DIRECT BOND COPPER SUBSTRATES

Specifications and Design Rules

Material Combinations

STANDARD Al_2O_3					
	Thickness	.010”	.015”	.025”	.040”
Copper	.005”	✓	✓	✓	✓
	.008”	✓	✓	✓	✓
	.012”		■	✓	✓

Al_2O_3 OPTIONAL			
	Thickness	.030”	.035”
Copper	.005”		
	.008”	■	■
	.012”	■	■

■ Special order only.

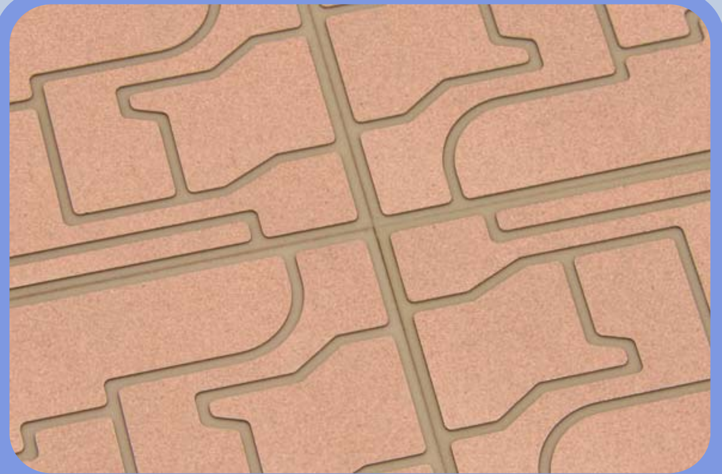
.010” Copper is special order only.

Single side Copper available in limited configurations.

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

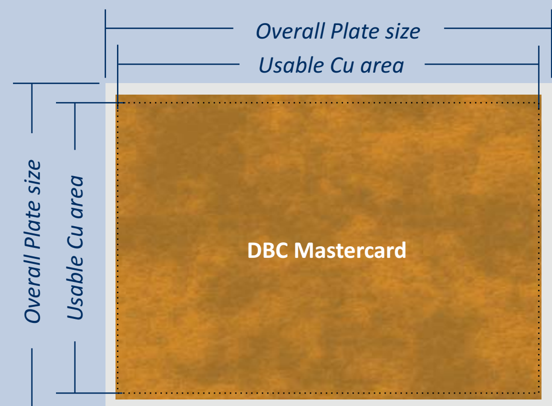
Physical Properties

Thermal conductivity:	Al_2O_3 24-26 W/mK @ 20°C AlN 170-180 W/mK @ 20°C
Electrical resistivity:	>10^{14} Ωcm
Dielectric constant:	Al_2O_3 9.8 ±10% @ 1MHz 10.0 ±10% @ 1GHz AlN 9.0 ±10% @ 1MHz
Dielectric loss:	Al_2O_3 0.0003 @ 23°C, 1MHz AlN 0.0005 @ 23°C, 1MHz
Dielectric strength (DC):	Al_2O_3 20 kV/mm @ .025” 28 kV/mm @ .010” AlN 20 kV/mm @ .025”
Copper peeling strength: *(typical Cu-thickness .008”)*	Al_2O_3 ≥22.8 lb/in. @ 2 in./min AlN ≥28.6 lb/in. @ 2 in./min
Operating temperature:	-55°C to +850°C (critical in H_2 atmosphere >400°C)
E-Module *(blank ceramic)*:	Al_2O_3 340 GPa AlN 320 GPa
Electrical conductivity: *(Cu surface)*	58 x 10^6 S/m



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:	Al_2O_3 as fired ±2% AlN as fired ±0.5%
Copper surface finish:	R_{max} ≤ .002”; R_a ≤.00008”; R_z ≤.00063”



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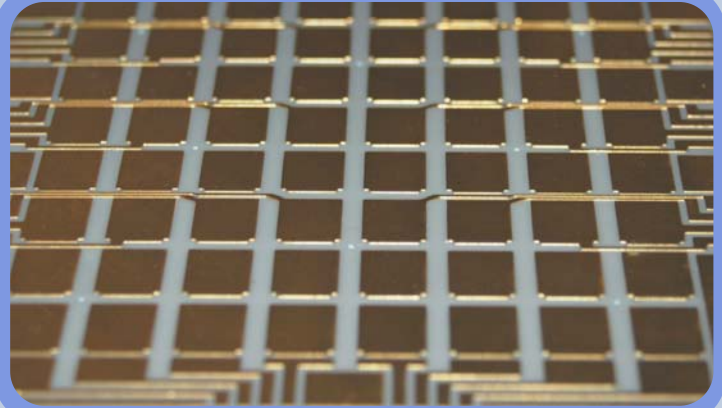
Physical Properties Cont'd

Bending Strength: Al_2O_3 > 350 N/mm²
(blank ceramic) AlN > 300 N/mm²

Coefficient of linear thermal expansion for bare Cu:
(dependent on Cu thickness)

Al_2O_3	6.8 ppm/K @ 20°C - 300°C
	7.3 ppm/K @ 20°C - 600°C
	8.0 ppm/K @ 20°C - 1000°C
AlN	4.7 ppm/K @ 20°C - 300°C
	5.2 ppm/K @ 20°C - 600°C
	5.6 ppm/K @ 20°C - 1000°C



Design Rules

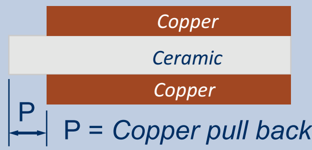
Mininum width of Copper lines
Minimum width of spaces

Tighter tolerances are possible but not guaranteed in volume production.

Min. Width Min. Space	Copper thickness	Minimum Pitch
Typical .012"	@≤.005"	.024"
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"

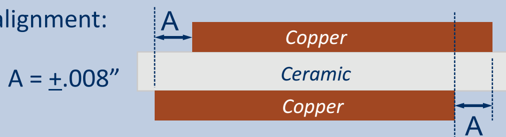
Copper pull back:
(lasered edge)

typical P > .020" ± .012"
minimum P = .014" ± .010"
depends on copper thickness



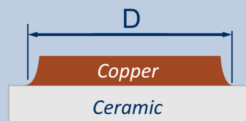
Front to back alignment:

A = ±.008"



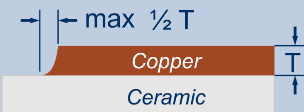
Etching tolerance:

typical ±.006" @ ≤.008" Cu
minimum ±.004" @ ≤.008 Cu
typical ±.008" @ ≤.012" Cu
minimum ±.006" @ ≤.012 Cu

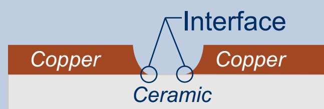


Taper of etched pattern:

Maximum ½ Cu thickness

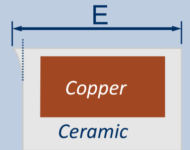


All Copper feature measurements are taken from ceramic and copper interface unless otherwise noted.



Ceramic perimeter tolerance:
single parts laser scribed

E= +.008"/-.002" @ ≤ .025"
E= +.012"/-.002" @ > .025"



Chips along ceramic edge:

Length of chip: maximum 1 x ceramic thickness
Width of chip: ½ x ceramic thickness

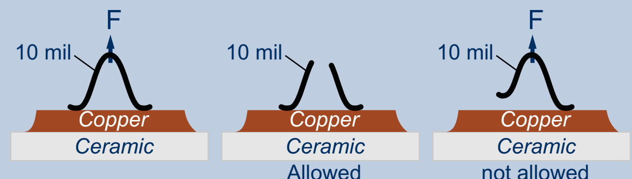
Surface plating *(all over)*:

Electroless Nickel 80µ" - 400µ" (8%±2% Phosphorus)
Pd 2µ" - 12µ"
Immersion Au 0.4µ" - 2µ"
Electroless Au 2µ" - 50µ"

Bonding Area *(wetting)*: ≥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



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