

AUTOMOTIVE

# Thermal Management Solutions

Innovative Engineering for Increased Reliability

ABOUT TTM

TTM Technologies, Inc. is a leading global manufacturer of technology products, including mission systems, radio frequency ("RF") components, RF microwave/microelectronic assemblies, and technologically advanced interconnect products, including PCBs and substrates. TTM stands for time-to-market, representing how TTM's time-critical, one-stop design, engineering and manufacturing services enable customers to reduce the time required to develop new products and bring them to market. Additional information can be found at [www.ttm.com](http://www.ttm.com)

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0003-000001-2026



Inspiring Innovation



Inspiring Innovation

AUTOMOTIVE

# The Hybrid & Electric Vehicle Revolution is now

Electric vehicles are becoming mainstream, along with increasingly complex electronic systems, including:



Engine Control Units



Electric Powertrain



Braking



Battery management



Charging Stations



Radar

And even more...



TTM recognizes our opportunity to positively impact the world around us by managing our operations in a sustainable manner. We believe that sustainable practices are essential to the long-term success of our business and that we have a responsibility to consider how our business interacts with society and impacts the environment. To learn more about our sustainability efforts, view our CSR report at [ttm.com](http://ttm.com).

Common to all these systems is the need for innovative thermal management solutions.

Thermal management is essential to maintaining the component temperature within designed values by removing excess generated heat.

TTM Technologies ("TTM") has a proven track record for developing heat management solutions for high-reliability applications. Our global team of dedicated engineers has broad experience with diverse applications; they offer design for manufacture guidance and stack-up reviews to find opportunities to improve reliability, manufacturability and save our customers' time.



## TEMPERATURE VS. RELIABILITY

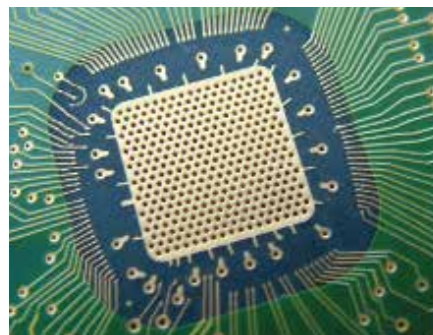
The long-term reliability of electronic systems is a function of operating temperature. Lowering the operating temperature and minimizing the thermal cycling delta increases reliability, which also be beneficial in extending product life.

A circuit board's primary function is to provide connectivity and a mechanical foundation for all circuit components. As circuit densities increase due to miniaturization, circuit boards have become an integral part of the thermal management system, transferring heat away from components to a region where the heat can be dissipated. At TTM Technologies, we understand the complexities of thermal management and strive to provide cost-effective solutions for high-volume production.

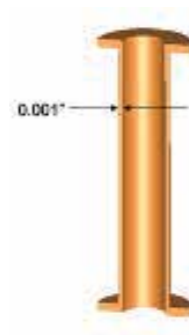
## TYPES OF THERMAL MANAGEMENT SOLUTIONS

### Thermal Via

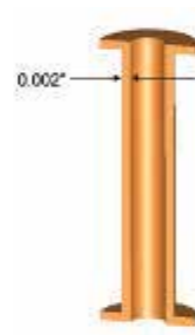
The most economical method to increase thermal conductivity is the thermal vias; this method provides an enhanced thermal path through the board or to an internal plane spreading the heat. Conductivity of thermal vias can be through thicker copper plating at a relatively low cost.



Thermal Via Farm



Standard Via

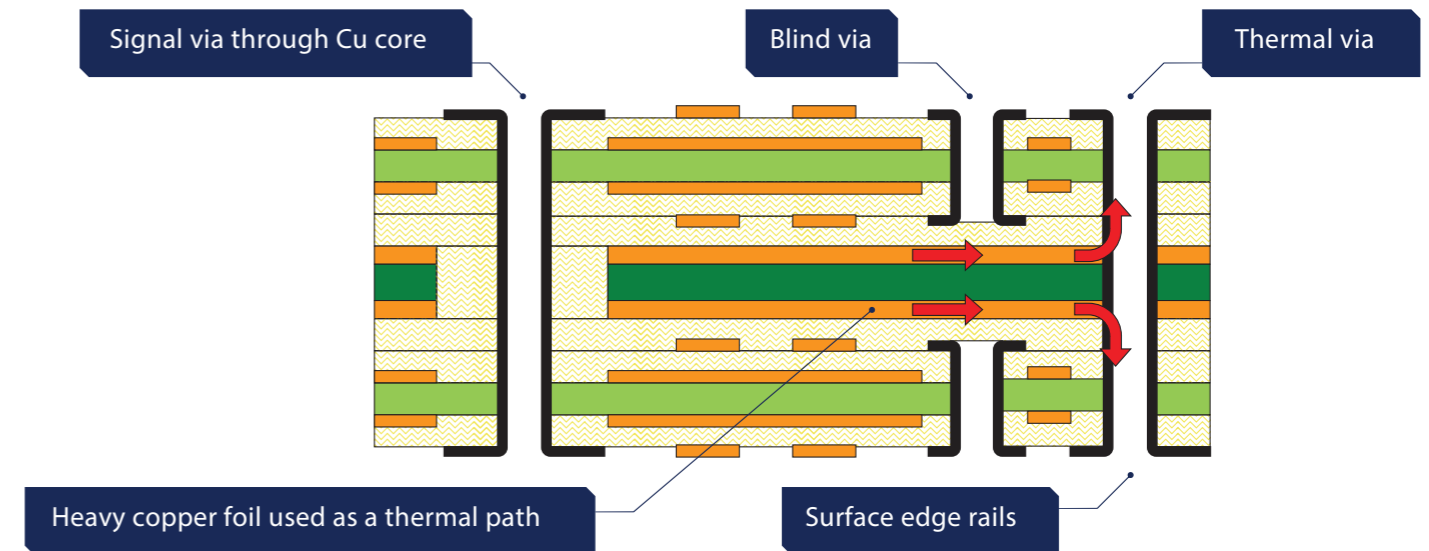


Enhanced Via

## TYPES OF THERMAL MANAGEMENT SOLUTIONS

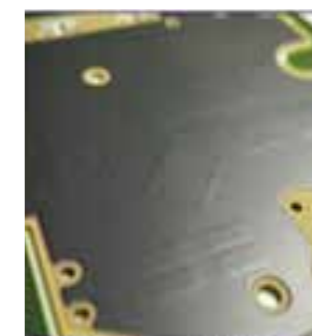
### Increased Copper Density

Increasing in-plane conductivity can be achieved using thicker copper within the board; depending on the design, planes ranging from 2 to 10 oz can be integrated with thermal vias, providing an enhanced thermal path.



### Screened Heat-sink Paste ("HSP")

When designs require both increased thermal conductivity as well as dielectric isolation, screened heat sink paste may be the preferred option.



HSP on base material (SIR Board)

## TYPES OF THERMAL MANAGEMENT SOLUTIONS

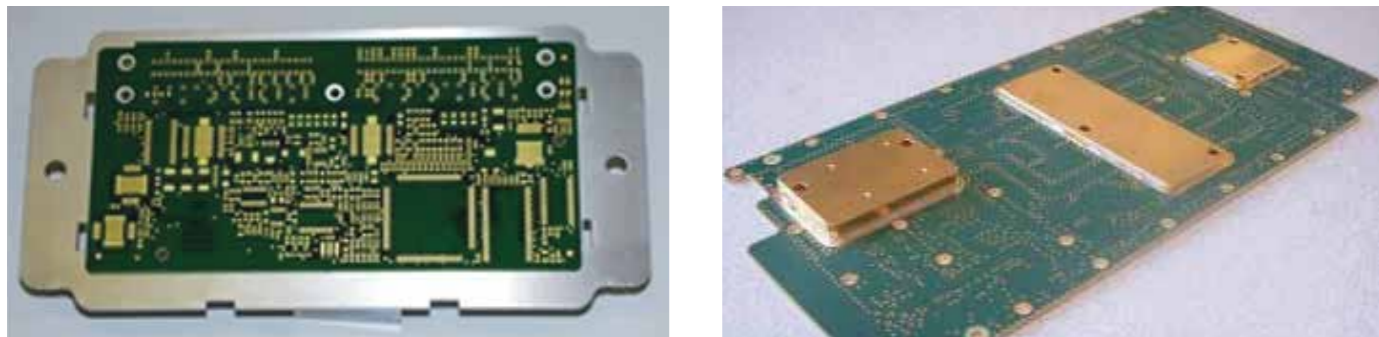
### Coin Technologies

Press-fit copper coins provide low thermal resistance and are common in high-volume production using automated pic, place, and lamination equipment.



### Heat-sinks and Pallets

TTM provides production viable external heat sinks and soldered pallets to enhance thermal conductivity when applications require an improved thermal path.



For more information on Thermal Management Solutions, please speak with your TTM Sales representative or contact us by:

 [CorporateMarketing@ttm.com](mailto:CorporateMarketing@ttm.com)

 [ttm.com/contact](http://ttm.com/contact)

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