AAVID THERMALLOY

SMALL FORM FACTOR COOLING WITH JET AIR MOVER TECHNOLOGY

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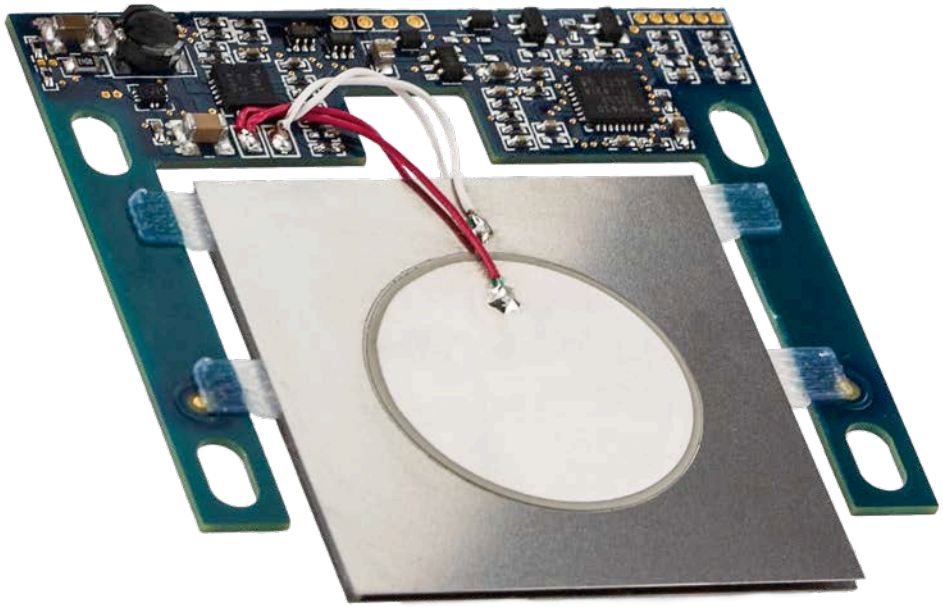
This presentation provides an in-depth look at the implications and practical applications of active jet cooling for small form factor electronics.

As jet cooling becomes smaller and more prevalent, these unique air movers have a greater impact on how we design smaller electronics, especially in regards to design space, design flexibility and overall performance and reliability.

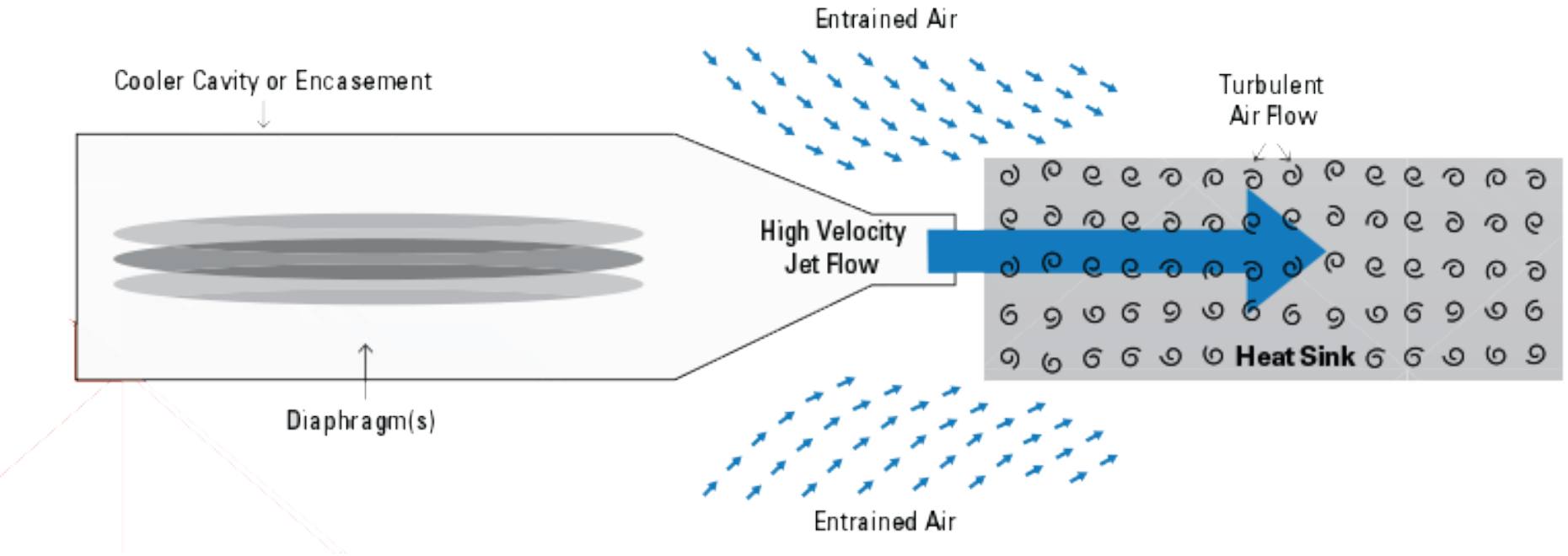
PulseJets & Jet Technology

A New Approach to Air Cooling.



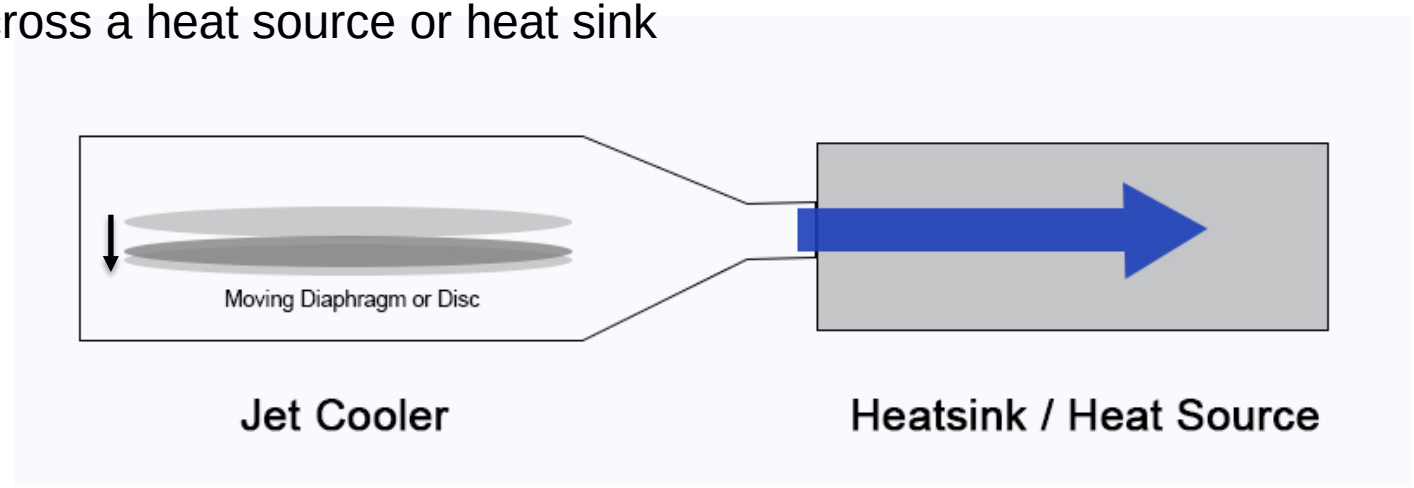
A Brief Look at the Technology

All Jet technology works with the basic principles of entrainment and turbulence of ambient air flow.

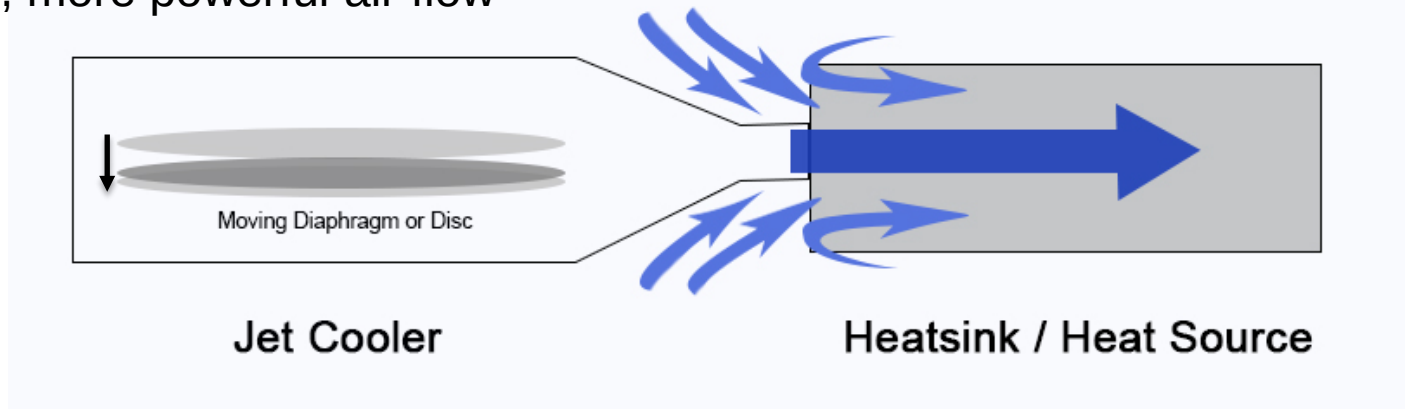


A Brief Look at the Technology

A moving diaphragm or disc creates pulses of air that blow quickly out of a cavity and across a heat source or heat sink

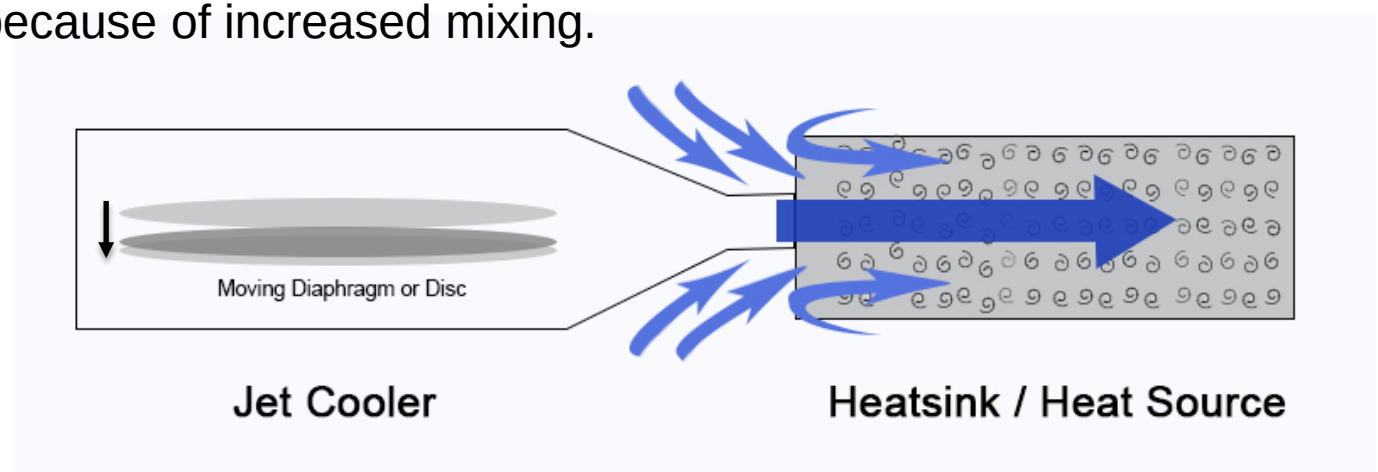


The high velocity pulse entrains the ambient air around the opening leading to a greater, more powerful air flow

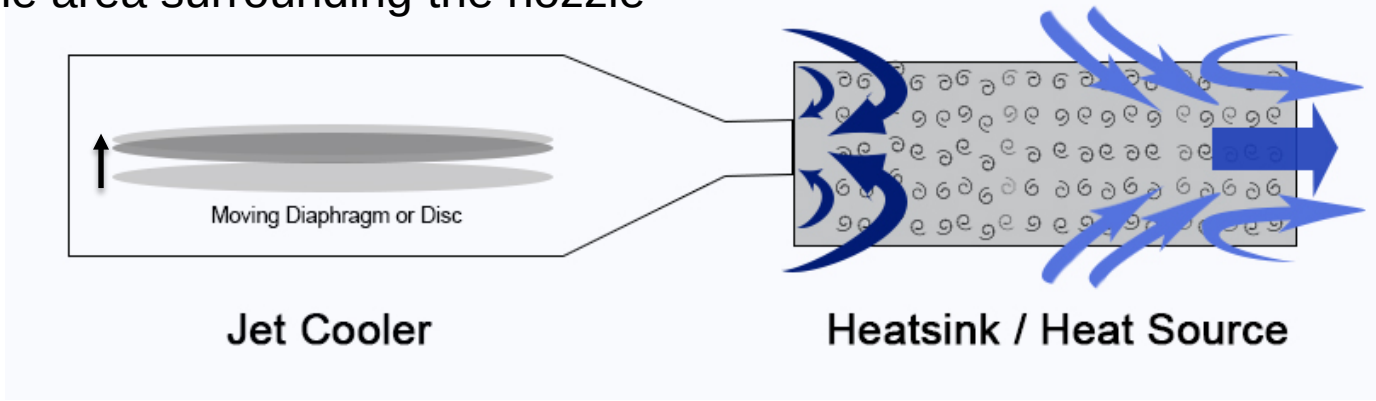


A Brief Look at the Technology

The air turbulence created by these quick “exhalation” pulses removes more heat because of increased mixing.

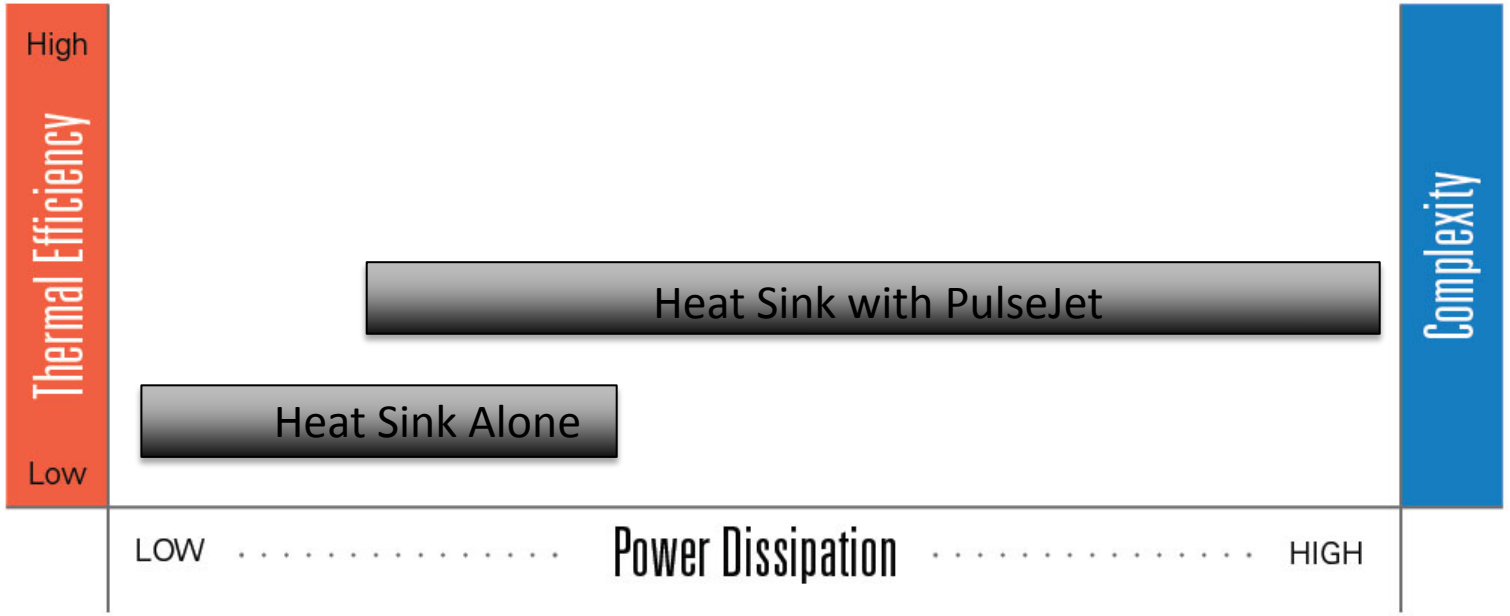


The “inhalation” movement of the diaphragm then brings in fresh ambient air from the area surrounding the nozzle



Jet Cooling vs. Passive Cooling

The addition of PulseJet to your passive thermal solution can increase heat transfer by as much as 2X, therefore enabling more powerful and/or smaller solutions



Jet Cooling vs. Traditional Air Cooling

- Whereas fan operate with frictional parts that can wear over time, PulseJets have no frictional moving parts. This leads to increased reliability, less noise over time, and resistance to dust or particle build up.

- The turbulence created by the quick pulses of air results in a highly mixed, more focused air flow that improves overall heat transfer

- PulseJets use less power than a fan or other forms of active cooling. The minimal power needed combined with the improved heat transfer increases the overall performance of the device

- PulseJets are extremely small and need little to no clearance space. Additionally they can be stacked or easily mounted wherever they are needed, enabling more flexibility in design and engineering.

Implications on Small Form Factor Design

- Ideal for retrofitting or boosting the performance of a current design without having to respin a board or redesign for more space.

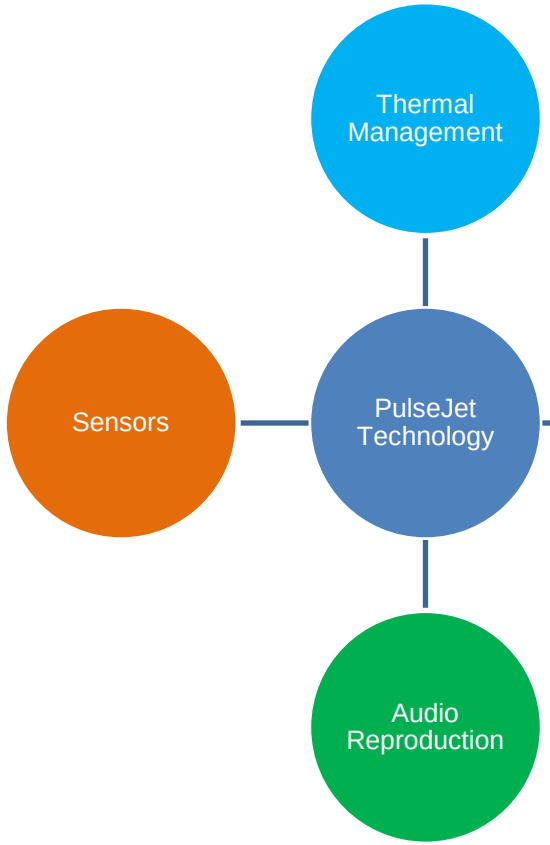
- Allow for more lightweight designs by decreasing the size of the passive component

- No breakdown, performance loss, or additional noise due to long periods or use or dust build up

- Frictionless solution is can be easily equipped and proofed for outdoor usage especially in harsh environments where salt spray, corrosion, water, and extreme temperatures are a hazard

- Stacking and attaching abilities allow for a scalable solutions without additional materials or sizeable increases to weight or volume.

Multi-function SynJets



- High Reliability Fanless Cooling
- Low power and acoustics

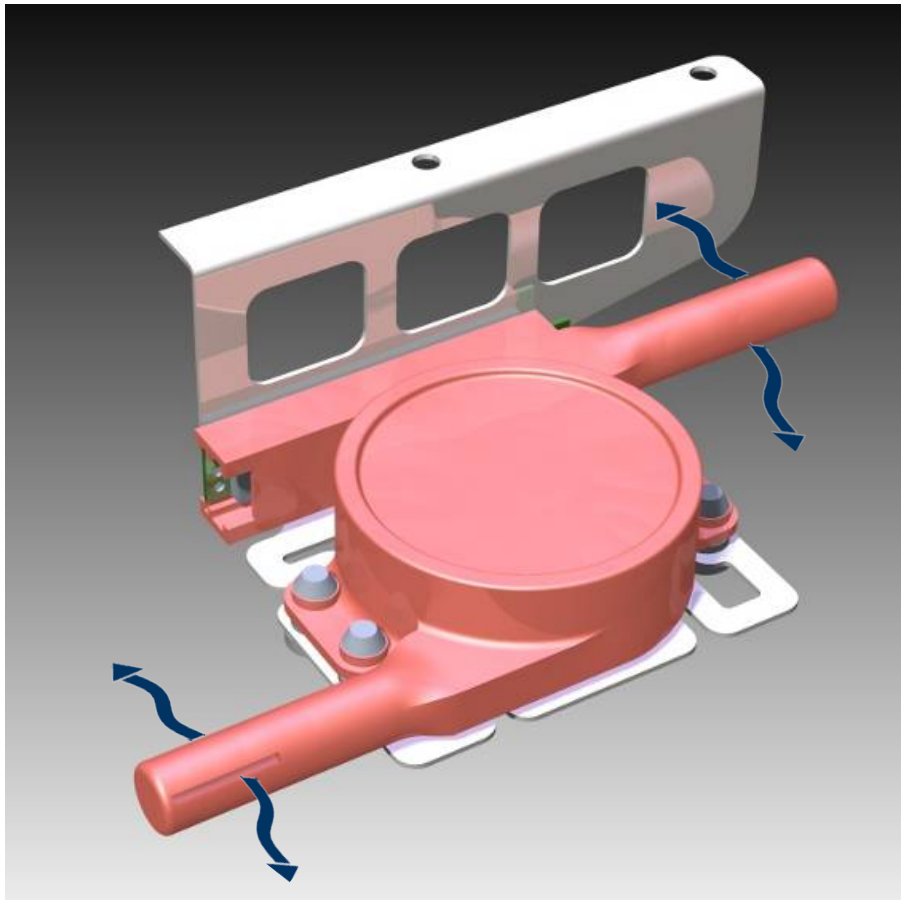
- Microphone, audio input
- Contaminant detection
- Vibration/Motion sensing

- Tactile Feedback for Gaming
- Notifications
- Eliminate Haptic Device

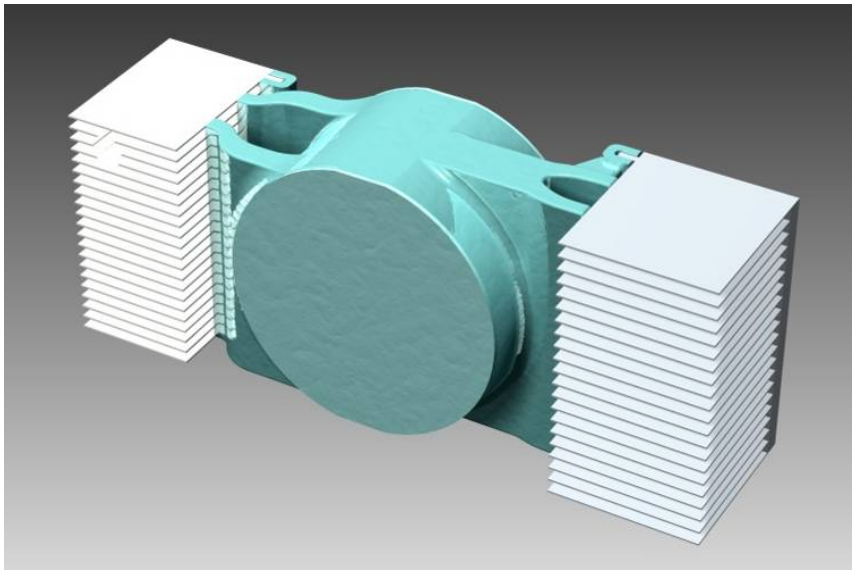
- Audio output for music, video, gaming
- Notifications
- Eliminate speakers

Multi-Directional Cooling

- Late-stage design that needed cooling on several different components without resorting to adding ducts or a fan
- Directed air from a single PulseJet device in four different directions successfully cooling the components
- Result: An almost silent CE device for living room use without thermal reliability issues



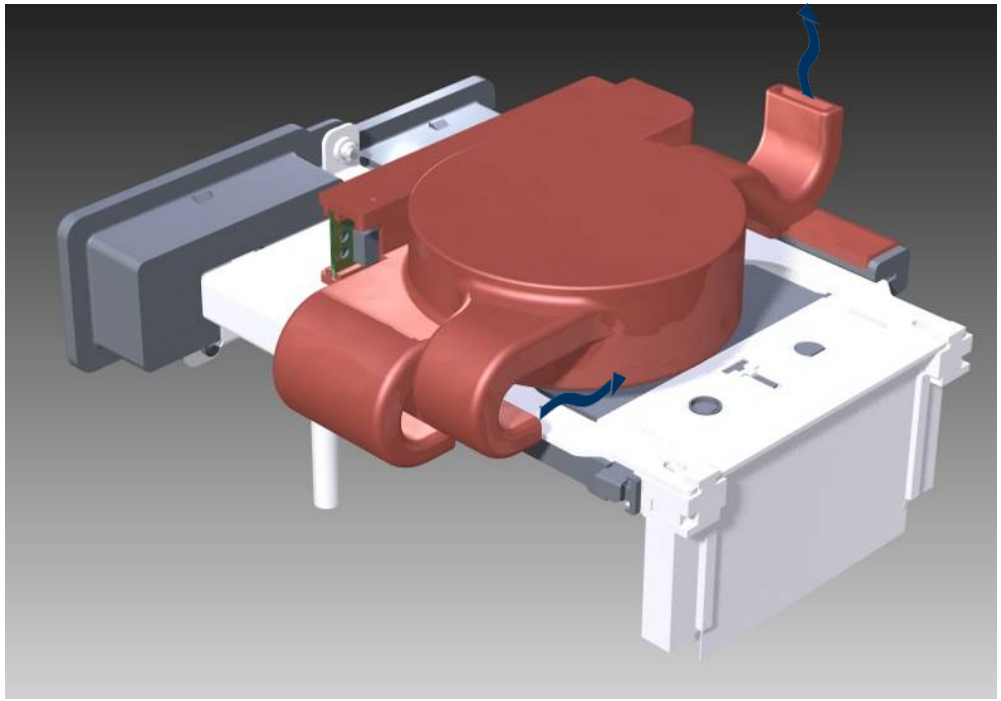
Asymmetric Cooling



- Cooling two heat loads with two different thermal efficiencies
- Larger load routed to the larger heat where it could be cooled more aggressively
- PulseJet flow divided between two “tuned” heat sinks
- Result: Over a 25dBA sound reduction compared to a fan, optimal thermal levels, high reliability plus enabling an innovative industrial design

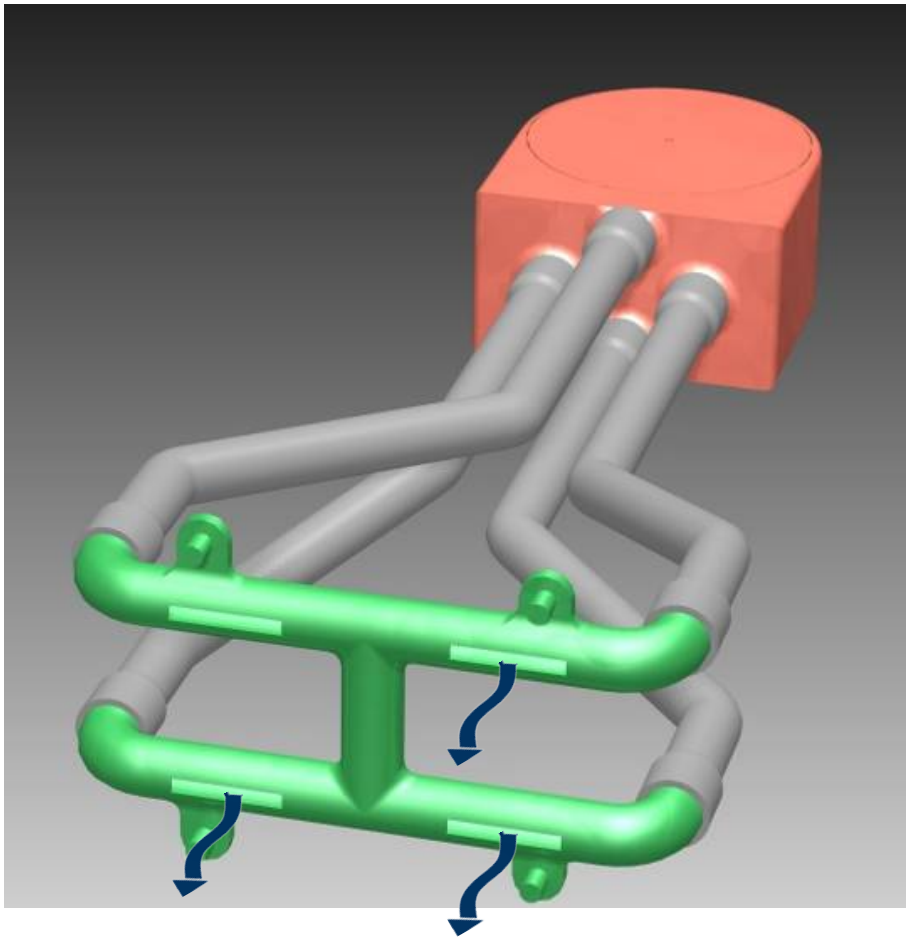
Embedded

- Embedded card
- Cool air directed over the top and bottom of the hot card cage
- PulseJet module air flow established to flush the hot air out of the chassis
- Local ambient temperatures inside the chassis dropped dramatically along with the case temperature of the card
- Result: Very low acoustic signature and reliability several times that of a fan



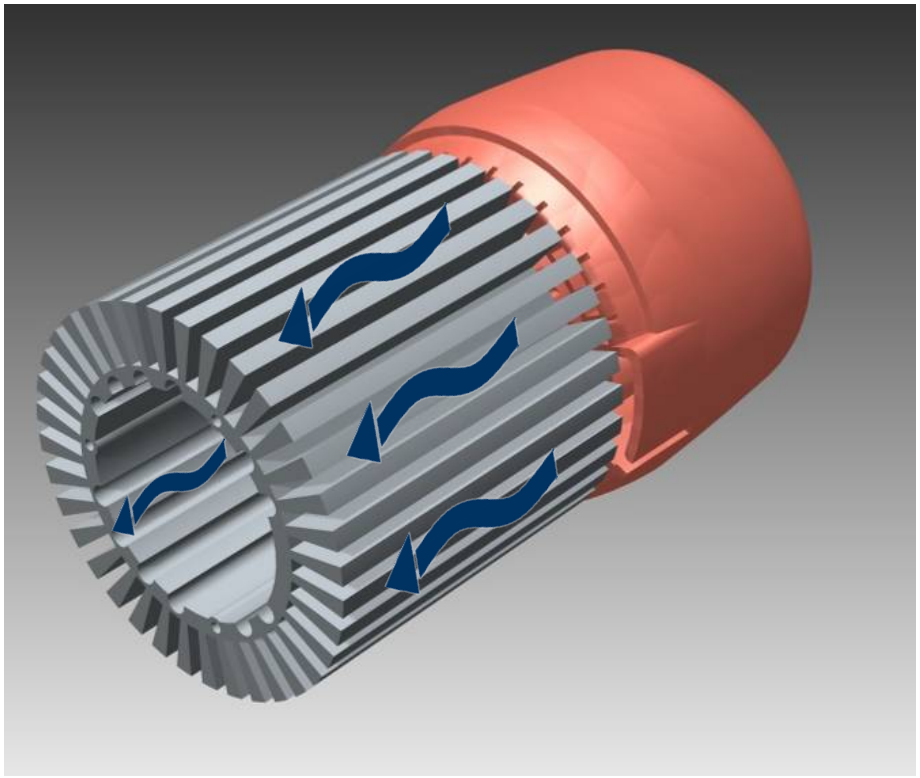
Remote Cooling

- As designs shrink, hot components get tucked into odd places
- The cooling synthetic jet can be formed far from the actuator
- Remote cooling allows components to be placed creatively in geometries previous thought impractical
- Result: Innovative industrial design with cooling in multiple chassis locations



Conformal Cooling

- PulseJet module cooling can be integrated into the industrial design of a product
- Form follows function, and PulseJet module cooling can be shaped into nearly any form
- Two concentric circles of flow were created to travel down the ID and OD of a cylindrical heat sink
- Result: Size of end product reduced, ultra-high reliability and almost silent operation



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