TacPreg® TPG Multilayer Prepreg

TacPreg® TPG prepregs are designed to have reduced electrical loss and improved ease of fabrication. Based on BT/epoxy/woven fiberglass/PTFE components, TacPreg® TPG offers 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 Dk x frequency x Df

Additional features of TacPreg® TPG prepregs include:

- 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 Dk 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

Taconic is a world leader in RF laminates and high speed digital materials, offering a wide range of high frequency laminates and prepregs. These advanced materials are used in the fabrication of antennas, multilayer RF and high speed digital boards, interconnections and devices.

Benefits & Applications:

- **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 PCBs**

- **High speed digital**
- **Military**
- **RF multilayer**

North & South America
Taconic - Headquarters
Petersburgh, NY 12138
Tel: 518-658-3202 / 1-800-833-1805
addinfo@4taconic.com

Europe/Middle East/Australia
Taconic International Ltd.
Republic of Ireland
Tel: +353-44-9395600
add@4taconic.com

Asia
Korea Taconic Company
Republic of Korea
Tel: +82-31-704-1858
sales@taconic.co.kr

China
Taconic Advanced Material (Suzhou) Co., Ltd.
Suzhou City, China
Tel: +86-512-8718-9678
tssales@taconic.co.kr

An ISO 9001:2000 Registered Company
www.taconic-add.com

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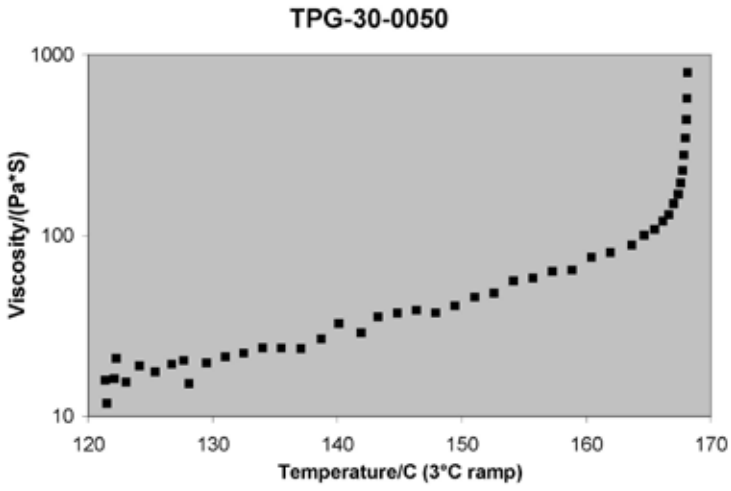
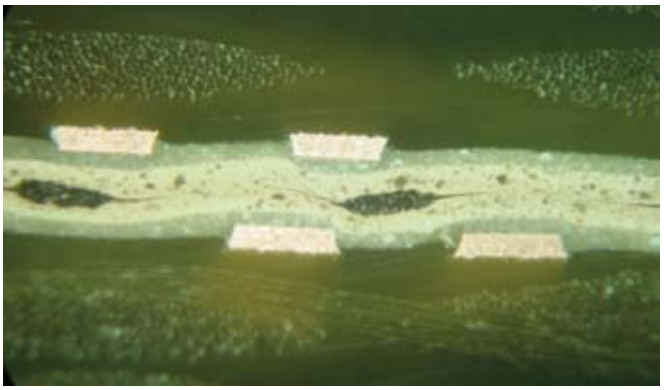
TPG prepregs have a liquid-like viscosity at 120° C. They are supplied with a very low degree of cure. As shown in the graph at right, curing does not accelerate until close to 170° C. Most FR-4-like thermosets have a high initial viscosity that suddenly decreases with enough temperature, reach a low 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.





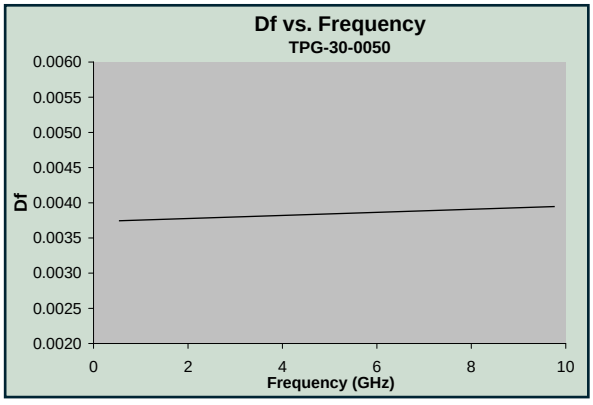
The figure at left shows TPG-30-0050 bonding together two FR-4 cores, each with 1 oz. copper. Foil laminations can be readily achieved because the bonding surface is a BT/epoxy containing resin system. Additionally, foil laminations yielding very predictable dielectric spacings can be obtained due to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

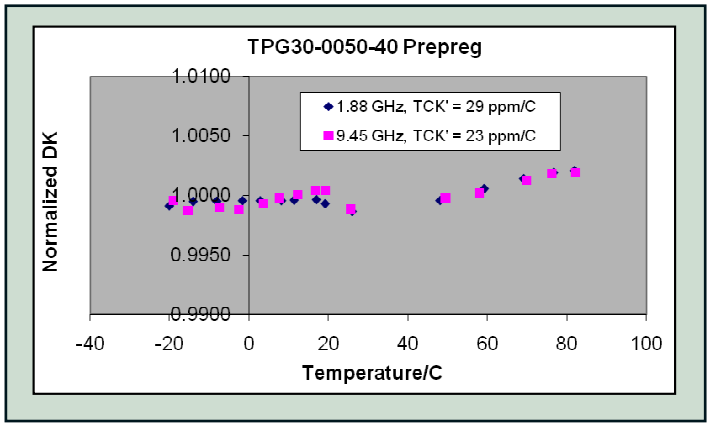
TacPreg® TPG prepregs exhibit the following benefits that are standard to the TacPreg®/TacLam® family of products:

- Good copper adhesion with flat reverse treated foils
- The ability to laminate at conventional FR-4 temperatures which enables Taconic to offer these products with FR-4 economies of scale
- TacPreg® TPG prepregs are dimensionally stable due to the woven glass design and show predictable movement when laminated at FR-4 conditions

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.

TPG Typical Values									
Property	Test Method	Unit	Value			Unit	Value		
Material			TPG-30	TPG-32	TPG-35		TPG-30	TPG-32	TPG-35
Dk @ 10 GHz	IPC-650 2.5.5.5.1		3.00	3.20	3.50		3.00	3.20	3.50
Df @ 10 GHz	IPC-650 2.5.5.5.1		0.0038	0.0050	0.0050		0.0038	0.0050	0.0050
Moisture Absorption	IPC-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-650 2.5.17.1 (Humidity Conditioning)	Mohms/cm	7.7×10^8		7.7×10^8	Mohms/cm	7.7×10^8		7.7×10^8
Surface Resistivity	IPC-650 2.5.17.1 (Humidity Conditioning)	Mohms	1.08×10^9			Mohms	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 oz. ED/CV1)	IPC-650 2.4.8	lbs./ linear inch	13			N/mm	2.3		
Peel Strength (1 oz. reverse treated foil/CL1)	IPC-650 2.4.8	lbs./ linear inch	7			N/mm	1.3		
Dimensional Stability	IPC-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-650 2.4.24.1	minutes	>60		>60	minutes	>60		>60
CTE (x-y axis)	ASTM D 3386 (30 - 100°C)	ppm/°C	21-23		21-23	ppm/°C	21-23		21-23
CTE (z axis)	ASTM D 3386 (30 - 100°C)	ppm/°C	28		28	ppm/°C	28		28
CTE (z axis)	ASTM D 3386 (30 - 280°C)	ppm/°C	108		108	ppm/°C	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/inch	0.16			dB/inch	0.16		
Attenuation @ 20 GHz (RTF 1/2 oz. foil)	50 ohm microstrip; 71.2 mil TW (TLG-30-0050)	dB/inch	0.32			dB/inch	0.32		
Attenuation @ 30 GHz (RTF 1/2 oz. foil)	50 ohm microstrip; 71.2 mil TW (TLG-30-0050)	dB/inch	0.48			dB/inch	0.48		
Resin Flow (TPG)	IPC-650 2.3.17	%	24			%	24		
Flammability Rating	UL 94		V-0				V-0		





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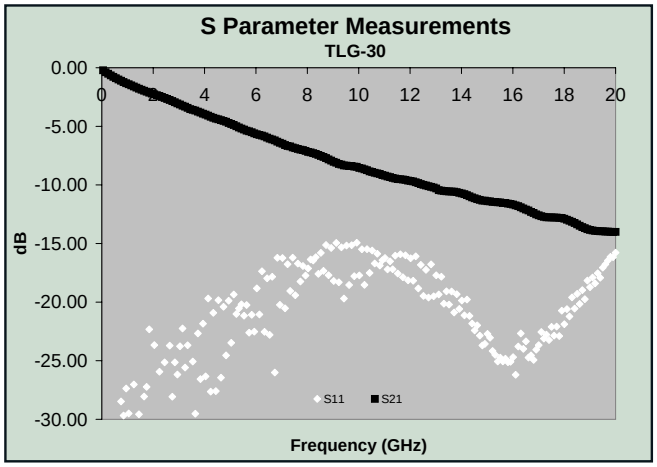
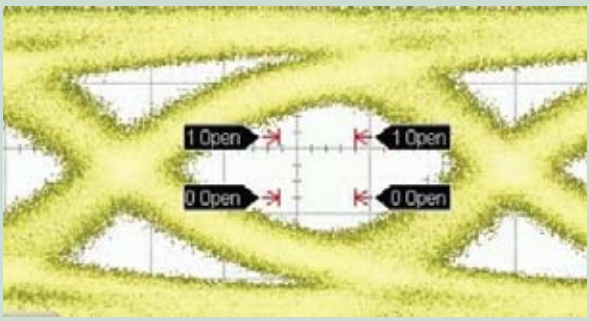
Designation	Dk	Dielectric Thickness inches
TPG-30	3.00	0.0045, 0.0050
TPG-32	3.20	0.0045, 0.0050
TPG-35	3.50	0.0045

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



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

Single-ended Eye Pattern Measurements



Courtesy of Northrop Grumman

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

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 oz. copper and a dielectric spacing of approximately 0.016" between ground planes. Signals were launched via SMA connectors. The via structure capaitance 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.

RoHS WEEE Compliant

rev. 1/09