RO4835T™ Core/RO4450T™ Bonding Layers Multi-Layer Board Processing Guidelines

These guidelines were developed to provide fabricators basic information on processing core and foil bonded multi-layered printed wiring boards (PWB's) using RO4835T™ laminates and RO4450T™ bonding layers. These same guidelines would also apply to processing of MLB designs using combinations of any RO4000® cores.

Storage:

Fully clad RO4835T laminates and RO4450T bonding layers should be stored at room temperature (between 50-90°F/ 10-32°C). A first-in-first-out inventory system and a method to track material lot numbers through PWB processing and delivery of finished circuits is recommended.

INNER LAYER PREPARATION:

Tooling:

RO4835T laminates are compatible with many pinned and pinless 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 on the capabilities and preferences of the circuit facility and final registration requirements. In general, slotted pins, a multiline tooling format, and post-etch punching will meet most needs.

Surface Preparation for Photoresist Processing and Copper Etching:

Copper surfaces should be prepared for photo imaging using chemical processes typically consisting of cleaning, micro-etching, water rinsing, and drying steps. Depending upon the thickness of the bonded assembly, mechanical processes can be used to prepare surfaces of sub-laminates prior to sequential bonding.

RO4835T materials are compatible with most liquid and dry film photo-resists and, once patterned, can be processed through develop, etch, and strip (DES) systems typically used to process FR-4 materials. For purposes of improved registration control, post-etch punch processing is preferred.

Advanced Connectivity Solutions
100 S. Roosevelt Avenue, Chandler, AZ 85226
Tel: 480-961-1382, Fax: 480-961-4533 www.rogerscorp.com

Oxide Treatment:

RO4835T cores can be processed through almost any copper oxide or oxide alternative process in preparation for multi-layer bonding. Depending upon core thickness and equipment capability, leader boards may be required to support very thin inner-layers through conveyorized oxide process.

Multi-Layer Bonding:

RO4835T laminates are compatible with all RO4400 bondplies, but are best matched with RO4450T bonding layers. For best overall outer-layer adhesion, CU4000™ & CU4000 LoPro® copper foils, also available from Rogers Corporation, should be used for all foil bonded MLB constructions.

DRILLING:

RO4835T cores, especially when used in combination with RO4450T bonding layers, are compatible with U.V. and CO2 laser processing of vias and holes. For mechanical drilling, standard entry (aluminum or thin pressed phenolic) and exit (pressed phenolic or fiber board) materials are recommended when drilling MLBs made using RO4835T cores.

RO4835T/RO4450T MLBs are compatible with a broad range of drilling parameters. However, drilling speeds greater than 500 surface feet per minute (SFM) should be avoided. Chip loads greater than 0.002"/"are recommended for mid-range and large diameter tools while lower chiploads (<0.002"/") are recommended for small (<0.0135") diameter drills. In general, standard geometry drills are preferred over undercut styles as they more effectively evacuate debris from the holes during the drilling process. Hit counts should be based on inspection of plated-through holes (PTH's) and not the appearance of the tools. Drilling RO4000 MLBs will result in an accelerated wear rate of drills. But, hole wall quality is determined by the size distribution of the ceramic powder and not by the cutting edge of the drill bit. A hole wall roughness ranging from 8 to 25 mm is expected and should remain consistent from the initial hit through several thousand hits.

Offered below are a summary of recommended drill parameters, equations for using surface speed and chip load to calculate spindle speeds and infeed rates, and a ready-reference drill table. A Rogers Technical Service Engineer (TSE) should be contacted for more detailed information.

Recommended Ranges:

Surface Speed	300-500 SFM (90 to 150m/min)
Chip Load	0.002"-0.004"/rev. (0.05-0.10mm)
Retract Rate	500 IPM (12.7m/min) for tools less than 0.0135" (0.343mm), 1,000 IPM (25.4 m/min) for all others
Tool Type	Standard carbide
Tool Life	2,000-3,000 hits

CALCULATING SPINDLE SPEED AND INFEED:

Spindle Speed =	(12 x Surface Speed (SFM)]/(π x Tool Diam. (in.))
Feed Rate (IPM) =	[Spindle Speed (RPM)] x [Chip Load (in/rev.)]
Example:	
Desired Surface Speed:	400 SFM
Desired Chip Load:	0.003”(0.08 mm)/rev.
Tool Diameter	0.0295”(0.75 mm)
Spindle Speed =	(12 x 400)/(3.14 X 0.0295) = 51800 RPM
Infeed Rate =	51,800 x 0.003 = 155 IPM

QUICK REFERENCE TABLE:

TOOL DIAMETER	SPINDLE SPEED (kRPM)	INFEED RATE (IPM)
0.0100” (0.254mm)	95.5	190
0.0135” (0.343mm)	70.7	141
0.0160” (0.406mm)	95.5	190
0.0197” (0.500mm)	77.6	190
0.0256” (0.650mm)	60.0	180
0.0258” (0.655mm)	60.0	180
0.0295” (0.749mm)	51.8	155
0.0354” (0.899mm)	43.2	130
0.0394” (1.001mm)	38.8	116
0.0453” (1.151mm)	33.7	101
0.0492” (1.257mm)	31.1	93
0.0531” (1.349mm)	28.8	86
0.0625” (1.588mm)	24.5	74
0.0935” (2.350mm)	16.5	50
0.0625” (1.588mm)	24.5	74
0.0925” (2.350mm)	16.5	50
0.1250” (3.175mm)	15.0	45

•*Conditions stated are tapered from 200 SFM and 0.002” chip load up to 400 SFM and 0.003”chip load.*

Advanced Connectivity Solutions
100 S. Roosevelt Avenue, Chandler, AZ 85226
Tel: 480-961-1382, Fax: 480-961-4533 www.rogerscorp.com

PTH PROCESSING:

Surface Preparation: Depending upon thickness, sub- and final lams can be processed through conveyorized debur equipment that uses oscillating nylon brushes to abrade the copper surfaces. Thinner constructions may require pumice scrubbing by hand, conveyorized processing with an abrasive spray, or chemical preparation. In general, the thickness of the material and registration requirements should be considered when choosing the best method of debur and surface preparation.

Aggressive chemical or plasma desmear is typically not required of drilled holes as the high glass transition temperature and low resin content minimize the occurrence of smear. When desmear is determined to be necessary by inspection of drilled holes, a shortened chemical desmear process (approximately one half the exposure times for a standard Tg FR-4 materials) should be considered. While exposures to solvent swellers and permanganates should be reduced, extended times may be required in the neutralize bath. No desmear or CF4/O2 plasma desmear are preferred when processing CAF sensitive designs.

As is the case with all RO4000 materials, we recommend against etchback of core and prepreg layers. Aggressive etchback can contribute to loosening of filler particles on the hole wall, extensive etchback of LoPro resin layers, and wicking of processing chemicals along glass bundles.

METAL DEPOSITION:

RO4835T and RO4450T materials do not require special treatments prior to metallization and are compatible with electroless copper processing and direct deposition of ionic and colloidal conductive layers. A copper flash plate (0.00025") prior to imaging might be considered for boards with high aspect ratio holes.

COPPER PLATING & OUTER-LAYER PROCESSING:

RO4835T and RO4450T MLBs are compatible with panel and pattern processing using standard acid copper and electrolytic tin or tin/lead plating. Once plated, the MLBs can be processed through any standard strip/etch/strip (SES) process.

The post-etch surfaces should be preserved to promote good adhesion to direct screened and photo-imageable solder masks.

Advanced Connectivity Solutions
100 S. Roosevelt Avenue, Chandler, AZ 85226
Tel: 480-961-1382, Fax: 480-961-4533 www.rogerscorp.com

FINAL METAL FINISHES:

RO4835T/RO4450T MLBs are compatible with organic solderability preservatives (OSP's), hot air solder levelling (HASL), and most chemically deposited or electroplated finishes.

FINAL CIRCUITIZATION:

Completed circuits boards made using RO4835T cores and RO4450T bonding layers can be "individualized" by dicing, sawing, shearing, routing, punching, or laser cutting. V-scoring and breakaway tabs can be used to facilitate individualization of circuits after automated assembly.

Recommendations for routing are provided below:

ROUTING:

RO4000 laminates and MLBs are routed using carbide tools and conditions that are typical to processing traditional epoxy/glass materials. Copper should be etched away from the routing path to prevent burring.

MAXIMUM STACK HEIGHT:

The maximum stack height should be based on 70% of the actual flute length to allow for debris removal.

Example:

Flute Length:	0.300" x 0.70 = 0.210"(5.33 mm)
Backer Penetration:	− 0.030"(0.762mm)
Max. Stack Height:	0.180"(4.572mm)

TOOL TYPE:

Carbide multi-fluted spiral chip breakers or diamond cut router bits.

ROUTING CONDITIONS:

Surface speeds below 500 SFM should be used whenever possible to maximize tool life. Tool life is generally greater than 30 linear feet when routing the maximum allowable stack height.
Chip Load: 0.0010-0.0015"(0.0254-0.0381mm)/rev
Surface Speed: 300 – SFM

Advanced Connectivity Solutions
100 S. Roosevelt Avenue, Chandler, AZ 85226
Tel: 480-961-1382, Fax: 480-961-4533 www.rogerscorp.com

QUICK REFERENCE TABLE:

Tool Diameter	Spindle Speed	Lateral Feed Rate
1/32	40k RPM	50 IPM
1/16	25k RPM	31 IPM
3/32	20k RPM	25 IPM
1/8	15k	25 IPM

SHELF LIFE:

Rogers' High Frequency laminates can be stored for extended durations under ambient room temperatures (55-90°F, 13-32°C) and humidity levels. At room temperature, the dielectric materials are inert to high humidity. However, metal claddings such as copper can be oxidized during exposure to high humidity. (Oxidation on the copper surface can easily be removed in a standard micro-etch process.) In addition, over an extended period (>5 years) the exposed dielectric along edges of the panel may experience detectable levels of oxidation. Accounting for standard tooling hole and trim loss, such trace levels of oxidation would not be expected to extend into the utilized portion of the laminate. Please note however, that as each application is different, Rogers cannot warrant that its products are fit for any particular end use, and, as always, Rogers recommends that the circuit designer and/or the end user test the properties and performance of these materials in each proposed application to determine their fitness for use over the entire product life.

Prolonged exposure in an oxidative environment may cause changes to the dielectric properties of hydrocarbon based materials. The rate of change increases at higher temperatures and is highly dependent on the circuit design. Although Rogers' high frequency materials have been used successfully in innumerable applications and reports of oxidation resulting in performance problems are extremely rare, Rogers recommends that the customer evaluate each material and design combination to determine fitness for use over the entire life of the end product.

These commodities, technology and software are exported from the United States in accordance with the Export Administration regulations. Diversion contrary to U.S. law prohibited.

Revised 1371 032918 Publication #92-546

Advanced Connectivity Solutions
100 S. Roosevelt Avenue, Chandler, AZ 85226
Tel: 480-961-1382, Fax: 480-961-4533 www.rogerscorp.com

Helping power, protect, connect our world

RoHS Compliant