

# Digital Photolithography Line

## Roll-to-Roll

100µm

### Applications

The variability of substrates and the ability to deliver a complete development and production cycle allows the technology to be used in such areas as:

- Flexible circuit boards and multilayer structures with interconnects and resolution down to 10 µm
- High-density fine-line technology for chip assembly
- Low-loss and high accuracy antennae for high frequency applications

### Fraunhofer EMFT services

Fraunhofer EMFT provides an extensive portfolio of process „know-how“ for R2R production of flexible electronics. This includes for example:

- In-house sputtering on PET and PI foils up to a web width of 215 mm
- Web ultrasound cleaning and drying
- Dry resist hot press lamination
- Digital double-sided photolithography exposure
- Wet development and etching
- Plasma surface cleaning and surface modification
- Laser ablation, via process and engraving

From  
pure substrate  
to assembled  
product!

- Laser cutting
- R2R bare die pick-and-placement
- Electrical and mechanical foil-to-foil assembly and packaging

These modules can be combined at will, depending on the requirements of the application in question. Parameters such as structural precision can be individually tailored to the customer requirements.

### Advantages

- Fast and flexible realization of innovative ideas with flexible circuit carriers on foil – from feasibility studies to prototypes and pilot production
- Expert support provided by highly qualified and experienced personnel throughout the whole development process – from circuit design through small batch production all the way to technology transfer for industrial manufacturing

### Technology

Standard substrates include 20  $\mu\text{m}$  - 100  $\mu\text{m}$  clean-on-demand PET, PEN and polyimide films. The use of other foil materials and thicknesses is possible as well. The width of the foils to be processed is up to 305 mm, with the possibility of infinite design along the length of the film.

### Foil materials

- Polyimide, PEN, PET and customer-specific materials
- Foil width 305 mm, exposure width 275 mm
- Roll-to-roll e-plated copper

### Photolithography

- Maskless digital lithography with the digital exposure heads with 10  $\mu\text{m}$  and 6  $\mu\text{m}$  writing resolution
- Exposure width 185 mm, length up to 100 m
- Multilayer design and alignment on both sides of the foil
- Alignment for the existing marks and infinite design stitching

### Process module 1: Roll-to-roll copper thin film

- Thin layer copper with  $d \sim 0.1 - 0.8 \mu\text{m}$  (typ.)
- Resistance  $\sim 43 \text{ m}\Omega/\text{Square}$  @ 0.5  $\mu\text{m}$
- Optionally, Cr as adhesive promoter for demanding substrates

*Picture front side: Via holes on double-sided structured foil*

### Process module 2: Roll-to-roll e-plated copper

- Thick layer copper with  $d < 10 \mu\text{m}$
- Resistance (5  $\mu\text{m}$ )  $\sim 4 \text{ m}\Omega/\text{Square}$
- Resistance (10  $\mu\text{m}$ )  $\sim 2 \text{ m}\Omega/\text{Square}$
- Cr as adhesive promoter (Optional)
- Patterning with lithography and wet chemical etching

### Laser Processing

- Laser microdrilling for interconnects and vias
- Cutting of device contours
- Laser engraving

### Lamination

- Application of e.g. protective foils to the whole surface
- Adhesive foils and lamination to the device or surface
- Lamination of the two different designs and foils

### Test and Characterization

- Visual control, optical inspection
- Testing of electrical parameters
- Degradation tests of humidity and temperature impact
- Measurement of HF-characteristics up to max. 100 GHz customer interface
- Further tests on request

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