ROGERS CORPORATION

AD1000™ Laminates Data Sheet

PTFE/Woven Fiberglass/Ceramic Filled Laminate for Microwave Printed Circuit Boards

AD1000™ high dielectric constant substrate permits circuit miniaturization, compared to traditional low loss materials. It is especially beneficial for power amplifiers, filters, couplers, and other components using low-impedance lines.

AD1000 woven-glass reinforced laminate allows for greater dimensional stability and mechanical robustness than other 10 Dk Products. Its large panel size is also advantageous for "multi-circuits per panel" processing.

AD1000 laminate is considered a "soft substrate" and is relatively insensitive to vibrational stress. This allows miniaturized circuitry without requiring the complicated processing or special handling associated with brittle pure ceramic or ceramic hydrocarbon materials.

AD1000 laminate is compatible with processing used for standard PTFE based printed circuit board substrates. In addition,the low Z-axis thermal expansion provided by the ceramic loading will improve plated through hole reliability, compared to typical PTFE based laminates. The low X-Y thermal expansion provides excellent matching to ceramic chip carriers and other ceramic components.

AD1000 laminate was specifically developed for Miniaturized Circuitry for compact devices (i.e., GPS Receivers), Patch Antennas (where smaller size is required), Satellite Communications Systems, Power Amplifiers (PAs), Low Noise Amplifiers (LNAs), Low Noise Block Down converters (LNBs), Radar Modules and Manifolds, Aircraft Collision Avoidance Systems (TCAS), and Ground BasedRadar Systems.

Features:

- Only Woven Glass Reinforced PTFE/ Ceramic with Dk of 10.2 or greater
- Thermal Conductivity is "Best-in-Class"
- High copper peel strength allows for thinner etched line widths
- Lowest Insertion Loss Available
- Larger Panel Sizes Available
- Low Moisture Absorption
- Excellent CTE Values lead to highly reliability ceramic component attachment and PTH reliability

Benefits:

- Mechanically Robust
- Greater Dimensional Stability than Other 10 Dk Products
- Circuit Miniaturization Leads to Weight Savings
- Heat Dissipation and Management
- Greater Signal Integrity
- Cost-Effective Board Layout and Board Processing
- Low Loss in Humid Environments

Typical Applications:

- Ideal for X-Band and Below
- Radar Modules and Manifolds
- Aircraft Collision Avoidance Systems (TCAS)
- Ground Based Radar Surveillance Systems
- Miniaturized Circuitry & Patch Antennas
- Power Amplifiers (PAs)
- Low Noise Amplifiers (LNAs)

Typical Properties: **AD1000**

Property	Units	Value	Test Method
1. Electrical Properties			
Dielectric Constant (may vary by thickness)			
@1 MHz	-		IPC TM-650 2.5.5.3
@ 10 GHz	-	10.20	IPC TM-650 2.5.5.5
Dissipation Factor			
@ 1 MHz	-		IPC TM-650 2.5.5.3
@ 10 GHz	-	0.0023	IPC TM-650 2.5.5.5
Temperature Coefficient of Dielectric	-		
TCεr @ 10 GHz (-40-150°C)	ppm/ºC	-380	IPC TM-650 2.5.5.5
Volume Resistivity			
C96/35/90	MΩ-cm	$1.40x10^{9}$	IPC TM-650 2.5.17.1
E24/125	MΩ-cm	$5.36x10^{7}$	IPC TM-650 2.5.17.1
Surface Resistivity			
C96/35/90	MΩ	$1.80x10^{9}$	IPC TM-650 2.5.17.1
E24/125	MΩ	$3.16x10^{8}$	IPC TM-650 2.5.17.1
Electrical Strength	Volts/mil (kV/mm)	622 (24.5)	IPC TM-650 2.5.6.2
Dielectric Breakdown	kV	>45	IPC TM-650 2.5.6
Arc Resistance	sec	>180	IPC TM-650 2.5.1
2. Thermal Properties			
Decomposition Temperature (Td)			
Initial	°C	>500	IPC TM-650 2.4.24.6
5%	°C	>500	IPC TM-650 2.4.24.6
T260	min	>60	IPC TM-650 2.4.24.1
T288	min	>60	IPC TM-650 2.4.24.1
T300	min	>60	IPC TM-650 2.4.24.1
Thermal Expansion, CTE (x,y) 50-150ºC	ppm/ºC	8, 10	IPC TM-650 2.4.41
Thermal Expansion, CTE (z) 50-150ºC	ppm/ºC	20	IPC TM-650 2.4.24
% z-axis Expansion (50-260ºC)	%		IPC TM-650 2.4.24
3. Mechanical Properties			
Peel Strength to Copper (1 oz/35 micron)			
After Thermal Stress	lb/in (N/mm)	>12 (2.1)	IPC TM-650 2.4.8
At Elevated Temperatures (150º)	lb/in (N/mm)	13.6 (2.4)	IPC TM-650 2.4.8.2
After Process Solutions	lb/in (N/mm)		IPC TM-650 2.4.8
Young's Modulus	kpsi (GPa)	200 (1.38)	IPC TM-650 2.4.18.3
Flexural Strength (Machine/Cross)	kpsi (MPa)	9.9/7.5 (68/52)	IPC TM-650 2.4.4
Tensile Strength (Machine/Cross)	kpsi (MPa)	5.1/4.3 (35/30)	IPC TM-650 2.4.18.3
Compressive Modulus	kpsi (GPa)	>425 (>2.93)	ASTM D-3410
Poisson's Ratio	-	0.16	ASTM D-3039
4. Physical Properties			
Water Absorption	%	0.03	IPC TM-650 2.6.2.1
Density, ambient 23ºC	g/cm^3	3.20	ASTM D792 Method A
Thermal Conductivity	W/mK	0.81	ASTM E1461
Flammability	class	Meets V0	UL-94
NASA Outgassing, 125ºC, ≤10^{-6} torr	%		NASA SP-R-0022A
Total Mass Loss	%	0.01	NASA SP-R-0022A
Collected Volatiles	%	0.00	NASA SP-R-0022A
Water Vapor Recovered	%	0.00	NASA SP-R-0022A

***Alternative Thickness and Dielectric Constant (Dk) options are available. Tighter tolerances are also available under the AD1001 designation for some thicknesses. Please discuss your needs with Rogers' Applications Engineering Teams.*

Thickness and Dielectric Constant Alternatives

Thickness (mils)	0.006 ±0.0005	0.0105 ±0.0010	0.015 ±0.0015	0.020 ±0.002	0.025 ±0.002	0.030 ±0.002	0.050 ±0.002	0.059 ±0.003	0.125 ±0.003	0.127 ±0.003
Dielectric Constant	8.0 ±0.35	9.1 ±0.35	9.7 ±0.35	10 ±0.35	10.2 ±0.35	10.35 ±0.35	10.2 or 10.6 ±0.35	10.7 ±0.35	10.2 ±0.35	10.9 ±0.35

** Thicker Options are available. Please Contact Customer Service or your Local Rogers' Representative*

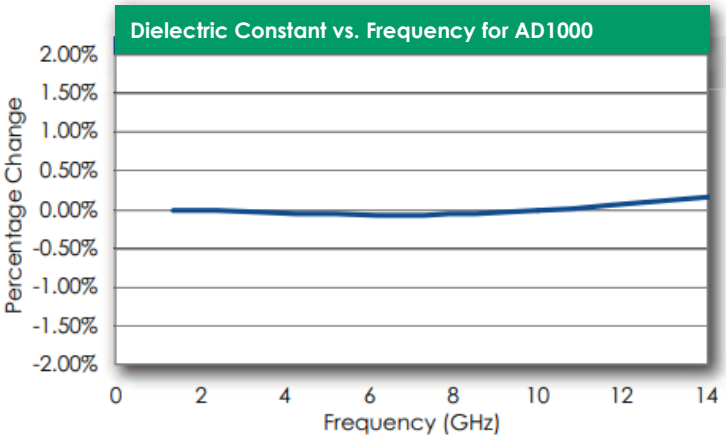

Figure 1
Demonstrates the Stability of Dielectric Constant across Frequency. This information was correlated from data generated by using a free space and circular resonator cavity. This characteristic demonstrates the inherent robustness of Rogers' laminates across frequency, thus simplifying the final design process when working across EM spectrum. The stability of the Dielectric Constant of AD1000 laminate over frequency ensures easy design transition and scalability of design.

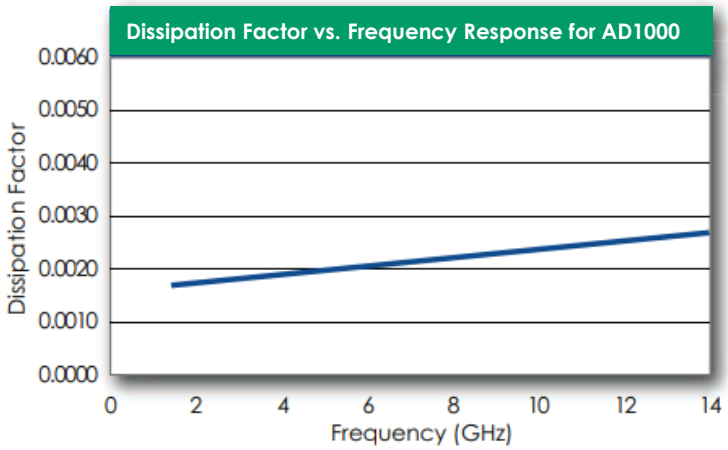

Figure 2
Demonstrates the Stability of Dissipation Factor across Frequency. This characteristic demonstrates the inherent robustness of Rogers' laminates across frequency, providing a stable platform for high frequency applications where signal integrity is critical to the overall performance of the application

Material Availability:

Standard Thicknesses	Standard Panel Sizes	Standard Claddings
AD1000L: 0.025" (0.635mm) ±0.002" 0.050" (1.270mm) ±0.002" **AD1000X:** 0.050" (0.08mm) ±0.002" *Additional non-standard laminate thicknesses available from 0.006" - 0.250" in varying increments	18" X 12" (457 X 305mm) 18" X 24" (457 X 610mm) *Additional panel sizes available	Electrodeposited Copper Foil 1/2 oz. (18µm) *HH/HH* 1 oz. (35µm) *H1/H1* *Additional claddings and cladding weights, such as heavy metal, Reverse Treated Electrodeposited Copper Foil and unclad, are available

*Contact Customer Service or Sales Engineering to inquire about additional available product configurations

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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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 Rogers' laminates may vary, depending on the design and application.