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IMPORTANT QUESTIONS TO ASK WHEN EVALUATING THERMAL ANALYSIS SOFTWARE FOR ELECTRONICS

This questionnaire highlights a range of issues – customer support and technical – associated with thermal analysis software for electronics. If you are an engineer or manager with responsibility for the thermal design of electronic hardware, the questionnaire may be of great relevance if you are considering an investment in thermal analysis software.

CUSTOMER SUPPORT

In evaluating thermal analysis software for electronic systems, it is imperative for the user to have ready access to technical support from the supplier. You may wish to ask the following questions:

Have we enough experience to use this software? Does it require a lot of expertise in thermal simulation from the user? Do we want to be simulation specialists, or make good thermal design decisions quickly and efficiently? How easy is it to get misleading results?

Strong technical support will help you to circumvent pitfalls associated with thermal analysis software. The following aspects are critical:

- What evidence is there regarding the quality of after-sales technical support?
- Can I see the results of a recent customer-satisfaction survey?
- How large is the support team, and how knowledgeable are they about thermal analysis of electronics? Can I talk to the engineer(s) who will be supporting me?
- How long would we expect to wait for a response from support?
- Can I preview your user-support web site, and your user newsletters?

What ‘real’ documentation can the supplier present as proof their expertise – for example, published technical papers, conference presentations, references and so on? The number and range of published technical papers is evidence of the successful use of the software.

What training will I receive in the use of the software? Can the supplier direct me towards general seminars addressing the thermal design of electronic systems? A supplier that is offering a range of general training courses is likely to have a broader view of the industry which goes beyond their own software.

Is the supplier fully focussed on the electronics industry? Can the supplier provide references from customers working in my industry sector? (e.g. telecomms, aerospace & defence, automotive, computers, networking, consumer, power)

Does the supplier also provide a full thermal design consultancy service? If so, can I see examples of completed projects? A supplier who is active in thermal design consultancy will be familiar with practical design issues associated with a range of electronic hardware.

Will the supplier readily arrange for a demonstration of the software at my facility, or allow me a trial run for a predefined period? A good software vendor will positively encourage you to "try before you buy", demonstrating confidence in their solution.

TECHNICAL ISSUES

In evaluating thermal analysis software for electronic systems, the user should consider the following technical issues: the modelling methodology; the definition of a system for analysis; the creation of a computational grid; the solution and control features; and the presentation of the results. These issues are reviewed in detail here.

Modelling methodology

Does the software represent all 3 modes of heat transfer – conduction, convection and radiation? If not – it's a non-starter! Heat transfer in electronics is a fully-coupled problem involving all 3 modes simultaneously. Methods which prescribe heat transfer coefficients at solid/fluid surfaces are simply not adequate.

Is it possible to include interfacial (or 'contact') resistances between objects or components?
Temperature gradients associated with interfacial resistances can greatly influence the accuracy of a simulation, so it is important to be able to incorporate these resistances in the software.

How does the software solve for radiation? Are view factors between radiating surfaces automatically calculated? Radiation exchange is a key heat transfer mechanism for many applications, especially for sealed boxes or systems cooled by natural convection. It should be quick and easy to allow for radiation exchange between user-selected surfaces, with view factors being calculated automatically.

Can the software represent the effect of solar radiation on an electronic enclosure? Solar radiation can greatly increase temperatures within electronic systems which are deployed outdoors, so it is critical to include solar radiation for the analysis of these systems.

Can the software do transient calculations specific to my requirements? What time steps and profiles can I impose for heat sources, ambient conditions and so on? If you are going to be solving transient problems, it should be easy to specify the time-varying profiles you need to use.

Definition of system

What form of interface do I use to define the geometry of my system? Check out the user interface yourself. Find out how easy it is to create geometry, and focus especially on how easy it is to move items around after gridding has been done.

Can I transfer complete system geometry from my MCAD software (i.e. true CAD integration), or must I transfer one part at a time? Look for a solution that not only allows you to transfer geometry, but also enables rapid simplification of the MCAD geometry where necessary. This will save considerable solution time.

Does the software have a comprehensive library of materials, facilitating the swift definition of material and surface properties? This feature will save you time finding the relevant data in engineering handbooks and other sources.

Are intelligent parameterised objects implemented in the software to allow easy definition of parts such as enclosures, heat sinks, fans, PCBs, and vents? Ideally, the creation of such common objects should involve simply filling in the blanks in an on-screen menu.

If I need to predict junction temperatures of particular components accurately, how easy is it to get the necessary internal details of these components into the software, and is there a proven method for doing this? There are now JEDEC standards for creating “compact” thermal models of components. A “compact” model is simply a connected network of thermal resistances which collectively represent the thermal behaviour of the device in any environment. Choose a software which allows you to populate a simple form and which creates JEDEC-compliant models automatically. This is the only way to be sure you are predicting junction temperatures accurately. Beware of software offering a “generalized resistance network” allowing you to create an arbitrary network of thermal resistances yourself – this is likely to take a lot of time and lead to the wrong results unless you know exactly how to create the correct, validated network for the part in question.

Computational mesh

Does the meshing technique of this software lead to the most efficient, speedy solution for the kind of problems I need to solve? How quick and easy is it to create the computational grid? Look for software which creates the grid instantly around the objects, and then allows you to refine the grid between objects as necessary. You should be able to move or re-size an object after the grid has been generated, and the grid should adjust itself instantly.

Does the software allow multi-level nested mesh? This allows you to use a locally fine grid inside a much coarser grid. This is an important feature because it allows you to focus on regions of specific interest, without wasting computational cells elsewhere (e.g. to capture temperature gradients or boundary-layer effects inside or around a critical component).

‘Non-conformal’ or ‘unstructured’ meshing is often touted as an advantage – in reality it can be an Achilles heel. Non-conformal or unstructured meshing allows a mesh to be created around almost any geometry (which is clearly an advantage), but carries a very significant overhead in terms of user mesh-creation time, mesh complexity, and solution times. For the vast majority of geometries encountered in electronics cooling problems, the use of non-conformal unstructured mesh represents an unnecessary over-complication of the problem.

Solution features

Is it possible to view variables of interest – the temperatures of critical components, for example – while the solution is converging? Early indication of the solution can facilitate swift decisions, speeding up the design process.

Can I set the software to solve a pre-defined batch of scenarios overnight or over a weekend?
Batch processing allows for the optimum use of processing time, preventing those awkward ‘out-of-hours’ trips to work to run extra models…

Does the software provide automatic optimisation of my design? Can I perform rigorous ‘what if’ analyses of my design in order to determine the influence of particular parameters – for example, to optimise a heat sink or the layout of a circuit board? The software should allow you to specify what you are trying to optimise (e.g. minimize the temperature of a particular component), specify the variables which can change, and the range of variation (e.g the size/location of a vent), and then the software should find the optimum solution for you in an intelligent way, without running every single possible combination of variables.

Can I configure the software to exploit free processing time on other computers in my network in order to speed up convergence time? This feature allows big, complex problems to be solved extremely quickly.

Results

How does the software present the generated results? Can I output data in both tabular and 3D graphical form? Can I easily view point, planar and surface plots of variables such as temperature or air speed? Can I present the results in a way which non-technical people will quickly understand (e.g. can I visualise the air flow through my system as a 3D animation)? Can I save images as JPG or GIF files for quick and easy incorporation into reports?