KLA+

Surfscan® SP7XP

Unpatterned Wafer Defect Inspection System

The Surfscan® SP7XP unpatterned wafer inspection system facilitates qualification and monitoring of processes and tools for IC, wafer, equipment and materials manufacturers for ≤5nm logic and advanced memory design nodes. With industry-best 12.5nm sensitivity and high throughput, the Surfscan SP7XP provides a single tool solution for both R&D pathfinding applications and process monitoring during high volume manufacturing. Built on the industry-standard Surfscan® platform, the Surfscan SP7XP delivers ultimate sensitivity to critical defects and enhanced defect classification for bare wafers, smooth and rough films, and fragile resists and litho stacks, including those used for EUV lithography. By discovering and identifying critical defects and surface quality issues, the Surfscan SP7XP enables faster identification of process and tool issues, driving faster ramp, higher yield and improved fab profitability.

As an extension of the Surfscan SP7, the Surfscan SP7XP incorporates new hardware technologies and innovative algorithms that enable enhanced capability, including:

- Ultimate sensitivity for advanced design node R&D pathfinding by IC fabs, wafer houses and equipment manufacturers

- High throughput for cost-effective monitoring during high volume manufacturing of advanced design node devices

- Capture of unique defects types using new inspection modes for support of a broad range of process monitoring applications

- Image based defect classification using revolutionary machine learning algorithms for faster time to root cause

Surfscan SP7^{XP} Advanced Features

Defect Sensitivity
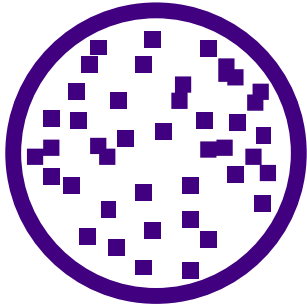
- **New 12.5nm inspection mode** and low noise sensors provide the inspection sensitivity required for R&D pathfinding at leading-edge design nodes, including development of logic devices using gate all around transistors.

- The new **Phase Contrast Channel (PCC)** provides enhanced signal for improved capture of defect types with weak scattering in the normal or oblique channel, such as shallow bumps or residue.

- The **Normal Illumination (NI)** inspection channel utilizes an independent objective to optimize capture of defects of interest not found in the oblique channel. NI finds unique non-cleanable defects, like embedded deformities and scratches, and provides higher capture of sliplines, residue and optical microscope visible (OMV) defects at higher productivity compared to the normal channel on Surfscan SP5^{XP}.

Defect Classification

- **Image Based Classification (IBC)** leverages an advanced TDI camera and revolutionary machine learning algorithms to accurately classify detected defects, reducing the time to root cause. IBC greatly reduces the time required for classification recipe setup compared to previous-generation classification engines, with >60% time savings demonstrated for some layers. Enhanced Signal Detection (ESD), a key feature of IBC, leverages information from all inspection channels to improve classification of defects such as scratches and epi stacking faults (ESF), helping engineers better understand and improve processes.

- The **Z7™ multi-channel defect classification engine** provides a unique classification solution for embedded defects in 3D NAND and other thick film applications. The Z7 classification data facilitates troubleshooting of excursion root causes and correlates defect characteristics to inline yield impact. In addition to reducing time to root cause, Z7 reduces the need for SEM/FIB and additional test wafers when troubleshooting process issues.

Productivity

- High volume manufacturing inspection modes have **improved cost of ownership** compared to the Surfscan SP7, enabling use of the Surfscan SP7^{XP} for advanced design nodes and high end film applications.
- The Surfscan SP7^{XP} offers up to 1.6x **higher throughput** for production modes compared to the Surfscan SP7 enabling more sampling, fast defect sourcing and effective wafer dispositioning.

Production Integration
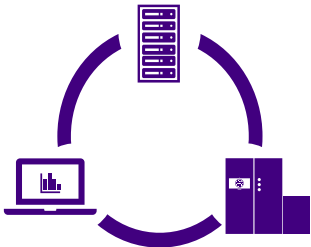
- The **SurfServer™** centralized recipe management system facilitates recipe portability and helps streamline fab's fleet management. The Recipe Distribution System (RDS) enables seamless recipe migration from Surfscan SP7 to Surfscan SP7^{XP}, one-click recovery, all-time synchronization and complete user management. With SurfServer, fab operators save time through faster recipe creation and the ability to publish recipes that sync to all tools.
- Matching and correlation of Surfscan SP7^{XP} and Surfscan SP7 baselines allow fabs to mix-and-match systems based on their unique sensitivity requirements – enhancing fleet flexibility and protecting fabs' capital investment.

Surfscan® Platform

The industry-leading Surfscan® family of unpatterned wafer inspection systems identifies defects and surface quality issues that affect the performance and reliability of semiconductor devices. Surfscan systems support 300mm IC, OEM, materials and substrate manufacturing for both leading-edge and larger design nodes.

Surfscan Family

Design Node	Surfscan System
≥4Xnm	Surfscan SP-A3
3Xnm	Surfscan SP3
2Xnm	Surfscan SP5
1Xnm	Surfscan SP5^{XP}
7nm	Surfscan SP7
≤5nm	Surfscan SP7^{XP}

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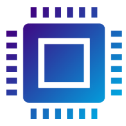
IC Manufacturing

Process Tool Monitoring
Within the IC fab, the Surfscan SP7XP qualifies and monitors process tools for 3nm and 5nm design node R&D and high volume manufacturing. By capturing tiny blanket film defects at production speeds, the Surfscan SP7XP allows engineers to monitor for defects that may be introduced by process tools during film deposition, CMP, litho, etch, anneal or other process steps.

R&D
The high sensitivity operating mode of the Surfscan SP7XP supports characterization and qualification of new processes during the R&D phase of IC manufacturing. With image-based defect classification and seamless connectivity to KLA's eDR7xxx™ e-beam review system, the Surfscan SP7XP provides engineers with a robust solution for quickly finding, identifying and sourcing critical defects on advanced processes and new materials.

Incoming Wafer Qualification
The extended DUV sensitivity of the Surfscan SP7XP helps IC manufacturers ensure that incoming wafers meet their strict quality specifications.

Materials and Equipment Manufacturing

Process Tool and Materials Qualification
Defects added by process tools, such as fall-on particles or metal contamination, can adversely affect wafer yield or device performance. Certain process steps, like polishing, can worsen the wafer surface quality and create abnormal defect signatures that may render the wafer unsuitable for further processing. Early detection and classification of these subtle wafer conditions is critical to ensure optimal yield. The Surfscan SP7XP captures critical defects and produces high resolution SURFimage™ maps, providing equipment suppliers with the information required to build reliable, production-worthy process tools.

Process Uniformity Monitor
The full wafer, high resolution SURFimage data produced by the Surfscan SP7XP represents the variations of the wafer surface quality in response to changes in process chemistries or recipes, enabling process optimization and production monitoring.

Substrate Manufacturing

Process Monitoring
Within wafer houses, the Surfscan SP7XP supports process development and production monitoring of advanced substrates, including prime silicon, epitaxial and SOI wafers.

Final Quality Control
With industry-leading sensitivity to critical defects, the Surfscan SP7XP provides accurate defect information, ensuring that outgoing substrates meet the required quality specifications of their customers.