IS580G Preliminary

Halogen-free, Very Low Loss Material

Processing Guide

The processing guidelines contained in this document were developed through in-house testing and field experience. However, they should be considered to be starting points that will require further adjustment. Read the following review of processes for applicability to your particular Printed Wiring Board (PWB) fabrication environment.

Remember that the suggestions contained herein cannot account for all possible board designs or processing environments. Additional adjustments by the fabricator will be necessary. Isola can and will assist with this process, but the fabricator, not Isola, is ultimately responsible for their process and the end results.

Fabricators should verify that PWBs made using these suggestions meet all applicable quality and performance requirements.

Part 1: Prepreg Storage and Handling

Isola Group's prepreg bonding sheets for use in multilayer printed circuit board applications are manufactured to specifications that include physical properties, electrical properties and processing characteristics relative to the laminating application. Handling and storage factors have an important influence on the desired performance of the prepreg. Some parameters are affected by the environment in which prepregs are stored. They can also deteriorate over extended periods of storage. The prepreg received by the customer is a glass fabric that has been impregnated with a stated quantity of low volatile, partially polymerized resin. The resin is tack free but somewhat brittle. Many lamination problems arise from resin loss off the fabric or damage to the woven glass due to improper handling. The fabric used is based on the order and supplies the required thickness. In most cases the amount of resin carried by the fabric increases as the fabric thickness decreases.

Handling Suggestions

Handle all prepreg using clean gloves. Use sharp, precision equipment when cutting or paneling prepreg. Treat all prepreg as being very fragile. Use extreme care when handling very high resin content prepreg (glass fabrics 1080 and finer).

Storage Suggestions

Upon receipt, all prepreg should be immediately moved from the receiving area to a controlled environment. Material should be kept in original packaging until ready to use. All prepreg should be used as soon as possible. A First-In-First-Out (FIFO) inventory management system should be used. Do not stack heavy objects on top of the prepreg. High pressure can result damage and resin pull off.

If not handled properly, IS580G prepreg will absorb moisture, which will lead to depressed Tg and cure and affect flow in the press. If extended storage is required, separate facilities should be reserved with appropriate environmental control. Prepreg should be stored at ≤ 23ºC and below 50% humidity. Prepreg packages should be allowed to equilibrate to layup room conditions before opening to prevent moisture condensation on the prepreg.

Stabilization

Stabilization time will depend on storage temperature. In cases where storage temperature is significantly below room temperature, keep prepreg in package or plastic wrapping during the stabilization period to prevent moisture condensation. Once the original packaging is opened, the prepreg should be used immediately. Remaining prepreg should be resealed in the original packaging with fresh desiccant, do not vacuum seal IS580G prepreg. Storage should be in the absence of catalytic environments such as high radiation levels or intense ultraviolet light.

Part 2: Innerlayer Preparation

Isola Group's IS580G laminates are fully cured and ready for processing. It has been the experience of most fabricators that stress relief bake cycles are not effective in reducing any movement of high-performance laminates such as IS580G. Therefore, it is suggested that the movement of unbaked laminate be characterized, and the appropriate artwork compensation factors are used.

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Dimensional Stability

The net dimensional movement of laminate after the etch, oxide and lamination processes is typically shrinkage. This shrinkage is due to the relaxation of stresses that were induced when the laminate was pressed as well as shrinkage contribution from the resin system. Most of the movement will be observed in the grain direction of the laminate.

There are situations that have been known to alter the proportion of shrinkage in grain versus fill direction in some board shops. These include autoclave pressing and cross-plying laminate grain direction to that of prepreg. While both of these practices have their advantages, material movement must be uniquely characterized. FR408HR artwork compensation factors can be used as a starting point or use those listed in Table 1. This table assumes that laminate and prepreg grain directions are oriented along the same dimension. Shrinkage factors differ based on the process and processing equipment used in manufacturing.

Table 1: Initial Artwork Compensation Factors Base Thickness Configuration

Base Thickness	Configuration	Direction	Comp (in/in)
≤ 0.005″	Signal/Signal	Warp	0.0007-0.0009"
"	"	Fill	0.0001-0.0003"
"	Signal/Ground	Warp	0.0005-0.0007"
"	"	Fill	0.0001-0.0003"
"	Ground/Ground	Warp	0.0002-0.0004"
"	"	Fill	0.0000-0.0002"
0.006-0.009"	Signal/Signal	Warp	0.0005-0.0007"
"	"	Fill	0.0001-0.0003"
"	Signal/Ground	Warp	0.0003-0.0005"
"	"	Fill	0.0000-0.0002"
"	Ground/Ground	Warp	0.0000-0.0002"
"	"	Fill	0.0000-0.0002"
0.010-0.014"	Signal/Signal	Warp	0.0002-0.0004"
"	"	Fill	0.0002-0.0004"
"	Signal/Ground	Warp	0.0001-0.0003"
"	"	Fill	0.0001-0.0003"
"	Ground/Ground	Warp	0.0001-0.0003"
"	"	Fill	0.0000-0.0002"

Table 1 (for reference) illustrates the suggested approach to characterizing laminate movement and provides approximate artwork compensation factors.

Imaging and Etching

IS580G® laminates are compatible with all industry standard image resists and copper etchants. Bond Enhancement Oxide alternative chemistries have been used successfully in fabricating IS580G multilayer boards to date. They are the only bond enhancement process recommended for lead-free applications. Reduced black oxide is not recommended and is more design and process sensitive, as well as being less thermally stable. Users should make sure the oxide or oxide alternative coating exhibits a consistent and uniform color.

For conveyorized oxide alternatives, the dryer should be capable of removing all moisture from the inner layer surface.

However, drying of layers for 120 minutes minimum @ 110°C (230°F) or higher is required for boards to be subjected to "Lead-Free" processes. Drying in racks is preferred.

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Wet cores interfere with the curing of prepreg, leading to low Tg values and degraded performance. Users need to verify the effectiveness of their process to achieve dry cores. It is generally suggested that post oxide baking be performed vertically, in racks.

Part 3: Lamination

The amount of time at cure temperature and the required pressure will be a function of board design. Thinner boards and lightweight copper designs can be run at the lower end of the ranges. Low rates of rise work better when using light weight copper and thinner board designs.

Thicker board designs may require longer cure times. Heavy weight copper or hard to fill designs with significant low-pressure areas should use a higher-pressure setting. Faster heat ramps lower the minimum viscosity and improve resin fill and flow but requires that full pressure application occur before the product reaches the flow temperature. Slower heat ramps may not achieve the required minimum melt viscosity to properly fill the copper pattern.

Sequential Lamination

Sub-assemblies ***must be baked*** prior to performing the secondary lamination. Water will interfere with the curing of the IS580G resin system. Sub-assemblies require much longer baking, particularly when stored in open warehouse environment. Baking times can range from 3-24 hours at 110-180°C (230-356°F). Extended baking should be performed just before the inner layer bond treatment process. Post bond treatment bake must be adequate to ***remove all surface moisture***. Consult with an Isola Technical Expert for recommendations.

Removal of IS580G flash should be performed by routing rather than shearing to minimize crazing along the panel edges.

Table 2: IS580G General Lamination Parameters

Process	Recommendation
Vacuum Time	>10 minutes (no pressure, product on risers)
Curing Time	>100 minutes at or above 210°C (410°F). Higher Temperatures are acceptable to 220°C (430°F)
Resin Flow Window	110-165°C (230-330°F) 2-3°C/min Heat rise. Maintain heat ramp in this temperature range.
Heat Ramp	2-2.5°C/min (3.6-4.6°F/min) Preferred for best curing results 3°C/min (5.5°F/min)
Pressure	375-425 PSI (26.5-30 Kg/cm^2)
Pressure Application	Single Stage: Apply pressure after vacuum dwell time. Dual Stage: 100 PSI (7.0 Kg/cm2) after vacuum dwell time, switch to high pressure ≤ 90°C product temperature.
Pressure Drop	After 30 minutes at cure temperature, reduce pressure to 50 PSI (3.5 Kg/cm2) in hot press**(optional)**.
Cool Down	Cool to 135-140°C (275-285°F) at 2.8°C/min (5.0°F/min) with 50 PSI (3.5 Kg/cm2) pressure prior to removing ortransferring the load.

Note: Pressure requirements are dependent on product design and technology. Higher pressures have been used on difficult to fill designs.

Part 4: Drill

IS580G materials exhibit robust thermal stability and generate little or no smear. Generation of smooth, debris free hole walls is influenced by the degree of resin cure, drilling conditions and board design considerations. The reduction or elimination of heavy glass styles (whenever possible), coupled with properly adjusted drill parameters has been shown to improve overall drilled hole quality. Drill bit geometries can impact drilled hole quality and using newer drill bit designs generally produce superior results. For high layer count technologies and thicker board designs, peck drilling parameters may be necessary. Suggested parameters in Table 3 can be used for typical multilayer designs.

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Cutting Speed and Chipload

IS580G uses lower chiploads to drill compared to typical FR-4 materials. Too high of cutting speeds and chiploads are associated with rough holes and fracturing around the glass yarn. Too low of chiploads have been associated with hole debris and hole wall adhesion issues. The parameters in Table 3 provide a a moderate initial starting point for typical multilayer board designs.

Stack Height and Hit Count

Stack heights and hit counts will vary with the construction and overall thickness of the PCB board being drilled. For thicker boards, above 2.5 mm (100 mils) overall, with high layer counts or heavy copper, drill a one PCB high stack. Lubricated aluminum entry and backing materials produce better hole wall quality.

Table 3: Suggested Drilling Parameters for Initial IS580G Setup

Drill Size		Spindle Speed	Surface Speed/Minute		Infeed		Chipload		Retract	
inch	mm	RPM	SMPM	SFPM	m/min	in/min	mm/rev	mil/rev	m/min	in/min
0.0079	0.20	120,000	74	247	1.27	50	0.011	0.42	15	600
0.0098	0.25	120,000	94	309	1.57	62	0.013	0.52	15	600
0.0118	0.30	105,000	99	325	1.78	70	0.017	0.67	20	800
0.0138	0.35	94,000	103	339	1.98	78	0.021	0.83	20	800
0.0157	0.40	85,000	107	350	2.16	85	0.025	1.00	25	1000
0.0197	0.50	75,000	118	387	2.54	100	0.034	1.33	25	1000
0.0248	0.63	60,000	119	390	2.29	90	0.038	1.50	25	1000
0.0295	0.75	50,000	118	387	2.19	85	0.043	1.70	25	1000
0.0354	0.90	43,000	122	399	1.91	75	0.044	1.74	25	1000
0.0394	1.00	38,000	119	392	1.73	68	0.045	1.79	25	1000
0.0500	1.27	32,000	128	419	1.57	62	0.049	1.94	25	1000
0.0591	1.50	28,000	132	433	1.42	56	0.051	2.00	25	1000
0.0787	2.00	22,000	138	454	1.27	50	0.058	2.27	25	1000

Part 5: Hole Wall Preparation

When IS580G® is properly cured and drilled, it will generate very little smear and therefore desmear processing on this material is performed to remove debris and provide an acceptable texture to the drilled hole walls. Good desmear and electroless copper deposition performance are more easily achieved when the drilled hole quality is good.

Desmear

Plasma etching and chemical desmear are effective on IS580G. Combining these two processes is the recommended process flow. IS580G requires similar plasma etch times as FR408HR followed by a chemical desmear process used primarily for hole cleaning and conditioning. Plasma etching is recommended for microvia technology.

A chemical only desmear process can also be used on IS580G for low aspect plated through holes. Good agitation and solution flow through the PTH is critical. For best results, horizontal processing equipment is recommended. It is strongly recommended that permanganate only process be evaluated to determine process limits for high aspect ratio PTH designs.

It is suggested that checking plating quality coupons after plasma etching for positive etchback to determine the best processing parameters. Contact Isola Technical support with any questions.

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3-Point Etchback
True 3-point “etchback” exposes the inner layer “post” on all three sides for subsequent plating processes. This will require a more robust approach using a combination of plasma and chemical processing is required. Testing indicates that the plasma provides nearly all of the resin removal.

Permanganate chemistry alone does not provide adequate 3-point etchback of IS580G. If plasma is not available, chemical etchback for 3-point connections must be done with extreme care to minimize copper wicking.

Secondary Drilling
The use of entry and backer material may be necessary during the secondary drilling of larger hole sizes to avoid crazing/fracturing at the hole perimeter. Use of the same tool types as primary drilling is recommended. Note that parameters listed may require further adjustment.

Routing and Scoring
Parameters listed in Table 4 may require further modifications of the final PCB routing process due to the greater modulus properties of the IS580G materials. Table 4 lists initial starting parameters using chip breaker or diamond cut tool designs.

For PCB designs requiring scored geometries, **thinner web thicknesses are typically required.** This is influenced by layer count, glass types and retained copper in the design. Your Isola Technical Account Manager may also be able to provide some initial suggestions, but these should be validated through testing by the individual PCB fabricator.

Table 4: Suggested Routing Parameters for Initial IS580G

Tool Diameter		Spindle Speed	Spindle Travel Speed	
inch	mm	RPM	in/min	m/min
0.062	1.57	45,000	20	0.51
0.093	2.36	35,000	40	1.02
0.125	3.18	25,000	50	1.27

Chip breaker or diamond cut tool designs recommended

Part 6: Packaging and Storage

IS580G finished boards have low moisture sensitivity and good shelf life. However, Isola recommends using best practices in storage and packaging, as noted below, to reduce risk during lead-free assembly. IS580 boards should be dry prior to packaging to ensure the most robust lead-free performance. The use of a Moisture Barrier Bag (MBB) with a Humidity Indicator Card (HIC) and adequate drying desiccant inside the MBB are recommended practices for improving shipping robustness and long-term storage.

Upon opening the MBB, the boards should be processed within 168 hours when maximum shop floor conditions are at < 30°C (85°F)/60% RH. MBB bags that are opened for inspection should be resealed immediately to protect the boards from moisture uptake.

Part 7: Health and Safety

Always handle laminate with care. Laminate edges are typically sharp and can cause cuts and scratches if not handled properly. Handling and machining of prepreg and laminate can create dust (see FR408HR Material Safety Data Sheet).

Appropriate ventilation is necessary in machining/punching areas. The use of protective masks is suggested to avoid inhaling dust. Gloves, aprons and/or safety glasses are suggested if individuals have frequent or prolonged skin or eye contact with dust.

Isola Group does not use polybromidebiphenyls or polybromidebiphenyloxides as flame retardants in any product. Material Safety Data Sheets are available upon request.

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Part 8: Ordering Information

Contact your local sales representative or contact: **info@isola-group.com** for further information.

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NOTES

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