Lumina™

Inspection and Metrology for Advanced IC Substrates and Panel-Level Packaging

Yield-Critical Pattern and Via Inspection and Metrology

The Lumina™ system provides innovative defect inspection and metrology for the advanced IC substrates (ICS) and panel redistribution layer (RDL) required to support complex packaging architectures, such as flip chip BGA (FC-BGA) including glass core, 2.5 and 3D heterogeneous integrations, as well as panel-level packaging (PLP). With Omnisphere™ illumination, enhanced area camera and multi-modality scanning capability, the Lumina system enables high-sensitivity capture of unique defect types.

Benefits

- Optimized for advanced ICS, including glass core, TGV (through glass via) and Panel RDL

- Detection and measurements across a wide range of applications and defect types

- VRS-less, resource-lean verification

- Support for current and future production needs

- Detectability of the most challenging defects
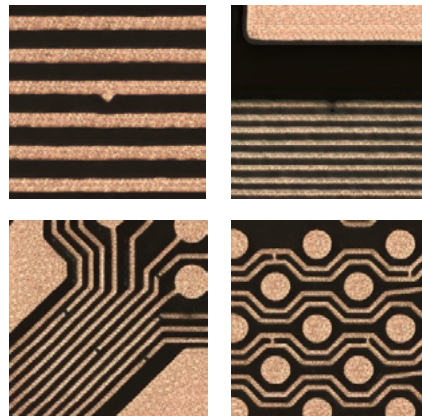
Lumina ViVID™ Images (LS 2/2)

Technologies

 Multi-Modality Imaging™ Technology

 Omnisphere™ Technology

Faster Cycles and Higher Yields

Lumina, KLA's inspection and metrology system for advanced IC substrates and panel-level packaging, enables high-sensitivity capture of distinct defect types. Featuring on-the-fly, AI-based actionable classification, Lumina offers seamless connectivity to the next process step. It efficiently completes a full on-tool review and verification cycle, identifying issues without verification stations.

Lumina optimizes processes through connectivity with KLA's comprehensive AI-enhanced portfolio of defect inspection, metrology, and intelligent software solutions. This optimizes yield, accelerates delivery cycles and improves overall profitability throughout the leading edge IC substrate and PLP manufacturing workflow.

Detection Across a Wide Range of Applications

Omnisphere: Optimized Detection for Critical Defects and CD Measurements

Lumina's Omnisphere™ is a 360-degree, flexible, dome-shaped lighting system, enabling unobstructed, unified substrate illumination. As Omnisphere covers the entire light spectrum without angular gaps, detection signal-to-noise ratio (SNR) is improved.

Omnisphere eliminates 3D shadows and image graininess with high sensitivity to defect characteristics, revealing defects that would otherwise be invisible or masked.
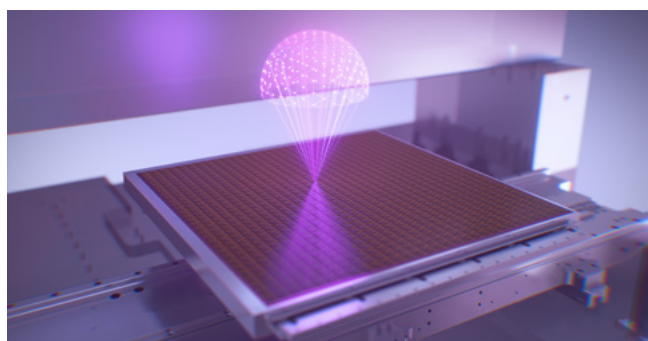
Area Camera: Optimized Image Acquisition for Fine Copper Lines

Image quality is superior with Lumina's area camera. Together, the area camera and Omnisphere, form Lumina's perfectly symmetrical inspection and metrology system. It reduces system noise, like blurring and mechanical jitter. It also minimizes local noise, such as warpage, height variations, and substrate temperature variations. In addition, the area camera provides a live scan image for ease of use.

Multi-Modality Imaging: Multiple Images in A Single Scan

Lumina's Multi-Modality Imaging (MMI)™ technology enables full defects of interest detection coverage in a single scan, with low false alarm rate (FAR) and full setup flexibility for each modality throughout the PLC phases.

In addition, Lumina's multi-modality feeds EcoNet™ AI engine with a vast stream of information, further enhancing filtering and classification.

VRS-less, Resource-lean Verification with EcoNet

With Lumina's EcoNet connectivity, verification stations are no longer required. EcoNet on-tool automated defect classification (ADC) builds on distinct metadata and multi-modality images, and uses advance machine learning algorithms to allow on-the-fly actionable classification. As a result, AOI-to-AOS transitions are seamless, yields are higher and cycle times are shorter.

The AOI-AOS closed feedback loop enables AI retraining, improving auto classification precision, optimizing detection and cost of ownership.

Through EcoNet, Lumina offers AI-based connectivity with other KLA portfolio capabilities such as 3D metrology and CAM-based data analytics. This improves production yield, reduces manufacturing costs and provides an energy efficient solution.

Support for Current and Future Production Needs

Lumina offers a strong signal down to 0.5μm defect size, with inspection ranging from 9/12 down to 2/2 μm line/space.

Featuring a dual resolution for fine lines and very fine lines, Lumina optimizes inspection throughput for a range of line/space requirements. With automated glass and organic panel loading, a panel warpage solution and high cleanliness levels, Lumina supports a fully automated production line, across a wide range of panel types.

Integrated, Automated Metrology

Lumina's on-the-fly mass metrology capabilities reveal hidden process variations on via and traces. The Lumina inspection and metrology solution supports a range of advanced ICS technologies with the finest line/space dimensions and varying panel materials, including glass core substrates and organic interposers.

Specifications

	Lumina HS	Lumina HP	Lumina HT
Technology Range	Down to 2µm line/space *	Down to 2.5µm line/space	Down to 5µm line/space
Inspected Products	- **Inner layers:** Signal, power and ground, mixed, cross shielding, inner with holes, buildup - **Outer layers:** Signal, mixed, cross shielding, buildup - **RDL:** Panel RDL - **Build-up layers:** Pattern and Via at various production stages - **Glass and TGV:** Bare, pattern, Vias and Crakes (Top, bottom, waist, and in between), LIDE - **TGV post plating:** Recess, Dome		
Inspected Materials	- **Conventional:** Bare copper (shiny, matte), etched additive or plated copper, reverse treated foil (RTF), double-treated copper, gold plated conductors. Any laminate including ABF, FR4, Teflon, Roger - **Flex material:** Polyimide, polyester - **Advanced process:** SAP, mSAP, Corless ABF, ETS, Organic interposer, Glass interposer, TGV, Glass core, Glass carrier, RDL - **Advanced build-up board materials:** ABF, PID, RCC, BT, ALIVH, FR4, Glass Core, Glass, Silicon, PI types - **Photoresist:** Blue, purple and brown		
Detected Defects	Shorts | Fine shorts | Dark shorts | Opens | Minimum line/space violations | Nicks | Protrusions | Cu on Cu | ABF bubbles | Dents | Dish downs |Copper splashes | Pinholes | Missing or excess features | Wrong size and position of features | Clearance and split plane violations |Blocked holes | Annular ring violations | SMT violations | Glass crakes (including TGV) | Black spots | Laser via defects as missing drill | Over drill | Under drill | Via shift |Residue in the via | Via size & shape (including TGV top, bottom, and waist) | Dome | Pillars | Carrier detachment residues		
Inspection Methods	- **Omnisphere™ technology, with area camera:** providing high quality multi-modality imaging - **Multi-Modality Imaging (MMI)™ technology:** Simultaneous inspection and analysis of different types of images for pattern & LV inspection, ensuring highest detection rate of cracks, transparent layers, dark/bright and fine shorts - **Advanced sub-pixel detection algorithm:** combined Die to CAM (D2CAM) with on-the-fly model - based comparison, contour comparison and specific criteria per feature - **AI Filtering:** State-of-the art artificial intelligence (AI) to reduce false-alarm rate without masks - Full multi-layer panel understanding		
Panel Dimensions	**Thickness range:** 0.2 – 4.3mm (<0.2mm with adapting plate) **Maximum warpage **:** 10mm **Maximum panel size:** 620mm x 620mm		
Alarm Verification	- EcoNet and RMIV Pro ready - **Verification and repair stations:** Orbotech Ultra VeriFine-A - **On-system verification:** built-in HD video camera or by RMIV Pro color digital image		
Metrology	2D Mass Metrology scan ready		
Automatic Defect Shaping	Seamless connectivity with Orbotech Precise™ series, Orbotech Ultra PerFix™ series, next generation AOS		
Setup Data Sources	ODB++/GDS		
Enhanced Digital Color Image	On the fly high quality digital color image for verification, powered by KLA's ViVID™ technology, eliminates verification stations		
Cost Options	- RMIV Pro seat - 2D Metrology solution - 2D barcode reader - Panel Foup EFEM (various sizes) - EcoNet Connectivity	- Automation kit - Large table, supporting panels @620*620mm - On tool video - Frontline InShop® connectivity	- Automation kit - Large table, supporting panels @620*620mm - On tool video - Frontline InShop® connectivity
Dimensions (W x D x H)	2675mm x 2017 x 2614		
Weight	3900Kg		
Automation	EFEM ready, Glass support, Lift pins/Class 100		

Specifications are subject to change without notice.
Lumina system is a class-1 laser product.
* Line/space can be extended to 1.5/1.5µm with some limitations. ** May vary depending on the size and material of the panels.

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