



Tetrafunctional Epoxy Laminate and Prepreg

Isola Laminate Systems' FR402 consists of a modified tetrafunctional epoxy resin system engineered for multilayer applications that require performance characteristics exceeding those of difunctional epoxies. The formulation of FR402 is designed to enhance throughput and accuracy of laser based Automated Optical Inspection (AOI) equipment. FR402 offers superior resistance to chemical and thermal degradation.

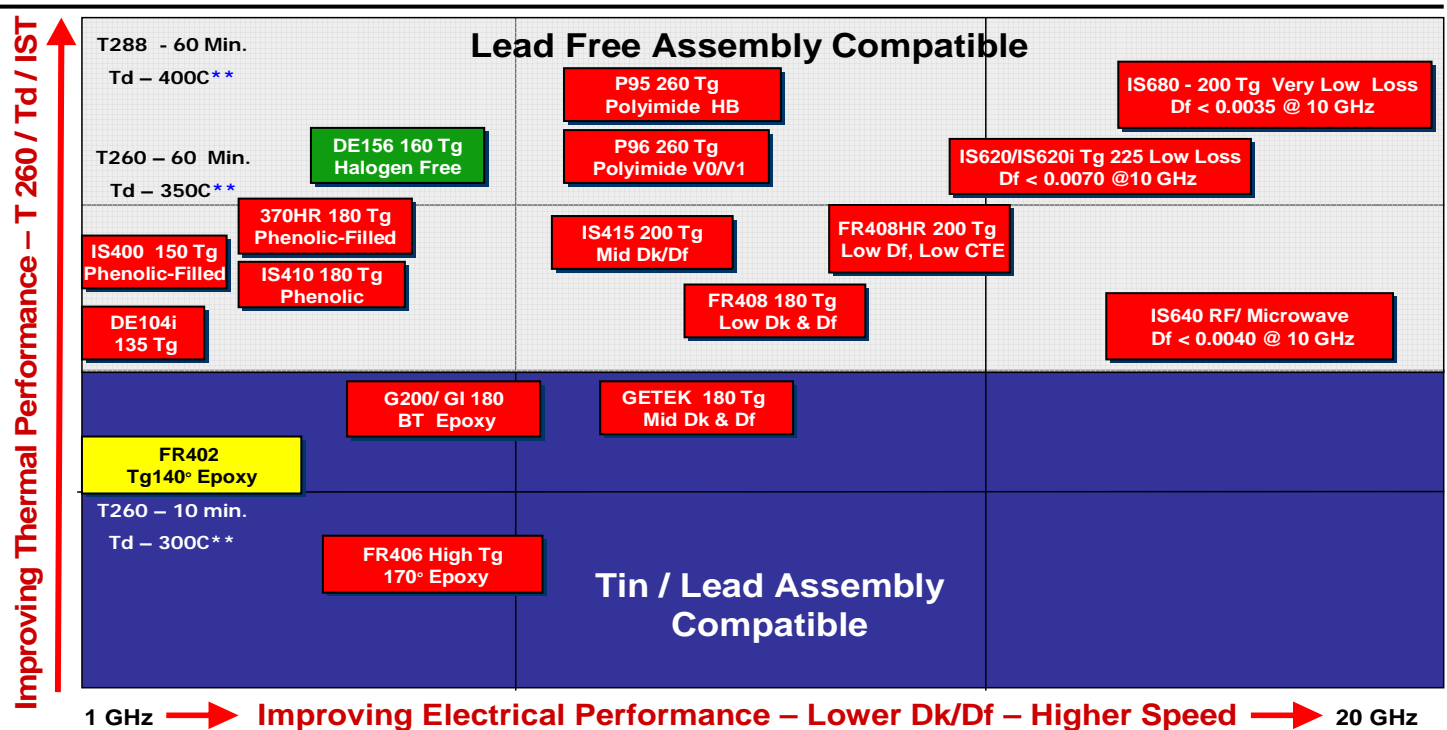
Industry Approvals

- IPC-4101B /21
- UL Recognized – FR-4, File Number E41625
(Part of Isola's FR-4 Family)

- **High Tg — 140 °C**
Superior performance through multiple thermal Excursions Resistance to measing Extended capabilities
- **UV Blocking and AOI Compatible**
Increased throughput and accuracy Compatible with all AOI equipment
- **FR-4 System**
Processes as a standard FR-4
- **Availability**
Thickness: 0.002" [.05 mm] to 0.125" [3.2 mm]
Available in sheet or panel form
Copper Foil Cladding: Grade 3 (HTE), 1/2, 1 and 2 oz.
Foil Options: Double treat, reverse treat
Prepregs: Available in roll or panel form
Glass Styles: available on standard styles



Isola - Product Position
Thermal Performance vs Signal Integrity



Speed is a function of design such as line length etc.

** Laminate Data - IST performance is a function of Hole diameter, board thickness, plating parameters and laminate attributes.

FR402 Typical Laminate Properties

| | | English | | | Metric | | | Test Method | | |
|--|--|---|-------------------------|-------------------|-----------|---------------------|-------------------|-----------------------------|----------|------------|
| | | Value | Specification | Units | Value | Specification | Units | IPC-TM-650 (or as noted) | | |
| Glass Transition Temperature (Tg) by DSC, spec minimum | | 140 | 110-150 | °C | 140 | 110-150 | °C | 2.4.25 | | |
| Decomposition Temperature (Td) by TGA | | @ 5% weight loss | | 320 | — | °C | 320 | — | °C | ASTM D3850 |
| T260 | | 30 | | min | 30 | | min | | | |
| T288 | | >5 | | min | >5 | | min | 2.4.25 | | |
| CTE, Z-axis | | Pre-Tg | 50 | AABUS | ppm/°C | 50 | AABUS | ppm/°C | | |
| | | Post-Tg | 250 | — | ppm/°C | 250 | — | ppm/°C | 2.4.24 | |
| CTE, X-, Y-axes | | Pre-Tg | 15 | AABUS | ppm/°C | 15 | AABUS | ppm/°C | | |
| | | Post-Tg | 17 | — | ppm/°C | 17 | — | ppm/°C | 2.4.24 | |
| Z-Axis Expansion (50 – 260C) % | | 4.2 | AABUS | % | 4.2 | AABUS | % | 2.4.24 | | |
| Thermal Stress 10 Sec @ 288°C (550.4°F), spec minimum | | Unetched | Pass | Pass Visual | Rating | Pass | Pass Visual | Rating | | |
| | | Etched | Pass | Pass Visual | Rating | Pass | Pass Visual | Rating | 2.4.13.1 | |
| Dk (Permittivity, Laminate & prepreg as laminated) 1 Mhz (Fluid cell) 500Mhz and 1Ghz (HP4291) | | 1 Mhz | 4.60 | 5.4 | — | 4.60 | 5.4 | — | 2.5.5.3 | |
| | | 500 Mhz | 4.27 | — | — | 4.27 | — | — | 2.5.5.9 | |
| | | 1 Ghz | 4.25 | — | — | 4.25 | — | — | 2.5.5.5 | |
| Df (Loss Tangent, Laminate & prepreg as laminated) 1 Mhz (Fluid cell) 500Mhz and 1Ghz (HP4291) | | 1 Mhz | 0.016 | 0.035 | — | 0.016 | 0.035 | — | 2.5.5.3 | |
| | | 500 Mhz | 0.015 | — | — | 0.015 | — | — | 2.5.5.9 | |
| | | 1 Ghz | 0.015 | — | — | 0.015 | — | — | 2.5.5.5 | |
| Volume Resistivity, spec minimum | | 96/35/90 | 4.0X10 ⁸ | 1X10 ⁴ | M° -cm | 4.0X10 ⁸ | 1X10 ⁴ | M° -cm | 2.5.17.1 | |
| | | After moisture resistance at elevated temperature | 7.0X10 ⁷ | 1X10 ⁵ | M° -cm | 7.0X10 ⁷ | 1X10 ⁵ | M° -cm | | |
| Surface Resistivity, spec minimum | | 96/35/90 | 3.0X10 ⁶ | 1X10 ⁴ | M° | 3.0X10 ⁶ | 1X10 ⁴ | M° | 2.5.17.1 | |
| | | After moisture resistance At elevated temperature | 6.0X10 ⁶ | 1X10 ⁶ | M° | 6.0X10 ⁶ | 1X10 ⁶ | M° | | |
| Thermal Conductivity | | 0.36 | — | W/mK | 0.36 | — | W/mK | ASTM D5930 | | |
| Dielectric Breakdown, spec minimum | | >50 | 40 | kV | >50 | 40 | kV | 2.5.6 | | |
| Arc Resistance, spec minimum | | 120 | 60 | Seconds | 120 | 60 | Seconds | 2.5.1 | | |
| Electric Strength, spec minimum (Laminate & prepreg as laminated) | | 1100 | 736 | V/mil | 48000 | 29000 | V/mm | 2.5.6.2 | | |
| Peel Strength, spec minimum | | profile – all copper weights >17 microns | 8 | 4 | (lb/inch) | 105 | 70 | N/mm | 2.4.8 | |
| | | | Standard profile copper | | | | | | | 2.4.8.2 |
| | | -----1. After thermal stress | 9 | 6 | | 145 | 105 | | 2.4.8.3 | |
| | | 2. At 125°C (257°F) | 8 | 4 | | 125 | 70 | | | |
| | | 3. After process solutions | 9 | 4.5 | | 145 | 80 | | | |
| Moisture Absorption, spec maximum | | 0.3 | 0.8 | % | 0.3 | 0.8 | % | 2.6.2.1 | | |
| CTI | | | 3 | 175-249 | volts | | | | | |
| HWI | | | 0 | | | | | | | |
| HAI | | | 3 | | | | | | | |
| Max Operating Temp | | | 130 | | | | | | | |
| DSR | | | yes | | | | | | | |

ORDERING INFORMATION:

Contact your local sales representative or the Customer Service Department in Chandler, AZ
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 For further information visit www.isola-usa.com

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