

# Park Advanced Circuitry Materials

## N9000

### PTFE Laminates

The N9000 PTFE laminate system is designed for critical RF/Microwave components, antennas, power amplifiers and subassemblies. Superior mechanical and electrical performance make the N9000 PTFE laminate system the material of choice for your lowest loss, high frequency applications.

### Key Features

#### Complete spectrum of controlled dielectric constants

- Dk of 2.08 through Dk of 4.50
- The first reinforced PTFE laminate with a dielectric constant less than 2.17 for very low loss antenna designs
- Available in sheets up to 80 inches long (2.03 meters) by 48 inches wide (1.22 meters)

#### Enhanced N9000 IM materials available

- Enables reduced passive intermodulation in antenna and high power designs - up to 25% better than other PTFE laminates available
- Offers two-tone passive intermodulation performance of less than -155 dBc which is typically 8-20 dB lower than other PTFE materials available.

#### Consistent Quality

- Statistic Process Control "SPC" methods provide consistent dielectric values from sheet to sheet and lot to lot
- Park's facilities are ISO 9001:2000 quality certified and comply to ISO 14001:2004 environmental regulations
- Meets UL 94V-0 and IPC-4103 specifications
- All of Park's materials are RoHS compliant

#### Optimized N9000 PTFE processing

- Foil adhesion is 50-100% greater than competitive glass reinforced PTFE laminates and 200-300% greater than other ceramic loaded hydrocarbon laminates
- Superior solvent absorption resistance compared to ceramic-loaded PTFE
- Reduced dielectric constant changes due to solvent absorption and no additional baking cycles are needed during processing



### Applications

- Antennas
- Wireless Communications
- Power Amplifiers
- Dual Band Hi Power Passive Circuits
- Automotive Applications
  - Forward Warning and Near Field Radar
- Digital/Microwave Hybrid Multilayer PCB Assemblies
- Millimeter Wave Components
- Satellite Communications
- Microwave Links

### Global Availability

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**Park's UL file number: E36295**



## N9000 - Typical Engineering Values

Typical Parameter	Test Method	NY SERIES	NX SERIES	NX SERIES
Dielectric Constant at 10 GHz (Dk) (range)	IPC-TM-650, 2.5.5.5	2.08 - 2.33	2.40 - 2.60	2.70 - 3.20
Dissipation Factor at 10 GHz (Df) (range)	IPC-TM-650, 2.5.5.5	0.0006 - 0.0011	0.0016 - 0.0019	0.0020 - 0.0024
Passive Intermodulation Formulation Availability		Yes	Yes	Yes
Passive Intermodulation Performance		-155 dBc	-155 dBc	-155dBc
Dielectric Breakdown	IPC-TM-650, 2.5.6	50kV	50kV	50kV
Volume Resistivity	IPC-TM-650, 2.5.17	10 <sup>9</sup> MΩ - cm	10 <sup>9</sup> MΩ - cm	10 <sup>8</sup> MΩ - cm
Surface Resistivity	IPC-TM-650, 2.5.17	10 <sup>7</sup> MΩ	10 <sup>7</sup> MΩ	10 <sup>7</sup> MΩ
Arc Resistance	ASTM D-495	180 sec.	180 sec.	180 sec.
Flexural Strength Lengthwise	IPC-TM-650, 2.4.4	82.7 MPa	82.7 MPa	158.6 MPa
Flexural Strength Crosswise	IPC-TM-650, 2.4.4	68.9 MPa	68.9 MPa	131.0 MPa
Copper Peel Strength	IPC-TM-650, 2.4.8	2.33 kN / m	2.33 kN / m	2.33 kN / m
18, 35, and 70µm copper (1/2 oz, 1 oz, and 2 oz copper)				
After Thermal Shock (30 sec. at 260°C)		2.31 kN / m	2.31 kN / m	2.31 kN / m
Moisture Absorption	IPC-TM-650, 2.6.2.1	0.02%	0.02%	0.05%
Specific Gravity	ASTM D-792, A	2.23 g / cm <sup>3</sup>	2.23 g / cm <sup>3</sup>	2.25 g / cm <sup>3</sup>
Thermal Conductivity	ASTM E-1225	0.272 W / m / K	0.272 W / m / K	0.251 W / m / K
Coefficient of Thermal Expansion (CTE)				
X	IPC-TM-650, 2.4.41	25 ppm / °C	25 ppm / °C	12 ppm / °C
Y	IPC-TM-650, 2.4.41	35 ppm / °C	35 ppm / °C	18 ppm / °C
Z	IPC-TM-650, 2.4.24	260 ppm / °C	260 ppm / °C	150 ppm / °C
Flammability	IPC-TM-650, 2.3.10	V-0	V-0	V-0
		Product Dk Df	Product Dk Df	Product Dk Df
		NY9208 2.08±.02 0.0006	NX9240 2.40±04 0.0016	NX9270 2.70±04 0.0020
		NY9217 2.17±.02 0.0008	NX9245 2.45±.04 0.0016	NX9294 2.94±04 0.0022
		NY9220 2.20±.02 0.0009	NX9250 2.50±.04 0.0017	NX9300 3.00±04 0.0023
		NY9233 2.33±.02 0.0011	NX9255 2.55±.04 0.0018	NX9320 3.20±04 0.0024
			NX9260 2.60±.04 0.0019	

### Cladding - Copper Foil

Foil Weight	Foil Thickness	Copper Type
.25 oz	9 microns	Electro-Deposited (ED)
.33 oz	12 microns	CQ
.50 oz	18 microns	CT
1 oz	35 microns	CH RH
2 oz	70 microns	C1 R1
		C2 R2

### Cladding - Heavy Backed Metal

Plate Thickness	Plate Thickness	Plate Thickness
mm	mm	mm
inches	inches	inches
0.800	2.362	4.750
1.000	2.500	5.000
1.200	3.000	6.000
1.500	3.175	6.350
1.575	4.000	7.000
2.000	4.750	8.000

Heavy cladding plate material available in aluminum or brass for all NY and NX constructions.  
Rolled annealed available upon request.

## N9000 - Typical Engineering Values

Typical Parameter	NH SERIES	Typical Parameter	Test Method	NL SERIES
Dielectric Constant at 10 GHz (Dk)	2.94 - 4.50	Dielectric Constant at 10 GHz (Dk)	IPC-TM-650, 2.5.5.5	2.94 - 3.50
Dissipation Factor at 10 GHz (Df)	0.0022 - 0.0030	Dissipation Factor at 10 GHz (Df)	IPC-TM-650, 2.5.5.5	0.0017
PIM Formulation Availability	Yes	PIM Formulation Availability		Yes
Passive Intermodulation Performance	-1.55 dBc	Pressure Cooker-60 min then solder dip @288°C until failure (max 10 min) (modified)	IPC-TM-650, 2.6.16	Pass
Dielectric Breakdown	45kV	Dielectric Breakdown	IPC-TM-650, 2.5.6	>50kV
Volume Resistivity	10 <sup>8</sup> MΩ - cm	Volume Resistivity	IPC-TM-650, 2.5.17.1	6.1x10 <sup>7</sup> MΩ - cm
Surface Resistivity	10 <sup>7</sup> MΩ	Surface Resistivity	IPC-TM-650, 2.5.17.1	4.4x10 <sup>6</sup> MΩ - cm
Arc Resistance	180 sec.	Arc Resistance	IPC-TM-650, 2.5.1	215 sec.
Flexural Strength Lengthwise	158.6 MPa	Flexural Strength Lengthwise	IPC-TM-650, 2.4.4.0	58.6 MPa
Flexural Strength Crosswise	131.0 MPa	Tensile Strength (warp/fill)	ASTM D3039	64.1 / 48.9 MPa
Copper Peel Strength - 18, 35, 70 μm (1/2 oz, 1 oz, and 2 oz copper)	2.33 kN / m	Copper Peel Strength - 35 μm (1 oz)	IPC-TM-650, 2.4.8	1.8 kN / m (10.3 lb/in)
After Thermal Shock (30 sec. at 260°C)	2.31 kN / m	Modulus (warp)	ASTM D3039	1.1 x 10 <sup>6</sup> MPa
Moisture Absorption	0.08%	Moisture Absorption	IPC-TM-650, 2.6.2.1	<0.05%
Specific Gravity	2.459 g / cm <sup>3</sup>	Specific Gravity		2.25 g / cm <sup>3</sup>
Thermal Conductivity	0.230 W / m / K	Thermal Conductivity	ASTM E1461	0.381 W / m / K
Coefficient of Thermal Expansion (CTE)		Coefficient of Thermal Expansion (CTE)		
X	9 ppm / °C	X		25 ppm / °C
Y	12 ppm / °C	Y		35 ppm / °C
Z	71 ppm / °C	Z	IPC-TM-650, 2.4.24	320 ppm / °C
Flammability	V-0	Flammability	IPC-TM-650, 2.3.10	V-0
	<b>Product</b>	Poisson's Ratio (warp/fill)	ASTM D3039	<b>Product</b>
	NH9294 2.94±.07			0.180 / 0.221
	NH9300 3.00±.07	Dk		<b>Dk</b>
	NH9320 3.20±.07	NH9294 2.94±.05		NL9294 2.94±.05
	NH9338 3.38±.10	NH9300 3.00±.05		NL9300 3.00±.05
	NH9348 3.48±.10	NH9320 3.20±.05		NL9320 3.20±.05
	NH9350 3.50±.10	NH9338 3.38±.10		NL9350 3.50±.05
	NH9410 4.10±.10	NH9348 3.48±.10		
	NH9450 4.50±.10	NH9350 3.50±.10		
		NH9410 4.10±.10		
		NH9450 4.50±.10		
				<b>Df</b>
				NL9294 2.94±.05
				NL9300 3.00±.05
				NL9320 3.20±.05
				NL9350 3.50±.05

## Ordering Information

Please specify the product and / or Dk, material thickness, copper thickness, copper type and panel size. Request Passive Intermodulation Formulation when necessary for antenna applications.  
 Example: 9220, .010" thick, 1 oz two sides, ED copper, 12"x18" or Dk=2.20, .010" thick, 1 oz copper two sides, ED copper, 12"x18". For Passive Intermodulation Formulation material, add the IM suffix, i.e.: 9220IM.

# Park Advanced Circuitry Materials

## N9000 - Standard Laminate Thicknesses

Series	Product	0.005 0.127	0.010 0.254	0.015 0.381	0.020 0.508	0.030 0.762	0.031 0.787	0.045 1.143	0.060 1.524	0.062 1.575	0.125 3.175
NY	9208				X	X			X		X
NY	9217	X	X	X	X	X	X	X	X	X	X
NY	9220	X	X	X	X	X	X	X	X	X	X
NY	9233	X	X	X	X	X	X	X	X	X	X
NX	9240	X	X	X	X	X	X	X	X	X	X
NX	9245	X	X	X	X	X	X	X	X	X	X
NX	9250	X	X	X	X	X	X	X	X	X	X
NX	9255	X	X	X	X	X	X	X	X	X	X
NX	9260	X	X	X	X	X	X	X	X	X	X
NX	9270				X	X	X	X	X	X	X
NX	9294				X	X	X	X	X	X	X
NX	9300				X	X	X	X	X	X	X
NX	9320					X	X	X	X	X	X
NH	9294	X	X	X							
NH	9300	X	X	X							
NH	9320	X	X	X	X						
NH	9338	X	X	X	X	X	X	X	X	X	X
NH	9348	X	X	X	X	X	X	X	X	X	X
NH	9350		X	X	X	X	X	X	X	X	X
NL	9294	X	X		X	X	X				
NL	9300	X	X		X	X	X				
NL	9320				X	X	X				
NL	9350				X	X	X				

inches  
mm

### Constructions

NY Series: PTFE / woven-glass composite. Low glass:PTFE ratio for lowest loss applications.

NX Series: PTFE / woven-glass composite. Medium glass:PTFE ratio for increased mechanical strength.

NH Series: PTFE / woven-glass / ceramic composite. Medium glass:PTFE ratio with ceramic added for thermal stability and Dk uniformity at higher Dks.

NL Series: PTFE / woven glass / ceramic composite. Higher Dk, Low glass:PTFE ratio for low loss applications.

## Additional Materials for RF/Microwave Applications

Mercurywave™9350	Controlled Dk/Df Modified Epoxy Dk 3.50 / Df 0.004 at 10 GHz	N4350-13 RF	Controlled Dk/Df Modified Epoxy Dk 3.50 / Df 0.0065 at 10 GHz
Meteorwave™1000	Low Dk/Df Modified Epoxy Dk 3.70 / Df 0.0055 at 10 GHz	N4380-13 RF	Controlled Dk/Df Modified Epoxy Dk 3.80 / Df 0.0070 at 10 GHz
Meteorwave™2000	Low Dk/Df Modified Epoxy Dk 3.40 / Df 0.0040 at 10 GHz	N9000-13 RF	PTFE and Epoxy Composite Dk 3.00 / Df 0.0040 at 10 GHz Dk 3.20 / Df 0.0045 at 10 GHz Dk 3.38 / Df 0.0046 at 10 GHz Dk 3.50 / Df 0.0055 at 10 GHz
N4800-20	Low Dk/Df Modified Epoxy Dk 3.80 / Df 0.0075 at 10 GHz		
N4800-20 SI*	Low Dk/Df Modified Epoxy Dk 3.40 / Df 0.006 at 10 GHz		



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