

	Chandler Division	Aurora Division	Maple Grove Division	Capabilities (Overall)
Material				
FR-4				
	Number of Conductive layers	Number of Conductive layers	Number of Conductive layers	Number of Conductive Layers
Standard FR4	40	18	40	40
Isola FR406	40	18	40	40
HALOGEN FREE				
Ventec VT-441, VT-447	40		40	40
Isola TerraGreen	40		40	40
RoHS				
ITEQ IT-180A		18	40	30
Isola 185HR		18	40	30
Isola 370HR	40	18	40	40
FR408HR	40	18	40	40
Isola I-TERA MT (RF/MW)	40		40	40
Nelco BT-N5000			40	30
Nelco 4000-29	40		40	40
Nelco 4000-13 & 13Si	40		40	40
Nelco 4000-13EP & EPSi	40		40	40
Polyimide	40	18	40	40
Cyanate Ester			20	20
RF Materials				
Rogers 3000 Series	Max. 20 lyr. FR-4 w/ RO3000 caps		Max. 20 lyr. FR-4 w/ RO3000 caps	Max. 20 lyr. FR-4 w/ RO3000 caps
Rogers 4000 Series (4003C & 4350B)	20	18	40	20
Rogers 5870/5880	2		20	8
Taconic RF Materials	2		10	2
Isola IS680	40		40	40
I-Tera RF MT	40		40	40
Isola Astra M177	40		40	40
Advanced RF Materials				
Nelco 9000 Series (PTFE)	2		10	2
Rogers 6000 Series	4		10	4
Rogers 5000 Series	2		20	2
Rogers Duclad 880, AD300A, CuClad 250 & 233, CTLE	20		30	20
Isola I-Speed	40		40	40
Arlon Genclad 280, LX250, GYN 2.17 Dk			40	10
New Expanded Materials Used For Signal Integrity, Advanced HDI, Stacked Microvia				
Panasonic Megtron 6	Yes		40	Yes
3M ECM (embedded Capacitance material)	Yes		Yes	Yes
ROHACELL			12	12
Taconic FastRise 27 & 28 Bondply	Yes		Yes	Yes
Isola Tachyon 100G	40		40	40
Isola I-Tera MT40	40		40	40
Rogers 2929 Bondply	Yes		Yes	Yes
Arlon 6700 and 6250 Bondply	Yes		Yes	Yes
Maximum Useable Area (for 12" x 18" panel)	10" x 16"		10.5" x 16.5"	10.5" x 16.5"
Maximum Useable Area (for 18" x 24" panel)	16" x 22"	16.6" x 22"	16.5" x 22.5"	16" x 22"
Maximum Useable Area (for 18" x 27" panel)			16" x 25"	16" x 25"
Maximum Useable Area (for 18" x 32" panel)			16" x 30"	16" x 30"
Maximum Useable Area (for 18" x 36" panel)			16" x 34"	16" x 34"
Maximum Useable Area (for 18" x 42" panel)			16" x 40"	16" x 40"
Maximum Useable Area (for 18" x 54" panel)			16" x 52"	16" x 52"
Maximum Useable Area (for 21" x 24" panel)			19" x 22"	19" x 22"
Maximum Useable Area (for 21" x 60" panel)			18" x 58"	18" x 58"
Maximum Useable Area (for 24" x 30" panel)			22" x 28"	22" x 28"
			Please contact us for layer counts exceeding specific panel sizes listed above	
Stack-ups				
Overall Thickness Range and Tolerances				
Overall Board Thickness:	0.010" - 0.240"	.010" - .155"	0.001" - 0.250"	0.010" - 0.250"
Overall Board Thickness Tolerance:				
< 0.020":	Standard +/- 0.004", Special +/- 0.003"	Std +/- .005", Special +/- 0.003"	Standard +/- 0.004", Special +/- 0.003"	Standard +/- 0.004", Special +/- 0.003"
0.031":	Standard +/- 0.004", Special +/- 0.003"	Std +/- .005", Special +/- 0.003"	Standard +/- 0.004", Special +/- 0.003"	Standard +/- 0.004", Special +/- 0.003"
0.062":	Standard +/- 0.006", Special +/- 0.004"	Std +/- .006", Special +/- 0.003"	Standard +/- 0.006", Special +/- 0.004"	Standard +/- 0.006", Special +/- 0.003"
0.093":	Standard +/- 0.009", Special +/- 0.006"	Std +/- .009", Special +/- 0.006"	Standard +/- 0.009", Special +/- 0.006"	Standard +/- 0.009", Special +/- 0.006"
0.125":	Standard +/- 0.012", Special +/- 0.009"	Std +/- .012", Special +/- 0.009"	Standard +/- 0.012", Special +/- 0.009"	Standard +/- 0.012", Special +/- 0.009"
0.187":	Standard +/- 0.018", Special +/- 0.014"	NA	Standard +/- 0.018", Special +/- 0.014"	Standard +/- 0.018", Special +/- 0.014"
0.250":			Standard +/- 0.025", Special +/- 0.018"	Standard +/- 0.025", Special +/- 0.018"
Thinnest Dielectric Finished				
Thin Board Overall Thickness:	.010" (non HASL finish)	.010"	0.001"	0.010" (2-sided)/0.015" (4-layer)
Thinnest Plated Core:	0.004"	.004"	0.004"	0.004"
Special Products/Unique Capabilities				
Heavy copper up to 20 oz.	NA	NA	we can build	Available
Heatsinks	NA	NA	we can build	Available
Backplates	NA	NA	we can build	Available
2 Layers up to 37" x 96" panel w/ NPT's	NA	NA	we can build	Available
Rohacell Foam Bonding	NA	NA	we can build	Available
Buried Chips and Resistors	NA	NA	we can build	Available
Light Hand Assembly	NA	NA	we can do	Available
Resistance and Conductance Test Equipment	NA	NA	we can do	Available
Drill and Rout capabilities up to 38" x 120"	NA	NA	Available.	Available
PEM Nut Installation	Available	Available	Available.	Available
Mechanical Capabilities				
Machining Drill Capabilities				
Primary Drilled Hole Location Tolerance to Datum (Hole) Zero (DTP):	0.005"	.005"	0.005"	0.005"
2nd Drill Hole Location Tolerance to Datum Zero (DTP):	0.005"	.005"	.005"	0.005"
Minimum Clearance from Copper Conductor to Mechanical Drilled Hole:	0.004"	.008"	0.005"	0.004"
Minimum Clearance from Copper Conductor to a Laser Drilled Hole:	0.004" (Design Dependent)	NA	.004"	0.004"
Plated Through Hole Capabilities				
Smallest Plated Through Hole Size with 0.001" Minimum Average Copper Requirement				
Finished Panel Thickness < 0.020":	0.003" finished hole	0.004" finished hole	0.005" finished hole	0.003" finished hole
Finished Panel Thickness 0.031":	0.003" finished hole	0.004" finished hole	0.005" finished hole	0.003" finished hole
Finished Panel Thickness 0.062":	0.004" finished hole	0.004" finished hole	0.005" finished hole	0.004" finished hole
Finished Panel Thickness 0.093":	0.008" finished hole	0.009" finished hole	0.007" finished hole	0.008" finished hole

	Chandler Division	Aurora Division	Maple Grove Division	Capabilities (Overall)
Finished Panel Thickness 0.125"	0.010" finished hole	0.012" finished hole	0.01" finished hole	0.010" finished hole
Finished Panel Thickness 0.187"	0.012" finished hole	NA	0.018" finished hole	0.012" finished hole
Finished Panel Thickness 0.250"	0.018" finished hole (.240" thick)	NA	0.025" finished hole	0.018" finished hole (excluding HAL finish)
Plated Hole Size Tolerance:	+/- 0.003" standard	+/- 0.005" standard; special +/- .002"	+/- 0.003" standard; Special +/- .002	+/- 0.003" standard; Special +/- .002
Plated Hole Size Press Fit applications:	+/- 0.002" typical	+/- 0.003" typical; special +/- .002"	N/A	+/- 0.002" typical
Aspect Ratio (with 0.010" drill):	18:1	10:1	12:1	18:1 (.007" finish in .130" thick)
Plated Hole Spacing Minimum (Drilled hole to hole):	0.008"	0.008"	0.008	0.008"
Non Plated Through Holes				
Smallest Non Plated Hole Size (Finished):	0.006"	0.006"	.006"	0.006"
Largest Non-Plated Hole Size Routed:	No limit	No limit	No Limit	No limit
Non-plated Routed Hole Tolerance:	+/- 0.005" Typical +/- 0.003" Special	+/- 0.010" Typical; Special +/- .005"	+/- 0.005" Standard +/- 0.003" Special	+/- 0.005" Typical +/- 0.003" Special
Minimum NPTH to Edge of Board Spacing:	0.010"	0.010"	0.010"	0.010"
Blind/Buried Vias (Sequential Lamination)				
Minimum FINISHED Via Hole Diameter - Epoxy Filled	0.006"	NA	0.007"	0.006"
Maximum FINISHED Via Hole Diameter - Epoxy Filled	0.04	NA	0.040"	0.04
Maximum Aspect Ratio for Epoxy Filled Via Holes	10:1	NA	11:1	10:1
Available Epoxy Fill Types	Conductive & Non-Conductive	NA	Conductive & Non-Conductive	Conductive & Non-Conductive
Laser Microvia (µVia) Capabilities				
Smallest (as ablated) Laser Via:	0.003"	NA	0.004"	0.003"
Largest (as ablated) Laser Via:	0.010"	NA	0.01"	0.010"
Via Aspect Ratio (Depth to Diameter)	0.75:1 Standard 1:1 Advanced	NA	1:1	0.75:1 Standard 1:1 Advanced
Capture Pad Size:	µVia + 0.008" Std µVia + 0.006" Adv	NA	0.007"	µVia + 0.008" Std µVia + 0.006" Adv
Landing Pad Size:	µVia + 0.008" Std µVia + 0.006" Adv	NA	0.007"	µVia + 0.008" Std µVia + 0.006" Adv
Stacked Via	Yes	NA	Yes	Yes
Type I Capabilities	Yes	NA	Yes	Yes
Type II Capabilities	Yes	NA	Yes	Yes
Type III Capabilities	Design Dependent	NA	Yes	Design Dependent
Copper-Filled Microvia:	Yes	NA	Yes	Yes
Control Depth Drill Capabilities				
Backdrill - PTH Stub Removal	PTH + 0.010" Diameter (typ.)	NA	PTH + 0.010" Diameter (typ.)	PTH + 0.010" Diameter (typ.)
Minimum Backside Dielectric Separation	0.005	NA	0.010"	0.005
Control Depth Drill Depth Tolerance	+/- 0.004"	NA	+/- 0.005"	+/- 0.004"
Edge Milling Available	Yes	Yes	Yes	Yes
Back Drilling Capabilities				
Minimum Back Drill Drilled Diameter	0.014"	NA	0.014"	0.014"
Drilled Hole Over Finished Hole Size	0.010" (typ.)	NA	0.010" (typ.)	0.010" (typ.)
Drill Depth Tolerance	0.005" Typical, 0.004" Minimum	NA	+/- 0.005"	0.005" Typical, 0.004" Minimum
Scoring Capabilities				
Angles:	30 degrees, 60 degrees	30°, 60°	Standard 30°, Available 20°, 45°, and 60°	Standard 30°, Available 20°, 45°, and 60°
Offset Tolerance:	+/- 0.005"	+/- 0.005"	+/- 0.005"	+/- 0.005"
Optimum Remaining Web Thickness:	1/3 of thickness (0.020" typ. For 0.062")	1/3 of thickness (.018" typ. For 0.062")	1/3 of thickness (0.014" typ. For 0.062")	1/3 of thickness (0.014" typ. For 0.062")
Remaining Web Tolerance:	+/- 0.005"	+/- 0.005"	+/- 0.005"	+/- 0.005"
True Position Tolerance:	+/- 0.005"	+/- 0.005"	+/- 0.007"	+/- 0.005"
Edge Connector Bevel Capabilities				
Finger Tip Angle:	20, 30, 45 degrees	15, 20, 30, 45 degrees	Any	15, 20, 30, 45 degrees
Bevel Depth Tolerance:	+/- 0.005"	+/- 0.005"	+/- 0.005"	+/- 0.005"
Profile Capabilities				
Standard Router Bit Diameter:	0.093", 0.062", 0.031" (Router Bits)	0.093", 0.062", 0.050", 0.031" (Router Bits) Special 0.021"	Any	0.093", 0.062", 0.031" (Router Bits) Special 0.021"
Routed Profile Tolerance:	+/- 0.005" std. +/- 0.004" spl.	+/- 0.010" std.; special +/- 0.005"	+/- 0.003"	+/- 0.005" std. +/- 0.004" spl.
Minimum Internal Rout Radius:	0.015"	0.0105"	0.015"	0.0105"
Minimum Routed PTH Slot Width:	.026" typ. .016" min.	.026" typ. .016" min.	0.022"	.022" typ. with .008" min
Controlled Depth Milling	Yes	Yes	Yes	Yes
Laser Routing	0.001" min. radius		Yes	0.001" min. radius
Feature Size Capabilities				
Innerlayer Capabilities				
Minimum Conductor Width and Spacing				
Internal Starting Copper Weight ½ oz.:	0.00275" line / 0.003" space	0.003" finished	0.003" finished	0.00275" line / 0.003" space
Internal Starting Copper Weight 1 oz.:	0.00375" line / 0.0045" space	0.004" finished	0.005" finished	0.00375" line / 0.0045" space
Internal Starting Copper Weight 2 oz.:	0.005" line / 0.006" space	0.005" finished	0.008" finished	0.005" line / 0.006" space
Internal Starting Copper Weight 3 oz.:	0.009" line / 0.011" space	0.009" finished	0.010" finished	0.009" line / 0.011" space
Internal Starting Copper Weight 4 oz.:	.012" line / .016" space	0.010" finished	0.012" finished	0.012" line / 0.016" space
Contact us for > 4 oz.				
Outerlayer Capabilities				
Minimum Conductor Width and Spacing				
External Copper Finished Thickness 1.0 oz.:	0.00275" finished	0.003"(3/8oz start) - 0.004"(1/2oz start)	.003"	0.00275" finished
External Copper Finished Thickness 1.5 oz.:		.004" finished	0.004" finished	0.004" finished
External Copper Finished Thickness 2.0 oz.:	0.005" finished	0.005" (1oz start)	0.005" finished	0.005" finished
External Copper Finished Thickness 3.0 oz.:	0.009" finished	0.009"	0.009" finished	0.009" finished
External Copper Finished Thickness 4.0 oz.:	0.011" finished	0.010"	0.014" finished	0.010" finished
External Copper Finished Thickness 5.0 oz.:			0.020" finished	0.020" finished
External Copper Finished Thickness 6.0 oz.:			0.030" finished	0.030" finished
External Copper Finished Thickness 7.0 oz.:			0.045" finished	0.045" finished
External Copper Finished Thickness 8.0 oz.:			0.060" finished	0.060" finished
Pad Diameter to Drilled Hole Size				
IPC-6012 Class 2				
Component holes:	Drilled size plus 0.010"	Drilled size plus 0.006" .008" Drill / .062" or Thinner	Drilled size plus 0.010"	Drilled size plus 0.006"
Via holes:	Drilled size plus 0.008"	Drilled size plus 0.006" .008" Drill / .062" or Thinner	Drilled size plus 0.010"	Drilled size plus 0.006"
IPC-6012 Class 3				
Component holes:	Drilled size plus 0.012"	Drilled size plus 0.012"	Drilled size plus 0.012"	Drilled size plus 0.012"
Via holes:	Drilled size plus 0.010"	Drilled size plus 0.010"	Drilled size plus 0.011"	Drilled size plus 0.010"
Pad Diameter to Laser Ablated Hole Size				
Component holes:	Drilled size plus 0.004" min.	NA	Drilled size plus 0.004" min.	Drilled size plus 0.004" min.
Via holes:	Drilled size plus 0.008" std.	NA	Drilled size plus 0.008" std.	Drilled size plus 0.008" std.
Solder Mask and Silkscreen				
Solder Mask				
Min. LPI Soldermask Clearance: (Flood)	0.002"/side (Pad size + 0.004")	0.002"/side (Pad size + 0.004")	0.002"/side (Pad size + 0.004")	0.002"/side (Pad size + 0.004")
Min. LPI Soldermask Clearance: (LDI Imaged)	1:1 (Design Dependent)	1:1 (Design Dependent)	.002"/side (Pad size + 0.004")	1:1 (Design Dependent)
Pad size larger than NPTH:	0.005"/side (Pad size + 0.010")	NA	0.005"/side (Pad size + 0.010")	0.005"/side (Pad size + 0.010")
Web Between Surface Mount Pads:	0.004" preferred, 0.003" min. (green)	.002" min. Green (Cu dependent)	0.003" min.	0.004" preferred, 0.002" min. (green)
LEW Processing		.007" min LEW only (2.4mil Cu) .005" min LEW / Clear Undercoat	Can be ordered	.007" min LEW only (2.4mil Cu) .005" min LEW / Clear Undercoat
Solder Mask Colors:	Green, Blue, Red, Black, LEW White, Clear, Orange, Brown, Purple, Pink, Matte Green & Matte Black	Green, Blue, Red, Black, White, LEW White, Clear, Purple, Pink, Grey, Matte Green & Matte Black, Yellow, Orange	ANY -Green, Blue, Red, Black, Yellow, White, Orange, Purple, Pink, Brown, Clear	Green, Matte Green, Blue, Red, Black, Matte Black, Yellow, LEW White, White, Orange, Purple, Pink, Brown, Clear
Solder Mask Type:	Liquid Photo Imageable (LPI)	Liquid Photo Imageable (LPI)	Liquid Photo Imageable (LPI)	Liquid Photo Imageable (LPI)
Special Solder Mask Type:	Laser Direct Imaging (LDI)	Laser Direct Imaging (LDI)	Laser Direct Imaging (LDI)	Laser Direct Imaging (LDI)
Minimum Mask Defined Pad Diameter:	0.006"	0.008"	0.005"	0.005"
Soldermask Plugged Vias	Yes	Yes	Yes	Yes

	Chandler Division	Aurora Division	Maple Grove Division	Capabilities (Overall)
Silkscreen				
Minimum Stroke/Width Screened Legend:	0.005"	0.005"	0.005"	0.005"
LPI Legend Capability:	Yes	Yes	Yes	Yes
Minimum Stroke/Width LPI Legend:	0.002"	.002"	0.002"	0.002"
Screened/LPI Legend Colors:	White, Black, Yellow, Red, Blue	White, Black, Yellow, Red, Blue	Any	White, Black, Yellow, Red, Blue
Serialization / Unique Serialization:	Yes	Yes	Yes	Yes
Via-in-Pad - HDI				
Epoxy Filled - Non Conductive				
Epoxy Filled Thru Hole Capability:	Yes	Yes	Yes	Yes
Epoxy Filled Thru Hole Minimum:	.004" FHS	.004" FHS	0.004" FHS	0.004" FHS
Epoxy Filled Thru Hole Maximum:	0.040" FHS	0.020" FHS	0.040" FHS	0.040" FHS
Minimum Board Thickness:	0.015"	.015"	.008"	0.015"
Maximum Board Thickness:	0.187"	.155"	0.250"	0.187"
Via Fill Aspect Ratio:	10:1	10:1	11:1	10:1
Conductive VIP Options:	Yes	No	Yes	Yes
Non-Conductive VIP Options:	Yes	Yes	Yes	Yes
Copper Plated / Filled				
Copper Filled μ Via Process:	Yes	NA	yes	Yes
Copper Filled μ Via Hole Minimum:	0.003" Laser Drilled	NA	.004"	0.003" Laser Drilled
Copper Filled μ Via Hole Maximum:	0.010" Laser Drilled	NA	.01"	0.010" Laser Drilled
Via Fill Aspect Ratio:	0.75:1 standard 1:1 advanced	NA	1 to 1	0.75:1 standard 1:1 advanced
Military				
Etch Back				
IPC Class 3 Etchback Specification:	0.0002" - 0.002"	0.0002" - 0.002"	0.0002" - 0.002"	0.0002" - 0.002"
Surface Finishes Options				
Surface Finishes Selection				
Hot Air Solder Level (lead-free, lead based):	Leaded Only	Leaded and Lead-Free	Leaded 37"x96"	Yes
Immersion Silver:	Yes	Yes	31"x96"	Yes
OSP:	No	No	Outsource	Yes (outsource)
Electroless Nickel Immersion Gold:	Yes	Yes	24"x24"	Yes
ENEPIG:	Yes	Yes (outsource)	Outsource	Yes
Immersion Tin:	Yes (outsource)	Yes (outsource)	21"x24"	Yes (outsource)
Full Body Gold:	Yes	Yes	24"x54"	Yes
Bondable Gold:	Yes (outsource)	Yes (outsource)	Outsource	Yes (outsource)
Plated Nickel:	Yes	Yes	24"x54"	Yes
Electroless Nickel:	Yes	Yes	24"x24"	Yes
Copper:	Yes	Yes	31"x96"	Yes
Hot Oil Reflow:			24"x26"	Yes
Mixed Finishes				
HASL with Selective Gold:	Yes	No	Yes	Yes
Dual Gold Plating:	Yes	Yes	Yes	Yes
Immersion Gold with Selective Hard Gold on Fingers:	Yes	Yes	Yes	Yes
Recessed Fingers:	Yes	Yes	Yes	Yes
Testing Capabilities				
Minimum Test Continuity Resistance:	1 ohm - 10K ohm	1 ohm - 10K ohm	1 ohm - 10K ohm	1 ohm - 10K ohm
Maximum Test Voltage:	1000 volts	1000 Volts	1000 volts	1000 volts
Maximum Test Isolated Resistance:	100Gohm	100Gohm	100Gohm	100Gohm
Largest Test - Fixture:	10" x 10"	16" x 22"	12.5" x 9.5"	16" x 22"
Largest Test - Flying Probe:	18" x 24"	21" x 24"	27" x 24"	27" x 24"
Electrical Test Pitch (Fixture Test):	0.020"	0.020"	0.020"	0.020"
Electrical Test Pitch (Flying Probe Test):	0.004"	0.004"	0.004"	0.004"
DC Line Resistance Testing:	Yes	No	Yes	Yes
Electrical Performance				
TDR Test Tolerance (Print and Etch):	Standard 10%, Adv 5%	Standard 10%, Adv 5%	10 % or +/- 5 Ohms Minimum	Standard 10%, Adv 5%
TDR Test Tolerance (Plated Copper):	Standard 10%, Adv 5%	Standard 10%, Adv 5%	10 % or +/- 5 Ohms Minimum	Standard 10%, Adv 5%
TDR Test Tolerance Differential Measurements:	Standard 10%, Adv 8% (Edge-Coupled)	Standard 10%, Adv 5%	10 % or +/- 5 Ohms Minimum	Standard 10%, Adv 5%
TDR Tolerance Single Ended Tolerance:	Standard 10%, Adv 5%	Standard 10%, Adv 5%	10 % or +/- 5 Ohms Minimum	Standard 10%, Adv 5%
HIPot Testing (AC & DC):	Yes	Yes (outside)	Yes	Yes
Data & Documentation				
Tooling Formats				
Film Data Formats:	DXF, 274X, ODB++	DXF, RS-274-X, RS-274-D, ODB++, IPC-2581	ODB++, RS-274-X, RS-274-D	DXF, RS-274-X, RS-274-D, ODB++
Drill Data Formats:	ASCII, Excellon Format	ASCII, Excellon Format; RS-274-X, RS-274-D	ASCII, Excellon Format; RS-274-X, RS-274-D	ASCII, Excellon Format; RS-274-X, RS-274-D
Electrical Test Formats:	IPC-D356	IPC-D356	IPC-D356	IPC-D356
Netlist Compare Formats:	IPC-D356	IPC-D356 / D356-A	IPC-D356	IPC-D356 / D356-A
Tooling Communication				
Media Types & Data Transfer:	Email	Email, FTP	Email, FTP	Email, FTP
Compression Formats:	ZIP, TAR, TGZ	ZIP, TAR, TGZ	ZIP, TAR, TGZ	ZIP, TAR, TGZ
Secured Data Transfer Methods:	Secure Data Transfer, PGP	Secure Data Transfer, PGP	Secure Data Transfer, PGP	Secure Data Transfer, PGP