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ZTA Direct Copper Bonding (DCB) Substrates Design Guidelines

Zirconia-toughened Alumina (ZTA) DCB facts

- ZTA ceramic (ZrO_2: 9 - 14%)
  Thicknesses: 0.25mm / 0.32 mm
- Direct Copper Bonding Cu-OFE
  Thicknesses(1): 0.2 mm / 0.25 mm / 0.3 mm
- Single unit or master card size 7" x 5" (usable area)
- Surface finish: Bare Cu, Ni, Ni / Au, full or selective Ag plating

(1) Different material combinations on request

Key features

- Good thermal and mechanical properties
- Low coefficient of thermal expansion (CTE)
- Special treatments possible to adjust surface properties

ZTA material properties

	Rating	Unit
Bending strength	≥ 600	N/mm^2
Thermal conductivity (@ 20 °C)	≥ 22	W/m·K
Coefficient of thermal expansion (100 °C - 600 °C)	7 ppm	1/K
Young’s modulus (@ 20 °C)	≥ 300	GPa
Density	≥ 3.95	g/cm^3
Electrical resistivity	≥ 10^{14}	Ohm.cm
Dielectric strength	≥ 20	kV/mm

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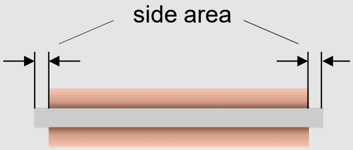
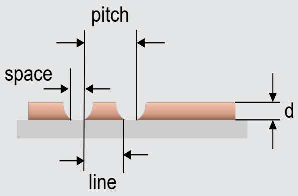
Copper free area to metal-free perimeter



Thickness Cu [mm]	Min. side area [mm]
0.20	0.20
0.25	0.23
0.30	0.25

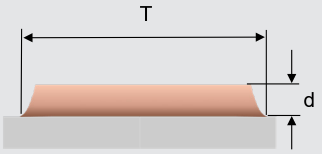
Tolerance of copper-free perimeter depends on ceramic thickness and manufacturing tolerances.

Structuring



Thickness Cu [mm]	Min. space [mm]	Min. line [mm]	Min. pitch [mm]
0.20	0.40	0.40	0.80
0.25	0.45	0.45	0.90
0.30	0.50	0.50	1.00

Structuring tolerance



Tolerance length & width [mm]	Thickness Cu [mm]
Ttyp. = ± 0.15	d = 0.2
Ttyp. = ± 0.20	d ≤ 0.3

All isolation gaps in a layout should have the same dimension. Isolation gaps with different dimensions may result in larger etching tolerances.

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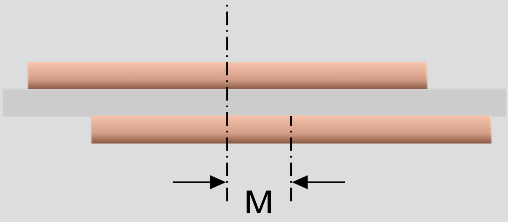
Tolerances

Tolerance



Mismatch M ≤ 0.1 mm

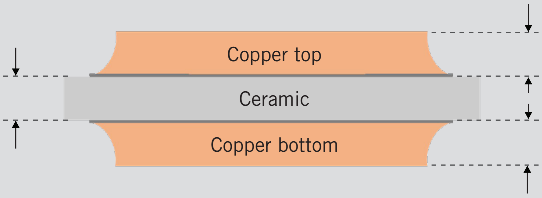
Tolerance of total thickness = + 7 % / -10 %

Mastercard / Single unit dimension & tolerances

General dimensions	Rating [mm]	Tolerances of single parts	Rating [mm]
Max. usable area	127 x 178	Ceramic thickness ≤ 0.32 mm	+ 200 µm - 50 µm
Minimum dimension for ceramic thickness ≤ 0.63 mm	10 x 10 (smaller on request)		

Warpage behavior depends on specific layout, single part size and material combination and can only be specified after initial sample preparation.

Thickness combinations



ZTA Thickness [mm]	Cu Thickness* [mm]		
	0.20	0.25	0.30
0.32	√	√	√

* Other combinations incl. asymmetric on request.

Surface plating

Plating Method	Thickness (um)
Electroless Ni	3 - 7 (9% ± 2 % P)
Electroless NiAu	Ni 3 - 7 (9 % ± 2 % P) Au Class 1: 0.01 - 0.05 Au Class 2: 0.03 - 0.13
Full or selective Ag plating	Ag 0.3 - 1

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Metal and hole properties

Surface roughness*
Rmax = 50 µm
Ra ≤ 1 µm
Rz ≤ 16 µm

*Different roughness on request

Minimum hole diameter
d_{hole} = 1 mm

Electrical conductivity raw copper
$G_{cu} = 58 .10^6$ S/m

Thickness Cu	Copper peeling strength
0.30 mm	> 4 N/mm

Technology and Application Centers

Besides offering Assembly Materials, Bonding Wires and Metal Ceramic Substrates, Heraeus Electronics provides matching material solutions and R&D oriented partnerships to create individual solutions.

Customized surfaces

Heraeus Electronics offers collaborative development initiatives with focus on the optimization of surfaces and process parameters for various assembly techniques including:

- Silver sintering
- Solder wetting
- Heavy wire bondability
- Increased die shear strength

Heraeus Electronics offers the following Metal Ceramic Substrates and Services:

- IATF 16949 certified supply of:
  - ✓ Condura®.ultra AMB-Si_3N_4 (Ag-free Active Metal Brazed Si_3N_4)
  - ✓ Condura®.prime AMB-Si_3N_4 (Active Metal Brazed Si_3N_4)
  - ✓ Condura®.extra DCB-ZTA (Zirconia-toughened Alumina)
  - ✓ Condura®.classic DCB-Al_2O_3 (Direct Copper Bonded Al_2O_3)
- Engineering Services:
  - ✓ Simulation, Prototype Design & Assembly, Testing and Qualification, Material Analysis

Heraeus Electronics does not take responsibility for the final layout design. This document offers only Design Guidelines for the substrate layout.

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