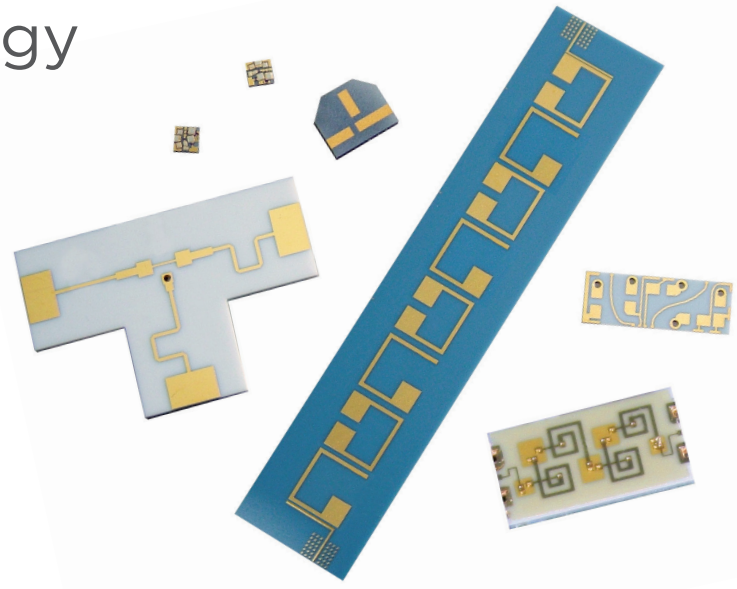
PRECISION DEVICES knowles

BUILD TO PRINT

Best Practices

Thin Film Technology and Process Guide



Purchased Materials/Metal Systems

Purchased Materials		
Properties	**Aluminum Nitride (AlN)**	**99.6% Alumina (Al_2O_3)**
Dielectric Constant (@ 1MHz)	8.85	9.9
Dielectric Loss (@ 1 MHz)	0.0005	0.0001
Dielectric Breakdown Strength (kV/mm)	14	23
Electrical Resistivity (Ω-cm)	$>10^{14}$	$>10^{14}$
Thermal Conductivity (W/mK)	170 (+30,-0)	26.6
Thermal Expansion Coefficient (x 10^{-6}/°C)	4.5	7
Density (gm/cm^3)	3.3	3.88
Fracture Toughness-Single Edge Notch Beam (MN/$m^{1.5}$)	3.5 ± 0.2	4.0 ± 0.2
Young's Modulus-Ultrasonic Method (N/m^2)	3.23 x 10^{11}	3.50 x 10^{11}
Poisson Ratio	0.24	0.2
Hardness (Knoop)	1200	466

If a maximum thickness is required for a metallization layer it has to match best practices for manufacturability.

Knowles generally recommends industry standards for solder and epoxy attachments. For Build to Print products the attachment method is the customers responsibility to define.

For metallization scheme changes consult with applications engineers to determine if metallization scheme needs to be adjusted for your application.

Metallization Systems	
KCC	**KCM**
300 Å min TiW, 50µin NiV, 100µin Au	250Å-1500Å TiW, 50µin Ni, 18-22µin Au. Sputter, 100µin Au min.plated
300 Å TiW, 50µin NiV, 300µin AuSn	
300 Å TiW, 100µin Au	250Å min. TiW, 18-22µin Au Sputter, 100µin Au min.plated
300 Å TiW, 200µin Au	250Å min. TiW, 18-22µin Au Sputter, 200µin Au min.plated
300 Å TiW, 6µin Pt, 100µin Au	250Å min.TiW, 8-12µin Pd, 100µin Au
300 Å TiW, 100µin Au, 50µin Ni / 3-6µin Au	
300 Å TiW, 200µin Au, 50µin Ni / 3-6µin Au	
300 Å TiW, 100µin Cu, 50µin Ni / 3-6µin Au	250Å min. Ti, 100µin Cu, *µin Ni, *µin Au
300 Å TiW, 200µin Cu, 50µin Ni / 3-6µin Au	
50 Ω/ sq. TaN, 300 Å TiW, 100µin Au	50 Ω/ sq. TaN, 250Å min. TiW, 18-22µin Au. Sputter, 100µin Au

µin = microinches

*open to customization

Resistors

Resistor Material	Facility	Available Sheet Resistivity (Ω/sq)	Temperature Coefficient of Resistance for -25 to 125 °C (ppm/°C)
Tantalum Nitride (TaN)	KCM	25 to 150	-75 to -100
	KCC	25 to 100	-75 to -100
Nickel Chromium Alloy (NiCr)	KCM	25 to 150	-100

Laser Trimming			
Method	**Tolerance**	**Facility**	**Comments**
Bake to Value*	±10% STD	KCC/KCM	Resistors must be optimized for manufacturability
Bake to Value*	±5% special	KCC/KCM	Resistors must be optimized for manufacturability
Laser Trim- Plunge Cut	1-10%	KCM	Compensate resistor width to accommodate laser kerfs of .0015" for each plunge
Laser Trim- Single Side Scan Cut	1-10%	KCM	Design to accommodate 50% width reduction
Microwave Trim	1-10%	KCM	Design to accommodate 50% width reduction, 10% by request
*As sheet resistivity increases bake to value tolerance goes down			

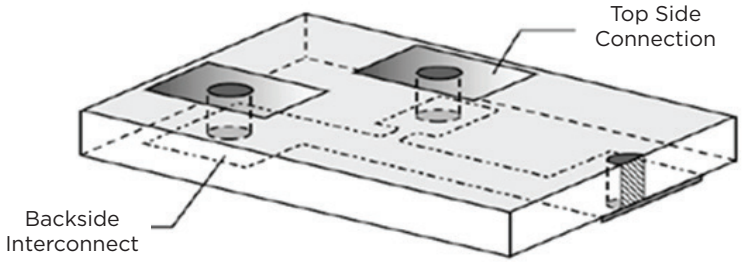
Vias

Via Type	Facility	Via Sizing Minimum	Notes
Plated Via	KCM	50% of the substrate thickness and not less than 5 mils	
Epoxy filled	KCC	50% of the substrate thickness and not less than 7 mils	Criteria for epoxy filled is walls are completely coated. Small hole may be visible in center
Gold filled	KCM	50% of the substrate thickness and not less than 5 mils	Vent on both sides of the plate
Copper filled	KCM	50% of the substrate thickness and not less than 5 mils	Vent on backside only
Castellation rim (I/Os)	KCM	5 mils	

Via Tolerance Rules	
Filled via planarity	±.002 mils
Via locational tolerance	±.001 mils
Plated via capture pad	Diameter +0.010"
Filled via captured pad	Diameter +0.005"

Vias

Filled vias are vented for even application of the metal in the hole. Filled vias plate from the outer edge of the vent until the center is filled.



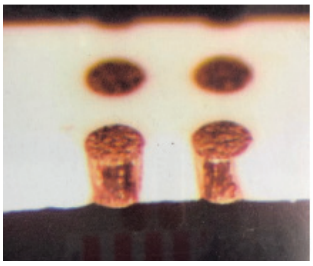


Figure 1: DPA/cross section profile 1, showing barrel uniformity

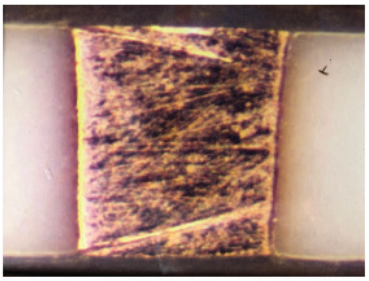


Figure 2: DPA/cross section profile 2, showing slight locking taper

Figure 3: DPA/cross section top view

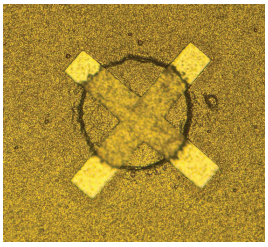
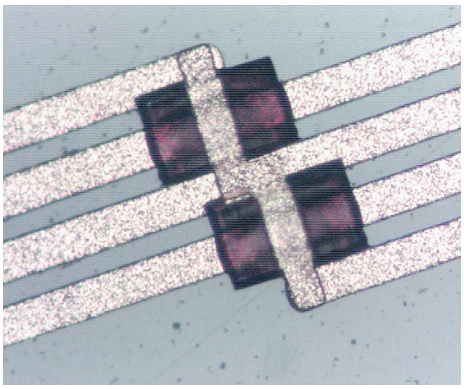


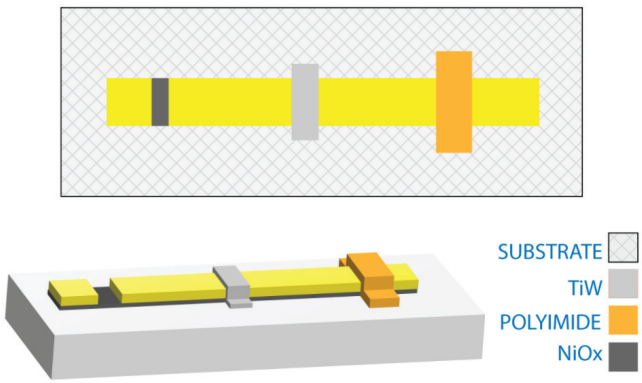
Figure 4: Vented via sample

Bridges

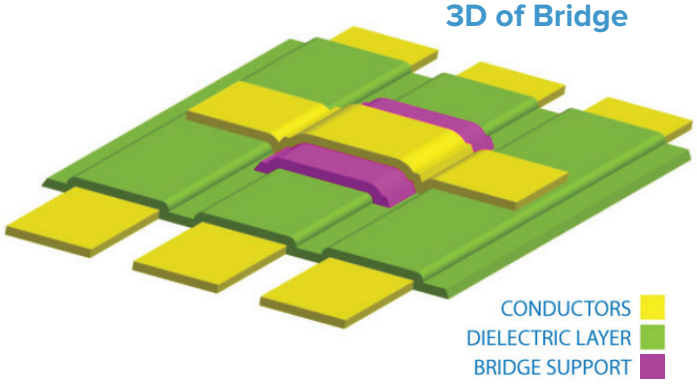
Fine Line Conductor Standard Layout Guidelines		
Feature	**Values and Tolerances**	**Comments**
Line Spacing (Inches)	.0004 min. ± .0001	min. space width avaliable in TiW films only
Line Width (Inches)	.0005 min. ± .0001	min. line width avaliable in TiW films only
Bridge Width (Inches)	.001 min.	.0001 bridge/conductor pullback
Bridge Contact Area (Inches)	.001 sq min.	
Bridge Span (Inches)	.003 min.	
Bridge Support (Inches)	.0015 x .003	.0025"overlap insulator to conductor
Dielectric Layer (Inches)	width + .006, span + .008	
Bridge Height (Inches)	.0002 min.	.00025 ± .00005 typ.
Bridge Thickness	.00025 min.	.00030 ± .00005 typ.
Span: Width Ratio	6:1 max.	



Solder Barriers

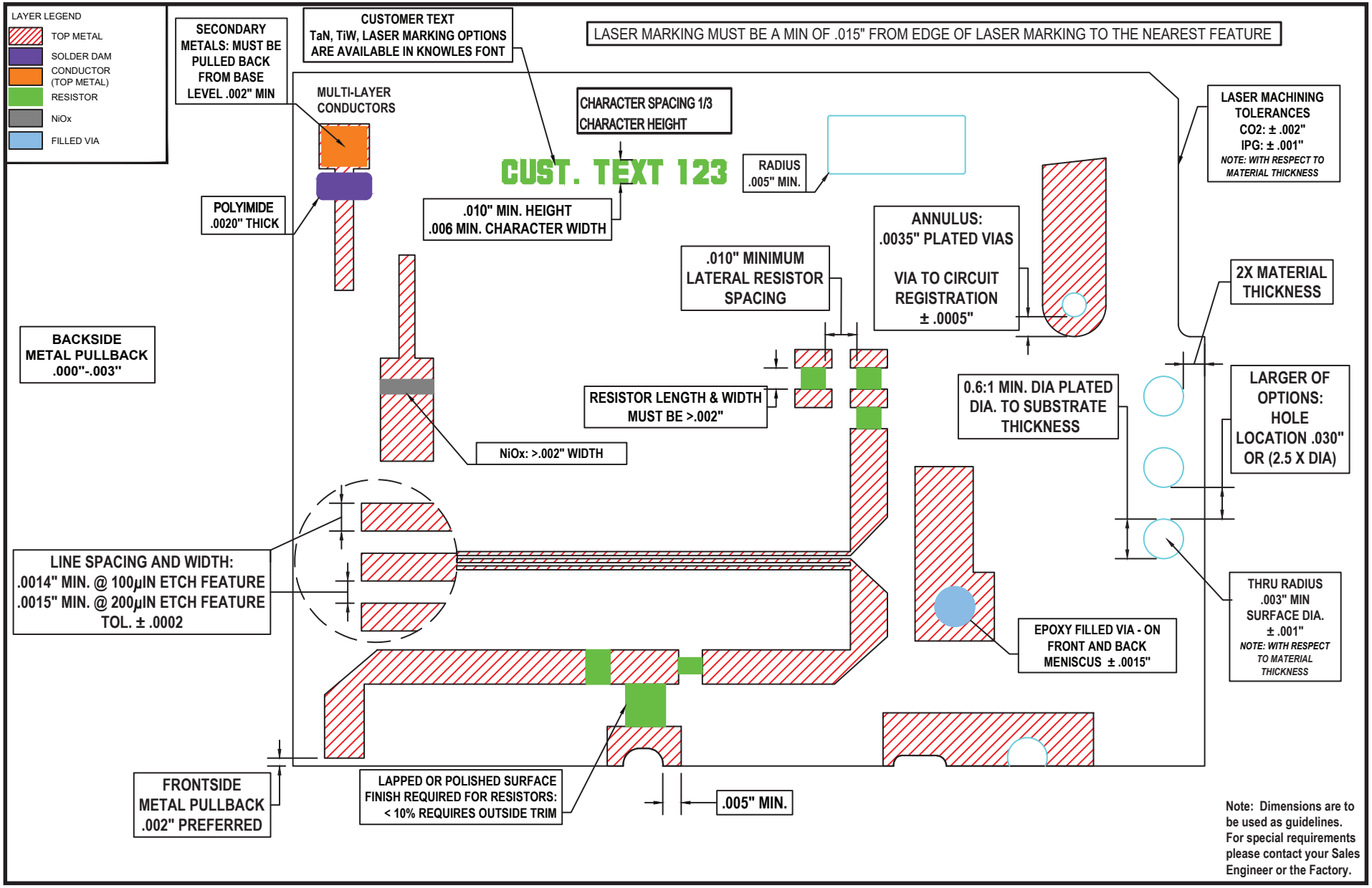


3D of Bridge



Solder Barriers				
Parameter	**Material**			
	TiW	**Polyimide**	**NiOx**	**Comments**
Thickness	1000 Å	.00016-.00032"	*.00020-.0003"	plated nickel thickness
Max Temperature (°C/60 sec)	350	425	N/A*	limited by metallization scheme
Min Gap Width (Inches)	0.002	0.004	0.001	
Min Conductor Overlap (Inches)	0.002	0.004	N/A*	
Min Feature Width (Inches)	0.002	0.004	*	*Width is equal to conductor width
Distance to Circuit Edge (Inches)	0.003	0.003	N/A*	*See metal feature to edge criteria
Additive or Subtractive Process	Additive	Additive	Subtractive	
Facility	KCM	KCM	KCM	

KCC Design Guidelines



KCM Design Guidelines