

Data Sheet and Processing Guidelines for RO4403™, RO4450B™ and RO4450B™-dx Prepreg

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™ laminates have been used in layers where operating frequency, dielectric constant control, 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.

RO4400™ prepreg adhesive systems permit bonding of homogeneous RO4000 multilayer designs. A high post-cure Tg (>280°C) makes RO4400 series prepreg an excellent choice for multilayers requiring sequential laminations as fully cured RO4400 prepregs will not thermally degrade through multiple bonding cycles. Low temperature bond requirements (350°F/177°C) permit RO4400 prepreg and restricted flow FR4 prepregs to be combined into multilayer constructions using a single bond cycle.

RO4403™, RO4450B™ and RO4450B™-dx prepregs are based upon the RO4000 series core materials and are compatible in multilayer constructions with either RO4003C or RO4350B laminates. As with RO4000 laminates, RO4400 prepregs are compatible with the majority of standard FR4 processing practices.

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.

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MULTILAYER PREPARATION:

Each ply of RO4403 and RO4450B prepreg will bond to a nominal 0.004" (0.1mm) thickness and RO4450B-dx prepreg will bond to a nominal 0.0036" (0.09mm) 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:

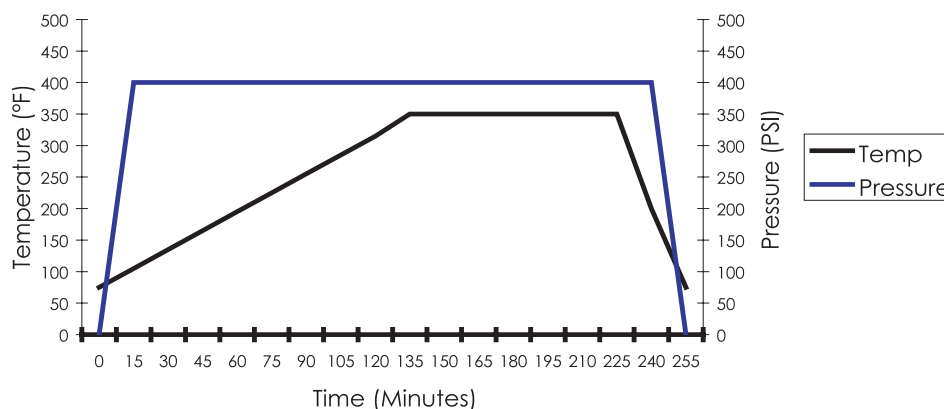
Circuit Foil America 625 rue du Luxembourg Granby J2J 2S9 - Canada Phone (+1) 450-770-8558 Fax: (+1) 450-770-8022	Contact Information:
	USA Customers Copper Rolls - petey.decarlo@circuitfoil.com (fax # +1-215-887-6911)(USA) Copper Sheets - carmen.pignon@circuitfoil.com (fax # +1-450-405-4622)(Canada)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

RO4403 prepreg requires a 1.1°C-2.2°C/Min (2°F-4°F) ramp rate from RT/177°C (350°F) to achieve maximum fill and cure potential. The full pressure of 400 psi should be used regardless of vacuum assistance potential and lengthy vacuum (>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 90 minute dwell at 177°C. The graph below provides an optimum temperature and pressure profile for bonding with RO4403 prepreg.

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RO4403 Bond Cycle

Cycle time:
4 hours

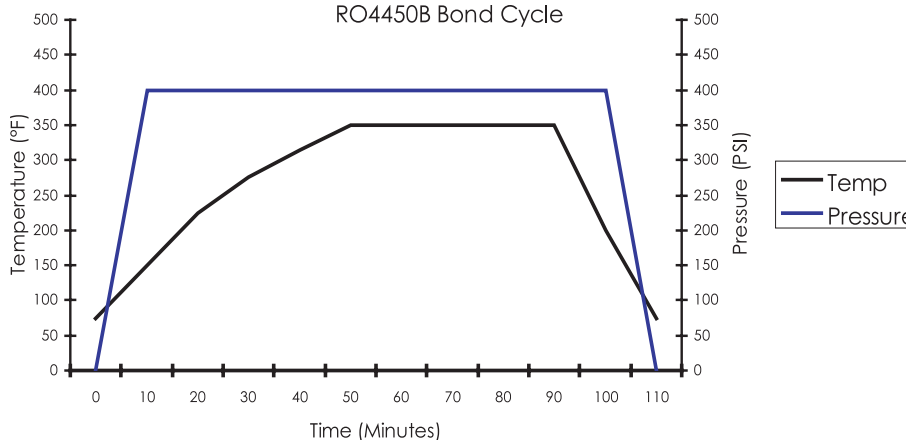


RO4450B and RO4450B-dx prepreg allows a rapid ramp to 107°C (225°F), a 2.8°C - 4.0°C/Min (5°F-7°F) ramp rate between 107°C and 121° (250°F), and a maximum 2.2°C/Min (4°F/min) from 121°C to 177°C (350°F). The full pressure of 400 psi should be used regardless of vacuum assistance potential and lengthy (>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 prepreg. 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 RO4450B-dx prepreg resin system is at it's 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 RO4450B-dx 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.

RO4450B Bond Cycle

Cycle time:
2 hours



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.

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Typical Values

RO4403™, RO4450B™, RO4450B™-dx Prepreg

PROPERTY	TYPICAL VALUES			DIRECTION	UNITS	CONDITION	TEST METHOD
	RO4403	RO4450B	RO4450B-dx				
Thickness	4 (0.10)	4 (0.10)	3.6 (0.09)	Z	mils (mm)	-	-
Dielectric Constant, ϵ_r	3.17 ± 0.05	3.54 ± 0.05	3.30 ± 0.05	Z	-	10GHz - 23°C	IPC-TM-650, 2.5.5.5
Dissipation Factor, $\tan \delta$	0.005	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	3.3X10 ¹⁰	>2.5 X 10 ¹⁰	>2.5 X 10 ¹⁰	-	MΩ•cm	23°C/50% RH	IPC-TM-650, 2.5.17.1
Surface Resistivity	5.7 X 10 ⁹	1.9X10 ⁸	1.9 X 10 ⁸	X,Y	MΩ	23°C/50% RH	IPC-TM-650, 2.5.17.1
Thermal Conductivity	0.46	0.60	0.60	Z	W/m/K	100°C	ASTM F433
Moisture Absorption	0.05	0.05	0.10	-	%	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	1.65	1.86	1.80	-	gm/cm ³	23°C	ASTM D792
Dimensional Stability	0.6	TBD	TBD	X,Y	mils/inch	After Etch +E2/150	IPC-TM-650, 2.2.4
Copper Adhesion	5* (0.88)	4.9* (0.86)	4.0* (0.70)	Z	pli (N/mm)	After Solder Float	IPC-TM-650, 2.4.8
Coefficient of Thermal Expansion	16 19 80	19 17 50	19 17 60	X Y Z	ppm/°C	-55 to 125°C	IPC-TM-650, 2.4.41
Color	White	White	White	-	-	-	-
Flammability	-	94V-0	94V-0				
Lead-Free Process Compatible	Yes	Yes	Yes				

*Tested on ½ oz. EDC foil for RO4450B and 1 oz. EDC foil for RO4403 prepreg. Rogers UL file number is E102763B.

STANDARD THICKNESS:

RO4403/RO4450B: 0.004" (0.101mm)
RO4450B-dx: 0.0036 (0.091mm)

STANDARD SIZE:

24X18" Sheets (610mm X 457mm) Contact Customer Service for other available sizes.

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