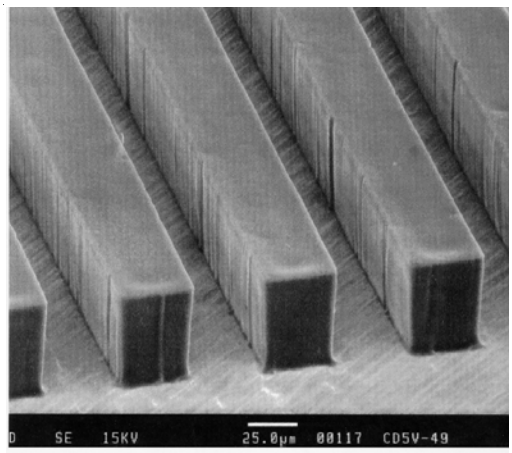
DuPont™ Riston®
Special FX250 Series
DATA SHEET & PROCESSING INFORMATION

Photopolymer Dry Film For Most Demanding PWB Applications

Secondary Image Transfer Resist for Electroless and Electrolytic Ni/Au Plating Applications



Product Features/ Applications

- Negative working, aqueous processable dry film photoresist
- Specially formulated for secondary imaging in electroless nickel/immersion gold plating (ENIG) and electrolytic Ni/Au when applied over UV-cured LPI solder mask.
- Excellent Fine Line capability and low sensitivity to off-contact exposure.
- Wide processing latitude and high yield capable.
- Outstanding flow characteristics and strong adhesion, particularly over epoxy-based materials.
- Fully strippable after post-development UV-curing cycle.
- Replaces labor-intensive hand taping with an accurate photo-imaging.

Product Description (Physical Parameters)

Available Thicknesses:	50 microns
Unexposed Color in Yellow Light:	Green
Exposed Color in Daylight:	Blue
Exposed Color in Yellow light:	Green
Print-Out (Phototropic) Image:	Strong
Contrast to Copper:	Strong
Odor:	Low

Quality Certification

DuPont's Quality System is ISO Approved

All Riston® products are produced under the most stringent manufacturing conditions. They have been thoroughly tested by DuPont during production and are certified as conforming to the relevant production standards applicable at the time of manufacture. As DuPont's photopolymer manufacturing facilities are ISO 9001 approved, additional certification of product quality should not be necessary. However, should you require certification please contact your local DuPont representative.

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The miracles of science™

PART 1: Surface Preparation

Over Solder Mask

FX250 is best suited for SIT (Secondary Image Transfer) processes where a selective metallization is desired. Adhesion characteristics vary with the type of solder mask used. The surface needs to be free of all organic contaminants, use a spray cleaner (acid or alkaline), if necessary.

PART 2: Lamination

Lamination Conditions: HRL Hot Roll Laminators

- Pre-Heat: Optional
- Roll Temperature: 115°C ± 5°C (230 ±9°F)
- Roll Speed: 0.6-1.5 m/min (2-5 ft/min)
- Air Assist Pressure: 0-2.8 bar (0-40 psig)

Note: For air pressures > 1.7 bar (25 psig) heavy-duty hot rolls must be used.

Laminator Conditions: ASL/CSL/DFL Automatic Cut Sheet Laminators

- Seal Bar Temp.: 65 ±15°C (150 ±25°F)
- Lam. Roll Pressure: 3.0-5.0 bar (45-70 psig)
- Lamination Temp.: 115 ±5°C (230 ±10°F)
- Seal Time: 1-3 seconds
- Seal Bar Pressure: 3.5-4.5 bar (50-65 psig)
- Lamination Speed: 1.5-3 m/min (5-10 ft/min)

Vacuum Lamination

Vacuum lamination is used to provide optimum conformation over extreme surface topography.

DuPont SMVL or Drawer-Type Vacuum Laminators:

Platen Temp:	70 - 85°C
Cycle Time:	30 - 60 sec
Slap Down Time:	5 - 10 sec
SMVL Free Space:	1 - 2 mm (40 - 80 mils)
Panel Exit Temp:	50 - 70C

Post-Lamination Hold Time

- Panels should be allowed enough time to cool to room temperature before exposure (about 15 minutes; use accumulator in in-line systems).
- Maximum hold time: Up to 3 days. Hold times should be determined empirically based on the temperature and relative humidity of the storage area.

Panel Handling/Racking/ Stacking:

Preferred:	Vertical racking of rigid panels in slotted racks
Less desirable:	Vertical Stacking after cooling

PART 3: Exposure

Resolution

50 micron features are the finest resolution obtainable in an optimized production environment with acceptable yields attained on full size panels with Riston® FX250 Series photoresist. Optimized conditions include strong exposure vacuum contact high intensity (≥ 10mW/cm2) exposure and well-controlled steady-state development.

Exposure Energy Vs. Steps Held

Riston®	FX250
mJ/cm2	40 - 150
RST	6 -18
SST	6 - 10

- Exposure energy (mJ/cm2) from an International Light Radiometer model IL1400A with a SSD001A Super Slim UV Detector (275-400 nm).
- Steps held can vary by ± 1 RST (14%) depending on the development breakpoint used.
- If panels are exposed when warm, there may be a slight increase in the steps held.
- RST = DuPont Riston® 25-Step Density Tablet.
- SST = Stouffer 21-Step Density Guide.
- "Step Held" = last step covered > 50% with photoresist.

PART 4: Development

Chemistries/Make-up

- **Potassium carbonate (potash; K2CO3)**
  Use either potassium carbonate powder, i.e. anhydrous (potash) K2CO3 or a liquid concentrate such as DuPont D-4000 developer (40% concentrate). Working solution: 0.8 - 1.0 wt%
- **Sodium carbonate, anhydrous, (soda ash), Na2CO3**
  Working solution: 0.7 -1.0 wt%
- **Sodium carbonate, monohydrate, Na2CO3•H2O**
  Working solution: 0.8 -1.0 wt%

Equations to calculate required amounts for desired wt% of working solutions:

- D-4000: liters (or gallons) D-4000 = wt% x sump vol liters (or gallons) x 0.018
- K2CO3: kg K2CO3 = wt% x sump vol liters x 0.01
  lb. K2CO3 = wt % x sump vol gallons x 0.083
- Na2CO3: kg Na2CO3 = wt% x sump vol liters x 0.01 lb. Na2CO3 = wt% x sump vol gallons x 0.083

Developer Analysis

Titrate the working developer solution (e.g. 25 ml) with 0.1N HCl to a Methyl Orange end point**:**

wt% = N x ml HCl x FW / 20 x ml Sample
(N= acid normality; FW = formula weight)
FW of Na_2CO_3=106
FW of $Na_2CO_3 \cdot H_2O$= 124
FW of K_2CO_3 = 138

Defoamers

Riston® FX250 has been successfully used without defoamer, but this is highly equipment dependent. The need for defoamer and the amount required are dependent on water quality, carbonate purity, photoresist loading, and equipment design. If required, add 1.3 ml/liter (5 ml/gallon) of BASF's Pluronic 31R1, or equivalent polyethylene-polypropylene glycol block co-polymer.

- For batch operation: add defoamer mix with water to the initial make up. Add additional **small** amounts of defoamer during continued developing operation as needed.
- Automatic replenishment systems: Add defoamer directly to a high turbulence sump area at a predetermined rate. Do not add defoamer to the supply tank or the pumped replenishment solution.

Development Conditions

- Spray Pressure: 1.5 - 1.8 bar (22-25 psig)
- Spray Nozzles: high impact direct-fan nozzles preferred.
- Chemistry:
  Na_2CO_3: 0.7-1.0 wt%; 0.85 wt% preferred
  $Na_2CO_3 \cdot H_2O$: 0.8-1.0 wt%; 0.9 wt% preferred
  K_2CO_3: 0.8-1.0 wt%; 0.9 wt% preferred
- Temperature: 27-32°C (80-90°F); 30°C (85F) preferred
- Clean Breakpoint: 50-70% (60% preferred).
- Typical time in developer (total dwell time), at 1.5 - 1.8 bar (22-25 psig) spray pressure, 60% breakpoint, 30°C: 45 - 52 secondsRiston® FX250: 45 - 52 seconds.
- Typical time-to-clean (time to reach a 60% breakpoint): 30 seconds.
- Range of pH: 10.5-11.0; Optimum and feed-and-bleed set-point = 10.7-10.8.
- Resist Loading Range: 2-12 mil-ft2/gal (0.05 -0.30 mil-m2/L.)

Rinsing & Drying Recommendations

- Rinse water: Hard water 150-450 ppm $CaCO_3$ equivalent). Softer water can be hardened by the controlled addition of magnesium sulfate (Epsom salts).
- Rinse temperature: 20-27°C (68-80°F)
- Rinse spray pressure: 1.7-2.4 bar (25-35 psig). Use high impact, direct-fan nozzles.
- Effective Rinse Length: 1/3-1/2 of length of developer chamber.
- Drying: Warm air turbine dry thoroughly.

Developer Maintenance

Clean at least once a week to remove resist residue, calcium carbonate (scale), defoamer, and dye from developed resist. Dye build-up can be minimized by the use of anti-foam.

PART 5: Post-Development Cure

A post-development UV-cure is usually necessary to minimize resist sidewall damage in harsh plating cycles and minimize leaching into electroless nickel/gold plating baths.
The full range of UV-curing for FX250 is from 150 to 750 mJ/cm2, depending on the specific plating application. Optimum curing is usually attained between 250 and 500 mJ/cm.

PART 6: Plating

Riston® FX250 is suitable for secondary imaging in a variety of metallization processes, including electroless nickel and gold. It is also compatible electrolytic copper, tin, tin-lead, nickel and gold.

PART 7: Stripping

Aqueous Caustic (NaOH or KOH) Conveyorized Stripping

- Stripper Dwell Times (seconds) at 55°C (130°F), 25psig (1.7 kg/cm2), at recommended exposure range

Stripping Dwell Times	
Riston®	**FX250**
1.5 wt% (15 g/l) NaOH	100
3.0 wt% (30 g/l) NaOH	70
1.5 wt% (15 g/l) KOH	140
3.0 wt% (30 g/l) KOH	70

Note:

- Dwell Time = 2x time to strip resist at 50% breakpoint.
- High caustic concentrations produce larger skin sizes and higher loading capabilities.
- KOH generally produces smaller skin sizes than NaOH.
  Particle Size at 1.5% NaOH: 5-10mm
  Particle Size at 3.0% NaOH: Sheet
  Particle Size at KOH: 2-4mm
- Solubility of Stripped Particles: Nearly Insoluble
- Physical Characteristics of Particles: Non sticky

- Higher stripping temperature increases the stripping rate.
- Stripping rate can be increased with higher impact sprays. Use higher pressures and/or high-impact spray nozzles.
- Time to strip increases with white light exposure. A 20% increase in strip time over 8 days exposure is not unusual.
- Higher levels of exposure may slightly increase Time-to-Strip.

Proprietary Strippers

Commercial proprietary stripping chemistries can be used for higher strip speed and higher resist loading. Contact your DuPont and/or stripping chemistry representatives for specific recommendations.

Defoamers

Additives for foam control may not be required depending on equipment design and operation. However, if defoamer is needed, use DuPont FoamFREE™ 940 at 2ml/gallon (0.5 ml/liter) for resist loadings up to 25 mil-ft2/gal (0.6 mil-m2/liter).

Controls/ Solution Maintenance:

- Preferred: Continuous replenishment (feed & bleed) using panel count.
  Maintain resist loading at 20 mil-square feet/gallon (0.5 mil-m2/liter)
- Batch: up to 25 mil-square feet/ gallon (0.6 mil-m2/liter). Maintain breakpoint at 50% by lowering conveyor speed or by starting batch stripping with a lower breakpoint and changing the solution once breakpoint moves above 50%.

Filtration Systems

FX250 Series film is formulated to produce relatively insoluble stripped skins. Filtration can extend stripping solution life greatly. However, in machines which do not have automatic skin removal, filter baskets must be emptied more frequently to prevent filter “binding”.

For UV-cured FX250, it is a practical necessity that spray stripping equipment contain a filtration system to collect and remove resist skins to avoid nozzle clogging, to extend stripper life, and to keep resist skins out of the rinse chamber. The most effective filter systems collect the stripper skins immediately after they are generated, before entering recirculation pumps, and they feature continuous removal of skins from the stripper solution. Basket or screen filters collect resist skins and leave them in contact with the solution until they are dumped.

Off-line tank stripping can also be use with FX250. There should be two stripper tanks, one that will become heavily loaded before dump and remake, followed by one that remains lightly loaded. Next a spray rinse and panel drying station should be used.

Equipment Cleaning

Drain and flush with water. Fill unit with 5 wt% KOH or NaOH, heat to 55°C (130°F), and circulate (spray) for 30 minutes to dissolve photoresist particles. Then drain and recharge the unit. There are also proprietary cleaners available which may offer better results.

Storage

Temperature:	5 - 21°C (40 - 70°F)
Relative Humidity:	30 - 70%

Product that experiences conditions outside of the above recommendations should not automatically be discarded. We recommend inspecting material for signs of physical damage then running a small production test to confirm full functionality.

Safe Handling

Note safety and industrial hygiene precautions**.** Consult the Material Safety Data Sheet (MSDS) of any chemical used. MSDS’s for Riston® dry film photoresists are available with compositional information on out-gassing at elevated temperatures.

Safe Lighting

- Protect photoresist through lamination and development steps from UV radiation and visible light up to 450 nm by use of yellow, amber or gold fluorescent “safe lights”.
- High intensity (≥ 70 foot-candles) yellow “safe light” can cause a change in steps held and should be avoided.

Waste Disposal

For questions concerning disposal of photoresist waste refer to the latest DuPont literature, and Federal, State, and Local Regulations.

For further information on, please contact your local representative.

DuPont Electronic Technologies
14 T. W. Alexander Drive
Research Triangle Park, NC 27709 USA

www.imaging-materials.dupont.com

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