



# Nelco® N4000-13

## Nelco® N4000-13 SI®



### High-Speed Multifunctional Epoxy Laminate & Prepreg

*The Nelco® N4000-13 series is an enhanced epoxy resin system engineered to provide both outstanding thermal and high signal speed / low signal loss properties. 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.*

#### Key Features

##### **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**

- The low Z-CTE and proven CAF resistance provide long-term reliability for both RF and digital applications

##### **Signal Integrity Option**

- SI® glass available for low-loss applications and enhanced performance

##### **High-Tg FR-4 processing**

- Processes similar to traditional high Tg FR-4 materials
- 90 min press at 193°C and 275-350 psi

##### **Lead-Free Assembly Compatible**

- Ideally suited for assemblies with a maximum reflow temperature of 245°C<sup>1</sup>
- Nelco N4000-13 has shown acceptable results in reflow conditions up to 260°C<sup>1</sup> depending on the PCB design and manufacturing processing

##### **Available in a variety of constructions**

- Available in a wide variety of constructions, copper weights and glass styles including very low profile copper, standard copper, double treat and RTFOIL®
- Available as a 2 mil core product meeting the specifications of a capacitive laminate
- Meets UL 94V-0 and IPC-4101/29 specifications
- All of Park's electronic 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

# Nelco® 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 CTE Alpha 1 [50°C to Tg]         | 70              | 70              | ppm / °C              | 70                  | 70                  | ppm / °C            | IPC-TM-650.2.4.24   |
| Z Axis CTE Alpha 2 [Tg to 260°C]        | 280             | 280             | ppm / °C              | 280                 | 280                 | ppm / °C            | IPC-TM-650.2.4.24   |
| Z Axis Expansion [50°C to 260°C]        | 3.5             | 3.5             | %                     | 3.5                 | 3.5                 | %                   | IPC-TM-650.2.4.24   |
| Young's Modulus (X / Y)                 | 4.2 / 3.3       | 2.4 / 2.3       | psi x 10 <sup>6</sup> | 28.5 / 22.4         | 16.5 / 15.9         | GN / m <sup>2</sup> | 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                | 0.350               | 0.294               | W / mK              | ASTM E1461          |
| Specific Heat                           | 1.20            | 1.30            | J / gK                | 1.20                | 1.30                | J / gK              | ASTM E1461          |
| <b>Electrical Properties</b>            |                 |                 |                       |                     |                     |                     |                     |
| 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 <sup>8</sup> | 10 <sup>8</sup> | MΩ - cm               | 10 <sup>8</sup>     | 10 <sup>8</sup>     | MΩ - cm             | IPC-TM-650.2.5.17.1 |
| E - 24 / 125                            | 10 <sup>7</sup> | 10 <sup>8</sup> | MΩ - cm               | 10 <sup>7</sup>     | 10 <sup>8</sup>     | MΩ - cm             | IPC-TM-650.2.5.17.1 |
| Surface Resistivity                     |                 |                 |                       |                     |                     |                     |                     |
| C - 96 / 35 / 90                        | 10 <sup>7</sup> | 10 <sup>7</sup> | MΩ                    | 10 <sup>7</sup>     | 10 <sup>7</sup>     | MΩ                  | IPC-TM-650.2.5.17.1 |
| E - 24 / 125                            | 10 <sup>7</sup> | 10 <sup>7</sup> | MΩ                    | 10 <sup>7</sup>     | 10 <sup>7</sup>     | MΩ                  | IPC-TM-650.2.5.17.1 |
| Electric Strength                       | 1200            | 1000            | V / mil               | 4.7x10 <sup>4</sup> | 3.9x10 <sup>4</sup> | 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    |
| <b>Thermal Properties</b>               |                 |                 |                       |                     |                     |                     |                     |
| Glass Transition Temperature (Tg)       |                 |                 |                       |                     |                     |                     |                     |
| 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 d 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-650.2.4.24.6 |
| 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 |
| <b>Chemical / Physical Properties</b>   |                 |                 |                       |                     |                     |                     |                     |
| 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 <sup>3</sup>   | 1.91                | 1.79                | g / cm <sup>3</sup> | 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 company representative directly.

<sup>1</sup>Refer to the [N4000-13 Best Practices](#) document and [Contract Manufacturing Q&A](#) for PCB processing recommendations.

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### For Information about Park's materials:

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