CARAPACE® - EMP110 DI

LIQUID PHOTOIMAGEABLE SOLDERMASK

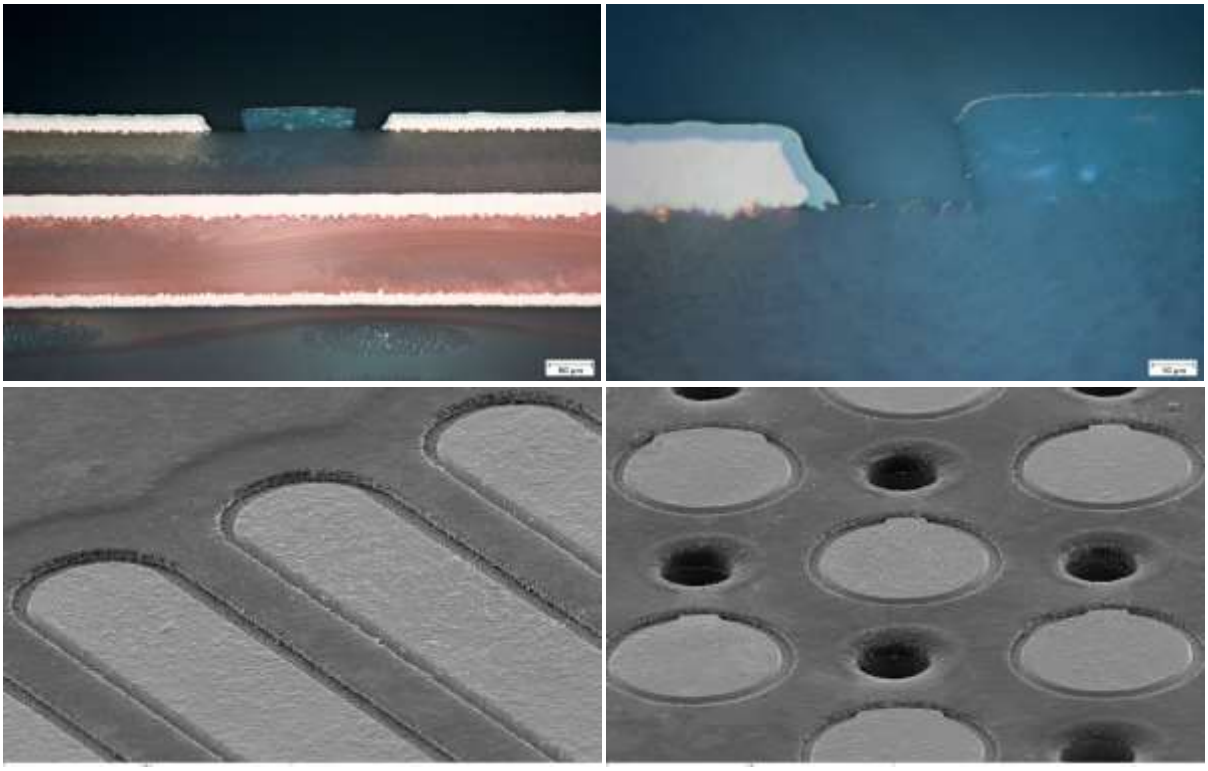
For Direct Image

Product Description

Carapace® EMP110 DI is the next generation in Liquid Photoimageable Soldermask for Direct Imaging. Using two-component epoxy technology, EMP110 DI soldermask is ideally suited for high-reliability, HDI PCB production where ultimate resolution and registration is required.

The EMP110 DI formulation has been engineered to deliver straight sidewalls and fine solder-dam resolution over the wide range of coating thicknesses associated with screen-printed and sprayed PCBs.
Optimised radiation curing characteristics deliver high levels of through-cure at low energy levels without compromise in surface hardness or chemical resistance.

- Low exposure energy to resolve small features sizes
- No surface damage or erosion during developing
- Fine solder-dam resolution (50μm, 2mil)
- Suitable for DI and conventional exposure systems
- High Resistance to Pb-Free, ENIG & Sn Processes
- Meets ASTM-E-595 Soldermask Outgassing requirements
- TGIC free, halogen-free, Reach and RoHS compliant
- Available for screen-print and spray application methods
- Available in variety of colours (supplied as universal Part A and coloured Part B)



Board surface preparation

Mechanical pre-cleaning:

Brush
320 to 400 grit silicon carbide brushes with a recommended footprint on the copper of 10-15mm. (0.4-0.6 inches).
Brushes should be regularly checked and dressed to ensure optimum preclean is retained.

Pumice Slurry Scrub
Pumice concentration between 18 - 22% (v/v) is recommended (3F or 4F virgin grade).
Slurry should be changed between 500-1000 panels

Aluminium Oxide Slurry Scrub
Aluminium oxide concentration between 18 - 22% (v/v) is recommended (400 grit).
Slurry should be changed between at least 20,000-30,000 panels

Aluminium Oxide Jet Slurry Spray
Aluminium oxide concentration between 18 - 22% (v/v) is recommended (220 grit virgin grade).
Jet spray pressure 20-24 PSI ensuring the jet nozzle patterns fully overlap
Slurry should be changed between at least 10,000-20,000 panels

Panels must be fully rinsed such that any slurry particles are completely removed. Failure to remove particles can result in poor cosmetics and adhesion loss.

If panels are heavily oxidised and tarnished then a micro-etch prior to mechanical pre-cleaning is strongly recommended. Panels must be thoroughly rinsed prior to mechanical cleaning stage.

Recommended Surface roughness figures are Ra 0.2-0.4µm.

Chemical pre-cleaning:

High Roughness, Deep-Etching Clean
Due to the excellent mechanical bond achieved between the copper surface and soldermask, proprietary deep-etch chemistries are the preferred method of pre-clean.
For a list of recommended and approved chemistries, please contact your Electra representative.

Microtech Clean
Simple microtech solutions such as sodium persulphate are not recommended as the sole method of preclean.

In all cases panels must be thoroughly rinsed and dried such that no tarnish is present and no water moisture remains in the holes or between closely spaced tracks.

It is recommended that all freshly cleaned panels are coated within 2-4 hours. The actual maximum time will vary depending upon ambient temperature and humidity. Panels left longer than 4 hours should be re-cleaned prior to coating.

Mixing:

Carapace® EMP110 DI is supplied as standard in pre-weighed 1kg or 3kg packs for screen print and 2kg or 10kg packs for air-spray.

The resist is supplied in pre-weighed packages of paste + hardener. The original supplied mix ratio must be used if mixing smaller amounts than the standard pack-size.

Incomplete mixing can cause poor developing, stickiness during exposure and impaired final properties

Product should be used within 24 hours mixing for screen print and 72 hours for air-spray.

Viscosity reduction:

Screen Print:

EMP110 DI is supplied screen ready. Viscosity adjustment is not recommended as this may result in thin deposits on track edges and/or prolonged drying times.

Spray:

To ensure effective track coverage EMP110 DI AS soldermask with Hardeners EMP110 PT B (H-5505) or EMP110 PT B (H-5550) must be reduced with a fixed 10% (w/w) addition of ER36 Spray Reducer**.** ER36 Spray Reducer will be supplied pre-weighed for the relevant pack size of EMP110 DI AS.

Further viscosity adjustment for spray should be made with Electrareducer ER-6.

All other EMP110 DI AS soldermask using should be reduced with Electrareducer ER6.

Where **ER6** is not available, an equivalent from an approved source may be used. The use of non-approved solvents is not recommended as they can cause contamination and other processing problems.

Addition level required will depend on spray system used however this is typically 20-25% (w/w).

Please contact Electra Technical Support Department for recommendation addition levels.

Due to the fast viscosity readings using a $Zahn_3$ cup, air inclusion can give erratic readings. It is therefore recommended to use the Ford Nº4 or a cup giving similar values (e.g. Frikmar Nº4).

Coating:

Screen-printing process settings:

Mesh count: 32-36T (81 – 92 mesh) polyester.
Squeegee: 60-70 Shore.

Minimum 25µm (1.0 mils) dry thickness should be aimed for; this is typically achieved using a 36T (92 mesh)

The board outline image may be made on the screen using conventional stencil material or masking tape and screen filler. To prevent a build up of ink on the reverse of the screen that may block holes, it is advisable to shift alternate boards along the x- or y-axis before printing. Alternatively, a rudimentary stencil, such as an expanded drill mask, can be used on the screen to prevent ink going into the holes.

Where available it is recommended to utilise the ISO facility on double-sided print equipment.

Do not utilise the vacuum bed, as this will suck an exaggerated amount of ink into the holes.
Spray process settings:

Exact spray parameters will depend on track height and circuit layout.
These parameters will also depend on equipment manufacturer, please contact Electra Technical Support Department for specific recommendations.

Below are general recommendations and guidelines:
Wet-weight: 70 to 80μm (approx.3 mils)

Tank pressure and coating speed are set to give desired wet thickness.
Atomising pressure should be set to give minimal mottling.
Shaping air is to be adjusted to give an even spray pattern.

Lower atomising pressures will lead to increased mottling.

Tack-dry:
The aim of the tack-drying stage is to solely remove the solvents. It is important for the drying chamber (static or conveyorised) to have good air circulation with air supply and extraction facilities.

Convection dry

Hardener	Recommended temperature	Recommended/Max time (mins)	Max hold-time after optimum tack-dry before developing
DI specific hardeners	75°C (167°F)	40-60	72 hours

Infra Red dry
IR drying is dependent on coating application method, IR wave-length and IR intensity.

Please contact Electra Technical Support Department for recommendations regarding specific equipment types and manufacturers.

Direct Imaging

Ensure panels are at room temperature before the exposure stage. Coated panels must be stored in yellow-room or UV-free conditions.

It is recommended to pass panels through a contact dust removal system prior to placing in the DI unit.

Light Source	Typical energy requirement $mJcm^{-2}$	Stouffer Step
355 nm (laser)	75 – 150	9 – 12
375 – 385nm (LED)	100 – 300	9 – 12
365/395nm (Multi Wavelength)	100 - 250	9 - 12
375/405nm (Multi Wavelength)	100 - 250	9 - 12
405nm (LED)	200 - 300	8 - 10
Arc-lamp	100 – 300	9 – 12

The exact energy requirement will be determined by copper height, soldermask thickness and resolution requirements.
Determination of the correct imaging energy should be carried out after setting the developing speed.

Above energy requirement is based on the standard green version, other colours may require higher energy levels.
It is strongly recommended to blank out vacuum holes except for those around the perimeter of the panel. This can be done using a sheet of mylar or a bespoke plate from the imaging equipment supplier.

Conventional Imaging

If required it is also possible to image EMP110 DI using conventional UV exposure units.

Step wedge: 9 - 11 clear (Stouffer 21 step)

Developing

Developer: 1% soln. sodium or potassium carbonate.
Spray pressure: 1.5-2.5 $kgcm^{-2}$, 20-40 psi.
Spray time: 30-90s in carbonate chamber(s) (dependent on quantity of ink in holes).
Temperature: 35°C (95°F)

Boards should be well rinsed with fresh water and fully dried after developing.
Do not final cure boards when wet.

The optimum developing speed is set when an unexposed board develops off completely, 25-30% of the way through the machine. This speed should be ascertained by preliminary tests prior to making exposure tests.

Developing speed and break-point settings will be determined by the amount of ink deposited in the holes during coating.

Final Cure

Convection oven: 60 mins at 150°C (300°F)

Time at board temperature

UV bumping

UV Energy: min. 3000 $mJcm^{-2}$.

If the soldermask is not UV bumped after final curing then occasionally white staining can be seen after final finish and post solder washes.
If staining does occur it is easily and permanently removed by a short bake cycle of 10-15 mins @ 120-150°C (248 - 300°F).

Safelight

It is recommended to process Carapace® EMP110 DI under safelight conditions. Between drying/exposing and exposing/developing, boards should be kept in yellow light. Boards should, in any case, be kept out of direct sunlight until completely processed.

Notation/marking inks

UV, thermal curing and Inkjet notation inks are suitable for use with Carapace® EMP110 DI. Thermal curing inks may be applied before or after final cure. If UV curing notation inks are used they should be applied before final cure and before UV bump. In this case UV curing the notation ink should serve as the bump for the soldermask, depending on cure energy.

Flux residues / staining

Occasionally flux residues or staining can be seen on boards, particularly when using very acidic or aggressive fluxes. Washing boards (post HASL or wave-solder) when still hot causes this and can be exaggerated by using hot water rinse. Boards must be allowed to cool after soldering before rinsing and it is recommended all rinse solutions be below 40°C (104°F).

If staining does occur it can be removed by post baking boards, after soldering, for 10-15 mins @ 120-150°C (248 - 300°F).

Stripping

After developing, any reject boards may be stripped of soldermask using a 5% NaOH solution at 40-50°C (104 - 122°F)

After curing, soldermask can be stripped using a proprietary soldermask stripper such as **ES108H/4000.**

Cleaning

Equipment should be cleaned of residual soldermask using **SW200 or Dowanol PMA.**

Shelf-life

Minimum 6 months from date of manufacture when stored in cool, dry, recommended conditions.
Storage should be between 10 and 25°C (50 - 77°F) and must be away from sources of heat and direct sunlight.

Final Properties

TEST	METHOD	RESULT	CLASSIFICATION
Hardness (pencil)	SM-840E	6H	Pass, class H
Adhesion (Rigid)	SM-840E	Copper: 0% removal Base laminate: 0% removal	Pass, class H
Chemical resistance Isopropanol (min.120s) Isopropanol/H_20 (75/25) D-Limonene 10% Alkaline detergent Monoethanolamine Deionised water	SM-840E Room temp. 120s 46 (± 2)°C 15 min Room temp. 120s 57 (± 2)°C 120s 57 (± 2)°C 120s 60 (± 2)°C 5 min	No surface roughness No blisters No delamination No swelling No colour change No cracking	Pass, class H
Methylene chloride	Internal testing:- Room temp. 60s		Pass
Hydrolytic stability	SM-840E	No evidence of reversion	Pass, class H
Insulation resistance	SM-840E	Before solder: 2.8E+12 Ω (avg.) After SnPB: 6.7E+11 Ω (avg.) After SAC305: 3.8E+11 Ω (avg.)	Pass, class H min req. 500MΩ (5.0E+08Ω)
Moisture & insulation	SM-840E	No blistering, separation, degradation.	Pass, class H min req. 500MΩ (5.0E+08Ω)

	Initial (Ω) (avg.)	During (Ω) (avg.)	After (Ω) (avg.)
No solder	2.8E+12	1.5E+09	1.5E+13
SnPB	6.7E+11	2.3E+09	1.4E+12
SAC305	3.8E+12	1.6E+09	3.2E+11

Resistance to Lead-Free Solder	SM-840E	No adherence of solder to the soldermask surface	Pass, class H
Simulation of Lead-Free Reflow	SM-840E	No adherence of solder to the soldermask surface	Pass, class H
Adhesion to other soldermask materials	SM-840E	0% removal	Pass, class H
Wave-solder resistance 10 (± 1)s at 260 (± 5)°C	SM-840E	No loss of adhesion or solder pick-up.	Pass, class H
Hot-air-solder-level	N/A	Minimum 5 cycles	Pass
Thermal shock	SM840 E	No cracks, delamination, crazing or blistering	Pass , class H

TEST	METHOD	RESULT	CLASSIFICATION
Dielectric strength	SM840 E		Pass , class H
	IEC60243-1 and IEC60464-2	134 KV/mm (3417 V / mil)	
Dielectric constant		4 (1 MHz)	

Soldermask Outgassing

	Total Mass Loss (TML)	Collected Volatile Condensable Material (CVCM)	Water Vapour Recovered (WVR)
ASTM-E-595 requirement	Max. 1.0%	Max. 0.10%	Report
EMP110 DI With min. 3000mJcm^{-2} UV bump	**0.69%**	**<0.01%**	**0.73%**

Other

IPC-SM840E Class H

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