

TSM Family of Thermally Stable Materials

TSM-26, 29 & 30 are specifically engineered as high reliability materials with consistent performance over broad temperature and frequency ranges. The low dielectric loss properties are optimal for high frequency microwave and digital applications.

The TSM family of materials provides a solution to the difficulty of manufacturing high layer count multilayer PCBs with PTFE cores. The low fiberglass content of the TSM family allows more predictable multilayer manufacturing vs. non-woven materials.

Typically non-woven ceramic filled PTFE laminates are low loss materials that exhibit undesirable moisture and solvent absorption. It is also typical that woven reinforced ceramic filled PTFE laminates have significantly lower moisture absorption but much higher loss. TSM-26, 29 & 30 offer the best of both worlds: an exceptionally low loss tangent *and* low moisture and solvent absorption.

Insertion loss is a combination of material losses (Df or loss tangent), conductor losses, and radiation losses. TSM-26, 29 & 30 are typically used at frequencies above 1 GHz. At these higher frequencies the surface roughness of the copper cladding will contribute to the conductor losses and overall insertion loss of the design. We recognize that smoother surface roughness of the copper will give lower insertion loss and better performance therefore we have standardized on a very low profile copper. Our very low profile copper has an R_{MS} surface roughness of approximately one third standard electrodeposited copper. This choice results in the lowest possible insertion loss while still maintaining exceptional copper bond strength.

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:

- Excellent Thermal Stability
- Exceptionally Low Loss
- Phase Stable Material
- Tight Dk Tolerance
- Stable Dk over Temperature
- Reinforced for High Layer Count Fabrication
- For use with *fastRise*™27 Prepreg

- Filters & Couplers
- Front End Down Converters
- Modulators
- Low Loss Antennas
- Radar Systems
- Power Amplifiers
- mmWave Modules
- ATE PCBs
- Multilayer PCBs



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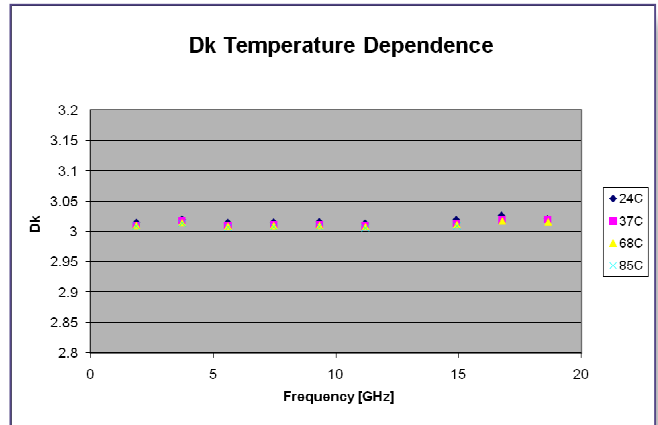
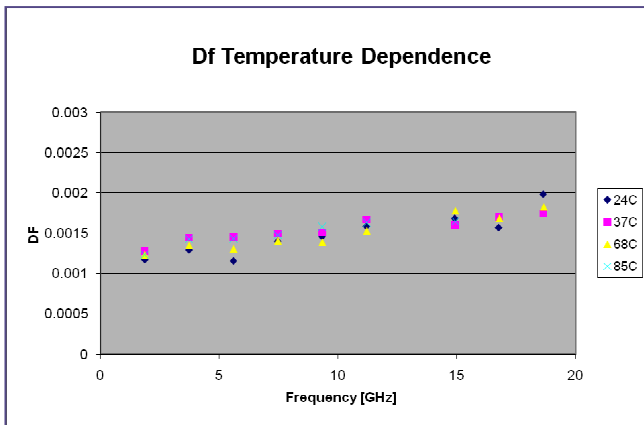
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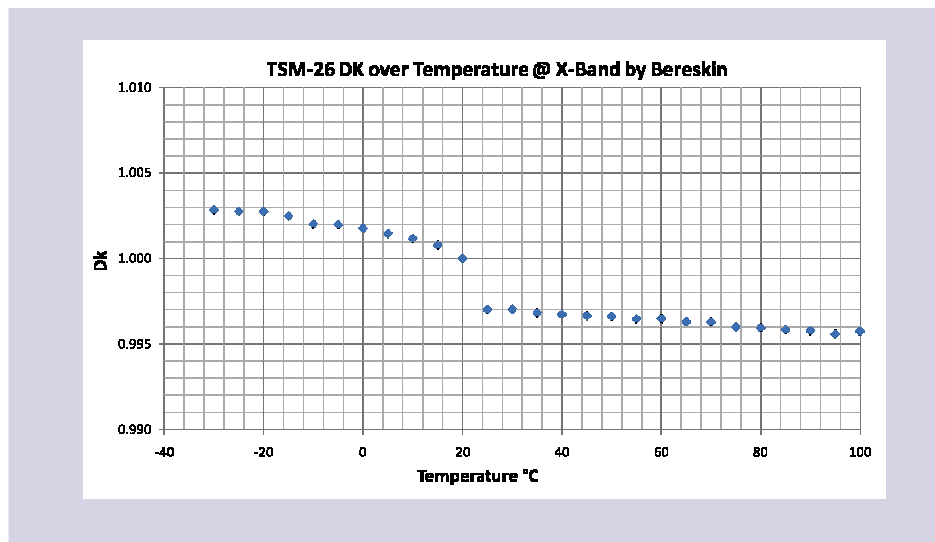
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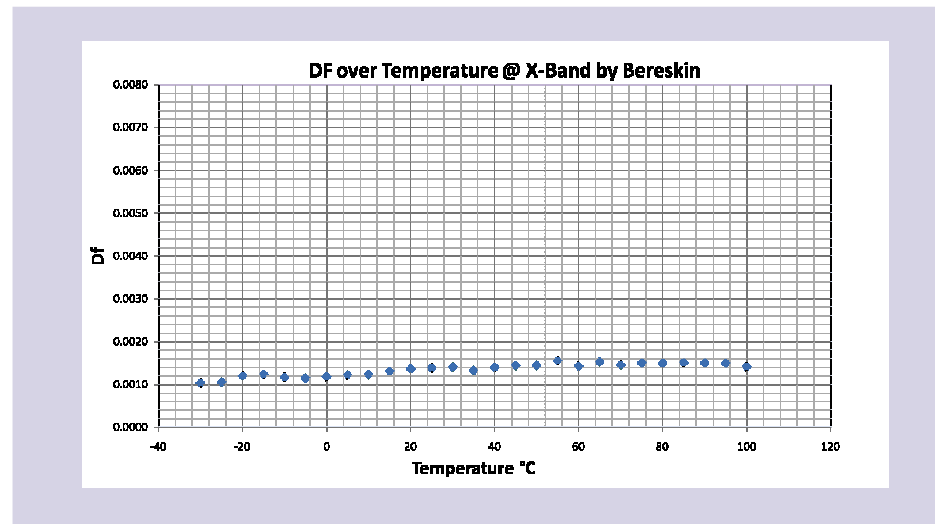
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Dk and Df Temperature Dependence of TSM-30



TSM-26 has a very low dielectric constant variation with temperature ($T_{ck} = -54\text{ppm}/^\circ\text{C}$).



The loss tangent properties of TSM-26 are relatively unaffected by temperature (measured at 10.1 GHz).

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TSM-26, 29 & 30 Typical Values**									
Property	Test Method	Unit	Value			Unit	Value		
			26	29	30		26	29	30
Dk @ 10 GHz	IPC-650 2.5.5.5.1 (modified)		2.6	2.94	3.0		2.6	2.94	3.0
Dk @ 40 GHz	Damaskos Open Resonator			2.94	3.0			2.94	3.0
Df @ 10 GHz	IPC-650 2.5.5.5.1 (modified)		0.0014	0.0013	0.0013		0.0014	0.0013	0.0013
Df @ 40 GHz	Damaskos Open Resonator			0.002	0.002			0.002	0.002
Moisture Absorption	IPC-650 2.6.2.1	%		0.03		%		0.03	
Dielectric Breakdown	IPC-650 2.5.6 (parallel to lamination)	Kv	75		68	Kv	75		68
Dielectric Strength	ASTM D 149	V/mil		610		V/mm		24,016	
Volume Resistivity	IPC-650 2.5.17.1 (after humidity)	Mohms/cm		1.7 x 10 ⁸		Mohms/cm		1.7 x 10 ⁸	
Surface Resistivity	IPC-650 2.5.17.1 (after elevated temp.)	Mohms		5.6 x 10 ⁷		Mohms		5.6 x 10 ⁷	
Arc Resistance	IPC-TM-650 2.5.1	Seconds		247		Seconds		247	
Flexural Strength (MD)	ASTM D 790	psi		6,900		N/mm ²		47.57	
Flexural Strength (CD)	ASTM D 790	psi		6,000		N/mm ²		41.37	
Tensile Strength (MD)	ASTM D 3039	psi		5,100		N/mm ²		35.16	
Tensile Strength (CD)	ASTM D 3039	psi		3,800		N/mm ²		26.20	
Young's Modulus	ASTM D 3039	psi		4.75 x 10 ⁵		N/mm ²		3275	
Poisson's Ratio	ASTM D 3039			0.24				0.24	
Compressive Modulus	ASTM D 695 (23°C)	kpsi		465		N/mm ²		3206.06	
Peel Strength (1 oz CV1)	IPC-650 2.4.8 Sec 5.2.2 (Thermal Stress)	lbs/in		8		N/mm		1.46	
Dimensional Stability (MD)	IPC-650 2.4.39 Sec 5.4 (After bake)	mils/in		-0.25		mm/M		-0.25	
Dimensional Stability (CD)	IPC-650 2.4.39 Sec 5.4 (After bake)	mils/in		-0.22		mm/M		-0.22	
Density (Specific Gravity)		g/cm ³		2.30		g/cm ³		2.30	
T _d (2% Wt. Loss)		°F		>932		°C		>500	
Melt Point		°F		620		°C		327	
Specific Heat	ASTM E 1269 (DSC)	J/g/K		0.627		J/g/K		0.627	
Thermal Conductivity	ASTM F 433	W/m/K		0.27		W/m/K		0.27	
CTE (x)	IPC-650 2.4.41 / ASTM D 3386	ppm/°C		23		ppm/°C		23	
CTE (y)	IPC-650 2.4.41 / ASTM D 3386	ppm/°C		28		ppm/°C		28	
CTE (z)	IPC-650 2.4.41 / ASTM D 3386	ppm/°C		78		ppm/°C		78	
Outgassing (% TML)	ASTM E 595 *	%		0.05		%		0.05	
Outgassing (% CVCM)	ASTM E 595 *	%		0.01		%		0.01	
Outgassing (% WVR)	ASTM E 595 *	%		0.01		%		0.01	
Flammability Rating	UL-94			V-0				V-0	

TSM-26 is not UL classified to date.

*As reported by NASA for TSM-30. See <http://outgassing.nasa.gov/>

**All typical values are for TSM 29 & 30 unless otherwise noted.

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.

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How to Order

Designation	Dk
TSM-26	2.6 +/-0.05
TSM-29 & 30	2.94, 3.0 +/-0.05

Typical Thicknesses ¹		
Product #	Inches	mm
TSM-26	0.0035	0.09
TSM-29, 30	0.0050	0.13
TSM-26	0.0070	0.18
TSM-29, 30	0.0100	0.25
TSM-26	0.0105	0.27
TSM-29, 30	0.0150	0.38
TSM-29, 30	0.0200	0.51
TSM-29, 30	0.0300	0.76
TSM-29, 30	0.0600	1.52

Available Sheet Sizes ²	
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

¹Other thicknesses may be available. Please call for information.

²Our standard sheet size is 36" x 48" (457 mm x 610 mm). Please contact our customer service department for availability of other sizes.

Available Copper Cladding						
Designation	Weight	Copper Thickness		R _{MS} Treated Side		Description
RH	1/2 oz / ft ²	~0.0007	~18 μm	16 μin	0.4 μm	Rolled annealed
R1	1 oz / ft ²	~0.0014	~35 μm	11 μin	0.3 μm	Rolled annealed
CLH	1/2 oz / ft ²	~0.0007	~18 μm	13 μin	0.3 μm	Reverse treated / Electrodeposited
CL1	1 oz / ft ²	~0.0014	~35 μm	13 μin	0.3 μm	Reverse treated / Electrodeposited
CVH (CH)	1/2 oz / ft ²	~0.0007"	~18 μm	27 μin	0.7 μm	Very low profile / Electrodeposited
CV1 (C1)	1 oz / ft ²	~0.0014	~35 μm	25 μin	0.6 μm	Very low profile / Electrodeposited
C2	2 oz / ft ²	~0.0028	~70 μm	77 μin	2.0 μm	Electrodeposited

Ticer and Ohmega Ply resistive foils are also available. Heavy metal claddings (aluminum, brass & copper) may also be available upon request. Please call for information.

An example of our part number is: TSM-26-0035-CV1/CV1 - 18" x 24" (457 mm x 610 mm)
 TSM-29-0050-CV1/CV1 - 18" x 24" (457 mm x 610 mm)
 TSM-30-0050-CV1/CV1 - 18" x 24" (457 mm x 610 mm)

