Compact, High Performance Air-Cooled Heat Sinks

Custom, compact, high performance air-cooled heat sinks, shown in Figure 1, designed to meet the most demanding electronics cooling requirements in both commercial and military applications. This product is the result of the DARPA Research & Development program, entitled Microtechnologies for Air-Cooled Exchangers (MACE), to advance the air side heat transfer performance over current State-of-the-Art heat sinks. The unique design integrates Therma-Base® Vapor Chamber technology within a truly 3-Dimensional heat pipe cooling product, where the vapor flow spreads the heat both laterally in the base and into planar appendage heat pipe blades for a highly efficient, isothermal 3D heat sink. Attached to the planar blades are high density rolled and louvered fins, resulting in an isothermal, high surface area, air-cooled heat sink with exceptionally low thermal resistance and high coefficients of performance.

Key Features:
- Compact
- Highly Reliable Passive Device
- Integrated Air-to-Air Compact Heat Exchanger
- High Volumetric Isothermally
- Available with COTS Fans
- Available for 3U to 6U Enclosures and Larger

Key Benefits
- Excellent Thermal Uniformity (shown in Figure 2)
- Ultra-low Thermal Resistance (shown in Figure 4)
- Lower Electronic Component Temperatures
- Longer Microprocessor Life and Reliability
- Compact Design with integrated Heat Exchanger
- Passive (i.e. no liquid pumps)
- Scalable and Reconfigurable Design
- Available in 3U, 4U, 5U, and 6U Formats (Example 4U shown in Figure 3)

Figure 1 – Compact, High Performance Air-Cooled Heat Sinks for 3U to 6U Electronics Formats

Figure 2 – Thermal Image of a 4U Heat Exchanger at 1000 watts dissipation.

Figure 3 – Example of a Complete 4U Assembly with fan, shroud, and mounting hardware.

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### Critical Application Needs

- Computer Server Microprocessors
- Military Electronics Cooling
  - ATX Chassis
  - Embedded Computing Applications
  - Avionics in Unmanned and Manned Aircraft
  - Vetronics in Ground and Surface Vehicles
  - Mobile Electronics
  - Military Radars
  - Microwave/RF
- Power Electronics and Power Converters
- Telecommunication Electronics
- Medical Equipment Electronics

### Other Related Technologies

- Embedded Heat Pipe Assemblies
- Therma-Base® Vapor Chambers
- VME/VPX Cold Plates
- k-Core® Annealed Pyrolytic Graphite (APG)
- Air-to-Air Heat Exchangers

### Specifications – High Performance Air-Cooled Heat Sinks

<table>
<thead>
<tr>
<th>Power / Heat Load</th>
<th>250 to 2000 Watts depending on model.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>See Performance Curves shown in Figure 4.</td>
</tr>
<tr>
<td>Materials of Construction</td>
<td>Wall – Copper Wick – Copper Fin - Aluminum</td>
</tr>
<tr>
<td>Working Fluid</td>
<td>Water or Methanol</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>3U</th>
<th>4U</th>
<th>5U</th>
<th>6U</th>
<th>6U 2 Fans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Air Flow Rate (CFM)</td>
<td>75</td>
<td>90</td>
<td>95</td>
<td>100</td>
<td>180</td>
</tr>
<tr>
<td>Dimensions (L x W x H) in. With fan</td>
<td>4 x 4 x 3.8</td>
<td>4 x 4 x 4.2</td>
<td>4 x 4 x 5.9</td>
<td>4 x 4 x 7.6</td>
<td>4 x 4 x 7.6</td>
</tr>
<tr>
<td>Mass (grams) without fan</td>
<td>600</td>
<td>700</td>
<td>900</td>
<td>1100</td>
<td>1100</td>
</tr>
<tr>
<td>Coefficient of Performance (@30°C ΔT)</td>
<td>33</td>
<td>33</td>
<td>38</td>
<td>42</td>
<td>27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fan Specifications Model</th>
<th>3U</th>
<th>4U-6U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage (VDC)</td>
<td>12-28</td>
<td>12-28</td>
</tr>
<tr>
<td>Power (Watts)</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>Size (mm)</td>
<td>80</td>
<td>90</td>
</tr>
</tbody>
</table>

| Max. Operating Temperature | 65 to 100°C |
| Storage Temperature Range | -55°C to +100°C |

| Mounting Features | Customized for each Application |

**Figure 4 – Thermal Resistance vs. Airflow Rate**

*95mm x55mm Heat Input Area*