AGC

Your Dreams, Our Challenge

TACONIC

TSM-DS3M Dimensionally Stable Low Loss Laminate

TSM-DS3M is a thermally stable, industry leading low loss core (Df = 0.0011 at 10 GHz) that can be manufactured with the predictability and consistency of the best fiberglass reinforced epoxies. TSM-DS3M is a ceramic-filled reinforced material with very low fiberglass content (~5%) that rivals epoxies in fabricating large format complex multilayers. TSM-DS3M is designed for high reliability military applications.

TSM-DS3M was developed for high power applications (thermal conductivity = 0.65 W/M*K) where it is necessary for the dielectric material to conduct heat away from other heat sources in a PWB design. TSM-DS3M was also developed to have very low coefficients of thermal expansion for demanding thermal cycling.

A TSM-DS3M core combined with *fast*Rise™27 prepreg (Df = 0.0014 at 10 GHz) is an industry leading solution for the lowest possible dielectric losses that can be attained at epoxy-like 420°F fabrication temperatures. The low insertion losses of TSM-DS3M/*fast*Rise™27 are only rivaled by fusion bonding (the melting of pure Teflon® laminates from 550°F to 650°F). Fusion bonding is expensive, it causes excessive material movement and it puts stress on plated through holes. For complex multilayers, the price of poor yield drives up the final material cost. *fast*Rise™27 enables the sequential lamination of TSM-DS3M at a low 420°F with consistency and predictability that reduces cost.

For microwave applications, the low x, y and z CTE values assure that critical spacings between traces in filters and couplers have very low movement with temperature. TSM-DS3M can be used with very low profile copper foils yielding a smooth copper edge between coupled lines.

Registration over many layers is critical for yield and variations in copper weight and copper etching across a panel can cause non-linear movement. Non-linear movement over large panels leads to a lack of registration of the drilled hole to the pad and possibly open circuits.

TSM-DS3M is compatible with Ticer® and OhmegaPly® resistive foils.

Benefits & Applications:

- Industry Best Df (Df = 0.0011 @10 GHz)
- High Thermal Conductivity (0.65 W/M*K)
- Low Z Axis Expansion for Military Applications
- Low (~5%) Fiberglass Content
- Dimensional Stability Rivals Epoxy
- Enables Large Format High Layer Count PWBs
- Builds Complex PWBs in Yield with Consistency and Predictability
- Temperature Stable Dk +/- 0.25% (-30 to 120°C)
- Compatible with Resistive Foils

- Microstrip and Stripline Circuitry for Military Applications
- Couplers
- Phased Array Antennas
- Radar Manifolds
- mmWave Antenna/Automotive
- Oil Drilling
- Semiconductor/ATE Testing

Resistor foil stability is best achieved when laminating at low temperatures using AGCs *fast*Rise™ family of prepregs. TSM-DS3M is intended for RF circuitry and requires OEM design validation for digital circuitry.

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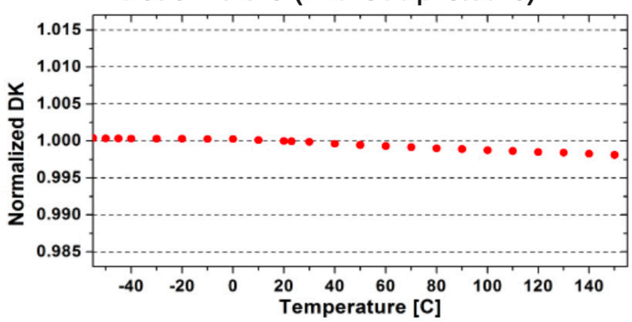
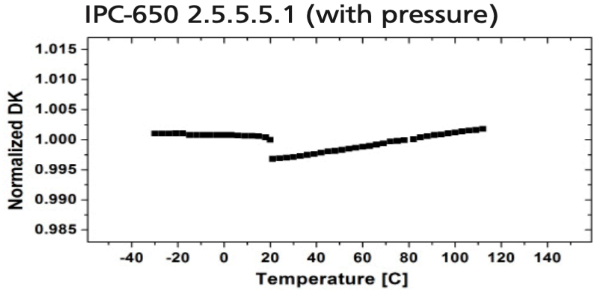
T_cK is an abbreviation of Thermal Coefficient of dielectric constant. Like many other dielectric test methods, the resulting dielectric values are test method dependent. T_cK is no exception. Most standard dielectric constant test methods are based on applying pressure with clamping to remove any air gap between the dielectric substrates and the pattern cards. If measured with fabricated PCBs, there could be variation in circuitry pattern length or width. Many conventional PTFE based materials show a negative T_cK. As PTFE expands, its density decreases and this helps explain why PTFE generally shows a negative T_cK. Another factor is molecular interactions or vibrations that increase with temperature resulting in increasing dielectric constant with temperature. This is the case of epoxy based laminates. IPC standard methods typically involve clamping of samples with pressure which may prevent natural expansion in the Z axis and may not be representative of an industrial or military application. The following graphs show different results according to the particular IPC test method. IPC-650 2.5.5.6 is a method using no applied pressure which is a condition more representative of actual use. IPC-650 2.5.5.5.1 (modified) is measured with applied pressure and the DK is somewhat sensitive to dielectric thickness. IPC-650 2.5.5.5 is also measured with applied pressure but is less sensitive to dielectric thickness.

IPC-650 2.5.5.6 (without pressure)



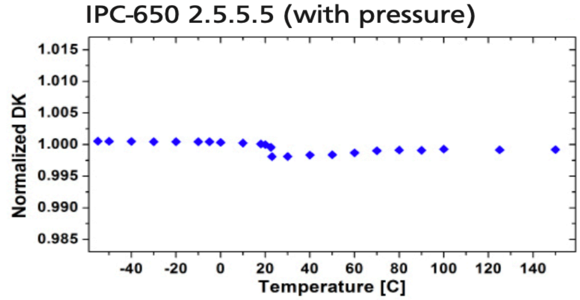
T_cK = -11 ppm/°C (-55 ~ 150°C)

IPC-650 2.5.5.5.1 (with pressure)



T_cK = +5.4 ppm/°C (-30 ~ 120°C)

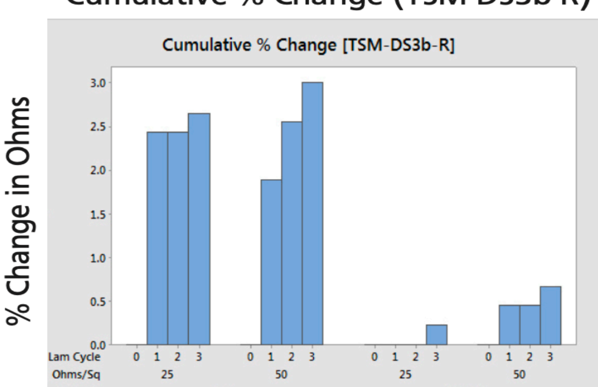
IPC-650 2.5.5.5 (with pressure)



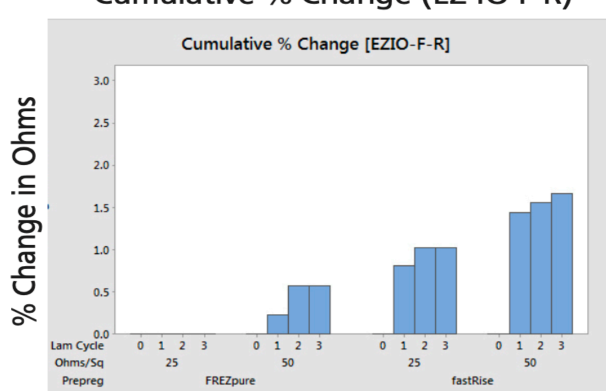
T_cK = -6.6 ppm/°C (-55 ~ 150 °C)

Resistor Foil Stability with Prepreg Lamination

Cumulative % Change (TSM-DS3b-R)



Cumulative % Change (EZ-IO-F-R)



TSM-DS3M Typical Values					
Property	Test Method	Unit	Value	Unit	Value
Dk @ 10 GHz	IPC-650 2.5.5.5.1 (Modified)		2.94		2.94
T_cK (-55 to 150 °C)	IPC-650 2.5.5.6	ppm/°C	-11	ppm/°C	-11
Df @ 10 GHz	IPC-650 2.5.5.5.1 (Modified)		0.0011		0.0011
Dielectric Breakdown	IPC-650 2.5.6 (ASTM D 149)	kV	47.5	kV	47.5
Dielectric Strength	ASTM D 149 (Through Plane)	V/mil	548	V/mm	21,575
Arc Resistance	IPC-650 2.5.1	Seconds	226	Seconds	226
Moisture Absorption	IPC-650 2.6.2.1	%	0.07	%	0.07
Flexural Strength (MD)	ASTM D 790/ IPC-650 2.4.4	psi	11,811	N/mm^2	81
Flexural Strength (CD)	ASTM D 790/ IPC-650 2.4.4	psi	7,512	N/mm^2	51
Tensile Strength (MD)	ASTM D 3039/IPC-650 2.4.19	psi	7,030	N/mm^2	48
Tensile Strength (CD)	ASTM D 3039/IPC-650 2.4.19	psi	3,830	N/mm^2	26
Elongation at Break (MD)	ASTM D 3039/IPC-650 2.4.19	%	1.6	%	1.6
Elongation at Break (CD)	ASTM D 3039/IPC-650 2.4.19	%	1.5	%	1.5
Young's Modulus (MD)	ASTM D 3039/IPC-650 2.4.19	psi	973,000	N/mm^2	6,708
Young's Modulus (CD)	ASTM D 3039/IPC-650 2.4.19	psi	984,000	N/mm^2	6,784
Poisson's Ratio (MD)	ASTM D 3039/IPC-650 2.4.19		0.24		0.24
Poisson's Ratio (CD)	ASTM D 3039/IPC-650 2.4.19		0.20		0.20
Compressive Modulus	ASTM D 695 (23°C)	psi	310,000	N/mm^2	2,137
Flexural Modulus (MD)	ASTM D 790/IPC-650 2.4.4	kpsi	1,860	N/mm^2	12,824
Flexural Modulus (CD)	ASTM D 790/IPC-650 2.4.4	kpsi	1,740	N/mm^2	11,996
Peel Strength (CV1)	IPC-650 2.4.8 Sec 5.2.2 (TS)	lbs/in	8	N/mm	1.46
Thermal Conductivity (Unclad)	ASTM F 433/ASTM 1530-06	W/M*K	0.65	W/M*K	0.65
Dimensional Stability (MD)	IPC-650 2.4.39 Sec. 5.4 (After Bake)	mils/in	0.21	mm/M	0.21
Dimensional Stability (CD)	IPC-650 2.4.39 Sec. 5.4 (After Bake)	mils/in	0.20	mm/M	0.20
Dimensional Stability (MD)	IPC-650 2.4.39 Sec. 5.5 (TS)	mils/in	0.15	mm/M	0.15
Dimensional Stability (CD)	IPC-650 2.4.39 Sec. 5.5 (TS)	mils/in	0.10	mm/M	0.10
Surface Resistivity	IPC-650 2.5.17.1 Sec. 5.2.1 (ET)	Mohms	2.3×10^6	Mohms	2.3×10^6
Surface Resistivity	IPC-650 2.5.17.1 Sec. 5.2.1 (HC)	Mohms	2.1×10^7	Mohms	2.1×10^7
Volume Resistivity	IPC-650 2.5.17.1 Sec. 5.2.1 (ET)	Mohms/cm	1.1×10^7	Mohms/cm	1.1×10^7
Volume Resistivity	IPC-650 2.5.17.1 Sec. 5.2.1 (HC)	Mohms/cm	1.8×10^8	Mohms/cm	1.8×10^8
CTE (x axis) (RT to 125°C)	IPC-650 2.4.41/TMA	ppm/°C	10	ppm/°C	10
CTE (y axis) (RT to 125°C)	IPC-650 2.4.41/TMA	ppm/°C	16	ppm/°C	16
CTE (z axis) (RT to 125°C)	IPC-650 2.4.41/TMA	ppm/°C	23	ppm/°C	23
Density (Specific Gravity)	ASTM D 792	g/cm^3	2.11	g/cm^3	2.11
Hardness	ASTM D 2240 (Shore D)		79		79
T_d (2% Weight Loss)	IPC-650 2.4.24.6 (TGA)	°C	526	°C	526
T_d (5% Weight Loss)	IPC-650 2.4.24.6 (TGA)	°C	551	°C	551

ET - Elevated Temperature
HC - Humidity Conditioning
TS - Thermal Stress

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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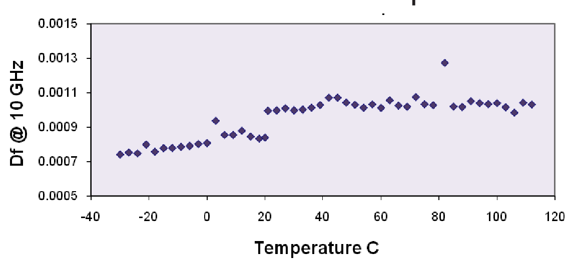
Designation	Dk
TSM-DS3M	2.94 ± 0.05

Typical Thicknesses* Inches	mm
0.0050, 0.0100, 0.0200	0.13, 0.25, 0.51
0.0300, 0.0600, 0.0900	0.76, 1.52, 2.29

*Other thicknesses in increments of 5 mils available upon request.

Available Sheet Sizes Inches	mm
12 x 18	305 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
18 x 48	457 x 1220

TSM-DS3M Df over Temperature



The dissipation factor varies from 0.0007 - 0.0011 over a typical application temperature range.

Please see our Product Selector Guide for information on available copper cladding.

An example of our part number is: **TSM-DS3M-0050-C1/C1 - 18” x 24” (457 mm x 610 mm)**