

PTFE/Woven Fiberglass Laminates: Microwave Printed Circuit Board Substrates

DiClad® laminates are woven fiberglass/PTFE composite materials for use as printed circuit board substrates. Using 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 Arlon to offer a greater variety of dielectric constants and produces a laminate with better dielectric constant uniformity than comparable nonwoven fiberglass reinforced laminates. The coated fiberglass plies in DiClad materials are aligned in the same direction. Crossplied versions of many of these materials are available as Arlon 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 522 and DiClad 527 ($\epsilon_r=2.40-2.65$) 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 522 and 527 are tested at 1MHz and 10GHz respectively.

DiClad 870 ($\epsilon_r=2.33$) uses a medium fiberglass/PTFE ratio for lower dielectric constant and improved dissipation factor without sacrificing mechanical properties.

DiClad 880 ($\epsilon_r=2.17, 2.20$) 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 to noise ratios.

Availability:

DiClad laminates are supplied with 1/2, 1 or 2 ounce electrodeposited copper on both sides. Other copper weights and rolled copper foil are available. DiClad 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 DiClad products please specify dielectric constant, thickness, cladding, panel size and any other special considerations. Available master sheet sizes include 36" x 48", 36" x 72" and 48" x 54".

Typical Properties: DiClad® PTFE/Woven Fiberglass Laminates

Properties	Test Method	Condition	Typical Values DiClad 880	Typical Values DiClad 870	Typical Values DiClad 522/527
Dielectric Constant @10GHz	IPC TM-650 2.5.5.5	C23/50	2.17, 2.20	2.33	2.40 to 2.65
Dielectric Constant @1MHz	IPC TM-650 2.5.5.3	C23/50	2.17, 2.20	2.33	2.40 to 2.65
Dissipation Factor @10GHz	IPC TM-650 2.5.5.5	C23/50	0.0009	0.0013	0.0022
Dissipation Factor @1MHz	IPC TM-650 2.5.5.3	C23/50	0.0008	0.0009	0.0010
Thermal Coefficient of E _r (ppm/°C)	IPC TM-650 2.5.5.5 Adapted	-10°C to +140°C	-160	-161	-153
Volume Resistivity (MΩ-cm)	IPC TM-650 2.5.17.1	C96/35/90	1.4 x 10 ⁹	1.5 x 10 ⁹	1.2 x 10 ⁹
Surface Resistivity (MΩ)	IPC TM-650 2.5.17.1	C96/35/90	2.9 x 10 ⁶	3.4 x 10 ⁷	4.5 x 10 ⁷
Arc Resistance (seconds)	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
Specific Gravity (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)	IPC TM-650 2.4.24 Mettler 3000 Thermomechanical Analyzer	0°C to 100°C			
X Axis			25	17	14
Y Axis			34	29	21
Z Axis			252	217	173
Thermal Conductivity (W/mK)	ASTM E-1225	100°C	0.261	0.257	0.254
Outgassing	NASA SP-R-0022A				
Total Mass Loss (%)	Maximum 1.00%	125°C, ≤ 10 ⁻⁶ torr	0.01	0.02	0.02
Collected Volatile Condensable Material (%)	Maximum 0.10%		0.01	0.00	0.00
Water Vapor Regain (%)			0.01	0.01	0.01
Visible Condensate (±)			NO	NO	NO
Flammability UL File E 80166	UL 94 Vertical Burn IPC TM-650 2.3.10	C48/23/50, E24/125	UL94V-0	UL94V-0	UL94V-0

Data based on 0.062" dielectric thickness, exclusive of metal cladding except where indicated by test method. 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 DiClad laminates may vary depending on the application.

The information and data contained herein are believed reliable, but all recommendations or suggestions are made without guarantee. You should thoroughly and independently test materials for any planned applications and determine satisfactory performance before commercialization. Furthermore, no suggestion for use, or material supplied shall be construed as a recommendation or inducement to violate any law or infringe any patent.

MATERIALS FOR ELECTRONICS