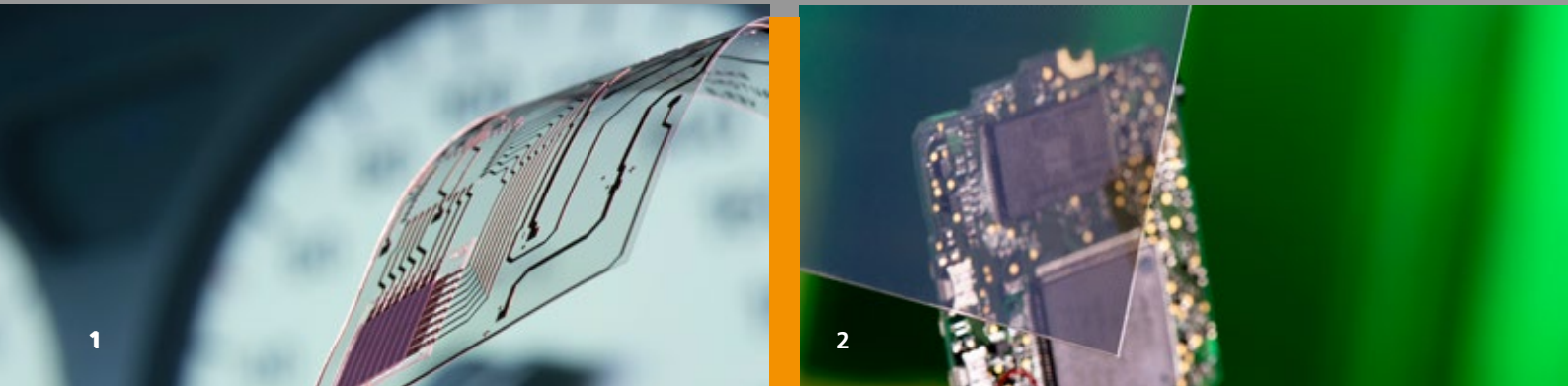




Fraunhofer

EMFT

FRAUNHOFER RESEARCH INSTITUTION FOR MICROSYSTEMS AND SOLID STATE TECHNOLOGIES EMFT



1 Demonstrator for system integration on foil

2 Sensor foil for protecting system integrity

WIRING SYSTEMS ON PLASTIC FILMS

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Applications

Interconnection of components for integration in electronic foil systems:

- Inexpensive screen-printing process for
- High density fine-line technology for chip assembly
- High frequency impedance controlled wiring with high precision requirements

- Double-side wiring technology
- Electrical and mechanical foil-to-foil assembly

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 close to 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

The Fraunhofer EMFT Offering

Fraunhofer EMFT provides an extensive portfolio of process modules for developing foil-based interconnections systems. These include for example:

- Multilayer screen printing
- Photolithographic patterning of thin film metallization
- Fabrication of electroplated conductors with semiadditive processing
- Multilayer wiring technology

Fraunhofer EMFT is participant in the



**Forschungsfabrik
Mikroelektronik
Deutschland**



Technology

Standard substrates include 50 µm thin 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, the area available for design is appr. 300 x 300 mm. The design parameters apply as listed here.

Foil materials

- Polyimid, PEN, PET and customer-specific materials
- Foil width 305 mm
- Foil length 5 - 100 m, typical length for R&D projects is ca. 15 m

Photolithography

- Maskless or mask-based approach
- VHDI-area 300 x 33 mm
- Step distance 300 mm

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

- Thin layer Copper with $d \sim 0,5 \mu\text{m}$ (typ.)
- Resistance $\sim 43 \text{ m}\Omega/\text{Square}$
- Cr as adhesive promoter
- Structuring with lithography and wet-chemical etching

Designrule	Highest	Relaxed
Line	4	60
Space	4	60
Long line	10	70

Process module 2: Roll-to-roll e-plating copper

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

Designrule	Min.	Recomm.	Relaxed
Line	20	40	60
Space	20	40	60
Long line		50	70
Line Ni/Au	24	40	60

Process module 3: MEMS - gold

- Foil processing with MEMS-Technology on 150 mm handling wafer
- Au- thin film $d \sim 150 \text{ nm}$
- Resistance $\sim 400 \text{ m}\Omega/\text{Square}$
- Resistance dependent on the process control
- No adhesives between foil and gold

Designrule	Min.	Recomm.	Relaxed
Line	8	10	20
Space	8	10	20
Long line		16	30

Process module 4: Roll-to-roll screen printing

- Structured application of functional materials 5 - 25 µm thick

- Multilayer application of functional layers is possible
- Functional materials for electroluminescent display elements available

Designrule	Min.	Recomm.	Relaxed
Line*	50	200	300
Space*	100	250	350
Long line*		350	500

* depending on the material

Laser processing

- Maskless patterning of single layers
- Laser drilling of foils
- Cutting of device contours

Lamination

- Application of e.g. protective foils to the whole surface

Test und 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

3 Controlling bio chips on foil substrate, manufactured by roll-to-roll process

4 Keypad on foil substrate, manufactured from a single part in a roll-to-roll process