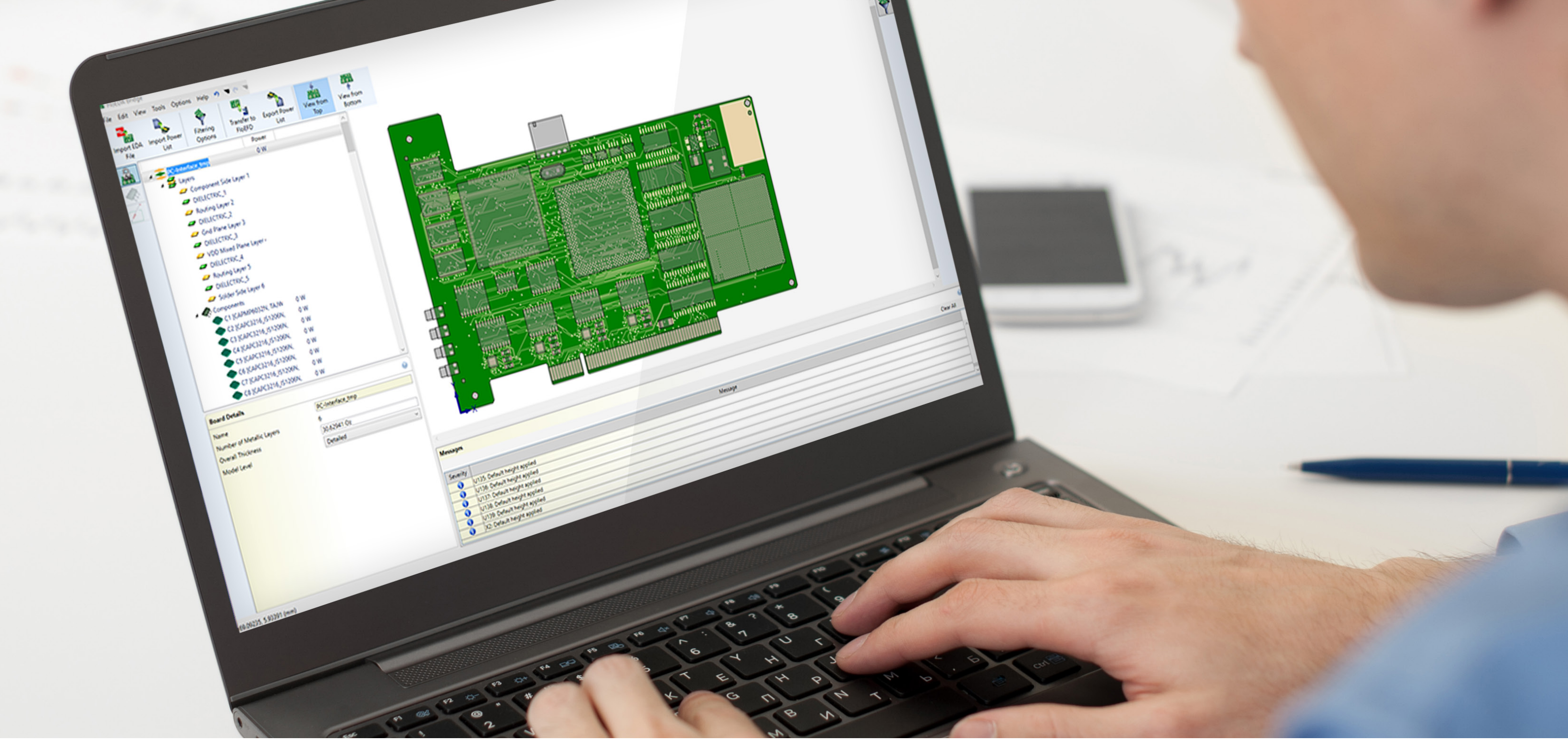


DIGITAL INDUSTRIES SOFTWARE

Simcenter FLOEFD EDA Bridge module

Using imported detailed PCB designs and IC thermal properties to streamline thermal analysis

Benefits

- Save time and effort by using imported detailed PCB designs and IC thermal properties for analysis
- Rapidly import detailed PCB data into Simcenter FLOEFD
- Improve analysis accuracy with more detailed thermal modeling of electronics

Summary

Simcenter™ FLOEFD™ software, EDA Bridge module provides capabilities for detailed import of printed circuit boards (PCBs) into your mechanical computer-aided design (MCAD) tool of choice in preparation for thermal analysis. Historically, the best way to access PCB data was to use Intermediate Data Format (IDF) file pairs, which have significant shortcomings, especially regarding the copper geometry in the PCB.

The Simcenter FLOEFD EDA Bridge enables detailed PCB import with material and integrated circuit (IC) thermal properties into Simcenter FLOEFD for thermal analysis either on its own, or as part of a larger system-level assembly.

PCB import file formats

The Simcenter FLOEFD EDA Bridge can use four file formats for import:

- IDF
- CC and CCE (native file format for Siemens Digital Industries Software's Xpedition™ software and PADS™ software)
- ODB++ (neutral file format for PCB manufacturing)
- IPC2581B (neutral file format of the IPC Digital Product Model Exchange consortium)

The benefit of using either CCE, ODB++ or IPC2581B is the PCB stack up and copper geometry can be read and used to create 3D geometry. This is particularly useful when thermal considerations, such as thermal vertical connect access (vias) or copper pours, have been designed into the board.

PCB modeling levels

A PCB can be modeled in one of four ways using Simcenter FLOEFD: compact, layered, explicit or using the novel smart PCB. The most suitable approach depends on the granularity required from the thermal simulation judged against time available for analysis in a project and the constraints of available EDA data at the design stage.

Further information on each approach:

Compact: An orthotropic material property is created to account for the in-plane and through-plane thermal conductivities based on the copper content within the board.

Layered (detailed): Each layer has its own material property based on the layer copper coverage, this includes dielectric layers with vias.

PCB material thermal conductivity modeling options for compact and layered approaches:

Analytical: A well-known legacy approach where effective properties are determined based on volume averaging of the copper and dielectric of either the individual board layers or entire board.

Empirical: A unique, patented approach where effective properties are based on a percent coverage correlation to explicit copper representation. Multiple validation examples have shown the results based on empirical effective thermal conductivities more accurately predict component temperatures than the analytical method.

Explicit: Explicit copper modeling can be performed at more mature design stages when a fully routed board information is available. You can import CCE, ODB++ or IPC-2581B files that contain the board netlist and copper layout and then all appropriate 3D geometry is created.

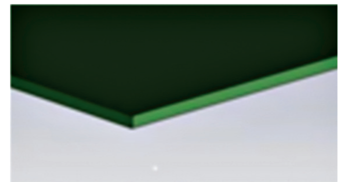
You can alternatively take the subset approach to model individual nets for Joule Heating analysis using the *explicit net* approach: Specific nets can be selected and modelled as explicit. The software will then create 3D geometry to resemble that entire net, including vias, in Simcenter FLOEFD.

Smart PCB: A novel approach where the copper and dielectric within a routed board are represented using a network assembly. For a fully routed board, this is a very computationally efficient method for faster solution time. The fidelity of the representation can be adjusted by switching between fine, which ensures two network assemblies across the width of the smallest trace, or averaging, which allows for full control to either coarsen or refine the network assembly.

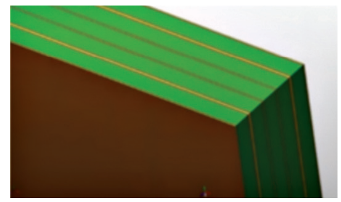
Thermal territories – Localized PCB modeling fidelity

Defining enhanced localized modeling fidelity supports faster, more computationally efficient PCB thermal analysis. It eliminates the requirement to model the entire PCB explicitly, without sacrificing accuracy where it is most needed. In order to accurately account for copper trace and layer complexity influences where it is most critical, users can select an area under a critical component (a standard thermal territory), or set a defined rectangular area arbitrarily anywhere on the PCB to encompass the board properties under a group of components (standalone thermal territory). Multiple thermal territories can be defined on a single board and set as compact, layered (detailed) or explicit type in conjunction with how the overall board thermal modeling level has been set.

Compact

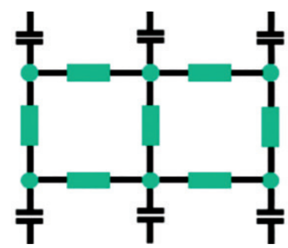


Layered (detailed)



Explicit

Smart PCB



Network assembly

IC modeling

Components or IC packages can be thermally represented in several ways for electronics cooling simulation.

Within EDA Bridge you can set during import the following models. If component heights are not set in the electronic design automation (EDA) tool, then a default can be specified in EDA Bridge:

1. **Simple:** Use block representations of the components. The size is based on the assembly or placement outline with the material properties defined.
2. **Two-resistor:** Use Joint Electron Device Engineering Council (JEDEC) θJB and θJC thermal resistances.

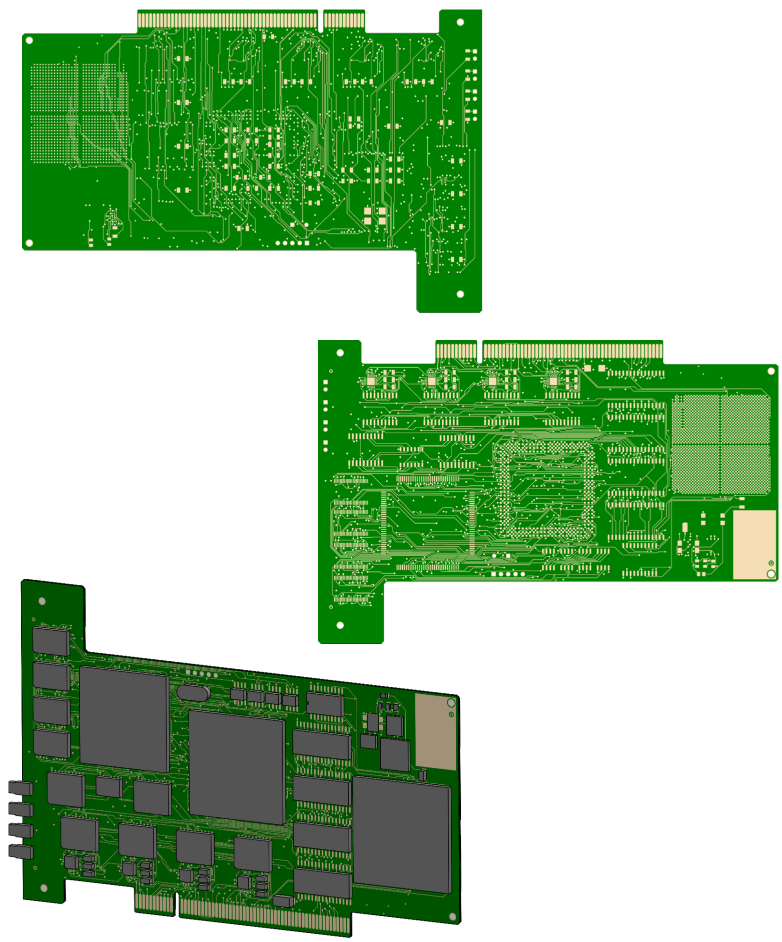
Once a PCB is transferred to Simcenter FLOEFD from EDA Bridge, users can then manually replace these models with the following types as suitable:

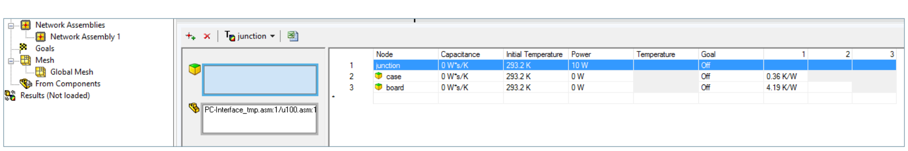
3. **DELPHI multi-resistor:** JEDEC guideline compliant advanced thermal resistance network with additional network nodes imported as a network assembly.
4. **Detailed** models represent the full 3D materials and geometry of a component.

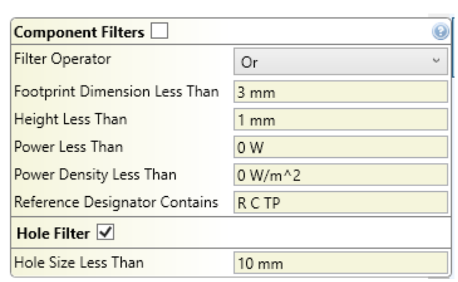
Note: Clean 3D CAD geometry based detailed models can be generated using Simcenter FLOEFD Package Creator application in minutes. Please see details in the "BCI-ROM and Package Creator Module" fact sheet.

PDML import

The PDML was originally a Simcenter Flotherm™ software format that is often used by vendors to supply users with IC package simulation model. This IC package definition in *.pdml format can be imported into Simcenter FLOEFD and contains information about the geometry, power load, material properties or the thermal compact model definition and surface radiative properties.







Electronic component filtering

ICs, resistors and other components can be filtered based on one or more criteria. This is designed to enable users to remove thermally insignificant components from the analysis to speed up computational time. Mounting holes can also be filtered.

Users can filter parts based on: footprint dimension, height, power, power density or reference designator.

Import power list

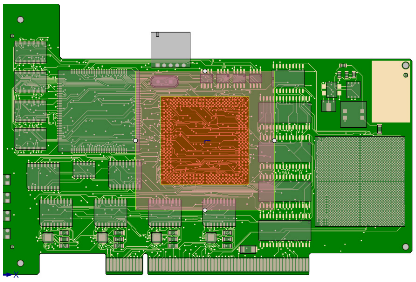
A comma separated values (CSV) file containing the reference designator and a number can be used to apply multiple boundary conditions in one operation rather than on a part-by-part basis. This functionality is useful when many components are present. A CSV file can be exported for later use or editing if needed.

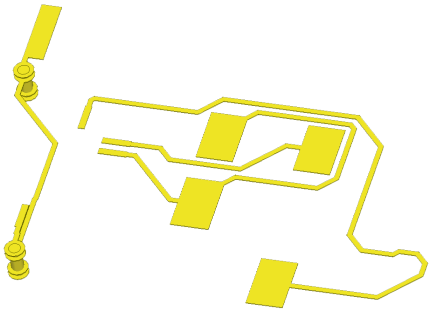
Possible imported boundary conditions range from IC modeling type and properties to their dissipated power.

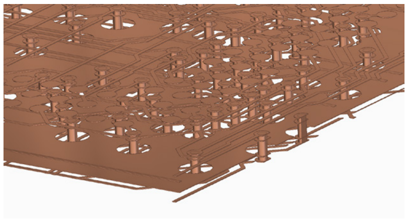
PCB electrothermal co-simulation

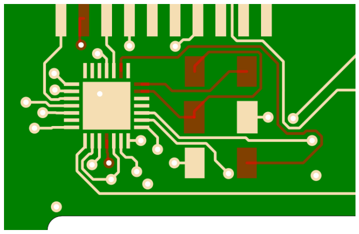
Using the Smart PCB generated in EDA Bridge and transferred to Simcenter Flotherm to model a board as a network assembley, users can set up a co-simulation with HyperLynx™ PI DC drop analysis software. This co-simulation more accurately represents board copper trace power dissipation by modeling electrical resistance changes versus temperature. It is set up in the PCB properties sheet and a user selects appropriate nets to model.

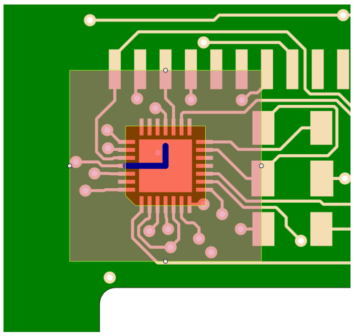
At each iteration in the co-simulation, temperature results are passed into a DC drop analysis to better model copper electrical resistance changes with temperature, and then an updated joule heating power map from the PCB electrical net is fed into system level thermal analysis for accurate temperature prediction and so on. It is also possible to control the frequency at which thermal information is passed between the two tools by setting the periodicity of co-simulation. Overall this electro-thermal modeling solution allows engineers to better predict temperature influences more accurately and then to identify areas of excessive voltage drop and high current density that can cause malfunctions.

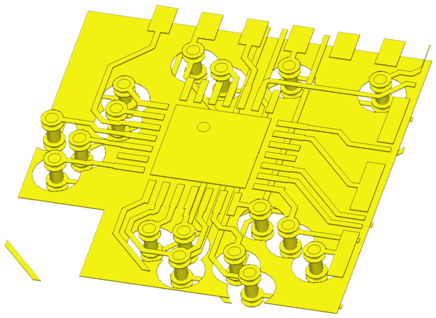












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