

N4000-13 N4000-13 SI®

High-Speed Multifunctional Epoxy Laminate & Prepreg

The Nelco N4000-13 series is an enhanced epoxy resin system specifically engineered to provide a unique solution for design applications that demand both outstanding thermal and high signal speed / low signal loss properties. N4000-13 boasts an outstanding Tg of >210 °C by DSC which is achieved by utilizing an advanced resin technology formulated exclusively by Nelco.

This material is available on both an E-glass and a signal integrity glass (N4000-13 SI®). The N4000-13 SI® is excellent for applications that require optimum signal integrity and precise impedance control, while maintaining high reliability through CAF and thermal resistance.

The Nelco N4000-13 series is a superior choice for high-speed and low-loss applications, when compared to conventional epoxies, BT and thermoplastic-modified epoxies or other blends. The low Dk and Df characteristics and proven CAF (conductive-anodic filament) resistance of N4000-13 make it especially suited for high frequency applications such as cellular base stations, high speed storage networks, internet switching / routing systems and chip-test devices.

Increased signal speed (low Dk) and low signal loss (low Df) are some of the decisive advantages provided by the N4000-13 products over standard epoxy / glass substrates. When N4000-13 SI® is used, even greater signal speed and integrity are realized.

The superior thickness control of N4000-13 translates into excellent impedance control. This results in the ability to significantly reduce the thickness of a multilayer device as compared to a construction made with standard epoxy materials. For more flexibility, the N4000-13 series can also be used as a ZBC-2000® substrate.

Reliability is one of the huge advantages N4000-13 and N4000-13 SI® afford over standard high-Tg epoxies and other epoxy blends. Key reliability features include thermal stability, toughness as provided by a high Tg and low Z-CTE, and proven CAF resistance.

As microprocessor speeds continue to escalate and wireless communications proliferate, the need for a fast, dependable and cost-effective material supply becomes paramount. You will find an excellent balance of these qualities in the N4000-13 series of enhanced multifunctional epoxy laminates and prepregs.

Product Application Environments

- Fine-Line Multilayers
- Backplanes
- Surface-Mount Multilayers
- BGA Multilayers
- MCM-Ls
- CSP Attachment
- Wireless Communication Infrastructure
- High Speed Services
- High Speed Storage Networks
- Internet Switching/Routing Systems

Vacuum Lamination Parameters

Full Cure In Press	90 min. @ 193°C
Heat Up Rate (°C/min.)	2 - 4
Critical Range (°C)	80 - 140
Cool Down Rate (°C/min.)	< 3
Pressure (kg/cm ²) / (psi) *	19 - 25 / 275 - 350

Set platen 3 - 6° C higher than cure temp. & control heat up rate through critical temperature range. For partial cure in press, full cure in oven: laminate product 60 minutes at 182°C followed by a 90 minutes postbake at 193° C.

*Large panel sizes, high layer count and/or thick panels require higher pressure depending on heat and pressure distribution during lamination.

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N4000-13 and N4000-13 SI®

High-Speed Multifunctional Epoxy Laminate & Prepreg

Mechanical Properties	N4000-13	-13 SI	U.S. Units	N4000-13	-13 SI	Metric	Test Method
Peel Strength - 1 oz. (35 micron) Cu							
After Solder Float	7.5	7.5	lb/inch	1.31	1.31	N/mm	IPC-TM-650.2.4.8
At Elevated Temperature	8.1	8.1	lb/inch	1.42	1.42	N/mm	IPC-TM-650.2.4.8.2a
After Exposure to Process Solutions	9.0	9.0	lb/inch	1.58	1.58	N/mm	IPC-TM-650.2.4.8
X/Y CTE [-40°C to +125°C]	10 - 14	9 - 13	ppm/°C	10 - 14	9 - 13	ppm/°C	IPC-TM-650.2.4.41
Z Axis Expansion [50°C to 260°C]	3.5	3.5	%	3.5	3.5	%	IPC-TM-650.2.4.41
Young's Modulus (X/Y)	4.2/3.3	TBD	psi x 10 ⁶	28.5/22.4	TBD	GN/m ²	ASTM D3039
Poisson's Ratios (X/Y)	0.13/0.11	TBD		0.13/0.11	TBD		ASTM D3039
Thermal Conductivity	0.350	0.294	W/mK	0.350	0.294	W/mK	ASTM E1461
Specific Heat	1.20	1.30	J/gK	1.20	1.30	J/gK	ASTM E1461
Electrical Properties							
Dielectric Constant (50% resin content)							
@ 1 GHz (RF Impedance)	3.7	3.5		3.7	3.5		IPC-TM-650.2.5.5.9
@ 2.05 GHz (Split Post Cavity)	3.9	-		3.9	-		
@ 10 GHz (Stripline)	3.6	3.2		3.6	3.2		IPC-TM-650.2.5.5.5
@ 10 GHz (Split Post Cavity)	3.7	3.3		3.7	3.3		
Dissipation Factor (50% resin content)							
@ 2.05 GHz (Split Post Cavity)	0.008	-		0.008	-		
@ 10 GHz (Stripline)	0.009-0.011	0.009		0.009 - 0.011	0.009		IPC-TM-650.2.5.5.5
@ 10 GHz (Split Post Cavity)	0.009	0.006		0.009	0.006		
Volume Resistivity							
C - 96/35/90	10 ⁸	10 ⁸	MΩ - cm	10 ⁸	10 ⁸	MΩ - cm	IPC-TM-650.2.5.17.1
E - 24/125	10 ⁷	10 ⁸	MΩ - cm	10 ⁷	10 ⁸	MΩ - cm	IPC-TM-650.2.5.17.1
Surface Resistivity							
C - 96/35/90	10 ⁷	10 ⁷	MΩ	10 ⁷	10 ⁷	MΩ	IPC-TM-650.2.5.17.1
E - 24/125	10 ⁷	10 ⁷	MΩ	10 ⁷	10 ⁷	MΩ	IPC-TM-650.2.5.17.1
Electric Strength	1200	1000	V/mil	4.7x10 ⁴	3.9x10 ⁴	V/mm	IPC-TM-650.2.5.6.2
Dielectric Breakdown	>50	>50	kV	>50	>50	kV	IPC-TM-650.2.5.6
Arc Resistance	123	123	seconds	123	123	seconds	IPC-TM-650.2.5.1
Thermal Properties							
Glass Transition Temperature (T _g)							
DSC (°C)	210	210	°C	210	210	°C	IPC-TM-650.2.4.25c
TMA (°C)	200	200	°C	200	200	°C	IPC-TM-650.2.4.24c
DMA (°C) (Tan δ Peak)	240	240	°C	240	240	°C	IPC-TM-650.2.4.24.3
Degradation Temp (TGA) (5% wt. loss)	350	350	°C	350	350	°C	IPC-TM-650.2.3.40
Pressure Cooker - 2 hour							IPC-TM-650.2.6.16
(10 second solder dip @ 288°C)	Pass	Pass		Pass	Pass		(modified)
T ₂₆₀	30+	30+	minutes	30+	30+	minutes	IPC-TM-650.2.4.24.1
Chemical/Physical Properties							
Moisture Absorption	0.1	0.1	wt. %	0.1	0.1	wt. %	IPC-TM-650.2.6.2c
Methylene Chloride Resistance	0.7	0.7	% wt. chg.	0.7	0.7	% wt. chg.	IPC-TM-650.2.3.4.3
Density [50% resin content]	1.77	1.64	g/cm ³	1.77	1.64	g/cm ³	Internal Method

All test data provided are typical values and not intended to be specification values. For review of critical specification tolerances, please contact a Nelco representative directly. Nelco reserves the right to change these typical values as a natural process of refining our testing equipment and techniques.

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*CAF resistance has been established to greater than 500 hours using a specific OEM coupon design and test procedure. For details on this or other CAF tests, please visit www.parkedelectro.com.

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