

DIRECT BOND COPPER SUBSTRATES

Specifications and Design Rules

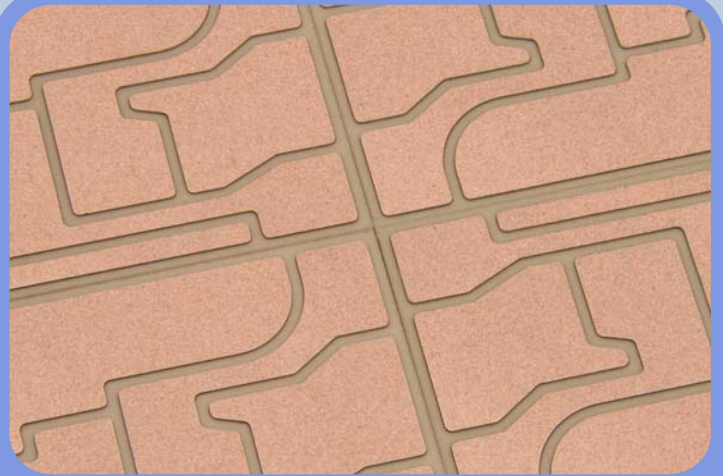
Material Combinations

STANDARD Al ₂ O ₃					
	Thickness	.010"	.015"	.025"	.040"
Copper	.005"	✓	✓	✓	✓
	.008"	✓	✓	✓	✓
	.012"		■	✓	✓

Al ₂ O ₃ OPTIONAL			
	Thickness	.030"	.035"
Copper	.005"		
	.008"	■	■
	.012"	■	■

■ Special order only.
 .010" Copper is special order only.
 Single side Copper available in limited configurations.

STANDARD AlN					
	Thickness	.010"	.015"	.025"	.040"
Copper	.005"		✓	✓	✓
	.008"		✓	✓	✓
	.012"			✓	✓



Geometric Properties

Mastercard Overall Plate size: Nominal 5.5" x 7.5"
 Actual 5.43" x 7.50"

Maximum usable Cu area: 5.0" x 7.0"

Overall thickness tolerance of ceramic + copper: +7%/-10%

Ceramic perimeter tolerance: Al₂O₃ as fired ±2%
 AlN as fired ±0.5%

Copper surface finish: R_{max} ≤ .002"; R_a ≤ .00008";
 R_z ≤ .00063"

Physical Properties

Thermal conductivity: Al₂O₃ 24-26 W/mK @ 20°C
 AlN 170-180 W/mK @ 20°C

Electrical resistivity: >10¹⁴ Ωcm

Dielectric constant: Al₂O₃ 9.8 ±10% @ 1MHz
 10.0 ±10% @ 1GHz
 AlN 9.0 ±10% @ 1MHz

Dielectric loss: Al₂O₃ 0.0003 @ 23°C, 1MHz
 AlN 0.0005 @ 23°C, 1MHz

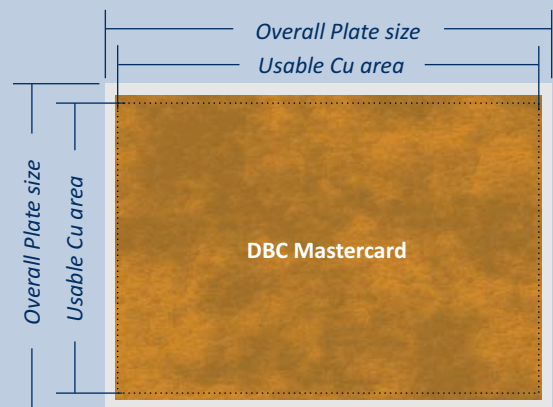
Dielectric strength (DC): Al₂O₃ 20 kV/mm @ .025"
 28 kV/mm @ .010"
 AlN 20 kV/mm @ .025"

Copper peeling strength: Al₂O₃ ≥22.8 lb/in. @ 2 in./min
 (typical Cu-thickness .008")
 AlN ≥28.6 lb/in. @ 2 in./min

Operating temperature: -55°C to +850°C
 (critical in H₂ atmosphere >400°C)

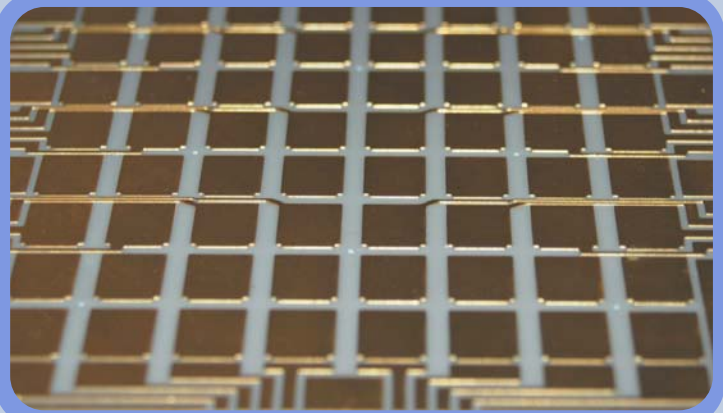
E-Module (blank ceramic): Al₂O₃ 340 GPa
 AlN 320 GPa

Electrical conductivity: 58 x 10⁶ S/m
 (Cu surface)



Physical Properties Cont'd

Bending Strength:	$Al_2O_3 > 350 \text{ N/mm}^2$
<i>(blank ceramic)</i>	$AlN > 300 \text{ N/mm}^2$
	6.8 ppm/K @ 20°C - 300°C
Coefficient of linear thermal expansion for bare Cu:	Al_2O_3 7.3 ppm/K @ 20°C - 600°C
<i>(dependent on Cu thickness)</i>	8.0 ppm/K @ 20°C - 1000°C
	4.7 ppm/K @ 20°C - 300°C
	AlN 5.2 ppm/K @ 20°C - 600°C
	5.6 ppm/K @ 20°C - 1000°C



Design Rules

	Min. Width	Copper thickness	Minimum Pitch
Minimum width of Copper lines	Min. Space		
	Typical .012"	@ ≤ .005"	.024"
Minimum width of spaces	Minimum .010"	@ ≤ .005"	.020"
	Typical .020"	@ ≤ .008"	.040"
	Minimum .016"	@ ≤ .008"	.032"
	Typical .0275"	@ ≤ .010"	.056"
	Minimum .020"	@ ≤ .010"	.040"
	Typical .0275"	@ ≤ .012"	.056"
	Minimum .020"	@ ≤ .012"	.040"

Tighter tolerances are possible but not guaranteed in volume production.

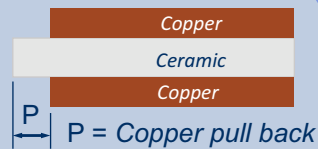
Copper pull back:

(lasered edge)

typical $P > .020" \pm .012"$

minimum $P = .014" \pm .010"$

depends on copper thickness



Front to back alignment:

$A = \pm .008"$



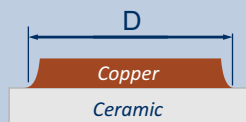
Etching tolerance:

typical $\pm .006"$ @ $\leq .008"$ Cu

minimum $\pm .004"$ @ $\leq .008"$ Cu

typical $\pm .008"$ @ $\leq .012"$ Cu

minimum $\pm .006"$ @ $\leq .012"$ Cu

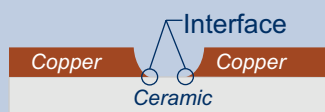


Taper of etched pattern:

Maximum $\frac{1}{2}$ Cu thickness



All Copper feature measurements are taken from ceramic and copper interface unless otherwise noted.

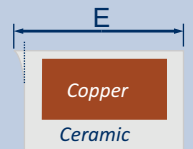


Ceramic perimeter tolerance:

single parts laser scribed

$E = +.008"/-0.002"$ @ $\leq .025"$

$E = +.012"/-0.002"$ @ $> .025"$



Chips along ceramic edge:

Length of chip: maximum 1 x ceramic thickness

Width of chip: $\frac{1}{2}$ x ceramic thickness

Surface plating *(all over)*:

Electroless Nickel $80\mu" - 400\mu"$ ($8\% \pm 2\%$ Phosphorus)

Pd $2\mu" - 12\mu"$

Immersion Au $0.4\mu" - 2\mu"$

Electroless Au $2\mu" - 50\mu"$

Bonding Area *(wetting)*:

$\geq 90\%$

Wire bonding: Standard Copper surface suitable for Stitch bond

≤ 8 mil Al, Au, Cu wire, > 8 mil wire requires a ball bond.

no lift off allowed during pull test @ 10 mil Al wire

