

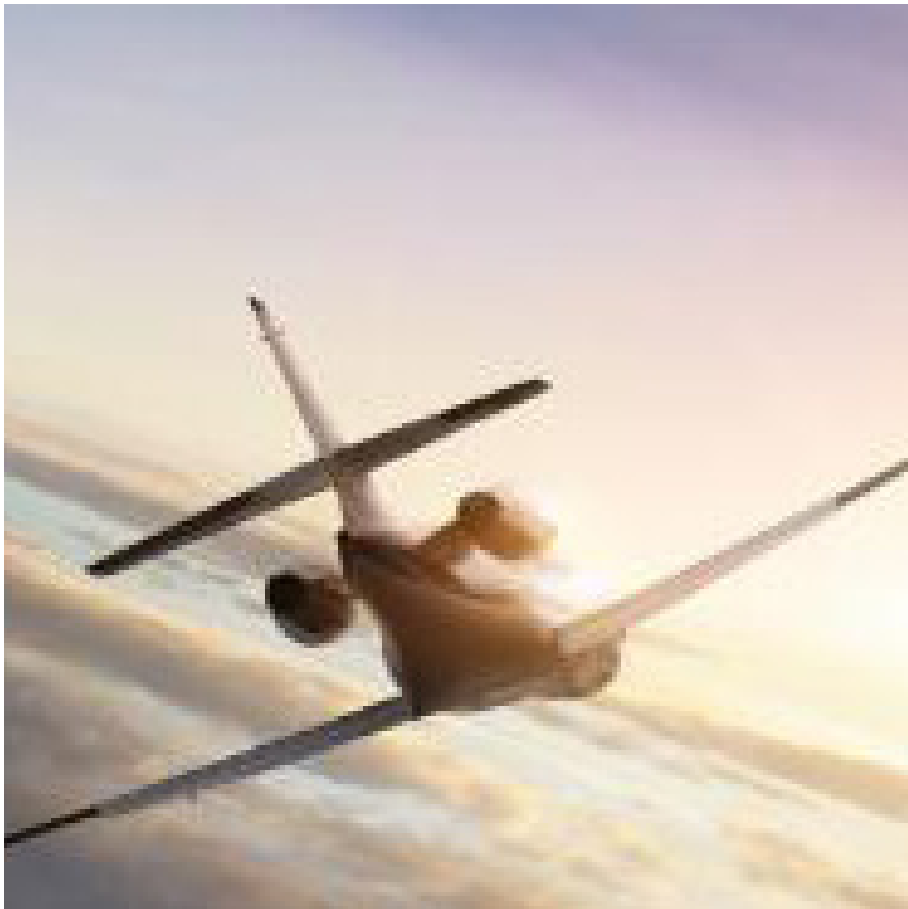
# CLTE™ and CLTE-XT™ Circuit Materials

## High Frequency Laminates

CLTE™ laminates have proven excellent dimensional stability and low planar CTE, providing consistent performance for embedded resistors: among the lowest variance available for PTFE-based laminates.

CLTE laminates have a long history of use with Resistor Foil and are available with a full range of other cladding types (including electrodeposited, reverse treated copper, rolled copper foil and more).

CLTE laminates' tried and tested performance continues to make them a top choice for a wide range of ground-based and airborne communications and radar systems. .



### /// Features and Benefits:

Loss Tangent of .0012 at 10 GHz

- Reduced circuit losses without sacrificing dimensional stability

Low Z-axis CTE of 20 ppm /°C

- High plated through hole reliability

Dielectric constant stability with temperature change

- Reduced stress attachment to ceramic active devices

Available with heavy metal backing (aluminum, brass and copper)

- Reliably designed with embedded resistor networks

### /// Typical Applications:

- Advanced Driver Assistance Systems (ADAS)
- Patch Antennas
- Phased Array Antennas
- Power Amplifiers

## Standard Properties Table

Properties		Typical Values <sup>1</sup>		Units	Test Conditions		Unit
		CLTE	CLTE-XT™				
<b>Electrical Properties</b>							
Dielectric Constant (process)		2.98	See Table Below	-	23°C @ 50% RH	10 GHz	IPC TM-650 2.5.5.5
Dielectric Constant (design)		2.98	2.93	-	C-24/23/50	10 GHz	Microstrip Differential Phase Length
Dissipation Factor		0.0021	0.0010	-	23°C @ 50% RH	10 GHz	IPC TM-650 2.5.5.5
Thermal Coefficient of Dielectric Constant		6	-8	ppm/°C	-50 to 150°C	10 GHz	IPC TM-650 2.5.5.5
Volume Resistivity		1.4 X 10 <sup>9</sup>	4.25 X 10 <sup>8</sup>	Mohm-cm	C-96/35/90	-	IPC TM-650 2.5.17.1
Surface Resistivity		1.30 X 10 <sup>6</sup>	2.49 X 10 <sup>8</sup>	Mohm	C-96/35/90	-	IPC TM-650 2.5.17.1
Electrical Strength (dielectric strength)		1100	1000	V/mil	-	-	IPC TM-650 2.5.6.2
Dielectric Breakdown		64	58	kV	D-48/50	X/Y Direction	IPC TM-650 2.5.6
PIM		-	-	dBc	-	50 ohm 0.060"	43dBm 1900 MHz
<b>Thermal Properties</b>							
Decomposition Temperature (Td)		538	539	°C	2hrs @ 105°C	5% Weight Loss	IPC TM-650 2.3.40
Coefficient of Thermal Expansion - x		9.9	12.7	ppm/°C		-55°C to 288°C	IPC TM-650 2.4.41
Coefficient of Thermal Expansion - y		9.4	13.7	ppm/°C		-55°C to 288°C	IPC TM-650 2.4.41
Coefficient of Thermal Expansion - z		57.9	40.8	ppm/°C		-55°C to 288°C	IPC TM-650 2.4.41
Thermal Conductivity		0.5	0.56	W/(mK)		z direction	ASTM D5470
Time to Delamination		>60	>60	minutes	as-received	288°C	IPC TM-650 2.4.24.1
<b>Mechanical Properties</b>							
Copper Peel Strength after Thermal Stress		1.2 (7)	1.7 (9)	N/mm (lbs/in)	10s @288°C	35 µm foil	IPC TM-650 2.4.8
Flexural Strength (MD, CMD)		92.4, 86.9 (13.4, 12.6)	40.7, 40.0 (5.9, 5.8)	MPa (ksi)	25°C ± 3°C	-	ASTM D790
Tensile Strength (MD, CMD)		73.8, 71.0 (10.7, 10.3)	29.0, 25.5 (4.2, 3.7)	MPa (ksi)	23C/50RH	-	ASTM D638
Flex Modulus (MD, CMD)		8122, 7984 (1178, 1158)	3247, 3261 (471, 473)	MPa (ksi)	25°C ± 3°C	-	ASTM D790
Dimensional Stability (MD, CMD)		-0.07, -0.02	-0.37, -0.67	mm/m	4 hr at 105°C	-	IPC-TM-650 2.4.39a
<b>Physical Properties</b>							
Flammability		V-0	V-0	-	-	C48/23/50 & C168/70	UL 94
Moisture Absorption		0.04	0.02	%	E1/105+D24/23	-	IPC TM-650 2.6.2.1
Density		2.31	2.17	g/cm <sup>3</sup>	C-24/23/50	-	ASTM D792
Specific Heat Capacity		0.60	0.61	J/g K	2 hours at 105°C	-	ASTM E2716
NASA Outgassing	Total Mass Lost	0.02	0.02	%	-		ASTM E595
	Collected Volatiles	0.00	0.00	%			

<sup>1</sup>Typical values are a representation of an average value for the population of the property. For specification values contact Rogers Corp.

Property Charts

Chart 1

Microstrip Differential Phase Length Method , Dk vs Frequency

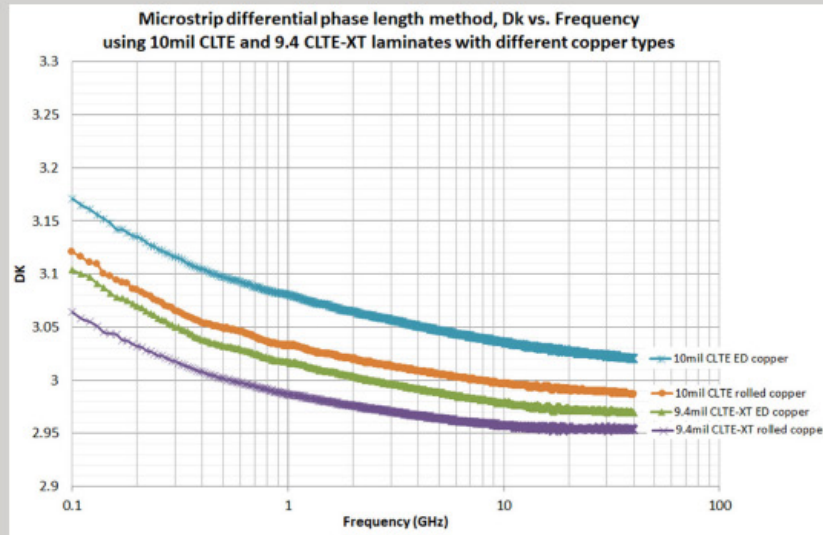
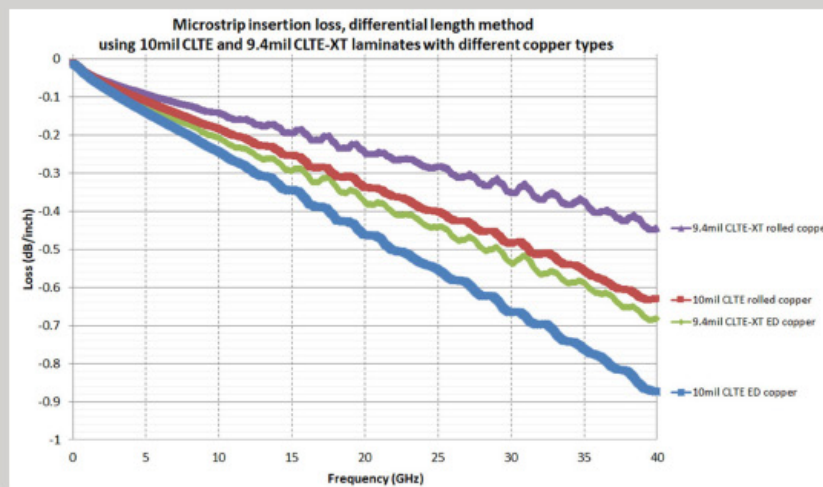


Chart 2

Microstrip Insertion Loss Differential Length Method With Different Copper Types



### CLTE-XT Dielectric Constant Table

Grade	Panel Thickness	Process Dk	Tolerance
<b>Dk by Thickness</b>			
CLTE-XT	0.0051" (0.135 mm)	2.79	± 0.03
	0.0094" (0.254 mm)	2.89	± 0.03
	0.020" (0.508 mm)	2.92	± 0.03
	0.030" (0.762 mm)	2.94	± 0.03

### Standard Offerings

Standard Thicknesses		Standard Panel Sizes	Standard Claddings
<b>CLTE:</b> 0.0053" (0.135 mm) ± 0.0005" 0.010" (0.254 mm) ± 0.0010" 0.020" (0.508 mm) ± 0.0020" 0.030" (0.762 mm) ± 0.0020"	<b>CLTE-XT:</b> 0.0051" (0.130 mm) ± 0.0005" 0.0094" (0.239 mm) ± 0.0007" 0.020" (0.508 mm) ± 0.0010" 0.030" (0.762 mm) ± 0.0010"	18" X 12" (457 X 305mm) 18" X 24" (457 X 610mm)	<u>Electrodeposited Copper Foil</u> 1/2 oz. (18µm) 1 oz. (35µm)  <u>Reverse Treated Electrodeposited Copper Foil</u> 1/2 oz. (18µm) 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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