ROGERS CORPORATION

Fabrication Notes

92ML(TM) Thermally Conductive Multi-Layerable Epoxy Laminate and Prepreg

These guidelines were developed to provide fabricators basic information on processing multi-layered printed wiring boards (PWBs) using 92ML core and prepreg materials. Users should check frequently for the most current information as additional processing evaluations are underway.

Storage:
92ML cores can be stored indefinitely at ambient conditions. The prepreg materials are certified to IPC-4101B or IPC-4103 and meet the shelf life requirements stated in these documents in paragraph 3.17. In essence, the prepreg shall be capable of and certified to meet all the requirements specified when stored per condition 1 or condition 2 for the specification sheet requirements. These conditions are applicable to the date the prepreg is received.

Condition 1: Six months (180 days) when stored at <5ºC (41ºF)

Condition 2: Three months (90 days) when stored at <23ºC (73ºF) and <50% relative humidity

Prepreg should be stored in the absence of a catalytic environment such as UV light or excessive radiation.

Vacuum desiccation of 92ML prepreg is recommended to remove moisture. Moisture trapped in a multiplayer PCB can cause excess resin flow, measles, delamination and depressed Tg values. Store the prepreg in either a nitrogen dry box or chemical desiccation box. Control the temperature and humidity in these chambers per the conditions stated above. Opened bags of unused prepreg should be returned to vacuum storage.

A first-in-first-out inventory system is recommended for the core and prepreg materials 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:
92ML materials are compatible with many pinned and pinless tooling systems. Choosing whether to use round and/or slotted pins, internal or external pinning, standard or centerline tooling, and pre- vs. post-

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etch punching would depend upon the capabilities of the circuit facility and the final registration requirements. In general, slotted pins, a centerline tooling format, and post-etch punching will meet most needs. An offset round copper dot pattern is recommended for venting signal layers. The copper dots could be 0.100" in diameter and on 0.250" centers. The dot patterns on alternating inner-layers should interlock and not be vertically overlapped. A nearly solid copper starburst pattern would be recommended for venting plane layers. The venting channels should be 0.150" wide or narrower. The venting channels etched into alternating inner-layers should be staggered to avoid vertical stacking of low pressure areas.

Surface Preparation for Photoresist Processing and Copper Etching:
A chemical process consisting of cleaning, micro-etching, water rinsing, and drying steps is the preferred method of surface prep, especially for thinner core materials. Suspended pumice or mechanical scrubs are not preferred, but can be used to prepare the surfaces of thick core layers. 92ML materials are compatible with most liquid and dry film photoresists and, once patterned, can be processed through develop, etch, and strip (DES) systems used to process traditional FR4 materials.

Oxide Treatment:
92ML cores can be prepared for multi-layer bonding using any oxide or oxide alternative process that is also used for high Tg FR4 material systems. In all cases, the processing recommendations of the chemical supplier would apply.

MULTI-LAYER BONDING:

Multi-Layer Booking: I
nner-layer cores should be baked in a rack for 30 minutes at 107C-121C (225F-250F) immediately prior lay-up. Cold stored prepreg should be allowed to equilibrate at processing conditions before use. Prepreg not stored under vacuum or in a nitrogen environment should be vacuum desiccated for 8-12 hours prior to lamination. 92ML cores and prepreg layers can be stacked as standard. CU4000™ sheeted copper foil, available from Rogers Corporation, is recommended to optimize adhesion of foil bonded outer-layers. The use of choice of hard tooling or conformal padding would depend upon the fill requirements of a given stack-up and the post-bond processing tolerance for non-planar surfaces. Some pre-tests may be needed to dial in pressure and determine how much low flow prepreg is required to the meet the fill requirements of high layer count MLBs or designs using thick (>1 Oz equivalent) copper inner-layers. A Rogers TSE should be consulted when deciding the stack-up, venting patterns, and optimum press conditions for a new design.

Multi-Layer Bonding:
The preferred thermal profile when bonding 92ML multi-layer boards includes a 2C to 4C (4F-7F) per minute ramp rate to 185C (365F) and a 90 minute dwell at the peak temperature. Transfer to a cold press for rapid cooling is permitted, but controlled cooling to 100C (220F) at <5C (10F) per minute may result in a more dimensionally stable MLB with improved flatness. A starting pressure of 400 PSI can be applied from the beginning of the thermal cycle or when bond temperature is between 95C and 100C (200F and 210F). Pressure may be adjusted upward to achieve complete fill of thick copper inner-layers.

PTH/VIA AND OUTER LAYER PROCESSING:

Hole/Via Formation:

The filler that provides 92ML materials with excellent thermal conductivity charactersitics also causes rapid wear of mechanical cutting tools. Forming vias/holes using UV, CO2, or UV/CO2 combination lasers is preferred when aspect ratios permit. A post-laser clean with alkaline permanganate or CF4/O2 plasma can be used to ensure a good electrical connnection to copper pads at the base of depth processed vias.

For mechanical drilling, standard aluminum or pressed phenolic entry and exit materials are acceptable. Surface speeds for mechanical drilling range from 200 SFM to 400 SFM and infeed rates range from chip loads of 0.0015"/"-0.003"/" depending upon drilled hole diameter. Slower feeds and speeds are recommended when drilling hole diameters <0.35 mm (0.0138"). Undercut drills are preferred when drilling hole diameters <0.45 mm (0.018"). When using standard carbide drills the expected tool life will be between 50 and 100 hits depending upon panel thickness. Tool life has been extended to hundreds and even thousands of hits when diamond coated drills were used.

Surface and Hole Wall Preparation:
Thick multi-layer constructions can be processed through conveyorized debur equipment that uses oscillating nylon brushes to abrade copper surfaces. Thinner layers 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. Desmear can be accomplished with alkaline permanganate chemical or CF4/O2 plasma processes that are used to desmear MLBs made using multi-functional epoxy resin systems.

Metal Deposition:
92ML materials do not require special treatments prior to metallization and are compatible with electroless copper processing and direct deposition of ionic or colloidal conductive layers. A copper flash plate (0.00025") prior to imaging should be considered for high aspect ratio holes.

Copper Plating and Outer-Layer Processing:
92ML materials are compatible with panel and pattern processing using standard acid copper and electrolytic tin plating. Once plated, the materials can be processed through any standard strip/etch/strip (SES) process. Post-etch surfaces should bond very well to direct screened and photo-imageable solder masks. A short bake for 30-60 minutes at 110C to 125C may be required to ensure board surfaces are dry prior to applying the solder mask.

Final Finishes:
92ML materials are compatible with organic solderability preservatives (OSPs), HASL, and most chemically or electrolytically deposited final metal finishes. A two hour bake at 121C (250F) is recommended prior to solder reflow or HASL exposures.

Final Circuitization:
Circuits made using 92ML materials 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. As was reported for drilling, standard cutting tools will experience accelerated wear. Diamond coatings have been found to significanlty extend the cutting life of dicing saws and mulit-fluted chipbreaker router bits.

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