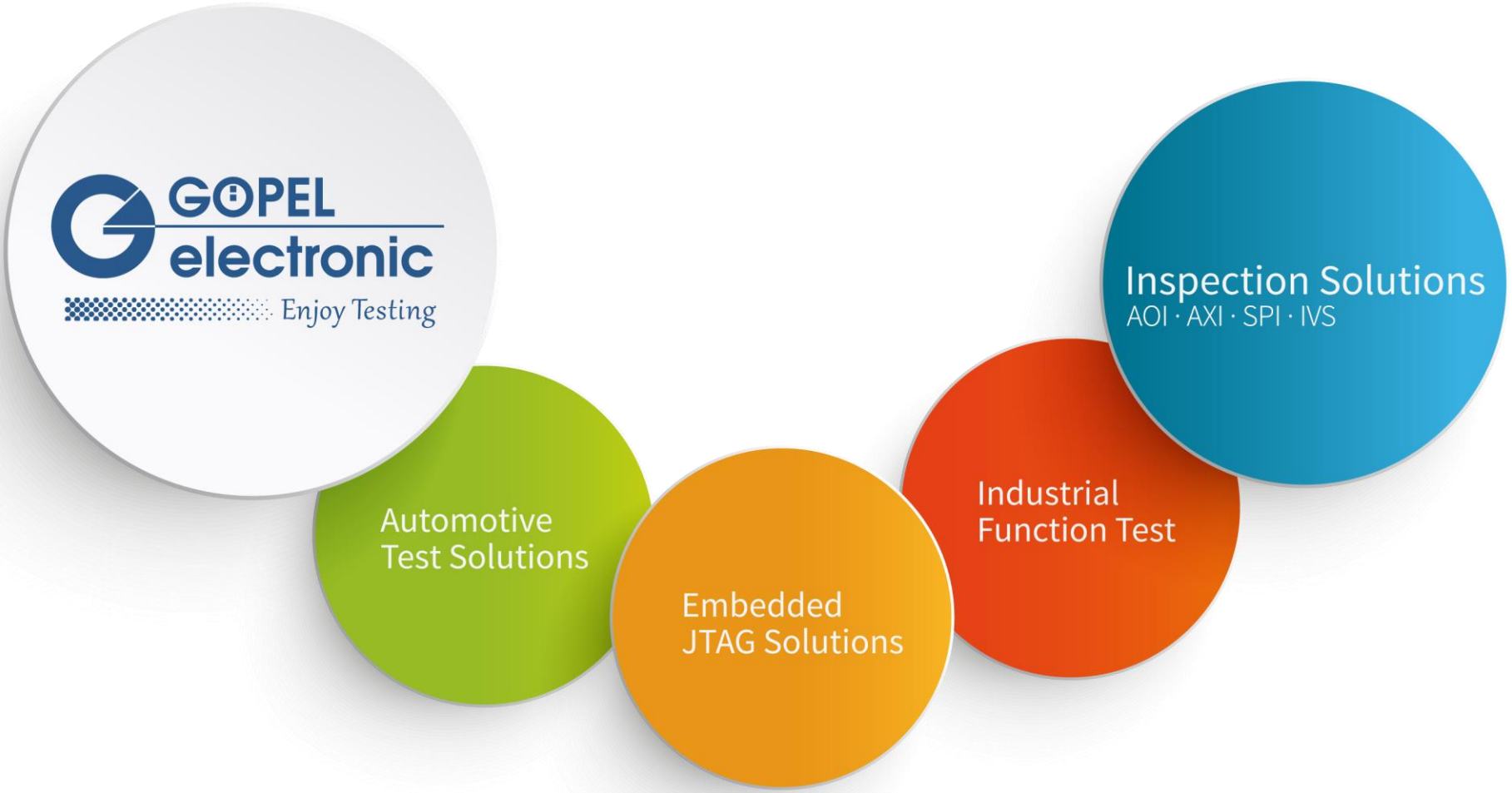


Detect faults early and optimize processes combined advantages through 3D solder paste inspection

David Whetstone

Profile

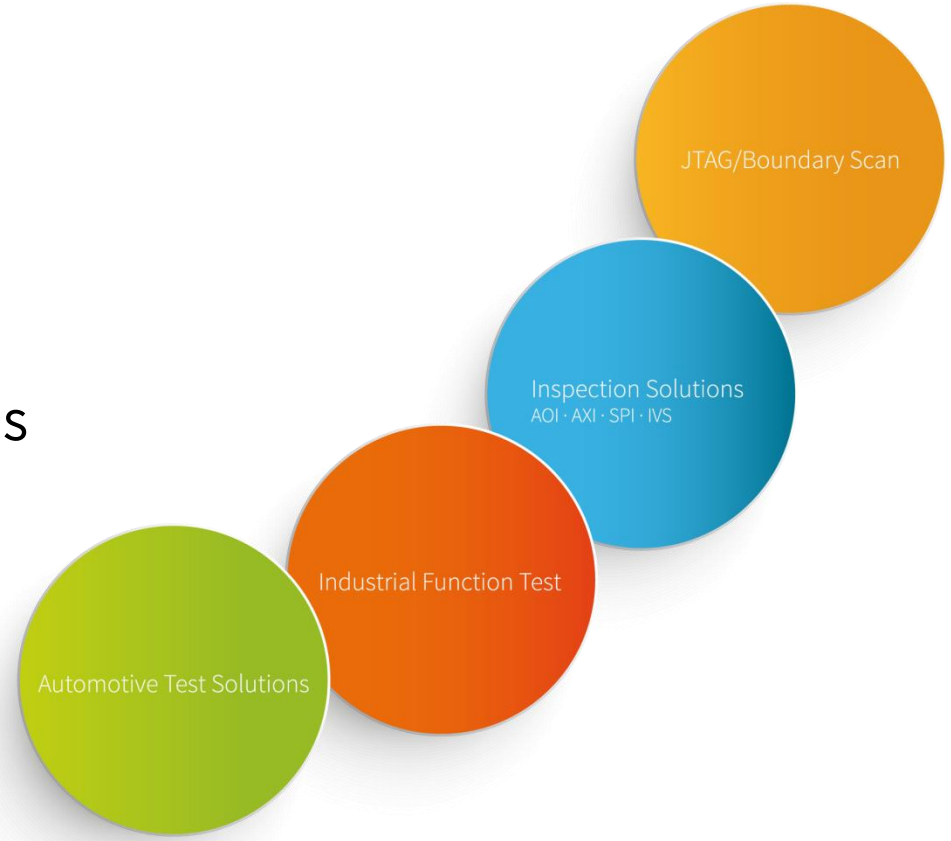
- Company founded in 1991
- Management board

  Holger Göpel
  Jörg Schneider
  Thomas Wenzel
- Headquarters in Jena, Germany
- Branches

  USA · Austin
  UK · Cambridge
  China · Hongkong, Chengdu
  Indien · Bangalore

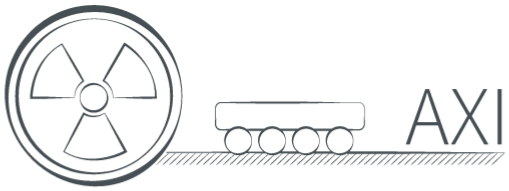
Business Units

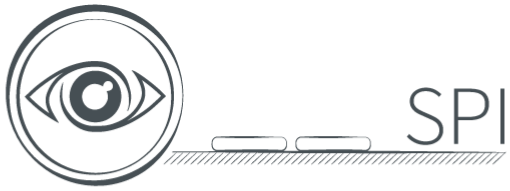
- JTAG/Boundary Scan
- Inspection solutions
- Industrial Function Test
- Automotive Test Solutions

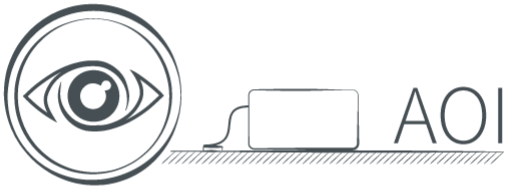


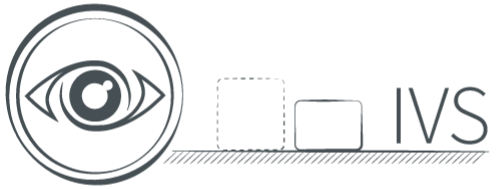
Inspection Solutions

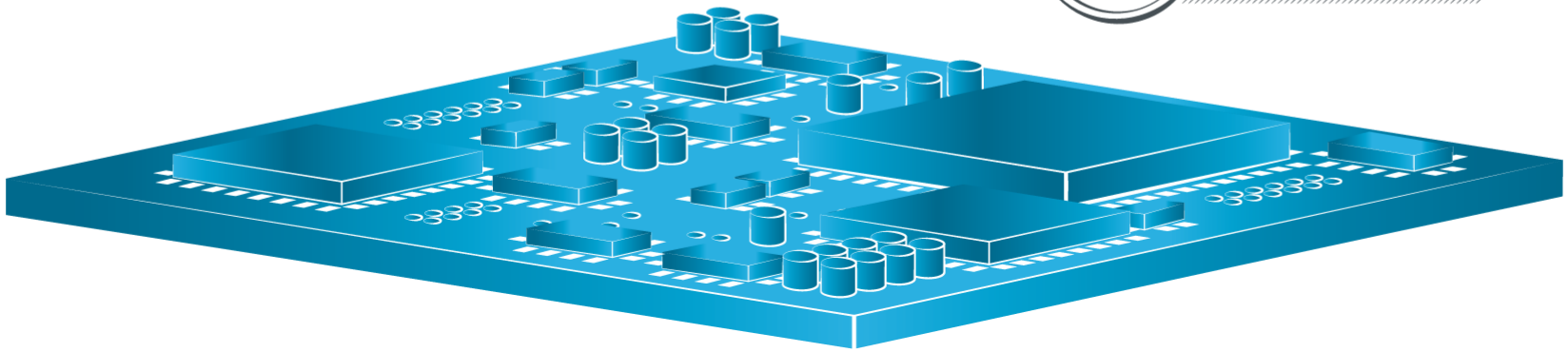
AOI · AXI · SPI · IVS



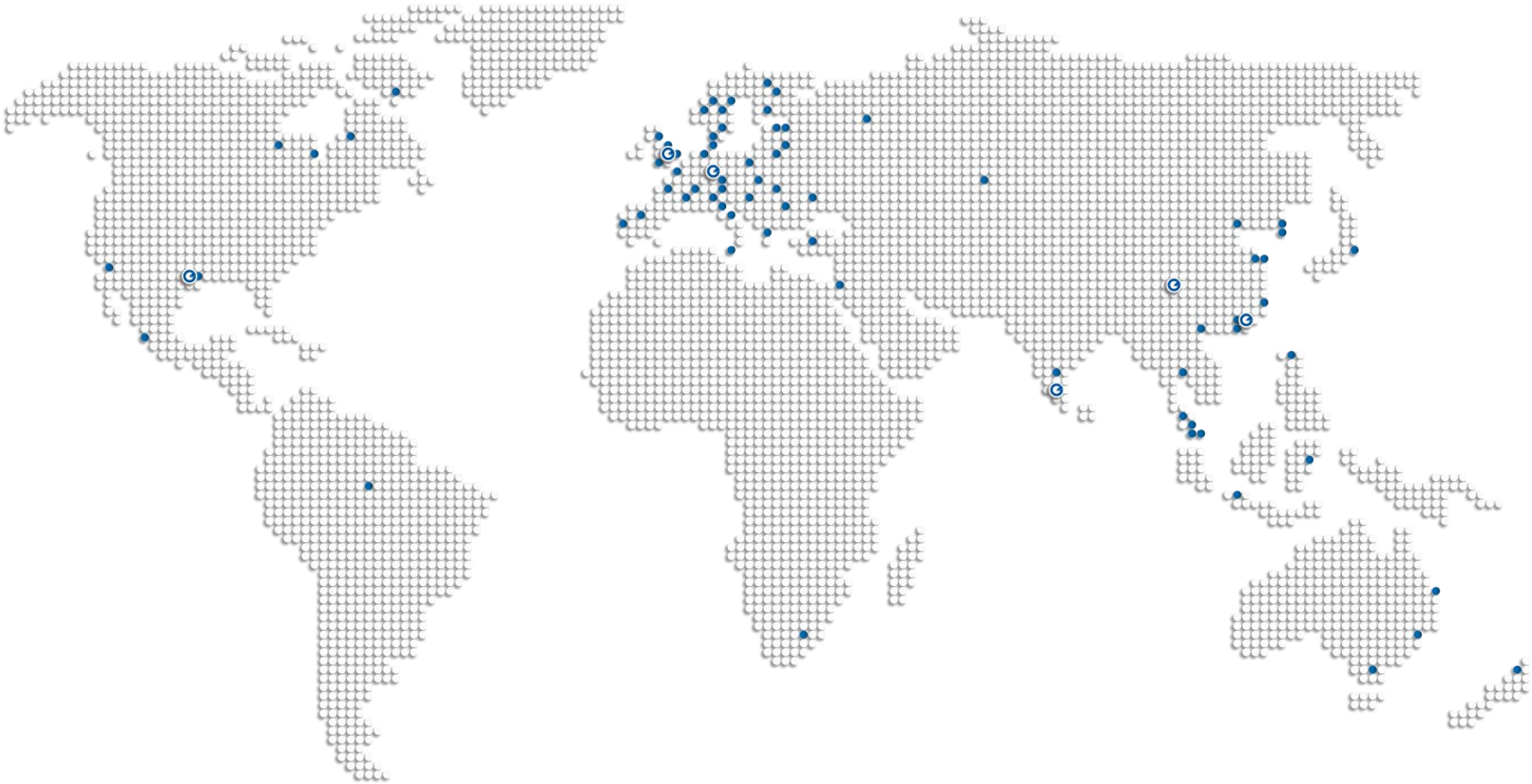






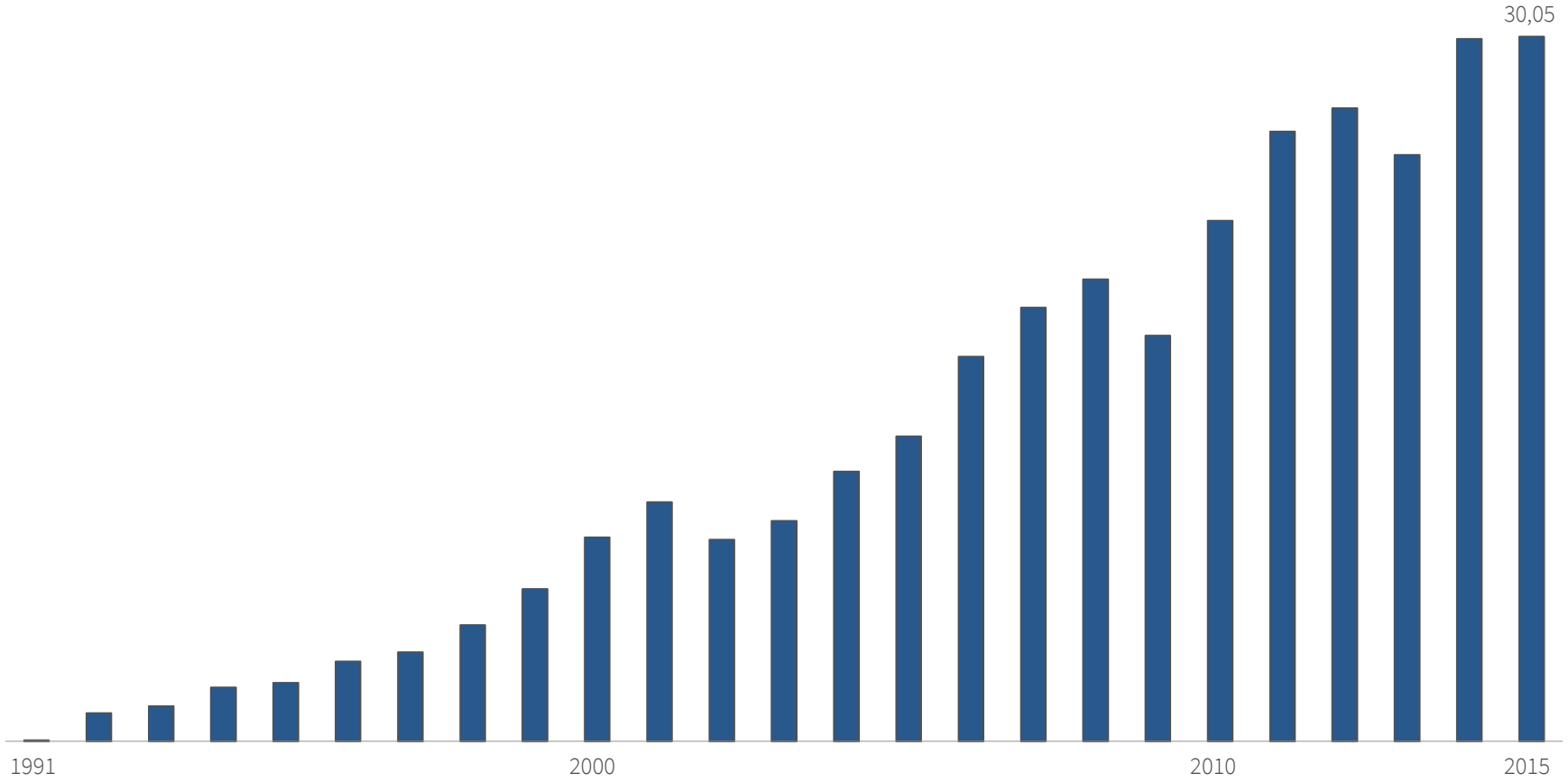


International presence



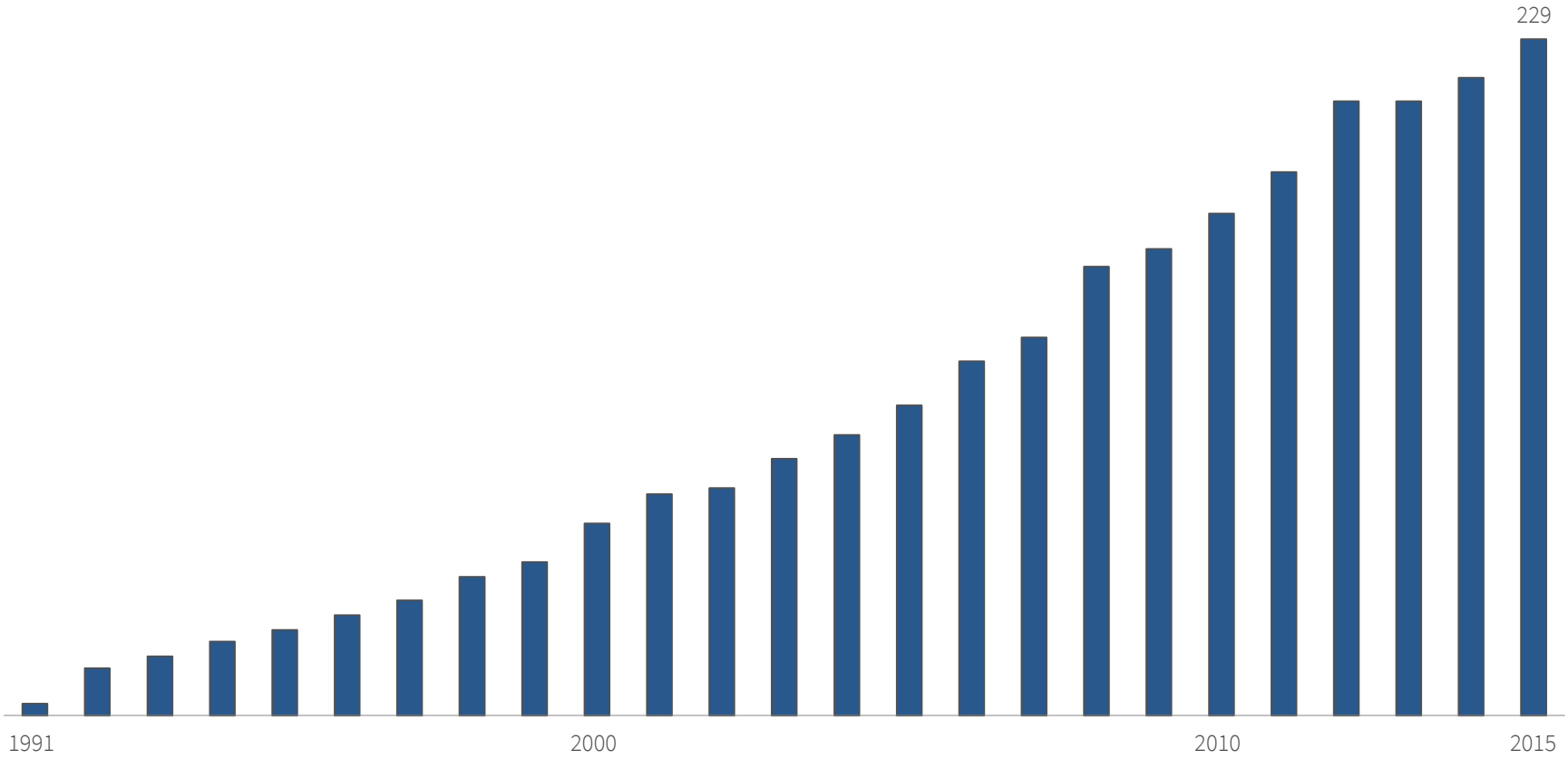
Sucess story

Turn over in Mio EUR



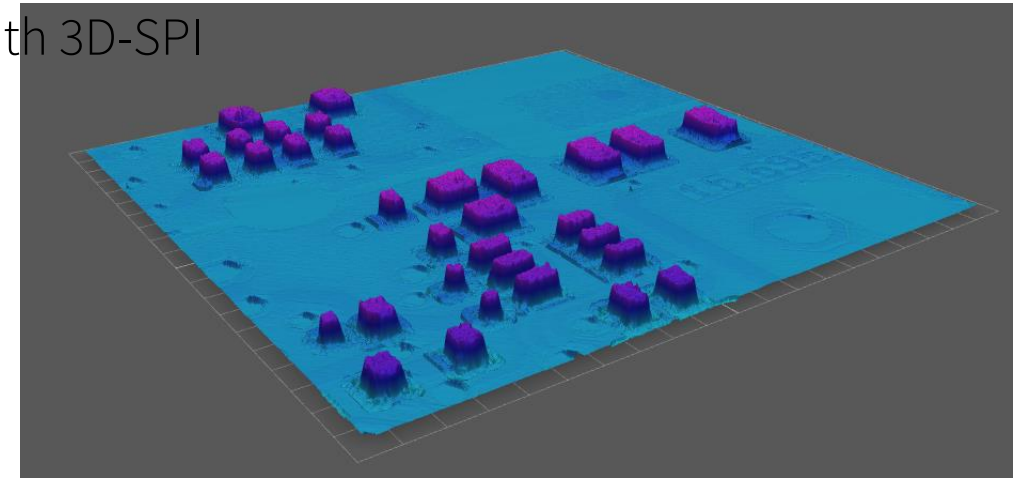
Success Story

Employees



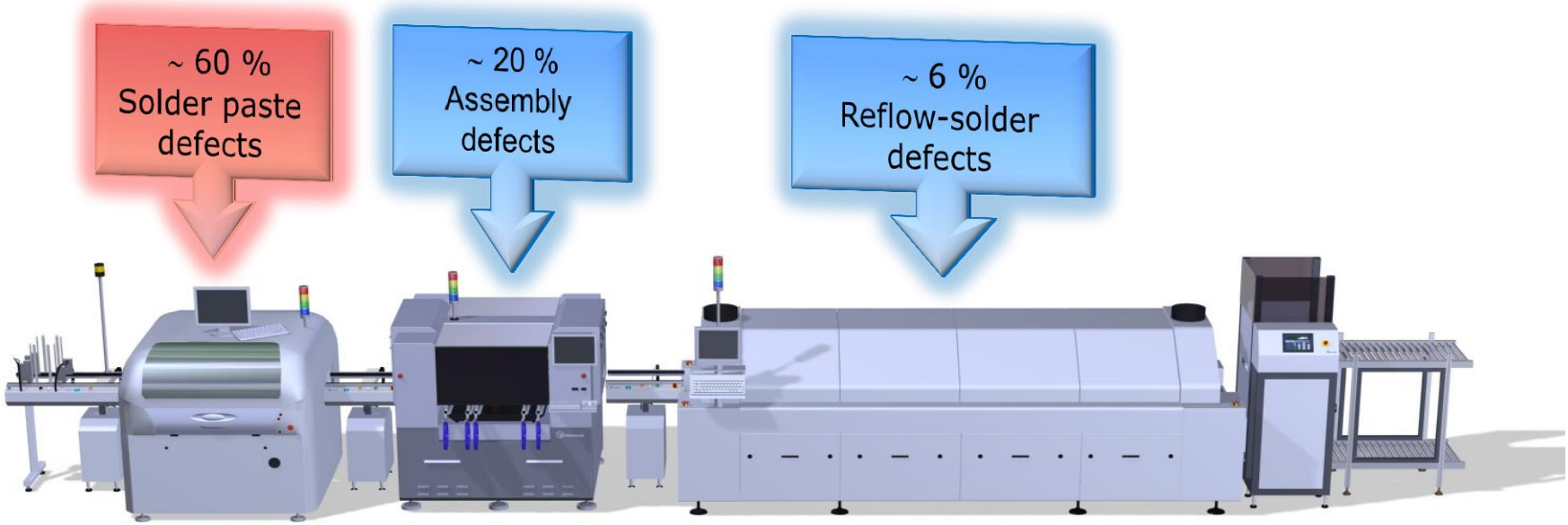
Content

- 1. Why 3D solder paste inspection
- 2. Requirements on SPI systems
- 3. SPI-Line 3D
- 4. Inspection of sinter paste
- 5. Process optimization with 3D-SPI
- 6. Summary

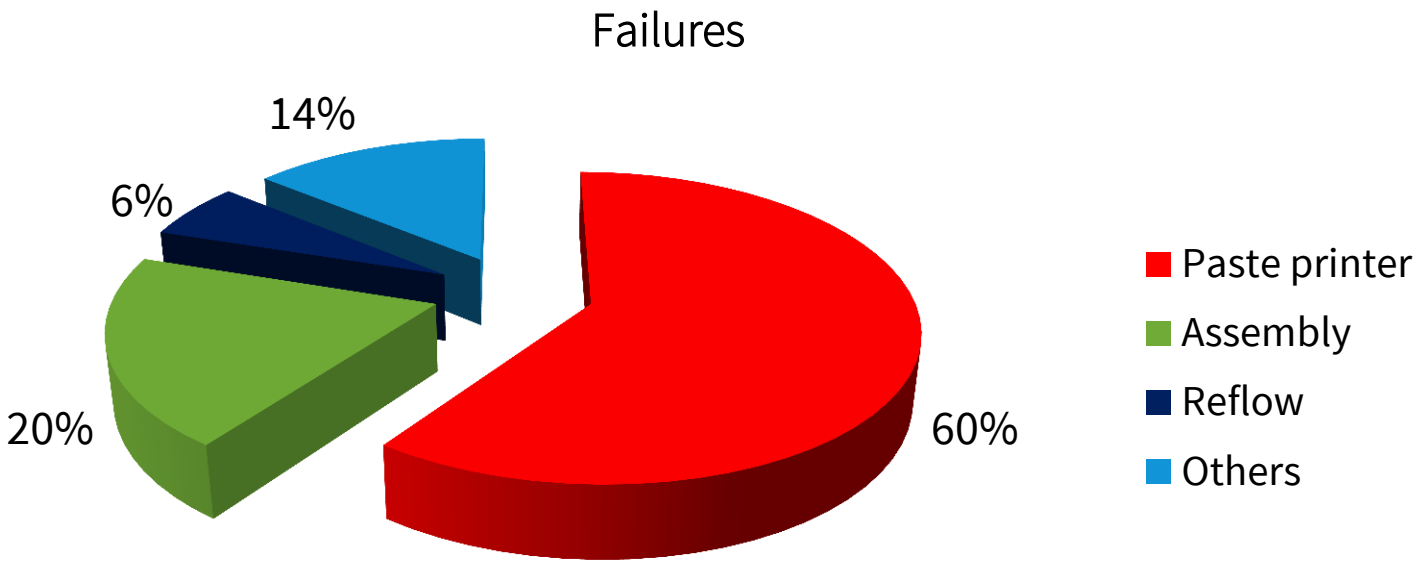


Why Solder Paste Inspection?

- Failures can happen at different places in the production
- About 60% of the failures are caused by faulty solder paste printing



Why 3D solder paste inspection?

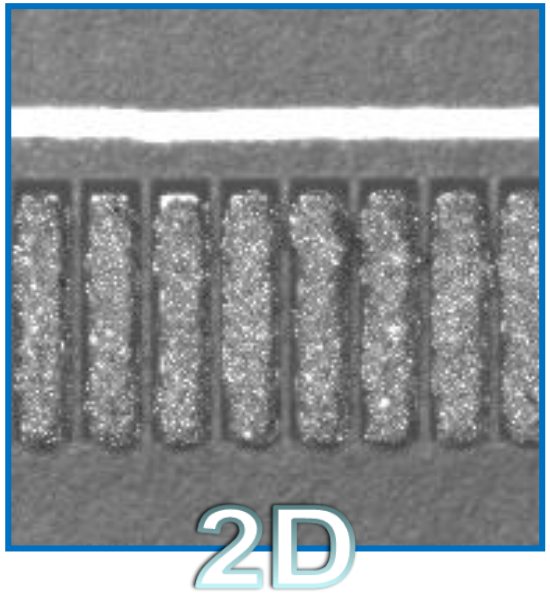


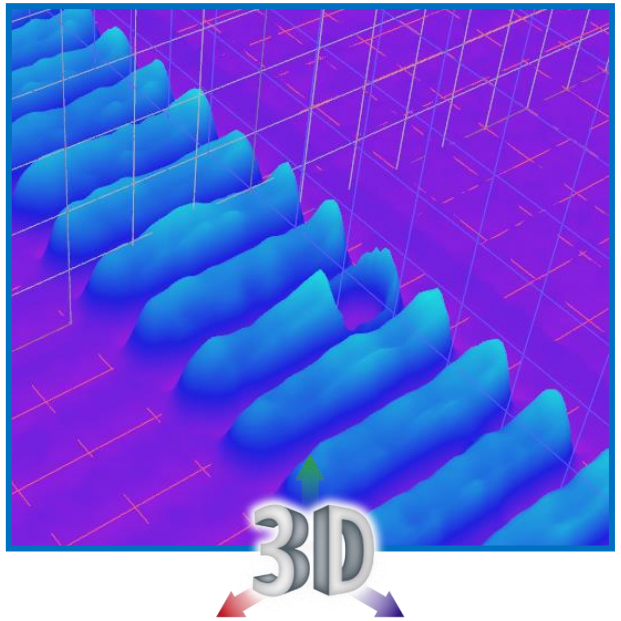
What can we do?

Detect paste failures = Avoid consequential failures

Why 3D Solder Paste Inspection?

Difference 2D / 3D test criteria





- OFFSET
- BRIDGES
- SURFACE COVERAGE

- HEIGHT
- VOLUME

Total test coverage is **only** possible with 3-dimensional analysis.

How complex is 3D solder paste inspection?

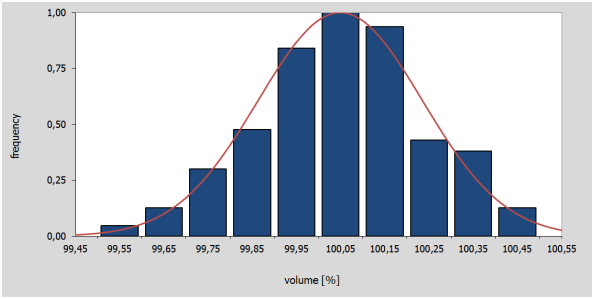
- Reliable inspection
- High precision
- High repeatability and reproducibility (Gage R&R)
- High speed

What is missing?

- Easy programming

✓ System characteristics

How complex is 3D solder paste inspection?



- Comfortable statistical evaluation possibilities
- Closed loop to paste printers
- Link to other inspection systems

✓ Additional tools for process optimization

SPI-Line 3D

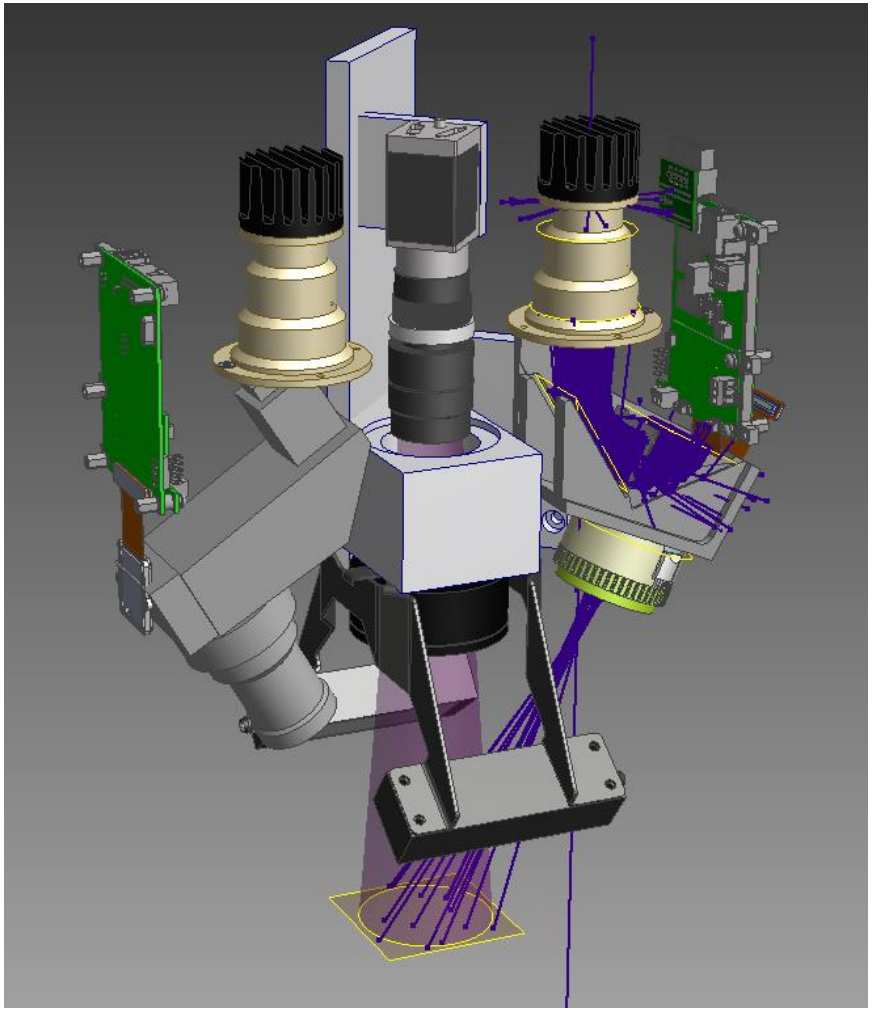
Special features:

- High speed 3D double projection head sensor
- Highly dynamic linear axis system
- Very intuitive and user friendly software
- Short programming times

SPI-Line 3D

High Speed 3D-Sensor:

- Double projection sensor based on LCoS* Micro display
- Pros:
  - Redundant measurement results
  - Maximum reliability



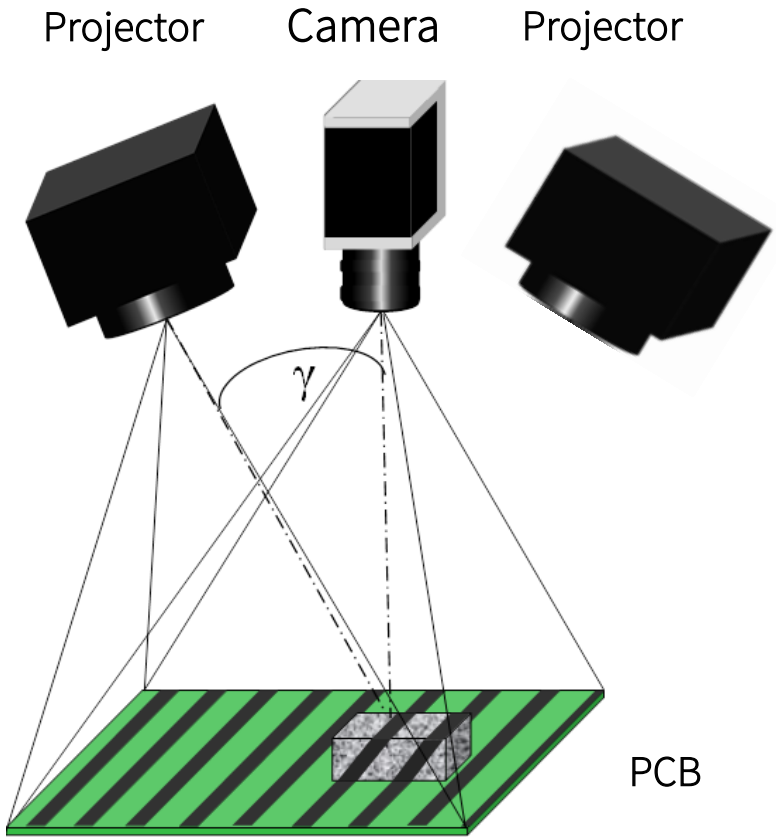
*LCoS- Liquid Crystal on Silicon

✓ Own development by GÖPEL electronic in Jena

SPI-Line 3D

High speed 3D sensor:

- Fringe projection
- 4 mega pixel CMOS camera, 180 fps
- LCoS* mikrodisplay, 180 fps
- Triangulation angle ≈ 30 °

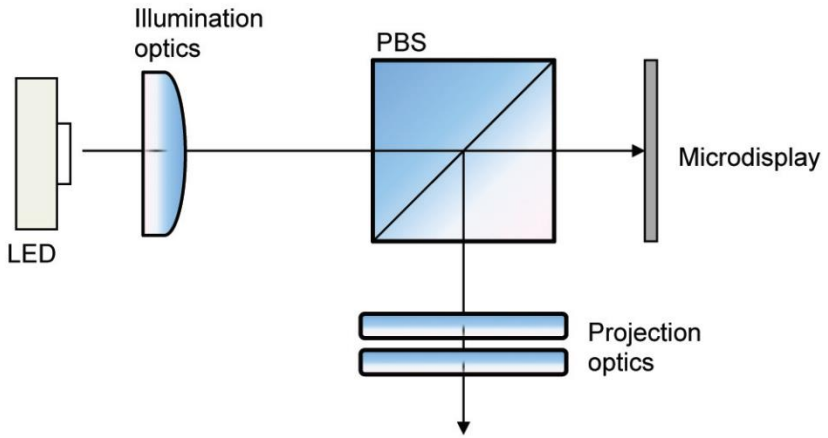


*LCoS- Liquid Crystal on Silicon

SPI-Line 3D

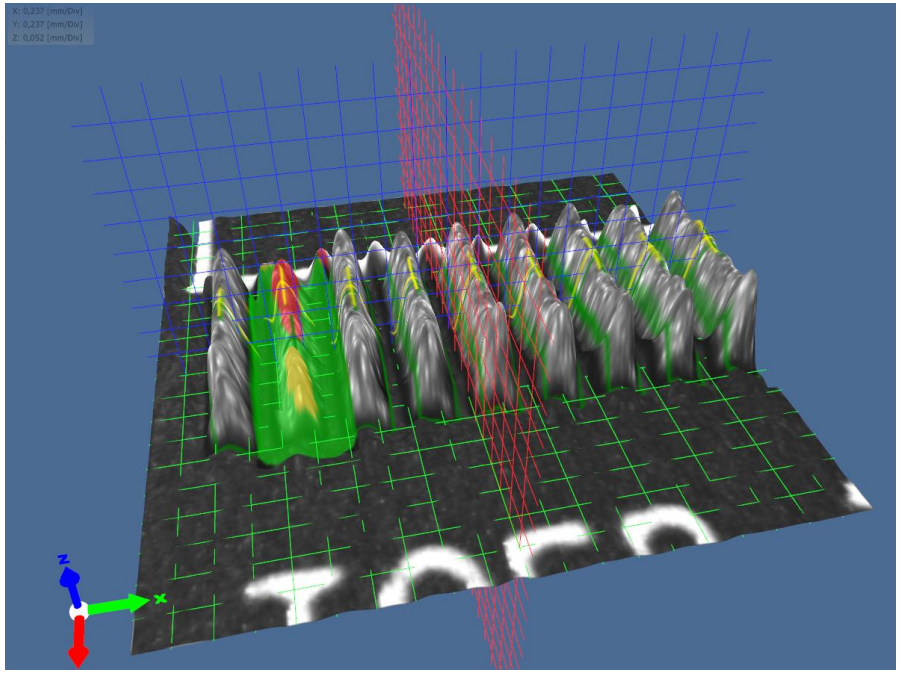
Electronic projector – Advantages:

- Area based measurement
- Short measurement times reachable
- Flexibility
- Extremely high resolution and precision
- No moving mechanical parts in the measuring head (very robust / minimized calibration operation)



SPI-Line 3D

Inspection parameters



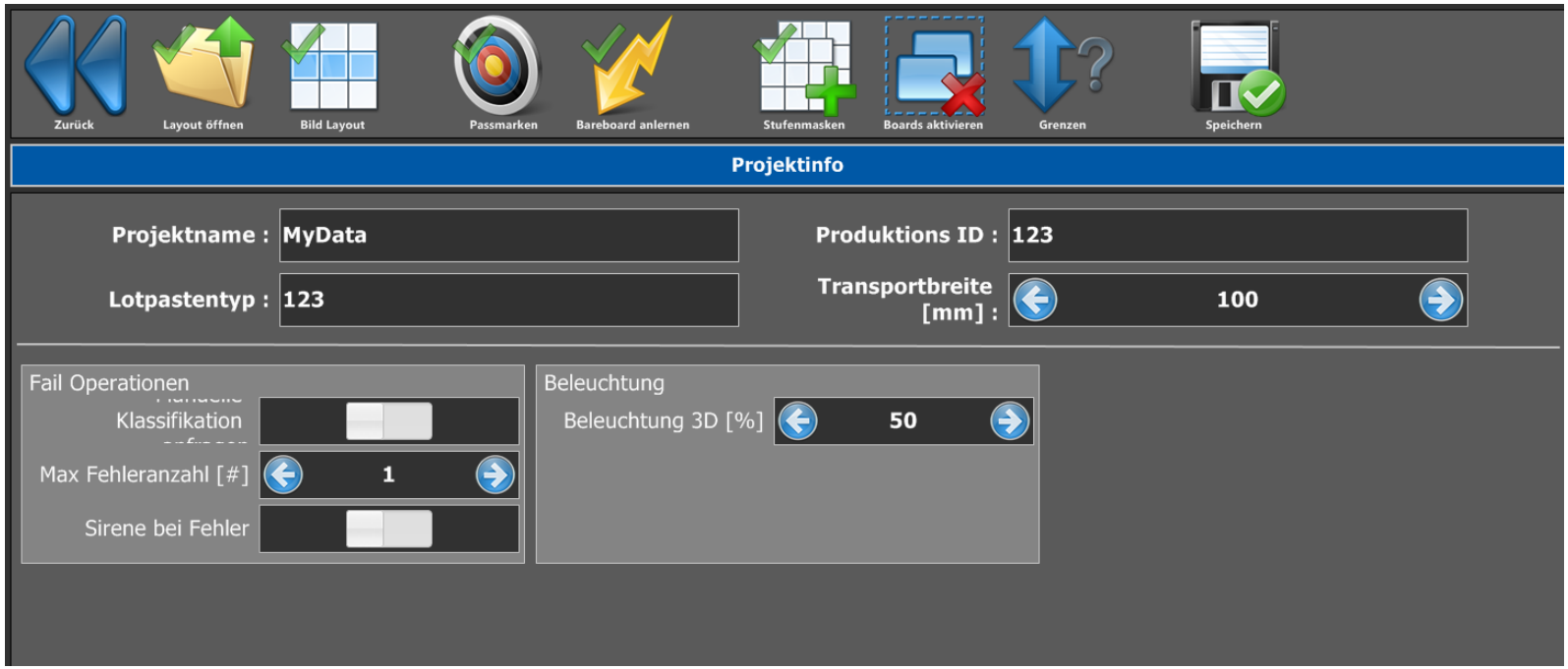
- *Volume* ✓
- *Height* ✓
- *Offset* ✓
- *Form* ✓
- *Shorts* ✓

SPI-Line 3D

Intuitive user friendly software interface

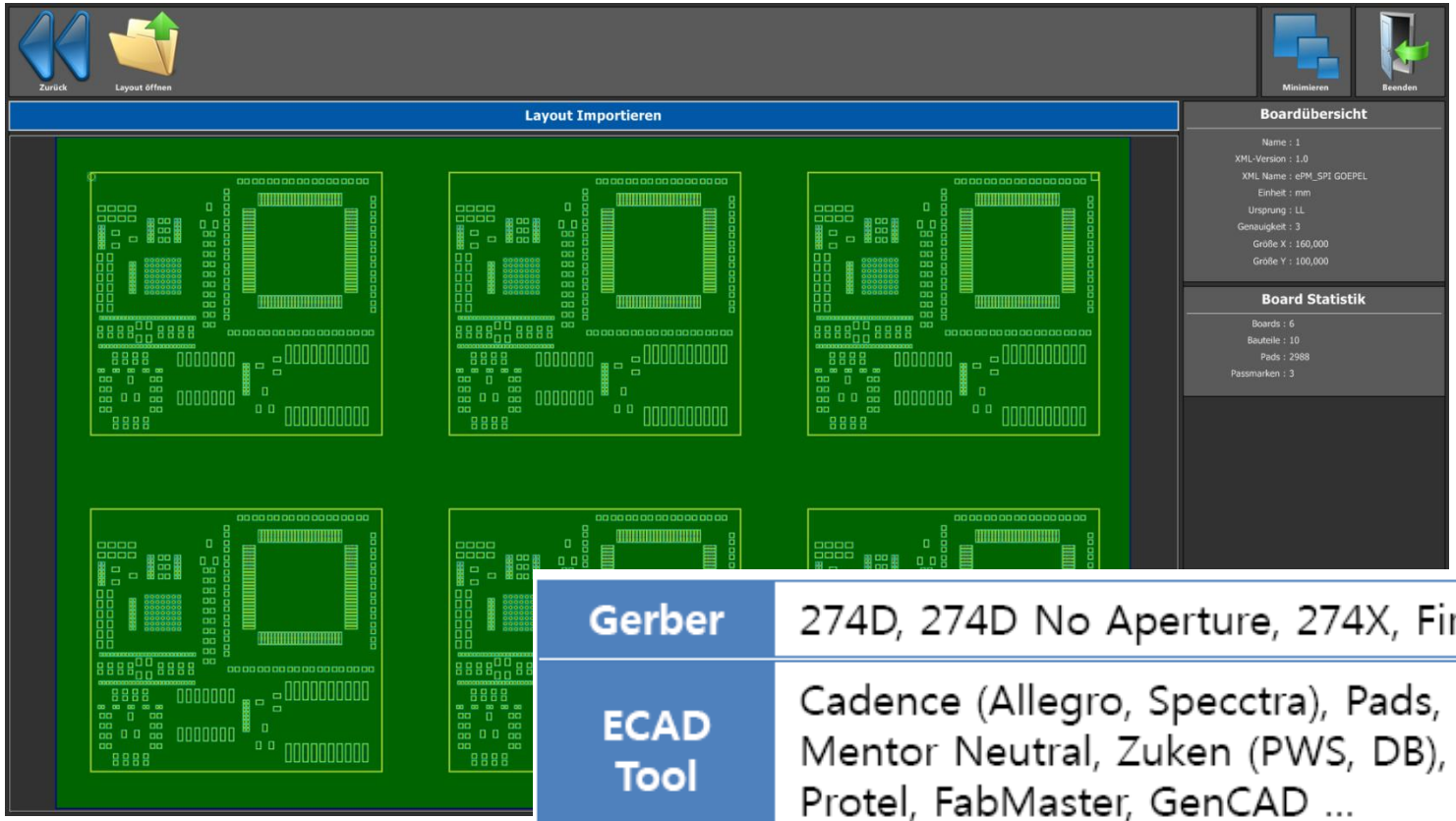
SPI-Line 3D

... fast programming by using SPI-Wizard



SPI-Line 3D

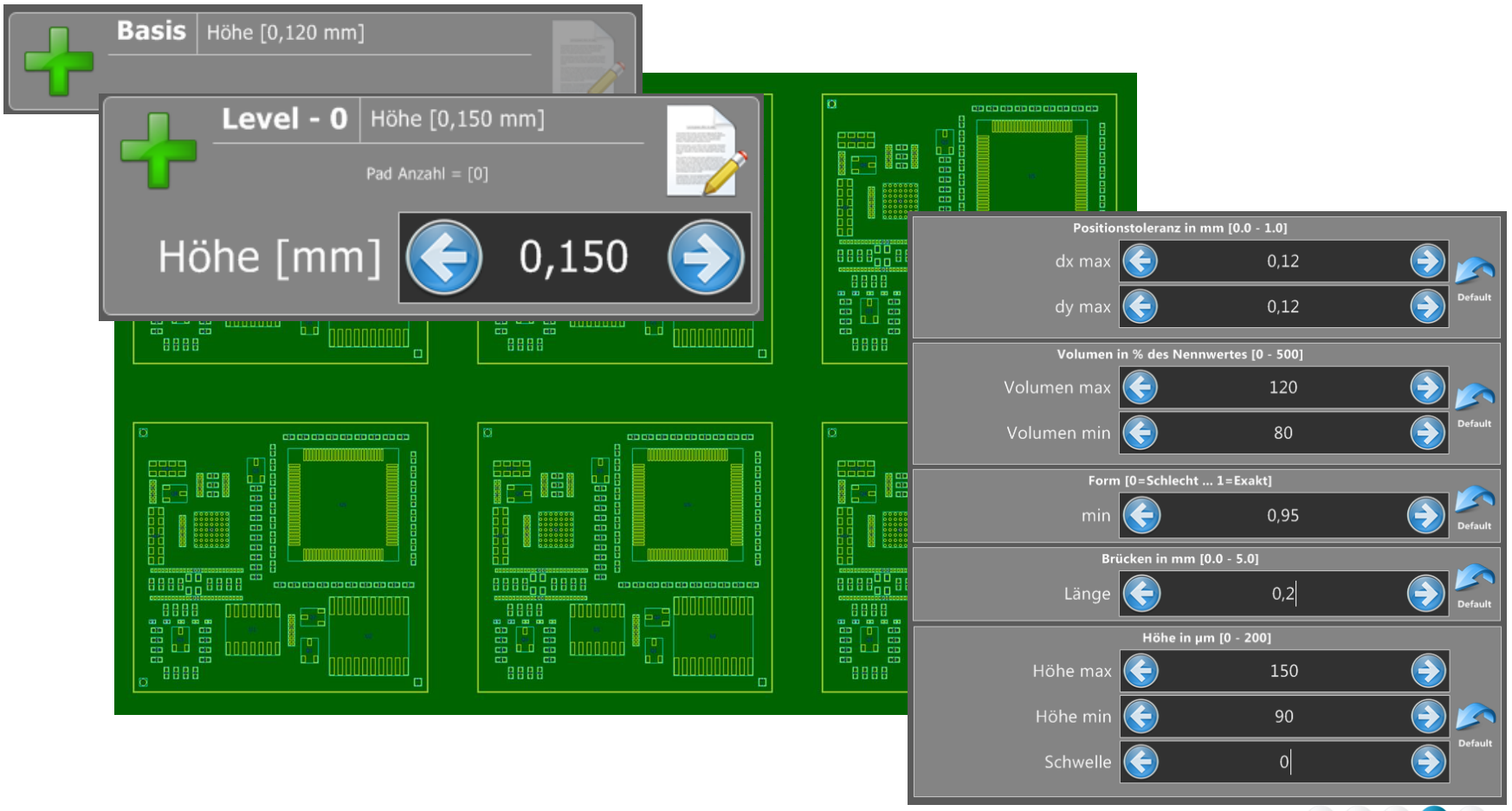
Data import



Gerber	274D, 274D No Aperture, 274X, Fire9XX0
ECAD Tool	Cadence (Allegro, Specctra), Pads, ODB++, Mentor Neutral, Zuken (PWS, DB), PCAD, Protel, FabMaster, GenCAD ...
Etc	Various CAD X-Y, JPG, BMP ...

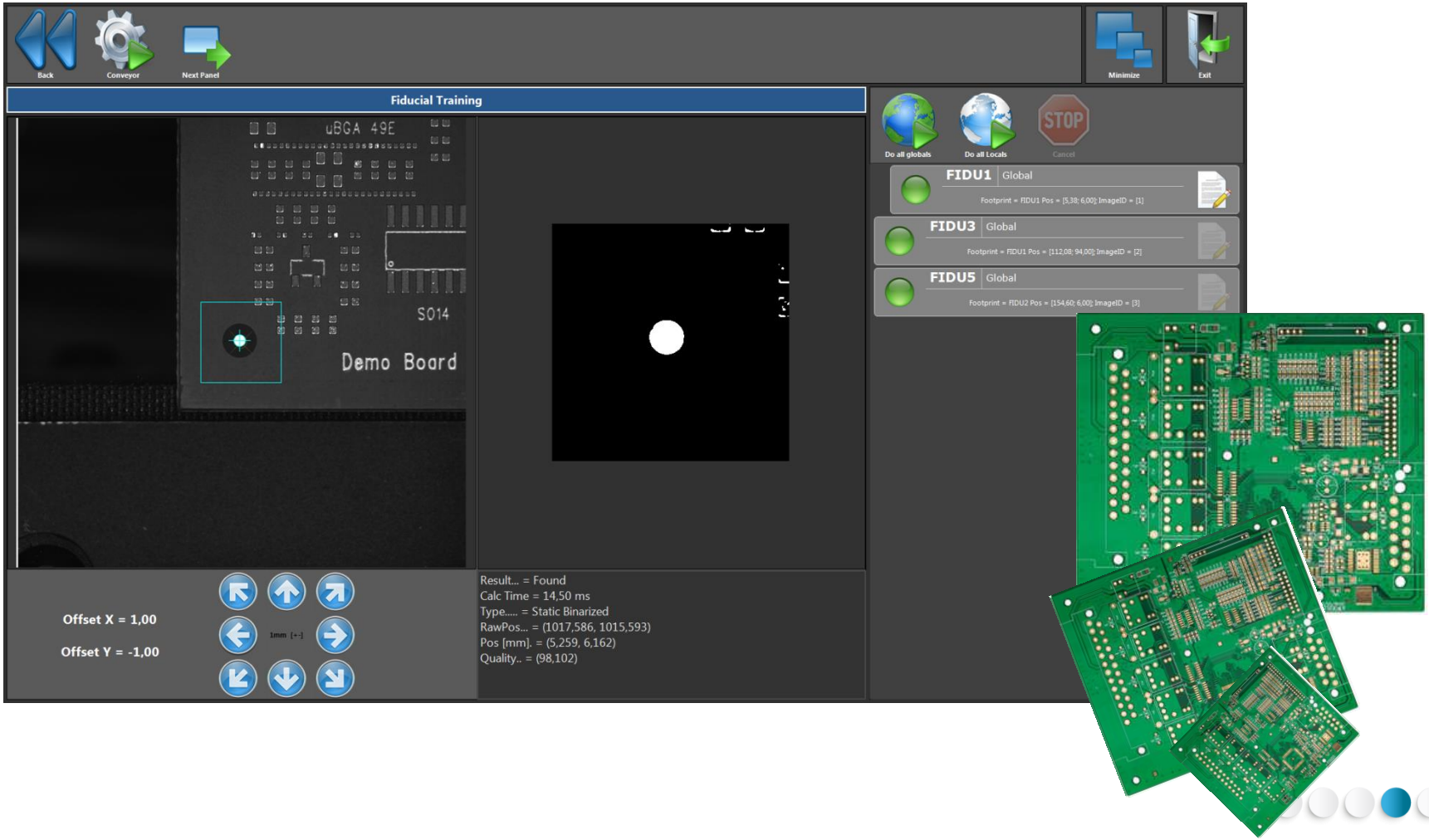
SPI-Line 3D

Intuitive parameterization



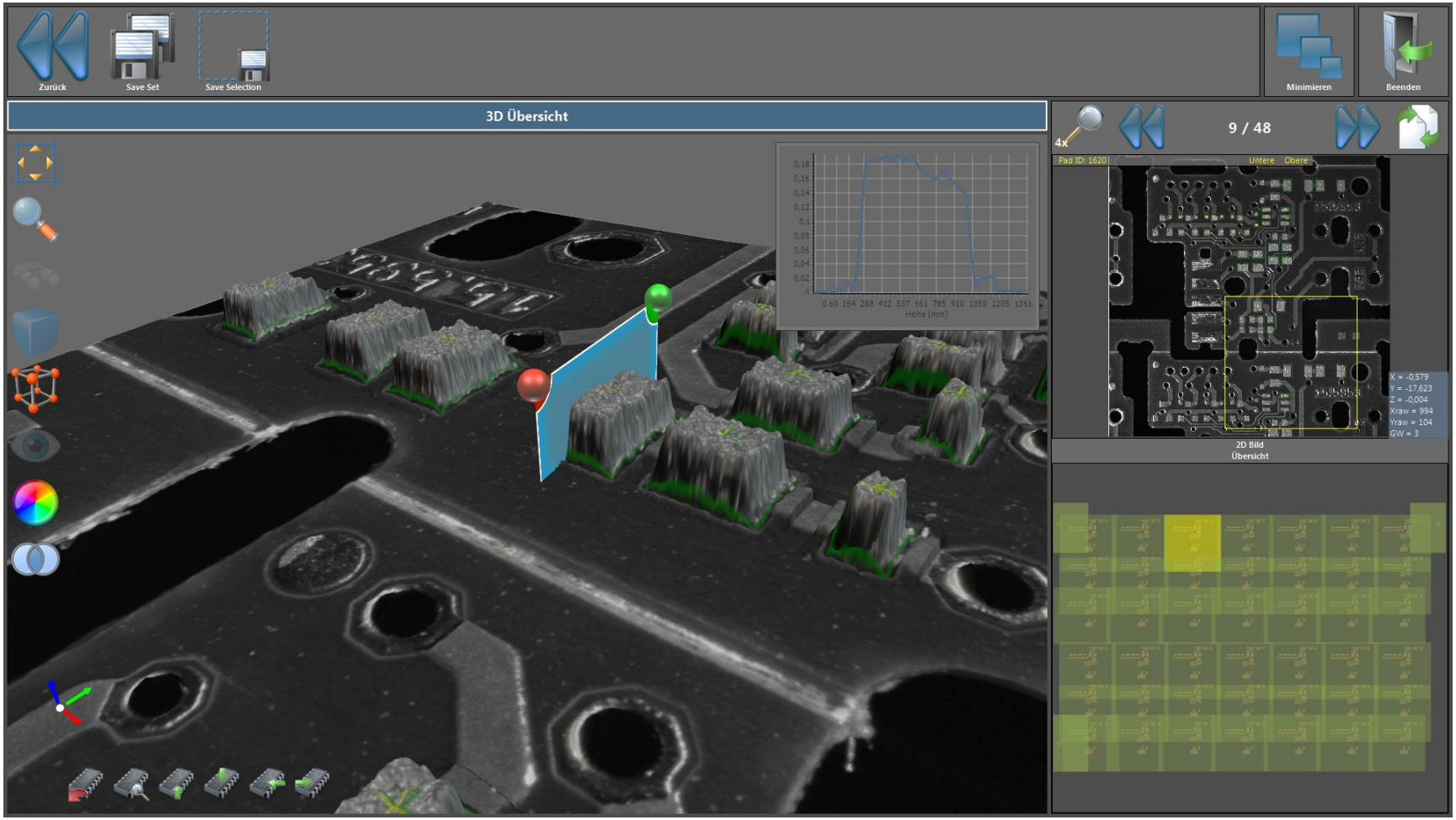
SPI-Line 3D

Fiducial training and bare board teaching



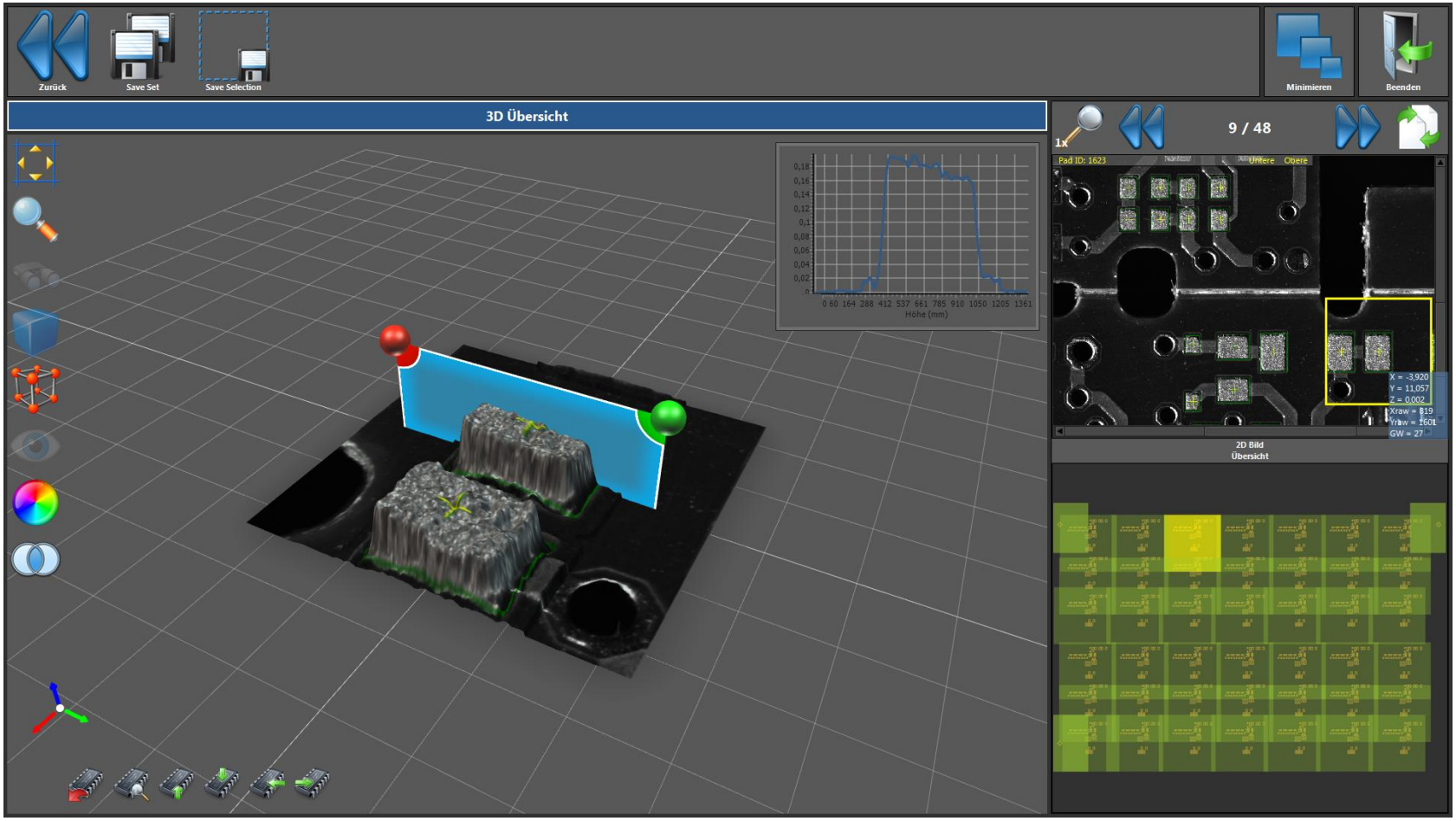
SPI-Line 3D

Inspection results



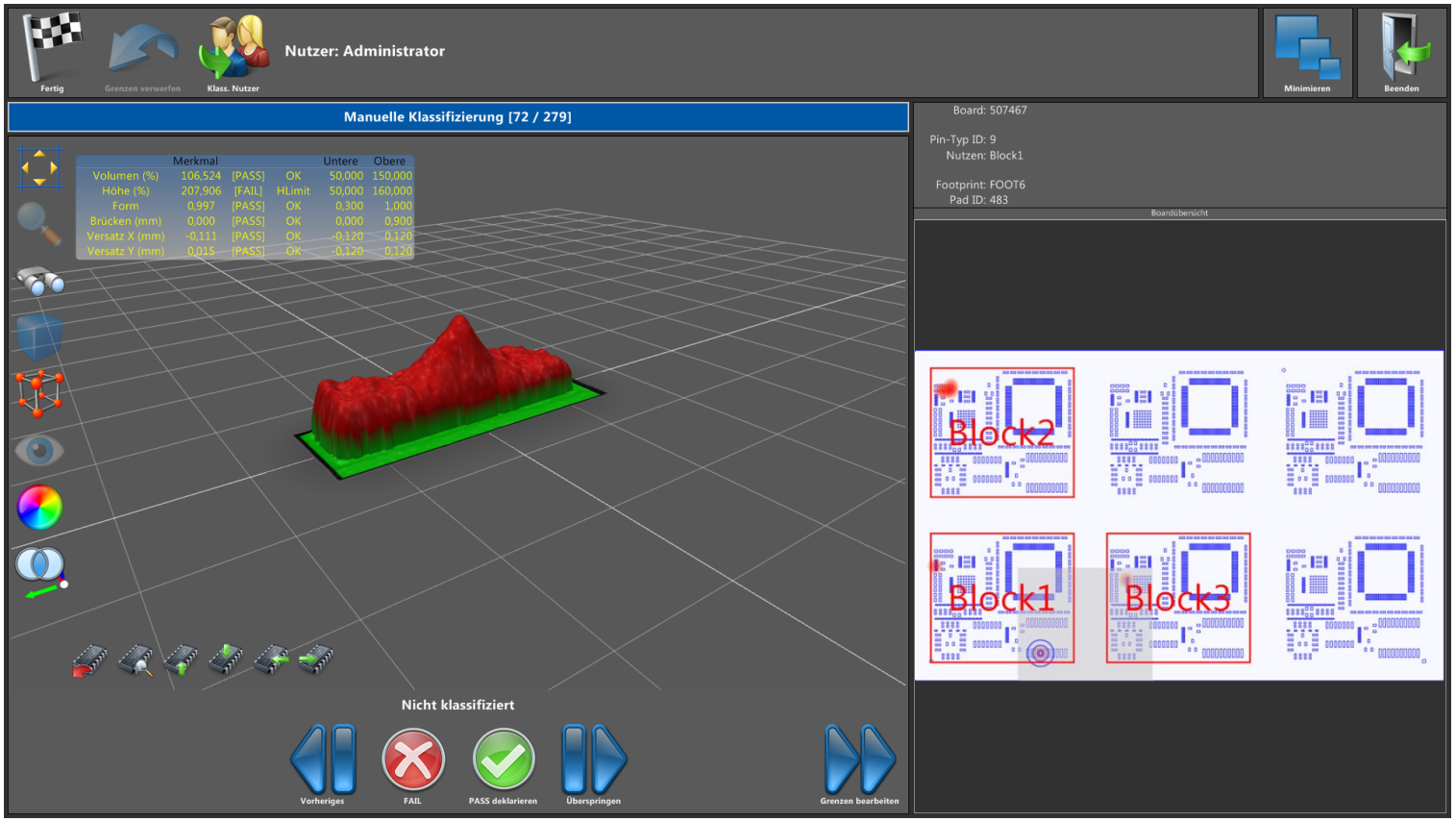
SPI-Line 3D

Inspection results



SPI-Line 3D

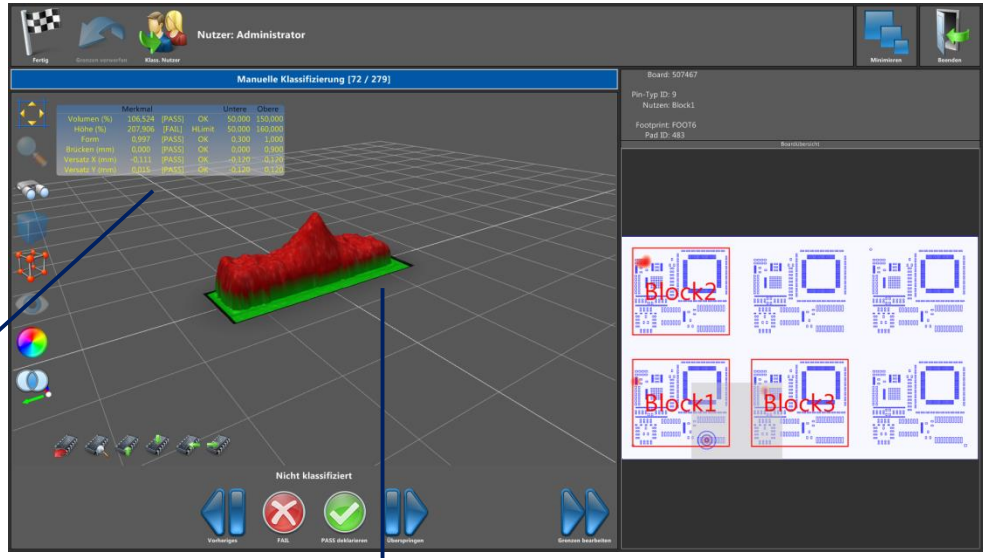
Inspection results



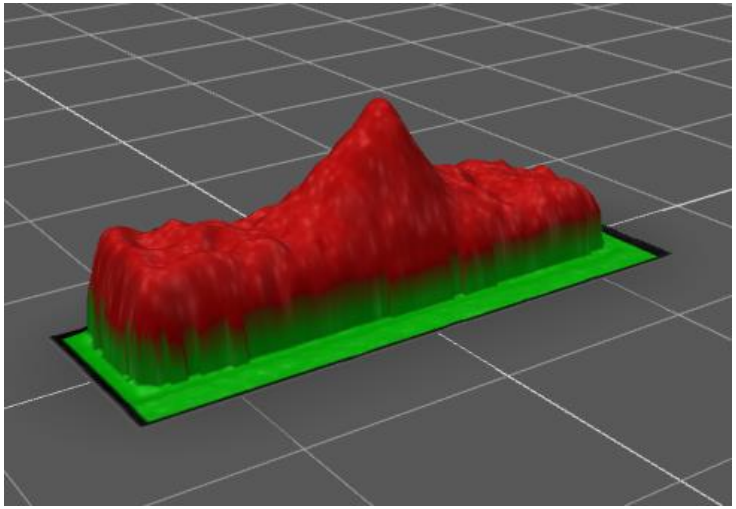
SPI-Line 3D

Failure detection/

paste height



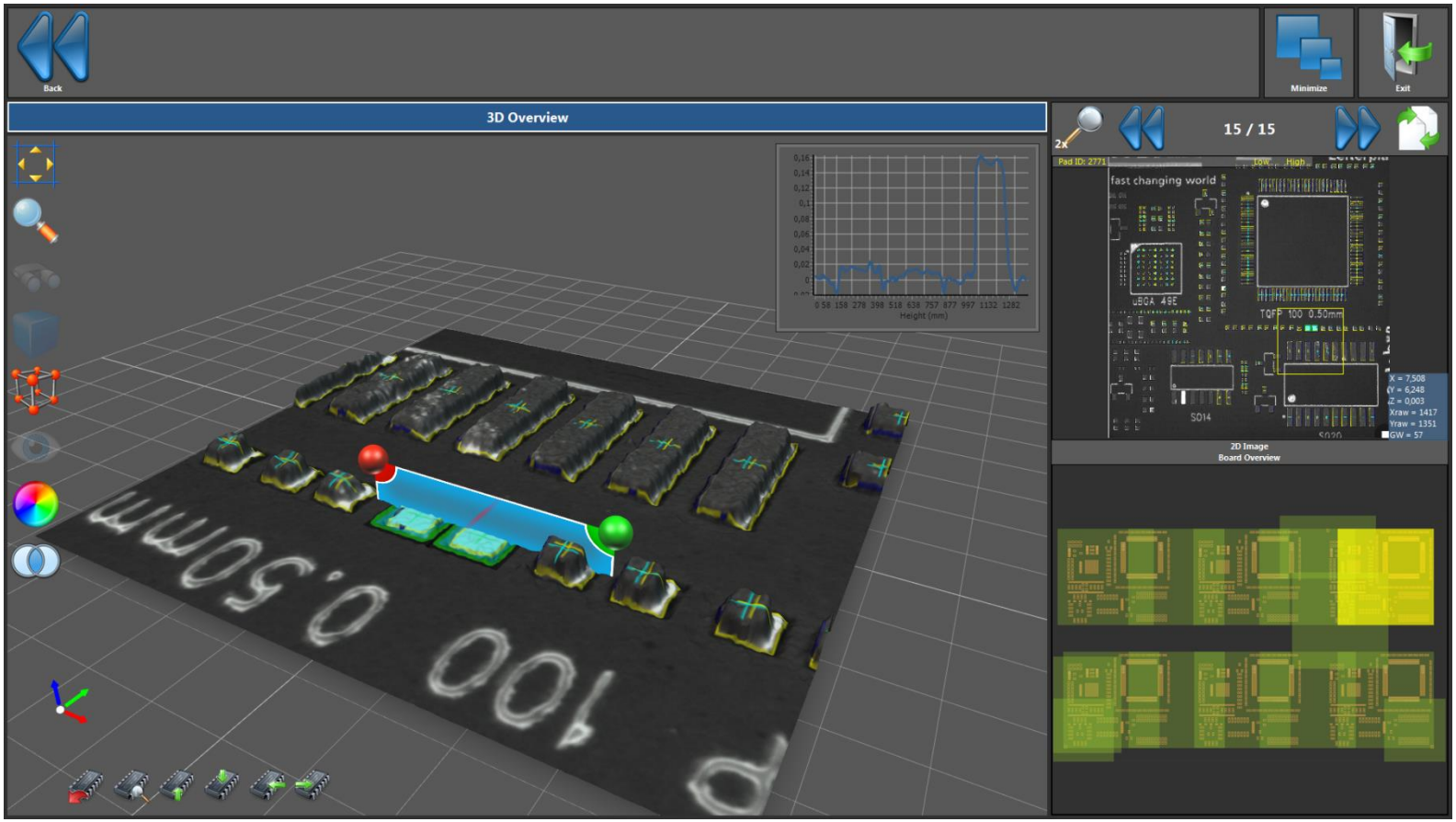
	Merkmal			Untere	Obere
Volumen (%)	106,524	[PASS]	OK	50,000	150,000
Höhe (%)	207,906	[FAIL]	HLimit	50,000	160,000
Form	0,997	[PASS]	OK	0,300	1,000
Brücken (mm)	0,000	[PASS]	OK	0,000	0,900
Versatz X (mm)	-0,111	[PASS]	OK	-0,120	0,120
Versatz Y (mm)	0,015	[PASS]	OK	-0,120	0,120



SPI-Line 3D

Failure detection/

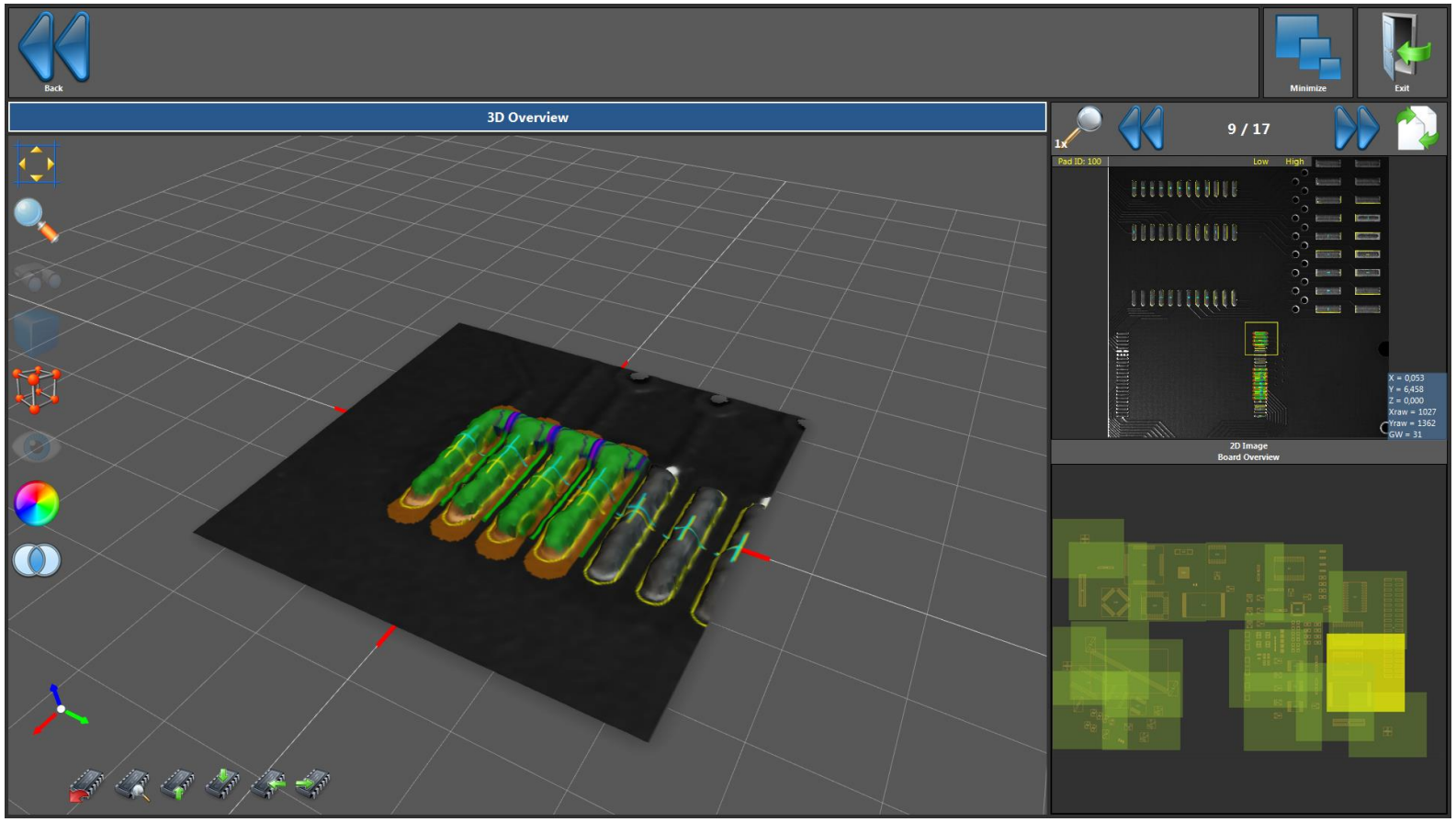
No paste



SPI-Line 3D

Failure detection/

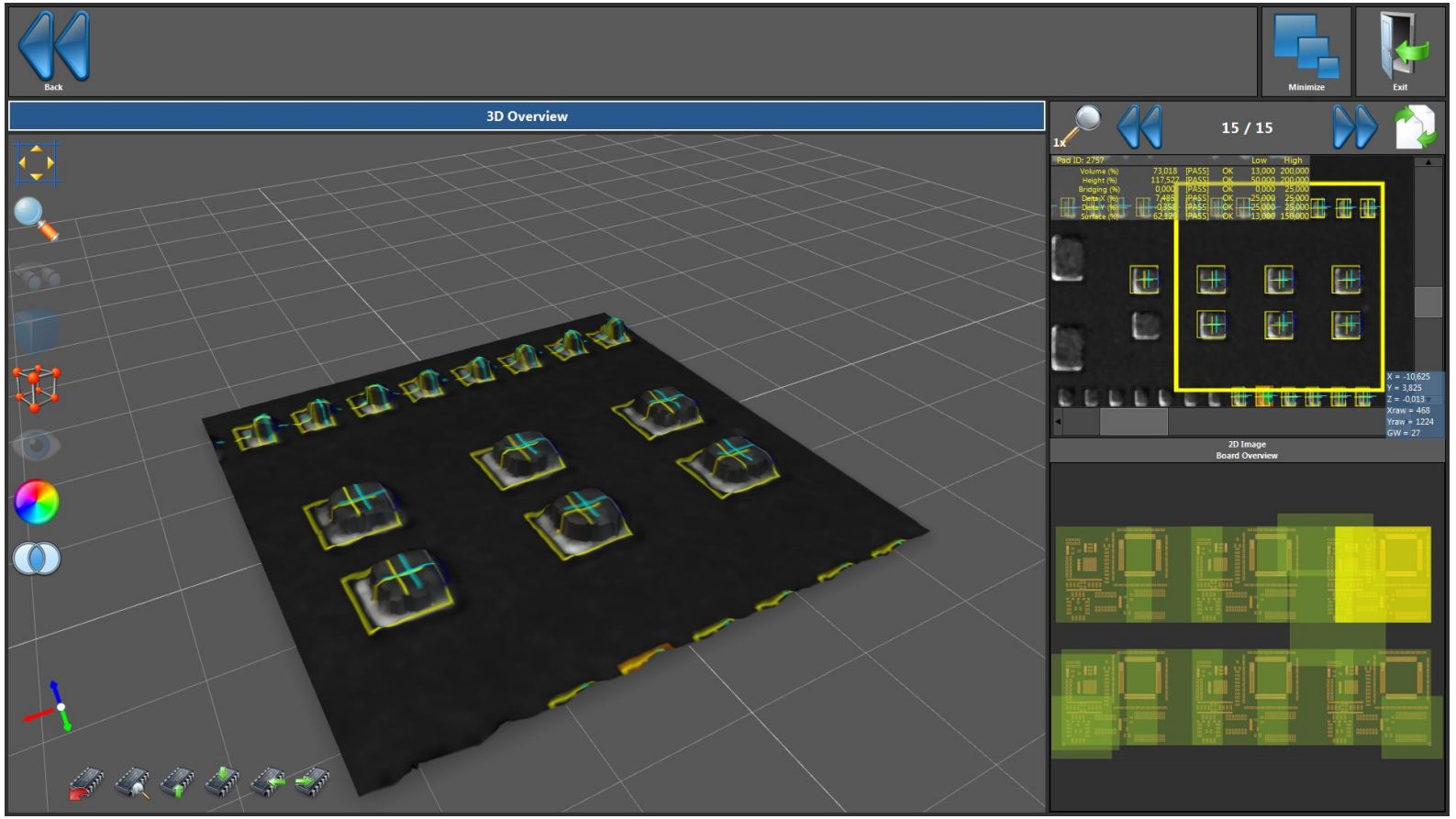
Bridges



SPI-Line 3D

Failure detection/

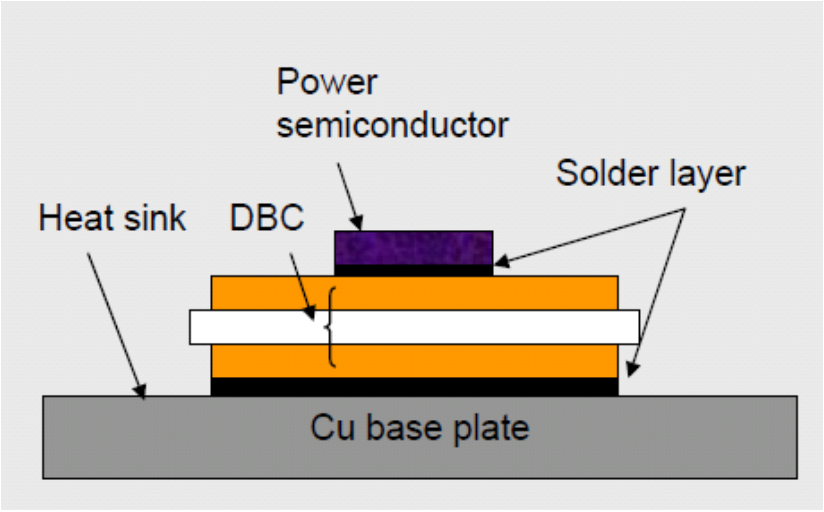
Offset



Inspection of Sinter paste

Sinter technology – why?

- Semiconductor power modules built as a thermal stack
- State of the art is large area soldering
- For long life-requirements the silver sintering promises big improvement

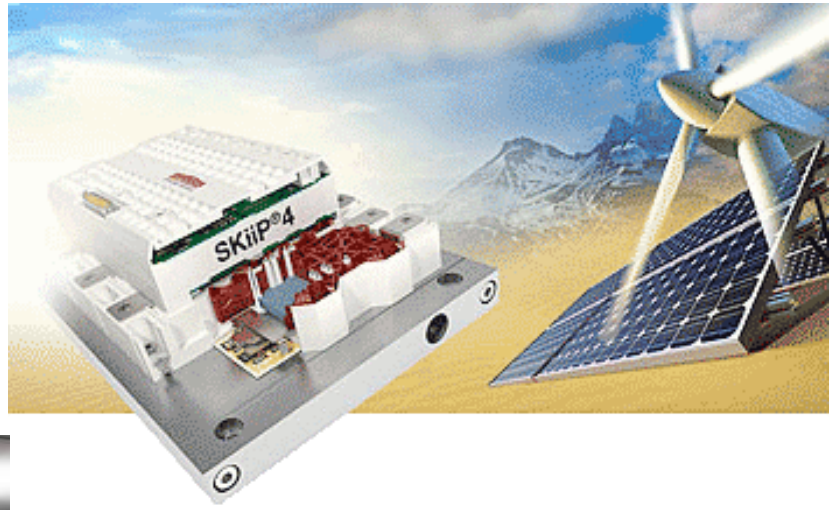


Source: Fachhochschule Kiel / Institut für Mechatronik

Inspection of Sinter paste

Sinter technologie – applications

- Photovoltaic
- Wind power stations
- Electric mobility



Source: SEMIKRON Elektronik GmbH & Co. KG

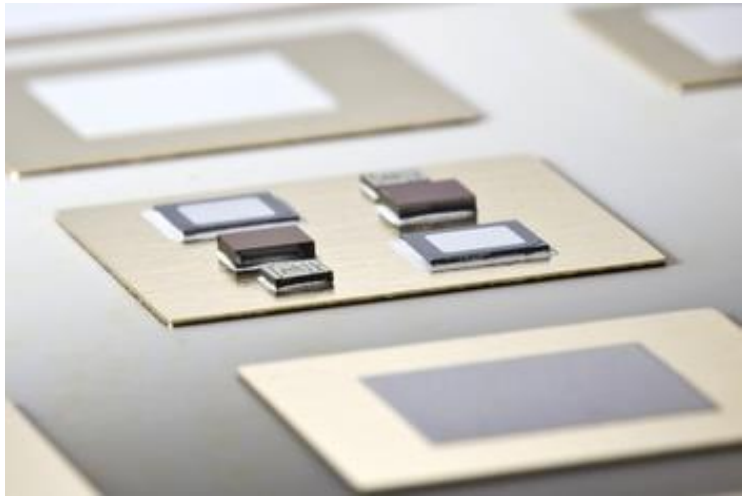
Source: VW AG

Inspection of Sinter paste

Inspection tasks for Sinter paste

- Height
- Volume
- Offset
- Holes in surface (cavities, scratches)
- Fringes on edge
- Coplanarity

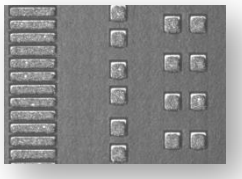
….



Inspection of Sinter paste

Differences between solder paste and Sinter paste:

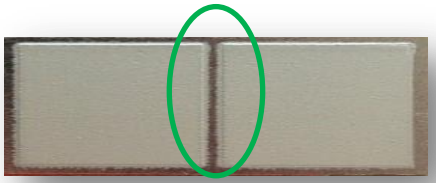
	Solder paste	Sinter paste
Paste height	80 µm… 150 µm	20 µm … 50 µm
Paste area	~ mm^2	~ cm^2
Structure size	25-45 µm	< 3 µm
Test fonctions	Height, area, volume, offset, form, bridges	Height, area, volume, offset, form, bridges, particles, scratches, holes, fringes



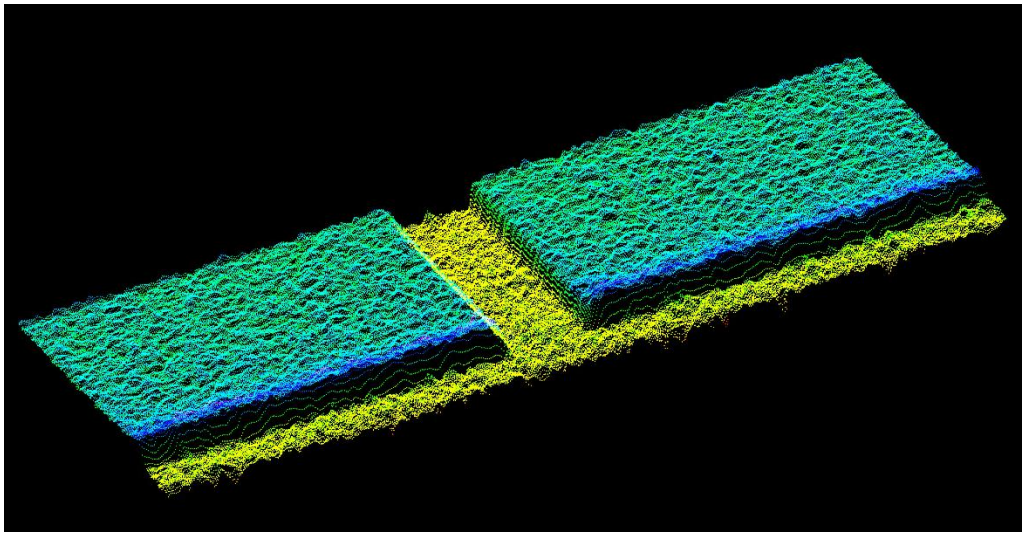
Inspection of Sinter paste

A highly precise measurement of Sinter paste is possible!

2D-image



3D-image with SPI-Line 3D



Process optimization g

Closed-Loop

Paste printer

- Many parameters
- Random failures
- Serial failures

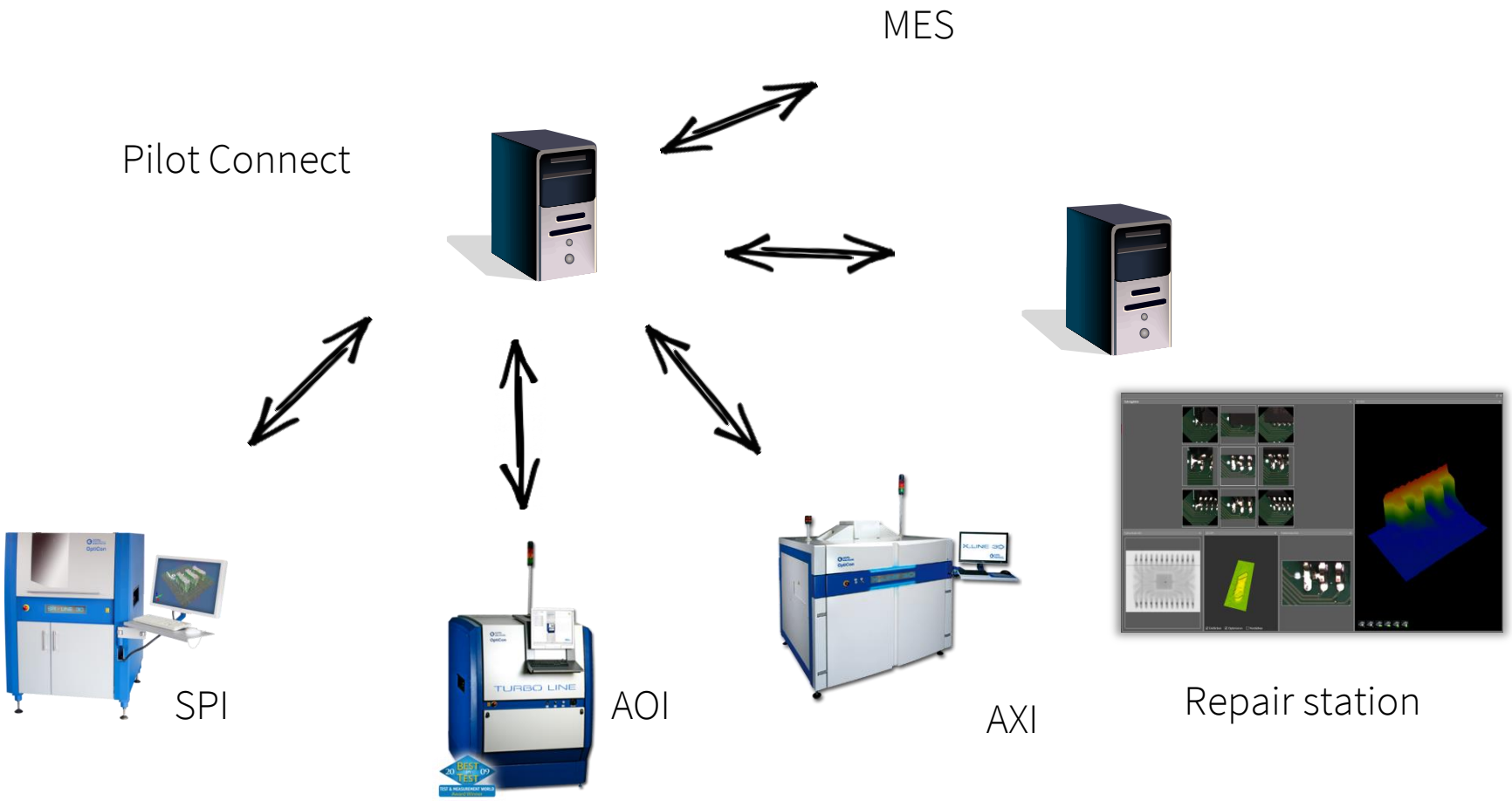
SPI-Line 3D

- Reliable measurement of paste

Response of results

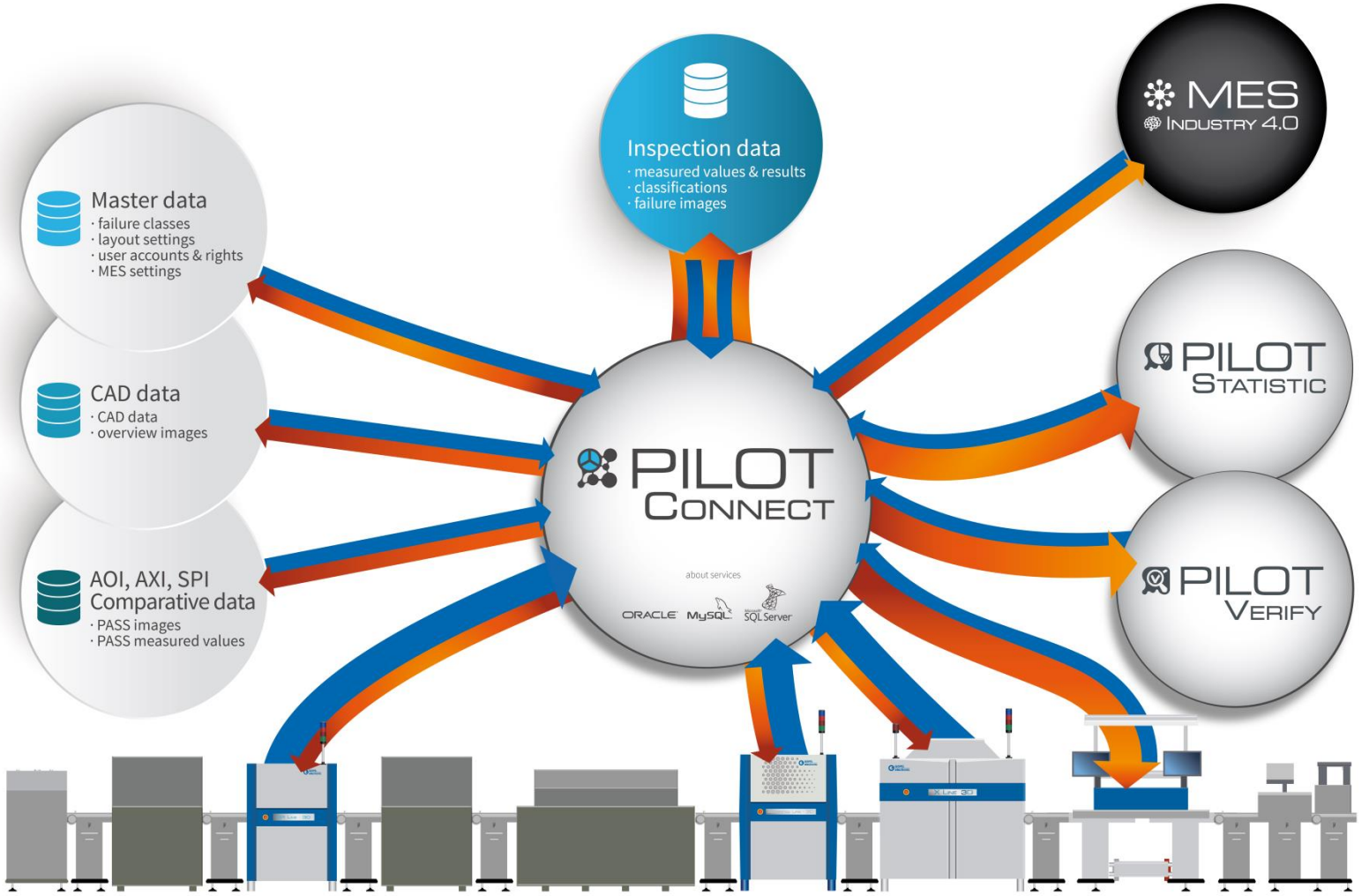
Process optimization

Many data – one channel / Pilot Connect



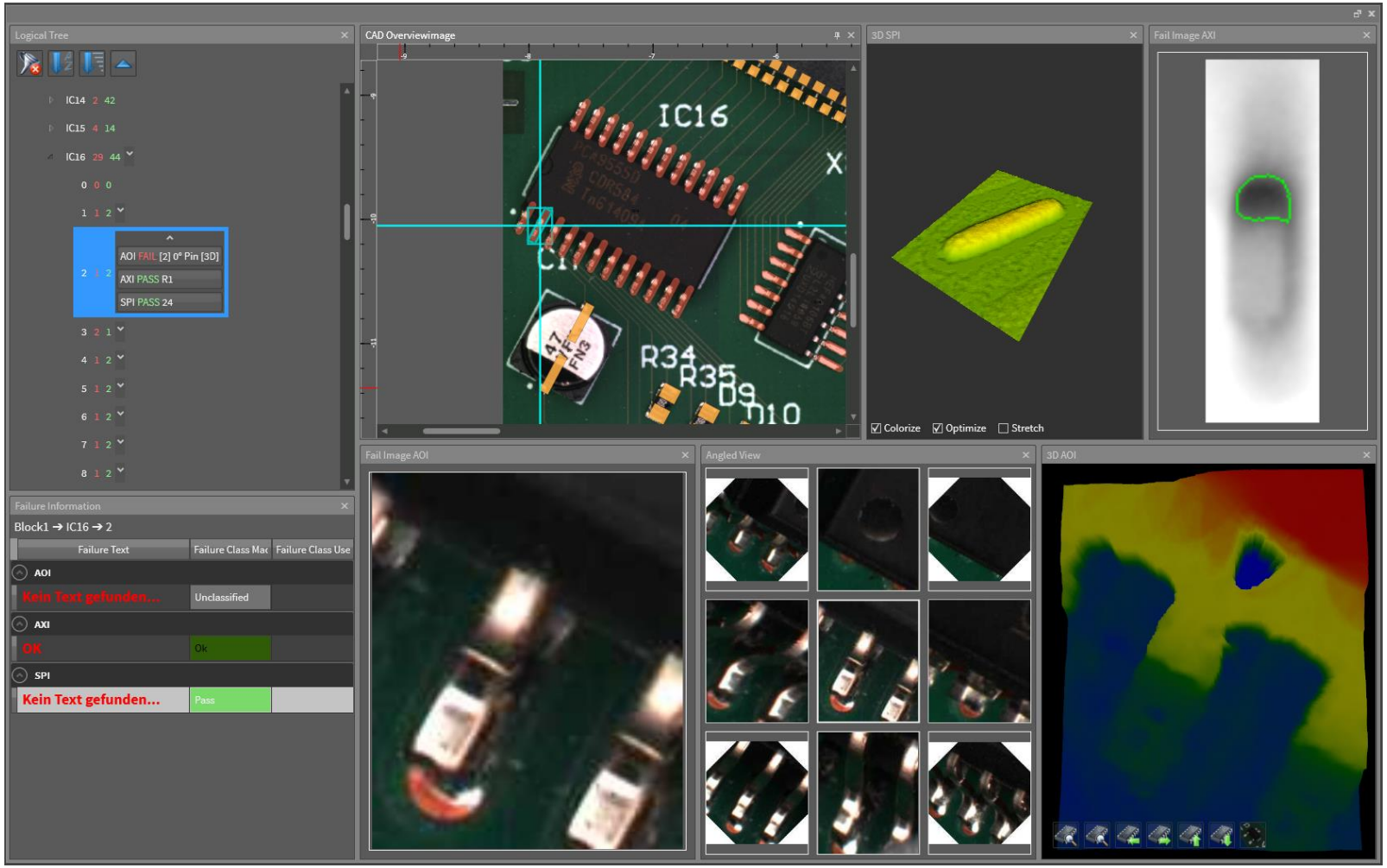
Process optimization

Many data – one channel / Pilot Connect



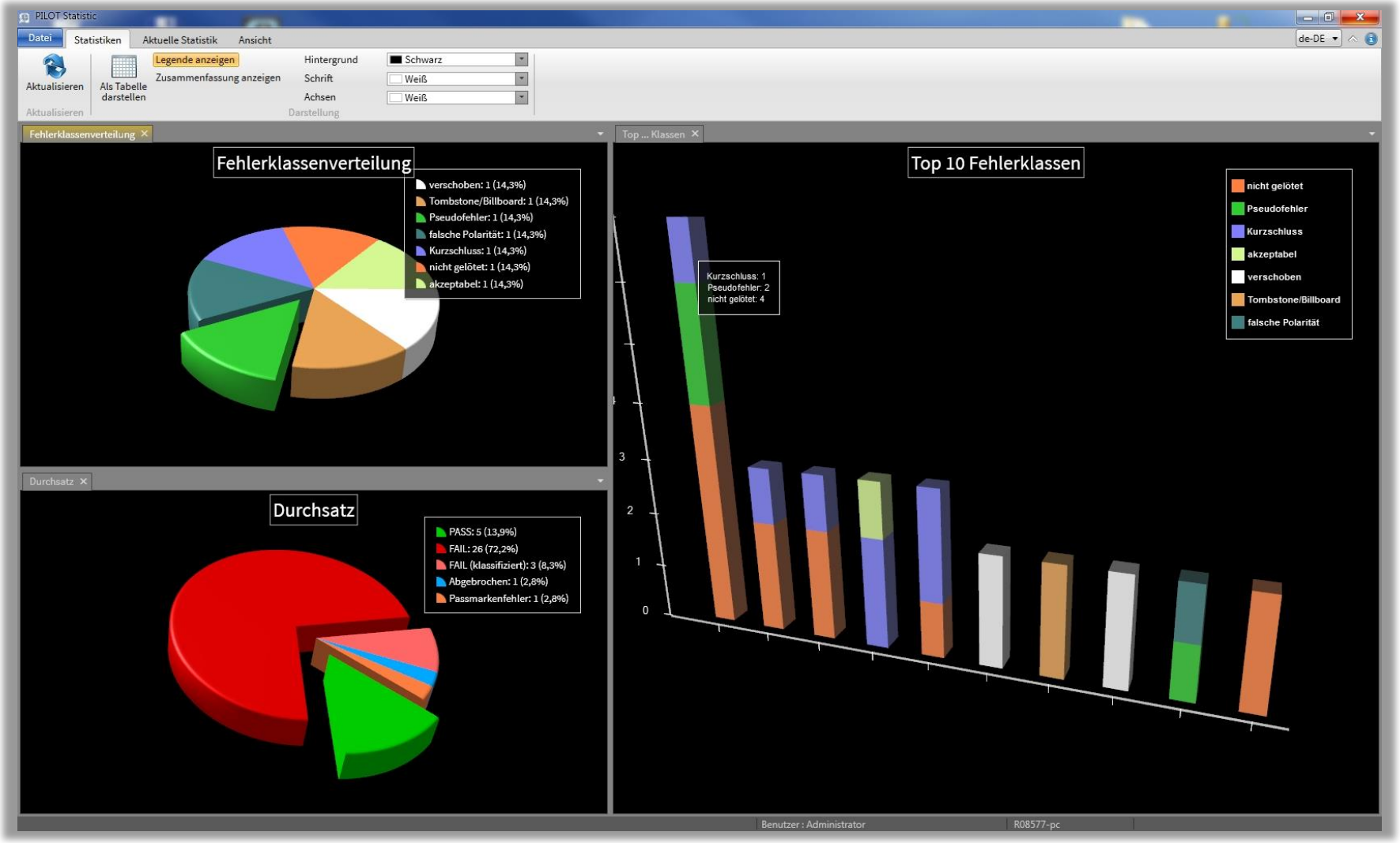
Process optimization

Failure visualization on a common repair station



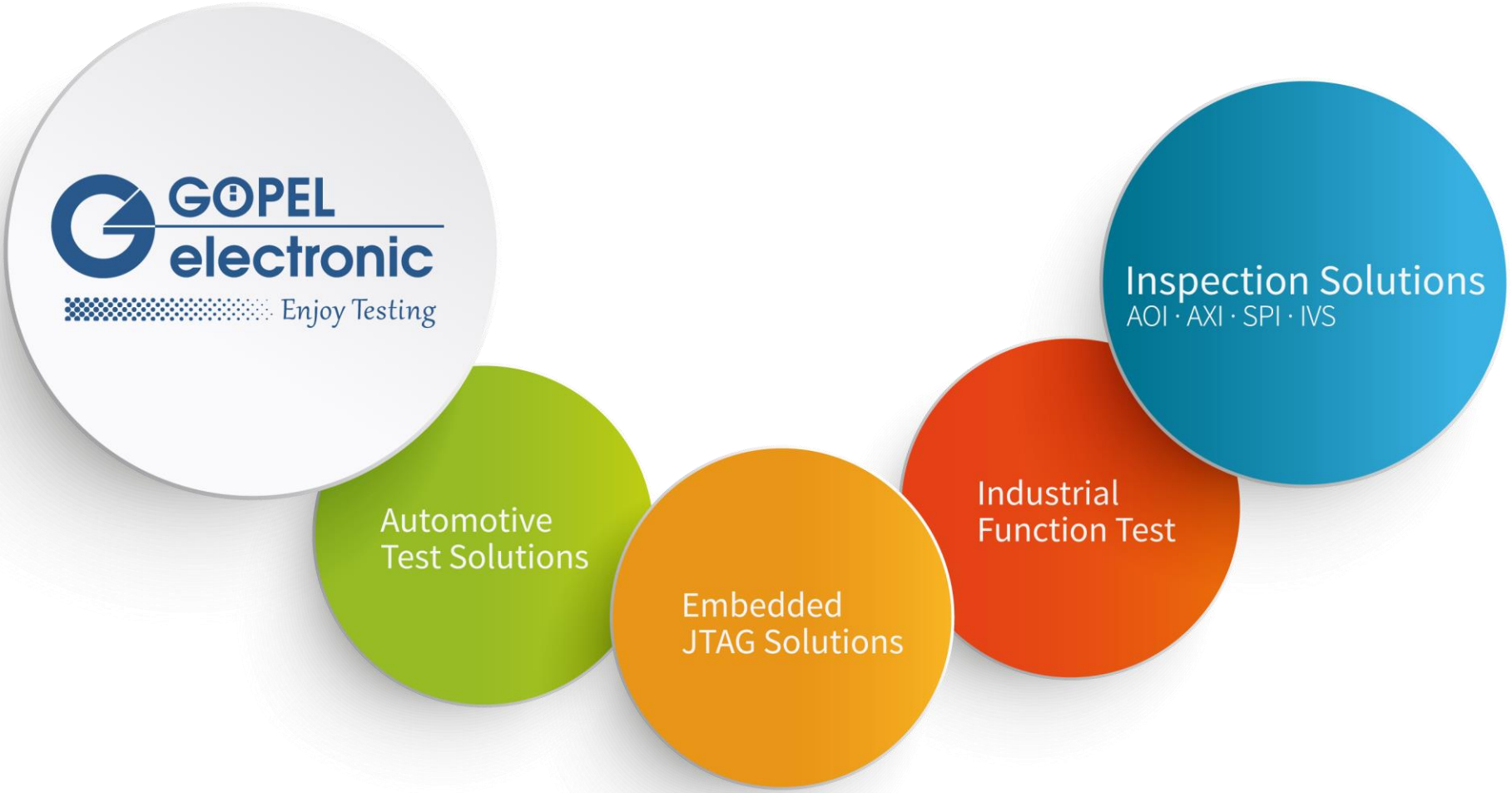
Process optimization

Common statistical evaluation of results



Summary

- A total test coverage can only be reached with a 3D solder paste inspection.
- Paste defects will be detected with a high precision and high speed.
- The user friendly system concept of the SPI-Line 3D allows a simple line integration.
- The use of SPI-Line 3D offers new possibilities for process optimization and process stability.



Thanks for your attention!

www.goepel.com