Fabrication Notes

Processing Guidelines for RO4400™ Bonding Layers

These guidelines were developed to provide fabricators basic information on processing core and foil bonded multi-layered printed wiring boards (PWB's) using RO4450F™, RO4460G2™, and RO4450T™ bonding layers and assorted RO4000® core materials.

STORAGE:
Upon receipt, all bondply should be immediately moved from the receiving area into a controlled environment. Proper storage conditions would include temperatures between 10°C and 32°C (50°F and 90°F) and protection against exposure to catalytic conditions such as high radiation and ultraviolet light. The bondply should not be stored frozen, refrigerated, or under vacuum. It is best to store the bondply in its heat sealed packaging. Partially used packages should be resealed with tape as the adhesive layers nearest the open end of a package may yellow and harden over time. Material in this condition should be discarded.

When properly stored, bondply properties will be maintained for 6 months from the shipment date.
A "first-in, first-out" inventory system is recommended.

UNPACKING:
The RO4400™ bondply is packaged in a dust-free environment, but will collect dust and debris from counter tops. We recommend counter tops be cleaned prior to unpackaging the bondply. Plastic slip-sheeting has been provided to ease separation of individual plies and to shield the bondply from contamination until it is ready for use.

TOOLING:
Tooling holes can be punched, drilled, or cut. Thin entry and exit materials may be needed to support the bondply through the tooling hole formation process. The slip-sheeting should remain in place through tooling as it will shield the bondply from contamination and should eliminate the risk of individual plies fusing together as the tooling holes are formed.

DESIGN AND USE CONSIDERATIONS:
The RO4400 bondply materials are recommended for pressing single-lamination or sequentially bonded multi-layer constructions using RO4000® cores. The bondply can be used in core and foil bonded multi-layer boards. The CU4000™ and CU4000 LoPro© sheeted copper from Rogers Corporation is recommended for use in foil bonded designs using RO4450F™, RO4450T™ and RO4460G2™ bonding layers. CU4000 LoPro copper foils use a thin adhesive layer to promote increased bond of smooth copper to dielectric layers and results in a thickness increase of approximately 0.00035".

Each ply of RO4450F and RO4460G2 bondply will bond to a 0.004" (0.101 mm) thickness and each ply of RO4450T bondply will bond to a nominal 0.003" (0.076 mm), 0.004" (0.101 mm), or 0.005" (0.127 mm) thickness (depending upon the grade

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selected) when pressed between opposing flat surfaces. The actual thickness each ply will add to a multi-layer construction is dependent upon the weight and distribution of copper on the inner-layer surfaces.

The RO4400 bondply layers can fill up to 0.0018" of total copper thickness whether the copper is on one side or split between both sides of the adhesive layer. It should be noted that the maximum copper thickness applies to entire inner-layer surfaces including functional areas of the PWB, venting/flow patterns, plating bars, etc. Additional layers of bondply are required when copper fill requirements exceed 0.002".

Vertically offset (non-stacking and non-connected) copper dot patterns are recommended for use in flow/venting areas between functional parts and around the perimeter of inner-layers. These same offset dot patterns are recommended for use on etched off layers and on core surfaces beneath foil bonded outer-layers. Solid copper borders or star-burst type patterns should be considered only when bonding together opposing plane layers.

It is good practice to use two or more plies of bondply between metal layers and to ensure the use of press cycle parameters defined in these guidelines. Any deviations from these recommendations may require adjustments made at the fabricators level and/or can lead to poor fill performance or electrical failures, especially in high-speed digital/high density designs. If the design requires single-ply usage between metal layers, higher bonding pressures may be required (see below) and the user must ensure a proper testing protocol is in place to evaluate fill/flow and electrical performance.

Etched dielectric surfaces should not be mechanically or chemically altered prior to multi-layer bonding. Inner-layer metal surfaces should be oxide treated to promote improved mechanical adhesion. Reduced black oxide, brown oxide, and additive or subtractive oxide alternatives have been successfully applied. Inner-layers should be baked for 15-20 minutes at 115°C (239°F) to 125°C (257°F) just prior to preparing the multi-layer package for bonding.

Contact your local technical services representative for questions or assistance with these quidelines. Also contact your local technical services representative when bonding designs with (1) more than six metal layers, (2) copper layers 35 microns or thicker, (3) plane layers on opposing sides of bondply, or (4) when bonding to FR-4 cores. In some instances special instructions may apply. For example, bonding pressures approaching 750 PSI may be required ensure proper fill when using single prepreg plies or filling thick copper inner-layers.

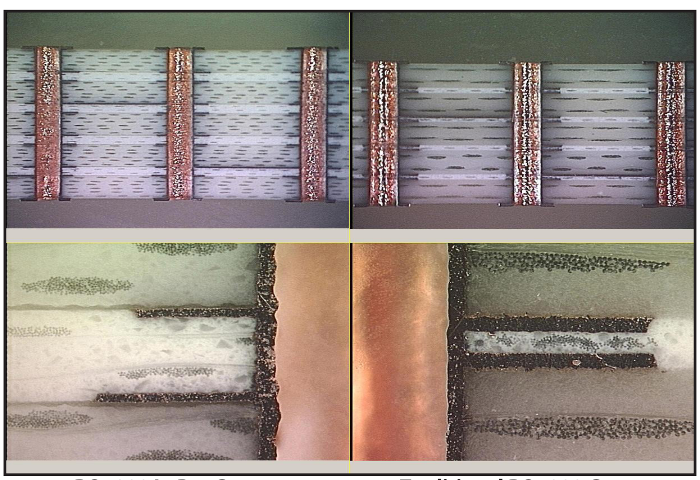
Recommended Bonding Cycle:
The RO4400 bondply resin systems are at their lowest viscosity at temperatures between 100°C (210°F) and 120°C (250°F). Fill of MLBs will benefit by spending 20 minutes in this reduced viscosity temperature window. This can be accomplished by ramping at a rate of 1°C/Min (2°F/Min) from room temperature 100°C (210°F) to 175°C (350°F), or by dwelling between 115°C (240°F) and 120°C (250°F) for 20 minutes. Should the latter approach be chosen, the ramp rates from RT to 115°C and from 115°C to 175°C can be 1.0°C-4.0°C/Min (2°F to 7°F/Min). Care should be taken to not exceed 120°C (250°F) during the 20 minute dwell. Time vs. temperature trials may be required to define requirements for lagging materials. Thermocouples should be included inside the press book when verifying the thermal profile.

Vacuum assistance is preferred. Bonding pressures between 400 and 750 PSI (depending upon fill requirements) should be applied before book temperature exceeds 38°C (100°F) and should be used for the entire heating cycle regardless of vacuum assistance potential. Lengthy (>5 minutes) vacuum drawdowns should be avoided. Transfer to a cooling press is allowed after a 60 minute dwell at 175°C (350°F).

PTH and Outer-layer Processing:

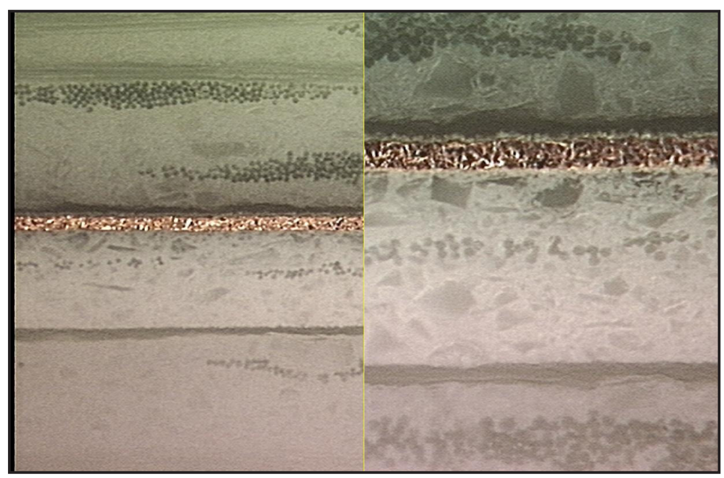
Processing guidelines for RO4003C™, RO4350B™, RO4360G2™, RO4835™, RO4835T™ and RO4000 LoPro core materials are applicable to RO4000 multi-layer boards. Multi-layer constructions may require desmear as determined by inspection of drilled hole walls. If desmear is required, CF4/O2 plasma is preferred over a traditional chemical desmear process. Shortened exposures to solvent swellers and permanganate should be considered when choosing chemical smear. Etchback of core and prepreg layers is not recommended.

Visual comparison of RO4000 LoPro laminates and traditional RO4000 cores in multi-layer constructions.



RO4000 LoPro Cores **Traditional RO4000 Cores**

Expected visual appearance in a cross section of RO4000 LoPro Laminates.



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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.

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Revised 1408 121318 Publication #92-005

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