*fast*Rise™ EZ BONDPLIES

AGC
Your Dreams, Our Challenge

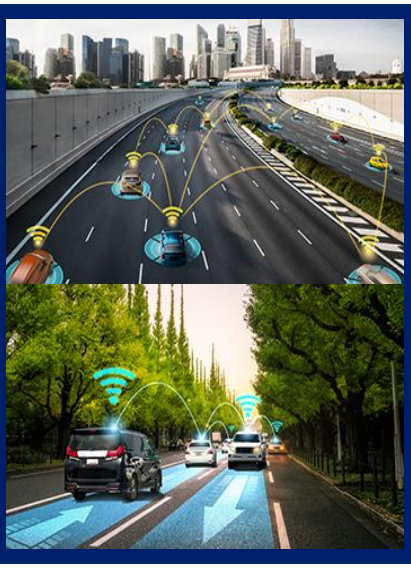
Low temperature curing, flexible prepreg/bondply

Benefits

- FR4 lamination temperatures
- Low DK enables reduced PWB thickness for the same impedance
- Thermosetting prepreg will not reflow
- Fiberglass-free prepreg
- Compatible with conventional lamination processes
- Can be combined with any core material
- Laser Ablatable

Applications

- High Speed Flex Cables
- Thin Multilayers
- ATE testing
- mmWave Antenna/Automotive



*fast*Rise™ EZ is a low temperature curing, low loss flexible prepreg/bondply series of products. FR-EZ is designed to enable the manufacture of complex rigid/flex PWBs containing polyimide (DuPont™ Pyralux® AP/TK flexible circuit materials), LCP or PTFE cores without excessive movement. *fast*Rise™ EZ is flexible when thin and can be combined with various flexible or rigid copper clad core materials. FR-EZ is based on a thermosetting adhesive and PTFE film. FR-EZ has low moisture absorption and is capable at high frequencies due to its low dissipation value. *fast*Rise™ EZ bonds well to AGC's PTFE cores and to otherwise difficult substrates such as Pyralux® AP polyimide, PEEK, LCP, flat planes of PTFE or hydrocarbon (synthetic rubber). AGC's PTFE-rich TLY 5 and other non-reinforced PTFE-rich substrates can be well bonded with FR-EZ.

*fast*Rise™ EZ's low loss enables the design of flexible high speed cables and rigid RF/digital multilayers without the uncertainties and costs associated with the high temperature lamination of PTFE or LCP materials. FR-EZ can also be used to replace cable harnesses with denser flex circuits. The low moisture absorption of 0.2% is very attractive vs. conventional polyimides.

FR-EZ can be sequentially laminated, has better bonding capabilities with copper than other RF prepregs and will yield higher peel strengths in a foil lamination. The low DK of FR-EZ is advantageous in flex applications to reduce thickness while maintaining the same impedance. The low modulus of FR-EZ allows for more ductility in a thicker multilayer. The low dissipation values of FR-EZ is an option for any multilayer stackup where pure packages of other materials have fabrication challenges.

*fast*Rise™ EZ for Traditional Rigid-Flex Builds

*fast*Rise™ EZ is well suited for higher layer count flex and rigid-flex builds as a replacement for bonding sheets utilizing acrylic adhesives. Acrylic adhesives in flexible circuitry are a known source of processing challenges that can lead to reliability concerns. Most of these difficulties are encountered in the processes from via formation through via metallization, as the acrylic is very sensitive to drill parameters, plasma parameters and some chemistries. *fast*Rise™ EZ eliminates these concerns by using a flexible thermoset resin system and additionally eliminates the need for a "bikini" approach to rigid-flex stripline structures.

What Does This Mean for the Fabricator?

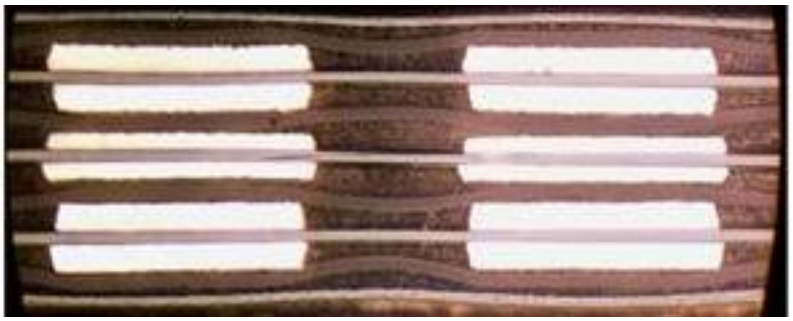
<u>Multilayer Flex</u>

- Increased yields from microsection evaluation
- Greater via reliability

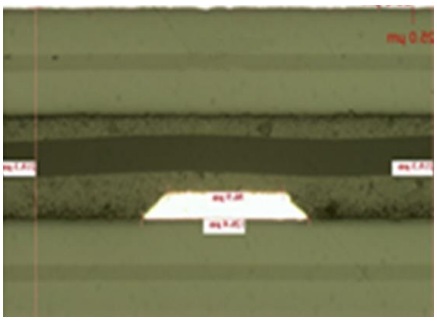
<u>Rigid-Flex</u>

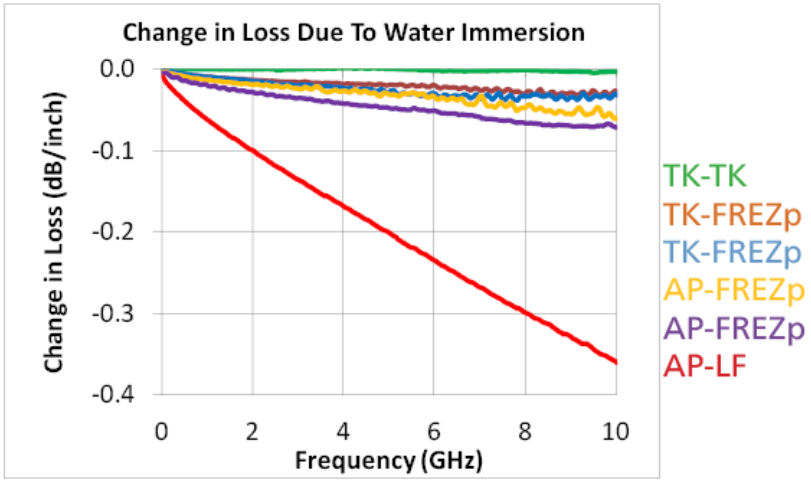
- Eliminate the need to pre-rout bond-ply before lamination
- Eliminate the need for no-flow prepreg and routing of that prepreg within a multilayer flex structure in a rigid-flex
- Eliminate expensive custom tooling for lamination

FR-EZ / PYRALUX®



FR-EZ / PYRALUX® TK





Change in insertion loss with moisture uptake after water immersion for various stripline test vehicles (Pyralux® TK/TK, Pyralux® AP/LF, Pyralux® TK/FREZ and Pyralux® AP/FREZ). Pyralux® is a registered trademark of E. I. du Pont de Nemours and Company

Typical Values

Properties	Conditions	FR-EZ-22P	FR-EZ-33P	Unit	Test Method
General Properties					
Overall Thickness		2.2	3.3	mil	
Carrier Film Thickness		1	1	mil	
Center Carrier Film Type		PTFE	PTFE		
Electrical Properties					
Dielectric Constant	@ 10 GHz	2.40	2.50		IPC-650 2.5.5.5.1
Dissipation Factor	@ 10 GHz	0.0018	0.0024		IPC-650 2.5.5.5.1
Volume Resistivity		1.5 x 109	1.5 x 109	Mohms/cm	IPC-650-2.5.17E
Surface Resistivity		6 x 106	6 x 106	Mohms/cm	IPC-650-2.5.17E
Dielectric Breakdown		35	35	kV	ASTM D149-09A
Dielectric Strength		2237	3229	V/mil	ASTM D149-09A
Thermal Properties					
Thermal Conductivity		0.33	0.33	W/M*K	IPC-TM-650 2.4.50
CTE (RT to 125 °C) *	X	109	97	ppm/°C	IPC-650 2.4.41
	Y	149	165	ppm/°C	
	Z	137	137	ppm/°C	
T_g (TMA)		ND	ND	°C	IPC-650 2.4.24.4A
T_d	2% wt. loss	410	395	°C	IPC-650 2.4.24.6 (TGA)
	5% wt. loss	445	440	°C	
T_cK	(-55 to 100 °C)	-112	-78	ppm/°C	IPC-650 2.5.5.5.1
Mechanical Properties					
Peel Strength		5.1	5.1	lbs/in	IPC-650 2.4.9E
	after thermocycling	4.8	4.8	lbs/in	
	chemical resistance	7.2	7.2	lbs/in	IPC-650 2.3.2, 2.4.9
Dimensional Stability	MD	0.85	0.85	mils/in	IPC-650 2.2.4 (TS)
	CD	0.61	0.61	mils/in	
Tensile Strength	MD	996	1194	psi	ASTM D 902
	CD	989	1091	psi	
Tensile Modulus	MD	33	23	psi	ASTM D 902
	CD	20	22	psi	
Flexural Fatigue and Ductility[1]	0.250 inch mandrel	293	110	Cycles	ASTM E796 / IPC 2.4.3.1
	0.199 inch mandrel	187	72	Cycles	
	0.125 inch mandrel	129	55	Cycles	
	0.075 inch mandrel	50	24	Cycles	
Flexural Strength	MD	2860	2900	psi	IPC-650 2.4.4
	CD	2880	2940	psi	
Flexural Modulus	MD	128,000	127,000	psi	IPC-650 2.4.4
	CD	124,000	126,000	psi	
Chemical / Physical Properties					
Moisture Absorption		0.13	0.14	%	IPC-650 2.6.2.1
Density	(Specific Gravity)	1.68	1.59	g/cm3	ASTM D 792
Resin Flow		8 – 14	12 - 22	%	IPC-650 2.3.17
Ultimate Elongation	MD	68	10	%	ASTM D 902
	CD	12	11	%	
Fungus Resistance		no growth	no growth		IPC-650-2.6.1
Moisture / Insulation Resistance		100,000	100,000	Mohms	IPC-650 2.6.3.2

* 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.

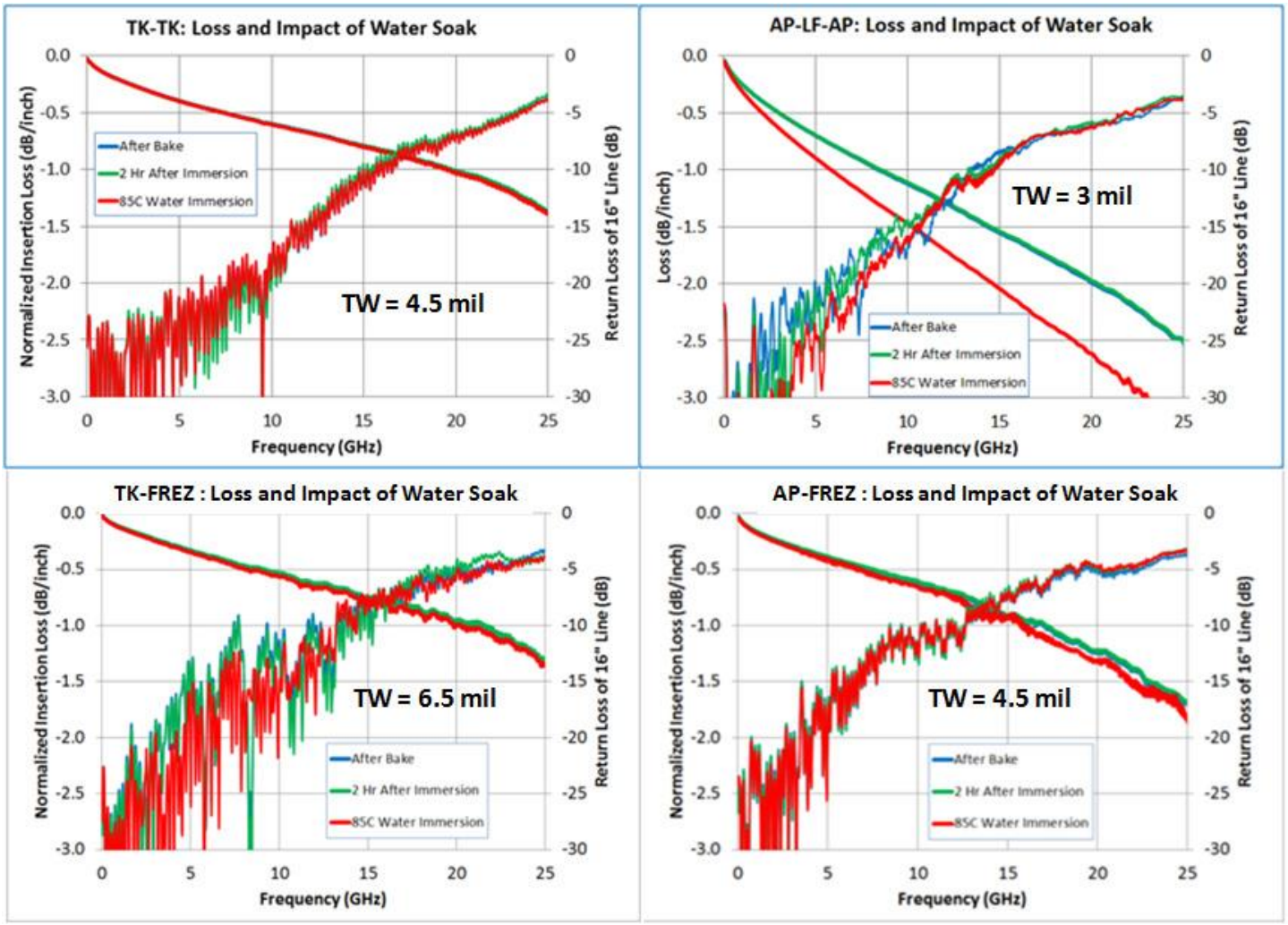
* Please contact AGC for availability of additional thicknesses, other sizes.

[1] RH copper, double sided, 4 mil dielectric, 8 oz. weight, cycles to failure

* 2nd TMA heating, cured at 420°C

ND - Not Detectable

Water Soak Testing



Insertion loss testing of various stripline test vehicles (Pyralux TK/TK, Pyralux AP/LF, Pyralux TK/FREZ and Pyralux AP/FREZ) before and after water immersion.

Photo credit: nasa.gov

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