USER GUIDE

UG013 | Graphite Foam Gasket – WE-TGFG

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1. INTRODUCTION TO WE-TGFG

The WE-TGFG is a graphite over foam gasket that utilizes the superior in-plane conductivity of natural graphite. It is designed for use as an interface between ICs and heat sinks. The foam core allows for pad elasticity and moderate pressure on components. Traditional elastomeric gap filling solutions require the cooling assembly to be parallel to the component, the WE-TGFG foam core allows for special profiles that give designers more freedom.

Heat flows over the graphite surface of the gasket while remaining electrically insulating thanks to its protective films. One side is adhesive to hold the gasket in place during installation.

In addition to its thermal management capabilities, the WE-TGFG gasket offers significant mechanical benefits. The elasticity of the foam core ensures that the gasket can accommodate slight variations in component height and surface irregularities, while maintaining consistent thermal contact and pressure distribution. This adaptability reduces the risk of mechanical stress and potential damage to sensitive components and solder joints, improving the overall reliability and longevity of the electronic assembly.

2. MATERIAL SPECIFICATIONS

The graphite over foam gasket has four main components, as shown in Figure 1.

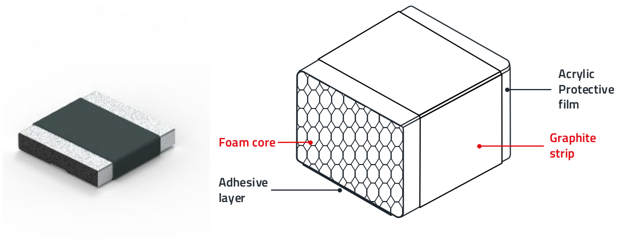

Figure 1: WE-TGFG cross-section.

- **Graphite stripe:**
  Natural graphite has excellent in-plane thermal conductivity. By wrapping it around a foam core we can take advantage of this performance to transfer the heat in a gap-filler setting.
- **Acrylic film:**
  To guarantee electrical insulation between contact surfaces, a thin acrylic film covers the graphite.
- **Foam core:**
  Open-core foam provides the gasket with its mechanical properties and creates pressure to ensure thermal transfer between contact surfaces.
- **Adhesive layer:**
  To make assembling the gasket easier, there is an adhesive layer on the bottom to help it stay in place until compression.

The properties of the WE-TGFG graphite over foam gasket can be grouped into three categories: material, thermal and electrical as can be seen in Table 1, Table 2 and Table 3.

Material Properties	
Height	1 - 30 mm
Length	10 – 300 mm
Width	10 - 70 mm
Compression recovery	98 %
Operating temperature	-40 up to 120 °C

Table 1: Material properties of WE-TGFG.

Thermal Properties (30x30x3 mm Gasket)	
Graphite in-plan thermal conductivity	400 W/m·K
Thermal conductivity in gap-filling application	3 W/m·K

Table 2: Thermal properties of WE-TGFG.

Electrical Properties	
Breakdown voltage	1 kV
Surface resistance	$1 \cdot 10^8$ Ω

Table 3: Electrical properties of WE-TGFG.

3. DESIGN CONSIDERATIONS

A WE-TGFG graphite over foam gasket is used in application the same way as a traditional elastomeric gap filler solution such as the WE-TGF, and it is designed to interface one component with a cooling assembly.

However, it does bring some additional characteristics to gap fillers:

- Profiles to interface non-planar contact surfaces
- Non-tacky surfaces that allow the disassembly of designs without the need to replace the pads as well as sliding insertions.

Let's consider a scenario where we have an embedded system that is dissipating 5 W within an aluminum housing. Since our board has multiple IO ports, there is a clearance of 10 mm between the heat source and the housing that we will use to transfer heat to the ambient. That distance in the field of thermal interface materials is quite significant. The formula for thermal resistance is:

$$R = \frac{L}{\lambda \cdot A} \tag{1}$$

Where:

- L is the bond line thickness; the thickness of the phase change material
- λ is the thermal conductivity of material
- A is the area of contact surface

The distance between the source and the housing significantly increases the thermal resistance. Here we should see the graphite excel in providing a path for heat to flow to the housing.

Calculating the thermal resistance of the graphite working as a gap filler is not a trivial task, therefore, we will support ourselves with a FEM simulator, ANSYS Icepak. We will perform two simulations to compare the performance of a traditional elastomeric solution and a WE-TGFG graphite over foam gasket. Both pads are 15x15x10 mm.

The two different set-ups are shown in Figure 2.

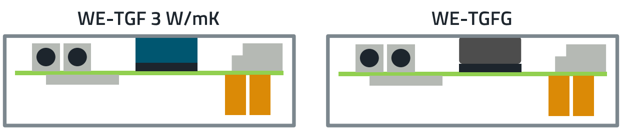

Figure 2: Comparison of traditional elastomeric solution (left) and WE-TGFG (right).

Table 4 shows the specifications of the case scenario:

Housing surface area	60.16 cm²
Heat source area	2.25 cm²
Gap to fill	10 mm
Power dissipation	5 W

Table 4: Specifications of the case scenario.

Since we only want to perform a comparison between solutions, to decrease the complexity of the simulation we simplify our board to only include the PCB and the heat source as shown in Figure 3.

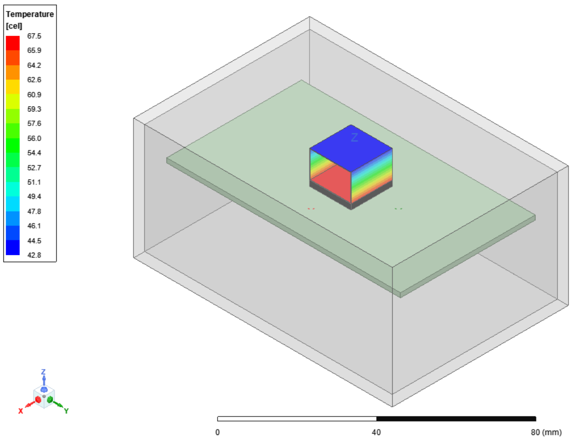

Figure 3: WE-TGFG Simulation.

After we perform both simulations, we compare the temperature of the heat source to evaluate the transfer of heat (Table 5).

Pad	Source temperature	Housing temperature	Calculated thermal resistance
WE-TGF 3 W/m·K	83.6 °C	42.7 °C	8.9 K/W
WE-TGFG	67.5 °C	42.9 °C	4.9 K/W

Table 5: Temperatures at different points with WE-TGF 3 W/m·K and WE-TGFG

In this case scenario where the gap to bridge is quite significant, the WE-TGFG out-performs the traditional elastomeric solution.

4. INSTALLATION AND HANDLING

The recommended approach is to install the graphite over foam gasket on the heat source and then assemble the cooling device. It is important to at least ensure a compression pressure of at least 6.8 N/cm^2 between source and sink to guarantee thermal transfer.

In order to ensure correct application, the following steps are recommended:

1. The surface of the component and cooling assemblies must be clean and dry. It is recommended to use isopropyl alcohol applied with a lint-free wipe or swab to remove any particles on contact surfaces.
2. Pick the graphite gasket from the carrier and place it on your design with a slight twisting motion to wet-out the surface and activate the adhesive.
3. Assemble the cooling assembly ensuring mechanical compression.

Cutting

Cutting the gasket to size is strongly discouraged. The heat conducting layer is natural graphite, which is a very flaky material by nature. Puncturing or damaging the protective acrylic film will result in the release of particles that can damage your design.

Reworking

If the part gets stuck in the wrong position during assembly, carefully peel it off and reposition it. If it has been previously assembled, there is a risk of delamination.

The non-adhesive contact surface of the gasket is completely dry, and can be joined and separated as long as it is undamaged.

5. MODIFICATION AND PROTOTYPING

Custom profiles can be implemented into the gasket, however, their viability will be verified and confirmed by the engineering team.

Reach out to your Würth Elektronik representative with the following information and they will get back to you with a personized quotation:

- Physical dimensions
- Number of parts needed
- Technical drawing of desired part
- Any special requests you may have

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