



**Tetrafunctional Epoxy Laminate and Prepreg**

Isola Laminate Systems' FR402 consists of a modified tetrafunctional epoxy resin system engineered for multilayer applications that require performance characteristics exceeding those of difunctional epoxies. The formulation of FR402 is designed to enhance throughput and accuracy of laser based Automated Optical Inspection (AOI) equipment. FR402 offers superior resistance to chemical and thermal degradation.

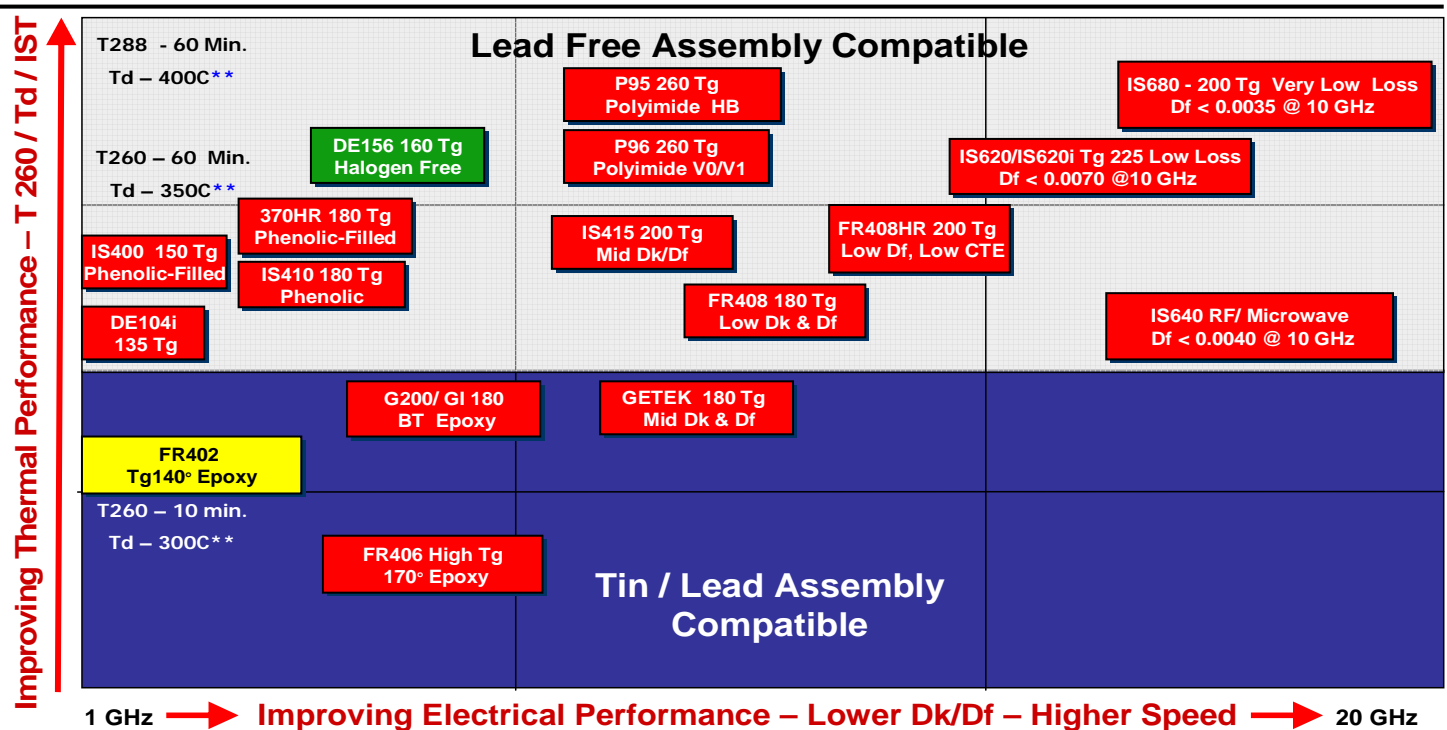
**Industry Approvals**

- IPC-4101B /21
- UL Recognized – FR-4, File Number E41625  
(Part of Isola's FR-4 Family)

- High Tg — 140 °C**  
Superior performance through multiple thermal Excursions  
Resistance to measing  
Extended capabilities
- UV Blocking and AOI Compatible**  
Increased throughput and accuracy  
Compatible with all AOI equipment
- FR-4 System**  
Processes as a standard FR-4
- Availability**  
**Thickness:** 0.002" [.05 mm] to 0.125" [3.2 mm]  
Available in sheet or panel form  
**Copper Foil Cladding:** Grade 3 (HTE), 1/2, 1 and 2 oz.  
**Foil Options:** Double treat, reverse treat  
**Prepregs:** Available in roll or panel form  
**Glass Styles:** available on standard styles



**Isola - Product Position**  
**Thermal Performance vs Signal Integrity**



Speed is a function of design such as line length etc.

\*\* Laminate Data - IST performance is a function of Hole diameter, board thickness, plating parameters and laminate attributes.

# FR402 Typical Laminate Properties

		English			Metric			Test Method	
		Value	Specification	Units	Value	Specification	Units	IPC-TM-650 (or as noted)	
Glass Transition Temperature (Tg) by DSC, spec minimum		140	110-150	°C	140	110-150	°C	2.4.25	
Decomposition Temperature (Td) by TGA									
	@ 5% weight loss	320	—	°C	320	—	°C	ASTM D3850	
T260	Minutes	30		min	30		min	2.4.25	
T288		>5		min	>5		min		
CTE, Z-axis	Pre-Tg	50	AABUS	ppm/°C	50	AABUS	ppm/°C	2.4.24	
	Post-Tg	250	—		250	—			
CTE, X-, Y-axes	Pre-Tg	15	AABUS	ppm/°C	15	AABUS	ppm/°C	2.4.24	
	Post-Tg	17	—		17	—			
Z-Axis Expansion (50 – 260C) %		4.2	AABUS	%	4.2	AABUS	%	2.4.24	
Thermal Stress 10 Sec									
@ 288°C (550.4°F), spec minimum									
	Unetched	Pass	Pass Visual	Rating	Pass	Pass Visual	Rating	2.4.13.1	
	Etched	Pass	Pass Visual		Pass	Pass Visual			
Dk (Permittivity, Laminate & prepreg as laminated) 1 Mhz (Fluid cell) 500Mhz and 1Ghz (HP4291)	1 Mhz	4.60	5.4		4.60	5.4		2.5.5.3	
	500 Mhz	4.27	—	—	4.27	—	—	2.5.5.9	
	1 Ghz	4.25	—		4.25	—		2.5.5.5	
Df (Loss Tangent, Laminate & prepreg as laminated) 1 Mhz (Fluid cell) 500Mhz and 1Ghz (HP4291)	1 Mhz	0.016	0.035		0.016	0.035		2.5.5.3	
	500 Mhz	0.015	—	—	0.015	—	—	2.5.5.9	
	1 Ghz	0.015	—		0.015	—		2.5.5.5	
Volume Resistivity, spec minimum	96/35/90	4.0X10 <sup>9</sup>	1X10 <sup>4</sup>		4.0X10 <sup>9</sup>	1X10 <sup>4</sup>		2.5.17.1	
	After moisture resistance at elevated temperature	7.0X10 <sup>7</sup>	1X10 <sup>6</sup>	M° -cm	7.0X10 <sup>7</sup>	1X10 <sup>6</sup>	M° -cm		
Surface Resistivity, spec minimum	96/35/90	3.0X10 <sup>6</sup>	1X10 <sup>4</sup>		3.0X10 <sup>6</sup>	1X10 <sup>4</sup>		2.5.17.1	
	After moisture resistance At elevated temperature	6.0X10 <sup>6</sup>	1X10 <sup>6</sup>	M°	6.0X10 <sup>6</sup>	1X10 <sup>6</sup>	M°		
Thermal Conductivity		0.36	—	W/mK	0.36	—	W/mK	ASTM D5930	
Dielectric Breakdown, spec minimum		>50	40	kV	>50	40	kV	2.5.6	
Arc Resistance, spec minimum		120	60	Seconds	120	60	Seconds	2.5.1	
Electric Strength, spec minimum (Laminate & prepreg as laminated)		1100	736	V/mil	48000	29000	V/mm	2.5.6.2	
Peel Strength, spec minimum	profile – all copper weights >17 microns Standard profile copper -----1. After thermal stress 2. At 125°C (257°F) 3. After process solutions	8	4	(lb/inch)	105	70	N/mm	2.4.8	
									2.4.8.2
		9	6		145	105		2.4.8.3	
		8	4		125	70			
		9	4.5		145	80			
Moisture Absorption, spec maximum		0.3	0.8	%	0.3	0.8	%	2.6.2.1	
CTI			3	175-249	volts				
HWI			0						
HAI			3						
Max Operating Temp			130						
DSR			yes						

## ORDERING INFORMATION:

Contact your local sales representative or the Customer Service Department in Chandler, AZ  
 Isola Group 3100 W Ray Road, Chandler, AZ 85226  
 Phone: 480-893-6527  
 For further information visit [www.isola-usa.com](http://www.isola-usa.com)

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