TACONIC
Synthane-Taylor Laminates

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FR-4 Product and Processing Guide

Grade Designations

- EF650M - Multifunctional Epoxy Prepreg 145ºC Tg
- EF650K - Multifunctional Epoxy Prepreg 170ºC Tg
- FB650M - Multifunctional Epoxy Laminate 145ºC Tg
- FB650K - Multifunctional Epoxy Laminate 170ºC Tg

Product/Plant Qualification

All Taconic Synthane-Taylor FR-4 products are U.L. approved and 94-V0 (please see enclosed U.L. file copy).

All Taconic Synthane-Taylor products are manufactured and certified to meet the requirements of IPC - 4101

Performance Characteristics

Prepreg - EF650M and EF650K
Please see attached Performance Data Sheets

Laminate - FB650M and FB650K
Please see attached Performance Data Sheets

Please see enclosed FB650M vs FB650K comparison.

Please see enclosed Permittivity and Loss Tangent data.

Note: Commonly requested data is listed on our performance data sheets. Additional data is available. Taconic Synthane-Taylor has product test data available for all test attributes required per IPC-4101

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Product Storage and Handling

Prepreg

Handling Recommendations

Handle all prepregs using clean, lint-free gloves. Wash hands in soap and water after handling prepreg to prevent abrasions caused by wiping glass fibers in the eye.

Use sharp equipment when cutting or paneling prepreg, replace or sharpen blades often as fiberglass will rapidly wear most tools.

Minimize handling individual pieces. Grasp and move multiple plies as much as possible to prevent fracturing the prepreg. Treat all prepregs as fragile especially when handling very thin, high resin content prepregs (i.e., 106 and 1080).

Storage Recommendations

Upon receipt, all prepreg should be immediately moved from the receiving area into a controlled environment.

All prepreg should be used as soon as possible. A “first in, first out” storage system should be used.

If extended storage is required, separate storage areas with appropriate environmental controls should be established.

Prepreg properties will be maintained for at least 6 months when stored at 40ºF (4.4ºC) maximum, and for at least 3 months when stored at 70ºF (21ºC) maximum and between 30 and 50% relative humidity.

If prepreg passes retesting after its shelf life has expired, it is acceptable for use up to the original storage limitations.

A moisture-proof package is desirable for storage from 0º (-18.0ºC) to 40ºF (4.4ºC).

Prepregs stored below 40ºF (4.4ºC) should be allowed to stabilize for 24 hours at room temperature prior to use.

Keep prepreg in package or plastic wrapping during stabilization period to prevent moisture condensation.

Storage should be in the absence of catalytic environments (such as high radiation levels or ultraviolet light).

Laminate

Handling Recommendations

Handle all laminate using clean, lint-free gloves.

Use sharp, precision equipment when cutting or paneling laminate.

When stacking laminate, care should be taken to prevent scratching of the copper surface.

Laminate should always be stacked on a fully supported flat surface.

When handling thin laminates, care should be taken to prevent bending or denting the laminate. Picking up panels by grasping diagonal corners will prevent folding or bending thin laminate.

Storage Recommendations

Laminate materials should be stored in a cool, dry environment.

The material should be supported over the entire surface area to prevent bow and twist.

Unclad or single-sided laminate which has been in storage more than 30 days should be baked for 3 hours at 265ºF (I29.0ºC). The purpose of this bake is to remove any possible moisture absorption.

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Lamination Process

Thermocouple Location

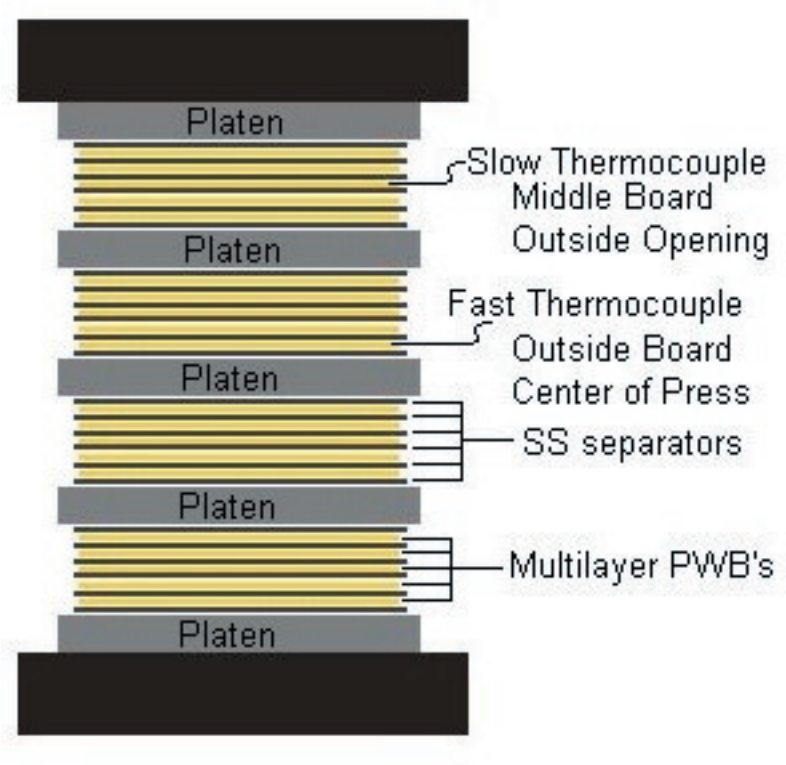
In the middle press opening, one thermocouple wire should be placed between two plies of prepreg in the dielectric closest to the platen (Outside board).

In an outer press opening, one wire should be placed between two plies of prepreg in the true center dielectric for the multilayer stack.

Make sure the twisted bare wires of the thermocouple are at 1/2 to 5/8 of an inch inside the panel in order to minimize radiative effects on temperature measurement.

These positions ensure that the full range of product temperatures (hottest to coldest) are used for control of the lamination process.

In the event that a timed press cycle is used, the above temperature measurement setup should be used to establish the appropriate lamination process.



Vacuum Cycle (if applicable)

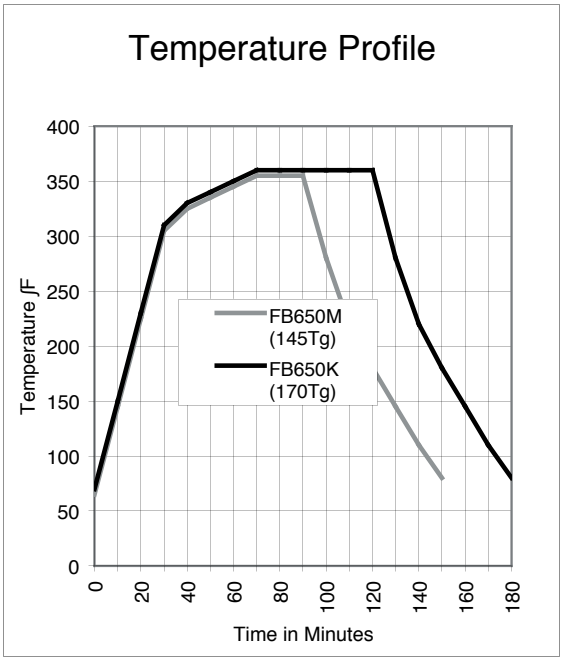
The target vacuum level should be 28 inches Hg minimum gauge reading.

Gauge levels less than 28 inches of Hg will make higher work piece pressure levels necessary. Vacuum levels less than 25 inches HG indicate system leakage.

A vacuum dwell time of 10-20 minutes is suggested before applying heat or pressure to the package. This will allow air and excess volatiles to diffuse through the package.

Since diffusion time is dependent upon minimum path length, select a dwell time based on panel size.

Vacuum can be discontinued at the onset of cure; 345ºF (I73.8ºC) measured at the coolest panel in the press load.



Temperature Cycle

Use a platen temperature set point of 360-365ºF (I82.2-185.0ºC).

A hot or cold start can be used as long as the average product heating rate between 150 and 250ºF (65.6 and 121.1ºC) is 8 to 12ºF (4.4 to 6.7ºC) for all products in the package.

Adjust the number and type of press pads to achieve the proper heat rate.

Optimization of the heat-up rate should result in less than a two degree per minute difference in the heating rate between fastest and the slowest panels.

The cure time for EF650M should be a minimum of 45 minutes past the time that the coldest panel in the load passes 345ºF (173.8ºC).

The cure time for EF650K should be a minimum of 75 minutes past the time that the coldest panel in the load passes 345ºF (173.8ºC).

The cooling rate should not exceed I0ºF (5.6ºC) per minute. Slower cooling will result in less outer panel warpage.

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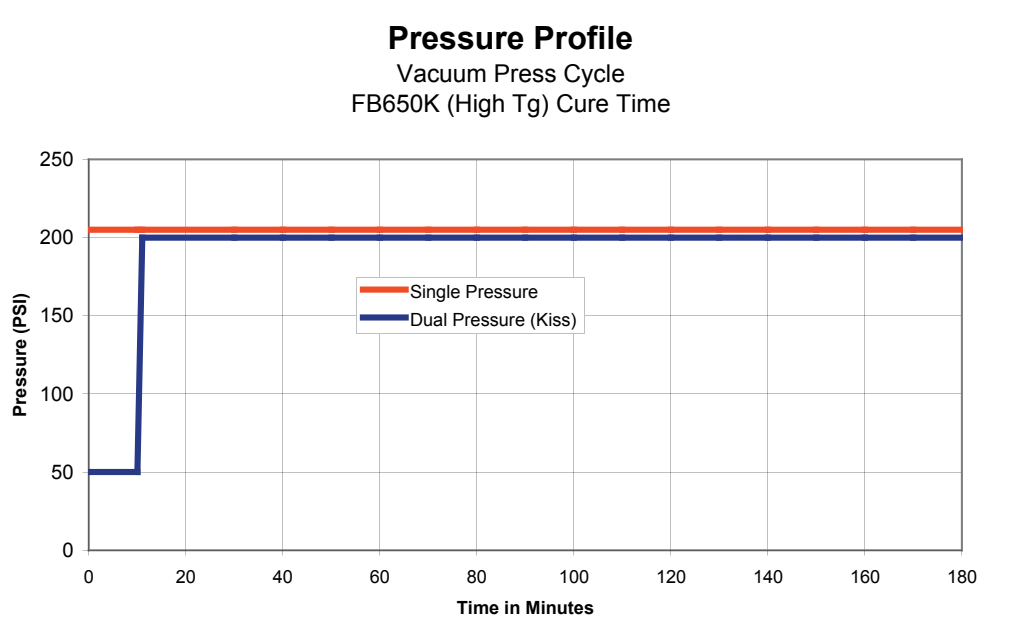
Pressure Cycle

Single Stage Cycle

For a one-stage process, full pressure can be applied at initial contact. While this process is simpler, it may not give adequate control for all applications such as rigid flex or blind and buried via hole filling or heavy copper signals.

The normal multilayer pressure range is 200-250 psi with Vacuum, and 350-400 psi without. The level chosen for high pressure will ultimately depend on the following factors:

- Fixture and equipment condition (i.e., flatness and parallelism of press retells and tooling plates).
- Vacuum level.
- Degree of difficulty for part being laminated (i.e., conductor thickness, etched configuration, via aspect ratio, etc.).



Dual Stage (Kiss) Cycle

A contact pressure of 50 psi will ensure good thermal contact for heat transfer.

The level chosen for high pressure will ultimately depend on the same factors mentioned above.

The temperature for transition from contact to high pressure will normally be between 220ºF and 230ºF (104.4 and 110ºC) as measured by the outside (hottest) positioned thermocouple wire.

Ideally, the difference in temperature between the inside and outside positioned panels at the point of pressure transition should be kept to an absolute minimum. Adjustment of the stack height is needed should the difference reach 30ºF

Modification of the pressure transition temperature may be necessary for some applications.

Post-Lamination Processing

No postbake is required to cure the multilayer board. Products receiving the above thermal history will be fully cured.

If stress relief is required, a four (4) hour postbake at a stack temperature of 325ºF (162.8ºC) is sufficient. After postbake is completed, the maximum product cooling rate to avoid reintroducing stresses is 5ºF (2.8ºC). Do not remove from the oven or increase the cooling rate until the center of the stack temperature is below 210.0ºF (98.9ºC).

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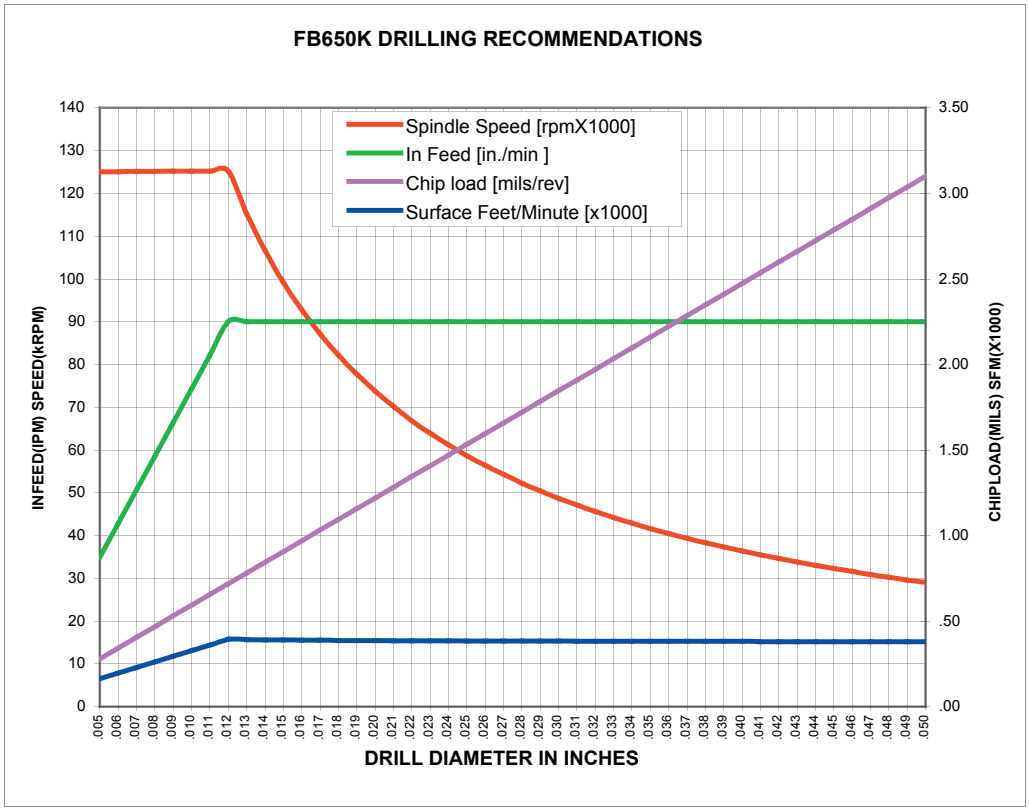
Processing Characteristics

The following processing characteristics apply to the use of Taconic Synthane-Taylor EF650M, FB650M, EF650K and FB650K products:

Drilling

Standard FR-4 drilling parameters may be used on all Taconic Synthane-Taylor products. If your normal drill parameters vary from those in the chart below, use those parameters, differences in drill geometry, backup and entry materials, and drilling equipment may dictate different parameters.



Oxide Treatments

Black, brown, or red oxides may be used with Taconic Synthane-Taylor products. Standard FR-4 oxide processing should be used. Post Oxide treatments such as DMAB are completely compatible with our resin systems and curing schedules.

Oxide replacement chemistries are being used successfully with both of our resin systems.

Desmear/Etchback

Permanganates may be used with all Taconic Synthane-Taylor products to condition drilled holes. Plasma may be used to achieve etchback. Where appropriate, standard FR-4 desmear and/or etchback processing can be used.

For 2 or three point, military type etchback on FB650K, plasma is preferred followed by a glass removal step.

Permanganate preconditioners (swellants) using non-aqueous solvents such as NMP (N-Methyl Pyrolidone) have been used successfully to provide 2-point etchback.

Routing

Standard FR-4 routing process parameters should be used. Tool wear will increase using FB650K (High Tg) materials, but normally the life should be 80-90% of that when processing low Tg FR-4.

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Permittivity and Loss Tangent Ratings

FB 650M and FB650K Laminates

Laminate Thickness	Construction	Dielectric Constant 1 Mhz (2 fluid cell)
0.0020	106	4.1
0.0025	1080L	4.2
0.0030	1080	4.2
0.0035	2113L	4.5
0.0040	2113	4.4
0.0040	106/106	4.2
0.0045	106/1080L	4.3
0.0050	1080L/1080L	4.4
0.0050	2116	4.5
0.0050	106/2113L	4.2
0.0060	1080/1080	4.2
0.0060	1080L/2113L	4.3
0.0070	2113L/2113L	4.4
0.0070	7628	4.8
0.0075	7628	4.8
0.0075	2113/2113	4.4
0.0080	2113L/2116	4.5
0.0080	7628HR	4.7
0.0080	2113/2113	4.4
0.0095	2116/2116	4.5
0.0100	1080/7628	4.5
0.0120	1080L/7628/1080	4.4
0.0140	7628/7628	4.8
0.0140	2113/7628/7628	4.8
0.0150	7628/7628	4.8
0.0160	7628HR/7628HR	4.7
0.0170	7628/1080/7628	4.7
0.0180	7628/2113/7628	4.8
0.0210	3x7628	4.8
0.0240	3x7628HR	4.7
0.0280	4x7628	4.8
0.0310	4x7628/1080	4.8
0.0350	5x7628	4.8
0.0420	6x7628	4.8
0.0470	6x7628/2113	4.8
0.0570	8x7628	4.8

EF 650M and EF650K Prepregs

Prepreg Type	Dielectric Constant 1 Mhz (2 fluid cell)
106	4.1
1080	4.2
2112	4.3
2113	4.4
2116	4.5
7628	4.8

The above values are based on Taconic Synthane-Taylor's Process and are for reference only.

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EF650K & FB650K High Tg (170ºC) Prepreg and Laminate Advantages

Taconic Synthane-Taylor EF650K and FB650K are grade designations for our 170ºC Tg multifunctional epoxy prepreg and laminate. These products are engineered to produce the following advantages over standard FR-4 products:

1. Excellent pad lifting resistance.
2. Reduced barrel and foil cracking.
3. Improved drill characteristics with minimal epoxy smear
4. Consistent etchback.
5. Higher cross-link density.
6. Improved chemical and moisture resistance.
7. Superior thermal shock resistance.
8. Z-axis expansion 40% less than FR-4 at soldering temperature.
9. Can be processed using standard FR-4 processes with little or no modification.
10. Excellent AOI fluorescence.
11. Excellent UV Blocking.

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FB650M & FB650K Laminate Property Comparison

Property	FB650M	FB650K
Nominal Glass Transition Temp. (Tg)	145°C	170°C
Solvent Resistance (Weight % increase) Methylene Chloride	1.40%	0.60%
Pressure Cooker Test Humidity Resistance 100% Pass after (min)	60 min.	120 min.
Copper Peel Strength (1 oz. lbs. in./in.)	10.0 lbs.	10.0 lbs.
Permittivity at 1 Mhz (Dielectric Constant) Average	4.7	4.7
Loss Tangent at 1 Mhz (Dissipation Factor)	0.019	0.019
UL Rating	94-V0	94-V0
Water Absorption (% by Weight)	0.25%	0.19%
Dimensional Stability Max. Change in./in.	0.0005 After Stress 0.0004 After Bake	0.0005 After Stress 0.0004 After Bake
Volume Resistivity		
Min. in megohm/centimeter After moisture resistance At elevated temperature	 1×10^6 1×10^7	 1×10^6 1×10^7
Surface Resistivity		
Min. in megohm/centimeter After moisture resistance At elevated temperature	 1×10^4 1×10^3	 1×10^4 1×10^3
Coefficient of Thermal Expansion - Z Axis Below Tg (Average)	50-80 ppm/°C	50-60 ppm/°C
Coefficient of Thermal Expansion - Z Axis Above Tg (Average)	300-350 ppm/°C	200-250 ppm/°C