TSM-DS3

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 (~5%) Fiberglass Content
- Dimensional Stability Rivals Epoxy
- Enables Large Format High Layer Count PWBs
- Builds Complex PWBs in Yield w/ Consistency and Predictability
- Temperature Stable Dk ± 0.25% (-30 to 120°C)
- Compatible With Resistive Foils

Applications

- Couplers
- Phased Array Antennas
- Radar Manifolds
- mmWave Antenna/Automotive
- Oil Drilling
- Semiconductor/ATE Testing

TSM-DS3 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-DS3 is a ceramic-filled reinforced material with very low fiberglass content (~ 5%) that rivals epoxies in fabricating large format complex multilayers.
TSM-DS3 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-DS3 was also developed to have very low coefficients of thermal expansion for demanding thermal cycling.

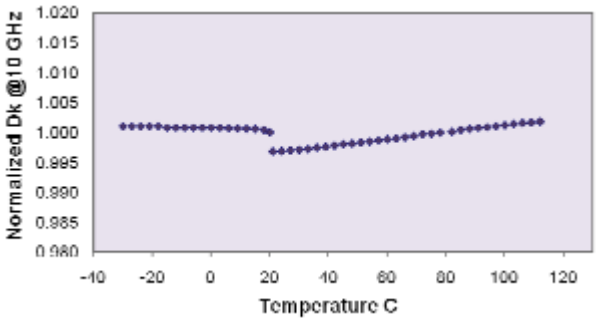
A TSM-DS3 core combined with fastRise™27 (Df = 0.0014 at 10 GHz) prepreg is an industry leading solution for the lowest possible dielectric losses that can be attained at epoxy-like 420°F fabrication temperatures. The low insertion losses of TSM-DS3/ fastRise™27 are only rivaled by fusion bonding (PTFE 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-DS3 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-DS3 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 nonlinear 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-DS3 is compatible with Ticer® and OhmegaPly® resistive foils. Resistor foil stability is best achieved when laminating at low temperatures using AGC's fastRise™27 family of prepregs.

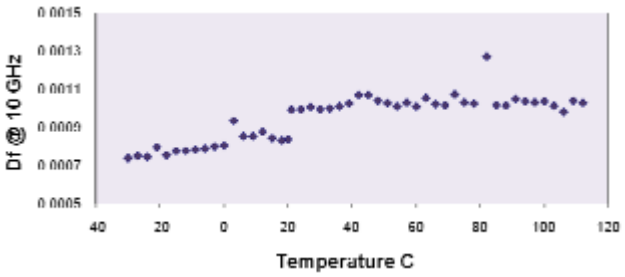
TSM-DS3 is intended for RF circuitry and requires OEM design validation for digital circuitry.

TSM-DS3: DK over Temperature



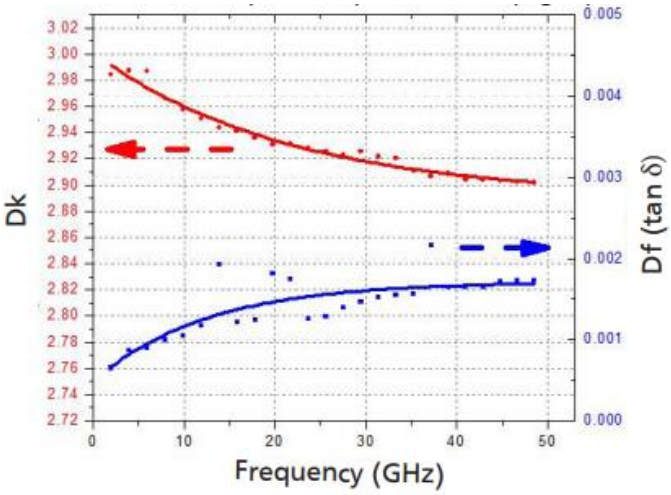
The TSM-DS3 dielectric constant shows a +/- 0.2% deviation with temperature.

TSM-DS3: DF over Temperature

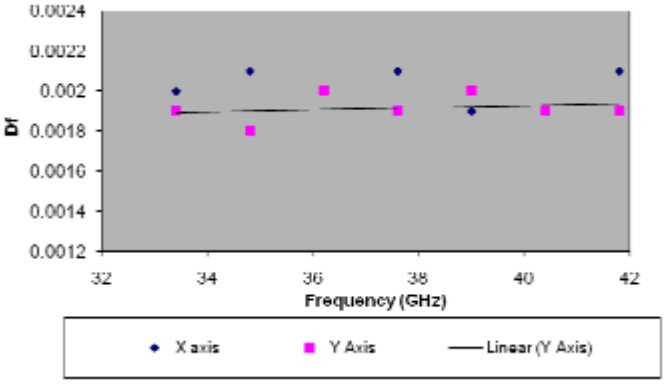


The dissipation factor varies from 0.0007 - 0.0011 over a typical application temperature range.

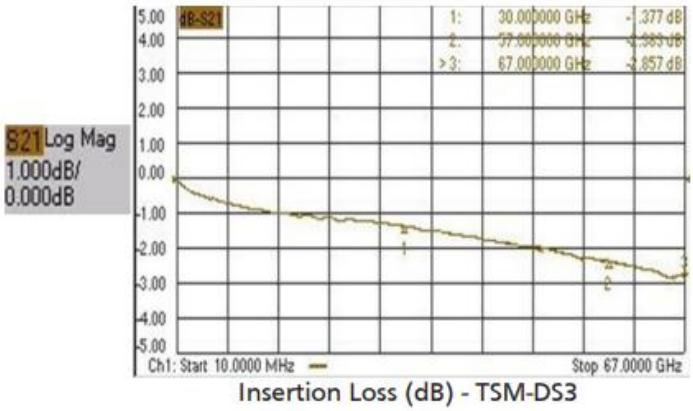
Ring Resonator Properties vs. Frequency on TSM-DS3-0100. (Test set up as shown on page 4).



TSM-DS3 at mmWave (Damaskos)

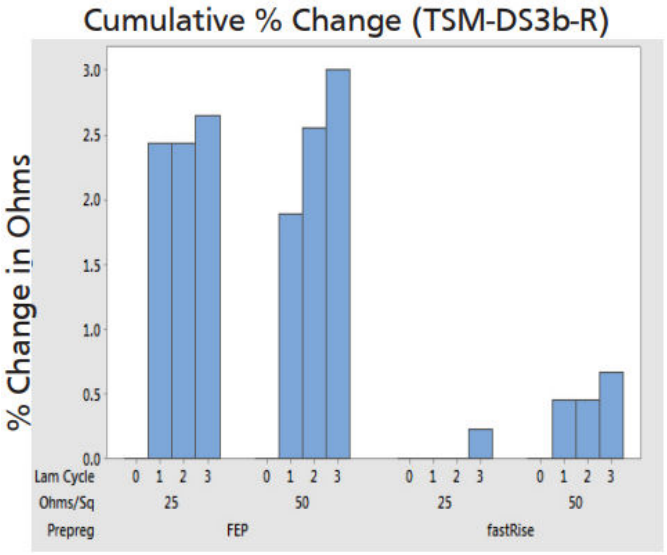


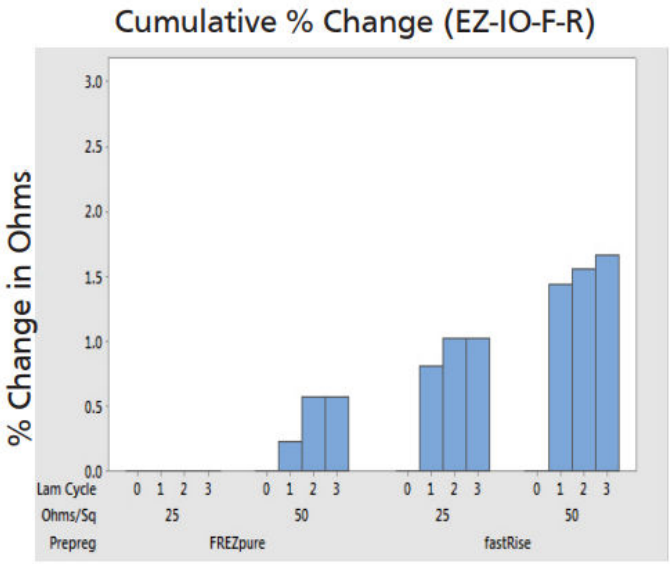
Insertion loss comparison of TSM-DS3 vs. a synthetic rubber hydrocarbon laminate. Test vehicle shown below using Southwest Connectors.



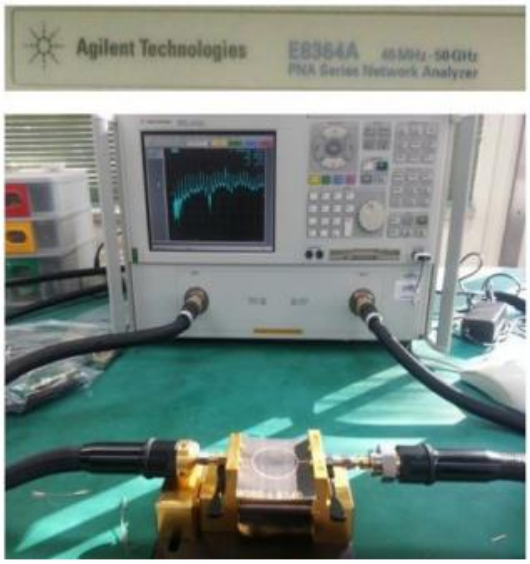
INSERTION LOSS - Loss Per Inch			
Item	**30 GHz**	**57 GHz**	**67 GHz**
TSM-DS3 (Dk = 3.0) Dielectric 5 mils Trace Width = 12 mils	- 1.038 dB	- 2.386 dB	- 2.861 dB
Hydrocarbon (Dk=3.38) Dielectric 8 mils Trace Width = 17 mils	- 2.023 dB	- 3.553 dB	- 4.150 dB

TSM-DS3b-R Resistor Foil Stability with Prepreg Lamination

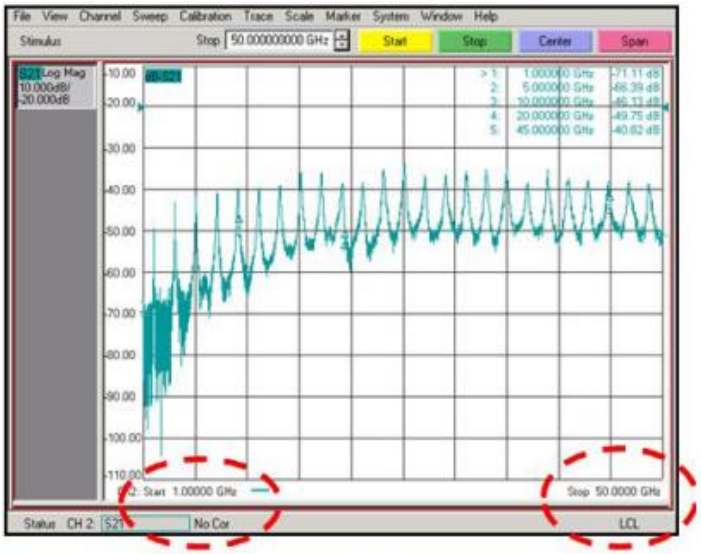




Measurement Instrument and Captured Results



Agilent E8364A PNA Network Analyzer and
Universal test fixture 3830 K (by ANRITSU) were used for ring resonator testing.



Properties	Conditions	Typical Value	Unit	Test Method
Electrical Properties				
Dielectric Constant		3.00 ± 0.05		IPC-650 2.5.5.3
Dissipation Factor		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				
Thermal Conductivity	unclad	0.65	W/M*K	ASTM F 433/ASTM 1530-06
T_d	2% Weight Loss	526	°C	IPC-650 2.4.24.6 (TGA)
	5% Weight Loss	551	°C	
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[1]	
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[2]			
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-DS3 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.

agc-ml.info-maltimaterial@agc.com