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[2] and thermal reliability.

Key Features

Lead-Free Assembly Compatible
- Suitable for assemblies with a maximum reflow temperature of 260°C[1]

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 propagation required by high frequency (1 - 10 GHz) and high reliability applications

CAF resistant[2]
- The low Z-CTE and improved CAF resistance[2] 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
- 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.
- Vacuum laminated

[1] Max suitable reflow temperature for N4000-13 EP assemblies is dependent upon design and fabrication details.

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

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Nelco® N4000-13 EP™ / 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	IPC-TM-650.2.4.41
Z Axis CTE Alpha 1 [50°C to Tg]				65	65	ppm / °C	IPC-TM-650.2.4.24
Z Axis CTE Alpha 2 [Tg to 260°C]				275	275	ppm / °C	IPC-TM-650.2.4.24
Z Axis Expansion [50°C to 260°C]	3.4	3.4	%	3.4	3.4	%	IPC-TM-650.2.4.24
Young's Modulus (X / Y)	4.2 / 3.3	2.5 / 2.3	psi x 10^6	28.5 / 22.4	17.2 / 16.5	GN / m^2	ASTM D3039
Poisson's Ratios (X / Y)	0.13 / 0.11	0.18 / 0.17		0.13 / 0.11	0.18 / 0.17		ASTM D3039
Thermal Conductivity				0.350	0.294	W / mK	ASTM E1461
Specific Heat				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	IPC-TM-650.2.5.17.1
E - 24 / 125				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 (Tg)							
DSC (°C)	410	410	°F	210	210	°C	IPC-TM-650.2.4.25c
TMA (°C)	392	392	°F	200	200	°C	IPC-TM-650.2.4.24c
DMA (°C) (Tan d Peak)	464	464	°F	240	240	°C	IPC-TM-650.2.4.24.3
Degradation Temp (TGA) (5% wt. loss)	662	662	°F	350	350	°C	IPC-TM-650.2.4.24.6
Pressure Cooker-60 min then solder dip							IPC-TM-650.2.6.16
@288°C until failure (max 10 min.)	Pass	Pass		Pass	Pass		(modified)
T260	30+	30+	minutes	30+	30+	minutes	IPC-TM-650.2.4.24.1
T288	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]				1.91	1.79	g / cm^3	Internal Method

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1Refer to the N4000-13 Best Practices document and Contract Manufacturing Q&A for PCB processing recommendations. Visit www.parkelectro.com for more information.2CAF resistance has been established to greater than 500 hours using a specific OEM coupon design and test procedure. Visit www.parkelectro.com for more information.

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