Halogen-free CEM-3

Epoxy resin copper-clad laminate using glass fabric and nonwoven glass fabric as base materials

Features
● S4V-0 has been achieved without using halogen compound and antimony in the UL flame resistance test.
● Excellent in tracking resistance (CTI value: 600).
● Excellent in thickness accuracy.
  Variations in board thickness are ±0.05 mm. This thickness accuracy is equal to that of New CEM-3 R-1786.
● Excellent in high frequency characteristics.
  Small dissipation factor and thickness variations can realize designed performance.

Provides dimensional stability equivalent to that of glass epoxy (FR-4).
● Reduces CO₂ emission amount in our manufacturing process to one-quarter by means of our unique manufacturing process. (Compared with our conventional FR-4)

Applications
● Liquid crystal television, PDP, PC peripheral equipment, air conditioner, plumbing equipment, power supply board, tuner, amusement machine, etc.

Specifications (Assured values)

<table>
<thead>
<tr>
<th>Standard size (Warp × Fill)</th>
<th>Nominal thickness</th>
<th>Including thickness</th>
<th>Copper foil 0.018mm (single-sided)</th>
<th>Copper foil 0.035mm (double-sided)</th>
<th>Thickness tolerance</th>
<th>Warpage, Twist</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.020±0.003×1.020±0.003 mm</td>
<td>1.0mm Including copper foil</td>
<td>1.00±0.08mm 1.04±0.08mm 0.99±0.08mm 1.01±0.08mm</td>
<td>≤9.0% ≤2.5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.220±0.003×1.020±0.003 mm</td>
<td>1.2mm Including copper foil</td>
<td>1.15±0.05mm 1.19±0.05mm 1.14±0.05mm 1.16±0.05mm</td>
<td>≤7.0% ≤2.5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.600±0.003×1.020±0.003 mm</td>
<td>1.6mm Including copper foil</td>
<td>1.52±0.05mm 1.56±0.05mm 1.51±0.05mm 1.53±0.05mm</td>
<td>≤6.0% ≤2.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: When thickness is measured at 10 positions according to Section 5.3.3 in JIS C6481, thicknesses of at least 9 positions are within the tolerance range specified above. Thickness outside the tolerance range is within 125% of the above tolerance.

Note: For detail dimensions, please confer with us separately.

General Properties

<table>
<thead>
<tr>
<th>Test item</th>
<th>Unit</th>
<th>Treatment conditions</th>
<th>Actual value</th>
<th>Guaranteed value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume resistivity</td>
<td>MΩ · m</td>
<td>C-96/20/65</td>
<td>1×10⁸</td>
<td>≥1×10⁸</td>
</tr>
<tr>
<td>Surface resistance</td>
<td>MΩ</td>
<td>C-96/20/65</td>
<td>3×10⁴</td>
<td>≥1×10⁴</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>MΩ</td>
<td>C-96/20/65</td>
<td>1×10⁷</td>
<td>≥1×10⁷</td>
</tr>
<tr>
<td>Dielectric constant (1MHz)</td>
<td>—</td>
<td>C-96/20/65</td>
<td>4.6</td>
<td>≤5.5</td>
</tr>
<tr>
<td>Dissipation factor (1MHz)</td>
<td>—</td>
<td>C-96/20/65</td>
<td>0.016</td>
<td>≤0.035</td>
</tr>
<tr>
<td>Solder heat resistance (260℃)</td>
<td>second</td>
<td>C-96/20/65+D-24/23</td>
<td>230℃60minutes No blister</td>
<td>200℃60minutes No blister</td>
</tr>
<tr>
<td>Peel strength</td>
<td>N/mm²</td>
<td>Copper foil : 0.018mm (18 μm)</td>
<td>A</td>
<td>1.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Copper foil : 0.035mm (35 μm)</td>
<td>S4</td>
<td>1.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>1.70</td>
</tr>
<tr>
<td>Heat resistance</td>
<td></td>
<td></td>
<td>230℃60minutes No blister</td>
<td>200℃60minutes No blister</td>
</tr>
<tr>
<td>Flexural strength (crosswise direction)</td>
<td>N/mm²</td>
<td>A</td>
<td>270</td>
<td>≥225</td>
</tr>
<tr>
<td>Water absorption</td>
<td>%</td>
<td>E-24/50+D-24/23</td>
<td>0.09</td>
<td>≤0.25</td>
</tr>
<tr>
<td>Flammability (UL method)</td>
<td>—</td>
<td>A and E-168/70</td>
<td>94V-0</td>
<td>94V-0</td>
</tr>
<tr>
<td>Alkali resistance</td>
<td>—</td>
<td>Immersion (3 minutes)</td>
<td>no abnormality</td>
<td>no abnormality</td>
</tr>
<tr>
<td>Punching workability</td>
<td>—</td>
<td>A</td>
<td>Suitable temperature 25℃</td>
<td>—</td>
</tr>
</tbody>
</table>

Note: Test piece thickness is 1.6 mm.
Note: The above tests are in accordance with JIS C6481. However, flame resistance is tested in accordance with UL94, and punching workability is in accordance with our company’s testing method.
■ Characteristic graph (reference value)

- Time-dependent change of surface resistance (40°C, 90%RH processing)
  (Comb pattern circuit width: 0.64mm, Circuit interval: 1.3mm)

- Temperature characteristic of surface resistance
  (Comb pattern circuit width: 0.64mm, Circuit interval: 1.3mm)

- Frequency characteristic of dielectric constant (IPC TM-650 2.5.5.9)

- Frequency characteristic of dissipation factor (IPC TM-650 2.5.5.9)

■ Peel strength of copper foil

- Through hole reliability
  - Test condition
    Create test pieces by applying copper through hole processing on test patterns, give the following thermal shocks, and measure the number of cycles until disconnection occurs.
  - Example

<table>
<thead>
<tr>
<th>Number of cycles to break</th>
<th>X₁</th>
<th>X₂</th>
<th>X₃</th>
<th>X̄</th>
</tr>
</thead>
<tbody>
<tr>
<td>260°C oil 10 seconds immersion</td>
<td>60</td>
<td>63</td>
<td>64</td>
<td>62</td>
</tr>
<tr>
<td>20°C water 10 seconds immersion</td>
<td>1 cycle</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

■ Thermal expansion and contraction rates (Dilatometer method)

(150°C scale)

- Expansion rate%
  X-axis: 0.248, Y-axis: 0.290, Z-axis: 0.025, Characteristic: 0.035

■ Thermal expansion and contraction rates (TMA method)

(150°C scale)

- Expansion rate%
  X-axis: 0.98, Z-axis: 0.48

Characteristic graph (reference value)

- Time-dependent change of surface resistance (40°C, 90%RH processing)
  (Comb pattern circuit width: 0.64mm, Circuit interval: 1.3mm)

- Temperature characteristic of surface resistance
  (Comb pattern circuit width: 0.64mm, Circuit interval: 1.3mm)

- Frequency characteristic of dielectric constant (IPC TM-650 2.5.5.9)

- Frequency characteristic of dissipation factor (IPC TM-650 2.5.5.9)
Tracking resistance (IEC method) (0.1% NH4Cl) (Electrode (platinum) interval)

Inner wall roughness (60,000rpm 0.05mm/rev 3 ply)

Dimensional variation ratio (plate thickness 1.6mm copper foil thickness 0.018mm)
Size: 305mm (X-axis) x 280mm (Y-axis) / Span: 270mm (X-axis), 260mm (Y-axis)

Punching characteristic (Punching temperature 25°C)
Maximum dynamic shearing stress N/mm²
Maximum dynamic pull-out stress N/mm²
161.7 46.1

Thickness accuracy board thickness 1.6mm copper foil thickness 0.018mm
\( \bar{x} = 1.52 \text{mm} \quad R = 0.053 \text{mm} \quad \bar{N} = 0.014 \text{mm} \)

Hammer wear rate
Drill: 0.8mm L/C: 35 Number of waves: 60,000rpm
Feed rate: 0.25mm/rev Entry board: Aluminum (0.15mm)
Backup board: Bakelite plate thickness: 1.6mm Copper foil 0.018mm 3 ply

Hole diameter contraction after punching (Punching temperature: 25°C R-1581)