ARLON
MICROWAVE MATERIALS

TC350

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

Features:

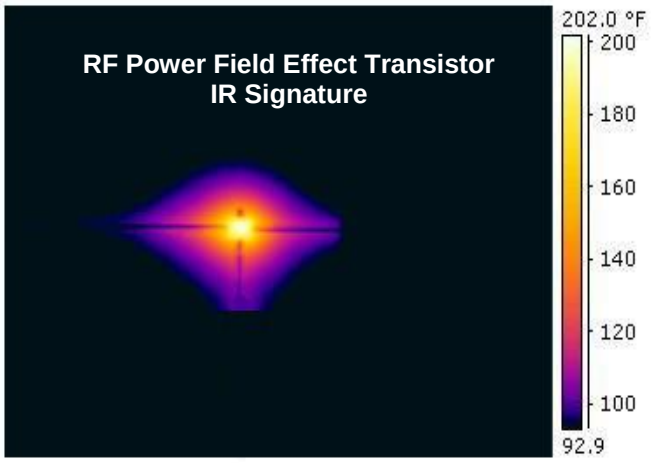
- "Best in Class" Thermal Conductivity and Dielectric Constant Stability across Wide Temperatures
- Very Low Loss Tangent provides Higher Amplifier or Antenna Efficiency
- Priced Affordably for Commercial Applications
- Easier to drill than traditional commercial based laminates utilizing thick and dense style woven glass
- High Peel Strength for Reliable Copper Adhesion in thermally stressed applications

Benefits:

- 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



Arlon's TC350 is a woven fiberglass reinforced, ceramic filled, PTFE-based composite for use as a printed circuit board substrate. TC350 is designed to provide enhanced heat-transfer through *"Best-In-Class"* thermal conductivity, while reducing dielectric loss and insertion loss. Lower losses result in higher Amplifier and Antenna Gains/Efficiencies.

The increased thermal conductivity of TC350 provides higher power handling, reduces hot-spots and improves device reliability. This higher heat transfer within the substrate complements designs using coins, heat sinks or thermal vias to provide designers additional design margin in managing heat. In designs with limited thermal management options, TC350 significantly improves heat transfer where the primary thermal path is through the laminate. This results in reduced junction temperatures and extends the life of active components, which is critical for improving power amplifier reliability, extending MTBF and reducing warranty costs. In addition, lower operating temperatures and chip-matching thermal expansion characteristics provide better reliability for component attachment prone to solder fatigue, solder softening and joint failure.

TC350 has excellent Dielectric Constant Stability across a wide temperature range. This helps Power Amplifier and Antenna designers maximize gain and minimize dead bandwidth lost to dielectric constant drift as operating temperature changes. Dielectric constant stability is also critical to phase and impedance sensitive devices such as network transformers utilized for impedance matching networks utilized in power amplifier circuitry or in Wilkinson Power Dividers.

TC350 has low Z-Direction CTE which matches copper. This feature provides unsurpassed plated through hole reliability. TC350 is a "soft substrate" and relatively insensitive to stress from vibration and impact from today's drop testing requirements.

TC350 enjoys a strong bond to copper, utilizing microwave grade, low profile copper. Unlike ceramic hydrocarbons that need to utilize "toothy copper" to achieve acceptable bond, TC350 utilizes relatively smooth copper. This results in even lower insertion loss due to skin effect losses of copper that are more obvious at higher RF and microwave frequencies.

Typical Properties: TC350			
Property	**Test Method**	**Condition**	**Result**
Dielectric Constant (10 GHz)	IPC TM-650 2.5.5.5a	C23/50	3.50
Dissipation Factor (10 GHz) Dissipation Factor (1.8 GHz)	IPC TM-650 2.5.5.5a DM-185-AR	C23/50 C23/50	0.0020 0.0018
Thermal Coefficient of εr (ppm/°C)	IPC TM-650 2.5.5.5 Adapted	-50°C to +140°C	–9
Arc Resistance (seconds)	ASTM D-495	D48/50	240
Density (g/cm^3)	ASTM D-792 Method A	A, 23°C	2.30
Water Absorption (%)	IPC TM-650 2.6.2.1	E1/105 + D24/23	0.05
Coefficient of Thermal Expansion (ppm/°C) X Axis Y Axis Z Axis	IPC TM-650 2.4.24 TMA	0°C to 100°C	 7 7 23
Thermal Conductivity (W/mK)	ASTM D5470	50°C, Both 25 psi and 432 psi	1.0
Peel Strength (lbs per inch)	IPC TM-650 2.4.8	After thermal stress	7
Outgassing Total Mass Loss (%) Collected Volatile Condensable Material (%) Water Vapor Recovered Visible Condensate (±)	NASA SP-R-0022A Maximum 1.00% Maximum 0.10%	125°C, ≤10^{-6} torr	 0.02% 0.01% 0.01% NO
Flammability	UL 94 Vertical Burn IPC TM-650 2.3.10	C48/23/50, E24/125	Meets requirements of UL94-V0

Material Availability:

TC350 laminate is supplied with 1/2, 1 or 2 ounce electrodeposited copper on both sides. Other copper weights and rolled copper foil are available. TC350 is available bonded to heavy metal ground planes. Aluminum, brass or copper plates also provide an integral heat sink and mechanical support to the substrate.

When requesting samples of TC350 product, please specify thickness, cladding, panel size, and any other special considerations. Panel sizes cut from a master sheet include: 12" x 18", 18" X 24", 16" X 18". Contact Customer Service for other custom panel sizes.

TC350 Laminate

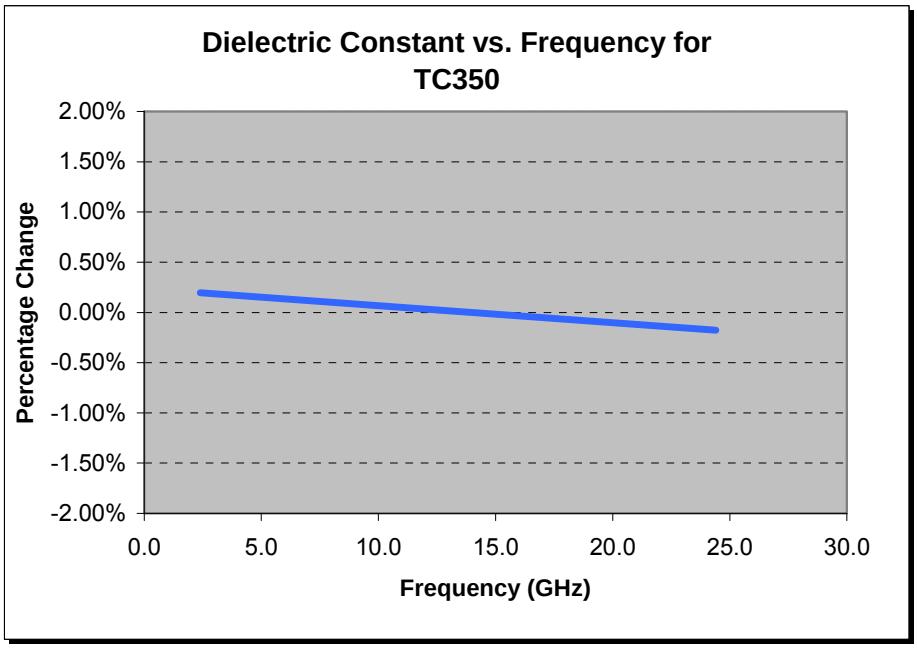


Figure 1

Demonstrates the Stability of Dielectric Constant across Frequency. This information was correlated from data generated by using a free space and circular resonator cavity. This characteristic demonstrates the inherent robustness of Arlon Laminates across Frequency, thus simplifying the final design process when working across EM spectrum. The stability of the Dielectric Constant of TC350 over frequency ensures easy design transition and scalability of design.

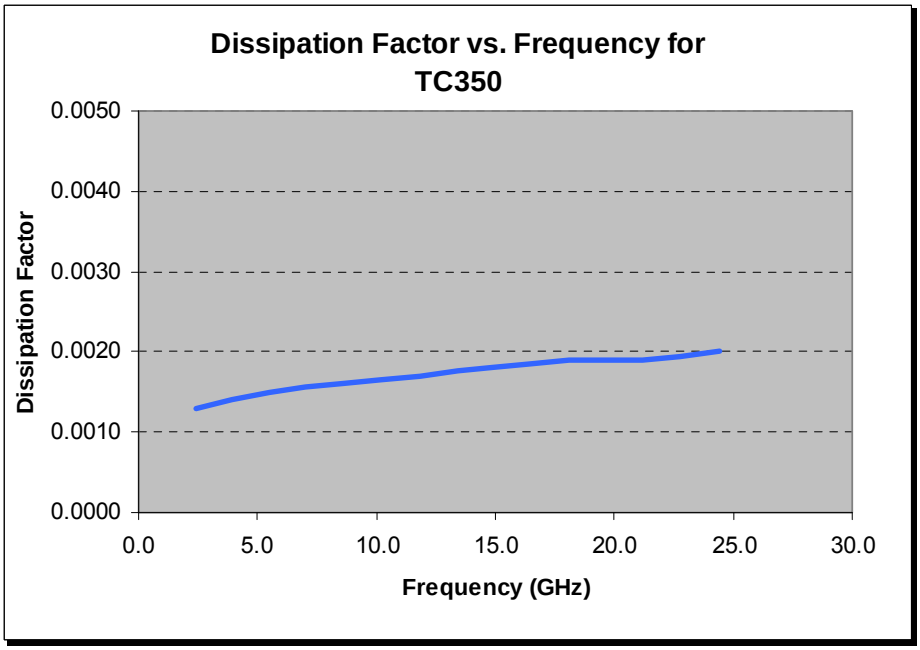


Figure 2

Demonstrates the Stability of Dissipation Factor across Frequency. This characteristic demonstrates the inherent robustness of Arlon Laminates across Frequency, providing a stable platform for high frequency applications where signal integrity is critical to the overall performance of the application.

Resonant Cavity Methods yielded slightly lower Dissipation Factor results than IPC 650-TM 2.5.5.5. Df across 1.8 GHz to 25.6 GHz averaged 0.0017 in the Z-Axis. Dielectric loss best correlates with Z-Axis (E-field perpendicular to the board) as the signal propagation down the length of the board maintains the E-Field perpendicular to the plane of the board (right hand rule), such as a microstrip or stripline design.

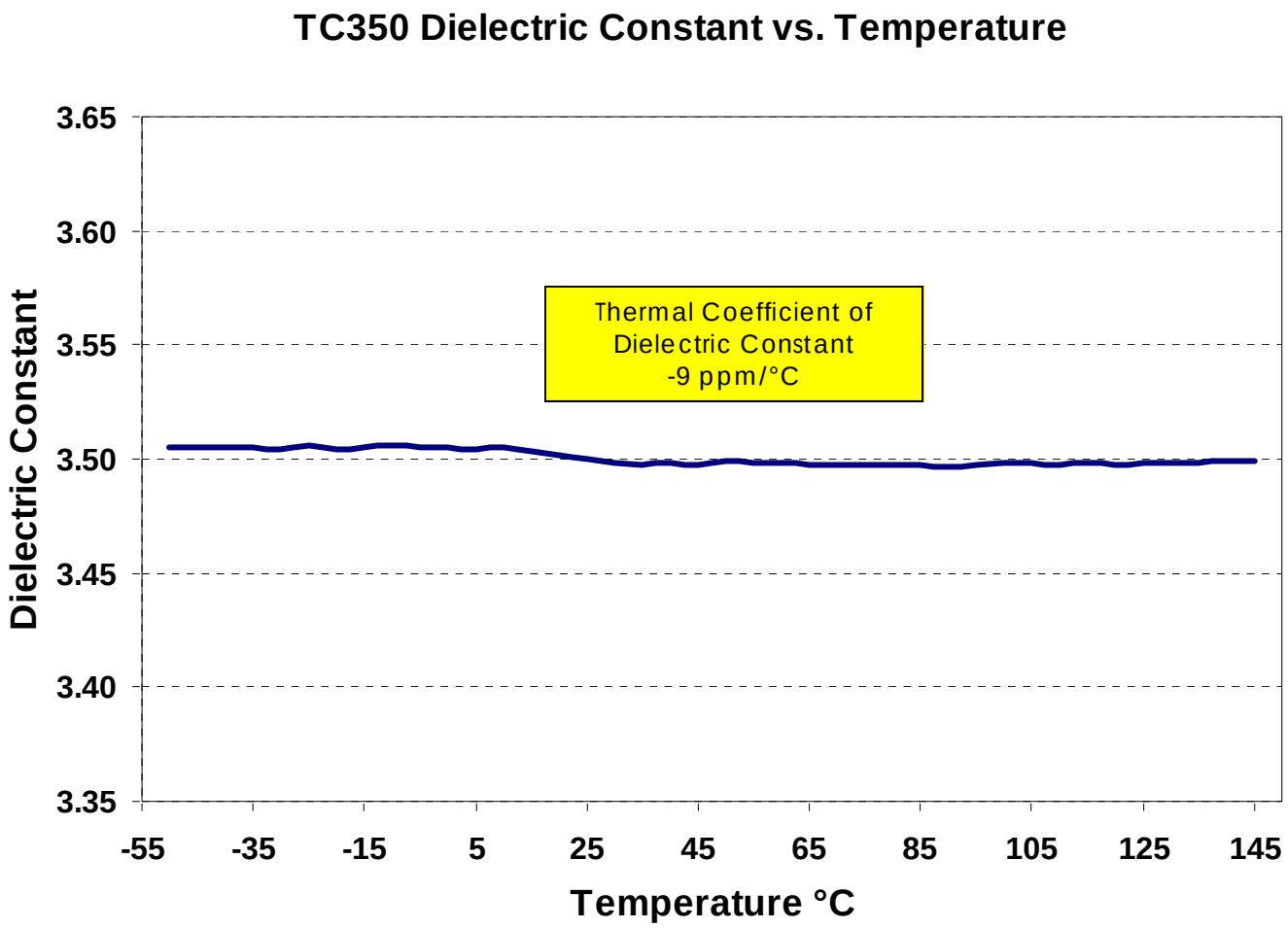


Figure 3

DIELECTRIC CONSTANT/TEMPERATURE CURVE shows the "Best-in-Class" thermal stability properties of TC350 when thermocycled over a wide temperature range. This helps Power Amplifier and Antenna designers minimize dead bandwidth which is lost to dielectric constant drift as operating temperature changes.

For antenna designs, a significant shift in Resonance Frequency and bandwidth roll off at specific frequencies, results in lower gain performance. The thermal stability feature is critical to phase sensitive devices such as impedance network transformers utilized for matching networks of power amplifiers as well phase sensitive transformers used in Wilkinson Power Dividers. Quarter Wave Transformers, etc..

TECHNOLOGY ENABLING INNOVATION

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ISO 9001:2000 CERTIFICATION Intertek

Rev H
Jan, 2009

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