

Drastic ICT Cost Reduction through Systematic AOI Use



Case Study AOI

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In light of the increasing demands for quality in electronic assemblies, the question arises: what is the optimal inspection strategy to achieve the best possible defect coverage, to optimize production processes and keep the cost structure as low as possible? This theme often provokes the discussion, is automatic optical inspection a sensible alternative to in-circuit tests? Ritter Elektronik GmbH in Remscheid, Germany, employs both inspection strategies. Yet their experience clearly indicates that AOI is the better, faster and less expensive inspection process, significantly reducing use of ICT and in some cases, eliminating it entirely.

Ritter Elektronik: Integrated solutions for difficult tasks

In 2004, Ritter Elektronik GmbH emerged from the former Profit-Center der Barmag (now Oerlikon). Today around 300 employees work at the Remscheid headquarters, with another 50 in Zábreh, Czech Republic. Drive converters, conversion systems and related power electronic components such as induction heating systems are developed in-house and produced on a production surface of over 10,000 m². Application-specific measurement, regulation and control electronics, including the requisite wiring systems, comprise yet another field of business. In addition to their own production, service contracts are also realized. Service offerings extend from prototype production to series production of up to 80,000 units with a high degree of variance. Ritter Elektronik caters to well-known firms from the textile machinery and beverage filling machine sectors, as well as the print and steel industries and medical, elevator and transportation technologies.



Control board EL392



Servo unit with internal electronics

Process optimization through AOI

Production in Remscheid runs on three SMD lines. SMD and THT printed circuit boards are assembled both automatically and manually. SMD production lines can place 0201 and fine pitch 0.4 mm chips, as well as BGAs. After SMD production, the flat assemblies are inspected by a high-end system from Viscom. Finally, most of the

assemblies also undergo in-circuit and functional testing. Currently, 1,500 flat assemblies per day are produced. The type variety for the SMD assemblies is 440 pieces.

Before AOI was introduced, informed optimization of the upstream SMD process was not possible since visual controls and ICT yielded inadequate information. Thus, defective boards left production, passing through all the production steps right up to ICT and FT. Only at ICT



F. l. t. r.: Klaus Spiecker, Series Production Manager, Ritter Elektronik; Wolfgang Herbig, Viscom representative, HERBIG TECHNOLOGIES and Harald Laubert, Production Manager, Ritter Elektronik, with the Viscom AOI system

did the defects come to light, where they were evaluated and compiled into a data bank. Because the defects only emerged at the very end of the production chain, sometimes the entire production run was defective and optimization was only feasible in a subsequent run of the same product. Each defect at the ICT stage also resulted in material expense, through repeated tests and other aspects.

These are the reasons why, in 2006, Ritter Elektronik invested in an AOI system from Viscom and integrated it directly into SMD production. The system is equipped with both orthogonal and angular cameras to attain maximum inspection depth. Now, before an order is released to SMD production, the first completed assembly from the order is taken from the line, briefly interrupting production during the few seconds needed for an initial sample inspection on the AOI system. The

quality data gained thereby is immediately reported back to the SMD employee. Process optimization measures can be derived from this data in time and implemented for the specific assembly, well before the end of the run.

Thanks to the AOI evaluation, Ritter Elektronik has already been able to direct various adaptations into quality improvement:

- Reduce squeegee mask thickness from 150 µm to 120 µm
- Adapt solder profile during reflow
- Modify pad geometry and layout for reflow and wave
- Modify spatial configuration of wired and SMD components
- Switch from HAL board surfaces to NiAg or chemical Sn
- Reduce transport damage to glued components by installing a new PCB magazine
- Rework varying pad geometries for the same component types and fiducials

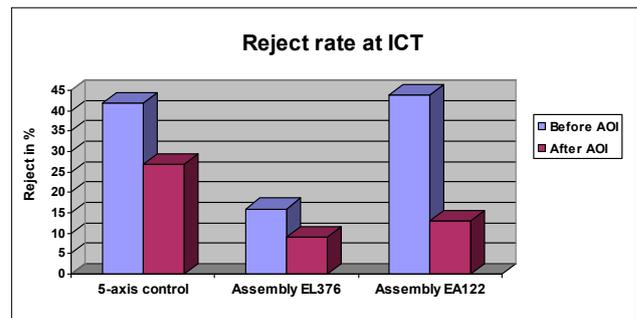
As soon as the order is completed, the entire production run is inspected by the AOI system, which stands as an off-line inspection island with automatic load/unloading and in/out magazines. Even the wave soldered SMD assemblies now go through AOI, after increased wave solder defects continued to crop up at ICT. Today the inspection scope reaches from paste print and assembly through to soldering, even on wave soldered, wired components. All assemblies are provided with PCB identification for unmistakable identification when read in on the AOI system, so inspection results can be accurately assigned at a later stage.

The decision in favor of an AOI system from Viscom came down on two reasons. One, the style of programming was simpler than on comparable systems; availability of a comprehensive inspection library for typical post-reflow inspections as well as for additional inspection tasks (including wave or selective soldering on wired components, etc.) was a significant factor here. Proximity and ease of communication with the German supplier and manufacturer also entered the picture. „Today we have over 300 AOI programs. We only have to place the printed circuit board in the system and we get a clean evaluation in the shortest time. The comprehensive component library Viscom provides was a tremendous advantage, given the wide range in our production. We only needed to make small adaptations. With systems from other suppliers, this would not have been possible with the same comparatively marginal effort. Even in the earliest planning phase, we found excellent support and competent advice for our specific needs“, says Klaus Spiecker, Ritter Elektronik, manager of series production. Today, depending on the complexity of the assembly, a new inspection program can be created in just 1 - 4 hours. In the end, given the rising complexity and increasing miniaturization of modern flat assemblies, AOI is absolutely imperative.

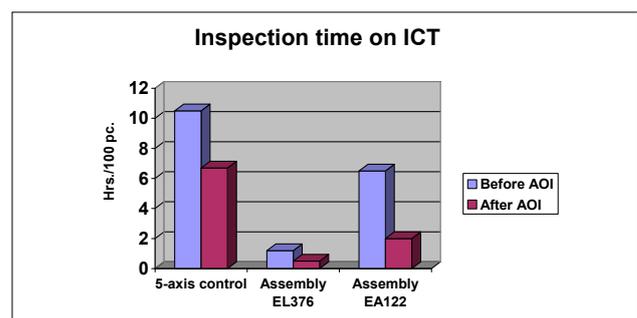
What effect does AOI have on ICT?

The introduction of AOI did not replace ICT, which is essentially a circuit measurement device. This has traditional grounds; as one of the major sales items, many assemblies are manufactured for worldwide use. This is why inspection strategy at Ritter Elektronik continues to rely on the combined use of both inspections. When it comes to service contracts, however, customers often prefer to do away with ICT. Many see ICT as superfluous because the high defect coverage Viscom AOI systems bring is sufficient for final testing; especially with small and medium lot sizes, customers are saved the costs an additional in-circuit test carries. The reason this makes thorough sense is best explained using three examples from practice.

Before AOI was introduced the ratio of defect-free product at the first ICT inspection, including material defects, was 85 %. After AOI, this ratio improved to 95 %. This 10 % advantage already results in substantial cost savings, achieved by reduced inspection and repair times at ICT and elimination of repeat tests. Three examples show how the changes occurred.

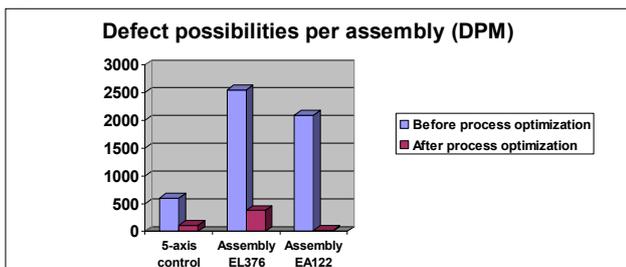


For all three assemblies, the ICT reject rate drops after introduction of AOI. AOI is fully compatible with IPC 610A acceptability standards because with it, defects can be better classified. ICT can only determine whether a solder joint is present; whether it is sufficient or not can only be measured by AOI. In contrast with ICT, an automatic optical inspection system achieves maximum defect coverage and can be flexibly deployed at various production stages. In short: an AOI system can reduce the scope of ICT; only the functional test (for the electrical properties of the assembly) must still be done. This, naturally, remains a strength of ICT, since rejects at this point are still a factor.



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Also, ICT inspection time is significantly decreased due to the higher yield coming to it after AOI was introduced. This raised throughput results is directly due to process optimization with AOI. Because in-circuit test generally comes at the end of the production chain, no comprehensive information regarding defect causes can be cycled back into production; optimization and improvement during the course of production is not possible. „If I only had the feedback from ICT to rely on, I would never be qualitatively finished; by the time ICT comes in, the entire lot has already been produced. With AOI, influence can still be exerted on the existing production lot“, continues Klaus Spiecker. Also, the production process is stopped automatically as soon as a defect crops up. The defect must first be remedied before the program is restarted. „When I have a test time of 10 minutes for a board and it fails ICT due to a defect, after repair I have to start from square one and take the time for yet another test. This costs money. Thanks to AOI and the process optimization it enables, fewer boards fail ICT so time for repair and repeated tests, with the associated personnel expenses, are eliminated for considerable cost reductions“, concludes Klaus Spiecker.



Process optimization with AOI has also led to clearly lowered dpm rates, as shown in the above illustration in the examples provided by Ritter Elektronik. This can be ranked as very positive, considering the accompanying drop in production down time and higher yields with minimized repair effort.

One other point is not to be dismissed from the question of whether AOI or ICT is the better inspection strategy: the lot size. A high mix with low piece counts, as is the case with Ritter Elektronik's role as typical service contractor, requires continual and costly investment in new ICT test adapters. „Inspection equipment like the ICT is always restricted to the same geometry. New adapters are always needed; their fabrication carries relatively high costs. An AOI system can be better adapted, with easily justifiable personnel expense“, according to Klaus Spiecker. Further, immense effort is required to completely prepare a program for ICT – depending on the complexity of the printed circuit board, preparation can run up to a week. In comparison? A new inspection program for AOI is ready after 1 - 4 hours. Last but not least, ICT is an expensive test system from the start. AOI systems, including repair and programming stations, typically cost less than the half.

In short, systematic application of an AOI system does not replace the good/bad decision rendered by an in-circuit test. It compiles valuable data such as solder quality, structure of the paste deposits, component and assembly placement, providing the basis for a progressive quality management policy.

Are you interested in more details on this application or do you have any question regarding automatic optical inspection? The Viscom SP Division will be glad to help you.

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