

## What is Thermal Glue? – A Guide for Designers and Engineers

Electronics are getting faster, smaller, and hotter. From LEDs to power modules and embedded CPUs, heat can quietly sabotage performance and reliability if not managed properly. Our TCG200 thermal glue is an ideal solution to combat these issues. It is a part structural adhesive, part thermal highway, and 100% mission-critical for the next generation of thin-and-light hardware.

### What Exactly is Thermal Glue?

The thermal conductive adhesive is a highly engineered composite material designed to perform two contradictory tasks: it must be a strong enough adhesive to hold a heavy heat sink in a vibrating EV engine, whilst simultaneously acting as a bridge for phonons to travel across. The TCG200 thermal glue has the following properties:

- Resin Matrix: TCG200 is silicone based which gives the material its “grip” and determines flexibility of the bond.
- Conductive Fillers: Metal particles help move the heat.
- Curing Agents: Chemical “timers” that tell the glue when to turn from a liquid to a solid thermal bridge.
- Wetting Agents: These ensure that glue flows into every microscopic canyon, eliminating air gaps.

### Why Designers are Using Thermal Glue Instead of Screws

Screwless solutions are becoming a necessity. As devices get thinner and more wearable, it is not practical to use a bulky mounting bracket or M3 screw. Mechanical fasteners add weight, create localized stress points on the PCB, and most importantly they do not help with heat. Thermal glue, however provides uniform contact pressure across the entire surface of the die. Choosing thermal glue over mechanical screws offers the below benefits:

- Weight Reduction: Removing four screws and a bracket can save 10-15g per unit.
- Vibration Resistance: Screws can back out. Using a properly cured epoxy bond provides a permanent seal and absorbs high frequency vibrations.
- Even Pressure: Unlike a spring-loaded clip that can “tilt” a heat sink, conductive adhesive creates a perfectly flat, uniform interface.
- Lower BOM Cost: Fewer parts mean a simpler supply chain and less assembly or packing time.

Moving to a thermal conductive adhesive simplifies your BOM and also provides design opportunities that mechanical fasteners cannot. It also moves the assembly process from a manual process to automated.

### Pros and Cons of Thermal Glue in Electronics

#### Pros:

- Permanent bond prevents mechanical separation.
- Fills gaps and irregular surfaces efficiently.
- Maintains a consistent thermal path over time.

#### Cons:

- Hard to remove or rework.
- Potential degradation under extreme temperatures.
- Less suited to prototyping or modular assemblies.

Thermal glue excels in long-life, low maintenance devices but is less ideal for iterative designs or systems requiring frequent disassembly. If you require a permanent bond, it is a perfect solution, but if you want to consistently rework the product then thermal glue is a poor choice.

### How to Apply Thermal Glue for Optimal Performance

Any thermal adhesive will fail if it is applied poorly. It is common to see thermal failures if the TIM is applied poorly. Due to precision required by high density boards, the difference between a 5°C and 15°C temperature delta is often a result of surface preparation and/or consistency of the dispensing bead. We suggest following the below steps:

- Surface Preparation: 99% Isopropyl alcohol is essential. Any finger oils or dust will affect adhesion.
- The “Pea Sized” Method: Just like paste, centre-point dispensing allows the glue to spread outward, pushing air bubbles out of the way.
- Managing BLT (Board Line Thickness): Use a shim on a controlled pressure jig to ensure the layer is as thin as possible while still maintaining a full bond.
- Curing Cycles: Do not rush the curing time. The TCG200 thermal glue requires a curing time of 24 hours at 25°C; therefore ensure this requirement is met. Even if you use a heat gun, the adhesive may appear fully set, however the core may be soft and thermally inefficient.

### Comparison: Thermal Glue v Thermal Paste v Thermal Pads

| Property             | Thermal Glue         | Thermal Paste            | Silicone Thermal Pad (WG-S) |
|----------------------|----------------------|--------------------------|-----------------------------|
| Bond strength        | Permanent/Structural | None                     | Low                         |
| Thermal Conductivity | 2.0W/mk              | Up to 6.5W/mk            | Up to 12.0W/mk              |
| Reworkability        | Very Difficult       | OK                       | Very Easy                   |
| Gap Filling          | Excellent            | Minimal (thin gaps only) | Excellent (large gaps)      |

In conclusion we suggest using paste for CPUs that need upgrading, thermal pads for bridging uneven gaps between VRMs, and thermal glue for when a heat sink has no other way of staying attached. Choose the TIM that suits the intended lifespan of the component.

### Common Thermal Glue Issues and How to Solve Them

- Voids and Air Bubbles: These act as heat dams. Resolve this by using a vacuum-degassed adhesive or improving the dispensing pattern.
- Incomplete Curing: Often caused by high humidity environments; keep the assembly line climate controlled.
- Delamination: If the glue comes apart from the heat sink it is usually a surface energy issue. Consider making the surface coarser or use a primer.
- Brittleness: If the bond snaps you need a glue with higher elongation or a silicone-based formula that stays flexible.

Most glue failures are predictable and preventable. By monitoring the curing and matching the flexibility of the glue to the thermal expansion of your products, you can avoid 90% of field failures.

## FAQs

### **Can I use thermal glue as a gap filler?**

Yes but be careful. Thick layers of glue have higher thermal resistance. If the gap is >1mm then use a thermal pad.

### **How do I remove glue from a surface?**

You will need a specialised solvent or use extreme cold/heat cycle to snap the bond, however there is a risk of damaging the PCB by doing this.

### **What is the difference between thermal glue and thermal paste?**

Thermal glue bonds components permanently and offers moderate conductivity, whereas thermal paste is removable and generally more conductive.

### **Is thermal glue suitable for high power applications?**

Yes, if the formulation supports the operating temperature and thermal load.

### **How long does TCG200 take to cure?**

24 hours around room temperature (25°C).

Thermal glue is more than a simple adhesive; it combines mechanical bonding with thermal management. Key takeaways from this document include:

- Proper application of the glue ensures both thermal performance and bond strength.
- Avoid shortcuts: preparation, dispensing and curing are critical.
- The TCG200 thermal adhesive is best used in long-life, vibration prone or permanently bonded devices.

Applying thermal glue correctly safeguards performance, reliability and longevity, making it an indispensable tool in modern electronics design. From cooling the AI sensors in autonomous vehicles to keeping next-gen LEDs, the right adhesive provides the structural integrity and thermal output that modern engineering demands.