AGC
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TACONIC

EZ-IO-F Spread Weave Next Generation Laminate

EZ-IO-F is a thermally stable composite based on nanotechnology, spread weave, and PTFE. Nanoparticle silica ensures a drill quality on par with FR4 materials. EZ-IO-F is based on a very low (~10 wt%) fiberglass content. The nature of the spread weave provides a uniform dielectric constant and impedance as suggested by skew testing. EZ-IO-F was created for the next generation of digital circuitry where digital transmission speeds start at 25 gbps and reach 112 gbps. EZ-IO-F was also designed for microwave applications operating at increasingly higher frequencies where there is a need to combine both digital and microwave circuitry onto one PWB. EZ-IO-F was developed to challenge the best FR4 materials at the fabricator level in the most difficult 30-40 layer digital applications.

Skew testing suggests a maximum skew of 0.3 picoseconds/inch and an average skew of <0.1 ps/inch with no artwork rotation. Artwork rotation of 15° shows a maximum skew of ~0.05 ps/inch and an average skew close to zero. Interestingly enough, skew is flat over frequency when tested from 1-20 GHz.

EZ-IO-F is manufactured on industry leading no profile copper. The newer ULP copper outperforms rolled copper and is the new benchmark for high performance laminates. Significant reductions in insertion loss can be achieved with ULP copper vs. HVLP or rolled copper.

EZ-IO-F is best combined with AGC's FR-28-0040-50S (DF = 0.0018 @ 10 GHz) non-reinforced prepreg to achieve a stripline channel having ~5 wt% fiberglass. AGC's *fast*Rise™ prepregs are the lowest loss prepregs commercially available that can be laminated at FR4-like 420 °F lamination temperatures. The low insertion loss of EZ-IO-F/*fast*Rise™ is only rivaled by the fusion bonding of pure PTFE laminates, an expensive process which causes excessive movement. *fast*Rise™ is typically used at 77 GHz and will compete favorably with any fusion bonded laminate without the cost and challenges of fusion bonding.

EZ-IO-F can be obtained with the lowest profile resistor foils. The nanoparticle's design and lack of surface porosity enable the etching of very fine lines (2-4 mil lines and spaces).

Benefits & Applications:

- Extremely Low Skew
- Nanotechnology Based PTFE Laminate
- Drill Quality of FR4 (1000+ Hits/Bit)
- Registration of FR4
- Extremely Low Fiberglass Content (~10%)
- <0.18% Dielectric Constant Variation within a lot
- Standard with ULP or Rolled Copper
- Temperature Stable DK
- Capable of 40+ Layer Large Format PWBs
- CAF Resistant

- Semiconductor Testing at 25 gbps and Higher
- Test and Measurement
- Optical Data Transport and Backplane Routers
- Hybrid FR4 PWBs Combining Microwave and Digital Signals
- Space and Defense

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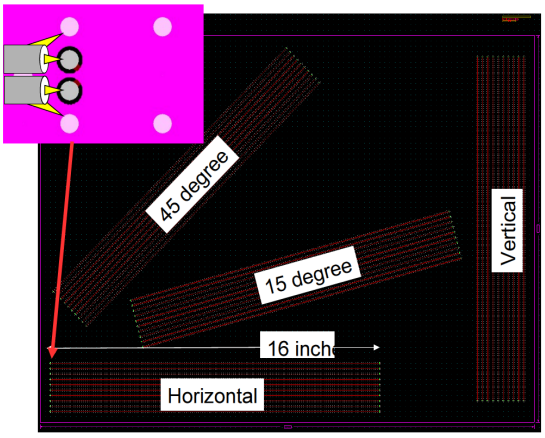
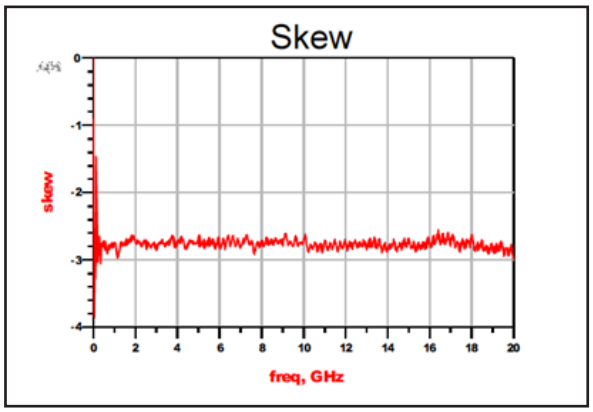
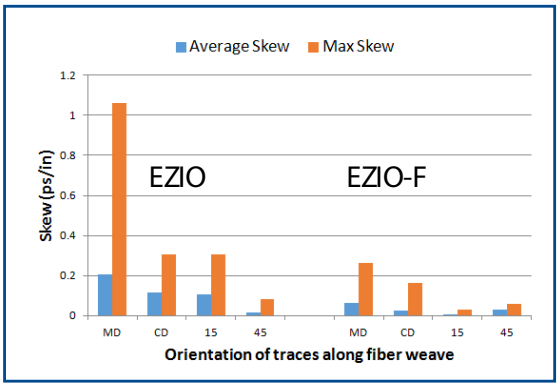
Skew Testing of EZ-IO/EZ-IO-F using *fast*Rise™ Prepreg



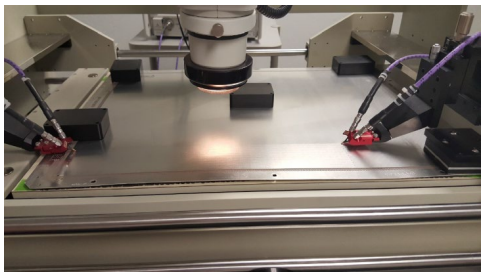
Layout of skew test vehicle for EZ-IO/EZ-IO-F and fastRise™ prepreg.



Skew testing of EZ-IO/EZ-IO-F and *fast*Rise™ consistently showed the skew to be independent of frequency.

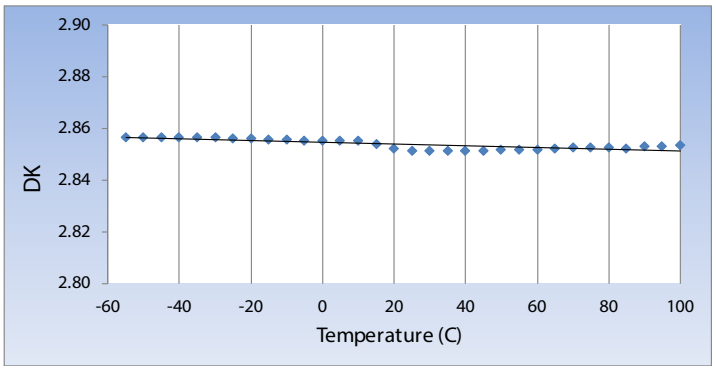


Average skew and maximum skew of paired transmission lines as a function of angle.

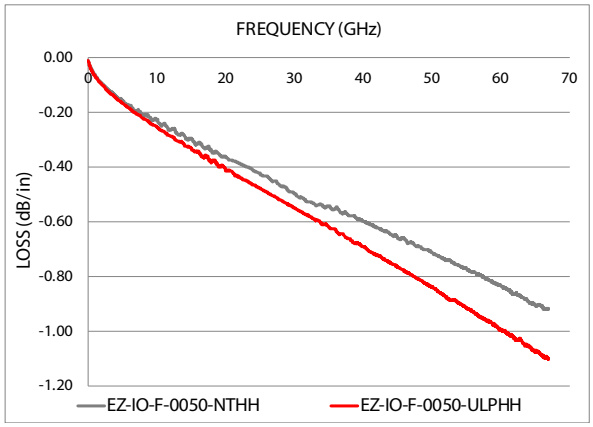


Probe testing of EZ-IO/EZ-IO-F and *fast*Rise™

Physical aspects of the stripline test vehicle were 5.2 mil lines, 7.4 mil spacing, 13.3 mils ground to ground, 7 mils of EZ-IO-F, 6.3 mils of *fast*Rise™ prepreg.



Variation of Dielectric Constant with temperature, TcK = -20 ppm/C



Microstrip Insertion Loss of EZ-IO-F-0050 over frequency, ULP and NT 0.5 oz copper foils using Southwest Connectors (12 mil wide traces, Southwest: 1892-04A-5 (1.85 mm female end launch), pin .005D, diel. .0290D)

EZ-IO-F 0050 Typical Values					
Property	Test Method	Unit	Value	Unit	Value
Dielectric Thickness		mil	5, 3.5*	mm	0.13, 0.09*
Dk @ 10 GHz	IPC-650 2.5.5.5.1 (Modified)		2.80, 2.85**		2.80, 2.85**
Df @ 10 GHz	IPC-650 2.5.5.5.1 (Modified)		0.0014, 0.0015		0.0014, 0.0015
Dielectric Breakdown	IPC-650 2.5.6/ASTM 229-13	kV	39.8	kV	39.8
Dielectric Breakdown	IPC-650 2.5.6.2/ASTM D149-09	kV	23.8	kV	23.8
Dielectric Strength	IPC-650 2.5.6.2/ASTM D149-09	V/mil	628	V/mm	24,724
Compressive Modulus	ASTM D695-15	psi	507,000	N/mm^2	3,496
Peel Strength (0.5 oz. ULP)	IPC-650 2.4.8, sec. 5.2.2	lbs/in	6	N/mm	1.05
Peel Strength (1 oz. ULP - MD)	IPC-650 2.4.8, sec. 5.2.2	lbs/in	6	N/mm	1.05
Peel Strength (1 oz. ULP - CD)	IPC-650 2.4.8, sec. 5.2.2	lbs/in	6	N/mm	1.05
Peel Strength (1 oz. ULP - MD)	IPC-650 2.4.8, sec. 5.2.2 (Thermal Stress)	lbs/in	6	N/mm	1.05
Peel Strength (1 oz. ULP - CD)	IPC-650 2.4.8, sec. 5.2.2 (Thermal Stress)	lbs/in	6	N/mm	1.05
Peel Strength (1 oz. ULP - MD)	IPC-650 2.4.8, sec. 5.2.2 (Chemical Exp.)	lbs/in	6	N/mm	1.05
Peel Strength (1 oz. ULP - CD)	IPC-650 2.4.8, sec. 5.2.2 (Chemical Exp.)	lbs/in	6	N/mm	1.05
Arc Resistance	ASTM D495-14	Seconds	248	Seconds	248
Dimensional Stability (MD)	IPC-650 2.4.39A (After Etch)	mils/in	0.45	mm/M	0.45
Dimensional Stability (CD)	IPC-650 2.4.39A (After Etch)	mils/in	0.44	mm/M	0.44
Dimensional Stability (MD)	IPC-650 2.4.39A (Thermal Stress)	mils/in	0.42	mm/M	0.42
Dimensional Stability (CD)	IPC-650 2.4.39A (Thermal Stress)	mils/in	0.33	mm/M	0.33
Surface Resistivity	IPC-650 2.5.17.1A (Elevated Temp.)	Mohms/cm	1.67×10^6	Mohms	1.67×10^6
Surface Resistivity	IPC-650 2.5.17.1A (Humidity)	Mohms/cm	2.29×10^4	Mohms	2.29×10^4
Volume Resistivity	IPC-650 2.5.17.1A (Elevated Temp.)	Mohms/cm	3.58×10^7	Mohms/cm	3.58×10^7
Volume Resistivity	IPC-650 2.5.17.1A (Humidity)	Mohms/cm	3.94×10^{10}	Mohms/cm	3.94×10^{10}
CAF	IPC-650 2.6.25		Pass		Pass
HATS, IST	Customer specific		Pass		Pass
CTE (X) 45 - 125 °C	IPC-650 2.4.41/ASTM D3386	ppm/°C	19	ppm/°C	19
CTE (Y) 45 - 125 °C	IPC-650 2.4.41/ASTM D3386	ppm/°C	25	ppm/°C	25
CTE (Z) 45 - 125 °C	IPC-650 2.4.41/ASTM D3386	ppm/°C	49	ppm/°C	49
Thermal Conductivity	ASTM E1530-11	W/M*K	0.49	W/M*K	0.49
Thermal Conductivity	ASTM E1461	W/M*K	0.53	W/M*K	0.53
Specific Heat	ASTM E1461	J/gK	1.18	J/gK	1.18
Diffusivity	ASTM E1461	mm^2/s	0.214	mm^2/s	0.214
Density (Specific Gravity)	ASTM D792 -13 (Method A)	g/cm^3	2.12	g/cm^3	2.12
Hardness	ASTM D2240-15		77.3		77.3

*All data is for 5 mil material unless otherwise specified.
**2.80 uses low DK spread weave glass; 2.85 uses regular DK spread weave glass.
All values are for single ply construction.
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.

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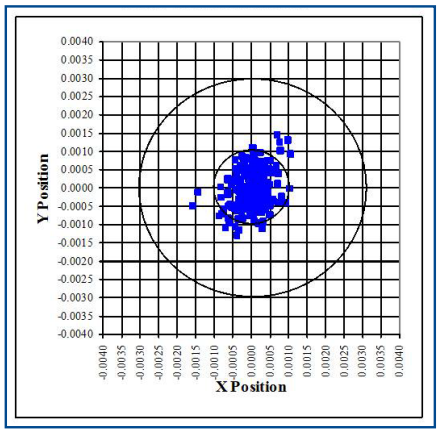
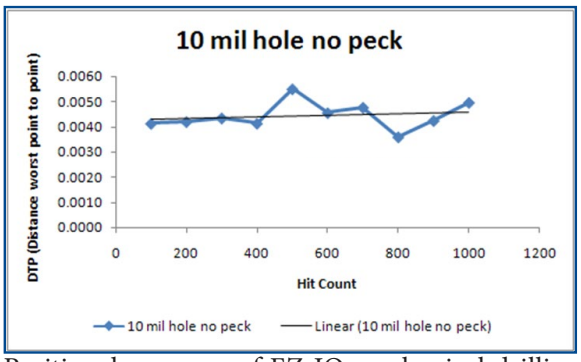
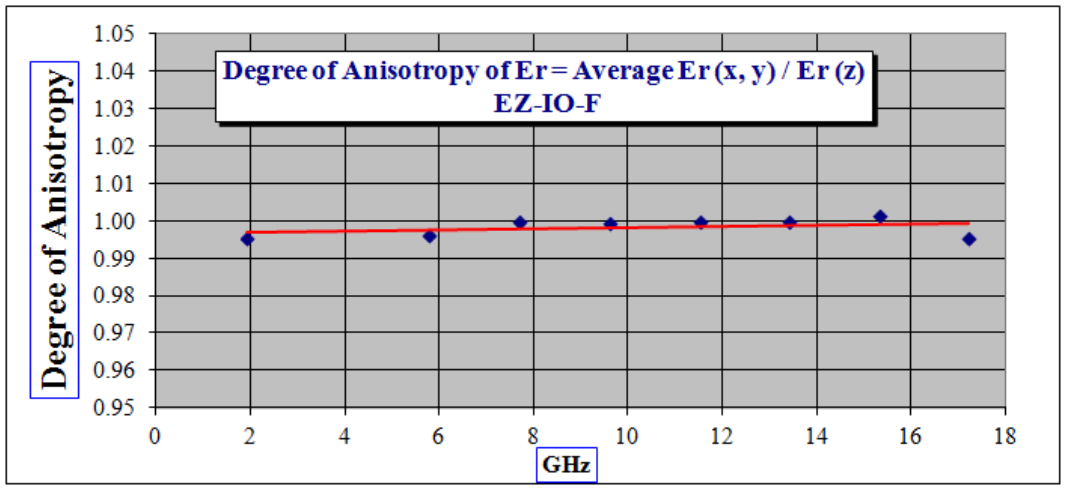
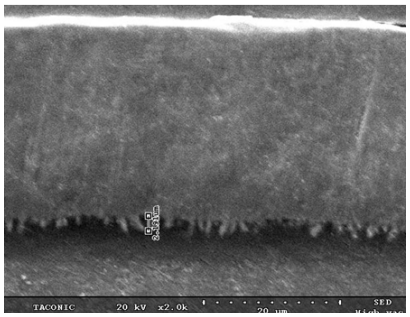


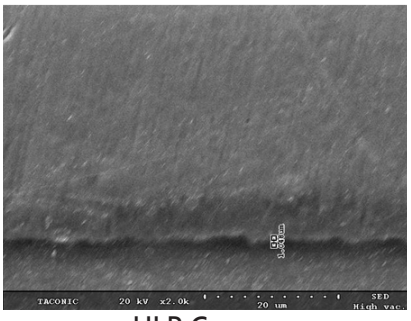


Positional accuracy of EZ-IO mechanical drilling showing no increase in drill wander with 1000 hits/bit.



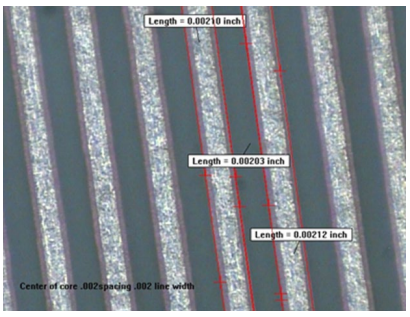


HVLP Copper



ULP Copper

Scanning Electron Microscopy Comparing Copper Roughness of HVLP Copper to ULP Copper, x2,000



2 mil lines and spaces etched on EZ-IO, courtesy of Sanmina

An example of our part number is:

EZ-IO-F-0050-ULPH/ULPH-18" x 24" (457 mm x 610 mm)

Please see our Product Selector Guide for information on available copper cladding.

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