

Motorized Stage Configuration



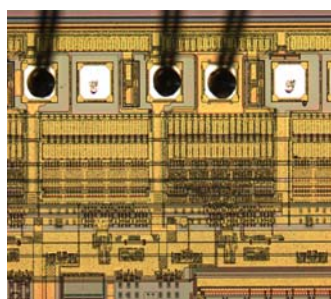
VISION_x INC.

www.visionxinc.com

Real-Time Full Color Image Acquisition

- ▶ Full support for NTSC and PAL cameras with Composite, Y/C (i.e. S-Video) and RGB video signal formats
- ▶ Image display at full 640 x 480 (NTSC) or 768 x 576 (PAL) resolution with "True Color" 24-bit color depth (i.e. 16.7 million colors)
- ▶ VisionGauge® supports many different video acquisition devices
- ▶ VisionGauge® works with all TWAIN and Video-for-Windows compliant devices
- ▶ VisionGauge® supports high-resolution digital cameras
- ▶ Built-in multiple camera support

Powerful & Easy-To-Use Image Viewing Tools



- ▶ Software "zoom-in" and "zoom-out"
- ▶ "Quick-zoom" (i.e. software magnifying glass) feature
- ▶ When working with very large images (i.e. larger than the available viewable area), VisionGauge® allows you to zoom-out to "see" – and work on – the entire image all at once without having to actually reduce its resolution
- ▶ "Pixel viewer" tool to examine individual pixel values (red, green and blue channels, as well as luminance, intensity, hue, lightness and saturation)
- ▶ Use the adjustable "Focus meter" tool to take the subjectivity out of focusing the image, to get the best possible image
- ▶ Full-screen image viewing (in both *Live Video* and *Frozen Image* modes): this popular feature is perfect when you have to carry out a lot of inspection and you want a larger, clearer image.
- ▶ Multiple image viewing (i.e. simultaneously view multiple saved and live images) for image comparison.

Intuitive Interface

- ▶ Simple and intuitive graphical user interface (i.e. full Windows™ "look and feel")
- ▶ VisionGauge's® user interface is completely configurable: configurations and user preferences can be saved to disk and reloaded

User-Friendly

- ▶ Complete and easy-to-use on-line help
- ▶ Clear and concise documentation

Image Archiving & Retrieval, Exchange, Printing & Email

- ▶ Save and reload images to and from disk (BMP, JPEG, TIFF and TGA graphic file formats)
- ▶ User-selectable JPEG compression factor
- ▶ Convenient one-key (or one-click) "Quick Save" feature automatically names, numbers and saves the current image (either live or frozen) in the location and format preset by the user
- ▶ Cut and paste images to and from the Windows™ clipboard
- ▶ Print image
- ▶ Built-in email

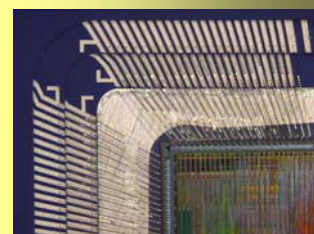
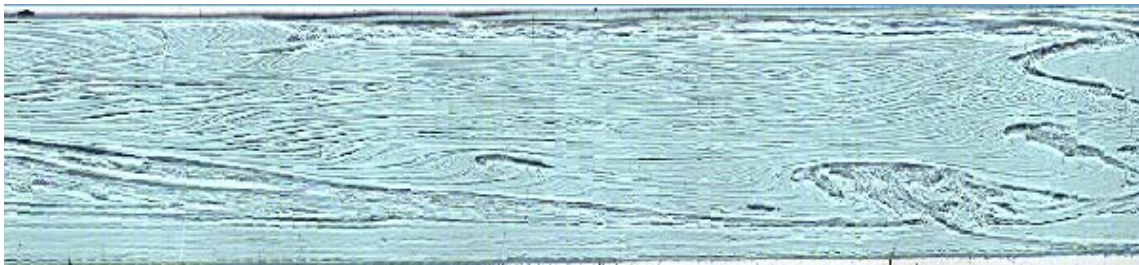


Image Sequence Capture & Video Sequence Capture

- ▶ VisionGauge's® "Video sequence capture" tool allows you to capture full-frame-rate (or slower, as set by the user) uncompressed video to system memory. VisionGauge® can save the video to disk as an "*.avi" movie file that can be played back by applications such as RealPlayer™ and Window Media™ Player. Once captured to memory, the video can be played back, modified, saved to disk and retrieved later on, etc... This tool is perfect for motion tracking and other time-dependent processes
- ▶ You can use VisionGauge's® "Combine" feature to transform a video sequence - made up of many component images - into one large image. The "Combine" feature also allows you to:
 - Specify an image offset (to get rid of the overlap that may exist between side-by-side images)
 - Resize the resulting "combined" image

The "Combine" feature is perfect when you are capturing video of a moving object or scene. In the case of a moving object, the "Combine" feature allows you to transform the video sequence's many component images into one "large" image of the entire object. In the case of a moving scene, the "Combine" feature lets you build a single "panorama" image from the video sequence.



This is an example of how the "Combine" tool works. In this example, a moving camera was used to capture approximately 70 images of a piece of glass after the solidification process. The "Combine" tool was then used to build a single panoramic image of the object

- ▶ VisionGauge's® "Image sequence capture" tool allows you to capture and display images at a given time interval (every five seconds, for example). The image can be displayed in *Normal* or *Full-screen* modes and the images can also be saved to disk. This tool is very useful when observing and characterizing time-dependent processes

Image Manipulation, Annotation, Retouching & Enhancement

- ▶ "Cutout", "Resize", "Flip" and "Rotate" images (rotation can be either in 90 degree increments or arbitrary)
 - ▶ Image "stitching" tools for creating mosaics by putting images side by side
 - ▶ Image retouching tools:
 - Contrast adjustment
 - Brightness adjustment
 - Color correction
 - Transformation to grayscale
 - Image sharpening (i.e. edge-enhancement for software focus adjustment)
 - Edge map (i.e. edge-detection filter)
 - ▶ Image annotation tools for adding:
 - Custom text (with user-selected font, color, pitch and point-size)
 - Line and geometric drawings (e.g. crosshair, circle, rectangle, ellipse, etc... with user-selected line and fill colors)
 - Arrows (line, filled, auto-sizing, etc...)
 - Labels attached to features
 - "Count" (to manually count and number objects on the image) with optional calibrated sizing ring
 - "Box" (to overlay a calibrated box of user-defined size on the image)
 - Free-hand drawings
 - ▶ Image averaging for noise removal (i.e. higher signal-to-noise ratio)
-

Image Manipulation, Annotation, Retouching & Enhancement (continued)

- ▶ ☐ Compute image histogram
- ▶ ☐ VisionGauge's® interlace offset correction tool allows you to remove "motion blur" and similar interlace offset error
- ▶ ☐ VisionGauge's® "Horizontal Profile" and "Vertical Profile" tools allow you to plot either a horizontal or vertical profile across the image of the following channels:
 - Luminance
 - Intensity
 - Hue
 - Saturation
 - Red
 - Green
 - Blue

You can select the profile position either by dragging the hash mark in the image or by entering it manually.

- ▶ ☐ "Undo/Redo" command for error correction with a user-selectable number of "Undo" levels

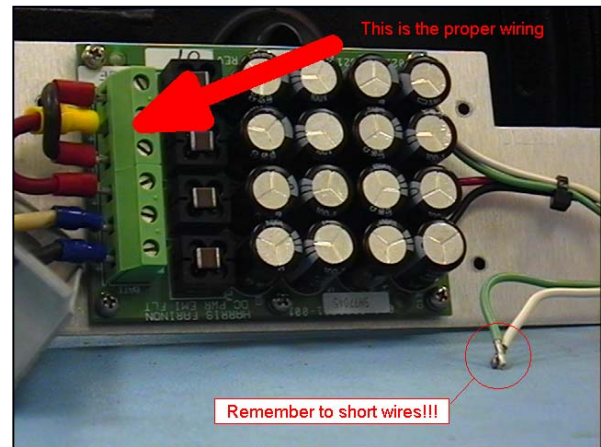
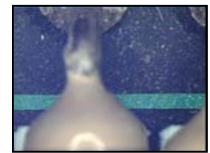
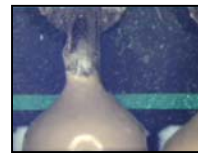
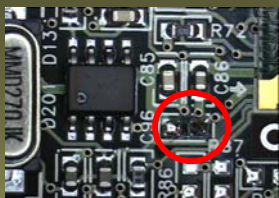


Image Blending ("Perfect Focus") Tool

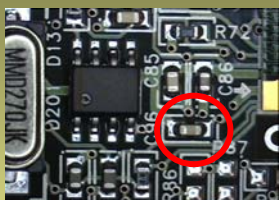


Partially Focused Component Images

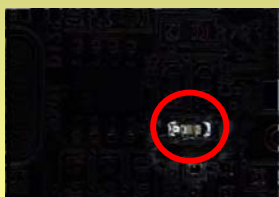
Image Comparison, Overlay & Differencing



Comparison Image



Reference Image



VisionGauge's® image differencing tools make even obscure defects stand out

- ▶ ☐ Image overlay with user-adjustable transparency and offset, as well as "image differencing" to make defects and non-conformities stand out
- ▶ ☐ Use VisionGauge's® "Swap with live" feature to switch back and forth between a stored "golden" image and the current live image. This is a good way to make defects and non-conformities stand out.
- ▶ ☐ Many image arithmetic functions are available (to combine images): add, subtract, minimum, maximum, etc...
- ▶ ☐ Measure X and Y offset errors when comparing the overlay and current images (e.g. useful to assess component placement error)

Unique and powerful "Perfect focus" tool (i.e. "Focus-based image blending") lets you combine two or more partially-focused images into one fully-focused image. This is extremely useful in applications where your instrument's optical depth-of-field is less than the height of the features and topography on the sample.

This is a fully automatic tool that works on color as well as grayscale images, and there is no limit on the number of component images that you can use. With this tool, you can choose from four different image blending algorithms:

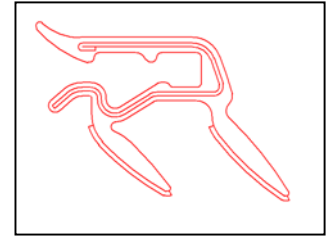
- ▶ ☐ Best focus
- ▶ ☐ Weighted focus
- ▶ ☐ Power-weighted focus
- ▶ ☐ Adaptive (i.e. neighborhood-weighted best focus)



Resulting Fully Focused Image

Powerful & Unique Non-Destructive Live Image Overlay Tools

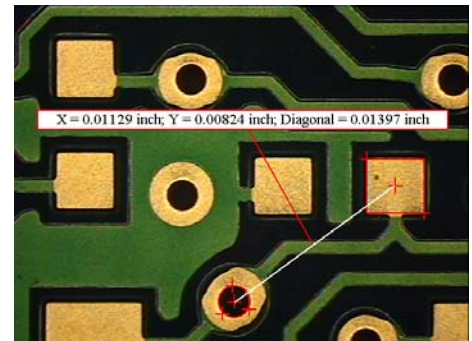
- ▶ VisionGauge® supports non-destructive live image overlays, including crosshair and bull's-eye live image overlays, with user-selectable color, line style (i.e. solid, dashed or dotted) and line thickness.
- ▶ VisionGauge® has a unique and powerful live image overlay builder that lets you construct your own non-destructive live image overlay using geometric constructions (full-screen lines and line segments, crosshairs, circles, etc...). A free-hand drawing tool is also available: this is the perfect tool for drawing the outline of a complex part quickly. The overlay builder is very simple to use and allows for user-defined line styles, colors, thicknesses, etc... You can save your custom overlays to disk and read them into VisionGauge® later on. Overlays can also be superimposed onto captured images
- ▶ VisionGauge's® live image overlay builder can also read in DXF format CAD drawings and automatically scale the drawing to match up with the system calibration. This is the perfect tool to use when comparing a part against its CAD drawing.
- ▶ VisionGauge's® live image overlay builder can also be used to display calibrated features (i.e. grid, circle, angle, etc...) over the live image.
- ▶ Using VisionGauge's® "part-tracking" tool with a stage (either manual or motorized), the overlay can be made to move with the part. By having the overlay "track the part" in this way, you can carry out inspections and compare the part with the CAD drawing at higher magnifications.



VisionGauge's® DXF-format CAD file live image "comparator" feature allows you to quickly determine how well a part matches up with its CAD file definition

Wide Selection of High-Accuracy Measurement Tools

- ▶ Wide selection of powerful and easy-to-use measurement tools:
 - True distance (i.e. point-to-point)
 - Horizontal distance
 - Vertical distance
 - Distance between parallel lines of arbitrary orientation
 - Simultaneous XY measurements
 - Diameter measurement
 - Radius measurement
 - Angle measurement
 - Orthogonal line width measurement
 - Arbitrary line width measurement
 - Automatic circle measurement (i.e. diameter)
 - Automatic angle measurement
 - Pathline measurement
 - Area measurement
 - Z measurement
 - Distance between a point and a plane
 - Coplanarity measurement
 - Thresholded object measurements
 - Wire bond ball size measurement
 - Position of wire bond ball measurement
 - Marker-to-marker measurement
- ▶ VisionGauge® has several "one-click" automated measurement tools.
- ▶ Measurements can be written to disk file and transferred to other applications (e.g. spreadsheet, database, etc...)
- ▶ Measured values can be shown in either absolute (i.e. always positive) or true "signed" form
- ▶ Draw the measurement objects (e.g. lines, hash-marks, cross-hairs etc...) on the image and attach labels with explanatory text, measured values, etc...
- ▶ Quick and easy calibration
- ▶ Calibrations can be saved to disk and reloaded. This way, the system does not need to be re-calibrated every time it is started or when magnification is changed
- ▶ Use the "Calibration toolbox" to quickly change measurement calibration in response to a change in optical magnification (e.g. when changing between objectives on a microscope). Values in the "Calibration toolbox" are carried over from one session to the next. The "Calibration toolbox" also indicates which calibration is currently active
- ▶ Calibrations can be protected using password protection. VisionGauge® also has a second level of password protection (i.e. "lock out" password protection) to stop users from changing the system's configuration

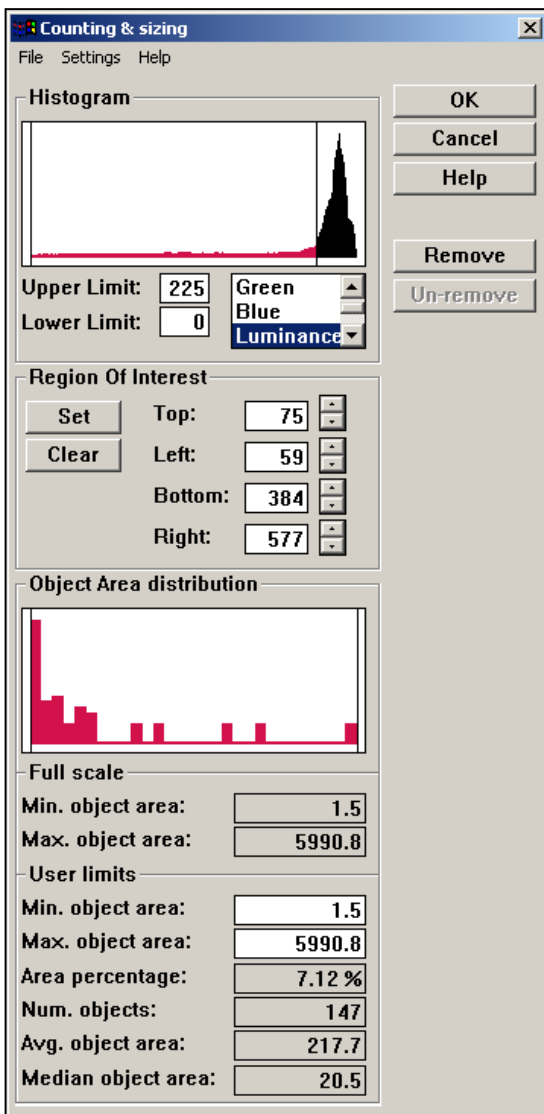


Wide Selection of High-Accuracy Measurement Tools (continued)

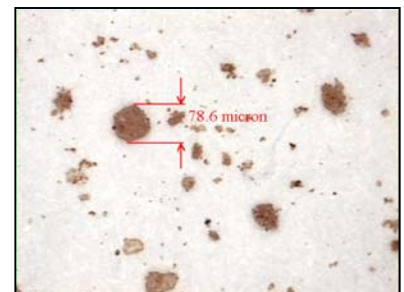
- Both imperial (i.e. inch, mil) and metric (i.e. micron, millimeter) units are supported for linear dimensions, as well as degrees and radians for angular dimensions
- By default, VisionGauge® always displays the correct number of significant digits for measured values – based on the optical magnification – regardless of the measurement units, etc... However, you can override this and manually set the number of digits for measured values
- Use the “Measurement toolbox” to store user-defined measurement tools and to quickly change measurement tools. Tools in the “Measurement toolbox” are carried over from one session to the next. The “Measurement toolbox” also indicates which measurement tool is currently active. The entire contents of the “Measurement toolbox” can be saved to disk and read in later on.
- VisionGauge® allows you to set measurement tolerances (both upper and lower limits)

Powerful and Intuitive Counting & Sizing Tool for Image Analysis

- Use VisionGauge’s® powerful “Counting & Sizing” tool to analyze particles, grains, cells and other discrete objects. You can separate the objects from the image background based on either red, green or blue channel values as well as luminance, intensity, hue or saturation values. You can also set limits on the object area. Results include the number of objects, the minimum, maximum, average and median object areas, as well as the object distribution curve



- You can define a region of interest for carrying out counting and sizing operations. This allows you to limit the Counting & Sizing tool's scope to a user-selected portion of the image rather than the entire image. You can either enter the limits of the region of interest manually or you can “draw” them directly on the image
- Obtain information about individual objects (i.e. area, equivalent diameter, perimeter, x and y axis projections, etc...) simply by clicking on them
- You can remove one or more objects from the sample by clicking on the Counting & Sizing window's “Remove” button and then clicking on the objects that you want to remove from the sample. The image of the objects, as well as the Counting & Sizing window's results are automatically updated. You can also un-remove all previously removed objects
- You can set the Counting & Sizing tool to disregard objects that touch the region of interest's borders (i.e. top, bottom, left and right)
- You can select the colors used to draw all of the objects in the sample, as well as the color used to draw individually-selected objects



Measurement Statistics

Measurement Statistics [X]

File Help

Clear:

6:	0.0234
5:	0.0233
4:	0.0233
3:	0.0233

Num.:

Min.:

Max.:

Mean:

Median:

Variance:

Std. dev.:

Specification limits

Upper:

Lower:

Process capability

Cp:

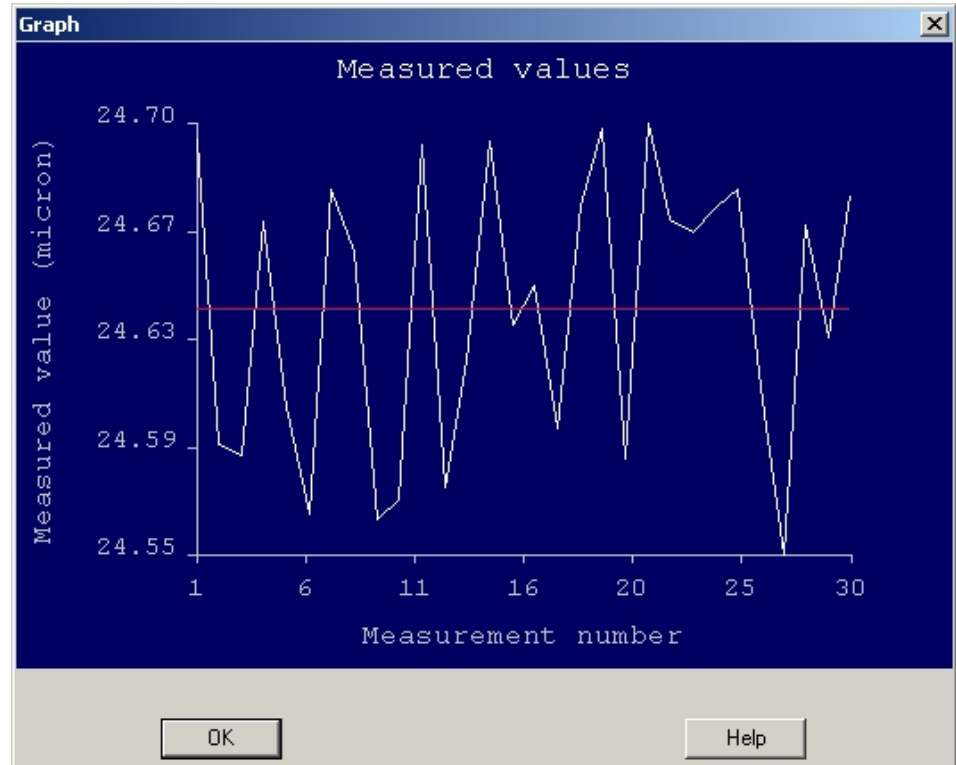
Cpk (+):

Cpk (-):

Automatically compute statistics (e.g. minimum, maximum, mean, median, variance, standard deviation, etc...) of measured values. Also compute process capability statistics (i.e. C_p and C_{pk}) based on operator-specified upper and lower limits

Save statistics to disk file or output them to the printer

Easily send measurement statistics to other applications such as Excel or Access.



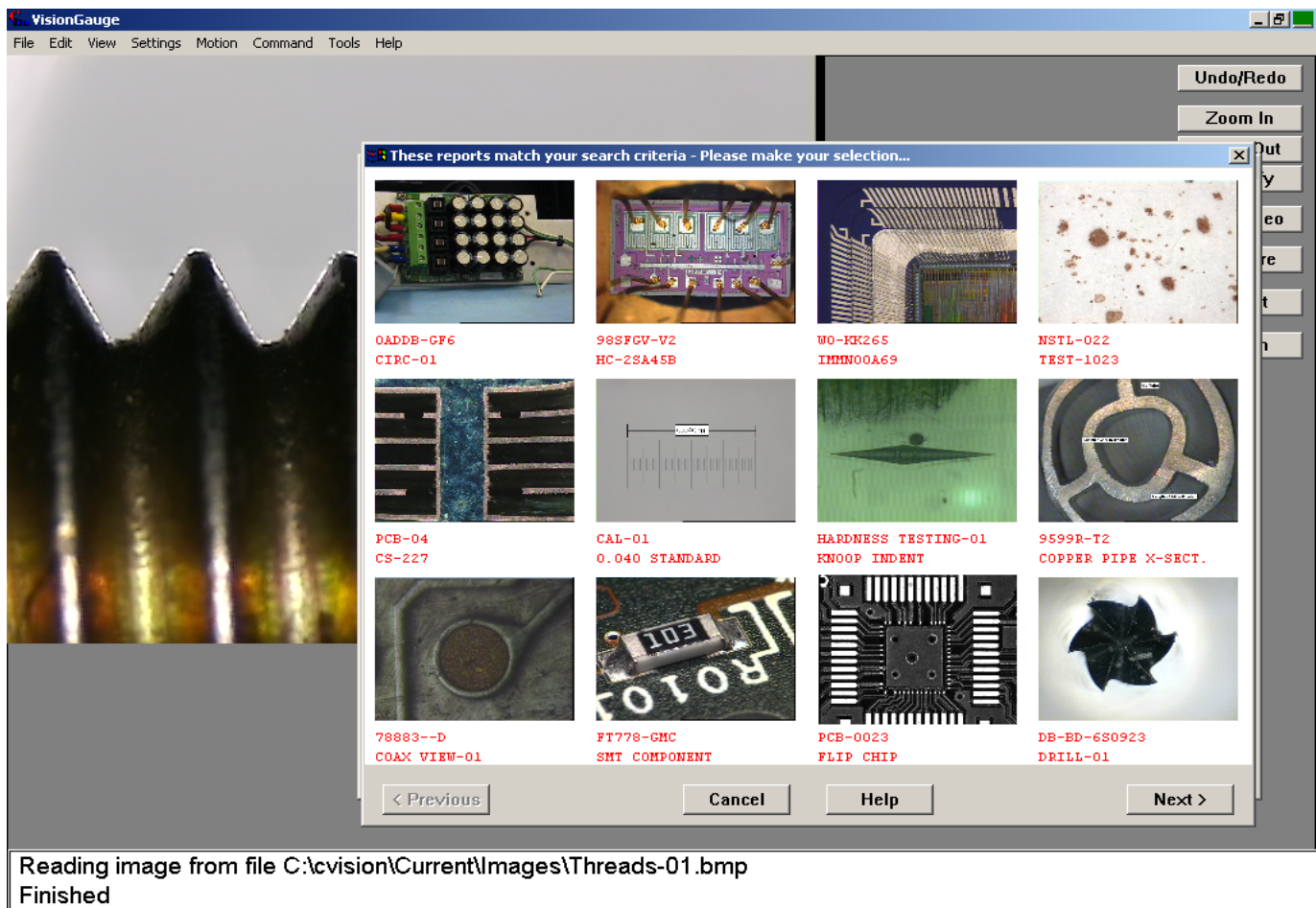
VisionGauge's® "Statistics Toolbox" also allows you to draw charts of all the measurements in a sample, as well as the sample mean.

Advanced Edge-Detection Technology

- VisionGauge® has advanced edge-detection technology that produces sub-pixel accurate measurements and increases measurement repeatability
- Powerful edge-detection based "Snap-to-Edges" cursor positioning tool eliminates operator-dependant measurement error

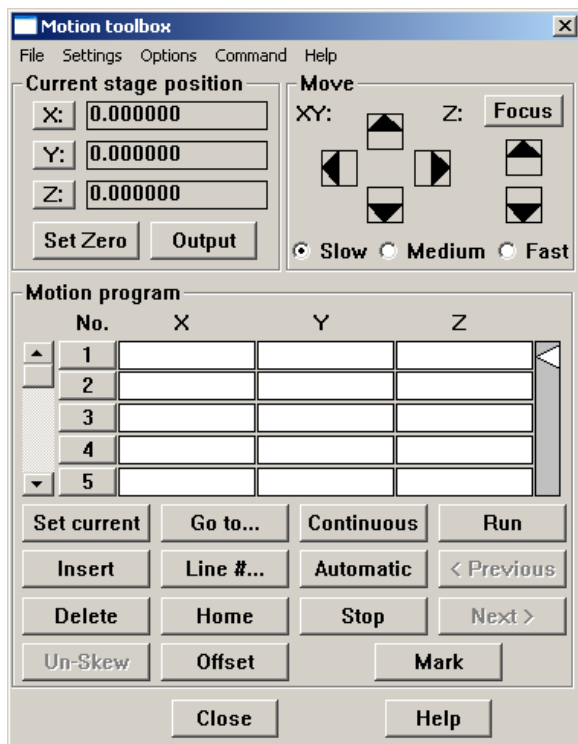
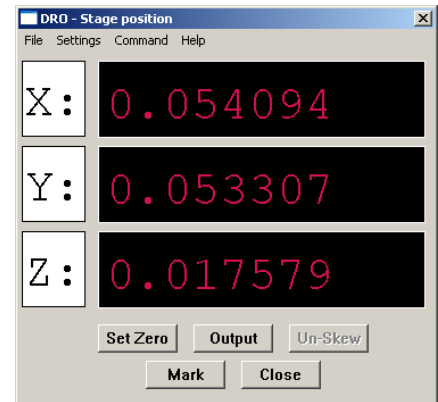
Report Generation and Databasing: Easily Collect Images & Related Data

- ▶ VisionGauge® has a fully integrated report generator and database with customizable fields. With it, you can easily produce illustrated inspection reports that can be:
 - Output to the printer
 - Archived in a database
 - Saved to disk
 - Transmitted electronically
- ▶ Report data and images can be saved to the database for retrieval and modification later on. Use the thumbnail image preview to retrieve the images and report data from the database
- ▶ You can also use VisionGauge's® database search tools to call up all of the reports in VisionGauge's® report database that contain a specific search string (eg: a date, an evocative keyword, a specialized term, etc...). Searches can either be case-sensitive or not
- ▶ VisionGauge's® report generator allows you to load in different "Report Configuration Files" at runtime, allowing you to work with multiple report templates and multiple databases
- ▶ Reports can be saved as standalone disk files using the standard RTF interchange format. These files can then be transmitted over the Internet and read into other word-processing applications
- ▶ Report data can easily be read into another application (e.g. spreadsheet) for further analysis
- ▶ All measurement functions are fully integrated with the report generator: measured values are automatically inserted into the appropriate fields in the report and saved along with the image and other report data in the database



Fully-Automated High-Accuracy Stage-Based Measurements and Auto-Reporting

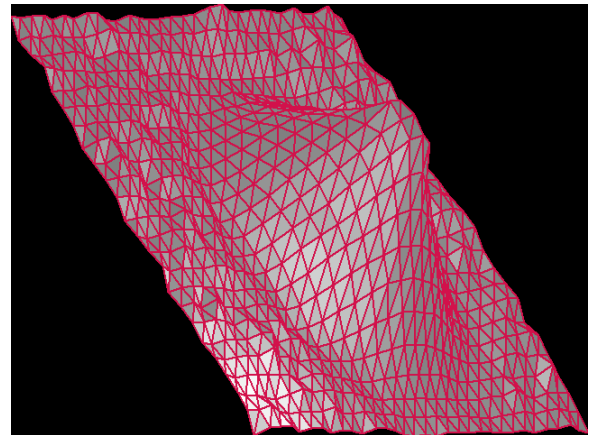
- ▢ High-precision, fully-automated measurements beyond the optical field of view
- ▢ VisionGauge's® Digital Read-Out (DRO) can be displayed in either regular or large format (with an appearance similar to traditional DRO boxes)
- ▢ All of the relevant commands that you will need to build and run part programs are conveniently grouped in VisionGauge's® intuitive Motion Toolbox
- ▢ Compensate for stage imprecisions on all 3 axes using either Linear Error Correction (LEC) or Non-Linear Error Correction (NLEC). The stage calibrations can also be password-protected
- ▢ VisionGauge® is compatible with both single-ended and differential encoders
- ▢ VisionGauge® also supports serial-port devices, such as micrometer heads, height gauges, dial indicators, etc... VisionGauge® can read in the stage position for any and all of the 3 axes through such serial-port data sources



- ▢ Wide measurement toolset support for measurements beyond the optical field of view
- ▢ "Zero out" individual axes or all three axes at once
- ▢ Output the current stage coordinates to an external ASCII data file
- ▢ While you are moving the stage and carrying out measurement, the "Measurement Objects" window sketches out the various measurement points and geometric constructions so that you can quickly see "where you are" in regard to the other measurement points and objects
- ▢ Use the Focus Meter to achieve the highest possible Z-axis measurement accuracy
- ▢ VisionGauge's® powerful "Edge Tracker" automatically locates edges and lets you carry out sub-pixel accurate measurements beyond the optical field of view
- ▢ VisionGauge's® easy-to-use Skew function allows you to adjust – or "correct" – both motion programs and measurements for a part's skew
- ▢ Programmable stage movement in both 2- and 3-axis
- ▢ Compatible with many full-, half- and micro-step motion controllers
- ▢ Able to operate in both open- or closed-loop mode
- ▢ On-screen "3-speed joystick" arrows for motion in all 3 axes
- ▢ VisionGauge® supports external 3-axis, 3-speed joysticks. Users can also adjust the joystick's settings (i.e. sensitivity, thresholds, etc...) directly from within VisionGauge®. The joystick can also be re-calibrated from within VisionGauge®
- ▢ Simple and intuitive interface to set motion control parameters (i.e. velocities, accelerations, etc...). Advanced users can also fine-tune motion parameters with the "Advanced" settings
- ▢ User-selectable "motion convergence criteria"
- ▢ "Goto" and "Line No." commands for quick absolute displacements
- ▢ Built-in "Emergency Stop"
- ▢ Use the simple and intuitive "teach" mode to quickly and easily set-up a motion program
- ▢ The "Teach Mode" within the Motion Toolbox allows you to add instructions within a motion program to automatically change the measurement mode, region of interest, illumination settings, zoom and focus settings, etc.... Furthermore, all of the commands associated with a part program are saved to disk along with the program's coordinate data and can thus be recalled for later use
- ▢ It is easy to edit motion program, as well as change, add and remove points

Fully-Automated High-Accuracy Stage-Based Measurements and Auto-Reporting (continued)

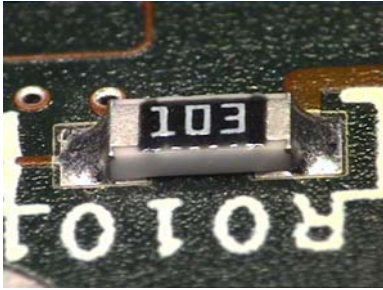
- ▶ ☐ There are no limits on the size of motion programs
- ▶ ☐ Save motion programs to disk and reload them in VisionGauge® later on
- ▶ ☐ Use the “Continuous Run” mode for continuous, unassisted stage movement with a user-set delay at each point
- ▶ ☐ In “Automatic” mode, VisionGauge® runs through the entire motion program (i.e. goes to every point) and carries out all of the measurements specified by the user – to sub-pixel accuracy – automatically, using VisionGauge’s® powerful “Edge Tracker”
- ▶ ☐ Users can set the number of iterations to carry out in both the “Continuous” and “Automatic” modes
- ▶ ☐ Built-in adjustable Autofocus
- ▶ ☐ Jog (i.e. joystick) velocities can be linked to the system’s optical magnification (because it is generally preferable to have slower movements at high magnification and faster movements at low magnification)
- ▶ ☐ VisionGauge® has the ability to read in generic ASCII data files containing raw coordinate data. This data can then be used to create full motion programs in VisionGauge®
- ▶ ☐ Users can add comments within a motion program. This feature allows you to instruct VisionGauge® to display a user-defined text message when an automated measurement program reaches a certain point.
- ▶ ☐ VisionGauge’s® powerful and easy-to-use “Offset” tool allows you to create and edit motion programs when your part has many identical devices. Using the “Offset” tool, you can take the definition of a device (including all of the related motion program data) and make multiple copies of it at specific (X,Y,Z) offsets
- ▶ ☐ VisionGauge’s® Fully Automated High Accuracy Volume Measurement Tool produces a numerical value of the measured volume, as well as 3D surface plots, which can be viewed from any perspective and rotated along all 3 axes
- ▶ ☐ The Fully Automated High Accuracy Volume Measurement Tool also has some options which you can use to define areas that you want VisionGauge® to ignore for volume calculations. A “limiter” control also exists, which can be used to automatically disregard areas where the edges are very weak (relative to all of the other edges across the entire image)
- ▶ ☐ Automatically create measurement reports that allow you to easily collect, manage and analyze the results of fully-automated measurement programs



This image was obtained using VisionGauge’s® Fully Automated High Accuracy Volume Measurement Tool. It represents a 3D plot with illumination of the computed surface of an object

Measurement report					
File Options Command Help					
No.	Label	Measured value	Lower limit	Upper limit	Pass / Fail
1	Diameter #1	0.0120	0.0115	0.0125	Pass <input checked="" type="checkbox"/>
2	Line width #1	0.0117	0.0115	0.0125	Pass <input checked="" type="checkbox"/>
3	Center-to-center #1	0.0697	0.0690	0.0720	Pass <input checked="" type="checkbox"/>
4	Diameter #2	0.0120	0.0115	0.0125	Pass <input checked="" type="checkbox"/>
5	Line width #2	0.0117	0.0115	0.0125	Pass <input checked="" type="checkbox"/>
6	Center-to-center #2	0.0697	0.0690	0.0720	Pass <input checked="" type="checkbox"/>
7					<input type="checkbox"/>
8					<input type="checkbox"/>
9					<input type="checkbox"/>
10					<input type="checkbox"/>

Send and Exchange Data Effortlessly With Other Applications



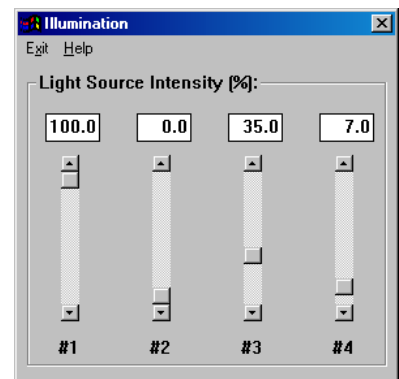
VisionGauge® fully supports Dynamic Data Exchange (DDE), allowing you to transfer data (measurements, statistics, results of counting & sizing operations, etc...) automatically into other DDE-compliant applications such as Microsoft Excel and Access. With a DDE link, two applications communicate with each other, exchange data effortlessly and work together seamlessly as one.

Support for Motorized Zoom and/or Focus, Computer-Controlled Illumination, etc...

- ▶ Support for computer-controlled motorized zoom and/or focus with user-selectable velocity

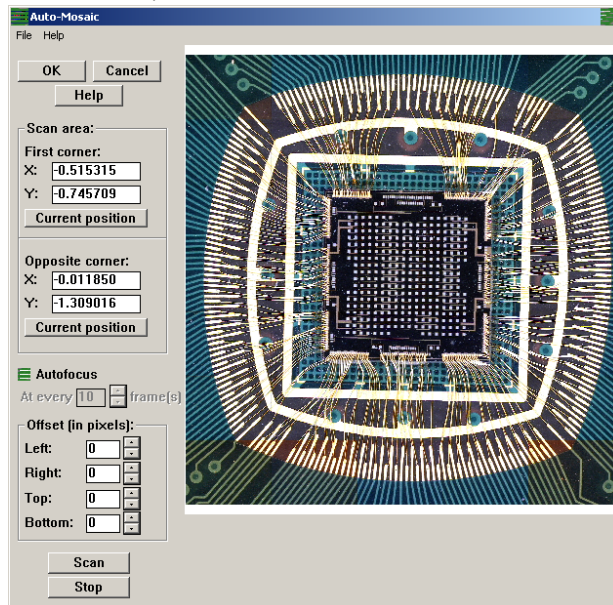


- ▶ Support for computer-controlled illumination (using up to four light sources)



Powerful & Easy-To-Use Auto-Mosaic Tool

- ▶ VisionGauge's® "Auto-Mosaic" tool allows you to automatically build a very high-resolution image of areas that are larger than your system's optical field-of-view, by automatically "stitching" together images of side-by-side views.
- ▶ VisionGauge's® "Auto-Mosaic" Tool can also be instructed to periodically refocus the image or ignore a certain numbers of rows and columns of pixels on each of the different borders of each field-of-view (to compensate for uneven illumination, for example).



Updates and Support

- ▶ We are continuously working to improve and enhance VisionGauge®. Incremental updates, containing new features and enhancements are produced regularly (typically once or twice a month).
- ▶ Every new license of VisionGauge® includes a full-year membership to the VisionGauge® **Annual Support and Update Program**, which entitles you to receive free updates for a full year as well as unlimited support by phone, fax and email.
- ▶ Members of the VisionGauge® **Annual Support and Update Program** can also subscribe to the VisionGauge® Users Newsletter to automatically be notified when new updates of VisionGauge® become available, and to receive other useful information.