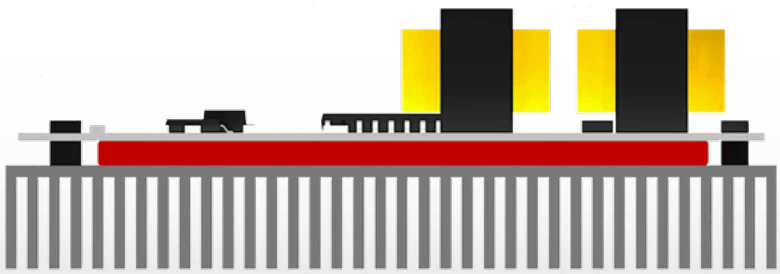
WÜRTH ELEKTRONIK

WE-TGF Design Guideline

Silicone Elastomer Gap Filler Pad



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Thermal Management is the term used to describe the methods used take care of the excess heat that electronic devices and components generate. It is a field of upmost importance in order to guarantee reliability of electronic devices and components as well as to prevent premature failure.

1. What is the WE-TGF used for?

The WE-TGF is a silicone elastomer gap filler pad, designed to fill a gap between one or multiple electronic components and a cooling assembly, such as a heatsink, cooling plate or metal housing.

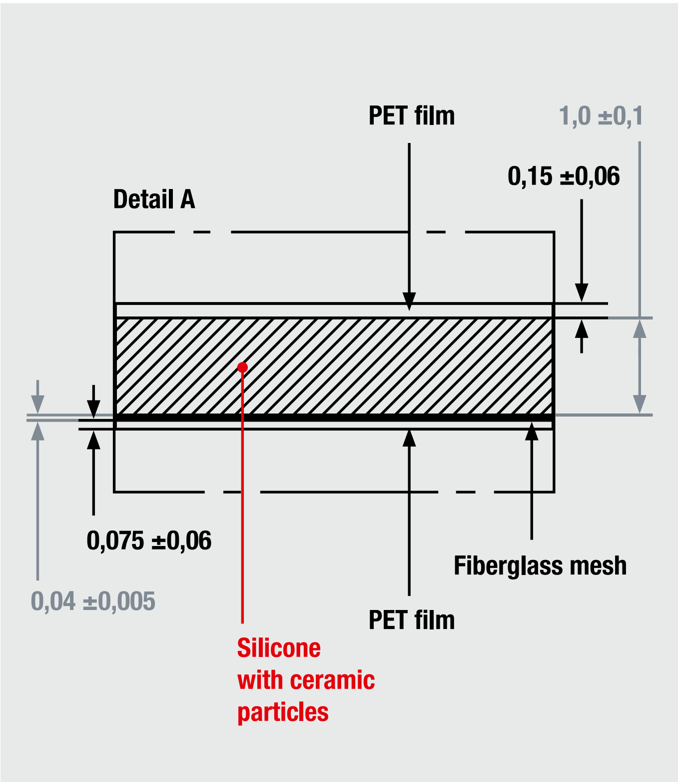

Fig. 1: *WE-TGF components*

The pad itself is composed by three main components, as shown in figure 1:

- **PET film:** The WE-TGF is protected by two PET films, a thicker one at the bottom that acts as a carrier and a thinner one on top to protect the material from foreign particles.
- **Thermally conductive silicone elastomer:** This is the main part of the component. Silicone allows the product to be soft and to conform with ease to contact surfaces, allowing the material to fill out the gap completely and remove any air. The silicone is doped with ceramic particles that are the thermally conductive component. The mixing ratio of both elements determine the overall thermal conductivity of the material.
- **Fiberglass mesh:** This component brings mechanical stability to the part in its thinner versions (under 2mm).

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2. Where can the WE-TGF be used?

The WE-TGF is designed to be used in low-pressure applications between a component and a cooling assembly. Because it is designed to be used between two mechanically mounted surfaces, the pad does not have any additional adhesive layer beside its natural tackiness.

Since it is a general purpose solution it covers a wide range of application requirements:

- **Thermal Conductivity:** Wide range from 1 up to 10 W/mK.
- **Thickness:** From 0.5 to 18 mm in the lower range of thermal conductivities, between 1 and 3 W/mK. For higher performance materials the thickness range is from 0.5 up to 3 mm.
- **Electric Insulation:** Since the product is based on a silicone matrix, there is complete electric insulation between the component's contact surfaces.
- **Low pressure applications:** The WE-TGF is designed to be compressed between 10 % and 30 % of its thickness for optimal performance and to ensure proper contact on both surfaces.

Thanks to its soft and electrically insulating nature the WE-TGF can be used to fill a gap between one or more electronic components and a cooling assembly without the need to worry about any shorts or unwanted contacts (**figure 2**).

When working with compact designs that use thermal vias to redirect heat to the back of a PCB, as shown in **figures 3 and 4**, the WE-TGF is a great choice to provide a thermal interface with a heat sink or a metal housing.

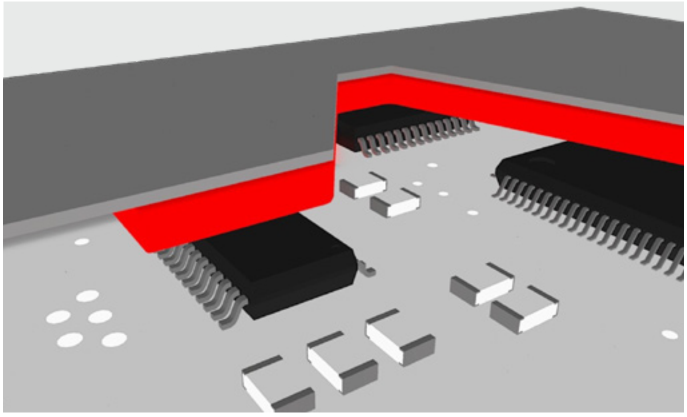

Fig. 2: *Multiple components cooled by the housing*

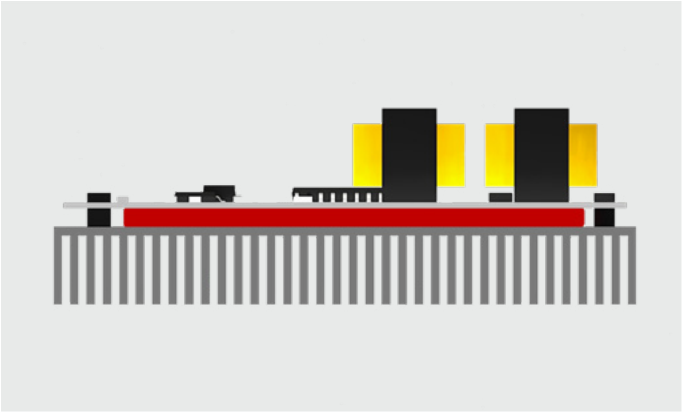

Fig. 3: *Backside of a PCB interfaced with a heat sink*

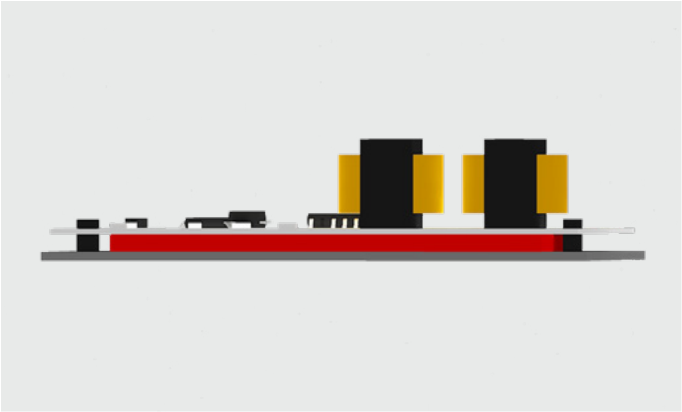

Fig. 4: *Backside of a PCB interfaced with a metal housing*

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3. Solutions specially tailored for you

Another benefit of the WE-TGF that adds value to its versatility is the ease of shape customization. Würth Elektronik brings this value to you by providing a customization service with no **MOQ** and **no tooling costs**.

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

- Thermal Conductivity needed for the application
- Desired thickness
- Volume or number of parts needed
- Technical drawing of the tailored solution
- Any other requirement you may have

4. General use of the WE-TGF recommendations

- For optimal adhesion properties, the surfaces of the component and the cooling assembly must be clean and dry. It is recommended to use Isopropyl alcohol applied with a lint-free wipe or swab for removing any particles on the surfaces.
- Gaps and/or air bubbles between the gap filler and the contact surfaces must be avoided. Otherwise, the performance of the product may be affected.
- The temperature rise of the component which needs thermal management must be taken into consideration. The operating temperature is comprised of ambient temperature and temperature rise of the component.
- It is highly recommended to cut the gap filler as straight as possible to improve the contact between the surfaces.
- For a proper operation, a compression between 10 % and 30 % of the original thickness is recommended.
- In case of exceeding the recommended compression range it may lead to an excessive silicone oil exudation, reducing expected lifetime as well as causing other harm on the PCB and its performance.
- It is recommended to compress the material with equal pressure on the whole surface.

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5. Frequently Asked Questions

Q: Can I modify standard parts? What if I need a non tackypad or something outside of the catalogue?

A: There are many ways to tailor the part to fulfil your requirements, please contact your Würth Elektronik representative for your specific solution:

- Thickness
- Dimensions
- Custom shapes

Q: What test method has been used for the thermal performance measurements provided by the datasheet?

A: All thermal related measurements have been performed following ASTM D5470.

Q: Is the WE-TGF electrically insulating?

A: Yes, as long as it is used under the dielectric strength recommended in the datasheet. Bear in mind that the primary purpose of this part is to fill a gap.

Q: Will the material change its mechanical properties under high temperatures?

A: If the material is used under the parameters specified in the datasheet there will be no significant change in its hardness or any other mechanical property.

Q: When is a fiberglass reinforcement recommended?

A: It is recommended in the thinner versions of the pad, between 0.5 and 2 mm in order to guarantee mechanical stability.

Q: Can the WE-TGF be reworked / re-attached?

A: This is not recommended, since foreign particles may end up on the contact surfaces that could lead to an under performance in the final assembly.

Q: Does the WE-TGF also help in vibration dampening?

A: Due to the soft nature of the product it will certainly help with vibration dampening without the need of any other mechanical help.

Q: How is the WE-TGF modified in shape?

A: The cutting process is done by kiss cutting. An oscillating knife cuts through the top PET film and the material the desired shape, but it does not go through the bottom PET film that acts as a carrier.

Q: Is the WE-TGF adhesive?

A: Silicone rubber has a natural inherent tack. This tackiness helps the pad to stay in place temporally while the final assembly of the device takes place. This means that mechanical fixing between the component and cooling assembly is still required, the product is not designed to carry this task.

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6. Thermal Properties & Glossary

Thermal interface materials (TIMs) are materials that are inserted between two surfaces to improve the thermal coupling between them. The usual application is between a heat source and a cooling assembly.

TIMs can be categorized in two main groups:

- **Vertical Thermal Interfaces:** The commonly used gap filling solution such as silicone elastomers, thermal transfer tapes or greases.
- **Heat spreaders:** these materials work great distributing heat from one spot to a whole surface.

Besides providing a path for heat energy to flow through, these materials provide a seamless interface between all contact surfaces, conforming to any microscopic irregularities in either the heat source or the cooling assembly. This is an important characteristic, since air is a thermal insulator and it can become a barrier, that affects the overall performance of the solution.

As represented in **figure 5**, we can combine two different TIMs to take advantage of a combination between vertical and horizontal interfaces. In the example TIM 2 could be a WE-TGF silicone gap filler and TIM 1 a WE-TGS graphite heat spreader. This combination would allow the use of a larger heatsink than the footprint of the heat source would allow, thus enhancing the cooling capabilities of the whole assembly.

There are many factors that should be taken into consideration when selecting the optimal Thermal Management Solution of your application. The most common ones are:

- **Thermal conductivity:** Determines the overall performance of the heat transfer between contact surfaces.
- **Thermal resistance:** Opposition of the material to transfer heat, the lower the resistance the more efficient the TIM is. This property is the reciprocal of the thermal conductivity.
- **Electrical conductivity:** Depending on the TIM, electrical insulation can be an intrinsic property of the material. But for those that are not, other layers can be added to the material in order to so insulate it.
- **Operating temp range:** TIMs work in different temperature ranges so it must be taken into consideration when selecting a solution.
- **Thickness/Height:** The distance between the mating surfaces is a key factor in order to select a TIM. Depending on the solutions, it must be taken into consideration that the material should be compressed (as recommended in the datasheet) to achieve optimal thermal performance.
- **Pressure:** Depending on the final application, some materials are designed to withstand higher pressure such as the WE-TINS.

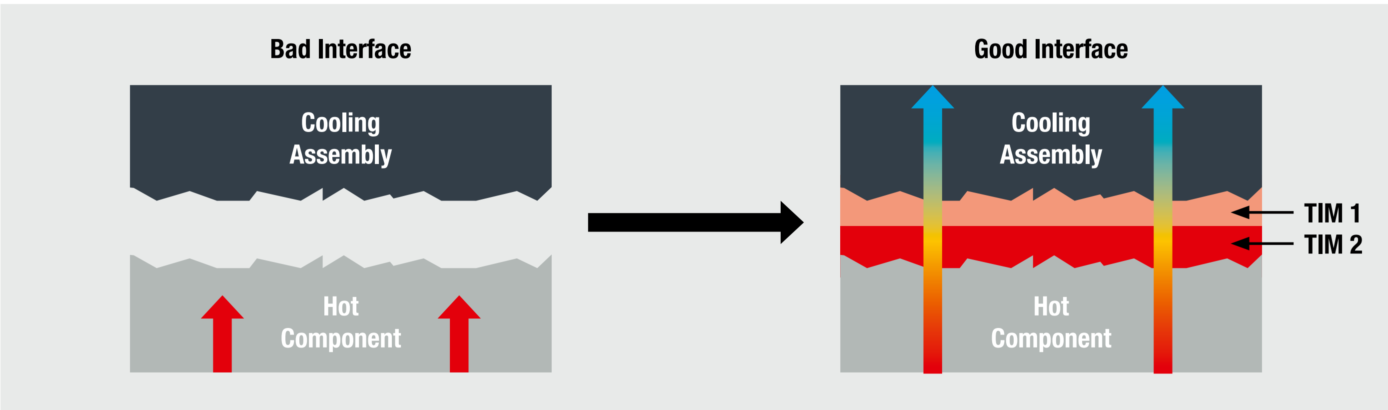

Fig. 5: *Detail of contact surfaces*

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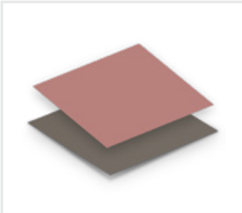
7. Würth Elektronik's Thermal Management Solutions

Gap filling solutions vary in shape and form, there are different criteria to be considered when looking for a solution: dimensions of the gap that needs filling, evaluation of the heat energy that needs to be managed and if electrical insulation is required between the hot component and the cooling assembly.

Würth Elektronik brings to you a broad portfolio with solutions for any gap, interface type and thermal conductivity.

WE-TGF
Silicone Gap Filler Pad
K: 1 – 10 W/mK
Thickness: 0.5 – 18 mm

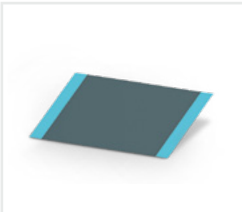


WE-TINS
Thermally Conductive Insulator
K: 1.6 – 3.5 W/mK
Thickness: 0.23 mm

WE-PCM
Phase Changing Material
K: 1.6 – 5 W/mK
Thickness: 0.2 mm

WE-TTT
Thermal Transfer Tape
K: 1 W/mK
Thickness: 0.2 mm

WE-TGFG
Graphite Foam Gasket
K: 400 W/mK
Thickness: 1.5 – 25 mm



WE-TGS
Graphite Sheet
K: 1800 W/mK
Thickness: 0.03 mm