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*fast*Rise™ EZ Bondplies and Coverlays

*fast*Rise™ EZ is a low temperature curing, low loss flexible prepreg/bondply/coverlay 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. Flame retardant FR-EZ27f bondply and FR-EZ CLHH and FR-EZ CL2H coverlays were designed for commercial applications requiring UL V-0.

*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.

Benefits & Applications:

- 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
- Flame Retardant UL V-0 Bondplies & Coverlays

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

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Flame Retardant Bondplies and Coverlays

FR-EZ27f bondply and FR-EZ coverlays use conventional technology to achieve UL VO flame retardance. AGC has been able to achieve extremely low electrical loss with these flame retardant materials. The flame retardant versions of FR-EZ and respective coverlays show greater flexibility than the non-flame retardant versions. Additionally, the flame retardant bondply and coverlays retain high thermal stability and do not outgas until temperatures of 400+°C / 752°F are reached.

*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?

Multilayer Flex

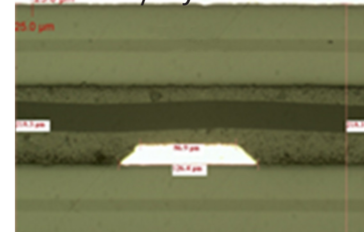
- Increased yields from microsection evaluation
- Greater via reliability

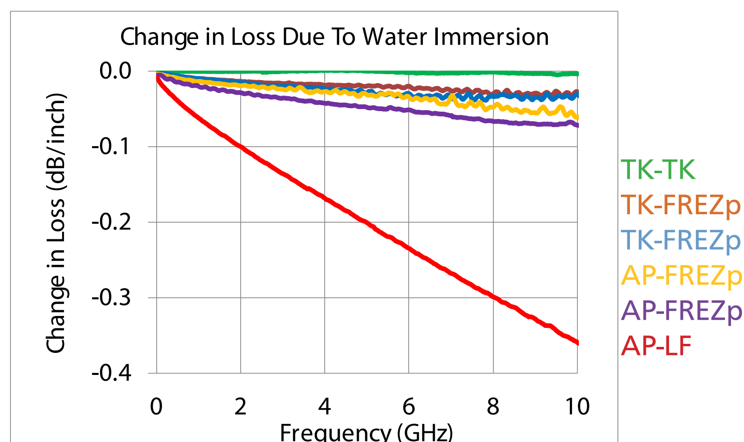
Rigid-Flex

- 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® AP

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).

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*fast*Rise™EZ Typical Values							
Property	Test Method	Unit	FR-EZ22p	FR-EZ33p	FR-EZ27f	FR-EZ CLHH	FR-EZ CL2H
Bondply/Coverlay			Bondply	Bondply	Bondply	Coverlay	Coverlay
Overall Thickness		mil	2.2	3.3	2.7	1.8	2.9
Carrier Film Thickness		mil	1	1	1	1	1
Center Carrier Film Type			PTFE	PTFE	PTFE	PTFE	PTFE
Dk @ 10 GHz	IPC-650 2.5.5.5.1		2.40	2.50	2.38	2.32	2.48
Df @ 10 GHz	IPC-650 2.5.5.5.1		0.0018	0.0024	0.0017	0.0015	0.0019
Volume Resistivity	IPC-650 2.5.17	Mohms/cm	1.5×10^9	1.5×10^9			
Surface Resistivity	IPC-650 2.5.17	Mohms/cm	6×10^6	6×10^6			
Moisture/Insulation Resistance	IPC-650 2.6.3.2	Mohms	100,000	100,000			
T_cK (-55 to 100 °C)	IPC-650 2.5.5.5.1	ppm/°C	-112	-78	-162	-175	-191
Dielectric Breakdown	ASTM D149-09A	kV	35	35	31	41	39
Dielectric Strength	ASTM D149-09A	V/mil	2237	3229	2486	2681	2348
Moisture Absorption	IPC-650 2.6.2.1	%	0.13	0.14	0.07	0.08	0.1
Peel Strength	IPC-650 2.4.9	lbs/in	5.1	5.1		NA	NA
Peel Strength (After Solder Float)	IPC-650 2.4.9	lbs/in	4.4	4.4		NA	NA
Peel Strength (After Thermal Cycling)	IPC-650 2.4.9	lbs/in	4.8	4.8		NA	NA
Peel Strength (Chemical Resistance)	IPC-650 2.3.2, 2.4.9	lbs/in	7.2	7.2		NA	NA
Tensile Strength (MD)	ASTM D 902	psi	996	1194	812	2234	813
Tensile Strength (CD)	ASTM D 902	psi	989	1091	1571	1609	709
Tensile Modulus (MD)	ASTM D 902	kpsi	33	23	51	65	37
Tensile Modulus (CD)	ASTM D 902	kpsi	20	22	61	69	30
Dim. Stability (MD) (Thermal Stress)	IPC-650 2.2.4	mils/in	0.85	0.85		NA	NA
Dim. Stability (CD) (Thermal Stress)	IPC-650 2.2.4	mils/in	0.61	0.61		NA	NA
Ultimate Elongation (MD)	ASTM D 902	%	68	10	380	464	214
Ultimate Elongation (CD)	ASTM D 902	%	12	11	458	416	24
Flexural Fatigue & Ductility†	ASTM E796						
0.250 inch Mandrel	IPC 2.4.3.1	Cycles	293	110	794	NA	NA
0.199 inch Mandrel	IPC 2.4.3.1	Cycles	187	72	678	NA	NA
0.125 inch Mandrel	IPC 2.4.3.1	Cycles	129	55	574	NA	NA
0.075 inch Mandrel	IPC 2.4.3.1	Cycles	50	24	329	NA	NA
Flexural Strength (MD)	IPC-650 2.4.4	psi	2860	2900	4260	4700	5350
Flexural Strength (CD)	IPC-650 2.4.4	psi	2880	2940	3890	4130	6380
Flexural Modulus (MD)	IPC-650 2.4.4	psi	128,000	127,000	110,000	114,000	135,000
Flexural Modulus (CD)	IPC-650 2.4.4	psi	124,000	126,000	96,600	100,000	135,000
CTE (X axis) (RT to 125 °C)*	IPC-650 2.4.41	ppm/°C	109	97	94	91	102
CTE (Y axis) (RT to 125 °C)*	IPC-650 2.4.41	ppm/°C	149	165	90	112	95
CTE (Z axis) (RT to 125 °C)*	IPC-650 2.4.41	ppm/°C	137	137	146	117	142
Density (Specific Gravity)	ASTM D 792	g/cm^3	1.68	1.59	1.58	1.68	1.56
Resin Flow	IPC-650 2.3.17	%	8 – 14	12 - 22	5.4	3.9	17
T_g (TMA)	IPC-650 2.4.24.4A	°C	ND	ND	186‡	186‡	188‡
T_d (2%Weight Loss)	IPC-650 2.4.24.6	°C	410	395	414	415	405
T_d (5%Weight Loss)	IPC-650 2.4.24.6	°C	445	440	428	438	417
Fungus Resistance	IPC-650 2.6.1		0 to no growth	0 to no growth			
UL Flammability Rating (V-O)	UL-94		No	No	Yes	Yes	Yes

All reported values are typical and should not be used for specification purposes. In all instances, the user shall determine suitability in any given application.

† RH copper, double sided, 4 mil dielectric, 8 oz. weight, cycles to failure

ND - Not detectable; T_g is very difficult to detect transition between 70 - 100 °C

‡ Weak transition; almost non-detectable by TMA

* 2nd TMA heating, cured at 420 °F

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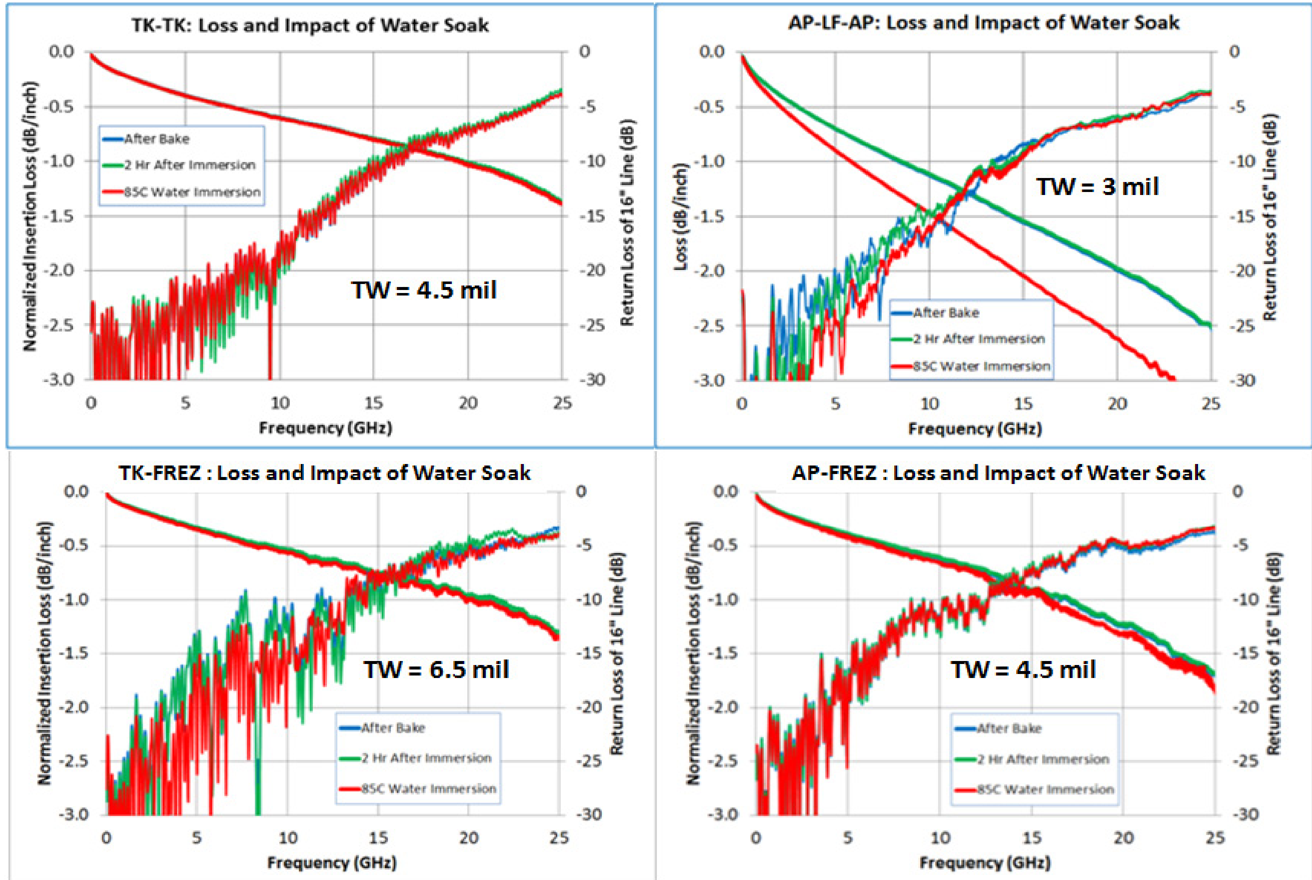
Water Soak Testing



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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