XV501T-4 LDI

From the Imagecure family of Photoimageable Solder masks

1. Description

Imagecure XV501T-4 LDI soldermask is a liquid product which dries by evaporation to give a film that can be sensitised by laser exposure to UV wavelengths between 330nm and 365nm. The unexposed material is developed in a dilute alkali solution and then cured to give a durable, chemical and heat-resistant film.

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

- Resolution capability down to 50µm (2mil.) and less.
- Exposure sensitivity 50 - 120 mJ/cm².
- Proven resistance to HASL processing.
- Compatible with a range of Ni/ Au and immersion tin chemistries.
- Excellent adhesion to and encapsulation of copper tracks.
- Halogen free (<300ppm total halogen content)
- RoHS & WEEE Directive Compliant
- Sony Green Partner Program Registered

ISO9001
FM 09568

U.L. FILE NUMBER E83564
® is a registered trade mark

ISO14001
EMS 40768

3. Product Range

CAWN2708	XV501T-4	LDI Green Halogen Free Screen Resist	2.00 kg.
CAWN2726	XV501T-4	LDI Clear Screen Hardener	1.00 kg.
CAWS2708	XV501T-4	LDI Green Halogen Free Spray Resist	5.00 kg.
CAWS2726	XV501T-4	LDI Clear Spray Hardener	2.50 kg.
CDSN4059	XZ107	Slow Screen Thinner	5.00 L.
CDSN4042	XZ90	Spray Thinner	5.00 L.
CDSN4065	XZ108	Spray Thinner	5.00 L.
CDSN4066	XZ108	Spray Thinner	25.00 L.
CDSN4008	XZ46	Screen Cleaner	5.00 L.

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4. General Handling

4.1 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 components have a minimum 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.

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 Processing Environment

The choice of printing and exposure environment has been found to have a direct effect on fine solder dam yield values. Every effort should be made to minimise the incidence of dust or fibres on the print room and exposure area.

It is therefore recommended that a Class 10,000 clean room be considered the minimum requirement for resolving features less than 100µm (4mil) at high yield.

Commercial, automated printing equipment may already contain some level of air filtration and the manufacturers or local Sun Chemical Circuits representatives can advise on its' suitability.

It is also recommended that the screen print area be fitted with UV screened illumination (yellow lights) due to the high photosensitivity of this particular product.

5.2 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.

Mechanical mixing is recommended to ensure thorough mixing of the resist and hardener components. Recommended mixers include those with variable speed motors / paddle type mixing blades as well as the shaker or rotating type mixers. Such mixers should guarantee a consistent mix for each mixed pack.

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. 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.

5.3 Thinning

Screen This product is supplied ready-to-use, and therefore further thinning is not generally recommended. However, if necessary, a maximum of 3% **Imagecure** Slow Thinner XZ107 should be used.

Spray The mixed product should be thinned to approximately 30 seconds Zahn 3 cup, using XZ90 or XZ108 Spray Thinner. Other reducers are available to suit customer's particular requirements. Your local Sun Chemical Circuits representative will be pleased to advise on product selection.

N.B. The mixed resist should be stirred thoroughly before reduction.

5.4 Pre-Clean

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

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 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.

Microetch Panels having close track/gap configurations, which may not be suitable for mechanical precleaning, the use of a "deep etching" micro-etch chemistry is recommended. 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).

NB. 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.

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

5.5 Application

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

Typical polyester meshes will be 32 - 43T/cm. (80TPI - 110TPI), with a 65 - 70° shore squeegee with a square edge profile. The optimum mesh for printing is 43T/cm (110TPI) 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 - 36T/cm. (80 - 90TPI) may be necessary.

Print tests with subsequent microsections are recommended to ensure adequate track encapsulation. Screens must be cleaned, thoroughly dried and free from cleaner or solder mask residues, before use.

Spray The **Imagecure** XV501T-4 spray series can be used with vertical and horizontal air and electrostatic spray units.

Once the thinned **Imagecure** has been added to the sump and the correct viscosity obtained, film weight may be set by the use of "weight gain panels" or a wet-wheel, and by adjustment of the conveyor, pot pressure and/or pump speed. Typical spray parameters are given below:

Argus Air Spray	Reservoir pressure:	7.5 - 20.0 psi
	Atomisation pressure:	30 - 45 psi
	Line speed:	0.8 - 1.4 m/min.
	Spray gun pin setting:	Opened 4 - 5 turns
	Spray pattern angle:	10° from direction of travel
	Spray pitch:	25 - 37mm.
	Gun temperature:	90°C
	Atomising air temperature:	90°C
Electrostatic Spray	Voltage:	40 - 100 kV. (Dependant on equipment)
	Bell speed:	25 - 35 (x 1000) rpm.
	Shaping air:	8 psi
Systronic Spray	Ink Pressure:	0.5 - 1.2 Bar (Depending on thickness required)
	Spray Pressure:	3 - 4 Bar
	Line speed:	0.8 - 1.4 m/min.
	Air temperature:	100°C

More detailed conditions for individual machines are available from manufacturers' operation manuals.

Wet weight values of 80 - 100gsm. are typical, with wet-wheel values of 65 - 80µm. This will give a dry coating thickness of approximately 30 - 40µm.

Coating thickness may need to be changed depending on board configuration and conductor heights as well as end use requirements (withstand voltage etc.). In some instances it my not be possible to achieve a suitable coating in a single coat and the use of double coating may be necessary.

Discussion with your **Imagecure** partner is recommended in order to obtain optimum results.

5.6 Washing Up

Screen Screen Cleaner XZ46 is recommended for washing up.
Spray Pipes, spray guns and accessories can be cleaned with XZ90 or XZ108 Thinner.

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.

5.7 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.

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.

Due to the products extreme photosensitivity, it is recommended that panels be allowed to cool either in a yellow light area or a darkened room (with controlled temp. and humidity). It is recommended that all panels be exposed and developed within 24 hours. If the humidity increases above 60% RH then the storage time of the dried panels will be reduced.

Screen 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.

For vertical screen print systems with a vertical drying oven a set air temperature of 75 - 85°C (167 - 185°F) for 30 - 50 min. is recommended. Optimum 80°C (176°F) for 45 mins 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 min.	at 75 - 80°C (167 - 176°F)
Side 2	30 - 40 min.	at 75 - 80°C (167 - 176°F)

The maximum drying time (Side 1 + 2) should not exceed 45 minutes at 80°C (176°F).

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

Spray **Imagecure** XV501T-4 Spray series can be dried with either horizontal or vertical convection/IR ovens. Board temperatures should be between 80 - 85°C (176 - 185°F) with dwell times of 30 - 45 min. Typical drying parameters are:

Argus Spray	Line Speed	0.9 - 1.2 m./min	Temp. Zones 1 – 3 = 100 - 130°C
Systronic Line	Line Speed	0.8 - 1.4 m./min	Temp. Zones 1 – 4 = 110/110/150/160°C

Note: Drying conditions may vary depending on laminate thickness, etc.

5.8 Exposure

LDI Exposure

Ensure panels are at room temperature before exposure step. Please note that due to the extreme photosensitivity of this material, it is recommended that the panels be allowed to cool either in a yellow light area or a darkened room.

To reduce the possibility of contamination, panels can be passed through a dust removal system (such as those supplied by Teknek), prior to placing in the LDI unit.

Optimal resist spectral sensitivity: 350 - 365nm.

Exposure energy requirement: 50 - 120mJ/cm²

Conventional 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 < 30°C (86°F). Optimum working temperature 22 – 25°C (72 – 77°F).

Exposure readings of 200 – 300mJ/cm² are typical*.

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

Stouffer values of 8 – 10 (solid resist) using a 21 step wedge are typical. For selective Ni/ Au and/or immersion Sn exposure levels of 10/11 are recommended.

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

After exposure, allow a hold time of 5 – 10 minutes before development. The maximum hold time for exposed panels is 24 hours in yellow light. Note that the Stouffer value achieved when LDI exposed will be lower than the Stouffer value achieved when conventionally exposed.

5.9 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 10.8 to 11.3 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°C (95°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.

It should be noted that **Imagecure** 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).

5.11 UV Bump

Generally **Imagecure** 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 - 1500mJ/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.

5.12 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 150 - 155ºC (302 - 311°F) for 60 - 90 min. Optimum is 155ºC 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.

5.13 Notation/ Legend Printing

All **Imagecure** XV501T-4 products are compatible with a wide range of Sun Chemical 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 2011/65/EU, 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.

Registered to the Sony Green Partner Program, Certificate Number 11490

Sony Green Book Number I8880002

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-4 LDI Screen

Pack Code	Viscosity	S.G.	Flash point	Non volatile content
CAWN/S2708	18.5 – 21.5 Pa.s	1.28	>70°C (158°F)	67 – 69%
CAWN/S2726	13.0 – 15.0 Pa.s	1.20	>70°C (158°F)	77 – 80%

*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)	71 - 73%
Volatile Organic Content (VOC)	360 - 400g./L.

7.2 Properties of Imagecure XV501T-4 Cured Film

Solder Resistance	MIL-PRF-55110F IPC SM840E	30 secs @ 288°C (550°F)
Resistance to Fluxes	IPC SM840E	Pass
Ni/Au Plating		Pass
Chemical Tin Plating		Pass
Immersion Silver 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
Abrasion Pencil Hardness	IPC SM840E Class H	Pass (7H)
Adhesion (Copper)	IPC SM840E Class H EN ISO 2409	Pass < GT1
Thermal Shock	IPC SM840E Class H MIL-PRF-55110F MIL-STD-202G Bosch Y 273 R80 029 Class TC1 and TC6 Siemens 657539.49.60 Class C	Pass Pass Pass Pass Pass
Thermal Storage	IPC SM840E Class H Bosch Y 273 R80 029 Class TC1 and TC6 Siemens 657539.49.60 Class C	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
Ionic Contamination	MIL-PRF-55110F (Alpha Ionograph 500M) Hella – N67036 Siemens 657539.49.60 (Alpha Ionograph 500M)	<0.3µg. NaCl/cm² < 0.8 µg / cm² < 3.1 µg / cm²
Flammability	UL 94V0 Rating	File No. E83564
Bellcore	TR-NWT000078	Pass
Insulation Resistance	IPC SM840E Classes T & H	Pass
Moisture & Insulation Resistance	IPC SM840E Classes T & H	Pass
Electromigration	IPC SM840E Classes T & H	Pass
E-Corrosion	Bosch Y 273 R80 029 Siemens 657539.49.60	Pass Pass
Dielectric Constant Er (1 MHz)		3.9 – 4.0
Dielectric Loss Factor tangent (10^2 Hz - 10^6Hz)		0.02
Dielectric Strength (50Hz.)	IPC SM840E Classes T & H DIN53481	120kV/mm.

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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

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