

# AUTOMATIC OPTICAL INSPECTION



**InterElectronic**



# INTRODUCTION



InterElectronic Hungary Ltd. offers equipments, machines and different materials (ESD) of different production technologies (SMT/THT/LED). Including high quality, special request fulfilling soldering machines, devices, tools, instruments and materials for the electronic industry and services.

## SERVICES

Our each and every product has a warranty granted by the InterElectronic Hungary Ltd. For more complex appliances our company offers a well-needed training for set up and usage. We grant the repair of all of the products traded by our company during and after the warranty period. As well as we guarantee the continuous supply of accessories and instruments.

## DEMONSTRATION

In case if any of our products aroused your interest the InterElectronic Hungary Ltd. would be glad to visit your company and hold a presentation of the product of your interest. As far as possible we serve you by bringing demo devices with us. In the most cases of our products we are proud possessors of references nation-wide. Major machines also could be observed at our partners' site.

## PRICE LIST

Most of the prices of our products can be requested on our website and will be sent via email to you. In case of special and more complex machines the prices are given after consultation individually through a price offer. If you are interested in more information or user manuals of our products we recommend you to visit our website ([www.interelectronic.com](http://www.interelectronic.com)), which is updated continuously with professional information. We also recommend you to visit our office, where you can purchase any of the needed devices and spare parts of the product of your interest.

## ORDER/SHIPPING

Our soon to be partners are welcomed to be helped via telephone, fax or e-mail. We use different ways of delivery, depending on the preference of our partner. We can deliver your purchased product by ourselves, by freight or courier service. The way of delivery might be negotiated previously. We offer you cash on delivery nation-wide!

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GOEPEL electronic has been one of the pioneers of the most innovative electrical test technology for electronic components and PCBs, JTAG/Boundary Scan. All engineering tasks required to introduce the Boundary Scan technology up to the generation of product-specific test programs as well as training seminars are part of the overall customer support by GOEPEL electronic. In the meantime, Automated Optical Inspection has developed to one of the most commanding test technologies in electronic production.

In the first year just a few systems were manufactured, but relatively quickly a product range emerged that found an appropriate infrastructure in the new company building, which was opened in 2003. Additionally, the functional test of electronic assemblies and devices, in particular for Automotive Testing, has been one of the supporting pillars in the Company's business activities. They are mainly focussed on the requirements of the automotive industry.

Furthermore the customized Functional Test Systems optimally suit for the automation of test runs. Integrated in a production line, as test system for final products or as repair station, versatile requirements can be realised with these systems.

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## AOI SmartLine

Desktop AOI System for efficient Inspection of Small Batches

The compact design enables space-saving utilization at various places within the production process. The optical inspection quality is ensured by the unique multispectral illumination and integrated reference data base.



Keyboard for comfortable fault analysis at the repair station



Repair station software



Statistics module

### SAFE FAULT DETECTION

Unique multispectral illumination

Program optimisation via statistically recorded inspection data

Assured inspection quality via reference data base

### COMPANY-SPECIFIC PRODUCTION INTEGRATION

Individual integration opportunities into the production process (repair station, fault output, usage of serial numbers)

Extensive data interfaces to quality

Management and traceability systems (ZVEI standard, iTAC, customised)

Compactness and mobility enable flexible utilisation opportunities

# AOI OptiCon SmartLine Specification

## INSPECTION PARAMETERS

### Orthogonal top inspection

Image capturing technology  
Lens  
Resolution  
Illumination  
Handling time  
Inspection speed  
PCB size  
Max. PCB weight  
PCB clearance top side  
PCB clearance bottom side  
Smallest inspectable component

up to 12 megapixels, 24 bit colour depth

telecentric

up to 10.5  $\mu\text{m}$

multispectral, multi-directional

minimised by quick-clamping

up to 25  $\text{cm}^2/\text{s}$

up to 400 mm x 390 mm

5 kg

up to 65 mm

up to 100 mm

01005 / pitch 0.3

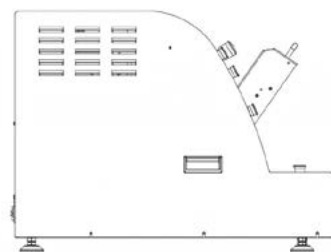
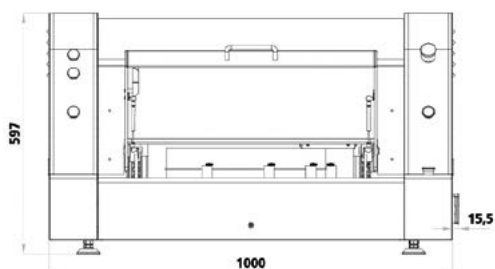
## SYSTEM SPECIFICATIONS

Power requirements  
Dimensions (w x d x h)  
Weight

230 V AC / 1 kVA

1,000 mm x 790 mm x 597 mm

ca. 200 kg



## AOI BasicLine

Stand-alone AOI System  
for manual Loading  
and flexible Adaptation  
of different Assemblies



The BasicLine can also be utilized as a separate repair station and is characterized by a comfortable fault classification via keyboard.



Keyboard for comfortable fault analysis at the repair station

### MAXIMUM FAULT DETECTION

Unique multispectral illumination  
patented 360° inspection in 1° steps with adapted focal plane  
program optimisation by means of statistically recorded inspection data



Repair station software

### COMPANY-SPECIFIC PRODUCTION INTEGRATION

Individual integration opportunities into the production process  
(repair station, fault output, usage of serial numbers)  
Extensive data interfaces to quality management and traceability systems (ZVEI standard, iTAC, customised)



Statistics module

### FLEXIBLE CAMERA CONFIGURATIONS

inspection modules for various speeds and test tasks (SMD, THT, THR)  
extension opportunities: rotatory angled-view inspection, laser height measurement and add-on camera with microscopic resolution

# AOI OptiCon BasicLine Specification

## INSPECTION PARAMETERS

### Orthogonal top inspection, angled-view top inspection

Image capturing technology

Lens

Resolution

Illumination

Handling time

Inspection speed

Angled-view inspec

PCB size

Max. PCB weight

PCB clearance top side

PCB clearance bottom side

Smallest inspectable component

up to 48 megapixels, 24 bit colour depth  
telecentric

up to 3.2  $\mu\text{m}$

multispectral, multi-directional

minimised by quick-clamping

up to 60  $\text{cm}^2/\text{s}$

0°–360° in 1° steps

up to 510 mm x 500 mm

5 kg

up to 65 mm

up to 65 mm

01005 / pitch 0.3

## SYSTEM SPECIFICATIONS

Power requirements

Dimensions (w x d x h)

Weight

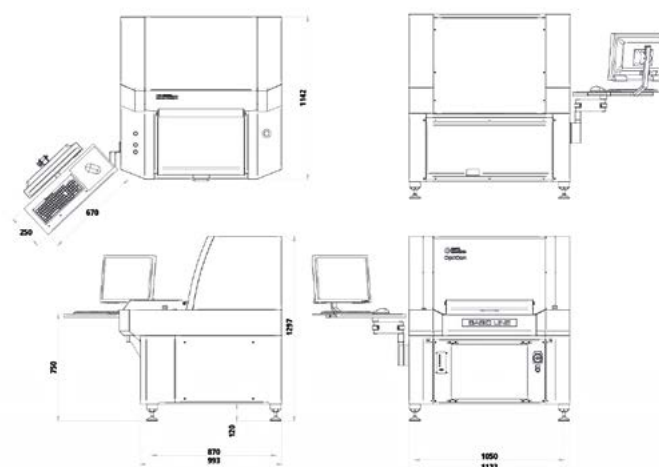
230 V AC / 1 kVA

1,000 mm x 790 mm x 597 mm

ca. 200 kg

This AOI system can be individually integrated into your process of PCB assembly. The various error output varieties per screen, label or test protocol are suited for many PCBs production methods.

A multitude of variants and settings in illumination and camera make the system a highly precise and fast inspection device. Customized configurations and technical upgrades are also possible.



## AOI AdvancedLine

Inline AOI System for  
flexible Integration  
Opportunities

The AdvancedLine AOI system's decisive advantage is the multitude of opportunities for inline integration into the production process. The system can be utilized at each position in a PCB production line. No requirements or specifications will remain unfulfilled as your boards can be transported in each direction.



Keyboard for comfortable fault  
analysis at the repair station



Repair station software



Statistics module

### MAXIMUM FAULT DETECTION

Unique multispectral illumination

Patented 360° inspection in 1° steps with adapted focal plane

Program optimisation by means of statistically recorded  
inspection data

### COMPANY-SPECIFIC PRODUCTION INTEGRATION

Individual integration opportunities into the production process  
(transportation direction, inline verification station,  
usage of serial numbers)

Extensive data interfaces to quality management and  
traceability systems (ZVEI standard, iTAC, customised)

### FLEXIBLE CAMERA CONFIGURATIONS

Inspection modules for various speeds and test tasks (SMD, THT, THR)

Extension opportunities: rotatory angled-view inspection, laser height  
measurement and add-on camera with microscopic resolution

# AOI OptiCon AdvancedLine Specification

## INSPECTION PARAMETERS

### Orthogonal top inspection, angled-view top inspection

Image capturing technology  
Lens  
Resolution  
Illumination  
Inspection speed  
Angled-view inspec  
PCB size  
Max. PCB weight  
PCB clearance top side  
PCB clearance bottom side  
Smallest inspectable component

up to 48 megapixels, 24 bit colour depth  
telecentric  
up to 3.2  $\mu\text{m}$   
multispectral, multi-directional  
up to 60  $\text{cm}^2/\text{s}$   
0°–360° in 1° steps  
up to 800 mm x 450 mm  
5 kg  
up to 65 mm  
50 mm  
01005 / pitch 0.3

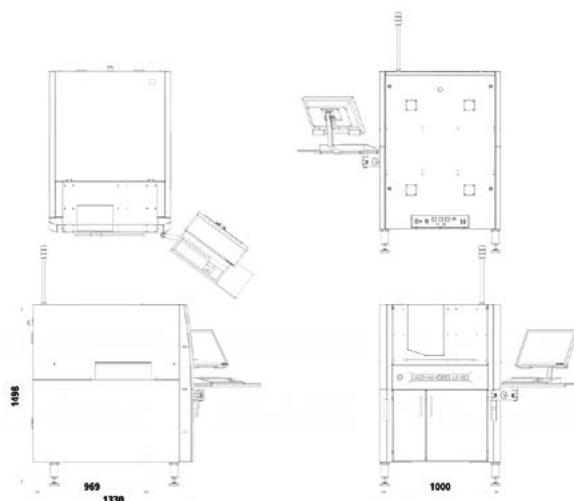
## SYSTEM SPECIFICATIONS

Inline interface  
Transportation directions  
Power requirements  
  
Dimensions (w x d x h)  
Weight

SMEMA, Siemens, Sensor  
left-right / right-left / left-left / right-right  
230 V AC / 1 kVA  
6 bar compressed air, consumption < 20 l/h  
1,000 mm x 1330 mm x 1500 mm  
ca. 580 kg

This AOI system can be individually integrated into your process of PCB assembly. The various error output varieties per screen, label or test protocol are suited for many PCBs production methods.

A multitude of variants and settings in illumination and camera make the system a highly precise and fast inspection device. Customized configurations and technical upgrades are also possible.



## AOI TurboLine

Inline AOI System for High-End Inspection

The TurboLine AOI system's special features are opportunities for double-sided inspection as well as various camera and illumination configurations.

It is possible to inspect the PCB bottom side without assembly turning. This is a decisive advantage over common AOI systems as in-line speed is guaranteed. The rotatable angled-view and the segmented band module also help for faster inspection.



Keyboard for comfortable fault analysis at the repair station



Repair station software



Statistics module

### MAXIMUM FAULT DETECTION

- Unique multispectral illumination
- Patented 360° inspection in 1° steps with adapted focal plane
- Program optimisation by means of statistically recorded inspection data

### 18 DIFFERENT CAMERA CONFIGURATIONS

- orthogonal top inspection (optional microscopic resolution)
- orthogonal bottom inspection
- rotatory angled-view inspection with unique inspection area

### SPEED ADVANTAGES OVER COMMON AOI SYSTEMS

- double-sided PCB inspection without flipping
- identical inspection areas of the orthogonal and angled-view cameras
- loading and reloading by three-segment-belt during inspection

# AOI OptiCon TurboLine Specification

## INSPECTION PARAMETERS

### Orthogonal top inspection, angled-view top inspection

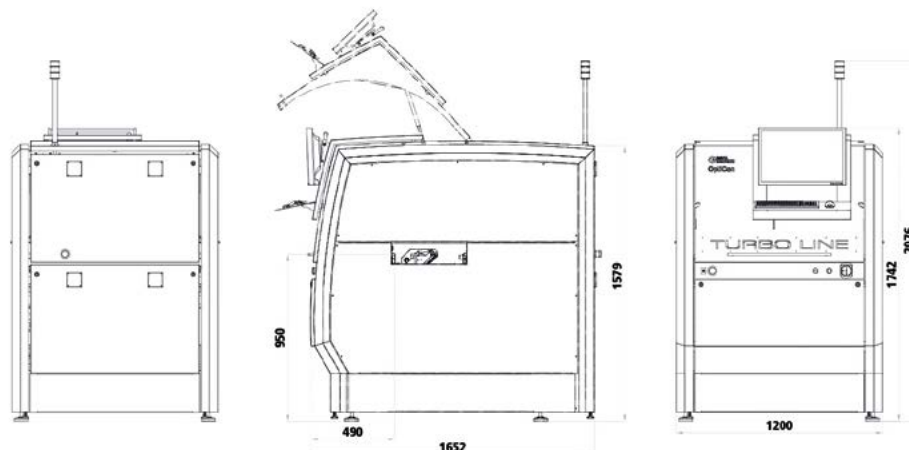
Image capturing technology  
Lens  
Resolution  
Illumination  
Handling time  
Inspection speed  
Angled-view inspect  
Double-side PCB inspection  
PCB size/ carrier size  
Max. PCB weight  
PCB clearance top side  
PCB clearance bottom side  
Smallest inspectable component

up to 48 megapixels, 24 bit colour depth  
telecentric  
up to 6.5  $\mu\text{m}$   
multispectral, multi-directional  
3 s  
up to 60  $\text{cm}^2/\text{s}$   
0°-360° in 1° steps  
without flipping  
up to 610 mm x 460 mm  
5 kg  
up to 80 mm  
up to 50 mm  
01005 / pitch 0.3

## SYSTEM SPECIFICATIONS

Inline interface  
Transportation directions  
Power requirements  
  
Dimensions (w x d x h)  
Weight

SMEMA, Siemens, Sensor  
left-right / right-left / left-left / right-right  
230 V AC / 1 kVA  
6 bar compressed air, consumption < 20 l/h  
1,200 mm x 1,652 mm x 1,742 mm  
ca. 1000 kg





## AOI THT-Line

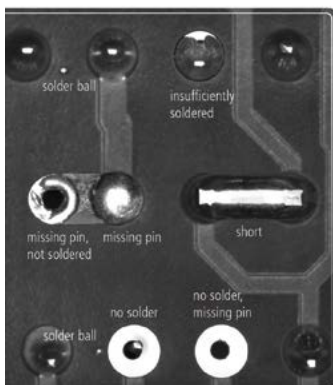
AOI System for efficient  
Quality Check of THT  
Assemblies

AOI System for efficient quality assurance of THT Assemblies in the production process. It can be utilised either per manual feeding or as an inline system utilising a roller conveyor transport system. THT-Line enables the automated inspection of THT assemblies with up to 80 mm component height.

- inspection of THT components, THT solder joints and wave soldered SMD components
- automatic or manual feed on an accumulating roller conveyor system or belt module
- efficient use of system due to double-sided inspection of THT assemblies without turning



Polarity check at THT components



Typical solder faults

## MAXIMUM FAULT DETECTION

- unsurpassed multi-spectral lighting
- freely configurable test functions and lighting options
- rapid creation of test programs based on flexible import modules

## FLEXIBLE INTEGRATION OPTIONS

- component and/or solder side can be tested at different points in the line
- inspection of the solder side on the upper conveyor belt or the lower return belt
- AOI modules operating in parallel and independently in one system during the PCB return in the lower system area

## MES/INDUSTRIE 4.0

- flexible data interface for MES and traceability connection
- data management and comprehensive error analysis via PILOT Connect
- data transfer from inspection systems from other manufacturers for verification and evaluation

# AOI OptiCon THT-Line Specification

## OPTICON THT-LINE

Image capturing technology  
Colour depth  
Integration

Inspection scope

Illumination system

Inspection speed

Maximum carrier size

Maximum inspection area

Inspection height

Clearance

### AOI module component side

CCD matrix camera  
up to 24 bit  
on upper conveyor belt

Presence, placement/  
positioning, polarity and label-  
ling (OCR) of THT assemblies

multispectral, multi-directional  
up to 60 cm<sup>2</sup>/s

up to 620 mm x 510 mm

540 mm x 450 mm

up to 80 mm

above PCB: up to 130 mm  
below PCB: up to 65 mm

### AOI module solder side

CCD matrix camera

up to 24 bit

on upper conveyor belt or  
lower return belt

THT solder joints, SMD compo-  
nents, SMD solder joints

multispectral, multi-directional  
up to 100 cm<sup>2</sup>/s

up to 620 mm x 510 mm

540 mm x 450 mm

5 mm

above PCB: up to 130 mm  
below PCB: up to 65 mm

## SYSTEM SPECIFICATIONS

Power requirements  
Carrier transport system  
Transportation direction  
Inline interface  
Dimension (W x D x H)

230 VAC / 2 kVA; 6 bar compressed air, consumption < 20 l/h  
accumulation roller or belt module

left-right / right-left / left-left / right-right

SMEMA, Siemens, Sensor

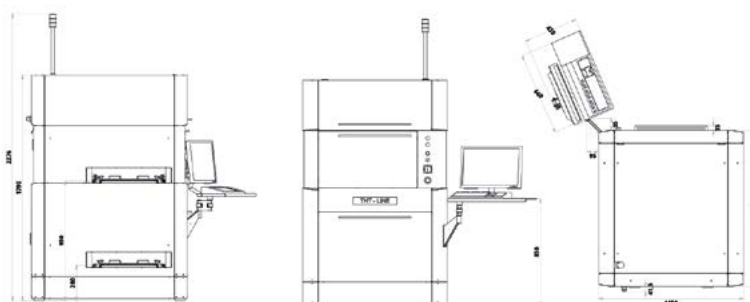
1150 mm x 1300 mm x 1800 mm

## OPTIONS

Barcode/2D code reading  
system

Communication with RFID  
reading systems

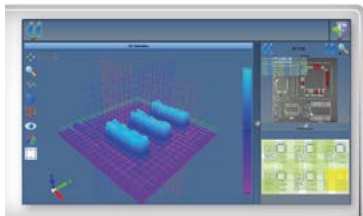
System configuration for  
manual feed



## AOI SPI-Line 3D

### 3D Solder Paste Inspection System

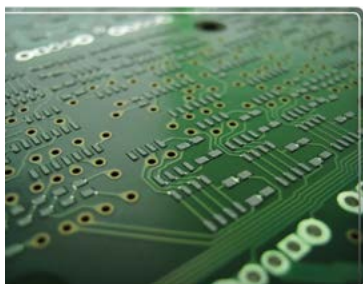
In comparison to other solder paste inspection systems, the SPI-Line 3D provides a true accurate measurement of applied solder paste. The solder paste printing is inspected for form, height, surface area, bridges, volume, x/y offset and coplanarity.



Software interface SPI-Pilot:  
3D display



Software interface SPI-Pilot:  
initial screen



PCB with solder paste

### PRECISE THREE-DIMENSIONAL SOLDER PASTE PRINTING MEASUREMENT

- Form • Bridges • X/Y offset • Surface area
- Height • Volume • Coplanarity

### CAMERA HEAD OPTIMISED FOR SPEED

- 180 images per second at 4 megapixel resolution
- Highly precise 3D image capturing based on fringe projection technology
- Operating without moving parts

### INTUITIVE SOFTWARE SPI-PILOT

- Touchscreen interface
- Program generation in less than 10 minutes

# AOI OptiCon SPI-Line Specification

## OptiCon SPI-Line 3D

Measured values

Camera

X/Y resolution

Z resolution

Z measuring accuracy (no target)

Z measuring area

Inspection Speed

Volume repeatability (on target)

Volume repeatability (on PCB)

Gage R&R

Illumination

Max. PCB size

Min. PCB size

Top side clearance

Bottom side clearance

Max. PCB thickness

Min. PCB thickness

Max. PCB warpage

Max. PCB weight

Program generation

Offline programming

Data import

Closed-Loop

Configuration 1

Configuration 2

Configuration 3

form, height, volume, bridges, X/Y offset, coplanarity, surface area

4 Megapixel, 180 fps

20  $\mu$ m

15  $\mu$ m

10  $\mu$ m

0.2  $\mu$ m

better than 2  $\mu$ m

1,000  $\mu$ m

90 cm<sup>2</sup>/s

51 cm<sup>2</sup>/s

20 cm<sup>2</sup>/s

< 0,5 % at  $\pm 3 \sigma$

< 2 % at  $\pm 3 \sigma$

<< 10 % at  $\pm 6 \sigma$

flexible illumination for fiducial and barcode/2D code recognition

510 mm x 510 mm

80 mm x 80 mm

50 mm

30 mm

5 mm

0,3 mm

$\pm 5$  mm

5 kg

simple programming in typically less than 10 minutes

yes

Gerber data import (RS-274-X, RS-274-D), CAD, ODB++

to paste printer

## SYSTEM SPECIFICATIONS

Operating system

Inline interface

Energy requirements

Transport directions

Dimensions (w x d x h)

Weight

Windows 7 (64 bit)

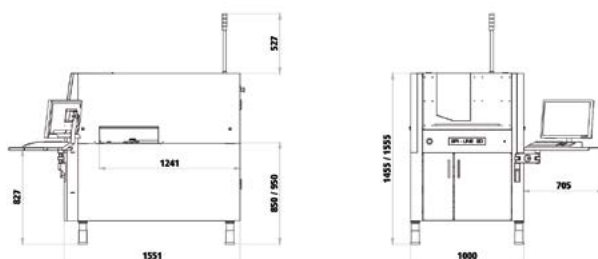
SMEMA, Siemens, Sensor

230 VAC / 2 kVA; compressed air 6 bar, consumption < 20 l/h

left-right / right-left / left-left / right-right

1000 mm x 1585 mm x 1520 mm

700 kg



# AOI OptiCon VarioLine - 2D/3D/360° AOI-In-line-System

## AOI VarioLine



**High inspection speed**

**Maximum error detection**

**Variable expandable**

### **HIGHEST INSPECTION SPEED**

Large, congruent field of view for all cameras

High positioning speeds and shortest image acquisition time

### **MAXIMUM ERROR DETECTION**

Excellent image quality of the orthogonal and angled-view cameras

Unique multispectral and multidirectional lighting

360° angled-view inspection with adapted focal plane

### **VARIABLE EXPANDABLE**

Shadow-free 3D-measurement with 3D · EyeZ

Laser height measurement system

Extended inspection area

# AOI OptiCon VarioLine - 2D/3D/360° Specification

## Inspection parameters

2D orthogonal inspektion

2D/360° angled-view inspection

3D-measurement (optional)

X/y resolution (2D)

X/y resolution (3D)

Z resolution (3D)

Smallest testable component size

Illumination

Component clearance above PCB

Component clearance below PCB

Inspection speed

Max. inspection area (optional)

Max. PCB weight

### Data

orthogonal camera with pixel adapted and telecentric optics

image acquisition with up to 48 megapixels and 24 bit color depth

4 angled-view cameras with viewing angle of 45° and adapted focal plane

rotational drive for 360° inspection in 1° steps

image acquisition with up to 48 megapixels  
and 24 bit color depth for each camera

measurement module 3D · EyeZ, based on scanning TMSA  
telecentric, orthogonal projection and measurement

selectable between 10 µm and 40 µm

selectable between 10 µm and 100 µm

< 5 µm

01005, 0.3 pitch

multi-spectral, multi-directional

50 mm (40 mm with 3D · EyeZ)

50 mm

up to 80 cm²/s

920 mm x 510 mm

5 kg

## SYSTEM SPECIFICATIONS

Power requirement

Inline interface

Transport directions

Dimensions (w x d x h)

Weight

230 V AC / 1,2 kVA; 6 bar compressed air, consumption < 20 l/h

SMEMA, Siemens, Sensor

left-right / right-left / left-left / right-right

1200 mm x 1450 mm x 1650 mm

ca. 950 kg

# Automated X-Ray Inspection (AXOI)



## AOI X-Line 3D

Combined 3D X-ray and Optical Inspection at Production Line Pace

**For maximum fault coverage using digital tomosynthesis with outstanding inspection speed.**

**Benefits of the 3D X-Ray Inspection:**

- Safe inspection of double-sided assembled PCBs
- Reconstruction of any layers
- Spatial allocation of detected faults
- Fast and user friendly test program generation by using a single unified library

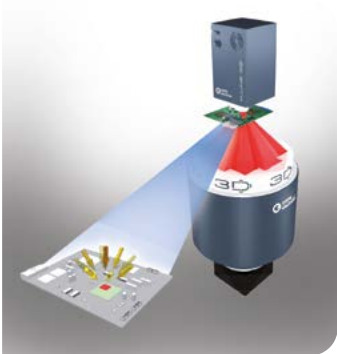
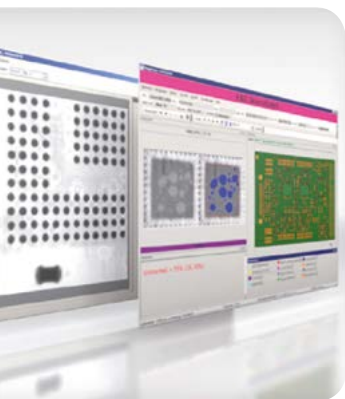


Image Capture

## IMAGE CAPTURE

- Complete 3D capturing can achieve test speeds of up to 40cm<sup>2</sup>/s by revolutionary GigaPixel™ technology
- Reconstruction processes possible due to tomosynthesis
- Simultaneous 3D x-ray inspection of top and bottom side of a double sided PCB
- Optimal adaptation to future components and manufacturing requirements via Software XI-PILOT
- Algorithm library suitable for all common components
- Minimal times for test program generation



Repair station- and analysis software

## PROCESS INTEGRATION

- Repair station software enables a visualisation of detected faults in various forms of presentation
- Powerful analysis software allows for the inspection of single layers objective rating of production quality and throughput with the help of comprehensive statistical evaluation package with numerous filter settings
- Warning and action limits as well as trend analyses are definable in the SPC Module

# Automated X-Ray Inspection (AXOI) AOI X-Line 3D Specification

## High-Speed X-Ray System for Maximum Test Coverage

OptiCon X-Line 3D is an automatic three-dimensional measuring X-ray inspection system for rapid inspection of printed circuit board assemblies. OptiCon X-Line 3D is based on a patent-pending detector concept, which has been developed in-house by GOEPEL electronic. Using a maintenance-free microfocus X-ray tube it allows for real-time multi-angle image capture.

A continuously scanning image acquisition unit provides for high-resolution X-ray images, which are acquired, pre-processed and re-constructed during axis motion. This enables an inspection throughput of up

to 40 cm<sup>2</sup>/s with full 3D acquisition of the board assembly. Reconstruction procedures based on digital tomosynthesis allow for concurrent inspection of top and bottom sides of assemblies, which are populated on both sides – within a single run. In addition, tomosynthesis allows for distinct analyses of defined board layers and inspection of solder joints with a reliable process. Inspection tasks, which can't be covered by X-ray technology, like polarity checks, character and/or colour recognition, will be addressed by an integrated AOI module.

## DATABASE

- Layered reconstruction of components and solder joints
- Test program generation and actual inspection process are executed with geometrically calibrated, distortion free imaging of the real test objects
- Fast test program generation based on CAD data using a component library
- Predefined test algorithms and classifiers

## FAULT DETECTION

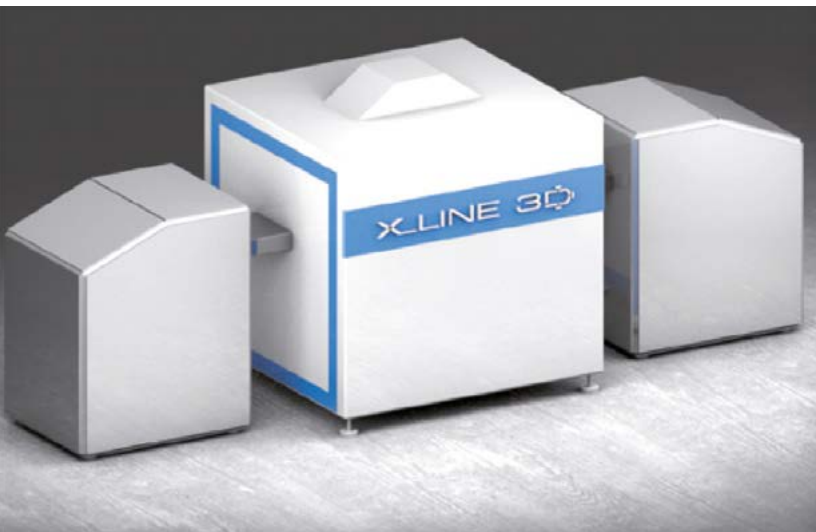
- Full-sized 3D x-ray inspection (AXI) allows layered analysis of all solder joints of a PCB within the production process
- Safe detection of critical faults and spatial allocation of the detected defects
- Fast test program generation based on CAD data using a component library
- Predefined test algorithms and classifiers

## FAULT ANALYSIS

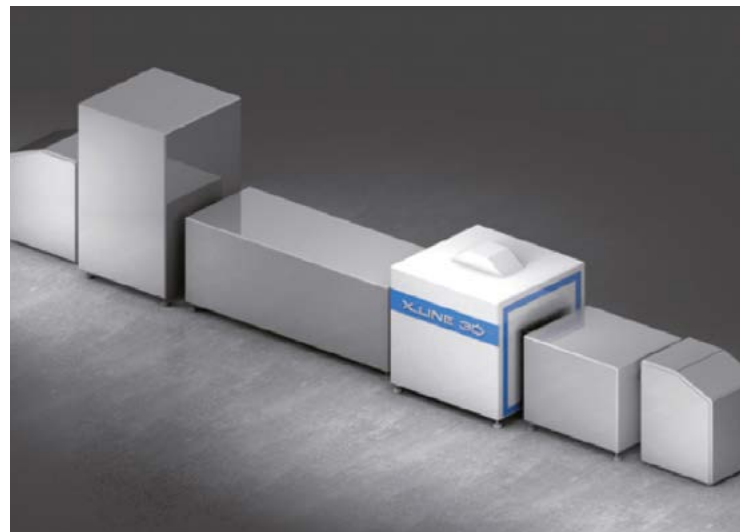
- Powerful analysis software provides the safe evaluation of detected faults
- Detailed examination of the inspection results in various Z-levels
- Clear representation of soldered joints and components via visualisation of selected areas
- Predefined test algorithms and classifiers

# Automated X-Ray Inspection

## AXOI OptiCon X-Line 3D



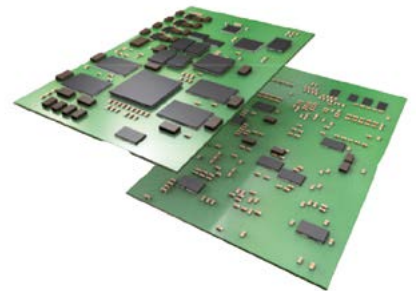
Stand-alone (off-line operation)



Integrated in the production line  
(in-line operation)

### INSPECTION EXAMPLE

Board assembly:	160 mm x 100 mm, assembled on both sides
Components:	509
Package styles:	6 x BGA, 20 x SO, 424 x Chip, 12 x THT
Solder joints:	2977
Resolution:	12 $\mu$ m
AOI fields of view:	8



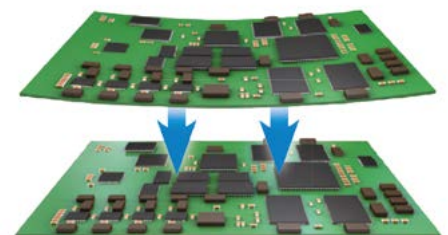
### BOARD CONVEYOR SYSTEM

Division of the system in three shielded segments allows for concurrent operation of board handling and inspection operations.



### CORRECTION OF BOARD WARPAGE & STABILITY MONITORING

Automatic correction of board warpage allows for precise reconstruction of the board in Z-axis direction



# Automated X-Ray Inspection

## X-Ray: 2D, 2.5D & 3D

### Maintenance and Safety

The OptiCon X-Line 3D uses a shielded, maintenance-free micro-focus X-ray source and a detector with high service lifetime, in-house-developed by GOEPEL electronic. Exchanging the X-ray source or the detector is simple and fast-ensuring minimal down time. The compact system captivates through its extraordinary accessibility. Two service hatches and two doors facilitate the access to

### 3D X-ray Inspection with OptiCon X-Line 3D

#### Principle of Image Acquisition

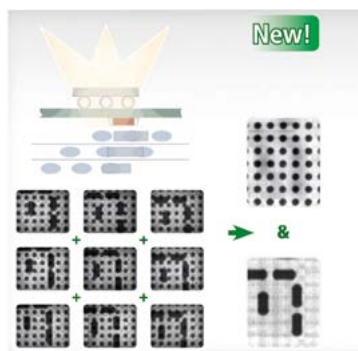
The PCB is radiated from at least nine different angles. The resulting images allow for the reconstruction of distinct layers.

#### Benefits of 3D X-ray Inspection

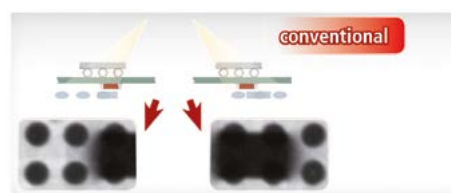
- safe inspection of PCBs with components on both sides
- reconstruction of arbitrary layers
- spatial assignment of detected faults
- rapid and comfortable inspection programme generation through use of a unified library

#### Fields of Application

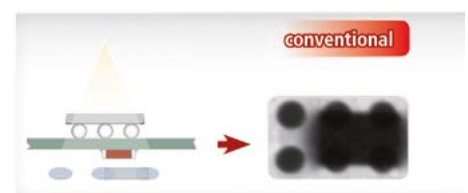
- 3D X-ray inspection in in-line production
- inspection of PCBs with components on both sides
- qualitative inspection of all solder joints (e.g. BGA, QFN)
- check for component presence, offset and shorts
- measurement of voids in different layers
- inspection of complex board assemblies with superimposed soldering layers and assembled heat sinks (integrated power electronics)



Different projections of a board with components on both sides during 3D X-ray inspection



Optically separated solder joints by means of angular radiography using 2.5D X-ray inspection



Optically separated solder joints by means of angular radiography using 2.5D X-ray inspection

all important system components. Redundant safety circuits and perfect radiation protection guarantee utmost safety. The emitted radiation dose is below the detection limit of conventional radiation detectors. Operating the system is therefore totally safe.

- measurement of the hole-fill in THT/THR solder joints
- inspection according to IPC-A-610 requirements

### 2.5D X-ray Inspection

#### Principle of Image Acquisition

Superimposed solder joints (e.g. top and bottom side of the assembly) are optically separated in the projections by means of angular radiography.

#### Disadvantages

- huge programming effort for assemblies with components on both sides due to manual parameter setting for all acquired images
- no unified library available
- long inspection duration

### 2D X-ray Inspection

#### Principle of Image Acquisition

Assemblies are radiated through orthogonally.

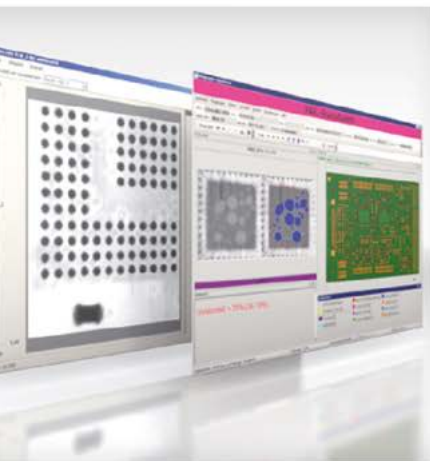
#### Disadvantages

- superimposed solder joints (e.g. top and bottom side of the assembly) can't be inspected
- insufficient information about the quality of BGA solder joints
- no spatial assignment of detected faults

# AXOI Automated X-Ray Inspection System Software OptiCon XI-PILOT



OptiCon XI-PILOT software interface



Repair station and analysis software



Statistical evaluation and SPC module



Detection of an unsoldered BGA ball in various layers of the solder joint

## INTELLIGENT SOFTWARE CONCEPT RAISES THE BAR - AXI/AOI PROGRAMMING FEATURING THE SAME USER INTERFACE

- system software OptiCon XI-PILOT
- off-line programming software
- repair station software
- analysis software
- statistics software
- SPC software

The OptiCon XI-PILOT system software is an open concept for a maximum fault-coverage and optimised adaptation to future component packages and manufacturing requirements. Automatic X-ray and optical inspections are programmed using the same user interface. The supplied component library, which complies with IPC standards, is linked with inspection algorithms and serves as the basis for the inspection of all common component packages. The measured values and features extracted by the algorithms will be automatically classified, resulting in minimum programme generation time.

Once the initial acquisition of all required X-ray images has been completed, the entire inspection programme generation and library adaptation can be done in the office using off-line programming software. The repair station software features a vivid visualisation of detected faults in different representations. Linked to this repair station software there is a powerful analysis software, which allows for viewing of all faults of a component in distinct layers. The statistics software, equipped with pre-defined filters and the possibility to create user-defined filters, enables the fast detection of main faults as well as an objective evaluation of production quality and throughput. The settable warning and action limits of the SPC module, as well as trend analyses allow for taking predictive measures before an actual fault occurs.

### Rapid Inspection Programme Generation through Effective use of Libraries

Due to the reconstruction of components and solder joints layer-by-layer, test programme generation and actual inspection processes are executed with geometrically calibrated, distortion-free imaging of the actual inspection objects. This enables a rapid and effective inspection programme generation based on CAD data and the use of a component library with pre-defined inspection algorithms and classifiers. Component packages, which are not included in the supplied component library, can be comfortably created using the integrated CAD editor.

### Reliable Failure Analysis through Vivid Visualisation

For reliable assessments of detected faults at the verification or repair station, the original X-ray image of the solder joint will be complemented by an image, which has been analysed by software algorithms and marked with colours. In addition, a powerful analysis software is available that aids the user in assessing the fault in different Z layers. The 3D visualisation of selected areas facilitates the vivid presentation of solder joints and components.

### Maximum Fault-Coverage at Outstanding Inspection Speed

The comprehensive 3D X-ray inspection permits analysis of all solder joints of an assembly layer-by-layer in-line with the line speed. This ensures a reliable detection of critical fault types and the spatial assignment of the recognised faults.

# AXOI Automated X-Ray Inspection

## Technical Data

### MODELS

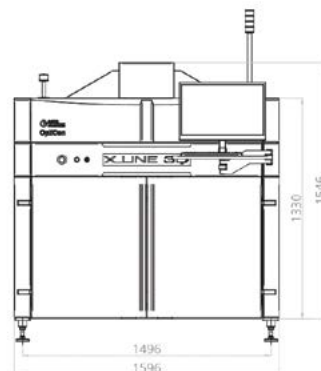
#### Version

OptiCon X-Line 3D X10

OptiCon X-Line 3D X40

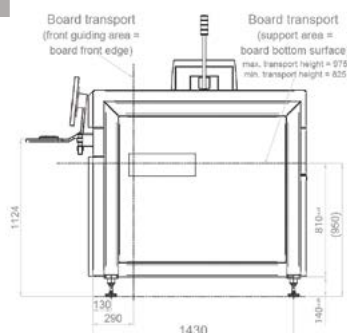
### X-RAY TECHNOLOGY

Tube type	maintenance-free, sealed microfocus X-ray tube
Tube voltage	max. 130 kV
Tube power	max. 39 W
Detector type	multi angle detector real-time image acquisition from different viewing angles
Grey scale resolution	12 bit
Resolution	variable: 6 $\mu\text{m}$ – 24 $\mu\text{m}^*$
3D inspection method	digital tomosynthesis
3D inspection speed	OptiCon X-Line 3D X10: up to 10 $\text{cm}^2/\text{s}$ OptiCon X-Line 3D X40: up to 40 $\text{cm}^2/\text{s}$
Calibration	geometric and grey scale calibration, automatic stability monitoring <sup>1</sup>
Z-axis adjustment	adaptable geometric magnification by means of motorised height positioning of the tube
X-ray protection	according to German Radiation Protection Ordinance (RöV), three segments, shielded, zero emission



### OPTICAL IMAGE ACQUISITION TECHNOLOGY

Resolution	10.5 $\mu\text{m}$
Field of view	42 mm x 42 mm
Lens	telecentric (pixel adapted lens)
Lighting	multi-spectral lighting, selectable from blue to IR



### BOARD HANDLING

Transport height	850 mm – 950 mm $\pm$ 25 mm
Width adjustment	automatic
Board size	max. 450 mm (L) x 400 mm (W) <sup>2</sup> / min. 60 mm (L) x 50 mm (W)
Board thickness	0.5 mm – 5 mm
Board support width	$\geq$ 3 mm
Board weight	$\leq$ 1.5 kg
Board warped	automatic compensation
Component clearance	bottom side: 65 mm / top side: max. 40 mm <sup>*</sup>
Handling time	approx. 5 s (concurrent loading/unloading and inspection)

### SYSTEM

Line interface	SMEMA, Siemens
System supply	230 VAC, 1 kVA, 6 bar compressed air, < 20 NI/min <sup>*</sup>
Typ. power consumption	< 700 W (average)
Dimensions	1596 mm (W) x 1540 mm (D) x 1470 mm (H, basis device) / 1720 mm (H, device including tube tower)
Weight	approx. 2.5 t



## PILOT 6

### A well-balanced Software Concept



The OptiCon PILOT software provides powerful functions for component recognition, solder joint and short inspection, OCR, colour verification as well as solder paste inspection.

In addition to the intelligent component recognition based on automated characteristic extraction from real images, the solder joint quality is determined by a complex grey value analysis using a range of illumination types.

## PILOT 6

Maximum failure detection through multiple inspection methods and verification of inspection depth

Efficient virtual programming for external generation and optimization of test programs

Individually adaptable test functions and library entries

### SmartGuide

Test program generation – easy as handling a smartphone ...

Clear and easy user guidance from data import to final inspection

Extremely easy and fast test program generation without AOI knowledge

fully operable via touch screen

### Reference-Database

The integrated reference database guarantees safe and documented fault detection at optimised false call rate. It enables the storage of previously detected faults and their verification after test program modifications. In case of inconsistent results after a program check, all corresponding parameters will be displayed. Likewise, the reference database serves as storage for PASS examples to ensure the stability of optimised test programs.

# OptiCon PILOT Software

Ease of use • inspection • reliability • flexibility



## Data import

of various formats (Gerber, Pick-and-Place, ODB++,etc.)  
for flexibility and ease of use

## Component library

with numerous packages; adaptable for product  
specific applications

## Inspection functions

for IPC compliant quality assurance and layout independent  
inspection

## Efficient inspection

for low volume production based on fast program generation  
and comfortable optimization

## Operator guidance

with smartphone-like interface for easy test program  
generation even for inexperienced users

## Unified management

of AOI/AXI/SPI data for joint failure verification, statistics  
and MES communication

## Maximum fault coverage

based on a wide range of inspection functions including  
detailed coverage reports

## PILOT 6

AOI , AXI and SPI networking



### PILOT Connect

Networking all the inspection data from automatic optical, X-ray and solder paste inspections

Repair station with a clear representation of the AOI, AXI and SPI test data at a glance

Opportunities for process analysis and optimization

Interfaces via ME and traceability systems

Integration with external systems possible

Integrated user management for all related systems and software modules

Extremely easy and fast test program generation without AOI knowledge

Convenient data maintenance tools

# OptiCon PILOT Connect all data at a glance



## **Supporting operators**

Use at verification and repair stations

All data from the AOI, AXI and SPI test systems is visible at a glance

It is possible to fully assess errors

## **Targeted checking**

Comprehensive, automatic system checking of ambiguous errors

Better assessment due to additional data capture

## **Process analysis and optimization**

Analysis, optimization and monitoring of the manufacturing process through statistical evaluation of the linked inspection data

## **Flexible use of different database systems**

Connection to different database systems such as MySQL, MSSQLServer and Oracle Database

## **Integrated user management**

Access to all computers and services that you are authorized for with a single log-on

## **Common use of CAD data**

Comprehensive system use of imported CAD data for creating the test programs



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