Commercialized the industry's top class high-speed inspection*1 "CT type X-ray automatic inspection system"

~High production quality for advanced semiconductors and electronic components, which are in increasing demand due to the spread of generative AI and xEVs.

CT type X-ray automatic inspection system value added proposition

① **Contributing to stabilization of production quality in semiconductor packages and power semiconductors with industry-leading high-speed 3D automated inspection.**

② **Advanced image processing using unique AI technology automates inspection settings to determine good/defective products.**

③ **First in the VT series to support clean rooms*3 and automates inspection setting changes according to production items*4**

VT-X950" CT type automatic X-ray inspection system

Recently, the amount of information used in the world is rapidly increasing with the expansion of user access to generative AI and data centers for interactive artificial intelligence and the development of 5G/6G communications, and the further miniaturization of semiconductors used for these applications is progressing.

In particular, miniaturization technology has advanced to a high level of technological difficulty, and along with miniaturization, the need for packaging using integration technology called chiplets will increase in the future. Unlike conventional flat designs, chiplets require more precise inspections as their structures become more complex through three-dimensional mounting.

The automotive industry, in particular, is becoming more environmentally friendly with the development of xEVs, and integrated EV modules (X in 1) that combine multiple functions, such as eAxle. Efforts are underway for 3D packaging to realize further space saving and higher efficiency in module design. Products using 3D packaging, which are being introduced in a variety of industries, are difficult to determine if they are good using conventional 2D-X-

ray inspection systems with transmission images, making it a major challenge to achieve both productivity and quality. At the same time, there is a growing need for stable production at multiple sites in preparation for the duplication of supply chains, and the establishment of a production system that is not overly dependent on human interaction.

In response to these needs, three newly commercialized models of automatic CT-type X-ray inspection systems combine OMRON's proprietary control and image processing technologies to achieve high-speed, high-precision inspection. The combination of continuous imaging technology[*5] and a high-sensitivity camera through seamless control of the equipment achieves high-speed imaging of high-resolution, easy-to-distinguish 3D images.

In addition, high-speed generation of modeling using state-of-the-art 3D inspection technology, which is also used in medical CT scanners, enables in-line quality inspection, which has been difficult to achieve at manufacturing sites. Utilizing proprietary AI technology, the system automatically optimizes the setting of inspection imaging conditions and automates the creation of inspection programs that were previously difficult only for skilled engineers and technicians.

OMRON has been contributing to the improvement of productivity at manufacturing sites by leveraging its strength in control technology under the Innovation Concept innovative-Automation. We will continue our efforts to improve productivity and to evolve into a sustainable at manufacturing site. OMRON will enrich the future for people, industries and the globe by innovative automation.

## CT type X-ray automatic inspection system New Product Overview

| Product name	VT-X750-XL	VT-X850	VT-X950
X-ray output characteristics	Microfocus X-ray source	High power X-ray source	Ultra-microfocus X-ray source
Main Inspection Products	Mounting boards for generation AI, 5G/6G communications, and in-vehicle controllers	IBGT Module Inverter Module	Advanced packages (CPU, GPU, communication chips, etc.)

Value Proposition

① **Contributing to stabilization of production quality in semiconductor packages and power semiconductors with industry-leading high-speed 3D automated inspection.**
Since the shape and constituent materials vary depending on the industry and inspection target, the output characteristics of the X-ray source and inspection method are optimized for each model. By combining OMRON's proprietary control and image processing technologies, the solder quality of µBump[*6] and C4Bump[*7] used in 3D mounting of each semiconductor package can be visualized. The imaging technology supports the miniaturization and thinning

of semiconductor devices. The 3D modeling of solder used for boards and semiconductors from X-ray transmission images has been sped up by approximately 30%. In addition, inspection result data using the SEMI communication standard (SECS/GEM) can be linked to a production control system to realize quantitative condition monitoring of the production process. High-speed inspection that does not place a burden on the production line improves semiconductor production yield.
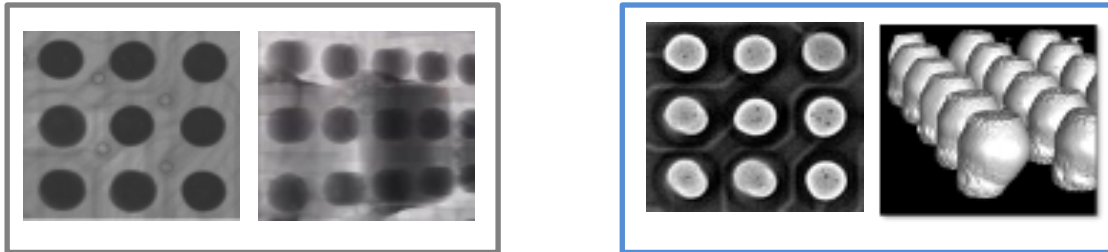
X-ray image of the same solder in 2D (left) and 3D (right)

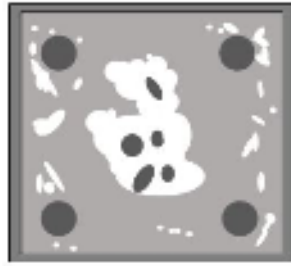**monolithic**   **chiplet**
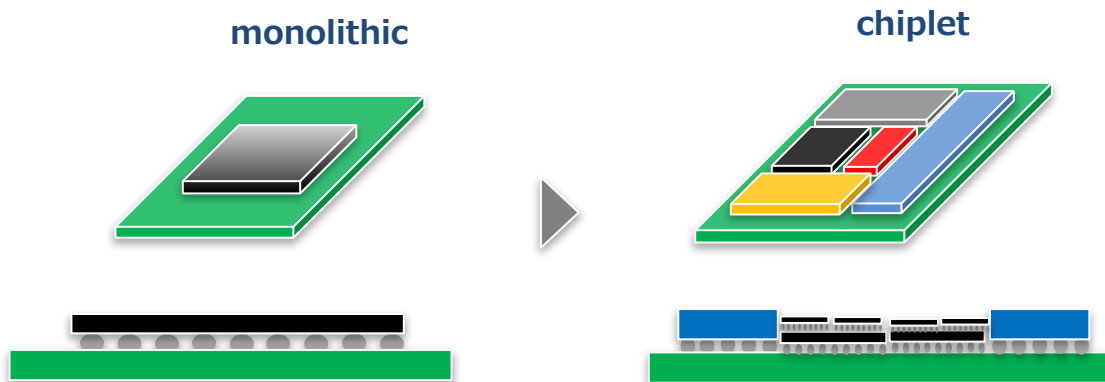
Difference between monolithic and chiplet product structures

② **Advanced image processing using proprietary AI technology automates inspection settings to determine good/defective products.**
The VT-X series is the first in-line inspection system that uses AI technology to determine whether a product is good or defective by processing captured images using deep learning. The AI automatically determines the soldering condition of each product based on the generated 3D model. This automates the creation of inspection programs without relying on the specialized skills of skilled workers in image processing.

<div align="center">

Conventional method   New method

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Figure: AI assists human judgment by clearly separating noise and inspection targets (voids) (image)

③ **First in the VT series to support clean rooms and automate setting changes according to production items.**

The X950 is the first in the VT series to support clean rooms for mid-process semiconductors where wafer-to-wafer bonding processes occur. The X950 is also equipped with a function that automatically changes inspection settings to accommodate sudden changes in production items due to fluctuating demand. The system automatically changes conditions by referencing measurement points and inspection settings registered in advance in the production control system that are appropriate for each production item. This reduces start-up losses and re-setting of inspection settings. In addition, as with the conventional VT series, the VT series is equipped with a conveyor-based automatic loading/unloading function, contributing to automation and manpower saving in the manufacturing process.

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1: According to our own research as of October 31, 2023. Inspection performance of a full 3D-CT type X-ray automatic inspection system capable of sub-micron order inspection.

2: An inspection device equipped with technology that uses X-rays to take continuous cross-sectional images of the inside of structures invisible to the human eye and process them by computer to obtain three-dimensional images. Uses the same technology as CT scans used by medical institutions.

3: Complies with Class 6 standards in ISO 14644-1.

4 : Only X950 supports clean room and automatic setting change.

5: Technology to capture stereoscopic images without stopping.

6: Bump electrodes formed with a narrow pitch to bond IC devices together.

7 : C4 (Controlled Collapsed Chip Connection): A bump-shaped conductor protrusion, called a bump, is formed on a substrate electrode and bonded to the wafer.

About "innovative-Automation"

OMRON is advancing a unique "innovative-Automation" concept, creating new types of automation that drive the manufacturing revolution forward at the same time as realizing coexistence with the global environment and a sense of purpose for all workers, as well as contributing to the growth of sustainable industries.

As we look to the future of manufacturing, OMRON will pursue novel approaches to productivity in the form of "Autonomation beyond human abilities" and "Advanced collaboration between people and machines," underpinned by "Digital engineering transformation" in order to enrich the future for people, industries and the globe by innovative-Automation.

About OMRON Corporation

OMRON Corporation is a leading automation company with its core competencies in Sensing & Control + Think technology, and is engaged in a wide range of businesses including industrial automation, healthcare, social systems, device & module solutions. The company transcends the value creation by leveraging diverse data acquired through these businesses and linking it to the data solutions business.

Established in 1933, OMRON has about 28,000 employees worldwide, working to provide products and services in more than 130 countries, contributing to the creation of a better society.

For more information, please visit https://www.omron.com/global/en/

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