

Capability Matrix	Standard Technology	Advanced Technology	Future Technology	Frequency	Notes
Definition	Manufactured with no special handling or involvement from key personnel. High Yields.	Manufactured with minimal special handling or involvement from key personnel. Reduced Yields.	Manufactured only with special handling or involvement from key personnel. Significant impact on Yields.	Designs with stated features are manufactured Daily, Weekly, Monthly, Quarterly, Annually or Never	
Feature	inch (mm)	inch (mm)	inch (mm)		
Minimum Outer Line Width	0.0025 (0.064)	0.002 (0.051)	0.00175 (0.044)	}	1/4 oz base copper & +/-20% tolerance
Minimum Inner Line Width	0.0025 (0.064)	0.002 (0.051)	0.00175 (0.044)		
Minimum Outer Space (Trace\Trace & Trace\Pad)	0.003 (0.076)	0.0025 (0.064)	0.00175 (0.044)		
Minimum Inner Space (Trace\Trace & Trace\Pad)	0.003 (0.076)	0.0025 (0.064)	0.00175 (0.044)		
Minimum Outer Line Width	0.004 (0.102)	0.003 (0.076)	0.0025 (0.064)	}	1/2 oz base copper & +/-20% tolerance
Minimum Inner Line Width	0.004 (0.102)	0.003 (0.076)	0.0025 (0.064)		
Minimum Outer Space (Trace\Trace & Trace\Pad)	0.005 (0.127)	0.0035 (0.089)	0.003 (0.076)		
Minimum Inner Space (Trace\Trace & Trace\Pad)	0.005 (0.127)	0.0035 (0.089)	0.003 (0.076)		
Minimum Outer Line Width	0.004 (0.102)	0.0035 (0.089)	0.003 (0.076)	}	1 oz base copper & +/-20% tolerance
Minimum Inner Line Width	0.004 (0.102)	0.0035 (0.089)	0.003 (0.076)		
Minimum Outer Space (Trace\Trace & Trace\Pad)	0.005 (0.127)	0.004 (0.102)	0.0035 (0.089) ⁽¹⁾		
Minimum Inner Space (Trace\Trace & Trace\Pad)	0.005 (0.127)	0.004 (0.102)	0.0035 (0.089) ⁽¹⁾		
Minimum Outer Line Width	0.007 (0.178)	0.006 (0.152)	0.005 (0.127)	}	2 oz base copper & +/-20% tolerance
Minimum Inner Line Width	0.007 (0.178)	0.0063 (0.160)	0.005 (0.127)		
Minimum Outer Space (Trace\Trace & Trace\Pad)	0.007 (0.178)	0.006 (0.152)	0.006 (0.152)		
Minimum Inner Space (Trace\Trace & Trace\Pad)	0.007 (0.178)	0.006 (0.152)	0.006 (0.152)		
Minimum Outer Line Width	0.012 (0.305)	0.010 (0.254)	0.010 (0.254)	}	3 oz base copper & +/-20% tolerance
Minimum Inner Line Width	0.012 (0.305)	0.010 (0.254)	0.010 (0.254)		
Minimum Outer Space (Trace\Trace & Trace\Pad)	0.012 (0.305)	0.010 (0.254)	0.010 (0.254)		
Minimum Inner Space (Trace\Trace & Trace\Pad)	0.012 (0.305)	0.010 (0.254)	0.010 (0.254)		
Minimum Outer Line Width	0.015 (0.381)	0.013 (0.330)	0.012 (0.305)	}	4 oz base copper & +/-20% tolerance
Minimum Inner Line Width	0.015 (0.381)	0.013 (0.330)	0.012 (0.305)		
Minimum Outer Space (Trace\Trace & Trace\Pad)	0.015 (0.381)	0.013 (0.330)	0.012 (0.305) ⁽¹⁾		
Minimum Inner Space (Trace\Trace & Trace\Pad)	0.015 (0.381)	0.013 (0.330)	0.012 (0.305) ⁽¹⁾		
Internal Etch tolerance	+/- 20%	+/- 10%	+/- 5%		Assumes 1/2 oz copper
External Etch tolerance	+/- 20%	+/- 10%	+/- 5%		Assumes 1/2 oz starting copper
Layer to Layer Registration - (> 2 layer)	+/- 0.008 (0.203)	+/- 0.006 (0.152)	+/- 0.003 (0.076)		
Layer to Layer Registration - (2 layer)	+/- 0.005 (0.127)	+/- 0.003 (0.076)	+/- 0.002 (0.051)		
Maximum PWB Thickness (inches)	0.150 (3.810)	N/A	N/A		
Minimum Board Thickness Tolerance	+/- 10%	+/- 8%	+/- 5%		
Maximum Number of Layers	18	24	30		
Profile Tolerance (Routed)	+/- 0.005 (0.127)	+/- 0.004 (0.102)	+/- 0.003 (0.076) ⁽²⁾		
Profile Tolerance (Scored)	+/- 0.010 (0.254)	+/- 0.005 (0.127)	+/- 0.005 (0.127) ⁽²⁾		Tolerance applies to boards before depanelization
Minimum Internal Cut-out Radius	0.046 (1.168)	0.032 (0.813)	0.016 (0.406)		
Smallest BGA footprint pitch - inches (mm)	0.032 (0.800)	0.020 (0.500)	0.01575 (0.400)		
I/L Copper to Board Edge (Routed)	0.010 (0.254)	0.007 (0.178)	0.007 (0.178)		
I/L Copper to Board Edge (Scored)	0.015 (0.381)	0.015 (0.381)	0.015 (0.381)		Assumes 62 mil thick using 30 deg blade with 1/3 material remaining web
O/L Copper to Board Edge (Routed)	0.008 (0.203)	0.005 (0.127)	0.005 (0.127)		
O/L Copper to Board Edge (Scored)	0.015 (0.381)	0.015 (0.381)	0.015 (0.381)		Assumes 62 mil thick using 30 deg blade with 1/3 material remaining web
Plating					
IPC-6012 Class 2	Yes	N/A	N/A	Daily	787µin avg / 709µin min (Through holes)
IPC-6012 Class 3	Yes	N/A	N/A	Daily	984µin avg / 787µin min (Through holes)
Military (MIL-PRF-31032)	Yes	N/A	N/A	Weekly	1000µin min (Through holes)
Heavy plating	N/A	1.4 mil	2.8 mil	Weekly	Per customer requirement

Pad and Hole					
Minimum Finished PTH Hole Size	0.008 (0.203)	0.006 (0.152)	0.004 (0.102) ⁽³⁾		
Component Finished PTH Size Tolerance Range	0.006 (0.152)	0.004 (0.102)	N/A		i.e. +/- 0.003 = 0.006 range
Via Finished PTH Size Tolerance Range	0.006 (0.152)	0.004 (0.102)	N/A		Optimum tolerance is +0.003/- (hole size)
PTH Locational Tolerance	0.003 (0.076)	N/A	N/A		
Internal Pad Size (Diameter over Drill)	0.012 (0.305)	0.008 (0.203)	N/A		Assumes pad breakout allowed (IPC-6012 Class 2) Add 2 mils for each 1 mil of annular ring required
Internal Anti-pad (Diameter over Drill)	0.016 (0.406)	0.012 (0.305)	0.010 (0.254)		
External Pad Size (Diameter over Drill)	0.010 (0.254)	0.006 (0.152)	N/A		Assumes pad breakout allowed (IPC-6012 Class 2) Add 2 mils for each 1 mil of annular ring required
Drilling					
Smallest Mechanical Drill Size	0.008 (0.203)	0.006 (0.152)	0.004 (0.102)		0.004" drill in test phase
Maximum Drill Aspect Ratio (w/ min. drill)	8:1	10:1	14:1		
Maximum Microvia Aspect Ratio (Depth:Diameter)	0.5:1	0.75:1	1.0:1		
Maximum Hole Size (Drilled)	0.250 (6.350)	0.250 (6.350)	0.25 (6.350)		Refers to drill size not finished hole size
Maximum Hole Size (Routed)	Unlimited	N/A	N/A		Minimum tolerance +/- 0.005"
NPTH Size Tolerance Range	0.004 (0.102)	0.003 (0.076)	0.002 (0.051)		i.e. +/- 0.002 = 0.004 range
NPTH Locational Tolerance	0.003 (0.076)	N/A	N/A		Assumes NPTH are drill during the primary drill cycle
Non-Plated Hole to Outer Copper Minimum Spacing	0.008 (0.203)	0.005 (0.127)	N/A		Assumes NPTH are drill during the primary drill cycle
Hole to Inner Copper Minimum Spacing	0.008 (0.203)	0.006 (0.152)	0.005 (0.127)		
Non-Plated Hole to Board Edge (No Breakout)	0.030 (0.762)	0.020 (0.508)	0.020 (0.508)		
Plated Hole to Board Edge (No Breakout)	0.040 (1.016)	0.030 (0.762)	0.020 (0.508)		
Back Drilled Vias (High Speed Transitions)	No	Yes	Yes	Quarterly	
Blind/Buried Vias (All Types)	Yes	Yes	Yes	Weekly	
Laser Drilled Vias	No	No	No	Never	2023 scheduled availability
Non-Conductive Epoxy Via Fill	Yes	Yes	Yes	Daily	Default: San-ei PHP900-IR-6P Recommended Via Dia: 0.006" to 0.063" Recommended Panel Thickness: 0.014" to 0.150" Blind Vias: Aspect ratio less than 1:1
Conductive Via Fill ⁽¹⁰⁾	No	Yes	Yes	Monthly	Default: DuPont CB-100 Recommended Via Dia: 0.008" to 0.018" Recommended Panel Thickness: 0.014" to 0.090" Blind Vias: Aspect ratio less than 1:1
Solder Mask					
Minimum LPI Soldermask Dam (\leq 1oz base copper)	0.003 (0.076)	0.003 (0.076)	0.0025 (0.064)		0.006" min spacing between fine pitch pads to achieve S/M dam
Minimum LPI Soldermask Dam (2oz base copper)	0.004 (0.102)	0.004 (0.102)	0.003 (0.076)		0.007" min spacing between fine pitch pads to achieve S/M dam
Minimum LPI Soldermask Dam (3oz base copper)	0.007 (0.178)	0.007 (0.178)	0.006 (0.152)		0.010" min spacing between fine pitch pads to achieve S/M dam
Minimum LPI Soldermask Dam (4oz base copper)	0.008 (0.203)	0.008 (0.203)	0.007 (0.178)		0.012" min spacing between fine pitch pads to achieve S/M dam
Soldermask Registration (+/-) or Clearance per side	0.0015 (0.038)	0.0010 (0.025)	0.00050 (0.013)		LDI used for all soldermask exposure since 4/1/2020
LPI Soldermask	Yes	Yes	Yes	Daily	Electra EMP110 HD - Default Finish: Satin Colors:Green,Blue,Red,Black ⁽⁴⁾ , Clear,Orange,Purple,Gray,White ⁽⁴⁾
Dry Film Soldermask	No	No	No	Never	
Peelable Soldermask	Yes	Yes	Yes	Monthly	Peters SD-2954; Min clearance to exposed feature: 0.040"
Soldermask Via Plug w/LPI mask	Yes	Yes	Yes	Weekly	Electra EMP-110 (15% min hole fill) Talyo PIHP 200 (70% min hole fill)
Soldermask Laser Ablation	No	No	No	Never	
Soldermask using Laser Direct Imaging	Yes	Yes	Yes	Daily	
Impedance					
Single-ended (+/- %)	10	N/A	N/A	Daily	
Differential/ Edge-coupled (+/- %)	10	N/A	N/A	Daily	
Differential/ Broadside-Coupled (+/- %)	10	N/A	N/A	Quarterly	
In-house Testing/Verification	Yes	Yes	Yes	Daily	Polar CITS880s TDR

Technology					
Etch back	Yes	Yes	Yes	Weekly	Plasma ⁽¹⁰⁾ , Modified Desmear Cycle ⁽¹¹⁾
Edge Plating	Yes	Yes	Yes	Monthly	
Castellated Holes	No	Yes	Yes	Monthly	
Heat Sinks	No	No	No	Never	
Backplanes	No	No	No	Never	
V-Cut (Scoring)	Yes	Yes	Yes	Daily	Jump scoring; 20°, 30° (default), 60° blades available
Milling	No	Yes	Yes	Monthly	Counterbore/Countersink/Pocket
Materials					
Available Panel Sizes	18x24, 21x24				18x24 (1 - 30 layers), 21x24 (1 - 20 layers) 18x24 only for speciality materials (high speed digital, teflon, etc.)
Maximum Board Size	15.6" x 22.7" ⁽⁵⁾ 16.7" x 21.6" ⁽⁵⁾ 18.6" x 22.7" ⁽⁶⁾ 19.7" x 21.6" ⁽⁶⁾				
Minimum Dielectric Thickness	0.003 (0.076)	0.0025 (0.064)	0.0025 (0.064)		UL qualified for 0.003 core thickness and above
Minimum Copper Weight - Inner Layers (oz)	0.5	0.25	N/A		
Minimum Starting Copper Weight - Outer Layers (oz)	0.5	0.25	N/A		
Maximum Copper Weight - Inner Layers (oz)	3	4	5		Standard foils stocked: 1/2oz, 1oz, 2oz., 3oz ⁽⁷⁾
Maximum Starting Copper Weight - Outer Layers (oz)	3	5	6		Standard foils stocked: 1/4oz, 3/8oz, 1/2oz, 1oz, 2oz, 3oz ⁽⁸⁾
Epoxy Glass (140C Tg min)	Yes	Yes	Yes	Daily	In stock Shengyi S1141
Epoxy Glass (170C Tg min)	Yes	Yes	Yes	Daily	In stock Isola 370HR, Isola 185HR
Polyimide Glass ⁽⁹⁾	Yes	Yes	Yes	Daily	In stock; Isola P95/P25; 10 day LT
Resin Coated Copper (for HDI)	No	No	Yes	Never	Material is NOT stocked
GeTek ⁽⁹⁾	Yes	Yes	Yes	Annual	Material is NOT stocked; 30 day LT
Isola 408 / Isola 408HR	Yes	Yes	Yes	Weekly	In stock; 10 day LT
Isola ISpeed ⁽⁹⁾ / Isola I Tera ⁽⁹⁾	Yes	Yes	Yes	Monthly	Limited material stocked; 10 day LT
Hitachi GHA-679G (Theta) ⁽⁹⁾	Yes	Yes	Yes	Quarterly	Limited material stocked; 20 day LT
Nelco 4000-13EPSI	Yes	Yes	Yes	Quarterly	Limited material stocked; 5-10 day LT
Rogers ⁽⁹⁾ 4003/4403	No	Yes	Yes	Monthly	Limited material stocked; 20 day LT
Rogers ⁽⁹⁾ 4350B/4450F	No	Yes	Yes	Weekly	Limited material stocked; 20 day LT
Rogers ⁽⁹⁾ 4533	No	Yes	Yes	Annual	Material is NOT stocked; 5-10 day LT
Teflons ⁽⁹⁾ (Rogers 6002, 6010, 5880)	No	No	Yes	Monthly	Material is NOT stocked; 20-30 day LT
Megtron 6	No	No	Yes	Monthly	Material is NOT stocked; 15-20 day LT
Aluminum MCB (Berquist MP, HT)	Yes	Yes	Yes	Monthly	Limited material stocked; 3-5 day LT
Halogen Free Epoxies ⁽⁹⁾	No	No	Yes	Never	Material is NOT stocked; 6 week LT
Buried Capacitance (i.e. BC2000, ZBC)	No	No	No	Never	License required to manufacture

Surface Finishes					C=Chemistry, V=Vendor, S=Specification
HASL	Yes	Yes	Yes	Weekly	Range: Coverage and solderable (30 - 1000µin) S: IPC-6012
Lead-free HASL	Yes	Yes	Yes	Weekly	Range: Coverage and solderable (30 - 1000µin) C: SN100C S: IPC-6012
Electroless Nickel Immersion Gold (ENIG)	Yes	Yes	Yes	Daily	Default Range: Ni:118µin min / Au:2-5µin C: DOW S: IPC-4552
Electroless Nickel Electroless Palladium Immersion Gold (ENEPIG) ⁽¹⁰⁾	Yes	Yes	Yes	Annual	Default Range: Ni:118µin min / Pd:2-5µin / Au:1-2µin V: Superior Processing S: IPC-4552 (Ni/Au), ASTM-B-679 (Pd)
Hard Gold ⁽¹⁰⁾	Yes	Yes	Yes	Monthly	Default Range: Flash gold: 5 - 15µin / Contact pads: 30µin min. V: Superior Processing S: ASTM-B-488
Hard Gold (Tabs)	Yes	Yes	Yes	Weekly	Default Range: Ni:118µin min / Au:30µin min S: ASTM-B-488
Soft Bondable Gold ⁽¹⁰⁾	No	Yes	Yes	Annual	Default Range: Ni:118µin min / Au:50µin min V: Superior Processing
Immersion Silver	Yes	Yes	Yes	Weekly	Range: 6 - 18µin C: MacDermid Sterling Silver S: IPC-4553
Organic Solderability Preservative (OSP) ⁽¹⁰⁾	No	Yes	Yes	Annual	C: Enthone Entek Plus HT V: AVT S: IPC-6012
Immersion Tin ⁽¹⁰⁾	No	Yes	Yes	Quarterly	Default Range: 30µin min C: MacDermid MacStan HSR V: AVT S: IPC-4554
Carbon Ink	No	Yes	Yes	Quarterly	
Combination Finishes (i.e. ENIG and Soft Gold)	No	Yes	Yes	Monthly	
Lead Time					
24 Hour	Yes	No	No	Quarterly	1 - 2 layer; no outside processes; local delivery only
48 Hour	Yes	No	No	Monthly	1 - 12 layer; no outside processes; data by 8:00am
3 Day	Yes	Yes	Yes	Weekly	Limited to ten 18x24 panels; no outside processes
5 Day	Yes	Yes	Yes	Daily	
10 Day	Yes	Yes	Yes	Daily	
15 Day and Greater	Yes	Yes	Yes	Daily	
Production Capability					
Low - Medium Volume Production	Yes	Yes	Yes	Daily	Domestic
High Volume Production	Yes	Yes	No	Weekly	Domestic & Offshore
Quality					
IPC-6012 Class 1	Yes	Yes	Yes	Never	
IPC-6012 Class 2	Yes	Yes	Yes	Daily	Default
IPC-6012 Class 3 (High Reliability)	Yes	Yes	Yes	Daily	
IPC-6012 Class 3/A (DS) - Space & Military Avionics	Yes	Yes	Yes	Monthly	
Certifications					
ISO 9001:2015	Yes	Yes	Yes		Cert # 56 900 19560016
AS9100D (Aerospace)	Yes	Yes	Yes		Cert # 56 900 19560016
MIL-PRF-31032	Yes	Yes	Yes		
ITAR Registered	Yes	Yes	Yes		
RoHS/Lead-Free	Yes	Yes	Yes		
UL Registered	Yes	Yes	Yes		
IPC Member	Yes	Yes	Yes		

⁽¹⁾ Assumes 30% etch tolerance

⁽²⁾ Obtainability will depend on board thickness, geometry, and copper design

⁽³⁾ Obtainability will depend on board thickness and layer count

⁽⁴⁾ Additional cost

⁽⁵⁾ 18x24 panel size

⁽⁶⁾ 21x24 panel size

⁽⁷⁾ Limited stock

⁽⁸⁾ Limited stock for double-sided boards

⁽⁹⁾ Multicircuits not UL certified (UL mark would not appear on finished product).

⁽¹⁰⁾ Outsourced

⁽¹¹⁾ Required for certain material types (i.e. High Speed Digital laminates)