TECHNICAL DATASHEET
CARAPACE®
EMP110 W- LED
PHOTOIMAGEABLE SOLDERMASK
for LED applications

PRODUCT SUMMARY

Carapace® EMP110 W-LED is a contact exposure, liquid photoimageable soldermask, using two-component epoxy technology

- **TGIC-free with no Reach SVHC content**
- **Fast processing times allowing High throughput and Productivity**
- **Brilliant White Coating with High Blocking Power**
- **Tailored Reflectivity for White LEDs**
- **Available in "cool" and "warm" white formulations**
- **High Resistance to Thermal and UV Ageing**
- **Rapid Tack Dry for Use on High Heat-sink Substrates**
- **Screen Print and Spray Versions**
- **Lead-free Compatible**
- **Contains no halogenated flame retardants**
- **RoHS compliant**

Product Description

Carapace® EMP110 W – LED is a 2-pack epoxy-acrylate system, consisting of pre-weighed packs of Part A and Part B.
EMP110/6010 WG LED – screen print
EMP110/6092 WG LED – screen print (increased thixotropic index for higher copper weight pcb's)
EMP110/6036 WG LED – spray

EMP110 Pt B (H6028 CW LED) "cool-white"
EMP110 Pt B (H6030 XCW LED) "extra-cool-white"
EMP110 Pt B (H6104 WW LED) "warm-white"

The mix ratio is 85:15 w/w.
Mixed pot life up to 72 hours

Product Mixing

To obtain optimum results, it is important that mixing of the components is done thoroughly. For quantities of less than approximately 200g, adequate mixing may be achieved manually, for example by rounded spatula, in 3 – 5 minutes.
Motor driven devices are recommended for larger quantities, but are generally less efficient at mixing-in product from the sides of containers. A minimum mixing period of 15 to 20 minutes is recommended.
High-shear mixers will cause air entrainment and are not recommended for screen-print inks.

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

Board surface preparation

***Mechanical pre-cleaning**:*
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.

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:
This is known to give lower surface roughness compared to other pre-clean methods. Where no other alternative method is available then the following conditions are suggested:

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.

***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.

Microetch 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.

Viscosity reduction:

Carapace® EMP110 W – LED screen print is supplied screen ready. If viscosity adjustment is required prior to, or during printing, then this may be achieved using **Electrareducer ER1.** No more than 5% reducer should be added or deterioration of the printing and drying properties may occur, resulting in thin deposits on track edges and/or prolonged drying times.

Carapace® EMP110 W – LED air-spray should be reduced with **Electrareducer ER6 or ER10.** Where ER6 or ER10 are 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. 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 N°4 or a cup giving similar values (e.g. Frikmar N°4).

Process settings:

SP: Mesh count: 43-55T (110-140 mesh) polyester.
Squeegee: 60-70 Shore.

20µm (0.75 mils) dry thickness should be aimed for; this is typically achieved using a 43T (110 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.

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

AS: 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: 40 to 65µm (1.5 to 2.5 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 and higher coating speeds will lead to increased mottling..

Drying

Carapace® EMP110 W – LED can be dried by convection or IR ovens. Drying times will depend on the coated thickness and type of drying equipment.
For air convection ovens, and coatings of 10-40,um, a typical drying cycle is 30 - 40 minutes at a board surface temperature of 70-75°C.
Total drying period should not exceed 60 mins at 70°C or 45 mins at 75°C.
It is important for the drying chamber (static or conveyorised) to have good air circulation and fume extraction.

IR Tack-drying conditions will be depend on equipment type, please contact Electra Technical Support Department for specific recommendations.

Max hold-time after tack-dry is 12 – 24 hours, depending on ambient conditions

Exposure

Source spectral output: 310-420 nm. Optimum wavelength is approx. 365-385nm.
At least 800mJ/cm2 UV energy is likely to be required (according to ILT 390B light bug)

Step wedge: 8 - 12 clear (Stouffer 21 step, under the artwork)

Higher exposure energies (e.g. higher step wedge) may be necessary to prevent wrinkling of the soldermask between tracks when processing at high film weights and / or increased copper track heights (i.e 2 oz and above),

Determination of the correct exposure should be carried out after setting the developing speed since this will affect the step wedge reading obtained.

Developing

Developer:	1% aq. sodium or potassium carbonate.
Recommended pH:	10.6 – 11.0
Spray pressure:	2.5 – 3.0 $kgcm^{-2}$, 35 - 45 psi.
Typical spray time:	45 - 60s
Temperature:	31 - 33°C (88 - 91°F)

Optimum developing speed is set when an unexposed board develops off completely, 25- 50% of the way through the machine. This speed should be ascertained by preliminary tests prior to making exposure tests.

The selection of developing speed and break-point settings may ultimately be determined by the amount of ink deposited in panel holes during coating

Boards should be well rinsed with fresh water and fully dried after developing.

Final Cure

Convection oven: 60 mins at 150°C (300°F) (*This is the time at board temperature)*

UV bumping

It is generally undesirable to UV bump Carapace®EMP110 W-LED, as this may cause embrittlement and excessive yellowing on subsequent soldering operations.

Safelight

It is not normally necessary to print Carapace®EMP110 W-LED under safelight conditions, although it may be advisable if there are long delays before drying. 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 / Legend / marking inks

Thermal curing notation inks are ideally suited for use with Carapace® EMP110 W-LED. Thermal curing inks may be applied before or after final cure.
A partial cure (30 mins at150C (300˚F) is recommended prior to LPI legend application.

UV-curing legend inks are not generally recommended because of the 'UV-bump' effect on the soldermask. However, if used, such inks should be applied before thermal cure of the soldermask.

Stripping

After curing, soldermask may be removed from copper surfaces using a high temperature proprietary strip solution. Some additional scrubbing may be required. Soldermask cannot be fully removed from laminate surfaces.

Sn/SnPB rework

Care should be taken if a re-working process incorporates Sn or Sn/Pb stripping and a subsequent re-HASL cycle. This has been found to increase the yellowing potential of the coating.

Cleaning

Equipment should be cleaned of residual soldermask using **SW100 or Dowanol PMA.**

Shelf-life

Minimum 9 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-840C	6H	Pass, class H
Adhesion	SM-840C	Copper: 0% removal Base laminate: 0% removal SnPb: <10% removal	Pass, class H
Chemical resistance Isopropanol (min.120s) Isopropanol/H_20 (75/25) D-Limonene 10% Alkaline detergent Monoethanolamine Methylene chloride Deionised water	SM-840C Room temp. 120s 46 (± 2)°C 15 min Room temp. 120s 57 (± 2)°C 120s 57 (± 2)°C 120s Room temp. 60s 60 (± 2)°C 5 min	No surface roughness No blisters No delamination No swelling No colour change No cracking	Pass, class H
Hydrolytic stability	SM-840C	No evidence of reversion	Pass, class H
Insulation resistance	SM-840C	Before solder 10^{11}-10^{12} Ω After solder 10^{11}-10^{12} Ω	Pass, class H

TEST	METHOD	RESULT	CLASSIFICATION
Moisture & insulation	SM-840C	No blistering, separation, degradation. Initial $10^{11} – 10^{12}$ Ω During $10^{9} – 10^{10}$ Ω After $10^{11} – 10^{12}$ Ω	Pass, class H
Wave-solder resistance 10 (± 1)s at 260 (± 5)°C	SM-840C	No loss of adhesion or solder pick-up.	Pass, class H
Hot-air-solder-level	N/A	Minimum 5 cycles	Pass
Thermal shock	SM840 C	No cracks, delamination, crazing or blistering	Pass , class H
Dielectric strength	SM840 C		Pass , class H
Dielectric constant		4 (1 MHz)	

Other **UL File E95722** 94 V-0

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