

/// Datasheet

TC350™ Laminates

Thermal Conductivity Ceramic Filled PTFE/Woven Fiberglass Laminate for Printed Circuits Boards

TC350™ fiberglass reinforced, ceramic-filled, PTFE-based composite for printed circuit board substrates, offers outstanding thermal conductivity to enhance heat transfer, thereby reducing dielectric and insertion loss. This leads to higher gains and efficiencies in amplifiers and antennas. Its increased thermal conductivity handles higher power, reduces hot-spots, and boosts device reliability. TC350 laminates are effective in designs with limited thermal management, improving heat transfer through the laminate, lowering junction temperatures, and extending the lifespan of active components. This is vital for power amplifier reliability, increasing MTBF, and minimizing warranty costs. Additionally, its lower operating temperatures and matching thermal expansion characteristics with chips enhance component attachment reliability, reducing issues like solder fatigue and joint failure.

TC350 laminates maintain excellent dielectric constant stability across various temperatures, crucial for power amplifier and antenna designers in maximizing gain and minimizing bandwidth loss. This stability is also key for phase and impedance sensitive devices like network transformers in power amplifiers or Wilkinson Power Dividers.

The laminate's low Z-Direction CTE matches copper, ensuring exceptional plated through-hole reliability. TC350 laminates, being a 'soft substrate', is resistant to stress from vibration and impact, meeting modern drop testing standards. It bonds strongly to copper using microwave grade, low profile copper, avoiding the need for 'toothy copper' used in ceramic hydrocarbons. This smooth copper results in even lower insertion loss, particularly beneficial at higher RF and microwave frequencies

/// Features and Benefits:

- Excellent Thermal Conductivity (0.72 W/mK) and Dielectric Constant Stability across wide temperatures (-9 ppm/°C)
- Very Low Loss Tangent provides higher amplifier or antenna efficiency
- Priced affordably for commercial applications
- Easier to drill than traditional commercial based laminates utilizing thick and dense style woven glass
- High Peel Strength for Reliable Copper Adhesion in thermally stressed applications
- Heat Dissipation and Management
- Improved Processing and Reliability
- Large Panel Sizes for Multiple Circuit Layout for lowered Processing Costs

/// Typical Applications:

- Power Amplifiers, Filters and Couplers
- Tower Mounted Amplifiers(TMA) and Tower Mounted Boosters (TMB)
- Thermally Cycled Antennas sensitive to dielectric drift
- Microwave Combiner and Power Dividers

/// Standard Offerings

| Standard Thicknesses | Standard Panel Sizes | Standard Claddings | |
|--|--|--|---|
| 0.010" (0.252mm) +/- 0.0007" 0.020" (0.508mm) +/- 0.0015" 0.030" (0.762mm) +/- 0.0020" 0.060" (1.524mm) +/- 0.0030" | .010": 18" X 12" (475 X 305mm) 18" X 24" (475 X 610mm) All Other Thicknesses: 12" X 18" (305 X 457mm) 24" X 18" (610 X 457mm) | .010": <u>Reverse Treated Electrodeposited Copper Foil</u> 1/2 oz. (18µm) 1 oz. (35µm) All Other Thicknesses: <u>Electrodeposited Copper Foil</u> 1/2 oz. (18µm) 1 oz. (35µm) | <u>Reverse Treated Electrodeposited Copper Foil</u> 1/2 oz. (18µm) 1 oz. (35µm) |

*Contact Customer Service or Sales Engineering to inquire about other available product configurations including additional thicknesses, panel sizes and claddings.

Standard Properties Table

| Properties | Typical Value | Units | Test Conditions | | Unit |
|--|----------------------------|-------------------|-------------------------------|----------------------------|---|
| Electrical Properties | | | | | |
| Dielectric Constant (Process) | 3.50 | - | 23°C | 1 MHz 1.8 GHz 10 GHz | IPC TM-650 2.5.5.3 Resonant Cavity IPC TM-650 2.5.5.5 |
| Dissipation Factor | 0.0015 0.0018 0.0020 | - | 23°C | 1 MHz 1.8 GHz 10 GHz | IPC TM-650 2.5.5.3 Resonant Cavity IPC TM-650 2.5.5.5 |
| Thermal Coefficient of Dielectric Constant | -9 | ppm/°C | -40°C to 150°C | 10 GHz | IPC TM-650 2.5.5.5 |
| Volume Resistivity | 7.4 x 10 ⁶ | MΩ-cm | C96/35/90 | | IPC TM-650 2.5.17.1 |
| | 1.4 x 10 ⁸ | | E24/125 | | |
| Surface Resistivity | 3.2 x 10 ⁷ | MΩ | C96/35/90 | | |
| | 4.3 x 10 ⁸ | | E24/125 | | |
| Electrical Strength (Dielectric Strength) | 780 (31) | Volts/mil (kV/mm) | - | | IPC TM-650 2.5.6.2 |
| Dielectric Breakdown | 40 | kV | - | | IPC TM-650 2.5.6 |
| Arc Resistance | >240 | sec | - | | IPC TM-650 2.5.1 |
| Thermal Properties | | | | | |
| Decomposition Temp (Td) | 520 | °C TGA | Initial | | IPC TM-650 2.4.24.6 |
| | 567 | | 5% | | |
| Time to Delamination | >60 | Minutes | T260, T288, T300 | | IPC TM-650 2.4.24.1 |
| Coefficient of Thermal Expansion | X | ppm/°C | 50°C to 150°C | | IPC TM-650 2.4.41 |
| | Y | | | | |
| | Z | | | | |
| % z-axis Expansion | 1.2 | % | 50°C to 260°C | | IPC TM-650 2.4.24 |
| Thermal Conductivity | 0.72 | W/(mK) | - | | ASTM D5470 |
| Specific Heat | 0.90 | J/g/K | - | | ASTM D5470 |
| Mechanical Properties | | | | | |
| Copper Peel Strength | 7 (1.2) | lbs/in (N/mm) | 35 μm foil | After Thermal Stress | IPC TM-650 2.4.8 |
| | 9 (1.6) | | | At 150°C | IPC TM-650 2.4.8.2 |
| | 7 (1.2) | | | After Process Solutions | IPC TM-650 2.4.8 |
| Tensile Strength (MD, CMD) | 11, 8 (76, 55) | kpsi (MPa) | - | | IPC TM-650 2.4.18.3 |
| Flexural Strength (MD, CMD) | 14, 10 (97, 69) | kpsi (MPa) | - | | IPC TM-650 2.4.4 |
| Physical Properties | | | | | |
| Flammability | V-0 | - | - | | UL 94 |
| Moisture Absorption | 0.05 | % | - | | IPC TM-650 2.6.2.1 |
| Density | 2.3 | g/cm ³ | METHOD A | | ASTM D792 |
| NASA Outgassing | Total Mass Loss | 0.02 | 125°C, ≤10 ⁻⁶ torr | | NASA SP-R-0022A |
| | Collected Volatiles | 0.01 | | | |
| | Water Vapor Recovered | 0.01 | | | |

Dielectric Constant may vary by test method or based on specific metal plate or composite constructions. Contact your representative with any specific questions.

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