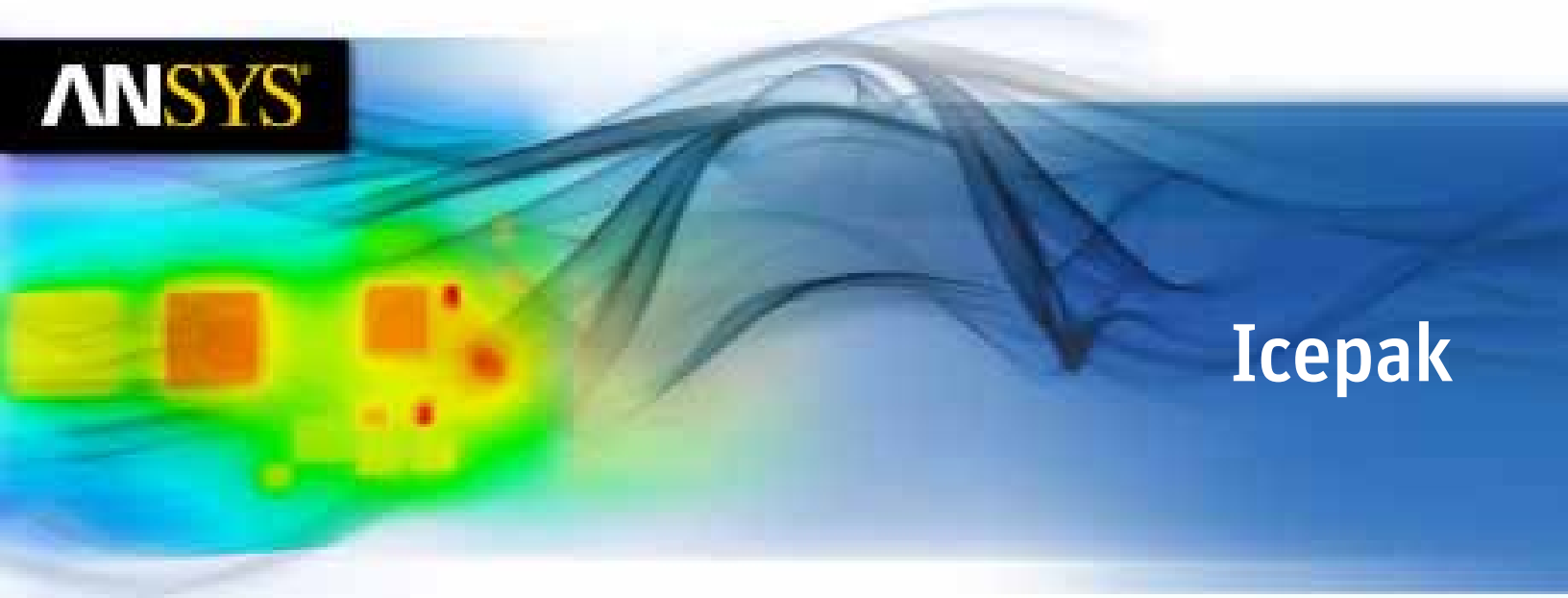
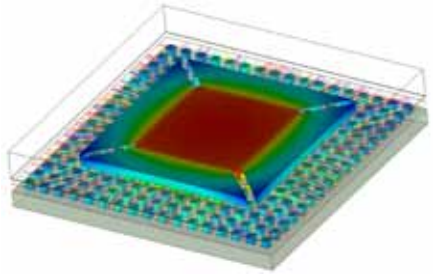
Realize Your Product Promise™



Icepak

ANSYS



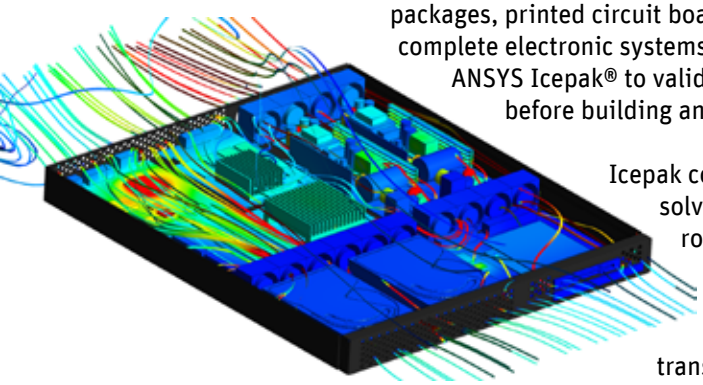
Temperature contours on a 272-pin ball grid array package on a substrate, package data imported from MCM file

"Icepak provides a quick, accurate and reliable tool for the thermal management design and analysis of our products."
Dr. Matteo Fabbri
Scientist, Corporate Research
ABB Switzerland Ltd.

ANSYS Icepak delivers powerful technology for electronics thermal management.

Simulating high-performance electronics cooling readily solves challenges in this rapidly evolving industry.

Electronic devices today have smaller footprints and unique power requirements that call for superior thermal designs. Overheated components degrade product reliability, resulting in costly redesigns. To ensure adequate cooling of IC packages, printed circuit boards (PCBs) and complete electronic systems, engineers rely on ANSYS Icepak® to validate thermal designs before building any hardware.



Fluid streamlines and temperature contours for 1U network server. Multi-level hex-dominant mesh accurately represents the complex geometry.

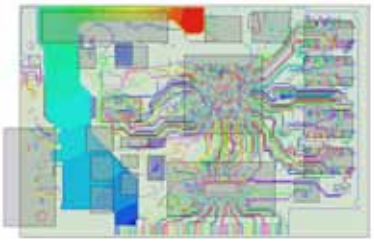
Icepak combines advanced solver technology with robust, automatic meshing to enable you to rapidly perform heat transfer and fluid flow simulation for a wide variety of electronic applications — including computers, telecommunications equipment and semiconductor devices, as well as aerospace, automotive and consumer electronics.

Rapid Thermal Simulation for Electronic Systems

Developing better products in a shorter amount of time demands rapid thermal simulation capabilities. Icepak's streamlined user interface allows you to quickly create and simulate electronics cooling models using smart objects combined with extensive libraries of standard electronic components. You can create electronics cooling models by simply dragging and dropping smart objects (such as cabinets, fans, packages, printed circuit boards and heat sinks) to rapidly create and simulate models of complete electronic systems for a variety of different cooling scenarios.

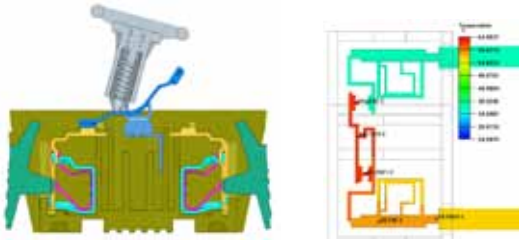
Accurate Analysis for PCBs

High temperatures detrimentally affect electrical performance of printed circuit boards. As a result, engineers increasingly want to incorporate thermal effects into their PCB designs. With ANSYS Icepak, you can import board layout from a variety of EDA tools for efficient thermal simulation. Board dimensions, component layout information, and electronic trace and via information can all be incorporated into a thermal simulation. Our tools enable you to accurately simulate different cooling scenarios for single and rack-mounted boards along with component power and copper resistive losses in trace layers. The end result is a high-fidelity prediction of PCB internal and component junction temperatures.



Electric potential contours on PCB trace; Joule heating of high current trace calculated as part of conjugate heat transfer solution

Multi-level hex-dominant mesh of cell phone assembly; hanging-node mesh resolves small geometric details.

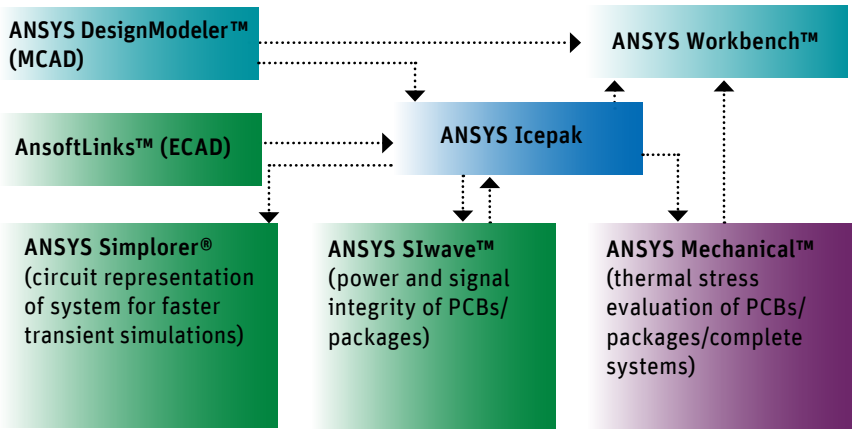


Schneider Electric used Icepak for thermal and electrical simulations on a wiring system switch device assembly to determine temperature and define conductor and insulator specifications.

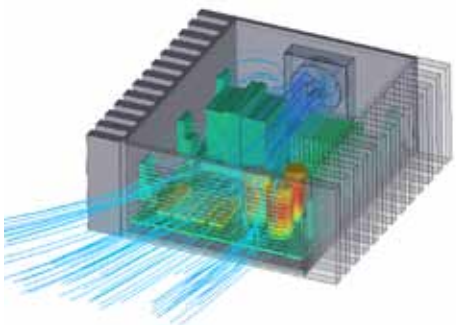
"Icepak results gave us confidence that the same modeling approach could be applied to the entire product family. This process reduced the number of prototypes and tests, and decreased product development time by 30 to 40 percent."
Arunvel Thangamani
Research and Development
Schneider Electric

Detailed and Compact Models for IC Packages

Advanced packaging techniques, including 3-D packages, require robust thermal simulation since high temperatures adversely affect device reliability. Icepak includes options for detailed and compact thermal modeling of IC packages. Based on electronic CAD data, you can import package information — such as substrate traces and vias, bond wires, solder bumps, die dimensions, and solder balls — to characterize package thermal response for a variety of environmental conditions. From a detailed package model, you can automatically generate an optimized DELPHI network model, which allows accurate junction temperature prediction of IC components when used in a board- or system-level thermal simulation.

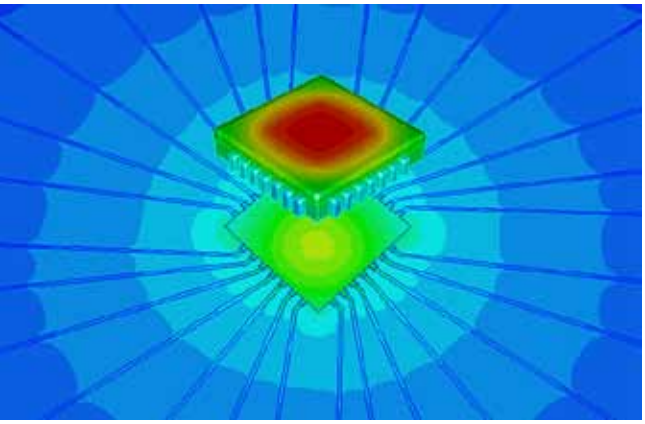


ANSYS Icepak is part of the ANSYS CFD suite, enabling multiphysics coupling between electrical, thermal and mechanical analyses for electronics design. It is integrated in ANSYS Workbench for coupling with MCAD, thermal–stress analysis with ANSYS Mechanical, and advanced post-processing via ANSYS CFD-Post.



Velocity streamlines and temperature contours for fan-cooled avionics box exposed to solar radiation; model combines MCAD data and Icepak objects

Icepak's advanced capabilities — from meshing to solver to visualization — enable fast and accurate predictions.



Temperature contours on micro lead-frame plastic quad (MLPQ) package in natural convection chamber

Robust and Rapid Numerical Solutions

Icepak uses the state-of-the-art ANSYS Fluent® CFD solver for thermal and fluid-flow calculations. Icepak solves fluid flow and includes all modes of heat transfer — conduction, convection and radiation — for steady-state and transient electronics cooling applications. The solver provides complete mesh flexibility for conjugate heat transfer; it allows you to solve even the most complex electronic assemblies using unstructured meshes.

Flexible Automatic Meshing

Advanced meshing algorithms automatically generate high-quality meshes that represent the true shape of electronic components. Options include hex-dominant, unstructured hexahedral and Cartesian; these generate body-fitted meshes of complex geometry with minimal intervention. Icepak's mesh controls enable you to refine the mesh and balance trade-offs between computational cost and solution accuracy. Such flexibility leads you to the most efficient solution times without compromising model fidelity.

Icepak Objects

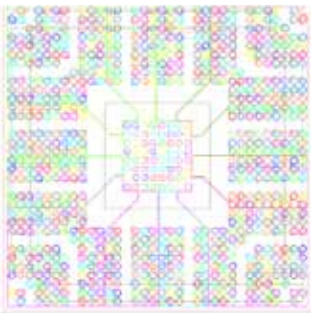
Predefined smart objects — cabinets, fans, blowers, packages, circuit boards, vents and heat sinks — capture geometric information, material properties, meshing parameters and boundary conditions for rapid creation and simulation.

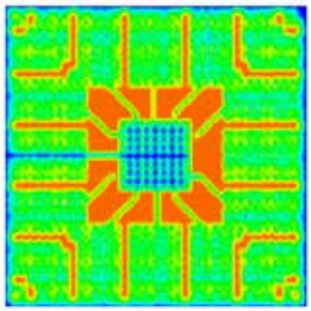
Electronic Components Libraries

Vast libraries of standard electronic components are included with Icepak, enabling model creation without having to search through manufacturers' data sheets for additional information. The libraries include data for materials, heat sinks, thermal interface materials, filters, packages, and manufacturers' fan and blower data.

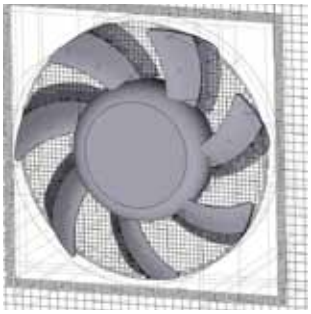
Automated Thermal Conductivity Computation

Based on electronic trace and via information, Icepak computes detailed thermal conductivity maps for PCBs and package substrate layers. Localized orthotropic thermal conductivity for PCBs and package substrate layers enables you to accurately represent thermal conduction in multi-layer structures, providing increased accuracy for your thermal solutions.

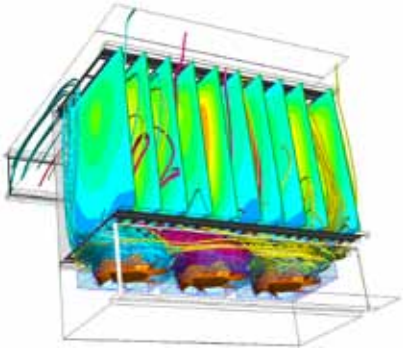




Detailed thermal conductivity map for IC package substrate layer computed based on electronic trace and via information



Multi-level hex-dominant mesh of fan represented directly as 3-D CAD geometry. Hanging-node mesh accurately resolves curved fan blade geometry.



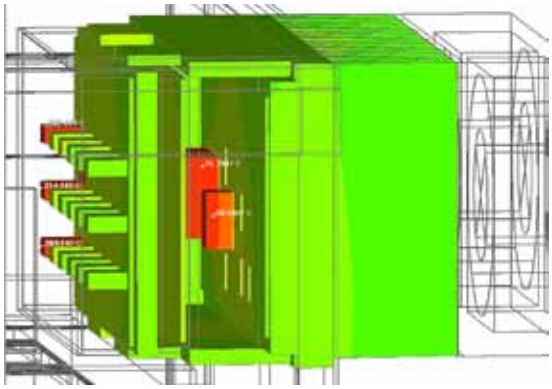
Velocity streamlines and temperature contours for card array in VME-format box cooled by three axial fans modeled using moving reference frame (MRF) fan model. The ANSYS Fluent solver enables fans to be modeled with actual fan geometry and rotational speed.

Automated DELPHI Extraction

Icepak automatically extracts an optimized DELPHI thermal network model for different boundary condition scenarios from a detailed package model. You can easily include the optimized DELPHI model in a board- or system-level simulation, predicting component junction temperatures that are not a function of boundary conditions.

Powerful Results Visualization and Reporting

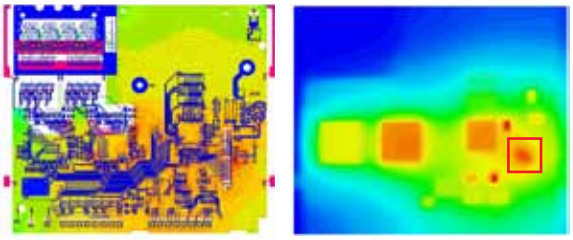
A full suite of qualitative and quantitative post-processing tools generate meaningful graphics, animations and reports to easily convey simulation results to colleagues and customers. Icepak also includes ANSYS CFD-Post for further post-processing with advanced graphics and animation tools.



Datron needed fast and accurate simulation technology for natural convection studies to design a field radio.

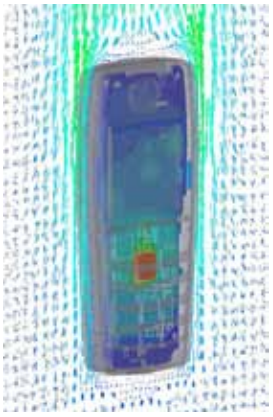
"Our engineers liked Icepak's non-conformal meshing tools that make it possible to separately mesh — usually with a finer mesh than the rest of the model — critical areas within the system, such as high-dissipation components. This increases accuracy in critical areas without unnecessarily increasing computational time requirements."

Patrick Weber
Mechanical Engineer
Datron World Communications, Inc.



Coupling ANSYS Icepak with ANSYS SIwave (left) provides additional insight into local hotspots (right) from copper resistive losses in PCBs and packages.

Improve workflow efficiency and gain additional insight into product design by leveraging the ANSYS multiphysics suite.



Velocity vectors and internal temperatures for cell phone assembly cooled by free convection

Icepak is one part of our suite that delivers state-of-the-art functionality — depth, breadth, a plethora of advanced capabilities and integrated multiphysics — providing confidence that your simulation results reflect real-world outcomes. The comprehensive range of solutions provides access to virtually any field of engineering simulation that a design process requires. Organizations around the world trust ANSYS to help them realize their product promises.

Importing and Preparing Geometries

Creating simulation models is a core part of the product development process. ANSYS geometry tools allow you to import layout data for PCBs and packages from a number of different EDA packages; you also can import 3-D mechanical CAD data from a variety of CAD packages and neutral geometry sources.

Interfaces to Electrical and Mechanical Simulation

The Icepak interfaces to SIwave, Simplorer and ANSYS Mechanical deliver a full suite of tools to address electrical, thermal and structural simulation requirements.

SIwave and Icepak can exchange power map and temperature data for PCB and IC package designs. From an SIwave DC voltage drop analysis, you can import the DC power distribution profile into Icepak to account for heating due to copper resistive losses in board or package designs. You can import the resulting temperatures from Icepak into SIwave to update electrical properties for the DC solution based on temperature field. This coupling enables you to predict both accurate thermal and electrical performance.

With Simplorer, you can extract equivalent thermal network models from transient parametric sweeps calculated with Icepak to include in a Simplorer simulation. The thermal network models generated by Simplorer allow you to rapidly evaluate transient-thermal response of electronic components using a system-level modeling tool.

Following an Icepak simulation, you can export temperatures from a thermal flow simulation into ANSYS Mechanical to evaluate thermal stresses in your electronic designs.

ANSYS Icepak

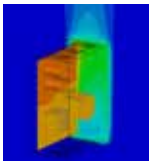
Geometry

Mechanical CAD geometry defeatured and converted into Icepak objects with ANSYS DesignModeler

Mesh

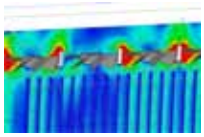
Multi-level hex-dominant mesh on sheet-metal heat sink represented directly as CAD geometry

Radiation Modeling



Temperature contours for solar load radiation with transparent surface materials

Advanced Fan Modeling

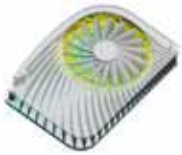


Back flow into failed fan from adjacent fans causes air recirculation; fans modeled with MRF fan model

Copper Resistive Losses

Component temperatures for multi-layer PCB. Resistive losses for copper trace layers are imported from SIwave.

Post-Processing



Velocity vectors for heat sink fan assembly post-processing with ANSYS CFD-Post

Pre-Processing **Simulation** **Post-Processing** **Archive**

Other ANSYS Engineering Simulation Capabilities

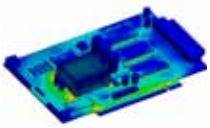
CAD

ANSYS DesignModeler and AnsoftLinks provide geometry import and simplification functions for electronics cooling simulation. The entire ANSYS suite is CAD independent, enabling data import from various 2-D and 3-D geometry sources. In addition, we collaborate with leading CAD developers to ensure an efficient workflow.

Integration

ANSYS Workbench is the framework for the industry's broadest and deepest suite of advanced engineering simulation technology. It delivers unprecedented productivity, enabling Simulation-Driven Product Development™.

Multiphysics

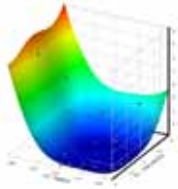


To help ensure a successful product, R&D teams must accurately predict how complex products will behave in a real-world environment. The ANSYS suite captures the interaction of multiple physics: structural, fluid dynamics, electromechanics and systems interactions. A single, unified platform harnesses the core physics and enables their interoperability.

HPC

High-performance computing enables creation of large, high-fidelity models that yield accurate and detailed insight. ANSYS offers scalable solutions and partners with hardware vendors to ensure that you get the power and speed you need.

Design Optimization



Good design starts with identifying the relationship between performance and design variables. ANSYS DesignXplorer™ enables engineers to perform design of experiments (DOE) analyses, investigate response surfaces, and analyze input constraints in pursuit of optimal design candidates.

Data Management

ANSYS EKM™ addresses critical issues associated with simulation data, including backup and archival, traceability and audit trail, process automation, collaboration and capture of engineering expertise, and IP protection.