Tachyon® 200JV

Halogen-free, Super 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. These recommendations contained herein cannot account for all possible board designs or processing environments and adjustments by the fabricator will be necessary. Fabricators should verify that PWBs made using these suggestions meet all applicable quality and performance requirements.

Tachyon® 200JV has been specifically designed for super low loss applications where the best possible electrical performance is required. In order to achieve optimal thermal and electrical performance, an ultra low loss bond treatment and use of one of the recommended press cycles is 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 and 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 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, Tachyon® 200JV prepreg will absorb moisture, which will lead to depressed Tgs 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 ≤ 23°C 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. Storage should be in the absence of catalytic environments such as high radiation levels or intense ultraviolet light.

After Opening

Prepreg removed from original packaging should not be stacked. Tackiness may occur if too much pressure is applied directly to the prepreg.

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Part 2: Innerlayer Preparation

Isola Group's Tachyon® 200JV 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 Tachyon® 200JV. Therefore, it is suggested that the movement of unbaked laminate be characterized and the appropriate artwork compensation factors are used.

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.

Table 1

PCB Resin Content	Direction	Comp(in/in)
High RC%	Warp(Grain)	0.00096
"	Fill	0.00031
Low RC%	Warp(Grain)	0.00083
"	Fill	0.00029

(for reference) illustrates the suggested approach to characterizing laminate movement and provides approximate artwork compensation factors for Tachyon® 200JV laminate when using a hydraulic press.

This table assumes that laminate and prepreg grain directions are oriented along the same dimension. Each shop must characterize material behavior given the specific lamination cycle used, border designs and grain orientation of laminate to prepreg. It is also suggested that specific laminate constructions are specified and adhered to so that dimensional variations due to changes in construction are avoided. Table 1 assumes that signal layers are either 1/2 or 1 ounce copper and ground layers are either 1 or 2 ounce copper.

Imaging and Etching

Tachyon® 200JV laminates are imaged using standard aqueous dry films and are compatible with both cupric chloride and ammoniacal etchants. Bond Enhancement Tachyon® 200JV uses < 1 micron Rz surface roughness copper (VLP1) to bond to the laminate surface. For optimal electrical performance, an equally high performance Ultra Low Loss (very low profile) bond enhancement is highly recommended.

Etch type bond enhancements are compatible for bonding and thermal properties with no limitation of use for PCB quality or reliability. However, electrical performance will be sacrificed and will result in significantly increased total signal loss, S21.

If immersion tin adhesion treatments are used, the fabricator should test the coating to verify adequate bond strength is developed with Tachyon® 200JV prepregs.

Reduced black oxide systems are not recommended for Tachyon® 200JV.

For conveyorized oxide replacements, an efficient dryer at the end of a conveyorized oxide replacement line must remove all moisture from the inner layer surface. However, drying of layers for 30 minutes minimum @ 100°C or higher is considered a "best practice," especially for boards to be subjected to "lead-free" processes. Drying in racks is preferred.

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Part 3: Lamination

The chemistry of Tachyon® 200JV is unique and can be laminated using typical FR4 type methods. The resin system requires more energy to cure than most materials. In order to achieve the optimal thermal properties for the resin system a longer press cycle for thick designs may be required.

Pressure requirements are dependent on product design and technology. Higher pressures can be used on difficult to fill designs such as heavy copper foil or partial plane features.

Isola Technical Service will provide support and lab testing to ensure the lamination cycle is performing properly.

After lamination, removal of Tachyon® 200JV flash should be performed by routing rather than shearing to minimize crazing along the panel edges.

Table 2: Tachyon® 200JV General Lamination Parameters

Process	Recommendations
Vacuum Time	Recommended Minimum: On Risers: >10 min. Product temperature to not exceed 100°C
Curing Profile	120 minutes above 200°C (395°F) Do Not Exceed 222°C (437°F) Product Temperature
Resin Flow Window	115-160°C (240-320°F) 2-3°C/min heat rise Maintain heat ramp in this temperature range.
Heat Ramp	2-3°C/min (3.6-4.5°F/min) for best curing results
Pressure	400-450 PSI (26.5-30 Kg/cm²)
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 ≤130°C product temperature; targeting 110°C.
Pressure Drop (optional)	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 or transferring the load.

Heat Ramp Rate is very important for Tachyon® 200JV. Lower Heating rates have better performance. High Temperature Post Bake can be used on very high reliability designs to provide stress relief. Post Baking is not required but can improve some high-end designs. Post bake at 210°C (410°F) for 2 hrs.

Part 4: Drill

General

To assure effective removal of the resin debris during drilling, undercut drill geometries and high helix tools are suggested. On high layer count technologies and thicker overall board thicknesses, peck drilling parameters may be necessary. Suggested parameters are outlined below for typical multilayer designs.

Cutting Speed and Chipload

Relative to standard FR-4 parameters, use lower chiploads and higher cutting speeds to drill Tachyon® 200JV printed circuit boards. The parameters in Table 3 and 4 provide a moderate initial starting point for typical board designs. Boards with large amounts of copper in drilled holes or Non-Functional pads on most/all layer will need to lower tip speeds. Keep the infeed the same as standard.

Stack Height and Hit Count

Stack heights and hit counts will vary according to construction and overall thickness of the boards being drilled. For thicker boards, above 2.5 mm (100 mils) overall, with high layer counts, drill one high. When using WC drill bits, maximum hit count on Tachyon 200JV L3 for drill diameters below 0.010" is 100, drills at or above 0.010" diameter can be permitted up to 200 hits. Drilling of Tachyon 200JV L3 with diamond coated WC bits, studies have shown maximum hit count can be significantly extended. These general guidelines are strongly influenced by board thickness, geometry, stack height, etc. Aluminum entry and lubricated backing help create good quality hole walls but are not essential in all applications. It is suggested that the fabricator's supplier of entry and backup be consulted.

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Table 3: Suggested Drilling Parameters (WC bits) For Initial Tachyon 200JV L and Tachyon 200JV L2 Setup

Drill Size		Spindle Speed	Surface Speed		Infeed		Chipload		Retract	
Inch	mm	RPM	SFPM	SMPM	in/min	m/min	mil/rev.	mm/rev.	in/min	m/min
0.0079	0.20	120,000	248	75	59	1.50	0.49	0.013	600	15
0.0098	0.25	120,000	304	94	65	1.64	0.54	0.014	600	15
0.0118	0.30	105,000	324	99	60	1.52	0.57	0.015	600	15
0.0138	0.35	95,500	345	105	60	1.53	0.63	0.016	600	15
0.0157	0.40	85,500	351	107	59	1.50	0.69	0.018	800	20
0.0197	0.50	85,500	441	134	71	1.80	0.83	0.021	800	20
0.0248	0.63	75,800	492	150	76	1.93	1.00	0.026	800	20
0.0295	0.75	63,700	492	150	71	1.82	1.12	0.029	800	20
0.0354	0.90	53,000	491	150	66	1.67	1.24	0.032	800	20
0.0394	1.00	31,800	328	100	43	1.10	1.36	0.035	800	20

Table 4: Suggested Drilling Parameters (WC bits) For Initial Tachyon® 200JV L3 Setup

Drill Size		Spindle Speed	Surface Speed		Infeed		Chipload		Retract	
Inch	mm	RPM	SFPM	SMPM	in/min	m/min	mil/rev.	mm/rev.	in/min	m/min
0.0079	0.20	120,000	248	75	53	1.34	0.44	0.011	600	15
0.0098	0.25	120,000	308	94	58	1.48	0.48	0.012	600	15
0.0118	0.30	105,000	324	99	54	1.37	0.51	0.013	600	15
0.0138	0.35	95,500	345	105	54	1.38	0.57	0.014	600	15
0.0157	0.40	85,500	351	107	53	1.35	0.62	0.016	800	20
0.0197	0.50	85,500	441	134	64	1.62	0.74	0.019	800	20
0.0248	0.63	75,800	492	150	69	1.74	0.91	0.023	800	20
0.0295	0.75	63,700	492	150	64	1.64	1.01	0.026	800	20
0.0354	0.90	53,000	491	150	59	1.51	1.12	0.028	800	20
0.0394	1.00	31,800	328	100	39	1.00	1.24	0.031	800	20

Part 5: Hole Wall Preparation

General

Good desmear and electroless copper deposition performance are more easily achieved when the drilled hole quality is good. The generation of smooth, debris free hole walls is influenced by the degree of resin cure, drilling conditions and board design considerations. The helps reduce smear and debris generation.

Factors which influence chemical desmear rates, and therefore the suggestions in this document, include:
resin type, chemistry type, bath dwell times, bath temperatures, chemical concentrations in each bath and the amount of solution transfer through the holes.

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Factors which influence the amount of solution transfer through the holes include: hole size, panel thickness, work bar stroke length, panel separation in the rack and the use of solution agitation, rack vibration and rack "bumping" to remove air bubbles from the holes.

Chemical Desmear

Trials show that many high frequency application materials, including Tachyon® 200JV, have sensitivity to alkali processes, so they should generally be avoided and preferentially use a plasma desmearing process. This is primarily due to the use of phosphorus-containing flame retardant materials in the matrix.

Plasma Desmear

Plasma can be used with or without a single permanganate pass (to be determined by each fabricator). Solely plasma processing tends to improve overall hole quality after plasma & additional copper micro etching with control of 1-2um, particularly in thick and/or high aspect ratio boards. Standard plasma gas mixtures and process cycles designed for I-Speed or similar grade materials are suggested for use as initial starting parameters for Tachyon® 200JV.

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 compared to simple desmear, which is designed only to remove resin smear from the vertical surface of the innerlayer interconnect "posts".

Plasma will readily etch back Tachyon® 200JV resin. Standard plasma gas mixtures and process cycles designed for conventional FR- 4 epoxy are satisfactory and are suggested for use as initial starting parameters for etchback of Tachyon® 200JV. The practice of following the plasma process with a chemical process is suggested rather than plasma alone to increase hole wall texture and remove plasma ash residues. Consult the chemical supplier for suggested conditions.

If plasma is not available, chemical etchback for 3-point connections must be done with extreme care on Tachyon® 200JV 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. Additionally, sharper plunge point angle geometries may be necessary to avoid crazing around secondary drilled hole perimeters.

Routing and Scoring

Modifications of the final PWB route fabrication process may be necessary. Table 5 lists initial starting parameters. **Note that parameters listed may require further adjustment.**

Table 5: Suggested Routing Parameters

Stack Height (Max) Inch	Spindle Speed RPM	Table Speed Inch/min.	Router Bit Life Linear Feet
0.200	25,000	25	35

The customer should contact the scoring equipment and/or bit supplier for application specific suggestions for use with Tachyon® 200JV materials. Your Isola Technical Account Manager may also be able to provide some initial suggestions, but these should be validated through testing by the individual PWB fabricator.

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Part 6: Packaging and Storage

Tachyon® 200JV 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.

Tachyon® 200JV boards should be dry prior to packaging to ensure the most robust lead-free performance. Printed boards made from Tachyon® 200JV that will use high temperature assembly and which require a long shelf life, recommended packaging is to use a Moisture Barrier Bag (MBB) with a Humidity Indicator Card (HIC) and adequate drying desiccant inside the MBB to prevent moisture absorption during shipment 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 Tachyon® 200JV 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 polybromide biphenyls or polybromide biphenyl oxides as flame retardants in any product. Safety Data Sheets are available upon request.

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Part 8: Ordering Information

Contact your local sales representative or visit: **www.isola-group.com** for further information.

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