

## Optimal inspection of THT assemblies

The use of small circuits and discrete components as well as large and high-mass components on a PCB requires that manufacturers expand their testing technology so they can fully check THT components and their solder joints.

The standard AOI (automatic optical inspection) tests are checks for presence, position, polarity, character recognition and solder joint checks. If PCBs are equipped with a mixture of SMD and THT components, the SMD components are generally positioned, soldered and tested first. The AOI of SMD components has become the standard in the vast majority of assembly productions, and there are a number of AOI system providers for these inspection tasks.

### The challenges of AOI for THT

PCBs that are also equipped with THT components pose a demanding task for AOI.

There are a range of challenges, which are detailed below:

a) The mass of the PCBs

PCBs for high current and high performance applications contain through-hole components such as resistors, transistors, diodes, capacitors, connectors, and inductors. The PCBs often weigh several kilograms. As a result, such assemblies are transported in workpiece carriers during the production process. AOI systems for PCBs with SMD components are equipped with flat or round belts for the transport of the assemblies. On the other hand, friction rollers are required for the handling of large and heavy workpiece carriers in the production line.

b) The design of the workpiece carriers

A large number of workpiece carriers are available on the market. Added to these are workpiece carriers that are produced by the PCB manufactures themselves. Workpiece carriers have different dimensions and clamping devices. The location of the PCB in the workpiece carrier can vary. This applies to both the horizontal and vertical position of the assembled PCB.

c) The height of the components

Capacitors, inductors, connectors and wire connections may well reach heights of up to 80 mm on the PCB, and as a result it must be possible to test both flat and high components.

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d) Access to the solder joints of the THT components

The THT solder joints are located on the bottom surface of the PCB. A map only shows the THT solder joints and protects the SMD components from accidental coating during wave soldering. The mat has cut-outs in many different sizes and shapes, its thickness can vary widely.

e) Mechanical deformation

Buckling in a downward or upward direction can occur due to the high temperatures that PCBs are exposed to during soldering.

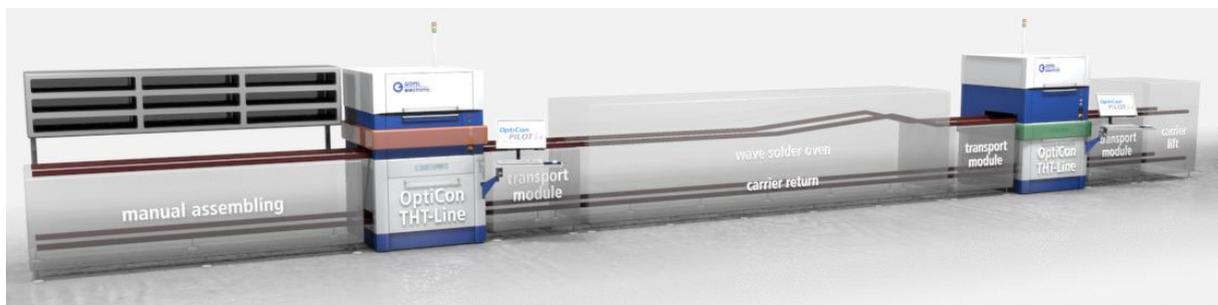
Independent of the conditions that are present: an AOI system for checking the assembly and the solder joints must be able to adapt to the conditions and carry out the test tasks reliably.

### Without challenges there is no innovation

The quality control of assemblies with through-hole components is performed in several steps according to the technological production process.

The through-hole components are assembled manually. Resultant errors are detected prior to the soldering process through the inspection of the top surface with an AOI system and eliminated accordingly.

After the assembly has been soldered, the solder joints of the through-hole components must be checked. The solder joints are located on the bottom surface of the PCB. An additional AOI system is generally used for this purpose. GÖPEL electronic offers the THT-Line for both tasks, which can either be equipped for component and/or solder joint inspection. The component inspection is symbolically represented in image 1 by the brown marking, and the solder joint inspection by the green marking.



*Image 1: Two AOI systems for top and bottom surface of assembly*

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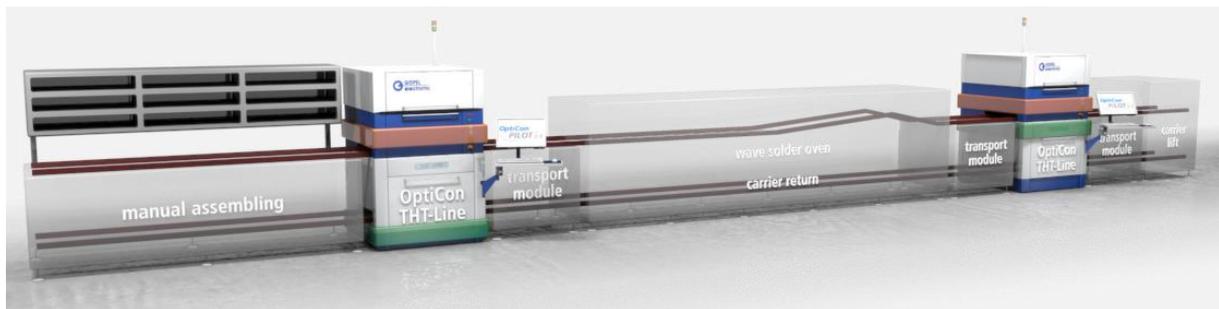
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In the event that the purchase of two AOI systems exceeds the budget or there is insufficient space available for setting up two AOI systems and additional equipment such as transport modules, GÖPEL electronic offers another configuration option of the THT-Line. This configuration allows the combination of two independent inspection units for checking the assembly and the solder joints in one device (see image 2).



*Image 2: Double-sided THT AOI in one system*

Each inspection unit includes all technical assemblies that are required for the test. Both inspection units can be arranged in different ways: The assemblies, which are assembled but not yet soldered, are conveyed on the upper transport module. The inspection unit for the assembly check is therefore located above the upper transport module.

The soldered assemblies are transported to the beginning of the production line on the workpiece carrier return conveyor. A second inspection system which is used to carry out the solder joint check can be mounted under this return conveyor.

As evident in image 1 and 2, the workpiece carriers are transported back to the assembly stations close to the floor. The return conveyor passes through all devices positioned in the production line. In contrast to the loading conveyor, the transport height of the return conveyor is not standardised.

To adjust to variable transport heights, the THT-Line is equipped with a variable height adjustment of the workpiece carrier return between 300 mm to 400 mm. This avoids the need to integrate additional handling modules into the production line.

### **Additional options provided by THT-Line**

The THT-Line also offers the option to incorporate the second inspection unit for checking solder joints below the upper transport module. This option is useful if the device is to be used to check a finished PCB. An example for this is its use as a "siloe" solution (offline).

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*Image 3: THT-Line for inline or offline usage*

The test results of the component inspection and the solder joint inspection of the same PCB become available at different times, due to the transport route through the production line. The serial number of the PCB to be checked can be recorded prior to each test and stored in a database.

In case different types of PCBs enter the THT-Line in an unpredictable order, provision is made for the test program, which is associated with the current assembly to be checked, to be loaded and executed. For this purpose, it is possible to read out, for example, a workpiece carrier equipped with a RFID chip that contains information on the program.

There is a wide range of workpiece carriers available - and a corresponding difference in PCB insertion heights. Due to its perspective-related properties, the use of a conventional lens would result in different image resolutions at different insertion heights, which can only be detected and corrected with considerable effort. GÖPEL electronic has developed a special lens that provides images with constant properties regardless of the mechanical conditions. This eliminates a complex set-up process in the event of a workpiece carrier change.

Like all GÖPEL electronic AOI systems, the THT-Line has a range of lighting options from ultraviolet, to the visible range, to infrared. The user can choose between lateral illumination, vertical illumination and illumination in the optical path of the lens. Of course, it is possible to combine these types of illumination.

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The THT-Line is unique in the AOI market because it offers previously unavailable configuration and testing capabilities for the quality assurance of THT assemblies.



*Image 4: Inspection of top and bottom surface of assembly*

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