FUJIPOLY

ISO 9001:2015

ADDRESSING THERMAL MANAGEMENT CHALLENGES WITH SILICONE-BASED SOLUTIONS

When designing electronic systems, it is very easy to forget about real-world limitations and effects that would not otherwise affect a circuit. For example, a circuit that works in theory (i.e., mathematically) may not work in reality due to inherent resistance in components, capacitance from PCB traces, and interference from the environment.

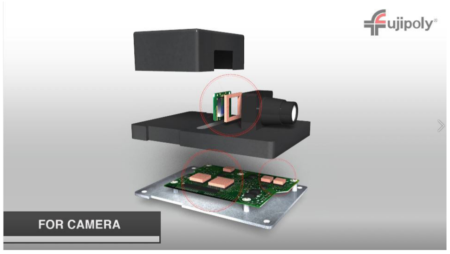
Truthfully, the same can be said for any other area of engineering. Mechanical designs may appear to function on paper, but said designs may not function in reality due to temperature fluctuations or because of harsh compounds in the environment. As such, engineers are required to carefully consider not only the function of their design but the environment in which that design will operate and how that design will be put together.

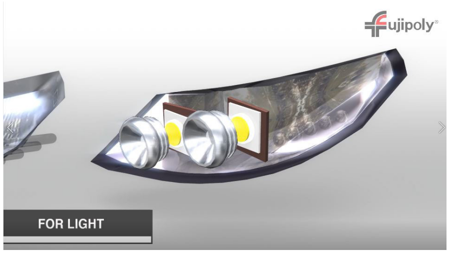
Generally speaking, thermal management in electronic products is disregarded, while other concerns such as ability, price, power usage, and weight take priority. However, a design that does not consider thermal management can quickly fall into problems if left unchecked, as many electronic products of the past have faced.

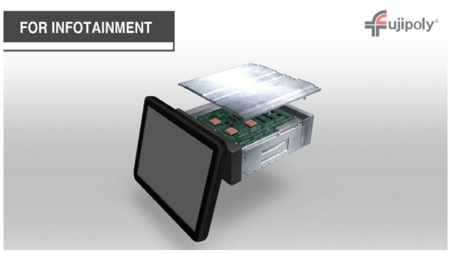
CURRENT SOLUTIONS ARE QUICKLY BECOMING DATED

Electronic designs that generate more heat than they can dissipate can often be rectified with a heat sink attached to specific heat-generating components. But this is not always possible, as is often the case in portable devices like smartphones and laptops — even if a heat sink can be integrated, there may be no natural convection airflow for the heat to be removed effectively.

Some designs may take an innovative approach by using a product’s casing to dissipate heat. While it might seem like a good solution in theory, complications can arise if the gap between the heat-generating components and the case is more than 0.5 mm. Thermal grease is effective only when two surfaces are essentially touching (as it fills air gaps with highly conductive thermal material). As such, thermal grease cannot always be used on gaps between heat sources and heat sinks.







UNDERSTANDING THE ADVANTAGES OF SILICONE-BASED THERMAL MATERIALS

Silicone-based thermal materials have many advantages:

- Compressibility
- Dryness
- Sealing properties
- Applicability to automated systems

COMPRESSIBLE

Silicone-based thermal materials are compressible, and this provides designers with multiple advantages. The first advantage is that it affords greater flexibility during installation. Typically, thermal designs have an element of compressive force to ensure that air gaps are minimized to, in turn, maximize heat transfer. As such, a compressible thermal layer allows for air gaps to be minimized, which leads to the second advantage — reduced mechanical strain on parts when compressed together. *(See Figure 1)*

DRY

As silicone-based thermal materials are dry, they do not suffer from drying out or accidentally spreading (unlike their thermal grease counterparts). This not only increases the shelf life of such materials, it makes it easier to apply to designs. Thermal greases are notoriously difficult to apply correctly — too much and the paste will overflow onto the design, while too little will see poor thermal characteristics. This comparison is not meant to show that silicone materials are better but to demonstrate the differences.

SEALING

Silicone-based thermal managements are inherently water-tight, and their compressibility allows them to be used as gaskets. This means that designs using such thermal materials can also integrate water, dust, and air tightness into a design. Depending on the silicone material used, a design can even be made to have a level of chemical resistance, too.

AUTOMATION

Silicone can be easily cut and shaped, and this ability allows for it to be automated during installation. Automation is quickly becoming an important feature for industrial processes, and being able to automate any production not only decreases costs but typically results in greater production rates.

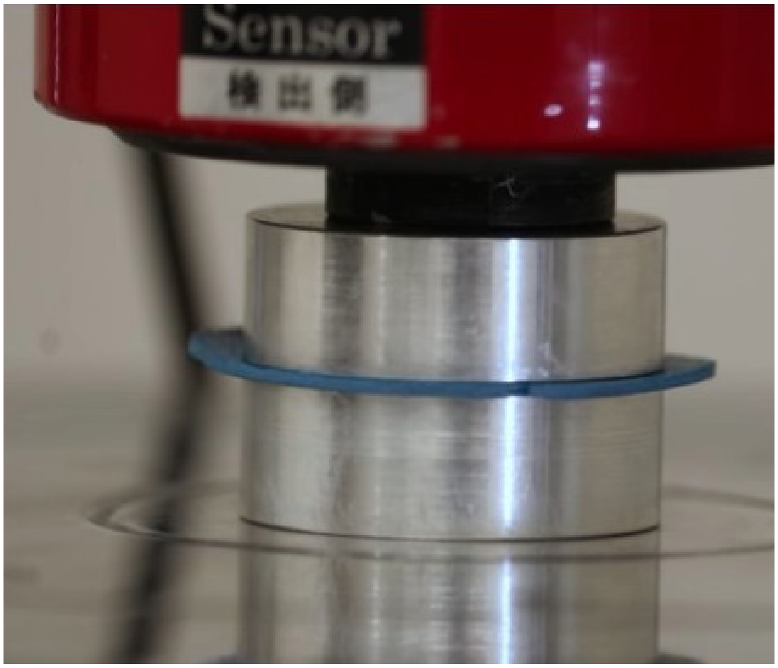


Figure 1

EXPLORING FUJIPOLY SILICONE-BASED PRODUCTS

GR130A

Fujipoly's GR130A is a conformable and high-heat conducting pad that is produced in sheet form. Its compressibility allows it to morph around protrusions and recessed areas on a design, and its non-conductive nature makes it ideal for combining multiple ICs to a single heat sink.

The material is silicone-based and has two sticky sizes, both of which adhere to most materials. The thermal conductivity of GR130A is 13.0 W/m-K. As the compressive force on the material is increased, the thermal resistivity reduces from a maximum of 1.3 K-cm2/W to a minimum of 0.2 K-cm2/W, depending on the pressure applied and thickness of the material.

SARCON LG SERIES

The SARCON LG Series is a thermally conductive and electrically insulative two-part gap filler that is ideal for filling complex shapes. Its insulating properties allow for a single mass of thermal material to coat an entire electronic circuit while also connecting to a single heat sink.

The two-part design allows the thermal material to be easily handled and poured into place, while its strong adhesive properties provide a reliable thermal transfer material that also doubles as a protective mass against shock and vibration for electronic components. The two options — the LGR23A and LG30A — provide thermal conductivities of 2.3 W/m-K and 3.0 W/m-K respectively.

Note: The two-part material is available in a drum, pail, or cartridge form, which enables the use of automated systems to dispense material into electronic products. *(See Figure 2)*

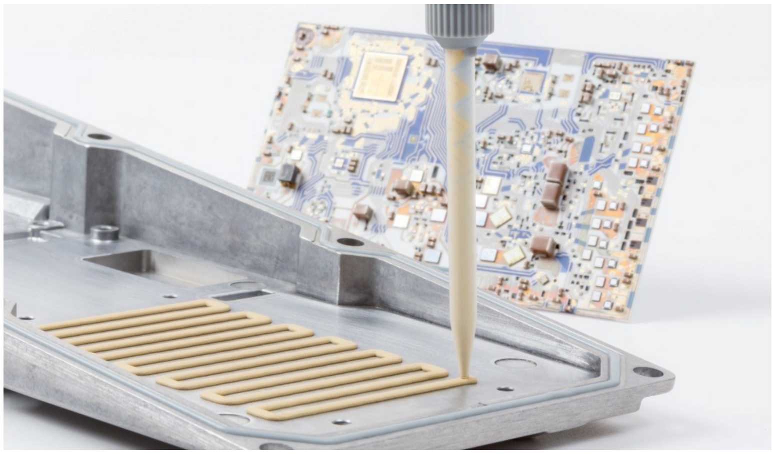


Figure 2 - SARCON® LG23A and LG30A

PG80B

PG80B is another silicone-based thermal interface material, but unlike GR130A, this product is designed for extreme compression. The thermal material (which comes in the form of putty), is ideal

for situations in which the gap between a heat sink and IC cannot be bridged using thermal grease. The thermal conductivity of PG80B is 8.0 W/m.K, but the final thermal resistance is determined by the amount of compressive force used and the thickness of the final material. Furthermore, PG80B is non-flammable, and Fujipoly has a defined equation for determining the amount of putty needed when requiring a specific thickness.
(See Figure 3)

EXPLORING FUJIPOLY SILICONE-BASED PRODUCTS

Worth noting is that Fujipoly products do not compete with thermal grease; rather, they are an ideal alternative when thermal grease cannot be used. To better understand how Fujipoly products can help with your next engineering project, let's take a look at several usage examples.

Product casings can often be ideal to dissipate heat, especially if they are made from metal. A smartphone is a common example of a device that typically generates a large amount of heat but cannot dissipate the heat using a heat sink due to size constraints. Instead, the backside of the smartphone can be used, but the gap between ICs and the case may be greater than 0.5 mm. It is here that we can look to Fujipoly silicone-based materials as a solution to serve as a thermal medium between the two surfaces as well as allow for compression to help ensure the mechanical integrity of the PCB.

Some Fujipoly silicone materials utilize a suspended conductive powder, which allows them to absorb stray electromagnetic emissions. If these materials are used on ICs, which are particularly noisy (i.e., poor EMC characteristics), the conductive nature of the thermal layer can also act as a simple Faraday cage.

- **TWO-PART CURE-IN-PLACE GEL**
- **NON-CURING FORM-IN-PLACE GEL**
- **THIN-FILM MATERIALS**
- **GREASE COMPOUNDS**
- **PADS PROVIDE HIGH PERFORMANCE**
- **PUTTIES**

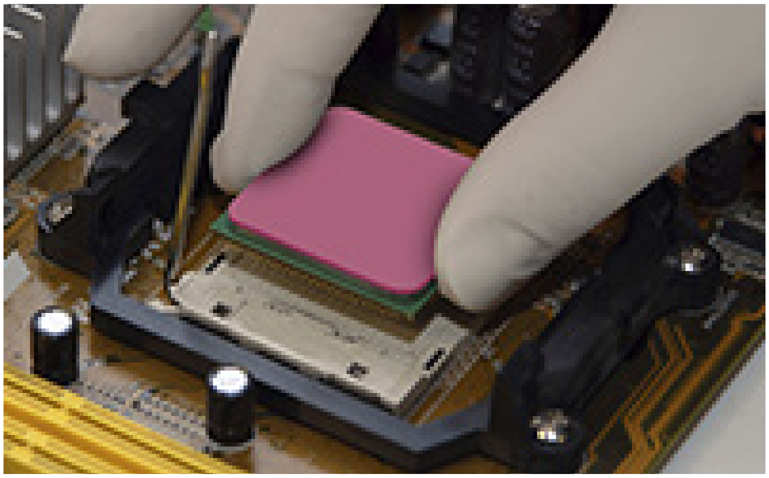


Figure 3 - PG80B

CONCLUSION

The high adaptability of Fujipoly's thermal materials allows this unique line of silicone-based products to be used across multiple applications with multiple advantages, while their malleability and ease of use allows for them to be applied to products in automated systems.