ARLON
MICROWAVE MATERIALS

CLTE-XT

The Next Generation of CLTE with Lowest Loss in its Class

Excellent Dimensional Stability with Highest Degree of Phase Stability vs. Temperature

Features:

- Ceramic/PTFE Microwave Composite
- Lowest Insertion Loss in Class
- "Best-in-Class" Loss Tangent (0.0012)
- Electrical Phase Stability vs. Temperature
- High Thermal Conductivity
- Tightest Dielectric Constant (±0.03) and Thickness Tolerance

Benefits:

- Excellent Thermal Stability of DK and Df
- Phase Stability across temperature
- High Degree of Dimensional Stability required for complex, multi-layer boards
- Excellent CTE in X,Y and Z Directions

Typical Applications:

- Defense Microwave/RF Applications
- Radar Manifolds
- Phase Fed Array Antennas
- Microwave Feed Networks
- CNI (communication, navigation and identification) Applications
- SIGINT, Satellite & Space Electronics
- Phase Sensitive Electronic Applications

CLTE-XT represents the e**X**tended **T**echnology of the existing **CLTE** product line. CLTE-XT is a micro dispersed ceramic PTFE composite utilizing a woven fiberglass reinforcement to provide the highest degree of dimensional stability, critical in multi-layer designs. CLTE-XT is in a "League of its Own" when utilizing thin (i.e. 0.005" and 0.010") substrates or when CLTE-XT is combined with thin film resistor-conductor materials such as Ohmega-Ply® and TCR® foils utilized for embedded resistors.

CLTE-XT has "Best-in-Class" Insertion Loss (S21) and Loss Tangent (0.0012). During Development, Arlon focused not only reducing Loss Tangent, but, also in reducing Conductive Losses. As a result, CLTE-XT Insertion Loss is "Best-In-Class".

The impact of copper foil roughness on conductor loss is due to increase in transmission line resistance as a result of skin effect. Arlon's CLTE-XT was designed to provide a quality peel strength without having to resort to the utilization of the lossier, rougher coppers prevalent in competitive products to achieve acceptable copper adhesion.

CLTE-XT has Low CTExyz and Very Low TCEr for applications that require Electrical Phase Stability, DK Stability, and Mechanical Stability well over a -55 to 150°C Operating Temperature. CLTE-XT continues the competitive advantages of CLTE (dimensional stability, low absorption of moisture and processing chemicals, ease of processability). The higher thermal conductivity of CLTE-XT improves heat transfer relative to alternative materials and enables better power handling.

Applications include Space and Military Electronics who require a higher degree of performance such as Phase Sensitive Arrays for Radar, RF/Microwave Communications, Aircraft Collision Avoidance Systems, JTRS, etc. CLTE-XT is also a preferred material for sensitive filter applications.

Typical Properties: CLTE-XT			
Property	**Test Method**	**Condition**	**Result**
Dielectric Constant @10GHz	IPC TM-650 2.5.5.5	C23/50	2.94
Dissipation Factor @10 GHz	IPC TM-650 2.5.5.5	C23/50	0.0012
Thermal Coefficient of Er	IPC TM-650 2.5.5.5 Adapted	-40°C to +150°C	- 9
Peel Strength (lbs. per inch)	IPC TM-650 2.4.8	After Thermal Stress	7.2
Volume Resistivity (MΩ-cm)	IPC TM-650 2.5.17.1	C96/35/90	4.25×10^8
Surface Resistivity (MΩ)	IPC TM-650 2.5.17.1	C96/35/90	2.49×10^8
Arc Resistance (seconds)	ASTM D-495	D48/50	250
Tensile Modulus (kpsi)	ASTM D-638	A, 23°C	242
Tensile Strength (kpsi)	ASTM D-882	A, 23°C	6.4
Compressive Modulus (kpsi)	ASTM D-695	A, 23°C	244
Flexural Modulus (kpsi)	ASTM D-790	A, 23°C	430
Dielectric Breakdown (kv)	ASTM D-149	D48/50	58
Specific Gravity or Mass (g/cm^3)	ASTM D-792 Method A	A, 23°C	2.02
Water Absorption (%)	MIL-S-13949H 3.7.7 IPC TM-650 2.6.2.2	E1/105 + D24/23	0.02
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	 8 8 20
Thermal Conductivity (W/mK)	ASTM E-1225	100°C	0.56
Outgassing Total Mass Loss (%) Collected Volatile Condensable Material (%) Water Vapor Recovered Visible Condensate (±)	NASA SP-R-0022A Maximum 1.00% Maximum 0.10%	1.25°≤10-6 torr	 0.02% 0.00% 0.01% NO
Flammability (UL File E 80166)	UL 94 Vertical Burn IPC TM-650 2.3.10	C48/23/50, E24/125	UL94V-0

Material Availability:

CLTE-XT laminates are supplied with 1/2, 1 or 2 ounce electrodeposited copper or reverse treat copper on both sides. Other copper weights and rolled copper foil are available. CLTE-XT 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. When ordering CLTE products please specify thickness, cladding, panel size and any other special considerations. Available master sheet sizes include 36" x 48", 36" x 72" and 48" x 54". Typical panel sizes include (but, are not limited to): 12" x 18", 16" x 18" and 18" x 24".

For design purposes it is important to note that both thicknesses and dielectric constant of CLTE-XT vary with nominal thickness. The following are optimal values to use for design:

Thickness Specification	0.0052 ±0.0005	0.0094 ±0.0007	0.020 ±0.001	0.025 ±0.001	0.030 ±0.001	0.040 ±0.002	0.045 ±0.002	0.059 ±0.002	0.060 ±0.002
Thickness Mean	0.0052	0.0094	0.020	0.025	0.030	0.040	0.045	0.059	0.060
Dielectric Constant specification (10 GHz)	2.79 ±.03	2.89 ±.03	2.92 ±.03	2.94 ±.03	2.94 ±.03	2.94 ±.03	2.94 ±.03	2.95 ±.03	2.94 ±.03

**** Thicker Options are available. Please Contact Customer Service or your Local Arlon***

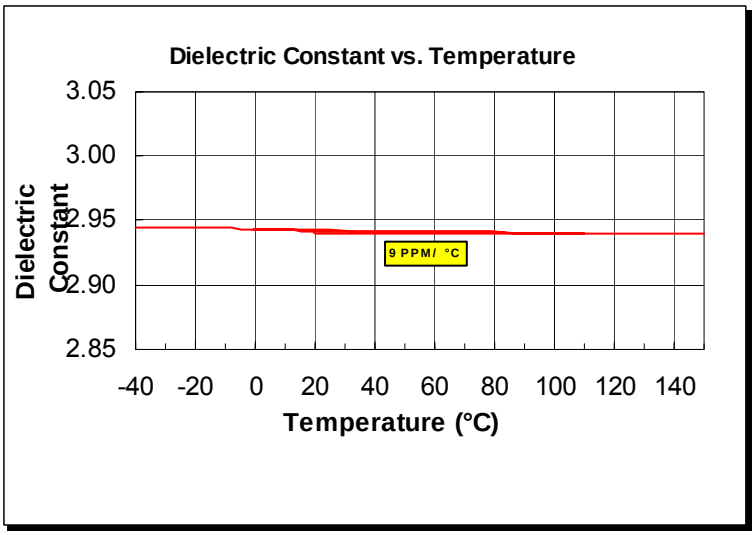

FIGURE 3

DK/TEMPERATURE CURVE shows the unique thermal stability properties of CLTE-XT materials when thermocycled over temperature. Even over a wider temperature variation, the material retains its ultra-stable dielectric constant characteristics. This feature is critical to phase sensitive devices, and phase fed apertures that must perform over a wide temperature range.

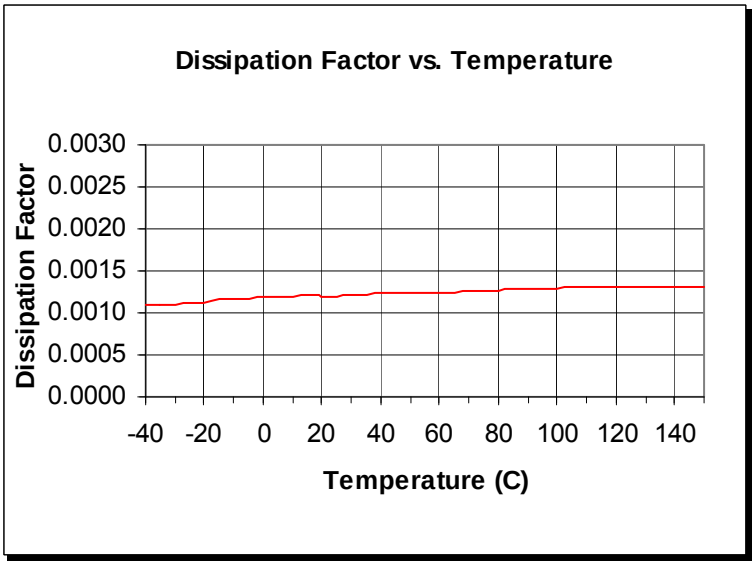

FIGURE 4

THIS DF/TEMPERATURE CURVE shows the unique thermal stability properties of CLTE materials when thermocycled over temperature.

Results listed above are typical properties; they are not to be used as specification limits. The above information creates no expressed or implied warranties. The properties of Arlon laminates may vary depending on the design and application.

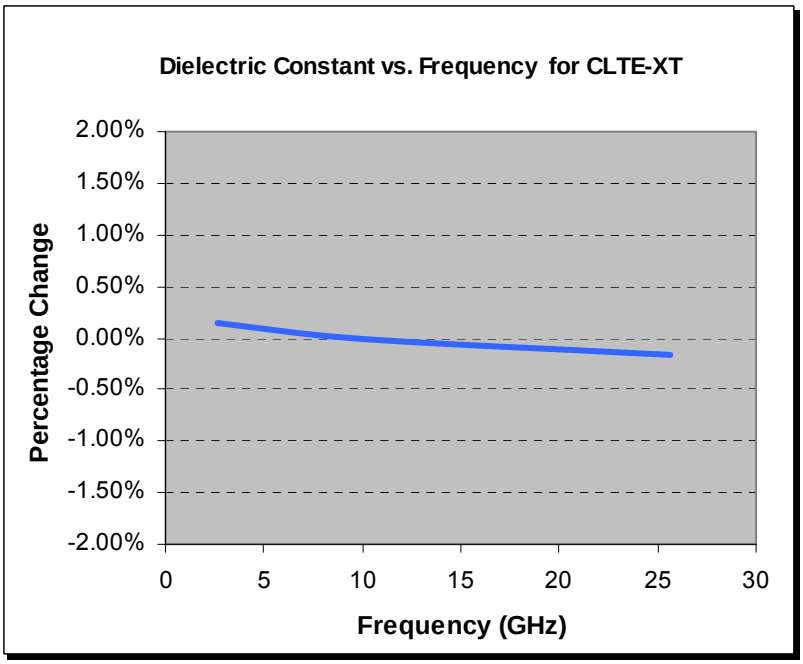

Figure 1

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-XT over frequency insures easy design transition and scalability of design.

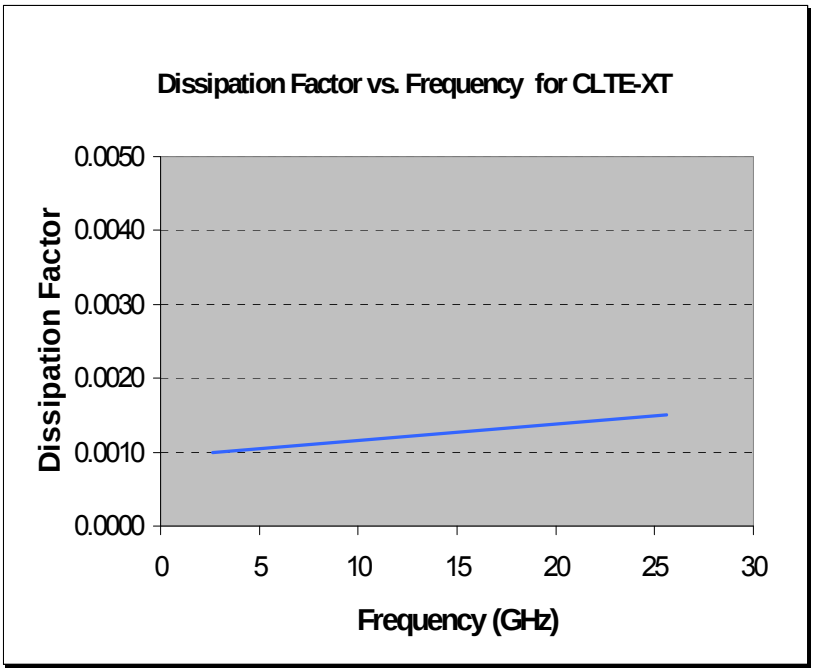

Figure 2

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.

Multilayer Lamination Recommendations

- Following the use of conventional imaging and etching processes, successful fabrication of multilayer circuit assemblies using the CLTE Series pre-pregs (designated CLTE-P) with the CLTE-XT series laminates can be achieved through use of the following recommendations.

Prepreg Material (CLTE-P)

- The Prepreg material consists of woven fiberglass fabric coated with a proprietary resin formulation that is matched in DK to the CLTE-XT and CLTE laminates. As received, the thickness of pre-preg is ≈.0032". After lamination, the thickness is compressed to ≈.0024".

Surface Preparation

- Substrate surface- No additional surface treatment, either mechanical or chemical, should be necessary to achieve good adhesion. However, this recommendation is based upon laboratory conditions where multilayer lamination was performed immediately after etching of the copper surface. For panels which have a long wait time between etching and lamination, a sodium etch (or plasma etch process appropriate for PTFE) of the CLTE-XT laminate surface will provide optimal results.

- 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.

Lamination

- 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.

- Temperature- CLTE-P requires a lamination temperature of 550°F/288°C to allow sufficient flow of the resin. The lamination temperature should be measured at the bond line using a thermocouple located in 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.

- 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.

- 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.

- Time at laminating temperature (45 minutes)- Good adhesion will be achieved by maintaining the recommended laminating temperature for a period of 45 minutes.

Alternative Bonding Materials

Arlon also offers the CuClad 6250 or 6700 thermoplastic bonding films. WL Gore's Speedboard® C thermoset pre-preg provides thermoset properties that are ideal for sequential lamination while maintaining a relatively low dielectric constant and thin bond line. Fluoropolymer bonding films such as FEP and PFA .

ARLON
MATERIALS FOR ELECTRONICS

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CERTIFICATION
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www.arlon-med.com