The TeraStar reticle inspection system provides photomask and IC manufacturers with powerful technological and productivity features that enable maximum yields from today’s complex low-k1 reticles. Using triple-beam inspection with synchronous STARlight™ and pattern inspection algorithms, the TeraStar system provides three times the scan speed of previous generation systems. Revolutionary Tera™ algorithms remove current barriers on linewidth, advanced optical proximity correction (OPC), and phase shift mask (PSM) geometries. TeraStar’s low false defect rate and high-speed inspection deliver substantially lower reticle verification costs.

Its high throughput and sensitivity make TeraStar ideal for pre- and post-pelliclization inspection in photomask manufacturing operations, as well as for incoming quality control and reticle re-qualification in wafer fabs. Optional defect simulation software assists mask shops and wafer fabs in analyzing how reticle defects print on wafers.

**PRODUCT DESCRIPTION**

**STARlight™ Technology** TeraStar is the newest evolution of KLA-Tencor’s STARlight™ technology. This technology meets the needs of deep UV lithography for 0.13-micron device manufacturing and 0.10-micron device research and development. TeraStar performs simultaneous transmitted and reflected STARlight™ inspection for contamination with concurrent** pattern inspection for detection of pattern defects on the chrome surface of reticles.

**eXtreme Performance Algorithm (XPA)** XPA†, a revolutionary new pattern defect detection algorithm, provides new linewidth capability to enable inspection of shrinking gates and sub-resolution optical proximity correction (OPC) assist features. This capability also allows inspection of attenuating, alternating, and tritone phase shift masks (PSM), and helps remove limitations on the use of assist bars and model-based OPC designs.

XPA significantly improves TeraStar’s defect sensitivity, meeting 100-nm defect sensitivity requirements.

**Superior Image Computer** The new Tera image computer†, which uses parallel processors to execute the XPA pattern inspection algorithm, triples the 300 series computational speed with the same machine footprint.

Triple Beam Inspection Using larger field high-resolution optics than previous generations, the new TeraStar triple-beam inspection system provides three times the scan speed of previous-generation systems. Combining pattern and contamination inspection** into a single pass with the TeraPro High Productivity Mode boosts system throughput beyond the increased scan speed capability, providing more than three times the productivity of previous-generation systems. Three selectable telescopes allow the use of larger pixel sizes for higher throughput on non-critical layer reticles.

**High-Resolution Graphics** The high-resolution graphical workstation enables detailed review of live-camera and stored defect images. Full transmitted and reflected-light defect images can be reviewed during inspection without disrupting it.

**Improved Resolution and Stability** TeraStar features an increased numerical aperture that improves system resolution and defect-detection sensitivity.

A new longer-life UV argon laser with automatic gas refill improves stability and reduces downtime. An evolution of the field-proven 300 series optics, the optical subsystem manipulates light with active mirror servos, aligning the multiple beams automatically to illuminate an acousto-optical scanner for fast and reliable scanning.

**Unpatterned Reticle Surface Analysis (URSA)** This optional feature is used for final post-pelliclization inspection in mask manufacturing and reticle re-qualification as wafer fabs. URSA monitors the back glass and pellicle of the reticle for new particles, smudges, pellicle tears, and other handling defects that may impact the imaging of the reticle pattern onto wafers. TeraPro HP High Productivity Mode provides pattern, contamination, and must-be-black (MBB) border inspections all in one inspection, saving time and increasing productivity. This multi-faceted inspection using MBB inspect for yield-killing pinhole defects in the opaque border, eliminating the need for an extra inspection. With TeraPro HP, multiple algorithms now run concurrently in multiple areas. Concurrent inspection modes—STARlight and die-to-die or STARlight and die-to-database—save time by reducing the number of inspection passes performed in the reticle process flow.

**TeraPhase Advanced Alternating Phase Shift Mask Algorithm** The TeraPhase algorithm provides significant improvement in the linewidth capability and defect sensitivity on Alt-PSM designs. Defects are processed through the selective use of reflected light to ignore bright artifacts on chrome. Bright halos around 180 degree shifters do not degrade a TeraPhase inspection.

The high productivity of the TeraStar is retained with low false and nuisance defects on most Alt-PSM designs.

**TeraFlux Figure Energy Measurement Capability** Using the TeraStar pattern inspection system’s image computer platform, the revolutionary TeraFlux algorithm inspects square or rectangular designed “closed” features. TeraFlux compares the energy flux differences on features for contacts, trenches,
and cells on chrome or half-tone reticles. The new algorithm provides detection of very small energy flux variation on the reticle. The dispositioning of such errors usually would require the precision and resolution of a CD SEM. A new review capability has also been developed for review of very small CD errors for this application, which displays the energy flux difference between the defect image and reference image.

**TeraPrep Data Preparation Processor** TeraPrep, the new data preparation system, features a KLA-Tencor jobdeck formatter with optional CATS software. TeraPrep provides a high-performance multi-processor UNIX server (with large and expandable disc capacity) that uses the same discs for prep and runtime for no file transfer wait and fiber connection to the inspection station for fast data transfers. Preps are processed with minimal inputs. Inspection areas and alignment marks are defined after prep processing; pixel size and light calibration may be left for runtime definition. This allows for any changes without re-prep, giving flexibility in preparation and inspection without sacrificing throughput.

**APPLICATIONS**

- **OPC/PSM Inspection**
  The new XPA algorithm enables inspection of OPC assist features and model-based OPC designs without limitation on attenuating, alternating, and tritium PSM.

- **CD Error Detection**
  Reticle CD defects, when found in low k1 lithography, can be magnified onto the wafer with greater printability. The XPA algorithm provides protection from these defect types by detecting localized CD variations caused by resist defects and systematic CD errors such as writer butting and placement errors.

- **Outgoing Qualification**
  TeraStar’s high sensitivity and throughput make it the ideal system for pre and post-pelliclization inspection in photomask manufacturing operations.

- **Incoming Qualification (IQC)**
  In fab IQC, TeraStar inspects advanced reticles for all defect types in a single pass, providing incoming certification before putting the reticle into production.

- **Reticle Re-qualification**
  In a STARlight™/URSA configuration, TeraStar provides high-speed reticle inspection for high frequency monitoring of critical layer reticles susceptible to degradation from DUV exposure. The system detects electrostatic discharge (ESD), crystal growth, particles, and semitransparent defects that occur during a reticle’s useful life in production.

### Inspection Modes

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**Benefits**

- High sensitivity to pattern and contamination defects on the chrome surface of the reticle.
- High resolution to inspect advanced optical proximity correction (OPC) and phase shift mask (PSM) reticles.
- Three times or more the productivity of previous generation systems.
- Inspection of the pellicle surface and backside of reticles for new particles added.
- Low cost of ownership (CoO) and best protection in a low-k1 environment.
- Superior review images, improved resolution, and better defect review tools.
- Low false defect counts shorten time to review defects and minimize operator error.
- Provides both die-to-die and die-to-database inspection.
- Provides concurrent multiple-inspection capability.
- Enables detection and disposition of very small energy flux variations on the reticle.
- Maintains high productivity inspection with low false and nuisance defects on most PSM designs.
The TeraStar technology featuring the new XPA die-to-die algorithm.

FINDING SMALL DEFECTS IN ASSIST OPC

TeraStar tolerates both assist and short assist features without de-sensing the inspection to a real defect on primary geometry.

LOW FALSE DEFECT COUNT WITH TERASTAR ALTERNATING PSM TEST MASK

Inspectability with TeraStar is greatly improved for alternating PSM reticles compared to the previous generation 305UV system.

KLA-TENCOR SERVICE and SUPPORT

Customer service is an integral part of KLA-Tencor’s portfolio that enables our customers to accelerate yield. Our extensive customer service organization collaborates with customers worldwide through the life stages of their factory and tools to achieve the required productivity and performance at the lowest overall cost.