ROGERS CORPORATION

CuClad® Series Laminates Data Sheet

PTFE/Woven Fiberglass Laminates
Microwave Printed Circuit Board Substrates

Features:
- Cross Plied Woven Fiberglass, alternating plies are oriented 90° to each other
- High PTFE to Glass Ratio
- Better dielectric constant uniformity than comparable non-woven fiberglass reinforced laminates

Benefits:
- Electrical and Mechanical Isotropy in theX-Y Plane
- Extremely Low Loss
- Well Suited for Er Sensitive Circuits

Typical Applications:
- Military Electronics (Radars, ECM, ESM)
- Microwave Components (LNAs, filters, couplers, etc.)

CuClad® laminates are woven fiberglass/PTFE composite materials for use as printed circuit board substrates. Using precision control of the fiberglass/PTFE ratio, CuClad laminates offer a range of choices from the lowest dielectric constant and loss tangent to a more highly reinforced laminate with better dimensional stability.

The woven fiberglass reinforcement in CuClad products provides greater dimensional stability than non-woven fiber glass reinforced PTFE based laminates of similar dielectric constants. The consistency and control of the PTFE coated fiberglass cloth allows Rogers to offer a greater variety of dielectric constants and produces a laminate with better dielectric constant uniformity than comparable non-woven fiberglass reinforced laminates. These properties make CuClad an attractive choice for filters, couplers and low noise amplifiers.

CuClad laminates are crossplied (alternating layers of coated fiberglass plies are oriented 90° to each other). This provides true electrical and mechanical isotropy in the XY plane, a feature unique to CuClad laminates. No other woven or nonwoven fiberglass reinforced PTFE based laminates make this claim. Designers have found this degree of isotropy critical in some phased array antenna applications.

CuClad 217 (Er=2.17, 2.20) uses a low fiberglass/PTFE ratio to provide the lowest dielectric constant and dissipation factor available in fiberglass reinforced PTFE based laminates. Together, these properties offer faster signal propagation and higher signal/noise ratios.

CuClad 233 (Er=2.33) uses a medium fiberglass/PTFE ratio to balance lower dielectric constant and improved dissipation factor without sacrificing mechanical properties.

CuClad 250 (Er=2.40–2.60) uses a higher fiberglass/PTFE ratio to provide mechanical properties approaching those of conventional substrates. Better dimensional stability and lower thermal expansion in all directions are other significant benefits. For critical performance applications, CuClad products may be specified with an “LX” testing grade; this designates that each sheet will be tested individually, and a test report will be issued with the order. “LX” designated products are higher priced, as a portion of each sheet is utilized in destructive testing.

Typical Properties: CuClad					
Property	**Test Method**	**Condition**	**CuClad 217**	**CuClad 233**	**Cuclad 250**
Dielectric Constant @10 GHz	IPC TM-650 2.5.5.5	C23/50	2.17, 2.20	2.33	2.40 to 2.55
Dielectric Constant @1MHz	IPC TM-650 2.5.5.3	C23/50	2.17, 2.20	2.33	2.40 to 2.60
Dissipation Factor @10 GHz	IPC TM-650 2.5.5.5	C23/50	0.0009	0.0013	0.0017
Thermal Coefficient of Er (ppm/°C)	IPC TM-650 2.5.5.5 Adapted	-10°C to +140°C	-160	-161	-153
Peel Strength (lbs.per inch)	IPC TM-650 2.4.8	After Thermal Stress	14	14	14
Volume Resistivity (MΩ-cm)	IPC TM-650 2.5.17.1	C96/35/90	2.3×10^{8}	8.0×10^{8}	8.0×10^{9}
Surface Resistivity (MΩ)	IPC TM-650 2.5.17.1	C96/35/90	3.4×10^{6}	2.4×10^{6}	1.5×10^{8}
Arc Resistance (seconds)	ASTM D-495	D48/50	>180	>180	>180
Tensile Modulus (kpsi)	ASTM D-638	A, 23°C	275, 219	510, 414	725, 572
Tensile Strength (kpsi)	ASTM D-882	A, 23°C	8.8, 6.6	10.3, 9.8	26.0, 20.5
Compressive Modulus (kpsi)	ASTM D-695	A, 23°C	237	276	342
Flexural Modulus (kpsi)	ASTM D-790	A, 23°C	357	371	456
Dielectric Breakdown (kv)	ASTM D-149	D48/50	> 45	> 45	> 45
Specific Gravity (g/cm3)	ASTM D-792 Method A	A, 23°C	2.23	2.26	2.31
Water Absorption (%)	MIL-S-13949H 3.7.7 IPC TM-650 2.6.2.2	E1/105 + D24/23	0.02	0.02	0.03
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	 29 28 246	 23 24 194	 18 19 177
Thermal Conductivity	ASTM E-1225	100°C	0.26	0.26	0.25
Outgassing Total Mass Loss (%) Collected Volatile Condensable Material (%) Water Vapor Regain (%) Visible Condensate (±)	NASA SP-R-0022A Maximum 1.00% Maximum 0.10%	125°C, ≤ 10^{-6} torr	 0.01 0.01 0.00 NO	 0.01 0.01 0.00 NO	 0.01 0.00 0.00 NO
Flammability	UL 94 Vertical Burn IPC TM-650 2.3.10	C48/23/50, E24/125	Meets requirements of UL94-V0	Meets requirements of UL94-V0	Meets requirements of UL94-V0

Material Availability:

CuClad laminates are supplied with 1/2, 1, or 2 ounce electrodeposited copper on both s ides. Other copper weights and rolled copper foil are available. CuClad 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 CuClad products please specify dielectric constant, thickness, cladding, panel size and any other special considerations. Available master sheet sizes include 36" x 36" in a crossplied configuration and 36" x 48" in a parallel plied configuration.

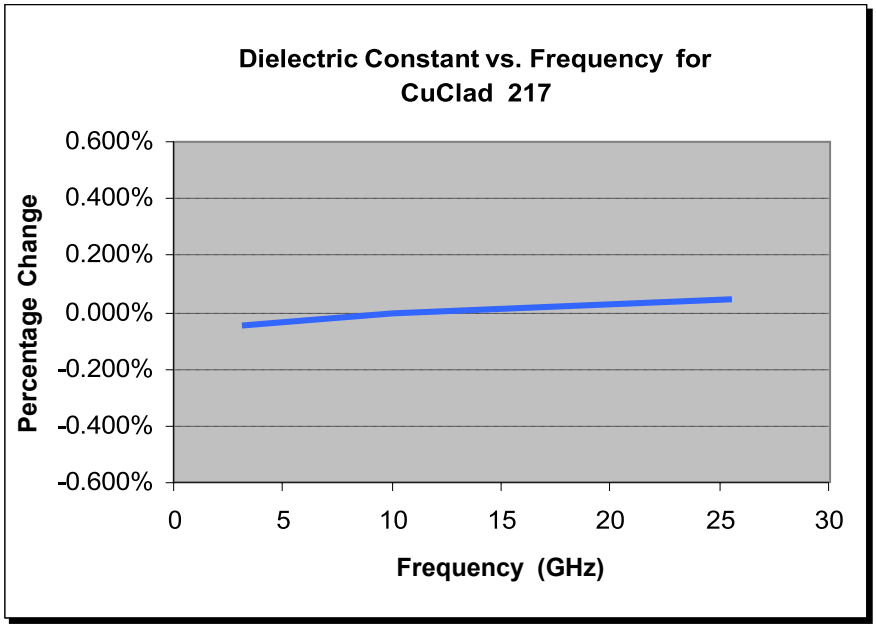

Figure 1

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 CuClad 217 laminate over frequency insures easy design transition and scalability of design.

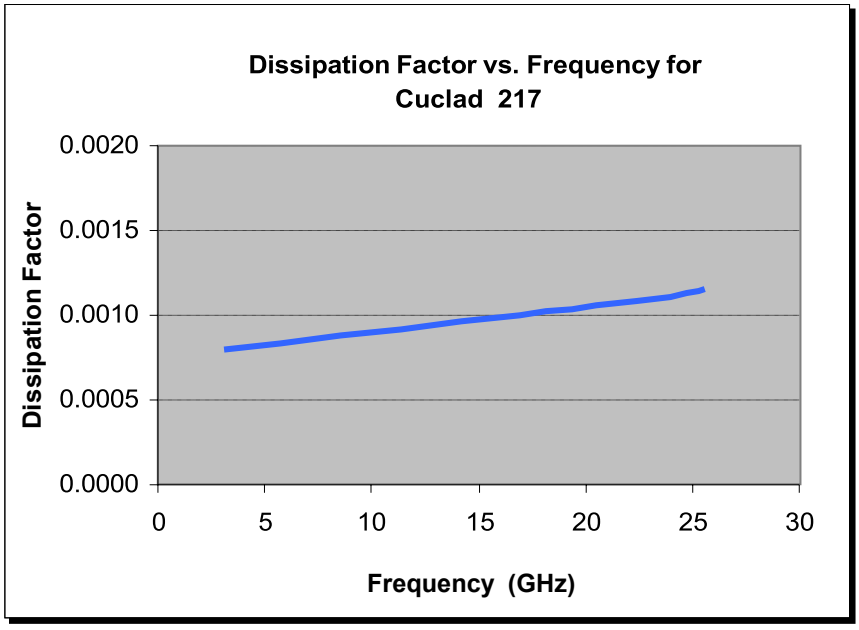

Figure 2

Demonstrates the Stability of DissipationFactor 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.

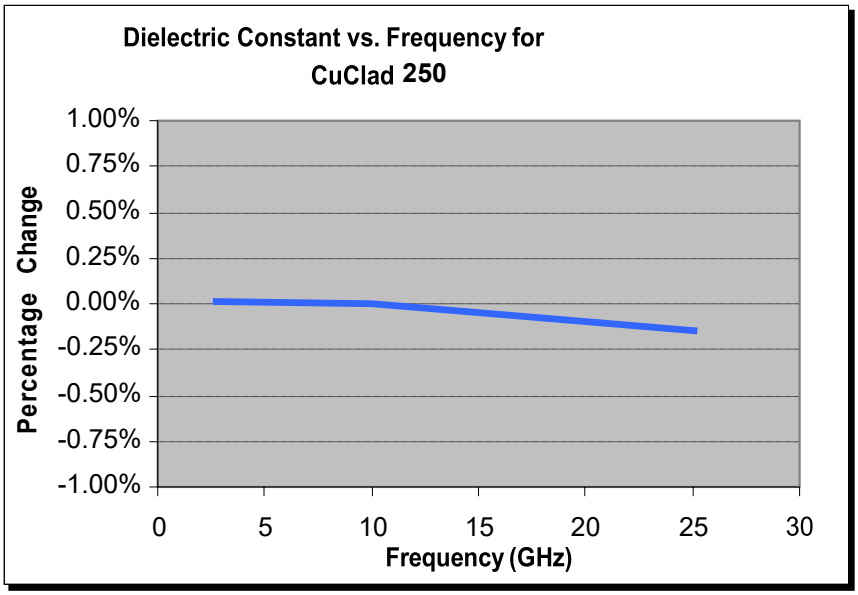

Figure 3

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 CuClad 250 laminate over frequency insures easy design transition and scalability of design.

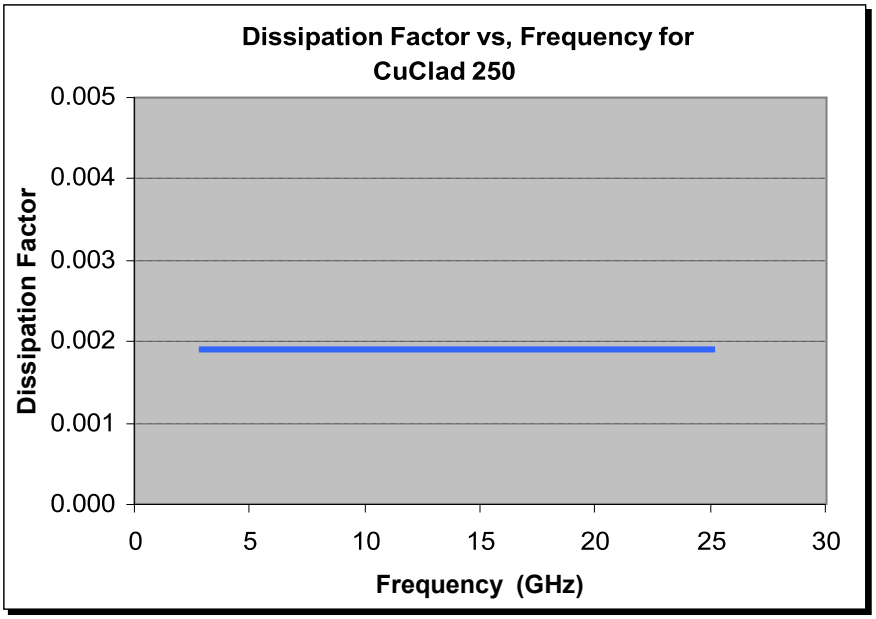

Figure 4

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.

Available Thickness	Standard Panel Size	Available Copper Cladding
0.010" (0.25mm) 0.020" (0.51mm) 0.031" (0.79mm) 0.062" (1.57mm)	18"x12" (457mm X 305mm) 18"x24" (457mm X 610mm)	½ oz. (18µm), 1 oz. (35µm) electrodeposited copper Foil

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 laminates may vary depending on the design and application.