



GORE® Thermal Insulation



TURN UP THE PERFORMANCE, TURN DOWN THE HEAT.

GORE® Thermal Insulation:
Enhanced heat spreading
for an enhanced user experience.

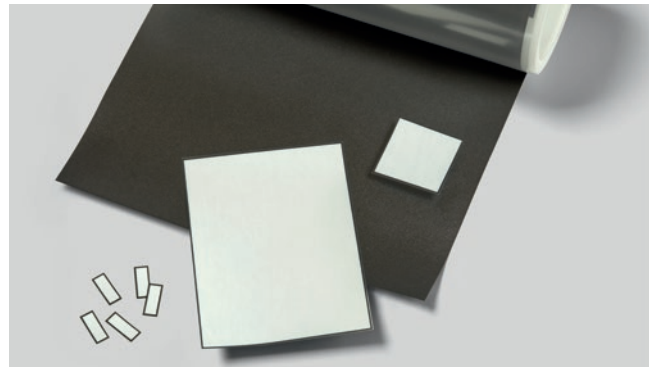
Together, improving life

GORE® Thermal Insulation: Enhanced Thermal Spreading for Electronic Components

Improve performance, reduce hot spots

The demand for greater performance, functionality, and smaller form factors is increasing thermal challenges in electronic devices, particularly as many powered components are generating more heat in smaller spaces. More heat generation requires advanced thermal solutions to spread heat more evenly across the device surface and reduce hot spots.

Thermal engineers use graphite, heat pipes and vapor chambers to spread and dissipate heat across a larger area to improve device performance. These solutions have a high thermal spreading ratio defined by the thermal conductivity in-plane (k_{xy}) divided by thermal conductivity through-plane (k_z). Despite a high spreading ratio, heat spreaders have relatively high k_z compared to insulators. They are often designed using an air gap with low k_z at the system level to improve the spreading ratio. As heat spreading requirements increase, these thermal solutions can still fail to reduce hot spots due to an insufficient spreading ratio within the available space.



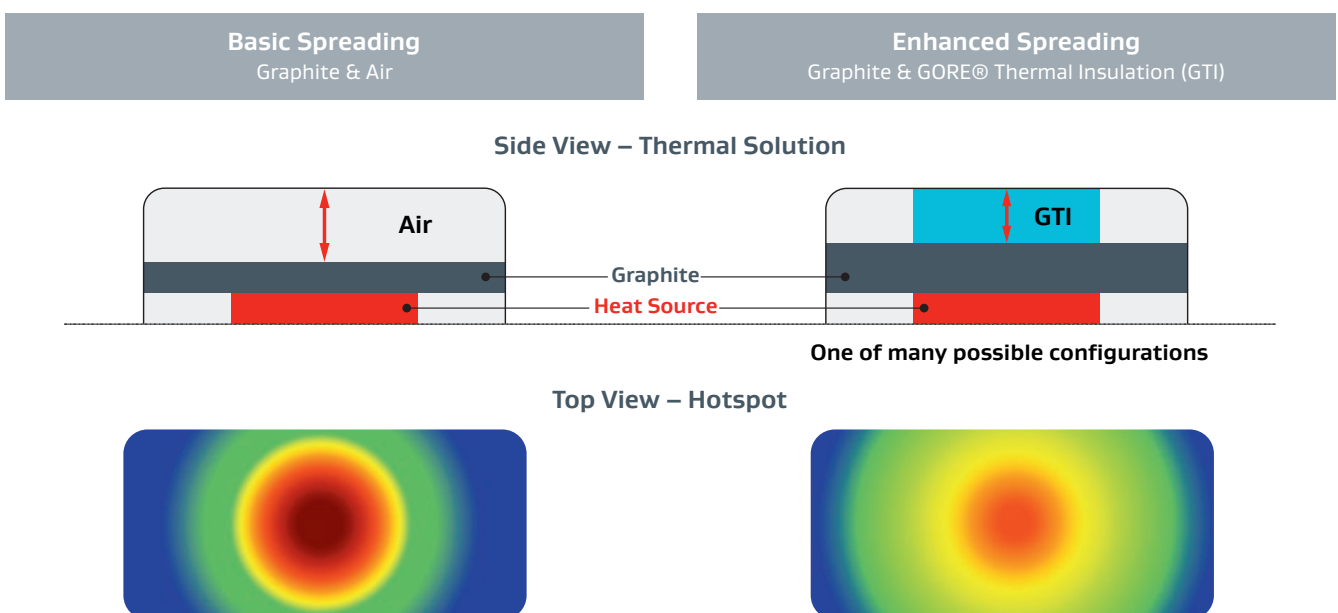
GORE® Thermal Insulation can be combined with graphite material

Now, with GORE® Thermal Insulation, you can improve the effectiveness of your heat spreading solutions. With a k_z significantly lower than air, enabled by premium aerogel technology, GORE® Thermal Insulation will improve the heat spreading ratio and outperform system level air gaps. It can be used independently or in conjunction with heat spreaders to create a higher performing thermal solution.

Including GORE® Thermal Insulation in thermal designs increases effectiveness of thermal spreading

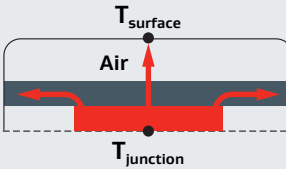
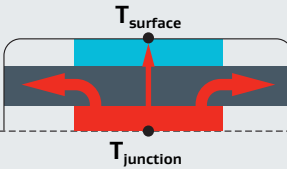
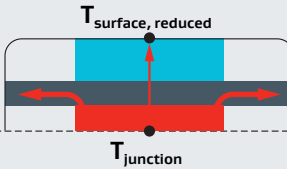
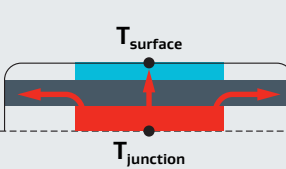
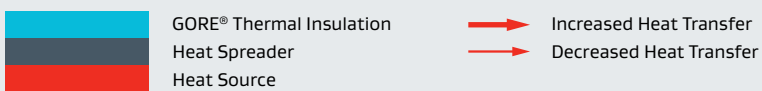
GORE® Thermal Insulation is a thermal management solution that increases the designer's ability to direct heat by greater control of z-axis thermal conductivity. More control means superior spreading options that

enable components to perform at higher levels for longer, accommodate shrinking form factors, and/or meet surface temperature requirements.



We can help you beat the heat

Improve your existing solution without compromises

GORE® Thermal Insulation Addresses Common Challenges			
CURRENT STATE	PERFORMANCE NOT OPTIMIZED	HOTSPOT	DEVICE THICKNESS
<p>Without GORE® Thermal Insulation</p> <ul style="list-style-type: none"> Components are throttled to maintain junction and surface temperatures below required thresholds Thermal engineers battle surface hot spots when device functionality is added and/or devices are designed thinner Air gaps are difficult to maintain as devices are designed thinner 	<p>Increase Performance</p> <ul style="list-style-type: none"> With a k_z lower than air, thinner GORE® Thermal Insulation can replace the air gap, allowing for more graphite to be included Delay throttling of performance by moving heat away from the heat source and blocking heat from device surface Enable components to operate at higher power for longer time 	<p>Reduce Hotspot Temperatures</p> <ul style="list-style-type: none"> Reduce surface temperatures by 1–6 °C (depending upon system power and insulation thickness) 	<p>Thinner Product Design</p> <ul style="list-style-type: none"> Enable thinner designs while maintaining performance by replacing an air gap with thinner insulation 
<p>Legend</p> 			

Additional Benefits of using GORE® Thermal Insulation:

Electrically Insulative

- Provides a physical barrier between device components
- Does not create electrical short circuits or EM/RF interference

Durability

- Minimal particulation
- Flexible and conformable

Ease of Integration

- Can be combined with graphite or heat pipes to optimize performance
- With 6 thicknesses options and ability to customize shape
- Easy to install with pressure sensitive adhesive

GORE® Thermal Insulation

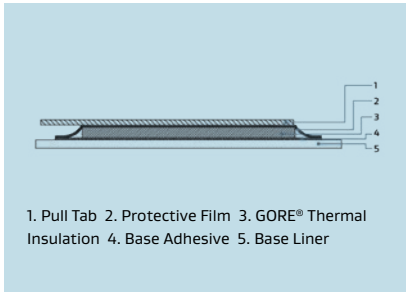


Figure 1: GORE® Thermal Insulation cross section

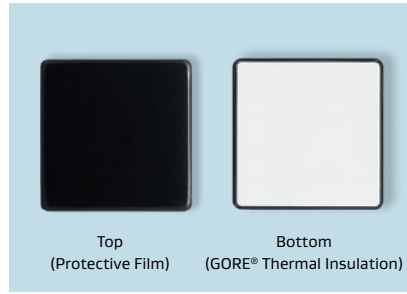


Figure 2: GORE® Thermal Insulation surface images

GORE® Thermal Insulation reduces surface “hot spots” and enables enhanced device performance for a better user experience.

MATERIAL DATA*						
Insulation thickness available ^a	0.12 mm	0.17 mm	0.23 mm	0.28 mm	0.38 mm	0.53 mm
Adhesive encapsulation width (minimum) ^b	1 mm	1 mm	1 mm	1 mm	1 mm	1.5 mm
Thermal conductivity (k) ^c	0.021 W/m•K		0.020 W/m•K			
Compression @ 100 kPa (14.5 psi)	13%		8%			
Specific heat capacity ^d	1.8 J/g °C					
Bulk density	0.37 g/cc					
Dielectric constant ^e	1.46					
Loss tangent ^e	0.017					
Typical signal loss with 350 µm part	< 0.3 dB					
Operating temperature ^f	-40 °C to 100 °C					
Protective cover film	Black PET					
Adhesive type	Acrylic					
RoHS ^g	Meets threshold requirements					
Max part size	100 mm × 200 mm					

^a Nominal thickness based on reported values of thickness of each component of the stack-up.

^b Nominal minimum width.

^c Nominal conductivity value based on a modified version of ASTM C518.

^d Nominal heat capacity measured according to ASTM E2716 Method B at 75 °C.

^e Nominal values representative of frequency range from 6 GHz to 70 GHz.

^f Alternate adhesives required to exceed 100 °C.

*All values based on nominal characteristic and do not represent the specification and tolerance.

TECHNOLOGY EXPERTISE

- High loading of aerogel to obtain low conductivity
- Consistent distribution of aerogel enables consistent conductivity
- Consistent thickness across a range of thicknesses from 120–530 µm

^g To the best of our knowledge, the product listed above does not have any restricted substances above the maximum concentration values listed in RoHS Directive 2011/65/EU and meets the substance restrictions of Article 4 of RoHS Recast including Commission Delegated Directive 2015/863.

W. L. Gore & Associates

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