curamik® Power curamik® Power Plus
curamik® Performance
Al₂O₃ ceramic based substrates are standard products with the best price performance ratio. They are mainly used in applications of medium and lower power ranges, such as
//  General Power Electronics
//  Concentrated Photovoltaics (CPV)
//  Peltier Elements

HPS substrates are enhanced in robustness through Zr doped Al₂O₃ ceramic. They are mainly used in applications of medium power ranges, such as
//  Advanced Industrial Applications
//  Automotive Power Electronics

Substrates based on Si₃N₄ ceramics are produced in an AMB process. They are mainly used in applications where a long lifetime, high reliability, and robustness are required and partial discharge should not occur, such as
//  Automotive Power Electronics
//  High Reliability Power Modules
//  Renewable Energy

Substrates based on AlN ceramics are used in applications with very high operational voltages and highest power density, such as
//  Traction
//  Smart Grid
//  Industrial High Power Modules
//  Energy
curamik® high temperature/high voltage substrates consist of pure copper bonded to a ceramic substrate such as Al2O3 (Alumina), AlN (Aluminum Nitride), HPS (ZrO2 doped) or silicon based Si3N4 (Silicon Nitride).

curamik provides two technologies to attach the substrate with the copper: DBC (direct bond copper) – a high temperature melting and diffusion process where the pure copper is bonded onto the ceramic and AMB (active metal brazing) – a high temperature process where the pure copper is brazed onto the ceramic and AMB (active metal brazing).

The high heat conductivity of Al2O3 (24 W/mK), AlN (170 W/mK) and Si3N4 (90 W/mK) as well as the high heat capacity and thermal energy storage of AlN and Si3N4 allow for high heat dissipation. The high thermal conductivity and energy storage enables great heat spreading, which is essential for the manufacture of high frequency and high power electronics, such as in automotive, aerospace, and power electronics applications.

Advantages:
- Efficient processing of master cards and single pieces
- Adjusted coefficient of thermal expansion
- High insulation voltage
- Great heat conductivity and temperature
- Renewable Energy
- Industrial High Power
- Smart Grid
- Traction
- Renewable Energy
- Peltier Elements

Applications:
- Automotive Power Electronics
- High Reliability Power Modules
- Smart Grid
- Renewable Energy
- Automotive Power Electronics
- Industrial High Power Modules
- High Reliability Power Modules
- Renewable Energy

Curamik® Power
Al2O3 ceramic based substrates are standard products with the best price performance ratio. They are mainly used in applications of medium and lower power ranges, such as
- General Power Electronics
- Concentrated Photovoltaics (CPV)
- Peltier Elements

Curamik® Power Plus
HPS substrates are enhanced in robustness through Zr doped Al2O3 ceramic. They are mainly used in applications of medium power ranges, such as
- Advanced Industrial Applications
- Automotive Power Electronics

Curamik® Thermal
Substrates based on AlN ceramics are used in applications with very high operational voltages and highest power density, such as
- Traction
- Smart Grid
- Industrial High Power Modules
- Energy

Modules
- Peltier Elements
- Renewable Energy
- Renewable Energy
- Automotive Power Electronics
- High Reliability Power Modules
- Renewable Energy

curamik® CERAMIC SUBSTRATES Product Information

Performance overview

Thermal conductivity
- very high
- high
- medium
- low
- very low

CU Thin film
CU Thick film
PCB
IMS

curamik® Thermal
curamik® Performance (AMB)
curamik® Power
curamik® Power Plus

Curamik® Thermal Substrates based on AlN ceramics are used in applications with very high operational voltages and highest power density, such as
- Traction
- Smart Grid
- Industrial High Power Modules
- Energy

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Al2O3 ceramic based substrates are standard products with the best price performance ratio. They are mainly used in applications of medium and lower power ranges, such as
- General Power Electronics
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Curamik® Power Plus
HPS substrates are enhanced in robustness through Zr doped Al2O3 ceramic. They are mainly used in applications of medium power ranges, such as
- Advanced Industrial Applications
- Automotive Power Electronics
**Performance overview**

curamik® high temperature/high voltage substrates with the copper. DBC (direct bond copper) – a high temperature curamik provides two technologies to attach the substrate pure copper bonded to a ceramic substrate such as Al₂O₃ (Alumina), Si₃N₄ (Silicon Nitride).

Thermal conductivity

<table>
<thead>
<tr>
<th>Material</th>
<th>Thermal conductivity @ 20°C (W/mK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al₂O₃</td>
<td>24 W/mK</td>
</tr>
<tr>
<td>AlN</td>
<td>170 W/mK</td>
</tr>
<tr>
<td>Si₃N₄</td>
<td>90 W/mK</td>
</tr>
</tbody>
</table>

Advantages:

- Great heat conductivity and temperature resistance high performance and high temperature applications
- High insulating voltage
- High heat spreading
- Adjusted coefficient of thermal expansion between chip and substrate
- Efficient processing of master cards and single pieces

**Available materials**

<table>
<thead>
<tr>
<th>Material</th>
<th>Copper thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al₂O₃</td>
<td>0.2 0.5 0.8</td>
</tr>
<tr>
<td>AlN</td>
<td>0.5</td>
</tr>
<tr>
<td>Si₃N₄</td>
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</tr>
</tbody>
</table>

**Available thickness combinations DBC**

<table>
<thead>
<tr>
<th>Copper thickness (mm)</th>
<th>DBC width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>0.6 0.8 1.0</td>
</tr>
<tr>
<td>0.5</td>
<td>0.9 1.2</td>
</tr>
</tbody>
</table>

**General dimensions**

- **Copper thickness**
  - 0.2 mm
  - 0.5 mm
  - 0.8 mm

- **DBC width**
  - 0.6 mm
  - 0.8 mm
  - 1.0 mm

- **AMB width**
  - 0.9 mm
  - 1.2 mm

**Surface options**

- **Platings**
  - Electroless Ni: 3 µm – 7 µm (8% ± 2% P) all-over
  - Electroless Au Class B: 0.03 - 0.13 μm all-over on Ni
  - Electroless Ag: 0.1 µm – 0.6 µm all-over

**Electrical and thermal properties**

- **Coeficient of linear thermal expansion (CTE)**
  - Al₂O₃: 2.5 ppm/K @ 20°C - 300°C
  - AlN: 7.1 ppm/K @ 20°C - 300°C

**Material combination AMB**

<table>
<thead>
<tr>
<th>Copper thickness (mm)</th>
<th>Cu-thickness width (mm)</th>
<th>AG thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>0.5 mm Cu-thickness</td>
<td>0.3 0.5 0.8</td>
</tr>
<tr>
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</tr>
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**Material combination DBC**

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**Material combination Case**

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</tbody>
</table>

**Typical thicknesses**

- **DBC**
  - 0.5 mm Copper
  - 0.6 0.8 1.0 mm Copper

- **AMB**
  - 0.3 0.5 0.8 mm Copper

**Max. useable area**

- 127 mm x 178 mm ± 0.05%

**Total Dimension master card**

- Width: 138 mm x 190.5 mm ± 1.5%
- Height: 248 mm x 340 mm ± 1.5%
- Depth: 0.8 mm ± 0.02 mm

**Copper strength**

- ≥ 4.0 N/mm @ 50 mm/min for DBC with copper plating 5% to 60% higher (dependent on copper thickness)

**Surface roughness**

- Lower roughness on request

**Coefficient of linear thermal expansion (CTE)**

- Al₂O₃: 2.5 ppm/K @ 20°C - 300°C
- AlN: 7.1 ppm/K @ 20°C - 300°C

**Adhesive strength**

- ≥ 4.0 N/mm @ 50 mm/min for DBC with copper plating 5% to 60% higher (dependent on copper thickness)

**Copper thickness**

- 0.2 mm
- 0.5 mm
- 0.8 mm
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