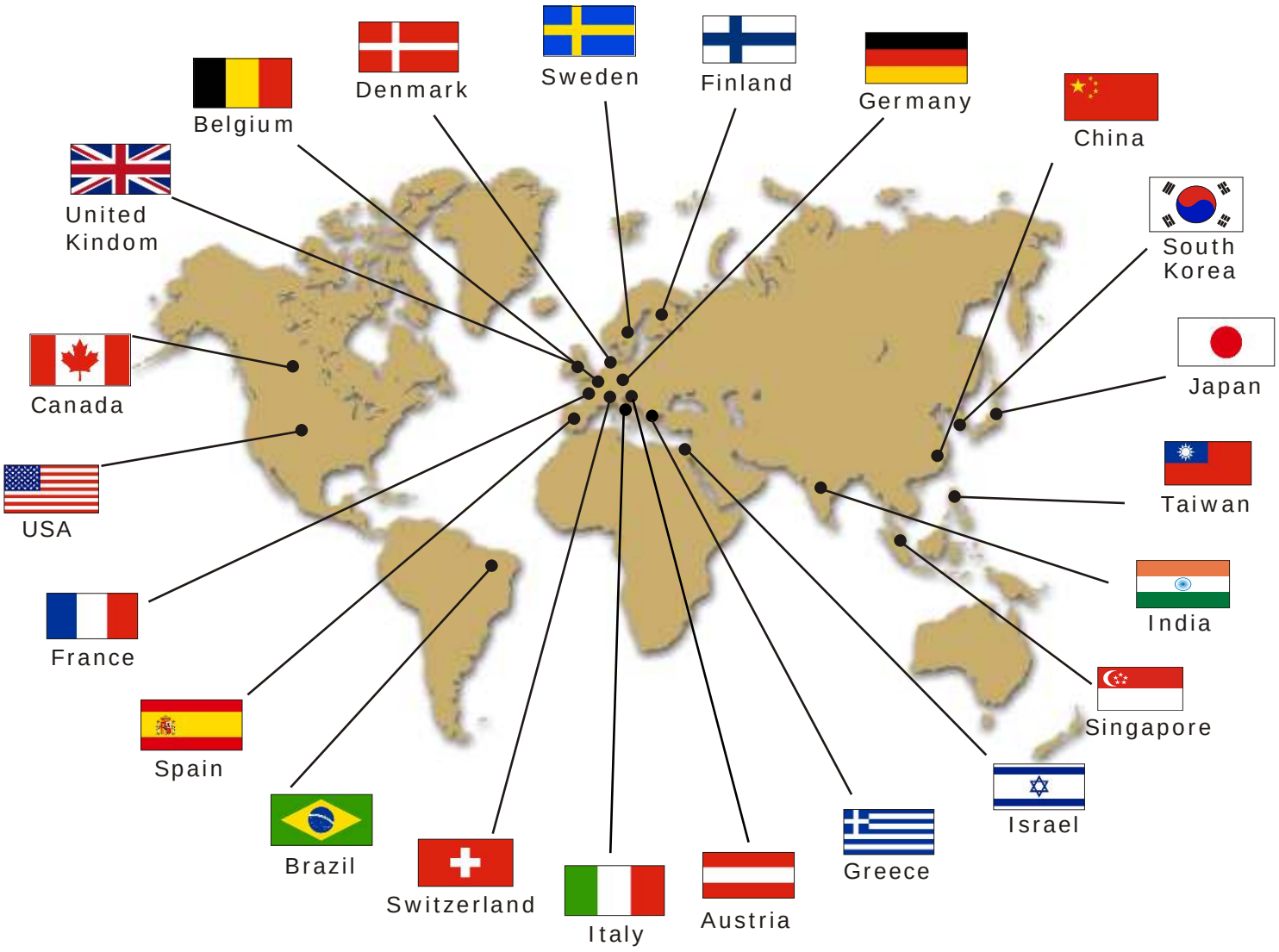
KERATHERM®

Thermal Management Material

TÜV MANAGEMENT SERVICE ISO 9001

KERAFOL®

KERATHERM® -Worldwide Representations



KERAFOL®

Keramische Folien GmbH
Stegenthumbach 4-6
92676 Eschenbach, Germany
Tel. +49 (0)9645/ 88300, Fax. +49 (0)9645/ 88390
eMail: info@kerafol.com, Internet: www.kerafol.com

November 2004

Table of Contents

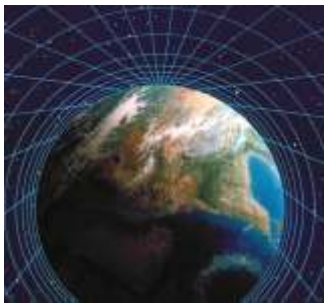
KERAFOL® - Your Partner for “Thermal Solutions”

Many years of experience with oxidic and non-oxidic ceramic materials, continuous development of innovative and customer-focused solutions, and a global sales and distribution network with short delivery times are just some of the reasons why Kerafol is one of the leading specialists and manufacturers of ceramic films and technical ceramics today.

Customer Focus Policy

Research and development, quality control and environmental compatibility

In order to offer our customers competent, customized advice and individual problem solutions, our engineers and staff are continually carrying out research, development and tests on new, innovative and reliable quality materials in our in-house R&D laboratory. During product develpoment already, we test the environmental compatibility of the raw materials used, the manufacturing process and the recyclability of the product.



International Distribution Network

Research & Development

Kerafol offers a wide range of products, suitable for diverse applications, as for example in microelectronics, thermal management, filtration and sensor technology or SOFC fuel cells and LTCC technology.

Quality Assurance

Environment-Friendly Products

Graphite Film

Thermally Conductive Adhesive Tape

Thermally Conductive Gap Filling Materials

Thermally Conductive Insulators

KERAFOL®: “Cool Solutions” based on innovative products

Optimum Price-Performance-Ratio

Because of our years of experience and our broad range of innovative solutions, Kerafol is your essential partner in the field of “Thermal Management”.

Short Delivery Times

Modern production facilities

Our ceramic films are manufactured on the latest production facilities either as standard or customer-specific products in a continuous process. The films can be ordered as endless, rolled material, or already individually punched in several thicknesses reaching from 50 µm to several millimetres. The flexible ceramic films can be used both in un-sintered form as an end product (e.g. heat conduc-ting films) or further processed into planar sintered ceramic components with the most diverse geometries (e.g. ceramic filters).

Our foremost goal is to provide our customers with competent, customer-oriented problem solutions, which we guarantee through continuous quality control, optimization of processes and manufacturing steps.

Modern Production Facilities

Innovative Products

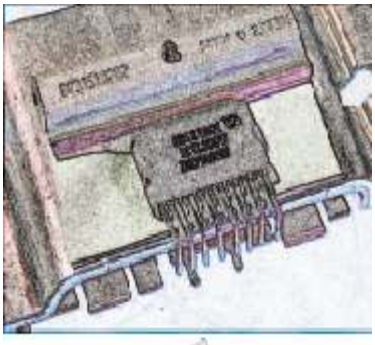
Ferrite Film

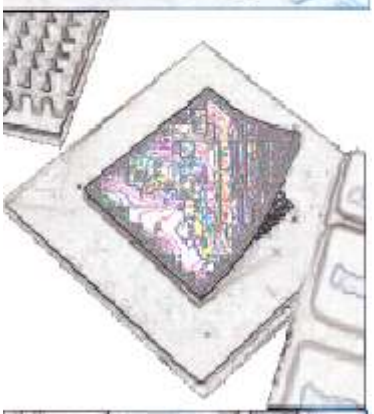
Phase Change Interface Materials

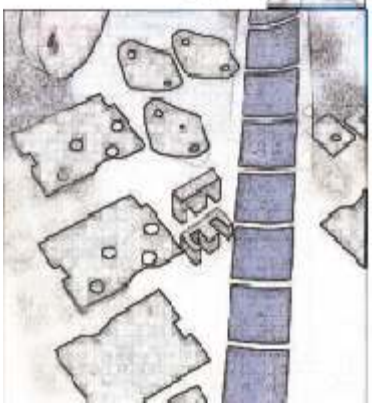
Thermal Interface Grease

Insulated Metal Substrates

Future-Oriented







Why “Thermal Solutions”

The continuously increasing technical demands placed by the electronics industry on electronic and electrical devices has led to a dramatic rise in the problem of heat generation. Higher frequencies, component miniaturization, enhanced functionality and increased device power ratings all lead to high temperatures that need to be controlled to ensure very good performance, stability and durability over the long term. Heat sinks, cooling plates and ventilators are often used to dissipate the heat and reduce the temperature of the electrical circuits to a minimum.

The thermal coupling of suitable heat-conducting materials is also gaining importance in this area. Kerafol, with “**KERATHERM®**” products, offers an effective, uncomplicated and cost-effective range of products for this purpose.

What is KERATHERM®

KERATHERM® are highly flexible products comprising thermally conductive and electrically insulating single or multi-component polymers filled with ceramic or heat-conducting materials.

KERATHERM®, when mechanically reinforced by the incorporation of fiber-glass or other materials, offers the user a versatile product that is superior in many aspects to conventional ceramic or mica discs.

KERATHERM® advantages and properties

KERATHERM®- heat-conducting films are characterized by their high thermal conductivity and their electrical insulation.

In contrast to discs made of mica, aluminum or polyamide, KERATHERM® can be used without a heat-conducting compound.

Compared to the thermal compounds still frequently used, KERATHERM® does not dry out during continuous use hence retaining its good thermal conductivity properties over the years.

By using KERATHERM® products, mounting problems such as smearing and assembly errors can be avoided.

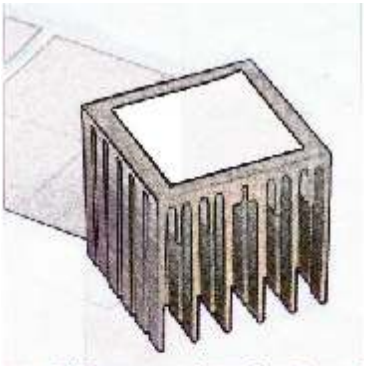
Silicone-based KERATHERM® facilitates component mounting thanks to their self-adhesive properties.

An optionally available single-sided adhesive coating also allows long-term attachment, even up-side down.

KERATHERM® product range

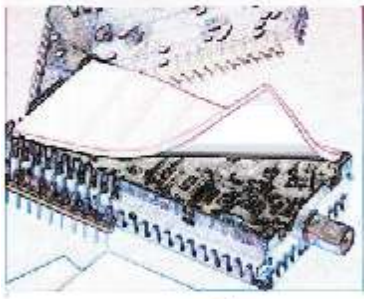
The surface of the KERATHERM® **white, green, pink, red** and **brown standard films** is smooth in order to ensure that there is no entrapped air that would interfere with the heat transfer between the component and the heat sink. The material smooths out microscopic irregularities in the contact surfaces which improves the thermal interface and therefore increases the heat dissipation.

KERATHERM® product range



KERATHERM® **silicone-free standard films** are used wherever the use of silicone can lead to problems. Besides good thermal and outstanding electrical properties, these foils are characterized by their good cut-through resistance.

The KERATHERM® **90 Series** is a new film type which, thanks to its outstanding thermal properties, is especially suitable for use for a high-end applications.

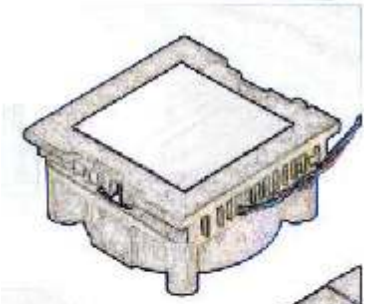


KERATHERM® **Flowtherm Phase Change Material** comprises a combination of hot-melt waxes with or without carrier material. These films smooth out even the smallest irregularities between the power module and heat sink and thereby improving the contact between the surfaces and increase heat transfer.

KERATHERM® **Thermal Grease** is characterized, in particular, by its good plasticity and very low thermal resistance. There is no drying out or leaking out of the silicone components.

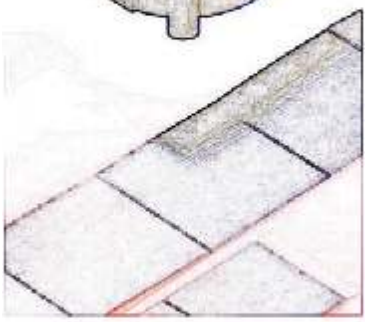
KERATHERM® **Softtherm Gap-Filler** is the ideal material for smoothing out even large component irregularities. Thanks to their outstanding compressibility, they produce an optimum thermal contact at the same time being electrically insulating. The supplied thicknesses range from 0.5-5.0 mm. Other thicknesses or shapes are available on request.

KERATHERM® **Copper** is heat conducting material with copper film on one side produced by a special process. Possible applications are for example, active EMC protection or as a system carrier for electronic switches. A tailored polymer paste system guarantees a wide scope of application.



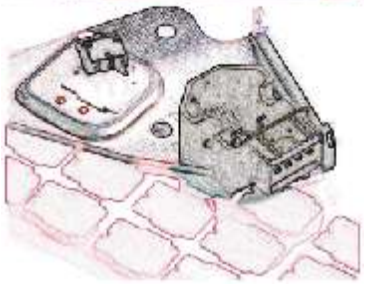
KERATHERM® **Spaceform** is a highly filled silicone compound with outstanding mechanical, electrical and thermal properties. Because of its excellent conformability, Spaceform allows a customized solution without any restrictions to dimensions or shape. Both crosslinked and non-crosslinked grades are available.

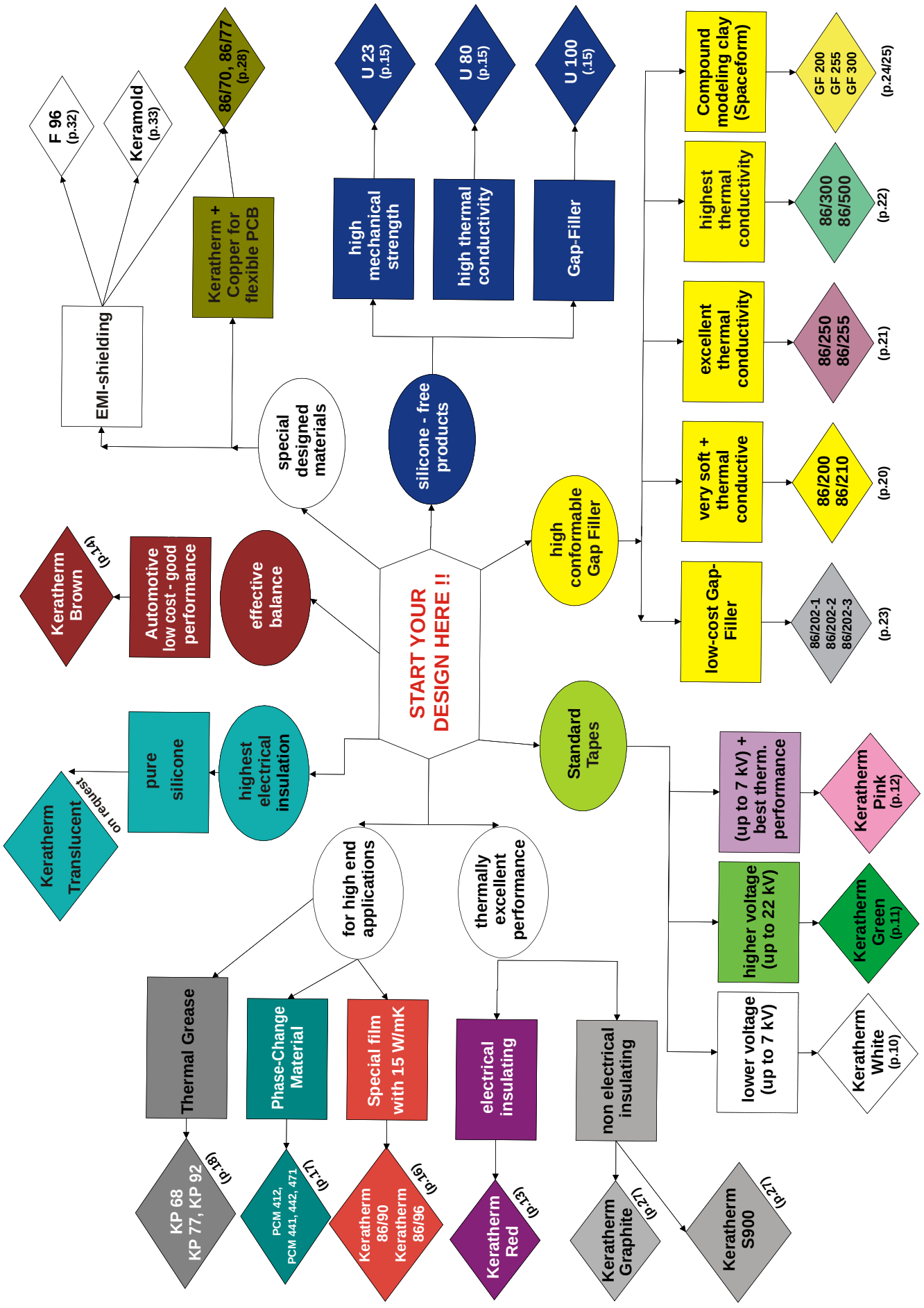
KERATHERM® **Ferrite products** can be purchased as "**KERAMOLD**" sealing compound or as the flexible "**F 96**" film.
The solvent-free, two-component polyurethane "Keramold" is used to encapsulate and embed electronic components. The F96 ferrite film comprises soft ferrite and, on account of its good magnetic properties, is especially suitable for electromagnetic shielding, flexible coils or other magnetic applications.



KERATHERM® **sealing compounds** can be used for encapsulating whole applications and dispensing housing lids or heat sinks. Thanks to its ease-of-use, it allows even the most complicated geometries to be encapsulated.

KERATHERM® **adhesive coating**: Every film type requires its own special adhesive system. Besides flexible adhesives with low adhesive strength, Kerafol® offers adhesives with high adhesive strength or with various fillings for improved heat transfer.




START YOUR DESIGN HERE !!
special designed materials
EMI-shielding
F 96 (p.32)
Keramold (p.33)
Keratherm + Copper for flexible PCB
86/70, 86/77 (p.28)
silicone - free products
high mechanical strength
high thermal conductivity
Gap-Filler
U 23 (p.15)
U 80 (p.15)
U 100 (.15)
high conformable Gap Filler
Compound modeling clay (Spaceform)
highest thermal conductivity
excellent thermal conductivity
very soft + thermal conductive
low-cost Gap-Filler
GF 200 GF 255 GF 300
(p.24/25)
86/300 86/500
(p.22)
86/250 86/255
(p.21)
86/200 86/210
(p.20)
86/202-1 86/202-2 86/202-3
(p.23)
effective balance
Automotive low cost - good performance
Keratherm Brown (p.14)
highest electrical insulation
pure silicone
Keratherm Translucent on request
Standard Tapes
(up to 7 kV) + best therm. performance
Keratherm Pink (p.12)
higher voltage (up to 22 kV)
Keratherm Green (p.11)
lower voltage (up to 7 kV)
Keratherm White (p.10)
for high end applications
thermally excellent performance
Thermal Grease
Phase-Change Material
Special film with 15 W/mK
electrical insulating
non electrical insulating
KP 68 KP 77, KP 92 (p.18)
PCM 412, PCM 441, 442, 471 (p.17)
Keratherm 86/90 Keratherm 86/96 (p.16)
Keratherm Red (p.13)
Keratherm Graphite (p.27)
Keratherm S900 (p.27)

In order to select the right product, the important selection criteria are thermal resistance, thermal conductivity and the dielectric properties of the material.

"Thermal Resistance":

The resistance to heat transfer, offered by a material of unspecified thickness, is called the thermal resistance. It can be influenced by a number of factors:

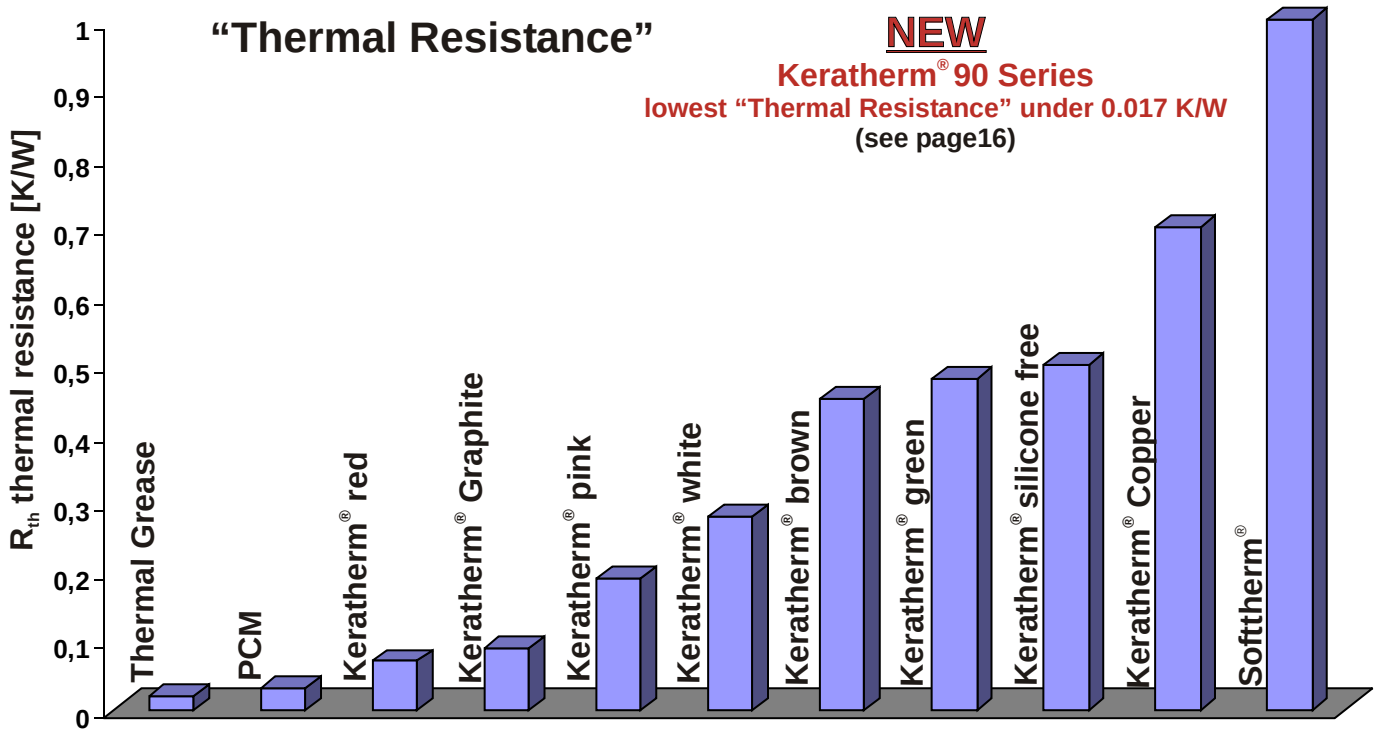
Material thickness: An increase of the material thickness, increases the thermal resistance, a reduction in the insulation thickness decreases the thermal resistance.

Pressure: Under ideal conditions, increasing the assembly pressure reduces the thermal resistance.

Surface area: An increase in the surface area or thermal contact reduces the thermal resistance.

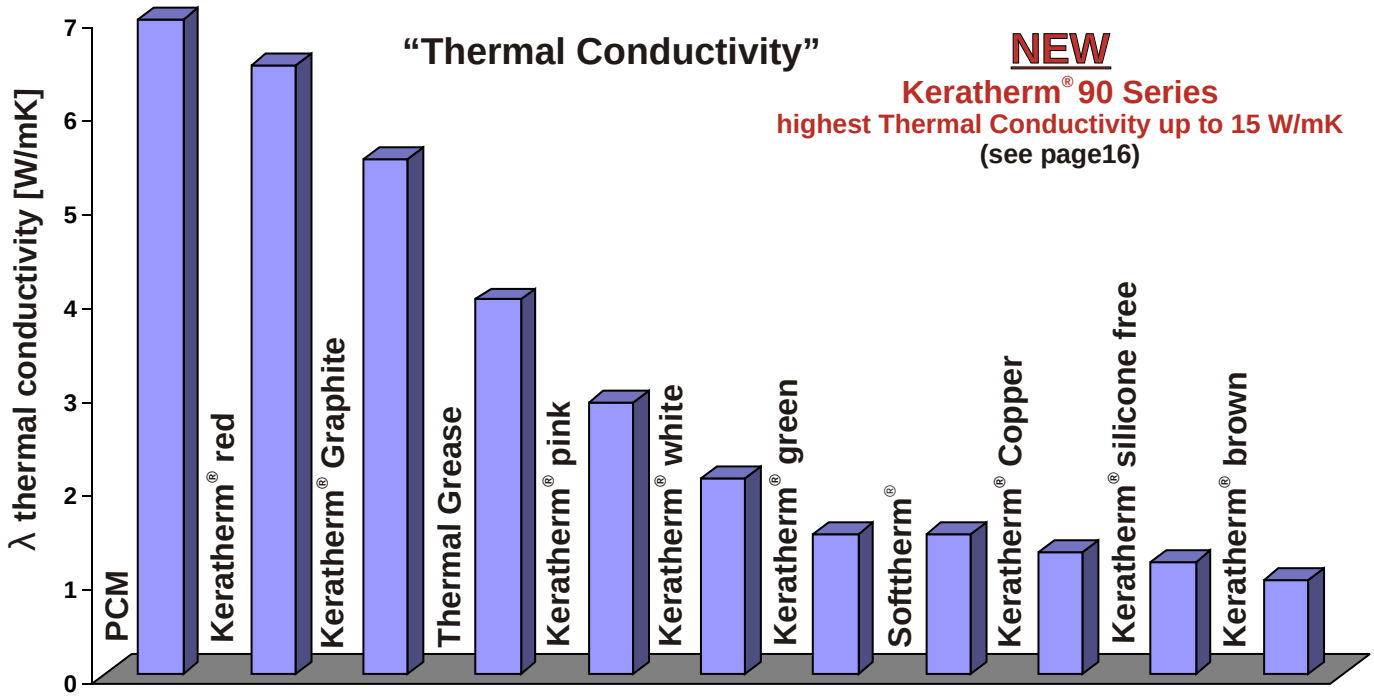
Material: The value of thermal resistance depends on the material selected

Surface: Depending on the surface texture (smooth or rough), the thermal resistance can either be high or low. For smooth surfaces, the thermal resistance will be lower than for uneven and rough surfaces.



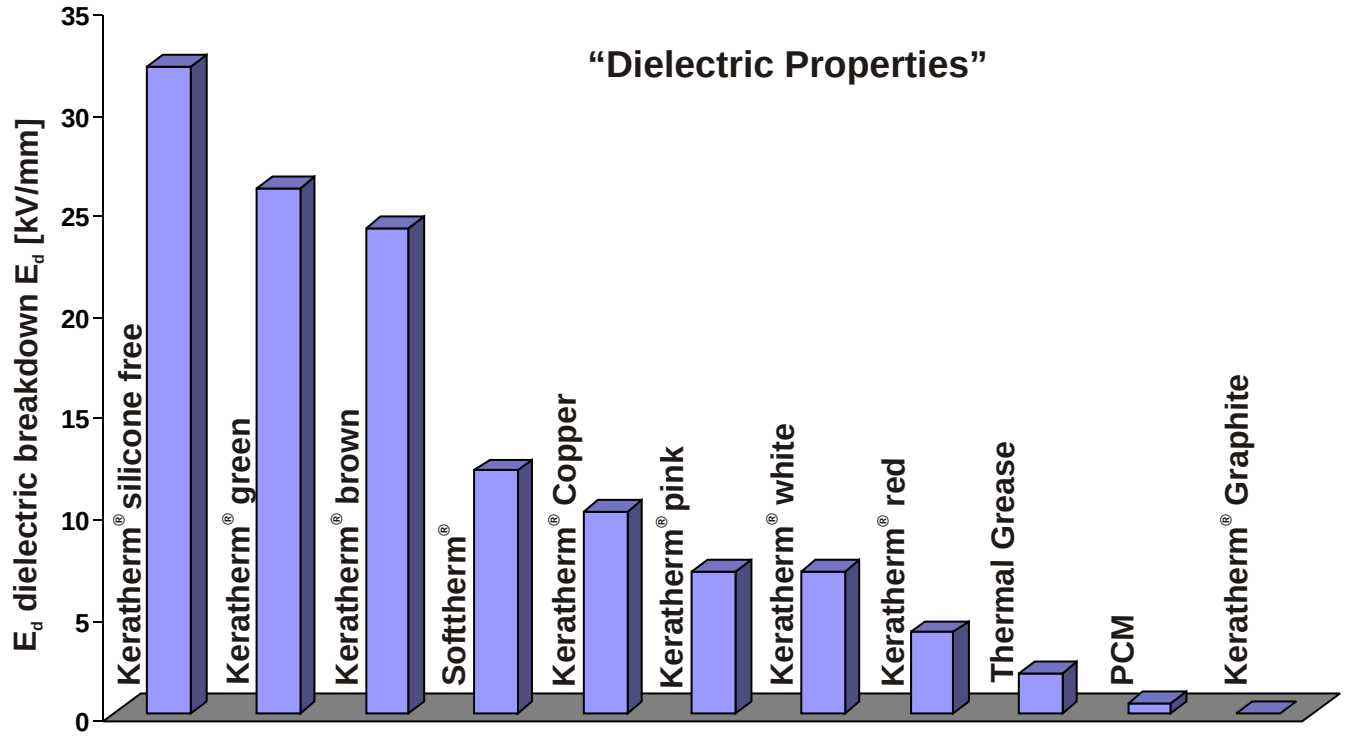
"Thermal Conductivity":

Thermal conductivity is the capacity of a solid, liquid or gas to transfer heat energy. The speed at which heat energy is passed on from one particle to another when a material is heated determines the thermal conductivity. The specific thermal conductivity is the intrinsic property of a material to transport energy. The outstanding thermal characteristics of "KERATHERM®" are guaranteed through the use of special materials with specific thermal conductivities.



"Dielectric Properties":

An important requirement of an insulator is that it can withstand the specific dielectric breakdown voltage. When voltage is applied to a "KERATHERM®" product, it must not cause a short circuit. The dielectric breakdown voltage of a material is determined to a large extent by its thickness and chemical composition.



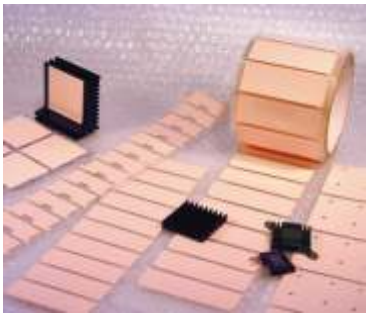
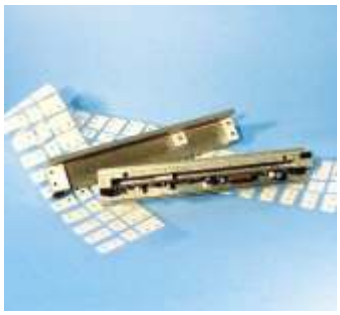
KERATHERM® - Standard Films

Flexible films consist of a silicone elastomer filled with various thermally conductive ceramic materials. All film types are electrically insulating. For increased mechanical strength, the films are also available with fibre glass reinforcement.

The standard films adapt to the component surface. Small irregularities can be evened out by using only minimal contact pressures.

The good thermal properties of these films guarantee optimum heat transfer to the heat sink and at the same time achieving good electrical insulation properties. All KERATHERM® standard films are UL tested.



PROPERTIES

- good insulation properties
- heat-conducting
- good compressibility
- fully crosslinked
- flexible
- environmental friendly

BENEFITS

- smooth surface
- very good properties even at very low contact pressure
- low hardness
- high self-adhesion
- UL listed

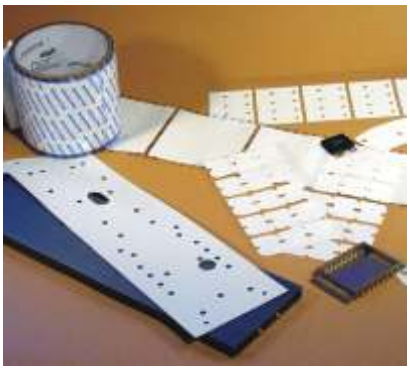
FILM OPTIONS

- optional single-sided adhesive coating
- special thicknesses available
- can be supplied on roll or already punched
- fibre glass reinforcement available
- delivery forms see page 36

APPLICATIONS

- power supplies
- automotive, engine controllers
- LCD displays
- white goods
- audio- and video components
- power converters (AC-DC; DC-DC)

Keratherm® white



The highly thermal conductive white group, with its well-balanced thermal and electrical or dielectric behavior, is created by filling a silicone elastomer base with aluminum oxide. An increase in mechanical strength can be achieved by fibre glass reinforcement. Both unreinforced and reinforced film types can optionally be supplied with an adhesive coating. In general however, the very good self-adhesion of the film will be sufficient for most mounting required.

Properties	Unit	86/30	86/40	86/10	86/20
Colour		white	white	white	white
Thermal Properties					
Thermal resistance R_{th}	K/W	0.28	0.37	0.46	0.49
Thermal impedance R_{ti}	°Cmm^2/W Kin^2/W	107 0.16	112 0.17	118 0.18	125 0.19
Thermal conductivity λ	W/mK	2.1	2.0	1.9	1.8
Electrical Properties					
Breakdown voltage $U_{d;\,ac}$	kV	1.5	1.5	1.5	1.5
Dielectric breakdown $E_{d;\,ac}$	kV/mm	7.0	7.0	7.0	7.0
Volume resistivity	Ωcm	2.5×10^{11}	1.8×10^{11}	1.8×10^{11}	1.6×10^{11}
Dielectric loss factor tan δ	1	6.5×10^{-4}	6.5×10^{-4}	6.5×10^{-4}	6.5×10^{-4}
Dielectric constant ε_r	1	3.7	3.7	3.7	3.7
Mechanical Properties					
Overall thickness (+/-10%)	mm	0.225	0.25	0.225	0.25
Hardness	Shore A	85	85	87	87
Tensile strength	N/mm^2	2.0	2.0	15	15
Elongation	%	31	31	3	3
Physical Properties					
Application temperature	°C	-60 to +250	-60 to +250	-60 to +250	-60 to +250
Density ρ	g/cm^3	2.4	2.3	2.3	2.3
Flame class	UL	94V-0	94V-0	94V-0	94V-0
With adhesive coating		-	yes	-	yes
Reinforced with fibre glass		-	-	yes	yes

Applications:

- power supplies
- white goods
- audio and video components
- engine controllers
- power converters (AC-DC, DC-DC)

Keratherm® green

This silicone elastomer film filled with aluminum oxide is characterized by its excellent electrical characteristics. It exhibits good thermal behavior. Optional fibre glass reinforcement leads to very good mechanical properties. These film types possess excellent mechanical stability along with good perforation strength. Because of its structure Keratherm® green has extremely good self-adhesive properties. Adhesive coatings are available.

Properties	Einheit	86/37	86/47	86/17	86/27
Colour		green	green	green	green
Thermal Properties					
Thermal resistance R_{th}	K/W	0.48	0.56	0.59	0.61
Thermal impedance R_{ti}	°Cmm^2/W Kin^2/W	125 0.19	132 0.2	148 0.23	173 0.26
Thermal conductivity λ	W/mK	1.8	1.7	1.5	1.3
Electrical Properties					
Breakdown voltage $U_{d;\,ac}$	kV	6.0	6.0	6.0	6.0
Dielectric breakdown $E_{d;\,ac}$	kV/mm	26.0	26.0	26.0	26.0
Volume resistivity	Ωcm	2.5 x 10^{11}	1.0 x 10^{11}	1.0 x 10^{11}	1.0 x 10^{11}
Dielectric loss factor tan δ	1	6.0 x10 $^{-4}$	6.0 x10 $^{-4}$	6.0 x10 $^{-4}$	6.0 x10 $^{-4}$
Dielectric constant ε_r	1	3.2	3.2	3.2	3.2
Mechanical Properties					
Overall thickness (+/- 10%)	mm	0.225	0.25	0.225	0.25
Hardness	Shore A	79	79	81	79
Tensile strength	N/mm^2	3.0	3.0	15	15
Elongation	%	75	75	3.4	3.4
Physical Properties					
Application temperature	°C	-60 to +250	-60 to +250	-60 to +250	-60 to +250
Density ρ	g/cm^3	2.4	2.2	2.3	2.2
Flame class	UL	94V-0	94V-0	94V-0	94V-0
with adhesive coating		-	yes	-	yes
reinforced with fibre glass		-	-	yes	yes

Applications:

- automotive
- telecommunication units
- DC-DC converters
- high voltage units

Keratherm® pink

Keratherm® pink has outstanding thermal conductivity which is achieved by a specially filled silicone elastomer. The good electrical insulation properties are thereby retained. On request, these films can also be supplied with fibre glass reinforcement and with or without adhesive coating. The excellent thermal resistance of this film enables the optimum heat transfer to the heat sink.

Properties	Unit	86/50	86/51	86/52	86/53
Colour		pink	pink	pink	pink
Thermal Properties					
Thermal resistance R_{th}	K/W	0.19	0.25	0.28	0.31
Thermal impedance R_{ti}	°Cmm^2/W Kin^2/W	78 0.12	83 0.13	90 0.14	99 0.15
Thermal conductivity λ	W/mK	2.9	2.7	2.5	2.3
Electrical Properties					
Breakdown voltage $U_{d;\,ac}$	kV	1.5	1.5	1.5	1.5
Dielectric breakdown $E_{d;\,ac}$	kV/mm	7.0	7.0	7.0	7.0
Volume resistivity	Ωcm	1.3×10^{14}	1.3×10^{14}	1.3×10^{14}	1.3×10^{14}
Dielectric loss factor tan δ	1	6.7×10^{-4}	6.7×10^{-4}	6.7×10^{-4}	6.7×10^{-4}
Dielectric constant ε_r	1	3.6	3.6	3.6	3.6
Mechanical Properties					
Overall thickness (+/-10%)	mm	0.225	0.25	0.225	0.25
Hardness	Shore A	72	72	77	77
Tensile strength	N/mm^2	2.0	2.1	15	15
Elongation	%	2.5	2.5	2.5	2.5
Physical Properties					
Application temperature	°C	-60 to +250	-60 to +250	-60 to +250	-60 to +250
Density ρ	g/cm^3	2.4	2.3	2.3	2.2
Flame class	UL	94V-0	94V-0	94V-0	94V-0
with adhesive coating		-	yes	-	yes
reinforced with fibre glass		-	-	yes	yes

Applications:

- automotive
- white goods
- engine controllers
- audio and video components
- LCD displays
- power converters (AC-DC, DC-DC)

Keratherm® red

This film is especially suitable for high-power applications. It has excellent thermal and electrical properties.

Thanks to its good performance, it can be used reliably in densely packed electronic applications.

Properties	Unit	86/81	86/82	86/82lb very low bleeding
Colour		red	red	red
Thermal Properties				
Thermal resistance R_{th}	K/W	0.10	0.09	0.14
Thermal inpedance R_{ti}	°Cmm^2/W Kin^2/W	39 0.07	35 0.05	54.5 0.09
Thermal conductivity λ	W/mK	5.5	6.5	4.3
Electrical Properties				
Breakdown voltage $U_{d;\,ac}$	kV	1.5	1.0	1.0
Dielectric breakdown $E_{d;\,ac}$	kV/mm	6.0	4.0	4.0
Volume resistivity	Ωcm	2.0 x 10^{14}	2.0 x 10^{14}	in test
Dielectric loss factor tan δ	1	1.9 x 10^{-3}	1.4 x 10^{-3}	in test
Dielectric constant ε_r	1	2.3	2.4	in test
Mechanical Properties				
Overall thickness (+/-10%)	mm	0.200	0.25	0.25
Hardness	Shore A	70	65	60
Tensile Strength	N/mm^2	0.6	10	10
Elongation	%	20	2	2
Physical Properties				
Application temperature	°C	-40 to +200	-40 to +200	-40 to +200
Density ρ	g/cm^3	2.9	2.35	2.35
Flame class	UL	in test	94V-0	in test
with adhesive coating		-	optional	optional
reinforced with fibre glass		-	yes	yes
TML	Ma.-%	not determined	< 0.60	< 0.29

Applications:

- high end thermal solutions
- hard disc drives
- controlling boards
- BGA applications

Keratherm® brown

Keratherm® brown with its very good thermal properties is an excellent choice for cost-effective solutions.
These fibre glass-reinforced films along with their very smooth surface has very good thermal resistance properties with a high insulation capacity at low mounting pressures.

Properties	Unit	70/50	70/60
Colour		brown	brown
Thermal Properties			
Thermal resistance R_{th}	K/W	0.44	0.52
Thermal Impedance R_{ti}	°Cmm^2/W Kin^2/W	178 0.25	220 0.34
Thermal conductivity λ	W/mK	1.4	1.2
Electrical Properties			
Breakdown voltage $U_{d;\,ac}$	kV	4.0	4.0
Dielectric breakdown $E_{d;\,ac}$	kV/mm	16	16
Volume resistivity	Ωcm	1.0 x 10^{13}	1.0 x 10^{13}
Dielectric loss factor tan δ	1	7.3 x 10^{-3}	7.3 x 10^{-3}
Dielectric constant ε_r	1	3.6	3.6
Mechanical Properties			
Overall thickness (+/-10%)	mm	0.250	0.265
Hardness	Shore A	85	85
Tensile Strength	N/mm^2	20	20
Elongation	%	5	5
Physical Properties			
Application temperature	°C	-40 to +200	-40 to +200
Density ρ	g/cm^3	2.25	2.25
Flame class	UL	94V-1	94V -1
with adhesive coating		–	yes
reinforced with fibre glass		yes	yes

Applications:

- automotive
- white goods
- engine controllers
- audio and video components
- LCD displays
- power converters (AC-DC, DC-DC)

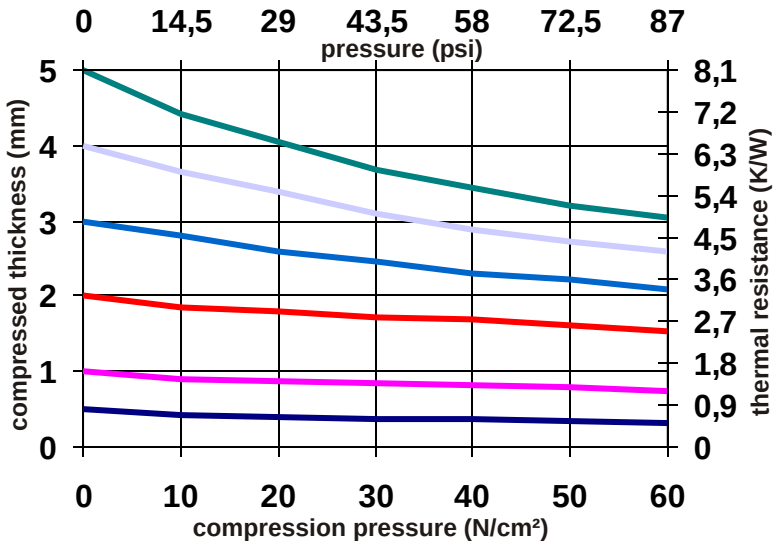
Keratherm® silicone free

In case of concerns about using silicones, Kerafol offers a ceramic-filled polyurethane film as an alternative material. Besides good thermal and outstanding electrical properties, these films are characterized by very good perforation strength. These good physical properties are matched with an excellent price-performance ratio.

Properties	Unit	U 23	U 80 NEW	U 100 NEW
Colour		white	light blue	blue
Thermal Properties				
Thermal resistance R_{th}	K/W	0.52	0.20	0.8 *
Thermal impedance R_{ti}	°Cmm²/W Kin²/W	188 0.29	73 0.11	292 * 0.57 *
Thermal conductivity λ	W/mK	1.2	1.8	1.2
Electrical Properties				
Breakdown voltage $U_{d;\ ac}$	kV	9.0	4.0	8.0 *
Volume resistance $R_{spez.}$	Ωcm	4.9×10^{11}	in test	in test
Dielectric loss factor tan δ	1	8.0×10^{-2}	in test	in test
Dielectric constant ε_r	1	4.2	in test	in test
Mechanical Properties				
Overall thickness (+/-10%)	mm	0.225	0.150	0.5 – 5.0
Hardness	Shore	85 (A)	85 (A)	45 (00)
Tensile strength	N/mm²	5.0	3.0	-
Elongation	%	250	130	-
Physical Properties				
Density ρ	g/cm³	2.32	2.9	2.3
Application temperature	°C	-40 to +90	-40 to +125	-40 to +125

***measured thickness 0.5 mm**

Compressibilities of Softtherm® U 100



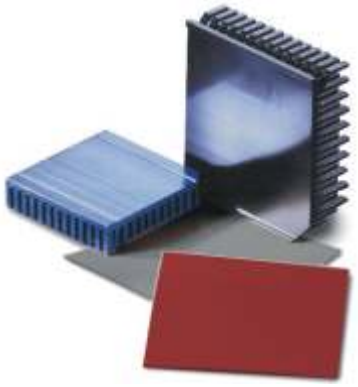
Applications:

- medical application
- laser equipment
- space units
- lighting systems
- aero units
- CD-Rom drives

Keratherm® 90 Series

New generation of ultra-heat-conductive films with outstanding thermal behaviour. The exceptional properties allow film thicknesses from very small layers to standard sizes.

Optional fibre glass reinforcement possible at standard thicknesses!



Properties	Unit	86/90	86/96
Colour		red	black
Thermal Properties			
Thermal resistance R_{th} (measured at 0.1 mm)	K/W	0.025	0.016
Thermal impedance R_{ti} (measured at 0.1 mm)	°Cmm²/W Kin²/W	10.0 0.01	7.0 0.01
Thermal conductivity λ	W/mK	10.0	15.0
Electrical Properties			
Breakdown voltage $U_{d;\,ac}$ (measured at 0.1 mm)	kV	1.0	-
Dielectric breakdown $E_{d;\,ac}$	kV/mm	10	-
Volume resistance	Ωcm	in test	in test
Dielectric loss factor tan δ	1	in test	in test
Dielectric constant ε_r	1	in test	in test
Mechanical Properties			
Overall thickness (+/-10%) *1	mm	0.10	0.10
Hardness	Shore A	50	60
Tensile Strength	N/mm²	1.2	1.7
Elongation	%	40	-
Physical Properties			
Application temperature	°C	-40 to +140	-40 to +140
Density ρ	g/cm³	0.95	0.87
Flame class	UL	in test	in test
with adhesive coating		optional	optional
reinforced with fibre coating*2		yes	yes
Total mass loss (TML)	Ma.%	not determined	not determined

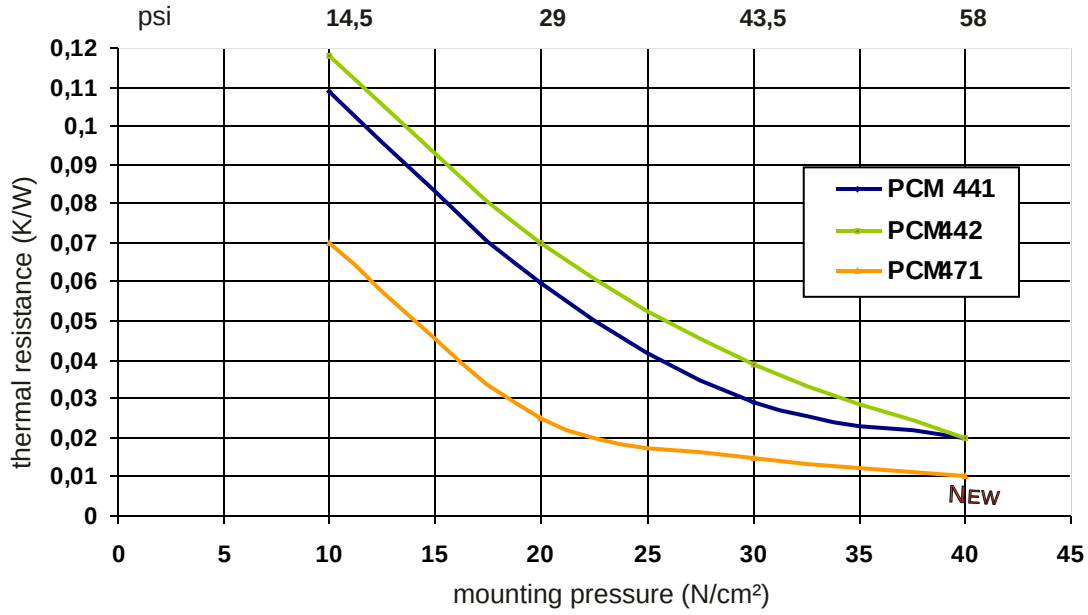
*1 optional thicknesses (50 - 150 µm) possible!
*2 all films available with fibre glass reinforcement (200µm)

Keratherm®- Flowtherm® Phase Change-Material

Kerafol's Flowtherm® films are a combination of hot-melt waxes with or without a carrier material. The wax mixture in Flowtherm® films melts at various temperatures depending on its dimensions therby filling even the smallest irregularities between the power module and heat sink. This creates an improved contact between the surfaces and increases the heat transfer. Its special design makes it easy to use and store. Flowtherm® films are optionally available with single-side adhesive.

Properties	Unit	PCM 412	PCM 441	PCM 442	PCM 471 NEW
Colour		dark grey	black	black	grey
Compound		filled hot-Setting wax	filled hot-setting wax	filled hot-Setting wax	filled hot- setting wax
Thermal Properties					
Thermal resistance R_{th}	K/W	0.07	0.02	0.02	0.01
Thermal conductivity λ	W/mK	3.0	3.9	4.0	8.0
Electrical Properties					
Dielectric breakdown $E_{d;\ ac}$	kV/mm	not insulating	0.5	1.0	6.0
Mechanical Properties					
Overall thickness (+/- 10%)	mm	0.100	0.075	0.055	0.070
Reinforcement		with grating	without	without	without
Wax melt-on temperature	°C	48	56	60	46
Continous operation temperature	°C	+125	+125	+125	+125

Comparison of the thermal resistance of different PCM´s in dependence on the contact pressure



Applications:

- notebooks
- desktop CPU´s
- IGBT units

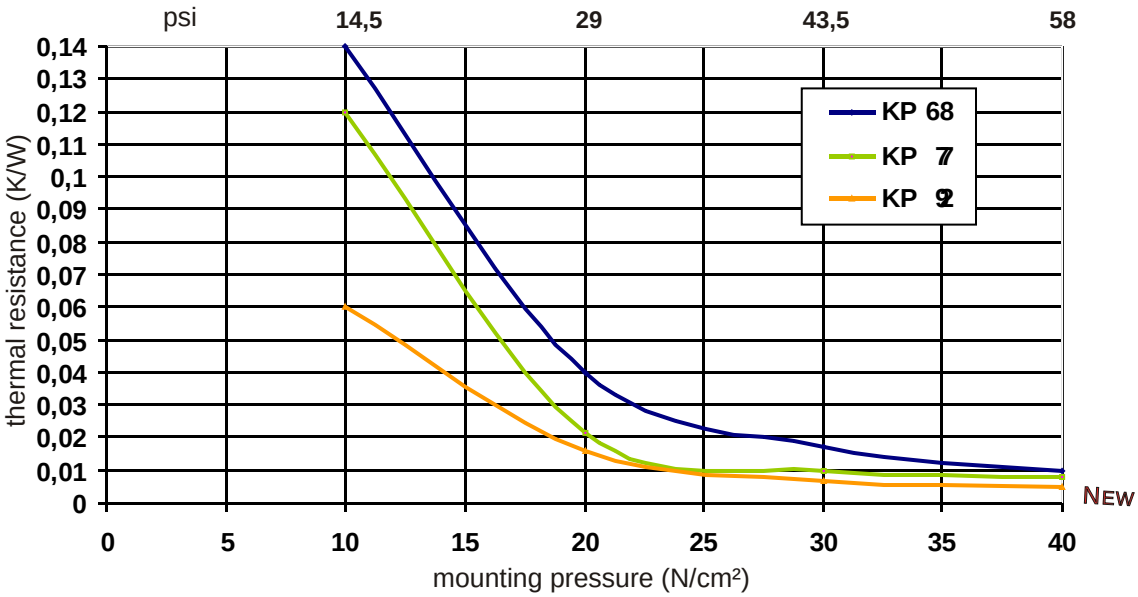
Keratherm® Thermal Grease

Ceramic-filled single-component silicone with a high thermal conductivity. The non-crosslinked thermal compounds do not dry out. The silicone components do not leak out of the compound. Special storage of KP 68/77/92 is not required, therefore they can be stored under normal climate conditions for up to 12 months .

If any separation of the filler materials becomes evident, KP 68/77/92 must be mixed thoroughly before use.

Properties	Unit	KP 68	KP 77 NEW	KP 92 NEW
Colour		black	white	silver
Consistency		soft / paste	soft / paste	soft /paste
Thermal Properties				
Thermal resistance R_{th}	K/W	0.01	0.009	0.007
Thermal conductivity λ	W/mK	7.0	8.0	10.0
Electrical Properties				
Dielectric breakdown $E_{d;\,ac}$	kV/mm	0.5	2.0	-
Mechanical Properties				
Coating thickness	mm	0.03 – 0.06	0.03 – 0.06	0.03 – 0.06
Density ρ	g/cm³	1.54	1.30	-
Application temperature	°C	-60 to +200	-60 to +200	-60 to +200
Long term stability (1000h / 85°C / 85% rel. humidity)				
Thermal resistance R_{th}	K/W	0.020	in test	in test
TML	Ma.-%	< 0.3	<0.002	0

Comparison of the thermal resistance of different pastes in dependence on the contact pressure



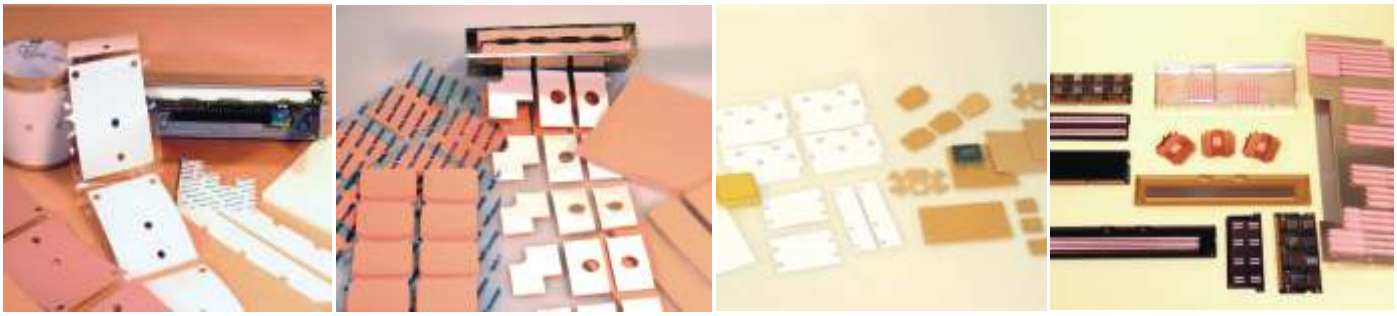
Applications:

- notebooks
- desktop CPU´s

KERATHERM® - Softtherm®

A group of highly elastic, ceramic-filled films. They are characterized by their extremely good compressibility, their optimum plasticity with good thermal conductivity, and good electrical properties. These films are especially suitable for compensating differences in planarity of the components or pressure-sensitive applications.

It is recommended, not to exceed the maximum compression of Softtherm® higher than 30% - 40% of the original thickness.



PROPERTIES

- highly flexible film
- outstanding flexibility
- graduated thermal conductivity
- good electrical insulation
- high temperature stability

BENEFITS

- compensates component size variations
- optimized thermal transition
- good compression behaviour
- UL-listed

FILM OPTIONS

- single-sided adhesive surface
- single sided adhesive coating possible
- can be supplied in sheets or punched
- Delivery forms see page 36

APPLICATIONS

- RD-RAM memory model
- heat pipe thermal solutions
- automotive engines
- control units
- plasma supply panels

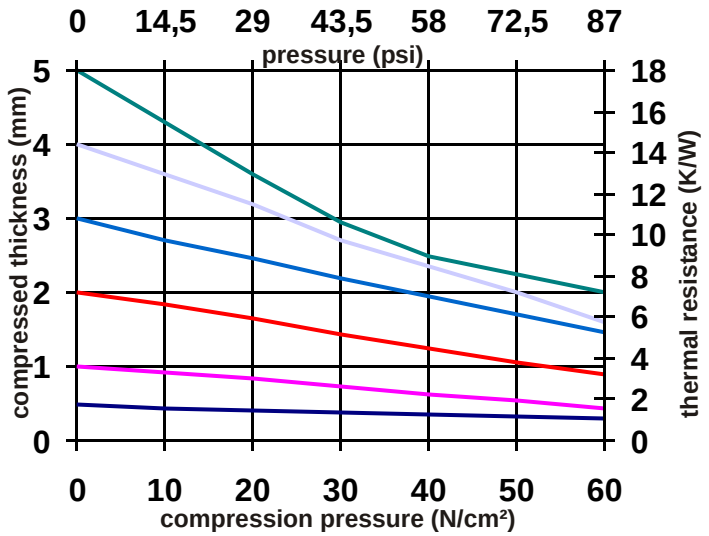
Softtherm® 86/200 and 86/210 low bleeding

A group of highly elastic, ceramic-filled films. They are characterized by their excellent compressibility, their optimum plasticity with good thermal conductivity and good electrical properties. These films are especially suitable for compensating differences in planarity of the components or pressure-sensitive applications. The film type 86/210 is also characterized by ist optimized outgassing and low bleeding behavior.

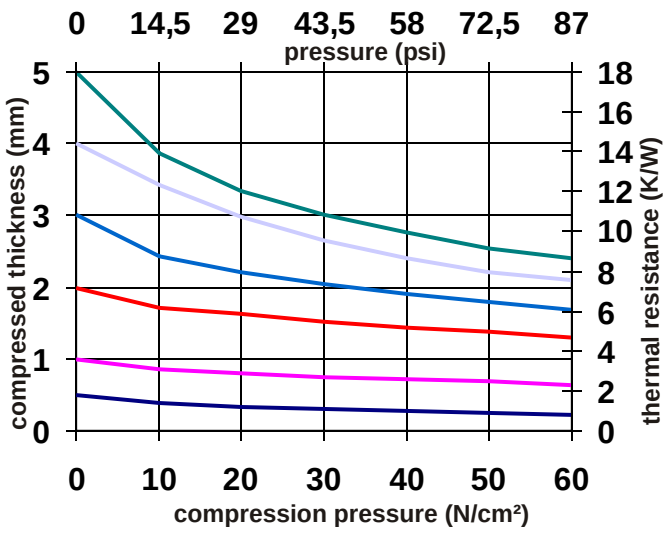
Properties	Unit	86/200	86/210 low bleeding
Colour		pink / yellow	pink / yellow
Thermal Properties			
Thermal resistance R_{th} (measured at 0.5 mm / 15 psi)	K/W	1.80	1.75
Thermal impedance R_{ti} (measured at 0.5 mm / 15 psi)	°Cmm²/W Kin²/W	625 0.97	617 0.96
Thermal conductivity λ	W/mK	0.8	0.81
Electrical Properties			
Breakdown voltage $U_{d;\ ac\ (measured\ at\ 0.5mm)}$	kV	6.0	10.0
Volume resistivity	Ωcm	1.0×10^{11}	1.0×10^{11}
Dielectric loss factor tan δ	1	1.5×10^{-3}	1.5×10^{-3}
Dielectric constant ε_r	1	3.9	3.9
Mechanical Properties			
Available thickness	mm	0.5-5.0	0.5-5.0
Hardness	Shore 00	10	15
Youngs modulus *	N/cm²	200	-
Physical Properties			
Application temperature	°C	-60 to +200	-60 to +200
Single-side adhesive		optional 86/200 K	optional 86/210 K
Flame class	UL	94V-1	in test
Total mass loss (TML)	Ma.-%	< 0.40	< 0.24

***Youngs modulus-sample size 30mmx30mmx2.5mm; variable contact pressure; compression 50% of the measured thickness**

Compressibilities of Softtherm® 86/200



Compressibilities of Softtherm® 86/210



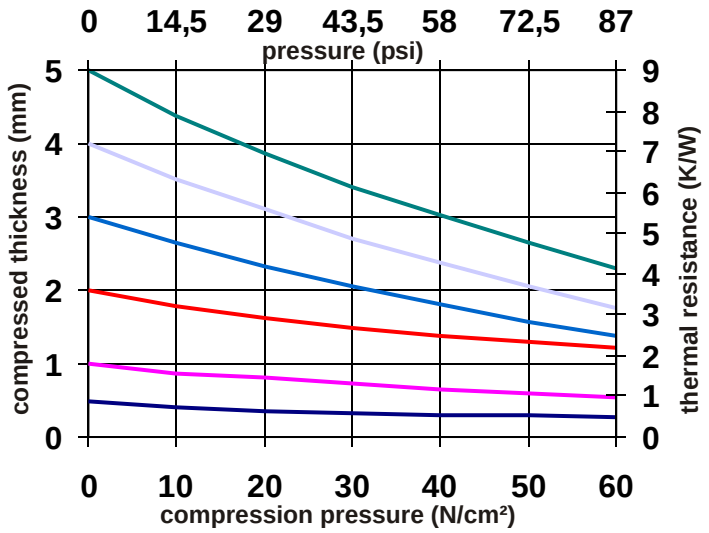
Softtherm® 86/255 and 86/250

This group of Softtherm® was created as a result of intensive collaboration with our customers.
They are characterized by their high thermal conductivity and the varying levels of hardness of the materials.

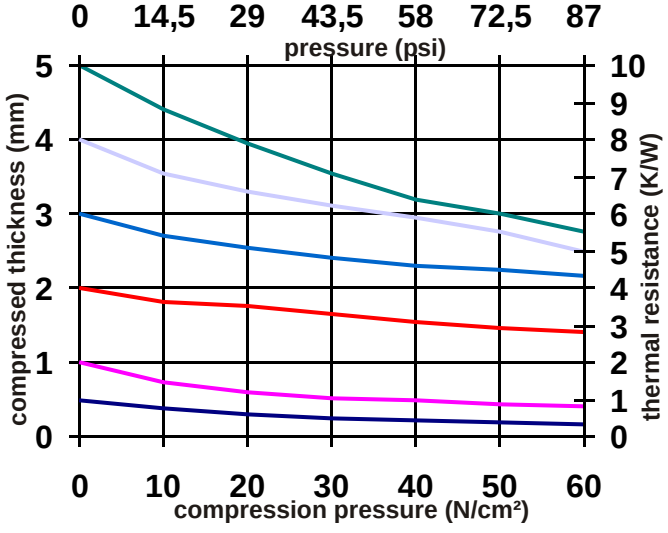
Properties	Unit	86/255	86/250
Colour		white / red	white / red
Thermal Properties			
Thermal resistance R_{th} (measured at 0.5 mm / 15 psi)	K/W	0.85	0.95
Thermal impedance R_{ti} (measured 0.5 mm / 15 psi)	°Cmm²/W Kin²/W	333 0.52	385 0.60
Thermal conductivity λ	W/mK	1.5	1.3
Electrical Properties			
Breakdown voltage $U_{d;\ ac\ (measured\ at\ 0.5mm)}$	kV	10.0	4.0
Volume resistivity	Ωcm	1.0×10^{11}	1.0×10^{11}
Dielectric loss factor tan δ	1	2.4×10^{-3}	2.5×10^{-3}
Dielectric constant ε_r	1	3.8	3.8
Mechanical Properties			
Available thickness	mm	0.5-5.0	0.5-5.0
Hardness	Shore 00	25	45
Youngs modulus *	N/cm²	276	138
Physical Properties			
Application temperature	°C	-60 to +200	-60 to +200
Single-side adhesive		optional 86/255 K	optional 86/250 K
Flame class	UL	94V-1	-
TML	Ma.-%	< 0.50	< 0.42

***Youngs modulus-sample size 30mmx30mmx2.5mm; variable contact pressure; compression 50% of the measured thickness**

Compressibilities of Softtherm® 86/255



Compressibilities of Softtherm® 86/250



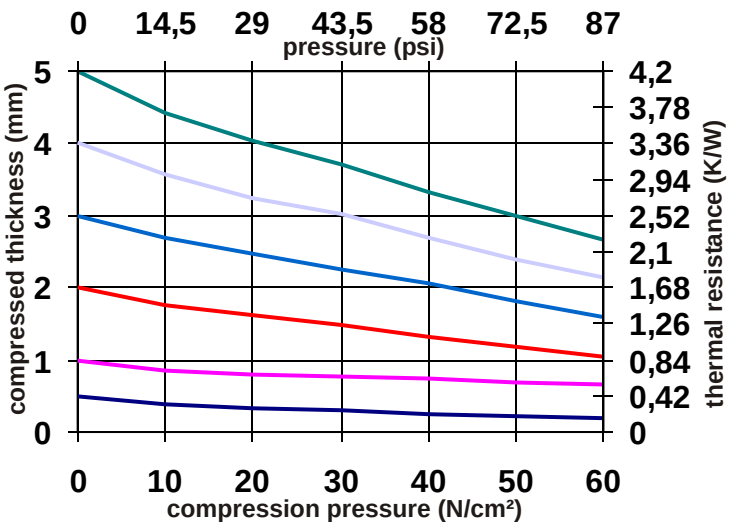
Softtherm® 86/300 and 86/500

This group of Softtherm® films has the best thermal behavior. The group is characterized by its low thermal resistance and best heat dissipation, as well as good dielectric strength. The good compressibility and low shore hardness ensure reliable and simple processability.

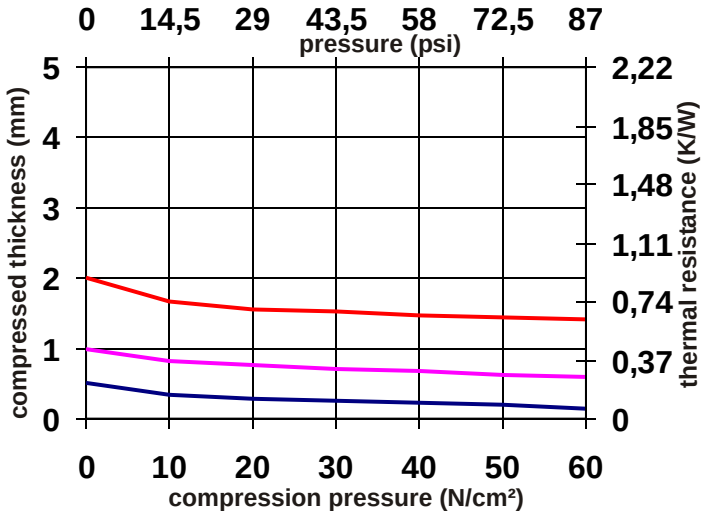
Properties	Unit	86/300	86/500
Colour		blue	brown
Thermal Properties			
Thermal resistance R_{th} (measured at 0.5 mm / 15 psi)	K/W	0.41	0.25
Thermal impedance R_{ti} (measured ar 0.5 mm / 15 psi)	°Cmm²/W Kin²/W	166 0.25	100 0.15
Thermal conductivity λ	W/mK	3.0 – 3.5	5.0
Electrical Properties			
Breakdown voltage $U_{d;\ ac\ (measured\ at\ 0.5mm)}$	kV	8.0	10.0
Volume resistivity	Ωcm	1.0×10^{11}	1.0×10^{11}
Dielectric loss factor tan δ	1	5.0×10^{-3}	1.5×10^{-3}
Dielectric constant ε_r	1	3.3	3.9
Mechanical Properties			
Available thickness	mm	0.5 - 5.0	0.5 - 2.0
Hardness	Shore 00	50 - 60	75
Youngs modulus *	N/cm²	220	-
Physical Properties			
Application temperature	°C	-60 to +200	-40 to +150
Single-side adhesive		optional 86/300 K	optional 86/500 K
Flame class	UL	94V-0	-
TML	Ma.-%	< 0.35	< 0.24

*** Youngs modulus-sample size 30mmx30mmx2.5mm; variable contact pressure; compression 50% of the measured thickness**

Compressibilities of Softtherm® 86/300



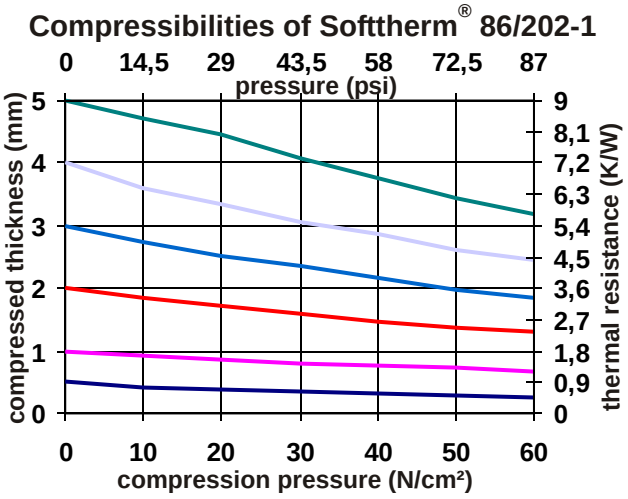
Compressibilities of Softtherm® 86/500

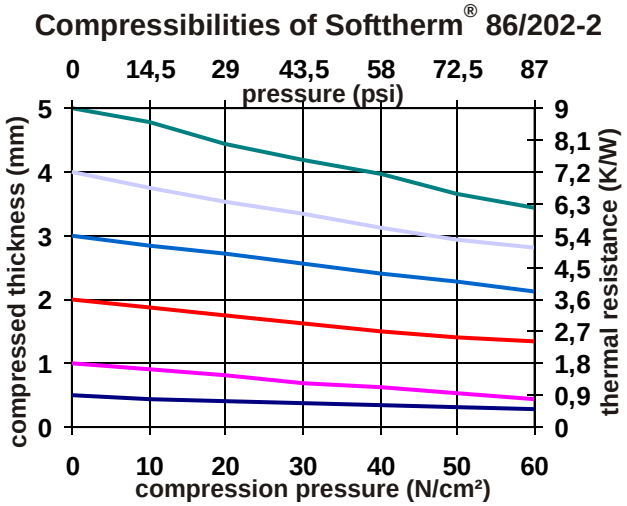


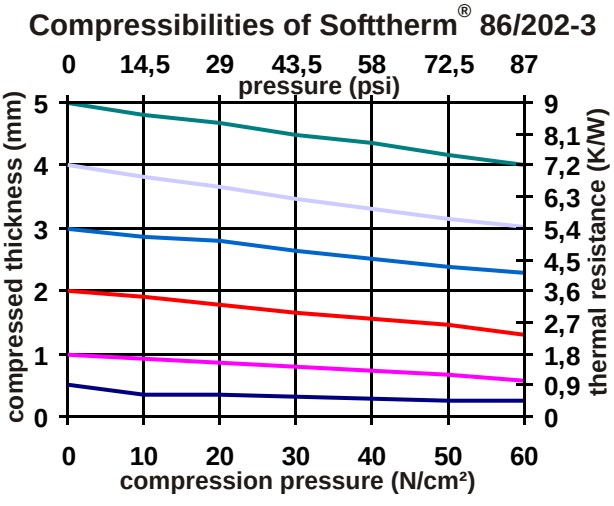
Softtherm® Gap-Filler

These films offer a cost-effective alternative to the standard films in the Softtherm® series. The films are characterized by their thermal and electrical properties and good plasticity.

Properties	Unit	86/202-1	86/202-2	86/202-3
Colour		grey	grey	grey
Thermal Properties				
Thermal resistance R_{th} (measured at 0.5 mm /15 psi)	K/W	0.9	0.9	0.9
Thermal impedance R_{ti} (measured at 0.5 mm / 15 psi)	°Cmm²/W Kin²/W	357 0.55	357 0.55	357 0.55
Thermal conductivity λ	W/mK	1.4	1.4	1.4
Electrical Properties				
Dielectric breakdown $E_{d;\,ac}$	kV/mm	1.0	1.0	1.0
Volume resistivity	Ωcm	in test	in test	in test
Dielectric loss factor tan δ	1	in test	in test	in test
Dielectric constant ε_r	1	in test	in test	in test
Mechanical Properties				
Available thickness (+/-10%)	mm	0.5 - 5.0	0.5 - 5.0	0.5 - 5.0
Hardness	Shore 00	40	50	60
Physical Properties				
Application temperature	°C	-60 to +200	-60 to +200	-60 to +200
Single-side adhesive		in test	in test	in test
Total mass loss (TML)	%	in test	in test	in test







KERATHERM® - Spaceform®

Self-curing moulding compound for individual thermal solutions. Spaceform® is a highly filled, mouldable silicone compound that is applied by the customer and possesses exceptional mechanical, electrical and thermal properties after a curing tempering process. Thanks to its excellent conformability, there are no restrictions in dimensions or shapability.

Whereas the type “A” and “B" Spaceform® compounds are self-curing by means of a thermal process, the Spaceform® “Q” moulding compound is uncured. Spaceform® “Q” is characterized by its exceptional flexibility, easy handling and recyclability .

Properties	Unit	Spaceform® A self- curing	Spaceform® B self- curing	Spaceform® Q uncured
Colour		dark grey	grey	brown
Thermal resistance R_{th} (measured at 1mm)	K/W	2.07	2.07	1.40
Thermal conductivity λ	W/mK	1.0	1.0	1.5
Breakdown voltage $U_{d;\,ac}$	kV	4.0	4.0	4.0
Thickness	mm	1.0 - 30	1.0 - 30	1.0 - 30
Hardness (after curing)	Shore	60 (A)	50 (A)	30 (00)
Application temperature	°C	-60 to +200	-60 to +200	-40 to +180
Density ρ	g/cm^3	2.03	2.03	2.85
Tempering needed		yes	yes	no*

***Important: Spaceform® Q does not require tempering!**

Processing details for the self-curing Spaceform® A and B compounds

Delivery form and transport

2-30 mm thick rolled sheet, or vacuum packed as a sheet in PE film.

Storage

Curing at room temperature after approx. 60 days. When stored in a cool place (e.g. refrigerator at approx. 8-10°C), the storage life increases up to 80 days!

Tempering process for Spaceform® A+B

The tempering process takes approx. 30 minutes at 140°C. No silicones or other harmful substances are released during the curing process.
A reduction in temperature by 10°C leads to a doubling of the curing time. In the packaged state at 60-70°C, the compound will cure within approx. 48-72 hours.

Advantages:

- spotted heat dissipation
- extremely good compressibility
- excellent plasticity
- good thermal properties
- good electrical, dielectrical properties

Applications:

- mechanical and automotive engineering
- PCB-housings
- computer units
- heat pipe thermal solutions

KERATHERM® Sealing Compounds

Ceramic-filled, two-component silicone elastomers. Because of their various thermal conductivities and differing compressibility behavior, their good dielectric properties, and being free of solvents, these materials are ideally suitable for encapsulating or dispensing. The wide range of different material viscosities available makes them of interest for "wet-in-wet" production.

Customer-specific solutions for the compound technology and processing technology are our strength.

Type	Unit	GF 200	GF 255	GF 300
Base material		Silicone	Silicone	Silicone
Colour		yellow	red	blue
Mix ratio		1 : 1	1 : 1	1 : 1
Viscosity	mPas	19.000	47.500	50.000
Curing		½ h;120°C	½ h;120°C	½ h;120°C
Technical Values				
Thermal conductivity λ	W/mK	0.55	1.5	3.0
Dielectric breakdown	KV/mm	5.0	1.5	1.0
Hardness	Shore 00	5	10	50
Density ρ	g/cm³	2.40	2.62	3.40
Application temperature	°C	-40 to +150	-40 to +200	-40 to +200

Applications:

- RD-RAM modules
- chipsets
- memory chips
- heat pipe thermal solutions
- micro BGA
- high voltage electronic components

Kerafol's® modern dispensing technologies allow the application of heat-conducting material onto the most diverse heat sinks or custom-specific components.
Just contact us and we will be happy to help you in finding a solution.

Processing of KERATHERM® Sealing Compounds

- Silicone sealing compounds are physiologically safe
- No irritation to the respiratory system when used in sealing compounds
- Avoid contact with skin
- Silicone hardeners / curing agents are physiologically safe
- We recommend the use of protective industrial ointment

Pre-treatment: The parts to be sealed should be dry, clean and grease-free.

Preparation: The silicone sealing compounds contain filler materials which may show sedimentation, depending on the storage temperature. It is therefore necessary to stir the compound thoroughly before the actual mixing process.

Mixing: Kerafol's silicone sealing compounds and their silicone curing agents (component B) must be mixed in the prescribed proportions. After intensive mixing with a suitable stirrer, the compound is immediately ready for use.

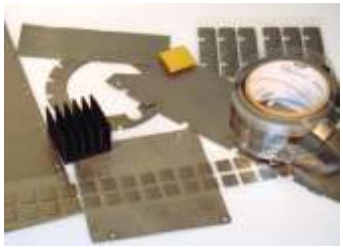
The use of cartridges is not recommended, since mixing of the components by a static mixer can no longer be performed. During the mixing process, ensure that no air is brought into the material. Avoid long standby times. Pay attention to the specified processing times. Silicone sealing compounds are moisture-sensitive. After mixing, sealing compounds should always be evacuated for a period of at least 10 minutes at < 100mbar.

Application: The processing time ranges from approx. 25 minutes up to 3 hours! The viscosity will increase slightly during this time, so you should only prepare as much material as you can process within this time. If the silicone sealing compound will be processed by means of dosing equipment, then it is possible to adjust the processing time with the aid of accelerators. Processing of the compound beyond this time should be avoided since the processing conditions will continuously change due to the curing process (viscosity increase, viscidity of the sealing compound, etc.).

Curing conditions: 48 h at room temperature or max. ½ h;120°C; refer also to the curing times specified on the datasheets. The heating regime from room temperature onwards should not climb faster than 5 K/min. When tempering or post-curing incompletely cured sealing compound, entrapped air can expand and cause smoke formation. It is therefore important to ensure that no bubbles are formed during dispensing. When curing at room temperature, please note that heat treatment can change the hardness slightly . Silicone sealing compounds that have been cured at room temperature should not be fully stressed mechanically and electrically before approx. 4 days waiting time.

Shelf life: At least 6 months in original packaging. When opened, the contents should be used as soon as possible since, due to the influence of humidity, the reactivity of the material can diminish.

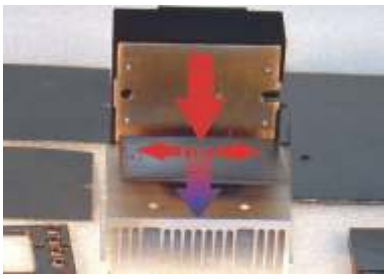
KERATHERM® Graphite Film



Keratherm® graphite films are based on 100% pure graphite. The films are available as uncoated types, or, for specific applications, coated with thermal wax, filled adhesive or standard adhesives. Because of their high thermal conductivity, they are used e.g. in the CPU sector,

Properties	Unit	90/10	90/10-S	90/15	90/20	90/25
Colour		black	black	black	black	black
Thermal Properties						
Thermal resistance R_{th}	K/W	0.09	0.07	0.07	0.13	0.05
Thermal impedance R_{ti}	°Cmm²/W Kin²/W	36 0.05	36 0.05	29 0.04	55 0.08	21 0.03
Thermal conductivity λ	W/mK	5.5	5.0	6.0	4.0	7.0
Electrical Properties						
Breakdown voltage $U_{d;\ ac}$	kV	not insulating	insulating on wax-side	not insulating	not insulating	not insulating
Volume resistivity	Ωcm	0.06	-	0.06	0.06	0.05
Mechanical Properties						
Overall thickness (+/-10%)	mm	0.200	0.25	0.175	0.25	0.125
Hardness	Shore D	30	30	30	30	30
Tensile strength	N/mm²	5.5	5.5	6.0	5.5	4.0
Elongation	%	10	10	10	10	10
Physical Properties						
Application temperature	°C	-40 to +500	-40 to +180	-40 to +180	-40 to +180	-40 to +400
Density ρ	g/cm³	1.0	1.0	1.0	1.0	1.1
Flame class	UL	94V-0	94V-0	94V-0	94V-0	94V-0
Adhesive coating		-	PCM-mixture	filled adhesive	yes	-
Shelf Life	Months	-	12	12	12	-

KERATHERM® S 900



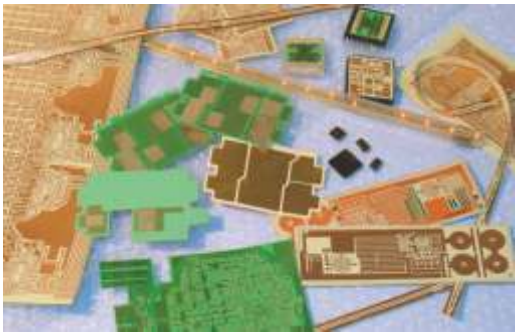
High-density graphite with very high thermal conductivity, as a cost-effective alternative to conventional heat spreaders. Up to 1/3 weight saving compared to conventionally used materials made from copper or aluminum. No electrical insulation!

Properties	Unit	Value	
Colour		black	
Possible thicknesses*	mm	0.3 / 0.55 / 0.85 /1.10 / 1.55	
		over the horizontal plane	through the thickness
Thermal resistance $R_{th\ (measured\ at\ 0.3\ mm)}$	K/W	0,002	0.08
Thermal conductivity λ	W/mK	450	7.5
Electrical resistance	Ω µm	6	1000
Breakdown voltage E_d	KV/mm	electrical conductive	
Hardness	Shore D	30	
Density ρ	g/cm³	1.8	
Application temperature	°C	-40 to +400	

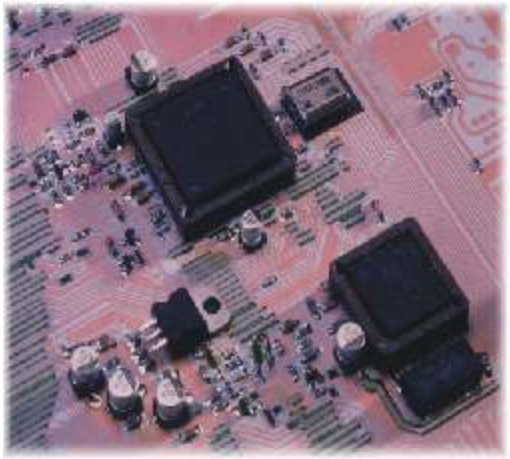
KERATHERM® Copper

Heat conducting films manufactured by a special process with copper film (electrolyte) on one side. The beneficial properties of the heat-conducting film and copper create entirely new application possibilities, for example, active EMC protection or as a system carrier for electronic switches.

The following copper thicknesses are available:
17 µm, 25µm, 37µm, 50µm, 75µm und 101µm



Properties	Unit	86/70	86/77
Colour		pink / copper	green / copper
Thermal Properties			
Thermal resistance R_{th}	K/W	0.45	0.9
Thermal impedance R_{ti}	°Cmm^2/W Kin^2/W	147 0.21	227 0.35
Thermal conductivity λ	W/mK	1.7	1.1
Electrical Properties			
Breakdown voltage $U_{d;\,ac}$	kV	1.0	2.0
Breakdown strength $E_{d;\,ac}$	kV/mm	5	10
Mechanical Properties			
Overall thickness (+/-10%)	mm	0.250	0.300
Thickness of copper layer	mm	0.05	0.037
Tensile strength	N/mm²	65	70
Elongation	%	50	15
Hardness	Shore A	80	85
Physical Properties			
Application temperature	°C	-60 to +250	-60 to +250
with adhesive coating		optional	optional
Fibreglass reinforced		–	optional single-/ double layered



On these system carriers, power densities of 5-10 W/cm² can be realized. In this case the heat conductive silicone film carries the electrical conducting circuit paths in copper etching technique. The second conductor path layer, for example in resistors, capacitors or coils, can be produced by applying polymer paste pressure. In contrast to conventional circuit board technology, this method allows efficient production from a roll. The outstanding flexibility of the film permits the formation of interfaces and cable harnesses.

These system carriers for electronic switches represent state-of-the-art design from an economical and ecological perspective.

Polymer Pastes for KERATHERM® - Products

When processing Keratherm® Copper as a system carrier for electronic switches, a compatible polymer paste system is necessary in order to create a second conductor path layer and to realize a roll-to-roll technology (SMD technology).

The silicone-based paste system is characterized by its very good adhesive properties and is suitable for SMD technology.

Keratherm® polymer pastes show improved properties compared to conventional pastes, which is a basic prerogative for developing multi-layer technology or individual multi-layer structures.

Type - Nr.	electrical resistance [mΩ/sq]	Application / Suitability
Conductive paste		
LKS 1093	< 130	Flexible direct surface coating from PS
LKS 1245	< 180	Contact etched Cu-structure
LKS 1046	< 40	Multilayer superstructure
Resistive paste		
LKS 9351	10k	Power resistance
LKS 9341	10k	Power resistance
LKS 9331	1k	Power resistance
LKS 9325	500	Power resistance
LKS 9323	250	Power resistance
Dielectric paste		
LKS 4293	-	Cu - insulation, cross-over, covering
LKS 4866	-	cross -over covering
Covering lacquer		
LKS 48550	-	Covering, surface grouting

Applikationen:

- EMI - shielding
- flexible PCB
- LED - arrays

Frequently asked questions regarding the use of polysiloxane film as a circuit board material

What kind of etching methods can be used?
All conventional kinds of etching methods can be used: spraying, immersion and foam etching. The preferred method is spray etching in a continuous processing machine. Roll-to-roll production is also possible.

What sorts of etchants can be used?
At present, wet-chemical etching using sodium persulfate, ammonium persulfate or ferric (III) chloride has been tested.

What resolutions are possible / viable when etching?
On standard film Keratherm 86/77, minimum circuit path widths and distances of 300 - 350 µm can be reliably reproduced. Circuit path distances down to 125 µm are possible. Narrower circuit paths are possible but will probably show a lower adhesive strength.

Any problems regarding chemical resistance?
The films are chemically resistant against all chemicals used in circuit board technology, for example, sulfuric acid, hydrochloric acid, acetone, ethanol, sodium hydroxide, sodium carbonate, sodium persulfate, etc.

Can the film cause damage to chemical baths as a result of silicone monomers leaching out?
No, the films can be used without problems concerning other circuit board basis materials being processed in the same chemical baths and equipment.

Which film type should be used for flexible printed circuit boards?
The standard material is the film KERATHERM 86/77. For special applications, the highly thermoconductive films KERATHERM 86/30, 86/50, 86/82 can also be used, however, significantly lower adhesive strengths regarding the copper lamination and significantly lower mechanical stability of the films are to be expected. In this case,circuit paths are only possible at circuit path widths of 700-1000 µm and show inferior adhesive strength.

Is laser processing possible?
Yes. The polysiloxane films (with or without copper lamination) are very suitable for laser processing. The laser can be used for structuring and seperating the films. Holes, blind holes and ultrafine copper structures (30 µm in width) can be produced.

Is the film suitable for use as a high-frequency circuit board material?
No, because the dielectric constant and loss factor are strongly frequency-dependent and the loss factor is approx. 10 to 20 times higher than for conventional high-frequency circuit board materials.

In what widths can the films be manufactured and processed?
The films are currently manufactured and processed in the following standard widths: 100, 200, 300 and 400 mm. They can currently be etched in widths up to 300 mm in a roll-to-roll process. Large-batch assembly and soldering is currently possible at a width of 70 mm.

Moisture absorption compared to Kapton
The moisture absorption for polysiloxane is 0.3 to 1.0 % compared to 2 - 4% for Kapton; polysiloxane therefore causes less problems during soldering. The moisture (predominantly from the wet-chemical processing step) is released again. Kapton must be dried in a complex process and will absorb humidity from the surrounding air within 24 hours.

What design principle is used for electronic assemblies?
The recommended design principles are EPAC or sandwich construction, similar to samples available. To ensure optimal heat dissipation and mechanical stability, the back of the polysiloxane film should be pressed directly onto an aluminum platet. Gluing is possible but decreases the heat dissipation.

Can the film be glued on?
The films can be glued onto aluminum plates with the aid of a suitable adhesive. The adhesive however decreases the heat dissipation. We are currently working on improving the adhesive properties with respect to adhesive strength, thermal resistance and thermal conductivity.

How should the film be processed mechanically?
The films can be processed by using mechanical tools such as scissors, knives, drills. They can also be processed by means of a laser.

For what applications are the films particularly well suited?
The films are particularly well suited for boards in the field of power electronics (engine control, IGBT control, etc) and high-performance LED arrays. The film also offers further application possibilities in the area of rigid-flexible sub-assemblies.

What soldering methods can be used
Because of the mechanical properties (flexibility) of the film, only the reflow method is suitable for serial production. The solder joints are heated by convection or radiation. Due to the very good thermal conductivity of the film, soldering by conduction would be suitable. For samples or very small-batch production, soldering can also be performed by soldering iron or soldering robots.

Are the films suitable for lead-free solders ?
Thanks to their high temperature stability, the films are optimally suited for lead-free solders.

Which assembly methods can be used?
For series production, only SMD assembly is worth considering. Conventional wired components need to be placed and soldered manually.

Is it possible to use COB (Chip On Board) / bonding technologies?
Only the flip-chip process is possible, using either soldering techniques or polymer flip-chip techniques. Conventional wire bonding processes (thermal compression and ultrasonic) are not possible due to the low hardness of the film material.

How can multilayer technology be realized?
One way is by combining circuit board and polymer thick film technology (copper coating with printing of polymer paste). The copper coating can be structured by means of etching technology and/or laser processing. Further layers are applied by means of screen printing of polymer pastes (insulation, trace, resistor). Another possible way is the lamination or or continuous bonding of multiple polysiloxane films. This variation, however, is currently only in the developmental stage.

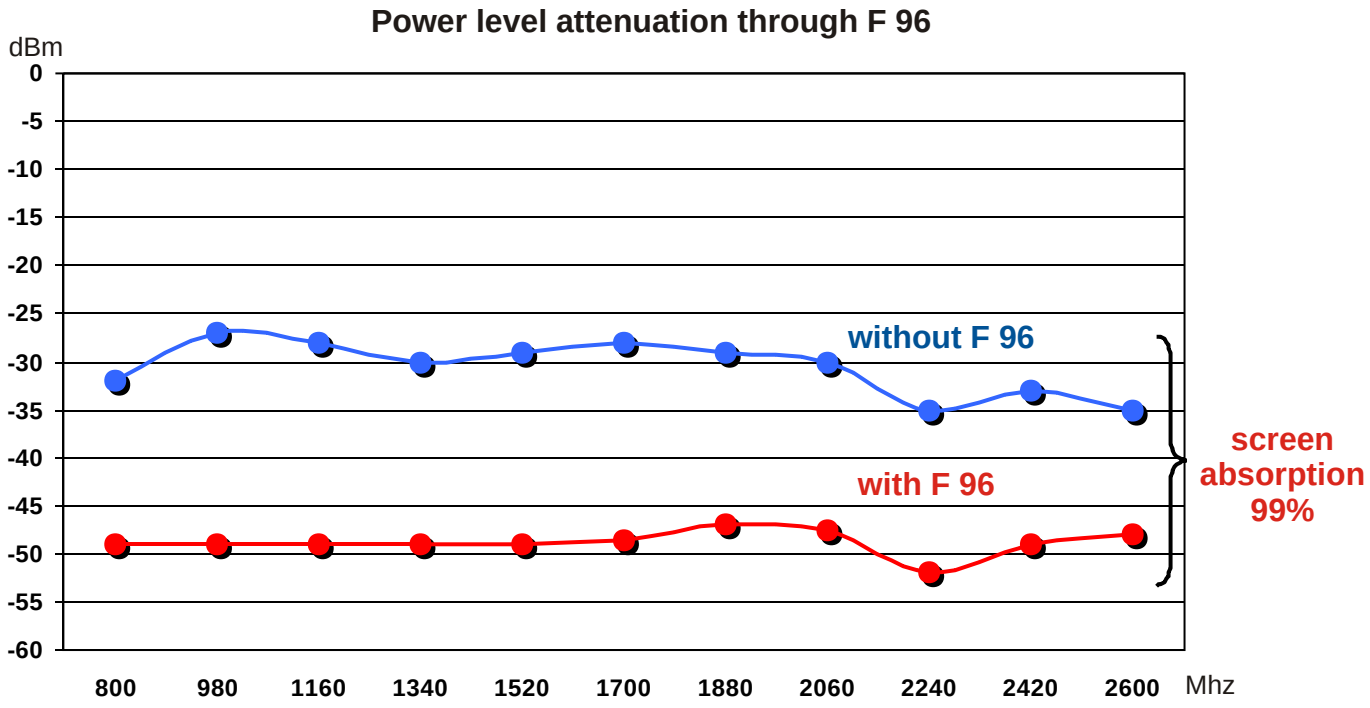
What is the costs for polysiloxane circuit boards?
The costs for the KERATHERM 86/77 polysiloxane film is comparable to those of standard epoxy resin based materials (FR4). The cost of processing these films is identical to that of standard materials (FR4) both at a laboratory and large-batch production scale and can even be lower because cost-effective roll-to-roll processing is both feasible and preferred.

What particular regulations need to be considered when designing the electronic boards?
Yes. We can supply the user with the exact requirements and layout recommendations.

KERATHERM® F 96® (Ferrite Film)

A new material made from soft-magnetic ferrite for electromagnetic shielding, flexible coils or other magnetic applications. The film has a very good shielding efficiency and a high EMC absorption capacity! Its high initial permeability ensures good magnetic properties. Its high flexibility allows preforms and customer-specific punching in all kinds of shapes.

Properties	Unit	Ferrite F 96
Colour		black
Initial permeability µi		14 ± 20%
Relative loss factor (tan δ/µi) 1.0 KHz 0.1 MHz		 0.20 0.01
Dielectric constant ε_r 1.0 KHz 0.1 MHz		 2.80 0.20
Overall Thickness (+/-10%)	mm	0.225
Density ρ	g/cm³	2.8
Dielectric breakdown $E_{d;ac}$	KV/mm	1.0
Thermal conductivity λ	W/mK	1.0
Tensile strength	N/mm²	0.7
Elongation	%	40
Hardness	Shore A	82
Application temperature	°C	- 40 to +200



KERATHERM® Keramold® (ferrite sealing compound)

Keramold® consists of a two-component ferrite-polyurethane sealing compound and is used to encapsulate or embed electronic components. Both components are already packed in the correct mixed proportions.

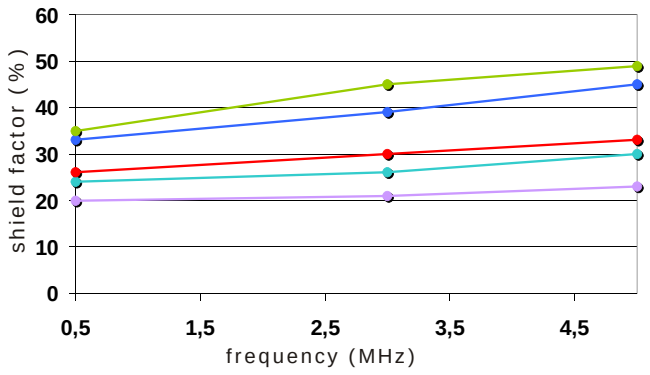
Keramold® shields electronic assemblies, acts as an electrical insulator, dissipates heat extremely well and exhibits very low shrinkage. The solvent-free Keramold® is characterized by its high mechanical strength and good impact and vibration protection.

without Keramold®

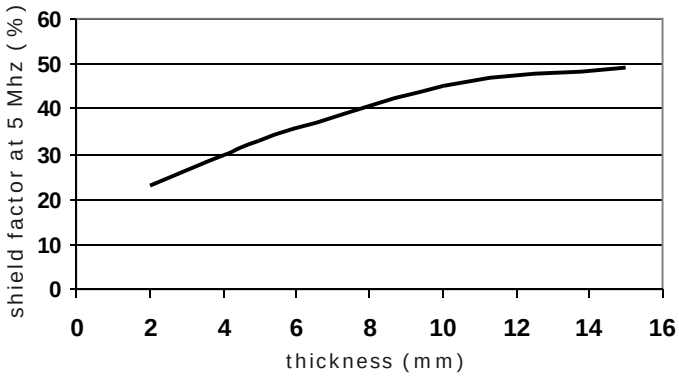
with Keramold®

Properties	Unit	Keramold®	Keramold® Silicone basis NEW
Colour component A		white	black
Colour component B		black	black
Mix ratio A : B		4 :1	1 :1
Thermal conductivity λ	W/mK	1.0	0.6
Dielectric breakdown $E_{d;ac}$	KV/mm	4.0	0.4
Hardness	Shore A	95	55
Viscosity	mPas	80.000	25.000
Density ρ	g/cm^3	2.35	2.40
Drip time at room temperature	Min.	approx. 85	approx. 85
Shrinkage	%	approx. 1	approx. 1
Application temperature	°C	- 40 to +100	- 40 to +180
Curing time at 80°C	Min.	30	30

Shield factor as function of the frequency at different thicknesses



Shield factor as function of the thickness at 5 MHz



KERATHERM® Adhesives

KERATHERM® -**adhesive coating**: Each film type requires its own special adhesive system. Besides flexible adhesives with low adhesive strength, Kerafol® also offers adhesives with high adhesive strength or with various fillings for improved heat transfer.

Properties	Unit	Silicone PSA	Silicone GEL	Acrylate	Acrylate + Wax	Filled Acrylate Adhesive
Colour		translucent	translucent	translucent	translucent	milky
Film type		films with glass fibre	film with and without glass fibre	silicone free films	graphite films (90/10-S)	graphite films (90/15)
Application temperature	°C	-60 to +250	-60 to +250	-40 to +180	-40 to +150 *	-40 to +180
Hardness	Shore A	75	40	70	80	80
Adhesive properties		highly adhesive	slightly adhesive	highly adhesive	adhesive and hot-setting wax	filled, conducting adhesive
Peel resistance [1]	N	7-15	4-8	10-25	3	4
layer thickness	µm	10-20	20-35	10-20	50	25
Shelf-Life [2]	month	8	8	12	12	12

***phase change at 50-55°C**

[1] **Peel resistance:** Peeling at 180°C, peel speed: 300 mm/min.;
Width of test strip: 25 mm; length of test strip: 220 mm;
Final test-method in accordance with DIN 53375, 53282,53283.

[2] **Shelf Life:**

Silicone adhesive: eight (8) months from date of manufacture provided the material has been stored in its original packaging and at max. 21°C (70°F) and 50% relative humidity.

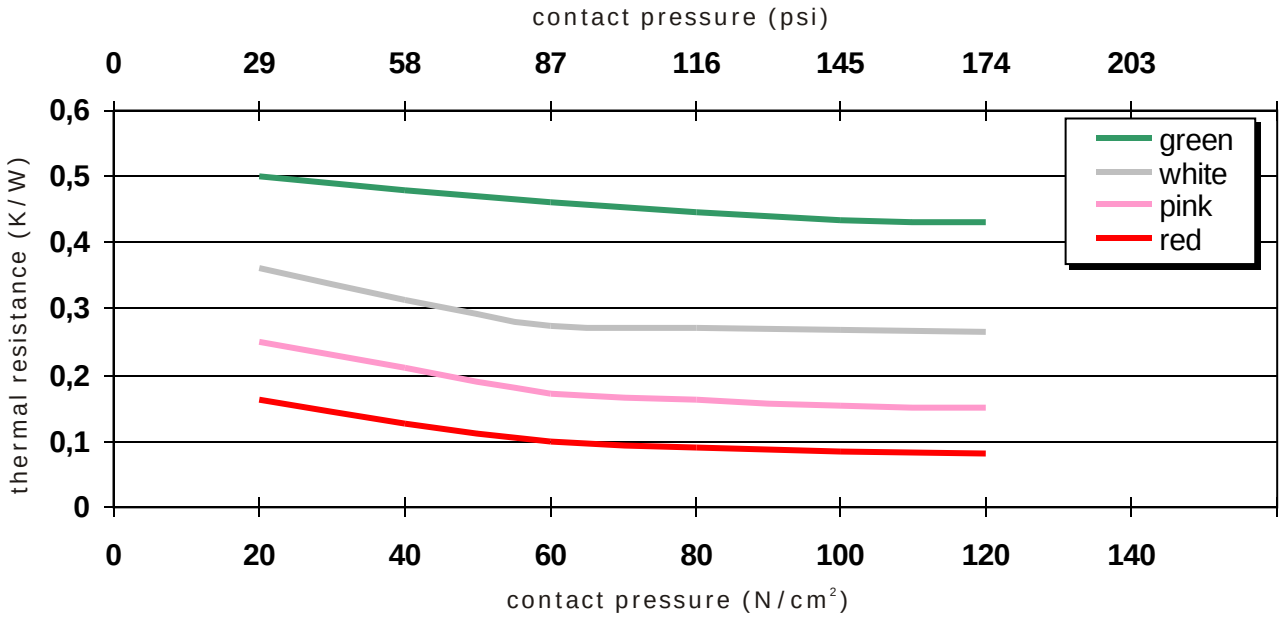
Acrylate adhesive: twelve (12) months from date of manufacture provided the material has been stored in its original packaging and at max. 21°C (70°F) and 50% relative humidity.

Determination of thermal properties

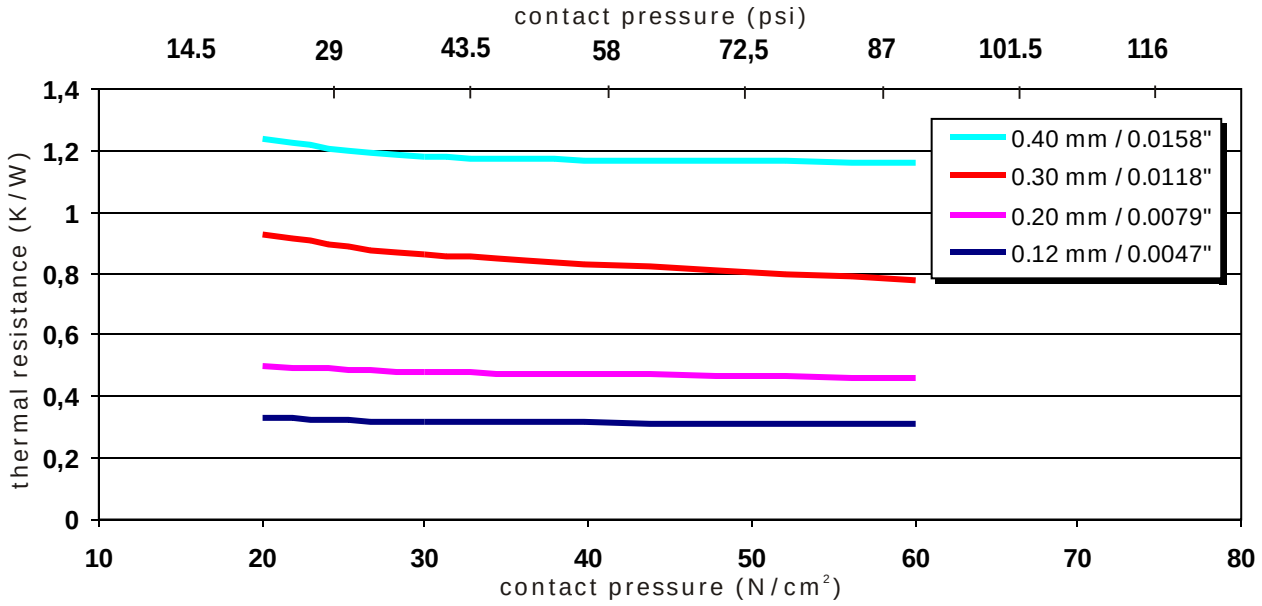
The thermal properties of interlayers are normally specified in terms of their thermal resistance in Kelvin/Watt, which defines the intrinsic thermal resistance of the material to possible heat loss. The lower the value, the better heat can be dissipated through the material. The thermal resistance values depend on the film thickness, the contact surface produced between the power module and the heat sink, the film surface, and finally the assembly pressure.

The thermal resistance of KERATHERM® products does not change significantly with contact pressure. The relaxation processes within the silicone polymer in KERATHERM® **improve the thermal resistance by 10-15%.**

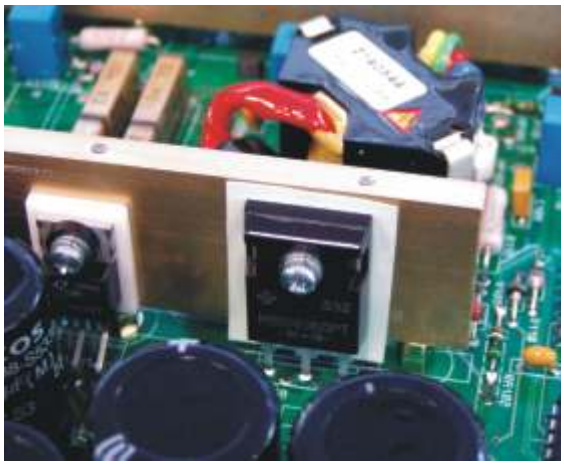
Thermal resistance of various film types



Thermal resistance at various film thicknesses for 86/37 foil



KERATHERM®- Films are mainly resistant to water, oils and their mixtures, organic solvents and chlorinated hydrocarbons, as well as the cleaning agents used to degrease and wash heat sinks, housings and printed circuit boards. These materials merely cause swelling of exposed edges of the heat-conducting film, whereby the degree of swelling depends on the contact period and the type of solvent applied.
After dry-out, the exposed edges return to their original state with no change in thermal or electrical properties. Due to the short contact times involved, KERATHERM® may be exposed to the conventional baths used in soldering processes.



Standard application of KERATHERM®

The various KERATHERM® products are crosslinked and cured to elastomers during the manufacturing process. KERATHERM® products involve none of the substances specified on the VDA List of Declarable Substances. Our products do not require labeling in accordance with "ChemG/Gefahrstoff V" (Act for the Protection against Hazard Substances / Hazardous substance V). KERATHERM® products contain no asbestos, lead, mercury, chromium-6, cadmium and/or halogenated hydrocarbons.

Delivery form

Besides a large number of standard shapes (TO, TIP, DO or other power housing shapes), we can supply punch parts in customized shapes of any arbitrary size based on customer drawings (max. 400x400 mm). Roll goods can be supplied in widths of 15 mm up to 500 mm. All formats can also be ordered as bulk material.
All flexible films - Softtherm® - can be delivered in thicknesses up to 1.0 mm or as roll goods up to 500 mm in width. Above a thickness of 1.5 mm, the Softtherm® films are supplied as sheets in sizes up to a maximum of 250 x 450 mm².

Time of delivery

Shipping of parts and/or rolls or sheet goods are delivered within 10 working days of receipt of order. Express orders with very short leadtimes are of course possible by arrangement.

Tolerances

In terms of geometry, as well as position and shape of the parts or holes to be punched or relevant recesses and outlines,the tolerances are fixed at a minimum of 0.1 mm in accordance with DIN ISO 2768-m. Regarding the thickness, a deviation from the required dimension of +/- 10% of the total thickness is allowed .Dimensions are measured with a Qick-Scope (QSPAK 3.0) image processing measurement system, or using a dial gauge or measuring microscope. All tools and punching are qualified by means of the first piece inspection report.

Batchwise determination of thermal properties

An equi-area measurement sample (4 cm² base area) is placed between a heatable upper die and a cooled lower die. The lower die is pressed against the upper one by means of a pneumatic pressure cylinder. The pressure-dependence of the thermal resistance of the samples is derived from the variation in contact pressure. After approx. 20 minutes, the resultant temperature gradient above the sample is determined via Pt-100 sensors. The thermal resistance (R_{th}) and the thermal conductivity (λ) are calculated on the basis of this temperature gradient, the heating power passed through the sample, and the sample geometry.

Determination of electrical properties

The electrical insulation effect of the heat-conducting films is characterized by their dielectric strength. The higher the breakdown voltage, the better the insulation behaviour. Measurements are performed with an AC high-voltage detector.

Determination of mechanical properties

State-of-the-art equipment and measurement devices facilitate the batch-wise determination of tensile strength and elongation of the films . In addition to this, the peel strength of adhesive coated materials is determined on the basis of the "Finat Test Method No.1“ (180°).

YOUNGS MODULUS studies

Kerafol analyses the behaviour of flexible films under pressure, using the method described in ASTM D 575-91, to determine the so-called YOUNGS MODULUS. The sample geometry of the individual film types is 30x30mm at 2.5 mm thickness, and pressure is applied with a constant traverse path of 1 mm/min (0.04 in/min). The pressure-dependence of the films is shown on the graphs.

Determination of flame class

The available KERATHERM® products have been certified and categorized into classes with regard to their inflammability by the American institute "Underwriters Laboratories Inc.“ (UL). In addition to this, the company KERAFOL® endeavours to test its products on the basis of the latest findings in research and development.

Further information regarding the UL identifiers of Kerafol® products is available on the UL website. Visit http//www.ul.com and select the category “Online Certifications Directory”. From there you can search for the Kerafol file under the following file number:

QMFZ2E140693: Plastics Component. This category contains all Kerafol® products.

Keratherm®-Test methods

Description	Unit	Test method	
Thermal resistance R_{th} *1	K/W	Kerafol®-test method	
Thermal conductivity λ *1	W/mK	Kerafol®-test method	ASTM D 5470
Breakdown voltage ($U_{d;\,ac}$)	kV	IEC 243 1+2	ASTM D 149
Dielectric breakdown ($E_{d;\,ac}$)	kV/mm	IEC 243 1+2	ASTM D 149
Volume resistivity	Ωcm	DIN 53482 - 3	ASTM D 257-3
Dielectric loss factor tan δ	1	DIN 53483	ASTM D 150
Dielectris constant ε_r	1	DIN 53483	ASTM D 150
Overall thickness	mm	DIN 53370	ASTM D 734
Tensile strength	N/mm^2	DIN 53455	ASTM D 412
Elongation	%	DIN 53455	ASTM D 412
Hardness	Shore (A,D) Shore 00	DIN 53505	ASTM D 2240
Compressibilitiy *2	mm	DIN 2039/ 53512 / 53517	ASTM D395/ASTM D695/M 1054
Youngs Modulus *2	N/cm^2	-	ASTM D 575-91
Flame class	UL	UL 94 / E140693	UL 94 / E140693
Total mass loss (TML)	Ma.-%	-	ASTM E 595

*** modified test geometry:**

1. Thermal conductivity λ, thermal resistance R_{th} and thermal impedance R_{ti} (4cm²)
2. Compressibility and “Youngs modulus” (3.0cm x 3.0cm = 9cm²)

Conversion

Shape: 1000 mil = 1 inch (1”) = 2,54 cm = 25,4 mm
Area: 1 $inch^2$ = 6,45 cm^2 = 645 mm^2
Pressure: 100 N/cm^2 = 1MPa = 10 bar = 145,037 psi

KERAFOL®

Innovation in Technology and Environmental Protection ...

Special Ceramics

...are the objectives of our company. Competent customer-focused advice and solutions are just as much a part of our principles as the targeted further development of our product range in order to be able to offer an optimum solution for any particular application.

Ceramic Filters

Porcelain Film

Scandia stabilized zirconia powder

Discover our broad range of products and take advantage of the diverse application possibilities!

Your Contact:

KERAFOL®

Keramische Folien GmbH
Stegenthumbach 4-6
92676 Eschenbach, Germany
Tel. +49 (0)9645/ 88300, Fax. +49 (0)9645/ 88390
eMail: info@kerafol.com, Internet: www.kerafol.com

December 2004