High Reliability, High Heat Resistance
Glass Epoxy Laminate & Prepreg
for High Count Layer PCB

MCL-E-679F(J) (Copper Clad Laminate)
GEA-679F(J) (Prepreg)
<Features>
◆ High Tg (170-175deg.C by TMA method)
◆ High Heat resistance (288deg.C/20s Dip after PCT-5hr OK)
◆ Suitable for the Lead-free process
   (260deg.C reflow ;8 cycle OK)
◆ Lower coefficient of thermal expansion
◆ Better IVH filling property
◆ High Reliability (Superior CAF restraining property)

<Application>
◆ High count layer PCB
◆ Automotive application
### Table 1; Laminate Line-up

<table>
<thead>
<tr>
<th>Core Thickness</th>
<th>Actual Thickness</th>
<th>Glass-cloth</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0.07</td>
<td>0.07+/-0.03mm</td>
<td>#1078</td>
</tr>
<tr>
<td>0.07</td>
<td>0.07+/-0.03mm</td>
<td>#1080</td>
</tr>
<tr>
<td>0.075</td>
<td>0.08+/-0.03mm</td>
<td>#1080</td>
</tr>
<tr>
<td>0.10</td>
<td>0.10+/-0.03mm</td>
<td>#2116</td>
</tr>
<tr>
<td>0.11</td>
<td>0.11+/-0.03mm</td>
<td>#1080 x 2</td>
</tr>
<tr>
<td>Y0.11</td>
<td>0.11+/-0.03mm</td>
<td>#106 x 2</td>
</tr>
<tr>
<td>0.13</td>
<td>0.13+/-0.03mm</td>
<td>#2116</td>
</tr>
<tr>
<td>0.15</td>
<td>0.15+/-0.03mm</td>
<td>#1501</td>
</tr>
<tr>
<td>0.20</td>
<td>0.20+/-0.04mm</td>
<td>#2116 x 2</td>
</tr>
<tr>
<td>V0.20</td>
<td>0.19+/-0.04mm</td>
<td>#7629</td>
</tr>
<tr>
<td>0.30</td>
<td>0.31+/-0.06mm</td>
<td>#1501 x 2</td>
</tr>
<tr>
<td>0.40</td>
<td>0.39+/-0.07mm</td>
<td>#2116 x 2 + #7629</td>
</tr>
<tr>
<td>V0.40</td>
<td>0.39+/-0.07mm</td>
<td>#7629 x 2</td>
</tr>
<tr>
<td>0.50</td>
<td>0.50+/-0.08mm</td>
<td>#1501 x 2 + #7629</td>
</tr>
<tr>
<td>0.60</td>
<td>0.58+/-0.09mm</td>
<td>#2116 x 2 + #7629 x 2</td>
</tr>
<tr>
<td>V0.60</td>
<td>0.58+/-0.09mm</td>
<td>#7629 x 3</td>
</tr>
<tr>
<td>0.70</td>
<td>0.70+/-0.10mm</td>
<td>#1501 x 2 + #7629 x 2</td>
</tr>
<tr>
<td>0.80</td>
<td>0.77+/-0.10mm</td>
<td>#7629 x 4</td>
</tr>
<tr>
<td>1.00</td>
<td>0.96+/-0.10mm</td>
<td>#7629 x 5</td>
</tr>
<tr>
<td>1.20</td>
<td>1.15+/-0.13mm</td>
<td>#7629 x 6</td>
</tr>
<tr>
<td>1.60</td>
<td>1.53+/-0.15mm</td>
<td>#7629 x 8</td>
</tr>
</tbody>
</table>

### Table 2; Prepreg Line-up

<table>
<thead>
<tr>
<th>Type name</th>
<th>Cured Thickness*</th>
<th>Cloth-style</th>
<th>R.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>JORE</td>
<td>0.054mm</td>
<td>#106</td>
<td>73.5+/-2%</td>
</tr>
<tr>
<td>JUME</td>
<td>0.075mm</td>
<td>#1080</td>
<td>65+/-2%</td>
</tr>
<tr>
<td>JUNE</td>
<td>0.083mm</td>
<td>#1080</td>
<td>68+/-2%</td>
</tr>
<tr>
<td>JGKE</td>
<td>0.108mm</td>
<td>#3313</td>
<td>59+/-2%</td>
</tr>
<tr>
<td>JSJE</td>
<td>0.120mm</td>
<td>#2116</td>
<td>55+/-2%</td>
</tr>
<tr>
<td>JSKE</td>
<td>0.140mm</td>
<td>#2116</td>
<td>60+/-2%</td>
</tr>
<tr>
<td>JQEE</td>
<td>0.165mm</td>
<td>#1501</td>
<td>49+/-2%</td>
</tr>
<tr>
<td>JPDE</td>
<td>0.192mm</td>
<td>#7629</td>
<td>45+/-2%</td>
</tr>
</tbody>
</table>

The dielectric thickness after lamination (Cured thickness) is defined as the thickness of one sheet of prepreg when the resin flow is within 5%. This value changes according to the press condition and inner-layer pattern.
1. Material Properties
### General Properties

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>E-679F(J) New Product</th>
<th>E-679(W) High Tg FR-4</th>
<th>E-679F High Elastic FR-4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Shimodate made</td>
<td>Hong Kong made</td>
<td></td>
</tr>
<tr>
<td>Tg (TMA method)</td>
<td>ºC</td>
<td>170 - 175</td>
<td>170 - 175</td>
<td>173 - 183</td>
</tr>
<tr>
<td>CTE X (&lt;Tg )</td>
<td>ppm/C</td>
<td>12 - 15</td>
<td>12 - 15</td>
<td>12 - 15</td>
</tr>
<tr>
<td>CTE Y (&lt;Tg )</td>
<td>ppm/C</td>
<td>14 - 17</td>
<td>14 - 17</td>
<td>14 - 17</td>
</tr>
<tr>
<td>CTE Z (&lt;Tg )</td>
<td>ppm/C</td>
<td>35 - 45</td>
<td>35 - 45</td>
<td>50 - 60</td>
</tr>
<tr>
<td>CTE Z (&lt;Tg )</td>
<td>ppm/C</td>
<td>180 - 240</td>
<td>180 - 240</td>
<td>200 - 300</td>
</tr>
<tr>
<td>Solder Heat Resistance (288 ºC, 20s/Dip)</td>
<td></td>
<td>&gt;PCT 5Hr OK</td>
<td>&gt;PCT 5Hr OK</td>
<td>&gt;PCT 1Hr OK</td>
</tr>
<tr>
<td>260 ºC Reflow Heat Cycle Test cycle</td>
<td>cycle</td>
<td>&gt;8</td>
<td>&gt;8</td>
<td>&gt;8</td>
</tr>
<tr>
<td>Solder Heat Cycle Test (288ºC, 10s/Float)</td>
<td>cycle</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>7</td>
</tr>
<tr>
<td>T288 min.</td>
<td></td>
<td>&gt;20</td>
<td>&gt;20</td>
<td>&gt;20</td>
</tr>
<tr>
<td>Decomposition temperature (5% weight loss temp.)</td>
<td>ºC</td>
<td>340 - 360</td>
<td>340 - 360</td>
<td>340 - 360</td>
</tr>
<tr>
<td>Copper Peel Strength (18um)</td>
<td>kN/m</td>
<td>1.1 - 1.4</td>
<td>1.0 - 1.2 (MP)</td>
<td>1.2 - 1.4</td>
</tr>
<tr>
<td>Dk (1GHz) measured by</td>
<td></td>
<td>4.2 - 4.4</td>
<td>4.2 - 4.4</td>
<td>4.2 - 4.3</td>
</tr>
<tr>
<td>Df (1GHz) Triplate-line Resonator</td>
<td></td>
<td>0.017 - 0.019</td>
<td>0.017 - 0.019</td>
<td>0.021 - 0.022</td>
</tr>
<tr>
<td>Dk (1GHz) measured by</td>
<td></td>
<td>4.3 - 4.5</td>
<td>4.3 - 4.5</td>
<td>4.3 - 4.5</td>
</tr>
<tr>
<td>Df (1GHz) Material Analyzer</td>
<td></td>
<td>0.014 - 0.016</td>
<td>0.014 - 0.016</td>
<td>0.019 - 0.021</td>
</tr>
<tr>
<td>TCT (-55ºC, 0.5Hr / 150ºC, 0.5H) cycle</td>
<td></td>
<td>&gt;2000</td>
<td>&gt;2000</td>
<td>&gt;500</td>
</tr>
<tr>
<td>CAF Restraining Property *) (85ºC, 85%RH, DC100V)</td>
<td>Hr</td>
<td>&gt;2500</td>
<td>&gt;2500</td>
<td>&gt;1400</td>
</tr>
<tr>
<td>Inner Layer Copper Peel Strength (35um) (Oxide-reduction treatment)</td>
<td>kN/m</td>
<td>0.7 - 0.8</td>
<td>0.7 - 0.8</td>
<td>0.7 - 0.8</td>
</tr>
<tr>
<td>IVH Filling Property (t1.6mm / #7629prepreg x 2ply / t1.6mm)</td>
<td>-</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
</tbody>
</table>

*) Pretreatment; JEDEC L3 + 260ºC reflow 3times
How does CAF occur?

**Deposition of Copper Ion**
- Cathode side
- \[ \text{H}_2\text{O} + \text{e}^- \rightarrow \frac{1}{2}\text{H}_2 + \text{OH}^- \]
- \[ \text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu} \]

**Elution of Copper Ion**
- Anode side
- \[ \text{H}_2\text{O} \rightarrow \frac{1}{2}\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \]
- \[ \text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^- \]

**Migration of Copper Ion**
(H\text{2O} becomes a conductor.)

Cl\text{−}, Na\text{+}, OH\text{−}, NO_3\text{−} etc.: Glass fabric / Resin
(Ion impurities promote the migration of copper ion.)

Using high purity glass fabric (include coupling agent) and resin system
Material Technology – CAF Restraining

Technology for the CAF Defect prevention

Glass Fiber

Using Original Addition

Soluble of Copper Ion
Suppression of Copper Ion Dissolution
(SCID)

Migration of Copper Ion
Suppression of Copper Ion Migration
(SCIM)

CAF

The anode(+) The cathode(-)

Using Original Resin System
Filler Interphase Control System (FICS)

- Low CTE
- High modulus
- Low water absorption

Conventional (no surface control)

- Increase water absorption
- Decline of the electric insulation & CAF restraining property
1. Material Properties

CAF Restraining Property

Sample construction

Test condition
a) Laminate: t0.81mm 12/12 (#2116 x 8ply )
b) T/H wall distance: 0.3mm
c) Drill diameter: 0.4mm
d) Condition: 85°C, 85%RH, DC100V

Pretreatment: JEDEC L3(C-168/30/60) + 260°C reflow 3 times
1. Material Properties

Very Narrow Pitch CAF Restraining Property

Sample construction

- a) Laminate: t0.21mm (core and prepreg: #1080 x 1ply)
- b) T/H wall distance: 0.05mm
- c) Drill diameter: 0.1mm
- d) Condition: 110°C, 85%RH, DC6V

Test condition (HAST)

- E-679(W)
- E-679F(J)
- FR-4

Pretreatment; JEDEC L3(C-168/30/60) + 260°C reflow 3 times

Graph:
- Insulation Resistance (ohm)
- Treating time (Hr)
Thermal Expansion

Test method (z-direction): TMA 10 °C/min (t0.8mm)

Room Temp.

High Temp.

<table>
<thead>
<tr>
<th>Material</th>
<th>Expansion (um)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-4</td>
<td></td>
</tr>
<tr>
<td>High Tg FR-4</td>
<td></td>
</tr>
<tr>
<td>MCL-E-679F(J)</td>
<td></td>
</tr>
<tr>
<td>MCL-E-679F</td>
<td></td>
</tr>
</tbody>
</table>

Temperature (°C) vs. Expansion (um)
1. Material Properties

Sample construction

Test condition

- Laminate: t0.81mm 12/12 (#2116 x 8ply)
- Drill diameter: 0.4mm
- Condition: -65°C/30min ↔ 125°C/30min

Graph showing change ratio of electric resistance over number of cycles (cycle) for High Tg FR-4, E-679F(J), and E-679F.

Pretreatment: JEDEC L3 (C-168/30/60) + 260°C reflow 3 times
1. Material Properties

**Sample construction**

- a) Laminate: t1.6mm 18D + 20um-plating (#7629 x 8ply)
- b) Drill diameter: 0.4mm diameter
- c) Test pattern: 320-hole daisy-chain

**Test sample**

- a) Laminate: t1.6mm 18D + 20um-plating (#7629 x 8ply)
- b) Drill diameter: 0.4mm diameter
- c) Test pattern: 320-hole daisy-chain

Test condition: -65°C 30min / 125°C 30min
Pre treatment: E-3/130 ⇒ C-72/40/90 ⇒ max 260°C reflow, 2cycle
⇒ C-12/40/90 ⇒ 260°C solder dip

![Graph showing change ratio of electric resistance over number of cycles for FR-4, E-679F, and E-679F(J).]
1. Material Properties

Sample construction

<table>
<thead>
<tr>
<th>Sample</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Laminate: t1.6mm 18D + 20um-plating (#7629 x 8ply)</td>
</tr>
<tr>
<td>b</td>
<td>Drill diameter: 0.4mm diameter</td>
</tr>
<tr>
<td>c</td>
<td>Test pattern: 320-hole daisy-chain</td>
</tr>
</tbody>
</table>

Test condition: -55deg C 30min / 150deg C 30min
Pre treatment: E-3/130 ⇒ C-72/40/90 ⇒ 260Cmax reflow, 2cycle ⇒ C-12/40/90 ⇒ 260C solder dip

Change ratio of electric resistance (%)

Number of Cycles

- FR-4
- E-679F
- E-679F(J)
1. Material Properties

**E-679F(J)**

- **Laminates**: t1.6mm x 2-core
- **Prepreg**: t0.1(#2116) x 2ply
- **IVH diameter**: 0.3mm
- **IVH pitch**: 1.27-2.54mm

**High Tg FR-4**

4-layer board construction (2-core)
- a) Laminates : t1.6mm x 2-core
- b) Prepreg: t0.1(#2116) x 2ply
- c) IVH diameter: 0.3mm
- d) IVH pitch: 1.27-2.54mm
## General Properties

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>E-679F(J) New Product</th>
<th>E-679(W) High Tg FR-4</th>
<th>E-679F (High Tg epoxy with filler)</th>
<th>#D (High Tg epoxy)</th>
<th>#P2 (High Tg epoxy)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Shimodate made</td>
<td>Hong Kong made</td>
<td>(175 by DSC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tg</td>
<td>°C</td>
<td>170 - 175</td>
<td>170 - 175</td>
<td>173 - 183</td>
<td>160 - 170</td>
<td>160.6</td>
</tr>
<tr>
<td>DMA method</td>
<td>°C</td>
<td>195 - 205</td>
<td>195 - 205</td>
<td>205 - 215</td>
<td>190 - 200</td>
<td>199.4</td>
</tr>
<tr>
<td>CTE</td>
<td>ppm/°C</td>
<td>12 - 15</td>
<td>12 - 15</td>
<td>12 - 15</td>
<td>12 - 14</td>
<td>14.2</td>
</tr>
<tr>
<td>Z (&lt;Tg)</td>
<td>14 - 17</td>
<td>14 - 17</td>
<td>14 - 17</td>
<td>12 - 14</td>
<td>17.0</td>
<td></td>
</tr>
<tr>
<td>Z (&gt;Tg)</td>
<td>35 - 45</td>
<td>35 - 45</td>
<td>50 - 60</td>
<td>20 - 30</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>T288</td>
<td>min.</td>
<td>&gt;20</td>
<td>&gt;20</td>
<td>&gt;20</td>
<td>&gt;20</td>
<td></td>
</tr>
<tr>
<td>T260</td>
<td>min.</td>
<td>&gt;60</td>
<td>&gt;60</td>
<td>&gt;60</td>
<td>&gt;60</td>
<td></td>
</tr>
<tr>
<td>T288 (20L-PCB)</td>
<td>min.</td>
<td>&gt;10</td>
<td>-</td>
<td>-</td>
<td>&gt;10</td>
<td></td>
</tr>
<tr>
<td>T300 (20L-PCB)</td>
<td>min.</td>
<td>&gt;3</td>
<td>-</td>
<td>-</td>
<td>&gt;3</td>
<td></td>
</tr>
<tr>
<td>Decomposition temperature (Td) (5% weight loss temp.)</td>
<td>°C</td>
<td>340 - 360</td>
<td>340 - 360</td>
<td>340 - 360</td>
<td>340 - 360</td>
<td>365</td>
</tr>
<tr>
<td>Cupper Peel Strength (18um)</td>
<td>kN/m</td>
<td>1.1 - 1.4</td>
<td>1.0 - 1.2 (MP)</td>
<td>1.2 - 1.4</td>
<td>1.1 - 1.2</td>
<td>(1.1 - 1.2)</td>
</tr>
<tr>
<td>Dk (1MHz)</td>
<td>-</td>
<td>4.6 - 4.8</td>
<td>4.6 - 4.8</td>
<td>4.7 - 4.8</td>
<td>4.8 - 5.0</td>
<td>(4.7)</td>
</tr>
<tr>
<td>Df (1MHz)</td>
<td>-</td>
<td>0.011 - 0.013</td>
<td>0.011 - 0.013</td>
<td>0.013 - 0.015</td>
<td>0.008 - 0.010</td>
<td>0.014 - 0.015</td>
</tr>
<tr>
<td>Dk (1GHz)</td>
<td>Measured by Triplate-line Resonator</td>
<td>-</td>
<td>4.2 - 4.4</td>
<td>4.2 - 4.4</td>
<td>4.2 - 4.4</td>
<td>4.3</td>
</tr>
<tr>
<td>Df (1GHz)</td>
<td>Measured by</td>
<td>-</td>
<td>0.017 - 0.019</td>
<td>0.017 - 0.019</td>
<td>0.021 - 0.022</td>
<td>0.013 - 0.015</td>
</tr>
<tr>
<td>Dk (1GHz)</td>
<td>Measured by Material Analyzer</td>
<td>-</td>
<td>4.3 - 4.5</td>
<td>-</td>
<td>4.3 - 4.5</td>
<td>4.6 - 4.9</td>
</tr>
<tr>
<td>Df (1GHz)</td>
<td>Measured by</td>
<td>-</td>
<td>0.014 - 0.016</td>
<td>-</td>
<td>0.019 - 0.021</td>
<td>0.010 - 0.012</td>
</tr>
<tr>
<td>Thermal Conductivity</td>
<td>W/mK</td>
<td>0.4 - 0.5</td>
<td>0.4 - 0.5</td>
<td>0.3 - 0.4</td>
<td>0.71 - 0.75</td>
<td>0.48</td>
</tr>
<tr>
<td>Flexural Strength (Lengthwise)</td>
<td>MPa</td>
<td>430 - 530</td>
<td>-</td>
<td>530 - 570</td>
<td>430 - 530</td>
<td>-</td>
</tr>
<tr>
<td>Flammability (UL-94)</td>
<td>-</td>
<td>V-0</td>
<td>V-0</td>
<td>V-0</td>
<td>V-0</td>
<td>V-0</td>
</tr>
</tbody>
</table>

Note) The above-mentioned other companies material data is a catalog value.
1. Material Properties

Electric Properties

Measured by Triplate-line Resonator

- Dielectric Constant (Dk)
- Dielectric Loss (Df)

Measured by Material Analyzer

- Dielectric Constant (Dk)
- Dielectric Loss (Df)
2. PCB Properties
20-Layer PCB construction

a) t3.0mm 20L-PCB
   Core: t0.1mm 35/35
   Prepreg: #1080x2ply
b) T/H diameter:
   0.2mm, 0.35mm, 0.9mm
c) SVH diameter:
   0.15mm, 0.2mm
d) Prepreg L10-L11: #1080x3ply
2. PCB Properties

Transmission Loss Property

Measuring Sample Pattern

Micro-strip Line

Transmission Loss Property

Frequency (GHz)

Transmission Loss (dB)

E679F(J) #D
2. PCB Properties

Solder Heat Cycle Test (1)

Test condition: 288deg C, 10s float x 6cycle
T/H diameter: 0.9mm

E-679F(J)

No crack

No crack
2. PCB Properties

Solder Heat Cycle Test (2)

Test condition: 288deg C, 10s float x 6cycle
T/H diameter: 0.9mm

Resin recession

Resin crack

Resin crack
Test condition: 288deg C, 10s float x 6cycle
T/H diameter: 0.9mm

Resin crack

Resin crack
2. PCB Properties

**Reflow Heat Cycle Test (1)**

Test condition: 260deg C max. Reflow x 8cycle
T/H diameter: 0.7mm

**E-679F(J)**

- No crack
- No crack
- No crack

![Image](https://example.com/image1.png)

![Image](https://example.com/image2.png)

![Image](https://example.com/image3.png)
2. PCB Properties

Reflow Heat Cycle Test (2)

Test condition: 260deg C max. Reflow x 8cycle
T/H diameter: 0.7mm

- Resin crack
- Recession
- Resin recession
2. PCB Properties

Reflow Heat Cycle Test (3)

Test condition: 260deg C max. Reflow x 8cycle
T/H diameter: 0.7mm

Resin crack

Resin crack

Resin crack
### Test condition

- **a)** Test sample: 20L-PCB (t3.0mm)
- **b)** Drill diameter: 0.2mm, 0.35mm, 0.7mm
- **c)** Aspect ratio: 4.3 - 15.0

### 260deg C max reflow

*Delaminated sample / Total tested sample*

<table>
<thead>
<tr>
<th>Sample</th>
<th>E-679F(J)</th>
<th>#D</th>
<th>#E</th>
</tr>
</thead>
<tbody>
<tr>
<td>3cycle</td>
<td>0 / 3</td>
<td>0 / 3</td>
<td>0 / 3</td>
</tr>
<tr>
<td>5cycle</td>
<td>0 / 3</td>
<td>0 / 3</td>
<td>0 / 3</td>
</tr>
<tr>
<td>8cycle</td>
<td>0 / 3</td>
<td>3 / 3</td>
<td>3 / 3</td>
</tr>
</tbody>
</table>

- Resin crack

---

*Confidential*
2. PCB Properties

SVH Filling Property (1)

**E-679F(J)**

- Diameter: 0.2mm
- Diameter: 0.15mm

Good filling property
2. PCB Properties

SVH Filling Property (2)

#D Diameter: 0.2mm

#E Diameter: 0.2mm

Separation of Filler and Resin
<Conclusion>

- E-679F(J) have the Superior CAF restraining property
- E-679F(J) have the High Heat resistance
  - ex. 288deg.C/10s float; 6 cycle OK (20L-PCB)
  - ex. 260deg.C max reflow; 8 cycle OK (20L-PCB)

- Suitable for the Lead-free process
- Lower Df; 0.018 at 1GHz

- Lower Transmission Loss than High Tg FR-4
- Better IVH filling property
16-Layer PCB construction

a) t2.2mm 16L-PCB

Stack-up

18µm Copper + 25µm plating

#1080x1

1.0 .13 18/18

#2116x1

1.0 .13 35/35

#2116x1

1.0 .13 18/18

#3313x2

1.0 .13 35/35

#3313x2

1.0 .13 18/18

#2116x1

1.0 .13 35/35

#2116x1

1.0 .13 18/18

#1080x1

18µm Copper + 25µm plating
2. PCB Properties

**TMA Analysis**

*Measurement method by TMA*

a) Test board: 16L-PCB (t2.2mm)
b) Size: 5mm square without copper foil
c) Heating rate: 10deg.C/min

<table>
<thead>
<tr>
<th>Item</th>
<th>unit</th>
<th>E-679F(J) No-filler type</th>
<th>#I filler type</th>
<th>#P filler type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tg</strong></td>
<td>deg.C</td>
<td>170</td>
<td>166</td>
<td>157</td>
</tr>
<tr>
<td><strong>CTE</strong> (50 - 120deg.C)</td>
<td>ppm/C</td>
<td>53.8</td>
<td>93.6</td>
<td>74.0</td>
</tr>
<tr>
<td><strong>CTE</strong> (200 - 240deg.C)</td>
<td>ppm/C</td>
<td>278</td>
<td>350</td>
<td>319</td>
</tr>
<tr>
<td><strong>Thermal Expansion</strong> (50 - 260deg.C)</td>
<td>%</td>
<td>3.2</td>
<td>4.5</td>
<td>4.2</td>
</tr>
</tbody>
</table>
### Test condition

- **a)** Drill diameter: 0.2mm, 0.85mm
- **b)** Plating thickness: 25 - 30um
- **c)** Aspect ratio: 2.6, 11.0
- **d)** Condition: 20deg.C ↔ 150deg.C, 5min/ cycle
- **e)** Criteria of failure: more than 10% change of resistance

### IST Result of 16L-PCB

<table>
<thead>
<tr>
<th>Pre-treatment (Reflow cycle)</th>
<th>E-679F(J)</th>
<th>#I No-filler type</th>
<th>#P Filler type</th>
</tr>
</thead>
<tbody>
<tr>
<td>after 260deg.C × 3cycle</td>
<td>&gt;1000 cycle</td>
<td>434 cycle</td>
<td>577 cycle</td>
</tr>
<tr>
<td>after 260deg.C × 6cycle</td>
<td>&gt;1000 cycle</td>
<td>270 cycle</td>
<td>449 cycle</td>
</tr>
</tbody>
</table>

\[ n = 6pnl \]
3. Process Conditions
1) Product temp.; **Heat more than 40min at higher than 180deg.C (356°F)**
2) Setting max. temp. (example); over 185deg.C (365°F), 90min.
3) Product Heating Rate; **1.5-3.0deg.C /min (2.7-5.4°F/min) at 80-130deg.C (176-266°F)**
4) Pressure; **2.0-3.0 MPa (290-430psi)**
   Inner pattern filling capability of prepreg may change according to inner pattern.
1) Characterize the drilling process, Because **MCL-E-679F(J)** is not equal to conventional FR-4.

2) **Please refer to example of Table1. (Recommend)**

Table1. Example for drilling condition

<table>
<thead>
<tr>
<th>Item</th>
<th>Diameter of drill bits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>φ 0.1</td>
</tr>
<tr>
<td>Drill bits</td>
<td></td>
</tr>
<tr>
<td>Entry Board</td>
<td></td>
</tr>
<tr>
<td>Stacked panel</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Layer PWB= 1 board,</td>
</tr>
<tr>
<td>Revolution number</td>
<td>200 - 300 krpm</td>
</tr>
<tr>
<td>Feed Rate</td>
<td>1.0 - 1.5 m/min</td>
</tr>
<tr>
<td></td>
<td>(3.3 - 4.9 ft/min.)</td>
</tr>
<tr>
<td>Life of drill bits</td>
<td>About 1,500 hits</td>
</tr>
</tbody>
</table>

**Caution**: Smear, resin cracking or nail heading may occur if drilling condition does not match.
3. Process Conditions

Drilling Processability (1)

Sample construction
- t0.41mm 18/18
- (#2116 x 4ply )

Drilling condition
- Diameter: 0.105mm
- Revolution speed: 300krpm
- Feed rate: 1.5m/min
- Number of stack:
  - 2 board

Hole Wall Roughness

Drill hits number (hits)

Drill hits number (hits) vs Hole wall roughness (um)

- High Tg FR-4
- E-679F(J)
- E-679F

Confidential
Annealing

We recommend to anneal the laminates just before plating to reduce residual stress. The condition of annealing is as follows.

**Please heat the laminates more than 1 hr at 200 deg.C, or more than 2hr at 190deg.C in material temperature.**

Desmearing

1) The desmear rate of **MCL-E-679F(J)** is inferior to that of conventional FR-4, in permanganate desmear process. Please check the smear and inner layer connection.

2) Please refer examples of desmear conditions in Table2.

The formulation of the chemical might be different in each area (US, EU, Asia), please confirm to the chemical suppliers.
# Desmearing Condition

## 3. Process Conditions

### Desmearing

Table 2. The example of desmear conditions

<table>
<thead>
<tr>
<th>Process</th>
<th>Atotech</th>
<th>Rohm &amp; Haas (Shipley)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Products</td>
<td>Temperature °F (°C)</td>
</tr>
<tr>
<td>Swellinging</td>
<td>Swelling dip Securiganth P</td>
<td>158-176 °F (70-80)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Etching</td>
<td>Dosing solution Securiganth P</td>
<td>158-176 °F (70-80)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newtralization</td>
<td>Reduction solution Securiganth P</td>
<td>77-104 °F (25-40)</td>
</tr>
</tbody>
</table>

If you use the horizontal desmear process, please contact chemical supplier.

**Caution:** The resin crack will take place at inner through hole after the wrong desmear treatment.
If you use only electroless plating process, it may be happened that heat resistance changes for the worse dependent on the plating condition. Please examine plating condition enough before mass production.

Regarding through hole plating copper process, we recommend conventional plating method. (electroless plating + electroplating) (Recommend)
4. Special Notes
MCL-E-679F(J) (Copper Clad laminate)

1) Please take care to treat thin core laminates because these easily bend and break.

2) Please keep laminates out of the direct rays of the sun. The storage condition of 20+-5deg.C(68+-9deg.F), less than 60%RH under control. We guarantee the laminates within 6months after the date of production above condition.

3) There is inorganic filler into this MCL. Carefully remove inorganic filler (resin powder) occurred from laminate in cutting, punching, shearing and drilling process. Otherwise short and open circuit may occur.

4) When the foreign force is added in the condition that resin powder gets between products, the scratch on the copper surface and copper foil separation may occur. So sufficient care must be taken to prevent this (Ex; Don’t adjust the disorderly boards by beating them vertically on the stand).
1) All the received prepreg should be immediately moved from the receiving area into a controlled environment.

2) All prepreg should be used as soon as possible.

3) The shelf life of prepreg is **3 months** after the date of production **under the storage condition of 20+/−5deg.C(68+/−9deg.F), less than 60%RH, in aluminum barrier packing.**

4) Please open the aluminum barrier packing just before lamination process to avoid a moisture.
We recommend moisture-proof packing with desiccant. *(Recommend)*

If PCB absorbed moisture during transport, delamination might occur in reflow process.

If the printed circuit board has more than 0.3% moisture included, *please dry it more than 2hr at 130deg.C, before reflow process or another heating process.*
Hitachi Chemical Co., Ltd.
PWB Materials Div.
Sales Dept.
Akihiro Takehana (a-takehana@hitachi-chem.co.jp)
Shibaura-Square Building, 9-25, Shibaura 4-chome,
Minato-ku, Tokyo, 108-0023, Japan
Phone : +81-3-5446-9495   Fax : +81-3-5446-9462
R & D Dept.
Akinori Hanawa (a-hanawa@hitachi-chem.co.jp)
Tetsuro Irino (t-irino@hitachi-chem.co.jp)
1500 Ogawa, Chikusei-city, Ibaraki, 308-8521 Japan
Phone : +81-(296)-20-2217  Fax : +81-(296)-28-6128

Note: The entry contents of these data base to the experiment results of our company at Oct. 2007 and do not guarantee these characteristic values. The contents may be revised necessary according to new findings. Please examine process condition enough and confirm before mass production. Please make sure that some difference of practical property such as heat resistance and insulation reliability might occur by the difference design PCB making process or working condition.