Hard Disk Player Thermal Analysis

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Abstract
When designing hi-fi components attention has to be paid to the thermal performance. Excessive heat would cause longer term reliability problems and short term problems in adhering to the various safety standards around the world. Naim products are sold and used worldwide in many climates.

1. Target Performance
The specification required the unit to run happily at ambient temperatures at or below 25 degrees C without the use of a fan to cool the components. At higher ambient temperatures the fan would be required to run to keep components inside the box cool.

2. Modelling
To optimise the thermal performance of the Naim Hard Disk player and server products a combination of computer analysis and verification testing was used.

Using the mechanical CAD model of the product as a start point, a thermal model was created and analysed using FEA (Finite Element Analysis) and CFD (Computational Fluid Dynamics) to predict airflow patterns within the product and the temperatures of key components. This involved calculating heat output values for all the heat generating components such as processors, power supplies and both hard drives.

The software uses these values and the thermal properties of the materials to predict the flow patterns and maximum temperatures reached from a meshed model. The software model predicted temperatures at different ambient temperatures and with the fan turned on or off. It was also possible to use the model to optimise the position of the fan and to confirm that the planned airflow was ideal.

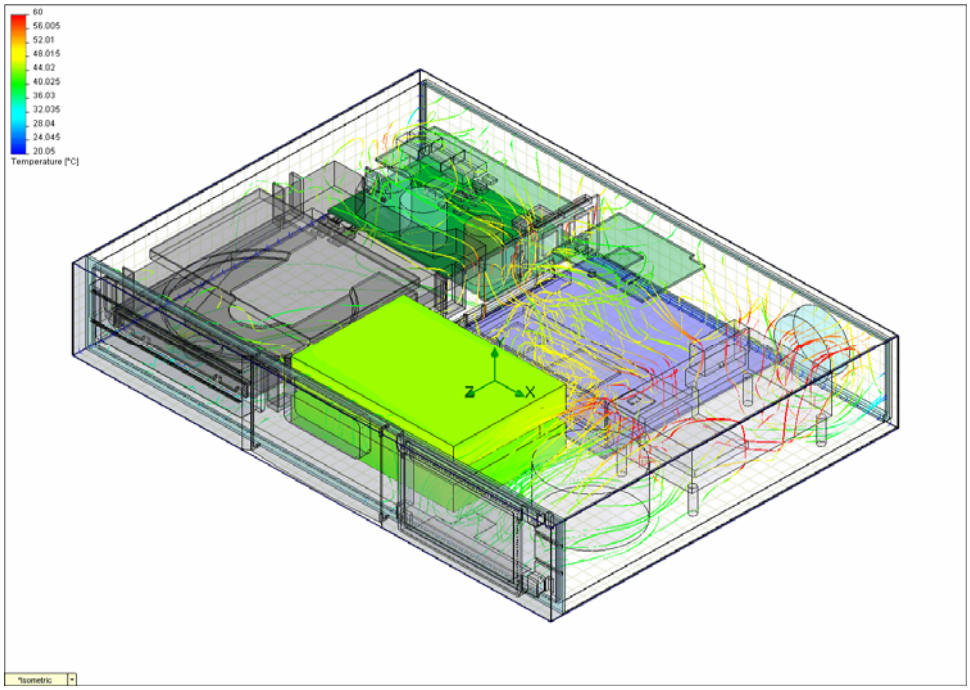
The Thermal model allowed predictions of what would happen when materials or the design changed and to fine tune the design for thermal performance.

The product case is constructed from 5mm thick aluminium, which provides an in-built heat sink for the components and a path to remove heat from the product. Key components have been coupled to the case to provide a direct conductive heat path to the cover and hence, the outside world. For instance the hard drives are connected directly to the cover via thick machined aluminium blocks.

The back-up drive is sent to sleep when not in use to limit the heat that is generated and the primary drive is located closest to the cover to shorten the distance of the heat path to the outside world.

The best grades of material were selected to minimise thermal resistance to provide a product with optimum passive cooling. The final product was sent to the design and verification test centre of Seagate (the hard drive manufacturer) who confirmed our analysis and testing. The results indicated that “the drive will remain within specification limits up to ambient conditions over 40°C even with the fan off.”

We have chosen to use the fan at ambient temperatures above 25 Degrees C to maintain the best reliability of the hard drives (the fan is controlled by monitoring the on board temperature sensor on the hard drives). The product also monitors the motherboard processor temperatures.



3. Conclusion

Thermal modeling using CAD, FEA and CFD has saved a huge amount of time in the development process.

The verification by Seagate's labs further increased confidence in the use and analysis of these powerful software tools thus potentially shortening product development times.

Naim's HDX is powered by the DigiFi™ platform; leading edge software technology licensed from DigiFi Ltd of London