# 51N

## Multifunctional, High Tg Epoxy Low -Flow Prepreg

**51N-LF** is a non-DICY multifunctional epoxy low-flow prepreg system designed to provide high reliability through lead-free solder operations. The high decomposition temperature and high thermal stability of this material is ideal for use in complex rigid-flex fabrication and assembly operations where minimum resin flow is required.

### Features:

- Decomposition temperature > 350°C is ideally suited for lead-free solder processing and offers significant improvement over traditional FR-4 Epoxy systems.
- Multifunctional epoxy resin system with a Glass transition temperature (Tg) of 170°C thermal cycling PTH reliability
- Improved bond adhesion over multiple thermal excursions results in better reliability through reflow and rework operations.
- Best-in-class thermal performance for an epoxy system with T260 > 60 minutes, T280 > 30 minutes and T300 = 15 minutes
- Electrical and mechanical properties meet the requirements of IPC-4101B/124 prepreg, modified to be “Low-Flow”
- Compatible with lead-free solder processing
- RoHS/WEEE compliant

### Typical Applications:

- Bonding multilayer rigid-flex boards
- Finished PCB assemblies requiring excellent thermal stability
- Dielectric insulators
- Other applications where minimal and uniform resin flow is required

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## Typical Properties:

# 51N

| Property | Units | Value | Test Method |
|---|---|---|---|
| **1. Electrical Properties** | | | |
| Dielectric Constant *(may vary with Resin %)* | | | |
| @ 1 MHz | - | 4.2 | IPC TM-650 2.5.5.3 |
| @ 1 GHz | - | 4.1 | IPC TM-650 2.5.5.9 |
| Dissipation Factor | | | |
| @ 1 MHz | - | 0.02 | IPC TM-650 2.5.5.3 |
| @ 1 GHz | - | 0.02 | IPC TM-650 2.5.5.9 |
| Volume Resistivity | | | |
| C96/35/90 | MΩ-cm | $2.6 \times 10^7$ | IPC TM-650 2.5.17.1 |
| E24/125 | MΩ-cm | $3.3 \times 10^7$ | IPC TM-650 2.5.17.1 |
| Surface Resistivity | | | |
| C96/35/90 | MΩ | $2.9 \times 10^7$ | IPC TM-650 2.5.17.1 |
| E24/125 | MΩ | $4.0 \times 10^6$ | IPC TM-650 2.5.17.1 |
| Electrical Strength | Volts/mil (kV/mm) | 1000 (39.4) | IPC TM-650 2.5.6.2 |
| Dielectric Breakdown | kV | | IPC TM-650 2.5.6 |
| Arc Resistance | sec | >120 | IPC TM-650 2.5.1 |
| **2. Thermal Properties** | | | |
| Glass Transition Temperature (Tg) | | | |
| TMA | °C | 166 | IPC TM-650 2.4.24 |
| DSC | °C | 170 | IPC TM-650 2.4.25 |
| Decomposition Temperature (Td) | | | |
| Initial | °C | 354 | IPC TM-650 2.3.41 |
| 5% | °C | 368 | IPC TM-650 2.3.41 |
| T260 | min | >60 | IPC TM-650 2.4.24.1 |
| T288 | min | >30 | IPC TM-650 2.4.24.1 |
| T300 | min | 15 | IPC TM-650 2.4.24.1 |
| CTE (x,y)* | ppm/°C | 13-15 | IPC TM-650 2.4.41 |
| CTE (z)* | | | |
| < Tg | ppm/°C | 44 | IPC TM-650 2.4.24 |
| > Tg | ppm/°C | 245 | IPC TM-650 2.4.24 |
| z-axis Expansion (50-260°C) | % | 2.6 | IPC TM-650 2.4.24 |
| **3. Mechanical Properties** | | | |
| Peel Strength to Copper (1 oz/35 micron) | | | |
| After Thermal Stress | lb/in (N/mm) | 6.7 (1.2) | IPC TM-650 2.4.8 |
| At Elevated Temperatures | lb/in (N/mm) | 6.7 (1.2) | IPC TM-650 2.4.8.2 |
| After Process Solutions | lb/in (N/mm) | 6.4 (1.1) | IPC TM-650 2.4.8 |
| Young's Modulus | Mpsi (GPa) | 2.6 (18) | IPC TM-650 2.4.18.3 |
| Flexural Strength | kpsi (MPa) | 84 (578) | IPC TM-650 2.4.4 |
| Tensile Strength | kpsi (MPa) | 6.5 (45) | IPC TM-650 2.4.18.3 |
| Compressive Modulus | kpsi (MPa) | | ASTM D-695 |
| Poisson's Ratio (x, y) | - | | ASTM D-3039 |
| **4. Physical Properties** | | | |
| Water Absorption | % | 0.15 | IPC TM-650 2.6.2.1 |
| Specific Gravity | $g/cm^3$ | 1.35 | ASTM D792 Method A |
| Thermal Conductivity | W/mK | 0.25 | ASTM E1461 |
| Flammability | class | Meets V0 | UL-94 |

* Based on typical thick laminate construction

*Results listed above are typical properties, provided without warranty, expressed or implied, and without liability. Properties may vary, depending on design and application. Arlon reserves the right to change or update these values.*

## Availability:

| Arlon Part Number | Glass Style | Resin % | Pressed Thickness | Flow Range |
|---|---|---|---|---|
| 51N0672 | 106 | 72 | 0.0022” | 60—120 mils |
| 51N0666 | 106 | 66 | 0.0017” | 60—120 mils |
| 51N8065 | 1080 | 65 | 0.0032” | 60—120 mils |
| 51N8060 | 1080 | 60 | 0.0027” | 60—120 mils |

## Recommended Process Conditions:

Process inner-layers through develop, etch, and strip using standard industry practices. Use brown oxide on inner layers. Adjust dwell time in the oxide bath to ensure uniform coating. Bake inner layers in a rack for 60 minutes at 225°F - 250°F (107°C - 121°C) immediately prior to lay-up. Vacuum desiccate the prepreg for 8 - 12 hours prior to lamination.

Lamination Cycle:

- Pre-vacuum for 30 - 45 minutes
- Control the heat rise to 8°F - 12°F (4.5°C - 6.5°C) per minute between 150°F and 300°F (65°C and 150°C)

| Panel Size | | Pressure | |
|---|---|---|---|
| in | cm | psi | kg/sq cm |
| 12 x 12 | 40 x 40 | 150 | 12 |
| 12 x 18 | 40 x 46 | 200 | 14 |
| 16 x 18 | 30 x 46 | 250 | 18 |
| 18 x 24 | 46 x 61 | 300 | 21 |

- Product temperature at start of cure = 360°F (182°C).
- Cure time at temperature = 90 minutes
- Cool down under pressure at ≤ 10°F/min (6°C/min)

Drill at 350-400 SFM. Undercut bits are recommended for vias 0.023” (0.9cm) and smaller

De-smear using alkaline permanganate or plasma with settings appropriate for multifunctional epoxy systems.

Conventional plating processes are compatible with 51N-LF

Standard profiling parameters may be used; chip breaker style router bits are not recommended

Bake for 1 - 2 hours at 250°F (121°C) prior to solder reflow or HASL

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