TSM-DS3M

Dimensionally Stable Low Loss Laminate

AGC
Your Dreams, Our Challenge

Benefits

- Industry Best Df (Df = 0.0011 @10 GHz)
- High Thermal Conductivity (TC = 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

Applications

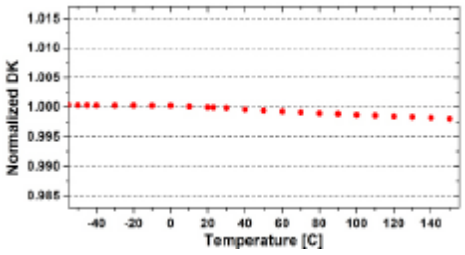
- Microstrip and Stripline Circuitry for Avionics and Aerospace Applications
- Couplers
- Phased Array Antennas
- Radar Manifolds
- mmWave Antenna/Automotive
- Oil Drilling
- Semiconductor/ATE Testing

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 (TC = 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 fastRise™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 (215°C) fabrication temperatures. The low insertion losses of TSM-DS3M/fastRise™27 are only rivaled by fusion bonding (PTFE laminates melt from 550 to 650°F (288 - 343°C)). 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. fastRise™27 enables the sequential lamination of TSM-DS3M at a low 420°F (215°C) 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.

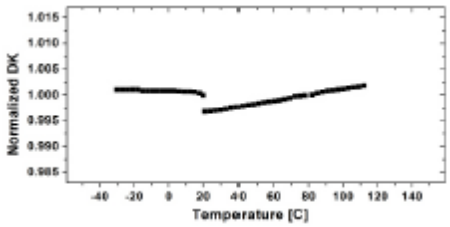
Resistor foil stability is best achieved when laminating at low temperatures using AGCs fastRise™ family of prepregs. TSM-DS3M is intended for RF circuitry and requires OEM design validation for digital circuitry. TcK is an abbreviation of Thermal Coefficient of dielectric constant. Like many other dielectric test methods, the resulting dielectric values are test method dependent. TcK 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 TcK. As PTFE expands, its density decreases and this helps explain why PTFE generally shows a negative TcK. 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)



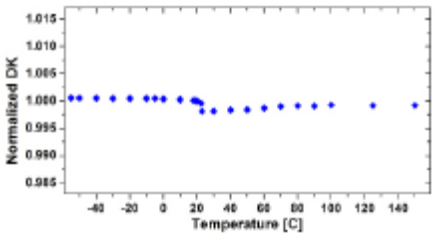
TcK = -11 ppm/°C (-55 ~ 150°C)

IPC-650 2.5.5.5.1 (with pressure)



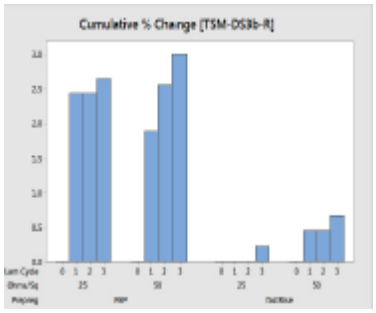
TcK = +5.4 ppm/°C (-30 ~ 120°C)

IPC-650 2.5.5.5 (with pressure)

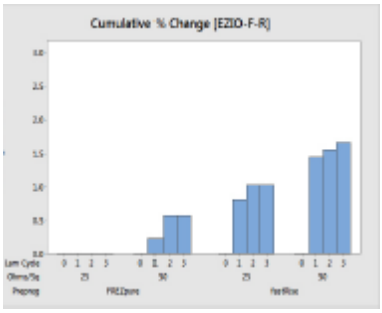


TcK = -6.6 ppm/°C (-55 ~ 150 °C)

Resistor Foil Stability with Prepreg Lamination

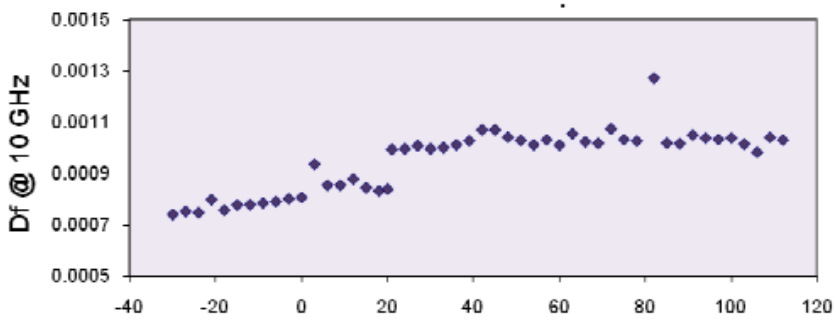


Cumulative % Change (TSM-DS3b-R)



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

TSM-DS3M Df over Temperature



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

Properties	Conditions	Typical Value	Unit	Test Method
Electrical Properties				
Dielectric Constant	@ 10 GHz	2.94 ± 0.04		IPC-650 2.5.5.5.1 (Modified)
Dissipation Factor	@ 10 GHz	0.0014		IPC-650 2.5.5.5.1 (Modified)
Volume Resistivity		2.3×10^6	Mohms/cm	IPC-650 2.5.17.1 Sec. 5.2.1 (ET)
		2.1×10^7	Mohms/cm	IPC-650 2.5.17.1 Sec. 5.2.1 (HC)
Surface Resistivity		1.1×10^7	Mohms	IPC-650 2.5.17.1 Sec. 5.2.1 (ET)
		1.8×10^8	Mohms	IPC-650 2.5.17.1 Sec. 5.2.1 (HC)
Thermal Properties				
T_d	2% Weight Loss	526	°C	IPC-650 2.4.24.6 (TGA)
	5% Weight Loss	551	°C	
Thermal Conductivity	Unclad	0.65	W/M*K	ASTM F 433/ASTM 1530-06
CTE (RT to 125°C)	X	10	ppm/°C	IPC-650 2.4.41/TMA
	Y	16		
	Z	23		
Mechanical Properties				
Density	Specific Gravity	2.11	g/cm^3	ASTM D 792
Flexural Strength	MD	81 (11,811)	N/mm^2 (psi)	ASTM D 790/ IPC-650 2.4.4
	CD	51 (7,512)	N/mm^2 (psi)	ASTM D 3039/IPC-650 2.4.19
Tensile Strength	MD	48 (7,030)	N/mm^2 (psi)	ASTM D 3039/IPC-650 2.4.19
	CD	26 (3,830)	N/mm^2 (psi)	
Elongation at Break	MD	1.6	%	ASTM D 3039/IPC-650 2.4.19
	CD	1.5	%	
Young's Modulus	MD	6,708 (973,000)	N/mm^2 (psi)	ASTM D 3039/IPC-650 2.4.19
	CD	6,784 (984,000)	N/mm^2 (psi)	
Poisson's Ratio	MD	0.24		ASTM D 3039/IPC-650 2.4.19
	CD	0.20		
Chemical / Physical Properties				
Dielectric Breakdown		47.5	kV	IPC-650 2.5.6 (ASTM D 149)
Dielectric Strength		21,575 (548)	V/mm (V/mil)	ASTM D 149 (Through Plane)
Arc Resistance		226	Seconds	IPC-650 2.5.1
Moisture Absorption		0.07	%	IPC-650 2.6.2.1

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

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

Available Sheet Sizes			
Inches	**mm**	**Inches**	**mm**
12 x 18	305 x 457	16 x 36	406 x 914
16 x 18	406 x 457	24 x 36	610 x 914
18 x 24	457 x 610	18 x 48	457 x 1,220

- All test data provided are typical values and not intended to be specification values. For review of critical specification tolerances, please contact a company representative directly.
- TSM-DS3M can be manufactured in increments of 0.005" (0.125mm).
- Standard panel size is 18" x 24" (457 mm x 610 mm).
- Please contact AGC for availability of additional thicknesses, other sizes & any other type of cladding.
- The resistor foil manufacturer covers the warranty for the copper foil that includes the resistor layer, as well as the performance and workability related to the copper foil. Our company does not take responsibility for the processing of resistor layers and the performance or workability of the final products.

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