curamik®
ENABLING POWER EFFICIENCY

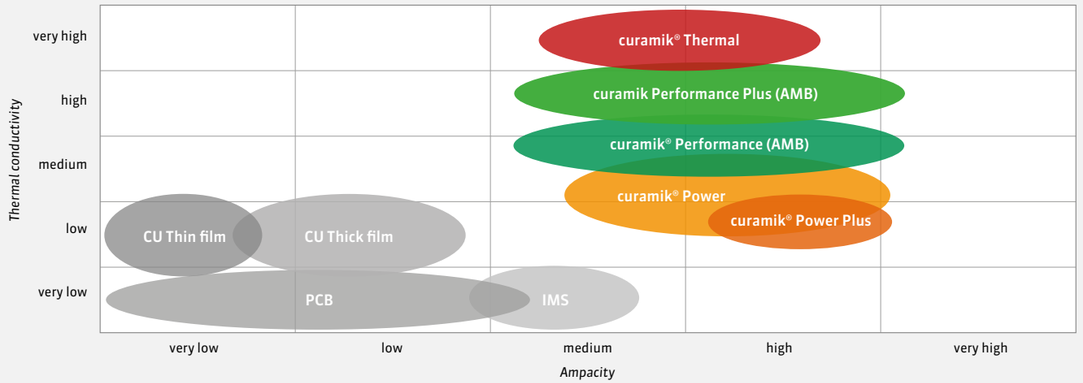
curamik® CERAMIC SUBSTRATES

Product Information
Technical data sheet

Explore a new dimension of usability

ROGERS CORPORATION

Performance overview



curamik® high temperature/high voltage substrates consist of pure copper bonded to a ceramic substrate such as Al_2O_3 (Alumina), AlN (Aluminum Nitride), HPS (ZrO_2 doped) or silicon based Si_3N_4 (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 substrate.

The high heat conductivity of Al_2O_3 (24 W/mK), AlN (170 W/mK) and Si_3N_4 (90 W/mK; 110 W/mK) as well as the high heat capacity

curamik® Power

Al_2O_3 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 Al_2O_3 ceramic. They are mainly used in applications of medium power ranges, such as

// Advanced Industrial Applications
// Automotive Power Electronics
// Renewable Energy

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

curamik® Performance

Substrates based on Si_3N_4 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

and thermal spreading of the thick copper cladding (127 – 800 µm) makes our substrates indispensable to power electronics. The mechanical stress on silicon chips mounted directly on the substrate (Chip on Board) is very low, since the coefficient of thermal expansion (CTE) of the ceramic substrate is better matched to the CTE of silicon compared to substrates using a metal or a plastic basis. Rogers produces high temperature/ high voltage substrates in a master card format that measures
5“ x 7“ and 5.5“ x 7.5“. The individual parts can be left in the master card format to support more efficient assembly and mounting of components before being separated into individual pieces. We also offer single pieces for single piece assembly.

Advantages:

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

Available materials

Al_2O_3	Alumina	curamik® Power
HPS*	Alumina (9% ZrO_2 doped)	curamik® Power Plus
Si_3N_4	Silicon Nitride	curamik® Performance
Si_3N_4	Aluminum Nitride (HiCon)	curamik® Performance Plus
AlN	Aluminum Nitride	curamik® Thermal

** The HPS products are subject to patent restrictions in some countries.*

Thermal conductivity

Al_2O_3	24 W/mK @ 20°C
HPS	26 W/mK @ 20°C
Si_3N_4	90 W/mK @ 20°C
Si_3N_4 (HiCon)	110 W/mK @ 20°C
AlN	170 W/mK @ 20°C

Available thickness combinations DBC

copper thicknesses mm

ceramic thicknesses mm	**0.127**	**0.2**	**0.25**	**0.3**	**0.4**	**0.5**
0.25	Al_2O_3	Al_2O_3 HPS	Al_2O_3 HPS	Al_2O_3 HPS		
0.32	Al_2O_3	Al_2O_3 HPS	Al_2O_3 HPS	Al_2O_3 HPS	HPS	HPS
0.38	Al_2O_3	Al_2O_3	Al_2O_3	Al_2O_3		
0.5	Al_2O_3	Al_2O_3	Al_2O_3	Al_2O_3	Al_2O_3	
0.63	Al_2O_3 AlN	Al_2O_3 AlN	Al_2O_3 AlN	Al_2O_3 AlN		
1.00	Al_2O_3 AlN	Al_2O_3 AlN	Al_2O_3 AlN	Al_2O_3 AlN		

Available thickness combinations AMB

copper thicknesses mm

ceramic thicknesses mm	**0.3**	**0.5**	**0.8**
0.25	Si_3N_4	Si_3N_4	
0.32	Si_3N_4 Si_3N_4 (HiCon)	Si_3N_4 Si_3N_4 (HiCon)	Si_3N_4 Si_3N_4 (HiCon)

Note *other copper thicknesses on request.*

Coefficient of linear thermal expansion (CTE)

Al_2O_3	6.8 ppm/K @ 20°C - 300°C
HPS	7.1 ppm/K @ 20°C - 300°C
Si_3N_4	2.5 ppm/K @ 20°C - 300°C
AlN	4.7 ppm/K @ 20°C - 300°C

with copper plating 5% to 60% higher (dependent on copper thickness)

General dimensions

Total dimensions master card	138 mm x 190.5 mm ± 1.5%
Max. useable area	127 mm x 178 mm ± 0.05%
Copper peeling strength	≥ 4.0 N/mm @ 50 mm/min for DBC with 0.3 mm Cu-thickness ≥ 10.0 N/mm @ 50 mm/min for AMB with 0.5 mm Cu-thickness

Typ. width of / spacing between conductors

Cu-thickness	**width DBC**	**width AMB**
0.127 mm	≥ 0.35 mm	n/a
0.2 mm	≥ 0.4 mm	n/a
0.25 mm	≥ 0.45 mm	n/a
0.3 mm	≥ 0.5 mm	≥ 0.5 mm
0.4 mm	≥ 0.6 mm	≥ 0.6 mm
0.5 mm	≥ 0.7 mm	≥ 0.7 mm
0.8 mm	n/a	≥ 1.0 mm

Surface options

Platings	Electroless Ni: 3 µm – 7 µm (8% ± 2% P) all-over	
	Electroless Ag	Ag Class A: 0.1 – 0.6 µm
		Ag Class B: 0.3 – 1.0 µm
	Electroless Au Class A: 0.01 - 0.05 µm all-over on Ni	
	Electroless Au Class B: 0.03 - 0.13 µm all-over on Ni	
Roughness (DCB)*	$R_a \leq 3$ µm; $R_z \leq 16$ µm; $R_{max} = 50$ µm	
Roughness (AMB)*	Ra ≤ 1.5 µm; Rz ≤ 10 µm; Rmax = 50 µm	

** Lower roughness on request*

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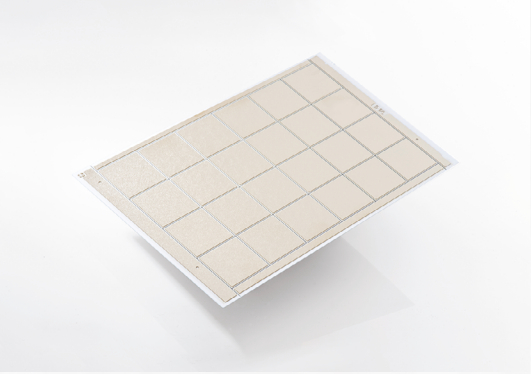

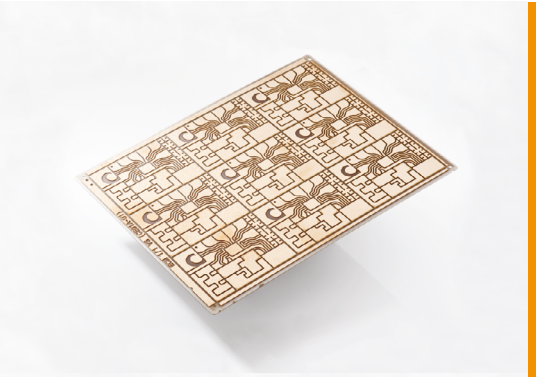

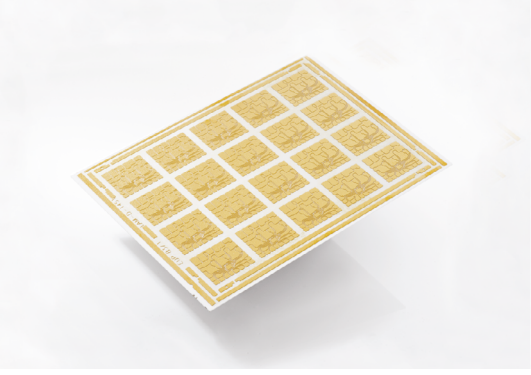

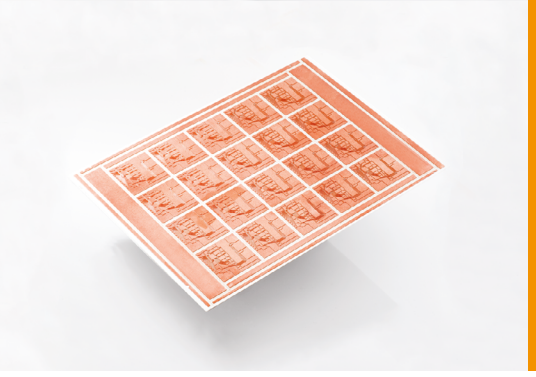

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