

# TECHNICAL DATA SHEET

## ***TAIYO PSR-4000 AUS5***

*(UL Name: PSR-4000BV / CA-40BB)*

### **LIQUID PHOTOIMAGEABLE SOLDER MASK**

- ③ **Designed for Packaging Applications**
- ③ **Screen or Spray Application**
- ③ **Excellent thermal and Crack Resistance**
- ③ **Hard Surface Finish**
- ③ **Fine Dam Resolution**
- ③ **RoHS Compliant**
- ③ **Excellent Resistance to ENIG and Immersion Tin Plating**
- ③ **Compatible with Lead-Free Processing**
- ③ **Low Water Absorption**



*Always on your side.*

Revised October 2013

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## PROCESSING PARAMETERS FOR PSR-4000 AUS5

**PSR-4000 AUS5** is a two-component, gloss Green, liquid photoimageable solder mask for flood screen and spray application methods. **PSR-4000 AUS5** has been specifically designed for BGA, Flip-Chip and other Chip Scale Packaging (CSP) applications. **PSR-4000 AUS5** has excellent moisture resistance properties, very good resistance to ENIG and can withstand pressure cooker type testing (PCT). **PSR-4000 AUS5** meets or exceeds the requirements of IPC SM-840E Class H and Class T, Bellcore GR-78-CORE Issue 1, and has 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 AUS5 COMPONENTS

	<b>PSR-4000 AUS5/ CA-40 AUS2</b>	
Mixing Ratio	100 parts	43 parts
Color	Green	White
<b><u>Mixed Properties</u></b>		
Solids	76%	
Viscosity	200-240ps	
Specific Gravity	1.36	

### MIXING

**PSR-4000 AUS5** is supplied in pre-measured containers with a mix ratio by weight of 100 parts **PSR-4000 AUS5** and 43 parts **CA-40 AUS2**. **PSR-4000 AUS5** 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.

### 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 AUS5**. Hold time after cleaning the printed circuit board should be held to a minimum to reduce the oxidation of the copper surfaces.



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### 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

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### 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 photo speed. Insufficient tack dry will result in artwork marking and/or sticking. Typical tack dry conditions for **PSR-4000 AUS5** are as followed:

- Oven Temperature: 160 - 180°F (71 - 82°C)
- For Single-Sided (Batch Oven)
  - 1<sup>st</sup> Side: Dwell Time: 15 - 20 minutes
  - 2<sup>nd</sup> Side: Dwell Time: 35 - 45 minutes
- For Double-Sided (Conveyorized or Batch Oven)
- Dwell Time: 35 - 60 minutes

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### EXPOSURE

**PSR-4000 AUS5** requires UV exposure to define solder mask dams and features. The spectral sensitivity of **PSR-4000 AUS5** 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 AUS5**.

- Exposure Unit: 5 kW or higher
- Stouffer Step 21: Clear 10 minimum (on metal / under phototool)
- Energy: 300 mJ / cm<sup>2</sup> minimum (under phototool)



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### DEVELOPMENT

**PSR-4000 AUS5** 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 - 105°F (29 - 41°C)
  - Spray Pressure: 25 - 45 psi
  - Dwell Time in developing chamber: 45 - 75 seconds
  - Water rinse is needed to remove developer solution followed by a drying step
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### FINAL CURE

**PSR-4000 AUS5** requires a thermal cure 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
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### UV CURE

**PSR-4000 AUS5** also requires a UV cure to insure optimal final property performance. The recommended process for UV curing is as follows:

- UV Energy: 3000 mJ / cm<sup>2</sup>
  - Lamps: High Pressure Mercury Lamps
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*For Process Optimization please contact your local Taiyo America Representative*

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## FINAL PROPERTIES FOR PSR-4000 AUS5

### 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 – 6H
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
Dielectric Strength	3.8.1	500 VDC / mil Minimum	3600 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 and UL Name	3.6.3	UL 94V-0	Pass – File #E166421 PSR-4000BV/CA-40BB
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 (4.18 x 10 <sup>12</sup> ohms) Pass (1.51 x 10 <sup>13</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 (1.53 x 10 <sup>10</sup> ohms) Pass (1.07 x 10 <sup>12</sup> ohms) Pass (1.42 x 10 <sup>10</sup> ohms) Pass (1.16 x 10 <sup>12</sup> ohms)
Electrochemical Migration	3.9.2	>2.0 x 10 <sup>6</sup> ohms, no dendritic growth	Pass (4.69 x 10 <sup>12</sup> ohms)

### Specific Class "T" Requirements

TEST	SM-840 PARAGRAPH	REQUIREMENT	RESULT
Flammability	3.6.3	Bellcore O <sub>2</sub> Index – 28 minimum	Pass – 74
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 (2.55 x 10 <sup>12</sup> ohms) Pass (8.86 x 10 <sup>10</sup> ohms)



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# TECHNICAL DATA SHEET

## FINAL PROPERTIES FOR PSR-4000 AUS5

### Specific Class "T" Requirements

TEST	SM-840 PARAGRAPH	REQUIREMENT	RESULT
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 (9.22 x 10 <sup>9</sup> ohms) Pass (2.60 x 10 <sup>13</sup> ohms) Pass (4.08 x 10 <sup>9</sup> ohms) Pass (6.40 x 10 <sup>12</sup> ohms)
Electrochemical Migration	3.9.2	< 1 decade drop, no dendritic growth	Pass

### Additional Tests / Results

TEST	REQUIREMENT	RESULT
Volume Resistivity	Internal Test: 25 - 65°C / 90% RH / 7 Days	Initial: 4.5 x 10 <sup>14</sup> ohm-cm Final: 2.9 x 10 <sup>13</sup> ohm-cm
Dielectric Constant	Internal Test: 1 MHz 25 - 65°C / 90% RH / 7 Days	Initial: 4.71 Final: 5.22
Dissipation Factor	Internal Test: 1 MHz 25 - 65°C / 90% RH / 7 Days	Initial: 0.0332 Final: 0.0466
Electroless Gold Plating Resistance	3 - 5 microns Nickel / 0.03 microns Gold	No Peeling
Electroless Gold Plating Resistance	5 - 10 microns Nickel / 0.03 microns Gold	No Peeling
Water Absorption	85°C / 85% RH (% Weight Gain)	1 hour: 0.65% 2 Hours: 0.73% 168 Hours: 0.84%
Pressure Cooker	After ENIG plating (121°C / 100%RH / 100hrs)	No Peeling
Wettability (Surface Tension)	Internal Test: After Curing: After Gold Plating: After (170°C / 7 Hours):	< 31 Dynes / cm 42 Dynes / cm 34 Dynes / cm
Tg	TMA Method	104.8°C
Poisson Ratio	Internal Test	0.467
Thermal Conductivity (W/mk)	Laser Flash (t <sup>1/2</sup> )	0.26
Young's Modulus	Internal Test Tensilon TM-H-20	3500 MPa
Ericson Test	Internal Test - Pushing distance (3mm)	3.0
Tensile Modulus	Specific Gravity: Tensile Force: Tensile Force Ratio:	1.5 2.19 kg/mm <sup>2</sup> 2.2
Fracture Toughness	Initial Elasticity: Internal Test	3.46 x 10 <sup>9</sup> kg / mm <sup>2</sup> R/2 = 12.7 mm Weight = 300 g
Coefficient of Linear Expansion	TMA Method Below Tg: Above Tg:	Height = 500 mm 6 x 10 <sup>-5</sup> 1.6 x 10 <sup>-4</sup>



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## FINAL PROPERTIES FOR PSR-4000 AUS5

### Additional Tests / Results (continued)

TEST	REQUIREMENT	RESULT
Dielectric Constant	Internal Test at:	
	1 MHz	4.3
	1 GHz	4.0
	5 GHz	3.8
Dissipation Factor	Internal Test at:	
	1 MHz	0.0330
	1 GHz	0.0280
	5 GHz	0.0290
Outgassing Test ASTM E-595-90 A 2 J/cm <sup>2</sup> UV Cure was done after thermal cure.	TML ≤ 1% CVCM ≤ 1%	TML – 0.40% CVCM-0.01%
Electroless Nickel / Immersion Gold Resistance	Nickel (85°C / 30 min) 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 AUS5 / CA-40 AUS2 Warranty period is 7 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.

