



## Why Electronics Cooling Is Crucial in Modern Engineering

What happens inside your product when no one is looking? Often, the answer is heat quietly building up.

From electric vehicles and aircraft systems to industrial machines and consumer electronics, modern products rely heavily on electronic components. These components are becoming smaller, faster, and more powerful every year. But with higher performance comes a serious challenge that many businesses underestimate: heat. Electronics cooling is the process of removing excess heat from electronic components so they can operate safely and reliably. If this heat is not managed properly, even the most advanced design can fail prematurely.

According to IEEE reliability studies, over 50% of electronic failures are directly linked to overheating. A widely cited Arrhenius-based reliability model shows that for every 10°C rise in operating temperature, the life of electronic components can reduce by nearly half.

Several industry trends are driving higher thermal loads:

- Higher power density due to compact designs
- Increased use of power electronics in EVs and automation
- Faster processors and higher switching frequencies
- Tighter packaging with limited airflow

In automotive applications, electronic control units, battery packs, and inverters must operate reliably in harsh environments.

In aerospace, electronics face extreme temperature variations and limited cooling options. In industrial machinery, downtime caused by electronic failure can stop entire production lines in design.

Many of these failures could have been avoided with better thermal planning early in design.

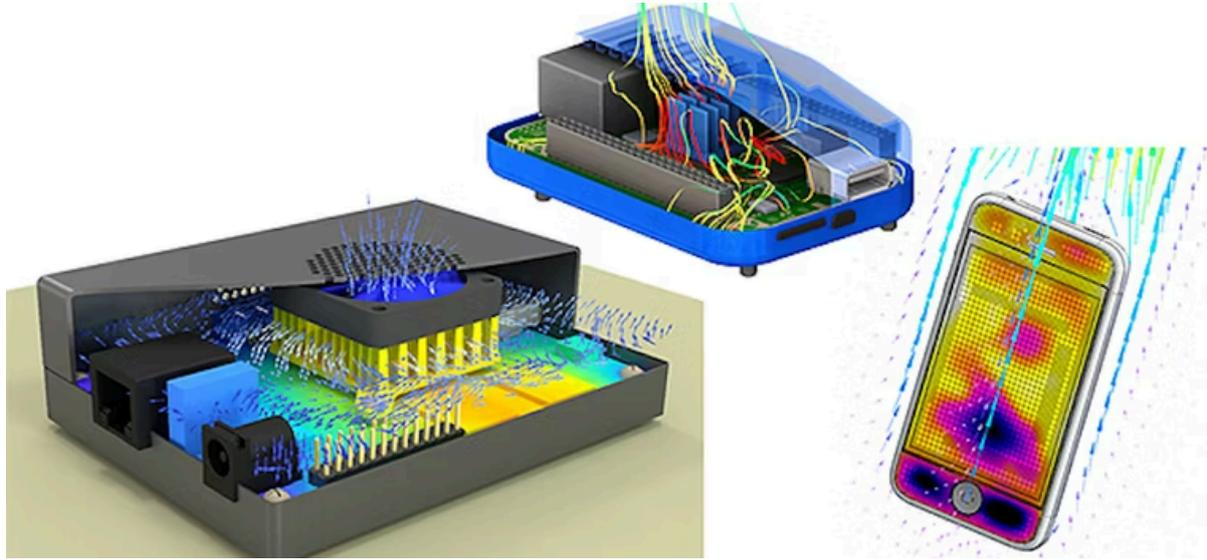
In this edition:

Why **Electronics Cooling** Matters

The ROI of **Cooling** and **Thermal Simulation**

**Simcenter FloTherm** for Electronics Cooling

*Simulation lets engineers test ideas, not just assumptions.*



(Source: siemens.com)

## How Electronics Cooling and Thermal Simulation Help Industries Improve ROI:

Heat-related problems are expensive. What makes them worse is that they often appear late in the development cycle, when changes are slow and costly. This is where thermal simulation has become a powerful business tool.

Thermal simulation allows engineers to predict temperature distribution, airflow, and heat transfer inside a product before it is physically built. Instead of relying on assumptions or over-design, teams can evaluate cooling strategies virtually and make informed decisions early.

### The Cost of Late Thermal Fixes:

When thermal issues are discovered during testing or after product launch, the impact can be severe. According to a McKinsey manufacturing study, design changes made late in development can cost up to 10 times more than those made during early design.

Common late-stage fixes include:

- Larger heat sinks
- Higher airflow fans
- Additional vents or cutouts
- Component relocation

While these may solve the thermal issue, they often increase material cost, assembly complexity, noise levels, and power consumption. Thermal simulation helps avoid this by identifying hot spots, airflow blockages, and inefficient cooling paths at the concept stage.

### Measurable ROI from Thermal Simulation:

A Siemens electronics industry report showed that companies using thermal simulation early in design achieved:

- Up to 30 percent reduction in physical prototypes
- 20 to 40 percent reduction in thermal-related rework
- Shorter validation cycles and faster design freeze

Even a small improvement in cooling efficiency can deliver meaningful savings. Reducing component temperature improves reliability, which directly lowers warranty and service costs. Fewer failures in the field also mean fewer recalls and customer complaints. In high-volume industries like automotive and consumer electronics, this impact multiplies quickly. A minor thermal improvement applied across thousands of units translates into significant long-term savings. Most organizations report that thermal simulation tools pay back within the first year of use, primarily through reduced rework, fewer prototypes, and improved first-pass success. For management, this means fewer surprises late in the program and more predictable timelines.

## Simcenter FloTherm for Electronics Cooling and Thermal Management:

As electronics system grow more complex, thermal challenges can no longer be solved with simple calculations or manual testing alone. This is where Simcenter FloTherm plays a critical role. It is a specialized thermal simulation software developed by Siemens for electronics cooling and thermal management. It is widely used across automotive, aerospace, industrial electronics, and data-driven industries.

FloTherm is built specifically for electronics, not adapted from general CFD tools. This allows it to model real electronic components such as chips, PCBs, heat sinks, fans, and enclosures with high accuracy and speed.

Key capabilities include:

- Detailed modeling of conduction, convection, and radiation
- Accurate representation of PCB layers and component placement
- Library-based electronics components for faster setup
- Support for air cooling, liquid cooling, and mixed strategies

According to Siemens technical documentation, FloTherm can deliver engineering-level accuracy with significantly lower setup time compared to general-purpose CFD tools, making it practical for everyday design use.

### Example: Automotive Power Electronics

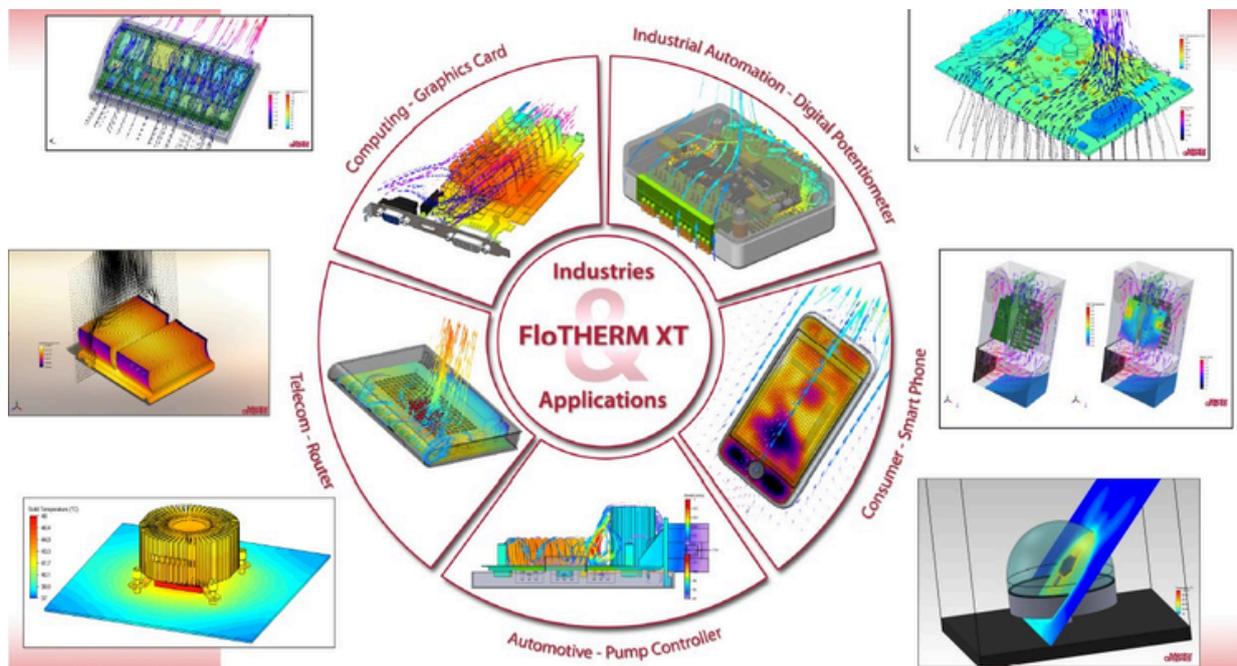
A global automotive supplier developing an electric vehicle inverter faced repeated thermal failures during testing. The power electronics module showed uneven temperature distribution, leading to reliability concerns and delayed validation.

Using Simcenter FloTherm, the engineering team created a detailed thermal model of the inverter, including power devices, PCB layout, cooling channels, and enclosure geometry. The simulation revealed localized hot spots caused by airflow bypass and poor heat spreading.

By adjusting component placement and optimizing the cooling path digitally, the team achieved:

- More uniform temperature distribution
- Lower peak component temperatures
- Elimination of one full physical prototype iteration

According to the project report, the redesign reduced development time by several weeks and significantly improved confidence before final testing. The software integrates well with broader digital workflows, supporting design reviews, validation planning, and long-term product optimization.



(Source: megaflow.com.tw)

FloTherm is not just a tool for analysts. Its results help decision-makers answer critical questions:

- Is the current cooling concept sufficient?
- Where should we invest in better cooling?
- Can we reduce cost without compromising reliability?

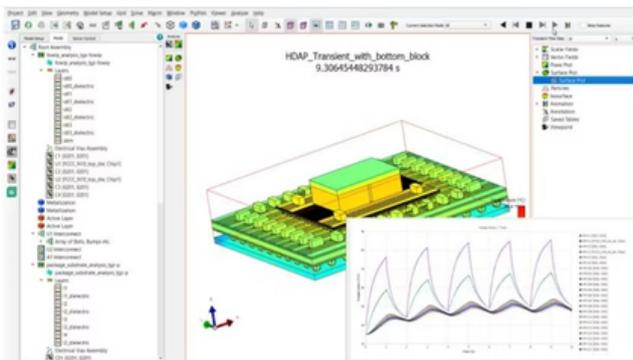
Thermal simulation replaces guesswork with data. Engineers can compare multiple cooling concepts digitally and select the most efficient option that meets temperature limits without excess margin. This is particularly valuable in electric vehicles, where cooling systems directly affect range, weight, and packaging.

### Looking Ahead

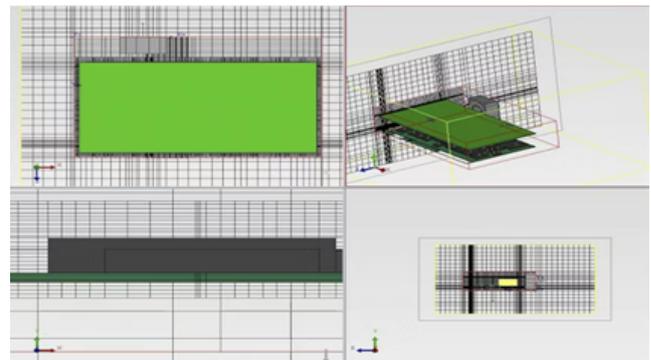
As products continue to integrate more electronics, thermal management will only grow in importance. Simcenter FloTherm enables companies to shift from reactive fixes to predictive design, where thermal risks are addressed early and systematically.

For organizations focused on reliability, efficiency, and faster launches, FloTherm is more than a simulation tool. It is a strategic enabler for building robust, competitive products in a heat-driven world.

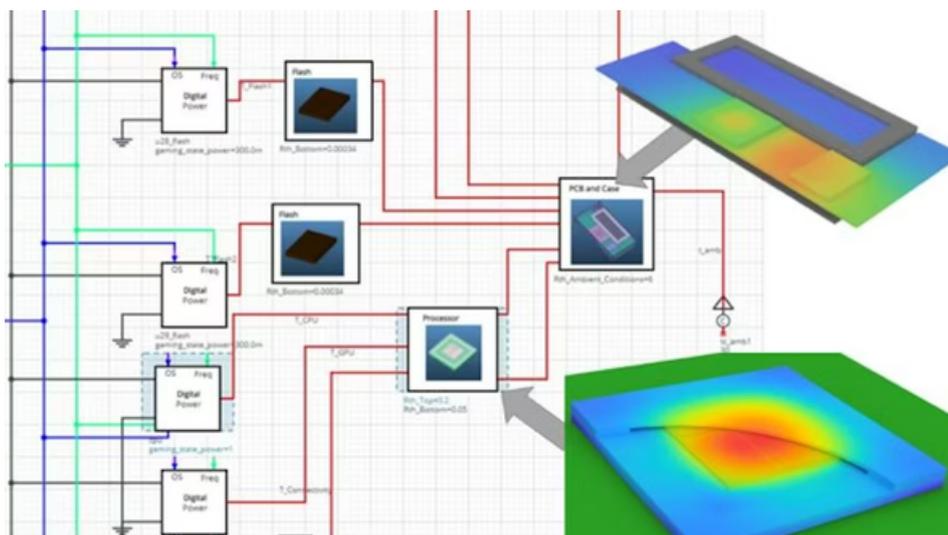
As power densities rise and systems become more compact, thermal considerations will shape decisions on component placement, enclosure design, and even material selection. Tools like Simcenter FloTherm enable teams to explore these design trade-offs early and with confidence. By embedding thermal insight into the earliest stages of product development, organizations can build solutions that are not only reliable today but also scalable and future-ready. Organizations that adopt this approach early will be better positioned to manage growing thermal complexity, respond faster to design changes, and deliver products that perform consistently in real-world conditions.



**Transient Thermal Analysis**



**Robust Meshing**



### BCI-ROM Technology

Boundary Condition Independent Reduced Order Model offers advantages for fast transient thermal analysis of electronics orders of magnitude faster than full 3D CFD while preserving accuracy.

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