

# XV501T Screen

From the Imagecure™ family of Photoimageable Solder masks

## 1. Description

Imagecure® AQ XV501T screen is a two component thermal hardening liquid photoimageable solder resist that dries by solvent evaporation to give a film that can be processed in either aqueous potassium carbonate, sodium carbonate or Butyl diglycol ( BDG ).

This Technical Information Leaflet (TIL) and the relevant Material Safety Data Sheet (MSDS) should be read carefully prior to using this product.

## 2. Product features

- RoHS & WEEE Directive Compliant
- Excellent adhesion to all clean copper surfaces
- Suitable for use with reflow tin/lead and electrolytic gold plated conductors
- The required colour and finish may be obtained by mixing the appropriate coloured resist with the clear hardener



**U.L. FILE NUMBER E83564**

® is a registered trade mark



## 3. Product Range

SAP No.

|          |            |        |                              |          |          |
|----------|------------|--------|------------------------------|----------|----------|
| 91171923 | Imagecure® | XV501T | Matt Black Screen Resist     | 2.00 kg. | CAWN2734 |
| 90173572 | Imagecure® | XV501T | Clear Screen Hardener        | 1.00 kg. | CAWN1347 |
| 90173589 | Imagecure® | XV501T | Semi Matt Red Screen Resist  | 0.67 kg. | CAWN2004 |
| 90173585 | Imagecure® | XV501T | Semi Matt Blue Screen Resist | 0.67 kg. | CAWN1375 |
| 90173604 | Imagecure® | XV501T | Matt Black Screen Resist     | 0.67 kg. | CAWN2117 |
| 90173544 | Imagecure® | XV501T | Clear Screen Hardener        | 0.33 kg. | CAWN1274 |
| 90160166 | Imagecure® | XZ107  | Slow Thinner                 | 5.00 L.  | CDSN4059 |
| 90160157 | Imagecure® | XZ46   | Screen Cleaner               | 5.00 L.  | CDSN4008 |



## 4. General Handling

### 4.1 Storage and Shipping

When stored in sealed containers, in a cool place (20°C / 68°F), away from sources of direct heat and sunlight, Imagecure® XV501T resist and hardener components have a shelf life of 18 months.

Imagecure® XV501T can withstand higher temperatures (40 - 60°C / 104 - 140°F), whilst in transit for up to periods of 1 month without any detrimental effect on its performance.

### 4.2 Waste disposal

Care should be exercised in the disposal of printing ink waste. This should be carried out in accordance with good industrial practice, observing all the appropriate regulations and guidelines.

For more specific handling advice refer to the detailed Safety Data Sheet (SDS), supplied by your local Sun Chemical Circuits representative.

## 5. Application / Processing Conditions

### 5.1 Mixing

The resist and hardener components must be thoroughly mixed together in the correct mixing ratio of 2:1 w/w before use. The hardener component must be added to the resist component.

For users of large pack sizes mechanical mixing is recommended to ensure thorough mixing of the resist and hardener components. Recommended mixers include those with variable speed motors and paddle type mixing blades as well as the shaker or rotating type mixers.

Mixing times will depend on the type of mixer or stirrer used but typical mix times of 10 - 15 minutes with stirrer speeds between 40 - 100 rpm can be expected. Avoid excessively fast speeds as this will entrap large volumes of air into the mixed resist.

It is recommended that attention be paid to ensuring that any resist at the sides of the container and on the bottom is completely mixed into the main body of the resist.

Returning of resist to the original container after use is not recommended as this can lead to dust particles or dried resist being introduced into the product which could affect future performance.

Mixed pot life at 23<sup>±</sup> 2°C (70 - 77°F) will be approximately 72 hours. Always ensure the lid is replaced on the container to avoid excessive solvent evaporation.

### 5.2 Thinning

Imagecure® XV501T Screen may be reduced with a maximum of 2% w/w Imagecure® Thinner XZ107.

**N.B. Stir well before use.**



### 5.3 Pre-Clean

Ensure that all copper surfaces are completely clean, tarnish free and dry prior to applying Imagecure® XV501T.

Mechanical pre-cleaning is recommended as follows: -

**Brushing** 280 - 400 grit silicon carbide brushes are recommended having a footprint on the copper of 8 - 15mm. (0.3 - 0.6 in.). The water rinse and heater sections should be capable of thoroughly rinsing and drying the panels such that no water is left in the holes or between closely spaced conductors and that moisture or tarnish is not present on the freshly brushed panels.

It is important that each brush is regularly checked and dressed as necessary to ensure optimum efficiency during use.

Please note that Nylon brushes of 600 - 800 grit can also be used.

**Pumice** Pumice or Aluminium oxide slurry of between 12 - 18% is recommended with an optimum of 15%. The water rinse and heater sections must be capable of rinsing and drying the panels such that residual pumice particles are completely removed and that no water is left in the holes or between closely spaced conductors and that moisture or tarnish is not present on the freshly cleaned panels.

For panels that are badly oxidised and tarnished then a micro-etch prior to mechanical pre-cleaning is recommended. The micro-etch should be capable of removing any oxide or tarnish staining and of thoroughly rinsing and drying the panel before being mechanically cleaned.

Panels which have close track/gap configurations (<100µm/4mil), may not be suitable for mechanical pre-cleaning and will need to be micro-etched. The use of either a standard micro-etch or the "deep etching" micro-etch chemistries can be effective in this process. It is recommended that each user ensures that the Imagecure product is compatible with the particular micro-etch used and all subsequent metal finishing processes.

Surface roughness figures of:-

|           |              |
|-----------|--------------|
| Ra        | 0.2 - 0.4µm. |
| R delta q | 4 - 9°       |

would be considered to be optimum values for copper surfaces pre-cleaned as above. A minimum Ra of 0.2µm with an R delta q value of >4° is recommended (optimum R delta q values 7 - 9°).

Please refer to separate technical document on surface roughness for a fuller explanation of the above roughness values.

NOTE. It is recommended that all freshly cleaned panels are coated with Imagecure within a maximum time of 2 - 4 hours. The actual maximum time will vary depending upon ambient temperature and humidity. Panels left longer than 4 hours before coating should be pre-cleaned again.



#### 5.4 Application

The Imagecure® XV501T series can be used with most types of vertical screen print units and horizontal screen print machines.

The viscosity and structure of the Imagecure® XV501T series enables the printed film to give good encapsulation to boards of varying geometry and conductor heights.

Typical polyester meshes will be 36/90 - 43/80cm (90/90 - 125/80inch) with a 65 - 70<sup>o</sup> shore squeegee with a square edge profile. The optimum mesh for printing is 43/80cm (110/80inch) and this will be suitable for most 18µm. and 35µm base copper board designs.

For boards with 70µm. base copper, or for boards requiring a specific withstand voltage the use of meshes with lower mesh counts of 32/100 - 36/90cm ( 80/100 - 90/90inch ) may be necessary.

Print tests with subsequent micro-sections are recommended to ensure adequate track encapsulation.

Screens must be cleaned, thoroughly dried and free from cleaner and solder mask residues before use.

#### 5.5 Washing Up

Screen Cleaner XZ46 is recommended for washing up.

Alternative cleaners and screenwashes are available to suit customers' particular requirements. Your local Sun Chemical Circuits representative will be pleased to advise on product selection.

#### 5.6 Pre-Dry

Good drying of the printed film is important so ovens with good temperature profiles and extraction are necessary. Specific drying parameters (time and temperature) will be dependent upon the specific oven used as well as the thermal mass and quantity of the panels being dried.

It is recommended that printed panels be allowed to debubble for approximately 5-10minutes in still air at ambient temperature prior to being placed in the oven.

Air flow speeds of 1 - 2ms<sup>-1</sup> are recommended to achieve sufficient removal of the volatile solvent. Drying is less efficient as the air velocity drops below 0.5ms<sup>-1</sup>.

For vertical screen print systems with a vertical drying oven a set air temperature of 80 - 90°C (176 - 194°F) for 30 - 50 min. is recommended. Optimum 85°C (185°F) for 45 minutes. Drying will depend on board thickness and Imagecure thickness as printed, as well as air flow in the oven.

For printing processes that only print one side at a time the following is recommended for box ovens:-

|        |   |
|--------|---|
| Side 1 | 10 - 25 min. at 80 - 90°C (176 - 194°F) |
| Side 2 | 25 - 35 min .at 80 - 90°C (176 - 194°F) |

Imagecure® XV501T can also be dried in IR ovens. Specific times and temperatures will depend on the specific Infra red oven used. Please discuss with your Imagecure partner the specific settings before use.

Allow an adequate gap between panels. Spacing of 25 - 40 mm (1 - 1.6 in.) is recommended to ensure sufficient air flow between panels.



After drying it is recommended that all panels be exposed and developed within 24 hours. The maximum storage time of boards before exposure/development is 72 hours. However it is recommended that boards be stored in yellow light conditions with controlled temperature and humidity. If the humidity increases above 60% RH then the storage time of the dried panels will be reduced.

### 5.7 Exposure

All Imagecure® XV501T systems are negative working and can be used with all exposure units using ferric doped mercury vapour lamps with UV wavelengths between 300 - 400nm.

Ferric doped lamps with power ratings of 5 - 10kW are recommended. It is recommended that to remove the infra red radiation the unit is either cooled or has an infra red filter to keep the temperature of the artwork < 30°C (86°F).

Optimum working temperature 22 - 25°C (72 - 77°F).

Exposure readings of \*250 - 500 mJ/cm<sup>2</sup> are typical.

\* Exposure readings taken with an IL390B radiometer from the International Light Co. Inc.

Stouffer values of 7 - 9 (solid resist) using a 21 step wedge are typical (note black may require a higher exposure energy). For selective Ni/ Au and or immersion Sn exposure levels of 11 - 12 (solid resist) are recommended.

**The artwork should have a Dmax > 4.0 and a Dmin < 0.15.**

### 5.8 Development

Imagecure® XV501T will readily develop in either potassium or sodium carbonate solutions.

The recommended carbonate concentration is 10 ± 2g. /lit.

The working pH range is 11.3 to 10.8 for aqueous carbonate solutions.

To ensure the quality of development it is recommended that the pH of the developer solution does not drop below 10.8. At a pH <10.6 the efficiency of the developer solution may drop due to the increased loading of photopolymer.

Temperature range is 30 - 40°C (86 - 104°F). Optimum 35 - 38°C (95 - 100°F).

Spray pressures 2 - 4 bar (30 - 60 PSI). Optimum 2.5 bar (37.5 PSI).

Dwell times in the developing chambers of 45 - 80s (optimum 60s). For boards with small via holes (0.2 - 0.4mm) or with laminate thickness > 3mm, longer dwell times may be necessary to ensure complete development of the holes.

Water rinse pressures to be 2 -3 bar (30 - 45 PSI), with operating temperatures 15 - 30°C (59 - 86°F).

It is recommended that hard water (~200 ppm dissolved ions) be used where possible to give good rinsing, followed by a final rinse in deionised water.



Anti-foams will need to be added to the aqueous developing chambers to avoid foaming. The amount of anti-foam to be added may vary depending upon the type of anti-foam used, the size and number of developing chambers and spray bars, spray pressures and the loading of developed resist. In all cases it is recommended that the minimum amount of anti-foam be added.

Imagecure® XV501T will also develop in BDG (butyl diglycol). The developer temperature should be  $30 \pm 2^\circ\text{C}$  (82 - 90°F), with a dwell time between 120 - 160s. Spray pressures of 4 - 5 bar (60 - 75 PSI) are normal. Optimum conditions will include a dwell of 150s @  $30^\circ\text{C}$  (86°F) with spray pressures of 4 - 5 bar (60 - 75 PSI).

It should be noted that Imagecure® XV501T films needing to be removed can be stripped by dipping in either a proprietary solder mask stripper or 5% sodium hydroxide solution at 50 - 70°C (122 - 158°F).

### 5.9 UV Bump

Generally Imagecure® XV501T does not require a UV bump. However there may be certain customer processes or requirements that render the use of a UV bump desirable or necessary.

If a UV bump is required then it is recommended that it be carried prior to post bake, and that a multi lamp double sided UV cure unit be used. Recommended UV energy is 1000 - 1500 mJ/cm<sup>2</sup>.

A UV bump can also be carried out after post bake, recommended energy of 2500 - 3000mJ/cm<sup>2</sup>.

A UV bump will improve surface hardness, reduce volatile emissions, reduce ionic contamination and give increased resistance to OEM assembly cleaning processes.

### 5.10 Post Bake

It is important to ensure that all ovens have an independent thermal profile taken, as the set air temperature is not always reliable and the air flow in the oven or the door seals may give rise to either hot or cold spots.

The recommended bake cycle is 140 - 150°C (284 - 302°F) for 60 - 90 min. Optimum 150°C (302°F) for 60 min. Bake times should be taken when oven temperature reaches the pre-set point.

Sufficient air flow is necessary to ensure a consistent temperature gradient in the oven as well as a uniform degree of cure for the solder resist.

With respect to batch ovens boards should be racked 25 - 40mm. (1.0 - 1.6 in.) apart.

All exhaust ducting and extraction fans should be adequately insulated to avoid any volatile emissions condensing around the oven area.

### 5.11 Notation/ Legend Printing

All Imagecure® XV501T Screen products are compatible with a wide range of UV curing, thermal curing and photoimageable notation inks.

Thermal curing inks can be applied prior to post bake to increase productivity.



**6. Health and safety**

Detailed material safety data sheets will be supplied by your local Sun Chemical Circuits representative.

The products detailed hereon have been tested in accordance with, and meet the requirements of, the RoHS Directive 2002/96/EC and the European Directive 2003/11/EC, regarding the presence of the metals - Pb (Lead / Lead compounds), Hexavalent Chromium, Cd (Cadmium), Hg (Mercury), and Poly Brominated Flame Retardants.

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II – Europe.

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Sony Green Book Number I8880001

As the world's foremost producer of inks, pigments and colour technology, Sun Chemical is leading our industry in developing and producing products which minimise our impact – and our customers' impact – on the environment and striving to maximise the use of renewable resources. We consider it our responsibility to be involved in the communities in which we live and work and to offer direction in meeting today's needs without compromising the ability of future generations to meet theirs.

**7. Film Performance/ Technical Specification**

**7.1 Physical Properties of IMAGECURE® XV501T Screen**

| Component                             | Viscosity (Haake VT550) | S.G. | Flash point      | Non Volatile Content |
|---------------------------------------|-------------------------|------|------------------|----------------------|
| CAWN2004                              | 17.5 - 20.5 Pa.s        | 1.22 | > 70 °C (158 °F) | 71.0%                |
| CAWN1375                              | 17.5 - 20.5 Pa.s        | 1.22 | > 70 °C (158 °F) | 71.0%                |
| CAWN2117                              | 17.5 - 20.5 Pa.s        | 1.22 | > 70 °C (158 °F) | 69.5%                |
| CAWN2734                              | 17.0 – 21.0 Pa.s        | 1.19 | > 70 °C (158 °F) | 68.0 – 70%           |
| CAWN1274 / CAWN1347                   | 28.0 - 34.0 Pa.s        | 1.39 | > 70 °C (158 °F) | 78.0%                |
| <b>Volatile Organic Content (VOC)</b> |                         |      |                  | 360 - 400g./L.       |



**7.2 Physical and Chemical Properties of IMAGECURE® XV501T Cured Film**

|  |   |  |
|--|---|--|
| Solder Resistance  | MIL-PRF-55110F<br>IPC SM840E  | 30 secs @ 288°C (550°F)<br>10 secs @ 260°C (500°F)             |
| Resistance to Fluxes   | IPC SM840E  | Pass   |
| Electroless Ni/Au Plating  |   | Pass   |
| Hydrolytic Stability   | IPC SM840E Class H  | Pass   |
| Solvent, Cleaning Agent, & Flux Resistance                               | IPC SM840E Class H  | Pass   |
| Fungal Resistance  | IPC SM840E Class H  | Pass   |
| Thermal Shock  | IPC SM840E Class H<br>MIL-PRF-55110F<br>MIL-STD-202G                                      | Pass<br>Pass<br>Pass   |
| Chemical Resistance  | IPA<br>1,1,1 Trichloroethane<br>MEK<br>Methylene Chloride<br>Alkaline Detergent<br>Fluxes | >1 hour<br>>1 hour<br>>1 hour<br>>1 hour<br>>1 hour<br>>1 hour |
| Abrasion Pencil Hardness   | IPC SM840E Class H  | Pass   |
| Abrasion Taber Method  | IPC SM840E Class H  | Pass   |
| Adhesion (Copper)<br>(Tin / Lead)  | IPC SM840E Class H<br>IPC SM840E Class H  | Pass<br>Pass   |
| Flammability   | UL 94V0 Rating  | File No. E83564  |
| Ionic Contamination  | MIL-PRF-55110F  | <0.3□g. NaCl/cm <sup>2</sup><br>Using Alpha Ionograph 500M     |
| Bellcore   | TR-NWT000078  | Pass   |
| Insulation Resistance  | IPC SM840E Classes T and H  | Pass   |
| Moisture & Insulation Resistance   | IPC SM840E Classes T and H  | Pass   |
| Electromigration   | IPC SM840E Classes T and H  | Pass   |
| Comparitive Tracking Index<br>(FR4 Laminate – CTI Rated 500 V)           | IEC 112   | >325   |
| Siemens E-Corrosion Test   | SN 57030  | Pass   |
| Dielectric Strength<br>(50 Hz.)  | IPC SM840D Classes T and H<br>DIN53481  | 120kV/mm.  |
| Dielectric Constant Er (1 MHz)   |   | 3.9 – 4.0  |
| Dielectric Loss Factor tangent (10 <sup>2</sup> Hz - 10 <sup>6</sup> Hz) |   | 0.02   |

IMAGECURE® XV501T IS APPROVED BY SIEMENS WHEN USED WITH SPECIFIED FLUXES





## 8. Disclaimers

This information has been carefully compiled from experience gained in field conditions and extensive laboratory testing. However the products' performance and its' suitability for the customers' purpose depend on the particular conditions of use and the material being printed. We recommend that customers satisfy themselves that each product meets their requirements in all respects before commencing a production run.

Since we cannot anticipate or control the conditions under which our products are used, it is impossible to guarantee their performance. All sales are also subject to our standard terms and conditions.

## 9. Technical Assistance / Contacts

Sun Chemical Circuits are an international company, and as such can offer technical, engineering and sales support to our customers worldwide.

For further information regarding this product, or any of our extensive range of materials for PCB fabrication, please contact your local Sun Chemical team or visit the Technical Help Desk at website: <http://www.sunchemicalhelpdesk.com>

Our Products are intended for sale to professional users. The information herein is general information designed to assist customers in determining the suitability of our products for their applications. All recommendations are made without guarantee, since the application and conditions of use are beyond our control. We recommend that customers satisfy themselves that each product meets their requirements in all respects before commencing a print run. There is no implied warranty of merchantability or fitness for purpose of the product or products described herein. In no event shall Sun Chemical be liable for damages of any nature arising out of the use or reliance upon this information. Modifications of the product for reasons of improvements might be made without further notice.

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