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How Omron is bringing high-quality inspection up to speed

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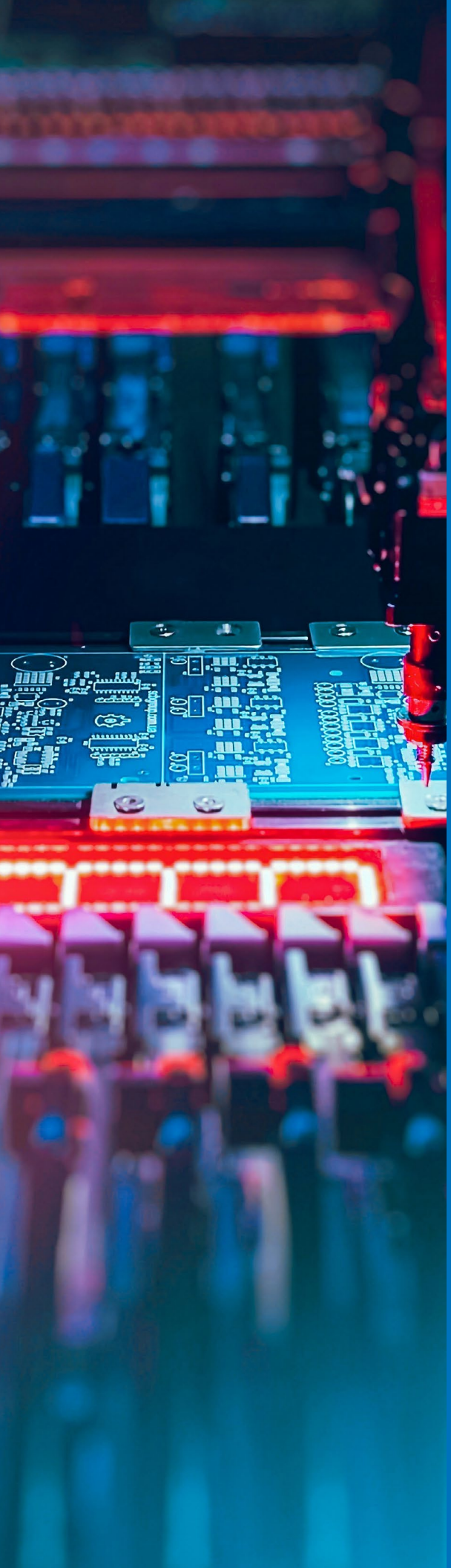
Introduction

PCB design, manufacturing, and inspection challenges are growing in number and difficulty. Since traditional 2D/2.5D X-ray imaging techniques are unable to inspect PCB components with sufficient accuracy and stability, 3D CT inspection has become essential.

However, even 3D X-ray techniques have certain drawbacks stemming from a tradeoff between cycle-time and image clarity. This article looks at how automated inspection pioneer Omron is helping to resolve this conundrum.



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What is true 3D X-ray inspection?

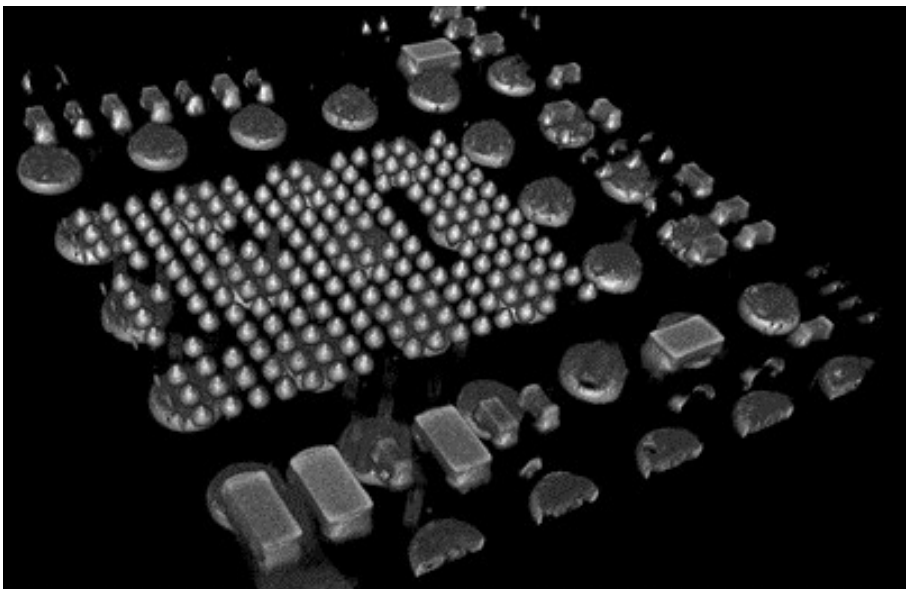
True 3D X-ray inspection can only be achieved using CT (computed tomography) imaging techniques. Although there are similarities in image data acquisition between CT X-ray and more traditional laminography or tomosynthesis X-ray (or what may be referred to as 2.5D or even 3D X-ray), there are key differences in the amount of data collected and how it is processed.

The resulting images are richer in detail, less impacted by noise, and capable of providing individual cross-sectional "visibility" through every area of the target. This gives a true 3D understanding and enables stable inspection at any region of interest from the same dataset without the loss of information or the need to adjust inspection angles. It also minimizes concerns about opposite side artifact interference.

Both the machine and the operator can use this clear 3D imaging to improve the quality and reliability of the inspection and human review process as well. The exceptional 3D imaging and completely interactive data that CT X-ray provides help operators review results, understand details, and distinguish between anomalies, acceptable results, and real defects.

Exceptional image quality positively impacts not only the stability of the process, but also the operator's ability to review resulting images. If operators must work through numerous false-calls, they can quickly become disengaged and miss a real defect. In some cases, they may be unclear about what they are seeing. These types of escapes can be costly and render the automated inspection process pointless, so it is critical to optimally balance speed and image clarity.

3D X-ray imaging, image processing, and inspection take time. As products gain more critical, bottom-terminated components, X-ray inspection becomes even more necessary to ensure quality. However, only 3D CT X-ray can properly overcome the challenges associated with these more advanced products and provide the capabilities and higher reliability needed now and in the future. Omron refers to this concept as delivering "PCB design constraint-free inspection" solutions.



Today's more sophisticated PCBAs contain an ever-growing number of critical devices with hidden solder joints that require more advanced X-ray imaging and inspection techniques.

Addressing the speed/quality tradeoff in CT X-ray

CT X-ray technology has been around for a while, but it has been kept out of many production environments due to its relatively long inspection times. It takes longer to capture the significantly larger amount of X-ray imaging data and then process that data for inspection. This legitimate disadvantage of CT X-ray has a real-world impact on production demands, and many companies prioritize cycle-time over inspection capability and quality.

Omron is closing the speed gap between CT X-ray and traditional X-ray so that companies no longer sacrifice quality for speed. Omron's new VT-X750-V3 delivers true 3D inspection of electronic substrates to meet the growing needs of fifth-generation mobile communication systems (5G), electric vehicles (EVs), and autonomous driving application products. Innovative updates are achieving inspection speeds up to 50% faster.

Speed is a major determining factor in process feasibility. The more closely Omron can make the CT X-ray inspection time match the heartbeat of the production line, the easier it is for customers to harness its value. CT X-ray is already considered industry-leading technology with respect to quality and capability, and Omron's improvements will help get it into the hands of more manufacturers.

The Omron VT-X750-V3 high-speed, true 3D CT AXI system

What innovations enable higher speeds?

A main driver of speed improvements is the fact that Omron is in full control of development, from the software to the individual hardware components inside the system. Most components are pulled from Omron's wide-ranging industrial automation technology portfolio. For example, an Omron NJ-series PLC connected to multiple Omron R88D-series servo drives controls multiple axes of movement via a unique and patented technique, without sacrificing accuracy or quality.

Along with this sophisticated motion control, Omron has introduced a more powerful PC and new hardware such as an advanced flat panel detector that is more sensitive and responsive. This combination of technology allows for faster X-ray imaging that delivers the same level of image quality Omron is known for, but achievable in a far more efficient manner.

The VT-X750-V3 takes full advantage of Omron's own motion control expertise and advanced hardware devices to speed-up the CT X-ray imaging process.

Omron's next generation of inspection technology

High-speed acquisition of clear 3D images has been actualized with Omron's flexible VT-X750-V3 system, which works in a variety of environments and lets programmers adjust imaging settings to optimize the speed-quality balance. However, because the VT-X750-V3 is a true 3D CT AXI and Omron continues to make it faster, users no longer need to settle for the "good enough" X-ray inspection approach they've historically had to take with lesser systems. Omron's CT technology is both fast and of the highest quality, especially when compared to other X-ray technologies

Additionally, AI development enables a shorter program-tuning time. These new features predict expected cycle times, model X-ray exposure amounts to critical components, and support tuning efforts. The software automatically determines ideal imaging settings for specific parts to improve and stabilize the process. The AI engine can also review process result data to identify the best criteria to bound normal process variation and identify potential defects, reducing the time spent on these tuning activities by 25-50%.

How 100% CT X-ray inspection maximizes consumer safety

In recent years, demand for electronic substrates to support 5G, EVs, and autonomous driving applications has grown rapidly, which in turn raises quality requirements for these substrates. These advanced applications may involve risks to human life, and the highest-quality inspection is necessary to ensure the reliability, performance, and safety of the final products.

Risk of death or serious injury is exacerbated by the growing number of mission-critical applications controlled by electronic and digital devices, including medical devices, automotive safety and control devices, and aerospace safety and guidance systems. There may also be an impact to quality of life if reliable operation of the devices people depend on every day is compromised, as well as to job security and personal finances if poor-quality products leave companies vulnerable to legal ramifications.

Omron contributes to the security and safety of society through high-speed, PCB design constraint-free, 100% X-ray inspection of electronic substrate assemblies to maintain and improve productivity while simultaneously ensuring the quality of customer products. For this reason, it is essential that automated inspection solutions providers continue to innovate in CT X-ray technologies with the goal of simultaneously maximizing quality and speed.

Summary

Omron contributes to the security and safety of society through high-speed, PCB design constraint-free, 100% X-ray inspection of electronic substrate assemblies to maintain and improve productivity while simultaneously ensuring the quality of customer products. For this reason, it is essential that automated inspection solution providers make this type of inspection strategy more attractive to electronics manufacturers.

This can be achieved by minimizing the current trade-off between speed and accuracy through strategies that make the CT X-ray process faster without compromising on image clarity. Omron's ability to provide complete control over system development (including software and hardware components) along with other innovations are helping eliminate this trade-off altogether to address the critical need of putting higher quality X-ray inspection capabilities into more production processes around the world.

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