ROGERS CORPORATION

MICROWAVE MATERIALS

DiClad® Series Laminates Data Sheet

PTFE/Woven Fiberglass Laminates

Features:
- Extremely Low Loss Tangent
- Excellent Dimensional Stability
- Product Performance Uniformity

Benefits:
- Electrical Properties are Highly Uniform Across Frequency
- Consistent Mechanical Performance
- Excellent Chemical Resistance

Typical Applications:
- Military Radar Feed Networks
- Commercial Phased Array Networks
- Low Loss Base Station Antennas
- Missile Guidance Systems
- Digital Radio Antennas
- Filters, Couplers, LNAs

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

The woven fiberglass reinforcement in DiClad products provides greater dimensional stability than nonwoven fiberglass 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. The coated fiberglass plies in DiClad materials are aligned in the same direction. Cross-plied versions of many of these materials are available as CuClad materials.

DiClad laminates are frequently used in filter, coupler, and low noise amplifier applications, where dielectric constant uniformity is critical. They are also used in power dividers and combiners, where low loss is important.

DiClad 527 laminates (Er=2.40−2.65) use a higher fiberglass/PTFE ratio to provide mechanical properties approaching conventional substrates. Other advantages include better dimensional stability and lower thermal expansion in all directions. The electrical properties of DiClad 527 laminates are tested at 1 MHz and 10 GHz, respectively.

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 may vary depending on the design and application.

Typical Properties: DiClad

Property	Test Method	Condition	DiClad 880	DiClad 870	DiClad 527
Dielectric Constant @ 10 GHz	IPC TM-650 2.5.5.5	C23/50	2.17, 2.20	2.33	2.40 to 2.60
Dielectric Constant @ 1 MHz	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[1]
Dissipation Factor @ 1 MHz	IPC TM-650 2.5.5.3	C23/50	0.0008	0.0009	0.0010
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	1.4×10^{9}	1.5×10^{9}	1.2×10^{9}
Surface Resistivity (MΩ)	IPC TM-650 2.5.17.1	C96/35/90	2.9×10^{6}	3.4×10^{7}	4.5×10^{7}
Arc Resistance	ASTM D-495	D48/50	>180	>180	>180
Tensile Modulus (kpsi)	ASTM D-638	A, 23°C	267, 202	485, 346	706, 517
Tensile Strength (kpsi)	ASTM D-882	A, 23°C	8.1, 7.5	14.9, 11.2	19.0, 15.0
Compressive Modulus (kpsi)	ASTM D-695	A, 23°C	237	327	359
Flexural Modulus (kpsi)	ASTM D-790	A, 23°C	357	437	537
Dielectric Breakdown (kV)	ASTM D-149	D48/50	>45	>45	> 45
Density (g/cm^3)	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	 25 34 252	 17 29 217	 14 21 173
Thermal Conductivity (W/mK)	ASTM E-1225	100°C	0.261	0.257	0.254
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 0.01 NO	 0.02 0.00 0.01 NO	 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	Meets requirements of UL94-V0	Meets requirements of UL94-V0	Meets requirements of UL94-V0

[1] **Based on a Dielectric Constant of ≤ 2.50, Thickness ≥ 0.020"**

Grade	Available Thickness	Standard Panel Size		Available Copper Cladding
DiClad 527	0.020" (0.51mm) ±0.0020" 0.030" (0.76mm) ±0.0020" 0.060" (1.52mm) ±0.0020"	USA	18"x12" (457mm X 305mm) 18"x24" (457mm X 610mm)	½ oz. (18µm), 1 oz. (35µm) electrodeposited copper Foil
		China	12"x18" (305mm X 457mm) 24"x18" (610mm X 457mm)	
DiClad 870	0.031" (0.79mm) ±0.0020" 0.093" (2.36mm) ±0.0030" 0.125" (3.18mm) ±0.0060"	USA	8"x12" (457mm X 305mm) 18"x24" (457mm X 610mm)	½ oz. (18µm), 1 oz. (35µm) electrodeposited copper Foil ½ oz. (18µm), 1 oz. (35µm) rolled copper Foil
DiClad 880	0.020" (0.51mm) ±0.0020" 0.030" (0.76mm) ±0.0020" 0.060" (1.52mm) ±0.0020"	USA	18"x12" (457mm X 305mm) 18"x24" (457mm X 610mm)	½ oz. (18µm), 1 oz. (35µm) electrodeposited copper Foil ½ oz. (18µm), 1 oz. (35µm) Reverse Treat electrodeposited copper Foil ½ oz. (18µm), 1 oz. (35µm) IM electrodeposited copper Foil
		China	12"x18" (305mm X 457mm) 24"x18" (610mm X 457mm)	

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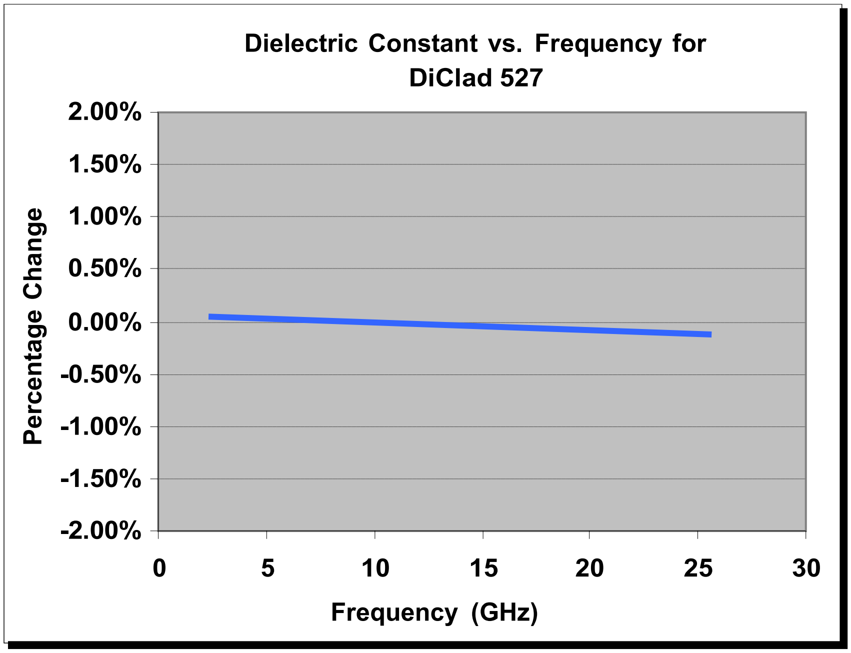

Figure 1

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 the laminates across frequency, thus simplifying the final design process when working across EM spectrum. The stability of the dielectric constant of DiClad laminates over frequency ensures easy design transition and scalability of design.

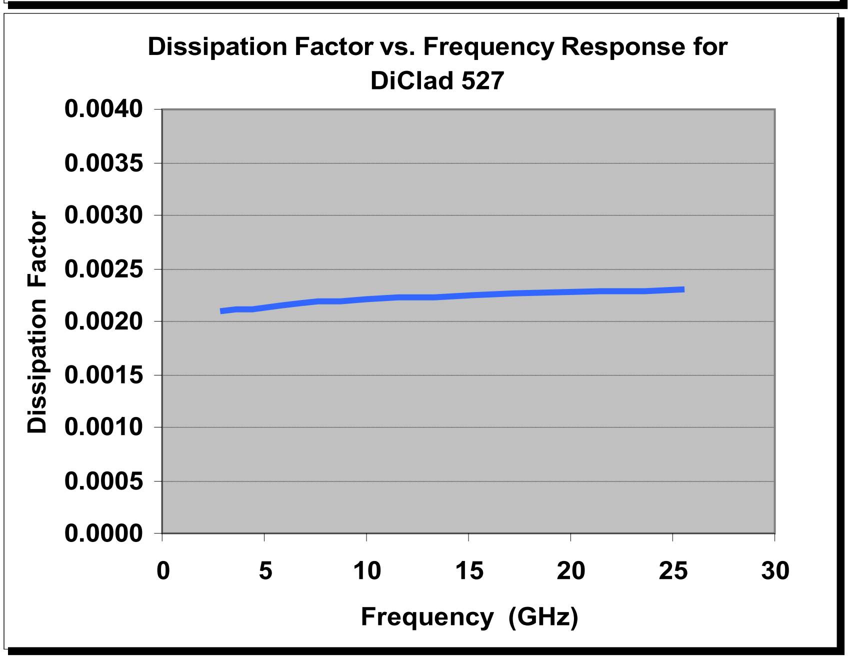

Figure 2

Demonstrates the stability of dissipation factor across frequency. This characteristic demonstrates the inherent robustness of the laminates across frequency, providing a stable platform for high frequency applications where signal integrity is critical to the overall performance of the application.

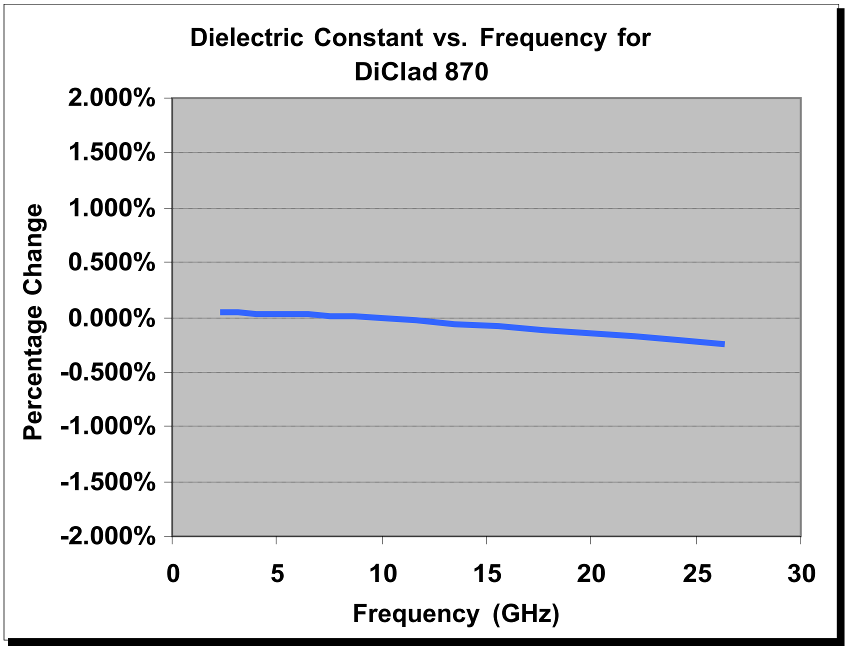

Figure 3

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 the laminates across frequency, thus simplifying the final design process when working across EM spectrum. The stability of the dielectric constant of DiClad laminates over frequency ensures easy design transition and scalability of design.

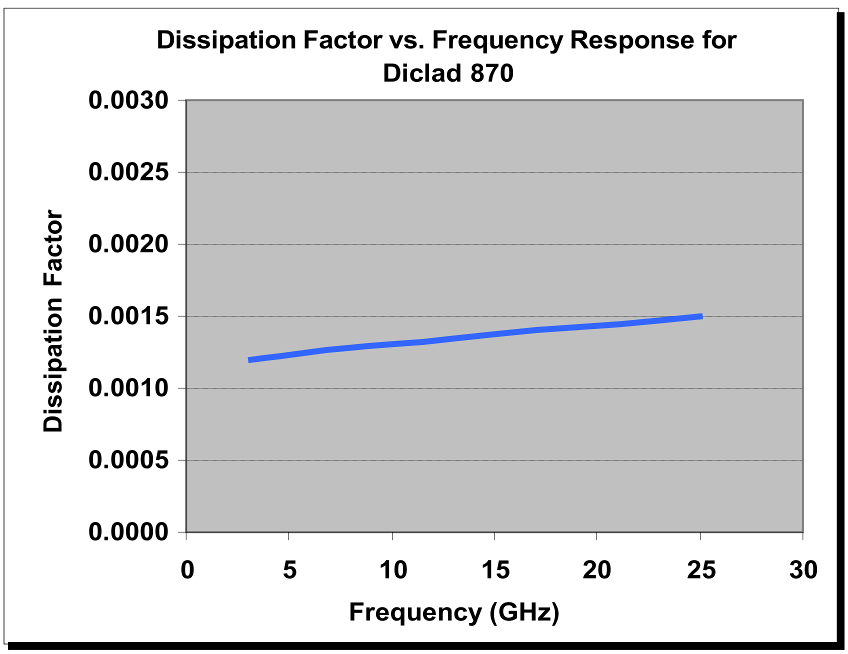

Figure 4

Demonstrates the stability of dissipation across frequency. This characteristic demonstrates the inherent robustness of the laminates across frequency, providing a stable platform for high frequency applications where signal integrity is critical to the overall performance of the application.

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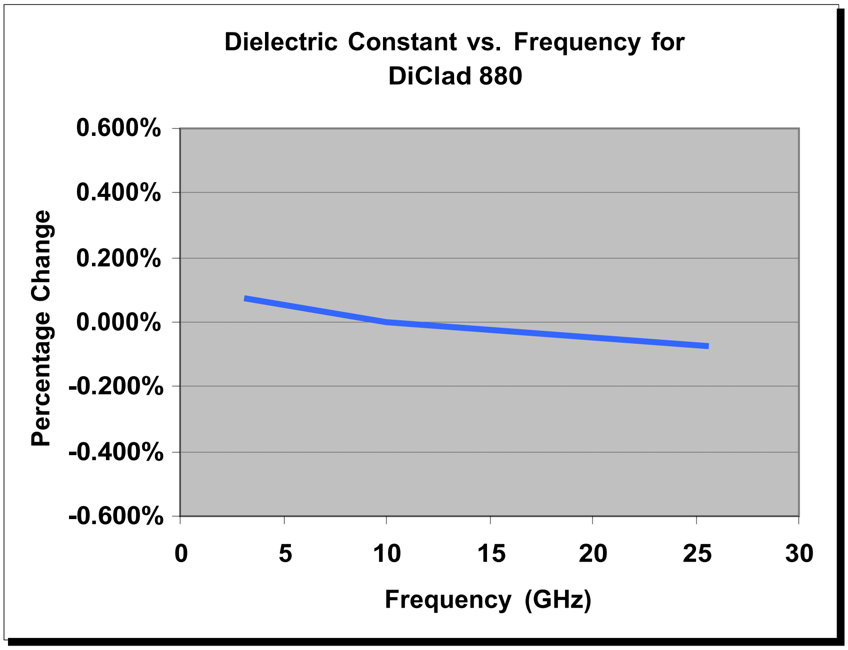

Figure 5

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 the laminates across frequency, thus simplifying the final design process when working across EM spectrum. The stability of the dielectric constant of DiClad laminates over frequency ensures easy design transition and scalability of design.

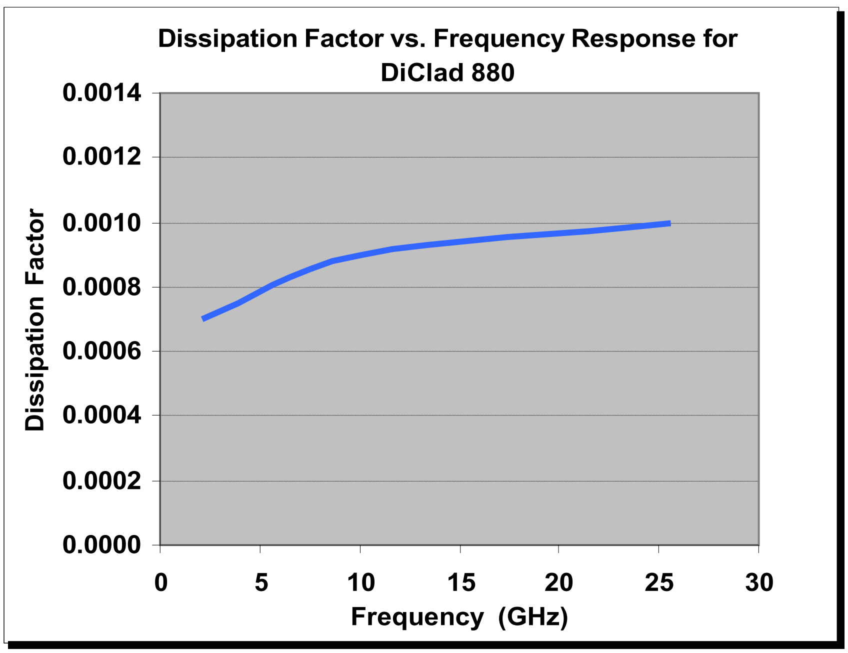

Figure 6

Demonstrates the stability of dissipation across frequency. This characteristic demonstrates the inherent robustness of the laminates across frequency, providing a stable platform for high frequency applications where signal integrity is critical to the overall performance of the application.

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The information in this data sheet is intended to assist you in designing with Rogers' circuit materials. It is not intended to and does not create any warranties express or implied, including any warranty of merchantability or fitness for a particular purpose or that the results shown on this data sheet will be achieved by a user for a particular purpose. The user should determine the suitability of Rogers' circuit materials for each application.

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