Custom Fabrications • Statistical Information

Melcor Thermal Solutions

To meet the requirements of a wide variety of heat transfer problems, MELCOR offers a complete line of thermal management products. **MELCOR Thermal Solutions** includes heat sinks and exchangers, cold plates, interface materials, power supplies, controllers, and fans.





Some **MELCOR Thermal Solutions** products:

Bonded Fin Heat Sinks
- High fin density (up to 10 fins/inch)
- Optional fan mount bracket
- Machined finish or solderable base
- Tapped & clearance assembly holes
- Sensor hole for temperature monitoring
- Custom options available

Extruded Fin Heat Sinks
- All aluminum
- Various finish options
- Low cost
- Custom options available

Liquid Heat Exchangers
- All copper construction
- Hose fittings
- Assembly holes (tapped or clearance)
- Machined flat finish
- Sensor hole for temperature monitoring

Interface Materials
- Wide variety of interface material types
- Expanded selection of thermal greases
- Choice of Aluminum Nitride, Aluminum Oxide, Graphite, and Paraffin/Aluminum interface pads
- Aluminum Nitride, Aluminum Oxide, and Silver filled thermally conductive epoxies

Cold Plates and Spacer Blocks
- All aluminum
- Assembly holes (tapped or clearance)
- Machine flat finish
- Sensor hole for temperature monitoring

Controllers
- Easy to use
- Very stable control
- Wide temperature control range
- Digital displays
- Universal AC input

Power Supplies
- Constant current or constant voltage operation
- Fully adjustable
- Digital displays
- Universal AC input

Thru Mount Solid State Air Conditioners (25-640 BTU/HR Capacity Range)

The MELCOR Thru Mount Series Thermoelectric Air Conditioners are designed for electronic cabinets, refrigeration and environmental chambers where temperature control is critical. Because there is no air exchanged between the cabinet and the ambient, these closed loop air conditioners are ideal for NEMA 12 requirements. They are virtually maintenance-free, with no filters to change, and can be moved in any orientation, offering design flexibility with solid-state reliability.

Model Number Nomenclature

M A A ____ T – ______

- M = MELCOR
- A = Cabinet Side (Air)
- A = Ambient Side (Air)
- ____ = Capacity
- T = Thru Mount
- ______ = Voltage

Capacity:
025 = 25 BTU/HR (12 VDC)
050 = 50 BTU/HR (12 VDC)
070 = 70 BTU/HR (12 VDC)
150 = 150 BTU/HR (12/24 VDC)
260 = 260 BTU/HR (24 VDC)
280 = 280 BTU/HR (12/48 VDC)
510 = 510 BTU/HR (24/48 VDC)
550 = 550 BTU/HR (12 VDC)
555 = 555 BTU/HR (115 VAC)
600 = 600 BTU/HR (12/24 VDC)
640 = 640 BTU/HR (48 VDC)

Voltage:
12 = 12 VDC
24 = 24 VDC
48 = 48 VDC
115 = 115 VAC

Call Melcor for our color brochure on Air Conditioners and matching Power Supplies

(609) 393-4178

For matching Power Supplies see page 36 of this catalog.

Externally Mounted Air Conditioners (1200 BTU/HR)

Model MAA1200E-115D

The MAA1200E is a series of 1200 BTU/Hr solid-state air conditioners available in 115 or 230 VAC and in 48 VDC input power. It is a closed loop system designed to cool below ambient temperature while keeping the internal cabinet air isolated from the dirty ambient air, so that NEMA 12 cabinet ratings are maintained. For harsher environments, our MAA1200E-_ _ _ X is capable of maintaining the integrity of a NEMA 4X system.

Our thermoelectrically-driven air conditioners offer distinct advantages over traditional compressor-based air conditioners in that they use no refrigerant at all, can mount in any orientation, and run quieter. Additionally, our units are filterless and virtually maintenance-free, with the inherent reliability of solid-state TECs.

Our units also serve as dehumidifiers that compensate for cabinet air leaks and route the condensate through a drain system to the outside. Standard units come equipped with a thermostat control that cycles the thermoelectrics and external fans (ambient side), preventing overcooling. The cooling fans (cabinet side), run continuously, promoting proper air temperature distribution within the cabinet.

Model Number Nomenclature

M A A 1200 E – ______ ______

- M – MELCOR
- A – Cabinet Side (Air)
- A – Ambient Side (Air)
- 1200 – Capacity (BTU/Hr)
- E – External Mount

Voltage:
- 115 = 115 VAC
- 230 = 230 VAC
- 48 = 48 VDC

Custom Options:
- A = Alarm
- D = Digital Controller
- H = Heating
- M = Mounting (Horizontal)
- P = 6’ Power Cord (1.8m) on outside
- X = Maintains NEMA 4X Rating

Digital control is available!

Call Melcor for our color brochure on Externally Mounted Solid-State Air Conditioners

(609) 393-4178

Standard Model: MAA1200E-115
(115 VAC, maintains NEMA 12, multi-position thermostat, 6’ power cord through inside, vertical mount and condensate removal system)

Example: MAA1200E-48HX (48 VDC, Heating option, maintains NEMA 4X, in addition to 6’ power cord through inside, multi-position thermostat, vertical mount and condensate removal system)

Specifications:

Model	MAA1200E-115	MAA1200E-115X
Capacity	1200 BTU/Hr. (352 Watts)	1200 BTU/Hr. (352 Watts)
Input Voltage	115 VAC	115 VAC
Max. Ambient Temp.*	140˚ F/60˚ C	140˚ F/60˚ C
Frequency	60/50 Hz	60/50 Hz
Current (Maximum)	9.0 amps	9.0 amps
Weight	52 lbs. (19.5 kgs)	52 lbs. (19.5 kgs)
NEMA Rating Maintained	12	4X
Overall Dimensions	18.5” H x 11.9” W x 8.5” D 470mm x 302mm x 216mm	18.5” H x 11.9” W x 8.5” D 470mm x 302mm x 216mm

NOTE: 230 VAC unit will draw about half the amperage of 115 VAC unit.

* Consult MELCOR for higher ambient temp.

Bonded Fin Heat Sinks

The MELCOR Thermal Solutions bonded fin heat sinks are designed specifically for our thermoelectric devices. These high performance heat sinks are ideal for fan forced convection and are available with fan mount brackets. Each bonded fin heat sink is part of a series of matching components designed to work together as a complete thermoelectric system. The HX8-401 and HX8-402 models have assembly holes for mounting two thermoelectric coolers.

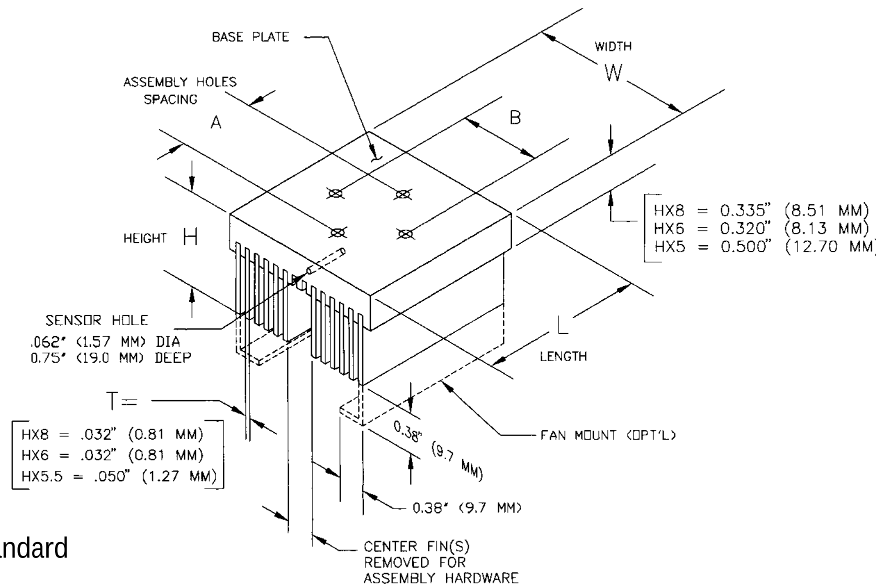
Features

- High fin density (up to 8 fins/inch)
- Optional fan mount bracket
- Machined or solderable plated finish
- Sensor hole for temperature monitoring
- Tapped or clearance assembly holes
- English (#6-32) or Metric (M3) tapped holes

Options	Description
FM	Fan Mount Bracket
CU	Solderable Base
L*	Machined Base
M	Metric Holes
E*	English Holes

*Standard

Mechanical Characteristics



Series #	Assembly Hole Spacing A & B	Number & maximum size of TECs
-100	1.5" (38mm) O.C.	1 x 1.34" (34mm)
-200	2.0" (51mm) O.C.	1 x 1.73" (44mm)
-300	3.0" (76mm) O.C.	1 x 2.44" (62mm)
-400	2.0" (51mm) O.C. (2 sets)	2 x 1.73" (44mm)

Models

HX8 101 L FM E

- FM, E: Options
- L: Options
- 101: Series #
- HX8: Group

Model	F fins/in	Dimensions W in (mm)	Dimensions L in (mm)	Dimensions H in (mm)	Assembly Holes A Type	Assembly Holes B Type	Assembly Holes Spacing	Performance Θ_R °C/Watts
HX8-101	8	2.0 (51)	2.0 (51)	1.25 (32)	Tapped	Tapped	1.5" O.C.	0.61 @ 6.7CFM
HX8-201	8	3.0 (76)	3.0 (76)	1.25 (32)	Clearance	Tapped	2.0" O.C.	0.34 @ 18CFM
HX8-202	8	4.0 (102)	4.0 (102)	1.25 (32)	Clearance	Tapped	2.0" O.C.	0.18 @ 45CFM
HX6-201	6	3.0 (76)	3.0 (76)	1.25 (32)	Clearance	Tapped	2.0" O.C.	0.39 @ 18CFM
HX6-202	6	4.0 (102)	4.0 (102)	1.25 (32)	Clearance	Tapped	2.0" O.C.	0.20 @ 45CFM
HX5-301	5.5	6.0 (152)	6.0 (152)	2.9 (74)	Clearance	Tapped	3.0" O.C.	0.07 @ 102CFM
HX8-401	8	3.0 (76)	6.0 (152)	1.25 (32)	Clearance	None	2.0" O.C. (2 sets)	0.19 @ 36CFM (2 x 18CFM fans)
HX8-402	8	4.0 (102)	8.0 (203)	1.25 (32)	Clearance	None	2.0" O.C. (2 sets)	0.10 @ 90CFM (2 x 45CFM fans)

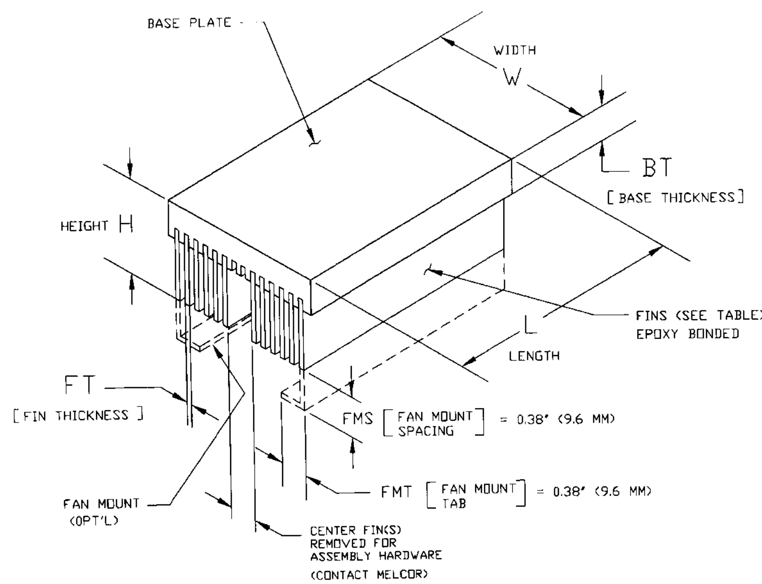
Custom Bonded Fin Heat Sinks

The MELCOR Thermal Solutions custom bonded fin heat sinks increase the flexibility of the design engineer to incorporate a heat sink of a different size than MELCOR's standard finned heat sinks. Each custom bonded fin heat sink can be designed into a complete thermoelectric heat transfer system or utilized as an individual component.

Features:

- High fin density (up to 10 fins/inch)
- Optional fan mount bracket
- Various base surface finish options
- Assembly hole options (contact MELCOR)
- Contact MELCOR with your special heat sink requirements

Mechanical Characteristics



Options	Description
FM	Fan Mount Bracket
CU	Solderable Base
L	Machined Base
CFR	Center Fins Removed
NFR	No Fins Removed

Models

CHX __ W L H CU FM

- CU, FM: Options
- H: Heat Sink Height (in)
- L: Heat Sink Length (in)
- W: Heat Sink Width (in)
- CHX __: Group

Model	F fins/in	Dimensions W (Max) in (mm)	L (Max) in (mm)	H(Typical) in (mm)	BT in (mm)	FT in (mm)	FMT in (mm)
CHX10-W-L-H	10	9.5 (241)	25.0 (635)	1.25 (32)	0.34 (8.6)	0.032 (0.8)	0.38 (9.7)
CHX8-W-L-H	8	4.0 (102)	25.0 (635)	1.25 (32)	0.34 (8.6)	0.032 (0.8)	0.38 (9.7)
CHX6-W-L-H	6	4.0 (102)	25.0 (635)	1.25 (32)	0.32 (8.1)	0.032 (0.8)	0.38 (9.7)
CHX5-W-L-H	5.5	6.0 (152)	25.0 (635)	2.9 (74)	0.50 (12.7)	0.050 (1.3)	1.00 (25.4)

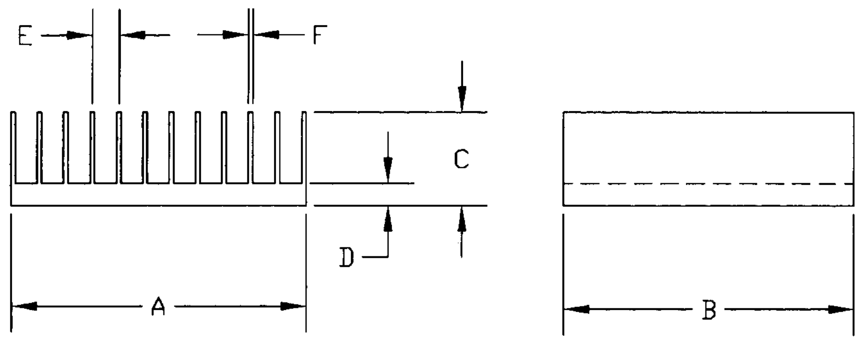
Extruded Fin Heat Sinks

The MELCOR Thermal Solutions extruded fin heat sinks offer low cost heat transfer for various thermal problems. They can be utilized individually or in thermoelectric systems, and are effective in both fan forced and free convection applications.

Features:

- All aluminum extrusions
- Various finishing options
- Low cost heat dissipation
- Two tapped and two clearance assembly holes
- Custom options available
- Contact MELCOR with your special heat sink requirements

Mechanical Characteristics



Standard Models

EXT 201 E X

- X — Options
- E — Options
- 201 — Series
- EXT — Group

Custom Models

CEXT 201 10 X

- X — Options (Contact Melcor)
- 10 — Heat Sink Length (in)
- 201 — Series
- CEXT — Group

Series #	Assembly Hole Spacing	Number & maximum size of TEC
-100	1.5” (38mm) O.C.	1 x 1.34” (34mm)
-200	2.0” (51mm) O.C.	1 x 1.73” (44mm)
-300	3.0” (76mm) O.C.	1 x 2.44” (62mm)
-400	2.0” (51mm) O.C. (2 sets)	2 x 1.73” (44mm)

Options	Description
E*	English Holes
M	Metric Holes
X	Contact Melcor

*Standard

Model	Θ_R (°C/W)*	A in (mm)	B in (mm)	C in (mm)	D in (mm)	E in (mm)	F in (mm)	# of Fins
EXT-201	1.3	4.125(104.8)	4.125(104.8)	1.312(33.3)	0.312(7.9)	0.312(7.9)	0.062(1.6)	14
EXT-202	1.0	5.375(136.5)	5.375(136.5)	1.312(33.3)	0.312(7.9)	0.312(7.9)	0.062(1.6)	18
EXT-301	0.8	7.340(186.4)	7.340(186.4)	1.312(33.3)	0.312(7.9)	0.312(7.9)	0.070(1.8)	24

*Thermal resistance with natural convection at 25°C and 100 watt load.

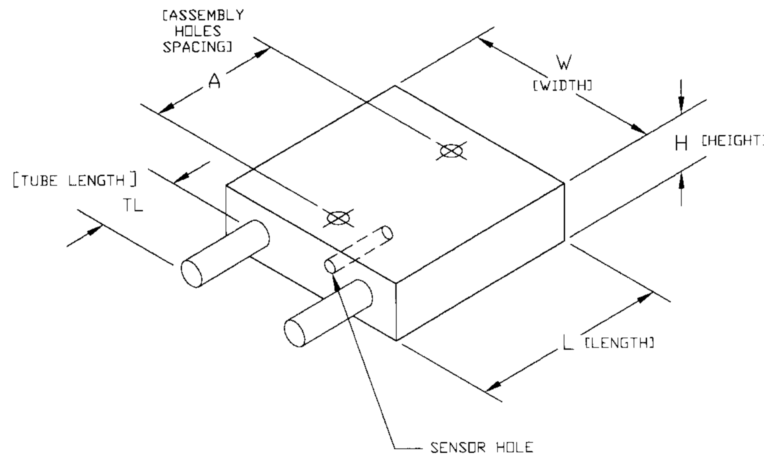
Liquid Heat Exchangers

MELCOR's liquid heat exchangers are effective for cooling high powered applications where minimal temperature rise is desired, or they can be used as the flow area where a liquid's temperature is to be controlled. One of these, the LI-401, can be used with two thermoelectrics. The liquid heat exchangers are designed for use with our thermoelectric devices.

Features

- All copper construction
- Machined finish
- Solderable surface
- External portion of tubes:
  Tube length = 1" (25.4mm) long,
  0.25" (6.4mm) outer diameter
- Internal waterways are 0.25" (6.4mm) inner diameter
- Sensor hole for temperature monitoring
  0.062" (1.58mm) diameter, 0.75" (19mm) deep
- Tapped or clearance assembly holes
  English 6-32 or Metric M3

Mechanical Characteristics



Models

LI 101 TH E

- Options (TH E)
- Series # (101)
- Group: Liquid Heat Exchangers (LI)

Series #	Assembly Hole Spacing A	Number & maximum size of TEC
-100	1.5" (38mm) O.C.	1 x 1.34" (34mm)
-200	2.0" (51mm) O.C.	1 x 1.73" (44mm)
-300	3.0" (76mm) O.C.	1 x 2.44" (62mm)
-400	2.0" (51mm) O.C. (2 sets)	2 x 1.73" (44mm)

Options	Description
NH	No Holes
CL*	Clearance Holes
TH-E	Tapped Holes - English
TH-M	Tapped Holes - Metric

*Standard

Dimensions

Model	Width in (mm)	Length in (mm)	Height in (mm)
LI-101	1.25 (32)	2.0 (51)	0.38 (9.7)
LI-102	2.0 (51)	1.25 (32)	0.38 (9.7)
LI-201	2.0 (51)	2.25 (57)	0.50 (12.7)
LI-301	2.5 (64)	3.50 (89)	0.50 (12.7)
LI-401	2.0 (51)	6.00 (152)	0.50 (12.7)

Cold Plates & Spacer Blocks

Cold Plates

Series #	Assembly Hole Spacing A	Number & maximum size of TEC
-100	1.5” (38mm) O.C.	1 x 1.34” (34mm)
-200	2.0” (51mm) O.C.	1 x 1.73” (44mm)
-300	3.0” (76mm) O.C.	1 x 2.44” (62mm)
-400	2.0” (51mm) O.C. (2 sets)	2 x 1.73” (44mm)

MELCOR’s cold plates can serve either as a heat spreader distributing a cooling or heating effect over a larger area, or as a cooling platform. Most of our cold plates are for use with a single thermoelectric module, but the CB-401 is designed for use with two thermoelectrics. The cold plates are intended for use with our thermoelectrics as part of a complete thermoelectric system.

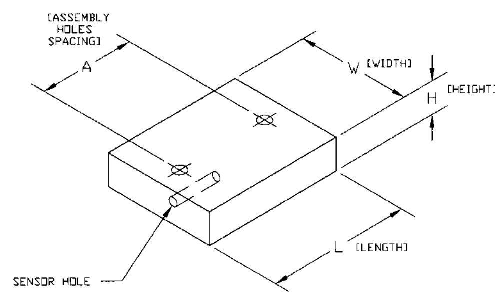
Features

• All aluminum construction • Machined finish • Sensor hole for temperature monitoring 0.062” (1.58mm) diameter, 0.75” (19mm) deep • Tapped or clearance assembly holes English 6-32 or Metric M3

Dimensions

Model	Width in (mm)	Length in (mm)	Height in (mm)
CB-101	2.0 (51)	2.0 (51)	0.25 (6.4)
CB-201	3.0 (76)	3.0 (76)	0.25 (6.4)
CB-301	4.0 (102)	4.0 (102)	0.25 (6.4)
CB-401	3.0 (76)	6.0 (152)	0.25 (6.4)

Mechanical Characteristics



Options	Description
NH	No Holes
CL*	Clearance Holes
TH-E	Tapped Holes - English
TH-M	Tapped Holes - Metric

*Standard

Models

CB 101 TH E

- E — Options
- 101 — Series #
- CB — Group: Cold Plates

Spacer Blocks

MELCOR’s spacer blocks widen the gap between the cold surfaces and hot side heat exchanger, allowing for more insulation material. The spacer blocks are intended for use with our CP, PT, or HT series of thermoelectrics as part of a complete thermoelectric system.

Series #	Assembly Hole Spacing A	Number & maximum size of TECs
-100	1.5” (38mm) O.C.	1 x 1.34” (34mm)
-200	2.0” (51mm) O.C.	1 x 1.73” (44mm)
-300	3.0” (76mm) O.C.	1 x 2.44” (62mm)
-400	Use two of the SB-201 spacer blocks	

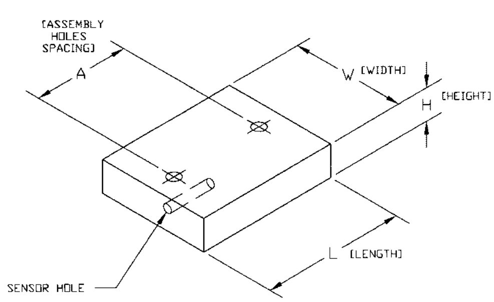
Features

• All aluminum construction • Machined finish • Sensor hole for temperature monitoring 0.062” (1.58mm) diameter, 0.75” (19mm) deep • Tapped or clearance assembly holes English 6-32 or Metric M3 • Height tolerance of ±0.001”

Dimensions

Model	Width in (mm)	Length in (mm)	Height in (mm)
SB-101	1.25 (32)	1.75 (45)	0.50 (12.7)
SB-201	1.62 (41)	2.25 (57)	0.50 (12.7)
SB-301	2.50 (64)	3.25 (83)	0.50 (12.7)

Mechanical Characteristics



Options	Description
NH	No Holes
CL*	Clearance Holes
TH-E	Tapped Holes - English
TH-M	Tapped Holes - Metric

*Standard

Models

SB 101 TH E

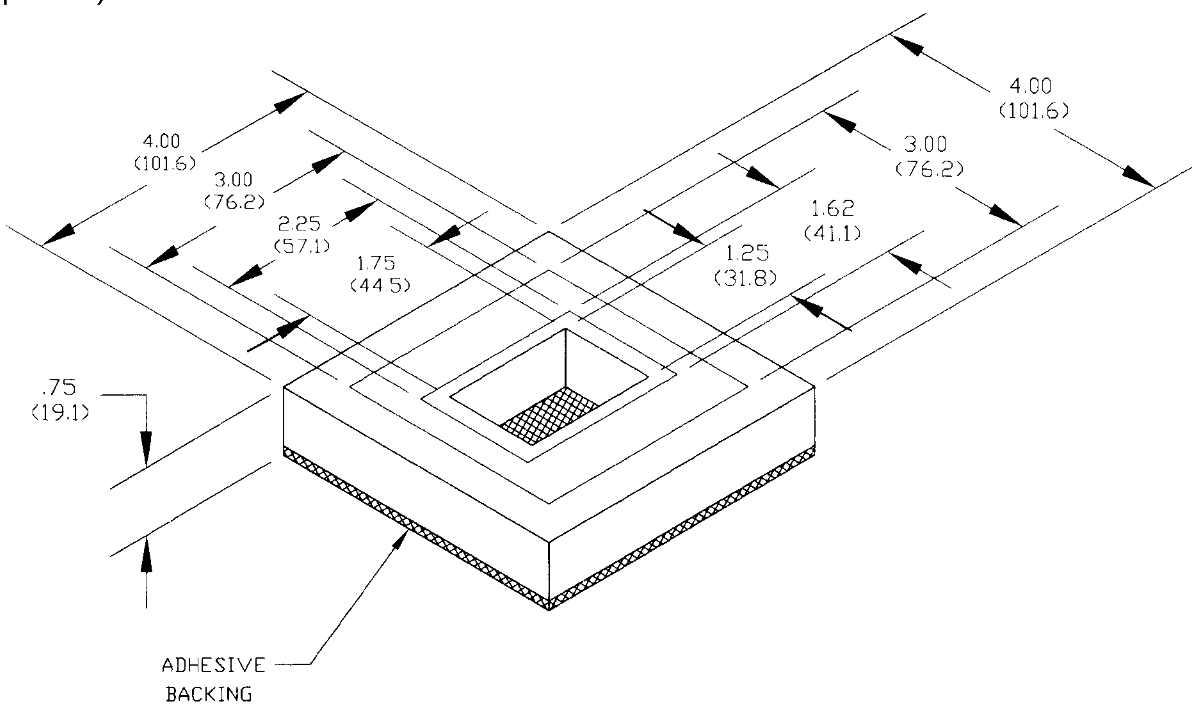
- E — Options
- 101 — Series #
- SB — Group: Spacer Blocks

The MELCOR Thermal Solutions insulating gaskets are designed specifically for our thermoelectric devices. The gaskets are a part of a series of matching components system. The unigasket is designed to work together as a complete thermoelectric and is die-cut to fit 100 and 200 Series components (see figure below). Sheets are also available.

Features:

- Neoprene material - closed cell foam
- Adhesive backed on one side
- Low thermal conductivity:
  k = 0.35 Btu•in/hr•ft^2•°F
  k = 0.05 Watts/m•K

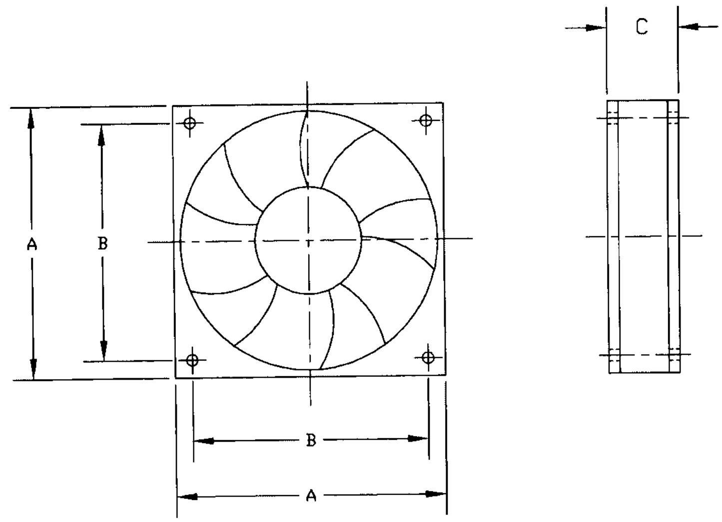
Mechanical Characteristics
(Unigasket pictured)



Model	Gasket	Width in (mm)	Length in (mm)	Height in (mm)
GSK-Universal	Unigasket	4.0 (102)	4.0 (102)	0.75 (19)
GSK-4x10	4x10 Neoprene Sheet	4.0 (102)	10.0 (254)	0.75 (19)
GSK-6x10	6x10 Neoprene Sheet	6.0 (152)	10.0 (254)	0.75 (19)
GSK-8x10	8x10 Neoprene Sheet	8.0 (203)	10.0 (254)	0.75 (19)

Fans

MELCOR's brushless DC fans can be mounted directly to our finned heat sinks, or be used separately to provide forced air convection. Each of our fans can be mounted on the fan mounts of our bonded fin heat sinks. (For our -400 series of heat sinks, use two of the -200 type fans.) In addition to our regular fans, MELCOR offers low-profile (-LP) fans with reduced thickness.

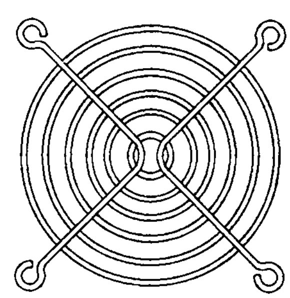


Model	Nominal Voltage	CFM (free air)	Dimensions (mm)			Series #
			A	B	C	
Fan-101	12 VDC	7	40	31	20	-100
Fan-101-LP	12 VDC	7	40	31	10	-100
Fan-201	12 VDC	20	60	50	25.4	-201,-401
Fan-201-LP	12 VDC	20	60	50	15	-200,-401
Fan-202	12 VDC	45	92	83	25.4	-202,-402
Fan-202-24	24 VDC	45	92	83	25.4	-202,-402
Fan-301	12 VDC	100	120	105	32	-300
Fan-301-LP	12 VDC	95	120	105	25.5	-300
Fan-301-LP-24	24 VDC	95	120	105	25.5	-300

Fan Guards

For safe operation of our fans, MELCOR offers nickel-chrome plated wire fan guards.

Model	Fans
FG-101	Fan-101, Fan-101-LP
FG-201	Fan-201, Fan-201-LP
FG-202	Fan-202, Fan-202-24
FG-301	Fan-301, Fan-301-LP, Fan-301-LP-24



Hardware & Solder

The MELCOR Thermal Solutions Hardware includes English and Metric type hardware kits with various screw lengths and washer types. In addition, three types of solders are offered; two for mounting a thermoelectric module to a heat exchanger and the other for lead attachment.

English Hardware Kit

Model	Consists of Items	Description	Length in (mm)	O.D. in (mm)	Material
HK-#6-001	2 of SCR-#6 x .75	6-32 Slotted Screw	0.75 (19.0)	0.138 (3.5)	Stainless Steel
	2 of SCR-#6 x 1.0	6-32 Slotted Screw	1.00 (25.4)	0.138 (3.5)	Stainless Steel
	2 of SCR-#6 x 1.25	6-32 Slotted Screw	1.25 (31.8)	0.138 (3.5)	Stainless Steel
	2 of SCR-#6 x 1.5	6-32 Slotted Screw	1.50 (38.1)	0.138 (3.5)	Stainless Steel
	8 of W-FF-001				
	8 of W-FM-001				
	8 of W-BL-001				

Metric Hardware Kit

Model	Consists of Items	Description	Length in (mm)	O.D. in (mm)	Material
HK-M3-001	2 of SCR-M3 x 20	M3-Slotted Screw	0.79 (20)	0.118 (3.0)	Stainless Steel
	2 of SCR-M3 x 25	M3-Slotted Screw	0.98 (25)	0.118 (3.0)	Stainless Steel
	2 of SCR-M3 x 30	M3-Slotted Screw	1.18 (30)	0.118 (3.0)	Stainless Steel
	6 of W-FF-001				
	6 of W-FM-001				
	6 of W-BL-001				

Specifications for Washers in Hardware Kits

Item	Type	Used on	I.D. in (mm)	O.D. in (mm)	Thickness in (mm)	Material
W-FF-001	Flat Fiber	#6 & M3	0.141 (3.6)	0.250 (6.4)	0.063 (1.6)	Fiber
W-FM-001	Flat Metal	#6 & M3	0.149 (3.8)	0.236 (6.0)	0.024 (0.6)	Stainless Steel
W-BL-001	Belleville	#6 & M3	0.138 (3.5)	0.281 (7.2)	0.015 (0.4)	Stainless Steel

SOLDER

Model	Used for	Coverage	Material	Melt Point	Form	Quantity
SLD-InSnCd-25P	Module Mounting	≈1gm 30mm module	44%In 42%Sn 14%Cd	93°C	Pellets	25gm
SLD-InSn-25P	Module Mounting	≈1gm 30mm module	52%In 48%Sn Eutectic	118°C	Pellets	25gm
SLD-InSn-100P	Module Mounting	≈1gm 30mm module	52%In 48%Sn Eutectic	118°C	Pellets	100gm
SLD-BiSn-2W	Lead Attachment	_	58%Bi 42%Sn Eutectic	138°C	Wire	2ft.(0.61m)

MES Series Power Supplies

MES Series Features

- Switching power supply for 115 VAC or 230 VAC input
- Single output
- UL approved (UL 1950)
- 100-600 Watts Output

Call Melcor for our color brochure on Air Conditioners and matching Power Supplies

(609) 393-4178

100 Watt Series

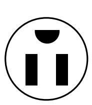
Power Supply Model #	Output			Input				Dimensions	Corresponding Air Conditioner Model Number
	Watts	Volts (DC)	Amps	Volts (AC)	Amps	Volts (AC)	Amps		
MES-12-08	100	12	8.5	115	1.9	230	1.0	7.83"L x 3.85"W x 1.49"H 198mm x 98mm x 38mm	MAA070T-12 MAA050T-12 MAA025T-12

150 Watt Series

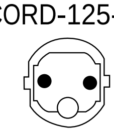
Power Supply Model #	Output			Input				Dimensions	Corresponding Air Conditioner Model Number
	Watts	Volts (DC)	Amps	Volts (AC)	Amps	Volts (AC)	Amps		
MES-24-06	150	24	6.5	115	3.2	230	1.6	7.83"L x 4.33"W x 1.97"H 198mm x 110mm x 50mm	MAA260T-24 MAA150T-24
MES-12-12	150	12	12.5	115	3.2	230	1.6	7.83"L x 4.33"W x 1.97"H 198mm x 110mm x 50mm	MAA150T-12

400-600 Watt Series

Power Supply Model #	Output			Input				Dimensions	Corresponding Air Conditioner Model Number
	Watts	Volts (DC)	Amps	Volts (AC)	Amps	Volts (AC)	Amps		
MES-48-12	600	48	12.5	115	9.3	230	4.7	11.46"L x 5.18"W x 2.68"H 291mm x 132mm x 68mm	MAA640T-48
MES-12-50	600	12	50	115	9.3	230	4.7	11.46"L x 5.18"W x 2.68"H 291mm x 132mm x 68mm	MAA550T-12
MES-24-17	400	24	17	115	6.2	230	3.1	11.46"L x 5.18"W x 2.68"H 291mm x 132mm x 68mm	MAA510T-24 MAA600T-24
MES-48-8	400	48	8.5	115	6.2	230	3.1	11.46"L x 5.18"W x 2.68"H 291mm x 132mm x 68mm	MAA510T-48
MES-12-34	400	12	34	115	6.2	230	3.1	11.46"L x 5.18"W x 2.68"H 291mm x 132mm x 68mm	MAA280T-12



CORD-125-NA



CORD-250-EU

AC Power Cords

AC Power Cords

Model Number	Rating	Plug Type	Termination	Length
CORD-125-NA	10 A / 125 VAC (105˚C)	NEMA 5-15P	Stripped	7.0 ft. (2.1m)
CORD-250-EU	10 A / 250 VAC (65˚C)	CEE 7/7	Stripped	8.2 ft. (2.5m)

MPS Series Laboratory Power Supplies

MELCOR offers four DC power supplies designed for bench-top and portable applications. These supplies may be used as either voltage sources or current sources.

MPS Series Features:

- Universal AC Input - 100V/120V/220V/240V
- Constant Voltage/Constant Current
  (Automatic crossover dependent on load)
- $3\frac{1}{2}$ digit LED display
- Series/Parallel operation
  (Multiple power supplies can be connected to extend voltage range)

Model	Voltage (VDC)	Current (Amps)	Voltage Load Regulation	Dimensions (inches)	Dimensions (mm)	Weight (lb)	Weight (kg)
MPS-18-05	0 to 18	0 to 5	≤0.01% + 5mV	5 x 5.7 x 11.2	128 x 145 x 285	12.1	5.5
MPS-18-10	0 to 18	0 to 10	≤0.01% + 5mV	10 x 5.7 x 11.2	255 x 145 x 335	23.5	11.5
MPS-18-20	0 to 18	0 to 20	≤0.02% + 5mV	8.9 x 5.7 x 16.5	255 x 145 x 420	40.8	18.5
MPS-35-10	0 to 35	0 to 10	≤0.01% + 5mV	8.9 x 5.7 x 16.5	255 x 145 x 420	40.8	18.5

AC/DC Converter

For a simple, low cost supply of DC power, MCV-001A converts standard 120 VAC current to 12VDC. This unit comes with a 6' long input cord, a $9\frac{1}{2}$"universal (cigarette) socket, and ± binding posts/banana jacks.

Model	Dimensions - W x H x D (inches)	Dimensions - W x H x D (mm)	Weight (lb)	Weight (kg)
MCV-001A	5 x 5.7 x 11.2	28 x 145 x 285	0.93	0.42

Input: 50/60Hz / 120VAC / 1.2A / 144VA

Output: 12VDC / 5ADC (maximum)

Thermal Interface Materials

MELCOR offers a complete variety of interface types, materials, and quantities. The selection of an interface material is an important part of the design of a heat management system. Factors that you should consider when choosing an interface material include performance, ease of application, and whether the interface will allow for different coefficients of thermal expansion. For assistance in choosing an interface for your application, please contact MELCOR.

THERMAL GREASES

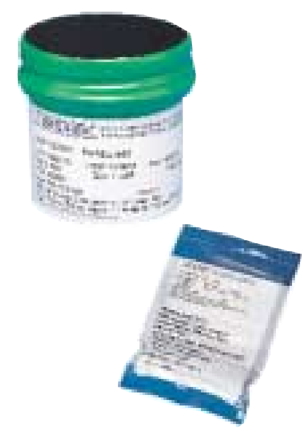
Thermally conductive greases are relatively easy to apply. A thermal grease will forgive mismatched CTE materials as well as provide the option of disassembling an assembly. MELCOR offers both silicone and high performance non-silicone based greases loaded with different conductive fillers. The recommended compression for a thermoelectric assembly using thermal grease is between 150 to 300 pounds per square inch (1030 - 2070 kPa).

Model	Material	Thermal Conductivity (W/m-K)	Approximate Coverage (Modules)	Quantity
TG-001	Zinc Oxide/Silicone Based	0.735	10	4 gram packet
TG-002	Zinc Oxide/Silicone Based	0.735	500	227 gram jar
TG-003	Al_2O_3 / Non-Silicone	2.0	25	10 gram jar
TG-004	Al_2O_3 / Non-Silicone	2.0	500	227 gram jar
TG-005	AlN / Non-Silicone	4.0	25	10 gram jar

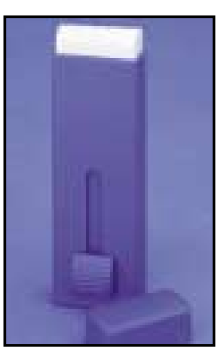
THERMAL EPOXIES

Epoxies are useful in cases where a permanent thermal bond is needed, but soldering is not an option. MELCOR offers three epoxy types. Our silver filled epoxy can be used from -55 to +125°C, while the Al_2O_3 and AlN types can operate up to 130°C for a limited amount of time. TCE-002, TCE-003, and TCE-004 are also usable in situations where materials of mismatched Coefficients of Thermal Expansion are to be interfaced.

Model	Material	Thermal Conductivity (W/m-K)	Approximate Coverage[1] (Modules)	Quantity	Cure Time
TCE-001	Silver Filled	1.35	10	2.5 gram packet	24 hrs. @ 22°C 2 hrs. @ 65°C
TCE-002	Al_2O_3 Filled	1.73	20	5 gram bi-pack	1 hr. @ 85°C
TCE-003	Al_2O_3 Filled	1.73	50	10 gram kit	1 hr. @ 85°C
TCE-004	AlN Filled	3.6	50	10 gram kit	1 hr. @ 85°C



1 Approximate coverage given for an epoxy thickness of 0.002" and a 30mm x 30mm coverage area.



Phase-Change Applicator

Solid, dry to the touch, silicone-free thermal compound which is easily dispensed from a convenient applicator stick. At 60˚C (140˚F), the PCA material undergoes a phase-change wetting action that allows it to fill all voids in the contact area. The capillary action prevents migration, resulting in a clean, simple, and highly effective thermal interface.

Model	Material	Thermal Conductivity (W/m-K)	Form
PCA-001	Paraffin/Phase-change	1.4	Applicator Stick

INTERFACE PADS

MELCOR provides three series of interface pads, with four different conductive materials. All of the interface pads can be used in situations of mismatched Coefficients of Thermal Expansion.

Adhesive Interface pads (ADI) Simple to apply, requiring low mounting pressures. MELCOR offers Aluminum Oxide pads, which are similar in performance to thermal grease, or high performance Aluminum Nitride.

Graphite Foil Interface pads (GRF) Excellent performance and easy to apply. Can be used at very high operating temperatures.

ThermoSet Interface pads (TSI) These pads generally need to be heated prior to use, but they have lower thermal resistance and can be used with low mounting pressures. MELCOR offers either Paraffin/Aluminum or Aluminum Nitride.

Model	Material	Thermal Conductivity (W/m-K)	Length (mm)	Width (mm)	Thickness (mm)	Quantity
ADI-ALO-119-135	Al_2O_3	1.7	30	34	0.10	10 pcs.
ADI-ALO-159-174	Al_2O_3	1.7	40	44	0.10	10 pcs.
ADI-ALO-245-245	Al_2O_3	1.7	62	62	0.10	10 pcs.
ADI-ALO-600-600	Al_2O_3	1.7	152	152	0.10	1 piece
ADI-ALN-600-600	AlN	3.6	152	152	0.10	1 piece
GRF-119-135	97% Graphite	5.0	30	34	0.13	10 pcs.
GRF-159-174	97% Graphite	5.0	40	44	0.13	10 pcs.
GRF-245-245	97% Graphite	5.0	62	62	0.13	10 pcs.
GRF-600-600	97% Graphite	5.0	152	152	0.13	1 piece
TSI-PAL-119-135	Paraffin/Al	6.2	30	34	0.08	10 pcs.
TSI-PAL-159-174	Paraffin/Al	6.2	40	44	0.08	10 pcs.
TSI-PAL-245-245	Paraffin/Al	6.2	62	62	0.08	10 pcs.
TSI-PAL-600-600	Paraffin/Al	6.2	152	152	0.08	1 piece
TSI-ALN-600-600	AlN	3.6	152	152	0.08	1 piece

Type	Reflow Temperature	Maximum Operating Temperature	Recommended Compression (kPa)	(psi)
ADI	N/A	150°C	100 - 2070	15 - 300
GRF	N/A	450°C	1000 - 2070	150 - 300
TSI-PAL	51°C	200°C[1]	690 - 2070[2]	100 - 300[2]
TSI-ALN	60°C	55°C	70 - 2070	10 - 300

1 200˚C maximum temperature given for operation in horizontal orientation.

2 Lower mounting pressures are possible. Please contact MELCOR for information on performance effects.

Temperature Controllers

MTCA controller and Power Boost Module

For accurate thermoelectric temperature control, Melcor provides five instruments with excellent temperature stability (<0.002˚C). Each controller features PID control and comes with a 10kΩ, 30kΩ, and 100kΩ thermistor.

Features

- Adjustable current and temperature limits
- High long-term stability, <0.002˚C
- Auto-tune function sets PID terms based on your system
- Optional RS-232 or RS-485 interface with TECView graphical Windows software
- Compatible with thermistors, RTDs, and certain IC sensors; Compatible with type J, K, or T thermocouples by request
- Three thermistors included: 10 kΩ, 30 kΩ, and 100 kΩ resistances
- Simultaneous LED display of both measured value and set point value
- Fast control with overshoot suppression
- Proportional, integral, and derivative terms adjustable
- Power Boost Modules for additional output power
- Optional ramp and soak function to set rate of temperature change and time at setpoint
- 115 or 230 VAC operation

Temperature Controllers

Model	Maximum Output Power[1]	Maximum Current	Compliance Voltage	Stability[2] 1 hour	Stability[2] 24 hours	Control Range[3]	AC Input
MTCA-3020	30 Watts	± 2.0 Amps	± 15 Volts	< 0.002˚C	< 0.004˚C	-50 to > 150˚C	115/230
MTCA-6040	60 Watts	± 4.0 Amps	± 15 Volts	< 0.002˚C	< 0.004˚C	-50 to > 150˚C	115/230
MTCA-9060	90 Watts	± 6.0 Amps	± 15 Volts	< 0.002˚C	< 0.004˚C	-50 to > 150˚C	115/230
MTCA-12080	120 Watts	± 8.0 Amps	± 15 Volts	< 0.002˚C	< 0.004˚C	-50 to > 150˚C	115/230
MTCA-15100	150 Watts	± 10.0 Amps	± 15 Volts	< 0.002˚C	< 0.004˚C	-50 to > 150˚C	115/230

1. Note that this refers to the power output of the controller, not the heat pumping capacity of the thermoelectric.
2. Stability quoted for a typical 10kΩ thermistor at 110µA
3. Higher temperatures can be set when using RTDs

Model	Dimensions - W x H x D (Inches)	Dimensions - W x H x D (mm)	Weight (lb)	Weight (kg)
MTCA-3020	7.2 x 4.9 x 10.6	183 x 125 x 270	10	4.5
MTCA-6040	7.2 x 4.9 x 10.6	183 x 125 x 270	10	4.5
MTCA-9060	7.2 x 4.9 x 10.6	183 x 125 x 270	10	4.5
MTCA-12080	7.2 x 4.9 x 10.6	183 x 125 x 270	11	5.0
MTCA-15100	7.2 x 4.9 x 10.6	183 x 125 x 270	11	5.0

Power Boost Modules

Model	Maximum Output Power	Maximum Current	Dimensions - W x H x D (Inches)	Dimensions - W x H x D (mm)	Weight (lb)	Weight (kg)
PBM-030	30 Watts	±2.0 Amps	7.2 x 4.9 x 10.6	183 x 125 x 270	10	4.5
PBM-060	60 Watts	±4.0 Amps	7.2 x 4.9 x 10.6	183 x 125 x 270	10	4.5
PBM-090	90 Watts	±6.0 Amps	7.2 x 4.9 x 10.6	183 x 125 x 270	10	4.5
PBM-120	120 Watts	±8.0 Amps	7.2 x 4.9 x 10.6	183 x 125 x 270	11	5.0
PBM-150	150 Watts	±10.0 Amps	7.2 x 4.9 x 10.6	183 x 125 x 270	11	5.0

Thermistors

Controller Type	Resistance @ 25°C	10µA Range	100µA Range
MTCA	10kΩ 100kΩ	-55°C to +120°C -20°C to +120°C	-25°C to +120°C +25°C to +120°C

Optional TECView graphical interface software enables control and data acquisition from a PC.

Design/Selection Checklist

The information requested below is vital to the design/selection of a thermoelectric device to achieve your desired performance.

Please attempt to define as many of your application's existing conditions and limiting factors as possible. *(Please indicate units on all parameters.)*

1. Application
Please describe the manner in which the thermoelectric is to be used in your application:

____
____

2. Performance Requirements

a) Heat Load

Active heat load: ______________W
Passive heat load: ______________W
Transient (sensible) heat load: ____W
or, please state the object to be cooled, the mass or volume, as well as the specific heat, if known

____
____

Total heat load:______________W

b) Cooling

Cold temperature:___________˚C
(Please describe the location of the Cold temperature in relation to the thermoelectric cooler)

____
____

c) Heat Sinks

Type of heat sink used ______________________
Thermal resistance of heat sink __________ ˚C/W,
or, please state the maximum hot side temperature ______________________˚C
Ambient temperature ______________________˚C
(Temperature where heat is to be moved to)

3. Electrical Requirements:

	Preferred	Maximum available
Current	________	________
Voltage	________	________
Power	________	________

4. Dimensional Requirements:

	Preferred	Min. available	Max. available	Tolerance
Length	_____	_____	_____	_____
Width	_____	_____	_____	_____
Height	_____	_____	_____	_____

5. Ceramic Substrate:

Hot side
❑ Al_2O_3 ❑ AIN ❑ BeO

Cold side
❑ Al_2O_3 ❑ AIN ❑ BeO

6. Internal Construction Solder:

❑ 138˚C BiSn ❑ 232˚C SnSb ❑ 271˚C BiSb (Patented)

7. External Finishing:

Hot side
❑ Bare ceramic
❑ Metallized
  ❑ Cu/Ni
  ❑ Cu/Ni/Au
❑ Pretinned ceramic
  ❑ 93˚C InSnCd
  ❑ 118˚C InSn
  ❑ 138˚C BiSn
  ❑ 183˚C SnPb
  ❑ Other
  ____

Cold side
❑ Bare ceramic
❑ Metallized
  ❑ Cu/Ni
  ❑ Cu/Ni/Au
❑ Pretinned ceramic
  ❑ 93˚C InSnCd
  ❑ 118˚C InSn
  ❑ 138˚C BiSn
  ❑ 183˚C SnPb
  ❑ Other
  ____

8. Wire Leads/Posts:

Wire leads
❑ Sn-plated Cu wire ❑ Au-plated Ni wire
❑ Other material for wires

Wire length __________ Tolerance ______________

Posts
❑ Wire bondable Au/Ni plated brass
❑ Other material ______________________

Post length ________ Width _________ Height _____

9. Special Requirements:

❑ Testing (describe or specify applicable standards)
____
❑ TEC assembly/mounting
____
❑ Packaging
____

10. Expected Part Release Schedule:

	Quantity	Date
❑ Samples	________	________
❑ Qualification pieces	________	________
❑ Production*	________	________

* Target price for production quantity ______________

Other requirements:

____
____

Structure & Function

Since thermoelectric cooling systems are most often compared to conventional vapor-compression systems, perhaps the best way to show the similarities in the two refrigeration methods is to describe and compare them.

A conventional cooling system contains four fundamental parts - the evaporator, compressor, condenser, and a metering control device (expansion valve). The evaporator, or cold section, is the part where the liquid portion of the two-phase refrigerant is allowed to boil and evaporate. During this change of state from liquid to gas, energy (heat) is absorbed. The compressor acts as the refrigerant pump and compresses the gas. The condenser expels the heat absorbed at the evaporator, along with the heat produced during compression, into the environment or ambient. Then the control valve changes the pressure of the refrigerant gas, allowing it to absorb heat when it enters the evaporator.

A thermoelectric system has analogous parts. At the cold junction, energy (heat) is absorbed by electrons as they pass from a low energy level in the p-type semiconductor element, to a higher energy level in the n-type semiconductor element. The power supply provides the energy to move the electrons through the system. At the hot junction, energy is expelled to a heat sink as electrons move from a high energy level element (n-type) to a lower energy level element (p-type). The use of elements of different materials (p- and n) creates the energy change responsible for the heat transfer, similar to the expansion valve's role in a conventional refrigeration system.

Another analogy often used to help comprehend a T.E. cooling system is that of a standard thermocouple used to measure temperature. Thermocouples of this type are made by connecting two wires of dissimilar metal (typically copper/constantan), in such a manner so that two junctions are formed. One junction is kept at a reference temperature, while the other junction is attached to the object being measured. The generated voltage is measured by a sensing device, which converts the magnitude of the generated. Reversing this train of thought, imagine a pair of fixed junctions into which electrical energy is applied, causing one junction to become cold while the other becomes hot.

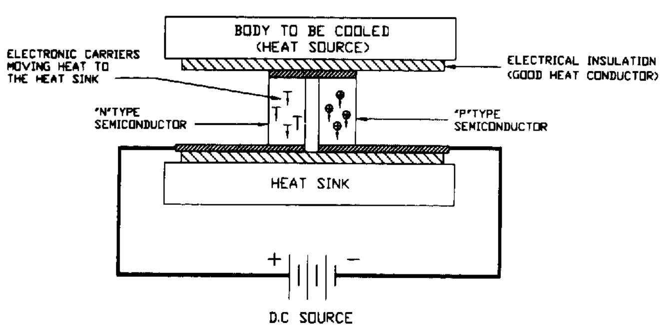


Figure 1: Cross Section of a Typical TE Couple

Thermoelectric cooling couples (Fig. 1) are made from two elements of semiconductor, primarily bismuth-telluride, heavily doped to create either an excess (n-type) or deficiency (p-type) of electrons. Heat absorbed at the cold junction is pumped to the hot junction at a rate proportional to current passing through the circuit and the number of couples.

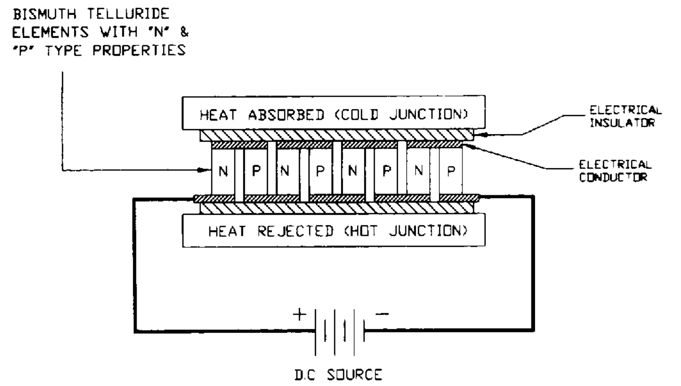


Figure 2: Typical TE Module Assembly

In practical use, couples are combined in a module (Fig. 2) where they are connected electrically in series, and thermally in parallel. Normally a module is the smallest component commercially available. Modules are available in a great variety of sizes, shapes, operating currents, operating voltages and ranges of heat pumping capacity. The user can select the quantity, size or capacity of the module to fit the exact requirement without paying for excess power.

There is usually a "need" to use thermoelectrics instead of other forms of cooling. The "need" may be a special consideration of size, space, weight, reliability or environmental conditions, such as operating in a vacuum. If none of these are a requirement, then other forms of cooling should be considered and, in fact, are probably desirable.

Once thermoelectrics have been decided upon, the next problem is to select the thermoelectric(s) that will satisfy the particular set of requirements. Three specific system parameters must be determined before device selection can begin. These are:

T_C (Cold Surface Temperature)

T_h (Hot Surface Temperature)

Q_C (The amount of heat to be absorbed at the Cold Surface of the T.E.)

In most cases, the cold surface temperature is usually given as part of the problem - that is to say that an object(s) is to be cooled to some specified temperature. Generally, if the object to be cooled is in direct intimate contact with the cold surface of the thermoelectric, the desired temperature of the object can be considered the temperature of the cold surface of the T.E. (T_C). There are situations where the object to be cooled is not in intimate contact with the cold surface of the T.E., such as volume cooling, where a heat exchanger is required on the cold surface of the T.E. When this type of system is employed, the cold surface of the T.E. (T_C) may need to be several degrees colder than the desired volume temperature.

The Hot Surface Temperature is defined by two major parameters:

1) The temperature of the ambient environment to which the heat is being rejected.

2) The efficiency of the heat exchanger that is between the hot surface of the T.E. and the ambient. These two temperatures (T_C & T_h) and the difference between them (ΔT) are very important parameters and must be accurately determined if the design is to operate as desired. Figure 3 represents a typical temperature profile across a thermoelectric system.

The third, and often most difficult parameter to accurately quantify, is the amount of heat to be removed or absorbed by the cold

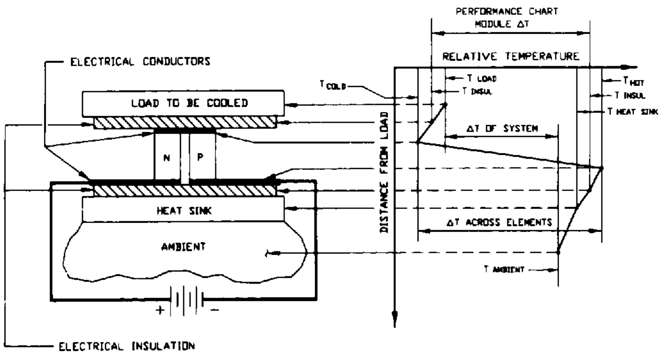


Figure 3: Typical Temperature Relationship in a TEC

surface of the T.E. All thermal loads to the T.E. must be considered. These thermal loads include, but are not limited to, the active or I^2R heat load from electronic devices and conduction through any object in contact with both the cold surface and any warmer temperature (i.e. electrical leads, insulation, air or gas surrounding objects, mechanical fasteners, etc.). In some cases radiant heat effects must also be considered.

Single stage thermoelectric devices are capable of producing a "no load" temperature differential of approximately 67°C. Temperature differentials greater than this can be achieved by stacking one thermoelectric on top of another. This practice is often referred to as cascading. The design of a cascaded device is much more complex than that of a single stage device, and is beyond the scope of these notes. Should a cascaded device be required, design assistance can be provided by MELCOR personnel.

Once the three basic parameters have been quantified, the selection process for a particular module or group of modules may begin. Some common heat transfer equations are included in this catalog for help in quantifying Q_C & T_h.

There are many different modules or sets of modules that could be used for any specific application. One additional criterion that is often used to pick the "best" module(s) is Coefficient of Performance (COP). COP is defined as the heat absorbed at the cold junction, divided by the input power (Q_C/Q_{in}). The maximum COP case has the advantages of minimum input power and therefore, minimum total heat to be rejected by the heat exchanger ($Q_h = Q_C + Q_{in}$). These advantages come at a cost, which in this case is the additional or larger T.E. device required to operate at COP maximum. It naturally follows that an advantage of the minimum COP case is often a lower initial cost.

Power supply and temperature control are additional items that must be considered for a successful T.E. system. A thermoelectric device is a DC device. Any AC component on the DC is detrimental. Degradation due to ripple can be approximated by:

$\Delta T / \Delta Tmax = 1 / (1+N^2)$, where N is % current ripple.

Example:

The effect on ΔT_{max} for a power supply with 20% ripple.
$\Delta T_{max} = 67^{\circ}C$

$\Delta T / \Delta T_{max} = 1/(1+N^2) = 1/(1+0.2^2) = 0.96$,
$\Delta T = \Delta T_{max} \times 0.96 = 64^{\circ}C$

MELCOR recommends no more than 10% ripple.

Temperature control can be generally considered as one of two groups: "open loop" and "closed loop", or manual and automatic. Regardless of method, the easiest device parameter to detect and measure is temperature. Therefore, the cold junction (or hot junction in heating mode) is used as a basis of control. The controlled temperature is compared to some reference temperature, usually the ambient or opposite face of the T.E.

In the Open Loop method, an operator adjusts the power supply to reduce the error to zero. A closed loop accomplishes this task electronically. The various control circuits are too numerous and complex to try to discuss in this text. Suffice it to say that the degree of control, and consequent cost, varies considerably with the application.

Parameters Required for Device Selection

There are certain minimum specifications that must be considered before the selection of a T.E. device can begin. There are three major parameters that are required. Two of these parameters are the temperatures that define the gradient across the T.E. device. The third parameter is the total amount of heat that must be pumped by the device.

The gradient across the T.E. device (Actual ΔT) is not the same as the apparent ΔT (System ΔT). The difference between these two ΔTs is often ignored, resulting in an under-designed system. The magnitude of the difference in ΔTs, is largely dependent on the type of heat exchangers that are utilized on the hot and cold sides of the system.

Unfortunately, there are no definite rules that will accurately define these differences. Typical allowances for the hot side of a system with respect to the heat exchange mode are:

1) Finned forced air: 10 to 15°C

2) Free convection: 20 to 40°C

3) Liquid exchangers: 2 to 5°C above liquid temperature

Since the heat flux densities on the cold side of the system are considerably lower than those on the hot side, an allowance of about 50% of the above-mentioned hot side figures can be used. It is good practice to check the outputs of the selection process to reassure that the heat sink design parameters are reasonable.

The third parameter that must be identified for the selection process is the total heat to be pumped by the T.E. device. *This is often the most difficult number to estimate.* To reduce the temperature of an object, heat must be removed from it faster than heat enters it. There are generally two broad classifications of the heat that must be removed from the device. The first is the heat load which is representative of the cooling that is required. This load could be the I^2R load of an electrical component (often referred to as the resistive heat load or Joule heating). This could also be the load of dehumidifying air (latent heat) or the load of cooling objects in a certain amount of time, based on their specific heat (sensible heat). There could be heat loads due to chemical reactions or the action of a source of intense light, such as the sun or a laser. We generally group these heat loads together as the “active” heat load.

The other kind of load is often referred to as the “parasitic” load. This is the load due to the fact that the object is cooler than the surrounding environment. This load can be comprised of conduction and convection of the surrounding gas, "leak" through insulation, conduction through wires, condensation of water, and in some cases formation of ice. Regardless of the source of these parasitic loads they must not be ignored.

There are other things that may be very important to a specific application, such as physical dimensions, input power limitations or cost.

If you should require any further assistance, please contact one of our engineers.

Multistage (Cascade) Devices

A multistage thermoelectric device should be used only where a single stage device cannot achieve the required differential. Figure 4, depicts ΔT, vs. COP max, vs. Number of stages. COP is defined as the amount of heat absorbed (in thermal watts of heat pumped) at the cold side of the device, divided by the input power (in electrical watts). This figure should help identify when to consider cascades since it portrays the effective ΔT range of each cascade. A two stage cascade should be considered somewhere between a ΔT of 40°C (T_C = -5°C), where the COP bars of the 1 and 2 stage devices begin to diverge, and a ΔT of 65°C (T_C = -30°C), where a single stage device reaches its maximum ΔT, and also, heat pumping "shutoff", Q_C = 0. Similar decisions must be made as to the number of stages to be considered at larger ΔTs. The two important factors again are ΔT and COP.

There is another very significant factor that must always be considered: cost. Usually, as the number of stages increase, so does the cost. Certain applications require a trade-off between COP and cost.

As with any other T.E. system, to begin the selection process requires the definition of at least three parameters:

T_C Cold Side Temperature

T_h Hot Side Temperature

Q_C The amount of heat to be removed (absorbed by the cooled surface of the T.E.) (in watts)

Once ΔT (T_h - T_C) and the heat load have been defined, utilization of Figure 4 will yield the number of stages that may be required. Knowing COP and Q_C, input power can also be estimated. The values listed in Figure 4 are theoretical maximums. Any device that is actually manufactured will rarely achieve these maximums, but should closely approach this value.

MELCOR offers a line of "standard cascades" though there are no "standard" applications. Each need for a cascade is unique; so too should be the device selected to fill the need. MELCOR has developed a computer program, Thermal Design Software, which will help select a device (see pages 10-11). The parameters of heat load, cold temperature and ambient temperature are used as inputs to the program. Other variables such as physical size, and operating voltage or current can, within limits, be used to make the final selection.

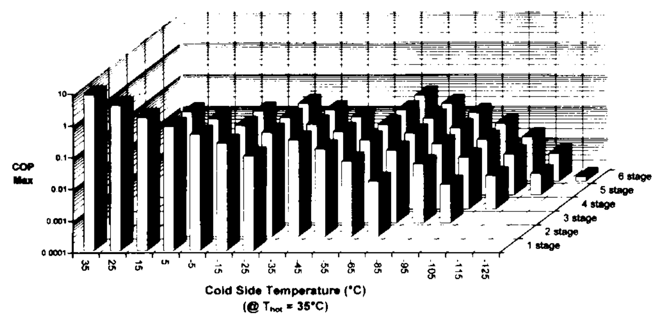


Figure 4: ΔT vs. COP Max as a Function of Number of Stages

Reliability Testing

MELCOR performs testing on thermoelectrics in accordance with several MIL-STD tests as required by Telcordia (Bellcore) standards. Tests involved include mechanical tests such as vibration and shock, and thermal tests involving storage, operation, and temperature cycling.

The data from the tests are compiled into an overall report that is available to customers in need of this information for determining the suitability of our thermoelectrics for an application. This report can be downloaded from our web site **www.melcor.com**

Reliability & Mean Time Between Failures (MTBF)

Thermoelectric devices are highly reliable due to their solid-state construction. Although reliability is somewhat application dependent, MTBFs calculated as a result of tests performed by various customers are on the order of 200,000 to 300,000 hours at room temperature. Over 90% of all modules returned were found to be failures resulting from mechanical abuse or overheating due to improper application. The combination of proper handling and proper assembly techniques will yield an extremely reliable system.

Historical failure analysis has generally shown the cause of failure as one of four types:

Moisture:

Moisture must not penetrate into the thermoelectric module area. The presence of moisture will cause an electro-corrosion that will degrade the thermoelectric material, conductors and solders. Moisture can also provide an electrical path to ground causing an electrical short or hot side to cold side thermal short. A proper sealing method or dry atmosphere can eliminate these problems.

Shock and Vibration:

Thermoelectric modules in various types of assemblies have for years been used in different Military/Aerospace applications. Thermoelectric devices have been successfully subjected to shock and vibration requirements for aircraft, ordinance, space vehicles, shipboard use and most other such systems. While a thermoelectric device is quite strong in both tension and compression, it tends to be relatively weak in shear. When in a severe shock or vibration environment, care should be taken in the design of the assembly to insure "compressive loading" of thermoelectric devices.

Mechanical Mounting:

A common failure mode for thermoelectric modules is uneven compression forces induced by improper torque, bolting patterns and mechanical conditions of heat exchangers. As mentioned above, the thermoelectric elements are quite strong in compressive strength and tend to be weak in the shear direction. During assembly, uneven torquing or insufficiently flat mounting surfaces can cause severe shear forces. Recommended compression value is 150-300 psi. (See assembly instructions for proper mounting techniques.)

Inadvertent Overheating of the Module:

The direct soldering process does result in temperature restriction for operation or storage of the modules.

For standard, non-high temperature modules (not ET, HOT, or HT type), temperatures above 80°C cause two phenomena which seriously reduce useful life:

Above 80°C copper diffusion into the thermoelements occurs due to increasing solid solubility in the thermo-electric material and increasing diffusion rate. At 100-110˚C the combined solubility and diffusion rate could result in approximately 25% loss of device performance within 100 hours.

Above 85˚C in the soldering process (using Bismuth-Tin Alloy) small amounts of selenium, tellurium, antimony and nickel are inherently dissolved into the bismuth-tin solder. Although the melting point of the base solder is 138˚C, the combined mixture of all elements results in either a minute eutectic phase or a highly effective solid-state reaction occurring at above 85˚C that starts to delaminate the ends of the thermoelements by physical penetration between cleavage planes in the thermoelectric material. This results in a mechanical failure of the interface.

Modules built without Bismuth-Tin solder, (ET, HOT, and HT types), do not experience the same effects. Nickel diffusion barriers for the thermoelements used in the ET series modules prevent the copper diffusion at 80˚C mentioned above. This makes using these thermoelectrics possible above 85˚C.

The HOT and HT series, rated for operation up to 225˚C use solder that does not contain tin in all. They are recommended for continuous operation at 175˚C and can handle short term use at temperature up to 225˚C. They are also recommended in cases where the operational temperatures change over a large range repeatedly, often known as thermal cycling.

Device Performance Formulae

Heat Pumped at Cold Surface (watts):

$Q_C = 2N \; [\alpha \, I \, T_C - I^2 \rho/2 G - \kappa \, \Delta T \; G]$

Voltage (volts):

$V = 2N \; [\, I \, \rho \, / \, G + \alpha \, \Delta T \,]$

Maximum Current (amps):

$I_{max} = (\kappa \, G/\alpha)[\sqrt{1 + 2 Z T_h} - 1]$

Optimum Current (amps):

$I_{opt} = \kappa \, \Delta T \, G \, (1 + \sqrt{1 + Z \bar{T}}\,) \, / \, (\alpha \, \bar{T})$

Optimum COP, (calculated at I_{opt}):

$$COP_{opt} = (\bar{T} \, / \, \Delta T) \left(\frac{\sqrt{1 + Z \bar{T}} - 1}{\sqrt{1 + Z \bar{T}} + 1} \right) - 1/2$$

Maximum ΔT with $Q_C = 0$ (°C or K):

$\Delta T_{max} = T_h - (\sqrt{1 + 2 Z T_h} - 1) \, / \, Z$

Geometry Factor (G)

TEC				G
OT	0.8	-xx-		0.016
OT	1.2	-xx-		0.024
OT	1.5	-xx-		0.030
OT	1.9	-xx-		0.038
OT	2.0	-xx-		0.040
ET	0.8	-xx-		0.016
ET	1.2	-xx-		0.024
ET	1.5	-xx-		0.030
ET	1.9	-xx-		0.038
ET	2.0	-xx-		0.040
HOT	1.2	-xx-		0.024
HOT	1.5	-xx-		0.030
HOT	2.0	-xx-		0.040
CP	0.8	-xx-	06	0.042
CP	0.8	-xx-	05	0.052
CP	1.0	-xx-	08	0.050
CP	1.0	-xx-	06	0.061
CP	1.0	-xx-	05	0.079
CP	1.4	-xx-	10	0.077
CP	1.4	-xx-	06	0.118
CP	1.4	-xx-	045	0.171
CP	2	-xx-	10	0.184
CP	2	-xx-	06	0.282
CP	2.8	-xx-	06	0.473
CP	5	-xx-	10	0.778
CP	5	-xx-	06	1.196

TEC				G
PT	2	-12-	30	0.046
PT	3	-12-	30	0.057
PT	4	-12-	30	0.079
PT	4	-7-	30	0.076
PT	4	-12-	40	0.076
PT	6	-xx-		0.121
PT	8	-xx-		0.171
HT	2	-12-	30	0.046
HT	3	-12-	30	0.057
HT	4	-12-	30	0.079
HT	4	-7-	30	0.076
HT	4	-12-	40	0.076
HT	6	-xx-		0.121
HT	8	-12-	30	0.159
HT	8	-12-	40	0.171
UT	4	-12-	30	0.079
UT	4	-7-	30	0.076
UT	4	-12-	40	0.076
UT	6	-xx-		0.121
UT	8	-12-	25	0.158
UT	8	-12-	30	0.159
UT	8	-12-	40	0.171
UT	11	-xx-		0.220
UT	15	-xx-		0.291

Definition of Expressions

Notation		Definition
T_h	=	Hot Side Temperature (*K*)
T_C	=	Cold Side Temperature (*K*)
ΔT	=	$T_h - T_c$ (*K*)
$\bar{T}$	=	1/2 ($T_h + T_c$) (Average temperature) (*K*)
G	=	Area/Length of TE Element (A/L) (*cm*)
N	=	Number of Thermocouples
I	=	Current (*amperes*)
COP	=	Coefficient of Performance (Q_c/IV)
α	=	Seebeck Coefficient (volts/*K*)
ρ	=	Resistivity (Ω *cm*)
κ	=	Thermal Conductivity (*watt/cm K*)
Z	=	$\alpha^2/\rho \, \kappa$ (Figure of Merit K^{-1})
S	=	Device Seebeck Voltage ($2\alpha N$) (*volts/K*)
R	=	Device Electrical Resistance ($2\rho N/G$) (*ohms*)
K	=	Device Thermal Conductance ($2\kappa NG$) (*watt/K*)
V	=	Voltage (Volts)

Typical Material Parameters

$\bar{T}$ (K)	α	ρ	κ	Z
225	1.70×10^{-4}	6.89×10^{-4}	1.87×10^{-2}	2.23×10^{-3}
250	1.84×10^{-4}	8.04×10^{-4}	1.77×10^{-2}	2.38×10^{-3}
273	1.94×10^{-4}	9.20×10^{-4}	1.61×10^{-2}	2.54×10^{-3}
300	2.02×10^{-4}	1.01×10^{-3}	1.51×10^{-2}	2.68×10^{-3}
325	2.07×10^{-4}	1.15×10^{-3}	1.53×10^{-2}	2.44×10^{-3}
350	2.10×10^{-4}	1.28×10^{-3}	1.55×10^{-2}	2.22×10^{-3}
375	2.00×10^{-4}	1.37×10^{-3}	1.58×10^{-2}	1.85×10^{-3}
400	1.96×10^{-4}	1.48×10^{-3}	1.63×10^{-2}	1.59×10^{-3}
425	1.90×10^{-4}	1.58×10^{-3}	1.73×10^{-2}	1.32×10^{-3}
450	1.85×10^{-4}	1.68×10^{-3}	1.88×10^{-2}	1.08×10^{-3}
475	1.79×10^{-4}	1.76×10^{-3}	2.09×10^{-2}	8.7×10^{-4}

Heat Transfer Formulae

Heat Transfer Formulae

NOTE: Due to the relatively complex nature of heat transfer, results gained from application of these formulae, while useful, must be treated as approximations only. Design safety margins should be considered before final selection of any device.

1) Heat gained or lost through the walls of an insulated container:

$$Q = \frac{A \times \Delta T \times K}{\Delta X}$$

Where

Q = Heat flow (Watts)

A = External surface area of container (m^2)

ΔT = Temp. difference (inside vs. outside of container) (Kelvin)

K = Thermal conductivity of insulation (Watt / meter Kelvin)

ΔX = Insulation thickness (m)

2) Time required to change the temperature of an object:

$$t = \frac{m \times C_p \times \Delta T}{Q}$$

Where

t = Time interval (seconds)

m = Mass of the object (kg)

C_p = Specific heat of material (J / kg - K)

ΔT = Temperature change of object (Kelvin)

Q = Heat added or removed (Watts)

3) Heat transferred to or from a surface by convection:

$$Q = h \times A \times \Delta T$$

Where

Q = Heat (Watts)

h = Heat transfer coefficient (W / (m^2 K) (1 to 30 = "Free" convection - gases, 10 to 100 = "Forced" convection - gases)

A = Exposed surface area (m^2)

ΔT = Surface Temperature - Ambient (Kelvin)

Conversions

Thermal Conductivity	1 BTU/hr-ft °F	= 1.73 W/m-K
	1 W/m-K	= 0.578 BTU/hr-ft-°F
Power (heat-flow rate)	1 W	= 3.412 BTU/hr
	1 BTU/hr	= 0.293 W
Area	1 ft^2	= 0.093 m^2
	1 m^2	= 10.76 ft^2
Length	1 ft	= 0.305 m
	1 m	= 3.28 ft
Specific Heat	1 BTU/lb-°F	= 4184 J/kg-K
	1 J/kg-K	= 2.39 x 10^{-4} BTU/lb-°F
Heat Transfer Coefficient	1 BTU/hr-ft^2-°F	= 5.677 W/m2-K
	1 W/m^2-K	= 0.176 BTU/hr-ft^2-°F
Mass	1 lb	= 0.4536 kg
	1 kg	= 2.205 lb

Typical Properties of Materials

Typical Properties of Materials (@ 21˚C)

Material Name	Density kg/m^3	Thermal Conductivity W/m-K	Specific Heat J/kg-K	Thermal Expansion Coefficient x 10^{-6} cm/cm/˚C
Air	1.2	0.026	1004	–
Alumina Ceramic-96%	3570	35.3	837	6.5
Aluminum Nitride Ceramic	3300	170-230	920	4.5
Aluminum	2710	204	900	22.5
Argon (Gas)	1.66	0.016	518	–
Bakelite	1280	0.23	1590	22.0
Beryllia Ceramic-99%	2880	230	1088	5.9
Bismuth Telluride	7530	1.5	544	13.0
Brass	8490	111	343	18.0
Bronze	8150	64	435	18.0
Concrete	2880	1.09	653	14.4
Constantan	8390	22.5	410	16.9
Copper	8960	386	385	16.7
Copper Tungsten	15650	180-200	385	6.5
Diamond	3500	2300	509	–
Ethylene Glycol	1116	0.242	2385	–
Glass (Common)	2580	0.80	795	7
Glass Wool	200	0.040	670	–
Gold	19320	310	126	14.2
Graphite	2560	5.7	837	3.6
Iron (Cast)	7210	83	460	10.4
Kovar	8360	16.6	460	5.0
Lead	11210	35	130	29.3
Molybdenum	10240	142	251	4.9
Nickel	8910	90	448	11.9
Nitrogen (Gas)	1.14	0.026	1046	–
Platinum	21450	70.9	133	9.0
Plexiglass (Acrylic)	1410	0.26	1448	74
Polyurethane Foam	29	0.035	1130	–
Rubber	960	0.16	2009	72
Silicone (Undoped)	2330	144	712	–
Silver	10500	430	235	–
Solder (Tin/Lead)	9290	48	167	24.1
Stainless Steel	8010	13.8	460	17.1
Steel (Low Carbon)	7850	48	460	11.5
Styrofoam	29-56	.029	1.22	–
Teflon	2200	0.35	–	–
Thermal Grease	2400	0.87	2093	–
Tin	7310	64	226	23.4
Titanium	4372	20.7	460	8.2
Water (@ 70°F)	1000	0.61	4186	–
Wood (Oak)	610	0.15	2386	4.9
Wood (Pine)	510	0.11	2805	5.4
Zinc	7150	112	381	32.4

The techniques used in the assembly of a thermoelectric (T.E.) system can be as important as the selection of the proper device. It is imperative to keep in mind the purpose of the assembly - namely to move heat. Generally a T.E. device, in the cooling mode, moves heat from an object to ambient. All of the mechanical interfaces between the objects to be cooled and ambient are also thermal interfaces. All thermal interfaces tend to inhibit the flow of heat or add thermal resistance.

Mechanical tolerances for heat exchanger surfaces should not exceed 0.001 in./in. with a maximum of 0.003 in. Total Indicated Reading. Should there be a need to use more than one TE module between common plates, the height variation between modules should not exceed 0.001 in. (request special thickness tolerance modules when ordering). Many T.E. assemblies utilize one or more "thermal grease" interfaces. The grease thickness should be held to 0.001 ±0.0005 in. (0.025 ± 0.013mm). [A printer's ink roller works well for this.] When these types of tolerances are to be held, a high level of cleanliness must be maintained. Dirt and grime should be minimized; this is very important when "grease" joints are utilized, due to their affinity for these types of contaminants.

Once the T.E. modules have been assembled between the heat exchangers, some form of insulation/seal should be provided between the exchangers surrounding the modules. Since the area within the module (the element matrix) is an open DC circuit and a temperature gradient is often present, gas flow, which may contain water that could condense, should be minimized.

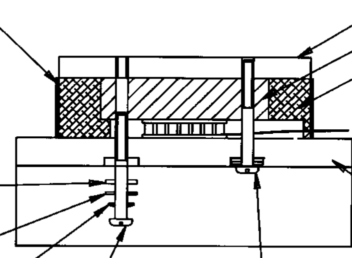
The insulation/seal is most easily provided by inserting sections of closed cell foam about the cavity and sealing with either an RTV-type substance, or, for more physical integrity, an epoxy coat. Whatever form is used, it should provide the protection outlined above.

The drawing shows the details of the recommended construction of a typical assembly. The use of a "spacer block" separates the hottest and coldest parts of the system by the maximum amount of insulation. The "spacer blocks" are used on the cold side of the system due to the lower heat flux density.

If you follow these recommendations, you should see a significant improvement in performance. When testing a thermoelectric system, it is important to monitor plate temperatures (our assembly components have sensor holes for this purpose), the temperature of any cooling fluids (inlet and outlet), and the flow rate of such fluids. Knowing the input voltage and current to the T.E. device will also help in analyzing performance. If you require any further assistance, please do not hesitate to contact one of our engineers. We have many years of working with customers to ensure reliable and efficient application of our products.

Procedure For Assembling Non-Metallized Modules (Type L) To Heat Exchangers

Please follow the steps outlined below for your particular interface material, including the Bolting Instructions. **Before starting, clean and degrease the thermoelectric modules and all surfaces that are to be interfaced.** If you are using another



interface material, please follow the manufacturer's suggested application procedures, and refer to the Bolting Instructions.

Thermal Grease

Step 1 Apply a thin continuous film of thermal grease to module hot side surface or to module area on hot side heat exchanger. A printer's ink roller works well for this.

Step 2 Locate module on hot side heat exchanger, hot side down.

Step 3 Gently oscillate module back and forth, exerting uniform downward pressure, noting efflux of thermal compound around edges of module. Continue motion until resistance is felt.

Step 4 Repeat Step #1 for cold side surface and cold side heat exchanger (or plate).

Step 5 Position cold side heat exchanger on module.

Step 6 Repeat Step #3, sliding cold side heat exchanger instead of module. Be particularly careful to maintain uniform pressure. Keep the module centered between the screws, or uneven compression may result.

Step 7 Follow Bolting Instructions.

Thermal Epoxy

Step 1 Thoroughly mix two parts of epoxy according to the included instructions.

Step 2 Apply thin film (< 0.003 in., 0.075 mm) of the epoxy to the hot side heat exchanger surface over the entire module footprint.

Step 3 Place the thermoelectric module, hot side down, on epoxy-covered surface.

Step 4 Gently oscillate module back and forth, exerting uniform downward pressure.

Step 5 Repeat steps for all interfaces to be epoxied, and bolt or clamp assembly together for curing process.

Step 6 Cure according to schedule given in Thermal Interfaces section.

Note: The thermoelectric module should not be used as a structural member of the assembly. Bolting or clamping will be required.

Interface Pads

Step 1 Apply the pad to the hot side heat exchanger, being careful to apply the pad evenly.

Step 2 Place the thermoelectric module on the pad, hot side down, with firm pressure. Be sure to center the module, or uneven compression may result.

Step 3 Repeat Steps for all other thermal interfaces.

Step 4 Follow Bolting Instructions

For TSI-PAL-type pads:

Step 5 If any of the interfaces will not reach 51°C (124°F) during operation, the assembly needs to be heated before operation. The assembly needs to be heated to 51°C only momentarily.

For TSI-ALN-type pads:

Step 5 Heat the entire assembly to 60°C (140°F) for 5 seconds.

Note: For both of the ThermoSet pads, do not heat the assembly above 85°C for non-HT type modules.

Bolting Instructions

Before bolting, best results are obtained by preloading the whole assembly in compression, applying a light load in line with the center of the module using a clamp or weights. Bolt carefully by applying torque in small increments and alternating between screws. Use a torque limiting screwdriver. The typical compression for a TEC assembly is 150 to 300 pounds per square inch (1030 to 2070 kPa). If less compression is required, check the Thermal Interface Materials part of this catalog for more information about recommended compression. If your thermal interface material is not from MELCOR, follow the manufacturer's recommendations for compression or contact MELCOR for further assistance. To determine the proper torque, use the equation below.

$$\text{Torque per screw (in-lbs)} = \frac{0.2 \times \text{Screw Diameter (in)} \times \text{Compression (psi)} \times \text{Module Surface Area (in}^2\text{)}}{\text{\# of Screws}}$$

Typical Screw diameters (4/40 = 0.112, 6/32 = 0.138, 8/32 = 0.164)

Notes:

Check torque after one hour and retighten if necessary. Use Stainless Steel Screws, fiber insulating shoulder washers, and steel spring (Belleville or split lock type) washers (see sketch).

Do Not use lead/tin solder (183°C) to replace leads.

Procedure For Assembling Solderable Modules (Type TL, LT, or TT) To Heat Exchangers

Step 1 Clean and degrease thermoelectric module, heat sink, and cold surface.

Step 2 Heat sink surface must be solderable (copper, copper plated aluminum, etc.) Clean module area of heat exchanger surface by light abrasion and degrease thoroughly. Pretin with indium-tin eutectic type solder (118°C) and flux.

Step 3 Module surface should be degreased lightly. Heat pretinned and cleaned heat exchanger surface to 120°C to 130°C (250°F - 265°F). The module should not go above 138°C (280°F) or the internal solder will reflow. Place module in position on surface, wait a few seconds for solder on module to melt and excess flux to boil out. When all solder is molten, module will have a tendency to float on the solder. Light swishing of the module will enhance wetting. (Note: After the solder is molten, if there is a slight dragging effect on the module, a deficiency of solder is indicated. Remove module and add additional solder to heat sink surface.)

Step 4 Cool unit to solidify solder and rinse the assembly thoroughly to remove all traces of flux residue.

Step 5 If only one side of the thermoelectric module is to be soldered (Type TL, LT), for the other side of the thermoelectric, follow the procedures for your interface material given above and on the previous page, including the bolting instructions.

Step 6 If you are soldering both sides of the thermoelectric module (Type TT), repeat Steps 2 through 4.

Notes:

The thermoelectric module should not be used as a structural member of the assembly. Low compression bolting or clamping will be required. Soldering both sides of the module (Type TT) in sizes larger than 12 mm x 12 mm is not recommended. Consult MELCOR for details.

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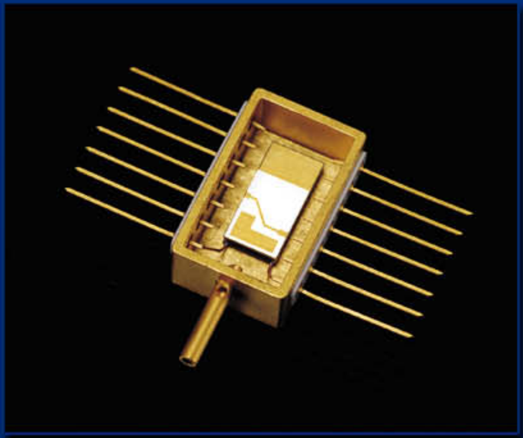

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