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DuraTEC Series Thermoelectric Coolers

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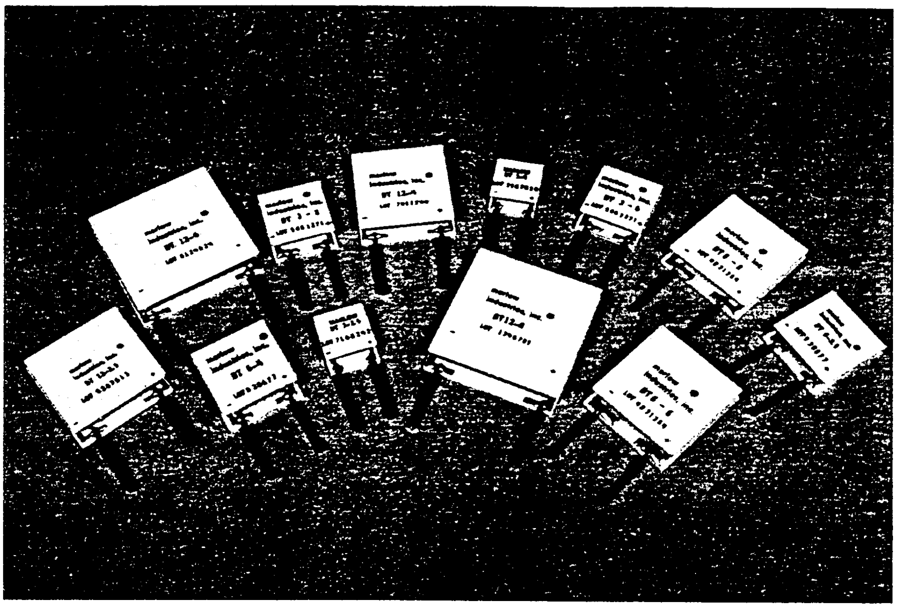


Product Description

The DuraTEC (DT) series of thermoelectric coolers are the ideal solution for medium to large heat pumping applications. Constructed with 183° C solder and incorporating an enhanced diffusion barrier, the DT series are extremely reliable under the most demanding environments. Made of high performance thermoelectric material, the DT series are designed to maximize your product's performance.

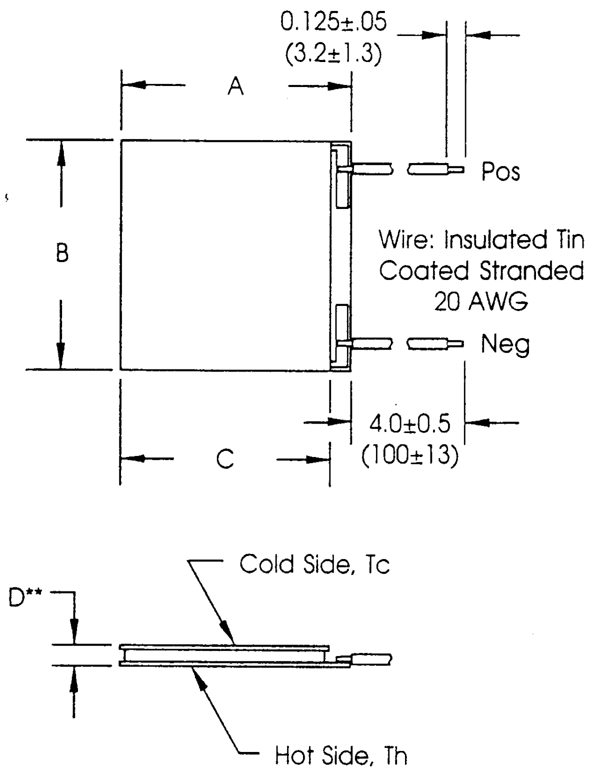
Applications

The DT series of coolers are suited for a wide variety of applications and products:

- Portable 12 volt food/beverage containers
- Chilled water dispensers
- Refrigerated medical storage enclosures
- High powered laser diode temperature stabilization
- Small refrigerators
- Wine cabinets
- Dehumidifiers
- CPU and other electronic component cooling
- Temperature stabilizing ink in industrial printers
- Temperature control of reagents in medical applications

Product Benefits

- Highest heat pumping efficiency (COP) in the industry
- Solid-state reliability
- Superior diffusion barrier construction for extended life
- Operating temperature up to 150° C
- Temperature stability of ± 0.1° C
- Porched configuration for improved leadwire strength
- Sealed option to improve reliability in condensing environments
- Lapped option for multi-module applications
- No vibration
- No CFCs or other gases
- SPC manufacturing
- Lot traceability



Alumina oxide ceramics

Mechanical Specifications

Table 1

Model Number (DTXX-X)	Dim A +.030 (.76) -.010 (.25)	Dim B +.030 (.76) -.010 (.25)	Dim C +.030 (.76) -.010 (.25)	Dim D** (Unlapped)
DT12-2.5	1.339 (34)	1.181 (30)	1.181 (30)	0.159 (4.04)
DT12-4	1.339 (34)	1.181 (30)	1.181 (30)	0.135 (3.43)
DT12-6	1.732 (44)	1.575 (40)	1.575 (40)	0.158 (4.01)
DT12-8	1.732 (44)	1.575 (40)	1.575 (40)	0.143 (3.63)
DT6-2.5	1.102 (28)*	0.925 (23.5)*	0.925 (23.5)*	0.159 (4.04)
DT6-4	1.102 (28)*	0.925 (23.5)*	0.925 (23.5)*	0.135 (3.43)
DT6-6	1.339 (34)	1.181 (30)	1.181 (30)	0.158 (4.01)
DT6-8	1.339 (34)	1.181 (30)	1.181 (30)	0.143 (3.63)
DT3-2.5	0.807 (20.5)*	0.630 (16)*	0.630 (16)*	0.159 (4.04)
DT3-4	0.807 (20.5)*	0.630 (16)*	0.630 (16)*	0.135 (3.43)
DT3-6	0.965 (24.5)	0.787 (20)	0.787 (20)	0.158 (4.01)
DT3-8	0.965 (24.5)	0.787 (20)	0.787 (20)	0.143 (3.63)

Dimensions are in inches, millimeters are in ( )
* Maximum size

	Ht. Tolerance	Flatness	Parallelism
Lapped	± 0.001 (0.025)	0.001 (0.025)	0.002 (0.051)
**Unlapped	± 0.005 (0.127)	0.002 (0.051)	0.003 (0.076)

(Lapped height 0.004 (.102) less than unlapped height)

Typical Performance Specifications (in dry nitrogen)

Table 2

Model Number (DTXX-X)	Imax (Amps)	Th=27° C Qmax (Watts)	Th=27° C Vmax (Volts)	Th=27° C ΔTmax (°C)	Th=35° C Qmax (Watts)	Th=35° C Vmax (Volts)	Th=35° C ΔTmax (°C)	Th=50° C Qmax (Watts)	Th=50° C Vmax (Volts)	Th=50° C ΔTmax (°C)	AC Resistance (Ohms)@27° C
DT12-2.5	2.5	23	14.7	66	24	15.2	69	26	16.4	74	4.9
DT12-4	3.7	36	14.7	66	37	15.2	69	39	16.4	74	3.2
DT12-6	5.6	54	14.7	66	56	15.2	69	60	16.4	74	2.2
DT12-8	7.4	71	14.7	66	74	15.2	69	78	16.4	74	1.6
DT6-2.5	2.5	13	8.2	65	14	8.6	68	14	9.2	73	2.8
DT6-4	3.7	20	8.2	65	21	8.6	68	22	9.2	73	1.8
DT6-6	5.6	30	8.2	65	31	8.6	68	33	9.2	73	1.2
DT6-8	7.4	39	8.2	65	41	8.6	68	43	9.2	73	0.9
DT3-2.5	2.5	6	3.6	65	6	3.8	68	6	4.1	73	1.2
DT3-4	3.7	9	3.6	65	9	3.8	68	10	4.1	73	0.8
DT3-6	5.6	13	3.6	65	14	3.8	68	14	4.1	73	0.5
DT3-8	7.4	17	3.6	65	18	3.8	68	19	4.1	73	0.4

Note: Sealing option will decrease the ΔTmax by approximately 1.5° C
For vacuum specifications, increase ΔTmax by approx. 4° C. Consult factory for more detailed information
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Thermoelectric Cooler (TEC) Selection Guide

This guide outlines a simplified procedure devised to allow the user to select several DT cooler designs and to estimate the performance of the selected coolers.

At the point you have narrowed the field of suitable TECs to two or three, you may proceed to steps 4 through 9 to determine the performance of the selected TECs within your application requirements.

Thermoelectric Cooler Selection

1. Heat Loads

	Example	Your Case
Heat Load (Qc)	15.0	______ watts

2. Temperatures

	Example	Your Case
TEC hot side (Th)	35°C	______ °C
TEC cold side (Tc)	-2.5°C	______ °C
ΔT (Th-Tc)	37.5°C	______ °C

3. Selection of the TECs
The performance graph (Figure 1) used in this brochure has been normalized to provide a universal curve for use with any single stage TEC for which the "Maximum" values are known. By using ratios of actual to "Maximum" performance values, performance may be estimated over a wide range of operating conditions.

a. Determine the ratio of ΔT/ΔTmax.

	Example	Your Case
ΔT (from step 2)	37.5	______ °C
ΔTmax (from Table 2 @ 35°C)	69	______ °C
ΔT/Tmax (calculate)	37.5/69=.54	______

b. On the performance graph, draw a horizontal line on the graph corresponding toΔT/ΔTmax (.54 in this example).

c. Obtain the "Optimum" value of Q/Qmax at the intersection of the horizontal line just drawn and the diagonal "Optimum" Q/Qmax line. Interpolation between curves may be necessary. (See example on Figure 1)
"Optimum" Q/Qmax - .25 ______

d. Obtain the "Maximum" value of Q/Qmax at the intersection of the horizontal line (drawn in step 3b) and the right vertical axis.
"Maximum" Q/Qmax-.45 ______

e. Divide the total heat load (from step 1) by the Q/ Qmax ratios above to calculate the "Optimum" and "Maximum" Qmax.
"Optimum" Qmax = 60 watts (15/.25) ______ watts
"Maximum" Qmax = 33 watts (15/.45) ______ watts

f. Select a TEC from Table 2 with a Qmax greater than the "Maximum" Qmax (33 watts in this example), but less than the "Optimum" Qmax (60 watts in this example). Keep in mind that within this range a TEC with a Qmax close to the "Optimum" Qmax will provide maximum efficiency, and a Qmax close to the "Maximum" Qmax will yield smaller and possibly less expensive TECs. Reading down the Qmax column results in the selection of the following TEC:
Qmax (maximum) = 37 watts ______watts
TEC DT 12-4 DT______

For this example, let us assume low cost is desired. Thus, the DT12-4 cooler is selected.

Thermoelectric Cooler Performance

4. Now that you have selected a cooler, the next step is to determine its performance.

a. Refer to Table 2, record the "Maximum" values at your application's hot side temperature for the TEC you selected above.

	Example	Your Case
ΔTmax	69	______ °C
Qmax	37	______watts
Imax	3.7	______amps
Vmax	15.2	______ volts

b. Determine the ratio of ΔT/ΔTmax:

	Example	Your Case
ΔT (from step 2)	37.5	______ °C
ΔTmax (from step 4a)	69	______ °C
ΔT/Tmax (calculate)	37.5/69=.54	______

c. On the performance graph draw a horizontal line on the upper graph corresponding to the ΔT/ΔTmax (.54 in this example).

d. Divide the total heat load (from step 1) by the value of Qmax for the TEC selected (from step 3f):
Q/Qmax = .41 (15/37) ______

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e. At the intersection of the horizontal line (drawn in step 4c) and the value of Q/Qmax (just calculated in step 4d), plot a vertical line on the performance graph.

f. Record the value of I/Imax at the intersection of the vertical line just plotted and the bottom I/Imax axis.

I/Imax = .81 ______________

5. Using the value of Imax (obtained in step 4a), and the value of I/Imax (just obtained in step 4f), calculate the TEC current (I).

TEC current = (Imax) x (I/Imax) = Amps
= 3.0 amps ________ amps
(3.7 x .81)

6. Calculate the TEC voltage:

a. Draw a horizontal line through each of the intersections of the vertical line (drawn in step 4e) and the two curves in the lower half of the performance curve. (Q=0, ΔT=0)

b. Record the values of V/Vmax at the intersection of the two horizontal lines drawn and the left vertical axis. These values determine the range of V/Vmax for the TEC selected. For large ΔT's (small values of Q/Qmax), the voltage will correspond to the high end range, and for small ΔT's (large values of Q/ Qmax), the voltage will correspond to the low end of the range.

High (V/Vmax) = .85 ______________
Low (V/Vmax) = .75 ______________

c. Multiply Vmax (obtained in step 4a) by each value of V/Vmax just obtained to get the range of TEC voltage.

High TEC voltage=Vmax x (V/Vmax)
=12.9 volts ________ volts
(15.2 x .85)

Low TEC voltage =Vmax x (V/Vmax)
= 11.4 volts ________ volts
(15.2 x .75)

7. Calculate maximum TEC power: Multiply TEC current (from step 5) by high TEC voltage (from step 6c).

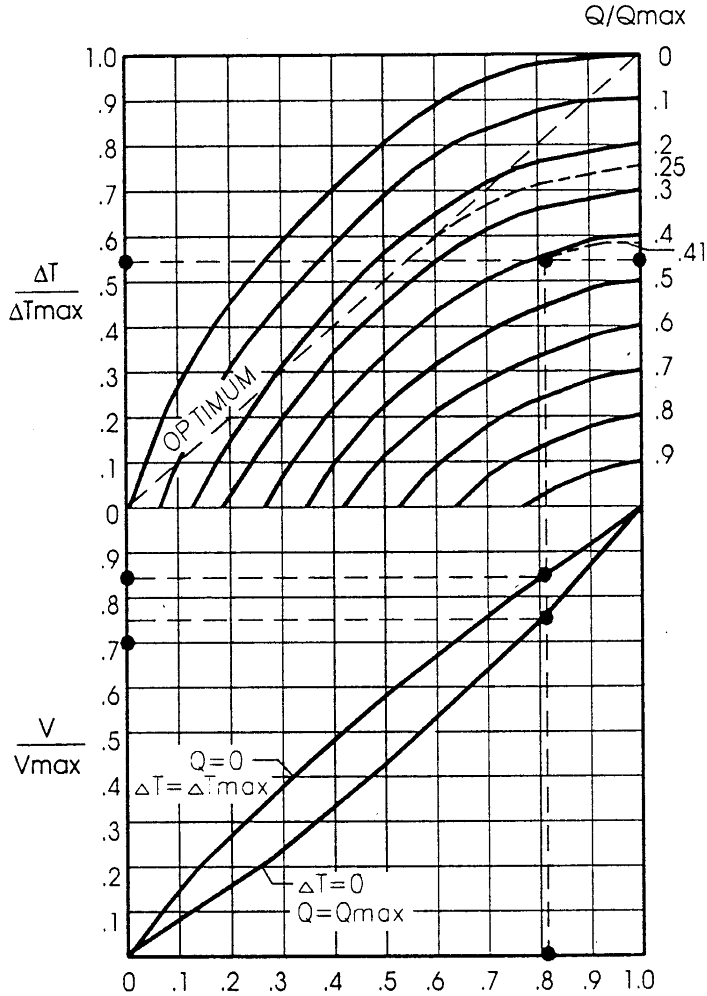
TEC Power = 38.7 watts ________ watts
(3.0 amps x 12.9 volts)

8. Calculate power dissipated into the heat sink (Qh): The power dissipated into the heat sink is the sum of the total heat load and the input power to the TEC.

Qh = 53.7 watts ________ watts
(15 + 38.7)

9. At this point you should have a candidate TEC with the approximate performance values and now be ready to order.

Normalized Cooling Curves
Figure 1



Definition of Terms:
I - Input current [Amps]
Imax - Input current resulting in greatest ΔT (ΔTmax) [amps]
Qc - Amount of heat absorbed at cold face of TEC [watts]
Qmax - Maximum amount of heat that can be absorbed at cold face (occurs at I=Imax, ΔT=0)[watts]
Tc - Temperature of the TEC cold side during operation [°C]
Th - Temperature of the TEC hot side during operation [°C]
ΔT - Temperature difference between TEC faces, Th-Tc [°C]
ΔTmax - Maximum temperature difference a TEC can achieve (occurs at I=Imax, Qc=0)[°C]
V - Input voltage [volts]
Vmax - Voltage at ΔTmax [volts]