ARLON MICROWAVE MATERIALS

TC600

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

Features:
- "Best in Class" Thermal Conductivity and Dielectric Constant Stability across Wide Temperatures
- Very Low Loss Tangent provides Higher Amplifier or Antenna Efficiency
- Mechanically Robust; replaces brittle laminates that cannot withstand processing, impact or High G forces
- Priced Affordably for Commercial Applications
- High Peel Strength for Reliable Narrow Lines

Benefits:
- Heat Dissipation and Management
- Replace Ceramic in Some Applications
- Improved Processing and Reliability
- Large Panel Sizes for Multiple Circuit Layout for lowered Processing Costs

Typical Applications:
- Power Amplifiers, Filters and Couplers
- Microwave Combiner and Power Divider Boards in Avionics Applications
- Small Footprint Antennas
- Digital Audio Broadcasting (DAB) Antennas (Satellite Radio)

Arlon's TC600 is a woven fiberglass reinforced, ceramic filled, PTFE-based composite for use as a printed circuit board substrate. TC600 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. Mechanical robustness is also greatly improved for the 6.15 dielectric constant market.

The increased thermal conductivity of TC600 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, TC600 significantly improves heat transfer where the primary thermal path is through the laminate. This results in reduced in 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.

TC600 has *"Best-In-Class"* 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 sensitive devices such as network transformers utilized for impedance matching networks utilized in power amplifier circuitry.

TC600 has low Z-Direction CTE. This feature provides unsurpassed plated through hole reliability. TC600 is a "soft substrate" and irrelatively insensitive to stress from vibration. Its robust nature overcomes the brittleness of thermoset ceramic loaded hydrocarbons or ceramics (such as alumina or LTCC) through suspension of micro-dispersed ceramics in a relatively soft, woven fiberglass reinforced PTFE-based substrate. This gives RF designers the advantage of low loss, without sacrificing mechanical robustness required to fulfill the needs of shock, drop and impact testing requirements of electronics. It is preferred by board manufacturers, as it can be easily cut, drilled and routed without being sensitive to cracking.

Typical Properties: TC600			
Property	**Test Method**	**Condition**	**Result**
Dielectric Constant (10 GHz)	IPC TM-650 2.5.5.5	C23/50	6.15
Dissipation Factor (10 GHz) Dissipation Factor (1.8 GHz)	IPC TM-650 2.5.5.5 DM-185-AR	C23/50 C23/50	0.0020 0.0017
Thermal Coefficient of εr (ppm/°C)	IPC TM-650 2.5.5.5 Adapted	-50°C to +140°C	-75
Arc Resistance (seconds)	ASTM D-495	D48/50	>240
Density (g/cm^3)	ASTM D-792 Method A	A, 23°C	3.20
Water Absorption (%)	IPC TM-650 2.6.2.1	E1/105 + D24/23	0.03
Coefficient of Thermal Expansion (ppm/^{o}C) X Axis Y Axis Z Axis	IPC TM-650 2.4.24 TMA	0°C to 100°C	 9 9 35
Thermal Conductivity (W/mK) Z-Direction (thru) X,Y Direction (in-plane)	ASTM E-1461	100°C	 1.1 1.4
Peel Strength (lbs per inch)	IPC TM-650 2.4.8	After thermal stress	8
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% 0.00% 0.00% NO
Flammability	UL 94 Vertical Burn IPC TM-650 2.3.10	C48/23/50, E24/125	Meets requirements of UL94-V0

Material Availability:

TC600 laminate is supplied with 1/2, 1 or 2 ounce electrodeposited copper on both sides. Other copper weights and rolled copper foil are available. TC600 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 TC600 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.

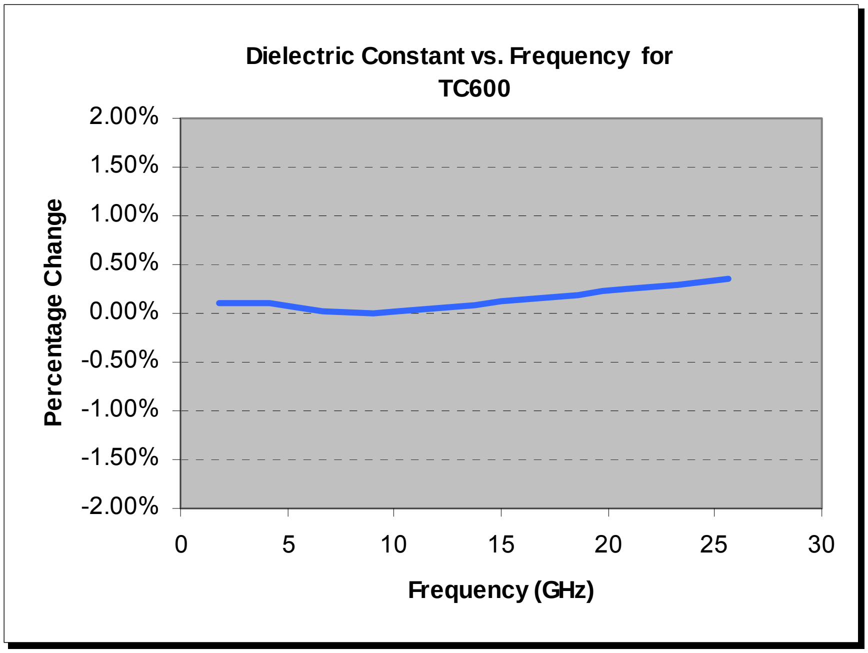

Figure 1

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 TC600 over frequency ensures easy design transition and scalability of design.

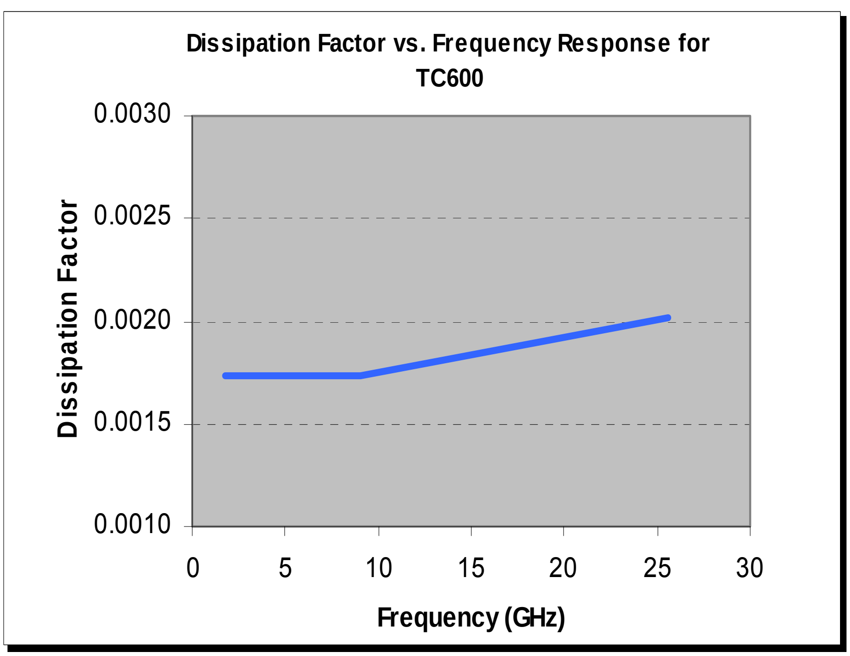

Figure 2

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 lower Dissipation Factor results than IPC 650-TM 2.5.5.5. Df across 1.8 GHz to 25.6 GHz averaged 0.0018 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.

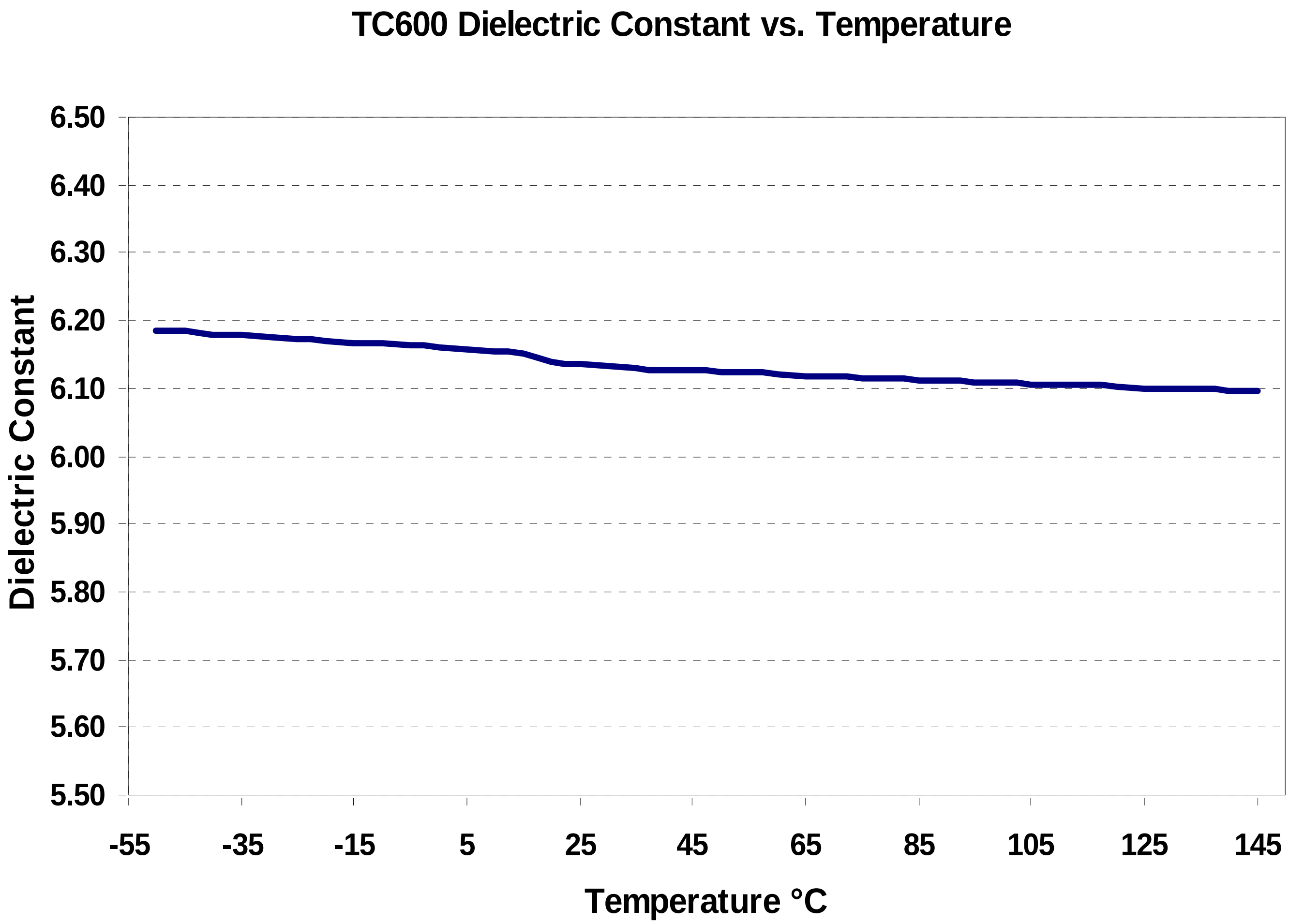

Figure 3

DIELECTRIC CONSTANT/TEMPERATURE CURVE shows the unique thermal stability properties of TC600 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.

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TECHNOLOGY ENABLING INNOVATION

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