

Fabrication Guidelines:

Theta[®] Circuit Materials

Material Description: Theta™ circuit materials are environmentally friendly materials designed for high speed digital applications. They are halogen free and thermally reliable. Their high heat resistance makes them suitable for lead-free applications.

These preliminary guidelines were developed to provide fabricators with basic information on processing multilayer boards. A Rogers' technical service or sales representative should be contacted for more detailed information or for testing of the material.

Storage: Laminates should be kept out of direct sunlight and stored in a controlled environment around 22°C (72°F) and 60% relative humidity. A first in first out system for managing the material is recommended.

Prepreg should also be kept in a controlled environment. Store prepreg at $7.5 \pm 2.5^\circ\text{C}$ ($45 \pm 5^\circ\text{F}$) and less than 60% relative humidity. Open prepreg packaging just before use to prevent moisture absorption. Any excess prepreg not used should be placed back in a moisture barrier bag and sealed. Shelf life of prepreg is 3 months from the date of receipt when stored under recommended conditions.

INNER LAYER PREPARATION

Tooling: Use your standard tooling system whether it is pin or slotted.

Scaling Factor: Theta materials will behave similar to other mid-loss products. Shrinkage values of -0.9 mils per inch in the grain direction and -0.5 mils per inch in the cross grain are a good starting point

Surface Preparation for Photo-resist Application: A chemical clean process with a micro-etch is the preferred method for preparing copper surfaces for coating with liquid or dry film photo-resist. A mechanical scrub could also be used to prepare copper surface.

Photo-resist Application: Liquid or dry film photo-resist can be applied using conventional dip or spray coating, screening, or roll lamination processes.

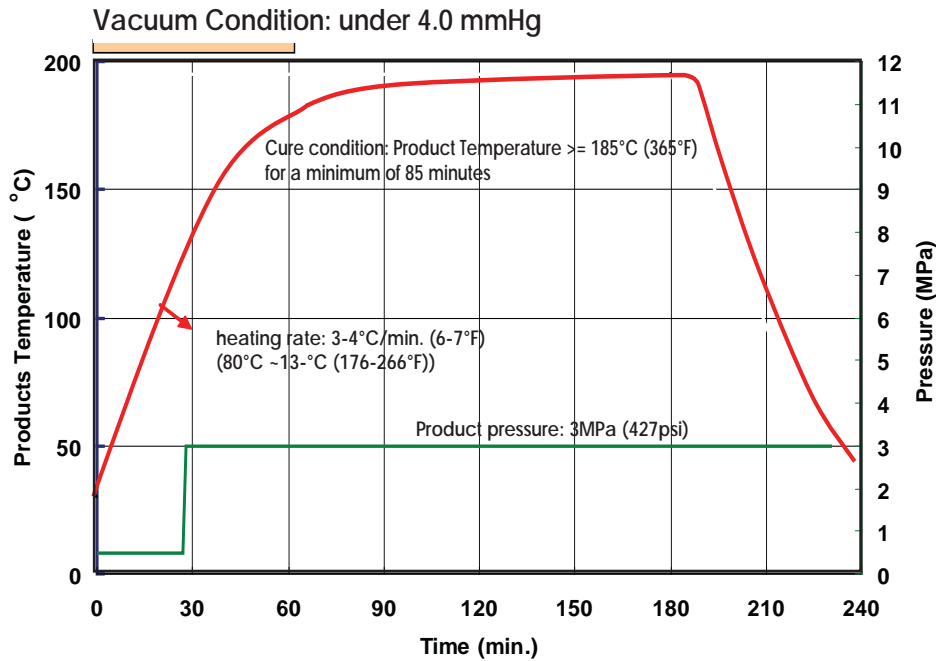
DES Processing: Any commercially available chemistry for develop, etch, and strip is acceptable.

Oxide Treatment: Reduced black oxides as well as alternative oxides that create topography through additive or subtractive means should give acceptable copper peel strength. Please contact a Rogers' technical service representative to discuss compatibility with your copper treatment or to set up initial testing on your treatment chemistry.

Bonding

Lamination Preparation: A moisture bake before lamination is not required when laminate has been stored as recommended. If baking is needed; use 2hrs at 130°C (266°F) then laminate material within 48 hours after inner-layer bake.

Lamination: Press under vacuum. Start pressure of 0.4-0.7MPa(50-85psi) for approximately 27 minutes and then increase to 3MPa(427psi) between 110°C-130°C(233°F-266°F). Heat rise should be around 3-4°C/min (6-7°F/min) between 80°C-130°C (176°F-266°F). Cure at a minimum product temperature of 185°C(365°F) for at least 85 minutes.



Drilling: The drilling conditions for Theta materials are different from standard FR-4 material. More attention to the drilling parameters should be taken. Undercut drill bits with a high helix are recommended over standard tool geometry.

Example of drilling parameters

Item	Parameters	Parameters	Parameters
Drill Size:	<0.009" (0.23mm)	0.0098"-0.0138" (0.25-0.35mm)	0.014" - 0.125" (0.36mm - 3.18mm)
Surface Speed:	100-150 sfm (30-45m/min)	200-300 sfm (60-90m/min)	300-400 sfm (90-120m/min)
Chip Load:	0.00075"-0.001"/rev (0.02mm-0.025mm/rev)	0.001"-0.0015"/rev (0.025mm-0.038mm/rev)	0.002"-0.003"/rev (0.05mm-0.076mm/rev)
Tool Life:	500-800 hits	1,000-1,500 hits	1,000-2,000 hits

Deburring: Use your standard processing parameters.

Desmear: Permanganate desmear chemistry removes smear more effectively on Theta laminates than standard FR-4 materials. We recommend starting off on a more conservative cycle of ½ to 1/3 of the FR-4 dwell times in order to achieve comparable weight loss to FR-4 materials and adjust from there. Some cycle development may be required and we recommend that any process changes are based on weight loss results, or other empirical methods.

Example of permanganate desmear conditions

Bath	Temp (°C)	Time (min)
Swell	70	2.5 to 4
Etch	70	4 to 5.5
Neutralization	40	5

Plasma desmear is also an effective method for removing smear. A standard FR-4 (CF₄/O₂) plasma cycle should be sufficient.

Outer Layer Processing:

Solder Mask: Theta materials are compatible with all commercially available soldermask types and processes.

Final Finishes: No issues have been observed with any of the immersion type processes or HASL.

Routing: It is recommended to utilize conservative parameters regarding tool life.

Plating: Conventional electroless and then electro plating is the recommended method for the through-hole plating process. Keep the etch-back to under 10µm. Contact your chemical supplier representative for direct plating processing or Rogers' technical service representative for initial testing of the direct plating processes.

Storage and Shipment of PWB: Finished boards should be packaged in a moisture proof bag with desiccant after final processing and prior to shipping. If finished boards are left out in an uncontrolled environment where they could absorb moisture then a bake is recommended before reflow or other thermal processing. The bake should be for 2 hours at 130°C (266°F).

The information in this fabrication guideline is intended to assist you in designing with Rogers' circuit material laminates. 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 in this fabrication guideline will be achieved by a user for a particular purpose. The user should determine the suitability of Rogers' circuit material laminates for each application.

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