



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

**NP-155FR**

**FEATURES**

- Dicy-Free
- Lead free Compatible
- Excellent dimensional stability and through-hole reliability
- Superior CAF-Resistance (Anti-migration)
- High luminance of multi-functional epoxy contrast with copper for A.O.I
- IPC-4101E L99/101

**PERFORMANCE LIST**

| Characteristics   | Unit   | Condition                 | Typical Values                          | SPEC              | Test Method |       |
|---|--------|---------------------------|---|-------------------|-------------|-------|
| Volume resistivity  | MΩ-cm  | C-96/35/90                | 5 x10 <sup>9</sup> ~ 5x10 <sup>10</sup> | 10 <sup>6</sup> ↑ | 2.5.17      |       |
| Surface resistivity   | MΩ     | C-96/35/90                | 5 x10 <sup>8</sup> ~ 5x10 <sup>9</sup>  | 10 <sup>4</sup> ↑ | 2.5.17      |       |
| Permittivity 1MHz   | -      | C-24/23/50                | 4.6-4.8                                 | 5.4 ↓             | 2.5.5.9     |       |
| Permittivity 1GHz   | -      | C-24/23/50                | 4.2-4.4                                 | -                 | 2.5.5.9     |       |
| Loss Tangent 1MHz   | -      | C-24/23/50                | 0.016-0.020                             | 0.035 ↓           | 2.5.5.9     |       |
| Loss Tangent 1GHz   | -      | C-24/23/50                | 0.014-0.016                             | -                 | 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                   | 0.05-0.10                               | 0.5 ↓             | 2.6.2.1     |       |
| Flammability  | -      | C-48/23/50                | V-0                                     | V-0               | UL94        |       |
| Peel strength 1 oz (≥0.5mm)   | lb/in  | 288°Cx10" solder floating | 8-10                                    | 6 ↑               | 2.4.8       |       |
| Thermal stress  | SEC    | 288°C solder dipping      | 600 ↑                                   | 10 ↑              | 2.4.13.1    |       |
| Pressure cooker<br>(2 atm 120°C)  | 1/2 hr | SEC                       | 288°C dipping                           | 600 ↑             | N/A         | -     |
|   | 1 hr   | SEC                       | 288°C dipping                           | 600 ↑             | N/A         | -     |
|   | 2 hrs  | SEC                       | 288°C dipping                           | 600 ↑             | N/A         | -     |
| Flexural strength   | LW     | N/mm <sup>2</sup>         | A                                       | 480-550           | 415 ↑       | 2.4.4 |
|   | CW     | N/mm <sup>2</sup>         | A                                       | 415-480           | 345 ↑       | 2.4.4 |
| Dimensional stability X-Y axis  | %      | E-2/150                   | 0.005-0.030                             | 0.050 ↓           | 2.4.39      |       |
| Coefficient of thermal expansion<br>X/Y-axis<br>Z-axis before Tg<br>Z-axis after Tg<br>50-260°C | ppm/°C | TMA                       | 12-17                                   | N/A               | 2.4.24      |       |
|   | ppm/°C | TMA                       | 40-60                                   | 60 ↓              |             |       |
|   | ppm/°C | TMA                       | 250-270                                 | 300 ↓             |             |       |
|   | %      | TMA                       | 3.5%                                    | 3.5% ↓            |             |       |
| Glass transition temperature  | °C     | DSC                       | 155 ± 5                                 | 150 ↑             | 2.4.25      |       |
| T260  | min    | TMA                       | >60                                     | 30 ↑              | 2.4.24.1    |       |
| T288  | min    | TMA                       | >20                                     | 5 ↑               | 2.4.24.1    |       |
| Decomposition temperature<br>(Td 5% W/L)  | °C     | TGA                       | 350                                     | 325 ↑             | 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**

# NP-155FTL

**■ FEATURES**

- Dicy-Free
- Lead-Free Compatible
- Excellent dimensional stability and through-hole reliability
- Superior CAF-Resistance (Anti-migration)
- High luminance of multi-functional epoxy contrast with copper for A.O.I
- IPC-4101E L99/101

**■ 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>8</sup> | 10 <sup>4</sup> ↑ | 2.5.17      |
| Permittivity 1 MHz                    | -      | C-24/23/50                | 4.4-4.6              | 5.4 ↓             | 2.5.5.9     |
| Permittivity 1 GHz                    | -      | C-24/23/50                | 3.9-4.1              | -                 | 2.5.5.9     |
| Loss Tangent 1 MHz                    | -      | C-24/23/50                | 0.016-0.020          | 0.035 ↓           | 2.5.5.9     |
| Loss Tangent 1GMHz                    | -      | 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            | 0.5 ↓             | 2.6.2.1     |
| Flammability                          | -      | C-48/23/50                | V-0                  | V-0               | UL94        |
| Peel strength 1 oz (≥0.5mm)           | lb/in  | 288°Cx10" solder floating | 8-10                 | 6 ↑               | 2.4.8       |
| Thermal stress                        | SEC    | 288°C solder dipping      | 600 ↑                | 10 ↑              | 2.4.13.1    |
| Glass transition temperature          | °C     | DSC                       | 155 ± 5              | 150 ↑             | 2.4.25      |
| Dimensional stability X-Y axis        | %      | E-4/105                   | 0.01-0.03            | 0.05 ↓            | 2.4.39      |
| Coefficient of thermal expansion      |        |                           |                      |                   |             |
| X/Y-axis                              | ppm/°C | TMA                       | 12-17                | N/A               | 2.4.24      |
| Z-axis before Tg                      | ppm/°C | TMA                       | 40-60                | 60 ↓              |             |
| Z-axis after Tg                       | ppm/°C | TMA                       | 250-270              | 300 ↓             |             |
| 50-260°C                              | %      | TMA                       | 3.5%                 | 3.5% ↓            |             |
| T260                                  | min    | TMA                       | >60                  | 30 ↑              | 2.4.24.1    |
| T288                                  | min    | TMA                       | >20                  | 5 ↑               | 2.4.24.1    |
| Decomposition temperature (Td 5% W/L) | °C     | TGA                       | 350                  | 325 ↑             | 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 |     | CONSTRUCTION | THICKNESS |      | CONSTRUCTION  |
|-----------|-----|--------------|-----------|------|---------------|
| mm        | mil |              | mm        | mil  |               |
| 0.05      | 2   | 106 1 ply    | 0.38      | 15   | 7628 2 plies  |
| 0.08      | 3   | 2112 1 ply   | 0.45      | 18   | 7628x2+1080x1 |
| 0.10      | 4   | 1080 2 plies | 0.50      | 20   | 7628 3 plies  |
| 0.11      | 4   | 2116 1 ply   | 0.53      | 21   | 7628 3 plies  |
| 0.13      | 5   | 1080 2 plies | 0.60      | 24   | 7628 3 plies  |
| 0.13 sp   | 5   | 2116 1 ply   | 0.77      | 30   | 7628 4 plies  |
| 0.15      | 6   | 1506 1 ply   | 0.8       | 31.5 | 7628 4 plies  |
| 0.21      | 8   | 7628 1 ply   | 0.9       | 36   | 7628 5 plies  |
| 0.26      | 10  | 2116 2 plies | 1.0       | 39   | 7628 5 plies  |
| 0.30      | 12  | 2116 3 plies | 1.1       | 43   | 7628 6 plies  |
| 0.30 sp   | 12  | 1506 2 plies | 1.2       | 47   | 7628 6 plies  |
| 0.35      | 14  | 7628 2 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                         | COPPER CLADDING    | SIZE        |             | THICKNESS TOLERANCE         |
|-----------------------------------|--------------------|-------------|-------------|-----------------------------|
|                                   |                    | inch        | mm          |                             |
| 0.002 (0.05)<br>to<br>0.047 (1.2) | Q (9) 3.0 (102)    | 48.8 x 36.6 | 1240 x 0930 | IPC-4101E SPEC<br>CLASS C/M |
|                                   | T (12) 4.0 (140)   |             |             |                             |
|                                   | H (17) 5.0 (175)   |             |             |                             |
|                                   | 1.0 (35) 6.0 (210) |             |             |                             |
|                                   | 2.0 (70)           |             |             |                             |

- 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.
- We recommend to evaluate the drilling property.
- Different oxide treatment may result in variations in the heat resistance properties of the laminates after processing. Pre-production batch runs are recommended to ensure compatibility of materials with chemicals.



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

# NP-155FB

**■ FEATURES**

- Dicy-Free
- Lead-Free compatible
- Rheology of resin controlled to benefit the lamination of the boards.
- Multi-functional epoxy provides outstanding heat resistance, better dimensional stability, and through-hole reliability.
- Superior CAF-Resistance (Anti-migration)
- We recommend to evaluate the drilling property.
- Different oxide treatment may result in variations in the heat resistance properties of the laminates after processing.  
 Pre-production batch runs are recommended to ensure compatibility of materials with chemicals.

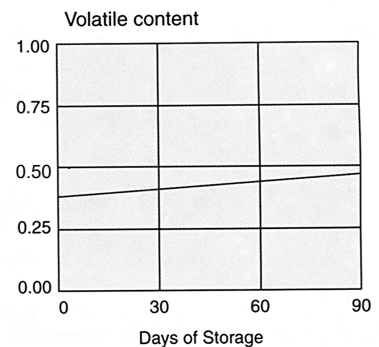
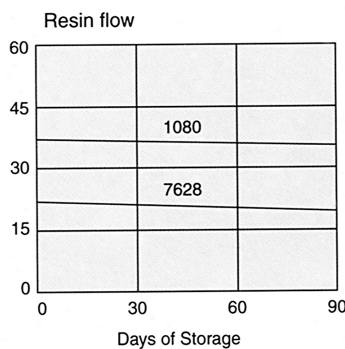
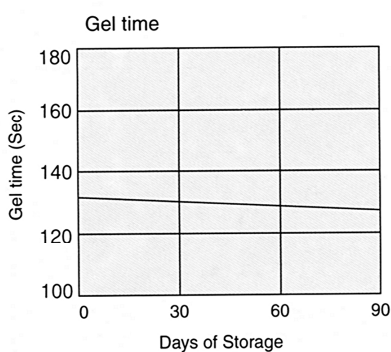
**■ PERFORMANCE LIST**

Specification: IPC-4101E is applicable

Data shown are nominal values for reference only. (Remained Copper 70-80%)

| Glass style | RC%    | GT sec<br>(171°C) | VC%   | After Pressed Thickness (per ply) |           |
|-------------|--------|-------------------|-------|-----------------------------------|-----------|
|             |        |                   |       | mm                                | mil       |
| 7628HR      | 52 ± 3 | 130 ± 20          | 1.5 ↓ | 0.199 ± 0.01                      | 7.8 ± 0.4 |
| 7628MR      | 49 ± 3 |                   |       | 0.191 ± 0.01                      | 7.5 ± 0.4 |
| 7628        | 45 ± 3 |                   |       | 0.181 ± 0.01                      | 7.1 ± 0.4 |
| 1506MR      | 54 ± 3 |                   |       | 0.160 ± 0.01                      | 6.3 ± 0.4 |
| 1506        | 50 ± 3 |                   |       | 0.150 ± 0.01                      | 6.0 ± 0.4 |
| 2116HR      | 60 ± 3 |                   |       | 0.132 ± 0.01                      | 5.2 ± 0.4 |
| 2116MR      | 56 ± 3 |                   |       | 0.118 ± 0.01                      | 4.6 ± 0.4 |
| 2116        | 52 ± 3 |                   |       | 0.105 ± 0.01                      | 4.1 ± 0.4 |
| 2113        | 58 ± 3 |                   |       | 0.090 ± 0.01                      | 3.5 ± 0.4 |
| 2112        | 62 ± 3 |                   |       | 0.079 ± 0.008                     | 3.1 ± 0.3 |
| 1080HR      | 70 ± 3 |                   |       | 0.076 ± 0.008                     | 3.0 ± 0.3 |
| 1080MR      | 67 ± 3 |                   |       | 0.071 ± 0.008                     | 2.8 ± 0.3 |
| 1080        | 64 ± 3 |                   |       | 0.064 ± 0.008                     | 2.5 ± 0.3 |
| 106         | 70 ± 3 |                   |       | 0.048 ± 0.008                     | 1.9 ± 0.3 |

**Storage Stability**

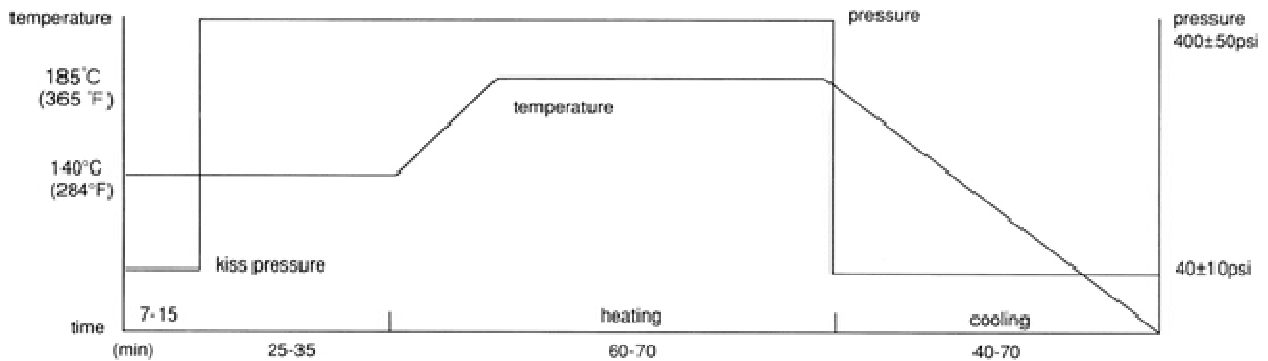


Storage Condition: 20°C, 50% RH for 3 months  
 : Max. 5°C for 6 months

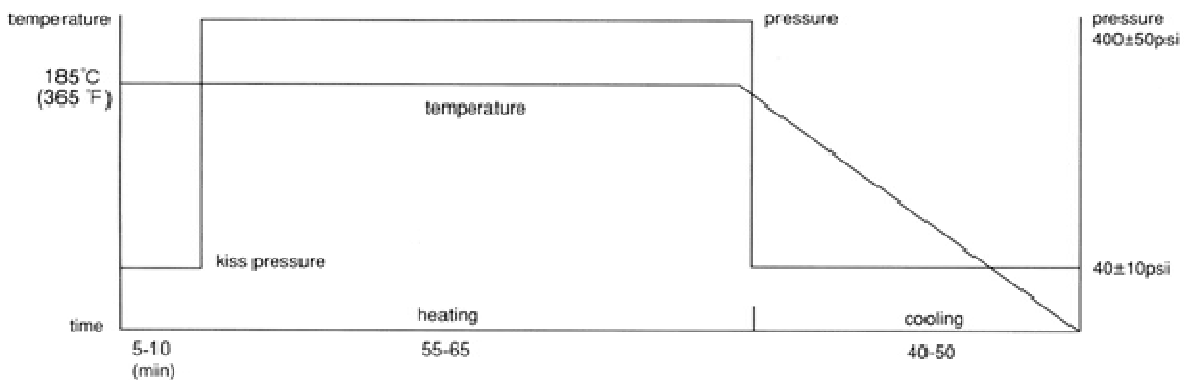


**Recommended press cycles:**

**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 and 140°C  
 1-3°C/min is acceptable.  
 1.5-2.5°C/min would be better.
2. Temperature of material over 170°C must be held for at least 60min. to allow epoxy 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 when the temperature of material is over 100°C, in order to avoid introducing twist.

**■ CERTIFICATION UL**

- UL File No.: E98983
- ANSI TYPE: FR-4.0
- UL 746 Recognition

| Minimum Material Thickness<br>inch<br>(mm) | Clad cond. Thickness<br>Min. Max.<br>mils mils<br>(µm) (µm) |               | Max. Area Diameter<br>inch<br>(mm) | Solder Lts<br>Temp Time<br>°C sec |    | UL 94 Flame Class | Max. Operating Temp |
|--|---|---------------|------------------------------------|-----------------------------------|----|-------------------|---------------------|
|  |   |               |                                    |                                   |    |                   |                     |
| 0.002<br>(0.05)                            | 0.36<br>(9)   | 8.40<br>(210) | 2.0<br>(50.8)                      | 300                               | 30 | 94V-0             | 130                 |