ROGERS CORPORATION

Data Sheet

AD Series™ Antenna Materials

AD250C™, AD255C™, AD300D™and AD350A™ Laminate Materials

The AD Series™ antenna materials from Rogers Co rporation are high performance, specialty materials that are specifically engineered and manufactured to meet the demands of today's wireless antenna markets. Increased antenna performance requirements are a constant trend in the market today. Rogers has the materials needed to meet the design needs of this market both today and into the future.

The AD Series antenna products are glass-reinforced, PTFE based materials that provide controlled dielectric constant, low loss performance, and very good passive intermodulation (PIM) performance. The woven glass reinforcement affords good circuit processability and enables high yield circuit board fabrication.

The AD Series antenna products are manufactured to meet the wide variety of dielectric constant options that are needed for today's antenna requirements. Dielectric constant options are available at 2.50, 2.55, 2.60, 3.00, 3.20, and 3.50 with a typical tolerance of ±0.05. The variety of options and tight control help to enable the circuit to meet the desired impedance every time.

All AD Series antenna products are manufactured with standard electrodeposited (ED) and reverse treated ED copper foil options. This provides choices that are sufficient to help reduce both circuit losses and antenna PIM. Typical PIM values using reverse treated ED copper foil are -159 dBc at 30 mil thickness and -163 dBc at 60 mil thickness. These are typical values obtained using the extensive PIM testing capability at Rogers at 1900 MHz using a two tone, reflected method on a 50Ω microstrip test vehicle.

Additionally, the AD Series antenna products are produced in a wide variety of thicknesses. Some products such as the AD250™ laminate are available from 10 mils through 250 mils. Others are more selective and offer fewer options. Please consult with your sales engineer or customer service representative for assistance in selecting the material options that are suitable for your application.

Lastly, as PTFE based composites, the AD Series antenna materials have very low loss (typically less than 0.002 at 10 GHz), very low moisture absorption (less than 0.1%), and very high copper peel strength (greater than 10 pli).

These features combined together make the AD Series laminates an ideal choice for antenna applications.

FEATURES AND BENEFITS:

Low loss tangent (<0.002 at 10 GHz)
- Excellent circuit performance in all typical wireless frequency bands

Controlled dielectric constant (±0.05)
- Repeatable circuit performance

Very low PIM (-159 dBc at 30 mil, 1900 MHz)
- Excellent antenna performance and reduced yield loss due to PIM related issues

Excellent dimensional stability
- Repeatable circuit performance and improved manufacturing yields

TYPICAL APPLICATIONS:

- Cellular infrastructure base station antenna
- Automotive telematics antenna systems
- Commercial satellite radio antenna

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Electrical Properties[1]	AD250C	AD255C	Units	Test Conditions		Test Method
PIM (30mil/60mil)[2]	-159/-163	-159/-163	dBc	Reflected 43 dBm swept tones at 1900 MHz, S1/S1		Rogers Internal 50 ohm
Dielectric Constant (process)	2.52	2.55	-	23°C @ 50% RH	10 GHz	IPC TM-650 2.5.5.5 (IPC TM-650 2.5.5.3)
Dielectric Constant (design)	2.50	2.60	-	C-24/23/50	10 GHz	Microstrip Differential Phase Length
Dissipation Factor (process)	0.0013	0.0013	-	23°C @ 50% RH	10 GHz	IPC TM-650 2.5.5.5
Thermal Coefficient of Dielectric Constant	-117	-110	ppm/°C	0°C to 100°C	10 GHz	IPC TM-650 2.5.5.5
Volume Resistivity	4.8×10^8	7.4×10^8	Mohm-cm	C-96/35/90	-	IPC TM-650 2.5.17.1
Surface Resistivity	4.1×10^7	3.6×10^7	Mohm	C-96/35/90	-	IPC TM-650 2.5.17.1
Electrical Strength (dielectric strength)	979	911	V/mil	-	-	IPC TM-650 2.5.6.2
Dielectric Breakdown	>40	>40	kV	D-48/50	X/Y direction	IPC TM-650 2.5.6
Thermal Properties[1]						
Decomposition Temperature (T_d)	>500	>500	°C	2hrs @ 105°C	5% Weight Loss	IPC TM-650 2.3.40
Coefficient of Thermal Expansion - x	47	34	ppm/°C	-	-55°C to 288°C	IPC TM-650 2.4.41
Coefficient of Thermal Expansion - y	29	26	ppm/°C	-	-55°C to 288°C	IPC TM-650 2.4.41
Coefficient of Thermal Expansion - z	196	196	ppm/°C	-	-55°C to 288°C	IPC TM-650 2.4.41
Thermal Conductivity	0.33	0.35	W/mK	-	z direction	ASTM D5470
Time to Delamination	>60	>60	minutes	as-received	288°C	IPC TM-650 2.4.24.1
Mechanical Properties[1]						
Copper Peel Strength after Thermal Stress	2.6 (14.8)	2.4 (13.6)	N/mm (lbs/in)	10s @288°C	35 µm foil	IPC TM-650 2.4.8
Flexural Strength (MD/CMD)	8.8/6.4 (60.7/44.1)	8.8/6.4 (60.7/44.1)	MPa (ksi)	25°C ± 3°C	-	ASTM D790
Tensile Strength (MD/CMD)	6.0/5.6 (41.4/38.6)	8.1/6.6 (55.8/45.5)	MPa (ksi)	23°C/50% RH	-	ASTM D3039/D3039-14
Flex Modulus (MD/CMD)	885/778 (6,102/5,364)	930/818 (6,412/5,640)	MPa (ksi)	25°C ± 3°C	-	IPC-TM-650 Test Method 2.4.4
Dimensional Stability (MD/CMD)	0.02/0.06	0.03/0.07	mils/inch	after etch + bake	-	IPC-TM-650 2.4.39a
Physical Properties[1]						
Flammability	V-0	V-0	-	-	-	UL-94
Moisture Absorption	0.04	0.03	%	E1/105 +D48/50	-	IPC TM-650 2.6.2.1
Density	2.28	2.28	g/cm^3	C-24/23/50	-	ASTM D792
Specific Heat Capacity	0.813	0.813	J/g°K	2 hours at 105°C	-	ASTM E2716

Product	Standard Thicknesses	Standard Panel Sizes	Standard Claddings
AD250C	0.020" (0.508 mm) +/- 0.002" 0.030" (0.762 mm) +/- 0.002" 0.060" (1.524 mm) +/- 0.003"	**AD250C .020":** 18" x 12" (457mm x 305mm) 18" x 24" (457mm x 610mm) **All Other Thicknesses** 12" x 18" (305mm x 457mm) 24" x 18" (610mm x 457mm) *Additional panel sizes available *Contact Customer Service or Sales Engineering to inquire about additional available product configurations	<u>Electrodeposited Copper Foil</u> ½ oz. (18µm) HH/HH 1oz. (35µm) H1/H1 <u>Reverse Treated Electrodeposited Copper Foil</u> ½ oz. (18µm) RH/RH 1oz. (35µm) R1/R1 *Additional claddings and cladding weights, such as Reverse Treated Electrodeposited Copper Foil and unclad are available
AD255C	0.020" (0.508 mm) +/- 0.002" 0.030" (0.762 mm) +/- 0.002" 0.040" (1.016 mm) +/- 0.002" 0.060" (1.524 mm) +/- 0.002" 0.125" (3.175 mm) +/- 0.006" *Additional non-standard laminate thicknesses available from 0.020" - 0.250" in varying increments		

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See Page 3 for Notes

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Electrical Properties[1]	AD300D	AD350A	Units	Test Conditions		Test Method
PIM (30mil/60mil)[2]	-159/-163	-159/-163	dBc	Reflected 43 dBm swept tones at 1900 MHz, S1/S1		Rogers Internal 50 ohm
Dielectric Constant (process)	2.97/3.03 (2.94/3.00)	3.54	-	23°C @ 50% RH	10 GHz (1 MHz)	IPC TM-650 2.5.5.5 (IPC TM-650 2.5.5.3)
Dielectric Constant (design)	2.94/3.00	3.50	-	C-24/23/50	10 GHz	Microstrip Differential Phase Length
Dissipation Factor (process)	0.0021	0.0033	-	23°C @ 50% RH	10 GHz	IPC TM-650 2.5.5.5
Thermal Coefficient of Dielectric Constant	-73	-57	ppm/°C	0°C to 100°C	10 GHz	IPC TM-650 2.5.5.5
Volume Resistivity	1.7×10^8	1.5×10^9	Mohm-cm	C-96/35/90	-	IPC TM-650 2.5.17.1
Surface Resistivity	5.1×10^7	9.5×10^7	Mohm	C-96/35/90	-	IPC TM-650 2.5.17.1
Electrical Strength (dielectric strength)	750	671	V/mil	-	-	IPC TM-650 2.5.6.2
Dielectric Breakdown	46	33	kV	D-48/50	X/Y direction	IPC TM-650 2.5.6
Thermal Properties[1]						
Decomposition Temperature (T_d)	>500	>500	˚C	2hrs @ 105˚C	5% Weight Loss	IPC TM-650 2.3.40
Coefficient of Thermal Expansion - x	24	18	ppm/°C	-	-55˚C to 288˚C	IPC TM-650 2.4.41
Coefficient of Thermal Expansion - y	23	18	ppm/°C	-	-55˚C to 288˚C	IPC TM-650 2.4.41
Coefficient of Thermal Expansion - z	98	63	ppm/°C	-	-55˚C to 288˚C	IPC TM-650 2.4.41
Thermal Conductivity	0.37	0.44	W/mK	-	z direction	ASTM D5470
Time to Delamination	>60	>60	minutes	as-received	288˚C	IPC TM-650 2.4.24.1
Mechanical Properties[1]						
Copper Peel Strength after Thermal Stress	3.2 (18.3)	2.6 (14.7)	N/mm (lbs/in)	10s @288˚C	35 µm foil	IPC TM-650 2.4.8
Flexural Strength (MD/CMD)	152.4/127.6 (22.1/18.5)	97.9/62.1 (14.2/9.0)	MPa (ksi)	25°C ± 3°C	-	ASTM D790
Tensile Strength (MD/CMD)	122.0/120.7 (17.7/17.5)	97.9/46.2 (14.2/6.7)	MPa (ksi)	23°C/50% RH	-	ASTM D3039/D3039-14
Flex Modulus (MD/CMD)	10,400/9,580 (1510/1390)	12,652/10,128 (1,835/1,469)	MPa (ksi)	25°C ± 3°C	-	IPC-TM-650 Test Method 2.4.4
Dimensional Stability (MD/CMD)	-0.08/0.02	0.15/0.17	mils/inch	after etch + bake	-	IPC-TM-650 2.4.39a
Physical Properties[1]						
Flammability	V-0	V-0	-	-	-	UL-94
Moisture Absorption	0.04	0.1	%	E1/105 +D48/50	-	IPC TM-650 2.6.2.1
Density	2.23	2.43	g/cm^3	C-24/23/50	-	ASTM D792
Specific Heat Capacity	0.80	0.757	J/g°K	2 hours at 105°C	-	ASTM E2716

NOTES:
(1) Typical values are a representation of an average value for the population of the property using a 0.060" laminate.
(2) PIM Performance is heavily influenced by the copper choice. PIM values provided are typical values based on testing of the S1 foil using Rogers' internal test method on 0.030" thick and 0.060" thick laminates.
Rogers recommends 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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Product	Standard Thicknesses	Standard Panel Sizes	Standard Claddings
AD300D	0.030" (0.762 mm) +/- 0.002" 0.040" (1.016mm) +/- 0.002" 0.060" (1.524 mm) +/- 0.002" 0.120" (3.048 mm) +/- 0.006"	12" x 18" (305mm x 457mm) 24" x 18" (610mm x 457mm) *Additional panel sizes available	Electrodeposited Copper Foil ½ oz. (18µm) HH/HH 1oz. (35µm) H1/H1 Reverse Treated Electrodeposited Copper Foil ½ oz. (18µm) RH/RH 1oz. (35µm) R1/R1 *Additional claddings and cladding weights, such as Reverse Treated Electrodeposited Copper Foild and unclad are available
AD350A	0.030" (0.762 mm) +/- 0.002" 0.060" (1.524 mm) +/- 0.003" 0.120" (3.048 mm) +/- 0.006" *Additional non-standard laminate thicknesses available from 0.006" - 0.200" in varying increments *Contact Customer Service or Sales Engineering to inquire about additional available product configurations		

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