SunChemical®

Circuits

Technical Information Leaflet

IMAGECURE®

XV501T-4 Matt White Screen

PRODUCT REFERENCE

Imagecure®	XV501T-4	Matt White Screen Resist	CAWN1298
Imagecure®	XV501T-4	White Screen Hardener	CAWN1299

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ISO9001 **SM840C CLASS H PASS** **ISO14001** **BELLCORE PASS**

RoHS & WEEE Directive Compliant

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1) DESCRIPTION

Imagecure® AQ XV501T-4 Screen is a two component thermal hardening liquid photoimageable solder resist / notation ink that dries by solvent evaporation to give a film that can be processed in aqueous potassium or sodium carbonate solution, 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.

Imagecure® XV501T-4 screen products have excellent adhesion to all clean copper surfaces, but are not recommended for use with reflow tin/lead and electrolytic gold plated conductors. For reflow tin/ lead and electrolytic gold plated conductors the Imagecure® XV501T screen products are recommended.

2) MIXING

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

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.

After the mixing operation is completed it is recommended to allow the mixed and thinned pack to debubble for ~ 30 min. before use.

Mixed pot life at 23º± 2ºC (70 - 77ºF) will be approximately 72 hours. Always ensure the lid is replaced on the container to avoid any contamination and excessive solvent evaporation.

3) THINNING

Imagecure® XV501T-4 Screen may be reduced with a maximum of 3% w/w Imagecure® Thinner XZ96 or XZ101.

N.B. The mixed resist should be stirred well before use.

4) PRE-CLEAN

Ensure that all copper surfaces are completely clean, tarnish free and dry prior to applying Imagecure®. 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 precleaning 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 - 9º

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 >4º is recommended (optimum R delta q values 7 - 9º).

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® XV501T-4 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) APPLICATION

The Imagecure® XV501T-4 series can be used with most types of vertical screen print units and horizontal screen print machines.

Typical polyester meshes will be 36/90 - 43/80cm (90/90 - 125/80inch) with a 65 - 70º 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 32/100 - 36/90cm (80/100 - 90/90inch) may be necessary.

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

When used as a legend ink 100 - 120T/cm. (255 - 305T/inch) polyester mesh is recommended. The legend ink can be applied to fully processed Imagecure® panels prior to final cure. The ink may be applied all over PCB's or as "oversize" lettering, and then photoimaged / developed to accurately achieve the required design.

All screens must be cleaned and thoroughly dried before use and free from residues of screen cleaner and ink.

6) 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.

7) 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 - 10 minutes in still air at ambient temperature prior to being placed in the oven.

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

For vertical screen print systems with a vertical drying oven a set air temperature of 80 - 90ºC (176 - 194ºF) for 30 - 50 min. is recommended. Optimum 85ºC (185ºF) 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 - 90ºC (176 - 194ºF)
Side 2	25 - 35 min .at 80 - 90ºC (176 - 194ºF)

When used as a legend ink, the recommended pre-dry is 10 - 15 minutes at 80°C (176°F).

The Imagecure® XV501T-4 series 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.

8) EXPOSURE

All Imagecure® XV501T-4 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 < 30ºC (86°F). Optimum working temperature 22 - 25ºC (72 - 77°F).

Exposure readings of 350 - 500 mJ/cm² are typical*.

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

Stouffer values of 7 - 11 (solid resist) using a 21 step wedge are typical.

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

9) DEVELOPMENT

Imagecure® XV501T-4 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.

Recommended temperature range is 30 - 40ºC (86 - 104°F), optimum 35 - 38ºC (95 - 100°F).

Spray pressures between 2 - 4 bar (30 - 60 PSI), optimum 2.5 bar (37.5 PSI).

Dwell times in the developing chambers of 45 - 80 seconds, optimum 60 seconds. 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 - 30ºC (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-4 will also develop in BDG (butyl diglycol). The developer temperature should be 30 ±2ºC (82 - 90°F), with a dwell time between 120 and 160 seconds. Spray pressures of 4 - 5 bar (60 - 75 PSI) are normal. Optimum conditions will include a dwell of 150 seconds @ 30°C (86°F) with spray pressures of 4 - 5 bar.

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

10) UV BUMP

Generally Imagecure® XV501T-4 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/cm².

A UV bump can also be carried out after post bake, recommended energy of 2500 - 3000mJ/cm².

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

11) 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 - 150ºC (284 - 302°F) for 60 - 90 min. Optimum is 150ºC 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.

12) ELECTROLESS NICKEL GOLD / IMMERSION TIN PROCESSING

There are a number of competing chemistries available, each with a differing aggressiveness towards the solder resist. The following guidelines are given to help Imagecure® users avoid some of the problems associated with solder resists and these alternative solderable finishes :-

Pre-clean: Either silicon carbide brushing, pumice scrubbing or the use of a deep etch copper microetchant. The copper must be clean, tarnish free and with a good micro topography.

Application: Ensure that the tracks have sufficient solder mask. A minimum of 8 - 10µm. (0.32 - 0.4mil.) is recommended.

Pre-dry: Insufficient pre-dry can lead to a lowering of the cured film's resistance to either Ni/Au or immersion tin as well as increasing the degree of undercut on development. The pre-dry should be carried out at 85 - 90ºC (176 - 194°F). It is recommended that oven thermal profiling be carried out to achieve optimum results.

Exposure: To achieve straight side walls with minimal undercut on development a Stouffer reading of 11 - 12 (solid resist) is recommended.

Development: Extended dwell times, high developing temperatures and high spray pressures should be avoided otherwise excessive undercut will take place. To achieve optimum results the developed edges should be straight with minimal undercut.

UV Bump: Can be used before post bake to eliminate film discoloration after metallisation. 1500 - 1800 mJ/cm² is recommended.

Post bake: Avoid excessive temperatures during post bake as these can lead to oxidation of the copper surfaces. Recommended process temperature 140 - 150ºC (284 - 302°F) with a maximum dwell of 60 minutes.

Micro-etch: Only 1.0µm. etching should be necessary to remove the oxide layer. Excessive micro-etching (> 2.0µm) can lead to under plating and edge lifting of the solder resist film. Ensure that the micro-etch process is controlled and consistent across the panel.

Tape Test: Panels should be tape tested a minimum of 1 hour after metallization.

13) NOTATION / LEGEND PRINTING

When used as a soldermask, Imagecure® XV501T Screen is 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.

14) STORAGE AND SHIPPING

When stored in sealed containers, in a cool place (20ºC / 68ºF), away from sources of direct heat and sunlight, Imagecure® XV501T-4 resist and hardener components have a shelf life of 18 months.

Imagecure® XV501T-4 can withstand higher temperatures (40 - 60ºC / 104 - 140ºF), whilst in transit for up to periods of 1 month without any detrimental effect on its performance.

15) 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.

The materials detailed above are present below the specified maximum limits.

16) PACKAGING

Imagecure®	XV501T-4	Matt White Screen Resist	0.67 kg.	CAWN1298
Imagecure®	XV501T-4	White Screen Hardener	0.33 kg.	CAWN1299
Imagecure®	XZ96	Thinner	5.00 L.	CDSN4035
Imagecure®	XZ101	Thinner	5.00 L.	CDSN4041
Imagecure®	XZ46	Screen Cleaner	5.00 L.	CDSN4008

17) FILM PERFORMANCE / TECHNICAL SPECIFICATION

PHYSICAL PROPERTIES OF IMAGECURE® XV501T-4 SCREEN

Pack Code	Viscosity*	S.G.	Flash point	Non volatile content
CAWN1298	230 - 360 Poise	1.25	86°C (187°F)	74.4%
CAWN1299	180 - 210 Poise	1.47	86°C (187°F)	79.2%

*Viscosity measured at 25°C (77°F). Please note viscosity can vary greatly depending on ink temperature, volume of ink tested, type of viscometer used and the test method.

Non Volatiles (as supplied)	76%
Volatile Organic Content (VOC)	390 - 400g/L.

PHYSICAL & CHEMICAL PROPERTIES OF IMAGECURE® XV501T-4 CURED FILM

Solder Resistance	MIL-PRF-55110F IPC SM840C	30 secs @ 288°C (550°F) 10 secs @ 260°C (500°F)
Resistance to Solder Levelling		> 5 passes
Resistance to Fluxes	IPC SM840C	Pass
Electroless Ni/Au Plating		Pass
Hydrolytic Stability	IPC SM840C Class H	Pass
Solvent, Cleaning Agent, & Flux Resistance	IPC SM840C Class H	Pass
Fungal Resistance	IPC SM840C Class H	Pass
Thermal Shock	IPC SM840C Class H MIL-PRF-55110F MIL-STD-202G	Pass Pass Pass
Chemical Resistance	IPA 1,1,1 Trichloroethane MEK Methylene Chloride Alkaline Detergent Fluxes	>1 hour >1 hour >1 hour >1 hour >1 hour >1 hour
Abrasion Pencil Hardness	IPC SM840C Class H	Pass
Adhesion (Copper)	IPC SM840C Class H	Pass
Ionic Contamination	MIL-PRF-55110F	<0.3µg. NaCl/cm² Using Alpha Ionograph 500M

17) FILM PERFORMANCE / TECHNICAL SPECIFICATION (cont.)

ELECTRICAL PROPERTIES OF IMAGECURE® XV501T-4 CURED FILM

Bellcore	TR-NWT000078	Pass
Insulation Resistance	IPC SM840C Classes T and H	Pass
Moisture & Insulation Resistance	IPC SM840C Classes T and H	Pass
Electromigration	IPC SM840C Classes T and H	Pass
Comparitive Tracking Index	DIN EN 60112 / IEC 112	>400V
Siemens E-Corrosion Test	SN 57030	Pass
Dielectric Strength (50 Hz.)	IPC SM840C Class H DIN53481	100kV/mm.

18) DISCLAIMER

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.

19) SUPPORT

Sun Chemical Circuits are an international company, and as such can offer technical, engineering and sales support to our customers worldwide. If you require more information regarding this product, or any of our extensive range of materials for PCB fabrication, please contact our local sales offices.