

TMM[®] Thermoset Microwave Materials

Features:

- Wide range of dielectric constants. Ideal for single material systems on a wide variety of applications.
- Excellent mechanical properties. Resists creep and cold flow.
- Exceptionally low thermal coefficient of dielectric constant.
- Coefficient of thermal expansion matched to copper. High reliability of plated through holes.
- Resistant to process chemicals. No damage to material during fabrication and assembly processes.
- Thermoset resin for reliable wirebonding. No specialized production techniques required. TMM 10 and 10i laminates can replace alumina substrates.

Some Typical Applications:

- RF and Microwave Circuitry
- Global Positioning Systems Antennas
- Power Amplifiers and Combiners
- Patch Antennas
- Filters and Coupler
- Dielectric Polarizers and Lenses
- Satellite Communication Systems
- Chip Testers

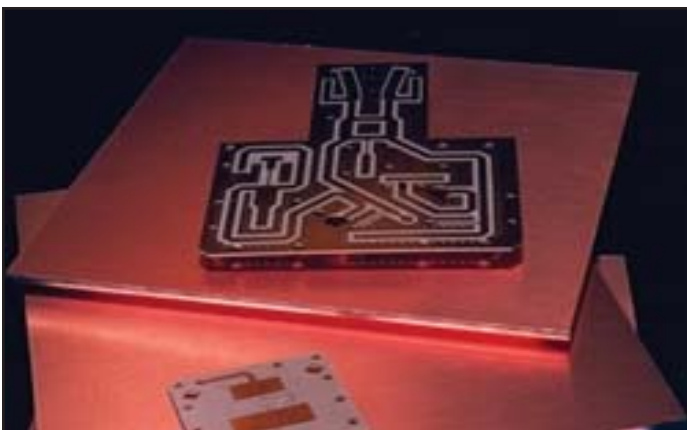
TMM[®] thermoset microwave materials are ceramic thermoset polymer composites designed for high plated-through-hole reliability stripline and microstrip applications. TMM laminates are available in a wide range of dielectric constants and claddings.

The electrical and mechanical properties of TMM laminates combine many of the benefits of both ceramic and traditional PTFE microwave circuit laminates, without requiring the specialized production techniques common to these materials. TMM laminates do not require a sodium naphthanate treatment prior to electroless plating.

TMM laminates have an exceptionally low thermal coefficient of dielectric constant, typically less than 30 ppm/°C. The material's isotropic coefficients of thermal expansion, very closely matched to copper, allow for production of high reliability plated through holes, and low etch shrinkage values. Furthermore, the thermal conductivity of TMM laminates is approximately twice that of traditional PTFE/ceramic laminates, facilitating heat removal.

TMM laminates are based on thermoset resins, and do not soften when heated. As a result, wire bonding of component leads to circuit traces can be performed without concerns of pad lifting or substrate deformation.

TMM laminates combine many of the desirable features of ceramic substrates with the ease of soft substrate processing techniques. TMM laminates are available clad with 1/2 oz/ft² to 2 oz/ft² electrodeposited copper foil, or bonded directly to brass or aluminum plates. Substrate thicknesses of 0.015" to 0.500" and greater are available. The base substrate is resistant to etchants and solvents used in printed circuit production. Consequently, all common PWB processes can be used to produce TMM thermoset microwave materials.



Typical Values

TMM® Thermoset Microwave Materials

PROPERTIES	TYPICAL VALUES					DIRECTION	UNITS	CONDITIONS	TEST METHOD
	TMM3	TMM4	TMM6	TMM10	TMM10I				
⁽¹⁾ Dielectric Constant, ϵ_r	3.27 ± 0.032	4.50 ± 0.045	6.00 ± 0.080	9.20 ± 0.230	9.80 ± 0.245	Z		10 GHz	IPC-TM-650 method 2.5.5.5
⁽¹⁾ Dissipation Factor, $\tan \delta$	0.0020	0.0020	0.0023	0.0022	0.0020	Z		10 GHz	IPC-TM-650 method 2.5.5.5
Thermal Coefficient of ϵ_r	+37	+15	-11	-38	-43*		ppm/K	-55 to +125°C	IPC-TM-650 method 2.5.5.5
Insulation Resistance	>2000	>2000	>2000	>2000	>2000		Gohm	C/96/60/95	ASTM D257
Volume Resistivity	3X10 ⁹	6X10 ⁸	1X10 ⁸	2X10 ⁸	2X10 ⁸		Mohm cm		ASTM D257
Surface Resistivity	>9X10 ⁹	1X10 ⁹	1X10 ⁹	4X10 ⁷	4X10 ⁷		Mohm		ASTM D257
Flexural Strength	16.53	15.91	15.02	13.62	-	X,Y	kpsi	A	ASTM D790
Flexural Modulus	1.72	1.76	1.75	1.79	1.80*	X,Y	Mpsi	A	ASTM D790
Impact, Notch Izod	0.33	0.36	0.42	0.43	-	X,Y	ft-lb/in		ASTM D256A
Water Absorption (2X2)									
1.27mm (0.050" thk)	0.06	0.07	0.06	0.09	0.16		%	D/48/50	ASTM D570
3.18mm (0.125" thk)	0.12	0.18	0.20	0.20	0.13				
Specific Gravity	1.78	2.07	2.37	2.77	2.77			A	ASTM D792
Specific Heat	0.87	0.83	0.78	0.74	0.72*		J/g/K	A	Calculated
Thermal Conductivity	0.70	0.70	0.72	0.76	0.76	Z	W/m/K	80°C	ASTM C518
Thermal Expansion	15	16	18	21	19	X,Y	ppm/K	0 to 140°C	ASTM D3386
	23	21	26	20	20	Z			
Td	425	425	425	425	425		°C TGA		ASTM D3850
Copper Peel Strength	5.7 (1.0)	5.7 (1.0)	5.7 (1.0)	5.0 (0.9)	5.0 (0.9)	X,Y	lb/inch (N/mm)	after solder float 1 oz. EDC	IPC-TM-650 Method 2.4.8
Lead-Free Process Capatible	YES	YES	YES	YES	YES				

Notes: ASTM D3386 corresponds to IPC-TM-650, method 2.4.4.1
* estimated

Typical values are a representation of an average value for the population of the property. For specification values contact Rogers Corporation.

(1) Prolonged exposure in an oxidative environment may cause changes to the dielectric properties of hydrocarbon based materials. The rate of change increases at higher temperatures and is highly dependent on the circuit design. Although Rogers' high frequency materials have been used successfully in innumerable applications and reports of oxidation resulting in performance problems are extremely rare, Rogers recommends that the customer evaluate each material and design combination to determine fitness for use over the entire life of the end product.

AVAILABLE THICKNESS:		STANDARD PANEL SIZE:	STANDARD COPPER CLADDING:
0.015" (0.381mm)	0.125" (3.175mm)	18" X 12" (457 X 305mm)	½ (17µm), 1 oz (35µm), 2 oz. (70µm) electrodeposited copper foil. Heavy metal cladding available. Contact Rogers customer service.
0.020" (0.508mm)	0.150" (3.810mm)	18" X 24" (457 X 610mm)	
0.025" (0.635mm)	0.200" (5.080mm)		
0.030" (0.762mm)	0.250" (6.350mm)		
0.050" (1.270mm)	0.275" (6.985mm)		
0.060" (1.524mm)	0.300" (7.620mm)		
0.075" (1.905mm)	0.500" (12.70mm)		
0.100" (2.540mm)			

The information in this data sheet is intended to assist you in designing with Rogers' circuit material laminates. It is not intended to and does not create any warranties express or implied, including any warranty of merchantability or fitness for a particular purpose or that the results shown on this data sheet will be achieved by a user for a particular purpose. The user should determine the suitability of Rogers' circuit material laminates for each application.

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