\\\ Datasheet

# CLTE-AT™ Circuit Materials
## Excellent Dimensional Stability
## High Degree of Phase Stability vs. Temperature

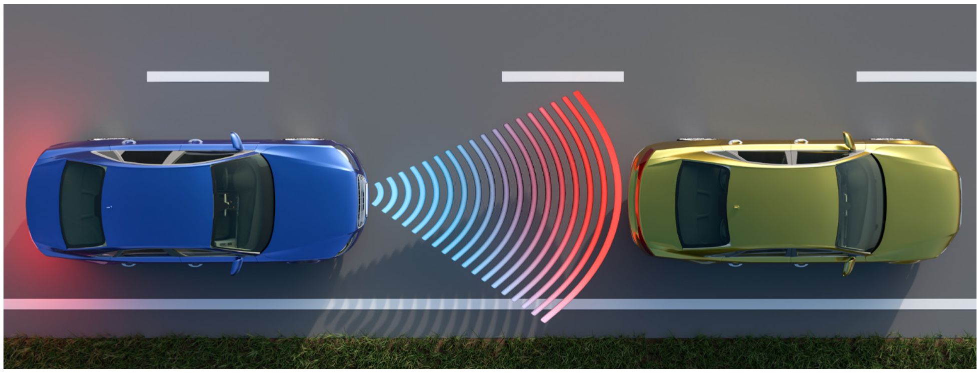
CLTE-AT™ laminates represent the commercial version of the CLTE™ product line. CLTE-AT laminates use the common building blocks developed with CLTE-XT™ laminates, but with some changes to make the product more affordable. This results in a higher dielectric constant (3.00) and a slightly different thickness than the CLTE-XT laminates.

CLTE-AT micro dispersed ceramic PTFE composites utilize a woven fiberglass reinforcement to provide the highest degree of dimensional stability, critical in multilayer designs. CLTE-AT laminates are in a "League of their Own" for registration when utilizing thin substrates (i.e. 0.005" and 0.010").

CLTE-AT laminates have "Best-in-Class" Insertion Loss (S21) and Loss Tangent (0.0013) in the commercial marketplace and second only to CLTE-XT laminates.

Rogers' CLTE-AT laminates were 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-AT laminates have Low CTE xyz 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-AT laminates continue the competitive advantages of CLTE laminates (dimensional stability, low absorption of moisture and processing chemicals, ease of processability). The higher thermal conductivity of CLTE-AT laminates improve heat transfer relative to alternative materials and enable better power handling.



### \\\ Features and Benefits:

Superior signal integrity

- Ceramic/PTFE Microwave Composite
- Mechanically more robust and more dimensionally stable than alternatives
- Lowest Insertion Loss in Commercial Class

Excellent thermal/mechanical performance characteristics

- Very Low Loss Tangent (0.0013)
- Electrical Phase Stability vs. Temperature
- High Thermal Conductivity
- Tight Dielectric Constant (±0.04) and Thickness Tolerance

Woven glass reinforcement

- Excellent Thermal Stability of Dk and Df
- Phase Stability across temperature
- High Degree of Dimensional Stability required for complex, multilayer boards
- Excellent CTE in X,Y and Z

### \\\ Typical Applications:

- Automotive Radar & Adaptive Cruise Control Applications
- Microwave/RF Applications
- Phase/Temperature Sensitive Antennas
- Phase Sensitive Electronic Applications
- RF and Microwave Filters

## \\\ Standard Properties Table

| Properties | | Typical Values[1] CLTE-AT | Units | Test Conditions | | Unit |
|---|---|---|---|---|---|---|
| **Electrical Properties** | | | | | | |
| Dielectric Constant | | 3.00 | - | 23˚C @ 50% RH | 10 GHz | IPC TM-650 2.5.5.5 |
| Dissapation Factor | | 0.0013 | - | 23˚C @ 50% RH | 10 GHz | IPC TM-650 2.5.5.5 |
| Thermal Coefficient of Dielectric Constant | | -10 | ppm/˚C | 0 to 100˚C | 10 GHz | IPC TM-650 2.5.5.5 |
| Volume Resistivity | | 4.25 X $10^8$ | Mohm-cm | C-96/35/90 | - | IPC TM-650 2.5.17.1 |
| Surface Resistivity | | 2.02 X $10^8$ | Mohm | C-96/35/90 | - | IPC TM-650 2.5.17.1 |
| Dielectric Breakdown | | | kV | - | - | IPC TM-650 2.5.6 |
| Arc Resistance | | 250 | sec | - | - | IPC TM-650 2.5.1 |
| **Thermal Properties** | | | | | | |
| Decomposition Temperature (Td) | | 529 | ˚C | - | 5% Weight Loss | IPC TM-650 2.4.24.6 |
| Coefficient of Thermal Expansion - x | | 8 | ppm/˚C | 50˚C to 150˚C | | IPC TM-650 2.4.41 |
| Coefficient of Thermal Expansion - y | | 8 | ppm/˚C | 50˚C to 150˚C | | IPC TM-650 2.4.41 |
| Coefficient of Thermal Expansion - z | | 20 | ppm/˚C | 50˚C to 150˚C | | IPC TM-650 2.4.41 |
| Thermal Conductivity | | 0.64 | W/(m·K) | - | z direction | ASTM E1461 |
| **Mechanical Properties** | | | | | | |
| Copper Peel Strength after Thermal Stress | | 1.3 (7) | N/mm (lbs/in) | 10s @288˚C | 35 µm foil | IPC TM-650 2.4.8 |
| Young's Modulus | | 1790 (260) | MPa (ksi ) | - | | IPC TM-650 2.4.18.3 |
| Tensile Strength (MD, CMD) | | 48, 30 (7.0/4.4) | MPa (ksi ) | - | | IPC TM-650 2.4.18.3 |
| Flexural Strength (MD, CMD) | | 101, 54 (14.6, 7.8) | MPa (ksi ) | - | | IPC TM-650 2.4.4 |
| Compressive Modulus | | 244 | ksi | - | | ASTM-D-3410 |
| Poisson's Ratio | | 0.17 | | - | | ASTM D-3039 |
| **Physical Properties** | | | | | | |
| Flammability | | V-0 | - | - | C48/23/50 & C168/70 | UL 94 |
| Moisture Absorption | | 0.03 | % | E1/105+D24/23 | - | IPC TM-650 2.6.2.1 |
| Density | | 2.06 | g/cm³ | C-24/23/50 | Method A | ASTM D792 |
| NASA Outgassing | Total Mass Lost | 0.04 | % | - | - | NASA SP-R-0022A |
| NASA Outgassing | Collected Volatiles | 0.00 | % | - | - | NASA SP-R-0022A |
| NASA Outgassing | Water Vapor Recovered | 0.00 | % | - | - | NASA SP-R-0022A |

[1] Typical values are a representation of an average value for the population of the property. For specifi cation values contact Rogers Corp.

## \\\ Property Charts

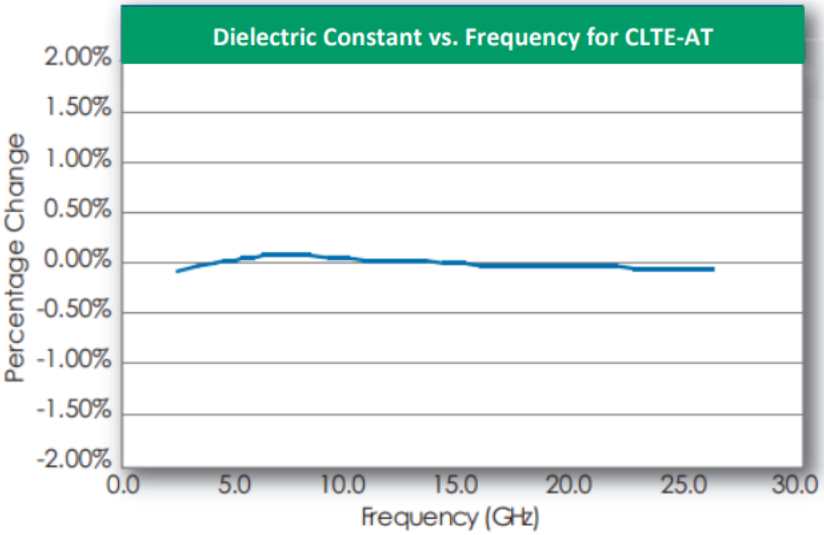



***Figure 1***

*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 Rogers' laminates across frequency, thus simplifying the final design process when working across EM spectrum. The stability of the dielectric constant of CLTE-AT laminates over frequency ensures easy design transition and scalability of design.*

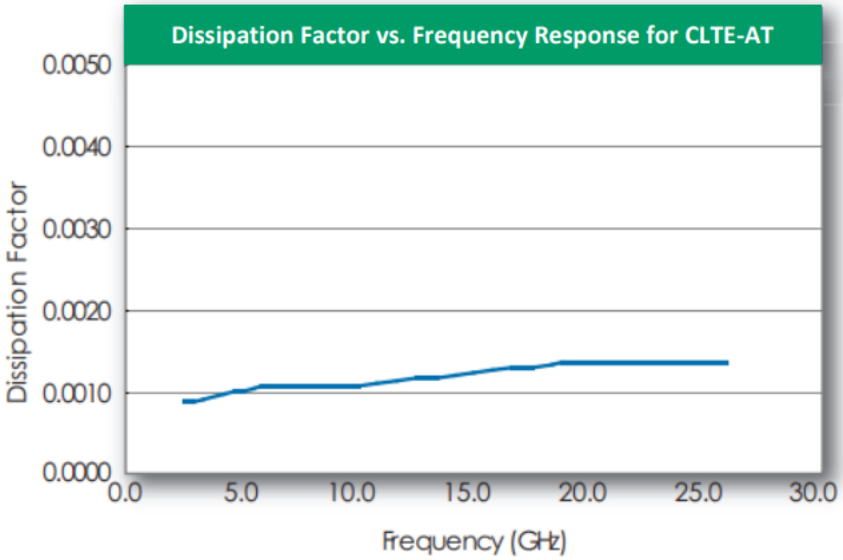



***Figure 2***

*Demonstrates the stability of dissipation factor across frequency. This characteristic demonstrates the inherent robustness of Rogers' 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 0.0011 in the Z-Axis. Dielectric loss best correlates with Z-Axis (Efield 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.*

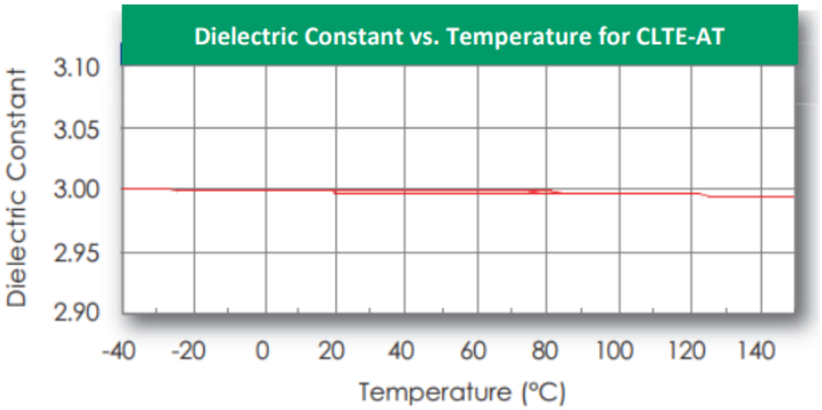



***Figure 3***

*Dk/Temperature curve shows the unique thermal stability properties of CLTE-AT 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.*

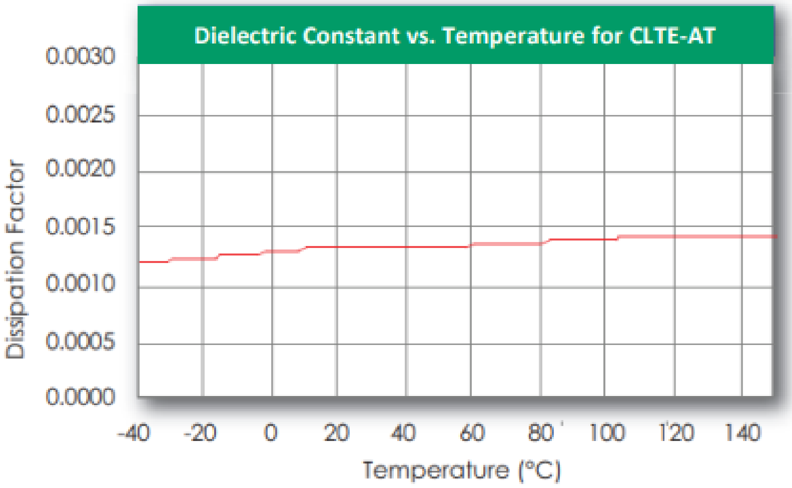



***Figure 4***
*This Df/Temperature curve shows the unique thermal stability properties of CLTE-AT materials when thermocycled over temperature.*

## \\\ Standard Offerings

| Standard Thicknesses | Standard Panel Sizes | Standard Claddings |
|---|---|---|
| 0.005" (0.13 mm) ± 0.0005"<br>0.010" (0.254 mm) ± 0.0010"<br>0.020" (0.508 mm) ± 0.0015"<br>0.030" (0.762 mm) ± 0.0020"<br>0.060" (1.52 mm) ± 0.0030" | 18" X 12" (475 X 305mm)<br>18" X 24" (475 X 610mm) | Electrodeposited Copper Foil<br>1/2 oz. (18µm)<br>1 oz. (35µm)<br><br>Reverse Treated Electrodeposited Copper Foil<br>1/2 oz. (18µm)<br>1 oz. (35µm) |

*Contact Customer Service or Sales Engineering to inquire about other available product configurations including additional thicknesses, panel sizes and claddings.

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