

Material Specifications

Specifications are offered as an assistance to engineers and purchasing professionals in the design and procurement of thin-film circuit substrates.

Properties	Polished High Density 996 Aluminum Oxide	Asfired Superstrate 996 Aluminum Oxide	Superstrate TPS	Beryllium Oxide	Aluminum Nitride	Fused Silica Quartz	Z-Cut Quartz	Sapphire (Crystalline)	Polished Titanates	Ferrites & Garnets
Chemical Composition	Al ₂ O ₃	Al ₂ O ₃	Al ₂ O ₃	BeO	AlN	SiO ₂	SiO ₂	A/C plane-Al ₂ O ₃		
Purity	99.6%	99.6%	99.6%	99.5%	98%	100%	100%	100%		
Color	White	White	White	White	Tan	Transparent	Transparent	Transparent	Cream	Gray
Nominal Density	3.87g/cm ³	3.87g/cm ³	3.95g/cm ³	2.85g/cm ³	3.28g/cm ³	2.2g/cm ³	2.65g/cm ³	3.97g/cm ³		
Surface Finish (Polished) CLA	< 1.0μ" (25nm)	n/a	< 1.0μ" (25nm)	2.0-4.0μ" (50-100nm)	< 2.0μ" (50nm)	60/40 Optical	60/40 Optical	< 1.0μ" (25nm) CLA	< 3.0μ" (76nm)	< 16.0μ" (400nm)
Surface Finish (Asfired) CLA	n/a	3-4μ" (76-101 nm)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Camber	0.0003-0.0005"	0.002"	n/a	0.0003-0.0005"	0.0003-0.0005"	0.0003-0.0005"	0.0003-0.0005"	0.0003-0.0005"	0.002"	0.002"
Camber	76nm / 152nm	0.0508mm	n/a	76nm / 152nm	76nm / 152nm	76nm / 152nm	76nm / 152nm	76nm / 152nm	0.0508mm	0.0508mm
Thickness	0.004-0.080" (0.100-2.0mm)	0.005-0.025"* (0.127-0.635mm)	n/a	0.005-0.025"* (0.127-0.635mm)	0.004-0.080" (0.100-2.0mm)	0.004-0.025"* (0.100-0.635mm)	0.004-0.025"* (0.100-0.635mm)	0.004-0.025"* (0.100-0.635mm)	0.005-0.025"* (0.127-0.635mm)	0.010-0.025" (0.254-0.635mm)
Thickness Tolerance	±0.0005" (±0.0127mm)	±0.001" (±0.0254mm)	n/a	±0.0005" (±0.0127mm)	±0.0005" (±0.0127mm)	±0.0005" (±0.0127mm)	±0.0005" (±0.0127mm)	±0.0005" (±0.0127mm)	±0.0005" (±0.0127mm)	±0.0005" (±0.0127mm)
Process Sizes (L&W)	1.0-4.0" (25.4-101.6mm)	1.0-6.0" (25.4-152.4mm)	n/a	1.0-4.00" (25.4-101.6mm)	1.0-4.00" (25.4-101.6mm)	1.0-3.00" (25.4-76.2mm)	1.0-3.00" (25.4-76.2mm)	1.0-2.25" (25.4-57.15mm)	1.0-2.25" (25.4-57.15mm)	1.0-2.25" (25.4-57.15mm)
Coefficient of Thermal Expansion (CTE)	7.0-8.3 x 10 ⁶ (25-1000°C)	7.0-8.3 x 10 ⁶ (25-1000°C)	8.2 x 10 ⁶ (25-1000°C)	9.0 x 10 ⁶ (25-1000°C)	4.6 x 10 ⁶ (25-300°C)	0.55 x 10 ⁶ (20-320°C)		A plane @ 25°C-5.3		
Thermal Conductivity	26.9 Watts/m ² K	26.9 Watts/m ² K	35 Watts/m ² K	270 Watts/m ² K & 325 Watts/m ² K	170 Watts/m ² K & 200 Watts/m ² K	1.38 Watts/m ² K		42 Watts/m ² K		
Dielectric Constant (k)	9.9 @ 1 MHz	9.9 @ 1 MHz	10.0 @ 1 MHz	6.5 @ 1 MHz	8.6 @ 1 MHz	3.826 @ 1 MHz	4.6 parallel 4.5 perpendicular	11.5/9.3 @ 1 MHz †	36-180 @ 1 MHz	14.5-17.6 @ 1 MHz
Dissipation Factor (Loss Tangent)	0.0001 @ 1 MHz	0.0001 @ 1 MHz	0.0001 @ 1 MHz	0.0004 @ 1 MHz	0.001 @ 1 MHz	0.000015 @ 1 MHz		0.00086/0.0003 @ 1 MHz †		
Dissipation Factor (Loss Tangent)	0.0002 @ >10 GHz	0.0002 @ >10 GHz	0.0001 @ >10 GHz		0.002 @ >10 GHz					
Q	5000 @ 1 GHz	5000 @ 1 GHz	5000 @ 1 GHz		5000 @ 1 GHz					
Hardness (Rockwell)	87	87	87	45	n/a	7 Mohs	7 Mohs	1800/2200A Knoop		
Flexural Strength	90 x 10 ³ K lbs/in ²	90 x 10 ³ K lbs/in ²	99 x 10 ³ K lbs/in ²	35 x 10 ³ K lbs/in ² (3 pt. bend)	59 x 10 ³ K lbs/in ² (4 pt. bend)	25 x 10 ³ K lbs/in ²		60 x 10 ³ K lbs/in ²		
Compressive Strength	54 x 10 ³ M lbs/in ²	54 x 10 ³ M lbs/in ²	n/a	n/a	n/a	161 x 10 ³ M lbs/in ²		350 x 10 ³ M lbs/in ²		
Grain Size	< 1.0μm	< 1.0μm	< 1.0μm	9-16μm	5-7μm	Amorphous	single crystal	single crystal		

* Additional thicknesses and tolerances available upon request.

† Value varies with orientation ("A" plane / "C" plane)

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