ROGERS CORPORATION

\\\ Datasheet

CLTE-MW™ Laminates

CLTE-MW™ laminates are ceramic filled, woven glass reinforced PTFE composites. CLTE-MW laminates were developed to provide a cost effective, high performance material for the circuit designer. This unique laminate system is well suited for applications that have limitations in thickness due to either physical or electrical constraints. The seven available thickness options from 3 mils to 10 mils ensure that ideal signal to ground spacing exists for today's 5G and other millimeter wave designs. In addition, a variety of copper foil options are available including rolled, reverse treated ED, and standard ED. Resistive foil and metal plate options are also available upon request.

The CLTE-MW laminates are reinforced with spread glass, which along with a high filler loading help minimize the high frequency glass weave effects on electromagnetic wave propagation. The woven glass reinforcement also provides excellent dimensional stability. Other key features of the laminate include low z-axis CTE (30ppm/°C) for excellent plated through hole reliability, a low loss tangent of 0.0015 at 10 GHz to enable low loss designs, and low moisture absorption of 0.03% to ensure stable performance in a range of operating environments. Thermal conductivity of 0.42 W/(m.K) enables heat dissipation in aggressive designs along with a high dielectric strength of 630 V/mil to ensure good z-axis insulation between conductor layers. The UL94 V-0 flammability rating enables the use of CLTE-MW laminates in commercial applications.

CLTE-MW laminates are well suited for a range of applications including Amplifiers, Antennas, Baluns, Couplers and Filters. Applicable markets range from Commercial and Consumer to Defense and Aerospace.

\\\ Features and Benefits:

Excellent Dimensional Stability

- Critical for Registration of Small Circuit Features

Low X, Y & Z-axis CTE

- Reliable Mechanical Performance under Thermally Challenging Environments

Low Loss Tangent

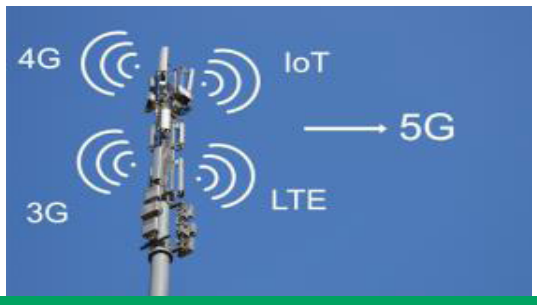
- Low Circuit Losses

Available in thicknesses from 3-10mils

- Suitable for very high frequency applications

\\\ Typical Applications:

- Commercial Communications and Avionics
- Military/ Aerospace Applications
  - Microwave Feed Networks
  - Phase Sensitive Electronic Structures
  - Satellite Communication Systems
- Passive Components (couplers, filters & baluns)



\\\ Standard Properties Table

Properties	Typical Value[1]	Units	Test Conditions		Test Method
Electrical Properties					
Dielectric Constant (process)	2.94 to 3.02 ± 0.04	-	23°C @ 50% RH	10 GHz	IPC TM-650 2.5.5.5
Dielectric Constant (design)	303 to 3.10	-	C-24/23/50	8-40 GHz	Microstrip Differential Phase Length
Dissapation Factor	0.0015	-	23°C @ 50% RH	10 GHz	IPC TM-650 2.5.5.5
Thermal Coefficient of Dielectric Constant	-35	ppm/°C	0 to 100°C	10 GHz	IPC TM-650 2.5.5.5
Volume Resistivity	1.3×10^7	MΩ-cm	C96/35/90	-	IPC TM-650 2.5.17.1
Surface Resistivity	2.5×10^6	MΩ	C96/35/90	-	IPC TM-650 2.5.17.1
Electrical Strength (dielectric strength)	630	V/mil	-	-	IPC TM-650 2.5.6.2
Dielectric Breakdon	44	kV	D-48/50	-	IPC TM-650 2.5.6
Comparative Tracking Index	600V/ PLC 0	class/volts	-	C-40/23/50	UL-746A, ASTM D6054
Thermal Properties					
Decomposition Temperature (Td)	500	°C	2hrs @ 105°C	5% Weight Loss	IPC TM-650 2.3.40
Coefficient of Thermal Expansion - x	8	ppm/°C	-	-55°C to 288°C	IPC TM-650 2.4.41
Coefficient of Thermal Expansion - y	8	ppm/°C	-		IPC TM-650 2.4.41
Coefficient of Thermal Expansion - z	30	ppm/°C	-		IPC TM-650 2.4.24
Thermal Conductivity	0.42	W/(m·K)	-	Z Direction	ASTM D5470
Time to Delamination	>60	minutes	as-received	288°C	IPC TM-650 2.4.24.1
Mechanical Properties					
Copper Peel Strength	1.1 (6.0)	N/mm (lbs/in)	10s @288°C	35 µm foil	IPC TM-650 2.4.8
Flexural Strength (MD, CMD)	113, 99 (16.4, 14.4)	MPa (ksi)	25°C +/- 3°C	-	ASTM D790
Tensile Strength (MD, CMD)	83, 80 (12.0, 11.6)	MPa (ksi)	23°C @ 50% RH	-	ASTM D3039/D3039-14
Flex Modulus (MD, CMD)	6468, 6360 (938.1, 922.4)	MPa (ksi)	25°C +/- 3°C	-	IPC TM-650 2.4.4
Dimensional Stability (MD, CMD)	0.22, 0.22	mil/inch	after etch + bake	-	IPC-TM-650 2.4.39a
Physical Properties					
Flammability	V-0	-	-	-	UL 94
Moisture Absorption	0.03	%	E1/105+D48/50	-	IPC TM-650 2.6.2.1
Density	2.1	g/cm³	C24/23/50	-	ASTM D792
Specifc Heat Capacity	0.93	J/g°K	2 hours at 105°C	-	ASTM E2716
NASA Outgassing — Total Mass Lost	0.03	%	TML/CVCM		ASTM E595
NASA Outgassing — Collected Volatiles	<0.01	%	TML/CVCM		ASTM E595

[1] Typical values are a representation of an average value for the population of the property. For specification values contact Rogers Corp.
[2] See Table 1 for more detailed design information

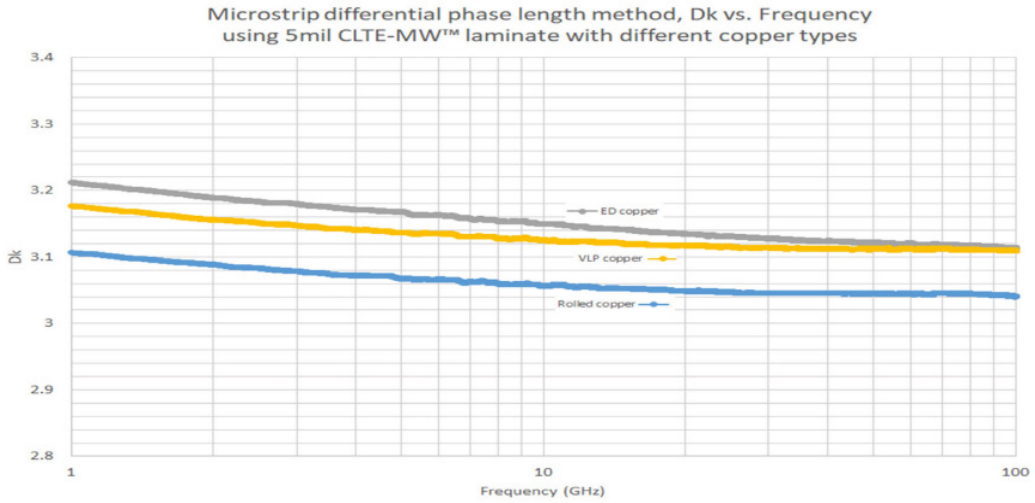


Figure 1. Microstrip Differential Phase Length Method, Dk vs Frequency

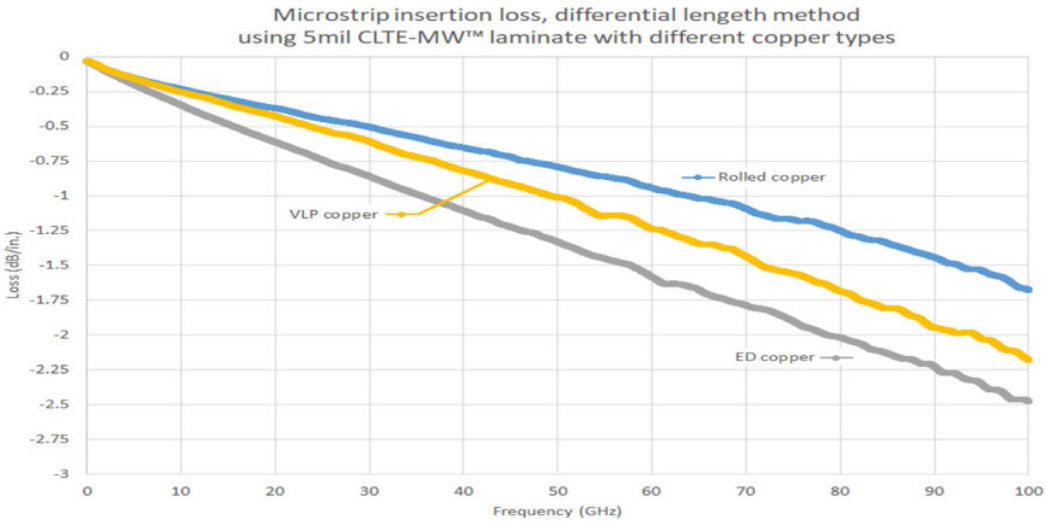


Figure 2. Microstrip Insertion Loss, Differential Length Method

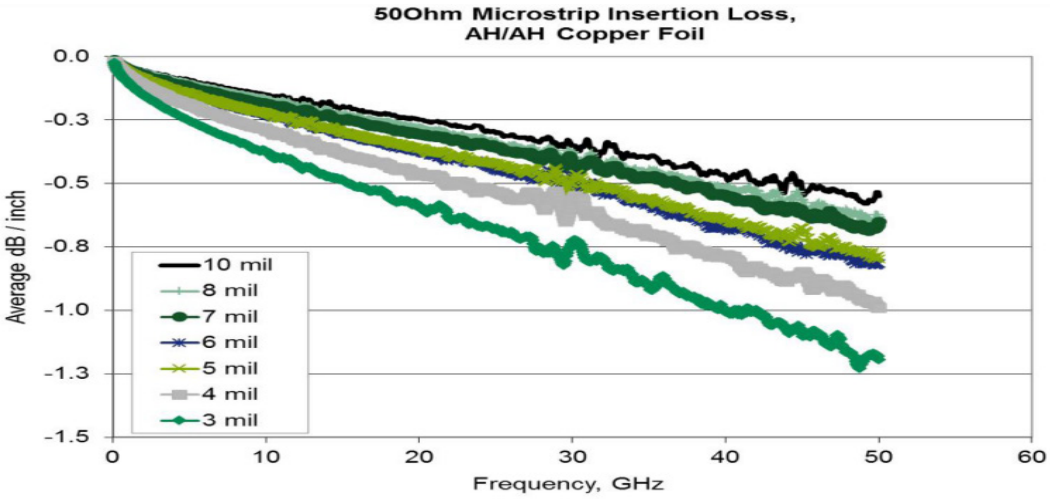


Figure 3. 50 Ohm Microstrip Insertion Loss

\\\ CLTE-MW Dielectric Constant Table

Grade	Panel Thickness	Process Dk (10 GHz)	Design Dk (AH/AH)
Electrical Properties			
CLTE-MW	0.003″	2.94	3.10
	0.004″	2.97	3.08
	0.005″	2.96	3.07
	0.006″	3.02	3.07
	0.007″	3.00	3.06
	0.008″	3.01	3.05
	0.010″	3.00	3.03

\\\ Standard Offerings

Standard Thicknesses	Standard Panel Sizes	Standard Claddings
0.003″ (0.076 mm) ± 0.0005″ 0.004″ (0.102 mm) ± 0.0005″ 0.005″ (0.127 mm) ± 0.0007″ 0.006″ (0.152 mm) ± 0.0007″ 0.007″ (0.178 mm) ± 0.0010″ 0.008″ (0.203 mm) ± 0.0010″ 0.010″ (0.254 mm) ± 0.0010″	12″ X 18″ (305 X 457mm) 24″ X 18″ (610 X 457mm)	Reverse Treated Electrodeposited Copper Foil 1/2 oz. (18µm) 1 oz. (35µm) 2 oz. (70 µm) Very Low Profile Electrodeposited Copper Foil 1/4 oz. (9µm) 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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