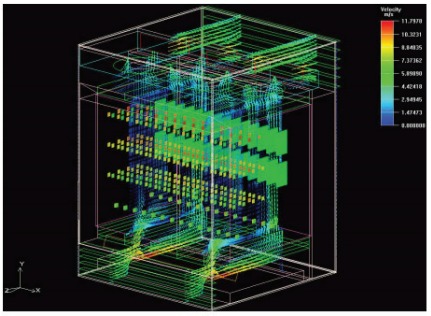
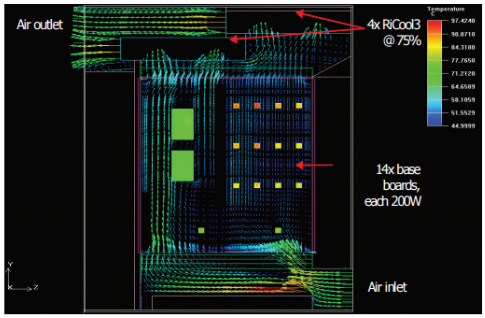
White Paper

Powerful Front-to-Rear Cooling Solutions for Embedded Computing Systems

Utilizing Reverse Impeller Blowers for Higher Performance

Cooling an embedded computing system is important for many reasons. Poor heat dissipation can not only cause system failures, but significantly shorten component life. Downtime in applications that require high reliability is not acceptable. It is critical to cool a system properly, while balancing other factors such as size, weight, and acoustic noise.





Airflow Physics

Air takes the path of least resistance, therefore pulling the air out is much more effective than pushing air through an enclosure. When pushing air, it can be challenging to have the proper bends to maximize cooling. Inevitably, there will be a backflow of the air and the backpressure will hamper the performance. Pulling the air alleviates these issues for much greater efficiency. Figure 1 shows various cooling methods using tube axial fans.

Tube axial fans can certainly do the job in many applications. However, systems with very high power processors may need another approach. Further, if rear I/O is required there could be challenges in removing rear modules efficiently and having enough chassis depth available.

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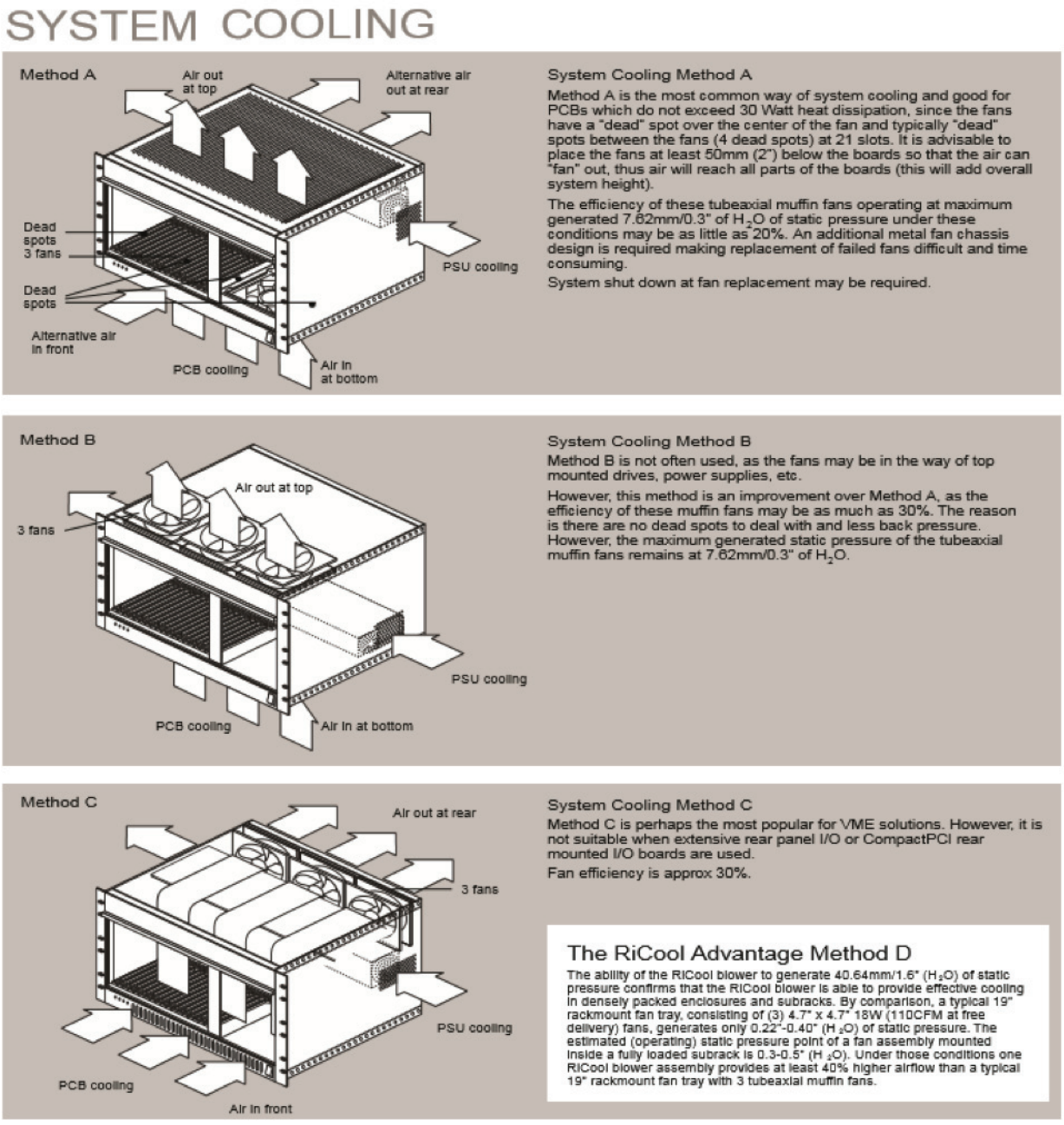
Figure 1: *Systems cooling configurations. (Note: The Method D RiCool Advantage refers to first generation RiCool blowers at 110 CFM. Today's RiCool blowers are at 191 CFM.)*



Reverse Impeller Blowers

For superior cooling performance, using powerful air-pulling fans above the card cage with reverse impeller blowers is a great alternative. These fans pull air in one axis (to the top of the chassis) and blow the air out in another axis (through the rear of the chassis). While this is done, its important to minimize SWaP (Size, Weight, and Power) in most applications. The RiCool III blowers (see Figure 2) only takes up 1U of the space in the chassis. Most front-to-rear airflow enclosures use 1U-3U above the card cage for airflow.

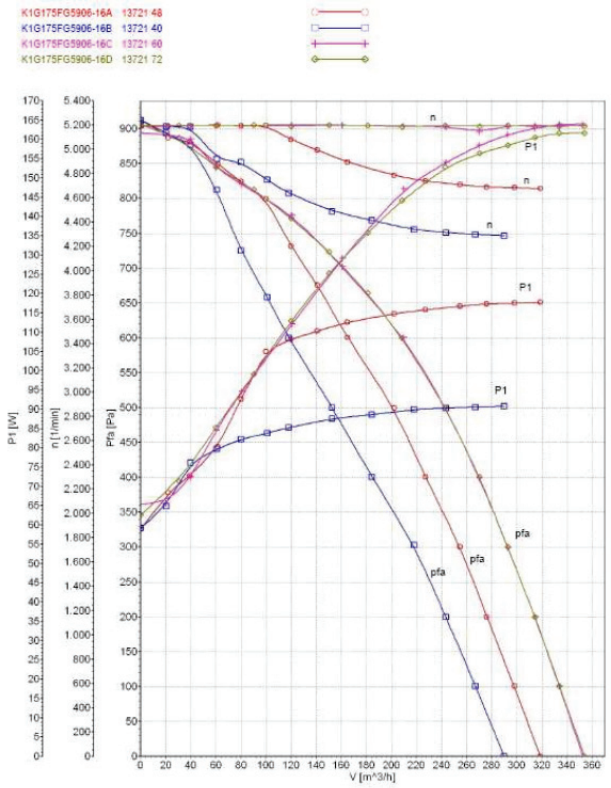
Figure 2: *RiCool III fan*

Today's RiCool III blowers can generate 191 CFM of airflow with 3.6" (H20) of static pressure. Figure 3 shows an example of reverse impeller blowers in a 9U VPX chassis with front to rear airflow. This chassis design can dissipate over 2400W in redundant mode. Even if a fan went out, it could dissipate over 2.4 kW while the faulty fan was hot-swap replaced. As weight is important in most Mil/Aero applications, it is important to note that the weight of the 3rd generation of blowers have decreased 25% from the RiCool I versions.

Figure 3: *RiCool III Spec Chart and Performance Chart*

RiCool III

CFM:	191
Static pressure:	3.6" H2O
Voltages:	12, 24, 48V
Amps:	1.5
Noise (full speed):	64 dB
Noise (70% speed):	59 dB
Weight:	3.75 lbs
Monitoring:	IPMI (PICMG 3.0, VITA 46.11, etc)
Hot Swappable:	Yes



The RiCool blowers were incorporated by Kaparel/Rittal over ten years ago in their first generation AdvancedTCA chassis that dissipated over 275W/slot. This highly successful design was chosen for the largest early ATCA programs and garnered over 15,000 installs globally. Today's enclosures require even more demanding cooling. Figure 4 shows a new 15U AdvancedTCA chassis using special RiCool IV blowers, providing a total of 942 CFM. It cools in excess of 400W/slot while meeting all NEBS compliance criteria and recommended practices from the CPTA. Today's reverse impeller blowers have options for 12V, 24V, and 48V input requirements.

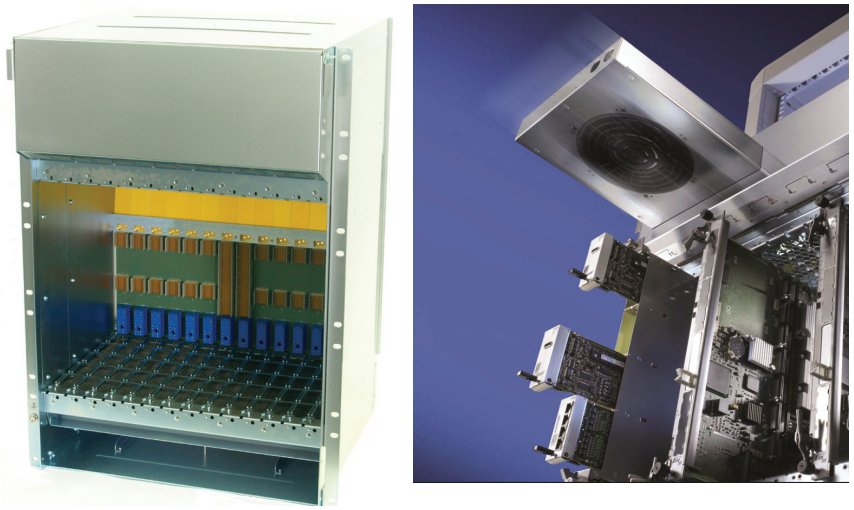


Figure 4: *15U AdvancedTCA enclosure supporting over 400W/slot of cooling.*

Static Pressure

Static pressure gauges the resistance to the airflow and how equal the flow is maintained in all directions. In embedded systems, it is particularly important to ensure the air can be moved through the tight spaces between the board slots. The reverse impeller approach creates over 91mm (H2O) of static pressure confirming that it is able to provide effective cooling in densely packed enclosures and subracks. By comparison, a typical 19" rackmount fan tray, consisting of (3) 4.7" x 4.7" 18W (110 CFM at free delivery) fans, generates only 0.22"-0.40" (H2O) of static pressure. The estimated (operating) static pressure point of a fan assembly mounted inside a fully loaded subrack is 0.3-0.5" (H2O). Under those conditions one reverse impeller blower assembly provides at least 75% higher airflow than a typical 19" rackmount fan tray with 3 tube-axial muffin fans.

Various Applications

Pixus Technologies utilizes a wide range of cooling solutions to match your performance requirements with your budget constraints. This includes all types of side-to-side, bottom-to-top, and front-to-rear approaches. For the most demanding Mil/Aero and Telecom applications, we leverage the patented Rittal RiCool blowers for superior cooling results. With the team that designed some of the most successful embedded computing enclosures in the industry, we have the expertise to provide the right solution for you.