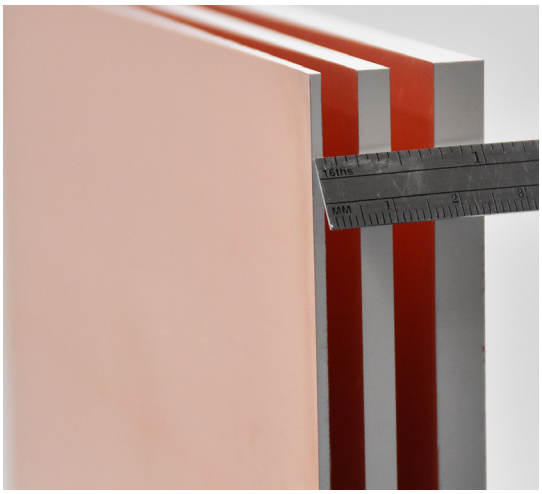
WavePro®

APPLICATION NOTE

Custom Laminates

Made-to-Order Panels for Maximum Performance

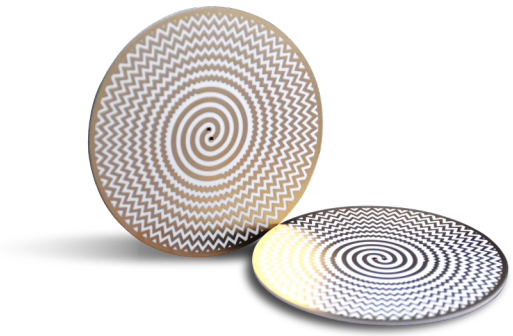


WavePro laminates are copper-cladded, ceramic-filled PTFE panels. With a PTFE base substrate, these low-loss laminates are ideal for fabricating patch antennas, specialized RF elements, and high-frequency PCBs.

DESIGN FLEXIBILITY

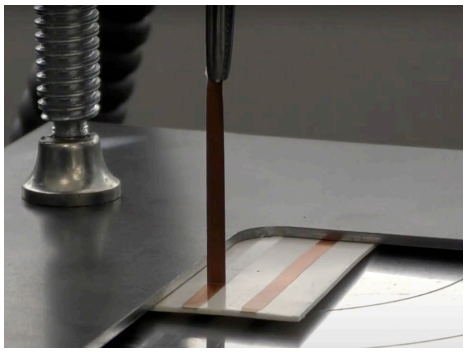
Custom laminates can offer improved performance over standard, off-the-shelf laminates. Three key parameters of a WavePro® laminate can be specified, allowing for more degrees of freedom to optimize performance, overcome design constraints, or reduce size, weight, and power.

CUSTOM DIELECTRIC CONSTANT	CUSTOM PANEL THICKNESS	CUSTOM COPPER CLADDING
2.3 - 20.3	0.25 - 10 mm	Single or Double-sided Type: Rolled or ED Weight: 0.5 or 1 oz Roughness Rz: 1.6 / 6µm

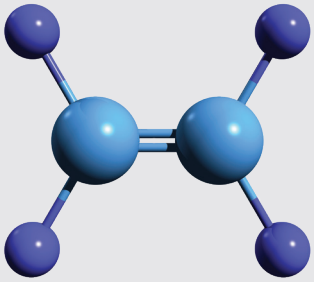


Spiral LPDA antenna: 3.03 Dk, 50mm diameter, 1mm thick, ED copper 1oz (35µm).

Standard panel dimensions are 18" x 24" (457 x 610 mm). Other sizes are available upon request.

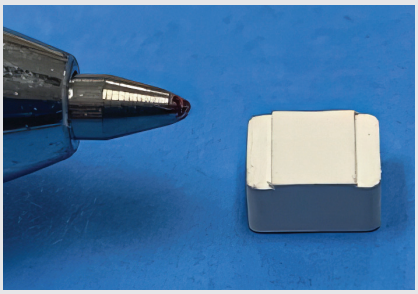


Copper peel strength test per IPC-TM-650.



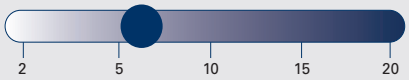
PTFE SPECIALISTS

Our expertise in developing and manufacturing engineered PTFE products started in 1967, when we introduced our first line of PTFE sealing products.



PRECISION MANUFACTURING

With sub-millimeter tolerances, we can manufacture mmWave components with intricate geometries and features with ease.



CUSTOMIZED DIELECTRICS

WavePro® is available off-the-shelf in different dielectric constants. To fully optimize your design, why not pick your own Dk? Our process allows us to quickly tune material properties.

MATERIAL PROPERTIES

Parameter	WP025LDf	WP025	WP030	WP050	WP108	WP120	WP156	WP204	Condition	Test Method
Dk (dielectric constant permittivity)	2.50	2.55	3.03	5.07	10.80	12.10	15.60*	20.40*	5 GHz @ 23°C	IPC-TM-650-2.5.5.5 *ASTM D2520
Df (loss factor, tan δ)	0.0007	0.0021	0.0009	0.0009	0.0015	0.0014	0.0010*	0.0100*	5 GHz @ 23°C	IPC-TM-650-2.5.5.5 *ASTM D2520
Moisture absorption	0.02%	0.09%	0.03%	0.03%	0.10%	0.10%	-	-	24 hrs/23°C	IPC-TM-650-2.6.2.1
CTE (coefficient of thermal expansion) ppm/°C	-	-	X: 42 Y: 36 Z: 40	X: 25 Y: 29 Z: 28	X: 22 Y: 19 Z: 21	-	-	-	-55 to 150°C	IPC-TM-650-2.4.41
Volume Resistivity MΩ-cm	-	-	2.66×10^8	1.94×10^8	0.62×10^8	-	-	-	1.5hr/25°C/90%RH	IPC-TM-650-2.5.17.1
	-	-	2.43×10^8	2.05×10^8	0.37×10^8	-	-	-	96hr/35°C/90%RH	
Tensile Strength (MPa)	26.0/3776	18.4/2675	16.0/2316	12.5/1816	10.8/1560	10.7/1558	-		X-axis	ASTM D1708
	25.1/3565	17.2/2501	14.9/2166	11.4/1657	9.7/1413	9.4/1359	-		Y-axis	
Flammability	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	-	UL-94V
Density (g/cm3)	2.17	1.96	2.17	2.49	2.89	2.98	3.02	3.57	23°C	ASTM D792

ISO 9001 2015 CERTIFIED

ITAR Registered International Traffic in Arms Regulations

RoHS compliant

WavePro, a Garlock Brand
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WaveProAntenna.com

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