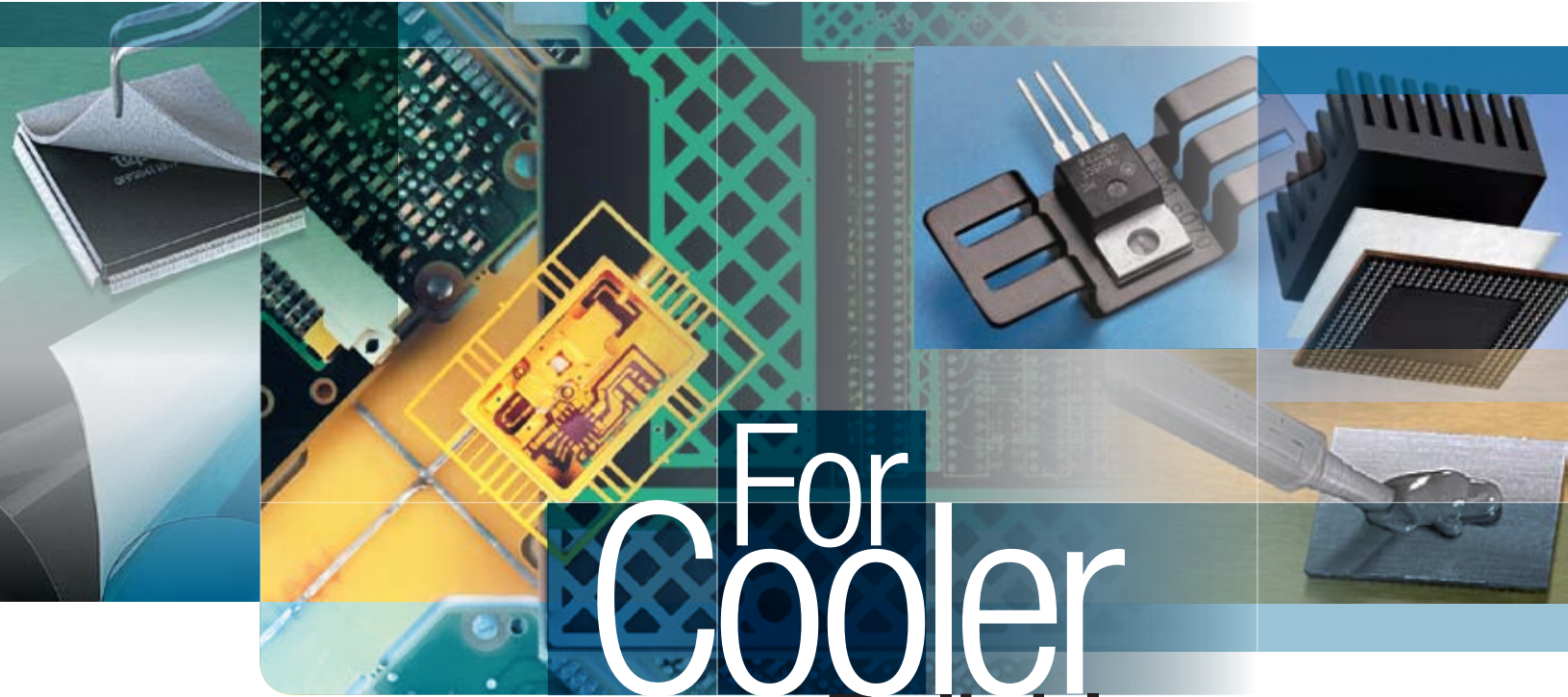


Thermal Management Solutions
For Electronics



For
Cooler
More Reliable
Devices



3M™ Thermal Management Solutions for Electronics

3M™ Thermally Conductive Adhesive Transfer Tapes

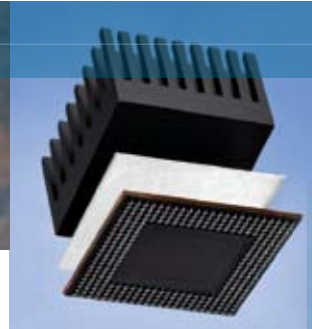
This range of high adhesion thin tapes offers efficient thermal transfer for a wide range of applications requiring a thermal management solution: bonding heat sinks, heat spreaders and other cooling devices to IC packages, power transistors, and other heat generating components.

Each tape combines 3M high performance acrylic adhesive with highly conductive ceramic particles for an extremely reliable and user-friendly thermal interface. Highly conformable construction provides excellent wet-out on surfaces.

Select 5, 10, 15 and 20 mil thicknesses to meet application requirements. The unique 40 mil 9889FR is a highly conformable pressure-sensitive film that offers a combination of high thermal conductivity, good dielectric properties, high bond strength, and ease of use.



3M™ Thermally Conductive Adhesive Transfer Tapes 8805, 8810, 8815, 8820. High temperature adhesion with good dielectric strength. Applies quickly and easily using die-cut shapes.

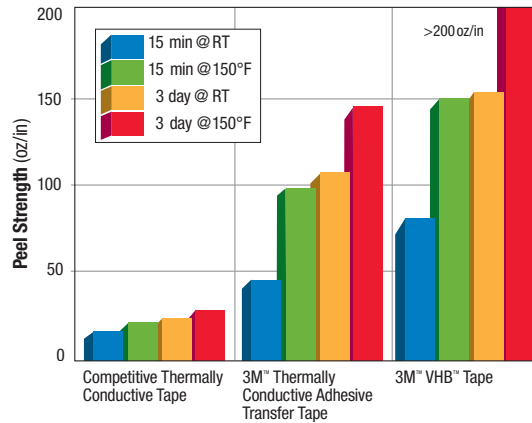


Heat Sink. Thermally Conductive Adhesive Transfer Tape bonds a heat sink to a component and provides a thermal path for component cooling.



Power Transistor Attachment. 3M™ Thermally Conductive Adhesive Transfer Tape 8810 replaces silicone grease and screws for attaching transistors to heat sink.

90° Peel Adhesion to Bare Untreated Aluminum



3M™ Thermally Conductive Interface Materials Selection Guide

Product	Description				Adhesion Peel Strength @ 72 hr. Dwell at RT (N/cm)	Thermal Performance		Dielectric Properties		UL Flammability Rating	Potential Operating Temperature Range** (°C)
	Base Material Type	Product Thickness mil (mm)	Filler Type	Liner Type		Conductivity (W/m-K 3M ASTM D5470 TM)	Impedance (°C-in ² /W (°C-cm ² /W))	Dielectric Strength (KV/mm)	Volume Resistivity (ohm/cm)		

3M™ High Adhesion Thermally Conductive Adhesive Transfer Tape (TCATT): Softer-Improved Surface Conformability Acrylic Thermal Tape

8805	Filled Acrylic Polymer	5 (0.13)	Ceramic	Silicone-Release Polyester: Dual Liners	5.8	0.6	0.48 (3.1)	26 8815 tested	5.2 X 10 ¹¹	UL Testing Note: Adhesive tapes are not intended to be used independently as a single component. Tapes are recognized for use with specific substrates and the tape/substrate is tested for a UL rating.	Short Term (Hours-Days): 125-150°C Long Term (Weeks-Months): 90-100°C
8810		10 (0.25)			8.3		0.88 (5.7)		3.9 X 10 ¹¹		
8815		15 (0.38)			9.8		1.17 (7.6)		3.8 X 10 ¹¹		
8820		20 (0.51)			11.9		1.50 (9.7)		3.8 X 10 ¹¹		

3M™ Thermally Conductive Adhesive Transfer Tape (TCATT): Standard Acrylic Thermal Tape

9882	Filled Acrylic Polymer	2 (0.05)	Ceramic	Silicone Release Polyester	2.1 - 3.4	0.6	0.32 (2.1)	29 9890 tested	2 X 10 ¹⁴	UL Testing Note: Adhesive tapes are not intended to be used independently as a single component. Tapes are recognized for use with specific substrates and the tape/substrate is tested for a UL rating.	Short Term (Hours-Days): 125-150°C Long Term (Weeks-Months): 90-100°C
9885		5 (0.13)					0.49 (3.2)				
9890		10 (0.25)					0.89 (5.7)				

3M™ Thermally Conductive Acrylic Soft Tape (TCAST): Thick Acrylic Thermal Tape

9889FR*	Filled Acrylic Polymer	40 (1.0)	Ceramic	Silicone Release Paper	3.7 on Al Substrate	0.5	—	—	—	UL 94 V-2	Short Term (Hours-Days): 90-125°C Long Term (Weeks-Months): 70-80°C
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Note: *1) 3M Tape 9889FR is a specialty tape used for very large panels or surfaces where a very conformable thermal tape is needed to achieve good wet-out/adhesion. The 3M Tape 8820 is the suggested standard TCATT Thermal tape for most typical, somewhat larger surface areas as the thermal impedance is lower vs the 3M Tape 9889FR.

** End use application testing will determine final temperature range based on final design and other environmental conditions. Suggested Temperature range is based on a UL-746 Test Method or a 3M Test Method.

Calculate Chip Temperature for use with Tapes, Pads, and Epoxies

Input Values

A (in²), size of thermal interface material

%WO, % wet-out of interface material (estimate of actual contact area)

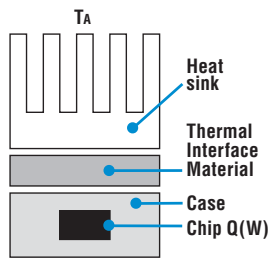
Q (W), power rating of chip

R_{chip-case} (°C/W) (0.55 ref.), thermal resistance of chip to case

R_{sink-air} (0.80 ref.), thermal resistance of heat sink to ambient

T_A (°C) (35°C ref.), ambient temperature

Z (°C-in²/W), thermal impedance of 3M interface material



Calculations

Thermal Resistance of 3M Interface Material

$$R \text{ (}^\circ\text{C/W)} = \frac{Z/A}{\%WO/100}$$

Total resistance, R_{total} (°C/W) = R_{chip-case} + R + R_{sink-air},
For temperature of Chip, T_{chip} = T_A + (Q x R_{total})

Obtain Maximum Operating Temperature of Chip from vendor.
Calculated T_{chip} should not exceed temperature specified.

3M™ Thermally Conductive Interface Materials Typical Applications

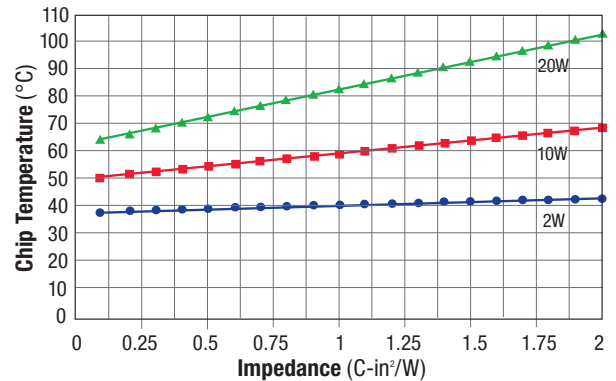
Product	Typical Applications
8805 8810 8815 8820	Thermally conductive adhesive transfer tapes with high mechanical strength, improved surface wet-out, and excellent shock performance. Applications include: heat sink attachment, flex circuit bonding, power device attachment and general thermal attachment solutions.
9882, 9885, 9890	3M's original thermally conductive adhesive transfer tape for applications requiring thin bonding with good thermal transfer.
9889FR	One millimeter thick, flame retardant acrylic soft tape for applications requiring gap filling and bonding with good thermal transfer, generally used for large surface area bonding.
5516/5516S ² 5519, 5519S ² 5591S ² , 5592 ¹ 5595 ¹	Thermally conductive interface pads (silicone) for applications requiring gap filling and superior thermal performance without bonding. Provides IC package and PCB thermal interfacing with heat sinks or other cooling device, and metal cases.
TC-2707 TC-2810 DP 190 Gray	Thermally conductive epoxies for applications requiring high adhesive strength, good surface wet-out, gap filling or thin bond lines with good thermal transfer.
5589H ² 5590H ²	Thermally conductive interface pads use an acrylic elastomer for applications that require a non-silicone thermal pad.
TCG-2035/ TCG-2031* TCG-2037/ TCG-2033*	Thermally conductive greases provide a thin thermal interface to optimize thermal heat transfer between hot running devices and heat sinking surfaces. Excellent flow properties for improved interface wet-out.

* Note 1) 3M Greases TCG-2031 and TCG-2033 are supplied with a small wt% of a solvent added to lower viscosity. Lower viscosity can allow for reduced thickness during application and may benefit screen printing options. Effective thermal measurements are not significantly different from non-solvent added versions.
Shear Rate viscosity reduced by 5-10x.

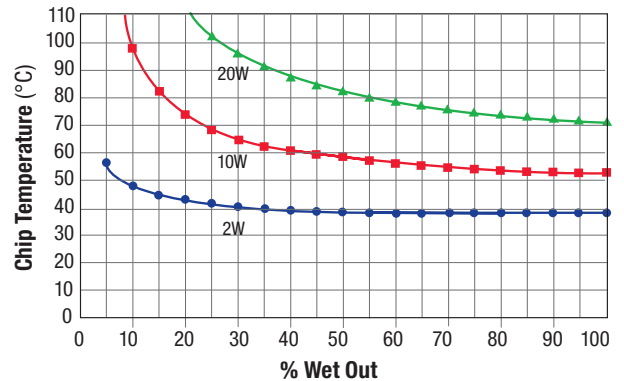
¹ 3M Pads 5592 and 5595 are also available with a polyester film on one side to provide a non-tacky surface.

² "S" designation signifies a polyester film on one side to provide a non-tacky surface. "H" designation signifies a product with one non-tacky surface without the use of a PET film.

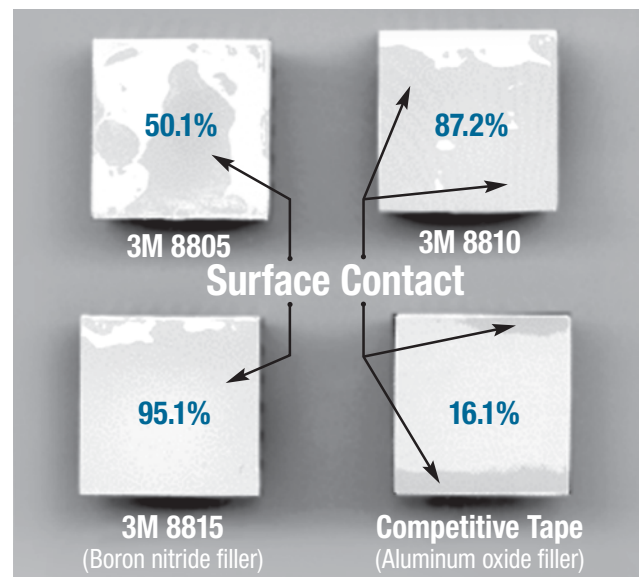
Effect of Thermal Interface Impedance and Device Power on Chip Temperature



Effect of Wet-Out (Interface Contact) and Device Power on Chip Temperature



% Wet-out of Heat Sink to Glass Slide



Dark areas show adhesive wet-out.

Increased wet-out improves both mechanical and thermal performance.

Relative darker color indicates surface contact has occurred. Boron nitride filler appears lighter in color versus aluminum oxide filler

Note: The technical information and data on these pages should be considered representative or typical only and should not be used for specification purposes.



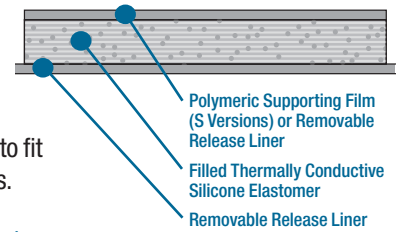
3M™ Thermally Conductive Interface Pads

Through innovative 3M technology, these soft and conformable pads provide high levels of conductivity for the more demanding applications in the electronics industry.

In addition, the pads provide excellent handling and can be die cut to fit most applications. Available in silicone and non-silicone elastomers.

• Thermal Conductivity: 1.0-4.1 W/m-k

• Available in silicone and acrylic elastomers



3M™ Thermally Conductive Interface Pads Selection Guide

Product	Description				Adhesion/Shore 00 Softness	Thermal Performance		Dielectric Properties		UL Flammability Rating	Potential Operating Temperature Range*** (°C)
	Base Material Type	Product Thickness mil (mm)	Filler Type	Liner Type	Adhesion Characterization /// Shore 00 Testing based on TM 6mm Thickness	Conductivity (W/m-K 3M ASTM D5470 TM)	Impedance**** (°C-in ² /W (°C-cm ² /W)	Dielectric Strength KV/mm (Film version tested)	Volume Resistivity (ohm/cm)		

3M™ Thermally Conductive Interface Pads

5516 5516S* Soft Pad	Filled Silicone Polymer	20(0.5) 40(1.0) 60(1.5) 80(2.0)	Ceramic	PET	No added adhesive layer. Pad is tacky and conformable /// Shore 00=73	3.1	0.31 (2.0) 0.53 (3.4) 0.76 (4.9) 0.98 (6.3)	3.1	6.9 x10 ¹⁴	3M V1 or VO TM**	Short Term (Hours-Days): 150°C Long Term (Weeks-Months): 100-125°C
Notes: *1) 3M Pad 5516S is Thermal Pad 5516 with a polymeric permanent film on one side to be used as a non-tacky surface for ease of reworking an assembly. Thermal Conductivity and Thermal Impedance are slightly changed with addition of the film, while Dielectric strength is improved. 2) Optional thicknesses >2.0mm are available. Call 3M for details.											
5519 5519S* Soft Pad	Filled Silicone Polymer	20 (0.5) 40 (1.0) 60 (1.5) 80 (2.0)	Ceramic	PET	No added adhesive layer. Pad is tacky and conformable /// Shore 00=80	4.1	0.29 (1.9) 0.48 (3.1) 0.65 (4.2) 0.82 (5.3)	3.1	6.9 x10 ¹⁴	3M V1/ VO or VO TM**	Short Term (Hours-Days): 150°C Long Term (Weeks-Months): 100-125°C
Notes: *1) 3M Pad 5519S is Thermal Pad 5519 with a polymeric permanent film on one side to be used as a non-tacky surface for ease of reworking an assembly. Thermal Conductivity and Thermal Impedance are slightly changed with addition of the film, while Dielectric strength is improved. 2) Optional thicknesses >2.0mm are available. Call 3M for details.											
5591S* Ultra Soft Pad	Filled Silicone Polymer	20 (0.5) 40 (1.0) 60 (1.5) 80 (2.0)	Ceramic	PET	No Added adhesive layer. Pad is tacky and conformable /// Shore 00=10-15	1.0	1.14 (7.3) 1.92 (12.4) 2.71 (17.5) 3.49 (22.5)	7.9	2.0 X 10 ¹²	3M V1 or VO TM**	Short Term (Hours-Days): 150°C Long Term (Weeks-Months): 100-125°C
Notes: *1) 3M Pad 5591S has a 12µm PET permanent film on one side to be used as a non-tacky surface for ease of reworking an assembly. 2) 3M Pad 5591S is available in the 0.5mm -2.0mm thickness. 3) Optional thicknesses > 2.0mm are available. Call 3M for details.											
5592 5592S* Soft Pad	Filled Silicone Polymer	20 (0.5) 40 (1.0) 60 (1.5) 80 (2.0)	Ceramic	PET	No added adhesive layer. Pad is tacky and conformable /// Shore 00=40-50	1.1	0.64 (4.1) 1.15 (7.4) 1.66 (10.7) 2.43 (15.7)	14.7	3.0 X 10 ¹²	3M V1 or VO TM**	Short Term (Hours-Days): 150°C Long Term (Weeks-Months): 100-125°C
Notes: *1) 3M Pad 5592S is Thermal Pad 5592 with a 12µm PET permanent film on one side to be used as a non-tacky surface for ease of reworking an assembly. Thermal Conductivity and Thermal Impedance are slightly changed with addition of the PET film, while Dielectric strength is improved. 2) 3M Pad 5592S is available in the 0.5mm -2.0mm thickness. 3M Pad 5592 1.0-2.0mm thickness. 3) Optional thicknesses > 2.0mm are available. Call 3M for details.											
5595 5595S* Soft Pad	Filled Silicone Polymer	20 (0.5) 40 (1.0) 60 (1.5) 80 (2.0)	Ceramic	PET	No added adhesive layer. Pad is tacky and conformable /// Shore 00= 50-60	1.6	0.70 (4.5) 1.21 (7.8) 1.71 (11.0) 2.22 (14.3)	15.7	5.0 X 10 ¹²	3M V1 or VO TM**	Short Term (Hours-Days): 150°C Long Term (Weeks-Months): 100-125°C
Notes: *1) 3M Pad 5595S is Thermal Pad 5595 with a 12µm PET permanent film on one side to be used as a non-tacky surface for ease of reworking an assembly. Thermal Conductivity and Thermal Impedance are slightly changed with addition of the PET film, while Dielectric strength is improved. 2) 3M Pad 5595S is available in the 0.5mm -2.0mm thickness. 3M Pad 5595 1.0-2.0mm thickness. 3) Optional thicknesses > 2.0mm are available. Call 3M for details.											
** 3M V1 or VO TM Notes: 1) Test results based on 3M UL Test Method. 2) The 3M V1 TM testing applies to the 0.5mm thick products in the "S" version.											
**** Thermal impedance is measured with the test sample under a nominal 10psi pressure to reflect a typical end use application.											

3M™ Thermally Conductive Interface Pads (Acrylic Elastomer)

5589H* Soft Pad	Filled Acrylic Polymer	40(1.0) 60(1.5)	Ceramic	PET	No added adhesive layer. Pad is tacky and conformable /// Asker C=16	2.0	1.33 (8.6) 1.67 (10.8)	21	3.4 X 10 ¹²	UL VO	Short Term (Hours-Days): 110°C Long Term (Weeks-Months): 80°C
Note: *1) 3M Pad 5589H has a very low tack surface and a medium tack surface.											
5590H* Soft Pad	Filled Acrylic Polymer	20(0.5) 40(1.0) 60(1.5)	Ceramic	PET	No added adhesive layer. Pad is tacky and conformable /// Asker C=30	3.0	0.46 (3.0) 0.70 (4.5) 0.95 (6.1)	33	2.7 X 10 ¹²	UL VO	Short Term (Hours-Days): 110°C Long Term (Weeks-Months): 80°C
Note: *1) 3M Pad 5590H has a very low tack surface and a medium tack surface.											
***End use application testing will determine final temperature range based on final design and other environmental conditions. Suggested Temperature range is based on a UL-746 Test Method or a 3M Test Method.											



3M™ EPX applicator and nozzle simultaneously and accurately mixes, meters, and applies adhesive with a squeeze of the trigger

3M™ Thermally Conductive Epoxies

This range of liquid adhesives has minimal odor and superior structural strength adhesion. Dispensing is easy for high output in-line automated manufacturing and manual application.

Adhesive flows and fills micro-spaces on surfaces. Ultra-thin bond line helps achieve low thermal impedance.

3M™ Thermally Conductive Epoxies Selection Guide

Product	Description				Thermal Performance		Dielectric Properties		Comments	Potential Operating Temperature Range** (°C)
	Base Material Type	Product Thickness mil (mm)	Filler Type	Packaging	Conductivity (W/m-K 3M ASTM D5470 TM)	Impedance °C-in ² /W (°C-cm ² /W) 2.0mil (50µm) bondline thickness	Dielectric Strength (KV/mm)	Volume Resistivity (ohm/cm)		

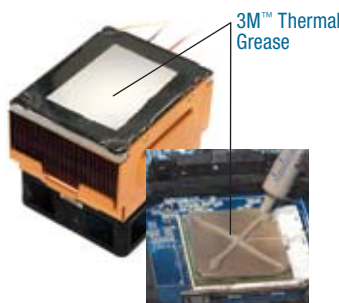
3M™ Thermally Conductive Epoxies

DP-190 Gray	Filled Epoxy	Various	Aluminum Silicate/Carbon Black	2-part Epoxy/3M Duo-Pak.	0.38	0.32 (2.1) estimate	32.7	5.0 x10 ¹²	—	Short Term (Hours-Days): 125-140°C Long Term (Weeks-Months): 80-100°C
TC-2707			Aluminum Metal		0.72	0.105 (0.67)	2.1	2.4 x10 ¹¹	See note 2	
TC-2810			Ceramic*		1.0-1.4*	0.05 (0.32)	3	7.6 x10 ¹¹	See note 1	

* Notes: 1) Thermal Conductivity (TC) can vary in an application as the filler is a Boron Nitride (BN) platelet shape and alignment of fillers can change effective TC.

2) As the 3M™ Thermally Conductive Epoxy Adhesive TC-2707 uses aluminum metal fillers, under certain end use application conditions, the effective resistivity and/or effective dielectric strength could be significantly lower than noted. If the metal fillers are “trapped” or “pinched” between two surfaces, an electrical bridge path via the aluminum fillers could occur between these surfaces. Epoxy Adhesive TC-2707 is not suggested for applications where a powered electrical circuit is used or where a reliable volume resistivity and/or dielectric strength is desired. 3M Thermally Conductive Epoxy Adhesives TC-2810 uses ceramic filler and is suggested product to test for these types of application performance needs.

** End use application testing will determine final temperature range based on final design and other environmental conditions. Suggested Temperature range is based on a UL-746 Test Method or a 3M Test Method.



3M™ Thermally Conductive Grease

The 3M™ Thermally Conductive Greases are high performance thermal interface materials for transferring thermal energy from a heat source (e.g. processor chip, graphics chip, High Power LED) to a heat sink. The proprietary blend of inorganic fillers contained in an organic matrix (non-silicone) ensures high thermal conductivity and low thermal resistance. Grease products are available in two versions: Standard viscosity and a lower viscosity version that can be useful in screen printing application methods.

Product	Description				Thermal Performance		Dielectric Properties		Comments	Potential Operating Temperature Range** (°C)
	Base Material Type	Product Thickness mil (mm)	Filler Type	Steady State Shear Viscosity @ 1.0 Shear/Rate	Conductivity (W/m-K 3M ASTM D5470 TM)	Impedance °C-in ² /W (°C-cm ² /W) @ Bond Line thickness of <2mil (0.05mm)	Dielectric Strength (KV/mm)	Volume Resistivity (ohm/cm)		

3M™ Thermally Conductive Grease

TCG-2035/TCG-2031*	Non-Silicone Polymeric Binder	Various	Ceramic	2100/150*	4.1	0.0127 (0.081)	4.7	1.36 x10 ⁹	See note 1	Short Term (Hours-Days): 125-150°C Long Term (Weeks-Months): 100-125°C
TCG-2037/TCG-2033*			Ceramic & Metallic	340/36*	3.0	0.0170 (0.109)	0.1	4.1 x10 ⁷	See note 1	

* Note 1) 3M Greases TCG-2031 and TCG-2033 are supplied with a small wt% of a solvent added to lower viscosity. Lower viscosity can allow for reduced thickness during application and may benefit screen printing options. Effective thermal measurements are not significantly different from non-solvent added versions. Shear Rate viscosity reduced by 5-10x.

** End use application testing will determine final temperature range based on final design and other environmental conditions. Suggested Temperature range is based on a UL-746 Test Method or a 3M Test Method.

Note: The technical information and data on this page should be considered representative or typical only and should not be used for specification purposes.

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3M Electronics
 3M Center, Building 21-1W-10
 St. Paul, MN 55144-1000
 www.3M.com/electronics
 1-800-251-8634

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