

# THERMATTACH® T404, T405 and T412

## Thermally Conductive Adhesive Tapes for Heat Sink Attachment to Ceramic or Metal Components

### DESCRIPTION

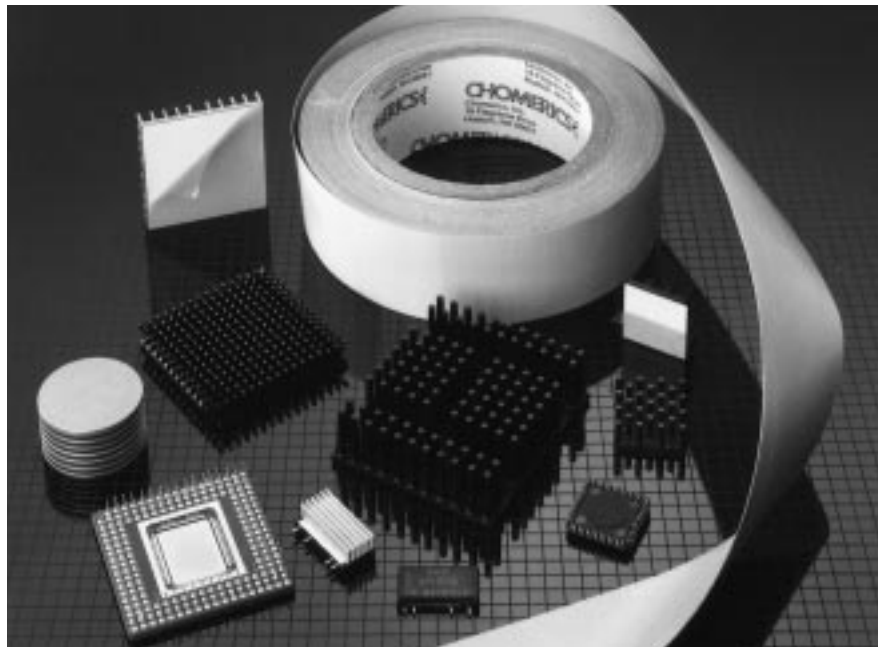
Chomerics' patented<sup>†</sup> THERMATTACH double-sided adhesive tapes provide an effective thermal interface between electronic components and heat sinks. These tapes have high thermal conductivity and exceptional bonding properties – eliminating the need for thermal grease and mechanical fasteners.

THERMATTACH T404 thermal tape consists of a high bond strength, pressure-sensitive acrylic adhesive, loaded with aluminum oxide particles and coated on 0.001 in (0.025 mm) Kapton® MT thermally conductive polyimide film. The tape provides good thermal performance and excellent electrical isolation.

THERMATTACH T405 thermal tape consists of a high bond strength, pressure-sensitive acrylic adhesive, loaded with aluminum oxide and coated onto a 0.002 in (0.050 mm) aluminum foil carrier. The aluminum foil provides added thermal conductivity for applications where electrical isolation is not required.

THERMATTACH T412 thermal tape consists of a high bond strength, pressure-sensitive acrylic adhesive, loaded with titanium diboride and applied to an expanded aluminum carrier. The combination of filler, expanded metal and embossed surface enhances both tape conformability and thermal performance. For additional application information concerning BGAs, PGAs, ceramic packages, packages with heat spreaders and/or PQFPs, contact Chomerics' Applications Department.

THERMATTACH tapes are embossed with a unique pattern for maximum conformability and minimal air pockets.



Extensive testing has shown that Chomerics' embossing system provides thermal and mechanical results superior to those of flat thermal tapes.

All THERMATTACH tapes offer excellent thermal, mechanical, environmental and chemical properties. Vibration testing at 10 G shows no adverse effects. Unlike traditional acrylic pressure-sensitive tapes, after extended temperature/humidity aging and harsh conditions, THERMATTACH tapes meet or exceed initial properties for shear strength and thermal conductivity.

### APPLICATIONS

**For heat sink attachment to plastic encapsulated components, such as BGAs, THERMATTACH T410 and 411 tapes are recommended. Please see Chomerics Technical Bulletin No.79 for more information.**

THERMATTACH thermal tapes bond heat sinks to hot components. They attach components to vertical heat sinks or to metal chassis walls in place of clips, screws or other mechanical fasteners, and require no additional thermal compound.

THERMATTACH tapes have many advantages over traditional adhesives such as hot melts or thermal epoxies. They can be consistently applied to meet design-level thermal and adhesive requirements. The tapes can be removed after application, reducing repair and rework costs in both the manufacturing plant and the field.

<sup>†</sup> U.S. Patent #5,298,791

**THERMATTACH® Heat Sink Attachment Tapes** *continued*

TYPICAL PROPERTIES		T404	T405	T412	TEST METHOD	
CONSTR.	Carrier	Kapton* MT	Aluminum	Expanded Al	--	
	Color	Beige	White	Grey	--	
	Thickness, inch (mm)	0.005 (0.127)	0.006 (0.152)	0.009 (0.229)	--	
	Thickness, Tolerance, inch (mm)	±0.001 (0.03)	±0.001 (0.03)	±0.001 (0.03)	--	
THERMAL	Thermal Impedance @<1 psi, °C-in <sup>2</sup> /W (°C-cm <sup>2</sup> /W)	0.6 (3.7)	0.5 (3.4)	0.25 (1.7)	ASTM D5470	
	Thermal Conductivity, W/m-K	0.37	0.50	1.40	ASTM D5470	
ELEC.	Voltage Breakdown, Vac	5000	NA	NA	ASTM D149	
	Volume Resistivity, ohm-cm	3 x 10 <sup>14</sup>	NA	1.3 x 10 <sup>-2</sup>	ASTM D257	
MECHANICAL	Flammability Rating (E140244)	V-0	V-0	Not Rated	UL94	
	Lap Shear Adhesion, psi (MPa)	125 (0.862)	135 (0.931)	70 (0.483)	ASTM D1002	
	Die Shear Adhesion, psi (MPa)	Aluminum 25°C	130 (0.897)	125 (0.862)	135 (0.931)	Chomeric Test Procedure No. 54
			150°C	50 (0.345)	55 (0.379)	
		Copper 25°C	120 (0.828)	160 (1.10)	115 (0.793)	
			150°C	45 (0.310)	70 (0.488)	
	Aluminum Oxide Substrate	25°C	170 (1.17)	145 (1.00)	125 (0.862)	
		150°C	50 (0.345)	60 (0.414)	40 (0.276)	
Creep Adhesion, days	25°C, 12 psi (0.083MPa)	>50	>50	>50	PSTC-7**	
	150°C, 12 psi (0.083MPa)	>50	>50	>50		
Adhesive CTE, ppm/°C, -40 to +150°C	400	400	400	400	Chomeric Test Procedure No.163	

\*Trademark of DuPont \*\*Pressure Sensitive Tape Council

Unlike rigid adhesives, Chomerics thermal tapes are pliable and conformable, reducing concerns over CTE mismatch and the cracking or splitting of components or epoxy bond lines. At very comparable installed cost, THERMATTACH tapes offer advantages over mechanical fasteners or liquid adhesives which may require a large capital investment.

**TEST METHODS**

*Summaries of test procedures used for THERMATTACH thermal tapes are described below. Thermal performance, die shear strength and visual inspection were used as pass/fail criteria.*

**Thermal Performance.** Thermal tape 0.6 x 1 inch (15.2 x 25.4 mm) was applied to a transistor. The second layer of release liner was removed and the transistor was attached to the heat sink. Four transistors were applied one after the other. After a one hour dwell, the Rj-s<sup>1</sup> and Rj-a<sup>†</sup> of each transistor was determined using an Analysis Tech® Thermal Analyzer. The test fixture was subjected to 1000 hours

at 150°C. The individual Rj-s and Rj-a values were again measured and recorded.

**Die Shear Strength.** 0.5 x 0.5 inch (12.7 x 12.7 mm) thermal tape was applied to 0.06 x 1 x 4 inch (15.2 x 25.4 x 101.6 mm) cleaned aluminum panels using light pressure. Six dies were applied to each aluminum panel. The samples were subjected to 1000 hours at 150°C and tested for die shear strength at room temperature.

**Visual Inspection.** All test specimens were examined for tape lifting, delamination or any other sign that the tape was failing.

**Test Method Descriptions and Results**

**1000 Hrs., 66°C, 85% Relative Humidity.** Samples of each product passed this test based on thermal performance, die shear strength and visual performance criteria.

**1000 Hrs., 25°C, 95% Relative Humidity.** Samples were subjected to high humidity at ambient laboratory

temperature for 1000 hours. Each product passed this test as evidenced by no decrease in adhesion or thermal performance.

**Heat Aging.** Samples were subjected to 1000 hour heat aging at 150°C. All products passed this test based on thermal performance, die shear strength and visual performance criteria.

**Mechanical Shock.** Samples were tested for mechanical shock resistance. All products passed the test as evidenced by no loss of adhesion or deterioration of thermal performance.

**Thermal Shock Resistance.** Samples were subjected to ten thermal shock cycles following ASTM D-1674 guidelines. All products passed this test based on thermal performance, die shear strength and visual performance criteria.

**Vibration Resistance.** Samples were subjected to random vibration testing. All products passed the test with no loss of adhesion or thermal performance.

<sup>1</sup>Rj-s = Thermal resistance from junction to heat sink.  
<sup>†</sup>Rj-a = Thermal resistance from junction to ambient.

**Vibration Resistance at Elevated Temperature.** Samples of THERMATTACH tapes were subjected to random vibration at elevated temperature. None of the tested products were negatively affected.

**APPLICATION PERFORMANCE – SUMMARY**

Test	Results*
High Temperature/Humidity Resistance, 1000 Hours, 66°C, 85% RH .....	Pass
High Humidity @ Ambient 1000 Hours, 25°C, 95% RH .....	Pass
Heat Aging 1000 Hours, 150°C .....	Pass
Mechanical Shock .....	Pass
Thermal Shock, -60 to +150°C	
10 Cycles .....	Pass
100 Cycles .....	Pass
Heat Aging .....	Pass
Vibration .....	Pass
Vibration @ 150°C .....	Pass
Temperature Cycling, -50 to +150°C, 1000 Cycles .....	Pass
Long-Term Storage .....	Pass

**Note:** Formal Test Reports are available from Chomerics' Applications Engineering Department.

\*See details on previous page or contact Chomerics for more information.

The base acrylic adhesive used in these THERMATTACH tapes has been evaluated for resistance to salt spray and typical solvents, and compatibility with common conformal coating compounds. Details can be obtained from Chomerics' Applications Engineering Department.

**APPLICATION INSTRUCTIONS**

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

For optimal performance, Chomerics recommends interface flatness of 0.002 in/in (0.05 mm/mm) max. for T412 and 0.001 in/in (0.025 mm/mm) max. for T404 and T405.

**Step 1:** Ensure that bonding surfaces are free from oil, dust, etc. Using rubber gloves, wipe surfaces with a cloth dampened with industrial solvents such

as MEK, toluene, acetone or isopropyl alcohol are recommended.

**Step 2:** Cut tape to size and remove clear liner or remove pre-cut tape from roll. (Due to variations in heat sink surfaces, Chomerics' data indicates that the tape should be cut slightly smaller than the area of the heat sink. See back page for size recommendations.)

**Step 3:** Apply to center of heat sink bonding area and smooth over entire surface using moderate pressure.

**Step 4:** Remove blue embossed liner from the tape. Center heat sink component and apply using any one of the recommended temperature/pressure options shown below:

Pressure	Temperature	Time
10 psi (0.069 MPa)	22°C	15 sec
30 psi (0.207 MPa)	22°C	5 sec
10 psi (0.069 MPa)	50°C-65°C	5 sec
30 psi (0.207 MPa)	50°C-65°C	3 sec.

Contact Chomerics' Applications Department for additional information.

**Note:** Increasing any of the application variables (pressure, temperature and time) can improve results due to the relationship of the variables. Elevated temperature can be achieved by exposing heat sinks to a conventional hot air/heat gun prior to application.

Approximately 70% of the ultimate adhesive bond strength is achieved with initial application, and 80-90% is reached within 15 minutes. Ultimate adhesive strength is achieved within 36 hours; however, the next manufacturing step can occur immediately following the initial application.

**REMOVAL INSTRUCTIONS**

**Materials needed:** Single-edged razor blade or a small, thin-bladed pocket knife; soft, thin metal spatula

Use safety precautions when handling sharp instruments and organic solvents.

**Step 1:** Carefully insert the blade edge into the bond line at a corner between the heat sink and the component. The penetration need not be very deep.

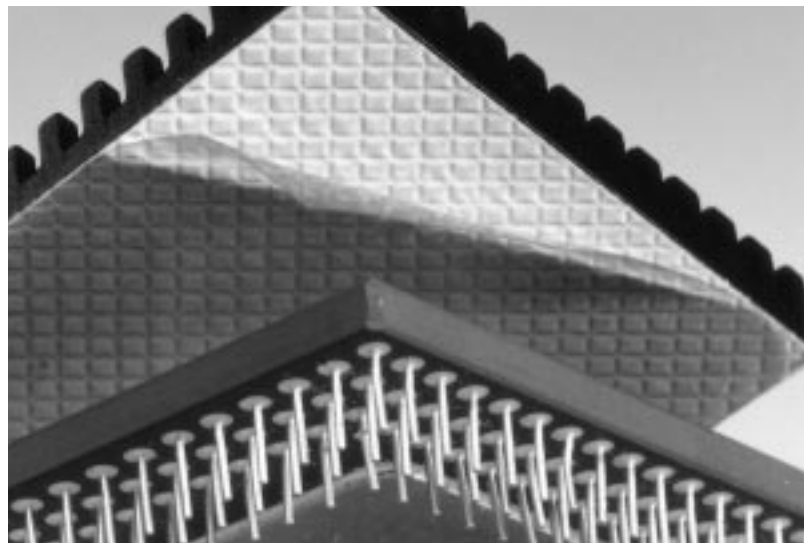
**Step 2:** Remove the blade and insert the spatula into the wedge. Slowly twist the spatula blade so that it exerts a slight upward pressure.

**Step 3:** As the two surfaces start to separate, move the spatula blade deeper into the bond line and continue the twisting motion and upward force.

**Step 4:** After the two components are separated, the tape can be removed and discarded. If adhesive remains on the component surfaces, it must be removed. Adhesive is best removed by wiping with a rag dabbed with isopropyl alcohol, MEK or toluene. Use sufficient solvent to remove all adhesive.

**Step 5:** Let solvent cleaned components air dry for 15 minutes before reapplying THERMATTACH tape.

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**ORDERING INFORMATION**

*Standard Rolls*

THERMATTACH T404, T405 and T412 thermal tapes are available in standard 100 ft. (30.5 m) rolls of various widths. Use this part number system when ordering rolls of THERMATTACH tapes. Pre-cut parts are available in kiss-cut, rectangular shapes on rolls (see table below).

**67 - 10 - YYYY - ZZZZ**

Roll Width
0050 = 0.50 inch (1.27 cm)
0075 = 0.75 inch (1.91 cm)
0100 = 1.00 inch (2.54 cm)
0125 = 1.25 inch (3.18 cm)
0150 = 1.50 inch (3.81 cm)
0175 = 1.75 inch (4.45 cm)
0200 = 2.00 inch (5.08 cm)
0800 = 8.00 inch (20.32 cm)

Material
T404 = THERMATTACH 404
T405 = THERMATTACH 405
T412 = THERMATTACH 412

**Size Recommendations and Part Numbers for Most Popular Microprocessor Packages**

Package Type	Heat Sink Base Size Range	THERMATTACH Part Number	Pre-cut Tape Size
<b>PGA</b>			
15 x 15	1.50 to 1.75 in. sq. (3.81 to 4.45 cm sq.)	69-13-Y110-T_ _ _	1.375 in. x 1.375 in. (3.49 cm x 3.49 cm)
17 x 17	1.75 to 1.90 in. sq. (4.45 to 4.83 cm sq.)	69-13-S799-T_ _ _	1.6 in. x 1.6 in. (4.06 cm x 4.06 cm)
19 x 19	1.90 to 2.10 in. sq. (4.83 to 5.33 cm sq.)	69-13-S438-T_ _ _	1.75 in. x 1.75 in. (4.45 cm x 4.45 cm)
21 x 21	2.10 to 2.30 in. sq. (5.33 to 5.84 cm sq.)	69-13-Y788-T_ _ _	2.0 in. x 2.0 in. (5.08 cm x 5.08 cm)
<b>CQFP</b>			
164 Pin	1.00 to 1.25 in. sq. (2.54 to 3.18 cm sq.)	69-13-Y790-T_ _ _	0.90 in. x 0.90 in. (2.29 cm x 2.29 cm)
196 Pin	1.25 to 1.50 in. sq. (3.18 to 3.81 cm sq.)	69-13-Y789-T_ _ _	1.125 in. x 1.125 in. (2.86 cm x 2.86 cm)

When using THERMATTACH tape for bonding heat sinks to microprocessors, Chomerics recommends that the THERMATTACH tape size be recessed a minimum of 0.05 in. (0.127 cm) from the edge of the heat sink base.

Pre-cut parts are supplied kiss-cut on rolls of 1000 parts per roll.

For availability of THERMATTACH parts for other components or package sizes, please contact Chomerics' Inside Sales Department.

  <a href="http://www.chomerics.com">www.chomerics.com</a>	Chomerics, Div. of Parker Hannifin 77 Dragon Court Woburn, MA 01888-4014 TEL: 781-935-4850 FAX: 781-933-4318	 Parker Hannifin PLC Chomerics Europe Parkway, Globe Park Marlow, Bucks, SL7 1YB, United Kingdom TEL: (44) 1628 404000 FAX: (44) 1628 404090 France Freephone TEL: (0590) 8170 Germany Freephone TEL: (0130) 818074	 Parker Hannifin Hong Kong Ltd. Chomerics Sales Department 8/F King Yip Plaza 9 Cheung Yee Street, Cheung Sha Wan Kowloon, Hong Kong TEL: (852) 2 428 8008 FAX: (852) 2 423 8253
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