



Advanced Circuit Materials

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*Fabrication
LCP8.3000*

ULTRALAM® 3000 Series Liquid Crystalline Polymer Circuit Materials

Fabrication Guidelines

ULTRALAM 3000 circuit materials are a thermotropic liquid crystalline polymer film which provides excellent high frequency properties in a thin dielectric. It offers low moisture absorption and good dimensional stability. The very low profile copper used on the ULTRALAM 3850 laminate allows fine line etching capability.

These guidelines are intended to provide fabricators with basic information on processing double-sided and multilayer boards using this unique material. For more specific information regarding your applications, please contact your Rogers representative.

Inner Layer Fabrication (Print and Etch)

Tooling Note

It is recommended that an interlocking (non-stacked) dot pattern border be used to allow proper venting when bonding multilayers with the ULTRALAM 3908 bondply.

Photo Resist Application

A chemical clean which includes a microetch is the preferred method for preparing the copper surface for photo resist lamination. Alternatively, a light pumice scrub followed by complete rinsing and drying may be used. Care in handling thin materials is needed and common flex circuit practices have worked well.

ULTRALAM 3000 materials are compatible with most photoresist systems.

Developing/Etching/Stripping/Acid Wash

Any of the commercially available etchants and resist stripper solutions may be used. It is important to insure complete removal of all photoresist material and residues from the etching and stripping processes.

Preparing Layers for Bonding with ULTRALAM® 3908 Bondply

In order to prevent degradation of residual photoresist chemistries, and to provide an adequate copper surface for bonding, it is recommended that the etched layers be processed through a microetch (40 to 60 u") and rinse, followed by a 5 minute soak in 5% acetic or sulfuric acid. This should be followed by a fresh DI water rinse and dry. When bonding to single-sided ULTRALAM 3850, it will be necessary to additionally texture the non-copper clad side of the material. This can be accomplished using the plasma cycle shown on page 4 of this guideline, under "Plating Preparation."

Oxide Treatment

Additional testing is needed to determine the effectiveness of alternative oxide as an adhesion promoter when bonding with ULTRALAM® 3908 bondply.

Multilayer Bonding With ULTRALAM® 3908 Bondply

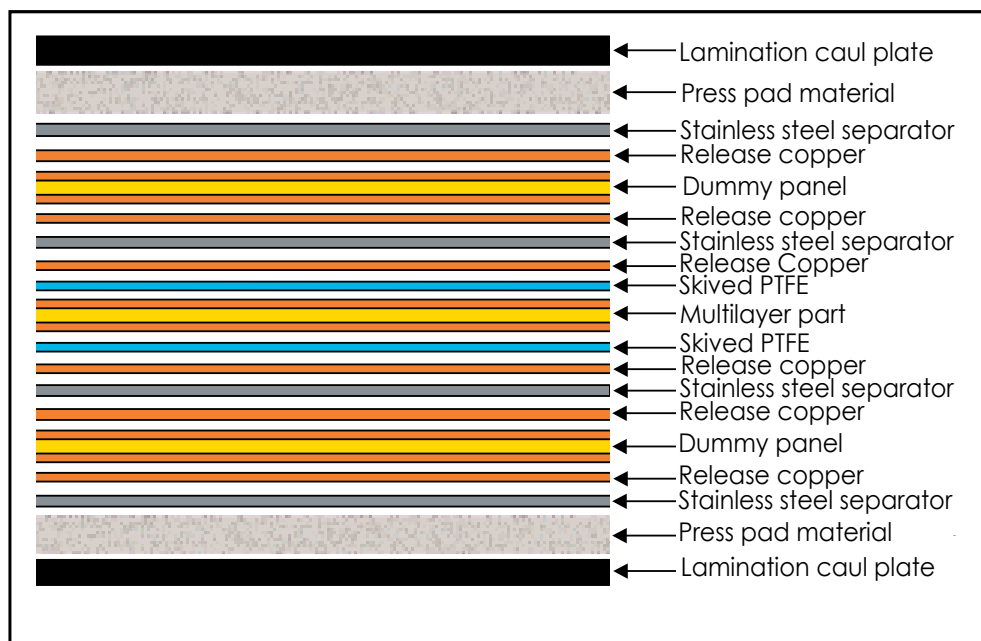
Prior to laying up the multilayer packages, the etched ULTRALAM® 3850 and the ULTRALAM 3908 bondplies should be baked to remove surface moisture at 125°C for a minimum of 2 hours.

Lay-up

Note: ULTRALAM® 3908 bondplies should never be stacked together in a multilayer construction. Where additional dielectric thickness is required in a bond opening, alternating layers of ULTRALAM 3908 and etched ULTRALAM 3850 layers should be used to achieve the desired thickness.

A dust-free environment is strongly recommended to avoid potential inclusions in the multilayer package.

A recommended stack-up for multilayer bonding is shown below.

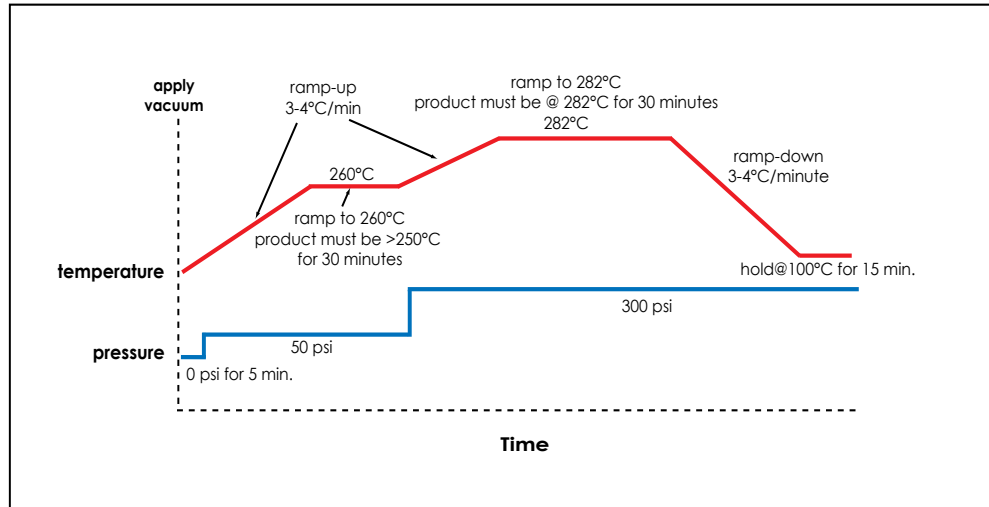


Notes:

- 1) A common presspad material, Fiberfrax® ceramic fiber paper (www.unifrax.com), product 970-J has been used successfully. The pad should be .250" thick (thicker if platen planarity is questionable) and wrapped in aluminum foil to contain dust.
- 2) Release copper foil can be 1 oz or 2 oz and should be oriented with the shiny side toward the parts.
- 3) The thickness of the skived PTFE conformal material should be a minimum of .005", but can be varied to provide required conformation.
- 4) Dummy panels can be .004" copper clad ULTRALAM 3850 laminates or other material of similar thickness capable of withstanding up to 290°C.
- 5) For designs requiring tight registration control, please contact your Rogers Technical Service Representative for additional assistance.

Lamination

In an all- ULTRALAM® 3000 material construction, fabrication robustness is dictated in large part by the ability of the press to achieve uniform platen temperature during the high temperature portion of the bonding process. In general, the larger the deviation in temperature across the panel, the larger the variation in resin flow and inter-layer adhesion within the ULTRALAM 3000 multilayer panel. For best results, a hot oil press or autoclave should be used. If an electrically heated press is used, care should be taken so as not to overshoot the target product temperature. The following press cycle has been shown to produce ideal lamination results.



Lamination cycle developed in conjunction with Metro Circuits, Rochester, NY

It is strongly recommended to monitor product temperature by thermocouple to insure the product reaches at least 280°C. Design thickness, book thickness and press pad condition are the three most common factors that will affect the dwell period.

Double-sided and Multilayer Panel Processing

Drilling

Since the ULTRALAM 3000 circuit materials are thermoplastic, drilling parameters should be designed to avoid overheating of the side wall surface which can lead to smearing of the LCP material over internal interfaces. The following guidelines are intended as a starting point:

Drills:	High quality carbide, new bits only
Entry material:	Aluminum - .007" thick, or .030" thick phenolic
Exit material:	Phenolic
Spindle Speed:	200 to 500 surface feet per minute
Chip Load:	.001" to .002"
Retract Rate:	200 to 600 IPM

Smaller diameter holes as well as higher aspect ratio holes may require the use of peck-drilling techniques.

Deburring

Proper drill parameters should negate the need for deburring. A high pressure rinse is recommended to insure loose debris is cleared from the drilled holes. If deburring is necessary, conveyorized deburring equipment should not be used, in order to avoid distortion of the ULTRALAM 3000 circuit material. A light manual sanding can be performed as required, followed by a high pressure rinse.

Laser Drilling

Both CO₂ and YAG types have been used successfully with ULTRALAM 3000 circuit materials. When compared to polyimide laser processing, we have seen the need for more hits of shorter duration to control

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sidewall melt. YAG will require 3 times the hits compared to polyimide, and CO₂, 10 times the hits. Cleaning laser residues has been done using permanganate or a short O₂ plasma burn.

Plating Preparation

Because of the chemical resistance of the ULTRALAM® 3000 circuit materials, conventional processes for desmearing, such as permanganate, are ineffective in roughening and wetting the exposed dielectric. Plasma or heated caustic systems are the preferred preparation techniques.

The following three-step plasma treatment cycle has been shown to produce proper hole wall conditions for subsequent electroless copper or direct metallization seed processes.

Segment	Gas Type%				Chamber Vacuum mTorr	Chamber Temperature °C	Segment time, min
	CF ₄	O ₂	N ₂	H ₂			
1	0	80	20	0	250	70	45
2	10	80	10	0	240	105	25
3	0	0	90	10	250	105	60

Power Level @ 6000W. Conditions developed in conjunction with Nordson March Plasma Systems

Alternatively, a heated caustic solution consisting of 30% to 35% potassium hydroxide (KOH) at 90°C has been shown to be effective. Drilled panels should be immersed in the solution for 2 to 3 minutes, followed by a 5 minute immersion in 5% acetic acid neutralization and water rinse. (Process developed in conjunction with NAVSEA CRANE, Crane, IN).

Finish Metallization

ULTRALAM® 3000 circuit materials are compatible with all of the typical circuit board metal finishes, including HASL, ENIG, immersion tin and immersion silver.

Final Rout

As with drilling, mechanical routing parameters need to be designed to avoid significant melting of the ULTRALAM® 3000 dielectric material. Parameters similar to those used for machining PTFE materials have been used successfully. ULTRALAM 3000 panels should be sandwiched between .030" phenolic material. Placing Kraft paper between the phenolic and the ULTRALAM 3000 panel can help to minimize burring. The following guidelines should provide a good starting place:

Tool type: 1-flute or 2 flute spiral-up end mill
Spindle Speed: 150 surface feet per minute
Linear infeed: .001" to .002" per revolution

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Revised 03/2009 0856-0309-0.3-CC, Publication #92-415