TacPreg TPG

Homogeneous Laminates for High Speed Data Transmission

Enables Manufacture of 20+ Layer PWBs at FR-4 Temperatures & Pressures

Foil Laminations for Controlled Thickness RF Multilayers

Alternative to Thermoplastic Films in Military Multilayer Printed Circuit Boards

TACONIC

An ISO 9001:2000 Registered Company

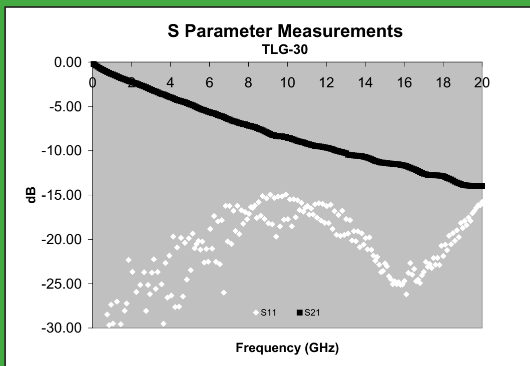
Petersburgh, NY: Tel: 800-833-1805 Fax: 518-658-3988

Europe: Tel: +353-44-9395600 Fax: +353-44-9344369 Asia: Tel: +82-31-704-1858 Fax: +82-31-704-1857

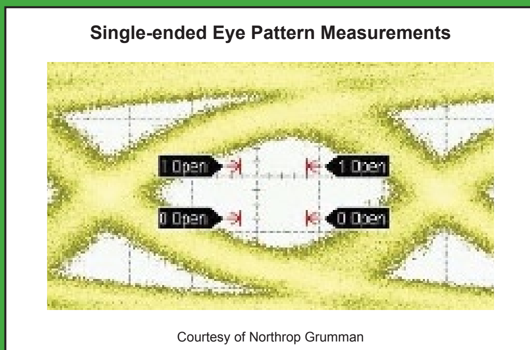
www.taconic-add.com

APPLICATIONS

High Speed Digital
RF Multilayer
Military



S parameter measurements by Northrop Grumman at 12.5 gpbs using a six layer test vehicle on a 16" transmission line (0.010" wide).



Single-ended eye pattern measurements by Northrop Grumman at 12.5 gpbs using a six layer test vehicle on a 16" transmission line (0.010" wide). 185 mVolts of eye height.

TacPreg TPG

TacPreg TPG prepregs were designed to have reduced electrical loss and improved ease of fabrication. TacPreg TPG prepregs are based on BT/epoxy/woven fiberglass/PTFE components.

TacPreg TPG prepregs offer the following benefits to high speed designs due to the reduced dielectric constant:

•Faster signal propagation speed/reduced propagation delay
•Thinner cores reduce overall multilayer thickness
•Wider traces/thinner spacings between edge coupled pairs reduce crosstalk
•Attenuation is proportional to the square root of dielectric constant x frequency x dissipation factor

TacPreg TPG prepregs offer the following additional features:
•Reduced loss at higher frequencies resulting in lower rise-time degradation
•More uniform construction resulting in less dielectric variation within the prepreg and laminate
•Reduced z-axis expansion (less temperature dependent dielectric constant variation)
•Improved prepreg flow for buried and blind via applications where through holes are not desired
•Impedance variation along a 24" microstrip of +/- 0.5 ohms

TacPreg TPG prepregs have the following benefits standard to the TacPreg/TacLam family of products:
•Good copper adhesion with flat reverse treated foils
•The ability to laminate at conventional FR-4 temperatures enabling Taconic to offer these products with FR-4 like economies of scale
•TacPreg TPG prepregs is dimensionally stable due to the woven glass design and shows predictable movement when laminated at FR-4 conditions

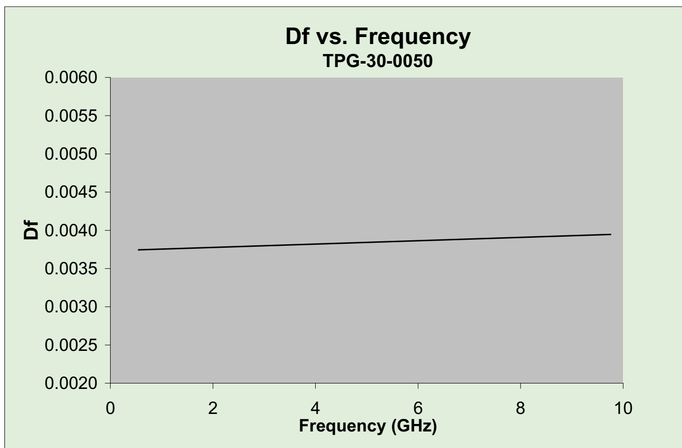
Electrical Testing

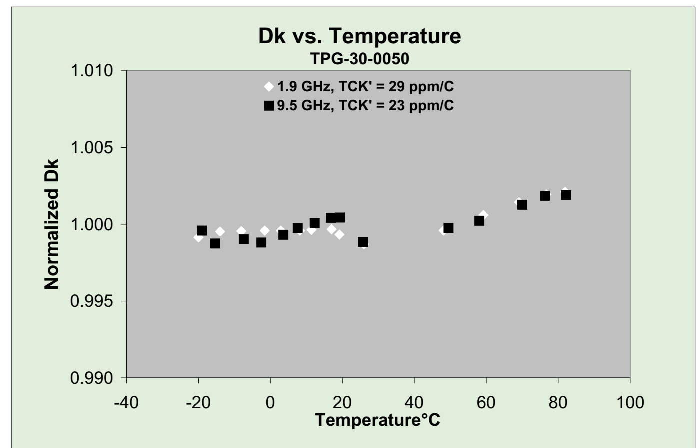
Electrical testing was performed by Northrop Grumman (Springfield, MO) on a six layer board. A via connected layer one to layer five to minimize stub effects for single-ended eye pattern measurements. The 16" stripline transmission lines used a line width of 0.010", 1.0 oz copper, and a dielectric spacing of approximately 0.016" between ground planes. Signals were launched via SMA connectors. The via structure capacitance was tuned to look like a 50 ohm transmission line by adjusting the size and shape of the antipad geometry. The loss of the SMA launches and via are well understood by launching signals directly in and out of the via with the SMA pins mounted vertically. The S21 parameter measurements suggest a 0.5 db/inch insertion loss at 10 GHz and 0.875 db/inch at 20 GHz. For digital measurements, rise times ranged between 40 to 70 picoseconds using a non return to zero pseudo random bit pattern. 500 mVolt swings were used. The eye heights for 10 and 12.5 gbps were 264 and 185 mVolts respectively.

TPG Typical Values

Property	Test Method	Unit	Value			Unit	Value		
Material Tested			TPG-30	TPG-32	TPG-35		TPG-30	TPG-32	TPG-35
Dielectric Constant @ 10 GHz	IPC-TM-650 2.5.5.5.1		3.00	3.20	3.50		3.00	3.20	3.50
Dissipation Factor @ 10 GHz	IPC-TM-650 2.5.5.5.1		0.0038	0.0050	0.0050		0.0038	0.0050	0.0050
Moisture Absorption	IPC-TM-650 2.6.2.1	%	0.13	0.22	0.13	%	0.13	0.22	0.13
Dielectric Breakdown	ASTM D 149	kV	54		54	kV	54		54
Dielectric Strength	ASTM D 149	V/mil	860		860	V/mm	33,858		33,858
Volume Resistivity	IPC-TM-650 2.5.17.1 (Humidity Conditioning)	Mohm/cm	7.7×10^8		7.7×10^8	Mohm/cm	7.7×10^8		7.7×10^8
Surface Resistivity	IPC-TM-650 2.5.17.1 (Humidity Conditioning)	Mohm	1.08×10^9			Mohm	1.08×10^9		
Flexural Strength (MD)	ASTM D 790	psi	19,900		19,900	N/mm^2	137.2		137.2
Flexural Strength (CD)	ASTM D 790	psi	14,900		14,900	N/mm^2	102.7		102.7
Tensile Strength (MD)	ASTM D 3039	psi	12,700		12,700	N/mm^2	87.6		87.6
Tensile Strength (CD)	ASTM D 3039	psi	8,200		8,200	N/mm^2	56.5		56.5
Poisson's Ratio	ASTM D 3039		0.22		0.22		0.22		0.22
Peel Strength (1.0 oz ED - CV1)	IPC-TM-650 2.4.8	lbs/ linear inch	13			N/mm	2.3		
Peel Strength (1.0 oz reverse treated foil - CL1)	IPC-TM-650 2.4.8	lbs/ linear inch	7			N/mm	1.3		
Dimensional Stability	IPC-TM-650 2.4.39 (after etch)	ppm (warp/fill)	98/99		98/99	ppm (warp/fill)	98/99		98/99
Density (Specific Gravity)	ASTM D 792	g/cm^3	2.02		2.02	g/cm^3	2.02		2.02
Thermal Conductivity	ASTM F 433	W/m/K	0.25	0.31	0.25	W/m/K	0.25	0.31	0.25
T300	IPC-TM-650 2.4.24.1	minutes	>60		>60	minutes	>60		>60
CTE (x-y)	ASTM D 3386 (30 - 100°C)	ppm/ºC	21-23		21-23	ppm/ºC	21-23		21-23
CTE (z)	ASTM D 3386 (30 - 100°C)	ppm/ºC	28		28	ppm/ºC	28		28
		%	0.20		0.20	%	0.20		0.20
CTE (z)	ASTM D 3386 (30 - 280°C)	ppm/ºC	108		108	ppm/ºC	108		108
		%	2.7		2.7	%	2.7		2.7
Attenuation @ 10 GHz (RTF 1/2 oz foil)	50 ohm microstrip, 71.2 mil TW (TLG-30-0050)	dB/in	0.16			dB/in	0.16		
Attenuation @ 20 GHz (RTF 1/2 oz foil)			0.32				0.32		
Attenuation @ 30 GHz (RTF 1/2 oz foil)			0.48				0.48		
Resin Flow (TPG)	IPC-TM-650 2.3.17	%	24			%	24		
Flammability Rating	UL 94		V-0				V-0		

All reported values are typical and should not be used for specification purposes. In all instances, the user shall determine suitability in any given application.



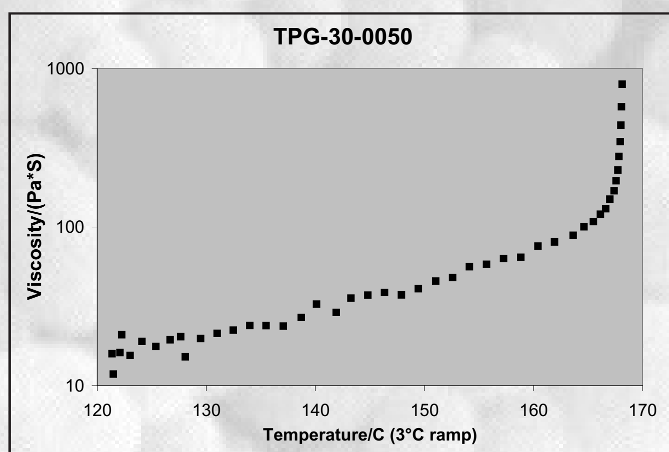


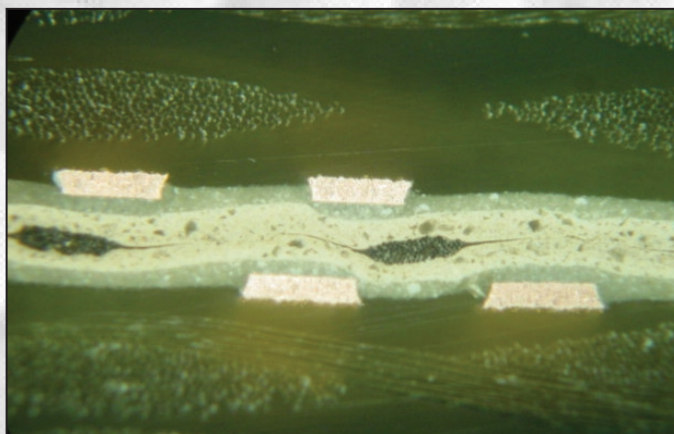
How To Order

Designation - Prepregs	Dielectric Constant	Typical Thicknesses
TPG-30	3.00	0.0045", 0.0050"
TPG-32	3.20	0.0045", 0.0050"
TPG-35	3.50	0.0045"

Available Sheet Sizes	
12" x 18"	304 mm x 457 mm
16" x 18"	406 mm x 457 mm
18" x 24"	457 mm x 610 mm
16" x 36"	406 mm x 914 mm
24" x 36"	610 mm x 914 mm

TPG prepregs have a liquid like viscosity at 120°C. They are supplied with a very low degree of cure. As shown in the graph on the right, curing does not accelerate until close to 170°C. Most FR-4 like thermosets have a high initial viscosity that suddenly decreases with enough temperature, reach a low viscosity (the process window), and then cure leading to higher viscosity. Because TPG prepregs have very low initial viscosities, a slow ramp rate will equate to more time at the low viscosities ensuring good flow/fill of very high layer count multilayers with complex lamination pressure variations. For thick high layer count multilayers (e.g. 20 layer boards with overlapping differential traces) a heat rise of 1.5 - 3.0 °C is recommended from 80 - 150°C. For less challenging multilayers typically used in microwave designs (4-10 layers), a temperature rise of up to 5.5°C can be used.





The figure to the left shows TPG-30-0050 bonding together two FR-4 cores, each with 1-oz copper. Foil laminations can be readily achieved because the bonding surface is a BT/epoxy containing resin system. Additionally, foil laminations yielding very predictable dielectric spacings can be obtained due to the ptfe-fiberglass layer.

TACONIC
An ISO 9001:2000 Registered Company
Petersburgh, NY: Tel: 800-833-1805 Fax: 518-658-3988
Europe: Tel: +353-44-9395600 Fax: +353-44-9344369 Asia: Tel: +82-31-704-1858 Fax: +82-31-704-1857
www.taconic-add.com

05/06:100-42

PTFE Particles