ARLON
MICROWAVE MATERIALS

CLTE-LC

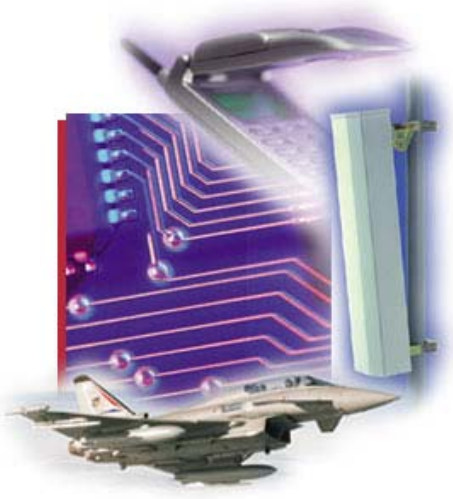
Dimensionally and Electrically Stable Microwave Printed Circuit Board Substrate

Features:

- Electrically Stable Er
- Dimensionally Stable
- Low Z Expansion
- Low Er and Loss
- High Thermal Conductivity
- Low Water Absorption

Benefits:

- Optimized circuit performance over a range of conditions
- Low propagation delay; minimizes power consumption
- Increased heat dissipation for improved performance in high power circuits
- Improved electrical performance



Arlon's CLTE-LC is a ceramic-filled, woven fiberglass reinforced PTFE composite engineered to produce a dimensionally and electrically stable, low water absorption laminate with a nominal dielectric constant of 2.94. It is designed to offer all of the same properties and functionality as Arlon's CLTE, but, in most cases, at a reduced cost.

CLTE-LC is engineered to minimize the change in Er caused by the second order phase transition of the molecular structure of PTFE at 19°C. This temperature stability simplifies circuit design and optimizes circuit performance in many microwave applications, such as phased array antennas. CLTE-LC provides reduced Z-direction thermal expansion (nearer to the expansion rate of copper). This improves plated hole reliability as it remains stable in thermal cycling experienced in process, assembly and finished PCB use. CLTE-LC also provides high thermal conductivity to allow heat dissipation for improved performance in high-powered circuits.

Typical Properties: CLTE-LC			
Property	**Test Method**	**Condition**	**Result**
Dielectric Constant @10 GHz	IPC TM-650 2.5.5.5	C23/50	2.94 *varies by thickness*
Dissipation Factor @10 GHz	IPC TM-650 2.5.5.5	C23/50	0.0025
Thermal Coefficient of Er (ppm/°C)	IPC TM-650 2.5.5.5 Adapted	-10°C to +140°C	See Figure 4
Peel Strength (lbs. per inch)	IPC TM-650 2.4.8	After Thermal Stress	7
Volume Resistivity (MΩ-cm)	IPC TM-650 2.5.17.1	C96/35/90	1.4×10^{8}
Surface Resistivity (MΩ)	IPC TM-650 2.5.17.1	C96/35/90	1.3×10^{6}
Arc Resistance (seconds)	ASTM D-495	D48/50	>180
Tensile Modulus (kpsi) x,y	ASTM D-638	A, 23°C	471, 462
Tensile Strength (kpsi) x,y	ASTM D-882	A, 23°C	8.2, 7.0
Compressive Modulus (kpsi)	ASTM D-695	A, 23°C	225
Flexural Modulus (kpsi)	ASTM D-790	A, 23°C	375
Dielectric Breakdown (kV)	ASTM D-149	D48/50	> 45
Density (g/cm^3)	ASTM D-792 Method A	A, 23°C	2.38
Water Absorption (%)	MIL-S-13949H 3.7.7 IPC TM-650 2.6.2.2	E1/105 + D24/23	0.04
Coefficient of Thermal Expansion (ppm/°C) X Axis Y Axis Z Axis	IPC TM-650 2.4.24 Mettler 3000 Thermomechanical Analyzer	0°C to 100°C	 10 12 35
Thermal Conductivity (W/mK)	ASTM E-1225	100°C	0.50
Flammability (UL File E 80166)	UL 94 Vertical Burn IPC TM-650 2.3.10	C48/23/50, E24/125	Meets requirements of UL94-V0

Material Availability:

CLTE-LC laminates are supplied with 1/2, 1 or 2 ounce electrodeposited copper on both sides. Other copper weights and rolled copper foil are available. CLTE-LC is available bonded to a heavy metal ground plane. Aluminum, brass or copper plates also provide an integral heat sink and mechanical support to the substrate. CLTE-P prepreg is available to match the stable electrical and mechanical performance characteristics of CLTE-LC laminates. When ordering CLTE-LC products, please specify thickness, cladding, panel size and any other special considerations. Available master sheet sizes include 36" x 48" and 36" x 72".

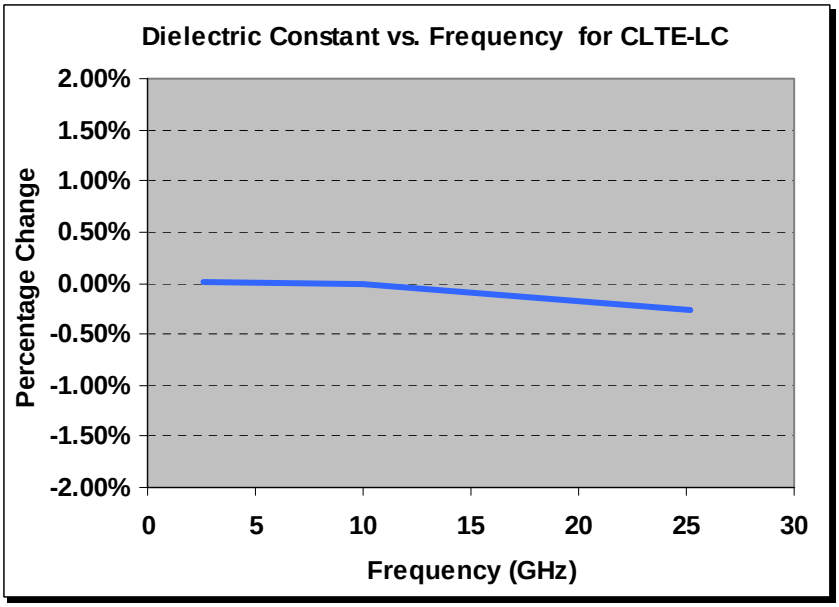


Figure 1

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 CLTE-LC over frequency ensures easy design transition and scalability

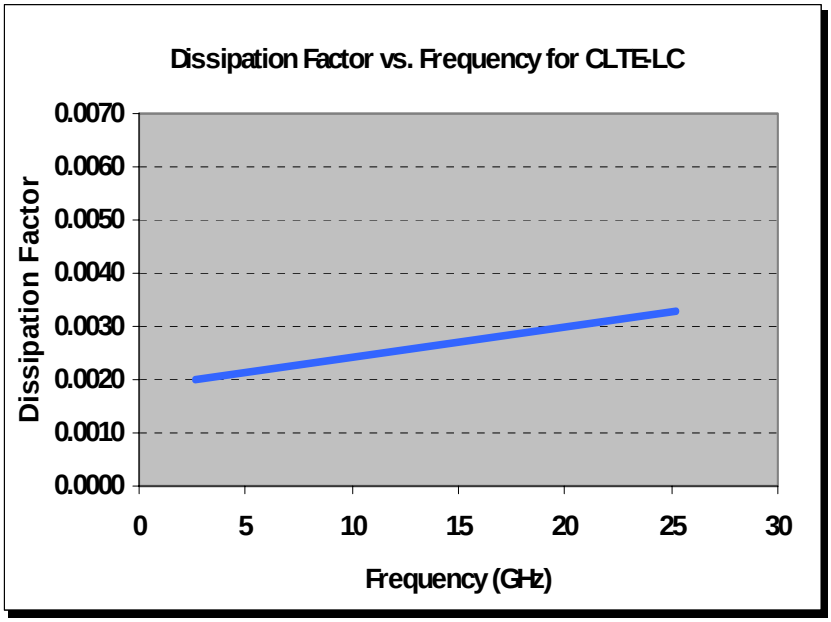


Figure 2

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.

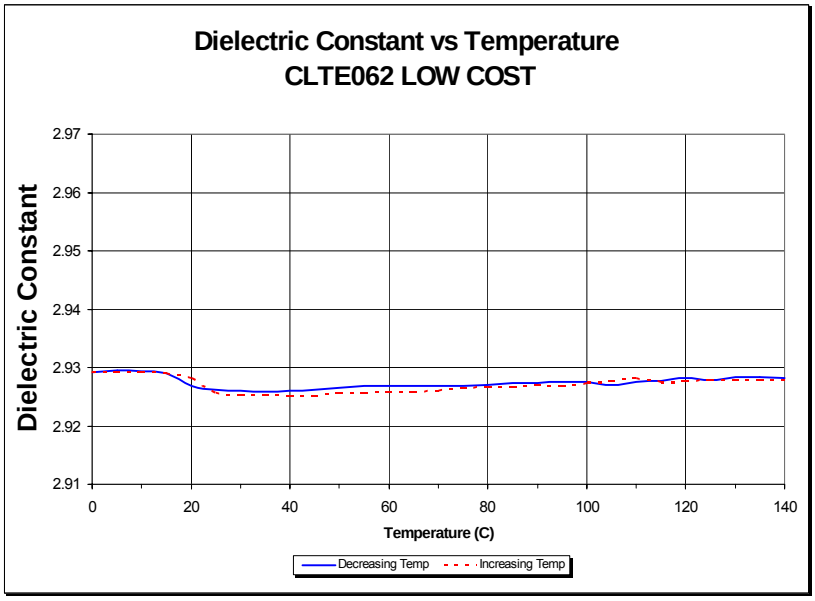


Figure 3

Er/Temperature Curve shows the unique thermal stability properties of CLTE-LC materials over temperature. Even over a wide temperature variation, the material retains its ultra-stable dielectric constant characteristics.

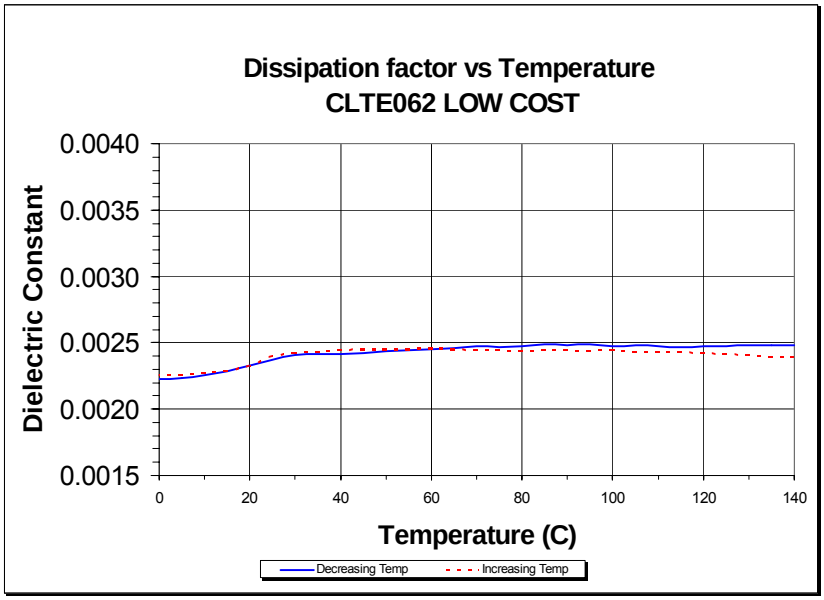


Figure 4

DF/Temperature Curve shows the unique thermal stability properties of CLTE-LC materials over temperature.

Multilayer Lamination Recommendations

Following the use of conventional imaging and etching processes, successful fabrication of multilayer circuit assemblies using the CLTE-P prepreg with the CLTE-LC series laminates can be achieved through use of the following recommendations.

1. Prepreg Material

The prepreg material consists of woven fiberglass fabric coated with a proprietary resin formulation. The pressed thickness of CLTE-P is approximately 0.0024" per ply.

2. Surface Preparation

a. Substrate surface - No additional surface treatment, either mechanical or chemical, should be necessary to achieve good adhesion. This recommendation is based upon multilayer lamination performed immediately after etching of the copper surface. For panels that have a long wait time between etching and lamination, a sodium etch (or plasma etch process appropriate for PTFE) of the CLTE-LC laminate surface will provide optimal results.
b. Copper surfaces - Microetch and dry the inner layer copper surfaces immediately prior to lay-up and lamination. Standard FR-4 black oxide processes may not provide optimal results due to the high lamination temperatures required to bond CLTE-P. Brown or red oxide treatments may improve the bond to large copper plane areas.

3. Lamination

a. Equipment - A press which has heat and cool cycles in the same opening is recommended. This ensures that constant pressure can be maintained throughout both the heat-up and cool-down cycle.
b. Temperature - CLTE-P requires a lamination temperature of 565°F/296°C to allow sufficient flow of the resin. The lamination temperature should be measured at the bond line using a thermocouple located at the edge of the product panel. Because of the high temperatures required for lamination, noncombustible peripheral materials, such as separator sheets and press padding material, should be used. Epoxy separator sheets are not recommended as they may char or burn. Paper and certain rubber press padding materials are also not recommended for similar reasons.
c. Pressure (400 psi actual) - A pressure of 400 psi is recommended to remove any entrapped air and force the flow of the prepreg into the exposed “tooth” present on the surface of the laminate. This pressure must be maintained throughout the full extent of the heating and cooling cycles.
d. Heat-up and cool-down rate - since CLTE-P is a thermoplastic material, precise control of heat up and cool down rates is not critical.
e. Time at laminating temperature (45 minutes)- Good adhesion will be achieved by maintaining the recommended laminating temperature for a period of 45 minutes.

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2010 Rev B