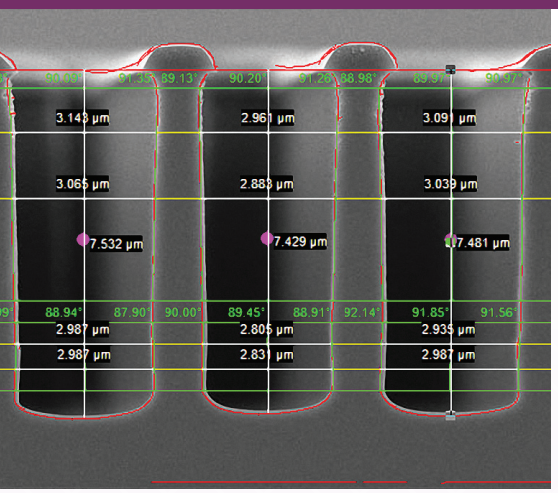
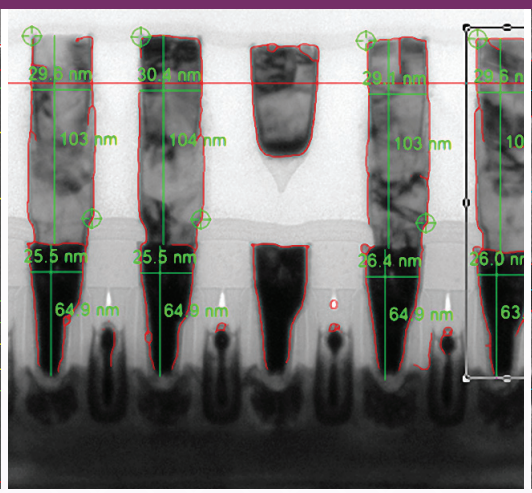
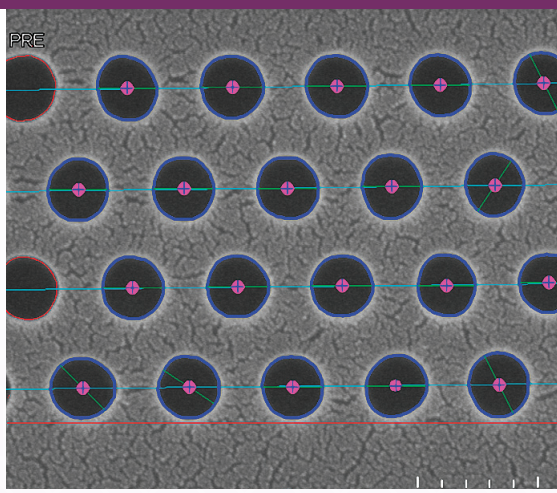
QUARTZPCI-AM 9

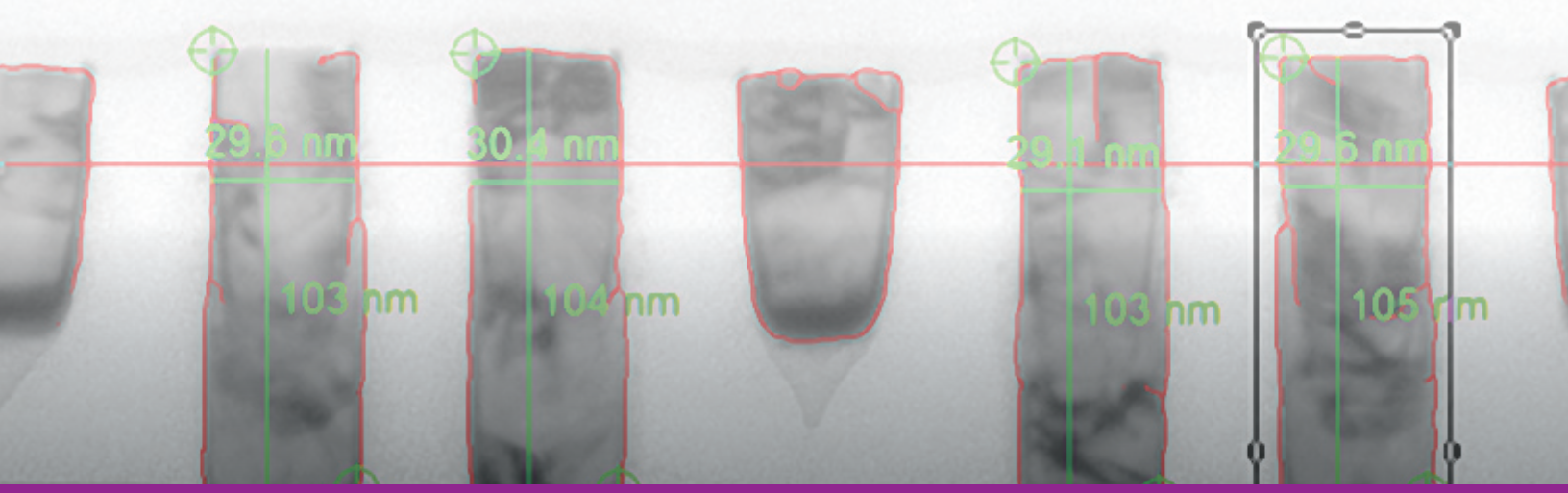






QUARTZ IMAGING CORPORATION

FOR A *FASTER*, SMARTER LAB



AUTOMATED MEASUREMENT FOR SEMICONDUCTOR FEATURES

JUST CLICK... AND THAT'S IT

ADVANCING AUTOMATED METROLOGY THROUGH AI

PCI-AM 9 represents a major evolution in automated, image-based metrology for semiconductor analysis.

Built on Quartz Imaging's proven PCI platform, this latest release integrates an enhanced AI and machine learning engine that intelligently detects, aligns, and measures complex structures in cross-section and top-view SEM and TEM images.

With its new template matching technology, PCI-AM 9 delivers consistent, high-accuracy measurements across varying device geometries—minimizing manual input and reducing user-to-user variability. Designed for demanding R&D and process-control environments, it supports large-scale batch analysis and provides the repeatability, traceability, and throughput required for today's advanced semiconductor manufacturing challenges.

About Quartz Imaging Corporation

Quartz Imaging Corporation has been a leader in microscopy imaging solutions for over three decades. Our award-winning PCI software platform is trusted by laboratories worldwide for image acquisition, measurement, and reporting.

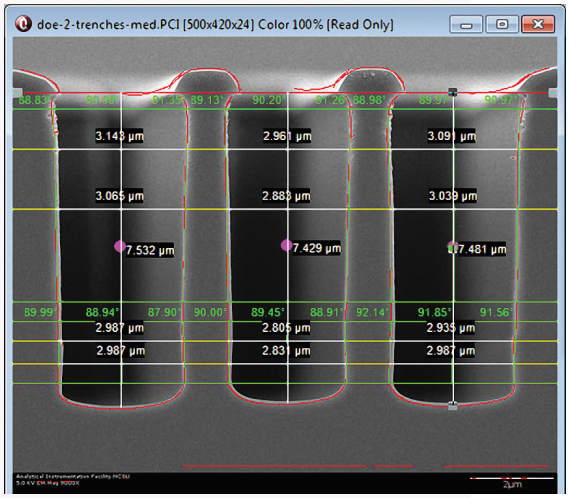
PCI-AM builds on this foundation to deliver next-level results in today's fast paced microscopy imaging landscape.

PCI-AM is a powerful module within Quartz PCI that automates feature detection, measurement, and data output from microscope images.

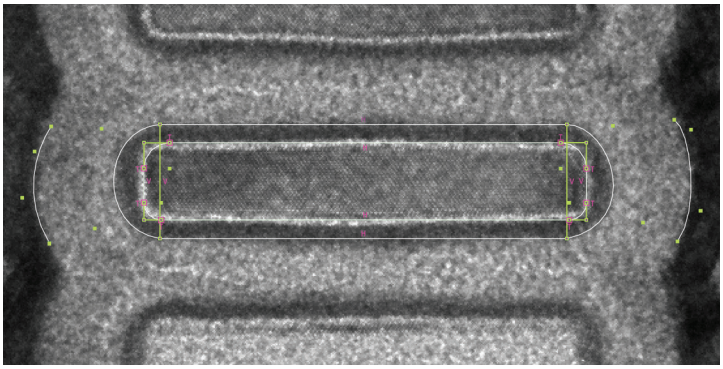
FOUR LEVELS OF AUTOMATION

PCI-AM introduces a tiered automation framework powered by advanced machine learning and AI methodologies, enabling measurement workflows to evolve from operator-assisted to fully autonomous.

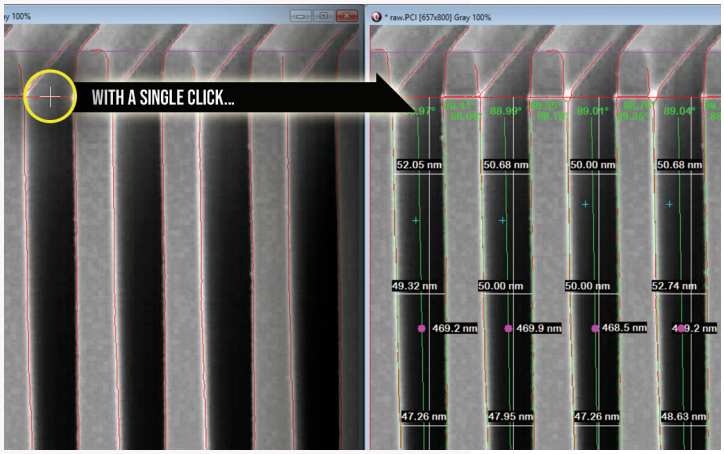
At the **first level**, an analyst simply clicks inside a device feature, and the software automatically measures it — delivering fast, precise analysis of individual structures.



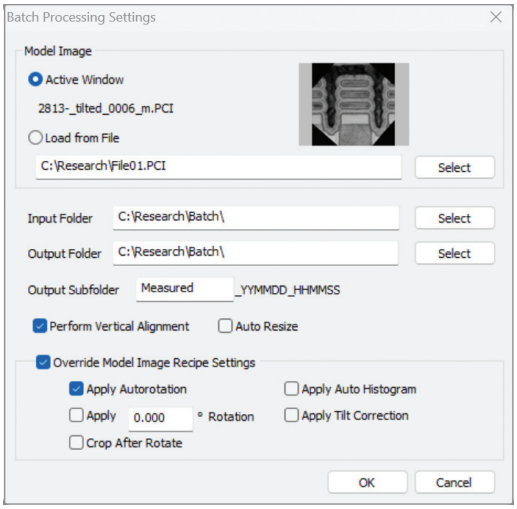
The **second level**, using an intuitive graphical editor, analysts design templates to specify measurements. The software then automatically identifies, aligns, and measures all template features in both individual and batched microscope images.



The **third level** extends this capability: once features in one image are characterized, the same set of AI-driven measurements can be applied to subsequent images with a single click, automatically compensating for misalignment.



The **fourth level** delivers complete automation by processing entire folders of images through template matching, batch categorization, and automated reporting. At this stage, PCI-AM's AI-powered engine handles high-volume measurement with minimal human intervention.



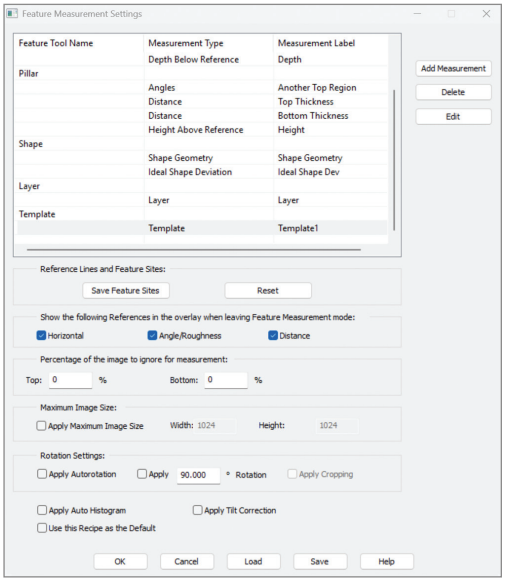
RECIPE DEVELOPMENT

The PCI AM Automated Measurement Module gives users complete control over how features are detected, measured, and displayed through the creation of measurement recipes. A recipe defines all parameters that govern measurement behavior—edge models, reference lines, tolerances, display options, templates and measurement positions—ensuring that measurements are consistent and repeatable across multiple images and sessions.

Recipes are built using the Feature Measurement Settings interface, which provides access to every measurement tool and parameter. Users can specify which tools to apply (line, space, shape, layer, or template), define limits, and save preferred reference positions. The system supports automatic rotation, tilt correction, and histogram adjustment to ensure optimal image alignment and clarity at the start of each measurement session.

Once developed, recipes can be saved, re-used, or shared across datasets, dramatically reducing setup time for routine inspections. Saved feature sites enable automatic recognition of identical structures in subsequent images, making high-throughput analysis fast and reliable. Tolerance limits and color-coded feedback highlight out-of-spec measurements instantly, while batch-processing functions apply the same recipe across entire folders of images.

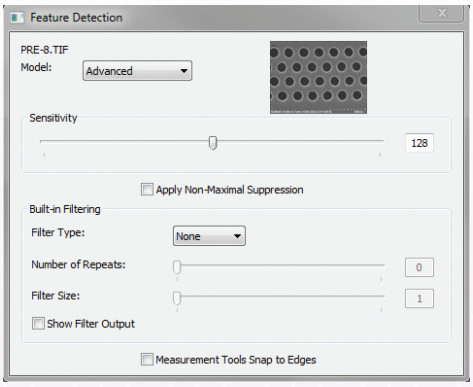
By encapsulating measurement logic and display configuration in an editable, reusable format, PCI AM recipes transform complex metrology tasks into an efficient, automated workflow that promotes both accuracy and productivity.



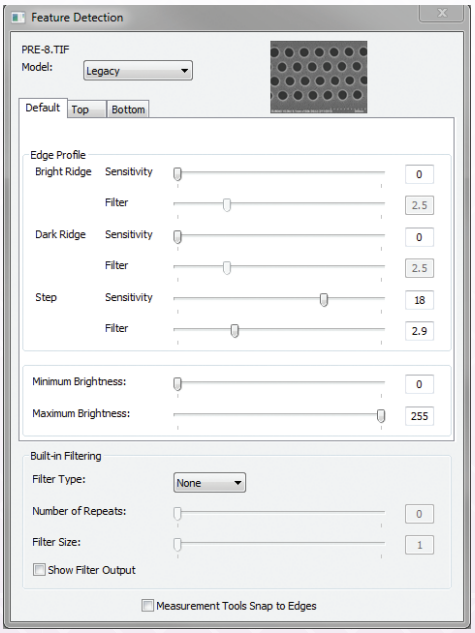
Create and Save Recipes for Measurement Types, Locations and Labels. Load the Recipe for Similar Images.

ADVANCED EDGE DETECTION

High-accuracy boundary detection reduces manual intervention. The result is cleaner, more reliable measurements that maintain nanometer-level accuracy across entire datasets. For analysts, this means less time spent fine-tuning detection parameters and more confidence that the measurements represent the actual physical features under observation.



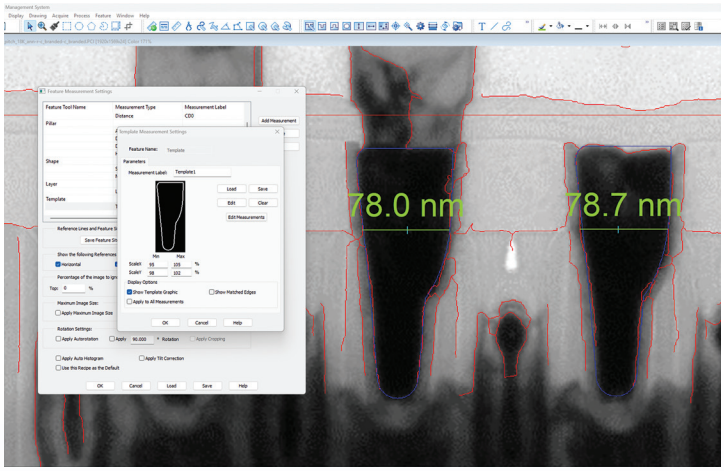
Our new Advanced Edge Detection model and our four Legacy Techniques allow you to work with more types of images and more types of features.



KEY CAPABILITIES

Template Matching:

PCI-AM 9's AI-powered template matching automates repetitive measurements that previously consumed hours of skilled analyst time. Once a measurement template is defined, the software can locate, align, and measure the same feature across hundreds of images—freeing staff to focus on higher-value analytical work and reducing overall labor overhead.



Template matching

Batch Processing:

Designed for high-throughput environments, PCI-AM 9's batch processing capability enables analysts to process large volumes of images in a single, automated run. Multiple datasets—potentially hundreds or thousands of images—can be analyzed with consistent parameters, eliminating the inefficiencies of manual, image-by-image workflows. The system's intelligent folder routing automatically categorizes results into "Pass," "Fail," or "Reject" bins, and it supports variable image sizes and formats within the same batch. This flexibility makes it ideal for mixed-mode operations where different microscopes, magnifications, or imaging conditions are in use. By removing manual handling between steps, batch processing not only accelerates turnaround times but also ensures uniform application of measurement standards, which is critical for both manufacturing QA and research reproducibility.

Seamless Reporting:

With PCI-AM 9, the path from raw image to finalized report is streamlined into a single, cohesive workflow. Measurements, labels, tolerances, and annotations are embedded directly into the image files and linked to the underlying data, ensuring full traceability. The software's integrated report generator allows users to compile multiple images, measurement results, and annotations into a professional, presentation-ready document with minimal effort. Reports can be tailored with custom headers, footers, logos, and layout options, making them suitable for client deliverables, regulatory submissions, or internal process documentation.

PCI Database Usage

An essential part of PCI's value lies in its built-in database functionality, which serves as a central hub for storing, organizing, and retrieving both imaging data and associated measurements. Unlike simple file storage, the PCI database keeps images, measurement results, annotations, and key metadata—such as capture date, operator name, and instrument details—linked together in one secure, structured environment. This direct connection between images and their measurements ensures full traceability, creating a complete audit trail from data capture to final report.

The system's search and retrieval tools allow users to filter and locate datasets with speed and precision, using criteria such as date ranges, sample identifiers, or measurement parameters. Data is organized in logical folder structures and grouped consistently, enabling effective project management and smooth collaboration across teams. By maintaining visual and numerical data in a unified location, PCI supports quality assurance processes, ensuring that verifiable, source-linked records are always available when needed.

In both production and R&D environments, this database-driven workflow reduces the risk of misplaced data, reduces reliance on external spreadsheets for tracking measurements, and guarantees that high-value information remains accessible for immediate analysis and long-term reference.

By reducing human input, PCI-AM ensures consistent, reproducible measurements while freeing staff for higher-value work.

QUANTIFYING ROI FOR MICROSCOPY LABS

Adopting PCI-AM 9 is more than a technical upgrade; it's a measurable business advantage. By automating labor-intensive measurement tasks, accelerating batch processing, and streamlining reporting, the software significantly reduces analyst time spent on repetitive, error-prone work.

These efficiency gains translate directly into lower operational costs, faster decision-making, and higher throughput, creating a rapid payback period and sustained long-term value.

The following analysis demonstrates how PCI-AM 9 can deliver a compelling financial return, even in a small-team environment.

Labor Cost Savings

- **Before PCI-AM:** A skilled operator spends ~3 minutes per feature on measurement.
- **With PCI-AM:** Same task completed in seconds, often in unattended batch mode.
- **Savings:** Labs can cut manual measurement time by up to 90%, allowing reallocation of staff to complex tasks.

Throughput Gains

- Increased capacity can enable labs to take on more projects or reduce turnaround times, boosting client satisfaction and retention.

Error Reduction & Quality Improvement

- Consistent algorithms eliminate operator-to-operator variability.
- Higher measurement repeatability improves the credibility of lab results.

ROI CALCULATION EXAMPLE

Assumptions for a mid-sized microscopy lab:

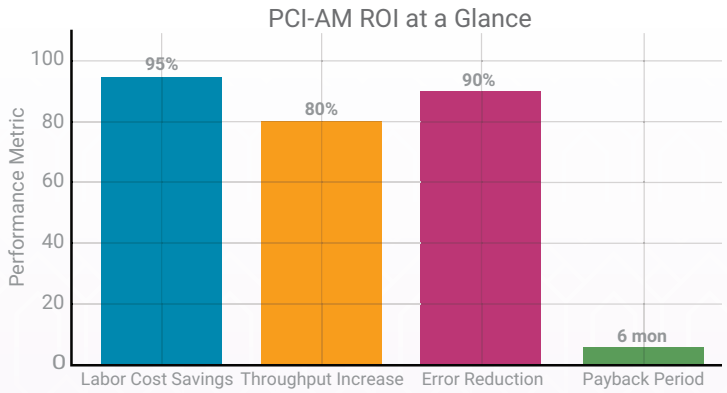
- 2 analysts performing measurements full-time.
- $45/hour fully burdened labor rate.
- **33 images/day**, 10 features per image (**330 features/day**).

Manual measurement:

- 3 minutes/feature → **16.5 hours/day total = 8.25 hours/day per analyst**.
- **Annual labor cost for measurement: $185,625** (≈$742.50/day × 250 days).

With PCI-AM:

- 90% reduction in measurement time (to **0.3 min/feature → 1.65 hours/day total = 0.825 hours/day per analyst**).
- **Annual savings: $167,000+** in labor costs alone



PCI-AM 9: Automation That Pays for Itself

STRATEGIC ADVANTAGES BEYOND ROI

Scalability

PCI-AM 9's automation capabilities allow organizations to handle increasing imaging and measurement workloads without proportional increases in headcount. As demand grows—whether from higher production volumes, expanded R&D programs, or additional client projects—the same team can process more data in the same amount of time. This scalability not only reduces future hiring costs but also enables a business to confidently take on larger contracts or respond quickly to spikes in workload without sacrificing quality or turnaround times.

Competitive Edge

In industries where precision and speed directly influence client satisfaction, PCI-AM 9's faster turnaround and consistent results create a significant competitive advantage. High measurement reliability builds trust, while the ability to deliver results quickly can secure repeat business and attract new customers. For service providers, these advantages often translate into stronger client relationships, a more favorable market reputation, and the potential for premium pricing based on performance and reliability.

Staff Morale

By offloading repetitive, time-consuming measurement work to automated processes, PCI-AM 9 enables analysts to spend more time on higher-value, intellectually engaging tasks such as data interpretation, anomaly investigation, and process optimization. This shift not only boosts job satisfaction but also helps retain skilled staff—reducing the costs and disruption associated with turnover. A more engaged team is often a more innovative and collaborative one, leading to further process improvements over time.

Regulatory & Quality Compliance

PCI-AM 9's automated measurement, data capture, and reporting features inherently support data integrity and traceability, which are critical for meeting regulatory requirements and quality standards. By embedding tolerances, labels, and measurement data directly into linked image files, the software ensures that every reported value can be traced back to its source. This reduces the risk of non-compliance findings during audits, simplifies certification processes, and strengthens overall quality assurance programs.

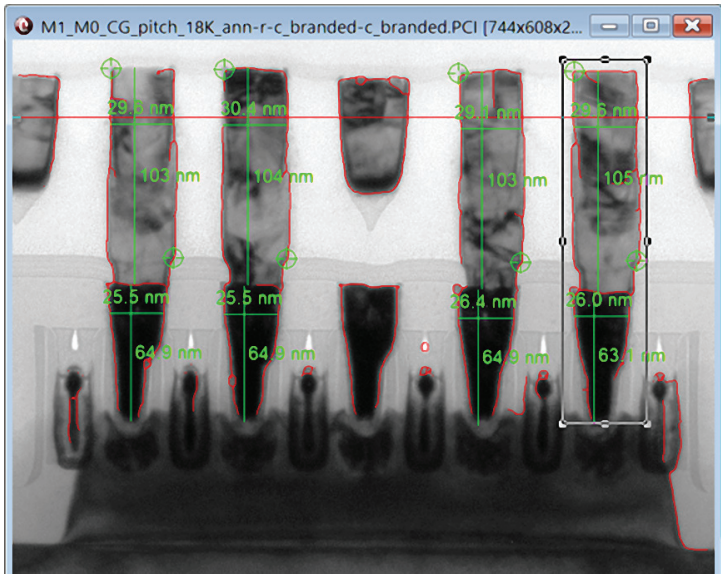
PCI-AM transforms microscope image analysis from a manual bottleneck into a high-speed, high-accuracy automated process. For most labs, the investment in PCI-AM pays for itself in months, not years, and continues to generate long-term efficiency and quality gains.

PCI-AM 9 is more than an incremental upgrade; it is a strategic enabler for the next generation of semiconductor metrology. By combining AI-driven features like template matching, advanced edge detection, high-throughput batch processing, and integrated reporting, it addresses the most pressing challenges faced by imaging analysts while delivering measurable efficiency gains and substantial ROI.

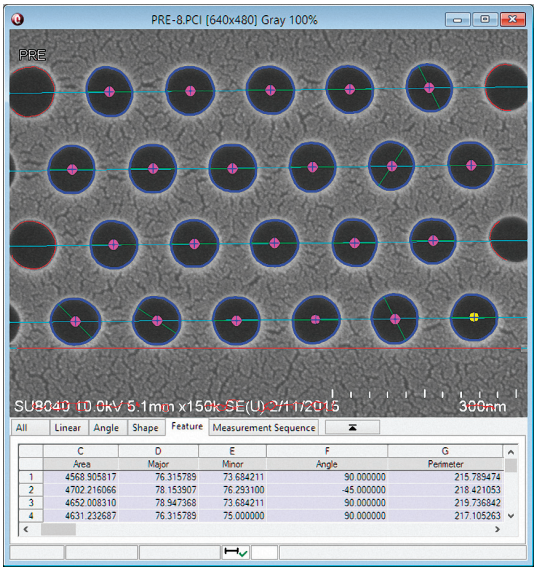
Beyond cost savings, the software provides scalability, consistency, and compliance advantages that strengthen competitive positioning and support long-term growth.

In an industry where precision, speed, and reliability are non-negotiable, PCI-AM 9 empowers organizations to meet today's demands and prepare for the complexities of tomorrow.

Quartz Imaging Corporation is committed to helping microscopy labs unlock these benefits through advanced, easy-to-use automation tools that integrate seamlessly into existing workflows.



Macro Cell



Shape Measurements

TECHNICAL FEATURES

ACQUIRING

- Most popular file formats can be imported.
- Support for 24-bit color and 8- and 16-bit grayscale images.
- Imports EMSA format x-ray.
- Can import files, and retain calibration information, from most EM manufacturers including Delong, FEI, Gatan (DM3, DM4), Hitachi, Hitachi CDSEM, JEOL, Phenom, Tescan, ThermoFisher and Zeiss. Keyence light microscope files are also supported.
- Common user interface for all image sources enhances ease of use.

ADVANCED MEASUREMENT

General

- Performs automatic measurement of lines, spaces, trenches, pillars, and circular, elliptical and irregular 2D shapes.
- Measures numerous parameters including Width, Depth, Height, Angle, Pitch, Roughness, Area, Perimeter, Aspect Ratio, and Centroid
- Calculates Ideal Shape Deviation, Top and Bottom Radius of Curvature and Feature Collinearity.
- Supports multi-layer thickness measurement with automatic layer detection.

Automation and Recipes

- Recipes define all measurement parameters including edge models, tolerances and display options.
- Reference line and feature site positions can be saved for repeatable automated measurements.
- Autorotation, Tilt Correction and Auto Histogram functions automatically prepare images for analysis.
- Out-of-tolerance measurements automatically highlighted in measurement grid and CSV reports.
- Saved recipes can be reused, shared or applied in Batch Processing for full automation.
- Batch Processing function applies a recipe to entire folders of images and aggregates results.

Measurement Tools

- Line, Space, Shape, Layer, Template and Macro Cell tools for all common feature geometries.
- Template Matching function locates predefined structures and performs stored measurements automatically. Includes built-in Template Editor.
- Macro Cell feature enables multiple distance or composite measurements in arbitrary directions.
- Performs equally spaced or all-segment distance measurements between designated points.
- Manual measurement tools can snap precisely to detected edges and reference lines.

Edge Detection and Models

- Advanced AI-based edge detection
- Built-in preprocessing filters reduce noise and enhance edge clarity.
- GPU acceleration automatically detects and utilizes compatible graphics cards to increase processing speed.

Output

- Measurement results displayed in grid view and updated automatically when edits are made.
- Measurement data saved in companion CSV files or exported for all open images simultaneously.
- Diagnostic log and combined CSV summary automatically generated during batch operations.

MANUAL MEASUREMENT

- Complete set of measurement tools for measuring distances, angles and shapes in the image.
- Values automatically update when measurements are adjusted with the mouse.
- Measurement results displayed in spreadsheet grid and can be easily pasted into Excel or other software.
- Numerous options for displaying arrow heads, extension lines, projections etc.
- Micron marker function for adding micron marker to images, such as from light microscope, that do not contain a micron marker.
- Measurement Sequence Function allows repeated sequence of measurements to be pre-programmed.
- Read out of the image's Field of View (FOV) on the status bar.

ANNOTATING

- Complete set of tools for adding text, arrows and geometric shapes to images.
- Drawing elements can be rotated.
- Drawing tools operate on separate overlay layer. Overlay elements can be moved or deleted without interfering with each other or the underlying image.
- Once you have selected multiple elements you can Group (and Ungroup) the elements.
- Grid overlay can be displayed on image.
- Default overlay burn-in option allows all images to be permanently marked, such as with company logo or confidential indicator.

REPORTING

- Comprehensive built-in report editor.
- Permits layout of images, text and drawing elements.
- Any number of pages.
- Secure PDF Export.
- Grid/Snap-to-grid features.
- Master page.
- Automatic population of database fields in the report.
- Automatic generation of reports from templates.
- Export reports in PDF or Microsoft Word and PowerPoint formats.

ARCHIVING

- Images can be stored in most popular file formats including TIFF and JPEG.
- Workgroup Database included as a standard feature. Enterprise Database available as an option. Workgroup Database tracks jobs, sessions, samples, images and external documents including multimedia files.
- Permits composition of sophisticated database queries.
- Robust record locking and file sharing in networked environments.
- "Send To" feature allows documents from other applications to be sent directly to the database.
- Burn CDs and DVDs from inside PCI.

PROCESSING

- Image resizing and fine image rotation.
- Ability to reverse raster rotation, using angle information contained in image file.
- Tilt correction.
- SEM resolution measurement.
- Image mixing using various arithmetic operators.
- "Plug-in" interface for user-developed processing and analysis code.
- Histogram functions for contrast, brightness and gamma adjustment.
- Smoothing, sharpening and median filtering functions.
- Display functions for zooming, panning, false coloring and slide show display.
- Construction of anaglyph stereo image from separate left and right images.
- Support for reading and manipulating x-ray spectra.

OTHER

- Supports Microsoft Windows 11. It also works on Microsoft Windows 7, Windows 8 and Windows 10.
- Runs on 32-bit and 64-bit operating systems.
- Dual Monitor and Widescreen Support.
- Output to any Windows®-supported printer.

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