FloTHERM Suite

FloTHERM® | FloTHERM® XT | FloTHERM® PCB | FloTHERM® PACK

Mentor®
A Siemens Business

M E C H A N I C A L A N A L Y S I S

www.mentor.com

FloTHERM suite because 'one size does not fit all'

The FloTHERM® family of products offers the most comprehensive solution for Electronics Cooling simulation. We have developed the suite based on the real electronics cooling challenges our users face, it is not a one size fits all approach but a considered toolbox offering a solution tailored to give the best outcomes. With more users than all other competing analysis software combined, making it the clear market leader in thermal analysis software for the electronics industry, engineers skilled in FloTHERM technologies are in high demand and are at the cutting edge of Electronic Cooling simulation. The FloTHERM suite comprises: FloTHERM, established over 25 years and the flagship tool for electronics cooling simulation; FloTHERM XT a CAD enabled electronics cooling simulation tool built to be truly part of the product design process; FloTHERM PACK and FloTHERM IC are solutions for package-level model and metric creation, whilst FloTHERM PCB excels at automating PCB-level thermal design.

The choice of electronics cooling software is not straightforward. Functionality is one important aspect of tool selection. However, product functionality alone does not necessarily translate into increased design productivity. It also depends on:

1. The background of the users (electrical engineers or mechanical engineers);
2. The extent to which they need to work with native MCAD data;
3. How central the MCAD system is to the company's overall design flow;
4. The CFD technology on which the thermal design tool is based; this in turn affects
5. How early in the product creation process electronics cooling software can be used effectively.

Mentor Graphics provides the broadest portfolio of solutions for electronics cooling applications and we strongly advocate that you work with your Mentor Graphics' Account Manager who will be able to guide you in your choice of electronics cooling software.

FloTHERM is the market-leading electronics cooling simulation software with more installed seats than all other electronics cooling CFD software. For over 25 years FloTHERM has supported a huge customer base, including almost all the major blue-chip electronics companies in the world. FloTHERM supports chip, package, board and system design, and even extends out to datacenters. It is designed as a vertically-specialized solution for the electronics thermal market through its innovative SmartPart technology, extensive libraries, tailored and stable solution technology, state-of-the art compact thermal modeling techniques and parametric analysis & optimization functionality. FloTHERM features advanced interfacing technologies for working with EDA data from Mentor Graphics, Cadence and Zuken and is backed by a family of ancillary solutions for PCB (FloTHERM PCB) and package modeling (FloTHERM PACK and FloTHERM IC).

FloEFD™ is a general-purpose CFD code capable of analyzing a wide variety of fluid-flow and heat transfer phenomena across various industries and applications. It is unique in that it is available as an embedded solution for most popular MCAD systems, and thus fully integrates into mechanical design engineering workflows. For electronics applications, FloEFD's Electronics Cooling Module offers a subset of thermal simulation capabilities tailored for mechanical design engineers who encounter electronics cooling alongside other design challenges in product development; and require some capabilities to reside inside their MCAD design environment for consistency and productivity reasons.

FloTHERM® XT, like FloTHERM, has been designed from the ground up as a full-scale, vertical solution with a customized GUI and focused functionality appropriate for electronics thermal applications. Building on FloTHERM's ethos and success, and FloEFD's meshing and solver technology, FloTHERM XT supports the SmartPart and Library functionality that first evolved in FloTHERM, but brings a CAD-centric approach to thermal engineering through its best-in-class CAD connectivity and advanced CAD modeling capabilities. It also features advanced EDA interfacing technologies with best-in-class interoperability with Mentor's Xpedition Enterprise suite. FloTHERM XT offers seamless simulation capabilities for all stages of the mechanical design process (concept, architecture, detailed optimization & verification). It enables a true integration between EDA and MCAD design flows, through concurrent engineering simulation, and extends our reach in addressing the needs of a rapidly evolving electronics thermal sector.

This brochure explains the technology, functionality, and productivity features of all the members of the FloTHERM product suite. Whether you are a new customer interested in purchasing your first electronics cooling software, or an existing customer at a company with a large suite of Mentor Graphics' electronics cooling solutions and looking to expand, this brochure will help you make the best choice to get the most value from your investment.

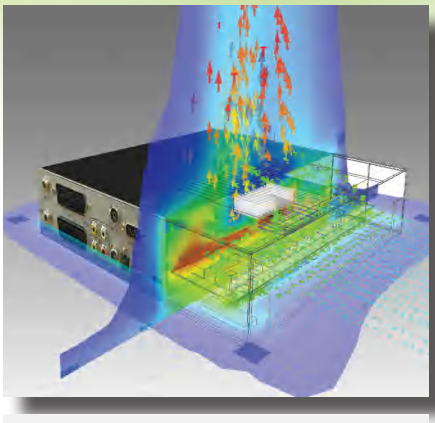
FloTHERM®

Optimizing the Thermal Design of Electronics

Small and large companies alike rely on FloTHERM to perform their thermal-fluid analysis confident of the return on their investment. FloTHERM is powerful 3D simulation software for thermal design of electronic components and systems. It enables engineers to create virtual models of electronic equipment, perform thermal analysis and test design modifications quickly and easily in the early stages of the design process well before any physical prototypes are built. FloTHERM uses advanced CFD (computational fluid dynamics) techniques to predict airflow, temperature and heat transfer in components, boards and complete systems. Its user interface supports language localization and is available in Japanese.

Experience the benefits of using FloTHERM for electronic thermal design, that include:

- Solving thermal problems before hardware is built;
- Reducing design re-spins and product unit cost;
- Improving reliability and overall engineering design; and
- Significantly reducing time to market.



Parameterized models of common components found in electronics systems enables plug and play with library swapping as well as easy parametric variation.

KEY SMARTPART FEATURES:

- Complete set of SmartParts (intelligent model creation macros).
- Multi-level SmartParts (compact and detailed representations in a single object).
- Explorer-style Project Manager with drag-and-drop functionality.
- CAD-style, mouse-driven drawing board using simple draw, drag and drop operations to create and manipulate geometry.
- Unstructured Cartesian-based grid providing full support for abutting, overlapping and nested "localized" fine grid regions to minimize solve times and enable multi-scale modeling.
- Hundreds of objects and attributes available in an installed library including fans, blowers, components, heatsinks, materials, thermal interface materials and more.
- Modeled objects combine geometry definition, material attributes and grid settings supporting easy model creation, re-use across different projects and sharing through FloTHERM's drag-and-drop library system.

Model Creation

SmartParts®

FloTHERM features a comprehensive set of intelligent model creation macros (SmartParts) to allow a broad range of electronics cooling applications to be built quickly and accurately. SmartParts are available for:

- Heatsinks
- Fans
- Printed circuit boards
- Thermo-electric coolers
- Enclosures
- Components
- Heat pipes
- Perforated plates
- Dies
- Racks (Datacenter application)
- Coolers (Datacenter application)

All SmartParts incorporate over two decades of electronics cooling modeling experience at Mentor Graphics' Mechanical Analysis Division, and are aimed at streamlining model creation, minimizing solution times, and maximizing results accuracy.

Integration with MCAD & EDA

FloTHERM also features advanced, tight integration with MCAD and EDA (Electronics Design Automation) software. Data from Creo Parametric, Solidworks, CATIA and other major MCAD tools can be imported, simplified and converted into FloTHERM objects. Interfaces to Board Station, Xpedition PCB, Allegro and CR5000 extract board outline and component information for import into FloTHERM.

FloMCAD™ Bridge

FloMCAD Bridge enables parts and assemblies from Mechanical Computer Aided Design (MCAD) software (such as Creo Parametric, SolidWorks, CATIA, etc.) to be transferred easily and rapidly to FloTHERM for thermal analysis.

FloMCAD Bridge is more than just an interface program - it intelligently filters the geometrical data for a particular part or assembly and creates a simplified "thermal equivalent" for analysis purposes. This is critical because production quality MCAD solid models contain a vast amount of thermally insignificant geometric detail (fillets, small holes, chamfers, screw threads, etc.) that provide no accuracy benefit if included, but can significantly slow down the solution process. The ability of FloMCAD Bridge to defeature a part to match its thermal importance prior to translation into FloTHERM objects offers a massive improvement in the efficiency of the model creation workflow process.

The software also offers an intelligent and efficient voxelization algorithm for fast and general handling of geometric features of any shape and complexity.

> "In half an hour or even less, we can construct a model that previously would have taken us two days to produce."
> *- Dr. Filip Christiaens, Alcatel*

FloEDA™ Bridge

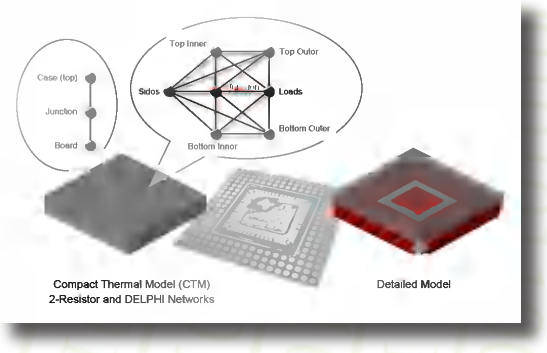
FloEDA Bridge enables both import of detailed PCB designs as well as the ability to quickly sketch out conceptual layouts.

Detailed PCB or BGA substrate designs can be imported in either the industry standard IDF format, or more detailed designs imported from our direct interfaces to the most common PCB design platforms. Full component layout, PCB stack-up and detailed descriptions of the metallic distribution on power, ground, signal, and dielectric layers are loaded. A unique method for the capturing of the metallic distribution provides a user controlled ability to define the level of resolution of the thermal conductivity map. Block, 2-Resistor, DELPHI or 'Detailed' component modeling levels can be selected, including an automated ability to 'swap-in' higher fidelity models from an existing thermal model library. T3Ster-generated RC ladder compact thermal models can be directly read in, as can Network Assembly from FloTHERM PACK.

Conceptual layouts can be quickly sketched out, stack-ups imported from a user defined library, then transferred to FloTHERM for preliminary thermal simulation investigations.

FloTHERM® PACK

FloTHERM PACK (www.flothermpack.com) is a web-based software program which produces reliable, accurate thermal models of IC packages and associated parts with the minimum of effort. Designed to fulfill the industry´s need for a rapid response to innovations in packaging design, FloTHERM PACK is a web-based application that contains a parametrically-driven menu for each part type. To take advantage of FloTHERM PACK, you use your standard web browser to enter data describing the IC package you want to use. For example, if you want to build a model of a ball grid array (BGA) package, the typical data entry items would include: number of balls, substrate conductivity, die size, and substrate metal layer thickness and coverage.



Automation

FloXML

FloTHERM's geometry and model data can be created by external scripts and utilities, for subsequent import into FloTHERM. The FloXML file format can hold any data that could be manually created in FloTHERM itself. Including objects, attributes, mesh and solver control settings. For standardized applications that would require repeated manual definition in the FloTHERM GUI, such FloXML generating scripts can drastically reduce the effort required for generation of ready-to-solve models and modeling data. A number of Microsoft Excel examples are supplied with the software that use VBA to create FloXML, automating common repetitive tasks.

FloSCRIPT

Actions performed in FloTHERM are logged to a FloSCRIPT file. This file can be re-played so as to repeat those actions in a FloTHERM session. This offers additional automation opportunites whereby changes to an existing model can be created by bespoke external scripts and utilities, further reducing what would otherwise be time-consuming manual model interventions.

> "We rely completely on engineering experience, along with structural and thermal simulation to meet our requirements. Using state of the art simulation tools, these analyses allow us to iterate multiple scenarios in a short period of time to optimize our systems for not only thermal performance, but also weight reduction, noise reduction, cost, and schedule."
> *- Andrea Schott, Curtiss-Wright Controls Defense Solutions*

Meshing

FloTHERM uses a locally-unstructured Cartesian-based mesh – the most stable and numerically efficient type of mesh available. The ability to localize is also included for finer resolution where it is needed, minimizing solution time.

Mesh in FloTHERM is associated with SmartParts and is generated as part of the model assembly process with refinement under user control. This methodology is intuitive and straightforward enabling engineers to focus on design rather than analysis.

Meshing is instantaneous and reliable in FloTHERM, as compared to traditional tools that require significant time and expertise to master. Finally, FloTHERM is the only analysis software with object-associated mesh that eliminates re-meshing for each model modification.

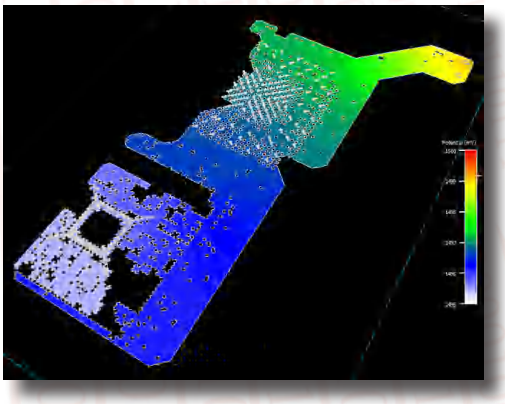
Solver

For over 25+ years, the FloTHERM solver has specifically addressed electronics cooling applications. The solver produces the most accurate results possible and the fastest solution time per grid cell. Massive disparities in geometric length scales are resolved using the unique 'localized-grid' technique which allows for integrally matched, nested, non-conformal grid interfaces between different parts of the solution domain. The conjugate nature of heat-transfer within electronic systems is concurrently solved using a preconditioned conjugate residual solver together with a flexible cycle multi-grid solution technique. Pragmatic, unique and accurate solution termination criteria produce useful results in engineering, not academic time scales.

> "FloTHERM continues to allow us to design better and more innovative electronics cooling devices for smaller and hotter applications. Using FloTHERM versus a prototype build in this type of application saves approximately $5-10k worth of development costs."
> *- Matt Connors, Application Engineering Manager, Thermacore*

KEY SOLVER FEATURES:

- Concurrent solution for convective, conductive and radiative heat transfer.
- Solution termination optionally based on convergence of user defined monitor points.
- Multi-fluids capability.
- Ability to simulate either turbulent, laminar and transistional flow.
- Definition in transient variation in terms of linear ramping, power increase, exponential increase, sinusoidal, periodic or imported .csv pointwise variations.
- Fully automatic radiation exchange and view factor calculation.
- Automatic solar loading boundary conditions.
- Transient thermostatic control with offset heating and cooling setpoints.
- Joule Heating: solve for 3D electric potential, current density and calculate Joule Heating.
- Interfacing to FEA tools for thermo-mechanical simulation.
- Enhanced PCB modeling using the PowerMap SmartPart for detailed copper representations.

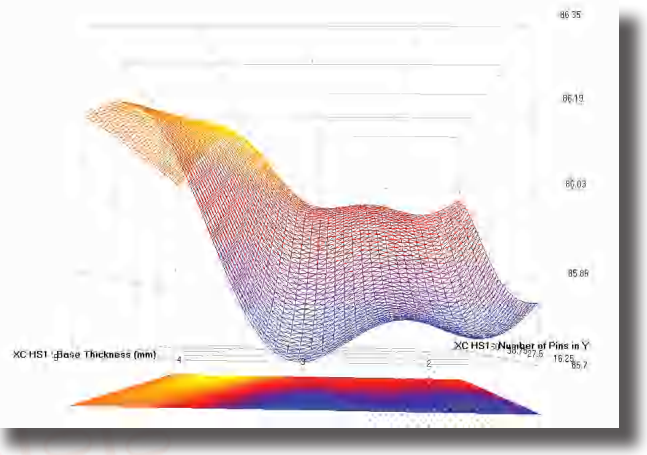


"The value of FloTHERM is in the time and the cost it saved us when developing an IC for a new generation of Energy Star-compliant mobile phone chargers. To achieve the same result by building prototype boards would have taken a long time and drawn resources away from other critical work. FloTHERM has helped us reduce development costs and kept our project on track to meet our customer's aggressive deadline."
- Nigel Heather, Vice President of Engineering, CamSemi

Transient Analysis

The powerful transient analysis capabilities in FloTHERM also allow for prediction of a number of different transient behaviors. Time dependent power dissipation in components can be defined via .csv import of power versus time data. An accurate prediction of the thermal response of the component temperature, in time, may then be produced without the conservative assumption of constant "steady state" power consumption.

Transient thermostatic control modeling can be performed via the ability to have a model input vary, not only as a function of time, but also optionally as a function of a monitored temperature during the transient solution. This allows for temperature controlled fans to be considered as well as determination of power derating and thermal mitigation strategies.



Pressure Drop vs Heatsink Parameters

Post-Processing

The FloTHERM visualization toolset is developed specifically to maximize productivity for design of electronics cooling. Fully rendered models, 3D flow animation and tools for dynamic manipulation of temperature and flow results, enable engineers to pinpoint thermal issues and visualize design improvements quickly and effectively. Texture mapping and AVI output enables communication of thermal-design concepts with non-technical colleagues.

KEY VISUALIZATION FEATURES:

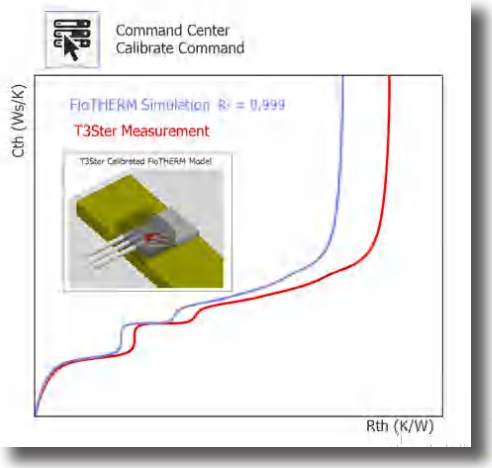
- Particle animation to visualize complex, 3D airflow.
- Contour animation to visualize heat transfer paths.
- Isosurfaces and surface temperatures.
- Airflow representation by vectors or ribbons colored by temperature or speed.
- AVI output of flow animation.
- Dynamic particle tracking allowing the user to gain a better understanding of complex flows.
- Image texturing for realistic visualization.
- Mentor's patented Bottleneck & Shortcut Numbers.
- Capture Indices (datacenters).

PARAMETRIC ANALYSIS AND OPTIMIZATION

SmartPart-based modeling and structured Cartesian grid enable Design of Experiments technology to be applied to a FloTHERM model. Design of Experiments (DoE) is a structured method for determining the relationship between design parameters (e.g. number of heatsink fins, location of vents, etc.) and results (component temperatures, fan flow rate, etc.). FloTHERM's Design of Experiments implementation efficiently explores the design space by building and solving variants of the initial model. This provides critical information regarding the sensitivity of the thermal results to changes in the design parameters while minimizing the number of simulations to be solved and serves as the foundation of the powerful response surface and sequential optimization design tools. To assist with the solution of the Design of Experiment cases, the user may optionally use a distributed network of computers using 'Volunteer' solution technology.

FloTHERM extends this concept by computing response surfaces for all results of interest. Response surfaces are mathematical equations derived from the DoE results that estimate the thermal solution anywhere in the design space instantaneously. The user may interact with the constructed Response Surfaces with real-time 2D and 3D plots that have slider bars to control the design parameter values. Mathematical optimization of a user defined cost function is fully supported with the Response Surfaces as well, enabling the optimal solution to be estimated without solving additional cases.

Automatic sequential optimization of the cost function can be performed as well. This gradient based approach will build and solve additional variants of the initial model to explicitly determine and confirm what the optimal thermal solution is. Sequential optimization is able to understand design constraints (such as maximum component temperatures) and incorporate them into the presented optimal configuration.

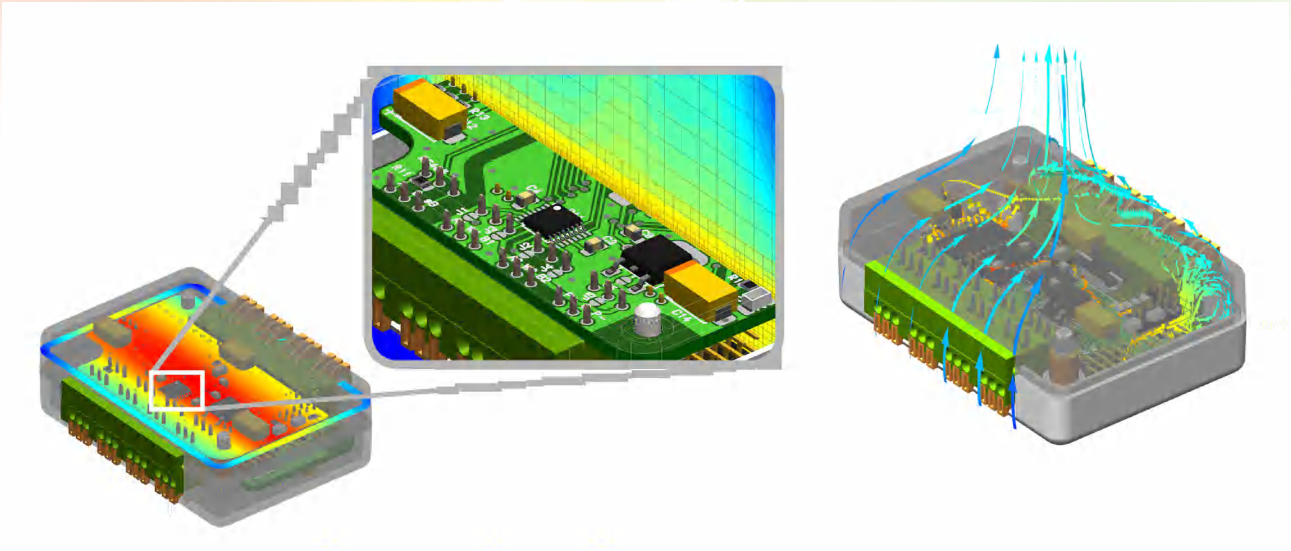


T3Ster Detailed Model Calibration

Automatic calibration of detailed thermal models against T3Ster-generated experimental results ensures a near-exact match to the package's structure function, ensuring accurate temperature vs. time response irrespective of the length of the power pulse – critical for use case analysis and reliability prediction.

FloTHERM® XT

FloTHERM® XT - Leading Innovation in Electronics Cooling

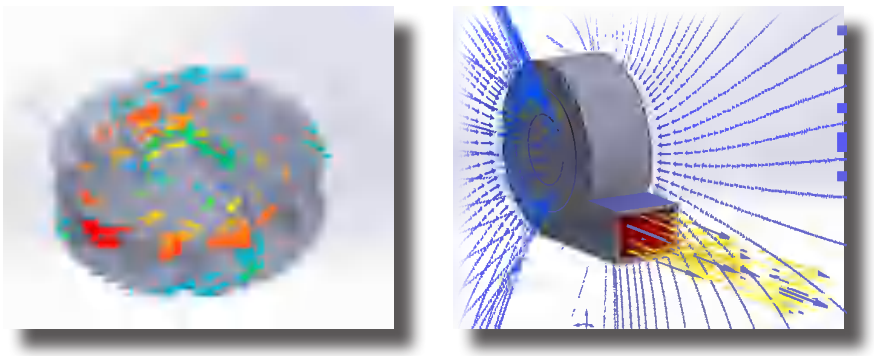


FloTHERM XT has been developed to facilitate electronics thermal design from concept to verification, with a consistent data model throughout and the seamless ability to import data from other mechanical design automation (MDA) or EDA sources as required in a particular design process. This design lifecycle support is inherent in FloTHERM XT's design and infrastructure: using SmartParts to build a simple concept model in minutes; work with complex mechanical parts directly from MCAD; create your own CAD geometry easily and efficiently; and use detailed electronic assemblies from EDA.

What is FloTHERM XT?

FloTHERM XT utilizes the powerful EFD solver and mesher as an enabling technology to give the broadest possible coverage of both simple and complex electronics systems. Advanced interaction with electronic design tools is provided by FloEDA Bridge. FloTHERM XT works with non-Cartesian geometry, supporting non-standard form factors, novel heatsink designs and with arbitrary, non-aligned or curved geometry. The software comes enabled with full SmartPart support for electronics modeling, including:

- Heatsinks
- Axial, Radial and Centrifugal Fans
- Printed circuit boards
- Thermo-electric coolers
- Enclosures
- Components
- Heat pipes
- Perforated plates



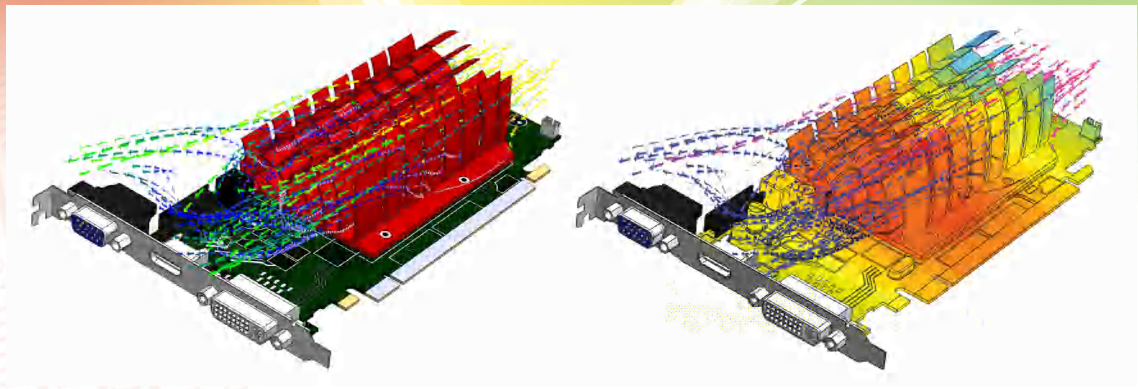
We also support the import of either detailed or compact package models generated from FloTHERM PACK or IC. In addition, using the CAD capabilities inherent in the software, any imported parts or SmartParts can be positioned at any arbitrary angle.

Who Can Use FloTHERM XT?

FloTHERM XT can be used by Thermal Design Specialists and Researchers, Thermal Designers, Mechanical Design Engineers and CAD users with thermal design responsibility. The user interface versatility has been specifically engineered to serve a diverse user group.

FloTHERM users can also use FloTHERM XT, as FloTHERM XT can read in FloTHERM project files. A Flexx license allows either FloTHERM or FloTHERM XT to be launched against the same license key.

FloTHERM® XT

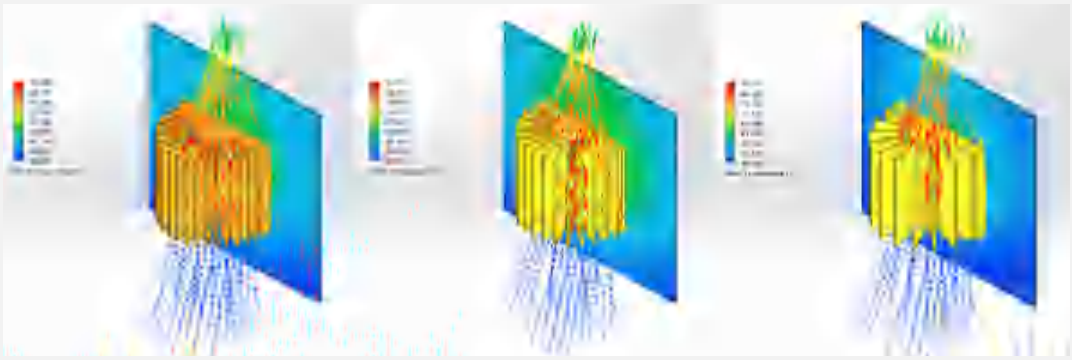


High-end graphics cards require novel cooling solutions – in this case, a heatsink with curved geometry has been designed to fit the enclosure.

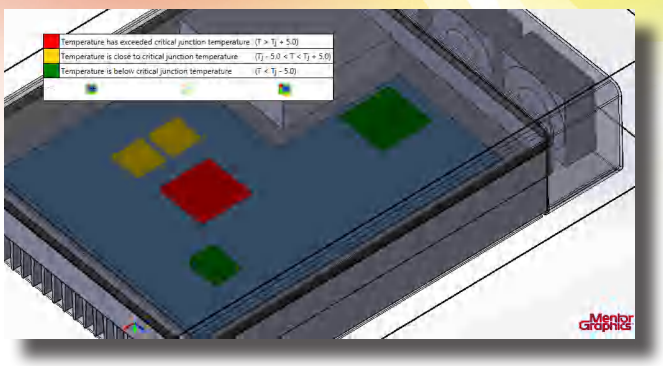
Surface temperatures and 3D particle plots can be used to assess the effectiveness of the new heatsink design.

KEY FEATURES:

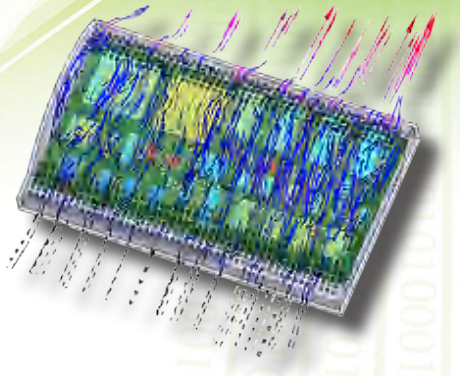
- A CAD-centric solution supporting the electronics thermal sector, complementary to FloTHERM.
- Supports axis-aligned, angled, arbitrary and rotating geometry.
- An appropriate tool for design engineers familiar with MCAD environments, with a CAD-centric UI, geometry engine and controls.
- Supports FloTHERM style SmartPart and Library functionality.
- Supports the import of FloTHERM project and assembly data as either PDML, FloXML or xCTM, as well as direct support for FloTHERM material libraries.
- Supports direct interfaces with all major MCAD vendors and supports all MCAD neutral file formats.
- The FloEDA Bridge module supports Xpedition Enterprise, ODB++, and PADS.
- Able to leverage package libraries – detailed, 2-R or DELPHI - from www.flothermpack.com.
- Automatic report generation via HTML, PDF and Microsoft Word (DOCX) and Excel (XLSX).
- Parametric study environment allows easy parametric variations of CAD and FloTHERM XT data, with ad-hoc and linear variations for Input Variables, Design of Experiment and Response Surface Optimization capabilities.



- Supports the ability to model selected copper nets and traces as detailed extrusions.
- Automatic Joule Heating, with a solution for 3D electric potential and current density for all defined geometry with a valid electrical circuit.



The surface temperatures on the PCB will quickly identify those devices which are non-compliant with thermal specifications.



Further understanding of the cooling performance can be achieved by examining the 3D flow field using the animated particle post-processing feature.

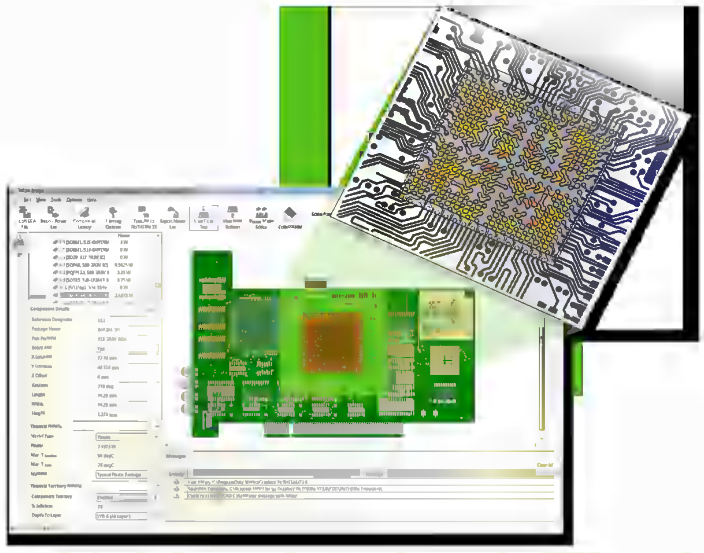
"We are now able to start optimizing designs from the early concept stage and, using the same data model, can continue to support our clients with increasing levels of sophistication and shape complexity as they progress onto the verification/prototype phase and prepare a fully vetted design ready for manufacturing."
- Guy Wagner, Electronic Cooling Solutions

FloEDA™ Bridge

The FloEDA Bridge module provides an interface to Xpedition Enterprise Enterprise, plus support for IDF and ODB++, and includes a powerful 'EDA Sync' update function to keep models concurrent with the latest board design as it evolves. FloEDA Bridge has a full undo/redo capability and includes a board outline editor; a power mode editor to switch between multiple powered states associated with the use case for the product being designed; and detailed capture of trace layout in the thermal territory around a component. Selected nets can also be represented explicitly for Joule Heating studies.

Block, 2-Resistor, DELPHI or 'Detailed' component modeling levels can be selected, including an automated ability to 'swap-in' higher fidelity models from an existing thermal model library. T3Ster-generated RC ladder compact thermal models can be directly read in, as can Network Assembly from FloTHERM PACK.

Conceptual layouts can be quickly sketched out, stack-ups imported from a user defined library, then transferred to FloTHERM for preliminary thermal simulation investigations.



"FloTHERM is a key component of our simulation-based design decisions strategy, ensuring that our thermal design goals are met and we can deliver on Continental's simulation vision of 'getting the product right the first time."
- Dr. Uwe Lautenschlager, Continental Automotive GmbH

FloTHERM® PCB

Optimizing Collaborative PCB Design by Simulation

Software for Collaborative Conceptual Design of Printed Circuit Boards

What is FloTHERM PCB?

FloTHERM PCB is a unique, software program for streamlining concept development of printed-circuit boards (PCBs), while ensuring good thermal design and accelerating the PCB design process. FloTHERM PCB facilitates collaboration between Product Marketing, Electronic Engineers and Mechanical Engineers on PCB design, particularly during the conceptual phase of the design process.

FloTHERM PCB serves as a common platform that Electrical Engineers and Mechanical Engineers can use to collaboratively create and thermally evaluate multiple proposed board layouts, quickly and accurately, as it supports:

- Creation of board layouts and cooling solutions (heatsinks, thermal vias, copper fills) with provided SmartParts;
- Import of layout data from EDA layout tools in several formats: IDF, CSV, or via direct interfaces for Xpedition, Boardstation, Allegro, and CR5000;
- Creation of an orthotropic material map of the board based on copper distribution;
- Import power dissipations in CSV format;
- Property sheet description of typical thermal environments in which the board will reside. Forced Air, Still Air, Conduction Cooled, and Card Slots can be used, as well as directly importing a 3D set of thermal boundary conditions from a pre-solved FloTHERM analysis;
- Fast, robust, 3D predictions of temperature and air flow. No traditional CFD constructs (meshing, boundary conditions, solving settings) are required;
- Import of FloTHERM and FloTHERM PACK component models and library swapping facilitate PCB definition;
- Side-by-side views of thermal results for multiple layouts to easily compare benefits and drawbacks of various designs;
- Automatic, configurable report generation;
- Command line support for model construction, solving, and report generation allowing FloTHERM PCB to be embedded in your organizations workflow;
- Thermal model transfer to FloTHERM to easily transition from the conceptual design stage to considering more detailed thermal design tasks and thermal verification; and
- Layout transfer to MCAD and EDA design flows via IDF, CSV, or EDA layout tool specific placement files.
- Language localization of the user interface and is available in Japanese.

Who can use FloTHERM PCB?

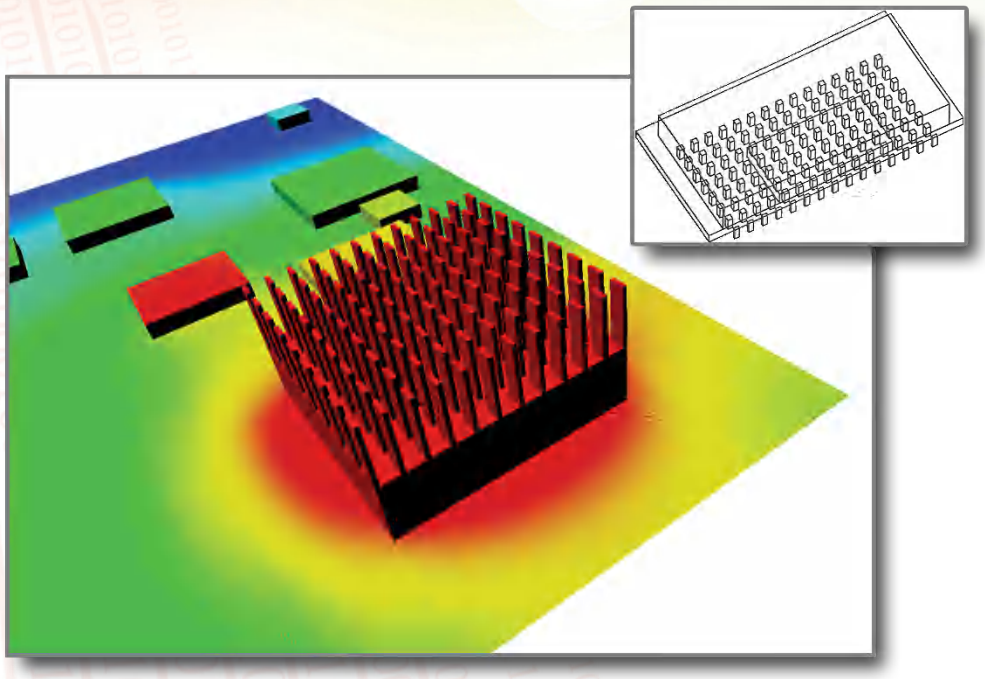
FloTHERM PCB is designed to be used by all those involved in the conceptual design of PCBs, including Product Marketing, Systems Architects, Hardware Designers, and Mechanical/Thermal Engineers.

How does FloTHERM PCB save my company money?

FloTHERM PCB saves your company money by addressing major inefficiencies in the board design process. On top of this, FloTHERM PCB minimizes the risk of board "re-spins" due to thermal problems. In a recent survey, 60% of Mechanical Engineers in electronics companies stated that thermal issues had forced board layout changes during the previous 12 months. Just one such re-spin costs many times the FloTHERM PCB license fee.

FloTHERM® PACK

FloTHERM® PACK Generates Optimized Thermal Models of Semi-conductor Packages... Fast



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> "FloTHERM PACK saved me seven hours of package model building time and another 2-3 hours of simulation time, compared to building the model manually."
> *- Mark Peterson, Applied Micro Circuits Corporation*

If you don't have detailed information about the internal geometry of your part, the JEDEC Library SmartPart wizard in FloTHERM PACK lets you create "best guess" thermal models quickly and easily. All you need to do is answer three or four questions about your component. Utilizing built-in intelligent rules based on common industry design practices, the SmartPart wizard derives the rest of the information needed to generate the model.

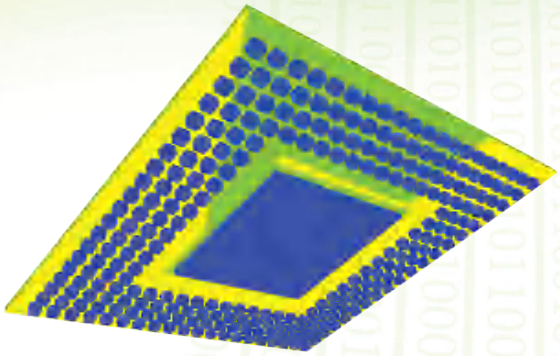
FloTHERM PACK also enables you to preview models in 3D to verify that your input parameters are correct. After previewing, simply download the model to your local computer and drop it into your FloTHERM analysis model.

All of the capabilities in FloTHERM PACK mean an enormous productivity boost for you. Indeed you can cut your component modeling time by a factor of 20 or more! FloTHERM PACK does all the thinking required for model generation, freeing you to concentrate on optimizing your design. FloTHERM PACK supports just about all popular package styles in the industry including Ball Grid Arrays, Leaded packages, Pin Grid Arrays, Discrete Transistor Outline packages, Chip-Scale packages and Multi-Die packages.

FloTHERM® PACK

Flexibility to Create Both Detailed and Compact Models

By default, FloTHERM PACK generates detailed models that include elements such as individual balls, individual thermal vias and metal layers in organic substrates. However, FloTHERM PACK also provides a variety of modeling options for each package, which allow you to simplify the detailed sub-models. For example, you may represent the effect of a ball grid array as an assembly of individual elements (more accurate but computationally expensive) or as a single block with lumped thermal properties.



Furthermore, FloTHERM PACK also allows you to generate compact models of your parts. Compact models are far more computationally efficient than detailed models, and are usually in the form of simple thermal resistance networks. FloTHERM PACK supports 2-resistor compact models as well as boundary condition independent, DELPHI-style compact models.

The Product of 15 Years R&D with Leading Component Makers

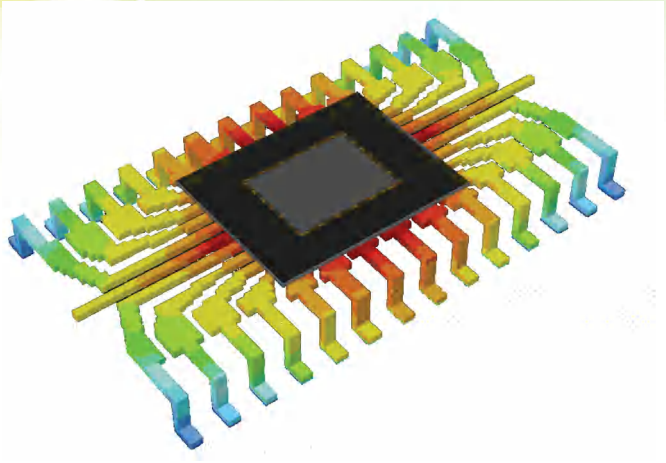
FloTHERM PACK is a direct outcome of Mentor Graphics, Mechanical Analysis' 25 years' experience working with the world's leading semi-conductor component manufacturers. Mentor Graphics has published more than 50 papers and technical articles in the area of modeling IC packages in CFD, and teaches the industry's only comprehensive training course in this field. Moreover, Mentor Graphics, Mechanical Analysis was the coordinating partner of the EU funded projects DELPHI and SEED, which laid the foundation for many of the modeling methodologies embedded within FloTHERM PACK. No other software company can claim as much depth of experience and knowledge in this area as Mentor Graphics.

"We simply enter the basic characteristics of the new chip into a form on the FloTHERM PACK web site. The web site then generates either a geometric or a behavioral model of the chip. We can then modify the geometric model to account for detailed characteristics of the new chip and predict its thermal performance with a high level of accuracy."
- Mark Patterson, AMCC

"Initially, I built a detailed IC package model from scratch in FloTHERM without using FloTHERM PACK. Building this model took me an entire day – at least eight hours. I then ran a FloTHERM thermal simulation and the results compared very favorably with the measured data – within about 5%. Then I went back to see how fast and accurate FloTHERM PACK was. I went to the FloTHERM PACK website, completed the online table, produced and downloaded the IC package model and ran my FloTHERM simulation. Once again the results were within about 5% of the measured data. The big difference was that with FloTHERM PACK, it only took me about an hour to create my IC package model.""
- Nigel Heather, Mark Peterson, Packaging Engineer, AMCC

FloTHERM® IC

What is FloTHERM IC?



FloTHERM IC is a software product from Mentor Graphics that incorporates a high level of automation for key tasks related to semi-conductor thermal characterization and design. An intuitive wizard-driven user interface, interoperability with package-level EDA tools, and enterprize-level data scalability and portability are the other key features of FloTHERM IC.

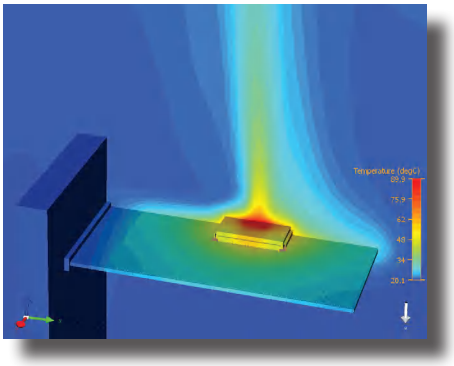
Built around FloTHERM® PACK, the well-established package Smartpart technology, and the industry leader FloTHERM's CFD solver technology, FloTHERM IC greatly boosts productivity of thermal analysis in the semi-conductor industry.

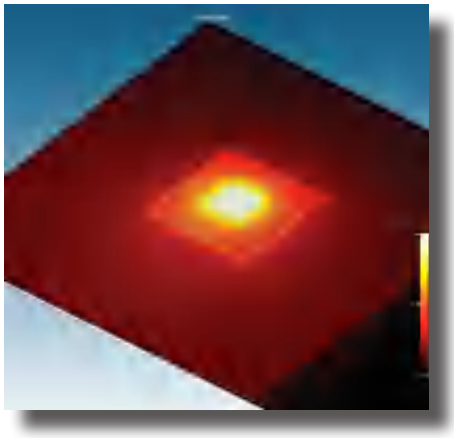
FloTHERM IC vs. FloTHERM PACK

FloTHERM IC builds upon the proven FloTHERM PACK technology of SmartParts but extends it much further. Here is a comparison of FloTHERM PACK and FloTHERM IC features:

Features	FloTHERM IC	FloTHERM PACK
Wizard-driven Interface	Y	Y
Model Preview	Y	Y
Detailed Models	Y	Y
Compact Models	Y	Y
JEDEC θ_{JX}/Ψ_{JX} Metrics	Y	-
CFD Solver	Y	-
Batch Characterization	Y	-
In-Built Design Parametrics	Y	-
Interface with Cadence APD	Y	-
Searchable Results Database	Y	-
Libraries for Package Elements	Y	-

Comparing FloTHERM IC with FloTHERM PACK





For the latest product information, call us or visit: www.mentor.com

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