Nelco N4000-13 EP™
Nelco N4000-13 EP™ SI®

High-Speed Multifunctional Epoxy Laminate & Prepreg

Nelco N4000-13 EP™ is an enhanced epoxy resin system engineered for today's lead-free requirements where multiple solder reflow at temperatures approaching 260°C are required. N4000-13 EP provides enhanced thermal reliability without compromising the electrical and signal loss properties that have made the Nelco N4000-13 product family the industry standard for demanding high speed / low loss designs. The N4000-13 EP™ SI® is excellent for applications that require optimum signal integrity and precise impedance control, while maintaining high CAF resistance and thermal reliability.*

Key Features

Reliability through multiple lead-free excursions
- Engineered to withstand multiple solder reflows through a traditional SAC reflow profile (260°C)

Tg >210°C, outstanding thermal, electrical and signal loss properties
- Excellent thickness control for tight tolerance impedance applications
- Low Df and Dk allows for low signal distortion and faster signal propogation required by high frequency (1 - 10 GHz) and high reliability applications

CAF* resistant
- The low Z-CTE and improved CAF resistance provide long-term reliability for both RF and digital applications
- Provides excellent CAF resistance even after multiple lead-free assembly exposures

Signal Integrity and Buried Capacitance™ options
- When used, SI glass provides enhanced electrical performance for even the most demanding applications
- Approved ZBC-2000® substrate available for thinner, more reliable assemblies and increased board densities

Proprietary advanced resin technology
- Industry standard material with well documented dielectric constant and loss tangent properties

High-Tg FR-4 processing
- Identical processing to the Nelco N4000-13. similar to traditional high Tg FR-4 materials
- 90 min press at 193°C and 275-350 psi

Available in a variety of constructions
- Vacuum laminated
- Available in a wide variety of constructions, copper weights and glass styles including standard copper, double treat and RTFOIL®.
- Meets UL 94V-0 and IPC-4101/29 specifications
- All Nelco materials are RoHS compliant.

Applications

- 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

Global Availability

Nelco, California	+1.714.879.4293
Nelco, New York	+1.845.567.6200
Neltec, Arizona	+1.480.967.5600
Nelco, Asia Pacific	+65.6861.7117
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Nelco N4000-13 EP™ and N4000-13 EP™ SI®

High-Speed Multifunctional Epoxy Laminate & Prepreg

Mechanical Properties	-13 EP	-13 EP SI	U.S. Units	-13 EP	-13 EP 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 CTE Alpha 1 [50°C to Tg]	65	65	ppm/°C	65	65	ppm/°C	IPC-TM-650.2.4.41
Z Axis CTE Alpha 2 [Tg to 260°C]	275	275	ppm/°C	275	275	ppm/°C	IPC-TM-650.2.4.41
Z Axis Expansion [50°C to 260°C]	3.4	3.4	%	3.4	3.4	%	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	3.4		3.7	3.4		IPC-TM-650.2.5.5.9
@ 2.5 GHz (Split Post Cavity)	3.7	3.2		3.7	3.2		
@ 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)							
@ 2.5 GHz (Split Post Cavity)	0.009	0.008		0.009	0.008		
@ 10 GHz (Stripline)	0.009	0.008		0.009	0.008		IPC-TM-650.2.5.5.5
@ 10 GHz (Split Post Cavity)	0.008	0.007		0.008	0.007		
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)	365	365	°C	365	365	°C	IPC-TM-650.2.4.24.6
Pressure Cooker-60 min then solder dip							IPC-TM-650.2.6.16
@288ºC until failure (max 10 min.)	Pass	Pass		Pass	Pass		(modified)
T_{260}	30+	30+	minutes	30+	30+	minutes	IPC-TM-650.2.4.24.1
T_{288}	10+	10+	minutes	10+	10+	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-650.2.6.2.1
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

Park Electrochemical Corp. is a global advanced materials company which develops and manufactures high-technology digital and RF/microwave printed circuit materials and advanced composite materials. The company operates under the Nelco® and Nelcote™ names.

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.

*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.parkelectro.com.