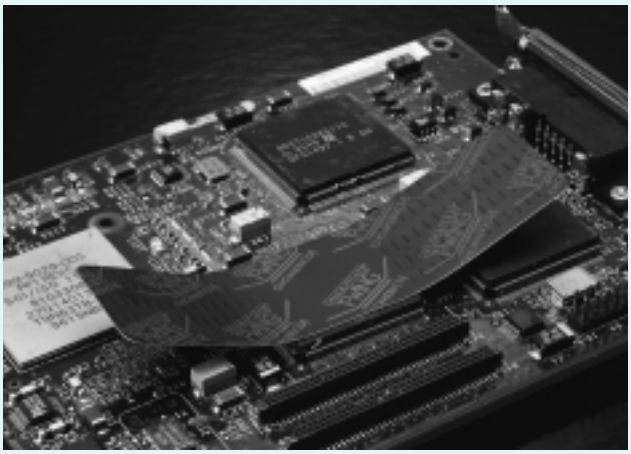
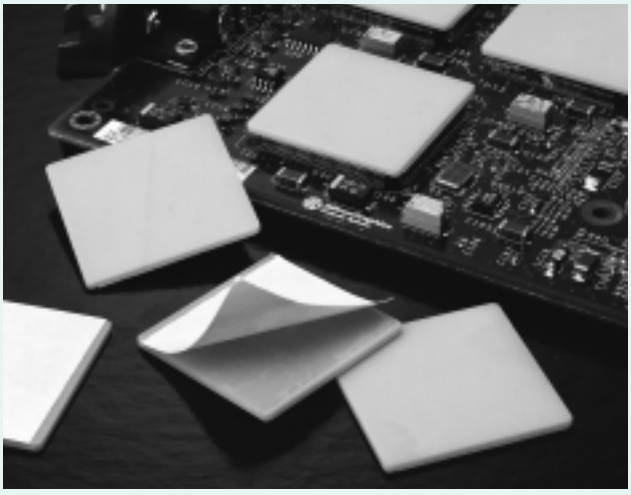
T-Wing® and C-Wing™ Heat Spreaders

***Note: T-Wings now available on continuious "kiss-cut" rolls**

Chomerics' family of thin heat spreaders provides a low-cost, effective means of cooling IC devices in restricted spaces where conventional heat sinks aren't appropriate. T-Wing spreaders consist of 5-oz. (0.007 inch/0.18 mm thick) flexible copper foil sandwiched between electrically insulating films. High strength PSA (pressure-sensitive adhesive) provides a strong bond to the component. The compliant nature of these "thermal wing" heat spreaders permits nearly 100% adhesive contact with non-flat package surfaces, optimizing thermal and mechanical performance.

C-Wing spreaders are a ceramic version which are available for EMI-sensitive applications. They consist of aluminum oxide or aluminum nitride substrates with the same PSA used on T-Wing heat spreaders.





Typical Applications

- IC Packages
- Memory Modules
- Printers
- Scanners

Features/Benefits

- component junction temperature reduction of 20°C is typical
- easily added to existing designs to lower component temperatures, improve reliability
- custom shapes available

Typical Properties

Heat Spreader	Total Thickness with PSA, inches (mm)	Thermal Conductor (std.)	Features/Typical Applications
T-Wing	0.013 (0.33)	Copper	**• Low profile allows use in limited headroom environments • Conforms to non-flat component surfaces for optimal thermal and mechanical performance • Peel and stick application**
C-Wing	0.060 (1.53)	Aluminum Oxide	**• Used where localized sensitivity to EMI (electromagnetic interference) may be an issue • Low profile • Peel and stick application**

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- *Phase-change thermal interface materials*
- *Thermally conductive adhesive tapes*
- *Thermally conductive insulator pads*
- *Thermally conductive gap fillers*
- *Thermally conductive silicone compounds*
- *Flexible heat spreaders • Thermal management for BGAs*

LEADER IN THERMAL MANAGEMENT: DESIGN, INNOVATION AND MATERIALS

TECHNICAL BULLETIN 71

T-WING® Flexible Heat Spreaders

DESCRIPTION

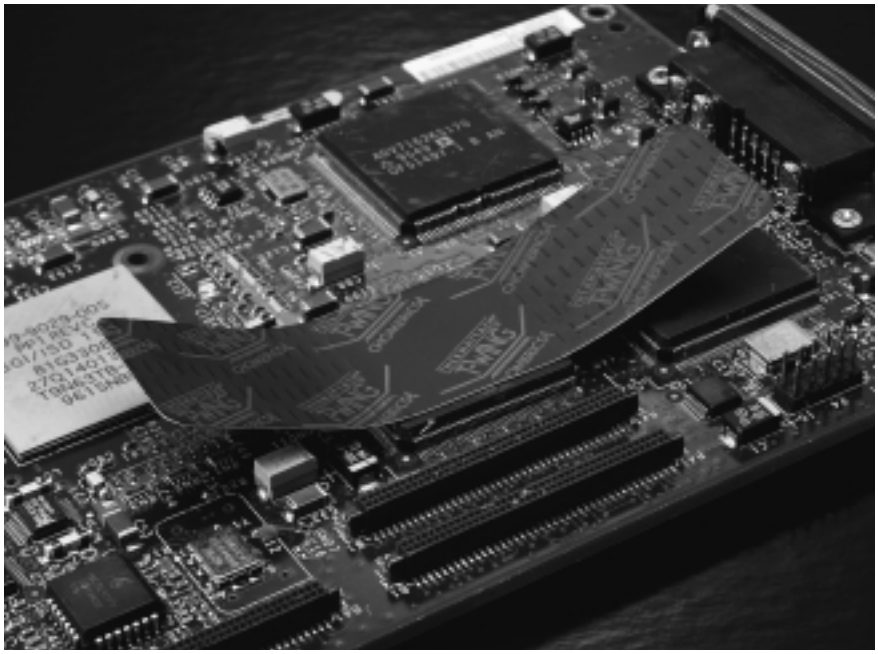
Chomerics' T-Wing heat spreaders* are thin, flexible, cooling devices with a high strength pressure-sensitive adhesive for easy attachment to component packages. T-Wing heat spreaders provide an effective method of cooling IC devices in restricted space environments where conventional heat sinks can't be used, thereby increasing component reliability.

T-Wing heat spreaders consist of 5 oz (0.007 in/0.178 mm) copper with electrically insulating film laminated on both sides. Attachment is easily accomplished with a high bond strength, pressure sensitive silicone adhesive (0.002 in/0.051 mm thickness), from the THERMATTACH family of double-sided, thermally conductive tapes. The adhesive is specially formulated for excellent bonding to plastic, metal and ceramic surfaces. It provides a strong bond at temperatures above 125°C.

The compliant nature of these "thermal wing" heat spreaders permits nearly 100% adhesive contact with non-flat package surfaces, optimizing thermal and mechanical performance. Pre-scored bend lines facilitate fitting into tight spaces.

T-Wing heat spreaders pass stringent thermal, mechanical and environmental testing. A 2000+ hour creep test at 135°C with a 43 gram load demonstrates reliable high temperature performance. After extended temperature/humidity aging, T-Wing spreaders meet or exceed initial values for peel strength and heat dissipation. T-Wing spreaders are UL 94V-0 rated. Standard part numbers appear on the last page.

*U.S. Patent No. 55,550, 326



APPLICATIONS

T-Wing heat spreaders are mounted on hot components such as CPUs to decrease case (and die junction) temperature. The result is enhanced reliability and extended component life. Both standard and custom configurations are offered to suit specific space and cooling needs.

T-Wing heat spreaders offer several benefits:

- Low cost cooling for many package types
- Low profile (0.013 in/0.33 mm) allows use in limited headroom environments
- Easy peel and stick adhesion to all surfaces, including packages with residual silicone mold release
- Low application force (<5 psi/0.03 MPa) minimizes risk of damage to component
- Wide range of standard sizes
- Pliable nature allows conformance to concave or otherwise non-flat surfaces for optimal thermal and mechanical performance
- Lightweight (0.039 oz/in^2)
- Standard parts scored for easy forming and alignment
- Easy removal for device replacement
- Low modulus adhesive eliminates concerns over CTE mismatch with any base material

Examples of specific packages for which T-Wing heat spreaders are appropriate include:

- PQFP
- Enhanced PQFP (with integral spreader)
- MQUAD
- PGA
- SQFP
- CQFP

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TABLE 1 – Construction and Typical Properties

PROPERTY		VALUE
Color		Black (glossy)
Total thickness including PSA	inches (mm)	0.013 (0.33)
Weight	oz/in^2	0.039
Pressure-sensitive adhesive (PSA) system		Polyester film (glossy black)
PSA thickness	inches (mm)	0.002 (0.05)
Insulator		Polyester
Insulator thickness	inches (mm)	0.0015 (0.038)
Thermal conductor		Copper
Thermal conductor thickness	inches (mm)	0.007 (0.178)
Dielectric Strength	volts	4,000*
Shelf Life (PSA)		1 year
Flammability		UL 94V-0

*Test Method ASTM D149. (Tested one side of film)

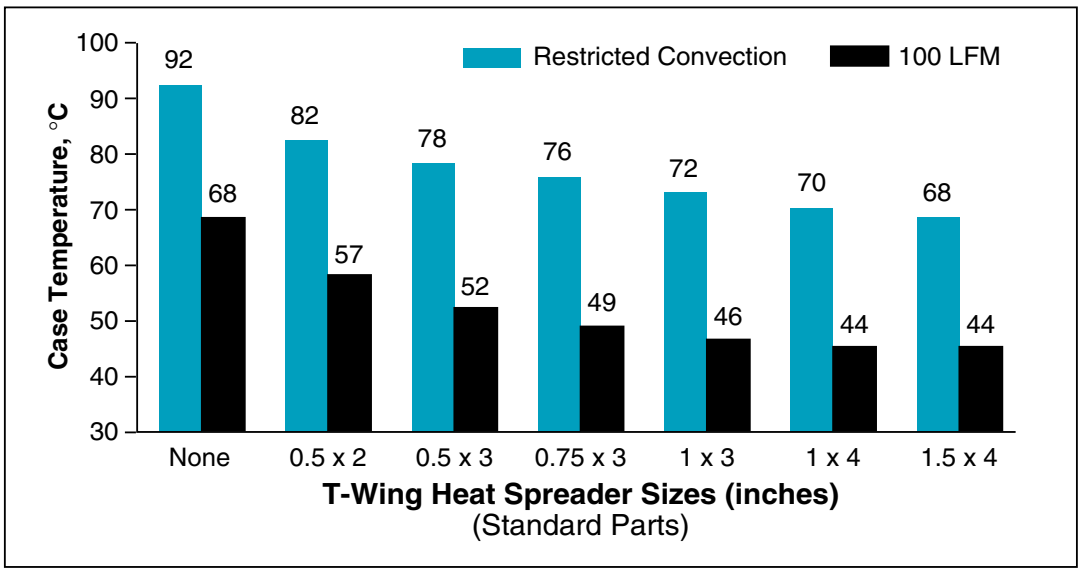
TABLE 2 – Thermal Performance of T-Wing Spreaders on 196 Lead, 3 Watt PQFP Package

Environment*	Part Number Size (inches)	Without T-Wing	20264 0.5 X 2	20265 0.5 X 3	20266 0.75 X 3	20267 1 x 3	20268 1 x 4	20269 1.5 x 4
Restricted convection**	Thermal resistance Rj-a (°C/W)	26	25	23	23	22	20	19
	Case temperature (°C)	92	82	78	76	72	70	68
100 LFM†	Thermal resistance Rj-a (°C/W)	18	16	14	14	14	13	12
	Case temperature (°C)	68	57	52	49	46	44	44

* Measured values do not account for heat losses through bottom of case and leads. Ambient temperature ranged from 21°C to 24°C.
** Restricted convection in a simulated notebook computer environment – a 1 x 5 x 6 inch (2.54 x 12.7 x 15.2 cm) plexiglass box.
† T-Wing long axis perpendicular to air flow direction in wind tunnel.

Notes:
Rj-a = thermal resistance from junction to ambient
LFM = airflow rate (linear feet per minute)
Full part numbers and ordering instructions on page 4; format is 60-12-20XXX-TW10

Figure 1 - Relative Thermal Performance by Size



T-Wing® Flexible Heat Spreader *continued*

TABLE 3 – Typical Adhesion Performance

Test	Procedure	Result	Test Method
Lap Shear – Room Temperature	apply/60 min. R.T. dwell/R.T. pull	960 oz/in^2 (414 kPa)	ASTM D1000
Lap Shear – Elevated Temperature	apply/60 min. R.T. dwell/100°C pull	53 oz/in^2 (23 kPa)	ASTM D1000
90° Peel – Room Temperature	apply/1 min. R.T. dwell/R.T. pull	40 oz/in (441g/cm)	ASTM B571/D2861
90° Peel – Elevated Temperature	apply/60 min. R.T. dwell/100°C pull	20 oz/in (220g/cm)	ASTM B571/D2861
Creep Adhesion, days	275°F (135°C), 7 oz/in^2 (3 kPa), on aluminum	>80 days, no failure	P.S.T.C. No. 7

Note: Unless stated otherwise, all tests performed on surface of 196 lead PQFP package, prepared by cleaning with isopropyl alcohol.

TABLE 4
Environmental Stress Thermal Performance

Environment	Before	After
Heat Aging		
Rj-a (°C/W) Restricted Convection	20.3	20.6
Rj-a (°C/W) 100 LFM	12.7	13.1
High Temperature/Humidity		
Rj-a (°C/W) Restricted Convection	21.4	21.4
Rj-a (°C/W) 100 LFM	14.1	14.0
Temperature Cycling		
Rj-a (°C/W) Restricted Convection	21.4	21.7
Rj-a (°C/W) 100 LFM	14.1	13.9

Note: Tested with a 1" x 4" (25.4 x 101.6 mm) T-WING

TABLE 5
Environmental Stress Adhesive Performance

Environment	90° Peel Strength	
	oz/in	(gm/cm)
Control	36	393
Heat Aging	36	393
High Temperature/Humidity	46	514
Temperature Shock	38	424
Temperature Cycling	30	335

Note: Average of three samples tested per ASTM B571/D2861.

TESTING SUMMARY

Summaries of test procedures used for T-Wing heat spreaders are described below. Thermal performance, adhesion strength and visual inspection were used as pass/fail criteria.

Apparatus

Anatek® Thermal Analyzer: The ATA was used to measure Rj-a before and after environmental stressing.

PQFP: 196 lead, plastic PQFPs known to contain silicone mold release were evaluated.

T-Wing Heat Spreader: 1 inch x 4 inch T-Wing parts were applied to the PQFP packages with a 5 psi (0.03 MPa) mounting pressure.

Thermal Performance

Various sizes of T-Wing heat spreaders were applied to a 196 lead PQFP using less than 5 psi (0.03 MPa) bonding pressure. Within 30 minutes of application, the test boards were mounted in an Analysis Tech® thermal analyzer. The devices were heated to equilibrium (45 to 60 minutes) with approximately 3 watt load on 3 x 3 inch (7.6 x 7.6 cm) test boards. Two test environments were used: restricted convention, achieved with a 1 x 5 x 6 inch (2.5 x 12.7 x 15.2 cm) plexiglass box; and 100 LFM (30m/min) air flow. Results were obtained using thermocouples for Tc (centered on case) and Rj-a.

Environmental Stressing

Control: Specimens were maintained for 1000 hours at standard laboratory conditions, 23°C, 35-60% RH.

Heat Aging: Test specimens were placed in a forced convection hot air oven maintained at 150°C ±5°C for 1000 hours. Test specimens were then removed and tested.

Elevated Temperature/High Humidity: Specimens were placed in a humidity chamber maintained at 85°C ±2°C and 90%-0 +10% RH for 1000 hours.

Temperature Cycling: Specimens were subjected to 500 cycles from -50°C to +150°C in a Tenney Temperature Cycling Oven.

Temperature Shock: Specimens were subjected to 100 temperature shocks by immersion into -50° and +150°C liquids. Temperatures were monitored with thermocouples.

Evaluation Procedure

Visual: All test specimens were examined for de-bonding, delamination or other signs that the tape was failing after environmental stress.

Thermal Performance: T-Wing was applied to the PQFP with 5 psi mounting pressure. After a one hour dwell, the Rj-a of each specimen was measured at 100 LFM and under restricted convection conditions. The Rj-a was again measured after environmental stressing.

90° Peel Strength: A T-Wing heat spreader was applied to each PQFP with 5 psi mounting pressure. The specimens were subjected to environmental stress and then tested for 90° peel strength at room temperature.

continued

Results

Visual: There was no visual evidence of T-Wing adhesion failure to the PQFP after the environmental stresses.

Thermal Performance: The before and after thermal resistances are given in Table 4. The data shows that the thermal resistances were essentially unchanged by the exposures.

90° Peel Strength: The results of the peel strength tests are given in Table 5. The data shows that the average peel strength actually increases with high temperature/humidity and temperature shock, while remaining unchanged with heat aging and decreasing slightly with temperature cycling.

APPLICATION INSTRUCTIONS

Materials needed: Clean cotton cloth or rag, industrial solvent, rubber gloves.

Step 1: For best results, clean the top surface of the component using a lint-free cotton cloth.

Step 2: Wipe the bonding surface of the component with an industrial solvent, such as MEK, acetone or isopropyl alcohol. In the case of a plastic package, select a cleaner that will not chemically attack the plastic substrate.

Do not touch the cleaned surface during any part of the assembly process. If the surface has been contaminated, repeat Steps 1 and 2.

Step 3: Remove the clear release liner from the T-Wing part, exposing the pressure-sensitive adhesive (PSA). Avoid touching exposed adhesive with fingers.

Step 4: For best bond strength and contact area, center the exposed PSA onto the component. Press and smooth the entire T-Wing bonding area with firm finger pressure of about 5 psi, for 5 seconds.

Note: Bond strength will increase as a function of time as the adhesive continues to wet out the bonding surface. Increasing any of the application variables (pressure, temperature and time) can improve bonding results.

ORDERING INFORMATION

Standard Parts: Refer to table below for Part Numbers and sizes. T-Wing heat spreaders are available in standard packages of 100 parts/pkg.

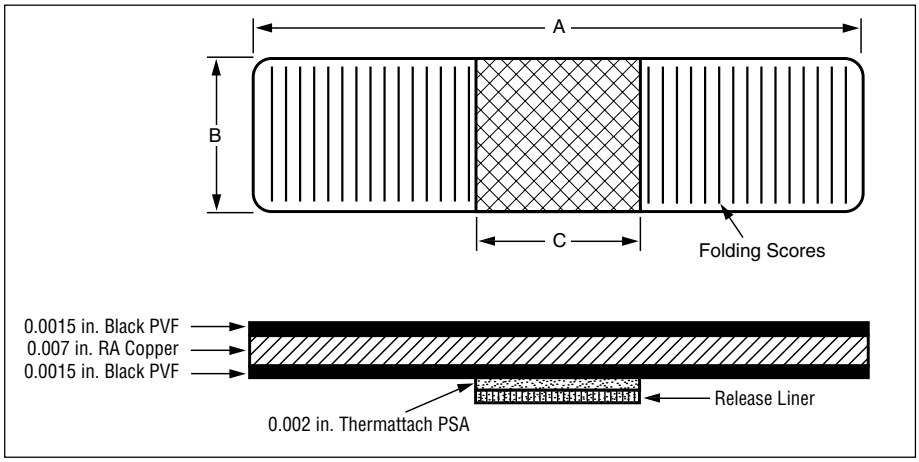
Custom Parts: Custom configured T-Wing parts are also available. Contact Chomerics' Applications Engineering Department for details. Die-cut parts on a roll are available on request.

Standard Sizes *(refer to Figure 2 below)*

Part Number	A	B	C
60-12-20264-TW10	2.0 (50.8)	0.5 (12.7)	0.5 (12.7)
60-12-20265-TW10	3.0 (76.2)	0.5 (12.7)	0.5 (12.7)
60-12-20266-TW10	3.0 (76.2)	0.75 (19.1)	0.75 (19.1)
60-12-20267-TW10	3.0 (76.2)	1.0 (25.4)	1.0 (25.4)
60-12-20268-TW10	4.0 (101.6)	1.0 (25.4)	1.0 (25.4)
60-12-20269-TW10	4.0 (101.6)	1.5 (38.1)	1.5(38.1)
Custom configurations – *contact Chomerics' Applications Department*			

Dimensions are in inches (millimeters). Tolerance is ±.015 in. (0.38 mm).

FIGURE 2



Dimensions are typical

PRELIMINARY PRODUCT DATA SHEET

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LEADER IN THERMAL MANAGEMENT: DESIGN, INNOVATION AND MATERIALS

Parker Seals

C-WING™ Heat Spreaders

***Note: Now available with an acrylic adhesive.**

Chomerics' C-WING heat spreaders are ceramic, electrically non-conductive devices that feature a strong, pressure-sensitive adhesive for easy attachment to component packages. C-WING spreaders are ideal cooling solutions where localized sensitivity to EMI (electromagnetic interference) may be an issue. Low profile C-WING spreaders can be used where conventional heat sinks and sink/fan systems are prohibited due to area constraints.

Standard C-WING heat spreaders are made from aluminum oxide. Parts can also be made from aluminum nitride for premium cooling performance. The thermally conductive adhesive on C-WING spreaders is the same silicone-based PSA (pressure-sensitive adhesive) used on most versions of Chomerics' THERMATTACH® tapes and on T-WING® heat spreaders. Chomerics provides a range of standard C-WING sizes. Custom parts are designed using advanced thermal measurement and modeling capabilities.

For more information on C-WING heat spreaders, contact Chomerics' Inside Sales department.

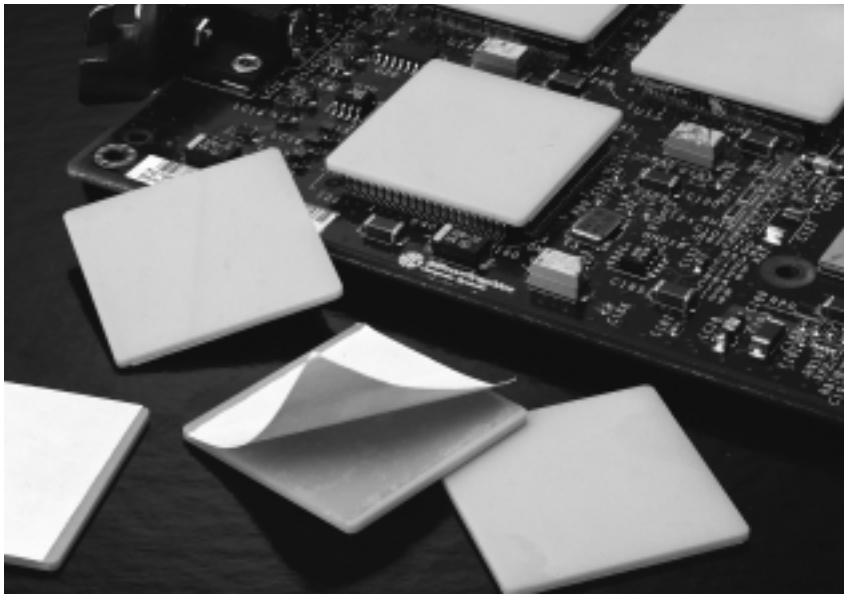

TABLE 1 – Construction and Typical Properties

Flammability	UL 94V-0
Color	Tan
Total thickness with PSA in. (mm)	0.60 (1.53)
Pressure-sensitive adhesive (PSA) system	Silicone-Based THERMATTACH
Thermal conductor	Aluminum Oxide (std.) / Acrylic (new)
Thermal conductivity (W/m-K)	26
Shelf Life (PSA)	1 year

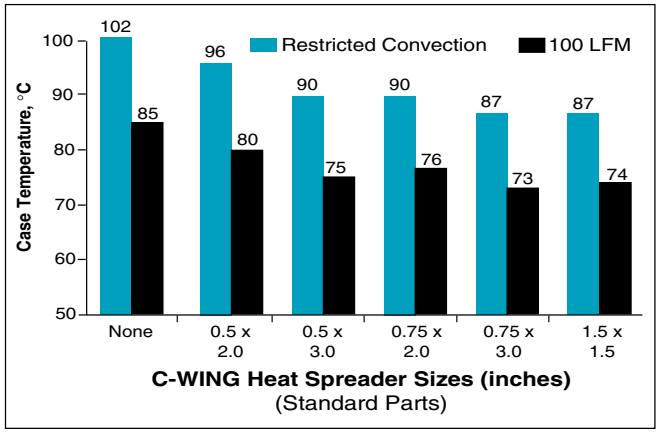

Figure 1 - Relative Thermal Performance by Size

Notes:
1. Temperature measured at center of Al_2O_3 heat spreader
2. Testing performed with a 0.75 x 0.75-inch,100-lead PQFP component dissipating 2 watts.

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