ROGERS CORPORATION

\\\ Datasheet

TC350™ Laminates

Enhanced Thermal Conductivity Ceramic Filled PTFE/Woven Fiberglass Laminate for Microwave 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:

- "Best in Class" Thermal Conductivity(1.0 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) andTower 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":** Reverse Treated Electrodeposited Copper Foil 1/2 oz. (18µm) 1 oz. (35µm) **All Other Thicknesses:** Electrodeposited Copper Foil 1/2 oz. (18µm) 1 oz. (35µm)	Reverse Treated Electrodeposited Copper Foil 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	7.4×10^6	MΩ•cm	C96/35/90		IPC TM-650 2.5.17.1
	1.4×10^8		E24/125		
Surface Resistivity	3.2×10^7	MΩ	C96/35/90		
	4.3×10^8		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	7	ppm/°C	50˚C to 150˚C		**IPC TM-650 2.4.41**
Y	7				
Z	**23**				
% z-axis Expansion	1.2	%	50˚C to 260ºC		IPC TM-650 2.4.24
Thermal Conductivity	0.72	W/(m·K)	-		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 150ºC	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/cm³	METHOD A		ASTM D792
NASA Outgassing Total Mass Loss	0.02	%	125ºC, ≤10-⁶ torr		NASA SP-R-0022A
NASA Outgassing Collected Volatiles	0.01				
NASA Outgassing 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.

\\\ 100 S. Roosevelt Avenue \\\ Chandler, AZ 85226 \\\ Tel: 480-961-1382 \\\ Fax: 480-961-4533 \\\ www.rogerscorp.com

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