

## ***PSR-4000 CC01SE*** (UL Name: PSR-4000JV / CA-40JV)

### **LIQUID PHOTOIMAGEABLE SOLDER MASK**

- ④ **Spray and Curtain Coat Application**
- ④ **Designed to work on the latest DI equipment**
- ④ **Aqueous Developing Solder Mask**
- ④ **RoHS Compliant**
- ④ **Halogen-Free**
- ④ **Compatible with Lead-Free Processing**
- ④ **Wide Processing Window**
- ④ **Excellent Resistance to ENIG & Immersion Tin**
- ④ **Resistant to Hot Storage**
- ④ **Conforms to IPC SM-840E Requirements**
- ④ **Compatible to LASER Marking**
- ④ **Available in Matte or Semi-Matte finish**

# TECHNICAL DATA SHEET



## PROCESSING PARAMETERS FOR PSR-4000 CC01SE

### PSR-4000 CC01SE COMPONENTS:

#### PSR-4000 CC01SE Matte or Semi-Matte / CA-40 CC01SE TR60817

|              |          |          |
|--------------|----------|----------|
| Mixing Ratio | 80 parts | 20 parts |
| Color        | Green    | White    |

#### Mixed Properties

|                  |              |
|------------------|--------------|
| Solids           | 81%          |
| Viscosity        | 185 – 225 ps |
| Specific Gravity | 1.99         |

### MIXING

**PSR-4000 CC01SE** is supplied in pre-measured containers with a mix ratio by weight of 80 parts, **PSR-4000 CC01SE** and 20 parts, **CA-40 CC01SE TR60817**.

For Curtain Coat and Spray, PMA solvent is added at 20-25%, of the mixed ink and hardener. **PSR-4000 CC01SE** can be mixed a mechanical mixer at low speeds to minimize shear thinning for 10 – 15 minutes. The resulting viscosity with the PMA addition should be between 60 – 100 seconds in a Ford #4 or Erichsen #4 cup at 24°C.

### 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. For full body gold an alkaline cleaner is recommended. All of these methods will provide a clean surface for the application of **PSR-4000 CC01SE**. Hold time after cleaning the PCB should be held to a minimum to reduce the oxidation of the copper surfaces.

### SPRAY APPLICATION

Start by setting the atomization pressure at 30 psi and spray a panel. Increase the spray atomization pressure until you have a smooth non-mottled surface. If you exceed 35 psi add additional solvent and reset the atomization pressure back to 30 psi and repeat process until you get a smooth sprayed surface. Adjust the Pot Pressure to get the desired solder mask thickness that meets your coverage requirements.

Method: HVLP sprayer

- Needle Set: 5 – 6 turns out
- Gun temperature: 90 - 100°C
- Atomization air temperature: 90 - 100°C
- Pot Pressure: 10-15 psi, adjust to get desired solder mask coverage
- Atomization Pressure: 30-35 psi, start at the low setting and increase until there is no mottling

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- Conveyor speed: 2.5 – 3.0 ft./min; as slow as production allows

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- CURTAIN COATING**      Method: Single Sided Coating
- Temperature: 24°C
  - Slot Width: 0.4 – 0.5 mm
  - Belt Speed: 70 – 100 m/min
  - Wet Weight: 85 – 140 grams/m<sup>2</sup>
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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 CC01SE** are as follows:

- Oven Type: Conventional Batch or Conveyor
  - Oven Temperature: 66 - 80°C (150 - 176°F)
  - For Single-Sided (Batch Oven)
    - 1<sup>st</sup> Side:              Dwell Time: 15 - 20 minutes
    - 2<sup>nd</sup> Side:             Dwell Time: 15 - 40 minutes
  - For Double-Sided (Batch or Conveyor)
  - Dwell Time: 30 - 60 minutes
  
  - Oven Type: IR or IR assisted
    - Conveyor Speed: 2.7 – 3.2 ft./min
    - Time above 80°C: 2 – 2.1 minutes
    - Maximum Peak Temperature: 115°C
    - Total Dwell Time: 3 – 6 minutes
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**EXPOSURE**              **PSR-4000 CC01SE** was designed to work on the latest DI equipment. It requires UV exposure to define solder mask dams and features. The spectral sensitivity of **PSR-4000 CC01SE** is in the area of 365 nm. Exposure times will vary by bulb type, age of the bulb and light source type. Below are guidelines for exposing **PSR-4000 CC01SE** using the latest DI equipment.

- Exposure Unit: 8 kW or higher
- Stouffer Step 21: **Clear 8 minimum** (on metal / under phototool)
- Energy: 90 – 150 mJ / cm<sup>2</sup> minimum (under phototool)

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**DEVELOPMENT**      **PSR-4000 CC01SE** 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 (1.7 – 3.1 bars)
  - Dwell Time in developing chamber: 45 - 120 seconds
  - Water rinse is needed to remove developer solution followed by a drying step
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**FINAL CURE**      **PSR-4000 CC01SE** 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**      To improve moisture and chemical resistance a UV cure of 2 – 3 J/cm<sup>2</sup> is recommended.

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

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## FINAL PROPERTIES FOR PSR-4000 CC01SE

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

| TEST                                       | SM-840 PARAGRAPH | REQUIREMENT                                      | RESULT                                     |
|--|------------------|--|--|
| Visual                                     | 3.3.1            | Uniform in Appearance                            | Pass                                       |
| Curing                                     | 3.2.5.1          | Ref: 3.6.1.1, 3.7.1 and 3.7.2                    | Pass                                       |
| Non-Nutrient                               | 3.2.6            | Does not contribute to biological growth         | Pass                                       |
| Pencil Hardness                            | 3.5.1            | Minimum "F"                                      | Pass – 6H                                  |
| Adhesion                                   | 3.5.2.1          | Rigid – Cu, Ni, FR-4                             | Pass                                       |
| Adhesion                                   | 3.5.2.6          | Doubled Layered Solder Mask                      | 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                            | 3123 VDC/mil<br>(123 VDC / $\mu\text{m}$ ) |
| 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               |
| Insulation Resistance<br>Before Soldering                       | 3.8.2            | $5 \times 10^8$ ohms minimum       | Pass ( $2.0 \times 10^{13}$ ohms) |
| After Soldering   |                  | $5 \times 10^8$ ohms minimum       | Pass ( $3.2 \times 10^{13}$ ohms) |
| Moisture & Insulation Resistance<br>Before Soldering–In Chamber | 3.9.1            | $5 \times 10^8$ ohms minimum       | Pass ( $3.2 \times 10^{11}$ ohms) |
| Before Soldering–Out of Chamber                                 |                  | $5 \times 10^8$ ohms minimum       | Pass ( $2.8 \times 10^{12}$ ohms) |
| After Soldering–In Chamber                                      |                  | $5 \times 10^8$ ohms minimum       | Pass ( $7.7 \times 10^{10}$ ohms) |
| After Soldering–Out of Chamber                                  |                  | $5 \times 10^8$ ohms minimum       | Pass ( $7.6 \times 10^{12}$ ohms) |
| Electrochemical Migration                                       | 3.9.2            | $>2.0 \times 10^6$ ohms, no growth | Pass ( $1.3 \times 10^{12}$ ohms) |

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## FINAL PROPERTIES FOR PSR-4000 CC01SE

### Specific Class “T” Requirements

| TEST                                      | SM-840 PARAGRAPH | REQUIREMENT                                | RESULT                             |
|---|------------------|--|------------------------------------|
| Flammability                              | 3.6.3            | Bellcore O <sub>2</sub> Index – 28 minimum | Pass – 89                          |
| Insulation Resistance<br>Before Soldering | 3.8.2            | 5 x 10 <sup>8</sup> ohms minimum           | Pass (1.5 x 10 <sup>11</sup> ohms) |
| After Soldering                           |                  | 5 x 10 <sup>8</sup> ohms minimum           | Pass (6.5 x 10 <sup>10</sup> ohms) |

### Specific Class “T” Requirements

| TEST  | SM-840 PARAGRAPH | REQUIREMENT                          | RESULT                             |
|---|------------------|--------------------------------------|------------------------------------|
| Moisture & Insulation Resistance<br>Before Soldering–In Chamber | 3.9.1            | 5 x 10 <sup>8</sup> ohms minimum     | Pass (1.6 x 10 <sup>9</sup> ohms)  |
| Before Soldering–Out of Chamber                                 |                  | 5 x 10 <sup>8</sup> ohms minimum     | Pass (1.8 x 10 <sup>13</sup> ohms) |
| After Soldering–In Chamber                                      |                  | 5 x 10 <sup>8</sup> ohms minimum     | Pass (2.5 x 10 <sup>9</sup> ohms)  |
| After Soldering–Out of Chamber                                  |                  | 5 x 10 <sup>8</sup> ohms minimum     | Pass (9.2 x 10 <sup>12</sup> ohms) |
| Electrochemical Migration                                       | 3.9.2            | < 1 decade drop, no dendritic growth | Pass                               |

### Additional Tests / Results

| TEST                             | REQUIREMENT  | RESULT  |
|----------------------------------|--|---------|
| Surface Tension after Cure       | Internal test; greater than 40 dynes/cm  | 42      |
| CTI (Comparative Tracking Index) | ASTM-D-3638-07   | ≥600    |
| Adhesion                         | GIP-008AA (TAIYO Internal Test Method)<br>Cross-cut tape stripping test            | 100/100 |
| Solder Heat Resistance           | Solder float test:<br>Rosin Flux 300°C/30sec., 1 cycle                             | Pass    |
| Solvent Resistance               | PGM-AC dipping, temp 20°C. / 20 min,<br>Tape peeling test                          | Pass    |
| Acid Resistance                  | 10 vol% H <sub>2</sub> SO <sub>4</sub> , temp 20°C. / 20 min, Tape<br>peeling test | Pass    |
| Alkaline Resistance              | 10 wt% NaOH, temp 20°C. / 20 min, Tape<br>peeling test                             | Pass    |
| Electroless Ni/Au                | TAIYO Internal Test Method<br>Ni: 3 microns, Au: 0.03 microns                      | Pass    |
| Immersion Tin Plating resistance | TAIYO internal test method<br>Tin thickness: about 1 um                            | Pass    |
| Hot Storage Resistance           | 160°C for 1000 hours – cross hatch<br>adhesion (Mec Etch pretreatment)             | Pass    |
| Hot Storage Resistance           | 150°C for 2000 hours – cross hatch<br>adhesion (Mechanical Brush pretreatment)     | Pass    |

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## FINAL PROPERTIES FOR PSR-4000 CC01SE

### Additional Tests / Results

|   |   |   |
|---|---|---|
| Legend Ink Adhesion   | Tape test: <ul style="list-style-type: none"> <li>LPI Legend – PSR-4100 WL(HD)</li> <li>Thermal Legend – S-200W</li> <li>UV Legend – UVR-110W</li> <li>Inkjet – IJR-4000 MW300</li> </ul>   | Pass<br>Pass<br>Pass<br>Pass  |
| Gloss after Final Cure  | Internal test; recorded at 60° angle <ul style="list-style-type: none"> <li>PSR-4000 CC01SE Matte</li> <li>PSR-4000 CC01SE Semi-Matte</li> </ul>  | <19<br>20 - 30  |
| Conformal Coat Adhesion   | Crosshatch adhesion/tape test: <ul style="list-style-type: none"> <li>Dow Corning 1-2577 (Silicone)</li> <li>Humiseal 1B51 (Synthetic Rubber)</li> <li>Humiseal 1B73 (Acrylic)</li> <li>Humiseal 2A64 (Urethane)</li> <li>Cytec CE 1155 (Urethane)</li> </ul> | Pass<br>Pass<br>Pass<br>Pass<br>Pass                                |
| Halogen Level   | Halogen Free if < 900 ppm   | 285 ppm   |
| Outgassing Test ASTM E595<br>A 2 J/cm <sup>2</sup> UV Cure was done<br>after thermal cure | TML ≤ 1%<br>CVCM ≤ 0.10%  | TML-0.87%<br>CVCM-<0.01%  |
| Dk / Df   | Internal Test at:<br>1.1 GHz<br>5.1 GHz<br>10.0 GHz<br>19.8 GHz   | Dk / Df<br>3.6 / 0.022<br>3.6 / 0.021<br>3.5 / 0.021<br>3.5 / 0.020 |
| Tg  | Internal Test   | 140°C   |
| CTE   | Internal Test   | α 1 = 39 ppm<br>α 2 = 99 ppm  |
| Resistance to IPC   | Internal Test   | Pass  |
| Resistance to Rosin Flux  | Internal Test   | Pass  |

Taiyo America, Inc. (TAIYO) warrants its products to be free from defects in materials and workmanship for the specified warranty period **PSR-4000 CC01SE Warranty period is 12 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.

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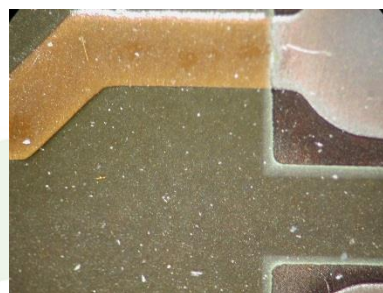
## FINAL PROPERTIES FOR PSR-4000 CC01SE

**Hot Storage Photographs:** 180°C for 250, 500, 1000 and 2000 hours – cross hatch adhesion (Mechanical Brush pretreatment). No cracking at the corners.

**Photo 1: after 250 hours over copper**



**Photo 2: after 250 hours over FR4 laminate**



**Photo 3: after 500 hours over copper**



**Photo 4: after 500 hours over FR4 laminate**



**Photo 5: after 1000 hours over copper**



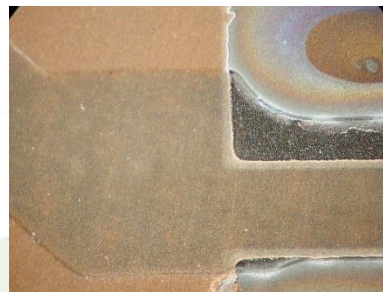
**Photo 6: after 1000 hours over FR4 laminate**



**Photo 7: after 2000 hours over copper**



**Photo 8: after 2000 hours over FR4 laminate**





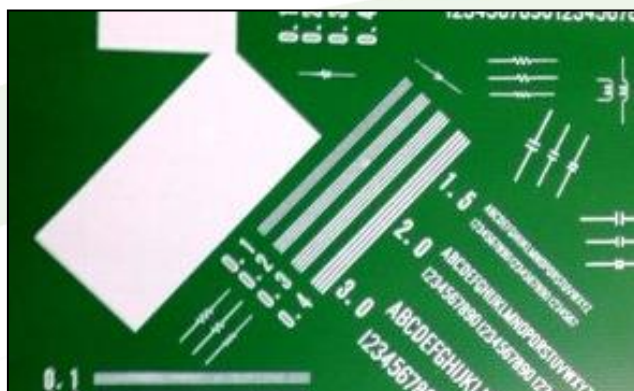
## FINAL PROPERTIES FOR PSR-4000 CC01SE

**Legend Ink Adhesion:** PSR-4000 CC01SE was coated with various types of Taiyo legend ink. Below are photos after tape testing of LPI, Thermal Cure, UV Cure and Inkjet.

**Photo 9: LPI Legend, PSR-4100WL (HD)**



**Photo 10: Thermal Cure Legend, S-200W**



**Photo 11: UV Cure Legend, UVR-110W**



**Photo 12: Inkjet Legend, IJR-4000 MW300**

