ROGERS CORPORATION

Advanced Circuit Materials

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Data Sheet
Antenna Grade Laminates

RO4500™ Series Cost Performance Antenna Grade Laminates

FEATURES	BENEFITS
Loss range (0.0020 to 0.0037)	Wide range of application use
Dk range (3.3 to 3.5)	
Low PIM response	
Thermoset resin system	Compatible with standard PCB fabrication
Excellent dimensional stability	Greater yield on larger panels sizes
Uniform mechanical properties	Robust handing and long life in use with thin materials
High thermal conductivity	Improved power handling

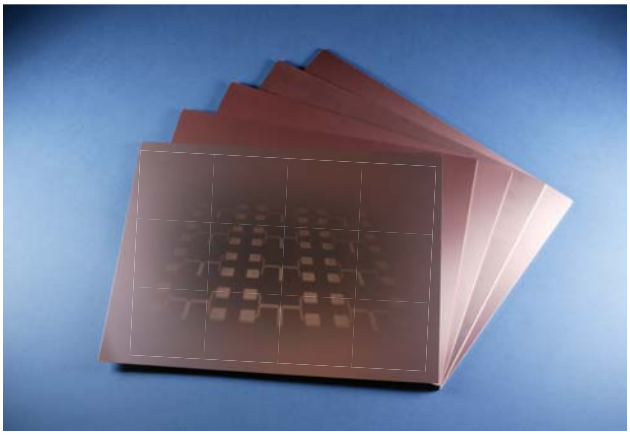
TYPICAL APPLICATIONS

- Cellular infrastructure base station antennas
- WiMAX antenna networks

RO4500™ Series High Frequency Laminates are cost/performance materials from Rogers Corporation, specifically engineered and manufactured to meet the specific demands of the antenna markets.

RO4533™, RO4534™ and RO4535™ laminates extend the capabilities of the successful RO4000® product series into antenna applications. This ceramic-filled, glass-reinforced hydrocarbon based material set provides the controlled dielectric constant, low loss performance and excellent passive intermodulation response required for mobile infrastructure microstrip antenna applications.

As with all RO4000 high frequency laminates, RO4500 laminates are fully compatible with conventional FR4 and high temperature lead free solder processing. These laminates do not require special treatment needed on traditional PTFE-based laminates for plated through hole preparation. This product series is an affordable alternative to more conventional antenna technologies, thus allowing designers to maximize the price and performance of their antennas. Moreover, these materials are available halogen-free to meet the most stringent "green" standards, or with our RoHS-compliant flame-retardant technology for applications requiring UL94 V-0 certification.



The resin systems of RO4500 dielectric materials are designed to provide the necessary properties for ideal antenna performance. The coefficients of thermal expansion (CTEs) in both the X and Y directions are similar to that of copper. The good CTE match reduces stresses in the printed circuit board antenna. The typical glass transition temperature of RO4500 materials exceeds 280°C (536°F), leading to a low z-axis CTE and excellent plated through hole reliability. These properties, in combination with a dimensional stability value of less than 0.05%, make RO4500 laminates an excellent candidate for printed circuit antenna applications. RO4500 materials also provide increased thermal conductivity over equivalent PTFE/woven glass materials, allowing for design of antennas with increased power handling capability.

In addition to these excellent thermo-mechanical properties, RO4500 laminates embody electrical characteristics that antenna designers need. The laminates have a dielectric constant (Dk) ranging from 3.3 to 3.5 (±0.08) and a loss tangent (Df) of 0.0020 to 0.0037 measured at 2.5 GHz. These values allow antenna designers to realize substantial gain values while minimizing signal loss. Materials are available with demonstrated low PIM performance, with values better than –155 dBC using two 43 dBm swept tones at 1900 MHz.

Typical Value **RO4500™ Series Cost Performance Laminates**

Property	Typical Value [1]			Direction	Units	Condition	Test Method
	RO4533	RO4534	RO4535				
Dielectric Constant, ε_r	3.3 ± 0.08	3.4 ± 0.08	3.5 ± 0.08	Z		10 GHz/23°C 2.5 GHz	IPC-TM-2.5.5.5
Dissipation Factor	0.0020	0.0022	0.0032	Z		2.5 GHz/23°C	IPC-TM-650, 2.5.5.5
	0.0025	0.0027	0.0037			10 GHz/23°C	
PIM	150-160	150-160	N/A		dBc	Reflected 43 dBm swept tones	Summitek 1900b PIM Analyzer
Dielectric Strength	>500	>500	>500	Z	V/mil	0.51mm	IPC-TM-650, 2.5.6.2
Dimensional Stability	<0.2	<0.3	<0.5	X,Y	mm/m (mils/inch)	after etch	IPC-TM-650, 2.4.39A
Coefficient of Thermal Expansion	13	11	14	X	ppm/°C	-55 to 288°C	IPC-TM-650, 2.4.41
	11	14	16	Y			
	37	46	35	Z			
Thermal Conductivity	0.6	0.6	0.6		W/m/K	80°C	ASTM C518
Moisture Absorption	0.02	0.06	0.05		%	D48/50	IPC-TM-650 2.6.2.1 ASTM D570
Tg	>280	>280	>280		°C TMA	A	IPC-TM-650 2.4.24
Density	1.8	1.8	1.9		gm/cm3		ASTM D792
Copper Peel Strength	0.9	1.0	0.9		N/mm	1 oz. EDC post solder float	IPC-TM-650 2.4.8
Flammability	NO	NO	V-0				UL94
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.

RoHS Compliant

(1) PIM Performance is heavily influenced by the copper choice. PIM values provided are based on testing of reverse-treat electrode-postied copper foils. Typical PIM rating on standard EDC foils are ≤ -145 dBm. Refer to the laminate thickness and copper option table for material options.
(2) UL94 V-0 certification in process; not certified by UL.

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.

Ordering Information:

Laminate Thickness and Copper Foil Options:

Product	Dielectric Thickness 30 (0.762)	40 (1.016)	60 (1.524)	Standard Panel Sizes:	24”X18” (610 X 457 mm) 48”X36”(1.224 X 0.915 m) Additional thicknesses and panel sizes are available up to 50” X 110” (Untrimmed)
RO4533	●▲	●▲	●▲	**Copper Cladding:** **Standard EDC:** ● 1/2 oz (17mm), 1 oz (35 μm) **LoPro™ Reverse Treated EDC for PIM Sensitive Applications:** ▲ 1/2 oz (17mm), 1 oz (35 μm) For most applications the standard EDC foil should be used. When PIM and insersion loss is critical, the LoPro reverse-treat copper should be considered. Rogers’ LoPro foil has a surface modifier to bond reverse-treat foils to RO4000 laminates.	
RO4534	32 (0.813) ●▲	●▲	●▲		
RO4535	●	●	●		

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