

## ***PSR-4000 HFX Series***

*(UL Name: PSR-4000DE / CA-40HF)*

### **LIQUID PHOTOIMAGEABLE SOLDER MASK**

- ④ **Application by Screen Printing**
- ④ **Dark Green Satin**
- ④ **Available in DI version**
- ④ **Halogen-Free**
- ④ **RoHS Compliant**
- ④ **Compatible with Lead-Free Processing**
- ④ **Fine Dam Resolution**
- ④ **Excellent Small Hole Clearing**
- ④ **Wide Processing Window**
- ④ **Excellent Resistance to ENIG and Immersion Tin**

## PROCESSING PARAMETERS FOR PSR-4000 HFX SERIES

**PSR-4000 HFX** has a dark green satin finish. It is a two-component, alkaline developable LPI solder mask products for screen printing application. This product is designed to be user friendly with a wide processing latitude. A version is available for latest in DI exposure equipment. It has a very fast photospeed and good resistance to alternate metal finishes such as ENIG and immersion Tin while maintaining solder dams of 2 mils or less. It also has very good small hole clearing capabilities. **PSR-4000 HFX Series** meet or exceed the requirements of IPC SM-840E Class H and Class T, Bellcore GR-78-CORE Issue 1, and have a UL flammability rating of 94V-0. All Taiyo America products comply with the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment.

### PSR-4000 HFX SATIN COMPONENTS

	<b>PSR-4000 HFX</b>	<b>/ CA-40 HF</b>
	<b>PSR-4000 HFX DI</b>	<b>CA-40 HF DI</b>
Mixing Ratio	70 parts	30 parts
Colors	Green	White
<b>Mixed Properties</b>		
Solids	75%	
Specific Gravity	1.39	

### MIXING

**PSR-4000 HFX Series** is supplied in pre-measured containers with a mix ratio by weight of 70 parts **PSR-4000 HFX** and 30 parts **CA-40 HF**. **PSR-4000 HFX Series** can be mixed by hand with a mixing spatula for 10 – 15 minutes. Mixing can be done with a mechanical mixer at low speeds to minimize shear thinning for 10 – 15 minutes. Also, mixing can be done with a paint shaker for 10 – 15 minutes. Pot life after mixing is 72 hours when stored in a dark place at  $\leq 25^{\circ}\text{C}$  (77°F).

### PRE-CLEANING

Prior to solder mask application, the printed circuit board surface needs to be cleaned. Various cleaning methods include Pumice, Aluminum Oxide, Mechanical Brush, and Chemical Clean. All of these methods will provide a clean surface for the application of **PSR-4000 HFX Series**. Hold time after cleaning the printed circuit board should be held to a minimum to reduce the oxidation of the copper surfaces.

## ***PROCESSING PARAMETERS FOR PSR-4000 HFX Series***

---

### **SCREEN PRINTING** Method: Single Sided and Double Sided Screening

- Screen Mesh: 74 – 110
  - Screen Mesh Angle: 22.5° Bias
  - Screen Tension: 20 - 28 Newtons
  - Squeegee: 60 – 80 durometer
  - Squeegee Angle: 27 – 35°
  - Printing Mode: Flood / Print / Print
  - Flood Pressure: 20 – 30 psi
  - Printing Speed: 2.0 – 9.9 inches/sec
  - Printing Pressure: 60 – 100 psi
- 

**TACK DRY CYCLE** The Tack Dry step is required to remove solvent from the solder mask film and produce a firm dry surface. The optimum dwell time and oven temperature will depend on oven type, oven loading, air circulation, exhaust rate, and ramp times. Excessive tack dry times and temperature will result in difficulty developing solder mask from through holes and a reduction in photospeed. Insufficient tack dry will result in artwork marking and/or sticking. The typical tack dry conditions for **PSR-4000 HFX Series** are as follows:

- Oven Temperature: 150 - 185°F (65 - 85°C)
  - For Single-Sided (Batch Oven)
    - 1<sup>st</sup> Side: Dwell Time: 10 - 20 minutes
    - 2<sup>nd</sup> Side: Dwell Time: 25 - 50 minutes
  - For Double-Sided (Conveyorized or Batch Oven)
  - Dwell Time: 25 - 50 minutes
- 

**EXPOSURE** **PSR-4000 HFX Series** requires UV exposure to define solder mask dams and features. The spectral sensitivity of **PSR-4000 HFX Series** is in the area of 365 nm. Exposure times will vary by bulb type and age of the bulb. Below are guidelines for exposing **PSR-4000 HFX**:

- Exposure Unit: 7 kW or higher
- Stouffer Step 21: Clear 10 minimum (on metal / under phototool)
- Energy: 150 mJ/cm<sup>2</sup> minimum (under phototool)

Below are guidelines for exposing **PSR-4000 HFX DI**:

- Exposure Unit: DI exposing unit
- Stouffer Step 21: Clear 8 minimum (on metal / under phototool)
- Energy: 350 mJ/cm<sup>2</sup> minimum (under phototool)

## ***PROCESSING PARAMETERS FOR PSR-4000 HFX Series***

---

### **DEVELOPMENT**

**PSR-4000 HFX Series** is developed in an aqueous sodium or potassium carbonate solution. Developing can be done in either a horizontal or vertical machine.

- Solution: 1% by wt. Sodium Carbonate or 1.2% Potassium Carbonate
  - pH: 10.6 or greater
  - Temperature: 85 - 95°F (29 - 35°C)
  - Spray Pressure: 25 - 45 psi
  - Dwell Time in developing chamber: 45 - 90 seconds
  - Water rinse is needed to remove developer solution followed by a drying step
- 

### **FINAL CURE**

**PSR-4000 HFX Series** needs to be thermally cured to insure optimal final property performance. Thermal curing can be done in a batch oven or conveyorized oven.

- Temperature: 275 – 300°F (135 – 149°C)
  - Time at Temperature: 45 – 60 minutes
- 

***For Process Optimization please contact your local Taiyo America Representative***

---

## FINAL PROPERTIES FOR PSR-4000 HFX Series

### IPC-SM-840E, Class H & T, Solder Mask Vendor Testing Requirements

TEST	SM-840 PARAGRAPH	REQUIREMENT	RESULT
Visual	3.4.8	Uniform in Appearance	Pass
Curing	3.4.5	Ref: 3.6.1.1, 3.7.1 and 3.7.2	Pass
Non-Nutrient	3.4.6	Does not contribute to biological growth	Pass
Dimensional	3.4.10	No Solder Pickup and Withstand 500 VDC	Pass
Pencil Hardness	3.5.1	Minimum "F"	Pass – 7H
Adhesion	3.5.2	Rigid – Cu, Ni, FR-4	Pass
Machinability	3.5.3	No Cracking or Tearing	Pass
Resistance to Solvents and Cleaning Agents	3.6.1.1	Table 3 Solvents	Pass
Hydrolytic Stability and Aging	3.6.2	No Change after 28 days of 95-99°C and 90-98% RH	Pass
Solderability	3.7.1	No Adverse Effect J-STD-003	Pass
Resistance to Solder	3.7.2	No Solder Sticking	Pass
Resistance to Solder	3.7.3	No Solder Sticking	Pass
Simulation of Lead Free Reflow	3.7.3.1	No Solder Sticking	Pass
Dielectric Strength	3.8.1	500 VDC / mil Minimum	3200 VDC/mil
Thermal Shock	3.9.3	No Blistering, Cracking or De-lamination	Pass

### Specific Class "H" Requirements

TEST	SM-840 PARAGRAPH	REQUIREMENT	RESULT
Flammability	3.6.3	UL 94V-0	Pass – File #E166421 UL Name: PSR-4000 DE / CA-40 HF
Insulation Resistance Before Soldering After Soldering	3.8.2	5 x 10 <sup>8</sup> ohms minimum 5 x 10 <sup>8</sup> ohms minimum	Pass (8.60 x 10 <sup>11</sup> ohms) Pass (1.98 x 10 <sup>12</sup> ohms)
Moisture & Insulation Resistance Before Soldering–In Chamber Before Soldering–Out of Chamber After Soldering–In Chamber After Soldering–Out of Chamber	3.9.1	5 x 10 <sup>8</sup> ohms minimum 5 x 10 <sup>8</sup> ohms minimum 5 x 10 <sup>8</sup> ohms minimum 5 x 10 <sup>8</sup> ohms minimum	Pass (7.6 x 10 <sup>10</sup> ohms) Pass (3.0 x 10 <sup>12</sup> ohms) Pass (4.4 x 10 <sup>10</sup> ohms) Pass (2.4 x 10 <sup>13</sup> ohms)
Electrochemical Migration	3.9.2	>2.0 x 10 <sup>9</sup> ohms, no dendritic growth	Pass (1.6 x 10 <sup>12</sup> ohms)

## FINAL PROPERTIES FOR PSR-4000 HFX Series

### Specific Class "T" Requirements

TEST	SM-840 PARAGRAPH	REQUIREMENT	RESULT
Flammability	3.6.3	Bellcore 02 Index – 28 minimum	Pass
Insulation Resistance			
Before Soldering	3.8.2	$5 \times 10^8$ ohms minimum	Pass ( $3.3 \times 10^{13}$ ohms)
After Soldering		$5 \times 10^8$ ohms minimum	Pass ( $3.9 \times 10^{12}$ ohms)
Moisture & Insulation Resistance			
Before Soldering–In Chamber	3.9.1	$5 \times 10^8$ ohms minimum	Pass ( $3.1 \times 10^9$ ohms)
Before Soldering–Out of Chamber		$5 \times 10^8$ ohms minimum	Pass ( $1.5 \times 10^{13}$ ohms)
After Soldering–In Chamber		$5 \times 10^8$ ohms minimum	Pass ( $8.4 \times 10^9$ ohms)
After Soldering–Out of Chamber		$5 \times 10^8$ ohms minimum	Pass ( $1.5 \times 10^{12}$ ohms)
Electrochemical Migration	3.9.2	< 1 decade drop, no dendritic growth	Pass

### Additional Tests / Results

TEST	REQUIREMENT	RESULT
CTI (Comparative Tracking Index)	ASTM-D-3638-07	600 Volts
Halogen Content	Halogen-Free if < 900 ppm	Pass-400 ppm
Dielectric Constant	Internal Test at: 1 MHz 10 MHz 100 MHz 1 GHz	3.6 3.4 3.3 3.5
Dissipation Factor	Internal Test at: 1 GHz	0.019
Electroless Nickel / Immersion Gold Resistance	Tape Test Adhesion	Pass

Taiyo America, Inc. (TAIYO) warrants its products to be free from defects in materials and workmanship for the specified warranty period (**PSR-4000 HFX Series / CA-40 HF Warranty period is 9 Months**) provided the customer has, at all times, stored the ink at a temperature of 68°F or less. TAIYO accepts no responsibility or liability for damages, whether direct, indirect, or consequential, resulting from failure in the performance of its products. If a TAIYO product is found to be defective in material or workmanship, its liability is limited to the purchase price of the product found to be defective. TAIYO MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AND MAKES NO WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR ANY PARTICULAR PURPOSE. TAIYO'S obligation under this warranty shall not include any transportation charges or costs of installation or any liability for direct, indirect, or consequential damages or delay. If requested by TAIYO, products for which a warranty claim is made are to be returned transportation prepaid to TAIYO'S factory. Any improper use or any alteration of TAIYO'S product by the customer, as in TAIYO'S judgment affects the product materially and adversely, shall void this limited warranty.