# TECHNICAL DATASHEET

# EPIC LSF60

## Aqueous Developable
## PHOTOIMAGEABLE SOLDERMASK

**PRODUCT DESCRIPTION**

**Epic LSF 60 Matte** is a liquid, photoimageable two component soldermask which is designed for aqueous processing. The product can be applied to printed circuit boards by screen printing, curtain coating and by electrostatic spraying.

**Epic LSF 60 Matte performance properties include**:

- High Productivity in processing
- Excellent resolution capability
- Compatible with no clean and aqueous based fluxes and solder pastes
- Use as a selective plating resist in electroless nickel gold.
- Low Odour

Epic LSF 60 meets international specification requirements such as:

- IPC SM 840 B CLASS 3
- Bellcore specification TR-NWT-000078 Issue
- Siemens SN 57030 ( With specific HASL fluxes)
- Underwriters laboratories UL VO flammability on 0.062 “and 0.025” (0.8 mm and 1.6 mm) thick FR4 base material (File No E68935 S)

**PROCESSING REQUIREMENTS**

**Process Environment**

Epic LSF 60 Matte is a negative Working Photopolymer, sensitive to ultraviolet light, excessive temperature and humidity. It is recommended that all application processing steps: coating, exposure, developing and inspection of processing steps should be done in a controlled yellow room environment:

| | |
|---|---|
| Lighting: | Yellow Light |
| Temperature: | 20 to 22°C |
| Relative Humidity: | 40 - 60% |

**Product Mixing**

To obtain the optimum results with the product it is important that mixing of the components A, B and C (the diluent solvent) is done thoroughly. A motor driven device is strongly advised. Adequate mixing will be achieved within 15 to 20 minutes.
The mixing ratio is 100 parts A to 20.4 Parts B. This equates to the ratio supplied in commercialised containers.
The shelf life of the mixed product is 5 days at a temperature of 23°C.

**Surface Preparation**

To obtain the optimum adhesion of Epic LSF 60 Matte, the surface to be coated should be free from surface contaminants such as grease, oxides and fingerprints. Suitable cleaning methods include the following:

1. **For Copper**
    a. Brush Pumice (grade 3F or 4F)
    b. Jet Pumice (grade 3F or 4F)
    c. Wet Brush (grade 320 grit)
    d. Chemical (oxide preferred)

When Mechanical cleaning is used, the surface roughness should be in the range of 2 to 4microns (with 18 to 24 peaks per 100 microns).

Note: Chloride based micro etch solutions should not be used.

- Typical Copper precleaning
    - Deoxidise Copper (acid spray rinse $H_2SO_4$)
    - Pumice Clean 3F of 4F or wet Brush 320 grit
    - High Pressure mains water rinse followed by
    - De-ionised water rinse.
    - Turbine dry

2. **For fused Tin/Lead and melting metals**
    All oxides, organic contaminants, fusing fluids and ionic contamination must be removed.

- Typical Fused Tin Lead Precleaning

    - Saponification spray cleaner @ 50 to 60°C with soft bristle brushes
    - Water rinse plus DE-IONISED water rinse.
    - Turbine dry or oven dry for 30 min @ 110 to 120°C

**Regardless of the type of substrate that has to be cleaned, drying is essential. Where in line drying is leaving moisture on the substrate additional drying should be done in a convection oven, at a temperature of 70 to 80°C for 30 minutes or a conveyorised IR drier for 60 seconds @ 121 to 149°C.**

**Ideally all precleaned panels should be coated within four hours. Since this may not always be possible, it is recommended that panels held longer than four hours be re-cleaned and dried before coating.**

## Coating

### Screen Printing

After mixing of components A and B the product should be allowed to stand for 15 minutes prior to use.
To obtain the correct film thickness and the required resist coverage over conductors the following parameters are recommended.

- Screen Printing Parameters

    - Screen mesh: 34-43T Polyester
    - Screen tension: 13 - 17 N/cm2
    - Squeegee hardness: 60-80 Shore
    - Squeegee edge: rounded
    - Squeegee angle: 75°
    - Print Speed: <3 m/min
    - Pressure: Operator and panel dependant
    - Print Mode: Flood/Print/Print
    - Snap off: 4mm

    After printing panels should be racked and dried horizontally. The recommended minimum dried resist thickness required over conductor edges is 12/15 microns.

- Curtain Coating Parameters

    - After mixing parts A and B together the viscosity is adjusted by the addition of ER10 Reducer
    - One set of product (8.3 Kg part A and 1.7kg Part B), requires the addition of 2 kg of ER10 Further additions of solvent are made to control viscosity
    - The correct viscosity is determined with a DIN No 4 cup (100ml content, nozzle diameter 4mm)
    - The time to empty the DIN cup @ 21°C should be between 100 and 125 seconds.
    - The parameters for curtain coating can vary depending on the type of coating equipment used. The following parameters should be used as a guideline:

        1. Viscosity: 90-120 seconds
        2. Pump setting: lowest possible to achieve an unbroken curtain

3. Head Gap: 0.5mm
4. By pass: >50% open
5. Belt Speed: 80 to 120 m/min

- Setting and adjusting the coating thickness is done by determining the wet weight of coated panels. Typical wet weights used range between 95 and 110 g/m$^2$.

- Electrostatic Coating Parameters

  - For electrostatic spray coating the recommended diluent solvent is ER10 reducer
  - The viscosity should be in the range of 100 to 180 seconds @ 21°C using a DIN No 4 cup.
  - The spray parameters will depend on the type of equipment used

    The following parameters for a Bolhoff Coresol line should be used as a guideline:

    1. Bell rotation speed: 20,000 to 30,000 rpm
    2. Voltage: 25 to 50kV
    3. Pump rate: 40 to 120 ml/min
    4. Conveyor Speed: 1 m/min

**Drying**

Epic LSF 60 Matte can be dried by batch, conveyorised or IR convection ovens. The drying times will vary depending on the type of equipment used.
For air convection ovens a typical drying cycle is 10 to 15 minutes per side at a board surface temperature of 75 to 80°C.
In conveyorised drying systems the drying time is dependant on the type of equipment and the weight of the solder mask.

Typical examples of drying parameters for two commonly used types of equipment, for dry wet weights of 105 to 110 g/m$^2$ are:

- Epic Cargo Drier CD20

  - Set temperature: 115/120°C
  - Recirculated air temp: 55°C
  - Index time: 17 seconds

- Infra Red Drying

  - The drying time and temperature in IR drying equipment has to be adjusted to the specific equipment being used. In practise a combined IR/hot air drying unit of 8m in length with an integrated leveling zone could be run e.g. with a temperature profile between 60 and 110°C. An overall drying time of 5 minutes would correspond to a conveyor speed of 1.6m/min.

- Hold Time Prior to exposure
    - It is recommended that coated panels be allowed to return to room temperature (20°C) prior to exposure. A hold time of 15 minutes will minimise panel to panel exposure variability.

**Exposure**

Epic LSF60 Matte soldermasks are negative working polymers which can be exposed utilizing conventional UV exposure sources. The exposure time for the proper polyerisation of the product is a function of the type and intensity of the light source used.

Epic LSF60 Matte will react with light in the spectral range of 340 to 420nm. Commercially available exposure units with mercury lamps in the 3 to 10 KW range which are doped with Fe are recommended. Units which have exposure frame air or water cooled are preferred, as excessive temperatures during exposure can result in the phototool sticking to the solder mask.

Good Vacuum is essential during exposure to obtain the optimum cross linking of the soldermask.
Exposure times will depend on the type of equipment used and the resist thickness. The correct exposure time can be determined by using a stouffer 21 step and sensitivity guide. A clear copper step 10 is required. With a 5 kW light source this will normally equate to an energy level of 350 mJ/cm$^2$.

Epic LSF 60 Matte contains a photofugitive dye which produces a visual contrast between exposed and non exposed resist.

**Developing**

The hold time between exposing and developing should not exceed 24 hours. This is important to note, since Epic LSF 60 Matte has a very high through put in coating and drying, compared to conventional products.

Epic LSF 60 Matte can be easily developed using a mild alkaline solution of **1.0 to 1.3% potassium or sodium carbonate at a temperature of 28 to 35°C**.

The developing time will depend on the equipment being used. The spray pressure, type of nozzle arrangement, and the length of the developing chamber will all affect the developing process. The process should be set up to achieve a clean break point at 50% of the distance through the developing chambers. A spray pressure of at least 2 bar is recommended to ensure clean developing of resist out of circuit holes.

A combination of high developing temperatures (+35°C) and solution concentrations in excess of 1.3% can degrade the surface of the soldermask.

A typical time to develop a 25 micron coating at a temperature of 30°C with spray pressure of 2Bar at 50% break point is 60 seconds.

To effectively remove all developing solution residues, panels must be thoroughly rinsed with water at temperatures ranging from 10 to 20°C and spray pressures of 1.5 to 2.0 Bar.

Complete rinsing prior to final curing is necessary to remove ionic contaminants which can affect post HASL ionic cleanlines values. In order to meet stringent ionic cleanliness requirements the use of deionized water rinse after mains water rinsing is recommended.
Following developing, panels should be dried thoroughly.

Mixed processing of Epic LSF 60 Matte with primary imaging dry films though possible is **not** recommended.

Antifoam is recommended for the defoaming of developer solutions. The concentration needed is between 0.2 and 1ml/ltr.

## Curing

To obtain the optimum chemical, mechanical and physical properties of Epic LSF 60 Matte, thermal curing is necessary. This is achieved using a convection air oven, either batch or conveyorised.

The recommended curing time is **60 minutes at a temperature of 150°C**. This will normally equate to a total curing cycle time of 75 to 90 minutes.

Epic LSF 60 Matte can also be cured using Infra Red curing equipment. Temperature settings and lines speeds will depend on the type of equipment being used.

Epic LSF 60 Matte does not require a UV cure to meet IPC SM840 B Class 3 requirements. A UV cure of 2.5 to 3.0 joules per $cm^2$ carried out after developing, has been found to increase the pencil hardness of the product from 6H and 7H. This increased hardness has proved to be beneficial in assembly soldering and defluxing process.

## Performance in electroless nickel gold

Epic LSF 60 Matte can be used as a selective plating resist in electroless nickel gold.
The recommended process is to partially thermal cure the resist for 15 minutes at 150°C, carry out the electroless nickel gold process, and then fully cure the panels at 150°C for 60 minutes.

The minimum resist thickness requirements is 12/15 microns over conductor edges.

Testing has also shown that when the product is cured by infra Red cure, the resist withstands the electroless nickel gold process successfully. This provides a single cure system for processing the resist to meet electroless nickel gold requirements.

Epic LSF 60 Matte has been tested and found compatible with the following Electroless nickel gold plating solutions:

- Atotech Aunic System (Strike)
- Atotech Aurotech system (Palladium)
- Enthone OMI Selrex SMT system
- Lea Ronal Ronamerse SMT System
- PMD Procirc Cirgold SMD System
- Shipley Aureus Nickel Gold System

Epic LSF 60 matte is compatible with most common hot air solder levelling (HASL) operations when used in accordance with the manufacturers' recommendations.

**Performance in Hot Air Solder Levelling (HASL)**

Panel coated with Epic LSF 60 Matte should be hot air solder levelled as soon as possible following final curing, this will reduce the possibility of moisture absorption by the base laminate, which has been shown to cause blistering. If moisture pick up has occurred, pre-conditioning the coated PCBs at 120 to 130°C for 60 minutes prior to HASL should eliminate this type of defect.

The use of an alkaline saponifying flux cleaner prior to water rinsing may be necessary to meet stringent end user ionic cleanliness requirements.

In order to meet Siemens specification requirements, approved HASL fluxes have been used. The following two products are approved:

- **Alpha 757 SG**
- **Pangaflow FM4010**

Chemical Cleaning Solutions of Fluxes which contain Chlorides should not be used**.**

**Assembly Soldering**

Epic LSF 60 Matte is compatible with most commercially available fluxes. In production the product has shown a low tendency to solder pick up with no clean fluxes.
As no clean fluxes, by definition, consist almost entirely of solvent, it is particularly important that there is sufficient resist coverage over conductors (12/15 microns) to protect against attack during the high temperatures encountered during soldering.

The following (non-exhaustive) list of the fluxes has been found to be compatible with Epic LSF 60 Matte:

- Alpha 32E Alpha FSW32
- Alpha 351 Alpha RF32D
- Alpha SM 2101 Alpha GR8
- Cobar 380 Cobar 390 RX
- Cobar398 Ersa RA 201
- Ersa SGF2 I/Flux 2005
- Litton 950 M/Core X32101
- Stannol ST500- 320IV9

**Resist Removal**

Errors in the product application process may require the resist to be stripped. The uncured resist can be removed in an aqueous solution of 5% potassium hydroxide at a temperature of 50 to 60 °C. Or alternatively, polar organic solvents like acetone may be used.
Cured Epic LSF 60 Matte is very difficult to strip. A proprietary stripper like ES108H can be used, contact your Electra representative for advice.

## Illumination of Working Areas

Epic LSF 60 Matte is sensitive to strong white light. It is recommended that the working areas be illuminated with yellow fluorescent lamps, such as Phillips type 1.2m TL-D36W-16. Windows should be coated with a non bleachable yellow film which is not transparent to wave lengths below 450nm.
Alternatively Plexiglas type yellow 303 is equally suitable.

## Storage Conditions

For optimum long term storage, EPIC LSF 60 Matte should be held in the unmixed state in a dry and cool environment (30 to 70% RH at a temperature of between 5 and 20°C).

The minimum shelf life of the product from date of manufacture recommended storage conditions is 12 months for LSF60 Part A and 24 months for LSF60 Part B.

## Shipping Conditions

EPIC LSF 60 Matte is a stable product in the unmixed state and does not require refrigeration for long-distance seafreight or trucking purposes but should be stored under recommended condition once delivered.

## Product Characteristics

| | | |
|---|---|---|
| Solid Content: | 55% to 58% for the Spray and Curtain Coat<br>67.5% for Screen Print | |
| Density (25ºC) | Component A | 1.25 g/cm³ |
| | Component B | 1.05 g/cm³ |
| | Mixture | 1.23 g/cm³ (before dilution) |
| Mixed Pot-life: | Mixed Components A+B | 8 Days at a temperature of 22º C |

## Product Final Properties

| TEST | METHOD | RESULT | CLASSIFICATION |
|---|---|---|---|
| **Hardness (pencil)** | SM-840B 2.4 27.2 | 6H | |
| **Hardness (acc Knoop)** | | 24/26 | |
| **Abrasion (Taber method)** | SM-840B 4.8.3.1 | Pass | |

| TEST | METHOD | RESULT | CLASSIFICATION |
|---|---|---|---|
| **Grid section** | DIN 53152 | GT 0 | |
| **Chemical resistance**<br><br>10% Sulphuric acid<br>5% Caustic soda<br>Alcohols, e.g. Ethanol<br>Ketones, e.g. Acetone<br>Methylene chloride<br>Fluoro-chloro-hydrocarbons | <br><br>Room temp. 60 mins<br>Room temp. 60 mins<br>Room temp. 24 hours<br>Room temp. 1 hour<br>Room temp. 1 hour<br>Room temp. 1 hour | <br><br>Pass<br>Pass<br>Pass<br>Pass<br>Pass<br>Pass | |
| **Thermal Shock Resistance** | MIL-Std 202F/107D<br><br>Siemens F12-F8089<br>(-65°C/15 min, 125°C 15 min – 100 cycles) | No Crack Formation<br><br>Pass | Pass |
| **Insulation resistance** | Siemens F12-F9089<br>23°C/50% RH/100V DC<br>After 4 days, 40°C/92% RH | $2.0 \times 10^{14}\ \Omega$<br>$4.0 \times 10^{10}\ \Omega$ | |
| **Specific Insulation resistance**<br>After 4 days storage at 40°C/92% RH | DIN 53 482<br>VDE 0303, part 3 | $1.1 \times 10^{15}\ \Omega$<br>$2.2 \times 10^{12}\ \Omega$ | |
| **Surface resistance**<br>After 4 days storage at 40°C/92% RH | DIN 53 482<br>VDE 0303, part 3 | $4.2 \times 10^{14}\ \Omega$<br>$7.2 \times 10^{11}\ \Omega$ | |
| **Electrolytic corrosion**<br>21 days 40°C/92% RH | Siemens F12-F9089 | 0 | |
| **Creepage Current Strength**<br>Test solution A | DIN, IEC 112<br>VDE 0303, part 1 | 550 | |
| **Break down Strength**<br>Mean value (kV/mm) | VDE 0303, part 2<br>DIN 53481 | 141 | |
| **Dielectric Constant**<br>23°C/50% RH | DIN 53483<br>VDE 0303, part 4 | 1 KHz 4.1<br>100 KHz 3.8<br>1 MHz 3.7 | |

| TEST | METHOD | RESULT | CLASSIFICATION |
|---|---|---|---|
| **Dielectric Loss Factor**<br>23°C/50% RH | DIN 53483<br>VDE 0303, part 4 | 1 KHz $3.3 \times 10^{-2}$<br>100 KHz $3.0 \times 10^{-2}$<br>1 MHz $2.1 \times 10^{-2}$ | |
| **Wave-solder resistance** | SM840B 4.8.9.2<br>MIL-Std 202F/210A | 10s at 260 (± 5)°C<br>30s at 280 (± 5)°C | Pass<br>Pass |
| **Hot-air-solder-level** | 255 (± 5)°C | Minimum 3 x 10s cycles | Pass |
| **UL Flammability** | UL 94 V-O | V-0 | E 68935 |

For further information, contact:

Electra
Roughway Mill
Dunk's Green
Tonbridge
Kent TN11 9SG
ENGLAND

Tel: +44 (0)1732 811 118
info@electrapolymers.com

Or visit our Website for details of local offices and Distributors

**www.electrapolymers.com**