ASYS GROUP

Skalierbare SMT Fertigung

Die Möglichkeiten das Drucksystem mittels Optionen an die Anforderungen der Fertigung anzupassen.

Torsten Vegelahn, Mai 2025

ASYS GROUP

Business Units

Business Unit

Electronics

Business Unit

Life Science

Business Unit

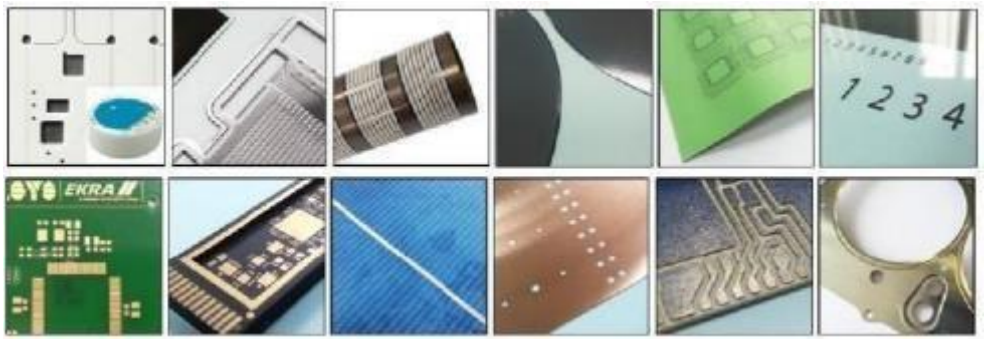
Energy

Technology: Unlimited Possibilities

Substrates

Ceramics, Fuel Cell, Pipe, Wafer, Flex-Ceramics, Glass;

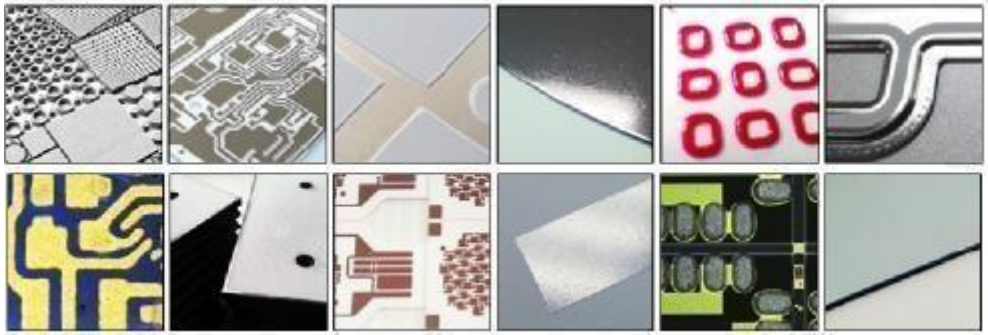
PCB, HTCC, Solar Cell, Metal Foil, DBC/ DCB, Cylinder Gaskets and many more…



Media

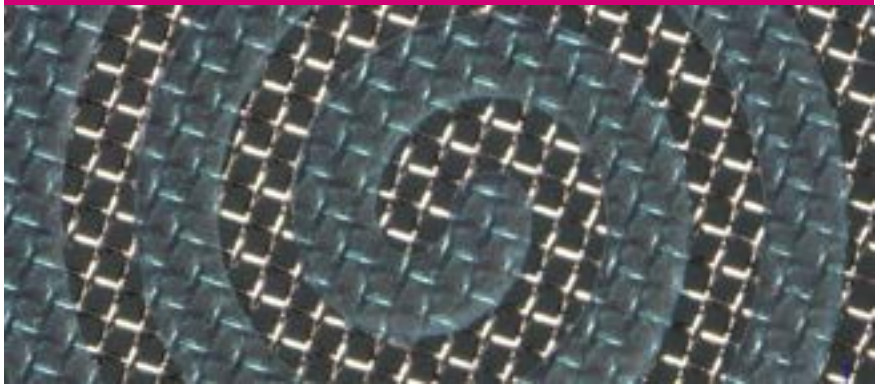
3D Print with Metal Paste, Silver Paste, Aluminium Paste, Polymer Paste, Glass Paste;

Gold-Paste, Heat Sink-Paste, Silicon-Paste, Copper-Paste, Solder-Paste, electrical Polymer and many more…



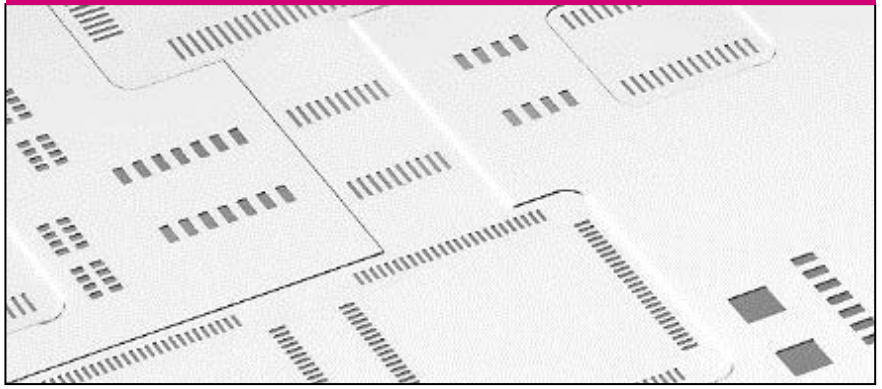
Screnn- vs .Stencil Print– Typical Applications

Screen-Printing



- Flexible layout design, especially on large areas, meanders and spirals, long lines, negative structures
- Thin layers app. 5 – 100 µm
- Low viscosity media/paste
- Cylindric substrate (tubes) round printing

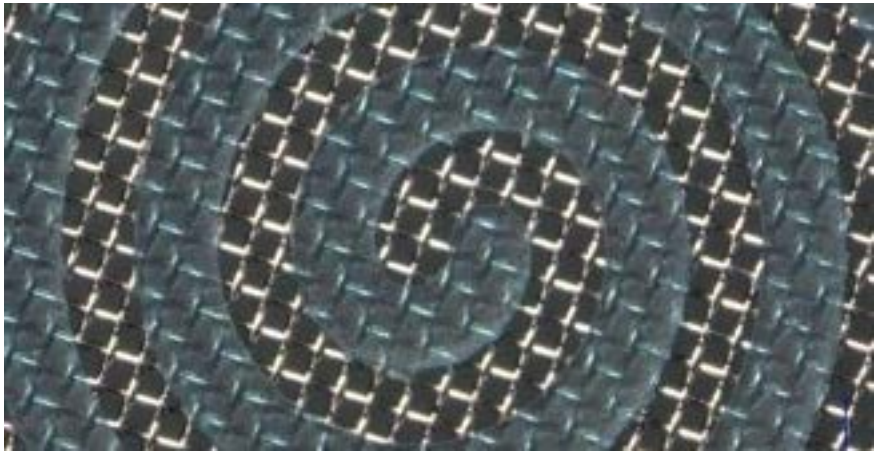
Stecnil-Printing

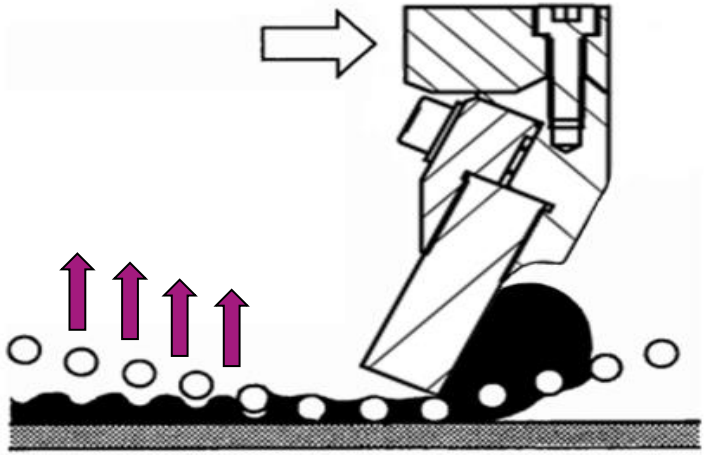


- Full-surface layouts
  → circle/ring require support structures
- High paste deposits app. 25 - 500 µm
- Paste with large grain i.e. Solder paste
- Slight Surface roughness
- Different / various layer thicknesses in one print

Pictures:: CK -Chrisian Koenen

How does Screenprinting works?

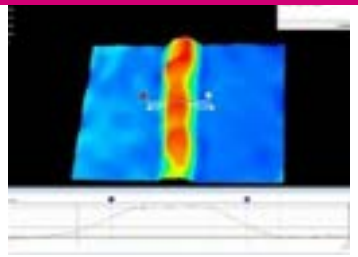




- Basis material: **Mash of fine Polyester or Stainless-steel filament**
- **Non-printable areas are sealed with a screen filler (emulsion)**
- Flood squeegee + **Rubber-Print-Squeegee**
- The flood squeegee sweeps the printing medium over the screen and fills the meshes. The rubber-squeegee then presses the screen onto the substrate. The screen tension pulls the screen away from the substrate directly after the squeegee. The print medium remains on the substrate.

Advantage Screen-Printing

Flexibility



- Particle sizes from Nanoscale up to ~50 µm applicable
- Layer thickness app. 5 – 500 µm (wet) possible
- Full surfaces as well as Fineline print up to 30 µm line width
- Almost all substrate materials processable
- Substrate thickness from ~10 µm up to solid objects printable

Speed

- Cycle time independent of the number and shape of the structures to be printed
- Established production processes in electronics with years of experience
- Step-by-step upscaling of production possible

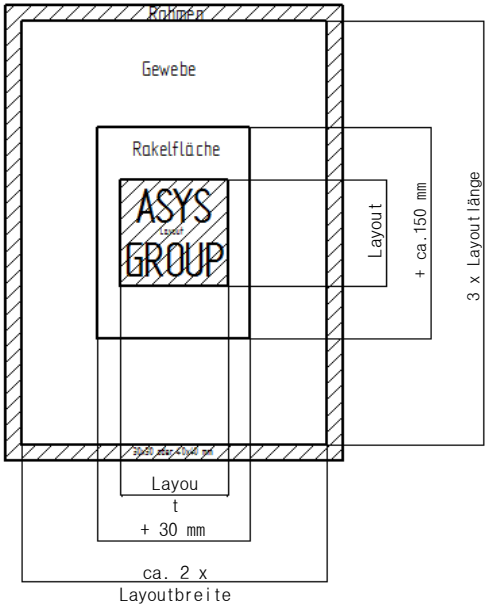
→ The Screen as exchangeable tool define Layout and thickness

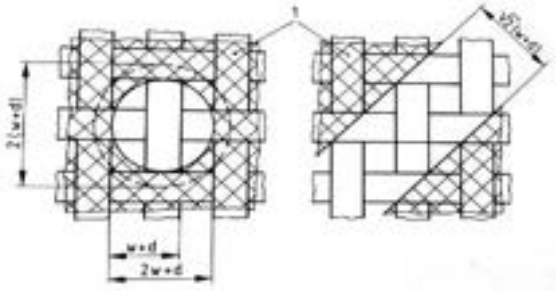
The Screen as limiting factor

- **Minimum Layout structure**
  › Rule of thumb :
  finest lines = wire gauge
- **Minimum and Maximum Layer thickness**
  - Availability of fabric
  - Fabric impression
- **Maximum particle size**
- **Maximum print format**
  - W = min. 2x Layout
  - L = min. 3x Layout

  or > 250 mm to frame inner side

  → Size of printing system!



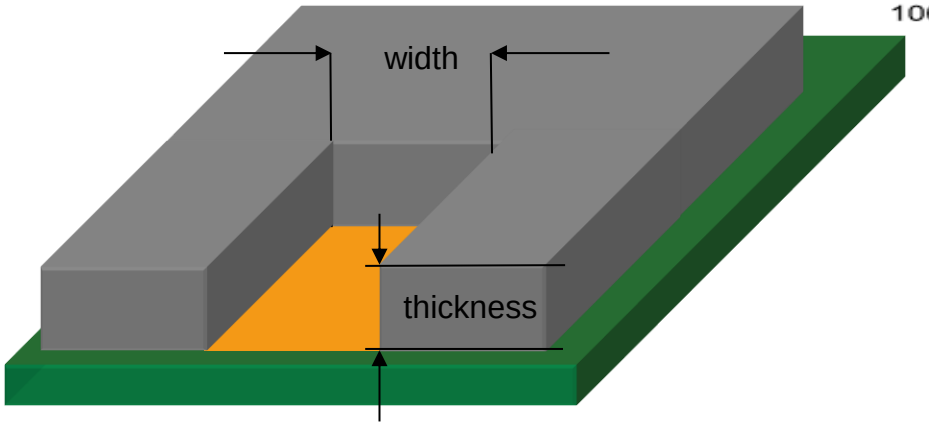


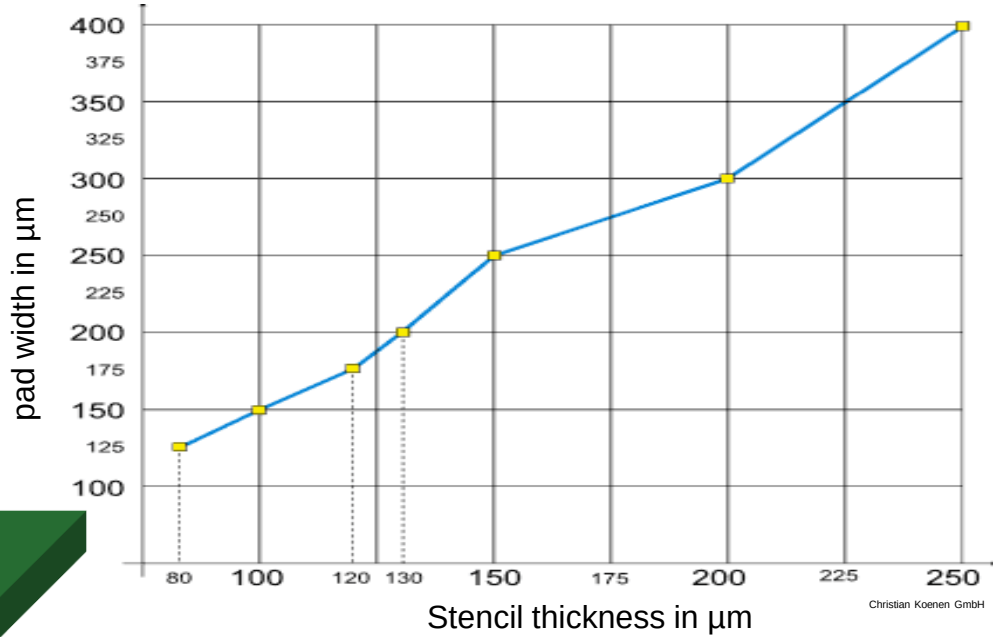
Quellen: Koenen; Kissel+Wolf

Stencil Design Rules

Design Rule 1: Aspect Ratio

$$\frac{\text{min. aperture width}}{\text{stencil thickness}} > 1{,}5$$





Stencil Design Rules

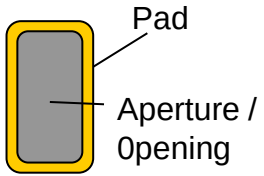
Design Rule 2: Area Ratio

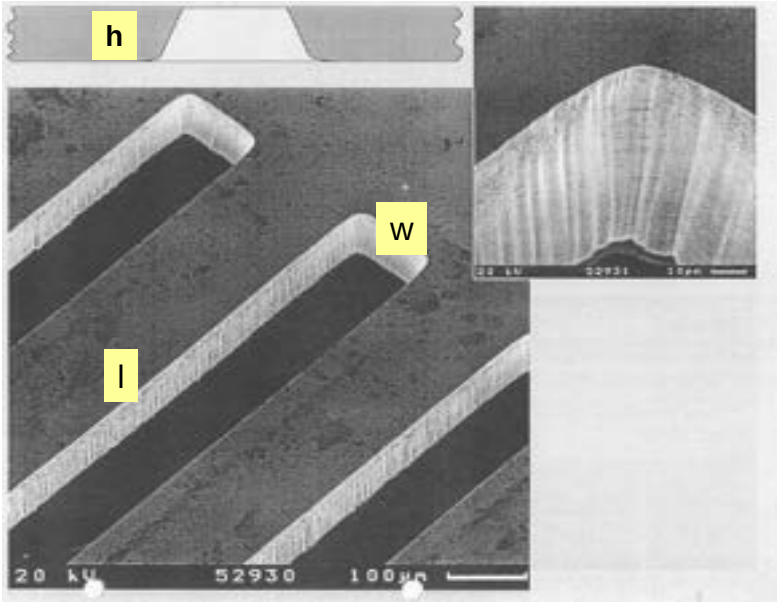
$$\frac{\text{Area stencil opening (aperture)}}{\text{Area stencil opening inner wall}} = \frac{l \times w}{2 \times h \times (l + w)} > 0.66$$

Best practise STM design rule:

- Aperture is 90% of the pad size

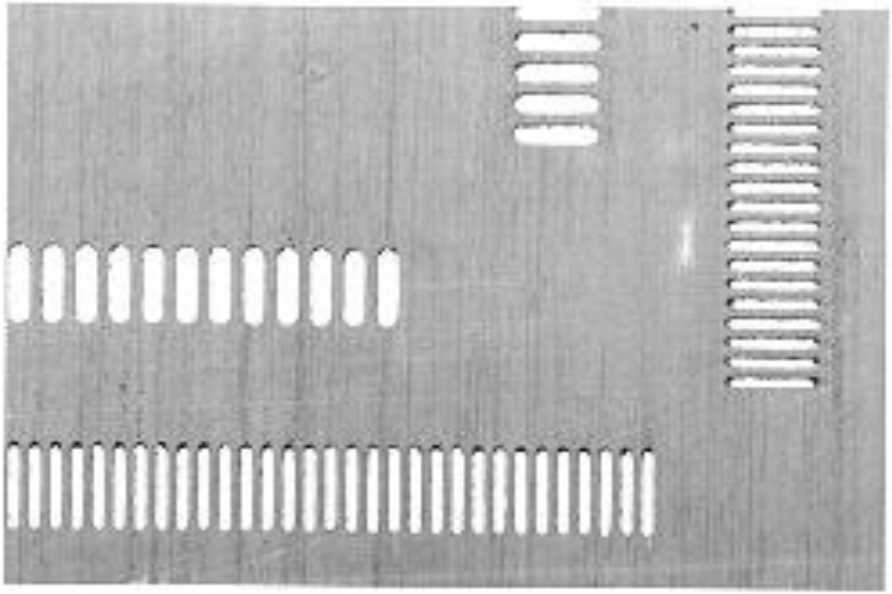
→ Specify area reduction or length reduction.



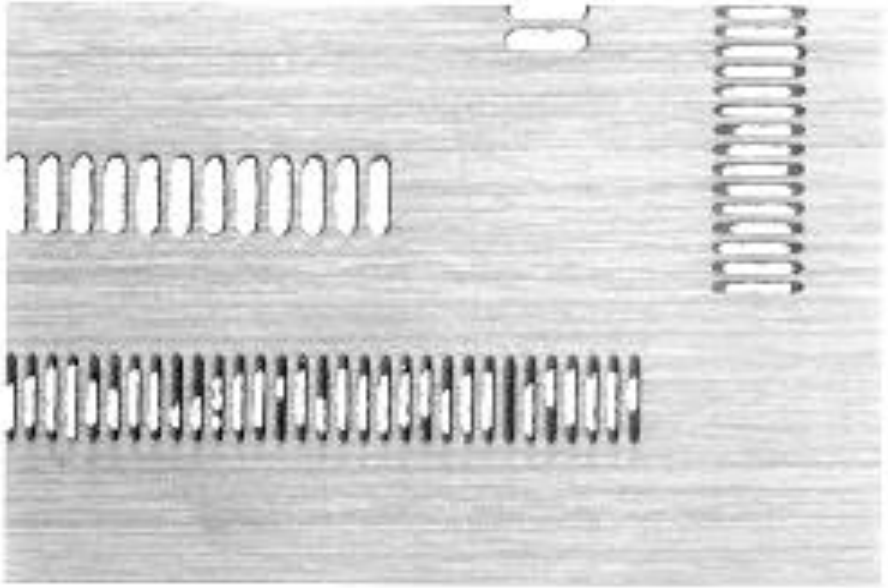


Stencil Design Rules - Effects

Non-compliance with design rules leads to poor paste dispensing, for example

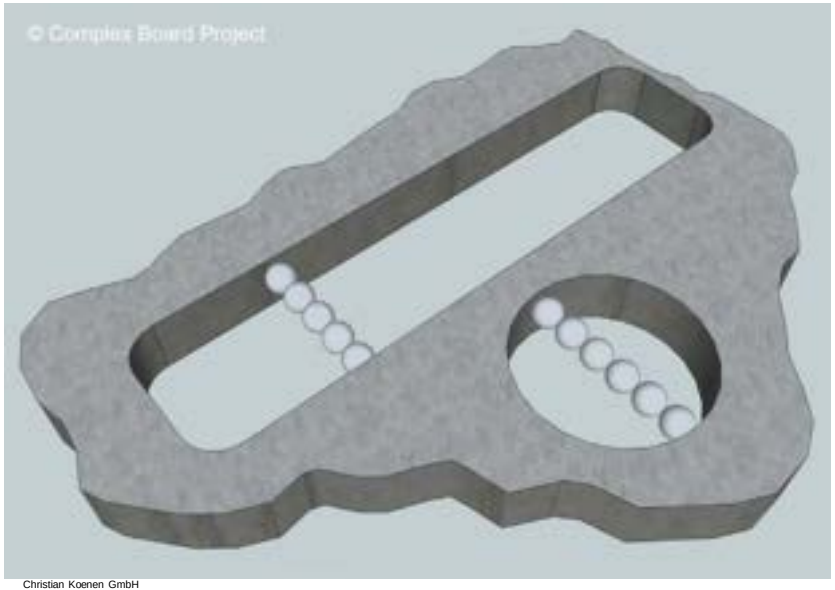


Aspect ratio w / t > 1.5



Aspect ratio w / t < 1.5

Solder Ball Rule (Aspect Ratio)



Christian Koenen GmbH

The smallest opening in the stencil determines the paste type.

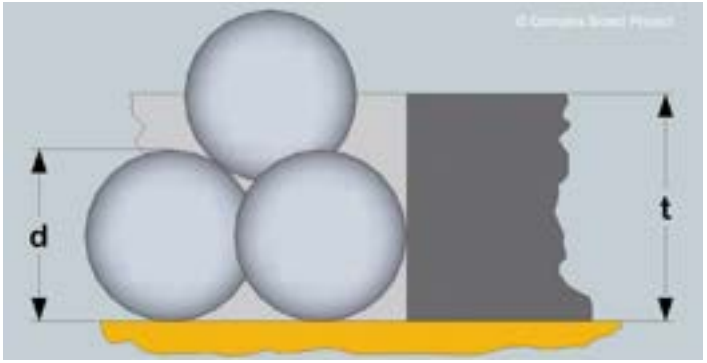
At least 6 solder balls should fit next to each other in round or square apertures,

or

respectively 4 to 5 should fit in elongated apertures

Solder Ball Rule in regard to stencil thickness

The smallest aperture defines the paste type (grain`

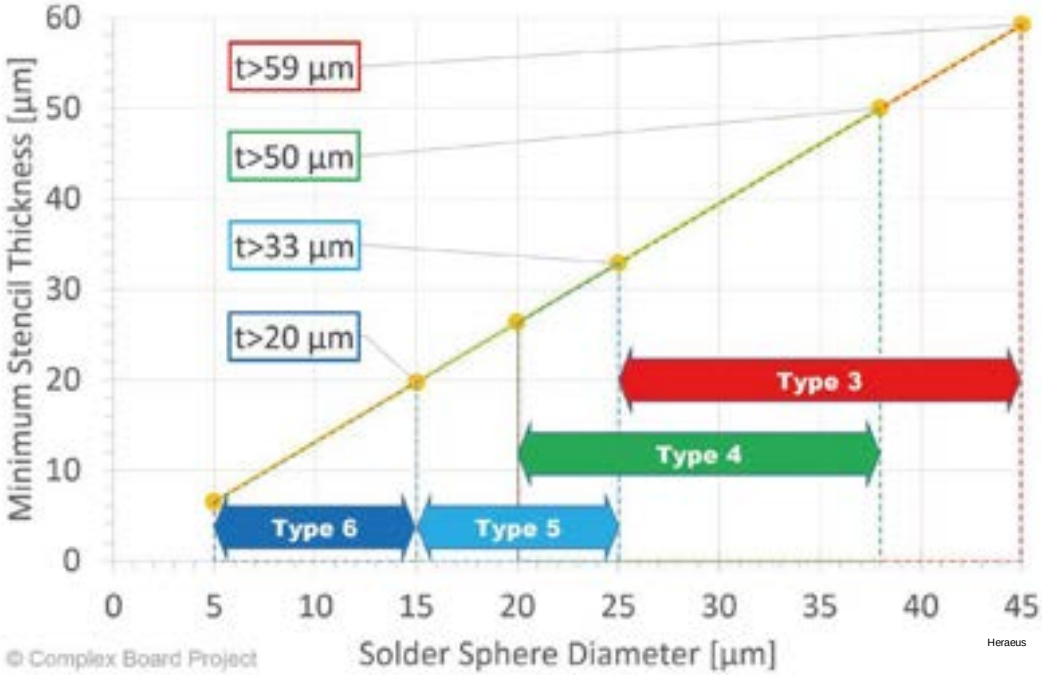


Christian Koenen GmbH

$$t \geq \frac{d}{2} \cdot \left(1 + \sqrt{\frac{8}{3}}\right)$$

$$t \geq d \cdot 1.32$$

with: t=stencil thickness; d=solder sphere diameter



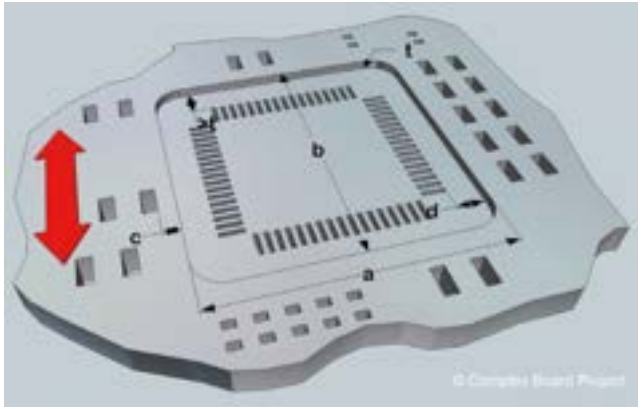
Step Stencil Rules

Different SMD components require different paste depot/volume.

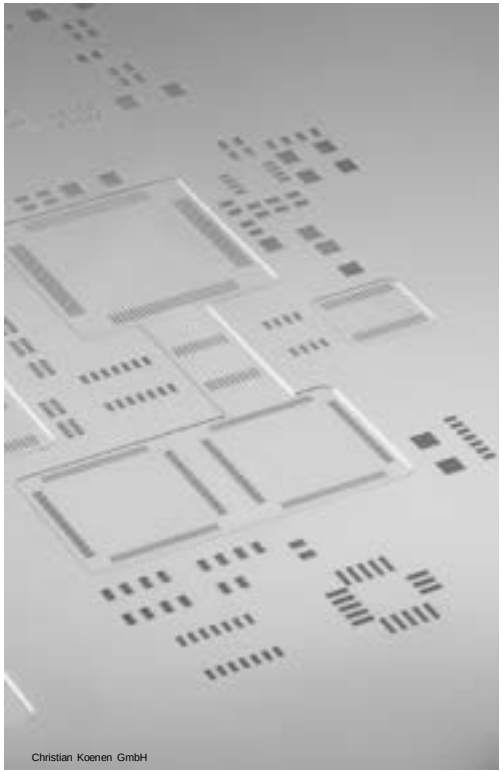
Therefore stencils require different thicknesses for ideal results/quality.

The thinnest area defines the paste type.

The step hight (t) defines c & d as well as squeegee blade typ.

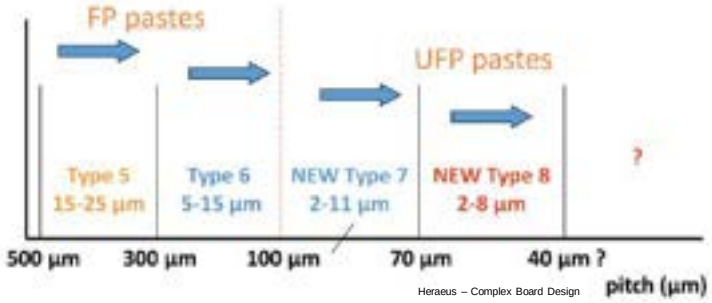


	Standard squeegee			Thinned squeegee		
t [µm]	d [mm]	a [mm]	b [mm]	d [mm]	a [mm]	b [mm]
10	0.30	> 0.25	> 0.25	0.30	> 0.25	> 0.25
30	0.90	> 1.00	> 1.50	0.60	> 1.50	> 1.50
50	1.70	> 10.00	> 2.00	1.50	> 10.00	> 1.50
100	5.80	> 30.00	> 10.00	2.50	> 10.00	> 1.50
250	12.00	> 75.00	> 10.00	9.00	> 30.00	> 10.00
Owing to the manufacture, (c) amounts to approx. 0.3 mm						



Solder Paste Type & Pitch

Stencil (Aspect Ratio), Solder Ball Rule and pitch define the paste.



Heraeus – Complex Board Design

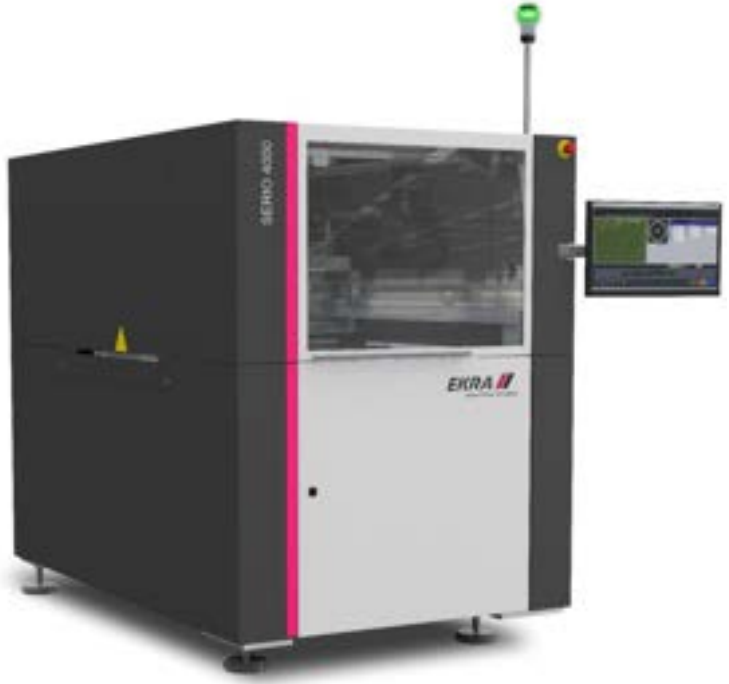
Type	No larger than	Less than 1 % are larger than	At least 80 % are between	No more than 10 % are smaller than
1	160 µm	150 µm	150 up to 75 µm	20 µm
2	80 µm	75 µm	75 up to 45 µm	20 µm
3	50 µm	45 µm	45 up to 25 µm	20 µm
4	40 µm	38 µm	38 up to 20 µm	20 µm
5	30 µm (28 µm)*	25 µm	90 % minimum 25 bis 10 µm	10 µm
6	20 µm (18 µm)*	15 µm	90 % minimum 15 up to 5 µm	5 µm
7	15 µm	11 µm	90 % minimum 11 up to 2 µm	maximal 1 % > 2 µm
8	11 µm	10 µm	8 up to 2 µm	

Heraeus – Complex Board Design

EKRA´s Unique Portfolio

Screen printing system using Template to Substrate alignment

Stencil printing systems using Substrate to Template alignment



Ideal Print Head for any Application

- ✓ **Pneumatic driven Head ideal for step stencil applications**
- ✓ **Screen print head with adjustable pendula and flood squeegee; electrical or pneumatic driven**
- ✓ **Sphere print head for autonomous operations**

Print Head`s

Standard Print Head

For standard Stencil applications

› Measure and control pressure every 40ms

› Ideal to compensate uneven surfaces and step stencils

Advanced Print Head

For Ultra Fine Pitch

› The squeegee releases the stencil to avoid any influence during separation

Autohead

Electric Print Head for Screen Printing

› Full automatic weight compensation

› Auto Zero Point detection

› Ideal for Wafer and Hycon applications

Special Transport Technology & Solutions

Mechanical Alignment

› Mechanical Alignment centering when lifted up

› Medium accuracy

› High throughput

Boat Transport

› Optical Alignment, individual alignment, individual print

› High accuracy

› Medium throughput

Optilign

› Optical Alignment individual alignment, single print

› High accuracy

› High throughput

Optilign MultiCarrier

› Collect up to 3 substrate / carriers, Optilign & print, Forward individually

› High accuracy

› Highest throughput

Transport System for regular shape Substrate

Standard

› Single Lane

› Special U-shape belts ensure secure transport of thin and large substrates

Disc Transport

› Perfectly supported all the way to the edge of the substrate

Heavy Duty

› To transport substrates with up to 20kg

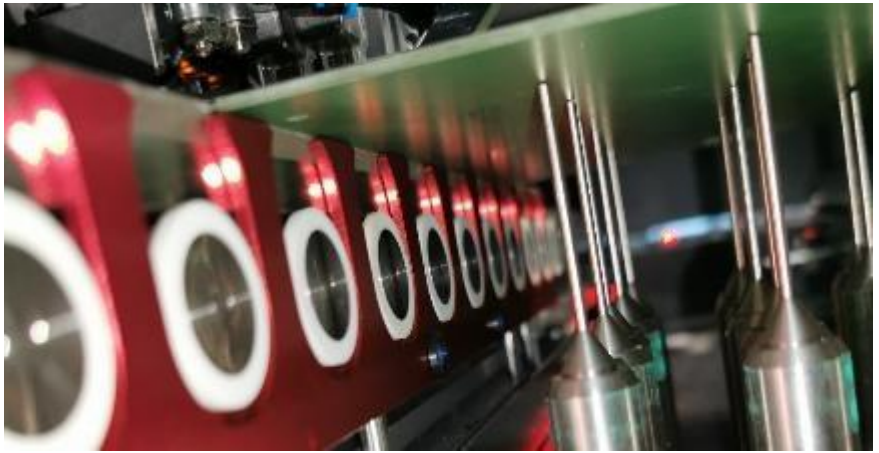
Dual Lane

› Dual lane transport

› Front- or Rear print + pass through lane

› Highest throughput on minimized footprint

Off-Belt Clamping for best print quality



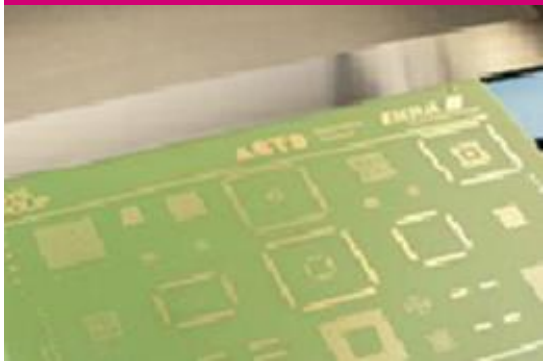
› Flexible! Side & top clamping as EKRA Standard featuring the unique U-Shape belt. Heavy duty optional available.

› Retractable clamping for unique snap off free contact area

› Disc transport for ideal ridged support on the very edge of the substate

Perfect Substrate Clamping

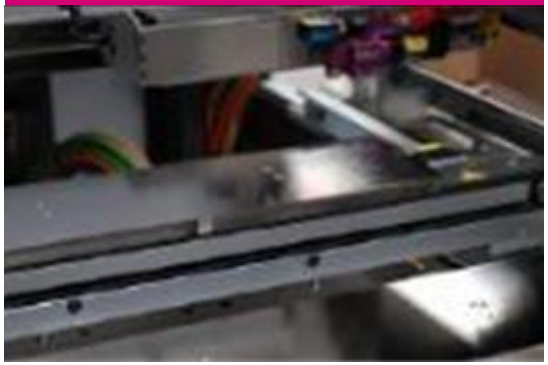
Side & Top- Clamps



› Top- & side clamping is standard on EKRA SERIO printers

› Side clamp force can be adjusted

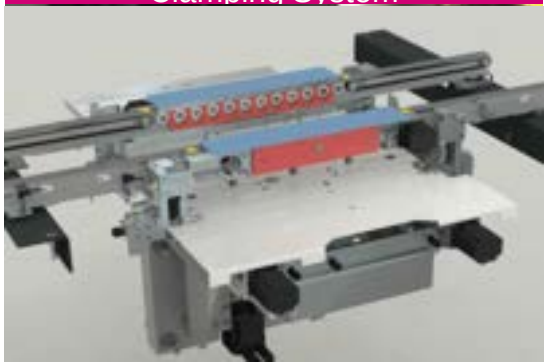
Retractable Clamping



› Hold down and side clamp the PCB, than retract the over top camps

› Snap-off free surface for ideal print results

Multiclamp: 3 in 1 Transport & Clamping System



› Combination of retractable clamping and Disc Transport

› Snap off free and ideal support on the outer edges

The challenges: Handling and Fixation of unusual Materials / Substrates

Thin Materials

Plastic foils

- „porous Stone“
- No imprints from vacuum holes
- White or grey for different substrate colors

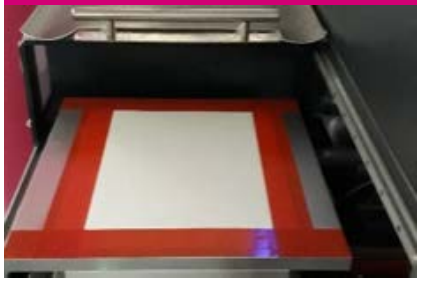
Metal foils

- Multiple vacuum circuits
- Avoidance of wrinkles

Vaulted Substrate

- Vacuum suction
- Hold-down device

Porous Materials



- clamping
- tensioning (Bahn)

Supports

Blocks

› Stable, rigid, ideal for non-populated PCB

Pins

› Flexible support

› Support on Substrate

Flex Pins Systems

› VarioGrid, GridLok, Quicktool…:

› Flexible Pin array systems support on the substrate and components

Vacuum-Pin

› Individual support pin featuring vacuum

› Ideal for prototyping substrates require a vacuum fixture

Flexible & Individual Support

APG

› Simple & precise!

› Software guides pin placement

› Automatic verification of pin position

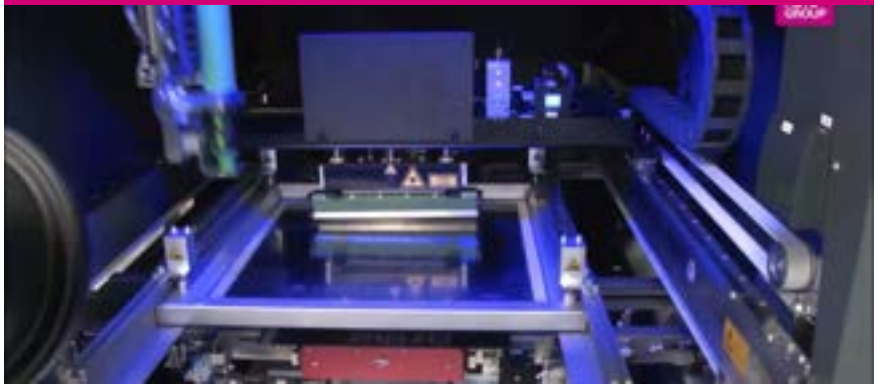
APS

› Full Automatic Pin Placement

› Autom. placement and verification with offset correction & unloading of support pins

Automatic Dispense Unit – Reload Paste/Glue onto Stencil

Cartridge Dispenser



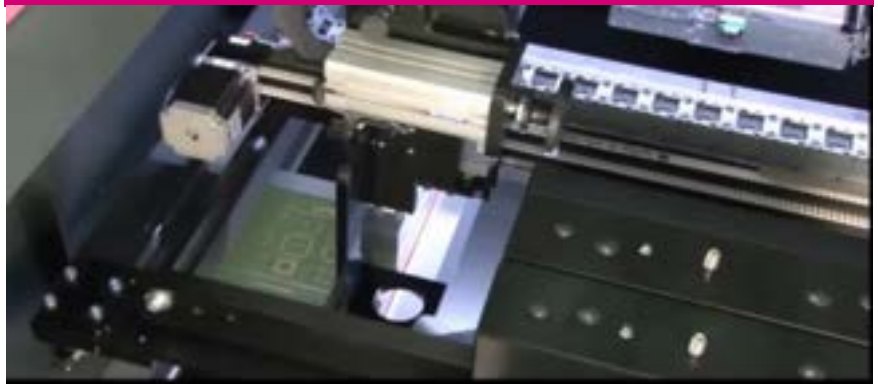
Dispense out of one or two Cartridges

› 6 or 12oz single cartridge

› Volume, cycle and position (x) programmable

› Applicable for glue/paste

Jar Dispenser



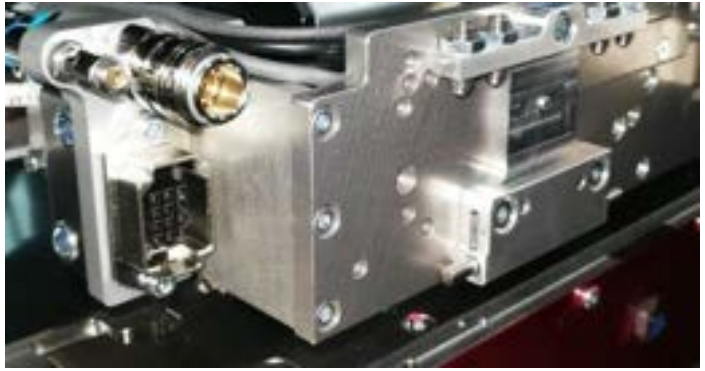
Dispense out of the Jar

› No additional cost for cartridges

› Paste can be put back into jar on job change

Modular Camera Unit (MCU)

MCU



Recognizes Modules and adjusts all Parameters:

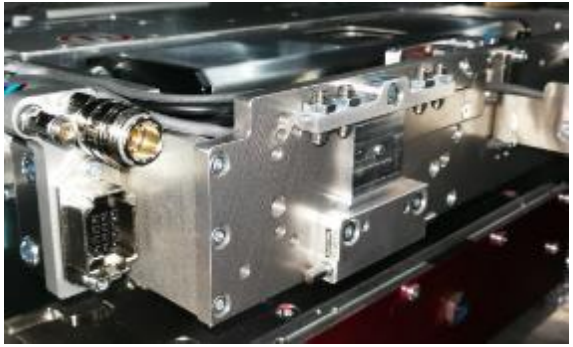
› extension to the camera axis

› supports two modules with multi-purpose connections

› premise to iPAG / APS / Optilign

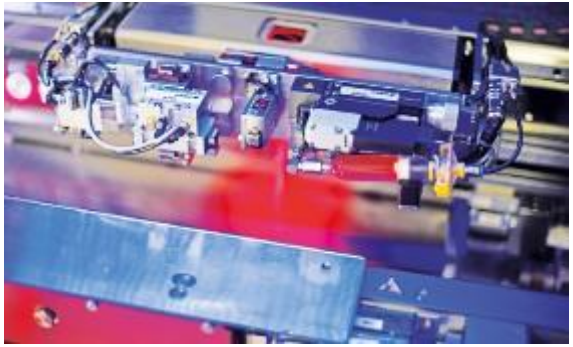
› exchangeable Modules between different printers

Additive Processes



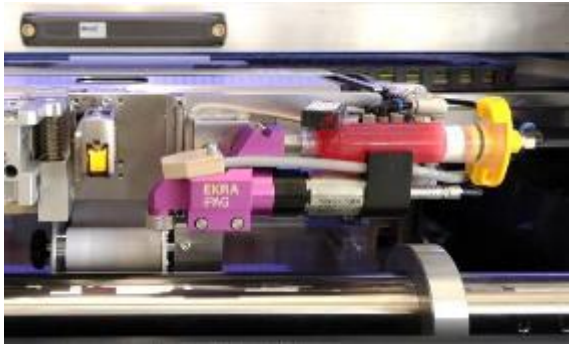
Modular Camera Unit (MCU)

Recognizes Modules and adjusts all Parameters automatically.



Flexible / Individual Support

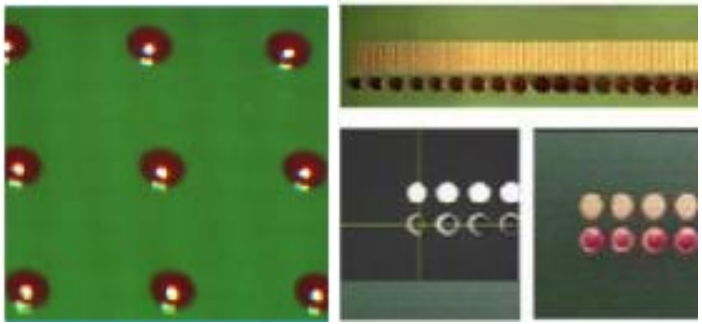
From individual support to fully automatic pin placement.



Paste & Glue Dispenser (iPAG)

Jet or screw paste or glue onto substrate directly in the printer.

Dispense – add Paste & Glue with iPAGs



Fully integrated Paste and Glue Dispenser:

Dispense additional media right after the print cycle. To add paste for higher solder volumes or glue to fix components. Auger and Jet valves available.

› Temperature controlled, inspection of applied depots and distance control (optional)

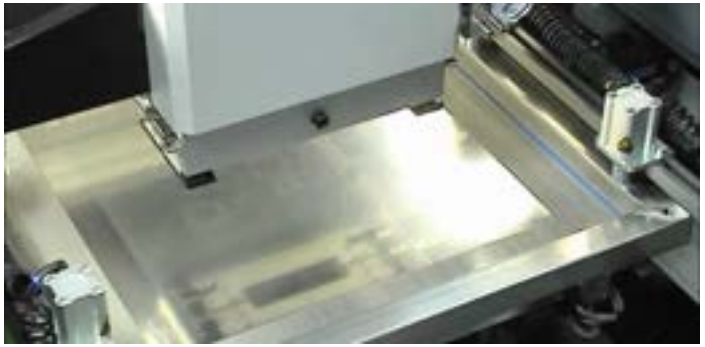
› Individual programmable: each depot its own parameter

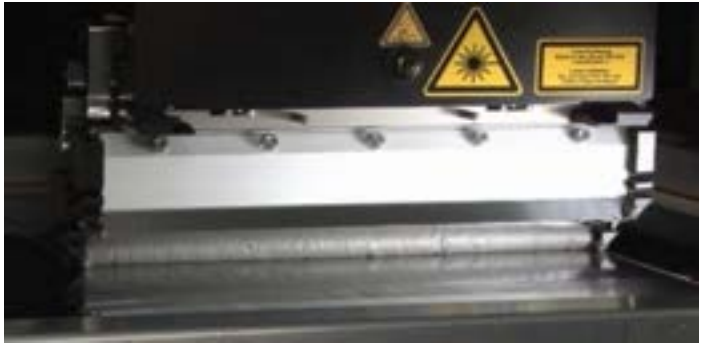
› High- speed dispense of small dots with Jet technology

› iPAG 100 works with various media

› iPAG 200, 300 check on our compliance list

iQUESS – Squeegee Quick Exchange System





Simple & Fast – Squeegee exchange as operators love it

› Poka Yoke

› various Squeegee angles

› Flexible squeegee side dams adjust automatically and ensure proper sealing against the stencil.

› Less paste is left over on the sides

› Less waste

› Higher usability

iROCS – Rapid Oscillating Stencil Cleaning System

iROCS light

› Dry, wet and vacuum cleaning
› Moistening product length dependent
› Observe roll diameter
› Full programmable cleaning recipes

iROCS

› Additionally exchange of wipe while machine is running
› No machine stop for wipe exchange

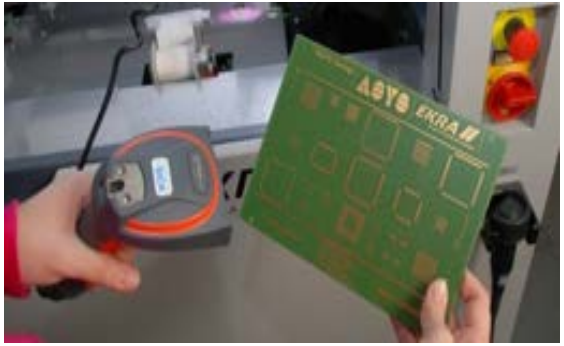
iROCS Ultra

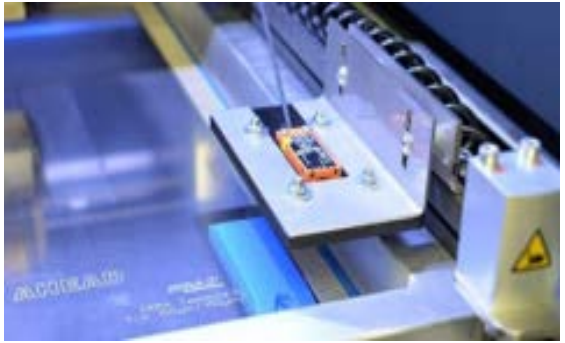
› Casset System for extreme fast wipe exchange
› Lower consumption of cleaning paper due to optimized dual use of some paper area
› No machine stop for wipe exchange

iSET - Setup Control and Traceability

Traceability and Setup by RFID or DMC

- Up to 10 user defined setup components, i.e.: Stencil, Squeegee, Paste, Support, Wipe, etc. must be scanned/verified by use of the hand-held scanner
- Data is defined within the printing program.
- Additional alternatives can be defined per setup component
- SIMPLEX guides the user through the procedure
- Wide range of MES connection available, customization welcome





Alignment & Inspection & Closed Loop

EVA: EKRA Vision System

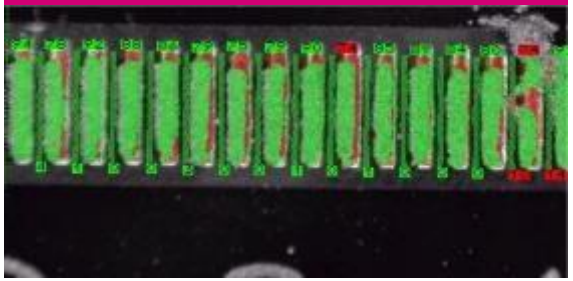
Fiducial detection and adjustment

› Highest precision

› Easy set-up by SIMPLEX

› Up to 5 Fiducials

2½D: Post Print Inspection



Coverage and Bridging detection

› No Gerber Data needed

› Clear Visualisation

› Automatically defines limits for bridging detection

Closed-Loop: Offset-Correction

Continuous data transfer between printer and SPI

› Increased print quality

› Reduction of cleaning cycles

› Increased throughput

› Advanced Closed Loop with Koh Young KPO

SIMPLEX – Simple Set-Up & Operations

Multi-Touch Input and Live Vision Support

› Fiducial teach in w/o any Gerber Files. Only product and stencil required.

› Define inspection regions with your fingertips within a few seconds.

› No additional Offline Programming necessary.

› A clear structure with icons simplify access and operation

› Integrated User Management

WINNER
of the NPI Award

A Comprehensive Product Portfolio from Manual to Autonomous Printers

Manual

INLINE PCB

Singulated PCB

Autonomous

Semi-Auto

Dual Lane

Hybrid & Specials

Large – XXL

System Concept – from laboratory status to high volume production

Semi-Automatic

- Max. print format: 300x300 / 550 x 600 mm
- Vision guided manual alignment
- High flexibility

Offline Automatic

- Max. print format: 300x300
- Full automated alignment and print
- Highest flexibility

Inline Automatic

- Max. print format: 600 x 600 mm
- Full automated alignment, print and material handling
- High throughput
- High flexibility

Reel to Reel

- Max. print format: 600 x 600 mm
- Full automated alignment, print and material handling
- Highest throughput

SERIO 6000 First Autonomous Printer

iROCS Ultra
35% less wipe usage

iSET
Set-up control & Traceability

Multiclamp
3 in 1 transport system

MCU
Smart Modul take-up

APS – Auto Pin Support System
Place & remove 52 Pins

iPAG
Auger & Jet-Dispenser

Scalable
upgrade your Options

Paste Dispenser
full electric Dispense system

Paste Height Control
as much Paste as one needs

SIMPLEX
Intuitive HMI

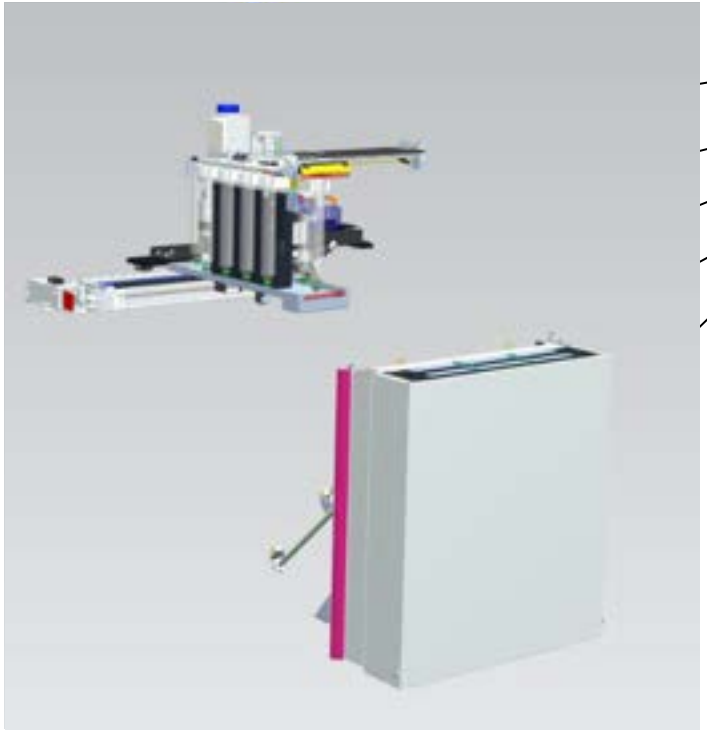
Paste-Magazine
9-Cartridges

Sphere Print Head
automatic Squeegee exchange

Squeegee Cassette
compatible to various length

Stencil Magazine
Asynchronous Set-Up

SERIO 6000 Major Differences to other Printing Systems



SERIO 6000 new „Key Components“ at a glance

› iROCS Ultra Stencil Cleaner & Cleaning Agent Reservoir

› Sphere Print Head

› Electric Paste Dispenser

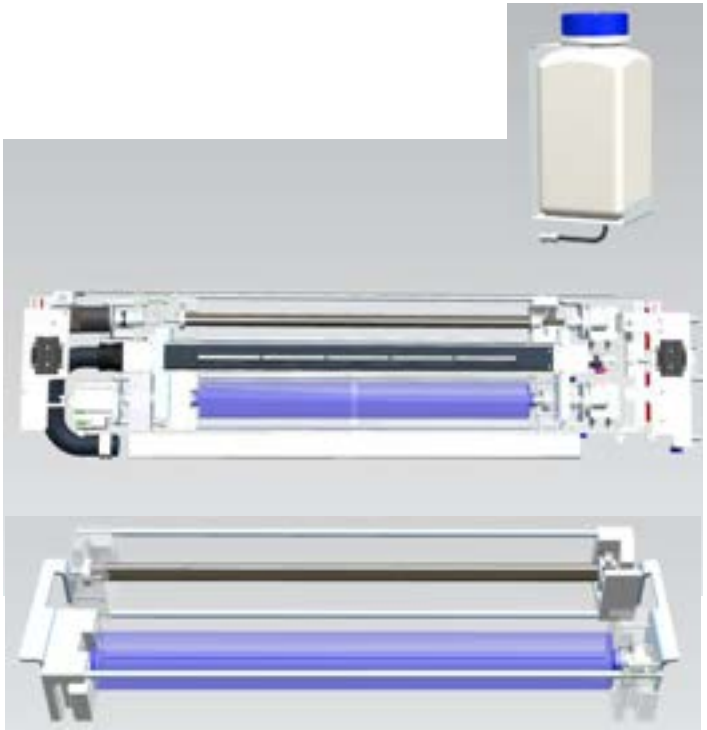
› Cartridge Magazine

› Stencil Magazine

Autonomous Functionalities are Optional to the Basic System.

→ SERIO 6000 is Scalable according Customer requirements

SERIO 6000 Stencil Underside Cleaning System



iROCS Ultra Stencil Underside Cleaning

› 2,5l Cleaning Agent

› **Fill Level Control**

› Oscillating Cleaning

› Cassette System for Wipes

› **Optimized Fabric Roll Control**

Advantage

› Cleaning Agent for more than 24h Operation

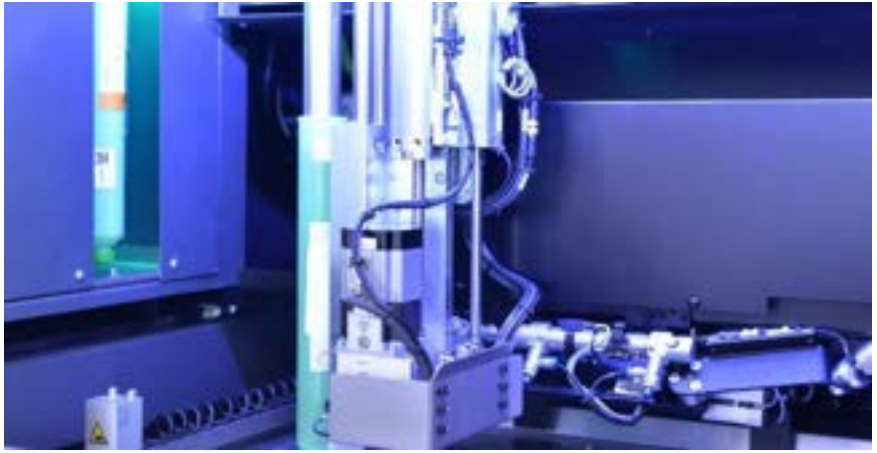
› Up to **35% less Wipe** Consumption

› Fast & Excellent Cleaning Result by improved Vacuum Supply

› Wipe Quick Exchange System

Less Consumable Consumption = Lower Cost Of Ownership

SERIO 6000 Cartridge Magazine & Automatic Cartridge Exchange



Cartridge Magazine

Store up to 9 cartridges directly in the printer.

› FIFO, traceability, Cartridge fill level saved

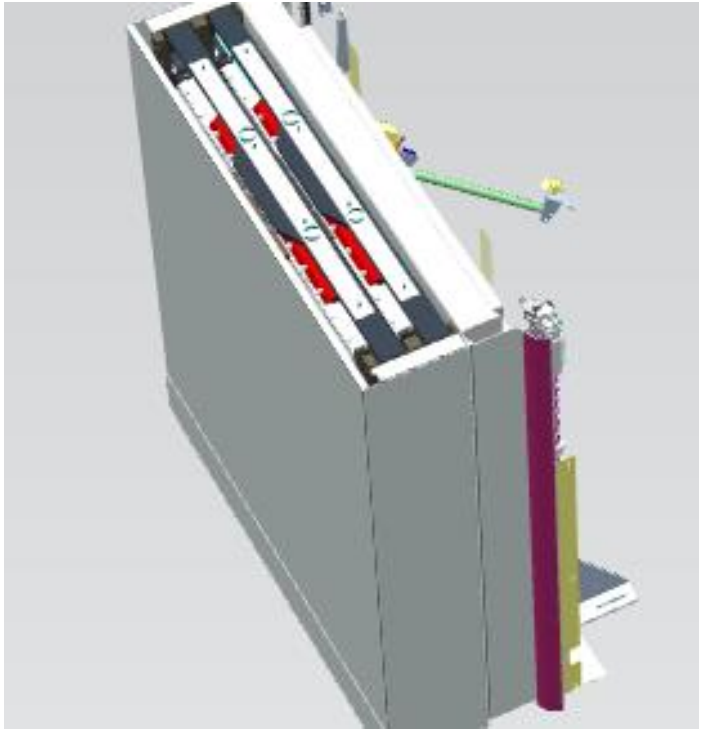
› Paste Supply up to 36 hours

Electric Paste Dispenser

Automatic exchange of paste cartridge

Paste dispense volume is adjustable, controllable and stored in the printing/product program.

SERIO 6000 Stencil Magazine



Stencil Magazine

› One stencil and one squeegee cassette are stored per slot

› Suitable for 23" or 29" stencils

› Slot 1: new stencil

› Slot 2: used stencil

› Crumb tray for easy cleaning

› Safe due to “Safety multi-range sensor technology”

Space-saving thanks to vertical placement

SPHERE – Electric Print Head

Full Electric Print Head

› Suitable for step stencils

› Squeegee angle optimally adjusted for the product

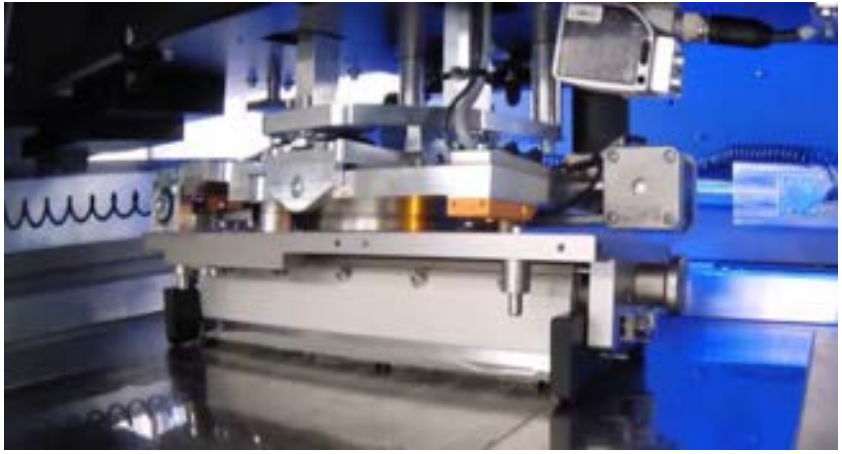
› Remove the paste from the stencil

› Transfer paste to another stencil

= Prerequisite for autonomy

› Squeegees can also be changed manually

Automatic Stencil Change



SPHERE – full electric print head

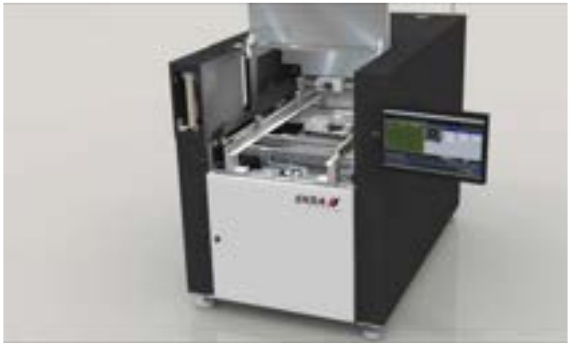
Full electric closed loop squeegee head

Transfer and positioning of Stencil from and to Stencil Magazine

Possible Expansion Stages of the SERIO 6000

SERIO 6000 with Cartridge Magazine and Dispenser

- ► Autonomous operation for up to 36 hours
- ► Automatic paste cartridge exchange



SERIO 6000 with Cartridge Magazine, Dispenser and SPHERE

- ► Squeegee Angle adjustment
- ► man. Paste transfer between stencil

SERIO 6000 with Cartridge Magazine, Dispenser, SPHERE and Stencil Magazine

- ► auto. Paste transfer between stencils
- ► Automatic stencil exchange
- ► Asynchronous set-up and job exchange

The issue with tools and production

Topic: Manufacturing must run as efficiently as possible with maximum plant utilisation → OUTPUT

- Changing an order must be quick and easy → **utilisation**
- Change-over time must be minimized to achieve highest availability → **utilisation**
- Any unplanned downtime due to poor tooling reduces usability, increases scrap and therefore increases cost per piece!

We have to ask: What is the impact if a poor stencil prevent the line running ?

Why not check + inspect before use, immediately after cleaning and before storage?

Real task: prevent failures before they occur

- How can you determine the quality of a stencil to ensure the best print quality?
- How can you ensure that the stencil is clean and all openings are open?
- How can you ensure that the stencil has no mechanical defects such as dents, frogs or deep scratches?

AISPECTURE SQC – Stencil **Q**uality **C**heck

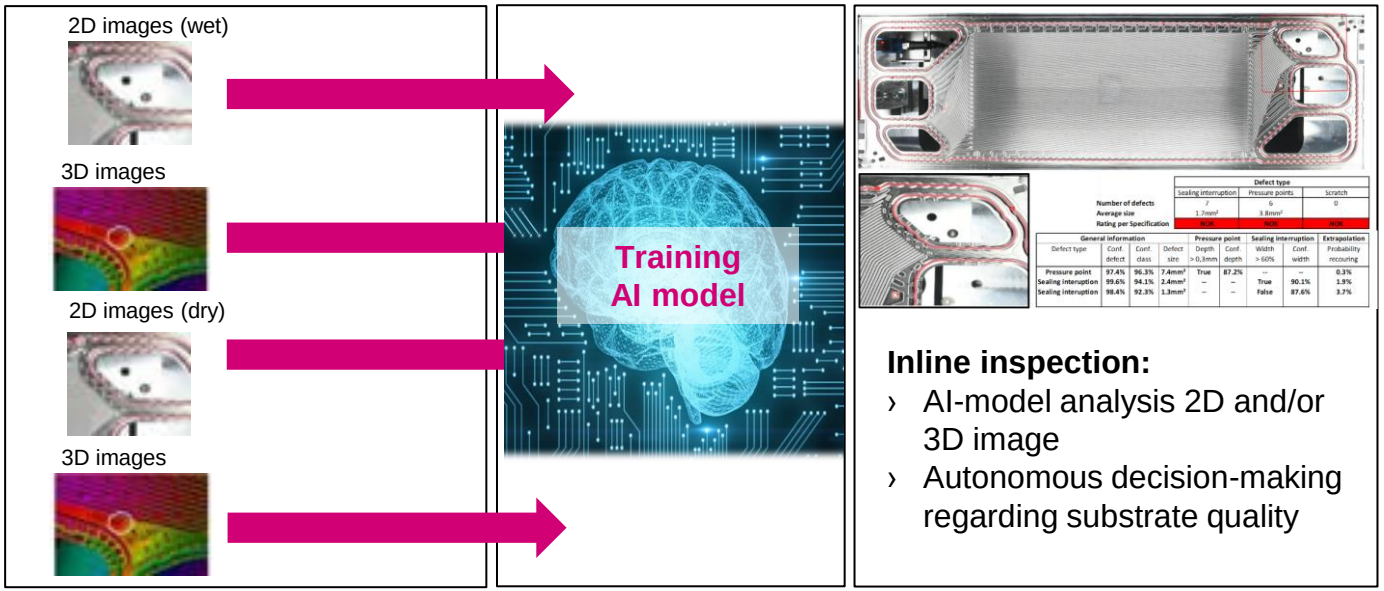
- Stencil inspection uses the 2D images
- EKRA AI-concept & method does not require gerber-data and time-consuming programming
- Images and Data remain on customer site
- Screen- / Stencil tension measurement
- AI can be trained i.e. for special stencils / appearances

AI-Powered Inspection, general workflow

Data Aquisition (selected samples/printing trails by experts)

Training AI model for image analysis

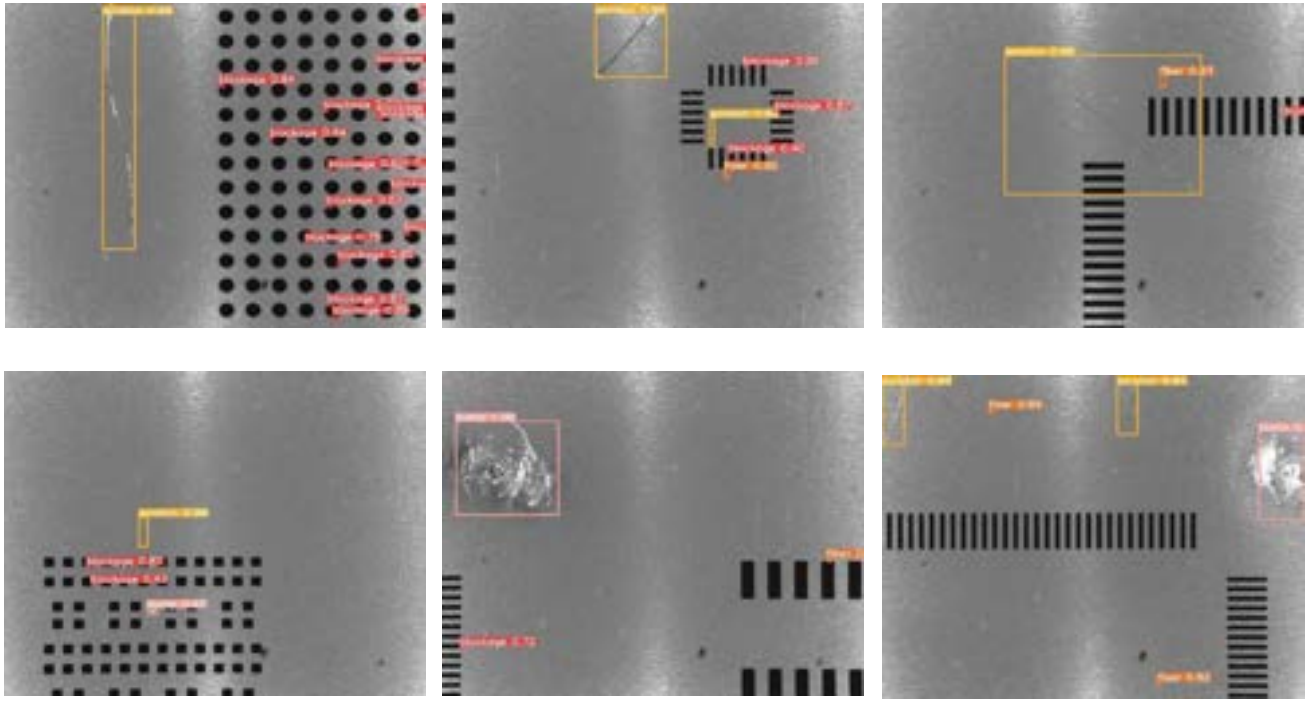
Fully Automated Inspection of BPP



Inline inspection:

- AI-model analysis 2D and/or 3D image
- Autonomous decision-making regarding substrate quality

AISPECTURE SQC – **S**tencil **Q**uality **C**heck



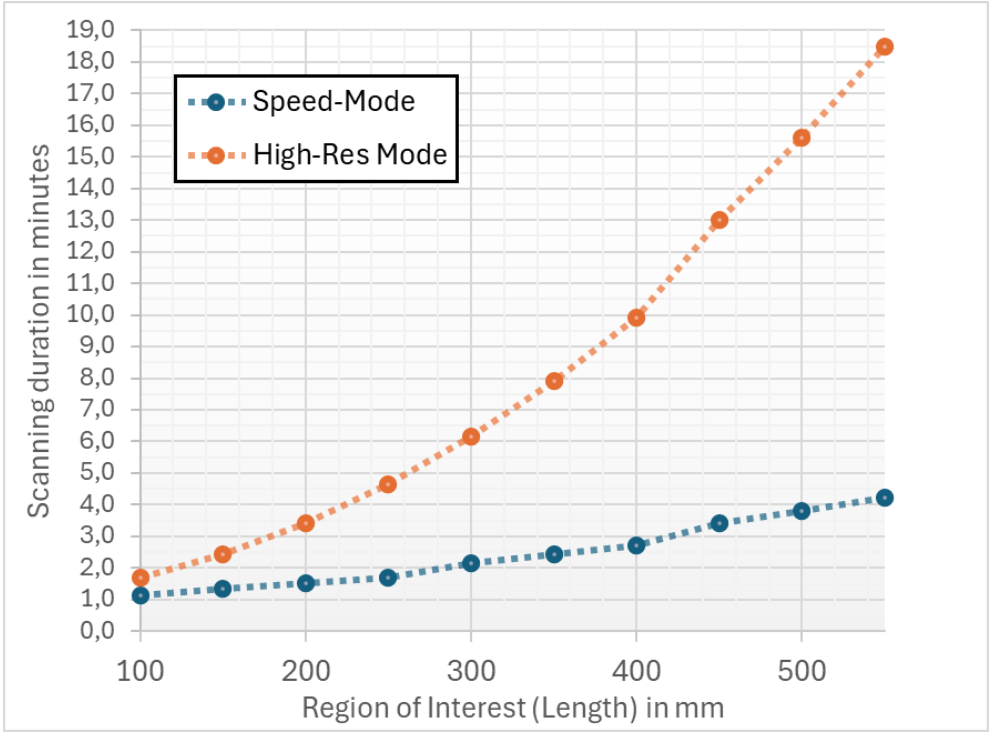
AISPECTURE SQC – Cycle time vs. Resolution

Two scan modes for the SQC:

The customer can choose between speed and resolution.

Speed Mode
Pixel Resolution: 16.5 µm / px

High-Res Mode
Pixel Resolution: 8 µm / px



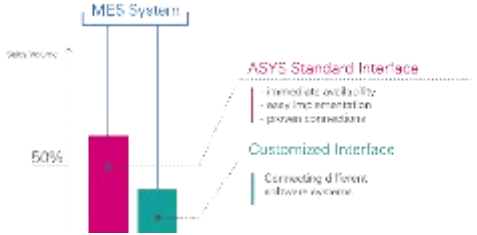
AISPECTURE SQC - Options & R&D Roadmap

- **Screen verification**
- **MES interface and full utilization od results**
- **Counting of apertures: compare given apertures with measured stencil**
- **Area sensitive stencil and screen tension measurements: → Q2/2025**
- **Squeegee blade inspection: check blade for deformation, sharp edges → Q3/2025**
- **Advanced AI based metrics of the stencil/screen regarding lifetime and expected performance during printing**

Smart Factory Ready

Home-Screen & Remote Cockpit

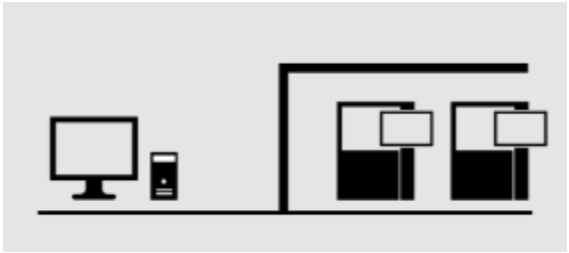
Customer Specific Interfaces



Synaptica OS

Material Logistics

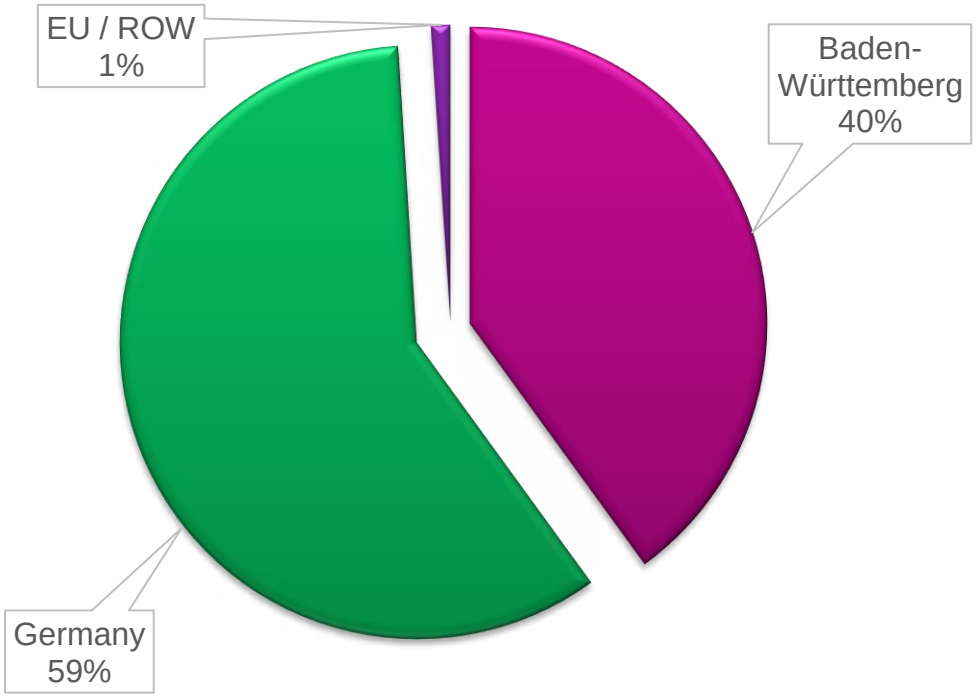
Product Pool & Offline Programming



Sustainability

- **Resource-friendly design & construction**
- **Waste management & Recycling**
- **Photovoltaic systems on all company roof**

- **Longstanding and close cooperation with specialists**
- **Predominant procurement within a radius of 200km**
- **60% our vendors are ISO 14001 certified***



*considering the TOP 50

Any questions.....

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