



## DE156 Halogen Free Laminates and Prepregs

**DE156** is a base material of type FR-4. The resin matrix is based on a modified epoxy resin; conventional E-glass-fabric is used for reinforcement. The requirements of flammability class V-0 as per UL 94 are met without addition of antimony compounds. Since this grade does not contain halogens, it displays greater thermal stability than a standard FR-4, as time to delamination (T260) measurements prove.

[www.isola-group.com/products/DE156](http://www.isola-group.com/products/DE156)

### ORDERING INFORMATION:

Contact your local sales representative or visit [www.isola-group.com](http://www.isola-group.com) for further information.

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Halogen Free

# DE156 Data Sheet

Tg 155, Td 390  
Dk 4.00, Df 0.02  
/94

## Features

- High Thermal Performance
  - ▶ Tg: 155°C (DSC)
  - ▶ Td: 390°C (TGA @ 5% wt loss)
  - ▶ Superior performance through multiple thermal excursions
  - ▶ Superior chemical and thermal resistance
  - ▶ Lower CTE from ambient to 288°C
- T260: 60 minutes
- T288: >10 minutes
- RoHS Compliant
- UV Blocking and AOI Compatible
  - ▶ UV blocking and enhanced fluorescence
  - ▶ Compatible with all AOI equipment, including laser-enhanced reflectance systems
- Core Material Standard Availability
  - ▶ Thickness: 0.002" (0.05 mm) to 0.060"/0.062" (1.5 mm)
  - ▶ Available in full size sheet or panel form
- Prepreg Standard Availability
  - ▶ Roll or panel form
  - ▶ Tooling of prepreg panels available
- Copper Foil Type Availability
  - ▶ Standard HTE Grade 3
  - ▶ RTF (Reverse Treat Foil)
- Copper Weights
  - ▶ ½, 1 and 2 oz (18, 35 and 70 µm) available
  - ▶ Heavier copper available upon request
  - ▶ Thinner copper foil available upon request
- Glass Fabric Availability
  - ▶ Standard E-glass
  - ▶ Square weave glass fabric available
- Industry Approvals
  - ▶ IPC-4101D WAM1 /94
  - ▶ UL - File Number E41625

# DE156 Specifications

| Property  |  | Typical Values      |                     |                      |                          |
|---|--|---------------------|---------------------|----------------------|--------------------------|
|   |  |                     |                     | Units                | Test Method              |
|   |  | Typical Value       | Specification       | Metric (English)     | IPC-TM-650 (or as noted) |
| <b>Glass Transition Temperature (Tg) by DSC</b>                                   |  | 155                 | 150-200             | °C                   | 2.4.25                   |
| <b>Decomposition Temperature (Td) by TGA @ 5% weight loss</b>                     |  | 390                 | –                   | °C                   | ASTM D3850               |
| <b>T260</b>   |  | 60                  | –                   | Minutes              | 2.4.25                   |
| <b>T288</b>   |  | >10                 | –                   | Minutes              | 2.4.25                   |
| <b>CTE, Z-axis</b>  | A. Pre-Tg  | 45                  | AABUS               | ppm/°C               | 2.4.24                   |
|   | B. Post-Tg   | 220                 | –                   |                      |                          |
| <b>CTE, X-, Y-axes</b>  | A. Pre-Tg  | 13                  | AABUS               | ppm/°C               | 2.4.24                   |
|   | B. Post-Tg   | 14                  | –                   |                      |                          |
| <b>Z-axis Expansion (50-260°C)</b>  |  | 2.8                 | –                   | %                    | 2.4.24                   |
| <b>Thermal Conductivity</b>   |  | 0.4                 | –                   | W/mK                 | ASTM D5930               |
| <b>Thermal Stress 10 sec @ 288°C (550.4°F)</b>                                    | A. Unetched  | Pass                | Pass Visual         | Rating               | 2.4.13.1                 |
|   | B. Etched  |                     |                     |                      |                          |
| <b>Dk, Permittivity (Laminate &amp; prepreg as laminated) Tested at 50% resin</b> | A. @ 100 MHz (HP4285A)   | 4.05                | 5.4                 | –                    | 2.5.5.3                  |
|   | B. @ 1 GHz (HP4291A)   | 4.01                | –                   |                      | 2.5.5.9                  |
|   | C. @ 2 GHz (Bereskin Stripline)  | 4.00                | –                   |                      | 2.5.5.5                  |
|   | D. @ 5 GHz (Bereskin Stripline)  | 3.97                | –                   |                      | 2.5.5.5                  |
|   | E. @ 10 GHz (Bereskin Stripline)   | –                   | –                   |                      | 2.5.5.5                  |
| <b>Df, Loss Tangent (Laminate &amp; prepreg as laminated) Tested at 50% resin</b> | A. @ 100 MHz (HP4285A)   | 0.0130              | 0.035               | –                    | 2.5.5.3                  |
|   | B. @ 1 GHz (HP4291A)   | 0.0161              | –                   |                      | 2.5.5.9                  |
|   | C. @ 2 GHz (Bereskin Stripline)  | 0.0167              | –                   |                      | 2.5.5.5                  |
|   | D. @ 5 GHz (Bereskin Stripline)  | 0.0172              | –                   |                      | 2.5.5.5                  |
|   | E. @ 10 GHz (Bereskin Stripline)   | 0.0172              | –                   |                      | 2.5.5.5                  |
| <b>Volume Resistivity</b>   | A. 96/35/90  | 5.0x10 <sup>6</sup> | 1.0x10 <sup>6</sup> | MΩ-cm                | 2.5.17.1                 |
|   | B. After moisture resistance   | 3.0x10 <sup>7</sup> | –                   |                      |                          |
|   | C. At elevated temperature   | 2.8x10 <sup>6</sup> | 1.0x10 <sup>3</sup> |                      |                          |
| <b>Surface Resistivity</b>  | A. 96/35/90  | 2.0x10 <sup>3</sup> | 1.0x10 <sup>4</sup> | MΩ                   | 2.5.17.1                 |
|   | B. After moisture resistance   | 4.0x10 <sup>6</sup> | –                   |                      |                          |
|   | C. At elevated temperature   | 1.0x10 <sup>7</sup> | 1.0x10 <sup>3</sup> |                      |                          |
| <b>Dielectric Breakdown</b>   |  | 60                  | 40                  | kV                   | 2.5.6                    |
| <b>Arc Resistance</b>   |  | 115                 | 60                  | Seconds              | 2.5.1                    |
| <b>Electric Strength (Laminate &amp; prepreg as laminated)</b>                    |  | 36 (1500)           | 30 (750)            | kV/mm (V/mil)        | 2.5.6.2                  |
| <b>Comparative Tracking Index (CTI)</b>   |  | –                   | –                   | Volts                | UL-746A<br>ASTM D3638    |
| <b>Peel Strength</b>  | A. Low profile copper foil and very low profile – all copper weights >17 microns | 7.0                 | 4.0                 | lb/inch              | 2.4.8                    |
|   | B. Standard profile copper   | –                   | –                   |                      | 2.4.8.2                  |
|   | 1. After thermal stress  | 8.0                 | 4.5                 |                      | 2.4.8.3                  |
|   | 2. At 125°C (257°F)  | 6.0                 | 4.0                 |                      | –                        |
|   | 3. After process solutions   | 7.0                 | 3.0                 | –                    | –                        |
| <b>Flexural Strength</b>  | A. Lengthwise direction  | 89,500              | –                   | lb/inch <sup>2</sup> | 2.4.4                    |
|   | B. Crosswise direction   | 62,700              |                     |                      |                          |
| <b>Tensile Strength</b>   | A. Lengthwise direction  | 55,242              | –                   | lb/inch <sup>2</sup> | –                        |
|   | B. Crosswise direction   | 39,335              |                     |                      |                          |
| <b>Young's Modulus</b>  | A. Grain direction   | 3677                | –                   | ksi                  | ww                       |
|   | B. Fill direction  | 3179                |                     |                      |                          |
| <b>Poisson's Ratio</b>  | A. Grain direction   | 0.175               | –                   | –                    | xx                       |
|   | B. Fill direction  | 0.143               |                     |                      |                          |
| <b>Moisture Absorption</b>  |  | 0.1                 | –                   | %                    | 2.6.2.1                  |
| <b>Flammability (Laminate &amp; prepreg as laminated)</b>                         |  | V-0                 | V-1                 | Rating               | UL 94                    |
| <b>Max Operating Temperature</b>  |  | 130                 | UL Cert             | °C                   | –                        |

The data, while believed to be accurate and based on analytical methods considered to be reliable, is for information purposes only. Any sales of these products will be governed by the terms and conditions of the agreement under which they are sold.

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