ROGERS CORPORATION

Advanced Circuit Materials

Advanced Circuit Materials Division
100 S. Roosevelt Avenue
Chandler, AZ 85226
Tel: 480-961-1382, Fax: 480-961-4533
www.rogerscorporation.com

Data Sheet
Preliminary Processing Guidelines
RO1.4400

Data Sheet and Processing Guidelines for RO4450B™ and RO4450F™ Prepregs

RO4000® dielectric materials have long been used in combination with FR4 cores and prepreg as a means to achieve a performance upgrade of standard FR4 multilayer designs. RO4003C™ and RO4350B™ glass reinforced hydrocarbon/ceramic laminates have been used in layers where operating frequency, dielectric constant, or high-speed signal requirements dictate the need for high performance materials. FR4 cores and prepreg are still commonly used to inexpensively form less critical signal layers.

The RO4400™ prepreg family is comprised of three grades based on the RO4000 series core materials, and are compatible in multilayer constructions with either RO4003C or RO4350B laminates. A high post-cure Tg (>280°C) makes RO4400 series prepreg an excellent choice for multilayers requiring sequential laminations as fully cured RO4400 prepregs are capable of handling multiple lamination cycles. In addition, FR4 capatible bond requirements (350°F/177°C) permit RO4400 prepreg and low flow FR4 prepreg to be combined into non-homegeneos multilayer constructions using a single bond cycle.

RO4450F™ prepreg is the latest product in the RO4400 family of prepregs. RO4450F prepreg has demonstrated improvement in lateral flow capability, and is becoming the first choice for new designs or as a replacement in designs that have difficult fill requirements.

RO4450B™ prepreg is available in both 3.6 mil and 4.0 mil thicknesses. The electrical properties of these two prepreg thicknesses differ slightly due to the resin-to-glass ratio, and this should be taken into consideration during electrical design review.

Each of the RO4450™ series prepregs are recognized by Underwriter Laboratories with the UL-94 flame rating, and are compatible with lead-free processes.

PROCESSING GUIDELINES:

STORAGE:
Upon receipt, all prepreg should be immediately moved from the receiving area into a controlled environment. Proper storage conditions would include temperatures between 10°C and 30°C (50°F and 85°F) and protection against exposure to catalytic conditions such as high radiation and ultraviolet light. The prepreg should not be stored under vacuum. It is best to store the prepreg in its heat sealed packaging, partially used packages should be resealed with tape.

When properly stored, prepreg properties will be maintained for 12 months from the date of manufacture. A “first-in, first-out” inventory system is recommended.

UNPACKING:
RO4400 prepregs are 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 prepreg. Plastic slip-sheeting has been provided to ease separation of individual plies and to shield the prepreg 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 prepreg through the tooling hole formation process. The slip-sheeting should remain in place through tooling as it will shield the prepreg from contamination and should eliminate the risk of individual plies fusing together as the tooling holes are formed.

MULTILAYER PREPARATION:
Each ply of RO4450F™ and RO4450B™ 4-mil prepreg will bond to a nominal 0.004" (0.101mm) thickness, and each ply of RO4450B 3.6-mil prepreg will bond to a nominal 0.0036" (0.091mm) when recommended bonding parameters are used. The actual thickness each ply will add to a multilayer construction is dependent upon the weight and distribution of copper on the innerlayer surfaces.

Rogers recommends the use of two or more plies of prepreg between metal layers, and that the proper press cycle parameters are used per our guidelines. Any deviation from these recommendations 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, the user must ensure the proper testing protocol is in place to evaluate fill/flow and electrical performance. Contact your local technical services representative for questions or assistance with these guidelines.

Also contact your local technical services representative for designs using more than six metal layers, or 35 micron foil on both sides, or when bonding against FR4 cores.

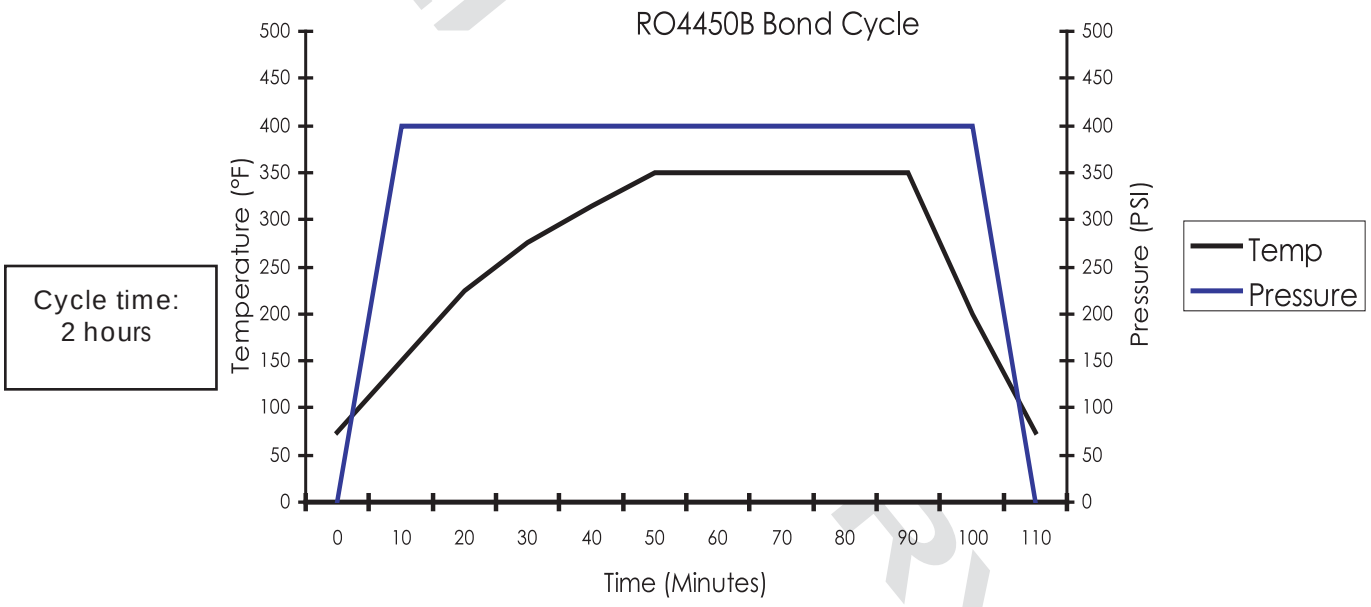
Etched dielectric surfaces should not be mechanically or chemically altered prior to multilayer bonding. Innerlayer metal surfaces should be oxide treated to promote improved mechanical adhesion. Reduced black oxide, brown oxide, and additive or subtractive oxide alternatives have been successfully applied. Inner-layers should be baked for 15 to 30 minutes at 115°C to 125°C just prior to preparing the multi-layer package for bonding.

Core bonded constructions are preferred, but foil bonded outer-layers are an option with RO4400 prepregs. Rogers' qualified and recommended copper foil is HTE-TWS available from Circuit Foils. Sheeted foils are available through the manufacturers or through the sheeting service listed below:

Circuit Foil America 625 rue du Luxembourg Granby J2J 2S9 - Canada Phone (+1) 450-770-8558 Fax: (+1) 450-770-8022	**Contact Information:**
	USA Customers Copper Rolls - petey.decarlo@circuitfoil.com (fax # +1-215-887-6911)(USA) Copper Sheets - carmen.pignon@circuitfoil.com (fax # +1-450-405-4622)(Canada)
	Europe and Asia Copper Rolls and sheets - paul.jung@circuitfoil.com (fax # +11 352 95 75 51 249)(Luxembourg)

RO4450B™ and RO4450F™ prepregs allow a rapid ramp to 107°C (225°F), a 2.8°C - 4.0°C/Min (5°F-7°F) ramp rate between 107°C and 121° (250°F), and a maximum 2.2°C/Min (4°F/min) from 121°C to 177°C (350°F). The full pressure of 400 psi should be used regardless of vacuum assistance potential, and lengthy (>5 minutes) draw downs should be avoided. Pressure should be applied before package temperature exceeds 38°C (100°F). Transfer to a cooling press is allowed after a 60 minute dwell at 177°C. The graph below provides an optimum temperature and pressure profile for bonding RO4450B and RO4450F prepregs. The temperature profile can be matched using an in-hot process. Time vs. temperature trials may be required to define requirements for lagging materials.

Special Bonding Note: The RO4450B and RO4450F prepreg resin system is at its lowest viscosity at temperatures between 210°F (100°C) and 250°F (120°C). High layer count MLB's, designs with buried metal layers thicker than ½ oz. copper, and constructions using single plies of RO4450B or RO4450F prepreg will benefit by spending 20 minutes in the reduced viscosity window. This can be accomplished by ramping at a rate of 2°F/Min (1°C/Min) or by dwelling at 240°F (115°C) for 20 minutes. Should the latter approach be chosen, the ramp rates from RT to 240°F (115°C) and from 240°F to 350°F (115°C-175°C) can be 5°F-7°F/Min (2.8°C-4.0°C/Min). Care should be taken to not exceed 250°F (120°C) during the 20 minute dwell.



Outerlayer and PTH Processing: Processing guidelines for RO4003C™ and RO4350B™ double-sided circuits are applicable to RO4000® MLB's. However, the multilayer constructions will require desmear. CF4/O2 plasma and alkaline-permanganate processes used to desmear high Tg (170°C) FR4 materials have been found to work well with RO4000 multilayers. While desmear may be required, etchback of the resin system is not recommended.

Typical Values

RO4450B™, RO4450F™ Prepreg

PROPERTY	RO4450B		RO4450F	DIRECTION	UNITS	CONDITION	TEST METHOD
Thickness	4 (0.102)	3.6 (0.091)	4 (0.102)	Z	mils (μm)	-	-
Dielectric Constant , ε_r	3.54 ± 0.05	3.30 ± 0.05	3.52 ± 0.05	Z	-	10GHz - 23°C	IPC-TM-650, 2.5.5.5
Dissipation Factor, tan δ	0.004	0.004	0.004	Z	-	10GHz-23°C	IPC-TM-650, 2.5.5.5
Dielectric Strength	1000	1000	1000	Z	V/mil	23°C/50% RH	IPC-TM-650, 2.5.6
Volume Resistivity	>2.5 X 10^{10}	>2.5 X 10^{10}	TBD	-	MΩ•cm	23°C/50% RH	IPC-TM-650, 2.5.17.1
Surface Resistivity	1.9X10^{8}	1.9 X 10^{8}	TBD	X,Y	MΩ	23°C/50% RH	IPC-TM-650, 2.5.17.1
Thermal Conductivity	0.60	0.60	0.65	Z	W/m/K	100°C	ASTM F433
Moisture Absorption	0.05	0.10	0.09	-	%	48 hrs immersion 0.060" sample temperature 50°C	ASTM D570
Tg	>280	>280	>280	-	°C TMA	-60°C - 300°C @ 10°C/min	IPC-TM-650 2.4.24
Td	390	390	390	-	°C TGA		ASTM D3850
Density	1.86	1.80	1.83	-	gm/cm^3	23°C	ASTM D792
Dimensional Stability	TBD	TBD	-0.065	X,Y	mils/inch	After Etch +E2/150	IPC-TM-650, 2.2.4
Copper Adhesion	4.9* (0.86)	4.0* (0.70)	4.0* (0.70)	Z	pli (N/mm)	After Solder Float	IPC-TM-650, 2.4.8
Coefficient of Thermal Expansion	19 17 50	19 17 60	19 17 50	X Y Z	ppm/°C	-55 to 125°C	IPC-TM-650, 2.4.41
Color	White	White	White	-	-	-	-
Flammability	94V-0	94V-0	94 V-0				
Lead-Free Process Compatible	Yes	Yes	Yes				

Typical values are a representation of an average value for the population of the property. For specification values contact Rogers Corporation.

*Tested on ½ oz. EDC foil for RO4450B. Rogers UL file number is E102763B.

STANDARD THICKNESS:	STANDARD SIZE:
RO4450F: 0.004", (0.101mm) RO4450B: 0.0036 (0.091mm), 0.004", (0.101mm)	24X18" Sheets (610mm X 457mm) Contact Customer Service for other available sizes.

The information contained in this data sheet and processing guide is intended to assist you in designing with Rogers' circuit materials and prepreg. 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 on this data sheet and processing guide will be achieved by a user for a particular purpose. The user is responsible for determining the suitability of Rogers' circuit materials and prepreg for each application.

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 11/2007 0773-1107-CC **Publication #92-005**