November 21, 2023

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

**新一代CT型X光自動檢測系統的商業化推廣**

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

隨著生成式AI和電動車的普及，先進半導體和電子元件的需求日益增長，推動了高生產質量的實現

**CT type X-ray automatic inspection system value added proposition**

**CT型X光自動檢測系統價值主張**

1. **Contributing to stabilization of production quality in semiconductor packages and power semiconductors with industry-leading high-speed 3D automated inspection.  
   通過業界領先的高速3D自動檢測技術，穩定半導體封裝和功率半導體的生產質量。**
2. **Advanced image processing using unique AI technology automates inspection settings to determine good/defective products.  
   利用專屬AI技術的先進影像處理技術，實現自動檢測設置，從而確定產品的合格與否。**
3. **First in the VT series to support clean rooms\*3 and automates inspection setting changes according to production items\*4****VT系列中率先支援無塵室並根據生產項目自動更改檢查設置**



VT-X950" CT type automatic X-ray inspection system   
**T-X950 CT型自動X光檢測系統**

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.  
隨著生成式AI和數據中心的用戶訪問不斷擴大，全球信息使用量急劇增加，並且5G/6G通信的發展加速了應用中使用的半導體的進一步微型化。

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.  
特別是在微型化技術方面，技術難度已達到相當高的水準，未來隨著微型化進程的推進，對使用稱為chiplets的集成技術進行封裝的需求也將增加。與傳統的平面設計不同，chiplets結構更為複雜，通過三維封裝，需要更精密的檢測。

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.  
汽車業方面，隨著xEV（電動車）及多功能集成模組（如eAxle）的開發，環保趨勢日益明顯。為了實現模組設計的進一步節省空間和提高效率，3D封裝技術成為了行業的重點。使用3D封裝技術的產品正逐步在各行各業得到應用，而傳統的2D-X光檢測系統已難以準確檢測這些產品的良品與否，這在提升生產率和產品質量方面帶來了重大挑戰。同時，為了應對供應鏈多樣化以及建立不依賴人工的生產系統，對於穩定多地生產的需求也在增加。

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.  
為應對這些需求，三款新商業化的CT型X光自動檢測系統結合了OMRON專有的控制和影像處理技術，實現了高速、高精度的檢測。通過無縫控制設備的連續影像技術與高靈敏度攝像機的組合，實現了高分辨率易辨識的3D影像的高速成像。

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.  
此外，利用最先進的3D檢測技術（亦應用於醫療CT掃描儀），高速生成模型，使得在生產現場難以實現的在線質量檢測變為可能。系統利用專屬AI技術，自動優化檢測影像條件的設置，並自動創建檢測程序，這一過程過去只有依賴熟練的工程師和技術人員才能完成。

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.  
OMRON憑藉其在控制技術方面的優勢，通過 “創新自動化” （innovative-Automation）概念，持續為提升生產現場的生產效率作出貢獻。我們將繼續努力提高生產力，並朝著可持續發展的製造現場邁進。OMRON將通過創新自動化，豐富人類、產業和地球的未來。

**CT type X-ray automatic inspection system New Product Overview  
CT型X光自動檢測系統新產品概覽**

|  |  |  |  |
| --- | --- | --- | --- |
| Product name **產品名稱** | VT-X750-XL | VT-X850 | VT-X950 |
| X-ray output characteristics **X光輸出特性** | Microfocus X-ray source | High power X-ray source | Ultra-microfocus X-ray source |
| Main Inspection Products **主要檢測產品** | Mounting boards for generation AI, 5G/6G communications, and in-vehicle controllers 生成式AI 5G/6G通訊及車載控制器用電路板 | IBGT Module Inverter Module IGBT & 逆變器模組 | Advanced package  (CPU, GPU, communication chips, etc.) 高級封裝（如CPU、GPU、通訊晶片等） |

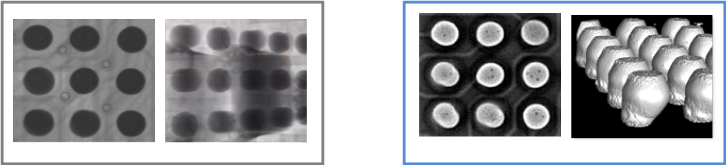
**Value Proposition  
價值主張**

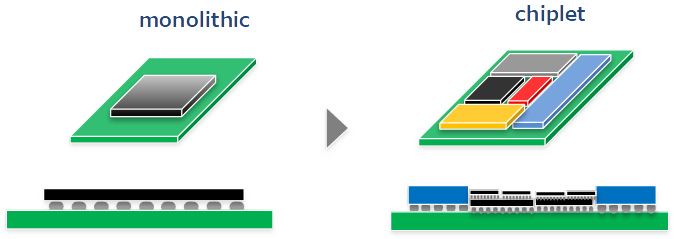
1. **Contributing to stabilization of production quality in semiconductor packages and power semiconductors with industry-leading high-speed 3D automated inspection.**

**通過業界領先的高速3D自動檢測技術，穩定半導體封裝和功率半導體的生產質量。**

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.

由於不同行業和檢測對象的形狀及構成材料有所不同，因此針對每個型號，X光源的輸出特性和檢測方法都進行了優化。通過結合OMRON專有的控制和影像處理技術，可視化每種半導體封裝中的微凸點（μBump）*6和C4凸點*7的焊接質量。這一影像技術支持半導體設備的微型化和薄型化。透過X光透射影像對電路板和半導體所用焊料的3D建模速度提升了約30%。此外，通過符合SEMI通訊標準（SECS/GEM）的檢測結果數據，可連接至生產控制系統，實現對生產過程的量化條件監控。高速檢測不會對生產線造成負擔，提升了半導體的生產良率。

  
X-ray image of the same solder in 2D (left) and 3D (right)



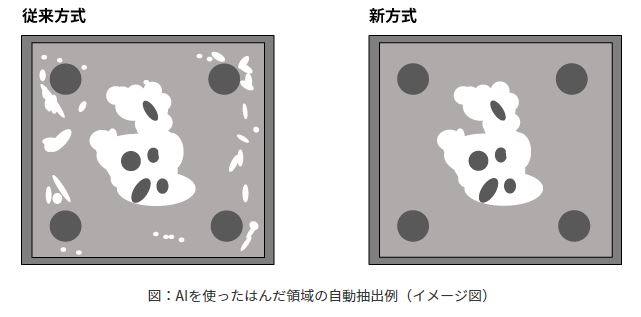
Difference between monolithic and chiplet product structures  
Monolithic 和 Chiplet 產品結構的區別

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

**利用專屬AI技術的先進影像處理技術，實現自動檢測設置，從而確定產品的合格與否。**  
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.

VT-X系列是首款採用人工智慧技術的線上偵測系統，透過深度學習處理所捕捉的影像來確定產品是否合格。 AI根據產生的3D模型自動判斷每個產品的焊接條件。這可以自動建立檢查程序，而無需依賴影像處理技術人員的專業技能。

　　　　 Conventional method　　　　　　　 　 New method

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

圖：AI透過清晰分離雜訊和檢查目標（空隙）來輔助人類判斷（影像）

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

**VT系列中率先支援無塵室並根據生產項目自動更改檢查設置**

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.

X950 是 VT 系列中首款支援中間製程半導體無塵室的產品，在該無塵室中進行晶圓間鍵合製程。X950還配備了自動更改檢查設定的功能，以適應由於需求波動而導致的生產項目的突然變化。系統透過參考預先在生產控制系統中註冊的適合每個生產項目的測量點和檢查設置，自動更改條件。這減少了啟動損失和檢查設定的重新設定。此外，與傳統VT系列一樣，VT系列配備了基於輸送帶的自動上下料功能，有助於製造流程的自動化和節省人力。

Contact us [Automated Inspection | Omron](https://automation.omron.com/en/us/products/category/automated-inspection)

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.

根據我們截至2023年10月31日的研究，能夠進行亞微米級檢測的全3D-CT型X射線自動檢測系統的檢測性能。

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.

檢查設備配備了利用X射線對人眼不可見的結構內部進行連續截面影像的技術，並透過電腦處理以獲得三維影像。使用與醫療機構使用的 CT 掃描相同的技術。  
3: Complies with Class 6 standards in ISO 14644-1.

符合 ISO 14644-1 中的 6 類標準。

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

僅X950支援潔淨室和自動設定變更。

5: Technology to capture stereoscopic images without stopping.

不間斷捕捉立體影像的技術。

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

窄間距形成凸塊電極以將IC元件接合在一起。

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.

C4（受控塌陷晶片連接）：在基板電極上形成凸塊狀的導體突起，稱為凸塊，並與晶圓接合。

**About “innovative-Automation”  
關於“創新-自動化”**

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.

歐姆龍正在推動獨特的「創新自動化」概念，創造新型自動化，推動製造革命向前發展，同時實現與全球環境的共存和所有工人的使命感，並為經濟成長做出貢獻的永續產業。

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.

展望製造業的未來，歐姆龍將在「數位工程轉型」的基礎上，以「超越人類能力的自動化」和「人與機器之間的高級協作」的形式追求生產力的新方法，以豐富製造業的未來。

### **About OMRON Corporation 關於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, and device & module solutions. Established in 1933, OMRON has about 30,000 employees worldwide, working to provide products and services in more than 130 countries. For more information,

please visit<https://www.omron.com/global/en/>

OMRON Corporation是一家領先的自動化公司，憑藉在感測與控制技術的核心能力，從事工業自動化、醫療保健、社會系統和設備模組解決方案等廣泛業務。成立於1933年，OMRON擁有約30,000名員工，在全球130多個國家提供產品和服務。更多資訊請訪問<https://www.omron.com/global/en/>。

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