



user interfacing and printed electronics

12 april 2018 - Veenendaal  
**USER  
INTERFACE  
DESIGN**  
Engineering & Design



12 april 2018 - De Basiliek Veenendaal

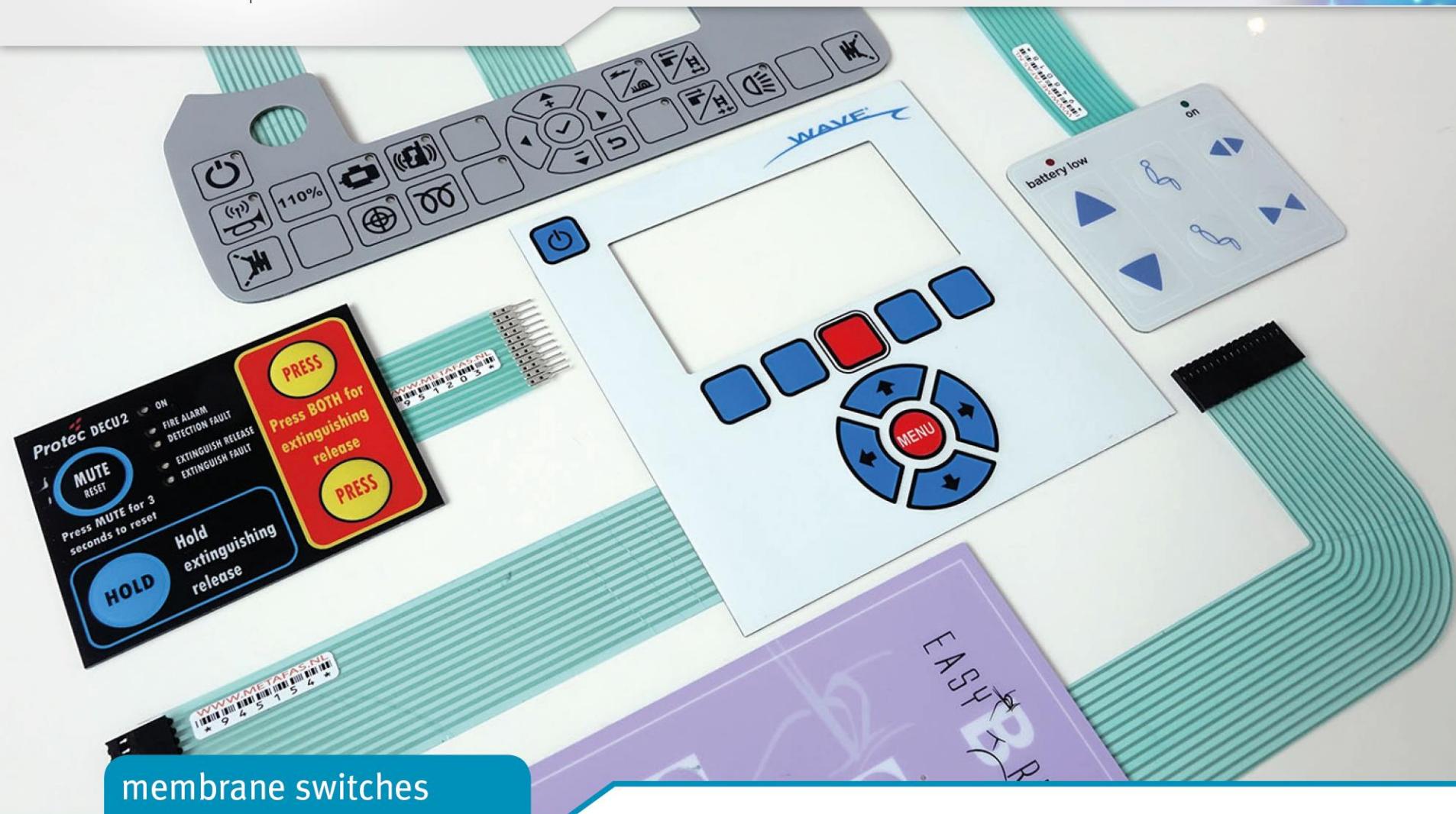
# USER INTERFACE DESIGN

Engineering & Design

*SMART THINKING IN PRINTING*



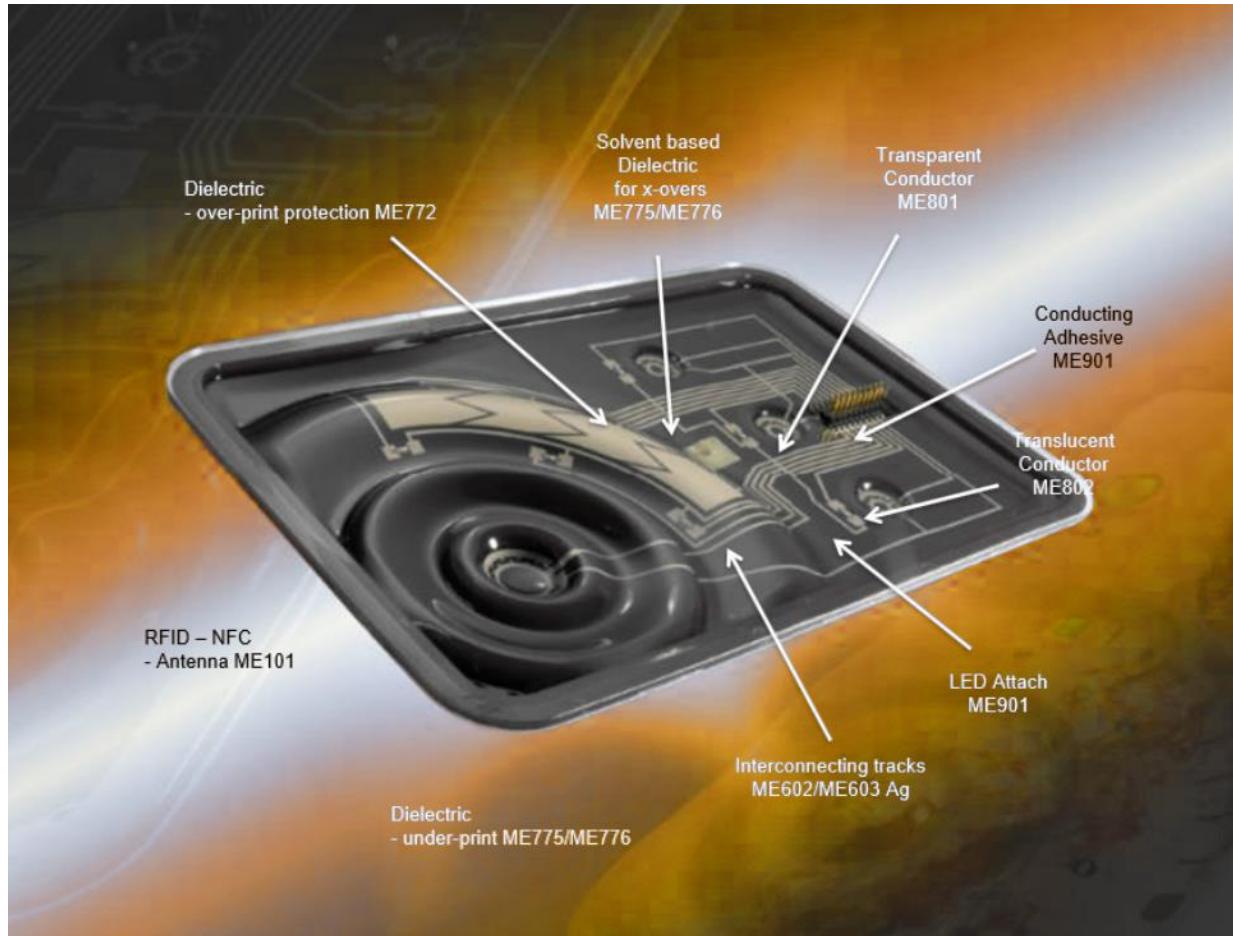
METAFAS



SMART THINKING IN PRINTING



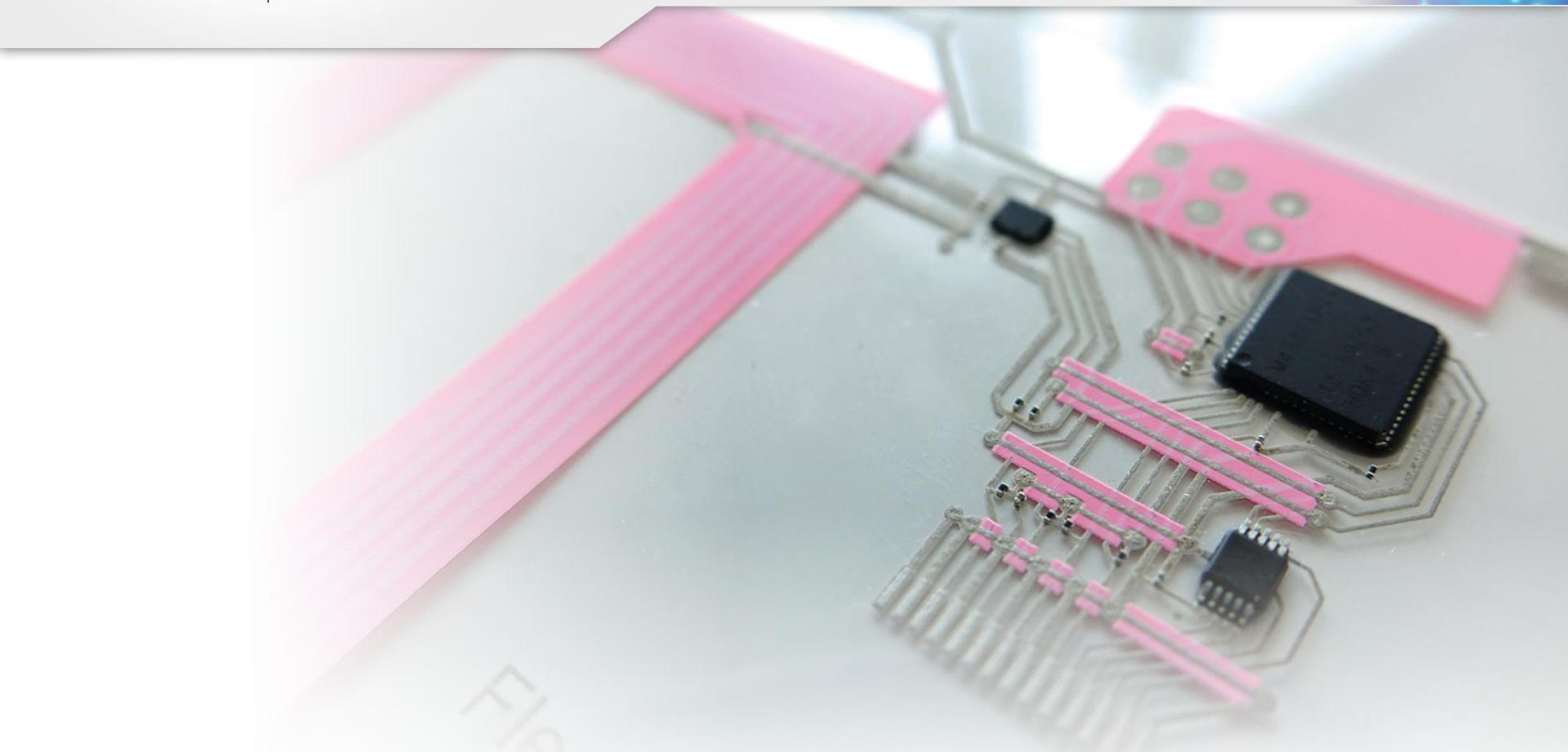
# Thermoforming / Injection moulding



SMART THINKING IN PRINTING



METAFAS



hybrid electronics

SMART THINKING IN PRINTING



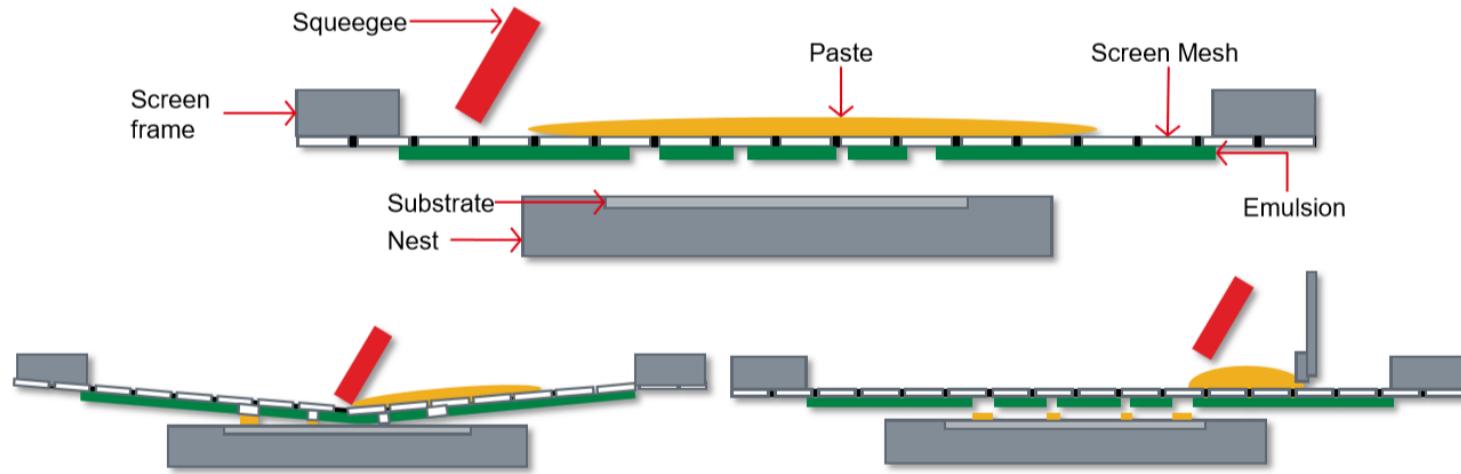
## Digital printing



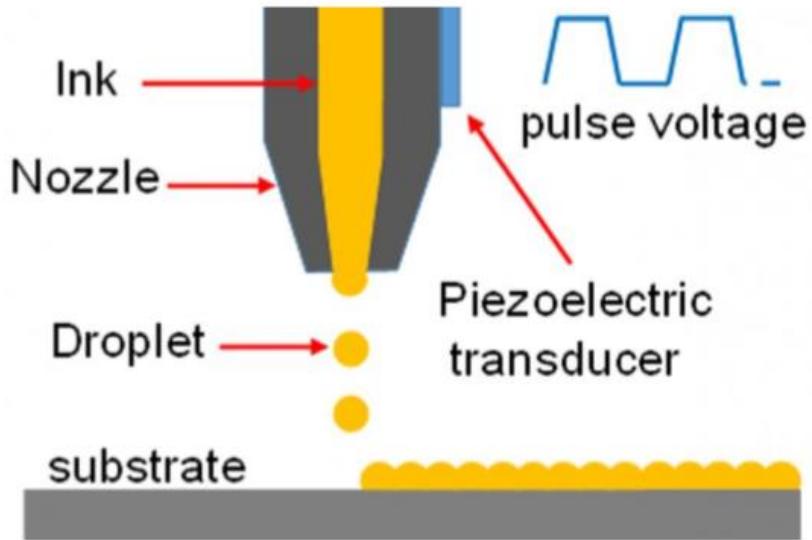
## Screen printing

SMART THINKING IN PRINTING

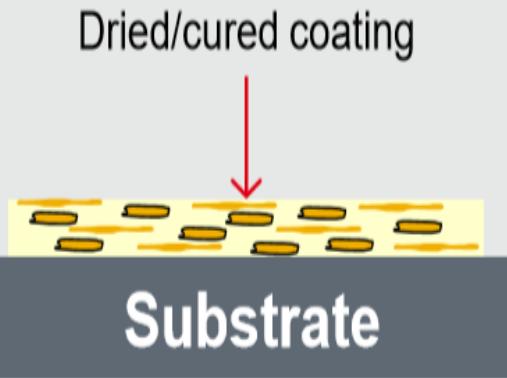
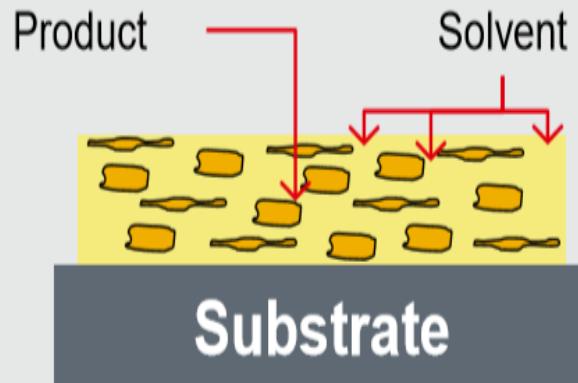
## Processing – Screen printing



## Processing – Digital printing



## Processing – Drying and Curing



Shrinkage solvent based materials during drying 50-70%

12 april 2018 - Veenendaal

# USER INTERFACE DESIGN

Engineering & Design



*SMART THINKING IN PRINTING*

## Compatibility with substrate and other used products

- **Electrical Properties**

- Sheet resistance
- Dielectric properties

- **Mechanical Properties**

- Adhesion/Cohesion
- Flexibility
- Hardness

- **Environmental stability**

- Heat
- Humidity
- Silver migration
- Resistance against solvents & chemicals

# Product Properties

<b>Shelf life</b>	Stability, sedimentation, changed performance
<b>Wet product specification</b>	Solids, viscosity, flashpoint, coverage
<b>Storage conditions</b>	Room temperature, refrigerator, freezer
<b>Application method</b>	Screen-, gravure-, flexo printing, or other methods
<b>Required drying/curing conditions</b>	Temperature, UV, hybrid
<b>Selling price</b>	For customer the cost in use (€/m <sup>2</sup> or €/part) is important



## Product Properties – Sheet resistance

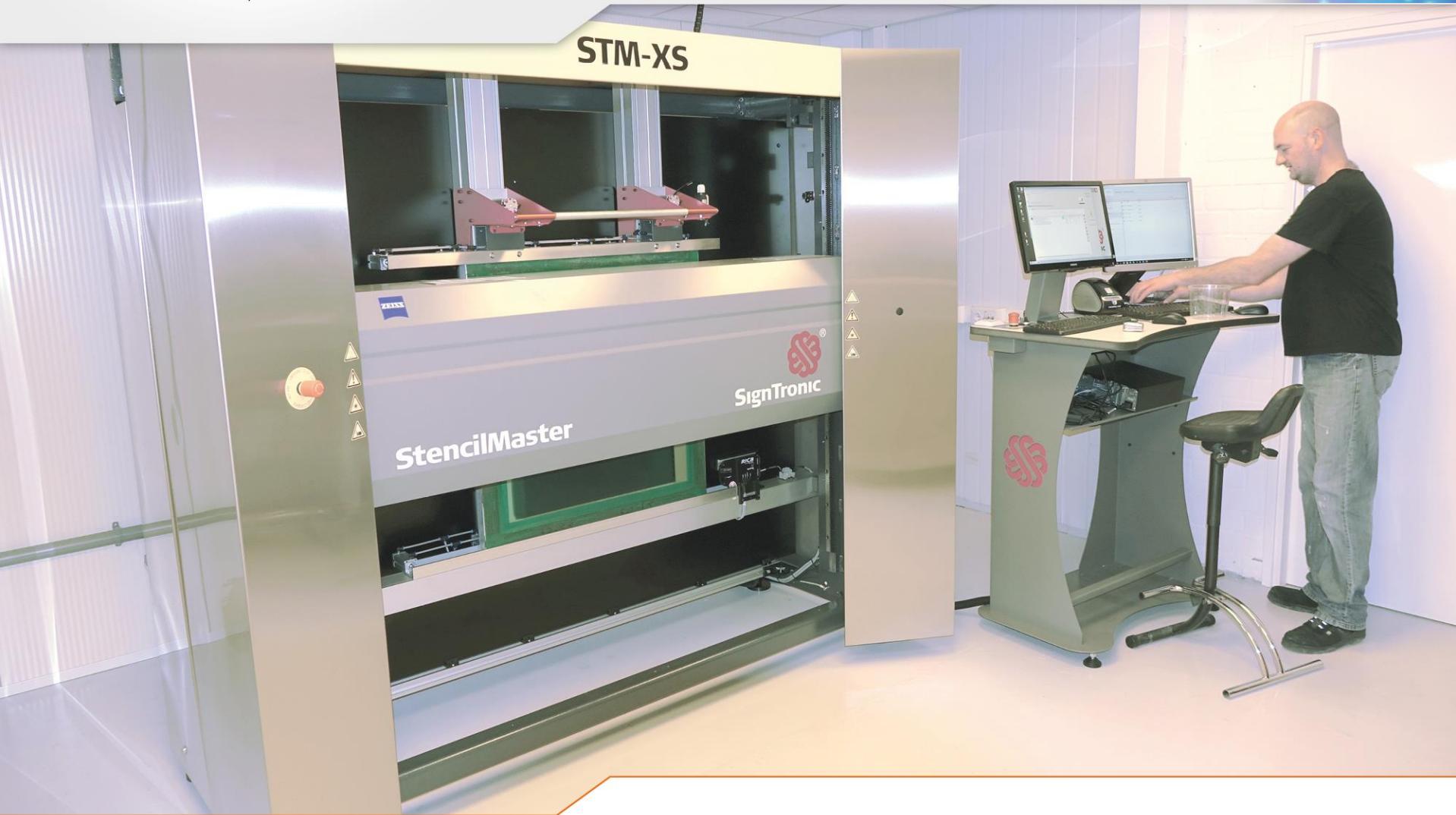
$$Rp (\Omega/\text{sq}/25\mu\text{m}) = \frac{Rt * t * W}{25*L}$$



R <sub>p</sub>	product resistance (ohm/sq./25μm)
R <sub>t</sub>	track resistance (ohm)
t	dry coating thickness (μm)
W	track width (mm)
L	track length (mm)

### Calculation Example

1. A track with a length of 100 mm and a width of 2 mm is  $100/2 = 50$  sq.
2. The track has a resistance of 3.0 ohm, which means  $3.0/50 = 0.060$  ohm/sq.
3. The dry film thickness is 10 μm, so product resistance is  $0.060 \times 10 / 25 = 0.024$  ohm/sq./25μm



SMART THINKING IN PRINTING

## Product Properties – Adhesion testing

Adhesion according to ASTM-3359B

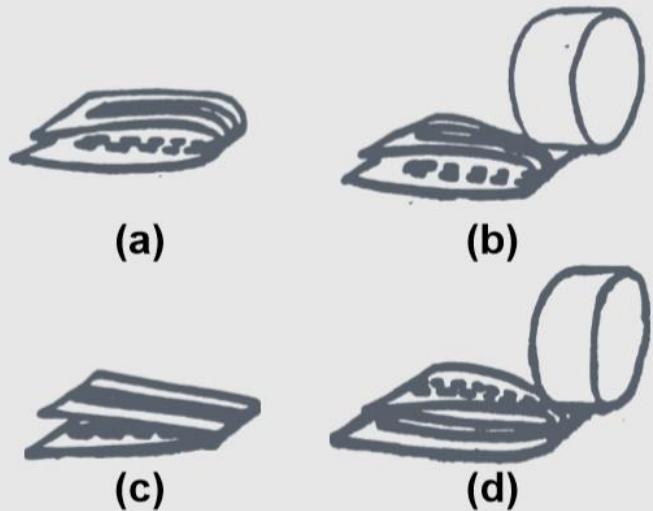
Rating	Appearance of the crosscut after adhesion test
5B	No removal
4B	
3B	
2B	
1B	
0B	More than 65% removal

### Rating

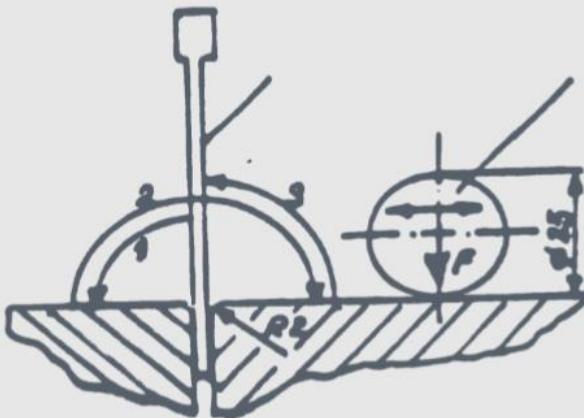
- 5B: no removal
- 4B: <5 % removed
- 3B: 5-15 % removed
- 2B: 15-35 % removed
- 1B: 35-65 % removed
- 0B: >65 % removed

## Product Properties – Flexibility

Flexibility test 2000 grs Roller



Flexibility test DIN 42115



## Silver Migration

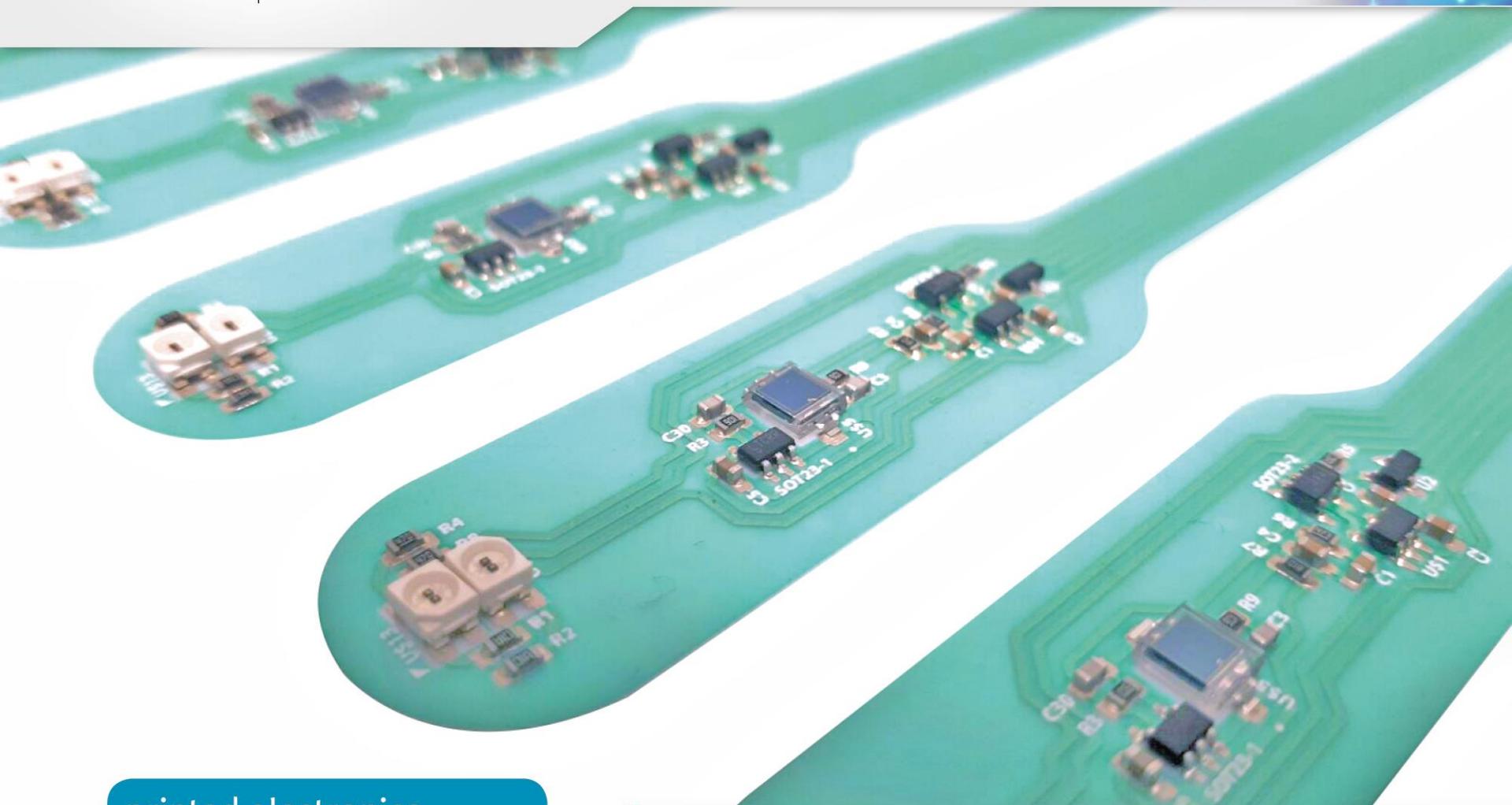
### How to avoid/reduce risk of silver migration

- No constant charge on the tracks
- Avoid absorption of moisture
- Protect silver tracks
- Upgrade track layout
- Use non-silver containing PTF inks
- Use better moisture resistant dielectric coating
- Do not print crossovers
  - THP
  - Old concept (separated circuits)





METAFAS



printed electronics

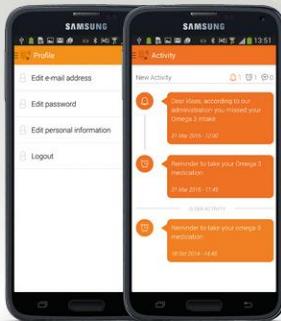
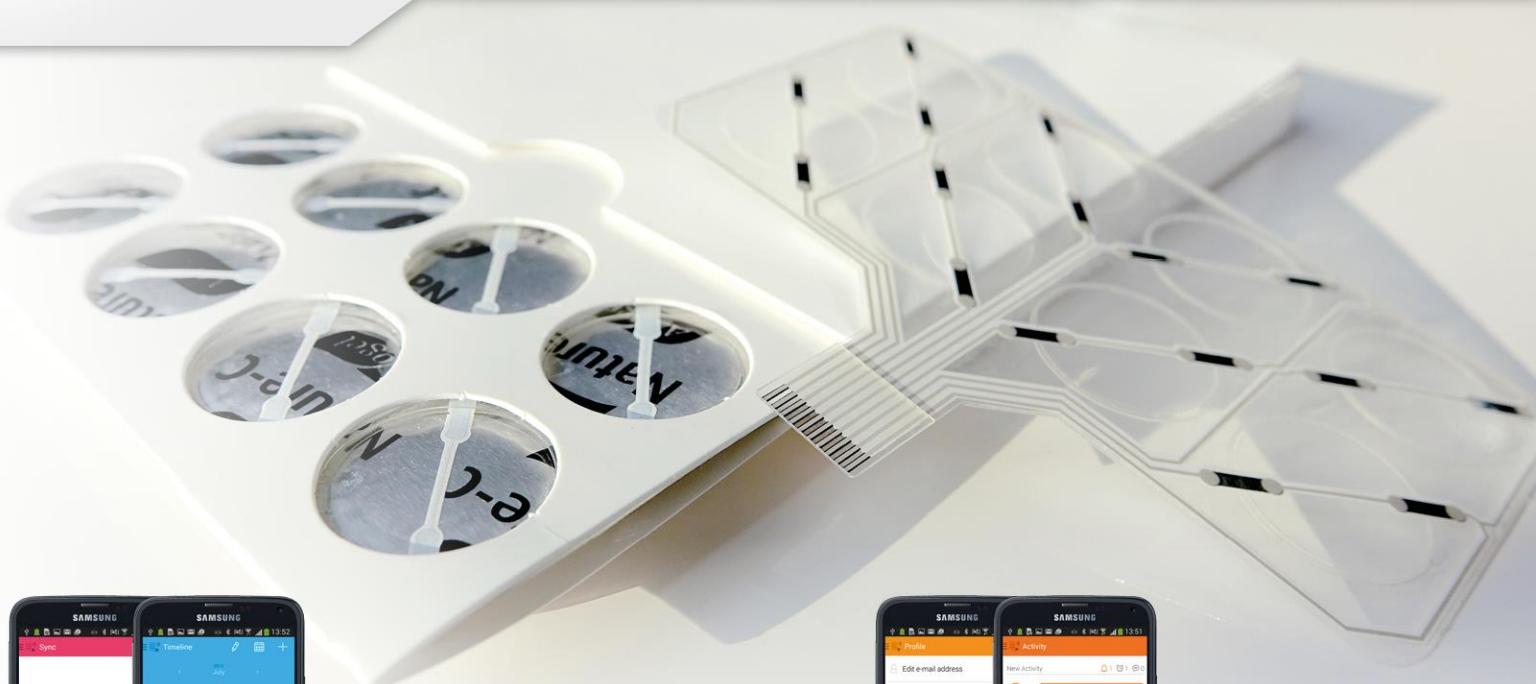
SMART THINKING IN PRINTING



SMART THINKING IN PRINTING



hybrid electronics



SMART THINKING IN PRINTING

## Applications – Heating Elements

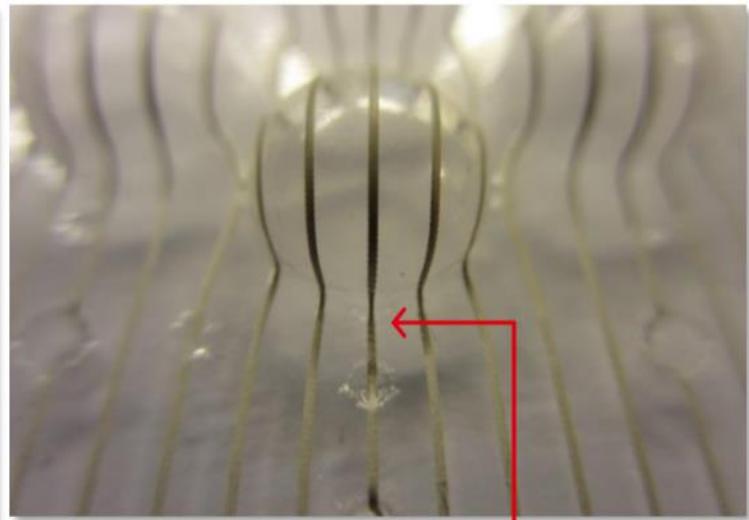
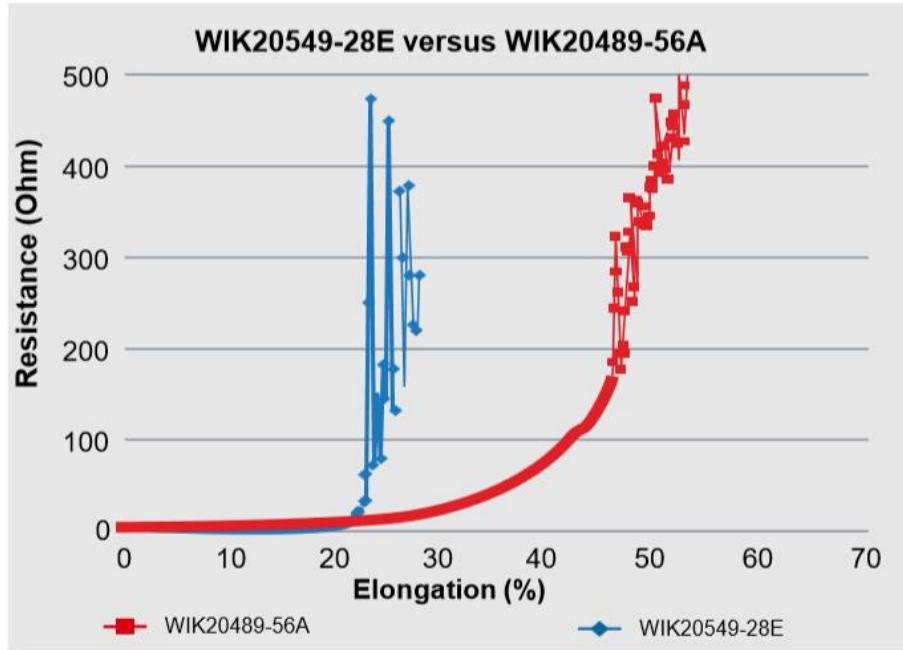
The following type of materials can be used for producing printed heating elements

- Silver inks
- Resistive inks (carbon/non conductive blends)
- PTC inks
- Dielectric inks (protective layers)



## New developments – thermo-formable inks

Resistance versus elongation curves



Courtesy Holst centre

Thermo-formed silver tracks



12 april 2018 - Veenendaal

# USER INTERFACE DESIGN

Engineering & Design



*Thank you for your attention*



*SMART THINKING IN PRINTING*