



**Glass cloth base epoxy resin  
Flame retardant copper clad laminate**

## NPG-R

### ■ FEATURES

- Halogen, antimony, and red phosphorous free
- Flammability meets UL 94V-0
- Excellent long term reliability
- UV blocking type
- Reactive type flame retardants
- High Tg and lower C.T.E will provide excellent through-hole reliability
- Superior CAF-Resistance (Anti-migration)

### ■ PERFORMANCE LIST

| Characteristics                            |        | Unit              | Condition                   | Typical Values                     | SPEC               | Test Method |
|--------------------------------------------|--------|-------------------|-----------------------------|------------------------------------|--------------------|-------------|
| Volume resistivity                         |        | MΩ-cm             | C-96/35/90                  | $5 \times 10^8 \sim 5 \times 10^9$ | $10^6 \uparrow$    | 2.5.17      |
| Surface resistivity                        |        | MΩ                | C-96/35/90                  | $5 \times 10^6 \sim 5 \times 10^7$ | $10^4 \uparrow$    | 2.5.17      |
| Permittivity 1MHz                          |        | -                 | C-24/23/50                  | 4.6-4.8                            | $5.4 \downarrow$   | 2.5.5.9     |
| Permittivity 1GHz                          |        | -                 | C-24/23/50                  | 4.1-4.3                            | -                  | 2.5.5.9     |
| Loss Tangent 1MHz                          |        | -                 | D-24/23/50                  | 0.014-0.016                        | $0.035 \downarrow$ | 2.5.5.9     |
| Loss Tangent 1GHz                          |        | -                 | D-24/23/50                  | 0.012-0.014                        | -                  | 2.5.5.9     |
| Arc resistance                             |        | SEC               | D-48/50+D-0.5/23            | 120 $\uparrow$                     | 60 $\uparrow$      | 2.5.1       |
| Dielectric breakdown                       |        | KV                | D-48/50                     | 60 $\uparrow$                      | 40 $\uparrow$      | 2.5.6       |
| Moisture absorption                        |        | %                 | D-24/23                     | 0.05-0.10                          | $0.8 \downarrow$   | 2.6.2.1     |
| Flammability                               |        | -                 | C-48/23/50                  | V-0                                | V-0                | UL94        |
| Peel strength 1 oz ( $\geq 0.5\text{mm}$ ) |        | lb/in             | 288°C x 10" solder floating | 7-9                                | 6 $\uparrow$       | 2.4.8       |
| Thermal stress                             |        | SEC               | 288°C solder dipping        | 200 $\uparrow$                     | 10 $\uparrow$      | 2.4.13.1    |
| Pressure cooker<br>(2 atm 120°C)           | 1/2 hr | SEC               | 288°C dipping               | 150 $\uparrow$                     | N/A                | -           |
|                                            | 1 hr   | SEC               | 288°C dipping               | 150 $\uparrow$                     | N/A                | -           |
|                                            | 2 hrs  | SEC               | 288°C dipping               | 150                                | N/A                | -           |
| Flexural strength                          | LW     | N/mm <sup>2</sup> | A                           | 430-500                            | 415 $\uparrow$     | 2.4.4       |
|                                            | CW     | N/mm <sup>2</sup> | A                           | 350-420                            | 345 $\uparrow$     | 2.4.4       |
| Dimensional stability X-Y axis             |        | %                 | E-2/150                     | 0.005-0.030                        | $0.050 \downarrow$ | 2.4.39      |
| Coefficient of thermal expansion           |        |                   |                             |                                    |                    |             |
| X-Y axis                                   |        | ppm/°C            | TMA                         | 9-13                               | N/A                | 2.4.24      |
| Z-axis before Tg                           |        | ppm/°C            | TMA                         | 30-50                              |                    |             |
| Z-axis after Tg                            |        | ppm/°C            | TMA                         | 200-230                            |                    |             |
| Glass transition temp                      |        | °C                | DSC                         | $150 \pm 5$                        | N/A                | 2.4.25      |
| Decomposition temperature<br>(Td 5% W/L)   |        | °C                | TGA                         | 350                                | N/A                | 2.4.24.6    |

**NOTE:**

The average value in the table refers to samples of .062" 1/1.

Test method per IPC-TM-650

Data shown are nominal values for reference only.



**Glass cloth base epoxy resin  
Flame retardant copper clad laminate**

## NPG-TL

### ■ FEATURES

- Halogen, antimony, and red phosphorous free
- Flammability meets UL 94V-0
- Excellent long term reliability
- UV blocking type
- Reactive type flame retardants
- High Tg and lower C.T.E will provide excellent through-hole reliability
- Superior CAF-Resistance (Anti-migration)

### ■ PERFORMANCE LIST

| Characteristics                              | Unit  | Condition                | Typical Values       | SPEC              | Test Method |
|----------------------------------------------|-------|--------------------------|----------------------|-------------------|-------------|
| Volume resistivity                           | MΩ-cm | C-96/35/90               | 5.0 x10 <sup>9</sup> | 10 <sup>6</sup> ↑ | 2.5.17      |
| Surface resistivity                          | MΩ    | C-96/35/90               | 5.0 x10 <sup>7</sup> | 10 <sup>4</sup> ↑ | 2.5.17      |
| Permittivity 1 MHz                           | -     | C-24/23/50               | 4.2-4.4              | 5.4 ↓             | 2.5.5.9     |
| Permittivity 1 GHz                           | -     | C-24/23/50               | 3.8-4.0              | -                 | 2.5.5.9     |
| Loss Tangent 1 MHz                           | -     | C-24/23/50               | 0.014-0.016          | 0.035 ↓           | 2.5.5.9     |
| Loss Tangent 1 GHz                           | -     | C-24/23/50               | 0.012-0.014          | -                 | 2.5.5.9     |
| Arc resistance                               | SEC   | D-48/50+D-0.5/23         | 120 ↑                | 60 ↑              | 2.5.1       |
| Dielectric breakdown                         | KV    | D-48/50                  | 60 ↑                 | 40 ↑              | 2.5.6       |
| Moisture absorption                          | %     | D-24/23                  | 0.20-0.30            | 0.8 ↓             | 2.6.2.1     |
| Flammability                                 | -     | C-48/23/50               | V-0                  | V-0               | UL94        |
| Peel strength 1 oz (≥0.5mm)                  | lb/in | 288℃x10” solder floating | 7-9                  | 6 ↑               | 2.4.8       |
| Thermal stress                               | SEC   | 288℃ solder dipping      | 200 ↑                | 10 ↑              | 2.4.13.1    |
| Glass transition temp                        | ℃     | DSC                      | 150 ± 5              | N/A               | 2.4.25      |
| Dimensional stability X-Y axis               | %     | E-4/105                  | 0.01-0.03            | 0.05 ↓            | 2.4.39      |
| Coefficient of thermal expansion<br>X-Y axis | ppm/℃ | TMA                      | 9-13                 | N/A               | 2.4.24      |
| Z-axis before Tg                             | ppm/℃ | TMA                      | 30-50                |                   |             |
| Z-axis after Tg                              | ppm/℃ | TMA                      | 200-230              |                   |             |
| Decomposition temperature<br>(Td 5% W/L)     | ℃     | TGA                      | 350                  | N/A               | 2.4.24.6    |

Data shown are nominal values for reference only.

**NOTE:**

The average value in the table refers to samples of .020" 1/1.

Test method per IPC-TM-650



## ■ CONSTRUCTION

| THICKNESS<br>mm      mil | CONSTRUCTION      | THICKNESS<br>mm      mil | CONSTRUCTION      |
|--------------------------|-------------------|--------------------------|-------------------|
| 0.05      2              | 106      1 ply    | 0.35      14             | 7628      2 plies |
| 0.08      3              | 2112      1 ply   | 0.38      15             | 7628      2 plies |
| 0.10      4              | 1080      2 plies | 0.45      18             | 7628x2+1080x1     |
| 0.11      4              | 2116      1 ply   | 0.50      20             | 7628      3 plies |
| 0.13      5              | 1080      2 plies | 0.53      21             | 7628      3 plies |
| 0.13 sp      5           | 2116      1 ply   | 0.60      24             | 7628      3 plies |
| 0.15      6              | 1506      1 ply   | 0.77      30             | 7628      4 plies |
| 0.21      8              | 7628      1 ply   | 0.8      31.5            | 7628      4 plies |
| 0.26      10             | 2116      2 plies | 0.9      36              | 7628      5 plies |
| 0.30      12             | 2116      3 plies | 1.0      39              | 7628      5 plies |
| 0.30 sp      12          | 1506      2 plies | 1.2      47              | 7628      6 plies |

• 1.2, 1.1, 1.0, 0.9, 0.8, 0.77 mm THICKNESS INCLUDE CLADDING, ALL OTHERS EXCLUDE CLADDING

## ■ PRODUCT SIZE & THICKNESS

| THICKNESS<br>inch (mm)            | COPPER CLADDING<br>oz (μm)                  | SIZE<br>inch      mm                                                                         | THICKNESS TOLERANCE         |
|-----------------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------|-----------------------------|
| 0.002 (0.05)<br>to<br>0.047 (1.2) | H (17)<br>2.0 (70)<br>1.0 (35)<br>3.0 (102) | 48.8 x 36.6      1240 x 0930<br>48.8 x 40.5      1240 x 1030<br>48.8 x 42.5      1240 x 1080 | IPC-4101E SPEC<br>CLASS C/M |

■ Keeping the core and prepreg in the same grain direction is crucial to ensure the flatness of multilayer boards.

■ Grain direction is shown on the certificate of conformance.



**Glass cloth base epoxy resin  
Flame retardant prepreg**

## NPG-B

### ■ FEATURES

- Halogen, antimony, and red phosphorous free
- Rheology of resin controlled to benefit the lamination of the boards.
- Modified phosphorous epoxy provides excellent heat and chemical resistance.
- Higher Tg: 150±5°C
- Other properties are similar to standard FR-4

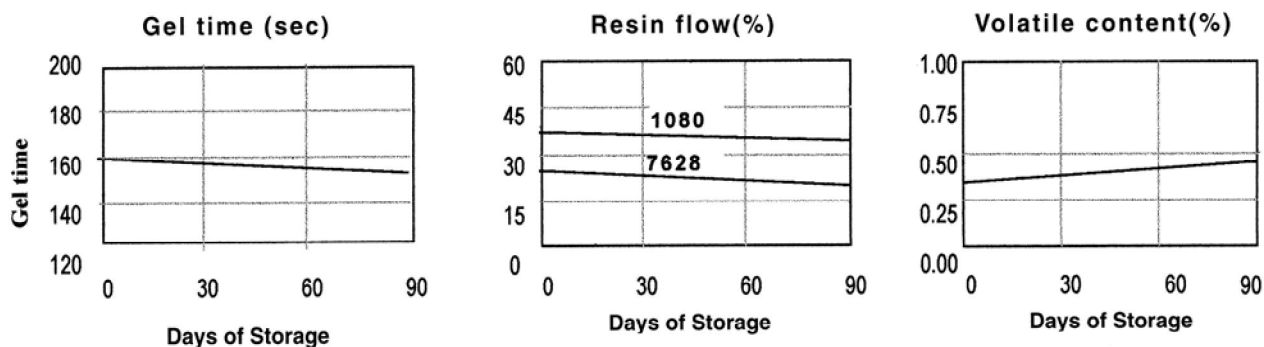
### ■ PERFORMANCE LIST

Specification: IPC-4101E is applicable

| Glass style | RC%    | GT sec<br>(171°C) | VC%    | After Pressed Thickness (per ply) |           |
|-------------|--------|-------------------|--------|-----------------------------------|-----------|
|             |        |                   |        | mm                                | mil       |
| 7628HR      | 50 ± 3 | 160 ± 20          | 0.75 ↓ | 0.193 ± 0.01                      | 7.6 ± 0.4 |
| 7628MR      | 47 ± 3 |                   |        | 0.183 ± 0.01                      | 7.2 ± 0.4 |
| 7628        | 43 ± 3 |                   |        | 0.173 ± 0.01                      | 6.8 ± 0.4 |
| 1506MR      | 52 ± 3 |                   |        | 0.157 ± 0.01                      | 6.2 ± 0.4 |
| 1506        | 48 ± 3 |                   |        | 0.145 ± 0.01                      | 5.7 ± 0.4 |
| 2116HR      | 58 ± 3 |                   |        | 0.120 ± 0.01                      | 4.7 ± 0.4 |
| 2116MR      | 54 ± 3 |                   |        | 0.109 ± 0.01                      | 4.3 ± 0.4 |
| 2116        | 50 ± 3 |                   |        | 0.097 ± 0.01                      | 3.8 ± 0.4 |
| 2113        | 56 ± 3 |                   |        | 0.081 ± 0.01                      | 3.2 ± 0.4 |
| 2112        | 60 ± 3 |                   |        | 0.069 ± 0.008                     | 2.7 ± 0.3 |
| 1080HR      | 68 ± 3 |                   |        | 0.064 ± 0.008                     | 2.5 ± 0.3 |
| 1080MR      | 65 ± 3 |                   |        | 0.061 ± 0.008                     | 2.4 ± 0.3 |
| 1080        | 62 ± 3 |                   |        | 0.058 ± 0.008                     | 2.3 ± 0.3 |
| 106         | 68 ± 3 |                   |        | 0.046 ± 0.008                     | 1.8 ± 0.3 |
| * 1086      | 62 ± 3 |                   |        | 0.066 ± 0.008                     | 2.6 ± 0.3 |
| * 1067      | 68 ± 3 |                   |        | 0.049 ± 0.008                     | 1.9 ± 0.3 |
| * 1078      | 62 ± 3 |                   |        | 0.058 ± 0.008                     | 2.3 ± 0.3 |

\*Laser drillable prepreg

### Storage Stability



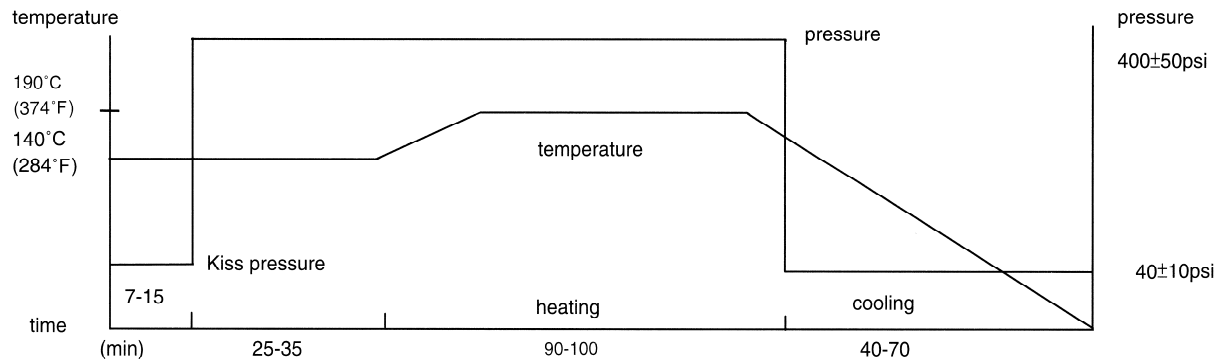
Storage Condition : 20°C 50% RH for 3 months  
: Max. 5°C for 6 months

Data shown are nominal values for reference only.

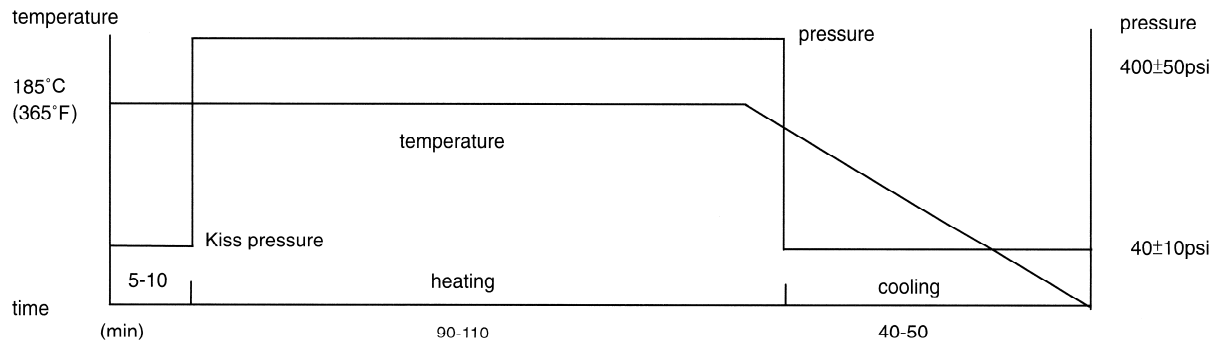


## Recommended press cycles:

### A:2T2P(2 temperature step/2 pressure step)



### B:1T2P(1 temperature step/2 pressure step)



## Suggestions:

1. Heating rate of material between 70°C (158°F) and 140°C (284°F).  
1-3°C/min (1.8~5.4°F/min) is acceptable.  
1.5-2.5°C/min (2.7~4.5°F/min) would be better.
2. Temperature of material over 170°C (338°F) must be held for at least 60 min to allow resin to fully cure.
3. The pressure should be kept below 100psi during cooling to ambient temperature.
4. Cooling rate of material should be kept under 2.5°C/min (4.5°F/min) when the temperature of material is over 100°C (212°F), in order to avoid introducing twist.

## CERTIFICATION UL

- UL File No.: E98983
- ANSI TYPE: FR-4.1
- UL 746 Recognition

| Minimum<br>Material<br>Thickness<br>inch<br>(mm) | Clad cond.<br>Thickness<br>Min. Max.<br>mils mils<br>(μm) (μm) |               | Max.<br>Area<br>Diameter<br>inch<br>(mm) | Max.<br>Operating<br>Temp | Solder Lts<br>Temp Time<br>°C sec | UL 94<br>Flame<br>Class |
|--------------------------------------------------|----------------------------------------------------------------|---------------|------------------------------------------|---------------------------|-----------------------------------|-------------------------|
| 0.0016<br>(0.04)                                 | 0.59<br>(15)                                                   | 4.02<br>(102) | 2.0<br>(50.8)                            | 130                       | 288 30                            | 94V-0                   |