

## RO3000® Series High Frequency Circuit Materials

### Features and Benefits:

- Low dielectric loss for high frequency performance (RO3003). Laminate can be used in applications up to 30-40 GHz.
- Excellent mechanical properties versus temperature for reliable stripline and multilayer board constructions.
- Uniform mechanical properties for a range of dielectric constants. Ideal for multilayer board designs with a range of dielectric constants. Suitable for use with epoxy glass multilayer board hybrid designs.
- Stable dielectric constant versus temperature and frequency for RO3003. Ideal for band pass filters, microstrip patch antennas, and voltage controlled oscillators.
- Low in-plane expansion coefficient (matched to copper). Allows for more reliable surface mounted assemblies. Ideal for applications sensitive to temperature change and excellent dimensional stability.
- Volume manufacturing process for economical laminate pricing.

### Typical Applications:

- Automotive Collision Avoidance Systems
- Automotive Global Positioning Satellite Antennas
- Cellular and Pager Telecommunications Systems
- Patch Antennas for Wireless Communications
- Direct Broadcast Satellites
- Datalink on Cable Systems
- Remote Meter Readers
- Power Backplanes

RO3000® High Frequency Circuit Materials are ceramic- filled PTFE composites intended for use in commercial microwave and RF applications. This family of products was designed to offer exceptional electrical and mechanical stability at competitive prices.

RO3000® series laminates are PTFE-based circuit materials with mechanical properties that are constant regardless of the dielectric constant selected. This allows the designer to develop multilayer board designs that use different dielectric constant materials for individual layers, without encountering warpage or reliability problems.

The dielectric constant versus temperature of RO3000 series materials is very stable (Charts 1 and 2). These materials exhibit a coefficient of thermal expansion (CTE) in the X and Y axis of 17 ppm/°C. This expansion coefficient is matched to that of copper, which allows the material to exhibit excellent dimensional stability, with typical etch shrinkage (after etch and bake) of less than 0.5 mils per inch. The Z-axis CTE is 24 ppm/°C, which provides exceptional plated through-hole reliability, even in severe thermal environments.

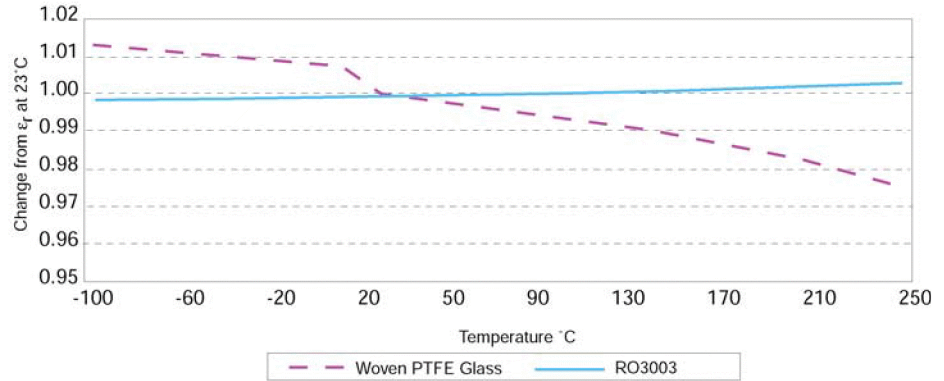
RO3000® series laminates can be fabricated into printed circuit boards using standard PTFE circuit board processing techniques, with minor modifications as described in the application note "Fabrication Guidelines for RO3000® Series High Frequency Circuit Materials."

Available claddings are ½ , 1 or 2 oz./ft<sup>2</sup> (17, 35, 70 µm thick) electrodeposited copper foil.

RO3000® laminates are manufactured under an ISO 9002 certified system.

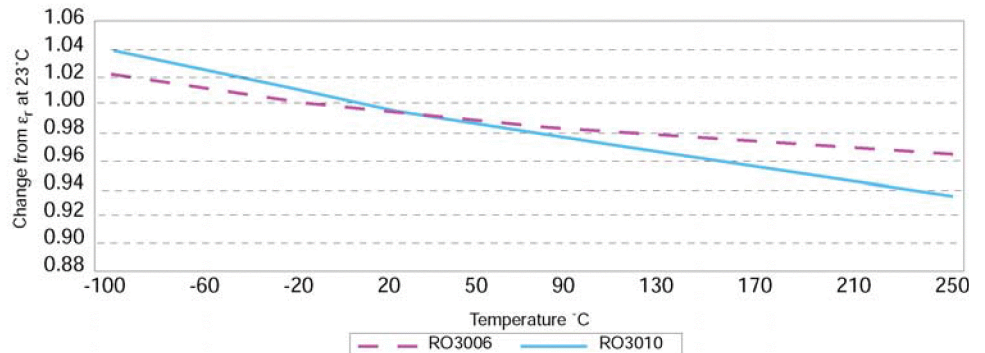
**Chart 1: RO3003™ Laminate Dielectric Constant vs. Temperature**

The data in Chart 1 demonstrates the excellent stability of dielectric constant over temperature for RO3003™ laminates, including the elimination of the step change in dielectric constant, which occurs near room temperature with PTFE glass materials.



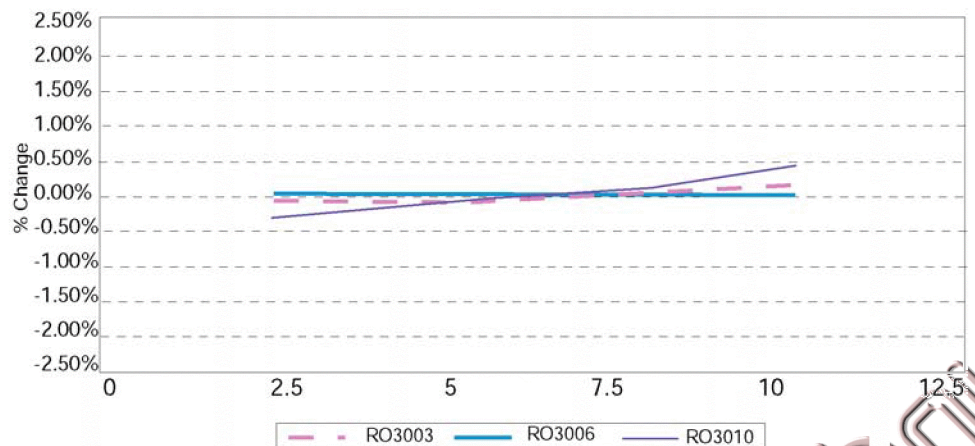
**Chart 2: RO3006™ and RO3010™ Laminate Dielectric Constant vs. Temperature**

The data in Chart 2 shows the change in dielectric constant vs. temperature for RO3006™ and RO3010™ laminates. These materials exhibit significant improvement in temperature stability of dielectric constant when compared to other high dielectric constant PTFE laminates.

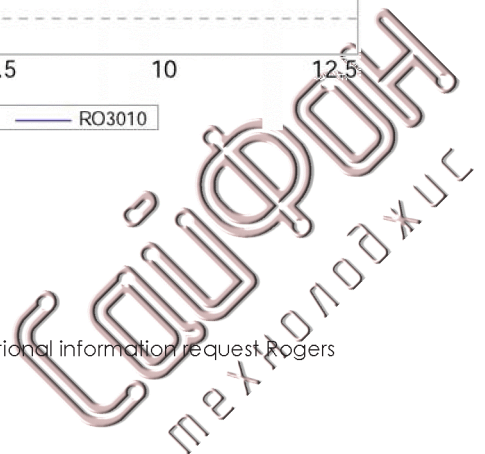


**Chart 3: Dielectric Constant vs. Frequency for RO3000® Series Laminate**

Chart 3 demonstrates the stability of dielectric constant for RO3000® series products over frequency. This stability simplifies the design of broad-band components as well as allowing the materials to be used in a wide range of applications over a very broad range of frequencies.



The data in Charts 1, 2 and 3 was produced using a modified IPC-TM-650, 2.5.5.5 method. For additional information request Rogers T.R. 5156 and T.M. 4924.



**Typical Values**

**RO3000 Series High Frequency Laminates**

PROPERTY	TYPICAL VALUE <sup>(1)</sup>			DIRECTION	UNIT	CONDITION	TEST METHOD
	RO3003	RO3006	RO3010				
Dielectric Constant $\epsilon_r$	3.00±0.04 <sup>(2)</sup>	6.15±0.15	10.2±0.30	Z	-	10GHz 23°C	IPC-TM-650 2.5.5.5
Dissipation Factor	0.0013	0.0020	0.0023	Z	-	10GHz 23°C	IPC-TM-650 2.5.5.5
Thermal Coefficient of $\epsilon_r$	13	-160	-280	Z	ppm/°C	10GHz 0-100°C	IPC-TM-650 2.5.5.5
Dimensional Stability	0.5	0.5	0.5	X,Y	mm/m	COND A	ASTM D257
Volume Resistivity	10 <sup>7</sup>	10 <sup>3</sup>	10 <sup>3</sup>		MΩ•cm	COND A	IPC 2.5.17.1
Surface Resistivity	10 <sup>7</sup>	10 <sup>3</sup>	10 <sup>3</sup>		MΩ	COND A	IPC 2.5.17.1
Tensile Modulus	2068 (300)	2068 (300)	2068 (300)	X,Y	MPa (kpsi)	23°C	ASTM D638
Water Absorption	<0.1	<0.1	<0.1	-	%	D24/23	IPC-TM-650 2.6.2.1
Specific Heat	0.93 (0.22)	0.93 (0.22)	0.93 (0.22)		J/g/K (BTU/lb/°F)		Calculated
Thermal Conductivity	0.50	0.61	0.66	-	W/m/K	100°C	ASTM C518
Coefficient of Thermal Expansion	17 24	17 24	17 24	X,Y Z	ppm/°C	-55 to 288°C	ASTM D3386-94
Td	500	500	500		°C TGA		ASTM D 3850
Color	Tan	Tan	Off White				
Density	2.1	2.6	3.0		gm/cm <sup>3</sup>		
Copper Peel Strength	3.1 (17.6)	2.1 (12.2)	2.4 (13.4)		N/mm (lb/in)	After solder float	IPC-TM-2.4.8
Flammability	94V-0	94V-0	94V-0				UL
Lead Free Process Capatible	Yes	Yes	Yes				

(1) References: Internal T.R.'s 1430, 2224, 2854. Tests at 23°C unless otherwise noted. Typical values should not be used for specification limits.

(2) The nominal dielectric constant of an 0.060" thick RO3003® laminate as measured by the IPC-TM-650, 2.5.5.5 will be 3.02, due to the elimination of biasing caused by air gaps in the test fixture. For further information refer to Rogers T.R. 5242.

STANDARD THICKNESS:	STANDARD PANEL SIZE:	STANDARD COPPER CLADDING:
<p><b>RO3003:</b> 0.005" (0.13 mm) 0.010" (0.25 mm) 0.020" (0.50 mm) 0.030" (0.75 mm) 0.060" (1.52 mm)</p> <p><b>RO3006/3010:</b> 0.005"(0.13 mm) 0.010"(0.25 mm) 0.025"(0.64 mm) 0.050"(1.28 mm)</p>	<p><b>RO3003:</b> 12" X 18" (305 X 457mm) 24" X 18" (610 X 457mm) 24" X 36" (610 X 915mm)</p> <p><b>RO3006/3010:</b> 18" X 12" (457 X 305mm) 18" X 24" (457 X 610mm) 18" X 36" (457 X 915mm) 18" X 48" (457 X 1.224m)</p>	<p>½ oz. (17µm), 1 oz. (35µm), 2 oz. (70µm) electrodeposited copper foil.</p>



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**CONTACT INFORMATION:**

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