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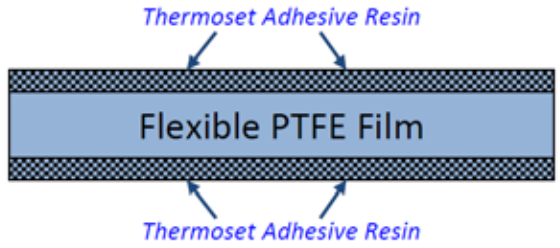
FR-EZ

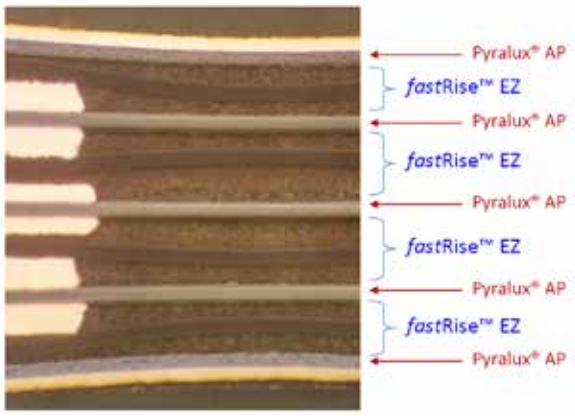
General Processing Guidelines

General Information

fastRise™ EZ

FR-EZ-22P and FR-EZ-33P prepreg use the flexible fastRise™ thermoset resin system which has been engineered for use in flexible printed circuit boards. It is compatible with most materials, especially those that are difficult to bond to including LCP, Polyimides (e.g. DuPont AP), and PTFE laminates (e.g. DuPont TK). fastRise EZ provides an ideal solution where flexible circuits with low loss, high operating temperature, and/or improved peel strengths are required. Similar to other parts in the fastRise family, fastRise EZ utilizes a flexible PTFE film for low electrical loss and a high performance thermoset resin as an adhesive on the top and bottom.





Storage

Store the material in a cool dry area away from direct sunlight and high humidity, avoiding material contamination. fastRise™ EZ is certified to meet all requirements as agreed upon between the user and supplier for a given shelf life as defined by the storage conditions below.

Storage Conditions

Condition 1 (i.e. refrigeration): <4.5°C (40°F)
Condition 2 (i.e. room temp): <23°C (73°F), Relative Humidity <50%

When removing fastRise EZ prepreg from refrigeration, it should be allowed to acclimate to room temperature in the sealed bag.

This will reduce the chance of moisture condensation on the prepreg and will also provide a more consistent start temperature for the lamination process. Bags should be resealed when not in use.

Shelf Life

If material is stored under Condition 1 above, a shelf life of 180 days after receipt of shipment will apply. If material is stored under Condition 2 above, a shelf life of 90 days after receipt of shipment will apply. AGC will not ship fastRise EZ material with less than 90 days of remaining shelf life. Packaging will default to indicate shelf life based on storage Condition 2 unless end user notifies AGC that Condition 1 applies. In the event that prepreg expires, please contact your AGC technical representative for assistance to coordinate re-testing the expired prepreg.

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Handling

fastRise™ EZ prepreg is supplied between two release sheets. The surface of fastRise EZ may be tacky, especially for freshly manufactured material. Although it is recommended to allow refrigerated fastRise EZ prepregs to acclimate prior to opening a sealed bag, in some cases it may be advantageous to use the prepreg while it is cool* which will reduce the tackiness of the material and make handling easier.

*do not allow condensation to form on the prepreg

Inner Layer Preparation

Laminate Preparation

fastRise™ EZ will bond well to most other materials. Inner-layers should be clean and dry before bonding. Oxide treatments of copper surfaces are recommended. As long as the uncured prepreg hasn't been exposed to moisture or high humidity, vacuum desiccating of the material is not required.

Flow Patterns / Thieving

Solid copper borders, 0.5-1.0" wide, are recommended and have been observed to allow the use of much higher lamination pressures without any negative effects or squeeze out. See Lamination section for more information. For thieving, retaining as much copper in between parts is preferred. Interlocking patterns such as offset diamonds, honeycombs, or other patterns which inhibit resin flow channels are ideal. Interlocking "star burst" flow patterns or other patterns which may promote resin flow channel formation should be avoided.

Baking

As a general recommendation, fastRise™ EZ should be baked after exposure to moisture for 3 hours at 80°C (175°F). This can be substituted with a 1 hour bake at 120°C (250°F). For simplicity in this processing guide, all bake steps will refer to the 120°C process even though they are both acceptable. Do not bake the material prior to cure/lamination.

Negative outcomes have occured when baking fastRise™ EZ at temperatures of 180°C (350°F) for as little as 30 minutes. It is up to each user to establish proper bake times and temperatures that are compatible with their equipment and the materials being used.

Lamination

Excessive resin flow should be avoided as it can cause flow channels or other undesirable conditions.

Quick Start

	***fast*Rise EZ**	***fast*Rise EZ Low Temp**
Cure Temp / Time (measured at bondline)	60 minutes at 215°C (420°F)	150 minutes at 200°C (390°F)
Pressure	100 (preferred) - 200 psi (see Pressure section page 7 for details)	
Heating Rate	2 – 4°C/min (3 – 8°F/min)	
Critical Range	80°C – 150°C (175°F – 300°F)	
Cooling Rate	Less than 3°C/min (6°F/min)	
Breakdown	Breakdown or transfer to cold press when bondline is below 90°C (200°F)	
Vacuum	Full vacuum is recommended through entire cycle	
Vacuum Delay	Hold vacuum 10-20 minutes before applying heat or pressure	

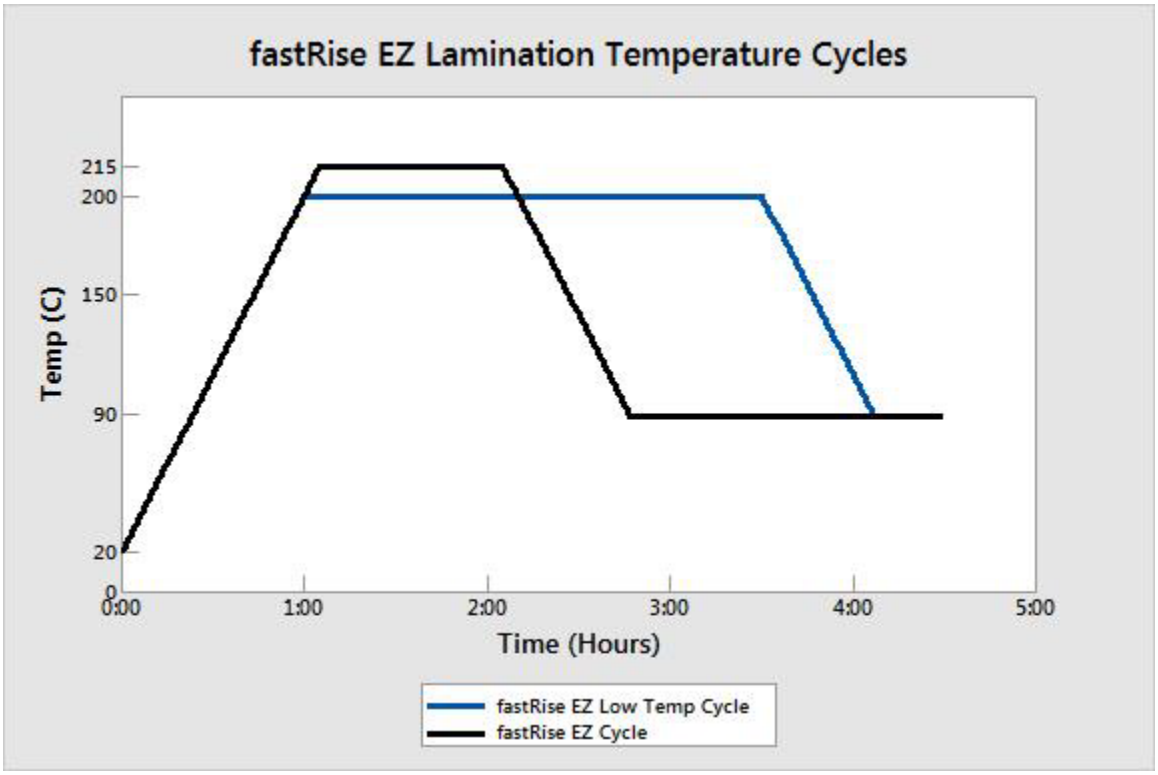
Padding and Conformance Materials
Typical padding and conformance materials used for rigid, rigid-flex, or flexible circuit manufacturing can be used (pending temperature ratings of the materials). Press padding (outside separator plates) is recommended. Use of conformance materials such as AGC TacPad, PTFE skive film, clutch lamination, or others are often helpful to balance pressure variations induced from circuits. Clutch laminations are recommended for foil lamination applications and when bonding plated up copper layers to achieve consistent dielectric thicknesses.

Pressure

Excessive pressure should be avoided; it can distort circuit patterns, induce resin/filler separation, or create flow channels.

Full pressure should be achieved before the fastRise™ EZ reaches 80°C (175°F). fastRise™ resin flow has been shown to be directly proportional to lamination pressure and higher pressures can increase resin flow when required. Lower pressures in the range of 100 psi are believed to aid the center film in laying flat which may reduce phase shift in the circuitry at elevated frequencies. Past data has also shown that lower lamination pressures are linked to decreased scale variation between panels..

Temperature



Resin Flow Window / Critical Range
fastRise™ resins gel and flow between 80°C - 150°C (175°F – 300°F) and reaches their lowest viscosity between 100°C – 125°C (212°F – 260°F).

Heating Rate
A cold start of the press is desirable. Typical fastRise™ heating rates are 2°C/min – 4°C/min (3°F/min – 8°F/min). In difficult to fill applications such as heavy copper or high layer count boards, a slow heating rate should be used (2°F/min – 3°F/min). It is also recommended that low heating rates be used if the process is to accommodate tight registration requirements or high layer counts. Past studies have shown that lower heating rates (i.e. <3°F/min) can provide substantial improvements in registration repeatability.

Curing
fastRise™ EZ resins cure at a lower temperature than other fastRise™ part numbers. A standard fastRise™ heating profile can usually be used where the bondline is held at 215°C (420°F) for a minimum of 1 hour. However, fastRise™ EZ can also be cured where the bondline is held at 200°C (390°F) for 2.5 hours. The lower cure temperature can provide some advantages in choosing release/padding/conformance materials as well as enabling the use of traditional lamination presses designed for FR-4. This also increases compatibility with other low-temperature flexible materials.

Cooling
A slow cool (<6°F/min) is necessary to avoid any issues associated with delamination. The hot press should be cooled below 90°C (200°F) before transferring to a cold press. In situations where mismatched CTE's may induce delamination or where warping may be an issue, slower cooling rates (<3°F/min) may provide better results.

Additional Notes

Multiple Ply Constructions
Resin flow can increase when multiple plies of fastRise™ EZ are used against each other. If higher-flow is not desired, pressure should be reduced to prevent excess resin flow, resin separation, or formation of flow channels.

Drilling

In most cases, the laminate cores will dictate drilling parameters. The following information is provided as a general suggested starting point where fastRise EZ is combined with typical low-loss PTFE-based laminates.

Quick Start

	Imperial units	SI units
Entry Material	Phenolic (0.010" – 0.024")	Phenolic (0.25mm - 0.6mm)
Backer Material	Rigid Phenolic, Slickback, or comparable	
Cutting Speed (Surface Speed)	100 SFM	30.5 MPM
Chip Load	0.0010 in	25 µm
Dwell	0-1000 ms (increase dwell time as speed and chip load deviate from above recommendations)	

Drill Bits
Sharp drill bits are critical to any PTFE drilling; new drill bits should always be used. Undercut drill bits are recommended, but past studies have shown that some drill bit brands may obtain better results using their standard drill bits.

Chip Load
A chip load of 1.0 mil (25.4 µm) is common with fastRise™ combined with AGC laminates. Increasing the chip load to 1.25 mils (31.8 µm) may provide acceptable hole quality and improved productivity.

Cutting Speed
Drill speeds of 100 SFM (30.5 m/min) or less will usually eliminate drill smear if it is present. The slower speeds allow generated heat to dissipate before smearing PTFE. Drill speed can be increased due to equipment limitations, but added dwell times may become more important.

Dwell Time
If smear is present and ideal cutting speeds cannot be obtained, a 250ms dwell is recommended for initial process setup in order to cool the drill bit between holes. Past AGC studies have shown that hole-wall quality in PTFE materials may improve as dwell times are increased to as much as 1000ms.

Peck Drilling
Peck drilling should be avoided where possible; it has been shown to increase drill bit wear as well as increase process time. Peck drilling may be required in some situations (e.g. bird nesting, hole plugging, chip extraction on thick panels, breaking thin drill bits, etc.). If traditional peck drilling is not used, hole-wall quality in PTFE laminates may be improved with the use of a "clean" peck where the peck depth is set to equal that of the phenolic entry. In this, the entry material will effectively clean the drill bit, retract to clear phenolic debris and cool, and then reenter to drill the hole.

Hit Count
Hit counts can vary widely and are usually determined by the laminates used, panel thickness, and hole size. Hit counts of 100-300 hits per bit are typical for ceramic/PTFE constructions. When paired with unreinforced and ceramic free laminates, little drill wear will take place and hit counts of 700-1000 are not unreasonable. When developing the process, the drill point edges should be periodically inspected to assess the level of drill wear and hit count should be adjusted accordingly.

Entry / Backer Materials
Rigid entry and exit material is usually beneficial in order to remove any debris or deposits from the drill bit. 10-25 mil phenolic entry is acceptable for most applications and 30-50 mil phenolic entry can be used if pressure foot clearance is substantial. Like the entry, rigid backer is usually necessary to prevent burring and aid in obtaining good hole-wall quality. Thick phenolic is typical and lubricated rigid backers such as SlickBack® from L.C.O.A.® have also been successful.

Coolant Assisted Drilling
Some drilling equipment is now equipped to apply coolant/lubricant to the drill bit during the drilling process. This process has been shown to provide substantial benefit to the drilling process and should be used if available. If available, expect increased chip loads, cutting speed, and improved hit counts.

Laser Drilling / MicroVias
A CO_2 laser is recommended for microvia formation in fastRise EZ. While a UV laser may be used to ablate the surface copper, UV energy directed into the fastRise will tend to leave a blown out microvia geometry instead of one with smooth hole walls and a slight taper. Unchecked, it may also negatively affect the capture pad. If copper foil thickness variation prevents consistent UV/CO_2 lasing, higher quality may be achieved by first etching away the surface copper where the microvias are to be formed, then ablating the fastRise EZ with a CO_2 laser only.

Hole Wall Preparation
fastRise™ EZ requires a PTFE activation cycle for the PTFE film. The thermoset adhesive resins can be desmeared / etched back prior to the PTFE activation as directed below..

Desmear

Plasma
If panels have been exposed to moisture, bake the boards at 120°C (250°F) for 1 hour to drive out moisture. Standard FR-4 CF_4/O_2 desmear processes should then be used. The CF_4 cycle time is typically half that of standard FR-4 times because the fastRise™ EZ resin system tends to etch back quickly.

Permanganate
A permanganate desmear IS NOT RECOMMENDED if the process contains glass etch chemistry. This is due to the high ceramic content of the fastRise™ EZ resin system and will result in excessive etchback. If glass etch chemistries must be used due to other materials in the stack up, consult with your AGC technical service representative for specific process recommendations. Standard permanganate and glass etch baths as a part of the electroless copper process are OK. However, note that this alone will not sufficiently desmear the fastRise™ EZ resin. A plasma process as described above is required for good hole wall quality.

PTFE Activation

Plasma
If panels have been exposed to moisture, pre-bake the boards at 80°C (175°F) for 3 hours. Plasma treat the PTFE resin using 70%/30% Hydrogen/Nitrogen gas mixture. 100% Helium may also suffice. Power settings for the RF-signal generator are typically 60-75% of full rated power for 30-60 minutes, but results may vary. Thick panels or high-aspect ratio holes may require extended plasma cycle times.

Sodium Etch
Sodium Etches (e.g. Fluoroetch) for PTFE activation works well with fastRise™ EZ. Follow the manufacturer's recommended treatment process. Subsequently, bake for 3 hours at 80°C (175°F) prior to plating to remove moisture that may have been absorbed during the sodium treatment process.

Chlorine can have adverse effects on the sodium treatment. Do not subject exposed sodium etch treated holes to heavily concentrated chlorine-based chemical processes.

Plating

A robust hole wall preparation process is necessary for a successful deposition plating process due to the PTFE content in the fastRise™ EZ . Following hole wall preparation, fastRise™ EZ will accept standard electroless copper or direct metallization plating.

Image, Develop, Etch, Srtip

When copper surface preparation is required, chemical cleaning processes are preferred (e.g. microetch); mechanical scrubbing (e.g. pumice scrub) should be avoided due to possible mechanical damage or distortion. Although fastRise™ EZ should be resistant to this type of damage, low loss materials typically used in conjunction with fastRise™ EZ may not be. Otherwise, standard processing should be used.

Solder Mask

Panels should be clean and dry. No other special treatment is required.

Solder Reflow

A pre-bake cycle of 2 – 3 hours at 120°C [250°F] is recommended prior to thermal stressing. Longer pre-heat times and reduced cycle times may be advantageous depending on design and processes.

Routing / Milling

fastRise™ EZ can be successfully machined using standard router bits or end mills. Rigid phenolic entry and a rigid backer should be used. In some cases, adding paper (white paper or craft paper) between the phenolic and the part allows better conformance to surface topography (e.g. circuits, soldermask, etc.) and may reduce burring. For tight tolerances or superior edge quality, a "rough cut" placed 0.005"- 0.010" off the part edge may be run prior to the "finish" cut at the nominal part edge.

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