

curamik® CERAMIC SUBSTRATES AMB technology

Design Rules Version #04 (09/2015)



Content

1. Geometric properties

1.01. Available ceramic types / thicknesses.....	03
1.02. Copper thicknesses (standard).....	03
1.03. Max. usable area	03
1.04. Delivery form.....	03
1.05. Tolerances of single parts outside dimensions.....	04
1.06. Available material thickness combinations.....	04
1.07. Copper free perimeter.....	04
1.08. Conductor dimensions width / spacing.....	04
1.09. Sidewall of etched pattern + Brazing side clearance...	04
1.10. Mismatch copper pattern front/back.....	05
1.11. Flatness (layout related)	05
1.12. Etching tolerance	05
1.13. Chip-off at ceramic edge.....	05
1.14. Tolerance of total thickness (ceramic + copper).....	05

2. Additional design features

2.01. Platings over entire surface	06
2.02. Copper surface.....	06
2.03. Lifetime AMB vs. DBC (typ. values).....	06
2.04. Solder stop.....	07
2.05. Holes and laser cut outlines.....	07

3. Quality

3.01. Solderability – wetting on metallization.....	08
3.02. Thick wire bondability on metallization	08

4. Physical properties

4.01. Thermal conductivity.....	09
4.02. Electrical resistivity of ceramic	09
4.03. Dielectric constant.....	09
4.04. Dielectric loss	09
4.05. Dielectric strength (DC voltage) of ceramic	09
4.06. Electrical conductivity of copper surface.....	09
4.07. Copper peeling strength	09
4.08. Application temperature	09
4.09. Bending strength (bare ceramic)	10
4.10. Fracture toughness (K_{1C}).....	10
4.11. Young's modulus (bare ceramic).....	10
4.12. Coefficient of linear thermal expansion (CTE).....	10

Available ceramic material



1. Geometric properties

1.01. Available ceramic types / thicknesses

ceramic thickness mm	Si_3N_4	
	0.25	✓
	0.32	✓

1.02. Copper thicknesses (standard)

copper thickness mm	Si_3N_4	
	0.3	✓
	0.5	✓
	0.8	✓

Note other thicknesses on request

1.03. Max. usable area

127 x 178 mm

1.04. Delivery form

Single parts	minimum dimension 15 x 15 mm edge length, smaller on request
Master card	127 x 178 mm, defect parts inked

1.05. Tolerances of single parts outside dimensions

+ 0.2 mm / - 0.05 mm

1.06. Available material thickness combinations

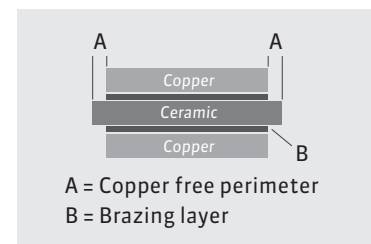
ceramic thickness mm	copper thickness mm		
	0.3	0.5	0.8
0.25	✓	✓	✓
0.32	✓	✓	✓

Note Other copper thicknesses on request. The copper thickness difference front side to back side shall not exceed 100 µm.

1.07. Copper free perimeter

Cu-thickness	A
≤ 0.3 mm	≥ 0.4 mm
≤ 0.5 mm	≥ 0.5 mm
≤ 0.8 mm	≥ 0.6 mm

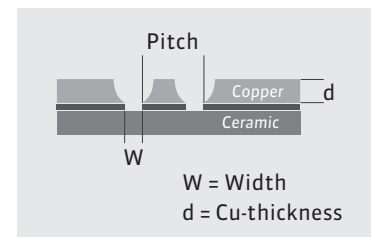
Note Metallization is measured at the interface of ceramic and copper. Final perimeter depend on ceramic thickness and manufacturing tolerances such as etching or lasering. For laser cut geometries in ceramic (e.g. holes) the copper free perimeter may vary.



1.08. Conductor dimensions width / spacing

Cu-thickness (d)	Conductor dimensions width / spacing (W)	Min. Pitch
0.3 mm	typ. 0.5 mm	1.0 mm
0.5 mm	typ. 0.8 mm	1.6 mm
0.8 mm	typ. 1.0 mm	2.0 mm

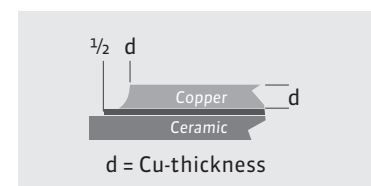
Note Metallization is measured at the interface of ceramic and copper. Upper width of conductors on Cu-layout side could be smaller (see sidewall of etched pattern).



1.09. Sidewall of etched pattern + Brazing side clearance

≤ 1/2 d

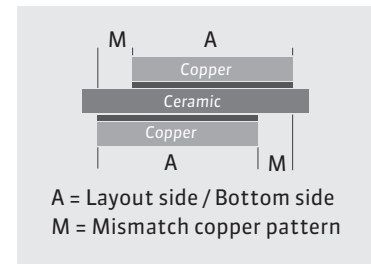
Note Metallization is measured at the interface of brazing layer and copper.



1.10. Mismatch copper pattern front/back

$M \leq 0.2 \text{ mm}$ for standard types

Note Metallization is measured at the interface of brazing layer and copper.



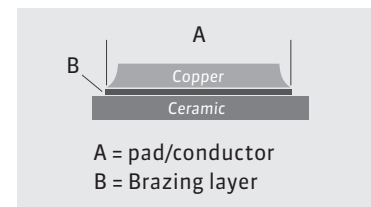
1.11. Flatness (layout related)

Requested flatness of single AMB substrates or master cards cannot be guaranteed in advance due to specific design influences of the circuit. A flatness (not 100% inspected) can only be specified after design definition and sample delivery with initial sample test report.

1.12. Etching tolerance

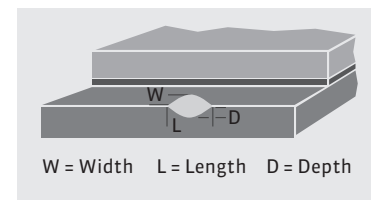
Cu-thickness	tolerance
$\leq 0.3 \text{ mm}$	typ. $\pm 0.2 \text{ mm}$
$\leq 0.5 \text{ mm}$	typ. $\pm 0.3 \text{ mm}$
$\leq 0.8 \text{ mm}$	typ. $\pm 0.4 \text{ mm}$

Note Metallization is measured at the interface of ceramic and copper. The etching tolerance is always symmetric to the center axis of the pad/conductor.



1.13. Chip-off at ceramic edge

Length	max. 1 x ceramic thickness
Width	max. $\frac{1}{2}$ x ceramic thickness
Depth	max. $\frac{1}{2}$ x ceramic thickness



1.14. Tolerance of total thickness (ceramic + copper)

$\pm 10 \%$

2. Additional design features

2.01. Platings over entire surface

Electroless Ni	3 – 7 μm (8% $\pm$ 2% P)
Electroless Ag	0.1 – 0.6 μm
Electroless NiAu	Ni: 3 – 7 μm (8% $\pm$ 2% P)
	Au Class A: 0.01 – 0.05 μm
	Au Class B: 0.03 – 0.13 μm

2.02. Copper surface

Roughness	$R_{\text{max}} = 50 \mu\text{m}$; $R_a \leq 1.5 \mu\text{m}$; $R_z \leq 16 \mu\text{m}$
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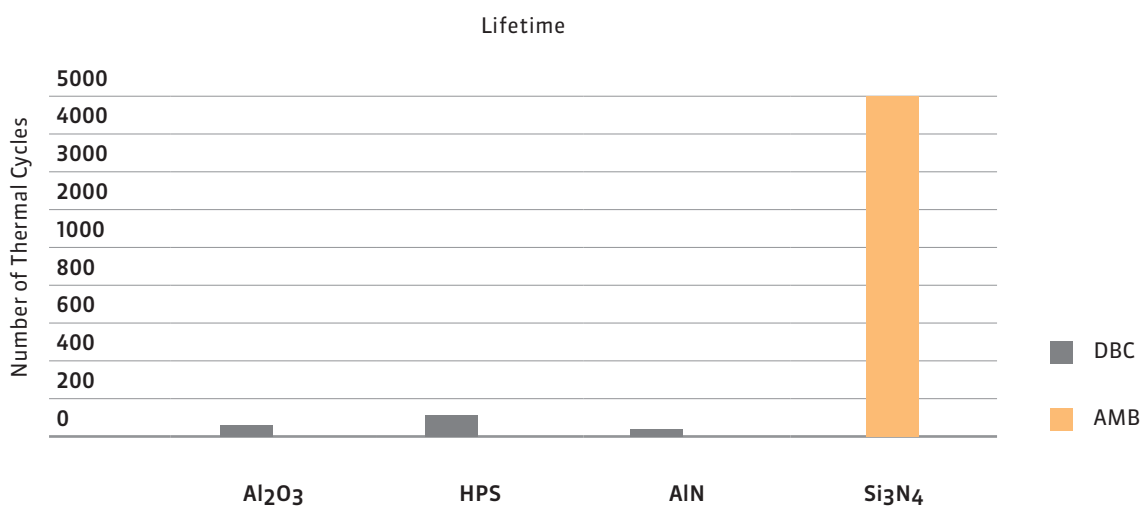
Note Lower roughness on request.

2.03. Lifetime AMB vs. DBC (typ. values)

Measurement conditions -55 °C up to 150 °C shock testing

ceramic AMB	ceramic DBC	Cu layout side	ceramic thickness	Cu back side	cycles without dimples [σ_0]
	Al ₂ O ₃	0.3 mm	0.32 mm	0.3 mm	> 65
	HPS	0.3 mm	0.32 mm	0.3 mm	> 110
	AlN	0.3 mm	0.63 mm	0.3 mm	> 35
Si ₃ N ₄		0.5 mm	0.32 mm	0.5 mm	> 5000

Note curamik internal tests with curamik test layout.



2.04. Solder stop

	standard solder stop	high temperature solder stop *
Width	min. 0.4 mm tolerance ± 0.2 mm	min. 0.4 mm tolerance ± 0.2 mm
Mismatch solder stop line (center) to layout (center)	± 0.2 mm	± 0.2 mm
Temperature resistance	≤ 288 °C / 10 sec.	≤ 400 °C / 5 min.

Note In case of mismatch between Cu pad and outside edge, the etching tolerance is to be considered. Higher/ longer temperature exposure only possible at customer's own risk. Solder stop is available for all platings except Au-platings. * samples available

2.05. Holes and laser cut outlines

Minimum hole diameter 1 mm, smaller on request.

3. Quality

3.01. Solderability – wetting on metallization

Soldering conditions on Cu surface	SnCu3In0.5 - Preform ≥ 95 % wetting, forming gas (10 % H ₂ , 90 % N ₂) and vacuum
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3.02. Thick wire bondability on metallization

300 μm aluminum wire AlH11
Shear speed 500 $\mu\text{m/s}$
Shear height ≤ 30 μm
Shear force ≥ 1000 cN
 ≥ 50 % aluminum residue on AMB after shear test

4. Physical properties¹

¹ Values from literature

4.01. Thermal conductivity

Si₃N₄ 90 W/mK @ 20 °C

4.02. Electrical resistivity of ceramic

> 10¹⁴ Ωcm @ 20 °C

4.03. Dielectric constant

Si₃N₄ 8.0 @ 1 MHz 7.5 @ 1 GHz

4.04. Dielectric loss

Si₃N₄ < 0.001 @ 20 °C, 1MHz

4.05. Dielectric strength (DC voltage) of ceramic

> 20 kV/mm

4.06. Electrical conductivity of copper surface

58 x 10⁶ S/m @ 20 °C

4.07. Copper peeling strength

≥ 10 N/mm @ 50 mm/min @ Cu-thickness 0.5 mm on Si₃N₄

Note According to curamik internal tests.

4.08. Application temperature

-55 °C up to +650 °C depending on atmosphere and time

4.09. Bending strength (bare ceramic)

Si₃N₄	> 700 N/mm ²
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Note According to curamik internal tests. σ_0 -value

4.10. Fracture toughness (K_{IC})

Si₃N₄	> 6 MPa√m
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4.11. Young's modulus (bare ceramic)

Si₃N₄	300 GPa
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4.12. Coefficient of linear thermal expansion (CTE)

	ceramic α_{ceramic}	substrate
Si₃N₄	2.5 ppm/K @ 20 °C – 300 °C	5% to 30% higher (dependent on copper thickness)

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This document is not subject of updating.
Version #04 issued in September 2015.

Issued by Bernd Lehmeier / Nico Kuhn
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