

Thermal Clad® Overview

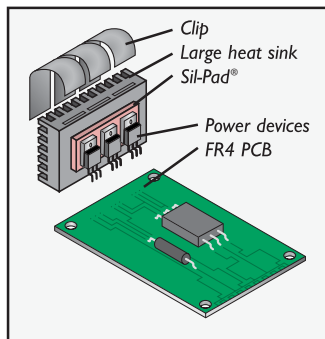
Key Benefits Of Thermal Clad

The Bergquist Company is the world leader in the development and manufacture of thermally conductive interface materials. Thermal Clad Insulated Metal Substrate (IMS®) was developed by Bergquist as a thermal management solution for today's higher watt-density surface mount applications where heat issues are a major concern.

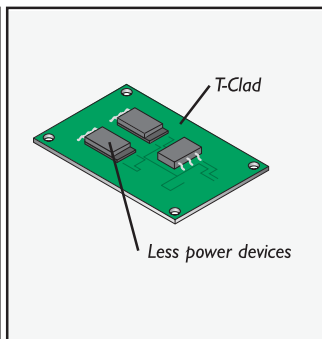
Thermal Clad substrates minimize thermal impedance and conduct heat more effectively and efficiently than standard printed wiring boards (PWB's). These substrates are more mechanically robust than thick-film ceramics and direct bond copper constructions that are often used in these applications.

Thermal Clad is a cost-effective solution which can eliminate components, allow for simplified designs, smaller devices and an overall less complicated production processes. Additional benefits of Thermal Clad include lower operating temperatures, longer component life and increased durability.

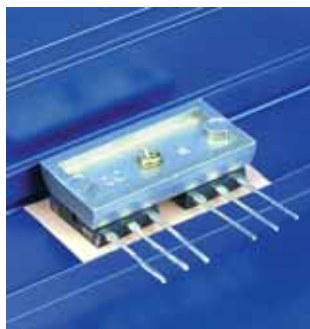
Bergquist Thermal Clad substrates are not limited to use with metal base layers. In one example, power conversion applications can enhance their performance by replacing FR-4 with Thermal Clad dielectrics in multi-layer assemblies. In this application, the thickness of the copper circuit layer can be minimized by the high thermal performance of Thermal Clad. For additional information on this topic, refer to the "Specialty Applications" section on pages 10-11 of this guide.



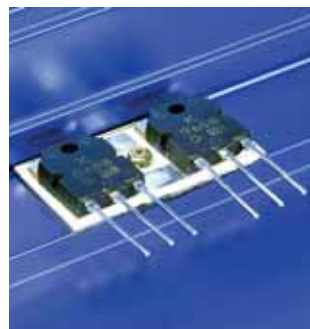
Traditionally, cooling an FR-4 board required use of a large heat sink, interface material and various hardware (brackets, screws or clamps): a configuration requiring labor intensive manual assembly.



Cooling with Thermal Clad can eliminate the need for heat sinks, device clips, cooling fans and other hardware. An automated assembly method will reduce long term costs.



Conventional methods
measured junction temperature
5W= Tj 43°C



Thermal Clad
measured junction temperature
5W= Tj 35°C

Original Power Board Assembly (Actual)



(66) Thru-hole FETs (15) High profile capacitors (9) High profile bus bars
Total Weight 3.4 lbs (1543.6g)

New Power Board Assembly (Actual)



(48) FETs (9) Low profile capacitors (5) Low profile bus bars
Total Weight 0.82 lbs (370.6g)

Thermal Clad is a complete thermal management system, unlike traditional technology which uses heat sinks, clips and other mounting hardware. Thermal Clad enables low-cost production by eliminating the need for costly manual assembly.

Thermal Clad Benefits

- RoHS compliant and halogen-free
- Lower component operating temperatures
- Reduce printed circuit board size
- Increase power density
- Extend the life of dies
- Reduce the number of interconnects
- Improve product thermal and mechanical performance
- Combine power and control
- Improve product durability
- Enable better use of surface mount technology
- Reduce heat sinks and other mounting hardware, including thermal interface material
- Replace fragile ceramic substrates with greater mechanical durability
- Bergquist is your one-stop source from raw materials to finished circuit

Improve Durability and Performance

Thermal Clad improves durability because designs can be kept simple while components are kept cool. The low thermal impedance of the Thermal Clad dielectric outperforms other insulators for power components, allowing for cooler operation.

Thermal Clad keeps assemblies cool by eliminating thermal interfaces and using thermally efficient solder joints. Voltage breakdown and thermal performance improve in potted assemblies using SMD's and bare die on Thermal Clad.

Thermal Clad can also reduce production costs by enabling automated pick-and-place equipment for SMD's.

Reduce Board Size and Replace Hardware

Thermal Clad greatly reduces board space while replacing other components including heat sinks. It offers the opportunity to eliminate mica and grease or rubber insulators under power devices by using direct solder mount to Thermal Clad. By eliminating this hardware, heat transfer is improved.

Interconnects can be eliminated by using etched traces on the Thermal Clad board. In fact, whole sections of PWB's are often eliminated. It permits the use of surface mount power and passive devices to reduce real estate. With Thermal Clad, many discrete devices can be replaced at the board level.

The Anatomy Of A Thermal Clad Board

Thermal Clad is a dielectric (ceramic-polymer blend) coated metal base with a bonded copper circuit layer. This unique material offers superior heat transfer to help cool components while eliminating the problems associated with fragile ceramics. Different than others, Bergquist doesn't use fiberglass, allowing for better thermal performance.

Thermal Clad is a three layer system comprised of the following:

- ▼ **Circuit Layer:** This is the printed circuit foil with a thickness of 1oz. to 10oz. (35-350 μ m) in standard Thermal Clad.
- ▼ **Dielectric Layer:** This offers electrical isolation with minimum thermal resistance. Glass carriers degrade thermal performance which is why our dielectrics are glass-free. CML is the one exception because of its prepreg form, a glass carrier is needed for handling purposes. The dielectric layer is the key element of Thermal Clad, and bonds the base metal and circuit metal together. The dielectric has U.L. recognition, simplifying agency acceptance of final assemblies.
- ▼ **Base Layer:** This is often aluminum, but other metals such as copper may also be used. The most widely used base material thickness is 0.062" (1.57mm) in aluminum, although many thicknesses are available. In some applications, the base layer of metal may not be needed. See "Specialty Applications" on page 11.



Bergquist's manufacturing facility located in Prescott, Wisconsin features state-of-the-art process capabilities. Process manufacturing uses the latest in technology including environmental clean room control, surface finishing, coating and lamination.

