ROGERS CORPORATION

Fabrication Notes

RT/duroid® 5280LZ High Frequency Laminates Fabrication Guidelines

Material Description: RT/duroid® 5280LZ filled PTFE composites are ideal for use in weight-sensitive high-performance applications. The laminate material is compatible with manufacturing processes for double-sided and multi-layer circuits and has a low Z-axis CTE that contributes to long-term reliability of plated-through holes.

These guidelines were developed to provide fabricators with basic information on processing stripline assemblies and multilayer boards using copper clad RT/duroid 5280LZ laminates. A Rogers' technical service or sales representative should be contacted for more detailed information pertaining especially to dimensional movement and plated through hole processing.

Storage: RT/duroid 5280LZ cores can be stored indefinitely at ambient conditions. A FIFO inventory system is recommended as is a method of record keeping that would allow tracking of material lot numbers through PWB processing and delivery of finished circuits.

INNER LAYER PREPARATION:

Tooling: RT/duroid 5280LZ is compatible with many tooling systems. Choosing whether to use round or slotted pins, external or internal pinning, standard or multiline tooling, and pre- vs. post-etch punching would depend upon the capabilities and preferences of the circuit facility and the final registration requirements. In general, slotted pins, a multiline tooling format, and post-etch punching will meet most needs. Whichever approach is used, it is good practice to retain copper around tooling holes.

A flow pattern compatible with the chosen adhesive system can be used between circuits and around the perimeter of the panel. But, in general, registration of layers (especially thin cores) is improved by retaining as much copper as possible.

Surface Preparation for Photoresist Application: A chemical process consisting of organic cleaners and a microetch is the preferred method of preparing copper surfaces for coating with liquid or film photoresist. A conveyorized spray system using an abrasive substance suspended in solution can be used to prepare copper surfaces at the slight risk of some registration control. Mechanical scrubbing should be considered for thick cores (≥0.060") only and, even then, should be performed at reduced pressures to minimize distorting the thin laminate or imparting deep scratches that change the functional spacing between copper planes.

Photoresist Application: Liquid or dry film photoresist can be applied using traditional dip or spray coating, screening, or roll lamination processes.

DES Processing: Developers, strippers, and copper etchants used to process epoxy glass materials will also work with RT/duroid 5280LZ. The ceramic filled material may require more stringent rinse & bake processing depending upon the next step in the process sequence.

Oxide Treatment: RT/duroid 5280LZ is compatible with most oxide and oxide alternative processes. It is best to use the process recommended by the supplier of the adhesive system chosen to bond together the multilayer board.

BONDING:

Final Preparation: Special pretreatments of etched surfaces using sodium or plasma processes shouldn't be necessary providing care was taken to protect the substrate surface after copper etch. Inner-layers should be baked at 120-150°C (248-302°F) for 30-120 minutes to ensure removal of volatile substances prior to MLB bonding. Guidelines for the oxide treatment should be referenced to make certain the dry bake doesn't degrade the bond-enhancing surface.

Multilayer Adhesive System: RT/duroid 5280LZ materials are compatible with a broad range of thermosetting (FR-4, Rogers 2929, RO4400™, etc.) and thermoplastic (3001 Bonding Film, FEP, PFA, PTFE, etc.) adhesive systems. Many factors, such as electrical performance, flow characteristics, ease of processing, and bond temperature requirements are considered when making the best overall choice. Rogers' Technical Service Engineers (TSE's) understand the trade-offs and, if asked, will help in the selection process.

Multilayer Bond Cycle: The press cycle is determined by the requirements of the chosen adhesive system. Cooling under pressure is required when using thermoplastic (melt processed) films.

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PTH AND OUTER LAYER/DOUBLE-SIDED CIRCUIT PROCESSING:

Drilling: Multi-layers are most commonly drilled in stacks of one. Phenolic composite boards are recommended for entry (0.010" to 0.030" thick) and exit (>0.060") layers. Sheeted aluminum and metal coated phenolic boards can also be used as entry layers.

New carbide drills are highly recommended. Standard or undercut styles can be used. Recommended chip loads (0.001" to 0.003" per revolution) and surface speeds (150 to 300 SFM) vary with tool diameter with slower infeeds and speeds being associated with finer diameter drills. Retract rate when drilling multilayer boards should be between 300 and 500 IPM and be 700 to 1000 IPM when drilling double-sided constructions. Below is a quick reference table that provides recommended parameters for commonly used drill diameters.

Tool life should be based upon inspection of cross-sectioned holes. The "twelve inch rule," which suggests changing a tool after drilling 12" of substrate, is a good place to start when setting tool life. For example, initial hit count when drilling a 0.060" thick board would be 12"/0.060" = 200 holes.

Tool Size		Spindle Speed	Infeed		Retract	
(in)	(mm)	(RPM)	(IPM)	(m/min)	(IPM)	(m/min)
0.0079	0.20	72,500	72.5	1.8	300.0	7.6
0.0098	0.25	68,200	88.7	2.3	300.0	7.6
0.0138	0.50	55,400	83.1	2.1	300.0	7.6
0.0197	0.50	37,200	96.4	2.4	400.0	10.2
0.0256	0.65	37,200	74.2	1.9	400.0	10.2
0.0295	0.75	32,200	64.4	1.6	400.0	10.2
0.0394	1.00	24,100	48.2	1.2	400.0	10.2
0.0492	1.25	20,000	40.0	1.0	400.0	10.2
0.0625	1.59	20,000	40.0	1.0	400.0	10.2
0.1250	3.18	20,000	40.0	1.0	400.0	10.2

Deburring: The use of flat, rigid entry materials, conservative drilling parameters, and limited hit counts with new drills should minimize the risk of copper burring. When drilled properly, cores should be ready for subsequent processing. If debur is necessary, a chemical microetch process is preferred. If mechanical processing is required, a hand pumice scrub is preferred over a suspended abrasive spray system which, in turn, is preferred over a conveyorized mechanical debur or planarization process.

Hole Preparation: Loosely deposited debris in the holes can be removed using a vapor or hydro-honing process. These processes involve directing water suspended abrasive particles through drilled holes. The soft laminates must be properly supported through these processes.

PTFE composite materials are not typically desmeared. However, the adhesive systems (bondplies & prepregs) used to bond multilayer boards or hybrid multilayer boards may require desmear prior to copper deposition. When desmear is required, plasma is preferred over a chemical desmear process because at elevated temperature, highly alkaline chemicals can interact with the filler used in RT/duroid 5280LZ cores. The interactions are not a risk to the processing bath, but can slightly impact the electrical properties and absorption potential of material surrounding the holes. For this reason a plasma desmear is preferred when possible. When plasma desmear is required, a dual cycle to accomplish (first) desmear of the thermosetting adhesive and core layers and (second) surface activation of the PTFE surfaces is possible by following the recommendations outlined in the table below. If desmear is not required, then steps 2 and 3 can be eliminated.

	Step 1 Warm-Up	Step 2 Desmear	Step 3 Clean	Step 4 Activation
Temp, C	80	80	80	80
Time, min	60	5-15	5-10	10-20
Power, W	4000-6000	4000-6000	4000-6000	4000-6000
Pressure, Torr	0.25	0.25	0.25	0.25
O2	80%	80%	100%	
CF4		10%		
N2	20%	10%		
He				100%

The PTFE activation step can also be accomplished by using 100% H2, 100% N2, or a 70%/30% combination of H2/N2.

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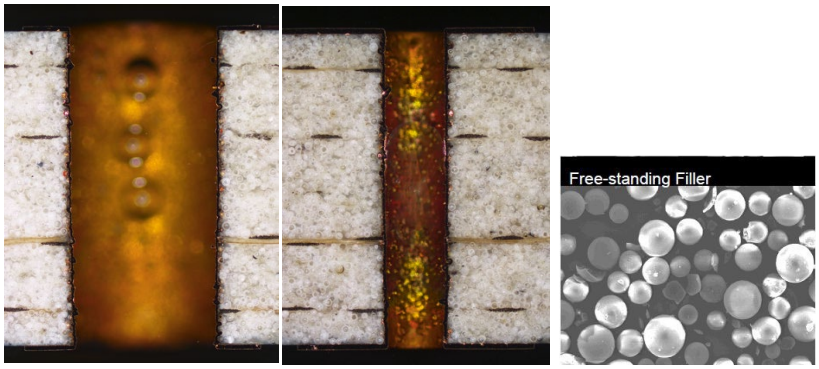
If plasma treatment is not available or desired, RT/d 5280LZ PTH wall treatment can be accomplished using a sodium based chemistry. Two common sources of this chemistry are FluoroEtch® from Acton Technologies (https://actontech.com/) and Tetra-Etch from W.L. Gore & Associates, Inc. Tetra-Etch is available from many chemical suppliers. PTH sodium treatment contract services are available from Acton Technologies (https://actontech.com/, Pittston, PA) and G&S Associates (https://gsassociates.com/, Corona, CA).

Metallization: RT/duroid 5280LZ materials are compatible with traditional electroless copper and direct deposit metallization processes. Cores should be baked (30-90 minutes @ 120-150°C [248-302°F]) prior to metal deposition unless plasma, which also serves as a vacuum bake, is used to prepare the hole walls for plating. A flash plate build-up of 0.0001" to 0.0003" (0.0025mm-0.0076mm) of copper is recommended to better support hole walls through pattern plating and outer-layer processing.

The RT/duroid 5280LZ product contains hollow microspheres. These spherical fillers are used to acheive the electrical and thermomechanical characteristics of RT/duroid 5280LZ laminate. During the PTH drilling process these spheres can be cut open at the edge of the hole wall. During the plating process these opened spheres will also plate with copper. In some extreme examples these opened spheres will plate shut. This results in a unique, but reliable wall structure. Images of "typical" hole walls are provided below:



PTH Plating and Outer-Layer Imaging: Standard equipment and chemical processes are used to plate, image, and etch circuit patterns onto RT/duroid 5280LZ materials. Care should be taken to preserve the post-etch laminate surface. The topography that remains after copper removal promotes improved adhesion to solder masks. Microspheres located at the surface of cores may be fractured during after-etch PWB processing. Spheres that are open to the surface may require more stringent rinsing to avoid staining.
Materials should be rinsed and baked prior to solder mask application. Rinsing in warm or hot water for 20-30 minutes followed by 60 minutes at 125°C (257°F) should be sufficient, especially if the bake is done under vacuum.

Final Surfaces: RT/duroid 5280LZ materials are compatible with most LPI solder masks. Epoxy solder masks are preferred if the application requires selective silk screening. Most final metal surfaces (ENIG, Sn, Ag, Ni/Au, OSP, etc.) can be applied without special issue or consideration. A bake, as was described prior to solder mask application, should be performed prior to HASL or reflow exposures.

Final Circuitization: Individual circuits can be routed, punched, or laser cut depending upon preference, tolerances, and edge quality requirements. Parameters for mechanical routing are provided below:

Chip Load	0.00125" to 0.00250"/rev, 32mm – 64 mm/rev
Speed	200-300 sfm, 61-92 m/min
Peripheries	Conventional cut
Internal cut- outs	Climb cut
Tool type	Carbide double fluted spiral-up End mill
Exit/Entry	Phenolic or composite board
Tool life	20-30 linear feet, 6-9 meters

Vacuum channels in backer board materials can be pre-routed to provide adequate air flow through the channels during routing. Use a double pass (opposite direction) approach when the cleanest edge quality is required.

The information in this fabrication guideline is intended to assist you in designing with Rogers' circuit materials. It is not intended to and does not create any warranties express or implied, including any warranty of merchantability or fitness for a particular purpose or that the results shown on this fabrication guideline will be achieved by a user for a particular purpose. The user should determine the suitability of Rogers' circuit materials for each application.

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