

# iNspect™ Express

## Software User's Manual

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iNspecT Express Software User's Manual

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# Preface

## About This Manual

This manual describes the iNspec™ Express software, supported by the BOA Vision System, Multi-camera Vision Systems, or a PC. Some features in this manual do not apply to all platforms, or to all versions of the BOA (mono vs. color). This manual is an introduction to the menus and most features of the iNspec Express software. More detail can be found in the online Help.

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# The iInspect Express Application

## Installation

**BOA:** The iInspect Express software is already installed and licensed on the BOA Vision System. Use any Web Browser to access the BOA home page and download and install the Nexus for BOA application.

**Emulator for BOA:** The emulator software comes in a software download file on the Teledyne DALSA website (Support/downloads center/Vision software). Refer to the document “BOA Software Emulator Installation Guide” in the software download. The version of the Emulator and BOA Firmware must match.

**Multi-camera Vision System:** The iInspect Express software is installed and licensed on your Vision System before it ships from Teledyne Imaging. If you need to upgrade the version, use the Windows uninstall utility (from the Control panel) to uninstall the old version before installing a newer version. The User Data Files directories and contents are not deleted when you uninstall iInspect Express.

**PC:** You need a dongle or system license from Teledyne Imaging to acquire images from the Genie cameras. You need to install 3 software applications from the software download file: Sentinel, iInspect Express and GenICamSetup. GenICamSetup is the acquisition driver for the Genie GigE cameras. **Note:** The Emulator or Demo mode does not require a license.

## Creating an Inspection Solution

### 1. Launch iInspect Express

#### A. For the BOA Vision System

There are **3 ways** to connect to the BOA and start iInspect Express on the client PC.

- Using the Nexus application downloaded from the BOA web server page or installed with the Emulator.
- Using “Connect to BOA Camera” in the Start menu if the Emulator for BOA Spot software was installed.
- Using a command line instruction,

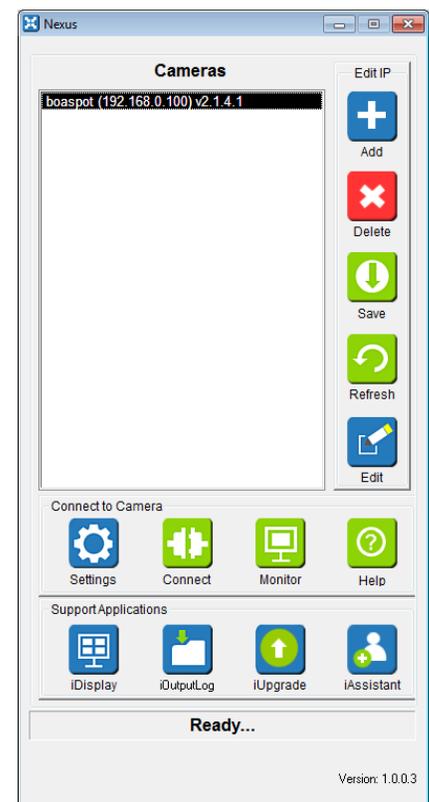
#### Using Nexus for BOA

- On the PC, open the “Nexus for BOA” application. Wait for the BOA to be discovered.

Most buttons are grayed out during the discovery process and while Nexus retrieves information on the BOA firmware version.

- Click on a BOA in the “Cameras” list, and then click the “Connect” button  to launch the iInspect Client application.

Please refer to the ***BOA Installation Manual*** for details on the Nexus application's options and controls. You can download a copy of the Installation Manual from the BOA home page using any web browser.



## B. For the Vision System or PC

a. Use a Start menu shortcut, or a desktop icon to launch the “iNspect Express Configurator” if you have not already done so (Shown below).

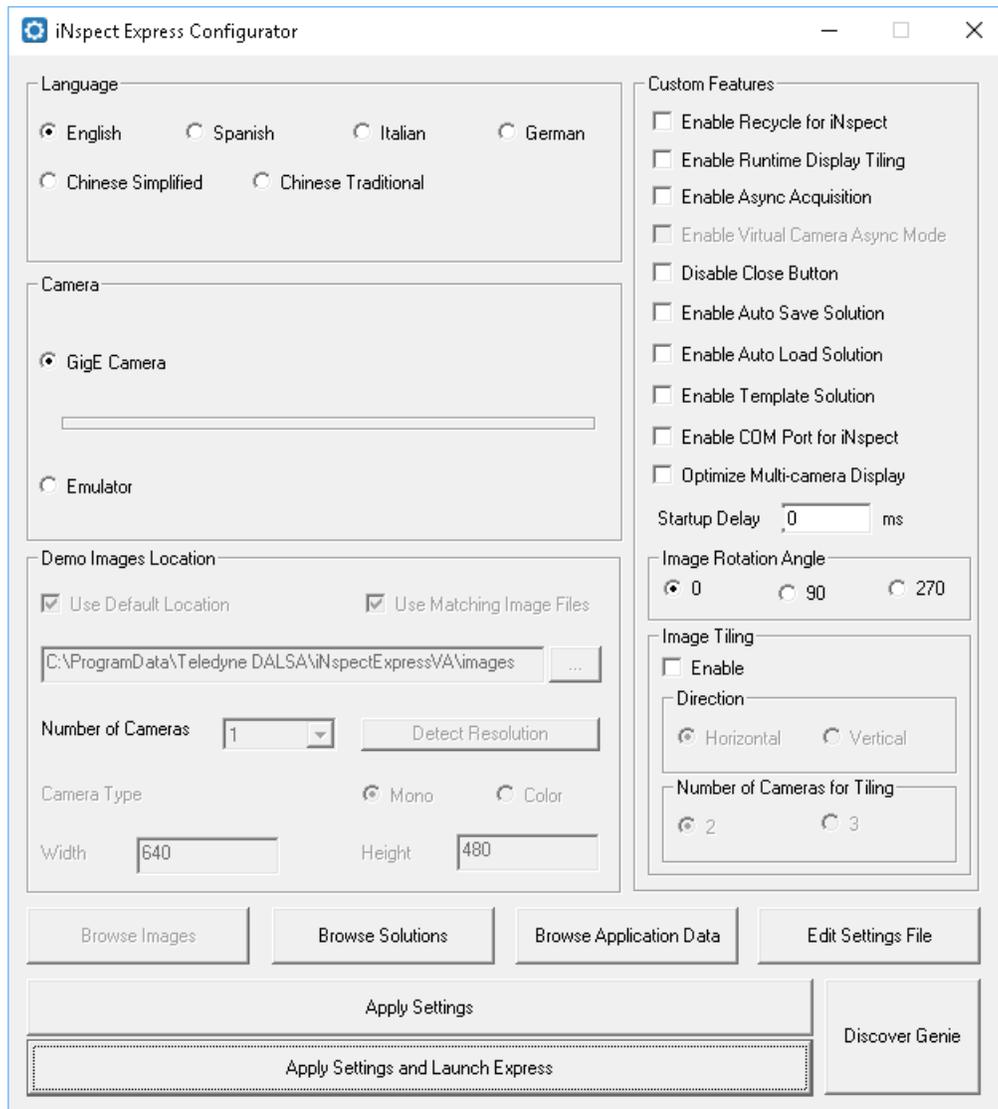
Start→Programs→Teledyne DALSA→iNspect Express for VA→iNspect Express Configurator

b. Select the Emulator or GigE Camera.

c. If using a GigE camera, click the “Discover Genie” button to configure the camera IP Addresses or order. Save the camera list and Close iDiscover.

d. Click the “Apply Settings and Launch Express” or use a Start menu shortcut, or a desktop icon to launch the iNspect Express application.

e. The iNspect Express application window will open.

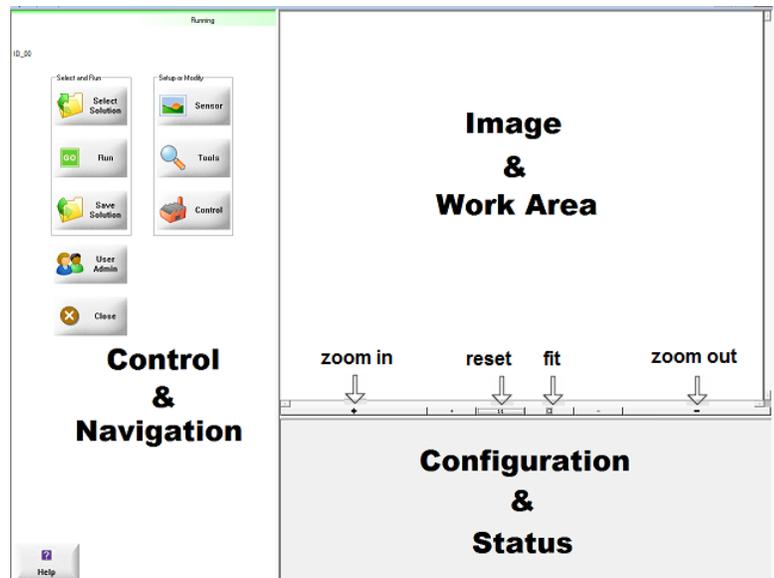


All options on this menu are covered later in this manual, on page [133](#).

## Introducing the iInspect Express GUI

The interface has three “panes” or “panels.” The left panel is for Control and Navigation, with the Action Buttons. The right panel is the Work Area, where you draw your tools on the displayed camera image. The bottom panel is for Configuration and Status. These panels are always present in the application window, but most of the following figures show only one panel.

If the BOA is currently running and inspecting, the application will open to the “Run” or “Monitor” panel, pictured on page [127](#). You can click the “Ok” button to return to the main panel.



The **Close** button closes the iInspect Client Application on the PC.

- The **BOA** continues running and inspecting. Only the Client interface is closed.
- The **GEVA series** or **PC** stops inspecting when you click “close”.

The **Help** button gives help information on the options in the current Navigation and Control panel. You can also navigate Help using hyperlinks, the *Table of Contents*, *Index*, or *Search* tabs.

The **Ok** button exits the current panel and goes back or up one level (does not appear in the main panel).

**Note:** The Graphic elements do not change size as you zoom in or out in the Image area. ROI shapes get larger or smaller, but the lines do not get thicker or thinner. Labels do not get larger or smaller.

### A Best Practice Suggestion

- Perform Calibration first (page [13](#)) before defining any tools. **If you perform calibration after defining tools, all tools will be deleted.** You can add Scale calibration after defining measurements. **NOTE:** An exception to this rule is when you are performing a 4-point calibration. Define just the tools that find your points. Then return to the Calibration setup. When you select 4-point calibration, your points will appear.
- Create just the tools that will be used for your Locator(s).
- Define the Locator or Locators (page [25](#)). There are examples of using the Locator starting on page [136](#), and in the on-line help.
- If you are using X,Y coordinates (for positioning or robot guidance) place the Axis Origin (page [26](#)).
- Create the rest of your measurement tools. Attach them to the locator (or locators).

## 2. Start Creating a Solution

- a. Click on the “Select Solution” button, in the Control and Navigation panel. The Configuration and Status panel shows new controls for selecting an existing Solution file or starting a new Solution.
- b. Click the “Start New Solution” button.

If you had an existing Solution running, this action would clear or overwrite it. The software will clear any running Solution and initialize iInspect to the default settings. The Camera Address, Trigger, and Exposure settings are not changed.



Up to 150 Solutions may be stored in the BOA memory. The actual number of Solutions you are able to store depends on the image size and complexity of the Solution (number of measurements, scripting, communications, etc.). You can export and import Solution files to the Client PC.

On a PC or Vision Appliance, Solution files are stored on the system hard drive under User Application Data. There is a shortcut to this directory. You can export and import additional Solution files in other directories or on a Network resource.

In the “Setup or Modify” area on the Navigation panel, only the Sensor button is active after “Start New Solution”. This step must be completed before any of the other Setup buttons can be accessed. If you had loaded a previously saved Solution, all of the buttons would be active.

**Note:** The camera type (Mono/Color) and Resolution (image size) are saved in the Solution file. The Solution file will not load if the attached camera(s) do not match. For multiple-camera Vision Systems the number of cameras is also saved, and must match for the Solution to load.

**IMPORTANT:** Editing Scripts and measurement Tools changes the running mode and disables solution switching. In some cases, editing scripts can interrupt normal communications with PLCs and peripherals. Save your Solution and then re-load it if you encounter problems. Loading a Solution resets the run mode unless you have selected the “Load for Edit/Disable Switching” option.

## 3. Set Up the Sensor

- a. Click on the “Sensor” button to access the Setup Sensor panel.

The Control and Navigation panel changes to show the Sensor Setup panel. Here you can set up the trigger and the sensor image settings. If you are using a conveyer or other moving parts, set up the trigger delay, exposure and brightness with moving parts.

Note: Images that appear dark to the human eye still contain all image edge information.

- b. Complete the Sensor Setup, then click “Ok” to return to the main panel. With the Sensor Setup completed, the “Tools” button is now active.

The screenshot shows the 'Setup Sensor' panel for a TELEDYNE DALSA camera. The panel includes a 'Camera View' section with a 'White Balance' button and a 'Demo Images Location' field. Below this is the 'Trigger Source' section with radio buttons for 'Internal Timer', 'Inspection Trigger', and 'Software Trigger', and a slider for the 'Internal Timer' set to 100 ms. The 'Inspection Trigger Delay' section has a checkbox and a slider set to 1 ms. The 'Strobe/Output Pulse' section has checkboxes and sliders for 'Duration' (1.0 ms) and 'Offset' (1 us). The 'Sensor Exposure' section has a slider set to 9.0 ms. The 'Brightness' and 'Contrast' sections have sliders set to 20% and 50% respectively. At the bottom, there is a 'Setup Calibration' button, a 'Help' button, and an 'Ok' button.

Callouts from the right side of the image point to specific features:

- A pull-down appears for selecting the current or active camera on a multi-camera Vision Appliance or PC.
- Perform a White Balance on a Color Camera.
- Location of the image files in Emulator or Demo mode.
- Select what causes the camera to snap an image:
  - Internal Timer - the slider sets the time between images.
  - Inspection Trigger - an external signal from a photosensor or a relay controls the image capture.
  - Software Trigger - a software command or a script function.
- Click the box to enable the slider, to set a delay between when the object is under the trigger sensor and when the object is under the camera.
- Click the box to enable the sliders, to define a pulse output for controlling a light source.
- You can adjust these sensor settings to get the best image.
- Calibrate measurements to give "real-world" units: cm, mm, inch.
- Click "Ok" when you are finished, to exit this panel.

Once you have clicked on a slider, you can also use your keyboard arrow keys to move the slider.

### Using the White Balance

This button is available only when using a Color camera. White Balance allows you to "color correct" the camera for changes in lighting or camera sensor temperature. Click the "Set White Balance" button and draw a rectangle on a white area in the image. You should use an area that is colored white. You should not use an area that is overexposed.

### Using the Internal Timer

If you are using the internal timer, and processing a complex application, you may need to increase the Trigger Source slider to avoid skipping parts. It is sometimes a good idea to start with a slow time during setup, say 100 ms, and then reduce it when the application is complete. First *save your Solution* with the internal timer set to the longer time interval, then go back and try adjusting the time to a smaller interval. Notice the Parts Skipped counter on the Monitor panel. If your time interval is too small, parts or images may be skipped. Remember to include a few bad parts, to see if your time increases significantly when the part or feature is not found, especially with the Match, 2D Codes, Barcode, and OCR Tools. You may want to change the timeouts in these tools. Note: Skipped parts are considered failures. A fail pulse is output.

### Using the External Trigger

If you are using a part-in-place sensor, and your part does not appear in the image area, you may need to use the Inspection Trigger Delay to compensate for any small time-difference between when the part is under the part-in-place sensor and when the part is actually in front of the camera lens. If the image of a still part is clear

but the image of a moving part is blurry, you need to use the Sensor Exposure control to decrease the exposure time. This should sharpen the image quality.

### Using the Exposure Control

If the image of a still part is clear but the image of a moving part is blurry, use the Sensor Exposure control to decrease the exposure time. This should sharpen the image quality.

The **Sensor Exposure** setting indicates the approximate exposure time. The slider range changes to match the programmable range of the camera. For fast moving parts, you must have a very low exposure time, and a very bright light source.

The time between external triggers (trigger rate), or the internal timer setting (frame rate), must be larger than the Exposure Time plus the Image Acquire Time (frame time) plus the Trigger Delay. The Exposure setting will override the Internal Timer setting, if this condition is not met.

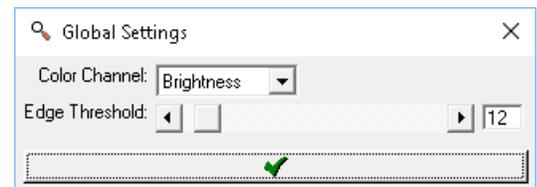
$$(\text{Trigger Rate or Internal Timer}) > (\text{exposure} + \text{frame time} + \text{trigger delay})$$

### Displaying Edges and Improving the Image

Many tools depend on finding edges in the image. It may be useful to display all edges as a check on the quality of lighting and exposure. The edges cannot be displayed in the Setup Sensor panel because the image is "live". You must go to the Setup Tools panel.

- a. In the Sensor Setup panel, click "Ok" to return to the main panel.
- b. In the main panel, click "Tools" to go to the Setup Tools panel.
- c. Click on "Take a Picture" or "Snap Triggered" to take a still picture.
- e. Move your cursor into the image area, and right-click on the image (not on a tool).

All the edges are displayed in the image area, and the "Global Settings" box opens. Changing the Edge Threshold should be your last resort. Decreasing the Edge Threshold also increases processing time.



**NOTE:** The image in the Setup Tools panel is a "still picture" You will not see changes in this image. You must go back to the Setup Sensor panel to see an interactive or live image.

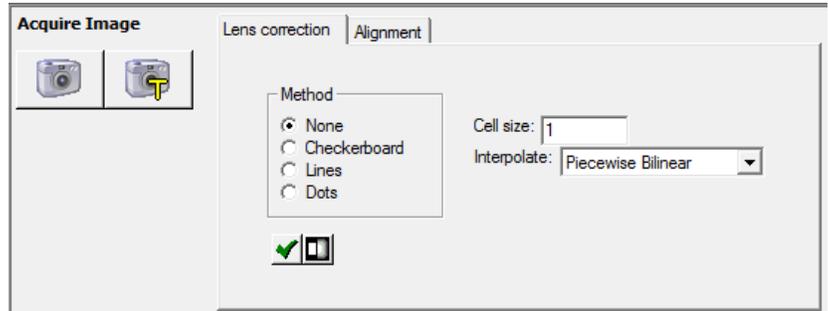
- Adjust the lighting, focus and iris (lens opening), to sharpen the image or improve the contrast.
- Adjust the Exposure time, Contrast and Brightness in the Setup Sensor panel to sharpen the image.
- Decrease the Edge Threshold only as a last resort. **NOTE:** Decreasing Edge Threshold also increases processing time, which makes the inspection run slower.

## Using the Calibration Tools

Calibration is an option, not a requirement.

**NOTE:** The Setup Calibration panel works with a frozen snapshot image. Click on the “Take a Picture” or “Snap Triggered” button to snap a new image. If you need to adjust the focus, click on the “Back to Sensor Setup” button in the Navigation panel, to get a live image. **Note:** Lens correction is performed first then Alignment if both are used.

**Lens Correction** corrects for perspective distortion caused by camera angle or lens distortion. You can perform a Lens Correction and an Alignment together. Lens correction is applied to images before Alignment.



## Performing a Lens Correction

- Place a grid of dots or lines, or a checkerboard of alternating black and white squares, in front of the camera, at the same distance where your inspection parts will be
- Click on “Take a Picture” or “Snap Triggered” to get a new image.
- Add preprocessing only if needed. Take a new picture to show the effect of preprocessing.
- Click on the radio button beside the correct target type.

**Checkerboard** – alternating dark and light squares (no rectangles),

**Lines** - a grid of lines that define squares.

**Dots** - a grid of circular dots that define squares.

- Enter the cell size if desired. **Optional!** Distance measurements will be affected by the cell size.
- Select an interpolation method:

Piecewise Bilinear corrects for localized distortion and perspective distortion by calculating and remapping each square of the grid. This takes more time to perform the calibration but is considered more accurate.

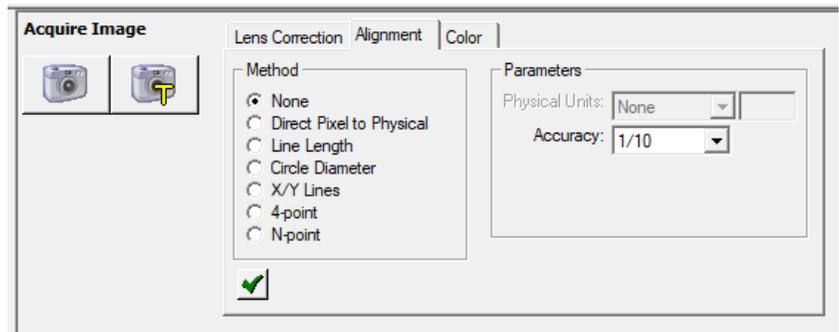
Piecewise Perspective corrects for local distortion by remapping each square of the grid. This method does not correct for perspective distortions. This takes less time than Piecewise Perspective and is slightly less accurate.

Radial corrects for radial distortion only. Does not correct for perspective distortion.

Perspective corrects for perspective distortion only. This is the fastest method because it performs less calculations.

- Click the “Perform Calibration” button to apply your scale changes. Wait for the software to detect the grid and draw a grid of lines on the image.
- When finished, click the “Back to Sensor Setup” button in the Control & Navigation panel.

**Alignment** changes the numbers and units reported. It does not change the image or pixel values. If you do **not** use calibration or scale, measurements are reported in pixels. If you perform calibration, measurements are reported in real units: cm, mm, or inches.



If you wish to only change numbers, you can use the Scale button  in any length or distance measurement. The Scale button does not add or remove the Units displayed.

### Performing an Alignment

- Place your known good object in front of the camera.
- Click on “Take a Picture” or “Snap Triggered” to get a new image.
- Click on the radio button beside the correct Calibration “Method”. Adjust the size of any lines or circles that appear in the image. The number of “Parameters” entry fields changes with the choice of Method.
- Select the Physical Units you want to see in the image display.
- Next to “Accuracy” select the number of decimal places you want displayed and reported.
- Enter the scale multipliers required for your Calibration Type if applicable.
- Click the “Perform Calibration” button to apply your scale changes. For the 4-point option wait for the software to draw a large rectangle connecting the 4 points.
- When finished, click the “Back to Sensor Setup” button in the Control & Navigation panel.

### Alignment Calibration Methods

**None** - No change to scale, no units displayed. Numbers are reported are associated with pixels as units.

**Direct Pixel to Physical** - Enter X and Y (horizontal and vertical) scale multipliers and select a Physical Unit and Accuracy.

**Line Length** - A line appears in the image area. Resize this line using the handles at each end. Place the line on a reference object or target. Enter the length or size of the target and select a Physical unit and Accuracy. The same scale or multiplier is applied horizontally and vertically.

**Circle Diameter** - A large circle appears in the image area. Resize this circle using the two handles. Place this circle on a reference object or target. Enter the diameter of the circle or target and select a Physical unit and Accuracy. The same scale or multiplier is applied horizontally and vertically.

**XY Lines** - Two lines appear in the image area, one horizontal and one vertical. Resize the two lines, using handles at each end. Place each line on a reference object or target. Enter the length or size of each target. Select a Physical unit and Accuracy.

**4-point** - Drag the four points that appear in the image, to the four corners of a rectangle or square object that shows perspective distortion. Or drag the four points onto active points you have created with tools. You can zoom in or out to help refine your placement. Click “Perform Calibration” and wait for the software to draw a rectangle with corners on the four points. **Note:** Initially the four points appear at the outer corners of the image area. If your image is larger than the current viewable area, you must zoom out to see the four points.

**N-points** – Left click in the image to create a point. Right-click on the point to display a coordinate edit menu. Enter “world” coordinates for the point. The image does not change when you click “Perform Calibration”.

### Performing a Color Calibration

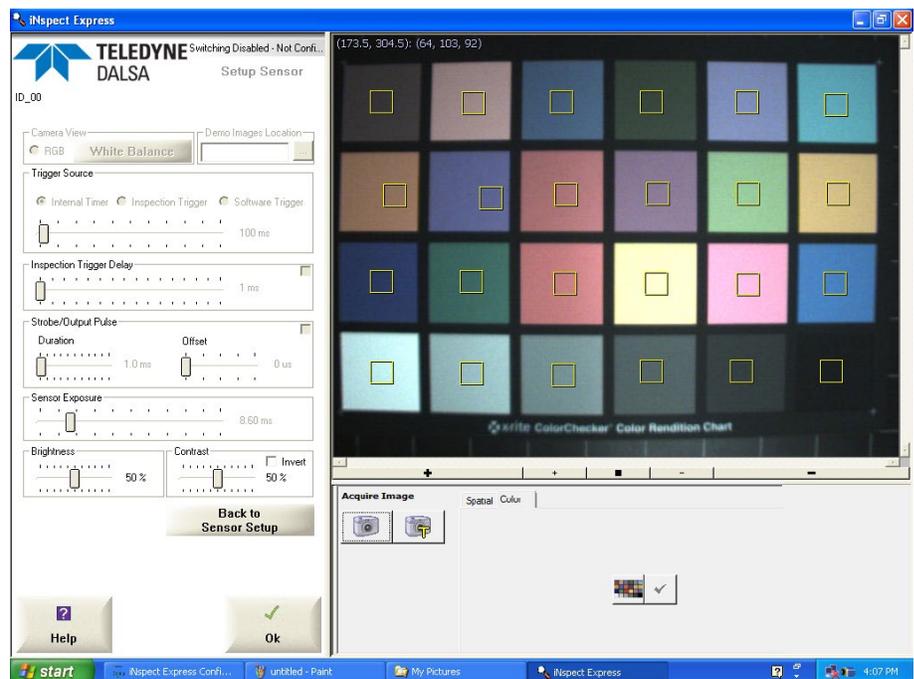
A Color Calibration calculates and changes the gain values in the displayed image. Color calibration changes the image pixel values. The resulting calibrated image may appear odd to you. The goal is not to calibrate the displayed image. The goal is to calibrate the camera's measured response to the current lighting conditions.

1. Place a Standard "ColorChecker" Chart in front of the camera using the same lighting conditions you will use later in your inspection.



2. Click on "Take a Picture" or "Snap Triggered" to get a new image. **Note:** You may get a warning if the image is too bright (possibly over exposed). IF this occurs, go back to the Setup Sensor page and adjust the lighting or the camera (lens).

3. Click the "Detect Color Cells"  button. Wait for the software to detect the colors and draw rectangles in each colored square on the chart as shown here. If the image is good, you will see a yellow rectangle drawn near the center of each color tile. If the software does not draw a rectangle in all 24 colors, repeat the first two steps or go back to the Setup Sensor page and adjust the camera lens or lighting.



4. Click the "Perform Calibration" button. Wait for the displayed colors to change. **Note:** The resulting calibrated colors may appear unusual on your display. Please remember this operation is calibrating the software response to the camera and lighting; not the display.
5. When finished, click the "Back to Sensor Setup" button in the Navigation panel.

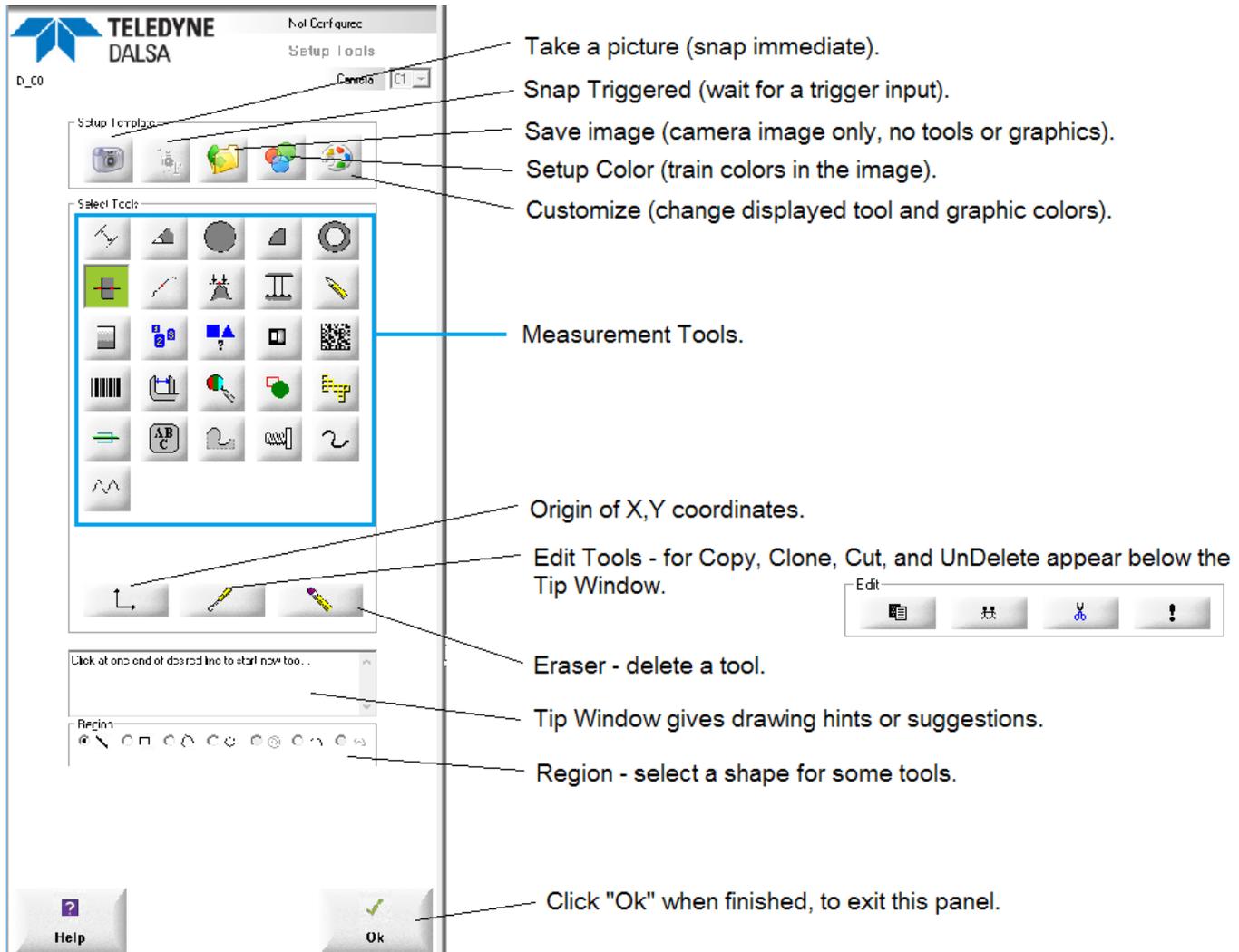
## 4. Set Up Measurements

a. In the main panel, click on the "Tools" button.

Setting up an inspection involves the following steps:

1. Define (acquire, snap) a template image (reference image of the part to be inspected).
2. Train the Color Map if you are using a color sensor.
3. Add a Locator if the part moves within the image area.
4. Apply vision tools and set up associated pass/fail tolerances.
5. Repeat these steps for each camera, on a multiple camera Vision Appliance or PC.
6. Exit the Tools panel and set up communications.

**Note:** You can also define scripts to further customize your application, in the Setup Control panel.



### **Define a Template Image**

Make sure a good (or perfect) part or assembly is in front of the camera, in the location where your inspection parts will appear; or a series of good parts moving past the camera.

b. Click on the “Take a picture” button (top left) to acquire a reference or template image. If using an external trigger click “Snap Triggered”.

You will use this Template image to set up your measurements and tolerances. If you change the lighting or exposure you must take a new picture.

### **Train the Color Map**

If you are using a color image sensor, you will need to train a color map that defines colors of interest for your inspection. Your trained colors are saved in the Solution file.

c. Click on the “Setup Color” button. “Train the Color Map” starting on page [18](#) gives step by step instructions on training colors to create a color map.

### **Add a Locator**

The **Locator** allows iNspect to track movement of the part in the image window and align or snap the measurements to the part in every position. Steps for using the Locator begin on page [25](#). You need to define one or two points or tools that define points, before you can define the locator. You can define multiple locators in each camera image.

**Repeat all steps for each camera in a multiple camera Solution (Vision System or PC).**

### **Apply Vision Tools**

d. Select a tool from the tool box and apply it to the template image. Use these drawing tools to draw your measurements in the image area.

In the case of a measurement tool such as “Distance”, simply click on two highlighted edges to form a measurement. For complex tools, such as barcode, construct a Region Of Interest (ROI) around the barcode according to the context sensitive instructions shown in the Tip Window. In some cases, the tool will automatically detect the feature of interest within the defined ROI. In some cases, you may have to adjust the tool settings to detect the code or feature of interest.

### **Using the Drawing Tools**

Pages [21](#) to [23](#) are subjects that apply to all measurement tools: Tolerance Settings, Relative Numbers, and Preprocessing.

Pages [27](#) through [108](#) give step by step instructions for drawing each tool, adjusting the properties, and Pass/Fail Tolerances.

### **Run the Solution**

After all your tools and settings are defined, the next step in setting up your inspection begins on page [123](#).

You should run the Solution to make sure your tools are behaving the way you expect. You should Save your Solution before you go back and edit it again.

### **Set Up Communication**

After all your tools and settings are defined, the next step in setting up your inspection begins on page [112](#), “Set Up Communication and Outputs”.

## Train the Color Map



The Setup Color panel allows you to define colors or teach “color classes“. Color classes represent “segmented colors“ in the image, on which some iInspect Express tools can be applied.

a. Click on the “Setup Color” button at the top of the “Setup Tools” panel.

The default (New Solution) list of “Classes“ has just the “Background” color. By default, all untrained color shades will fall into the “Background” class. You do not need to name and train all the colors that you see in the image. You need only name and train the colors you are looking for or interested in. You can also train or sample parts of the image to be included in the background.

b. When you are finished training color classes, click “Ok” to return to the Setup Tools panel.

The screenshot shows the 'Setup Color' panel in the TELEDYNE DALSA software. The panel is titled 'Not Configured Setup Color' and includes a 'Classer' list with 'Background' selected. A 'Create/Edit Class' dialog is open, showing a text input field with 'white', a 'Brush Size' selector, and a 'Color Sample' area. The 'Method' section is set to 'Learn by example (LBE)'. A 'Tip Window' is visible at the bottom left, and 'Help' and 'Ok' buttons are at the bottom.

- List of "color classes". Select a name to edit, train, or delete.
- Delete a color class name and data.
- Edit a color class name.
- Type a new name and click the check button.
- Select a "brush size" for sampling colors in the image window.
- Method is a read-only status.
- Tip Window.
- Save or Load a color classes definition file.
- Click "Ok" when finished, to exit this panel and return to the Setup Tools panel.

There are two different methods for specifying color supported by iInspect Express: “Learn by example” (LBE) and HSV (Hue Saturation and Value). This panel allows you to teach “LBE” colors. The file controls allow you to load a color definition that uses either LBE or HSV. The HSV or LBE color definitions are also saved in your Solution file. You cannot convert one method to the other.

The HSV definition is created and edited externally with a text editor. iInspect Express does not provide a way to create or edit HSV color definitions. When you load HSV color definitions, most of the controls in this panel are disabled. Method is provided as a “read only” status to indicate which type of color definition is currently in use. You cannot teach new colors to an HSV definition using iInspect Express.

**To add more color names**

- 1) Click the “plus” button (+). Type a color name in the text field.
- 2) Click on the green “check” button, to add this name to the list.

**To remove or delete a color name** (Color Class) and its trained data

- 1) Click on the color name in the “Classes” list.
- 2) Click on the “minus” button (-).

All colors associated with the deleted class become part of the “Background” class.

**To train a color** (Color Class)

- 1) Click on the color name in the “Classes” list.
- 2) Click on a button under “Brush Size” to select a larger or smaller sample area.
- 3) Click on an area in the image or hold down the left mouse button and drag across an area. This area is assigned to the highlighted color name (Color Class).
- 4) You can repeat training for a single color name (Color Class) to broaden the definition (increase the range) of color shades in a Color Class.

**NOTE:** The image window changes each time you train a color. The displayed image is partitioned (divided or segmented) into existing trained colors (Color Classes). There are no “untrained” colors or partitions displayed; all the areas in the displayed image are assigned to one of the trained partitions. **Hold down the right mouse button** (in the image area) to view the **original** color image.

The *displayed colors* in the image (with mouse buttons released) are the last sample trained for each Color Class. To change the displayed color, resample (select a Color Class, and train again) at the color shade you wish to see in the display. For example, if you started training “green” with the darkest green, and continued sampling at progressively lighter shades of green, the lighter shade would be shown on all of the green partition. Select the “green” class again and resample on the dark green. The darker shade is now displayed for the entire green partition.

**To train another color** (Color Class)

- 1) Click on the color name in the “Classes” list.
- 2) Move your cursor into the image area.
- 3) Hold down the right mouse button to see the original color image and move your cursor to an area of the image that matches the selected color name (Color Class).
- 4) Without moving the cursor, left-click on the image.

## Apply Vision Tools

a. Select a tool and draw your measurements in the image area. Some tools may not be available for your license or camera type. Pages [21](#) to [23](#) are subjects that apply to all measurement tools: Tolerance Settings, Relative Numbers, and Preprocessing.

Icon	Tool Name	Description
	Distance	Measure the distance between two edges or points. See page <a href="#">27</a> .
	Angle	Measure the angle between two edges. See page <a href="#">30</a> .
	Circle	Measure the diameter or circularity of a circle. See page <a href="#">32</a> .
	Arc	Measure the radius or circularity of an arc. See page <a href="#">34</a> .
	Concentric	Measure the on-center or wall thickness between two circles. See page <a href="#">37</a> .
	Edge Count	Find or count edge transitions. See page <a href="#">38</a> .
	Point	Detect an edge for position measurement or as a locator anchor. See page <a href="#">40</a> .
	Tip	Find an extremity or “tip” of an object or edge. See page <a href="#">42</a> .
	Rake	Measure multiple distances between two edges. See page <a href="#">44</a> .
	Pencil	Draw lines on edges or between other tools or objects. See page <a href="#">47</a> .
	Intensity	Calculate statistics or detect presence and absence. See page <a href="#">48</a> .
	Count	Count features or defects or locate a feature. See page <a href="#">49</a> .
	Match	Train and match features. See page <a href="#">53</a> .
	Preprocess	Apply a filter to enhance or accentuate features of interest. See page <a href="#">62</a> .
	2D Barcode	Read 2D Codes and Matrixes. See page <a href="#">62</a> .
	Barcode	Read linear barcodes, postal codes. See page <a href="#">70</a> .
	Caliper	Measure distances. Supports irregular shapes. See page <a href="#">81</a> .
	Color Meter	Measure properties of trained colors. See page <a href="#">84</a> .
	Graphics	Add text or shapes to label or highlight results or features. See page <a href="#">86</a> .
	Verify	Verify features. Trains on a series of good samples to learn acceptable variation. See page <a href="#">87</a> .
	Line	Fit a pencil line to a nearly straight edge using multiple points. See page <a href="#">90</a> .
	OCR	Train and read characters stamped printed or etched on a part. See page <a href="#">92</a> .
	OCV	Train characters and measure the quality of reproduction. <a href="#">97</a>
	Contour	Find flashing or burring along an edge. See page <a href="#">99</a> .
	Thread	Measure threads on a solid object. See page <a href="#">102</a> .
	Bead	Measure consistency of an applied material. See page <a href="#">105</a> .
	Spring	Measure repeating peaks or coils. See page <a href="#">108</a> .

## The Tool List

As you define measurement tools in the image area, the tools appear in the Tool List, in the Configuration and Status panel. You can right-click on a tool name to open the Properties edit menu for that tool. The columns and headings are explained in the on-line help. You can change the width of columns by dragging the dividing lines in the table header (the cursor does not change). A comments field has been added. These comments do not appear in other panels or screens.

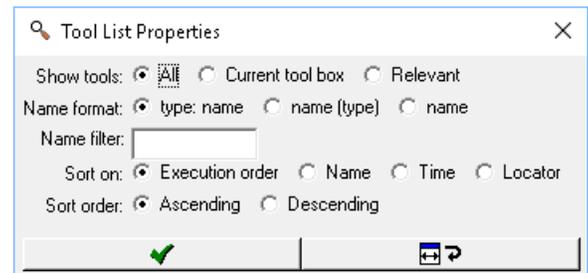
Tool							Min Rec...	Min Pass	Perfect	Max Pass	Max Re...	Comments		
[-] Match: M5	P1	x					1.844	100%	90	95	100%	100	100	Target1
Point: PP	P1	x					0.016							
[-] Count: N	A1	x					6.185	1	1	1	1	1	1	Target2
Point: PP1	A1	x					0.024							
Distance: L		1					0.089	187.7	182.7	183.7	187.7	191.7	192.7	
[-] Match: MS1							0.682	96%	86	91	96%	96	96	
Point: PP2		x					0.014							

Right-click on the heading "Tool" to open a Tool List Properties edit box that allows you to show and hide tools in the table and the Image Area. You can also sort how the tools are listed in the table.

**Current tool box:** show only tools of the currently selected tool type (and points they create). If the Distance tool is selected show all Distance tools.

**Relevant:** show the currently selected tool type, and tools that are related. For example, any points used to define these tools, and Locator points that position these tools.

**Name format** is how tool names appear in the Tool List.



**Name filter** show only tools that match the text field. This field is case-sensitive. For example, a small "c" will not show any tools (type: name). A capital "C" will show all Circle, Count, and Concentric circle tools.



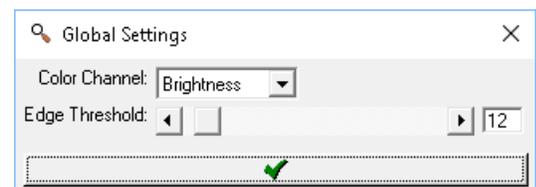
Restore the original column widths in the Tool List table.

## Using the Edge Threshold

You cannot adjust the edge sensitivity if you have an intensity-based tool selected (Count, Intensity, Match). You must select an edge-based tool, such as Distance or Edge Count.

- Move your cursor into the image area, and right-click on the image (not on a tool).
- The Global Settings box opens.

**NOTE:** Decreasing the Edge Threshold also increases processing time! You should first try adjusting your lighting, focus and exposure to improve the image if possible, before decreasing the Edge Threshold. An image that appears dark to the human eye still contains more edges. An image that appears over-exposed or "washed out" contains fewer edges.



- Use the slider and arrow keys to adjust the Edge Threshold from 0 to 127. **There is a delay** in the response time, because all edges in the image are updated as you change the threshold. Allow time for updates to occur. The response gets slower as you decrease the Threshold. Do Not continue moving the slider or tapping the arrow keys.
- Click on the Accept button to accept changes and close the Global Settings box. Click on the Cancel button to close without changes.

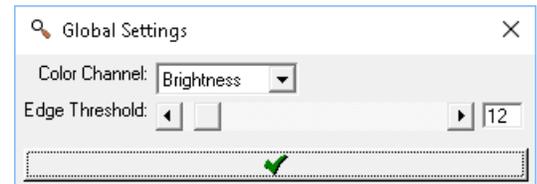
- Lighting, lens, focus, and exposure all affect the edge sensitivity and the sharpness and number of edges in the image.
- There is a limit to the amount of information (graphics and highlighted edges) the vision system can display. Setting the Edge Threshold to 6 or lower may cause many edges to be drawn in only the top half of the image, and no edges in the lower half. If this occurs, you must set the Edge Threshold to a higher number. The application will not identify edges in the lower part of the image if the limit is reached, even when the Global Settings box is closed.
- Generally, few or no edges will be displayed for a setting of 45 or higher.
- If you cannot find any edges in the image, the lighting may be too dim, too bright, or the edge threshold may be set too low.

### Using the Global Color

When you create new tools, the normal default “Channel” is “Brightness”. Changing the Global Color changes the default “Channel” in all tools you create.

- You must first train your color classes, using the Setup Color panel.
- Use the Global Color drop list to select a default Color Class.
- Click the “Accept” button to close the Global Settings

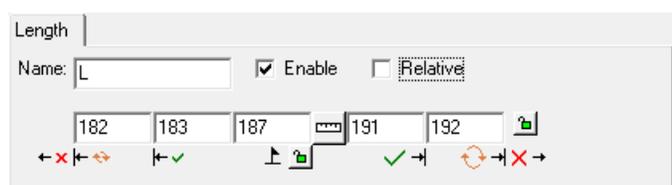
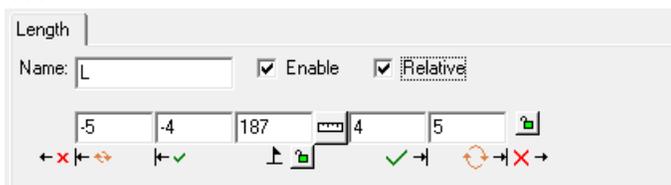
Changing the default Color Channel value may be useful in some tools where the object or feature you are inspecting for, appears in a specific color class better than it appears in the “Brightness” setting. The properties and tolerance settings will be created based on the selected Color Class.



### Relative Numbers

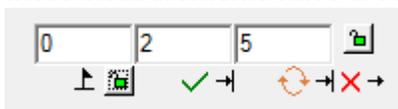
Many number measurements have a checkbox labeled “Relative”. With this box checked, the difference from “Perfect” is reported, not the actual measured numbers.

For Example: The value of “Perfect” is 15, and the measured value is 17. The difference from perfect is 2. With the “Relative” box checked, the number reported is 2. With the “Relative” box cleared, the number reported is 17.

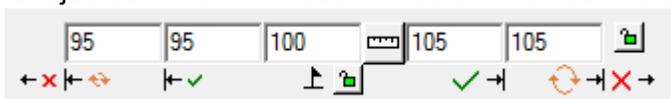


### Using the Tolerance Settings

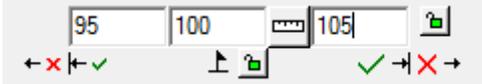
Most measurements have a Tolerance Setting; some are 1 sided,



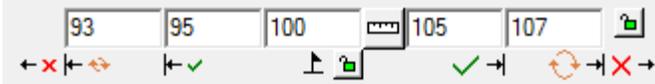
but most are 2 sided. Measurements are often specified as a value and tolerance, such as 100 +/- 5. This means the part is good if the measured value is between 95 (100 - 5) and 105 (100 + 5) and otherwise the part is rejected. This information would be entered in the Tool Properties menu like this:



You can also disable the Recycle values in the Application Setup page (in Internet Explorer, see page [132](#)) or the iNspect Express Configurator (see page [133](#)). The 100 +/- 5 tolerance would look like this:



A different specification may include information that the value is 100 +/- 5 and a part can be recycled or re-machined if the measurement is 100 +/- 7.



Another specification may be the value is 100 +/- 5 and the part can be recycled if the measurement is smaller than tolerance but not over. (smaller than 95 but not over 105).



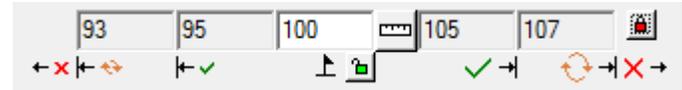
For example, if a drilled hole is too small the part can be re-drilled.

### Locking Tolerances

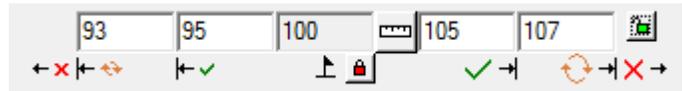
Use the padlock button to lock values so they do not change if you move or resize your measurement tool Region. Unlocked tolerances may be recalculated based upon the new contents of the Region.

The Green padlock  means your values are unlocked. The Red padlock  means your values are locked.

The padlock beside the tolerance fields locks the tolerance values for Pass, Recycle and Fail.



The padlock near  locks the value of "Perfect" only.



You will encounter other padlocks, used for locking some parameters, templates, or search patterns.

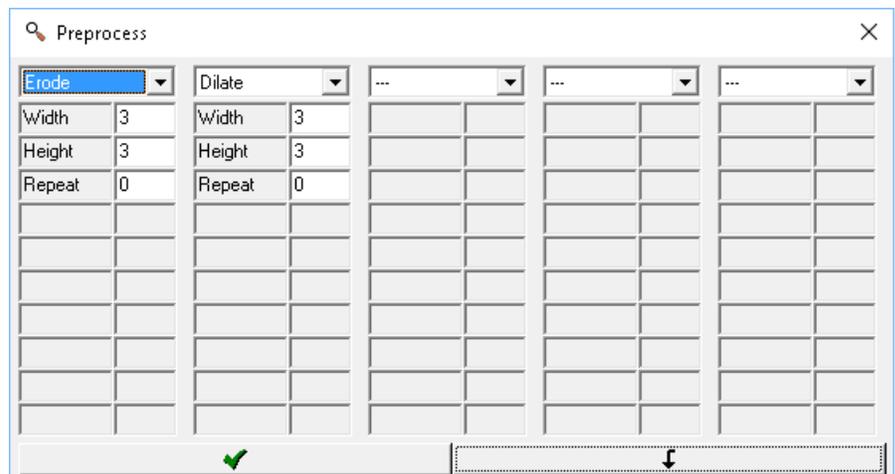
### Using Preprocessing

Preprocessing is optional, not a requirement. Preprocessing changes the image to enhance objects; for example, edge or contrast enhancement. You can enable preprocessing for each Tool.

Click the Preprocessing button  in any tool properties box, to open the Preprocess window. Use the drop lists to select up to 5 different preprocessing functions for the current ROI. (There is also a separate Preprocess tool.)

Multiple preprocessors are applied in order, from left to right. There are error messages that refer to the preprocessors by "stage" numbers (1 through 5).

Some preprocessors have parameters that you can change. The fields below the drop list will have names filled in and default numbers. The fields remain blank if there are no changeable parameters.



Click the "Accept" button  to apply changes and exit this menu.

Click the “Apply” button  to apply changes without closing this menu.

**Note:** Some applications may benefit from using a little preprocessing, for example using a low-pass filter to remove lighting artifacts or using erode and dilate to blend away distractions. **Do not over-use preprocessing.** The lighting and optics (lens) are more important to the success of your application. Preprocessing is changing the original image data. Preprocessing also adds to the inspection time.

**Note:** Erode and dilate are often used together, to attempt to restore object dimensions to their approximate original size. The order of erode and dilate may yield different results.

## Displaying the Effects of Preprocessing

1: Preprocessing added to another tool:

In the Setup Tools panel, preprocessing added to another tool only appears when you hover on the outline of a tool.

In the Run panel, preprocessing added to another tool does not appear by default. You can make the preprocessing appear using the Global Variable **ShowPreprocessed** in the “Pre Image Process” function (in the Script editor).

**ShowPreprocessed** = 1 – display all preprocessing added to other tools.

**ShowPreprocessed** = 0 – do not display preprocessing added to other tools.

2: A Separate Preprocess Tool

In the Setup Tools panel, preprocessing is always shown in Monochrome images but only when you hover over the outline of a tool in Color images. If the Visibility is off in the Tools list, preprocessing is not shown. But the results or effects (edges etc.) will still be shown.

In the Run panel, preprocessing is shown if the visibility is on (in the Tools List) and not shown if the visibility is off. But the results or effects (edges etc.) will still be shown. The **ShowPreprocessed** variable **does not** affect the Preprocess Tool.

## Available Preprocessors

Some processors are only available for Monochrome images.

**Convolve 3x3** - create a custom 3x3 filter with 9 coefficients and a divider. The first 3 coefficients form the top row of the filter. The last 3 coefficients form the bottom row. Program the coefficients and divider to keep the result from exceeding 255.

**Dilate** - Simple thickening or dilation. Bright lines become thicker (dilated) or dark lines thinner. Parameters: filter Width and Height.

**Equalize** - broadens image intensity to span the entire range from 0 to 255. The darkest pixels in the area will be set to 0; the brightest pixels in the area will be set to 255. Other pixels are set based on a statistical normalization of the intensity histogram.

**Erode** - Simple thinning or erosion. Bright lines become thinner (eroded) or dark lines thicker. Parameters: filter Width and Height.

**Gaussian** - Smooth image intensities using a Gaussian filter. Gaussian filtering blurs details and removes high spatial frequency structure from images. It is used to reduce noise, or smooth edges. Parameters: filter Width and Number of iterations.

**High-pass** - A high-pass filter “sharpens” image features. Parameters: filter Width and Height.

**Invert** - Reverses black and white (creates a “negative” image). Each pixel is replaced by 255 minus the pixel's value.  $(255 - \text{input pixel}) = \text{new pixel}$

**Low-pass** - A low-pass filter “blurs” image features. Parameters: filter Width and Height.

**Mask** – paint pixels in the ROI. Use Mask on a binary image (threshold result). Parameters: Fill (paint) value and Invert.

**Median** - A Median filter sorts the values of *Width x Height* neighbors and replaces the current pixel with the median or middle value. Parameters: filter Width and Height.

**Normalize** - Adjust the pixel intensities to cover the full range from 0 to 255. Remove Min% and Max% intensity pixels before adjusting. Parameters: *Min %* and *Max %*.

**Project H** - Sum all the pixels in a row, then “normalize” the sum to a range of 0 to 255. Each pixel in a row is replaced with the normalized sum. The result looks like horizontal streaks but emphasizes vertical transitions of dark and light. *Monochrome only*.

**Project V** - Sum all the pixels in a column, then “normalize” the sum to a range of 0 to 255. Each pixel in a column is replaced with the normalized sum. The result looks like vertical streaks but emphasizes horizontal transitions of dark and light. *Monochrome only*.

**Remove Blobs** – remove objects in the ROI. Enter values for size of blobs. Remove blobs larger than the limits, or smaller than the limits. Parameters: remove White blobs, 8-way, Remove edge blobs, Limit type, minimum and maximum: area/height/width.

**Shear X** - Shear horizontally. Positive angle shears clockwise (slant to the right). Parameters: shear *Angle* (degrees), *Interpolate method*, *Background mode*, *Background value*. See the Help file for more details.

**Shear Y** - Shear vertically. Positive angle shears clockwise (slant down). Parameters: shear *Angle* (degrees), *Interpolate method*, *Background mode*, *Background value*. See the Help file for more details.

**Sobel** - apply a 3x3 Sobel filter to the region. This highlights edges in the image.

**Subtract** - subtract the values of pixels in the acquired runtime image from the values of pixels in the template or train image. Because the possible range is -255 to +255 we add 128 to each pixel. All resulting values below 0 are set to 0. All resulting values above 255 are set to 255.

**Threshold** - create a binary image. All pixels below the value *Level* are changed to 0 (black). All pixels equal to or above the value *Level* are changed to 255 (white). Parameter: *Level*.

**Threshold (adaptive)** – creates a binary image sensitive to changes in lighting or reflection. For each pixel location, calculates the average or mean pixel value in a sample area *Width x Height* around the current pixel. Adds the value *Level* to the mean to get the threshold.

**Threshold (band)** - all pixels with intensity values less than *Low* and greater than *High* are changed to 0 (black). All pixels with intensity values equal to *Low*, equal to *High*, and all pixels with intensity values between *Low* and *High* are changed to 255 (white).

**Zoom** – increase or decrease the image inside the Region. Parameters *X scale*, *Y scale*, *Interpolation*, *Fill value*, *Position*. See the Help file for more details.

### Using the Locator

The Locator tracks movement of the part in the image area and aligns or snaps the tools to the part at every position. Up to 16 separate locators can be defined. Each measurement tool has a locator selection, to lock tools to different locators (or no locator). All measurement tools default to Locator 1. If you select X, or an undefined locator, the tool remains in a fixed position in the image.

The more parts vary in position, the more time it takes to locate the part before performing the inspection. The optimal situation is when the parts are mechanically placed or fixtured, and appear in exactly the same position without any change in rotation, twist, height, etc..

You must have already defined one or more tools that create an active point. You need two points to track rotation, with or without horizontal and vertical movement. You need only one point to track horizontal and vertical movement without rotation. For best results, the two points should be as far apart as possible.

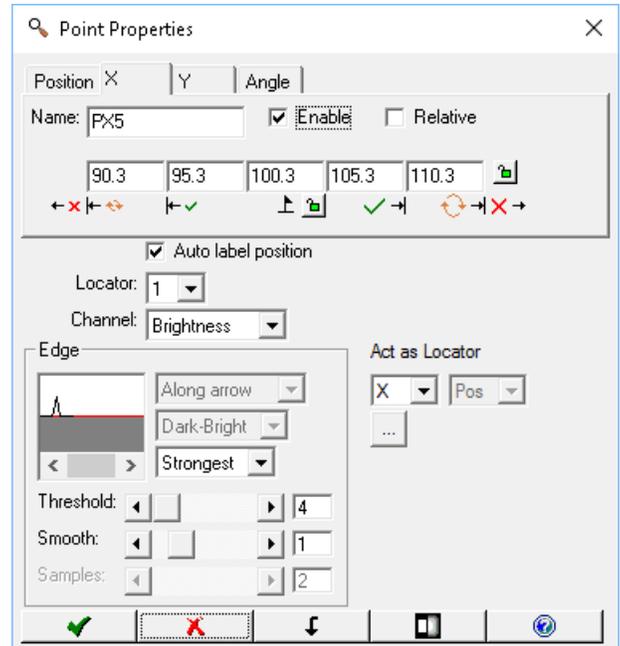
The Count tool is a popular choice for a locator because it normally executes quickly. The Edge Count tool is also popular. The Match tool is popular because it searches a defined area for a pattern. Other tools may be usable or even better suited, depending on the features in your particular part or image, and the amount of movement. The distance and angle tools are **not** suggested for defining a locator. A few Locator Examples are included in this manual starting on page [136](#). The on-line Help contains more examples of Locators.

For any tool used to define the locator, the search box or search area must be expanded to include all expected movement.

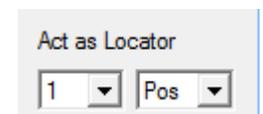
a. Click on the “Point” button in the Setup Tools panel.

b. Select a Point that you wish to use as a Locator Anchor point.

c. Right-click on the Point in the image area, or you can right-click on the Point in the Tools list, to open the Point Properties.

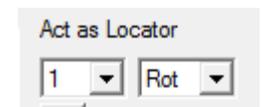


d. Use the first drop-list to select a number. Use the second drop-list to select “Pos” for Position anchor. Click on the Accept button  to apply changes and close the Point Properties edit box. A “cross hair” symbol appears in the Image Area, centered on the point.



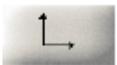
e. Right-click on another active point.

f. Use the first drop-list to select the same number again. Use the second drop-list to select “Rot” for Rotation anchor. Click the Accept button  to apply changes and close the Point Properties edit box. A flag symbol appears, attached to this point.



You can enable X and Y measurements on a Locator's Position anchor to track the part movement. You can enable the Angle measurement on a Locator's Rotation anchor to track the part rotation.

### Using the Origin



The axis origin, or point (0,0) can be relocated by clicking in the image area.

The origin will snap to (attach to or lock onto) the top left and bottom left corners of the image area, the position anchor of a locator, or a Point created with the Point Tool.

The origin cannot be located on a measurement tool, or the active point of a measurement tool.

The origin will follow the horizontal and vertical movement of the part, if it is attached to a position anchor, but does not follow rotation. The origin will not follow movement of the part if it is not attached to a position anchor (attached to a corner of the image, or any other location in the image).

a. Click on the “Origin” button in the Navigation panel.

b. Move your cursor in the Image Area to the desired location of the origin and click. The origin (2 joined arrows) appears at that location.

**Snap to a Corner** - Hover the cursor over the top left or bottom left corner of the image area. You will see a red highlight in the corner (if you zoom out, you will see an un-circled cross hair). Click on the corner of the image. (the origin can be moved to the top right or bottom right corner, but it does not snap.)

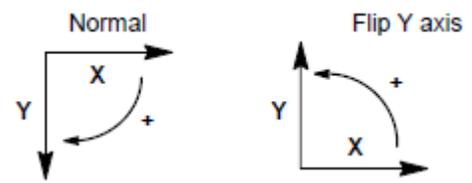
**Snap to a Locator Anchor** - Hover the cursor over the cross hair of a locator Position Anchor (not rotation), or over the label (Loc1) of a locator. If the cross hair and label turn red, click to snap the locator to the anchor point.

c. Right-click on the origin to open the Origin Properties box.

**Always Show** - display the Origin location during inspection or run time.



**Flip Y axis** - changes the direction of the Y axis and the direction of Rotation. Rotation is "positive" from the X axis to the Y axis. In the default setting, clockwise rotation is positive. In the "flip" setting, counter-clockwise rotation is positive.



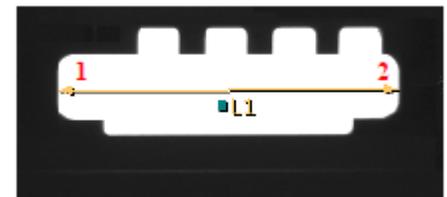
### Using the Distance Tool



The Distance tool measures the distance between two edges, or between a combination of edges, points, or pencil lines.

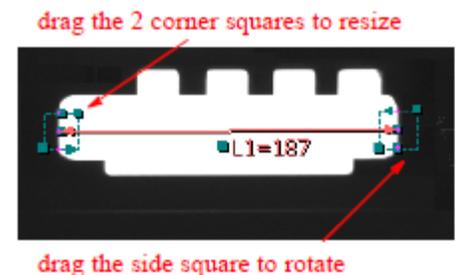
a. Click on the "Distance" button. As you move the mouse over the image in the Work Area, you should see small sections of the edges in the image highlighted. These are "edge candidates" that you can use with Distance. **Valid edges** can be very small curves, points, small or large lines, Circle center points, Angle intersection points, Pencil lines, or the edge of the image area. You can also draw the distance tool to a "free" pixel point where there is no edge.

b. Find two edges that match your measurement. Click on one edge (1), and a "rubber" line appears and follows your cursor movement. Click on the other edge (2). iInspect draws a "ruler line" between the edges that are closest to your two points. The distance tool will "snap" to the nearest edge where you click. The ruler line is labeled (L, L1, etc.).



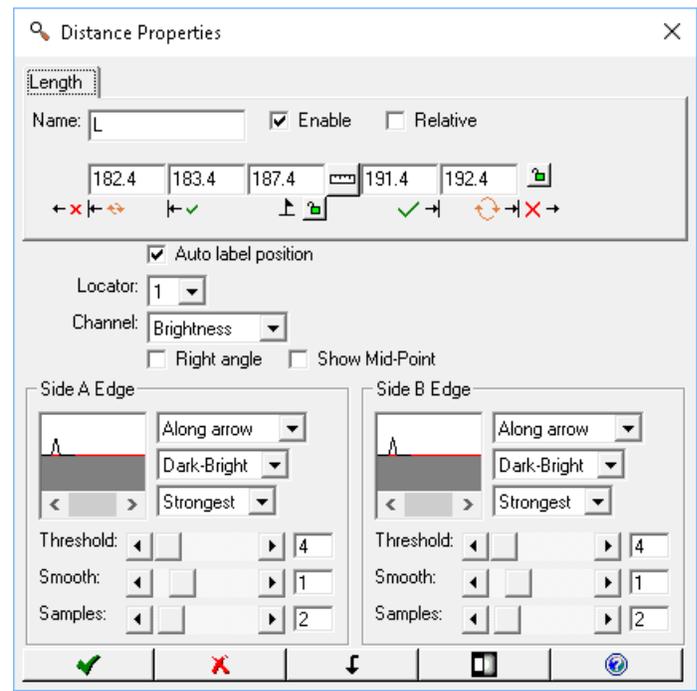
**Note:** A Distance between a Pencil Line and a Point, or any distance to the edge of the image, is always a perpendicular or right-angle distance. You will see a yellow "construction line" that forms the perpendicular

c. When the Distance tool is selected, you can drag the end points if they are not exactly where you wanted. The small boxes that appear around the end points define the search area for locating the edge at each endpoint. You can drag the solid square at the corners of the box, to resize the box and increase the search area; but searching more area increases the processing time, which can become significant for a large number of measurements. You can drag the solid square on one side of the search box to rotate the box, which changes the direction of locating the edge. An arrow on the opposite side of the search box shows the direction. The small pink crosses show the samples for finding the edge.



d. When you hover the cursor over a ruler line, the line turns red, the measured length is displayed on the image, and a message appears telling you to "Right-click to edit."

e. Right-click on the line (or on the Distance tool in the Tool list). A Distance Properties box opens. In this box you can: change the name of this measurement, set the tolerances for recycle and reject, change the number of sampling points to find the edge at the ruler end points.



<i>tab</i>	<i>Measurement</i>
Length	separation or distance between two edges, or between a combination of edges, points or pencil lines.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the ruler line in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Right angle** - measures the shortest distance, perpendicular to the second of the two edges. Measuring to the edge of the image area is always a right-angle measurement.

**Show Mid-Point** - allows you to use the midpoint of this line as a Point in other measurements.

#### **SideA Edge / Side B Edge**

There are separate adjustments for the two search areas at the two end points of your measurement. These adjustments control locating the two edges. Side A is usually the first click point. Side B is usually the second click point. When you click on a slider or change a pull-down, a red circle appears in the image area, to indicate which side you are editing.

**Direction** - the first drop-list selects the scan direction for finding the edges at the two end points.

**Along arrow** means scan in the direction of the arrowhead on the search box outline.

**Against arrow** means scan in the opposite direction from the arrowhead on the search box outline.

**Polarity** - the second drop-list selects the type of edge transition to detect.

**Dark-Bright** means a “dark-to-light” transition or edge.

**Bright-Dark** means a “dark-to-light” transition or edge.

**Either** means both edges.

**Selection** - the third drop-list selects which edge to use or how to find the edge that defines the end points.

**Strongest** use the strongest edge found in the search area.

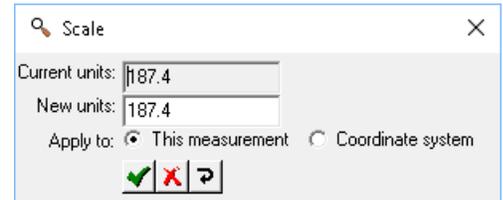
**First** use the first edge found in the search direction.

**Threshold** - a lower setting is better at detecting edges that are less sharp or less sudden transitions from dark to light (or light to dark). A higher setting may suppress false edges.

**Smooth** - number of times to apply a smoothing filter (low pass filter) in the edge search box, to remove noise effects.

**Samples** - the number of sampling points to find the edge at the ruler end points.

f. Click the Scale button  in the Distance Properties box, to set new units (Scale) on this one measurement, or on the whole coordinate system used for this camera view.



**NOTE:** If you enter new units, and select **Coordinate System**, clicking the “Accept” button in the Scale Properties immediately applies the changes to the whole coordinate system; the “Cancel” button in the Distance Properties does not undo the change to the coordinate system. Click the Undo button  to undo scale changes and revert to pixel coordinates for the whole coordinate system. This removes Alignment Calibration for this camera view.

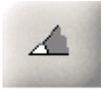
g. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

h. Click the Accept button  to accept changes and close the Scale box. Click the Cancel button  to close without changes. Click the Undo  button to undo scale and calibration.

i. In the Distance Properties box, click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.

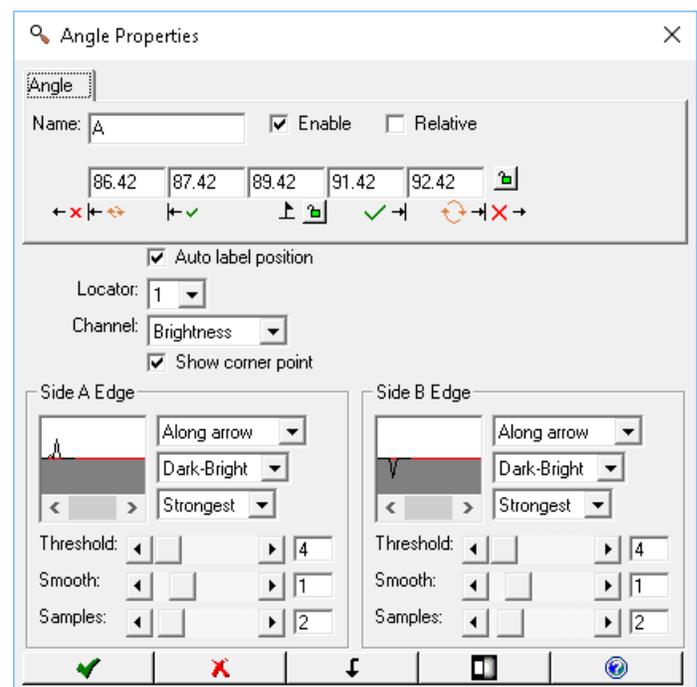
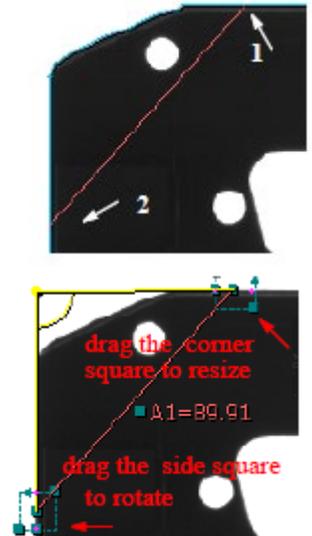
j. Click the Accept button  to accept changes and close the Distance Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

## Using the Angle Tool



The Angle tool measures the angle between two edges.

- Click on the “Angle” button. Move the mouse over the image in the Work Area. You should see sections of the edges in the image highlighted as you move across them. These are “edge candidates” that you can use with Angle. **Valid edges** are straight lines only.
- Find two edges that match your measurement. Click on the first edge (1), then click on the second edge (2). iInspect draws intersecting lines by using these two edges and calculates the angle between them. The curve drawn between the two edges shows the angle measured.
- When the angle tool is selected, you can drag the end points if they are not exactly where you wanted. To increase accuracy of the angle measurement, move the end points so they are not close together. The small boxes that appear around the end points define the search area for locating the edge at each endpoint. You can drag the solid squares at the corners, to resize the box and increase the search area; but searching more area increases the processing time. The small pink crosses show the samples for finding the edge at run time. You can drag the solid square on one side of the search box to rotate the box, changing the direction for finding the edge. A small arrow on the opposite side of the box shows the direction.
- When you hover the cursor over the line that connects the two edges, it turns red, the measured angle is displayed on the image, and a message appears telling you to “Right-click to edit.”
- Right-click on the highlighted line (or on the Angle tool in the Tool list). The Angle Properties box opens. In this box you can: rename the angle measurement, set the tolerances for recycle and reject, change the number of sampling points to find the edges at the end points.



Tab	Measurement
Angle	the angle formed by two edges.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the curve in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Show corner point** - allows you to use the corner point as a Point in measurements.

### **Side A Edge / Side B Edge**

There are separate adjustments for the two search areas at the two end points of your measurement. These adjustments control locating the two edges. Side A is usually the first click point. Side B is usually the second click point. When you click on a slider or change a pull-down, a red circle appears in the image area, to indicate which side you are editing.

**Direction** - first drop-list selects the scan direction for finding the edges.

**Along arrow** means scan in the direction of the arrowhead on the search box outline.

**Against arrow** means scan in the opposite direction from the arrowhead on the search box outline.

**Polarity** - second drop-list selects the type of edge transition to detect.

**Dark-Bright** means a “dark-to-light” transition or edge.

**Bright-Dark** means a “dark-to-light” transition or edge.

**Either** means both edges.

**Selection** - third drop-list selects which edge to use, or how to find the edge that defines the end points.

**Strongest** use the strongest edge found in the search area.

**First** use the first edge found in the search direction.

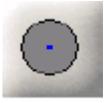
**Threshold** - a lower setting is better at detecting edges that are less sharp or less sudden transitions from dark to light (or light to dark). A higher setting may suppress false edges.

**Smooth** - number of times to apply a smoothing filter (low pass filter) in the edge search box, to remove noise effects.

**Samples** - the number of sampling points to find the edge at the ruler end points.

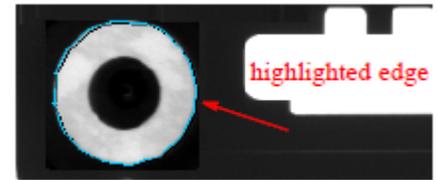
- f. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.
- g. In the Angle Properties box click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.
- h. Click the Accept button  to accept changes and close the Angle Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

## Using the Circle Tool



The Circle tool measures the diameter or circularity (roundness) of a circle. The Maximum diameter is 2000 pixels.

a. Click on the “Circle” button. Move the mouse over the image in the Work Area. You should see sections of the edges in the image highlighted as you move across them. These are “edge candidates” that you can use with Circle. **Valid edges** are circles only.



b. Find a curve or circle that matches your measurement and click on **3 points** along the curve. iInspect Express will draw a circle around the curve, and a center point. The circle is labeled (C, C1, etc.).

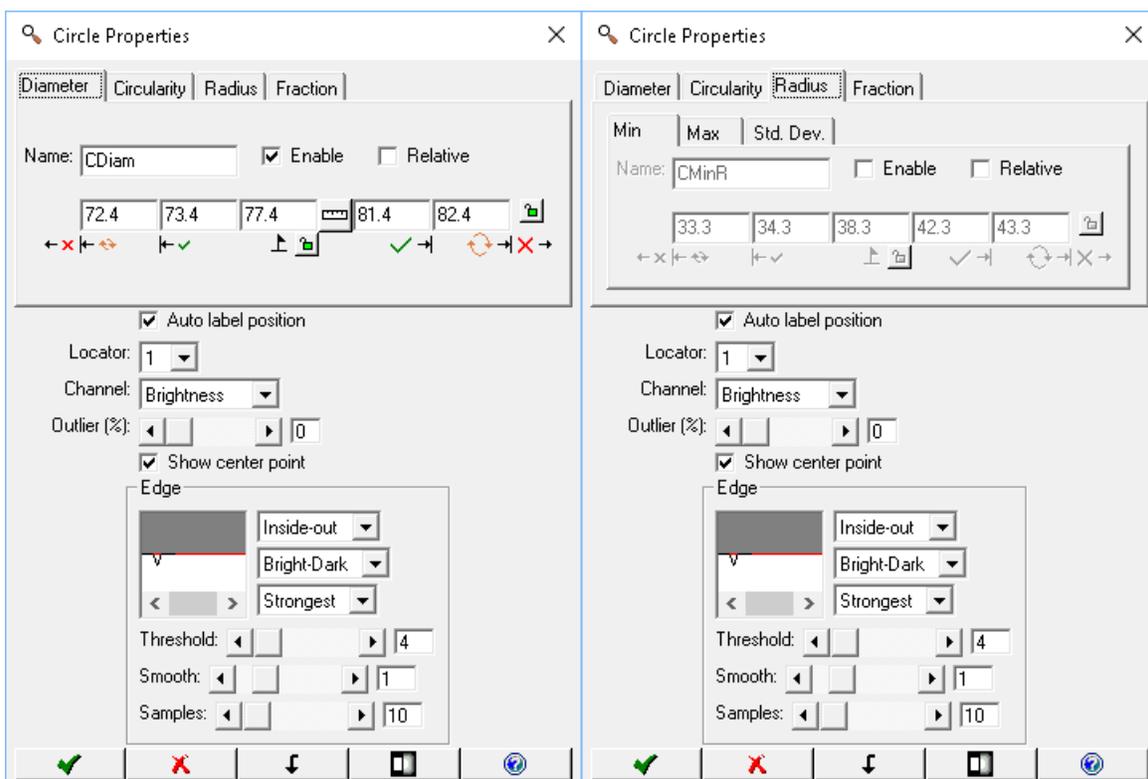
c. When you hover the cursor near the circle, a pair of blue circles appears, one inside and one outside the measured circle. These two circles define the search area for locating the circle. You can drag the small solid squares on these circles to resize them and increase the search area; but searching more area increases the processing time. Small pink crosses indicate the sample points along the circle.



d. When you hover the cursor over the circle, the circle turns red, the location and intensity are displayed on the image, and a message appears telling you to “Right-click to edit.” Several radial lines appear at even spacing around the circle. These show the “sample points” for finding the edges of the circle.

e. Right-click on the highlighted circle (or on the Circle tool in the Tool list). A Circle Properties box opens. In this box you can: use the tabs to select, enable and rename measurements, set the tolerances for recycle and reject, change the number of sampling points around the circle; the pink crosses and lines). The minimum sample setting is 8.

Notice that the Radius tab has three Sub-Tabs: Min, Max, Std. Dev.



<i>Tab</i>	<i>Measurement</i>
Diameter	measure the diameter of the circle. The maximum diameter is 2000 pixels.
Circularity	ratio of the smallest diameter to the largest diameter, sampled around the circle.
Radius: Min	minimum radius measured.
Radius: Max	maximum radius measured.
Radius: Std.Dev.	Standard Deviation calculated for all the measured diameter values.
Fraction	percent of samples that detected an edge. The number of "successful" samples divided by the total number of samples (accuracy number) multiplied by 100.

**Name** - you can change the default name of the tool or measurement. The name or "label" is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the circle in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Outlier %** - sets a number of samples to be ignored or discarded. Each measured radius is compared with the average radius, and the % of those that have the largest differences are discarded. The average radius is then calculated one more time using only the retained radii. If a radial line does not find an edge at all, then it is not counted towards the outlier percentage. For example, if there are 100 radial lines but only 80 of them find edges, then an outlier percentage of 10% means 8 of the found edge points will be ignored.

**Show center point** - displays the point at the circle center and allows you to use it in other measurements.

## Edge

These adjustments control locating the edges that define the circle.

**Direction** - first drop-list selects the search or scan direction.

**Inside-out** means starting from inside the circle moving out.

**Outside-in** means starting from outside the circle moving in.

**Polarity** - second drop-list selects the type of edge transitions to detect.

**Dark-Bright** means a "dark-to-light" transition or edge.

**Bright-Dark** means a "light-to-dark" transition or edge.

**Either** means both edges.

**Note:** If the edge Polarity selected is not encountered, the edge or circle may not be found.

**Selection** - third drop-list selects which edge to use, or how to find the edge that defines the circle.

**Strongest** use the strongest edge found in the search area.

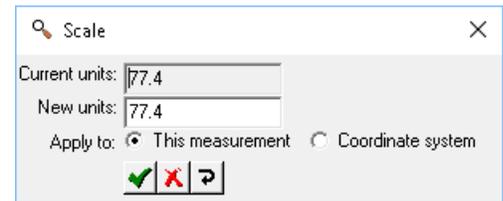
**First** use the first edge found in the search direction.

**Threshold** - a lower setting is better at detecting edges that are less sharp or less sudden transitions from dark to light (or light to dark). A higher setting may suppress false edges.

**Smooth** - the number of times to apply a smoothing filter (low pass filter) to remove noise effects.

**Samples**-- the number of sampling points around the circle, indicated by the pink crosses and radial lines.

- f. Click the Scale button  in the Circle Properties box, to set new units (Scale) on this one measurement, or on the whole coordinate system used for this camera view.



**NOTE:** If you enter new units, and select **Coordinate System**, clicking the “Accept” button in the Scale Properties immediately applies the changes to the whole coordinate system; clicking the “Cancel” button in the Circle Properties does not undo the change to the coordinate system. Click the Undo button  to undo scale changes and revert to Pixel Coordinates for the whole coordinate system. This removes Alignment Calibration for this camera view.

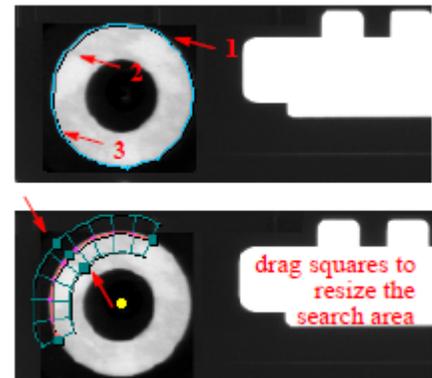
- g. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.
- h. Click the Accept button  to accept changes and close the Scale Properties. Click the Cancel button  to close without changes. Click the Undo button  to undo scale and calibration.
- i. In the Circle Properties box, click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.
- j. Click the Accept button  to accept changes and close the Circle Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

### Using the Arc Tool



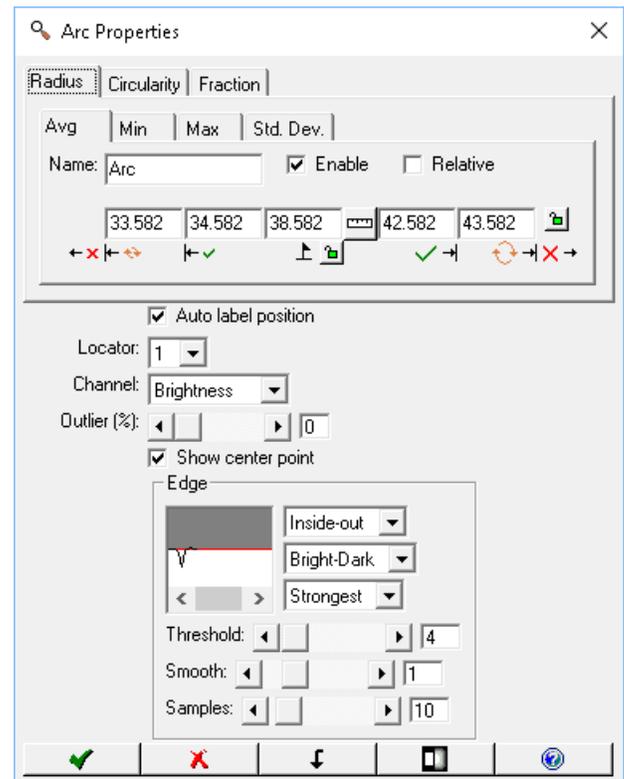
The Arc tool measures the radius or circularity (roundness) of an Arc, or an incomplete circle.

- a. Click on the “Arc” button. Move the mouse over the image in the Work Area. You should see sections of the edges in the image highlighted as you move across them. These are “edge candidates” that you can use with Arc. **Valid edges** are arcs, curves and circles only.
- b. Find a curve or circle that matches your measurement. Click on **3 points** along the curve edge: start, middle and end of the measurement. The Arc is labeled (Arc, Arc1, etc.).
- c. The measured Arc appears, and a pair of blue curves, one inside and one outside the measured Arc. These two curves define the search area for locating the Arc. You can drag the solid squares on these curves, to resize them and increase the search area; but searching more area increases the processing time. Several radial lines and small pink crosses appear at even spacing around the arc. These are “sample points” for finding the edges of the arc.
- d. When you hover the cursor over the Arc, the curve turns red, and a message appears telling you to “Right-click to edit.”



e. Right-click on the highlighted curve (or on the Arc tool in the Tool list). An Arc Properties box opens. In this box you can: use the tabs to select, enable and rename different measurements, set the tolerances for recycle and reject, change the number of sampling points around the curve (the pink crosses and radial lines).

Notice the use of Sub-Tabs in the Radius tab.



Tab	Measurement
Radius: Avg	Average of all measured radius values of the Arc.
Radius: Min	Minimum radius measured.
Radius: Max	Maximum radius measured.
Radius: Std.Dev.	Standard Deviation calculated for all radius values measured.
Circularity	ratio of the smallest radius to the largest radius, sampled around the Arc.
Fraction	percent of samples that detected an edge, (number of "sucessful" samples divided by the total number of samples (accuracy number) multiplied by 100).

**Name** - you can change the default name of the tool or measurement. The name or "label" is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the curve in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Outlier %** - sets a number of samples to be ignored or discarded. Each measured radius is compared with the average radius, and the % of those that have the largest differences are discarded. The average radius is then calculated one more time using only the retained radii. If a radial line does not find an edge at all, then it is not counted towards the outlier percentage. For example, if there are 100 radial lines but only 80 of them find edges, then an outlier percentage of 10% means 8 of the found edge points will be ignored.

**Show center point** - displays the point at the arc center and allows you to use it in other measurements.

## Edge

These adjustments control locating the edges that define the arc.

**Direction** - first drop-list selects the search or scan direction.

**Inside-out** means starting from inside the Arc moving out.

**Outside-in** means starting from outside the Arc moving in.

**Polarity** - second drop-list selects the type of edge transitions to detect.

**Dark-Bright** means a “dark-to-light” transition or edge.

**Bright-Dark** means a “light-to-dark” transition or edge.

**Either** means both edges.

**Note:** If the edge Polarity selected is not encountered, the edge or circle may not be found.

**Selection** - third drop-list selects which edge to use, or how to find the edge that defines the Arc.

**Strongest** use the strongest edge found in the search area.

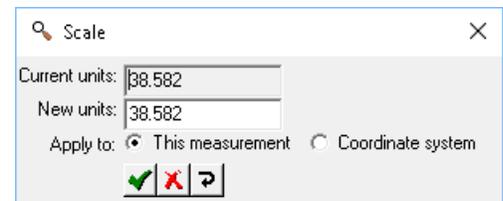
**First** use the first edge found in the search direction.

**Threshold** - a lower setting is better at detecting edges that are less sharp or less sudden transitions from dark to light (or light to dark). A higher setting may suppress false edges.

**Smooth** - the number of times to apply a smoothing filter (low pass filter) to remove noise effects.

**Samples**-- the number of sampling points around the circle, indicated by the pink crosses and radial lines.

f. Click the Scale button  in the Arc Properties box, to set new units (Scale) on this one measurement, or on the whole coordinate system used for this camera view.



**NOTE:** If you enter new units, and select **Coordinate System**, clicking the “Accept” in the Scale Properties immediately applies the changes to the whole coordinate system; clicking the “Cancel” button in the Arc Properties does not undo the change to the coordinate system. Click the Undo button  to undo scale changes and revert to pixel coordinates for the whole coordinate system. This removes Alignment Calibration for this camera view.

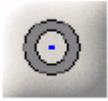
g. Click the Accept button  to accept changes and close the Scale box. Click the Cancel button  to close without changes. Click the Undo button  to undo scale and calibration.

h. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

i. In the Arc Properties box, click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.

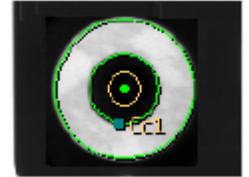
j. Click on the Accept button  to accept changes and close the Arc Properties box. Click on the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

## Using the Concentric Circles Tool

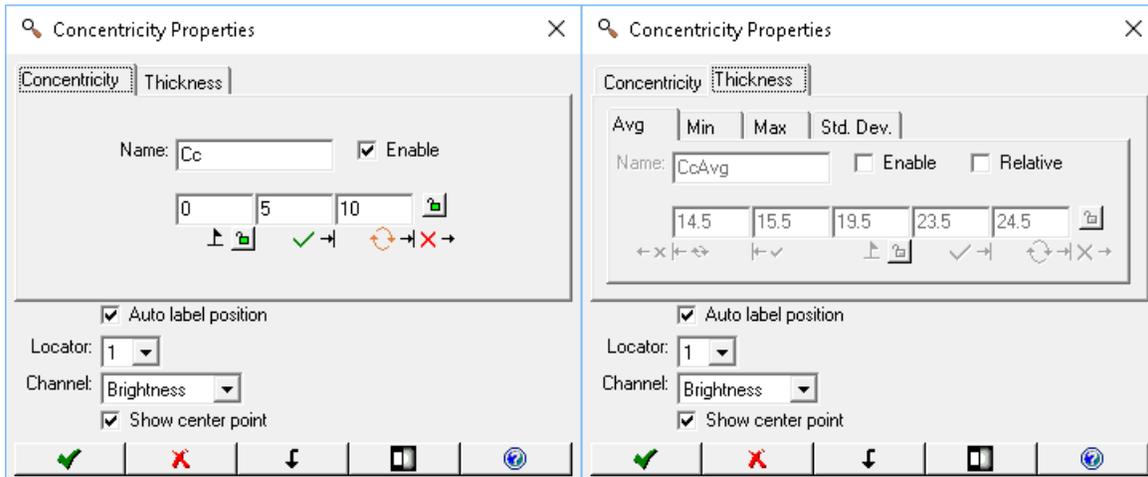


The Concentric Circles tool measures the distances between the actual centers of two circles, from the averaged center of both circles, or the average, minimum, maximum and deviation in distance between the edges of the two circles (wall thickness).

- Click on the “Concentric Circles” button. Move the mouse over the image in the Work Area. You should see the edges of circles highlighted as you move across them. *The Circles must already be defined using the Circle tool.*
- Click on the outer edge of each of the two circles. iInspect draws a (yellow) circle inside the existing circles. The new circle is labeled (Cc, Cc1, etc.). iInspect will not add the same circle twice.
- When you hover the cursor over the inside circle, the circle turns red, and a message appears telling you to “Right-click to edit.”
- Right-click on the inner circle. A Concentricity Properties box opens. In this box you can use the tabs to select, enable and rename different measurements, and set the tolerances for recycle and reject. **Note:** If you have difficulty selecting the inner circle, right-click on the Concentricity tool in the Tool list, below the image area.



Notice the Sub-Tabs used in the Thickness tab.



Tab	Measurement
Concentricity	maximum distance between the averaged center point (the calculated middle point) and the real centers of two circles. (this should be half the distance between the two center points.)
Thickness: Avg	average of the measured distances between the edges of two circles (wall thickness). This measurement creates an array of measured distance values. All the individual distance values for each measurement line are displayable on the Monitor panel, and are available in the Scripting editor. The number of sample points in the Circle tool defines the number of array entries.
Thickness: Min	minimum distance value measured between the edges of two circles.
Thickness: Max	maximum distance value measured between the edges of two circles.
Thickness: Std.Dev.	Standard Deviation of the measured distances between the edges of two circles.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the circle in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Show center point** - displays the point at the averaged center and allows you to use it in other measurements.

e. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

r. Click the padlock button beside "Perfect"  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.

g. Click the Accept button  to accept changes and close the Concentricity Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

### Using the Edge Count Tool



The Edge Count tool counts the number of edges crossed by a line, or the **outline** of the Region. This tool is sensitive to changes in light conditions.

a. Click on the "Edge Count" button. Select the Region shape. Refer to the Tip window for drawing suggestions.

b. Move the mouse over the image in the Work Area. There should not be any highlighted edges. Click, release, move the mouse and click again, to draw the Region where you want to count the edges. The Region is labeled (E, E1, etc.). Small pink crosses show the edges detected.

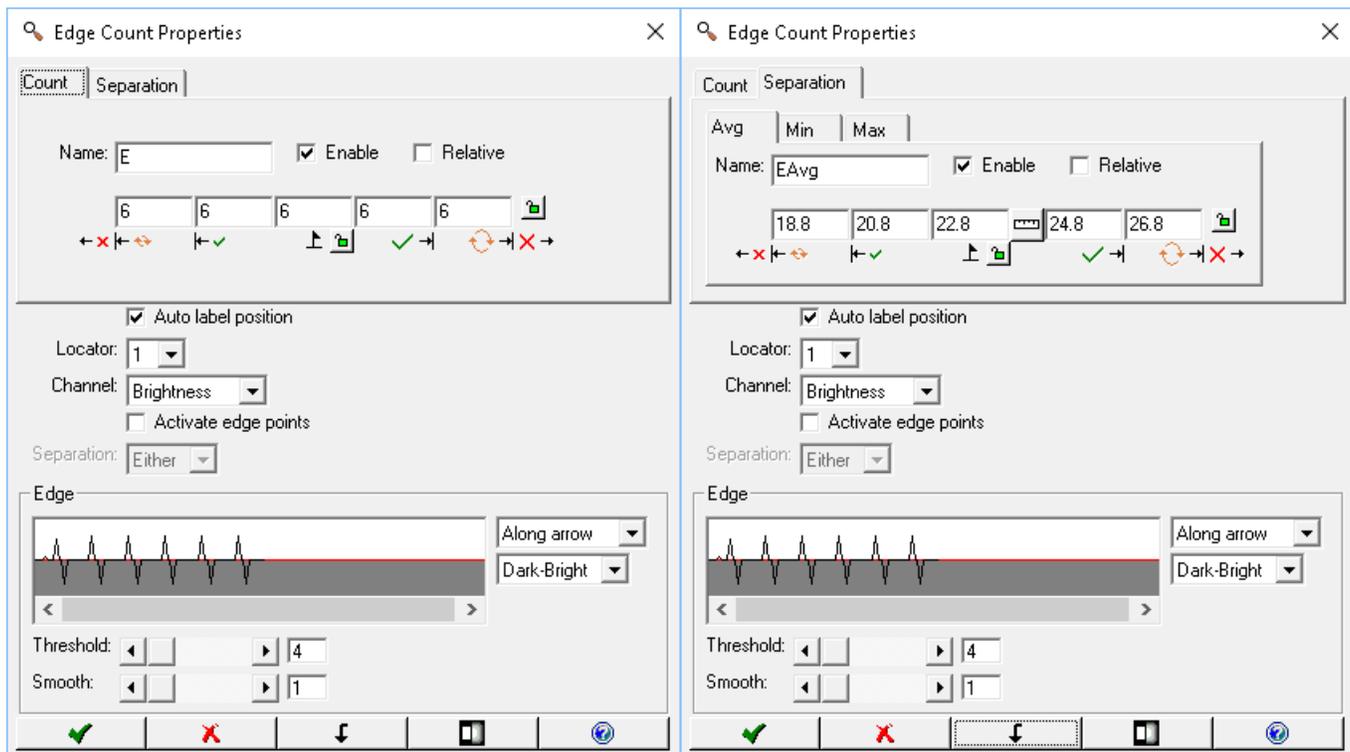


showing 6 Dark-to-Bright edges

c. When the Edge Count tool is selected, you can move and resize the Region.

d. When you hover the cursor over the edge of the Region, the Region and label turn red, and a message appears telling you to "Right-click to edit."

e. Right-click on the Region (or on the Edge Count tool in the Tool list). An Edge Count Properties box opens. In this box you can use the tabs to select, enable and rename different measurements, set the tolerances for recycle and reject, and change other settings.



Tab	Measurement
Count	count the number of edges crossed by the <b>outline</b> of the Region.
Separation: Avg	measure the Average Separation or average distance between edges. This measurement creates an array of measured distance values. All the individual distance values are displayable on the Monitor panel, and are available in the Scripting editor.
Separation: Min	measure the minimum separation or minimum distance between edges.
Separation: Max	measure the maximum separation or maximum distance between edges.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the Region in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Activate edge points** - allows you to use the edge points in other tools or the Locator.

**Separation** - when the **Polarity** parameter is **Either**, this parameter selects which areas are used to calculate the Average Separation. Select **Bright** to measure the bright areas. Select **Dark** to measure the dark areas. Select **Either** if the bright and dark areas are the same size. In the tool drawing example image, selecting **Bright** would measure the width of the (bright) slots cut into the (dark) part. Selecting **Dark** would measure the (dark) spacing between the (bright) slots.

## Edge

These adjustments control locating the edges to be counted.

**Direction** - first drop-list selects the search or scan direction.

**Along arrow** means scan in the direction of the arrowhead.

**Against arrow** means scan in the opposite direction to the arrowhead. For a rectangle or circle shape region, “along arrow” is clockwise and “against arrow” is counter clockwise.

**Polarity** - the type of edge transition to detect.

**Dark-Bright** means a transition from-dark-to-light.

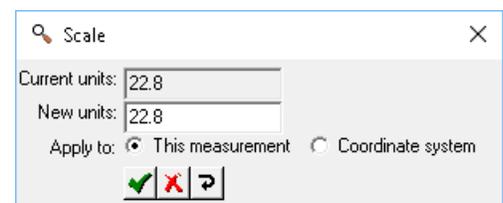
**Bright-Dark** means a transition from-light-to-dark.

**Either** means both edges (or transitions).

**Threshold** - a lower setting is better at detecting edges that are less sharp or less sudden transitions from dark to light (or light to dark). A higher setting may suppress false edges.

**Smooth** - sets the number of times to apply a smoothing filter (low pass filter) to remove noise effects.

f. Click the Scale button  in the Arc Properties box, to set new units (Scale) on this one measurement, or on the whole coordinate system used for this camera view.



**NOTE:** If you enter new units, and select **Coordinate System**, clicking the “Accept” in the Scale Properties immediately applies the changes to the whole coordinate system; clicking the “Cancel” button in the Arc Properties does not undo the change to the coordinate system. Click the Undo button  to undo scale changes and revert to pixel coordinates for the whole coordinate system. This removes Alignment Calibration for this camera view.

g. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

h. In the Edge Count Properties box, click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.

i. Click the Accept button  to accept changes and close the Edge Count Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

## Using the Point Tool

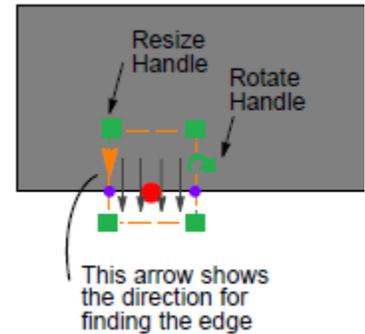


The Point tool creates a Point on an edge, usually for defining another measurement, or placing the Origin. The Point tool is used to edit points created by other tools. The Point tool is used to define Locators. You can also use the Point tool to enable measurements on Points in the center of a Circle or Arc, an Angle intersection, or the intersection of Pencil lines. **The default is no measurement enabled.**

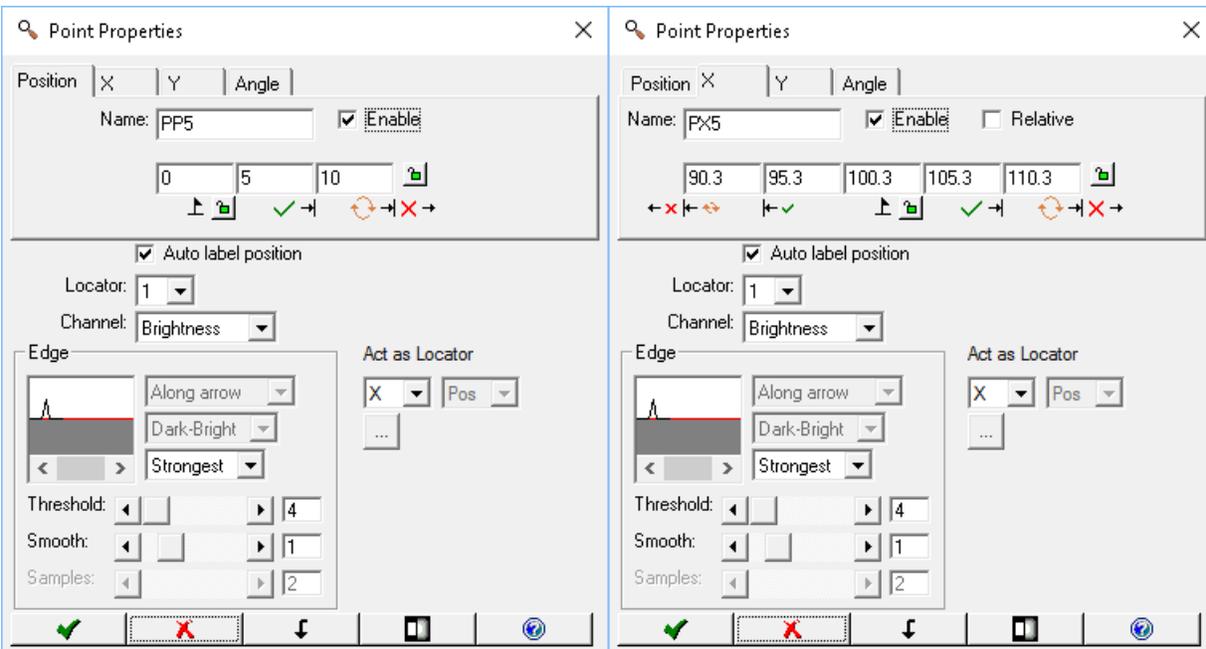
a. Click on the “Point” button. Move the mouse over the image in the Work Area. You should see the edges in the image highlighted as you move across them. You should see Points turn red as you move across them.

b. To create a new Point, click on an edge. When the Point tool is selected, you can drag a new point you created. Circle centers and angle intersection (corner) points cannot be dragged.

- c. When you hover the cursor over a point on an edge, a search box appears around the point. You can drag the solid squares at the corners of this box, to resize the search area for finding the edge. You can drag the solid square on one side of this box, to change the direction for finding the edge. A small arrow on the opposite side of the search box shows the direction.
- d. When you hover the cursor over a point, the point turns red, and a message appears telling you to “Right-click to edit.”



- e. Right-click on the Point (or on the Point tool in the Tool list). The Point Properties box opens. The default is no measurement enabled. In this box you can use the tabs to select, enable and rename different measurements, set the tolerances for recycle and reject, and change other settings.



Tab	Measurement
Position	variation in either horizontal or vertical position, relative to the original or “trained” position. Units are in Calibrated units, or in pixels if Calibration was not performed or was undone.
X	horizontal position or coordinate, relative to the Origin. Units are in Calibrated units, or in pixels if Calibration was not performed or was undone.
Y	vertical position or coordinate, relative to the Origin. Units are in Calibrated units, or in pixels if Calibration was not performed or was undone.
Angle	Rotation from the trained position, <b>only</b> if this point is a Rotation Anchor point in a Locator. For all other Points, the angle is always 0. You must define the position and rotation anchors for the current Locator. Rotation is always positive in the Clockwise direction.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the Point in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

### Edge

These adjustments control locating the edge.

**Direction** - first drop-list selects the search or scan direction for finding the edge.

**Along arrow** means scan in the direction of the arrow head on the search box outline.

**Against arrow** means scan in the opposite direction from the arrow head on the search box outline.

**Polarity** - second drop-list selects the type of edge transitions to detect.

**Dark-Bright** means a “dark-to-light” transition or edge.

**Bright-Dark** means a “light-to-dark” transition or edge.

**Either** means both edges

**Selection** - third drop-list selects which edge to use, or how to find the edge.

**Strongest** use the strongest edge found in the search area.

**First** use the first edge found in the search direction.

**Threshold** - a lower setting is better at detecting edges that are less sharp or less sudden transitions from dark to light (or light to dark). A higher setting may suppress false edges.

**Smooth** - the number of times to apply a smoothing filter (low pass filter) to remove noise effects.

**Act as Locator** - you can define up to 4 locators, by making a point the Position anchor (Pos) or the Rotation anchor (Rot). Defining a locator helps track movement of the part, and makes measurements follow that movement. Please refer to “Using the Locator” starting on page [25](#), and “Locator Examples” starting on page [136](#). **x** - not used as a Locator anchor. **Pos** - Position anchor point. **Rot** - Rotation anchor point.

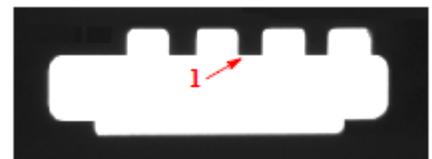
- f. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.
- g. Click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.
- h. Click the Accept button  to accept changes and close the Point Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

### *Using the Tip Tool*



The Tip tool finds the extreme edge, or “tip” of an object or edge. Tip creates a point that can be used by other measurements. **The default is no measurement enabled.**

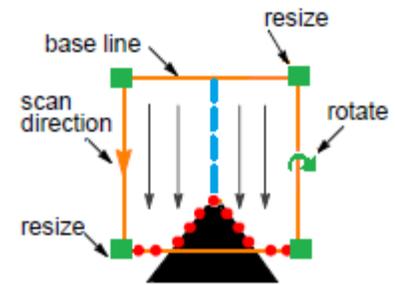
- a. Click on the “Tip” button. Move the mouse over the image in the Work Area. You should see the edges in the image highlighted as you move across them.
- b. Find the end or tip of an object or edge that you wish to track and Click on it (1). A point is created and labeled (Tip, Tip1) with a rectangle search box around the point. The Point is created at the point nearest to the base line.



- c. With the Tip tool selected, you can drag the solid squares at the corners of the rectangle to change the size of the rectangle. You can drag the solid square on one side of this rectangle to rotate, which changes the scan direction.



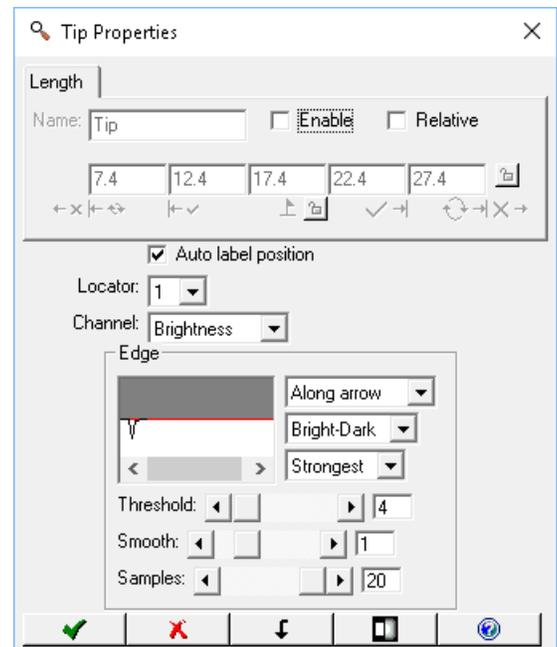
The pink crosses indicate the sample points, where the edges of the object were found. If the pink crosses are all on the edge of the search box, the tool properties (usually the direction) need to be adjusted for the correct measurement. The pink crosses should be on the edge of the object or point.



**Length**  
from base line to Tip Point  
Direction = Bright-Dark

- d. When you hover the cursor over the point or search box, the search box turns red and a message appears telling you to “Right-click to edit.”

- e. Right-click on the search box or Tip label (or on the Tip tool in the Tool list). A Tip Properties box opens. (If you right-click on the Point, a Point Properties box opens.) In this box you can: enable measuring the length, rename the measurement, and change the tolerances for recycle and reject.



Tab	Measurement
Length	Distance from the base line of the search box to the tip or the closest point.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the rectangle in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

## Edge

These adjustments control locating the edges.

**Direction** - select the scan direction for finding the edges.

**Along arrow** means scan in the direction of the arrowhead on the search box outline.

**Against arrow** means scan in the opposite direction from the arrowhead on the search box outline.

**Polarity** - select the type of edge transition to detect.

**Dark-Bright** means a “dark-to-light” transition or edge.

**Bright-Dark** means a “dark-to-light” transition or edge.

**Either** means both edges.

**Selection** - select which edge to use, or how to find the edges that define the measurement.

**Strongest** use the strongest edge found in the search area.

**First** use the first edge found in the search direction.

**Threshold** - a lower setting is better at detecting edges that are less sharp or less sudden transitions from dark to light (or light to dark). A higher setting may suppress false edges.

**Smooth** - number of times to apply a smoothing filter (low pass filter) in the edge search box, to remove noise effects.

**Samples** - the number of sampling points to find the edges (the number of scan or ruler lines) indicated by the pink crosses.

- f. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.
- g. Click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.
- h. Click the Accept button  to accept changes and close the Tip Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

## Using the Rake Tool

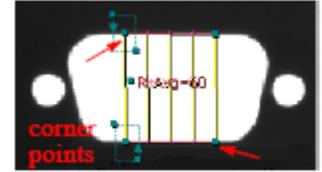


The Rake tool measures the distance between two parallel edges, by drawing a group of lines between the two edges and measuring the distance along the length of those lines. The Rake tool can also measure from one edge to a Pencil Line, or to the edge of the image area. The Rake tool cannot measure between two Pencil lines.

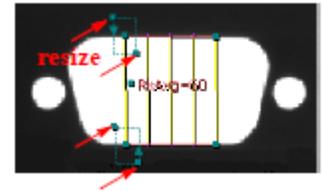
- a. Click on the “Rake” button. Move the mouse over the image in the Work Area. You should see the edges in the image highlighted as you move.
- b. Find two edges that match your measurement. Click on one edge (1), and a “rubber” line appears and follows your cursor movement. Click directly opposite (2) on the second edge. Now click along this second edge (3), to set the width of the Rake. Click directly opposite (4) on the first edge again. A group of “ruler lines” appears between the two edges, with four corner points.



c. When the Rake tool is selected, you can move the corner points if they are not exactly where you wanted. Moving the corner points also changes the spacing between the ruler lines.

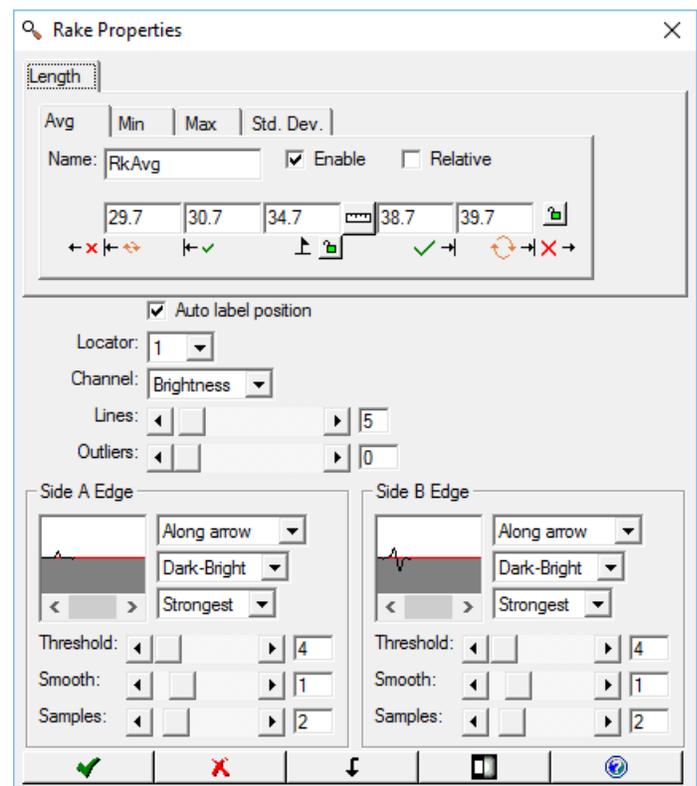


d. The small boxes that appear around the end points of each ruler line, define the search area for locating each end point. Small solid squares appear in the box around the endpoints of the first ruler line. You can drag these solid squares to resize the box and increase the search area, but searching more area also increases the processing time.



e. When you hover the cursor over the outer rectangle or the outside lines, the lines turn red, and a message appears telling you to “Right-click to edit.”

f. Right-click on the highlighted lines (or on the Rake tool in the Tool list). A Rake Properties box opens. There are tabs for the calculations available. You can use the tabs to select, enable and rename different measurements, set the tolerances for recycle and reject, change the “accuracy” (number of samples to find the edge at your endpoints) and the number of lines in the rake.



Tab	Measurement
Length: Avg	Mean or average distance measured along all rake lines. This measurement creates an array of measured distance values. All the individual distance values for each measurement line are displayable on the Monitor panel, and are available in the Scripting editor.
Length: Min	Minimum or shortest distance measured.
Length: Max	Maximum or longest distance measured.
Length: Std. Dev.	Standard Deviation of all measured distances, at all sample points.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the tool in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Lines** the number of ruler lines in the rake. Increase or decrease the number of measurements or samples.

**Outliers** – define a number of points to discard when finding the edges. A noisy or jagged edge may have a few points that are out of line with most of the points found. These could be considered data “outliers” and can be excluded or discarded.

### Side A Edge / Side B Edge

There are separate adjustments for the two search areas at the two end points of your measurement. These adjustments control locating the two edges. Side A is usually the first click point. Side B is usually the second click point. When you click on a slider or change a pull-down, a red circle appears in the image area, to indicate which side you are editing.

**Direction** - first drop-list selects the scan direction for finding the edges.

**Along arrow** means scan in the direction of the arrowhead on the search box outline.

**Against arrow** means scan in the opposite direction from the arrowhead on the search box outline.

**Polarity** - second drop-list selects the type of edge transition to detect.

**Dark-Bright** means a “dark-to-light” transition or edge.

**Bright-Dark** means a “dark-to-light” transition or edge.

**Either** means both edges.

**Selection** - third drop-list selects which edge to use, or how to find the edges that define the measurement.

**Strongest** use the strongest edge found in the search area.

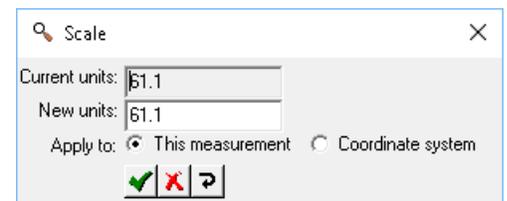
**First** use the first edge found in the search direction.

**Threshold** - a lower setting is better at detecting edges that are less sharp or less sudden transitions from dark to light (or light to dark). A higher setting may suppress false edges.

**Smooth** - number of times to apply a smoothing filter (low pass filter) in the edge search box, to remove noise effects.

**Samples** - the number of sampling points to find the edges (the number of scan or ruler lines) indicated by the pink crosses.

g. Click the Scale button  in the Rake Properties box, to set new units (Scale) on this one measurement, or on the whole coordinate system used for this camera view.



**NOTE:** If you enter new units, and select **Coordinate System**, clicking the “Accept” button in the Scale Properties immediately applies the changes to the whole coordinate system; clicking the “Cancel” button in the Distance Properties does not undo the change to the coordinate system. Click the Undo button  to undo scale changes and revert to Pixel Coordinates for the whole coordinate system. This removes Alignment Calibration for this camera view.

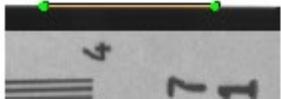
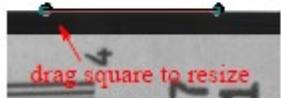
h. Click the Accept button  to accept changes and close the Scale box. Click the Cancel button to close without changes. Click the Undo button  to undo scale and calibration.

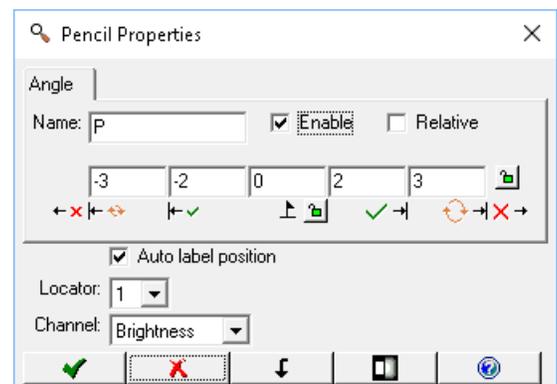
- i. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.
- j. In the Rake Properties box, click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.
- k. Click the Accept button  to accept changes and close the Rake Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

### Using the Pencil Tool



The Pencil tool draws a line on an edge, or from one point to another point or edge, or a “free” line at any location in the image. You can enable measuring the **slope** of the line. **The default is no measurement enabled.** You can use a Pencil line for setting up other measurements, usually for distance measurement.

- a. Click on the “Pencil” button. Move the mouse over the image in the Work Area. You should see the edges in the image highlighted as you move across them. You can start on a point, edge, or anywhere in the image. **If you start on an edge, the slope of the edge determines the slope of your line.**
- b. If you click on an edge, the pencil tool creates 2 sample points on the edge and uses the points to determine the slope of the pencil line. The length is controlled by your second click. You can click on the Point tool to see the search boxes around these two points. 
- c. With the Pencil tool selected you can drag the **square** endpoints of the pencil line, to increase the length. The slope does not change as you move the endpoints, unless the Pencil line was a “free” or floating line, not attached to points or edges. 
- d. When the Pencil tool is selected, you can drag the line to another location. The slope does not change when you drag the line. The click points remain on the edge. 
- e. If you have created Points on an edge, you can drag additional points onto a Pencil line to create a “best fit” line. With the Pencil tool selected, click on and drag a Point. A minus sign in a circle appears. As you drag the Point onto the line, the minus changes to a Plus sign, to signify the point can be released and will become part of the line’s sample points. The slope may change slightly when you add points to a Pencil line. The length of the Pencil line does not change, but the line may snap back onto the edge. You can also drag a point out of a Pencil line.
- f. When you hover the cursor over the line, the line turns red and a message appears telling you to “Right-click to edit.”
- g. Right-click on the line (or on the Pencil tool in the Tool list). A Pencil Properties box opens. In this box you can: enable measuring the **angle** of the line, change the tolerances for recycle and reject, or rename the line.



Tab	Measurement
Angle	the slope of the pencil line, from the first click point to the second click point. A horizontal line can be 0, 180, or -180 depending on the orientation of the second click to the first click.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the pencil line in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

h. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

i. Click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.

j. Click the Accept button  to accept changes and close the Pencil Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

### Using the Intensity Tool



The Intensity tool counts the number of pixels at each intensity value and calculates results based on the counts. This tool is sensitive to changes in light conditions. The Average and Standard Deviation measurements may be useful in detecting part presence/absence.

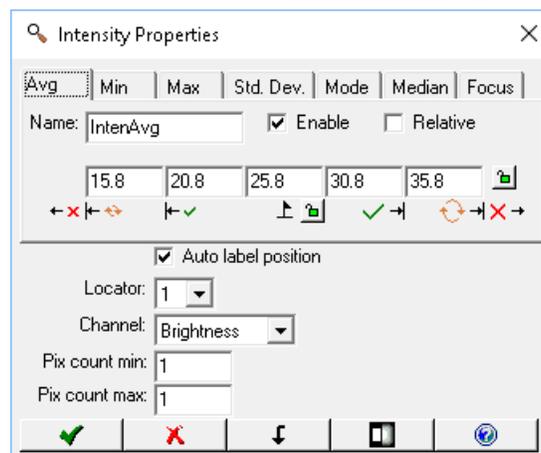
a. Click on the “Intensity” button. Select the Region shape. Refer to the Tip window for drawing suggestions.

b. Move the mouse over the image in the Work Area. There should not be any highlighted edges. Click, release, move the mouse and click again, to draw a Region shape on the image. The Region is labeled (IntenAvg). You can drag or resize the Region when the Intensity tool is selected.



c. When you hover the cursor over the edge of the Intensity tool, the Region outline turns red, and a message appears telling you to “Right-click to edit.”

d. Right-click on the Region outline (or on the Intensity tool in the Tool list). An Intensity Properties box opens. There are four tabs for the four calculations. Use the tabs and “Enable” check box to enable the calculations. The label changes with the calculation. More than one calculation can be enabled.



Tab	Measurement
Avg	Average (mean) pixel intensity value in the Region.
Min	Minimum pixel intensity value in the Region.
Max	Maximum pixel intensity value in the Region.
Std. Dev.	Standard Deviation of pixels intensity values in the Region.
Mode	Mode value: The intensity value that has the highest pixel count (largest number of members or largest population).
Median	Median pixel intensity value. If values are arranged in ascending order, the value in the middle (physically) is the median.
Focus	A value used to monitor changes in focus. The measured value depends on the image content. A change in the value indicates the focus (or image content) has changed.

**Name** - you can change the default name of the tool or measurement. The name or "label" is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the Region in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for monochrome intensity.

**Pix. Count min.** - sets a number (count) of darkest pixels to be discarded before calculating the intensity measurements. For example, if this value is 10, the 9 darkest pixels are discarded and pixel 10 represents the minimum value. This can be used to disregard dark anomalies from the intensity measure.

**Pix. Count max.** - sets a number (count) of brightest pixels to be discarded before calculating the intensity measurements. For example, if this value is 20, the 19 brightest pixels are discarded and pixel 20 represents the maximum value. This can be used to disregard bright anomalies from the intensity measure, such as bright reflections.

e. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

f. Click the padlock button beside "Perfect"  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.

g. Click the Accept button  to accept changes and close the Intensity Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

### Using the Count Tool



The Count tool looks for light objects on a dark background, or dark objects on a light background. The background does not have to be uniform. This tool is sensitive to changes in light conditions.

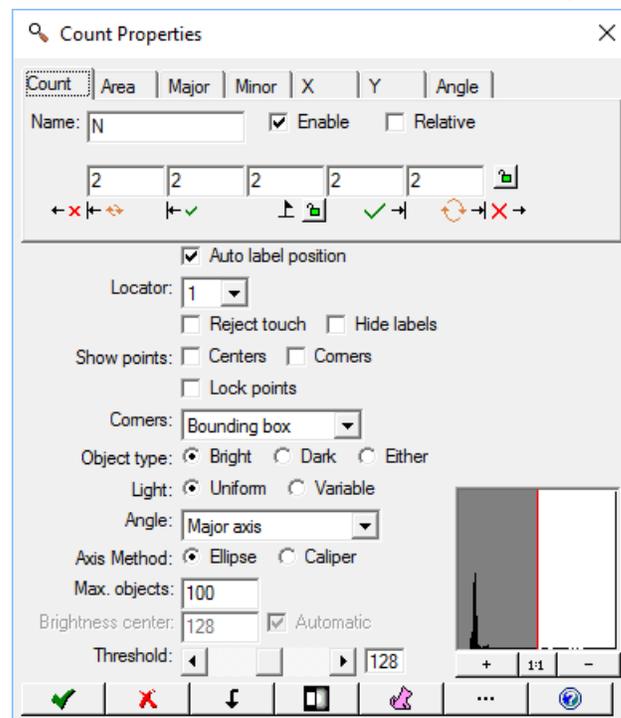
**Note:** The perceived "size" of a reflection changes greatly.

a. Click on the "Count" button. Select the Region shape. Refer to the Tip window for drawing suggestions.

- b. Move the mouse over the image in the Work Area. Click, release, move the mouse and click again, to draw a Region shape over the area where you want to count objects. iInspect draws (yellow) boxes around the blobs found. The Region is labeled (N, N1, etc.).
- c. When the Count tool is selected, you can drag the solid squares that appear at some corners, to resize the Region. You can drag the outline of the Region to reposition it.



- d. When you hover the cursor over the Count Tool, the Region outline turns red, and a message appears telling you to "Right-click to edit."
- e. Right-click on the Region outline (or on the Count tool in the Tool list). A Count Properties box opens. In this box you can: use the tabs to select, enable, and rename measurements, set the tolerances for recycle and reject, change the sensitivity and other settings. A higher sensitivity is more sensitive to defects or light changes.



Tab	Measurement
Count	count the number of objects, blobs or artifacts in the Region.
Area	measure the size (Area) of each object. This measurement creates an array of measured area values for all objects. All the individual area values are displayable on the Monitor panel, and are available in the Scripting editor.
Major	measure the major axis of each object. This measurement creates an array of measured values. All the individual values are displayable on the Monitor panel, and are available in the Scripting editor.
Minor	measure the minor axis of each object. This measurement creates an array of measured values. All the individual values for each measurement are displayable on the Monitor panel, and are available in the Scripting editor.
X	horizontal position of the center point of each object. This measurement creates an array of values. All the individual position values for each object are displayable on the Monitor panel, and are available in the Scripting editor.
Y	vertical position of the center point of each object. This measurement creates an array of values. All the individual position values for each object are displayable on the Monitor panel, and are available in the Scripting editor.
Angle	angle (of the major axis or longest edge, selected by the <b>Angle</b> parameter) from the horizontal, for each object. This measurement creates an array of measured values. All the individual values are displayable on the Monitor panel, and are available in the Script editor. The CountAngle reported in the Monitor is the average of the angles found for all objects.

**Name** - you can change the default name of the tool or measurement. The name or "label" is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the Region in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Reject touch** - do not include objects that touch the outline edges of the Region you created.

**Hide labels** - Use this check box to hide the number "labels" on each object. Normally the tool puts a number "label" beside each object found. If there are many objects this can be distracting.

**Show points** - displays points for each object found in the Region and allows you to use the points in other measurements. **Center** the center point of each object. **Corners** the top-left and bottom-right corners of the bounding box for each object found.

**Lock points** - locks the position of points found by this tool. The point position is not updated by changes to the Count tool such as a new image, parameter changes or a change in the tool outline. This feature only has effect in the Tools Setup and does not lock the points in the Run panel. This feature prevents deleting tools which are attached to points created by the Count tool (when snapping new image or making changes).

**Corners** - changes behavior when the Show points selection is Corners. **Bounding box** = use the corners of the bounding box rectangle that surrounds the blob object. **Major axis** = use the end points of the calculated major axis. The **Axis Method** should be **Caliper** when using the Major axis endpoints.

**Object type** - **Bright** means identify and count bright objects on a dark background. **Dark** means identify and count dark objects on a bright background. **Either** means find both bright and dark objects.

**Light** - type of light falling on the object or light variation across the Region. **Variable** means the light may vary across the object (left to right or top to bottom). Selecting **Variable** turns on "local adaptive threshold" but is less sensitive to background variation. Selecting **Uniform** turns on "adaptive threshold" that is applied uniformly to the whole Region.

**Angle** - measure and report angle of the **Major axis** or **Longest straight line** in the object. The choice depends upon the shape of objects you are looking for. The **Major axis** is computed by estimating an "equivalent ellipse" object with the moments of inertia as the actual object. This is a quick calculation that provides a very good estimate of the major axis for objects that are close to an ellipse or rectangle shape. This does not work for square or nearly square objects. The **Longest straight line** selects one side of the square and reports the angle. This works well for squares, but not well for other shapes.

**Axis Method** - selects a method for calculating the major axis of the blob object. **Ellipse** default or standard method calculates an "equivalent ellipse" for the blob. This is faster, but for some irregular objects it is not always the expected result. **Caliper** calculates a caliper diameter (also called Feret's diameter) based upon the largest width of the blob. The minor axis becomes the largest width perpendicular to the caliper diameter method's major axis. The caliper diameter is more accurate but requires more calculation time and is therefore slower.

**Max objects** - the maximum number of objects to find or expected in the image.

**Brightness center** - assign a "center" intensity threshold value, when the **Object type** is **Either** and the **Automatic** checkbox is cleared. The Brightness center is only used when the **Object type** is **Either**. If **Automatic** is checked, the center is calculated from the Region contents (this is the normal operation to detect and count objects or defects inside the Region). Assigning a center threshold means the count tool

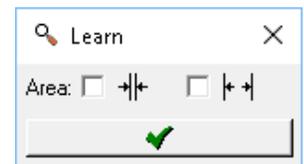
will count 1 object if the Region is completely filled with either all bright or all dark and will count 0 when the Region is filled with an intensity near to your "center" value. Use the Sensitivity to increase or decrease the area about this "center" value.

**Threshold** - a lower setting is more sensitive to defects or light changes. The field to the right (in the Properties window) shows the histogram or intensity plot (in black) for pixels along the Region, and the shaded area indicates the Threshold level. You can change the Threshold level using the slider, or by dragging the boundary between light and shade in the field. The slider and the boundary may move in the same direction, or in opposite directions, depending on the value of the **Object type** parameter. The shaded and white areas are reversed if you change the **Object type** setting.

f. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

g. Click the Learn button  to train or learn the maximum or minimum area from a series of "good" images.

A pop-up allows you to select **Min Area**, **Max Area**, or both. If selected, the min or max tolerances and parameters will be adjusted according to the series of images. **Remember to turn off this feature before inspecting parts!** The train icon appears in the tool label  **N=6** to show you are in Learn mode.



h. Click the padlock button beside "Perfect"  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.

i. Click the Advanced button  to change limits on the range of object (blob) sizes detected, using the *Object Selection* menu. (refer to the next page).

j. Click the Accept button  to accept changes and close the Count Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

## Object Selection

The **right pane** shows the measured values for the objects found. You can click on the icons along the top row to sort the data values.

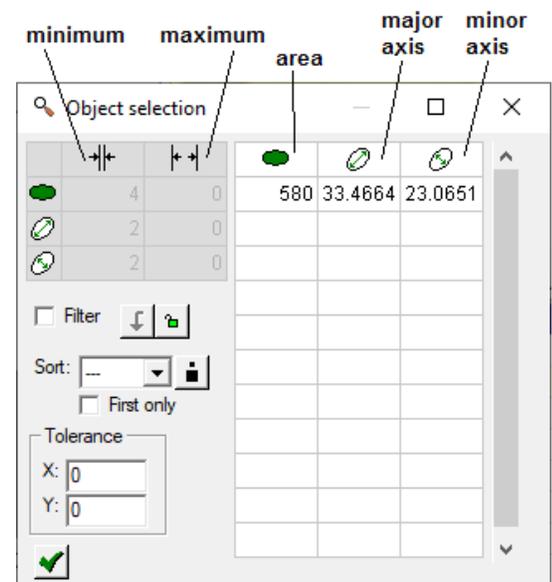
The **left pane** displays the Filter settings used to detect objects. You can enter new values in this pane. You can drag numbers from the right pane into the left pane. You cannot enter or drag values if the filter is locked or disabled. **Note:** The left pane is disabled if "Filter" is not checked.

### Left Pane

**Area** – minimum and maximum area of objects ("blob size"). With the Filter enabled, objects outside this range are not counted. A zero in the maximum field means there is no maximum limit.

**Major axis** - minimum and maximum for the major axis of objects. With the **Filter** enabled, objects outside this range are not counted. A zero in the maximum field means there is no maximum limit.

**Minor axis** - minimum and maximum for the minor axis of objects. With the **Filter** enabled, objects outside this range are not counted. A zero in the maximum field means there is no maximum limit.



**NOTE:** The minimums for Area, Major axis and Minor axis are initially set to 10% of the objects first detected when you draw the Region. These may need adjusting, depending on lighting or the range of defects. Objects smaller than the minimum settings, or larger than the maximum settings will be ignored. A zero in the maximum field means there is no maximum limit. Objects that are 2x2 pixels or smaller are ignored.

**Filter** - enable or disable using the filter values. Check the box to use the limits in the table. Clear the checkbox to disable the filter and ignore the ranges or limits in the table. Click the Apply button  to apply the filter changes without exiting this menu. Click the padlock button  to lock/unlock the filter values so they do not change as you adjust the size of the region or other property settings.

**Sort** - select a measurement or parameter to use for sorting the objects found: **X coordinate, Y coordinate, Area, Major axis, Minor axis**. Click the **Sort** button to change the sort direction. **Ascending**  sorts objects from smallest to largest. **Descending**  sorts objects from largest to smallest.

**First only** - check this box to report only the first object in the sorted list: the Sort selection and the ascending/descending button defines the “first” value. If the order is ascending, the first value is the minimum. If the order is descending, the first value is the maximum.

**Tolerance** – minimum distance between blobs. If the distance is smaller than the tolerance the blobs are considered one blob. **X** minimum horizontal distance, **Y** minimum vertical distance.

Click the Accept button  to apply your changes and close this window.

### Using the Match Tool

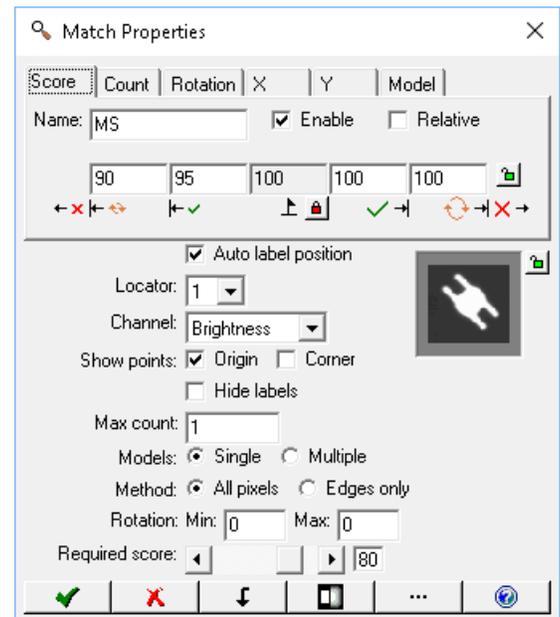


The Match tool compares the selected area to the same area in the trained image (“Golden template”) and returns a percentage score on the quality of match. Match may be useful for part presence/absence or creating a Locator.

- Click on the “Match” button. Move the mouse over the image in the Work Area. There should not be any highlighted edges.
- Click, release, move the mouse and click again, to draw a rectangle Region on the image. The Region is labeled (MS, MS1, etc.). The inside rectangle is the match Pattern. The outside rectangle is the Search area.
- When the Match tool is selected, you can drag the pattern area to another location. You can resize the pattern area or the search area by dragging the solid squares at the corners.



- d. When you hover the cursor over the edge of this tool, the Region outline turns red, and a message appears telling you to “Right-click to edit.”
- e. Right-click on the Region outline (or on the Match tool in the Tool list). A Match Properties box opens. In this box you can: use the tabs to select, enable and rename measurements, change the tolerances for recycle and reject, and change the other settings.



Tab	Measurement
Score	The quality of the match (in percent) for each object found. The 2-sided Tolerance allows training on a known defect. If you train on a “perfect” part, the value for Perfect and two fields to the right should also be 100. <b>You must lock</b> the Tolerances and Perfect values so they do not change when you close or reopen the Properties box. When the number of objects is greater than one, this measurement creates an array of measured score values for all objects. All the individual score values are displayable on the Monitor panel, and are available in the Scripting editor.
Count	The number of matches found.
Rotation	The angle of rotation for each object. The rotation angle is reported at the <b>Accuracy</b> selected in the Setup Calibration panel. When the number of objects is greater than one, this measurement creates an array of measured rotation values for all objects found. All the individual rotation values are displayable on the Monitor panel, and are available in the Scripting editor.
X	The horizontal position for the center point of each object. This measurement creates an array of values. All the individual position values for each object are displayable on the Monitor panel, and are available in the Script editor.
Y	The vertical position for the center point of each object. This measurement creates an array of values. All the individual position values for each object are displayable on the Monitor panel, and are available in the Script editor.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the Region in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Show points** - displays a point at the center (**Origin**) or **Corner** of the object found in the Region and allows you to use the point(s) in other measurements. You can also use the Point tool to drag the “center” point to a different position. This may be useful in some targeting applications like Robot guidance.

**Hide labels** - Use this check box to hide the number "labels" on each match object found. Normally the tool puts a number "label" beside each object found. If there are many objects this can be distracting.

**Max count** - the number of matches expected in the search area. This allows the tools to find multiple matches in one search area or stop searching when the Max count is reached.

**Models** select Single model or Multiple models. The Pattern Template window is not active if you select Multiple Model mode.

**Method** - what kind of template or type of pattern matching used. **All pixels** use the intensity of all pixels in the pattern template. **Edges only** use the edges in the template or pattern and ignore the pixel intensity values.

**Rotation** - range (in degrees) for rotation of the match object. **Min** - Enter a negative number for counter-clockwise rotation. **Max** - Enter a positive number for clockwise rotation. **NOTE:** You can enter rotation limits of Min= -180 and Max= 180, or Min= 0 and Max= 360.

**Required score** - sets a minimum acceptance or threshold for the score of each match. Potential matches that do not meet this minimum are discarded or not reported. **Note:** If you set this to zero, the reported score will always be zero! The **Required score** should be 70 or greater.

f. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

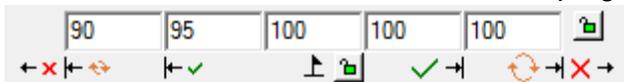
g. Click the padlock button beside "Perfect"  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values. Click the padlock button beside the Pattern image, to lock the Pattern, so it does not change if you reopen the Match Properties.

h. Click the Advanced button  to open additional setup menus for more control on the model and run time.

i. Click the Accept button  to accept changes and close the Match Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

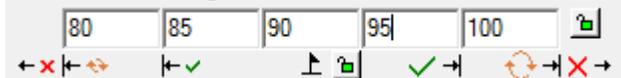
### Match Score Tolerance

If you trained the Pattern Locator tool on a "perfect" part, the perfect part with no defects, the "perfect" part would have a score of 100, and a defective part would have a score less than 100. The Tolerance values would be programmed something like this:



You must lock the Tolerances and Perfect values so they do not change when you close or reopen the Match Tool Properties.

If you train the Pattern Locator tool on a part with a known defect, the defective part would have a score of 100, and a good part would have a score less than 100, because the defect is missing. The Tolerance values would be programmed something like this:



For this example, the good part has a score of 90, and the know defect has a score of 100. You will have to test your part to see what score a good part produces. You must lock the Tolerance and Perfect values so they do not change when you close or reopen the Match Tool Properties.

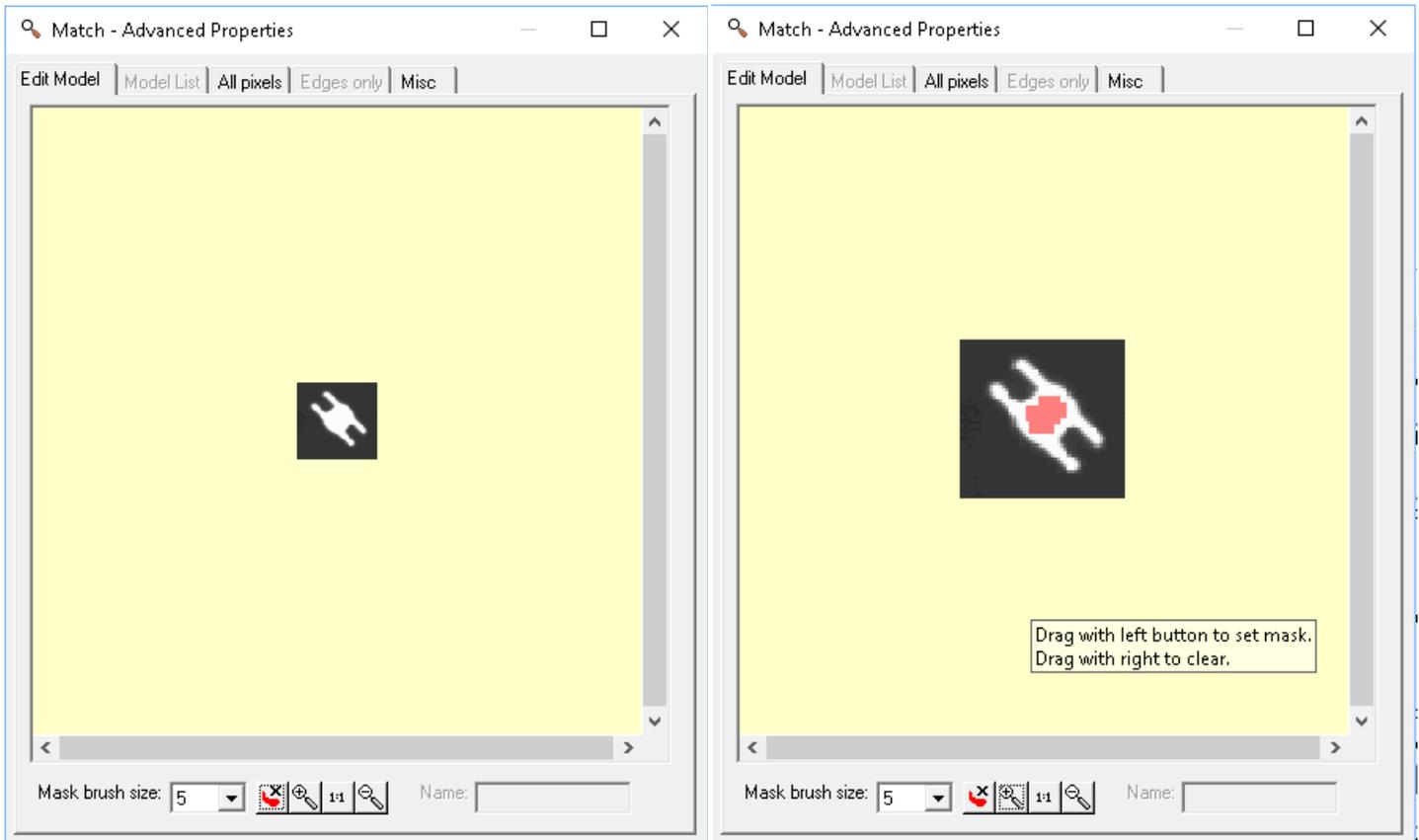
## Advanced Properties - Mask Editing

You can zoom in or out and paint out areas you do not want included in your match template, as shown in the image on the right. **Note:** Masking does increase the inspection time.

### How to Edit Mask

1. Click or drag with the left mouse button to paint out (mask) pixels.
2. Click or drag with the right mouse button to erase (undo) part of the mask.

Any area shown in Red will **not** be included in the template. This is useful for eliminating any features or textures in the background, or something that may be allowed to change in the match object.



**Mask Brush size** controls how large an area each mouse click will paint out.

 **Remove Mask** – Deletes the mask. Returns to the original model captured.

 **Zoom in** - Enlarge the template image.

 **Reset zoom** – Return to the original size.

 **Zoom out** - Shrink the template image.

**Name** – The active model name field in Multiple Models mode. Active model is selected in the Model List tab.

### Advanced Properties - All Pixels Parameters

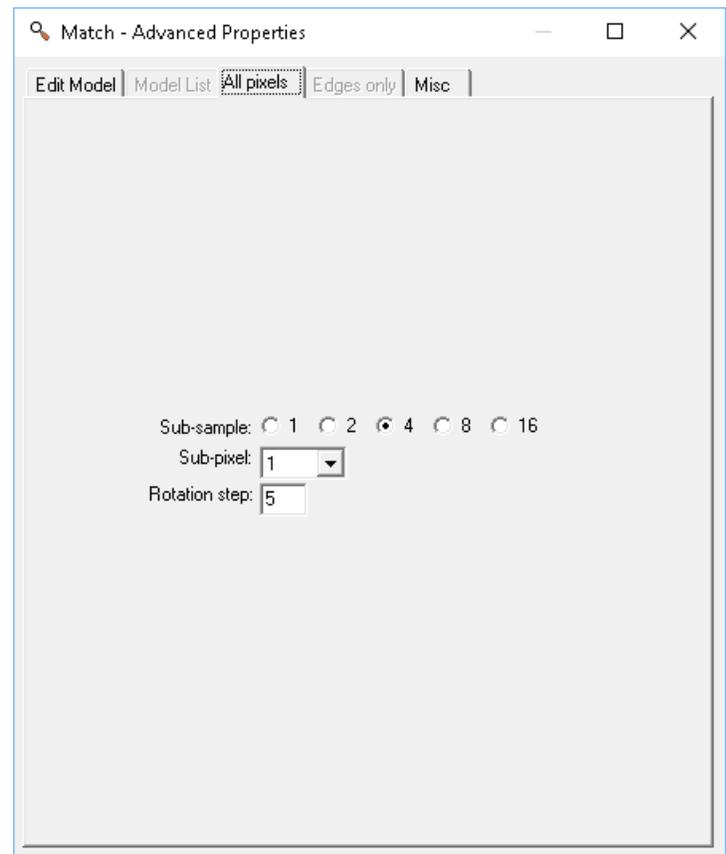
This tab is for editing parameters that are only used with “All Pixels” matching. (This is also known as a grayscale correlation match.)

Matching is performed as a two-step process. First a low-resolution (sub-sample) search is performed on the entire search area, to locate a potential match. Then a high-resolution (sub-pixel) search is performed around each potential match candidate, to find an accurate match and position.

**Sub-sample** - speeds up the tool by scaling down or sub-sampling the image and the pattern (similar to a zoom out) comparing half, one fourth, one eighth, or one sixteenth of the data at the low-resolution step of the match and increasing to the full data (no sub-sample) at potential match sites. Sub-sampling can miss matches if the pattern is complex or has tiny features that are lost when sub-sampled.

**Sub-pixel** - select the accuracy of match location in the high-resolution step. The value of 1 is fastest. The value of 1/64 is highest precision at slower speed.

**Rotation Step** - Enter a positive whole number (integer) for the step size (in degrees). Rotated copies of the model are created rotated by this step size, to compare to the image. A larger step size is faster, but accurate only if the rotation is at fixed values. A smaller step size is more accurate for variable rotation but takes more time.



## Advanced Properties - Edges Only Parameters

These two tabs are used with “Edges Only” matching. The “Target” tab (left image) affects the match candidates in the inspection images. The “Model” tab (right image) affects the match template at runtime.

Matching is performed as a two-step process. First a low-resolution (Coarse) search is performed on the entire search area, to locate a potential match. Then a high-resolution (Fine) search is performed around each potential match candidate, to find an accurate match and position.

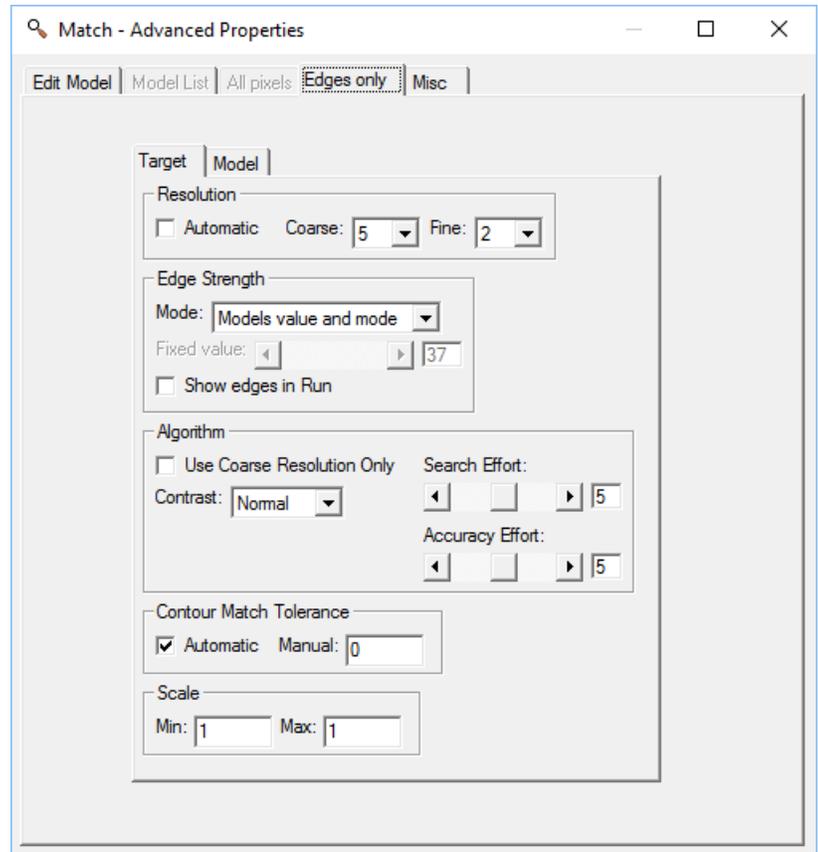
**Target tab** parameters are attached to the match target (or match candidate) in the inspection image:

### Resolutions

**Automatic** - calculates the coarse and fine resolutions based upon the template (model) contours.

**Coarse** - the contour sub-sample or scale down used in the low-resolution step. A value of 1 is no scale or full resolution. A value of 4 is sub-sampled or scaled to 1/4 size. Using a higher value makes the search faster but can miss smaller features. Usually the value of **Coarse** is larger than the value of **Fine**.

**Fine** - the contour subsample or scale down used in the high-resolution step. A value of 1 is no scale or full resolution. A value of 4 is sub-sampled or scaled to 1/4 size. Using a higher value makes the search faster but can miss smaller features.



### Edge Strength

**Mode** - adjusts the sensitivity of the edge strength threshold to control the amount of points.

**Low** Calculates a low-sensitivity adaptive threshold (from the image contours) so a small amount of contour points are detected.

**Normal** Calculates a normal-sensitivity adaptive threshold (from the image contours) so a reasonable amount of contour points are detected.

**High** Calculates a high-sensitivity adaptive threshold (from the image contours) so a large amount of contour points are detected.

**Manual** allows you to use the **Fixed value** slider to set a specific edge strength.

**Models mode** uses the Edge Strength Mode setting from the “Model” tab.

**Models value** uses the Edge Strength Fixed Value setting from the “Model” tab.

**Models value and mode** uses the lesser or lower of the Edge Strength Mode and Fixed Value settings in the “Model” tab.

**Show edges in Run** – display the match target’s edges in the Run panel.

### Algorithm

**Use Coarse Resolution only** - skip the second pass at fine resolution. Only use the coarse resolution pass to find matches. This speeds up the matching process.

**Contrast** - Selects the contrast mode accepted for the search. The contrast identifies the direction of change in gray-scale values between an object and its neighborhood. The contrast direction is defined with respect to the initial polarity of the model.

**Normal** the contrast must be the same as the trained model.

**Reverse** the contrast is the opposite of the trained model.

**Both** allows both contrast directions, but one at a time (normal OR reversed).

**Any** allows both contrast directions together (normal AND reversed). There can be reversal within the match candidate or within the background.

**Search Effort** - effort level of the search process. A value of 0 will lead to a faster search that may miss matches that are partly occluded. A value of 10 is useful for finding partly occluded matches in cluttered or noisy images, or for models made up of small contours.

**Accuracy Effort** - effort level of the positioning process. A value of 0 will provide rough positioning and faster execution time. A value of 10 will provide high accuracy positioning of the matches.

**Contour Match Tolerance** - how much position deviation (elasticity, stretch or flex) is allowed between the template (Model) and the match candidates. **Automatic** the tolerance is determined from the size of the contours in the template image. **Manual** a fixed value for the contour position deviations.

**Scale** - the range of scaling or size difference allowed. Values of 1 mean the candidates are (must be) the same size as the template. Increasing the range of scale increases the execution time (slower execution).

**Min** the minimum scale factor or smallest size. **Max** the maximum scale factor or largest size.

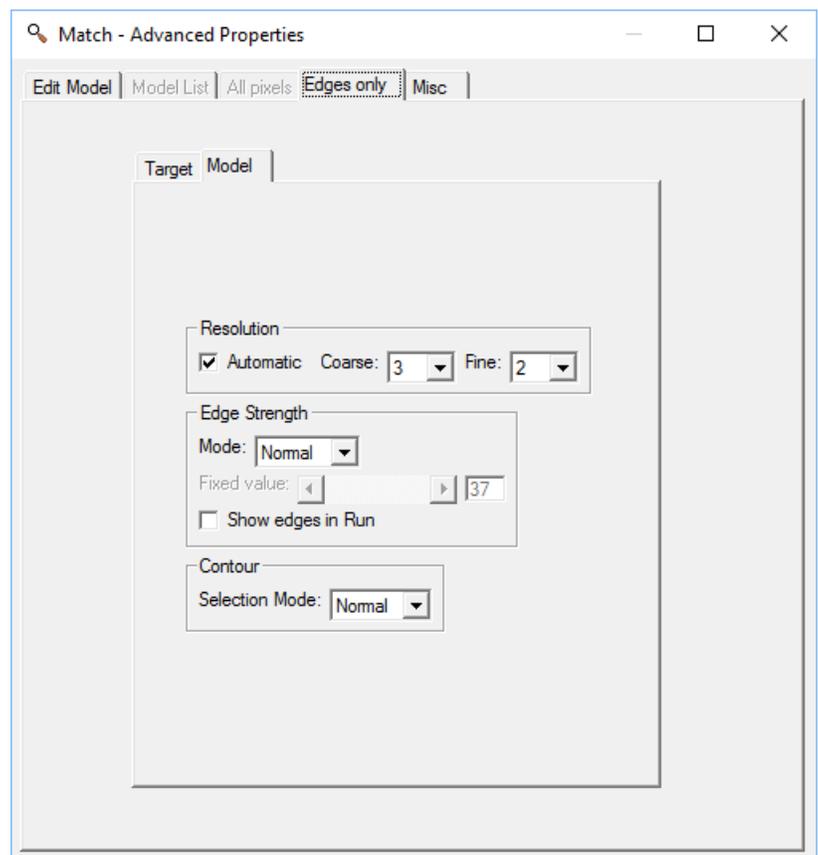
**Model tab** parameters are attached to the trained template (model):

#### Resolutions

**Automatic** calculates the coarse and fine resolutions based upon the template (model) contours.

**Coarse** - the contour sub-sample or scale-down used in the low-resolution step. A value of 1 is no scale or full resolution. A value of 4 is sub-sampled or scaled to 1/4 size. Using a higher value makes the search faster but can miss smaller features. Usually the value of **Coarse** is larger than the value of **Fine**.

**Fine** - the contour sub-sample or scale-down used in the high-resolution step. A value of 1 is no scale or full resolution. A value of 4 is sub-sampled or scaled to 1/4 size. Using a higher value makes the search faster but can miss smaller features.



#### Edge Strength

**Mode** - This parameter adjusts the sensitivity of the edge strength threshold to control the amount of points.

**Low** Calculates a low-sensitivity adaptive threshold from the input image so that a small amount of contour points are detected.

**Normal** Calculates a normal-sensitivity adaptive threshold from the input image so that a reasonable amount of contour points are detected.

**High** Calculates a high-sensitivity adaptive threshold from the input image so that a large amount of contour points are detected.

**Manual** allows you to use the **Fixed value** slider to set a specific edge strength threshold.

**Show edges in Run** – display the trained model's edges in the Run panel.

#### Contour

**Selection Mode** - determines which contours of the template (model) are included.

**Low** selects only the strongest contours (highest edge strength).

**Normal** selects a medium range of contours.

**High** selects most of the contours.

**All** includes all contours found in the template (model).

### Advanced Properties - Misc Parameters

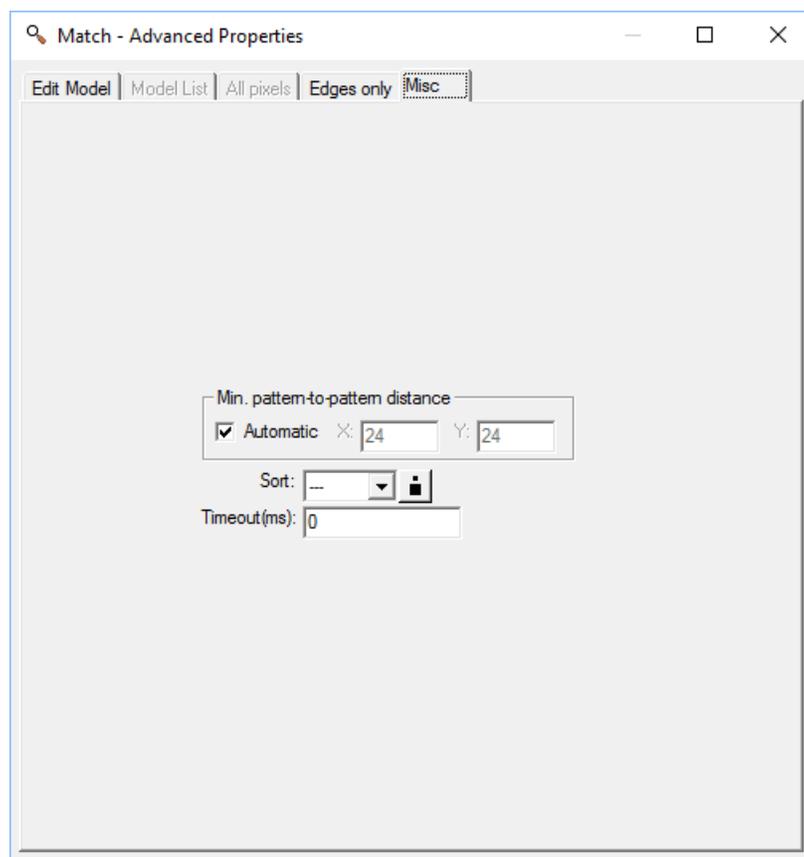
The Miscellaneous parameters apply to all models or matching methods.

**Min. pattern-to-pattern distance** - defines and area around each match candidate, where candidates of lesser scores will be ignored. This similar to a “quiet zone”. Real matches are not expected to be found any closer than this. **Automatic** calculates vicinity values based on the size of the template. **X** sets a horizontal distance in pixels. **Y** sets a vertical distance in pixels.

**Sort** - you can sort the match results by one of the measured values: **Score**, **Angle**, **X** coordinate, **Y** coordinate. Use the button to select ascending or descending order.

**Ascending**  sorts by the selected value, from smallest to largest. **Descending**  sorts by the selected value, from largest to smallest.

**Timeout (ms)** – set a timeout or maximum execution time for the Match tool A value of 0 means there is no timeout (timeout = false).



### Advanced Properties – Model List

This tab is only active if you selected Multiple models. The display area shows the current contents of the Pattern ROI in the main image window, and any trained models. The selected model (Red highlight) appears in the Edit Model tab.

 Change the selected model to the current content of the Pattern ROI.

 Add a new model from the current content of the Pattern ROI.

 Delete the selected model.

**No of models:** the number of trained models.

**Name:** enter a name to display for multiple models, or you can leave the default numbers.

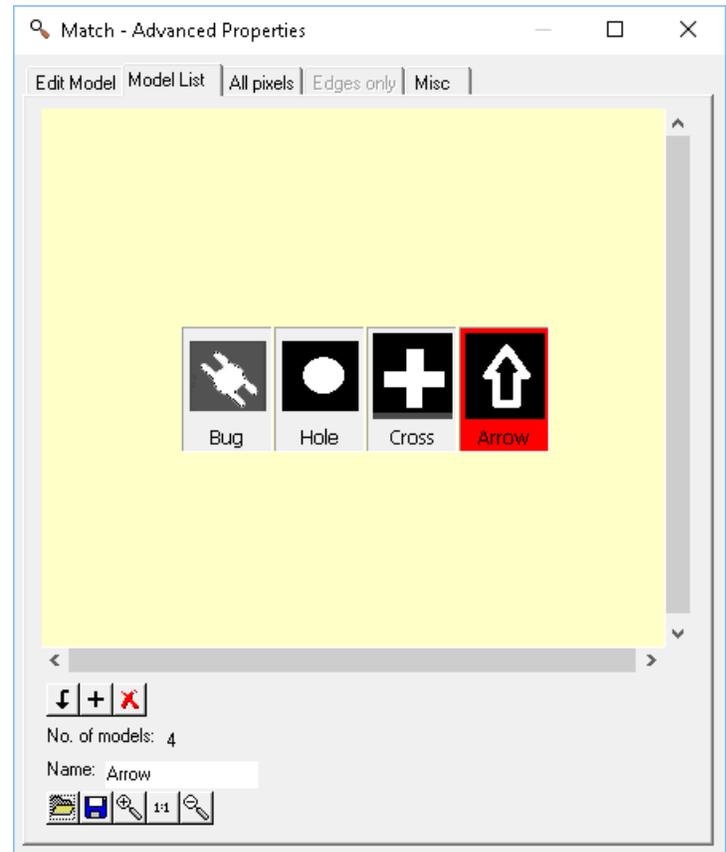
 Open or import a saved model file. **Note:** All models in a directory are imported.

 Save or export the selected model; one at a time.

 Zoom in or enlarge the image.

 Reset zoom to original size.

 Zoom out or reduce the image.



### How to Train or Add Multiple Models

1. When you select this tab, the content of the Pattern Region in the main image window appears and is highlighted or selected. Enter a Name for this model.
2. If you wish to add another model, there are a couple ways to capture a new model image:
  - a.) Without closing the Advanced Properties, you can move the ROI in the main image window to enclose the new model.
  - b.) Close the Advanced Properties and the Match Properties. Use the “Take a Picture” or “Snap Trigger” buttons in the Navigation panel to capture a new image with the new model. Move the ROI if needed. Reopen the Match Tool Properties and click the Model List tab.
3. Click the Add button in the Model List tab. A copy of the content of the Pattern Region appears beside the saved model.
4. Click on the new model and enter a name.
5. Repeat for all the models you need.
6. If you are finished and do not need to add another model close the Advanced Properties.

### How to Rename a Model

1. Click on a Model in the window. The selected model is framed in Red.
2. Type a new name in the Name filed.
3. Close the Advanced Properties window, or click on another tab.

### How to Edit or Retrain a Model

1. In the main image window, move or adjust the Pattern ROI.
2. Open the Match Properties. Open the Advanced Properties.
3. Click the on the Model you wish to change then click the Apply button. 

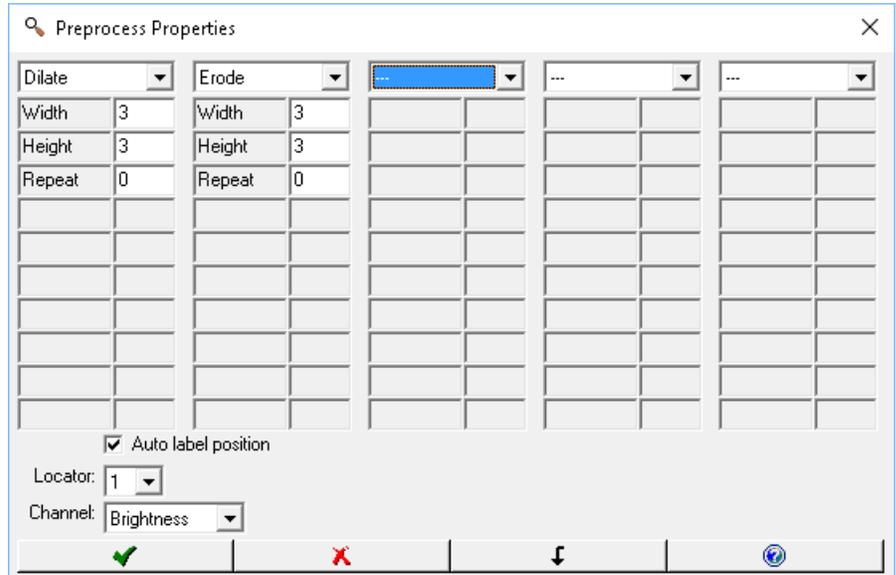
## Using the Preprocess Tool



The Preprocess tool applies a filter to alter the image data in the Region shape. You can use a preprocessor to filter noise or enhance edges in the image.

- Click on the “Preprocess” button. Select the Region shape. Refer to the Tip window for drawing suggestions.
- Move the mouse over the image in the Work Area. Click, release, move the mouse and click again, to draw a Region shape on the image. The Region is labeled (Pre, Pre1). You can drag or resize the Region when the Preprocess tool is selected.
- Hover your cursor over the edge of the Preprocess tool. The Region outline turns red, and a message appears telling you to “Right-click to edit.”
- Right-click on the Region outline (or on the Preprocess tool in the Tool list). A Preprocess Properties box opens. In this box you can choose up to 5 preprocessors, change the values of some preprocessors, select a locator or a color channel.
- Use the drop-lists at the top to select a preprocessor.

Please refer to “Using Preprocessing” on page [23](#), or the on-line help, for a complete list of available preprocessors.



**Auto label position** - puts the label (Pre, Pre1, etc.) beside the Region in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

- Click the Accept button to accept changes and close the Preprocess Properties box. Click the Cancel button to close without changes. Click the Apply button to apply changes without closing the Properties box.

## Using the 2-D Barcode Tool

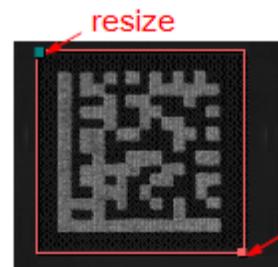


The 2-D Code tool reads DataMatrix, QR-codes, Micro-QR and PDF417 code. Light, lens, focus, exposure and distance (size of the code in the image) affect the ability to read a code.

- Click on the “2D Barcode” button. The Rectangle shape can read codes at any angle.
- If you are using the Search option, to separate codes from a noisy background, select a Region shape (below the Tip windows). Use Rectangle for text at 0, 90, 180, and 270 rotations. Use Polygon for text at any angle (not 90-degree increments). Polygon draws a rectangle at any angle. Refer to the Tip Window.

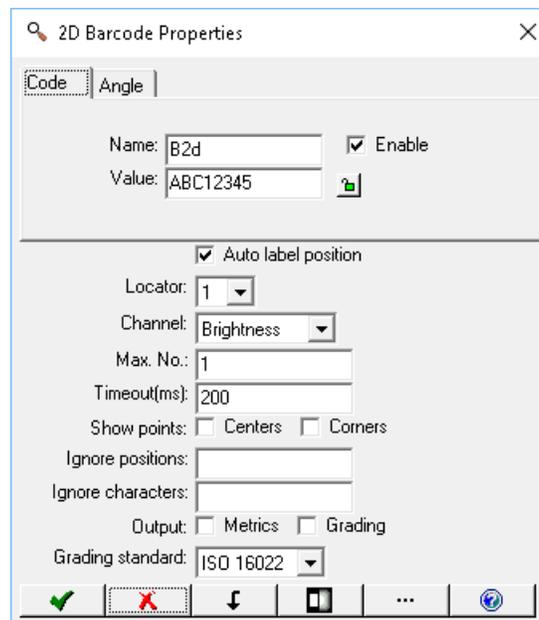
c. Move the mouse over the image in the Work Area. You should not see highlighted edges. Click, release, move the mouse and click again, to draw a rectangle around the Code. When the 2D Code tool is selected, you can move and resize the rectangle.

**Note:** The maximum Region size is 2048 x 2048. When using the Quick algorithm, if DPM option is changed from None, the maximum width is 1280 and the maximum size is 1280 x 960 (1228800 pixels).



d. When you hover the cursor over the edge of the rectangle, the rectangle turns red, and a message appears telling you to “Right-click to edit.”

e. Right-click on the highlighted rectangle (or on the 2D Barcode tool in the Tool list). A Properties box opens. In this box you can: enable, and rename measurement, enter a fixed code **Value**, and adjust parameter settings.



Tab	Measurement
Code	The code value read; or enter a fixed value for comparing to the read value.
Angle	The angle of the code, defined by a line drawn from the top-left to top-right corners, relative to the horizontal or otp edge or the image area. Clockwise is positive.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Value** - If the code was read with the current settings, it will appear in this field. If the code value should always be the same, type the expected value beside **Value**. The measurements will fail if the value read does not match this value. If the code value changes, leave an asterisk “\*” in this field; the measurement will report any value read and will only fail if unable to read any value. “?” is a single character “wild card”. “\*” is a multiple character “wild card”. The Padlock button  allows you to lock the **Value**, so it does not change while you move or resize the Region. The **Value** should be unlocked while you change parameter settings.

**Auto label position** - puts the **Name** label beside the Region in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Max. No.** - number of expected codes in the ROI. Increase this number if you have more than one code in your ROI. You can define a ROI with multiple codes, or multiple ROIs with one code in each. The maximum number is 64. Larger values result in an error message.

**Timeout(ms)** - sets a timeout (in milliseconds) for difficult, degraded, or nonexistent codes. This includes the decode or code reading algorithm but does not include added preprocessing time.

**Show points** – displays points and allows you to use them in other measurements.

**Center** the center point of the “bounding box” surrounding a code.

**Corners** the four corners of the “bounding box” surrounding a code.

**Ignore positions** - skips or ignores character positions in the string. You could ignore unimportant, unrelated or changing positions. Enter position numbers (only) separated by spaces. Use 1 for the first character position (not 0), use 2 for the second character, etc.. Use -1 for the last character, use -2 for the next to last or second from last character.

**Ignore characters** - skips or ignores characters that sometimes are added to some barcodes.

The “ignore” steps are applied after decoding. The position and character filters are applied at the same time. For example, if position 1 is ignored, and character \$ is ignored, a decoded string \$1234\$ has a result of 1234.

**Output** - enable additional output data.

**Metrics** adds details about the codes.

**Grading** enables calculation and output of the grading results.

**Grading standard** - select which grading standard is used for calculating grading.

- f. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.
- g. Click the Advanced button  to adjust additional settings. The **Value** should not be locked when you make these changes.
- h. Click the Accept button  to accept changes and close the 2D Barcode Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

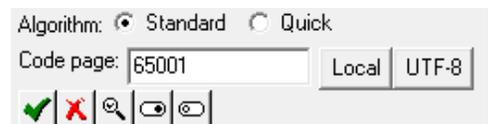
### Advanced Properties

The check bubbles and buttons at the bottom are common to all tabs.

**Algorithm:** select the **Standard** or **Quick** code reading algorithm.

**CodePage** displays the code page for decoding characters. Unicode

is now widely in use, but some codes still incorporate older code page characters in International Wide Character Encoding. The two buttons enter the most typical values. A different code page number can be typed in the field.



**Local** sets the code page to the same as the local language setting for the PC.

**UTF-8** sets the code page to the Unicode standard 65001 (Unicode Transformation Format 8).

 The Accept button applies your changes and closes the Properties edit box.

 The Cancel button closes the Properties edit box without changes.

 The “Identify” button automatically identifies and selects the code type in the ROI.

 The “Select all” button enables all code types on all tabs.

 The “Deselect all” button disables all code types on all tabs.

### Matrix Quality Standards and Outputs

The following table shows which available outputs are valid under each of the Matrix Quality Standards. Definitions appear below the table. Some outputs present both a “grade” and a “value”. Some outputs present only a “grade”. For more detailed information refer to the on-line help or the documentation for these standards, as published by the governing organizations: AIM “DPM Quality Guideline”, ISO/IEC 15415, ISO/IEC 16022 or SAE AS9132.

**NOTE:** iNspect uses an image, not multiple laser scans. This affects the validity of the “Overall Grade” calculations. *Please refer to the on-line Help for more details.*

#### Matrix Quality Standards and Measurements

Available Measurements	ISO/IEC 15415	ISO/IEC 16022	AIM DPM	AS9132
Angle distortion value & grade				◆
axial nonuniformity value & grade	◆	◆	◆	
cell contrast value & grade			◆	
cell modulation grade			◆	
fixed pattern damage grade	◆		◆	
grid nonuniformity value & grade	◆		◆	
minimum reflectance value & grade				
modulation grade	◆			
overall grade	X	◆	X	
Overall dot center offset grade				◆
Overall dot ovality grade				◆
Overall dot size grade				◆
print growth grade		◆		
print growth value	◆	◆		
scan grade	◆			
symbol contrast value & grade	◆	◆		
unused error correction value & grade	◆	◆	◆	
angle distortion value & grade				
overall dot size grade				
overall dot center offset grade				
overall dot ovality distortion				

◆ - Defined by this standard.

X - Defined but not a valid measurement in iNspect Express. No value is reported. Refer to the on-line Help for details.

## Standard Algorithm Properties

### Symbologies Tab

Select what types of codes (Symbologies) you want to read or decode. You can make multiple selections if your code types will change, but this can increase the inspection time.

**Data Matrix** - enabled decoding Data Matrix

**Size** - select a defined square or rectangular size, or auto-detect size.

**Minimum Print Growth, Maximum Print Growth** and **Nominal Print Growth** are ratios which are defined by the ISO/IEC specification. Values are particular to the industry and code and are not defined in the specification.

**QR Code** - enables decoding QR codes.

**Size** - select a defined square or rectangular size, or auto-detect (Automatic) size.

**Model Type** - the model or type of QR code. There is no auto-detect mode.

**Micro QR** - enables detecting Micro QR Code.

**PDF417** - enables decoding PDF417 codes.

**Size** - select a defined square or rectangular size, or auto-detect (Automatic) size.

**# of cols** - the number of columns in the code

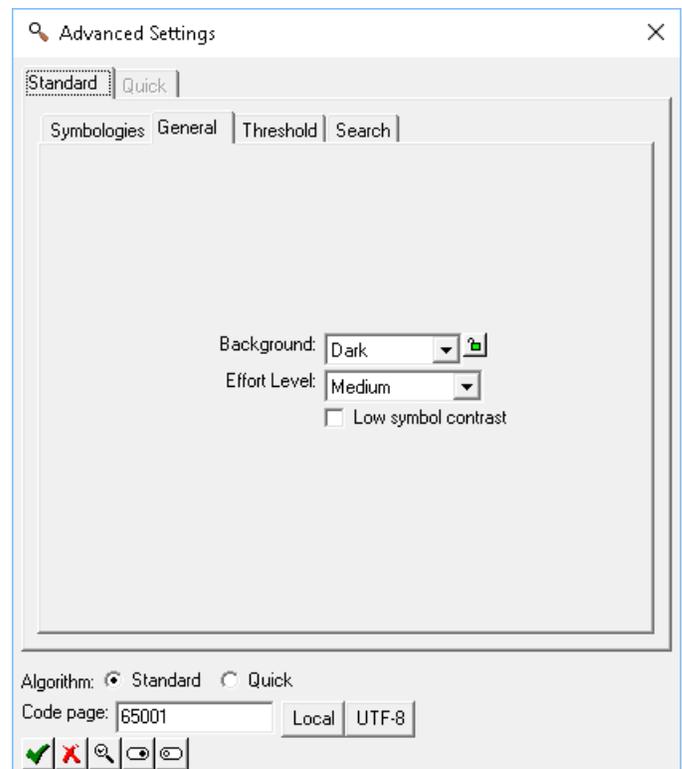
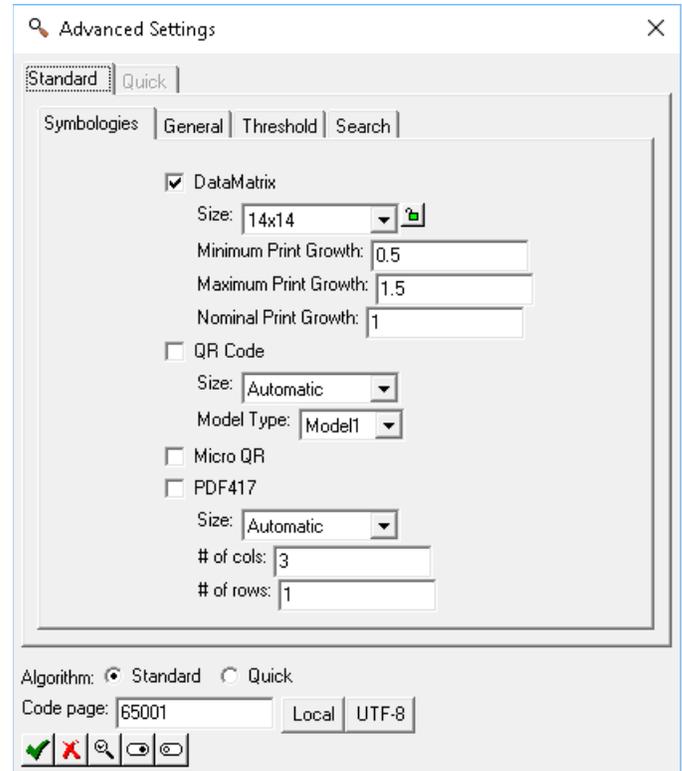
**# or rows** - the number of rows in the code.

### General Tab

**Background** - the type of background: Bright means dark codes on a light background. Dark means light codes on a dark background. Auto detect means the tool will try to decide which to use. You can lock the selection so it does not change when you edit the tool properties.

**Effort level** - apply a **Low** (relaxed), **Medium** or **High** (advanced or rigorous) read algorithm. A **High** setting is slower but is more rigorous and may perform better with degraded or poorly contrasted codes. A **Low** setting is faster, but less rigorous.

**Low symbol contrast** enables an edge detector, when the **Effort level** is set to **Low** or **Medium**, to find and read the code. This can improve speed when the contrast between the code and background is low. This can also allow reading more codes with **Low** and **Medium** effort, which may also improve speed by not requiring the **High** effort.



## Threshold Tab

**Method** - select the method for separating the barcode from the background. Threshold is disabled after orientation and code type are selected or detected. **Fixed** uses a single number (**Value**). This method works best when lighting is uniform or does not change. **Adaptive Global** calculates one threshold value for the whole Region, based on the intensities at the left and right sides of the Region. This method works best when the lighting changes gradually and evenly across the Region. **Adaptive Local** uses divisions or blocks within the Region to calculate several threshold values. This method works best when lighting is uneven.

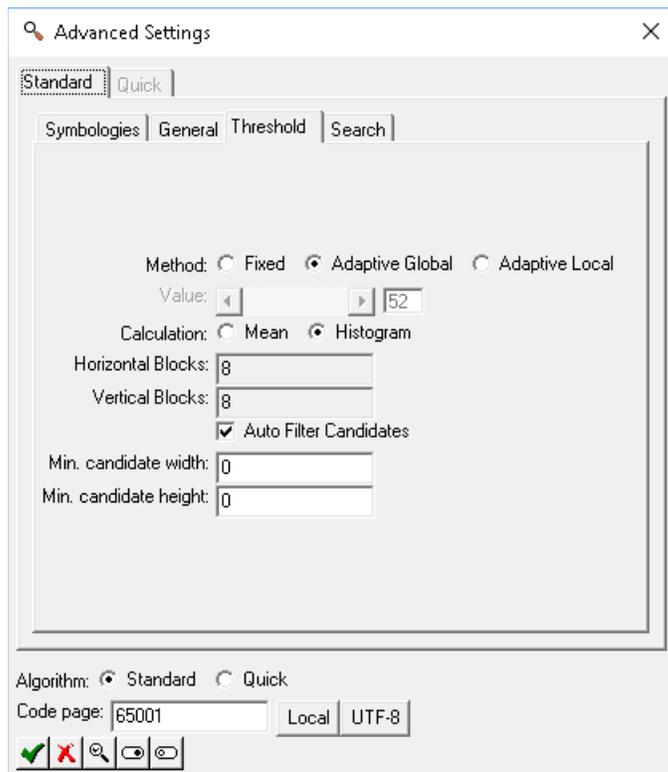
**Value** - A specific threshold number, used to divide light and dark, for separating the barcode from the background. Used for **Fixed** threshold.

**Calculation** - the adaptive threshold (global or local) can be based on the **Mean** (average) intensity, or on the **Histogram** of intensities.

**Horizontal/Vertical Blocks** - set the number of divisions used in the **Adaptive Local** threshold. The barcode Region is divided into this number of horizontal and vertical pieces (blocks). A threshold value is calculated for each block. A high number increases the accuracy, but also increases the execution time.

**Auto Filter Candidates** - when enabled, the tool calculates the minimum DataMatrix code size. When disabled, you must use the **Min Candidate Width/Height** fields to put a low limit on the expected code size. This may improve or speed up finding the code. This may speed up failure when **System** is **Auto detect** (and the code is not a DataMatrix). This filter only applies to DataMatrix codes.

**Min Candidate Width/Height** - set a minimum width and height for the DataMatrix code, if **Auto Filter Candidates** is disabled.



## Search Tab

The edge-based search is useful when the background is noisy or reflective, and the standard tool has difficulty separating the code from the background. Search increases the inspection time.

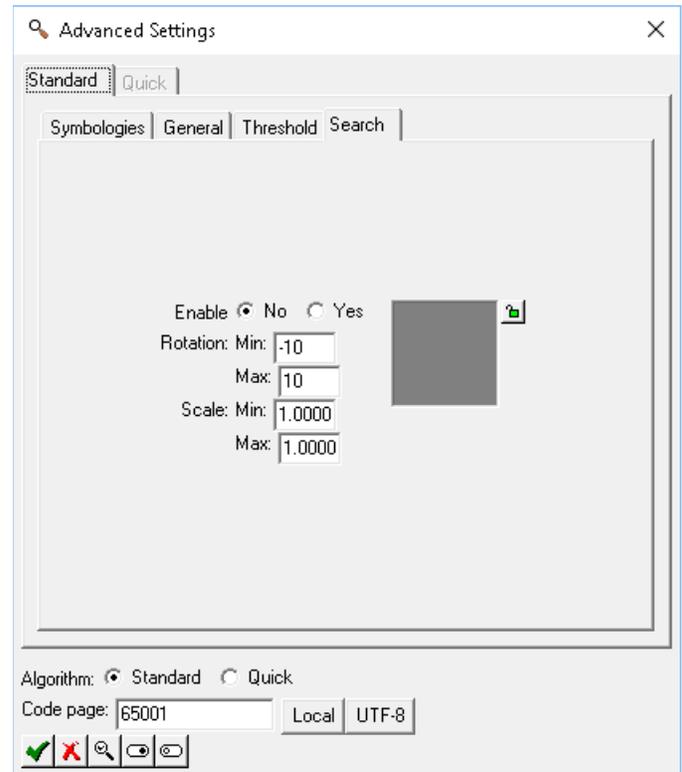
**Note:** the template image does not appear until you complete steps on the next page.

**Enable** - enable or disable the edge-based search.

The Code will not appear until you complete steps a through d below.

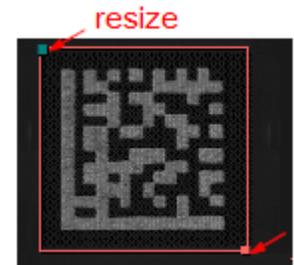
**Rotation** - if both numbers are zero, full 360 rotation is assumed. Enter a negative number in Min for maximum counterclockwise rotation. Enter a positive number in Max for the maximum clockwise rotation.

**Scale** - compensate for changes in size of the code by entering the minimum and maximum size of the code.

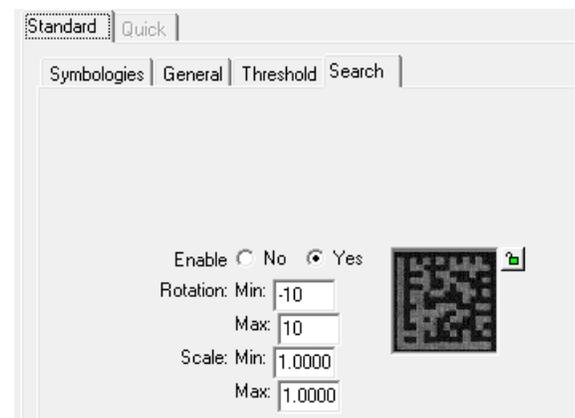


## How To Use the Search Feature

- Click the **Yes** radio button to enable the Search, then click the “Accept” button to close the Advanced Properties.
- Click the “Accept” button to close the 2D Barcode Properties. The properties edit box will take a few seconds to close, because the tool is detecting the edges in the ROI.
- Reduce the size of the ROI to enclose the entire code and eliminate any extraneous edge information. The complete code must be enclosed. The target or alignment marks must be enclosed with a very small gap outside them.



- Right-click to open the 2D Barcode Properties box. Click the “Advanced” button and click the “Search” tab.
- Click the Padlock button beside the template image, to lock the template.
- Change the other Search tab parameters as required.
- Click the “Accept” button to close the Advanced Properties. Click the “Accept” button to close the 2D Barcode Properties.
- Adjust the size of the ROI to enclose any movement of the code in the image area.



## Quick Algorithm Properties

### Symbologies tab

Select what types of codes (Symbologies) you want to read or decode. You can make multiple selections if you code types will change, but this can increase the inspection time.

**Data Matrix** - enable decoding Data Matrix.

The list box selects the Polarity:

- Black on White** dark codes on a light background,
- White on Black** light codes on a dark background,
- Either** allow both polarities.

**Mirror** enables decoding both normal and mirrored images of codes. Only normal images are decoded when this checkbox is clear.

**Rectangular** enable decoding standard Rectangular codes.

**Extended** enable decoding extended rectangular codes.

**QR 2005** - enable decoding QR 2005 code.

**Micro QR** – enable decoding Micro QR code.

**QR Model 1** – enable decoding QR Model 1 code.

The list box selects the Polarity:

- Black on White** dark codes on a light background,
- White on Black** light codes on a dark background,
- Either** allow both polarities.

**Mirror** enables decoding both normal and mirrored images of codes. Only normal images are decoded when this checkbox is clear.

**PDF 417** - enable decoding PDR417 code.

**Micro PDF417** - enable decoding Micro PDF417 code.

**Aztec** - enable decoding Aztec code.

The list box selects the Polarity:

- Black on White** dark codes on a light background,
- White on Black** light codes on a dark background,
- Either** allow both polarities.

**Mirror** enables decoding both normal and mirrored images of codes. Only normal images are decoded when this checkbox is clear.

**Han Xin Code** - enable decoding Han Xin Code

**MaxiCode** - enable decoding MaxiCode.

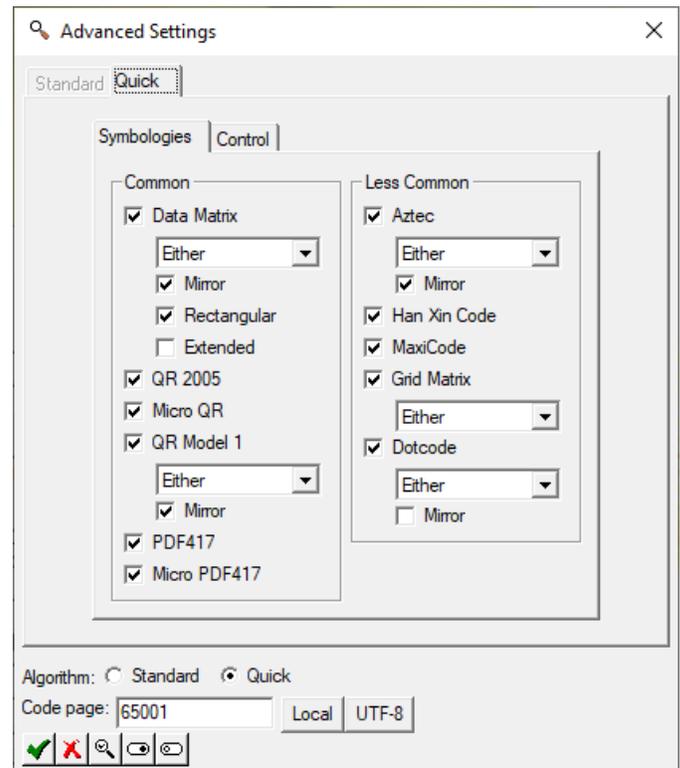
**Grid Matrix** - enable decoding Grid Matrix code.

**Dotcode** - enable decoding Dotcode code.

The list box selects the Polarity:

- Black on White** dark codes on a light background,
- White on Black** light codes on a dark background,
- Either** allow both polarities.

**Mirror** enables decoding both normal and mirrored images of codes. Only normal images are decoded when this checkbox is clear.



## Control tab

**Low contrast** - enables decoding low contrast or reverse contrast codes. This may increase the execution time.

**Enhance contrast** - enables enhancing the image to possibly decode poorly printed codes. This may increase the execution time.

### DPM

**Type:** - Select image conditioning options specific to DPM (Direct Part Marking).

**None** does not enable any DPM specific processing.

**Basic Etch** optimized for basic laser or chemical etching.

**Basic Dots** dot-peen and ink jet images.

**Basic Inkjet** basic ink jet and poor-quality ink jet images.

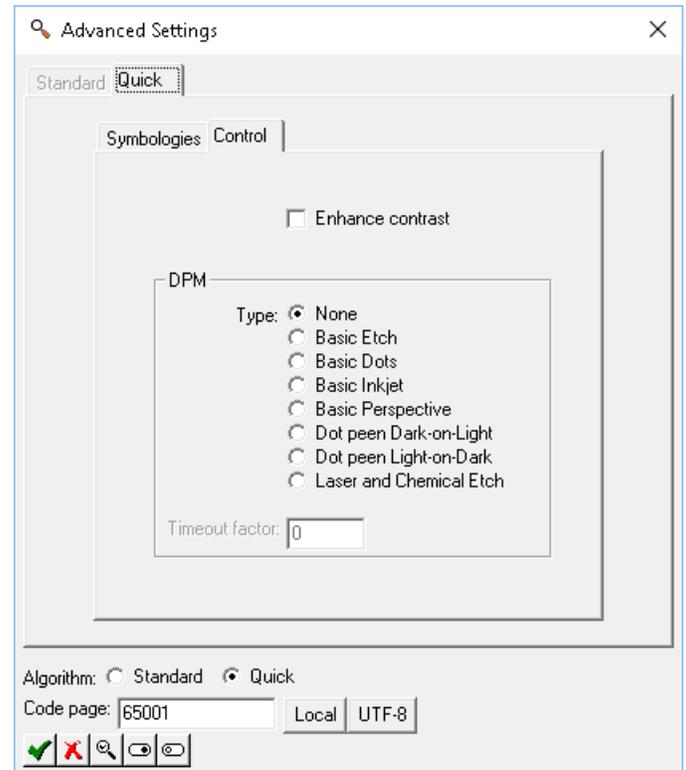
**Basic Perspective** reads good quality laser marks and normal codes centered in the image but with severe perspective distortion. This mode is faster but less robust than the "Basic Etch" for reading poor quality codes.

**Dot peen Dark-on-Light** (DPM License required) this is the most robust method for reading dark dot peen codes on a light background.

**Dot peen Light-on-Dark** (DPM License required) this is the most robust method for reading light dot peen codes on a dark background.

**Laser and Chemical Etch** (DPM License required) this is the most robust method for reading laser or chemical etch dot peen codes.

**DPM timeout** - sets a timeout for difficult, degraded or nonexistent DPM codes. The actual timeout is 10 to 15 times this number, in milliseconds. For a 500 MHz CPU 30 is recommended, for a 1 GHz CPU 15 is recommended, for a 2.5 GHz CPU 1 or 2 is recommended. If this field is 0, there is no timeout limit. This timeout does not apply if the DPM Type is **None**, **Basic Etch**, or **Basic Dots**.



## Using the Barcode Tool



The Barcode tool reads barcodes: UPCA, EAN13, Code39, ITF, Code128, UPCe, EAN8, Codabar, Pharmacodes, Postnet, Planet, and RSS14. Light, lens, focus, exposure and distance (size of the barcode in the image) affect the ability to read a code.

a. Click on the "Barcode" button.

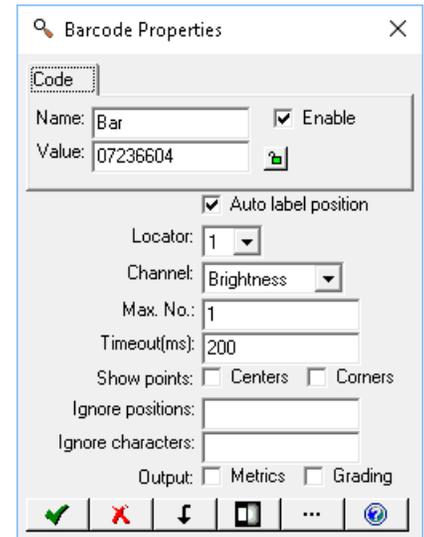
b. Move the mouse over the image in the Work Area. Click, release, move the mouse and click again, to draw a Region shape where you want to read a barcode. Refer to the tip window. The Region is labeled (Bar, Bar1, etc.). When the Barcode tool is selected, you can move and resize the Region.

**Note:** The maximum Region size is 2048 by 2048.



**Note:** The default "Orientation" or code direction is for horizontal codes from left to right, as shown (zero degrees). Codes at other angles (90, 180, 270) may not be recognized immediately with the default settings. The Details tab (Advanced settings) allows you to change this "orientation" to Automatic, or to a specific angle.

- c. When you hover the cursor over the edge of the tool, the Region outline turns red, and a message appears telling you to “Right-click to edit.”
- d. Right-click on the highlighted Region outline (or on the Barcode tool in the Tool list). A Barcode Properties box opens. In this box you can: use the tabs to select, enable, and rename measurements, set the tolerances for recycle and reject, set the code type (System), and adjust the other parameters.



Tab	Measurement
Code	The code value read; or enter a fixed value for comparing to the read value.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Value** - If a code was read with the current settings it will appear in this field. If the barcode should always be the same value, type the expected barcode beside **Value**. The code will fail if it does not match this value. If the barcode changes, leave an asterisk (\*) for wild card) in this field, to report any read. You can use a question mark (?) for a single character “wild card” or an asterisk (\*) for a multiple character “wild card”. For example; 123?? for any 5-character code starting with 123, or 123\* for any code of any length starting with 123. The Padlock button  allows you to lock the **Value**, so it does not change as you move the ROI. The **Value** should be unlocked while you change parameter settings.

**Auto label position** - puts the **Name** label beside the tool or region in the display. Clear the check box to move the label to another location (or with Properties closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Max. No.** - maximum number of codes to find. Stop when this number of codes are read. If this number is too high, the tool takes more time trying to find more codes and produces bad results. The maximum number is 255. Larger values are “wrapped” (256 is forced to 0, 257 is forced to 1, 258 is forced to 2, etc.).

**Timeout** - sets a timeout (in milliseconds) for difficult, degraded, or nonexistent codes. This applies to the code reading algorithm but does not include any added preprocessing.

**Show points** - displays points and allows you to use them in other measurements. The “Standard” algorithm draws a single blue line through/across the code. The “Quick” algorithm draws a blue “bounding box” around the code. **Centers** the center point of the line or bounding box. **Corners** the two ends of the line or four corners of the bounding box.

**Ignore positions** - skips or ignores character positions in the string. You could ignore unimportant, unrelated or changing positions. Enter position numbers (only) separated by spaces. Use 1 for the first character position (not 0), use 2 for the second character, etc.. Use -1 for the last character, use -2 for the next to last or second from last character.

**Ignore characters** - skips or ignores characters that sometimes are added to some barcodes.

The “ignore” steps are applied after decoding. The position and character filters are applied at the same time. For example, if position 1 is ignored, and character \$ is ignored, a decoded string \$1234\$ has a result 1234.

**Output** - enable additional output data.

**Metrics** adds more details about the code.

**Grading** enables grading calculation and outputs the results.

- e. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.
- f. Click the Advanced button  to adjust additional settings. The **Value** should not be locked when you make these changes.
- g. Click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.
- h. Click the Accept button  to accept changes and close the Barcode Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

### Advanced Properties

The check bubbles and buttons at the bottom are common to all tabs.

**Algorithm:** select the **Standard** or **Quick** code reading algorithm.



-  The Accept button applies your changes and closes the Properties edit box.
-  The Cancel button closes the Properties edit box without changes.
-  The “Identify” button automatically identifies and selects the code type in the ROI.
-  The “Select all” button enables all code types on all tabs.
-  The “Deselect all” button disables all code types on all tabs.

## Standard Algorithm Properties

### Symbologies Tab

Individual check boxes allow you to enable or disable decoding each specific code type supported. Select what types of codes (Symbologies) you want to read or decode. You can make multiple selections if your code types will change, but this can increase the inspection time.

#### Linear Codes:

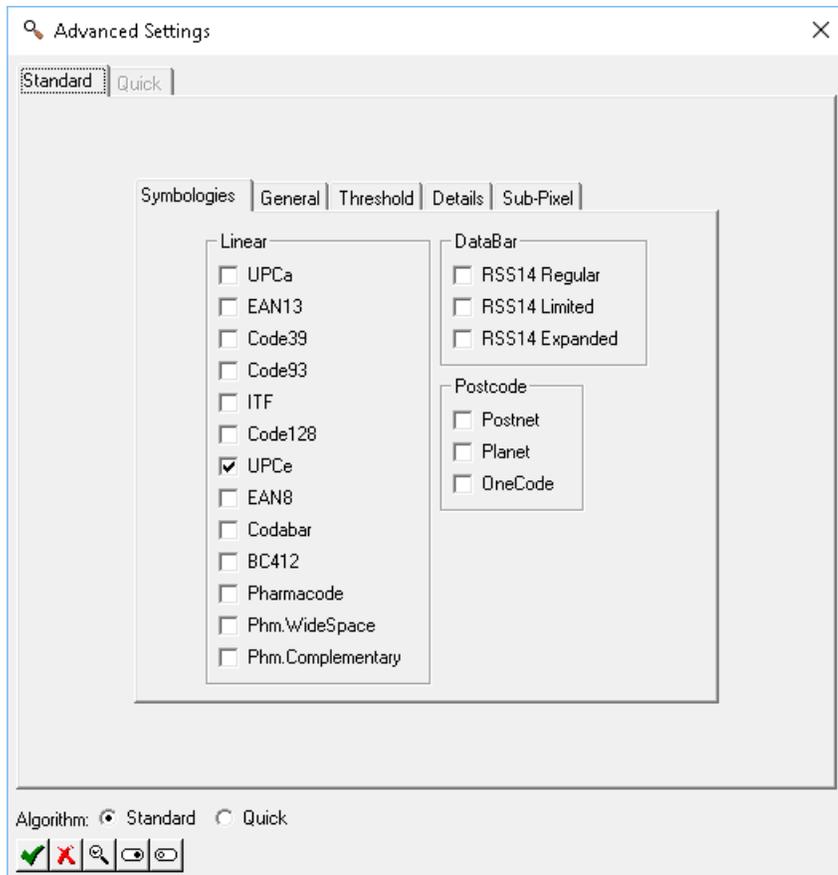
UPCa, EAN13, Code39, Code93, ITF, Code 128, UPCE, EAN8, Codabar, BC412, Pharmacode, Pharmacode Wide Space, Pharmacode Complementary.

#### DataBar codes

RSS14 Regular, RSS14 Limited, RSS14 Expanded.

#### Postcode codes

Postnet, Planet, OneCode.



## General tab

**Background** - the type of background:

**Bright** means dark codes on a light background. **Dark** means light codes on a dark background. **Auto** means the tool will try to decide which to use. You can lock the selection, so it does not change when you edit the tool properties.

**Effort level** - apply **Low** (relaxed), **Medium**, or **High** (advanced) read algorithm.

**High** setting is slower but is more rigorous.

**Low** setting is faster but less rigorous.

### Use only the specified level

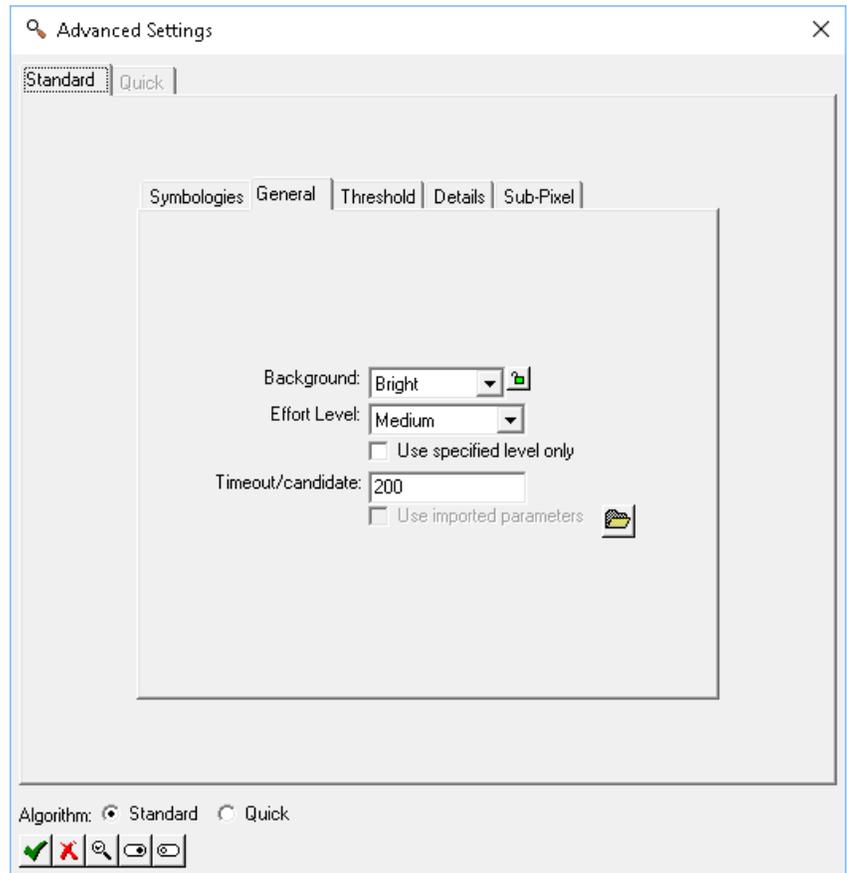
If the box is clear, the algorithm will start at a **Low** effort and work up to the setting you have selected. This may be faster if codes are easily read but could also lead to an incorrect reading of a difficult code.

If the box is checked, the algorithm only uses the effort level you have chosen.

This may be faster if all codes require a **High** effort level.

**Timeout/candidate** – number of milliseconds to allow for attempting each code type.

**Use imported parameters** - use the “file open” button to locate a parameters file exported from the Barcode Studio (if available). Use the check box to enable and disable these parameters. **Note:** When you enable imported parameters, the values displayed in this Edit Properties box are not the values being used!



## Threshold Tab

**Method** - select the method for separating the barcode from the background. Threshold is disabled after orientation and code type are selected or detected.

**Fixed** uses a single number (**Value**). This method works best when lighting is uniform or does not change.

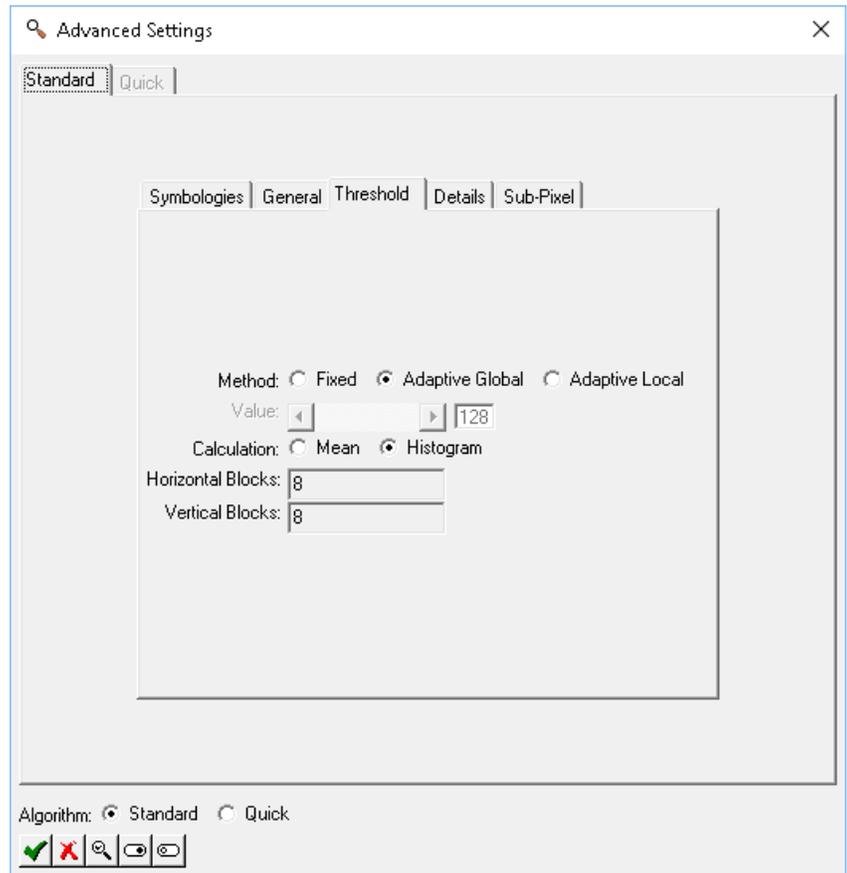
**Adaptive Global** calculates one threshold value for the whole Region, based on the intensities at the left and right sides of the Region. This method works best when the lighting changes gradually and evenly across the Region.

**Adaptive Local** uses divisions or blocks within the Region to calculate several threshold values. This method works best when lighting is uneven.

**Value** - a specific threshold number, used to divide light and dark, for separating the barcode from the background. Used for **Fixed** threshold.

**Calculation** - the adaptive threshold (global or local) can be based on the mean (average) intensity, or on the histogram of intensities.

**Horizontal/Vertical Blocks** - set the number of divisions used in the **Adaptive Local** threshold. The barcode Region is divided into this number of horizontal and vertical pieces (blocks). A threshold value is calculated for each block. A high number increases the accuracy, but also increases the execution time.



## Details Tab

**Orientation** - barcode direction (in degrees) is positive in the clockwise direction, starting from the horizontal.

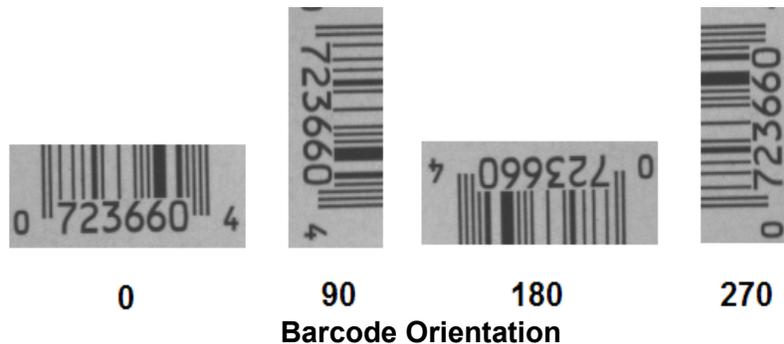
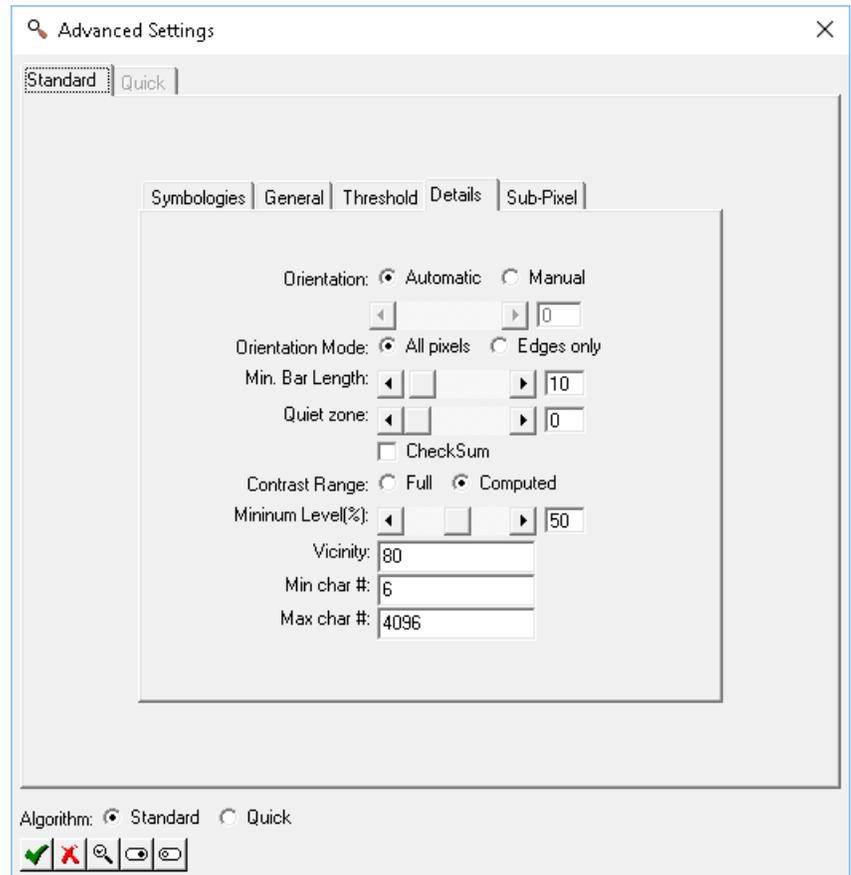
See figure below.

0 = left to right, 90 = top to bottom. 180 = right to left (upside down) 270 = bottom to top (-90). Select **Automatic** to have iInspect determine the direction or select **Manual** and use the slider to set the direction.

**Orientation Mode** - select **All pixels**

(standard method) or **Edges only** for identifying the direction or orientation of the barcode, in **Automatic** mode. The **Edges only** setting takes more time but may be useful in images with reflections or noise.

**Min. Bar Length** - the minimum length, in pixels, of the bars or lines that make up the code.



**Quiet Zone** - sets the minimum width of a blank area (the Quiet zone) before and after the code. Range: 0 to 100% of the amount specified in the code definition. If this minimum amount of blank area does not exist, the code will not be read. For Example; code39 specifies a quiet zone of 10 modules or the width of 10 bars.

**Checksum** - test for the CheckSum or check character. The checksum is required in Code128, EAN8, EAN13, UPCa, UPCE, and Postnet/Planet. Checksum is optional in Code39, BC412, and ITF. There is no checksum in Codabar, RSS14 and all Pharmacodes.

**Contrast Range** - intensity range in the barcode Region. Use the **Full** range from black to white (0 to 255) or **Computed** (calculated) based on the range of intensities found in the Region.

**Minimum Level (%)** - set the minimum contrast level, that separates light from dark, or code from background. This is a percentage of the **Contrast Range**.

**Vicinity** - the width and height of an area around the barcode, in pixels, where additional codes will be ignored.

**Min char #** - minimum number of characters in a code. Fail if below this number.

**Max char #** - maximum number of characters in a code. Fail if above this number.

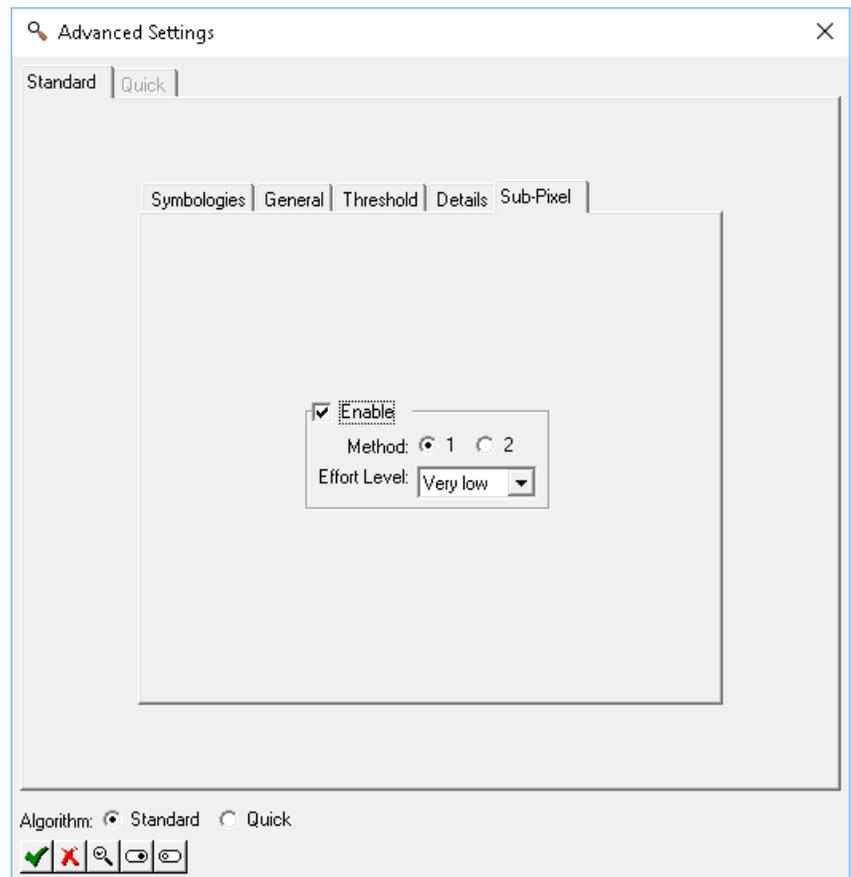
### Sub-Pixel tab

**Enable** check this box to enable detecting width-modulated barcodes to sub-pixel accuracy. This increases processing or read time.

**Method 1** is faster but less rigorous. If **Method 1** does not read the code, select **Method 2**.

**Method 2** is more rigorous and may work better with noisy or less focused images but works slower than **Method 1**.

**Effort level** apply a relaxed (**Very low, Low, Medium**) or advanced (**High, Very high**) read algorithm. A high setting is slower but is more rigorous and may perform better with degraded or poorly contrasted codes. A low setting is faster, but less rigorous.



## Quick Algorithm Properties

### Symbologies – Linear tab

Select what types of codes (Symbologies) you want to read or decode. You can make multiple selections if your code types will change, but this can increase the inspection time.

**Code 39** - enable decoding Code 39 codes.

Use the drop list to select a Checksum option in the list box.

**No checksum** - disable the checksum calculation.

**Use checksum, output check character** - calculate the checksum and include the check character in the read string output.

**Use checksum, strip check character** - calculate the checksum and do not include the check character in the read string output.

Support full ASCII enable or disable full ascii character support for Code 39. Output is numeric if disabled.

**ITF** - enable decoding ITF or Interleaved 2 of 5 codes.

Use the drop list to select a Checksum option in the list box.

**No checksum** - disable the checksum calculation.

**Use checksum, output check character** - calculate the checksum and include the check character in the read string output.

**Use checksum, strip check character** - calculate the checksum and do not include the check character in the read string output.

String length – sets a minimum string length and controls the quiet zone checking for ITF.

**0** - default quiet zone checking is used and no code length checking is performed.

**1** - short quiet zone allowed and no length checking is performed.

**even number** - default quiet zone is used and the decode string must be at least N in length to be decoded.

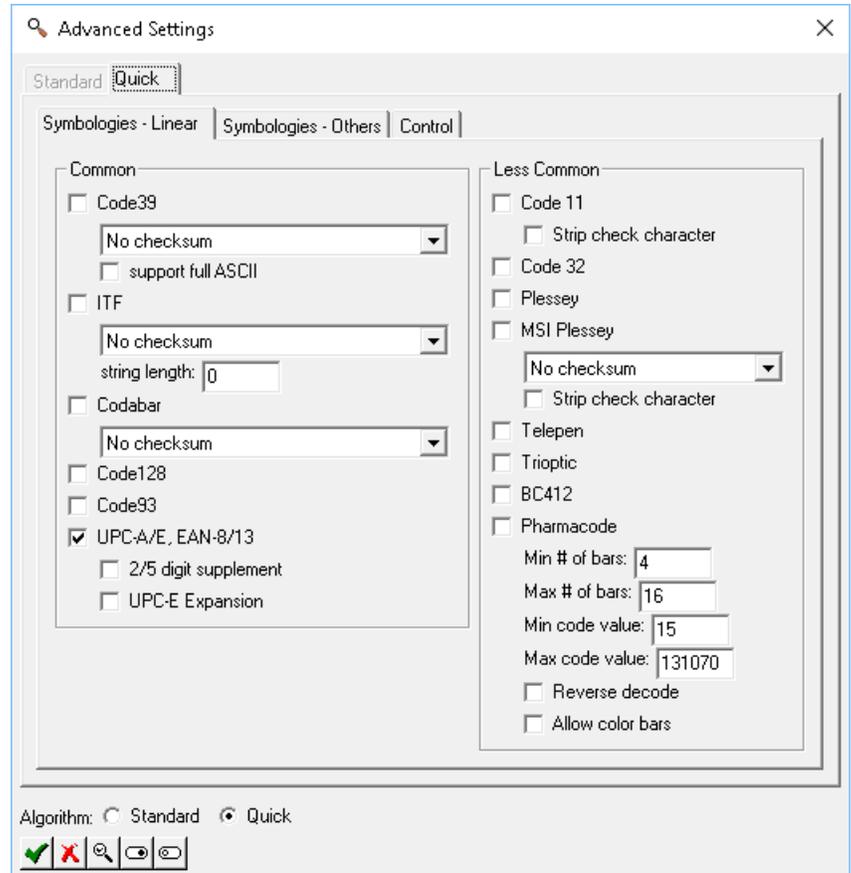
**odd number** (larger than 1) - short quiet zone is allowed and the decode string must be at least N-1 in length to be decoded.

**Codabar** - enable decoding Codabar codes.

Use the drop list to select a Checksum option in the list box.

**No checksum** - disable the checksum calculation.

**Use checksum, output check character** - calculate the checksum and include the check character in the read string output.



**Use checksum, strip check character** – calculate the checksum and do not include the check character in the read string output.

**Code 128** - enable decoding Code 128 codes.

**Code 93** - enable decoding Code 93 codes.

**UPC-A/E, EAN-8/13** - enable decoding UPC-A, UPC-E, EAN-8, and EAN-13 codes.

**2/5 digit supplement** - enable 2-digit or 5-digit supplemental code for UPC and EAN.

**UPC-E Expansion** - enable UPC-E expansion

**Code 11** enable decoding Code 11 codes.

**Strip check character** - calculate the checksum but do not output the checksum character.

**Code 32** enable decoding Code 32 codes.

**Plessey** enable decoding Plessey codes.

**MSI Plessey** enable decoding MSI Plessey codes.

Use the drop list to select a Checksum option in the list box.

**No checksum** - disable the checksum calculation.

**Use Mod 10 checksum.**

**Use Mod 10/10 checksums.**

**Use Mod 11/10 checksums.**

**Strip check character** - calculate the checksum but do not output the checksum character.

**Telepen** - enable decoding Telepen codes.

**Trioptic** - enable decoding Trioptic codes.

**BC412** - enable decoding BC412 codes.

**Pharmacode** - enable decoding Pharmacodes.

**Min # bars** - sets the minimum number of bars in the Pharmacode.

**Max # bars** - sets the maximum number of bars in the Pharmacode.

**Min code value** - sets the minimum numeric code value.

**Max code value** - sets the maximum numeric code value.

**Reverse decode** - enables decoding reversed images or reverse decoding.

**Allow color bars** - enable decoding colored codes.

## Symbologies – Others tab

Select what types of codes (Symbologies) you want to read or decode. You can make multiple selections if your code types will change, but this can increase the inspection time.

### DataBar

Databar RSS14, Databar RSS14 Stacked, Databar Limited, Databar Expanded, Databar Expanded Limited.

### Stacked

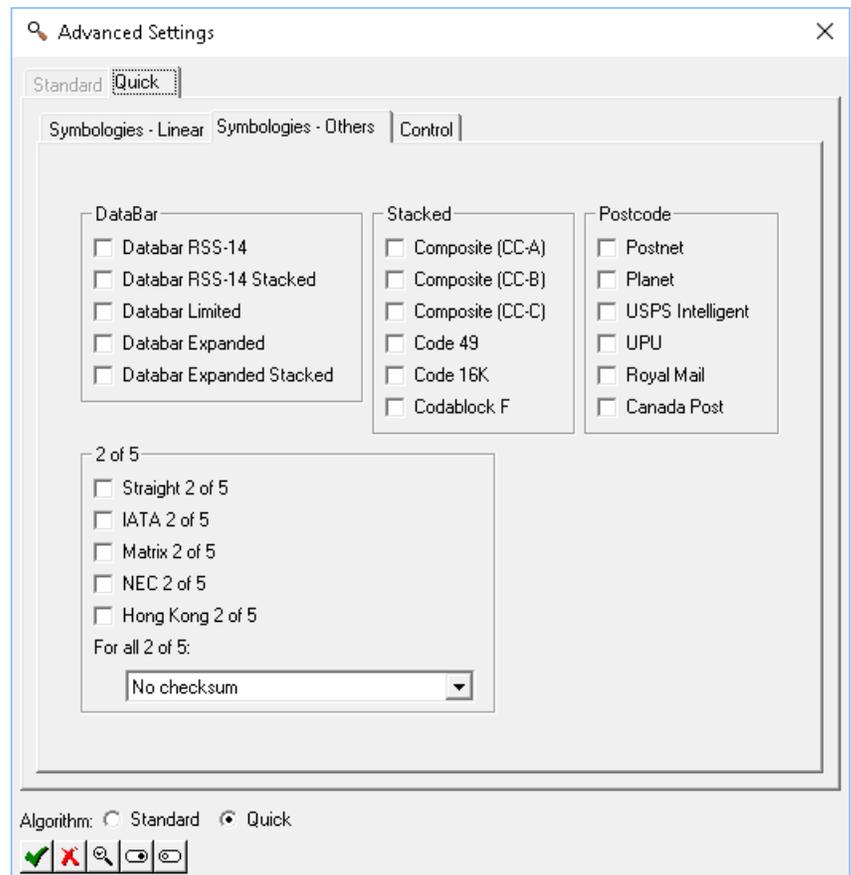
Composite (CC-A), Composite (CC-B), Composite (CC-C), Code 49, Code 16K, Codablock F.

### Postcode

Postnet, Planet, USPC Intelligent (oncode), UPU, Royal Mail, Canada Post.

### 2 of 5

Straight 2 of 5, IATA 2 of 5, Matrix 2 of 5, NEC 2 of 5, Hong Kong 2 of 5.



Use the drop list to select a Checksum option.

**No checksum** - disable the checksum calculation.

**Use checksum, output check character** - calculate the checksum and include the check character in the read string output.

**Use checksum, strip check character** – calculate the checksum and do not include the check character in the read string output.

## Control tab

**Low contrast** - enables decoding low contrast or reverse contrast codes. This may increase the execution time.

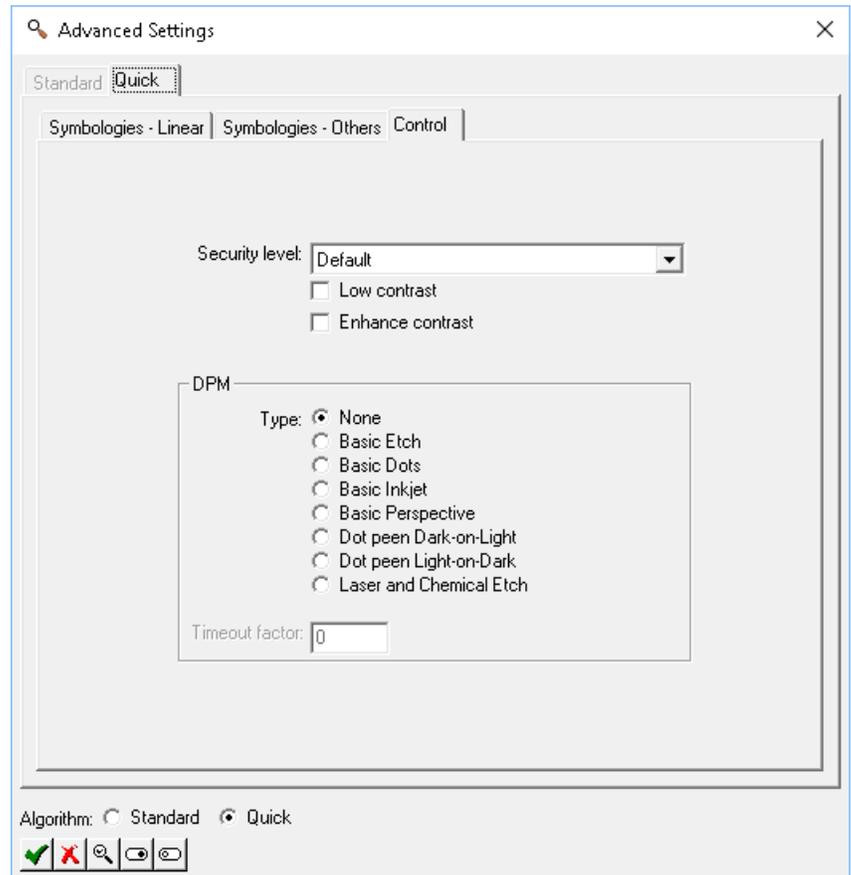
**Enhance contrast** - enables enhancing the image to possibly decode poorly printed codes. This may increase the execution time.

**Security level** - select the security level or reading “aggressiveness” to use. A higher level of aggressiveness means poorly printed codes may be read. This may increase the execution time. However, a higher aggressiveness means having less “security” against incorrect readings.

## DPM

**Type:** - Select image conditioning options specific to DPM (Direct Part Marking).

**None** does not enable any DPM specific processing.



**Basic Etch** optimized for basic laser or chemical etching.

**Basic Dots** dot-peen and ink jet images.

**Basic Inkjet** basic ink jet and poor-quality ink jet images.

**Basic Perspective** reads good quality laser marks and normal codes centered in the image but with severe perspective distortion. This mode is faster but less robust than the “Basic Etch” for reading poor quality codes.

**Dot peen Dark-on-Light** (DPM License required) this is the most robust method for reading dark dot peen codes on a light background.

**Dot peen Light-on-Dark** (DPM License required) this is the most robust method for reading light dot peen codes on a dark background.

**Laser and Chemical Etch** (DPM License required) this is the most robust method for reading laser or chemical etch dot peen codes.

**DPM timeout** - sets a timeout for difficult, degraded or nonexistent DPM codes. The actual timeout is 10 to 15 times this number, in milliseconds. For a 500 MHz CPU 30 is recommended, for a 1 GHz CPU 15 is recommended, for a 2.5 GHz CPU 1 or 2 is recommended. If this field is 0, there is no timeout limit. This timeout does not apply if the DPM *Type* is **None**, **Basic Etch**, or **Basic Dots**.

## Using the Caliper Tool



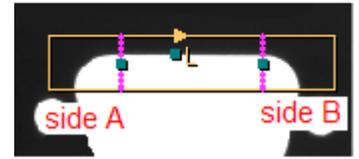
The caliper tool measures the distance between the two Tips of an object's outline or edges. This is useful for irregular shapes that cannot be measured with the Distance or Rake tools.

a. Click on the “Caliper” button. Draw a rectangle that encloses the area to be measured. You can draw a rectangle at any angle. Refer to the Tip Window.

b. Click at one end of the object (1), then click at the other end of the object (2), then click a third time (3) on the height of the measurement area. The first click is "Side A". The second click is "Side B". The Side A and Side B are used in adjusting the measurement properties.



c. With the Caliper tool still selected, you can move or resize the rectangle region. Use the handles (solid green squares) at the top corners of the rectangle (first two click points) to adjust the angle or length of the region. Use the handle in the center of the rectangle's bottom edge to adjust the height.



d. The inside handles, on the two vertical lines, are used to adjust the search areas for finding the edges of the object. The search area is between the outside rectangle and the vertical line.

**NOTE:** The Caliper tool has several construction lines. Notice the arrowhead on the top border of the enclosing rectangle. The arrowhead points from "Side A" to "Side B".

The pink crosses indicate the sample points, where the edges of the object were found. If the pink crosses are all on the edge of the rectangle (image above), the tool properties need to be adjusted for the correct measurement. The pink crosses should be on the edge of the object (following image).

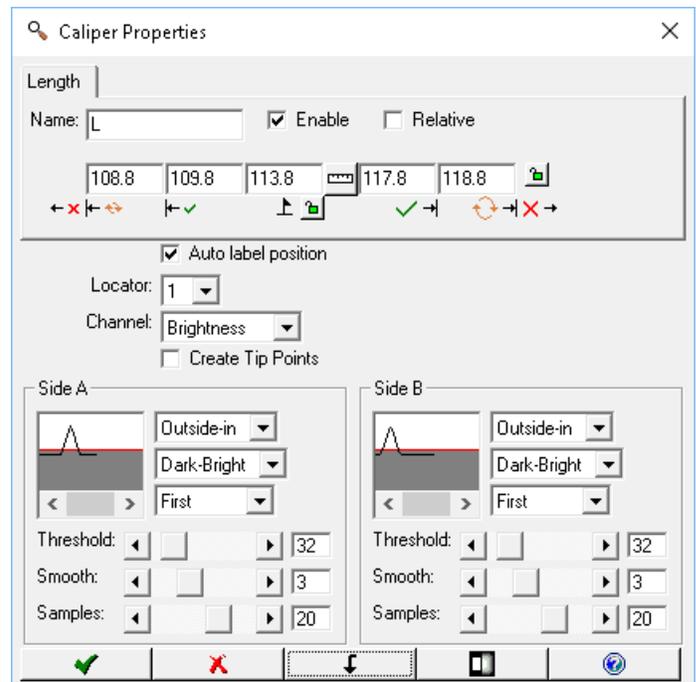
For this example, the **Direction** is "Outside-in" and the **Edge choice** is "Dark-Bright". The outer-most rectangle is the Region. The vertical yellow lines define the inside end of the Search Area. The vertical purple lines indicate where the tips are located. The horizontal yellow lines



attached to the purple lines indicate the direction of the search, from the outside of the ROI toward the inside, or "Outside-in". The reported Length is the distance between the two purple lines.

e. When you hover over the rectangle region, the region turns red and a message should appear, telling you to "Right-click to edit."

f. Right-click on the rectangle (or on the Caliper tool in the Tool list). A Caliper Properties edit box opens. In this box you can: enable and rename the measurement, set the tolerances for recycle and reject, change the sensitivity and other parameters for finding the correct tip points.



Tab	Measurement
Length	distance from the tip found at Side A to the tip found at Side B.

**Name** - you can change the default name of the tool or measurement. The name or "label" is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the Caliper tool in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the measurement follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the measurement from the locator, or make the measurement stay in a fixed position in the image window. Up to four locators can be defined for each image window.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Create tip points** - create active points at the two Tip points. Active points can be used by other tools.

### **Side A / Side B**

There are separate adjustments for the two search areas. These adjustments control locating the two tip points. When you click on a slider or change a pull-down, a red circle appears in the image area, to indicate which side you are editing.

**Direction** - first drop-list selects the search or scan direction.

**Inside-out** means starting from the inside edge of the search area (vertical yellow line) moving out toward the end of the ROI.

**Outside-in** means starting from the outer edge of the ROI or the search area, moving toward the center of the ROI.

**Polarity** - second drop-list selects the type of edge transitions to look for.

**Dark-Bright** means a transition from dark-to-light.

**Bright-Dark** means a transition from light-to-dark.

**Either** means both edges or both transitions.

**Selection** - select which edge to use, or how to find the edge that defines the end points.

**Strongest** use the strongest edge found in the search area.

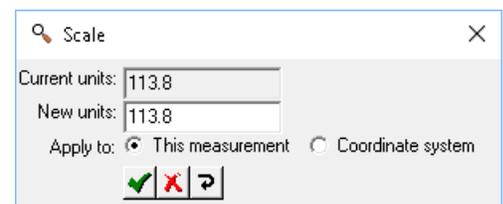
**First** use the first edge found in the search direction.

**Threshold** - a lower setting is better at detecting edges that are less sharp or less sudden transitions from dark to light (or light to dark). A higher setting may suppress false edges.

**Smooth** - number of times to apply a smoothing filter (low pass filter) in the edge search box, to remove noise effects.

**Samples** - the number of samples or rake lines used to locate the edge. The number of samples translates to the number of pink crosses on the edge.

g. Click the Scale button  in the Caliper Properties box, to set new units (Scale) on this one measurement, or on the whole coordinate system used for this camera view.



**NOTE:** If you enter new units, and select **Coordinate System**, clicking the “Accept” button in the Scale Properties immediately applies the changes to the whole coordinate system; the “Cancel” button in the Caliper Properties does not undo the change to the coordinate system. Click the Undo button  to undo scale changes and revert to Pixel Coordinates for the whole coordinate system. This removes Alignment Calibration for this camera view.

- h. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.
- i. Click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.
- j. Click the Accept button  to accept changes and close the Contour Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

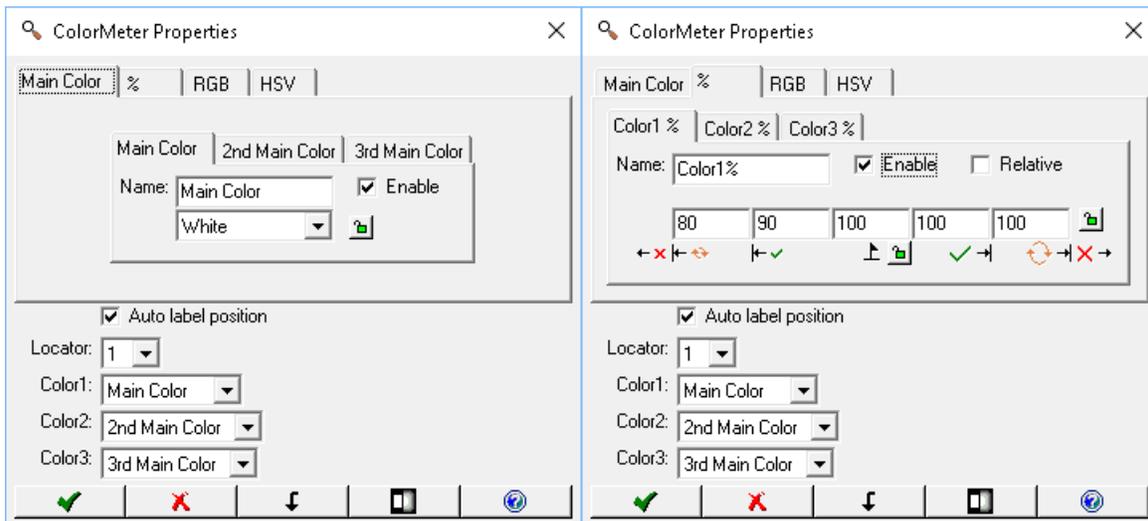
### Using the ColorMeter Tool



The ColorMeter tool can be used to identify colors in the image or can be used to report the amount of a color or colors occurring in the image.

- Click on the “ColorMeter” button. Select a Region shape. Refer to the Tip window for drawing instructions.
- Move the mouse over the image in the Work Area. Click and release the mouse button, move the mouse and click again, to draw a Region over the area you want to measure or report on.
- The Region is labeled (MainColor) the last number is the Tool number (for multiple ColorMeter tools: Color1%, Color1%1, Color1%2). You can move and resize the Region.
- When you hover over the ColorMeter Tool, the Region outline turns red, and a message should appear, telling you to “Right-click to edit.”
- Right-click on the Region outline (or on the ColorMeter tool in the Tool list). A ColorMeter Properties edit box opens. In this box you can: use the tabs to select, enable, and rename measurements, set the tolerances for recycle and reject. Use the drop lists to define or lock the colors measured.

Notice that each tab has 3 Sub-tabs.



<i>Tab</i>	<i>Measurement</i>
Main Color: Main Color	if the color (under Name) is not locked, reports the color class covering the largest area of the Region. You can lock the color, and fail if that color class does not cover the largest percentage of the Region.
Main Color: 2nd Main Color	if the color (under Name) is not locked, reports the color class covering the second largest area of the Region. You can lock the color, and fail if that color class does not cover the second largest percentage of the Region.
Main Color: 3rd Main Color	if the color value (under Name) is not locked, reports the color class covering the third largest area of the Region. You can lock the color, and pass or fail if that color class does not cover the third largest percentage of the Region.
%: Color1%	percent of the Region area, that is the Color Class selected as "Color1". The default for Color1 is "Main Color"; the color that covers the largest percent of the Region. You can assign "Color1" to a specific color class, and report the percent area of that color class.
%: Color2%	percent of the Region area, that is the Color Class selected as "Color2". The default for Color2 is "2nd Main Color"; the color that covers the second largest percent of the Region. You can assign "Color2" to a specific color class, and report the percent area of that color class.
%: Color3%	percent of the Region area, that is the Color Class selected as "Color3". The default for Color3 is "3rd Main Color"; the color that covers the third largest percent of the Region. You can assign "Color3" to a specific color class and report the percent area of that color class.
RGB: Red	average Red value for all pixels, in RGB color.
RGB: Green	average Green value for all pixels, in RGB color.
RGB: Blue	average Blue value for all pixels, in RGB color.
HSV: H	Average H value for all pixels, in HSV color.
HSV: S	average S value for all pixels, in HSV color.
HSV: V	average V value for all pixels, in HSV color.

**Name** - you can change the default name of the tool or measurement. The name or "label" is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the tool in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select X to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Color1** - a drop-list assigns a Color Class for the "Color1%" measurement.

**Color2** - a drop-list assigns a Color Class for the "Color2%" measurement.

**Color3** - a drop-list assigns a Color Class for the "Color3%" measurement.

f. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

g. Click the padlock button beside "Perfect"  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.

h. Click the Accept button  to accept changes and close the Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

## Using the Graphics Tool



Use the Graphics tool to add text or draw shapes, to label or highlight measurements or features in the image area. This is sometimes called “annotation”. There are no measurements made or reported by the Graphics Tool.

**NOTE:** The Graphics Tool is always shown when the Setup Tools panel is open. The Graphics tool appears only when the “Show When” condition is met in all other panels.

- Click on the “Graphics” button. Select a shape from the options that appear below the Tip Window. **NOTE:** You can only use text with the Rectangle shape.
- Move the mouse over the image in the Work Area. Click and release, move the mouse, and click again, to draw a Graphic shape over an area in the image.
- If the Graphics tool is still selected, you can resize your Graphic shape by dragging the small solid squares that appear at some corners. Click and hold your mouse button on the outline, and drag the Graphic shape to reposition it.
- When you hover over the Graphic shape, the outline turns red, and a message should appear telling you to “Right-click to edit”.
- Right-click on the shape outline (or on the Graphics tool in the Tool list). A Graphics Properties edit box opens. In this box you can: attach the Graphic to a Locator, change the color or disable the outline, enable and change the fill color, add text to a Rectangle and change the box size, and select a font style.

**Locator** makes the graphic shape follow the Locator and follow the part. Select a locator (by number) to follow or select X to disconnect the graphic from the locator or make the graphic stay in a fixed position in the image window. Up to four locators can be defined for each image window.

**Name** - you can change the default name of the tool. The name is used in scripts.

**Show when** - select when this graphic is displayed:

**Always** display in every image.

**Inspection passes** display graphic only when all tools pass.

**Inspection fails** display graphic only when any one or more tool fails.

**Related tool passes** display graphic only when all enabled measurements pass, for the tool chosen in the *Related tool* list box.

**Related tool fails** display graphic only when any one enabled measurement fails, for the tool chosen in the *Related tool* list box.

**Related tool** - select any defined tool to control the display of this graphic tool.

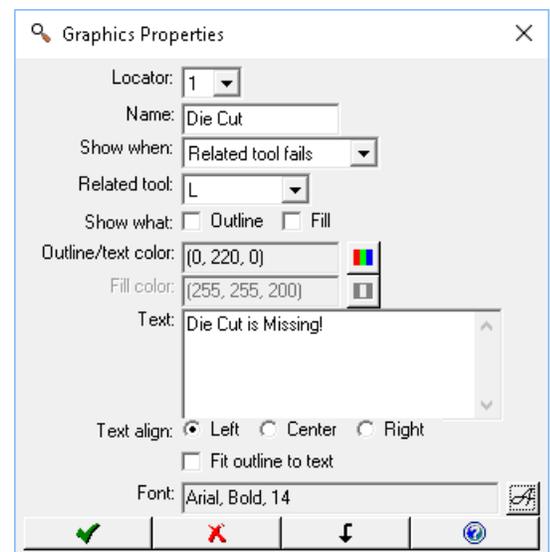
**Show what** - check a box to show the Outline or Fill (or both). Clear a box to disable or hide either the Outline or Fill. Fill is not available for Line, Polyline, Arc. If you clear both options: the graphic will have a black outline.

**Outline/text color** - enter RGB (red, green, blue) values or use the button to select a color for the shape outline or the text. Text is only available with the Rectangle shape.

**Fill color** - enter RGB (red, green, blue) values or use the button to select a color to fill the Rectangle or Circle.

**Text** - enter text for a Rectangle shape. The text will take the Outline color. Text is only available with the Rectangle shape. Use the Enter key to create multiple lines of text. If you do not use the Enter key, the text is all on one line, and may be wider than the Rectangle.

**Text align** - select where the text appears in the Rectangle: **Left** aligned, **Center**, or **Right** aligned.



**Fit outline to text** - shrink the Rectangle to fit the size of the text.

**Font** - displays the current font style and size. Click the A button  to select a different font, style, or size. Choices available will depend on the fonts installed on the Client PC.

f. Click on the Accept button  to accept changes and close the edit box. Click on the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

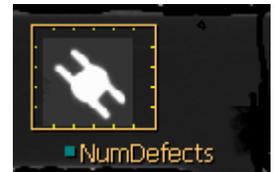
### Using the Verify Tool



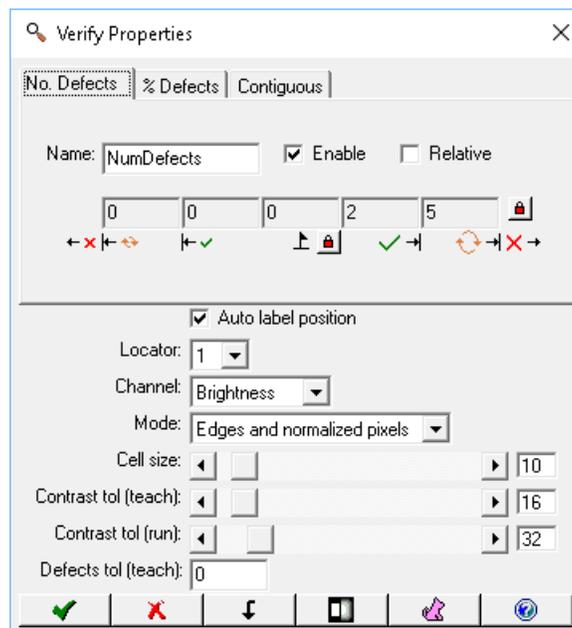
The Verify tool compares the template to an object in the image and reports how much the object differs from the template (number of unrecognized cells). The Verify tool can be trained on a series of known good examples, to learn a range of acceptable variation.

- Click on the “Verify” button.
- Move the mouse over the image in the Work Area. You should not see highlighted edges. Click, release, move the mouse, click again to draw a rectangle Region around the object. Refer to the Tip window.

After the second click, the region will be divided into a grid of cells, as indicated by yellow “tick” marks. The size of the Region may automatically change to create full-sized cells in the grid, fractional or partial cells are not allowed. You can change the cell (grid) size in the Properties edit menu to fit the object better.



- When the Verify tool is selected, you can drag the solid (green) squares to resize the Region.
- You can left-click on cells to delete (mask) them from the training image. You can hold the left mouse button and drag to delete multiple cells. The cells with a yellow X will not be included in the trained image and will not be included in the defects measurement. Hold the right mouse button and drag to add cells back into the trained image (un-delete or un-mask).
- When you hover the cursor over the edge of the tool, the Region outline turns red, and a message appear telling you to “Right-click to edit.”
- Right-click on the highlighted Region outline (or on the Verify tool in the Tool list). A Verify Properties box opens. In this box you can: rename the measurement, set the tolerances for recycle and reject, and adjust the other parameters.



<i>Tab</i>	<i>Measurement</i>
No. Defects	The number (count) of cells that did <b>not</b> match the trained images. 0 = perfect match.
%Defects	The percentage of cells that did <b>not</b> match the trained images. 0 = perfect match.
Contiguous: No.	The count or number of cells that form the largest single defect. "Continuous" cells are attached on one or more sides. Cells that only touch at corners are not counted.
Contiguous: %	The number of cells that form the largest single defect, as a percentage of the total number of cells in the Verify Tool rectangle or Region. "Continuous" cells are attached on one or more sides. Cells that only touch at corners are not counted.

**Name** - you can change the default name of the tool or measurement. The name or "label" is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the tool in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Mode** - select what information or what matching methods to use (at run time). **Note:** you do not need to re-train when you change the **Mode**. Data for all three modes is stored during the Learn/Teach process.

**Edges** use the standard deviation of pixels in each cell. This mode is mostly independent of illumination changes. This mode is useful when the lighting on the part being inspected could vary.

**Raw pixels** use the mean value of pixels in each cell. This mode is useful when you are looking for small but widespread changes in a part's reflectivity, such as caused by burn marks on the part. This mode is very sensitive to illumination changes, so you must use it with a light source that remains very stable over time.

**Normalized pixels** use the mean value of pixels in each cell, minus the mean value over the whole ROI region divided by the standard deviation of pixels for the ROI [ (cellMean - ROI Mean)/ROI StdDev ]. This mode is less sensitive to illumination changes and less sensitive to changes in reflectivity.

**Edges and normalized pixels** use the maximum value (or greater difference from) the edges and normalized pixels methods. This mode will detect some changes in reflectivity, for example when printed material starts to "fade" and also changes in a part's structure and texture.

**Cell size** - size of the square cells (grid) in pixels. Smaller cells give you more fine detail, but also take slightly more time. Range is 4 to 100 (each square cell is 4x4 pixels up to 100x100 pixels).

**Contrast tol (teach)** - acceptable contrast difference in gray scale levels, during teach or learn step. Changes below this threshold are ignored. Changes above this threshold are learned.

**Contrast tol (run)** - acceptable contrast difference in gray scale levels, during run time or inspection. Changes below this threshold are ignored. Changes above this threshold are defects.

**Defects tol (teach)** - acceptable percent of defect area during teach or learn. A new image is trained and stored if the difference is greater than this value. A higher setting reduces the number of learned images, reducing the amount of memory used.

g. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before learning, adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

h. Click the "Learn" button  to open a "Learn" menu.

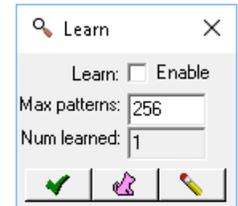
- l. Click the padlock button beside "Perfect"  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.
- m. Click the Accept  button to accept changes and close the Properties box. Click the Cancel  button to close without changes. Click the Apply  button to apply changes without closing the Properties box.

### Learn Menu

**Learn** - Check the box to enable learning examples. Clear the box to disable learning.

**Remember to return to this menu and disable Learn mode before running your inspection!** If you fail to disable learning, all inspection images will be added to the "good examples" database, and no defects will be reported.

**Max patterns** - set the maximum number of "good" images to keep in the database of trained good examples.



**Num learned** - shows how many images are currently stored in the database of trained good examples.

The Erase button  in this menu deletes all images from the database of trained good examples. **NOTE:** If you had to readjust the size, position or number of cells, you may have incorrect examples in the database. You should erase them and then add the current image to the database.

The Learn button  in this menu adds the current image to the database.

### How to Use Learn

Before you begin, make sure you have examples of good parts.

1. In the Verify Tool Properties menu, open the Learn menu.
2. In the Learn menu, check the box beside **Learn**.
3. If you have trained the wrong examples or unwanted images you can click the Erase button to delete ALL images in the "good examples" database and start over training again. You will see the "Num learned" change to 0.
4. Click the Learn button  in this menu to add the current image to the database of "trained good examples". You will see the "Num learned" change. With learn enabled, you can go to the Run panel to learn more examples of "good" images.

#### To teach multiple examples

5. Click the Accept button to close the Learn menu. Click the Accept button to close the Verify Properties.
6. Go to the Run panel. Use more examples of "good" parts to train the Verify tool. The Learn Icon appears beside the tool's label to indicate you are in Learn mode. If the difference between the new image and the first template is greater than the "Defects tol (teach)" threshold a new image is added to the "good examples" database.



#### Turn off Learn when done

7. Go back to the Setup Tools panel. Right-click on the Verify tool (in the image or in the Tools list).
8. Open the Learn menu and clear the check box beside **Learn** to turn off learning mode.
9. If you have trained the wrong examples or unwanted images you can click the Erase  button to delete ALL images in the "good examples" database and start over training again.
9. Click the Accept button to accept changes and close the Learn menu.

At run time the Verify tool highlights and reports the number of cells that do not match any image in the database of examples.

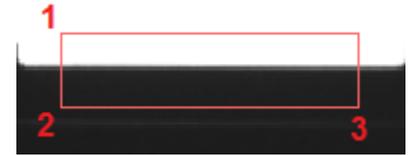


## Using the Line Tool



The Line Tool fits a line to an edge using multiple sample points on a relatively straight edge in the image. This tool does not apply to arcs, curves or complex shapes.

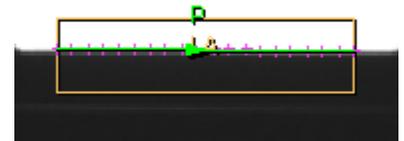
- Click the Line Tool button. Move your mouse into the image area.
- Click and release on one side of the edge. Not on the edge.
- Click and release on the opposite side of the edge. A line appears crossing the edge (perpendicular to the edge).
- Move your mouse along the direction of the edge (move parallel to the edge). A rubber band box appears and follows your movement.
- Click and release to create a rectangle search area for finding the edge. Do not go beyond the end of the edge or over a corner or termination. This rectangle may appear at an unwanted angle. You can adjust the angle and length.



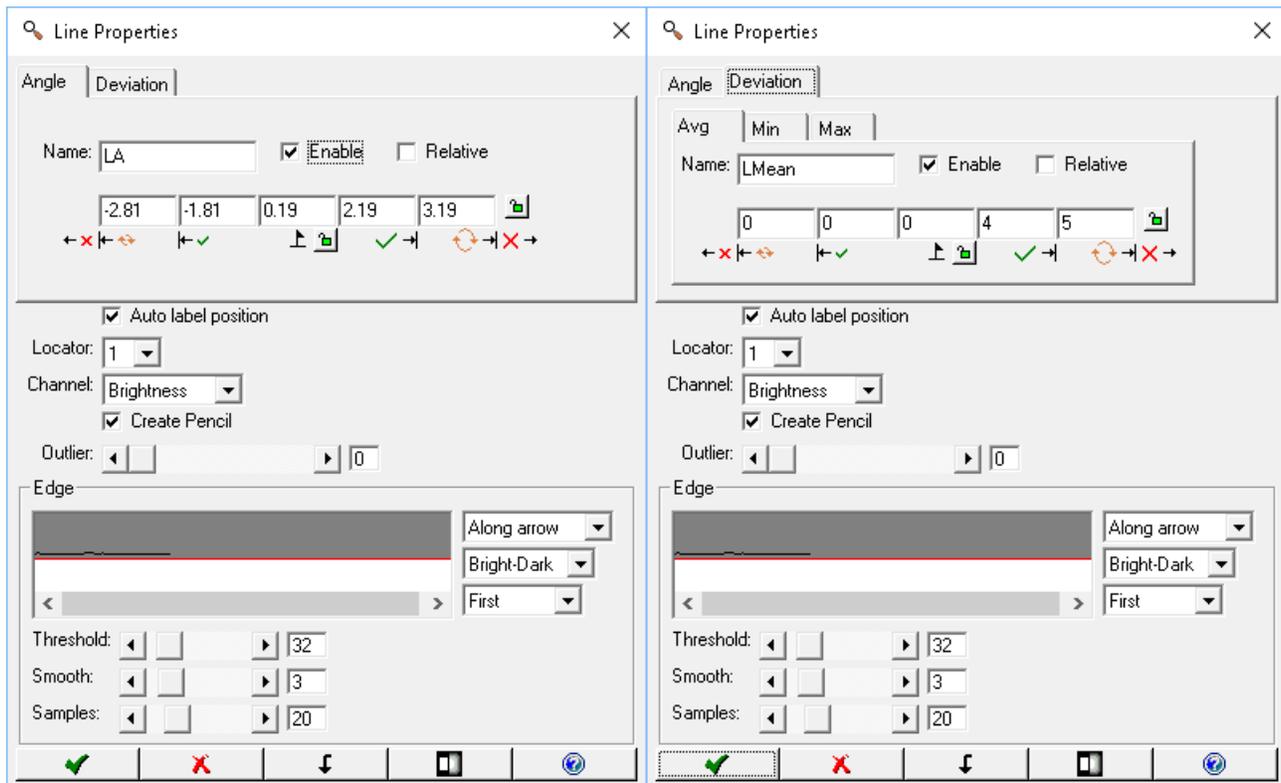
An arrow appears on one side of the rectangle to show the scan direction. The tool uses a series of rake lines in the direction of the arrow to find the edge. The samples parameter defines the number of rake lines. The pink crosses show where these rake lines intersect with the edge.



The tool creates a Pencil line using the best fit of the edge points. The arrow on the pencil indicates the direction of data points for the deviation measurement if enabled.



- If the Line tool is still active you can drag the small solid squares that appear on the corners to change the height and width of the rectangle. Use the curved arrow icon that appears on one side of the rectangle to rotate the ROI. **Note:** You want the rectangle to enclose the area of the edge that you wish to sample or fit. The rectangle search area does not have to be perfectly parallel or perpendicular to the edge you are detecting.
- If the Line tool is active when you hover over the edge of this tool the outline turns red and a message appears telling you to “Right-click to edit this tool”.
- Right-click on the outline to open the Line Properties edit box.



<i>Tab</i>	<i>Measurement</i>
Angle	The slope of the edge or pencil line relative to the horizontal or X axis and positive in the clockwise direction.
Deviation: Avg	Average change of the edge points positions from the positions in the trained image.
Deviation: Min	Minimum or smallest change of the edge point positions from the positions in the trained image.
Deviation: Max	Maximum or largest change of the edge point positions from the positions in the trained image.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the tool in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Create Pencil** a Pencil Line is created if checked. No Pencil line created if cleared.

**Outlier** define a number of points to discard when creating a Pencil line. A noisy or jagged edge may have a few points that are out of line with most of the points found. These could be considered data “outliers” and can be excluded or discarded when creating a Pencil line.

### Edge

These adjustments control locating the edge.

**Direction** - select the scan direction for finding the edges.

**Along arrow** means scan in the direction of the arrow head on the search box outline.

**Against arrow** means scan in the opposite direction from the arrow head on the search box outline.

**Polarity** - select the type of edge transition to detect.

**Dark-Bright** means a “dark-to-light” transition or edge.

**Bright-Dark** means a “dark-to-light” transition or edge.

**Either** means both edges.

**Selection** - select which edge to use, or how to find the edges that define the measurement.

**Strongest** use the strongest edge found in the search area.

**First** use the first edge found in the search direction.

**Threshold** - a lower setting is better at detecting edges that are less sharp or less sudden transitions from dark to light (or light to dark). A higher setting may suppress false edges.

**Smooth** - number of times to apply a smoothing filter (low pass filter) in the edge search box, to remove noise effects.

**Samples** - the number of sampling points to find the edge (the number of scan lines) indicated by the pink crosses.

- i. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before learning, adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.
- j. Click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.
- k. Click the Accept  button to accept changes and close the Properties box. Click the Cancel  button to close without changes. Click the Apply  button to apply changes without closing the Properties box.

**Note:** If the Pencil tool is active, you can drag the solid squares at the ends of the pencil line created by the Line tool. You can lengthen the pencil line outside the rectangle of the Line tool. This may be useful if you are attaching another tool to this pencil line.

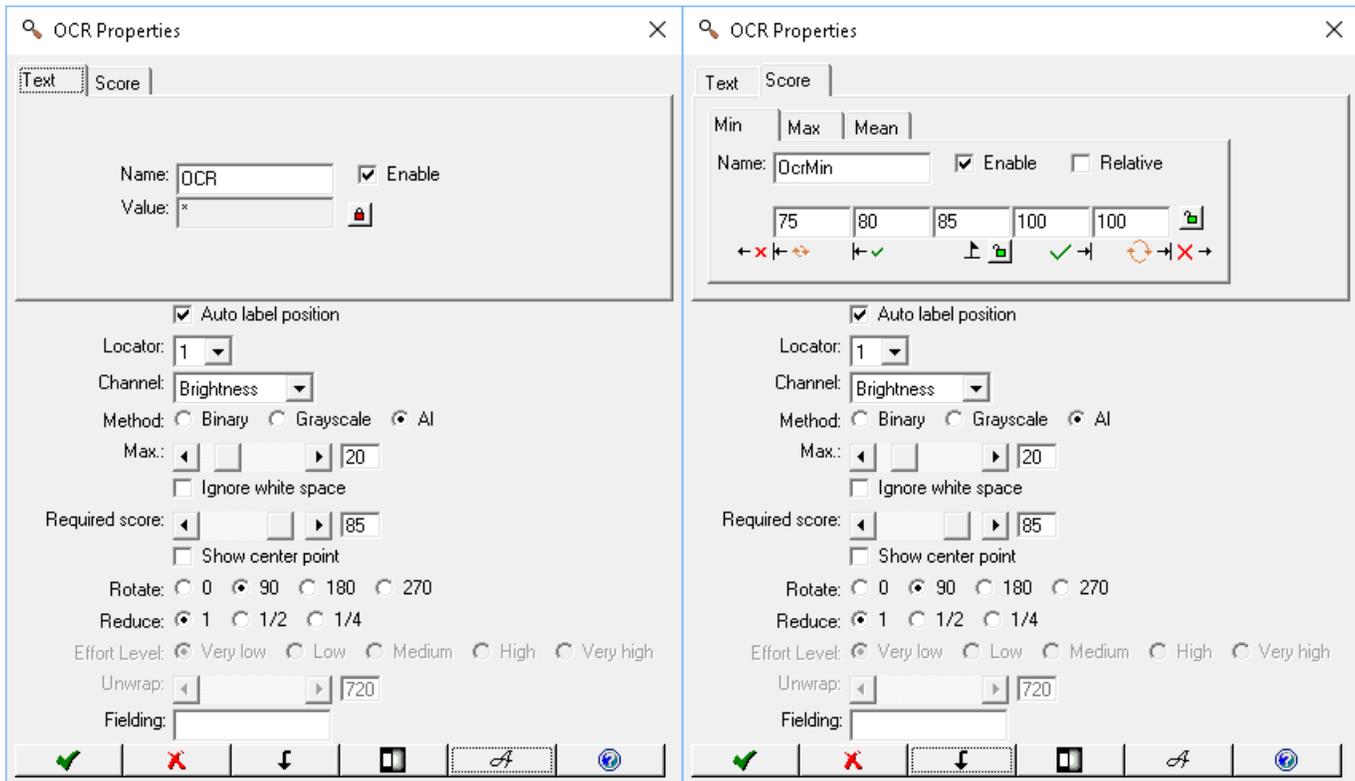
### Using the OCR Tool



The OCR tool reads Characters (letters and numbers). The OCR tool can read multiple lines, but it is recommended you use separate Regions for each line. Light, lens, focus, exposure, distance (size of characters in the image) affect the ability to read. OCR can also be used for logos and ID marks.

- a. Click on the “OCR” button. Select a Region shape. Use **Rectangle** for text at 0, 90, 180, and 270 rotations. Use **Polygon** for text at any angle (not at 90-degree increments). Polygon draws a rectangle at any angle. Use **Annulus** to unwrap text printed around a circle.
- b. Move the mouse over the image in the Work Area. You should not see highlighted edges. Draw a Region around the characters. Refer to the Tip window. When the OCR tool is selected, you can move and resize the Region shape. For the example shown, it is important to not include any of the black area outside this label. The autodetect feature will be confused and reading will be adversely affected.
- c. When you hover the cursor over the edge of the tool, the Region outline turns red, and a message appears telling you to “Right-click to edit.” **Note:** The text in this example is rotated **90** degrees (counter clockwise).
- d. Right-click on the highlighted Region outline (or on the OCR tool in the Tool list). An OCR Properties box opens. In this box you can: use the tabs to select, enable, and rename measurements, set the tolerances for recycle and reject, adjust the other parameters.





Tab	Measurement
Text	Report the string read, or compare the read string to a set Value.
Score:Min	Minimum character score.
Score:Max	Maximum character score.
Score:Mean	average score on all characters. This measurement creates an array of measured score values for all the characters identified. All the individual score values are displayable on the Monitor panel, and are available in the Scripting editor.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - (score tabs only) clear the box to report actual numbers; check the box to report difference.

**Value** - (text tab only) If a string can be read with the current settings and font training, it will appear in this field. If there is a fixed or known string value, you can enter it. This will limit the number of characters read. The read will fail if it does not match this value. If the string changes, leave this field blank or an asterisk (\*) for wild card) to report every read. You can use a question mark (?) for a single character “wild card” or an asterisk (\*) for a multiple character “wild card”.The Padlock button  allows you to lock the **Value**, so it does not change while you move or resize the Region.

**Auto label position** - puts the label (OCR) beside the tool in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Method** how to separate the characters from the background and identify characters at Training and Runtime. You should not change this value once you have begun training characters. You must retrain if you change the method used.

**Binary** uses a threshold to create a “binary” image, separating “blobs” from background.

**Grayscale** uses grayscale correlation matching.

**AI** uses a threshold to create a binary image and uses a library of previously trained characters. The characters are: ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890/-

**Max.** - maximum number of characters read. Limiting the number of characters read can increase speed.

**Ignore white space** - hides space separating characters. This is especially useful for vertical character strings or multiple line strings. In the sample (under “Using the Font Editor”), **Ignore white space** changes the reported string from DREA MERY to DREAMERY.

**Required score** - sets a minimum acceptance or threshold for the score of each match. Potential matches that do not meet this minimum are discarded or not reported.

**Show center point** - create an Active Point on the center of each character recognized.

**Rotate** - direction of the characters (left to right, top to bottom, etc.) Use this to change the direction characters are sampled or read. This setting also changes the direction in the Font Editor. For the Annulus and Curve Area regions: 0= scan or read counter-clockwise and use the outer circle for the base line, 180= scan or read clockwise and use the inner circle for the base line (see page 95 for an illustration of the Annulus and Rotate).



**Reduce** - when working with large characters, you can sub-sample the image at training and inspection time, to use less data, and run faster. Sub-sample should not be used with characters that have small or fine details.

**Effort Level** - apply a relaxed (Low, Very low) Medium or advanced (High, Very high) read algorithm. A higher setting is slower but is more rigorous and may perform better with degraded or poorly contrasted codes. A lower setting is faster, but less rigorous.

**Unwrap** - limit or increase the read or sample distance around the area between two circles. 360 is one complete revolution. 720 is two complete revolutions. Using a number greater than 360 will repeat the area located at the beginning of the unwrap scan and include characters that may be split by a 360 scan. This is important where the part is allowed to move or rotate. The OCR tool examines the 720 (default) sample rectangle for a 360-area rectangle that contains the string or strings that have the minimum total gap between characters. This makes the assumption that the string or strings do not occupy the entire circle, and the gap at the end of the strings is larger than any gap between characters or strings.

**Fielding** - limit positions in the string to be specific character types. This can speed up the OCR Tool by reducing the number of characters compared to the found characters.

character	defined (allowed) characters
?	any alphanumeric character
#	numeric characters only
a	lower case letters only
A	upper case letters only
\$	letters only, both upper and lower case

e. Click the A button  to open the Font Editor.

f. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

g. Click the Accept button  to accept changes and close the OCR Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

### Using the Font Editor



The Font Editor allows you to import fonts or individual characters, train new characters, and save trained fonts or characters.

- Click on the “Add” tab in the Font Editor. Your OCR rectangle (Region) is displayed in this new window. Use the zoom in and zoom out buttons to change the size of the Region. Use the rotate button if your characters are at a different orientation (direction).

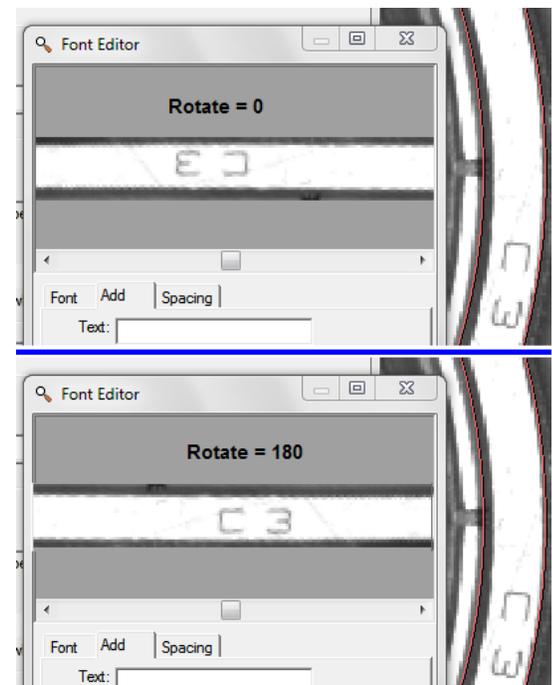
**Note:** For this example, the **Rotate** parameter was set to **90** in the OCR Properties box, to make the text appear horizontal in the Font Editor.

**Note:** The trained models must include some background space around the characters. If you use a larger ROI at training time, and use a smaller ROI at runtime, some characters may not be recognized because some of the pixels in the model are missing (the “space” pixels). If the text moves around in the image, make sure the ROI is large enough to compensate for this and still include the “space” around characters. For example, if the text moves very close to one edge of the ROI, it may contain less space than at training time. This could cause a failure to read or identify the wrong characters.



For the Annulus Region, the display shows 720 degrees or two full sweeps, to prevent missing characters where the sample begins, or the Annulus is “split”. “Rotate” in the OCR Properties box changes the direction characters are presented in this window: 0 degrees sweeps the Annulus counter-clockwise and uses the outer circle for the base line, 180 sweeps the Annulus clockwise and uses the inner circle for the base line.

**Note:** If the order of characters is changing in an Annulus, or spaces are randomly added in the read string, the space between characters may be close to the Automatic Maximum space value. Open the Font Editor and click on the “Spacing” tab. Clear the checkbox beside “Auto Maximum” and enter a value slightly larger than the space between your characters.



There are two ways to train characters: 1) Auto Detect Characters and 2) Manual.

### 1. Auto Detect Multiple Characters

In this mode you adjust the settings of a filter that auto-detects characters. Type all of the characters identified, including repeats, and add them (all) to the trained character set. You can delete repeats if you desire.

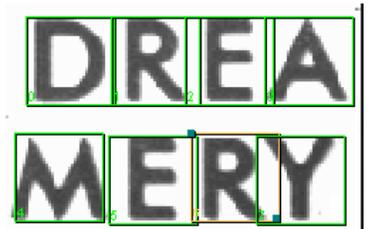
1a. Check the box beside "Auto detect".

1b. Clear the check box beside "All characters are same size" near the bottom of this menu if your characters are not all the same size. This box will become grayed out after you begin training.

1c. Select the proper Color: "White-on-black" for light characters on a dark background, or "Black-on-white" for dark characters on a light background.

1d. Select the Extent of the filter. Use "Global" if the lighting is fairly constant across the Region. A single Threshold value is applied to the whole Region. Use "Local" if the lighting varies or changes across the Region. The local adaptive filter uses the Local W and H to define a local filter size and calculate threshold values.

1e. Change the setting of "Level" to adjust the separation of characters from the background. The boxes around the characters should grow or shrink as you change the value of Level.



1f. Manually adjust the size of the boxes if necessary, to closely fit the entire character, and include as little background as possible.

1g. When all the characters are detected adequately, type all of the characters in the Text field, including repeats or duplicates. Click the "+" button at the bottom of this menu to add all characters. The menu jumps to the "Font" tab.

### 2. Manual

In this mode you train characters by drawing a box around each individual character, giving it a name or label, and add it to the trained character set.

2a. Clear the check box beside "Auto detect". Clear the check box beside "All characters are same size" near the bottom of this menu if your characters are not all the same size.

2b. Move your mouse to any corner of the first character. Click, release, move the mouse and click again, to draw a rectangle around the character. Use the resize handles to change the size of the box to closely fit the entire character and include as little background as possible. Draw a box around each character.



2c. Enter the labels for each character in the **Text** field. Usually the character itself is the label.

2d. Click the "+" button at the bottom of this menu, to add all characters. The menu jumps to the "Font" tab.

### 3. Continuing, for both methods (Manual and Auto Detect):

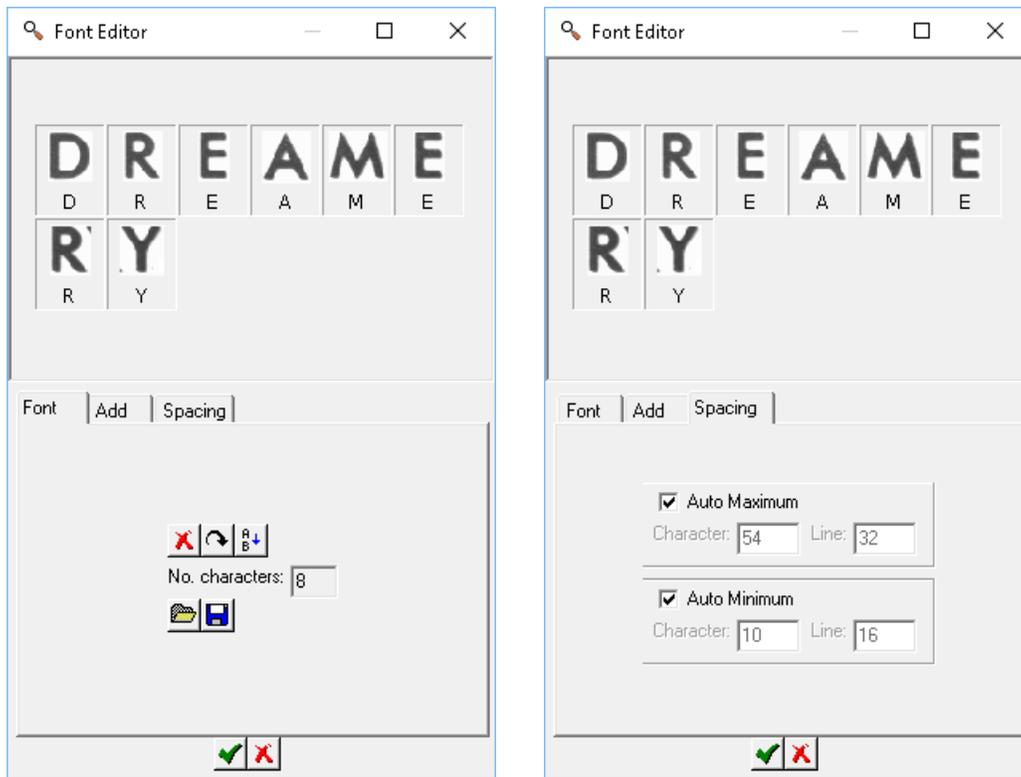
b. Click on the "Font" tab. You can delete or rotate selected characters. **Note:** If you used AI and all characters were detected correctly this tab will not show any trained characters. If you corrected any characters, only those will be shown.

You can sort by the labels you entered. Double-click on a character to change the label. You can also import characters from saved "font" files and save your characters to a "font" file. These panels show the characters and their labels.

You can keep multiple instances of a character, or you can delete the duplicates. Save the font set to a file before you start deleting.

The more characters in your font set, the longer it can take for the OCR Tool to recognize all characters. If the duplicate characters are identical, it is usually safe to delete duplicates. But if the characters are not closely identical, you may need the duplicates to identify character variations correctly.

- d. If your characters have different spacing, click on the “Spacing” tab and clear the check boxes for Auto min and Auto max. These values control the maximum and minimum size of character bounding boxes. **Character** controls the horizontal size and **Line** controls the vertical size.



- e. Click the Accept button  to accept changes and close the Font Editor. Click the Cancel button  to close without changes.

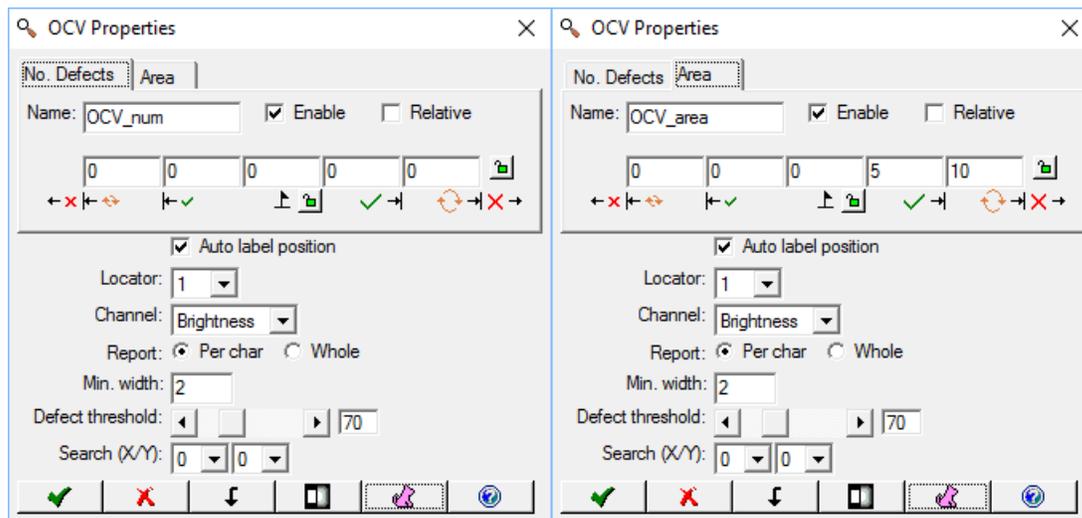
### Using the OCV Tool



The OCV tool measures the quality of a group of characters in an image, such as printed on a label or on a part. OCV does not read the characters.

- Click on the “OCV” button. Select a Region shape.
- Move the mouse over the image in the Work Area. You should not see highlighted edges. Draw a rectangle around the characters. Refer to the Tip window. When the OCV tool is selected, you can drag the tool rectangle, or resize the tool by dragging the solid squares at the corners of the rectangle.
- When you hover the cursor over the edge of the tool, the Region outline turns red, and a message appears telling you to “Right-click to edit.”
- Right-click on the highlighted Region outline (or on the OCV tool in the Tool list). An OCV Properties box opens. In this box you can: use the tabs to select, enable, and rename measurements, set the tolerances for recycle and reject, adjust the other parameters and train the pattern to match or measure. **NOTE:** The tolerance limits will default to zeros until you have trained a pattern of characters.





Tab	Measurement
No. Defects	Number of objects that did not match the trained pattern. This is a single number when <b>Report</b> parameter is <b>Whole</b> . This is an array of values when <b>Report</b> parameter is <b>Per char</b> .
Area	Areas that did not match the trained pattern. This is a single number when <b>Report</b> parameter is <b>Whole</b> . This is an array of values when <b>Report</b> parameter is <b>Per char</b> .

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Auto label position** - puts the **Name** label beside the tool in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Report** – how to detect characters and report measurements

**Per char** report as an array of values for each character.

**Whole** report one number for the total defect or area of the pattern.

**Min width:** - minimum blob size that will be reported as a defect. Smaller blobs are ignored.

**Defect threshold** – sets a pixel intensity threshold used a runtime for separating the characters from the background.

**Search(X.Y)** – allows for variation in position. The pattern is shifted by this amount in all directions. When Report is Whole, the whole pattern is shifted. When Report is Per char each character is shifted individually. This adds to the processing and inspection time and should only be used when needed. Entries of 1,1 create an 8-way shift. Entries of 2,2 create a 25-way shift.

f. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters and before training a pattern of characters. Please refer to page [23](#) for information on the preprocessors available.

g. Click the Advanced button  to open the OCV Training menu.

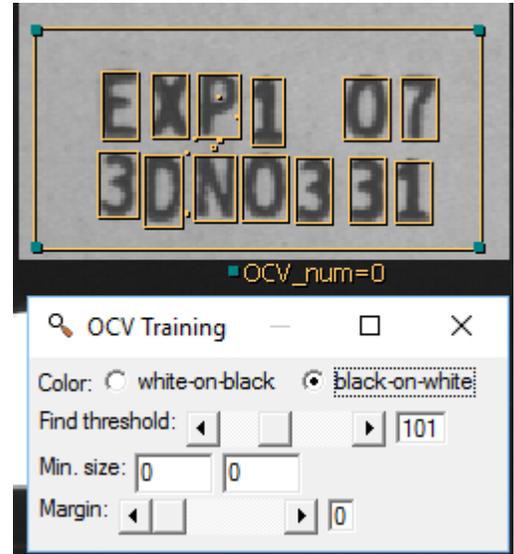
### Using the OCV Training Menu

As you make adjustments in this menu you can see “Character boxes” drawn around the individual characters increasing or decreasing in size.

1. Select the color by clicking on one of the radio buttons. You can update the character boxes in the image area by clicking on the same radio button again
2. Adjust the Find threshold used to separate characters from the background. This threshold only applies to Training characters.

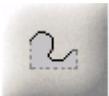
Notice this image shows some very small artifacts.

3. Minimum size controls the smallest blob area that will be used as a character. The first number is the short size of a blob and the second number is the long size of a blob.
4. Margin increases the character box beyond the detected blob or character, to add a small area surrounding the actual character.
5. Click the Close button at the top of this window.



- h. Click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.
- i. Click the Accept button  to accept changes and close the OCV Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

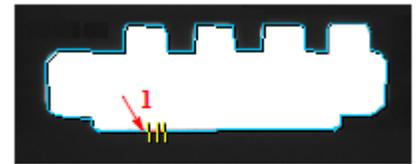
### Using the Contour Tool



The Contour Tool looks for flashing, burr, cut or thread defects along an edge; usually a machined part. This tool can be used for other edges as well. This tool measures deviation or change in positions and reports the number of “failed” sections that were located greater than the allowed distance tolerance. **By default, two measurements are enabled.**

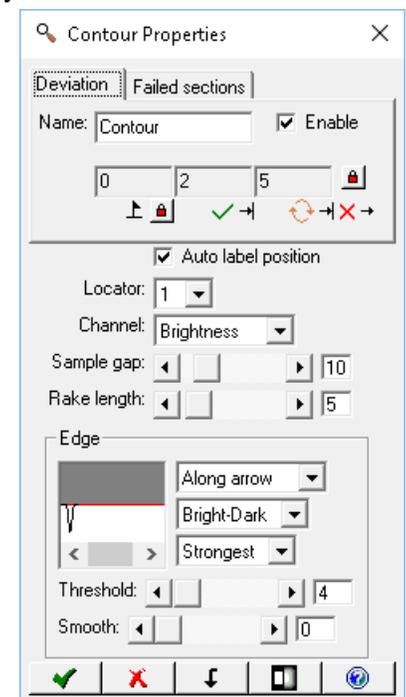
- a. Click on the “Contour” button. Move the mouse over the image in the Work Area. You should see the edges in the image highlighted as you move across them.

- b. Find the edge that matches your measurement. Click on the edge (1), and a “rubber” line appears and follows your cursor movement. If the edge is a closed loop, the line is the shortest distance from the first click and your mouse position. Right-click to reverse the direction of the rubber line. Left-click on a second (2) point along the same edge. A line is drawn following the edge, between the two click points, and a group of “ruler lines” are drawn perpendicular to the line and the edge. These lines are the sampling points for finding the edges.
- c. When the Contour tool is selected, you can drag the center points of the ruler lines, if they are not exactly where you wanted. Moving the center points also changes the spacing between the ruler lines. The small solid boxes that appear near the endpoints of the first and last ruler lines define the search “area”. You can drag the solid square to resize the ruler lines and increase the search area; but searching more area may increase the processing time.



**Complex Shapes:** The spacing of samples may round the corners of more complex shapes or simple curves, and place samples that are not centered on the edge. Zoom in and verify that the rubber line follows the edge of your part. You can try decreasing the sample gap value, to place more samples closer together. Or you can move individual samples by dragging the solid square at the center of each ruler line (where the ruler line crosses the rubber line). Change the sample gap, to fill in between the samples you moved.

- d. When you hover over the center line, the label turns red and a message should appear, telling you to “Right-click to edit.”
- e. Right-click on the center line (or on the Contour tool in the Tool list). A Contour Properties edit box opens. In this box you can: use the tabs to select, enable, and rename measurements, set the tolerances for recycle and reject, change the sensitivity and sample gap (space between ruler lines), and the number of sampling lines around the edge). **By default two measurements are enabled.**



Tab	Measurement
Deviation	maximum or largest change (distance) from the trained position.
Failed sections	number of samples that had a deviation larger than the allowed maximum, plus any sections where the edge was not found on the rake line.

**Name** - you can change the default name of the tool or measurement. The name or “label” is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Auto label position** - puts the **Name** label beside the tool in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Sample gap** - changes the spacing (in pixels) between the sample lines and changes the number of samples.

**Rake Length** - changes the length of the sample lines or ruler lines. This is the same as dragging the endpoint of the first line when the Contour tool is selected.

## Edge

These adjustments control locating the edges that define the contour.

Direction - the first drop-list selects the scan direction for finding the edges.

**Along arrow** means scan in the direction of the arrow head on the first rake line.

**Against arrow** means scan in the opposite direction from the arrow head on the first rake line.

Polarity - the second drop-list selects the type of transition to detect.

**Dark-Bright** means a transition from-dark-to-light.

**Bright-Dark** means a transition from-light-to-dark.

**Either** means both edges.

Selection - the third drop-list selects which edge to use, or how to find the edge that defines the measurement.

**Strongest** use the strongest edge found in the search area.

**First** use the first edge found in the search direction.

**Threshold** - a lower setting is better at detecting edges that are less sharp or less sudden transitions from dark to light (or light to dark). A higher setting may suppress false edges.

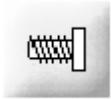
**Smooth** - number of times to apply a smoothing filter (low pass filter) in the edge search box, to remove noise effects.

f. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

g. Click the padlock button beside "Perfect"  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.

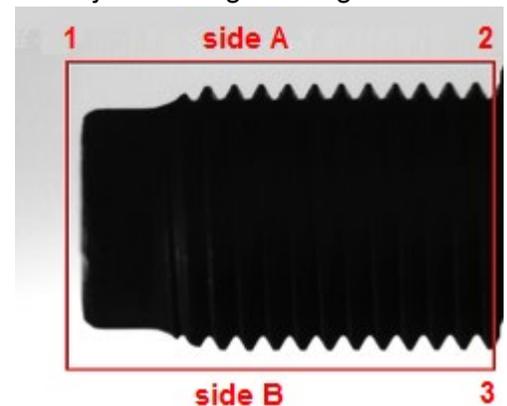
h. Click the Accept button  to accept changes and close the Contour Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

## Using the Thread Tool



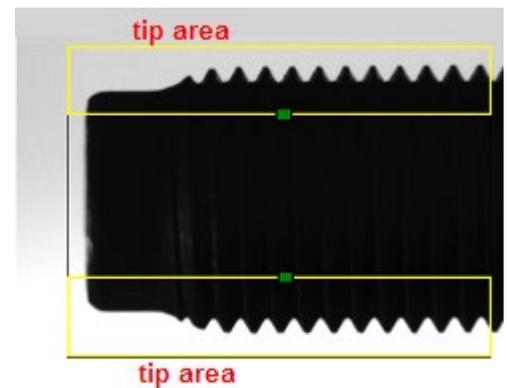
The Thread Tool measures the inner and outer diameters (ID and OD) Pitch, and Angle of a solid body, threaded object. If the ends of the shaft are inside the "end cap" area, the length of the shaft can be measured. **Note:** The image should be a dark object on a light background.

- Click on the "Thread" button. Draw a rectangle (at any angle) that encloses the area of the thread or the shaft of the bolt. Refer to the Tip Window instructions. The rectangle should be larger than the threaded object. Click at one end of the thread or shaft (1). Click at the other end of the thread or shaft (2), on the same side of the shaft. Click on the opposite side of the shaft. (3) For reference, the first two clicks define "Side A" of the tool, and the third click is "Side B".

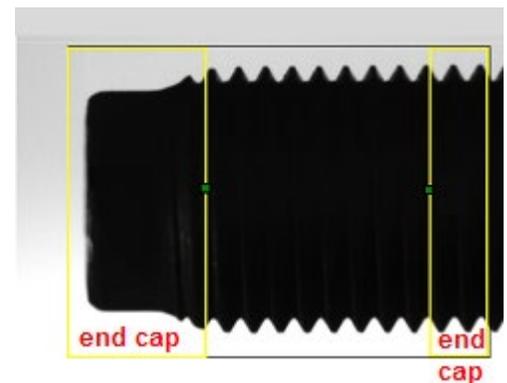


The Thread Tool draws four smaller, yellow, overlapping rectangles inside your larger rectangle (one of these may be collapsed or closed against the side of your larger rectangle).

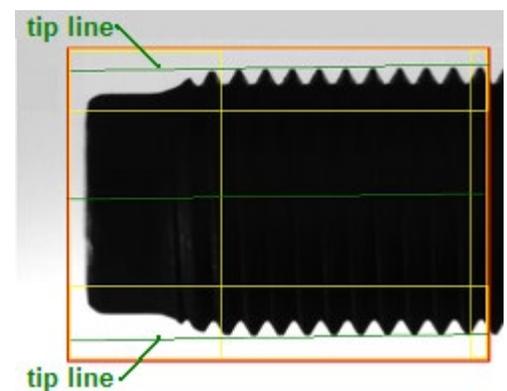
- The two "tip area" rectangles appear at the top and bottom (against Side A and Side B). Use the solid square to adjust the size of each "tip area" to enclose the tips and valleys of the thread, on opposite sides of the shaft.



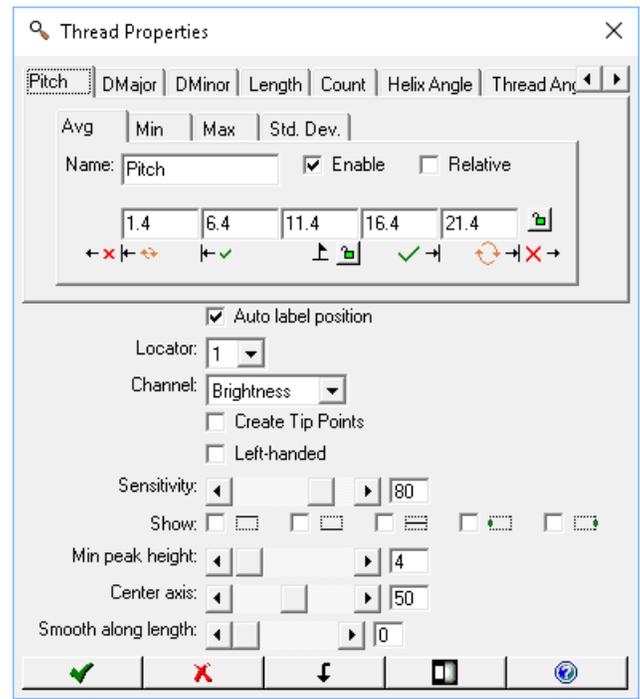
- The two "end cap" rectangles appear at the left and right ends of the shaft. One "end cap" may be closed against the side of your rectangle. Use the solid square to adjust the size of each end cap to enclose the area you do not want included in the thread measurement. The "end cap" encloses an area to be ignored in measuring the thread, where the thread is changing or where there is no thread. The end cap could enclose a tapered end, an un-threaded area of the shaft, the bolt head, or other areas to ignore, such as a plate supporting the bolt.



This image shows the Thread Tool with the tip areas and end caps adjusted. The tip lines and center line are also displayed in this example. **Note:** The end cap on the right may be open (to ignore the last thread) or closed (to include the last thread). With the right end cap open, the Length in this example would give a value 0 because the end of the shaft does not appear in the right end cap.



- d. If you hover your cursor over the outer rectangle, the rectangle turns red and a message should appear telling you to “Right-click to edit”.
- e. Right-click on the highlighted outer rectangle. A Thread Properties edit box opens. In this box you can: use the tabs to select enable and rename measurements, set the tolerances for recycle and reject. And change the other parameters and options for this tool.



Tab	Measurement
Pitch: Avg	Average distance between adjacent tip points. This measurement creates an array of measured distance values. All the individual distance values for each measurement are displayable on the Monitor panel and are available in the Scripting editor.
Pitch: Min	Minimum pitch, or smallest measured distance between adjacent tip points.
Pitch: Max	Maximum pitch, or largest measured distance between adjacent tip points.
Pitch: Std.Dev.	Standard deviation of distance between adjacent tip points.
DMajor: Avg	Major diameter, outer diameter or OD. The average of diameters calculated as distance from tip points to the center line multiplied by 2. This measurement creates an array of measured distance values. All the individual distance values for each measurement are displayable on the Monitor panel and are available in the Scripting editor. The order is reported as top tip points left to right, then bottom tip points right to left.
DMajor: Min	Minimum outer diameter or OD value. The smallest DMajor value (distance from tip to center line x 2).
DMajor: Max	Maximum outer diameter or OD value. The largest DMajor value (distance from tip to center line x 2).
DMajor: Std.Dev.	Standard deviation of outer diameter or DMajor measurements.
DMinor: Avg	Minor diameter, inner diameter or ID. The average of diameters calculated as distance from valley points to the center line multiplied by 2. This measurement creates an array of measured distance values. All the individual distance values for each measurement are displayable on the Monitor panel and are available in the Scripting editor. The order is reported as top valley points left to right, then bottom valley points right to left.
DMinor: Min	Minimum inner diameter or ID value. The smallest DMinor value (distance from valley point to center line x 2).
DMinor: Max	Maximum inner diameter or ID value. The largest DMinor value (distance from valley point to center line x 2).
DMinor: Std.Dev.	Standard deviation of inner diameter or DMinor measurements.
Length	Length of the shaft, including the area inside the end caps. This measurement expects to find the end or edge of the shaft in the end cap area. If the end cap is open, and the end of the shaft is not found, the length is reported as 0. If the end cap areas are closed the length is to the outer or largest rectangle, which measures the tool and not the shaft.

Count	Number of outer tips found on the top and bottom sides. If they are different, the smaller number is reported.
Helix Angle	The angle formed by two opposite tips. Reports the average of all outer pairs. The angle is calculated differently for right-handed and left-handed threads. Check the "left-handed" checkbox if you have a left-handed thread.
Thread Angle	The angle formed by the two sides of a thread profile in cross section. The value reported is the average of all measured angles.
Pitch Diameter: Avg	Average of the measured Pitch Diameters This measurement creates an array of measured distance values. All the individual distance values for each measurement are displayable on the Monitor panel and are available in the Scripting editor. The order of values is the top side left to right, then the bottom side right to left. The Pitch Diameter is not related to the measurement of the Pitch (distance between adjacent tips).
Pitch Diameter: Min	The maximum value of the Pitch Diameters.
Pitch Diameter: Max	The minimum value of the Pitch Diameters.
Pitch Diameter: Std.Dev.	The Standard Deviation of all Pitch Diameter measurements.

**Name** - you can change the default name of the tool or measurement. The name or "label" is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the tool in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Create tip points** - makes active points at the tips, which can be used in other measurements.

**Left-handed** - thread direction. Check this box for a left-handed thread. Clear this box for a right-handed thread. This affects the Pitch Angle calculation.

**Sensitivity** - a higher setting is more sensitive to edge transitions that have less contrast between light and dark.

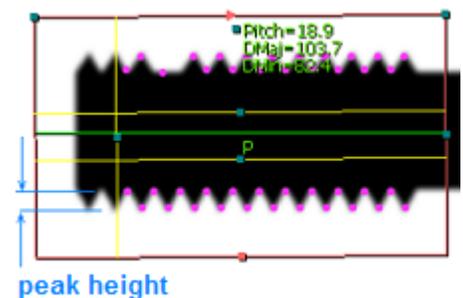
**Show** - display or hide measurement lines and points in the tool display:

- top "tip" line drawn through the top "tip points".
- bottom "tip" line drawn through the bottom "tip points".
- center-line, centered between the tip lines.
- left end point, first detected edge along the center line.
- right end point, last detected edge along the center line.

**Min peak height** - sets a minimum distance in pixels between the peaks and valleys for including or rejecting tips and valleys.

**Center axis** - position of the "center axis" line relative to the "side A" and "side B" (in percent). **Length** is measured on the Center axis. A value of 0 places the Center axis very close to the Tip line of side B. A value of 100 places the center axis very close to the Tip line of side A. The default 50% places the Center axis in the middle between "side A" and "side B".

**Smooth along length** - a higher setting should remove small noise against a larger threaded object but could eliminate some peaks in a smaller object. A lower setting removes less.



- f. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.
- g. Click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.
- h. Click the Accept button  to accept changes and close the Bead Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

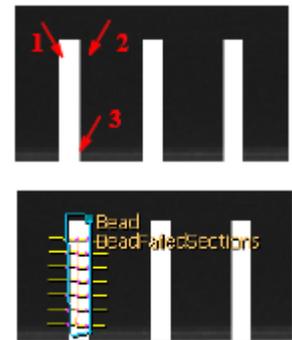
### Using the Bead Tool



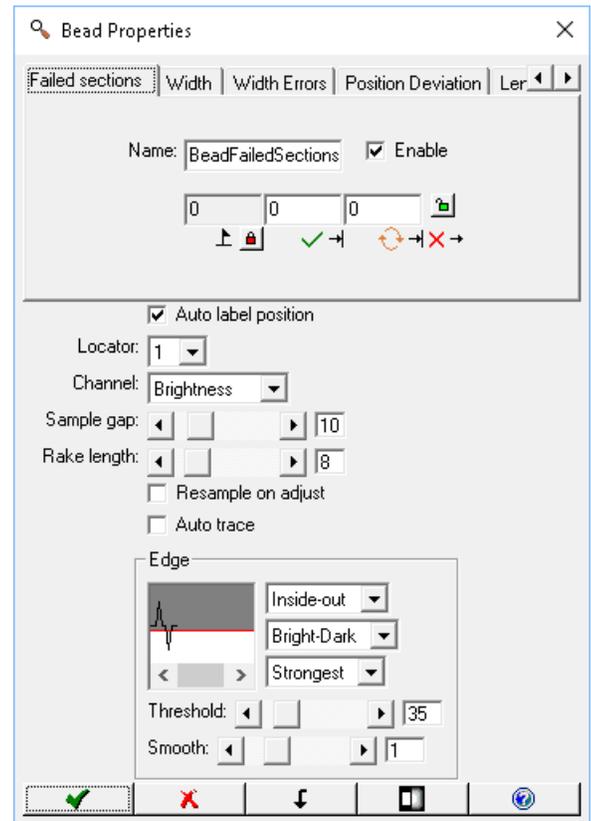
The Bead Tool measures the uniformity, consistency or repeatability of the distance between the edges of a strip of material, such as an applied strip of adhesive or paste, or an etched track. **By default, two measurements are enabled.**

The Bead tool creates a series of ruler lines (or “sample lines”) used to find the edges of a strip of material and calculates the center of the two edges to draw a center-line of the strip. The tool measures change in center positions (movement of the center-line) and edge to edge distances (thickness).

- a. Click on the “Bead” button. Move the mouse over the image in the Work Area. You should see the edges in the image highlighted as you move across them.
- b. Find the edges that match your measurement. Left-click on one edge (1), and a “rubber” line appears and follows your cursor movement. Click on the opposite side of the bead (2). Move the mouse along the second edge and click again on the second side of the bead (3). A line is drawn through the center of the bead. This line is intersected by several perpendicular “ruler lines”. These lines and the smaller pink crosses (where the ruler lines cross the edges of the bead) indicate the sampling points for finding the edges. These lines locate the two edges of the bead and measure the distances between edges. At inspection time the lines locate the edges of the bead and compare the distances between the edges to the trained distance.
- c. When the Bead tool is selected, you can drag the center points of the ruler lines (where they cross the center line) if they are not where you wanted. Moving the center points also changes the spacing between the ruler lines. The small solid box that appears at the end of the first ruler line defines the search “area” for locating each edge of the bead; how far to look from the center line to find the edge. You can drag the solid square to resize the ruler lines and increase the search area; but searching more area may increase the processing time.



- d. When you hover over the center line, the rectangle turns red and a message should appear, telling you to “Right-click to edit.”
- e. Right-click on the rectangle (or on the Thread tool in the Tool list). A Thread Properties edit box opens. In this box you can: use the tabs to select, enable, and rename measurements, set the tolerances for recycle and reject, and change the other parameters and options for this tool.



<i>Tab</i>	<i>Measurement</i>
Deviation	the maximum or largest distance change of the center points on each rake line (or movement of the center-line of the strip of material). This measurement creates an array of measured distance values. All the individual distance values for each rake line are displayable on the Monitor panel, and are available in the Scripting editor.
Failed sections	the number of rake lines (sample lines) that failed for any reason: the deviation failed its tolerance, one or both edges were not found, or the width failed the Min or Max tolerance, if enabled.
Width: Min	the minimum (smallest) measured width (edge to edge) of the bead.
Width: Max	the maximum (largest) measured width (edge to edge) of the bead.
Width: Mean	the average measured width of the bead. This measurement creates an array of measured width values. All the individual width values for each rake line are displayable on the Monitor panel, and are available in the Scripting editor.
Width Errors: Total small	the total number of samples or rake lines where the width was too small.
Width Errors: Cont small	largest number of continuous or adjacent samples where the width was too small. The longest section of the bead with the width too small.
Width Errors: Total big	the total number of samples or rake lines where the width was too big.
Width Errors: Cont big	the largest number of continuous or adjacent samples where the width was too big. The longest section of the bead with the width too big.
Position Deviation: Total pos dev.	the total number of center points that failed the "deviation" tolerance.
Position Deviation: Cont pos dev.	the largest number of continuous or adjacent center points that failed the "deviation" tolerance. The longest section of the bead with the center-line out of position.
Length	Measure the total length of the bead trace from end to end. You must enable the "Auto trace" feature, to find the ends of the path. <b>Note:</b> All other measurements except the Width, are turned off when you enable the Length measurement.

**Name** - you can change the default name of the tool or measurement. The name or "label" is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the tool in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Sample gap** - changes the spacing between samples and changes the number of samples.

**Rake Length** - changes the length of the ruler lines. This is the same as dragging the endpoint of the first line when the Bead tool is selected.

**Resample on adjust** - recalculates all the sample positions each time you move the end sample, spacing the samples using the **Sample gap** setting.

**Auto trace** - follows the path of the bead to find the two ends. Uncheck to disable Auto trace, and the tool is confined to the area where you drew the tool. Check to enable Auto trace, and the tool follows the path to its ends, and uses an edge-detector to find the ends of the path. You must enable Auto trace to use the Length measurement.

## Edge

These adjustments control locating the edges that define the bead.

**Direction** - the first drop-list selects the search or scan direction on the ruler lines.

**Inside out** means starting at the center of the Bead, moving out along each ruler line.

**Outside in** means starting at the ends of the ruler lines, moving in toward the center of the bead.

**Polarity** - the second drop-list selects the type of edge transition to detect.

**Dark-Bright** means a “dark-to-light” transition or edge.

**Bright-Dark** means a “dark-to-light” transition or edge.

**Either** means both edges.

**Note:** If the edge Polarity selected is not encountered, the edge of the bead may not be found.

**Selection** - the third drop-list selects which edge to use, or how to find the edge that defines the bead.

**Strongest** use the strongest edge found in the search area.

**First** use the first edge found in the search direction.

**Threshold** - a lower setting is better at detecting edges that are less sharp or less sudden transitions from dark to light (or light to dark). A higher setting may suppress false edges.

**Smooth** - number of times to apply a smoothing filter (low pass filter) in the edge search box, to remove noise effects.

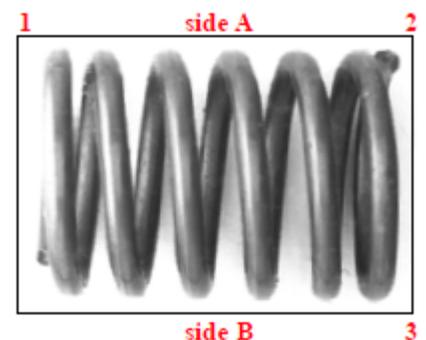
- f. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.
- g. Click the padlock button beside “Perfect”  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.
- h. Click the Accept button  to accept changes and close the Bead Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

## Using the Spring Tool



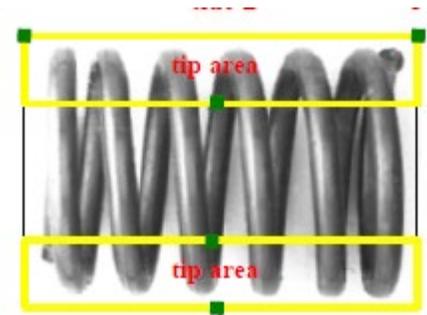
The Spring tool measures periodic or repeating objects, such as a screw thread or coil spring. The Spring tool finds the tips and calculates distances between these tip points. **Note:** The image should be a dark object on a light background.

- a. Click on the “Spring” button. Draw a rectangle (at any angle), that encloses the area of the repeating object. Refer to the Tip window instructions. The rectangle should be larger than the object. Click at one end of the spring (1), then click at the other end (2), on the same side of the spring. Then click at the opposite side (3) of the spring. The first 2 clicks define “side A” and the third click defines “side B”.
- b. The Spring Tool draws four yellow overlapping rectangles inside, across the top and bottom from side to side (“tip area”), and across each side from top to bottom (“end cap”) shown separately in the two illustrations.

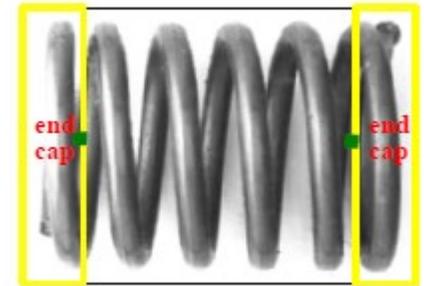


**NOTE:** The left end cap area may default to zero area, with the handle resting on the left edge of the outside ROI. Drag the handle to create a left end cap area.

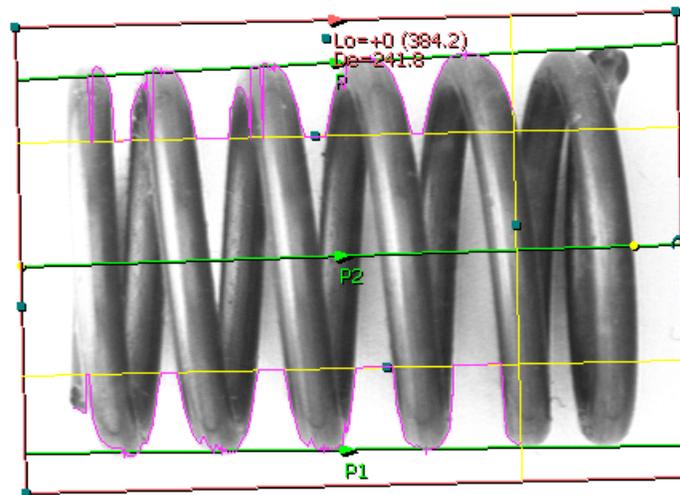
c. When the Spring button is still selected, you can drag any of the small solid boxes (grab handles) that appear on the outside rectangle, or the inside rectangles. The two handles on the base line (first and second click) control angle and length of the rectangle (in this illustration, horizontal size). The single handle on the opposite side controls width (or height) of the rectangle (in this illustration, vertical size).



d. Adjust the “tip area” rectangles to enclose the tips of the wave object (tips of threads or top and bottom of coils). Each area has its own resize handle. Allow for variation in the product size when adjusting the top and bottom rectangles. Small pink crosses indicate the tips (tip points). A line is drawn on each side connecting the pink crosses. A larger tip area can increase the time to find the tips and may also introduce noise or irrelevant objects. A smaller tip area can miss normal variations or defects in the product and may make the spring tool fail to calculate measurements.

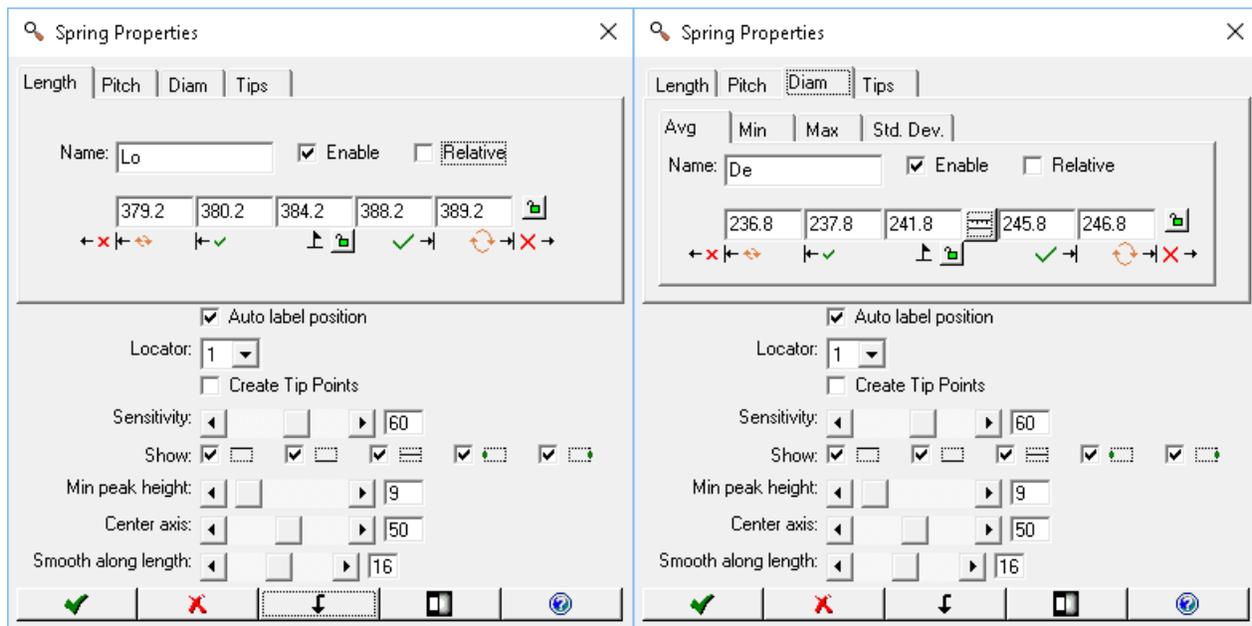


e. Adjust the “end cap” rectangles to enclose the ends of the object, where the period (distance between tips) may not be constant (near the end of a spring). Each end cap has its own adjustment handle. The end cap area will not be included in the period and amplitude measurements. The following figure is a screen capture of the Spring tool drawn in an image. Both “tip lines” are displayed. The Center line and end points are not displayed in this example.



**Spring Tool**

- f. If you hover your cursor over the outer rectangle, the rectangle turns red, and a message should appear telling you to “Right-click to edit.”
- g. Right-click on the highlighted outer rectangle (or on the Spring tool in the Tool list). A Spring Properties edit box opens. In this box you can: use the tabs to select, enable, and rename measurements, set the tolerances for recycle and reject, change the other parameters and options.



Tab	Measurement
Length	distance along the center line, from the first detected edge to the last detected edge. This is the "total length" of the product, including the area inside the end caps.
Pitch: Avg	average distance between adjacent tip points. This measurement creates an array of measured distance values. All the individual distance values for each measurement are displayable on the Monitor panel, and are available in the Scripting editor. The measured values are presented in the following order: the top side tips left to right, then the bottom side tips right to left.
Pitch: Min	minimum distance between adjacent tip points. (minimum pitch)
Pitch: Max	maximum distance between adjacent tip points. (maximum pitch)
Pitch: Std. Dev.	standard deviation of distances between adjacent tip points.
Diam: Avg	averaged diameter (the distance between the tip points and the center line multiplied by 2). This measurement creates an array of measured distance values. All the individual distance values for each measurement are displayable on the Monitor panel, and are available in the Scripting editor. The values are presented in the following order: The top tips left to right, then the bottom tips right to left.
Diam: Min	minimum diameter (minimum of distance from tip points to center line x2).
Diam: Max	maximum diameter (maximum of distance from tip points to center line x2).
Diam: Std. Dev.	standard deviation of the diameters.

**Name** - you can change the default name of the tool or measurement. The name or "label" is displayed in the image, the Tool List, and in the measured results. The name is used in scripts.

**Enable** - check this box to report a measurement and pass or fail the part on this measurement; or clear this box to not report a measurement and not pass or fail the part on this measurement.

**Relative** - clear the box to report actual numbers; check the box to report difference.

**Auto label position** - puts the **Name** label beside the Region rectangle in the display. Clear the check box to move the label to another location (or with the Properties box closed, drag the label).

**Locator** - makes the tool follow the Locator and follow the part. Select a locator (by number) to follow or select **X** to disconnect the tool from the locator, or make the tool stay in a fixed position in the image area.

**Channel** - select a color class or select **Brightness** for (monochrome) intensity.

**Create tip points** - create active points on the tip points.

**Sensitivity** - a higher setting is more sensitive to edge transition that have less contrast between light and dark.

**Show** - display or hide measurement lines and points in the tool display:

top "tip line" drawn through the top "tip points".

bottom "tip line" drawn through the bottom "tip points".

center line, centered between the tip lines.

left end point, the first detected edge along the center line.

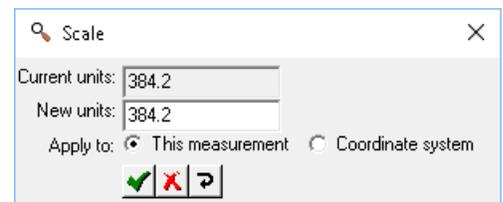
right end point, the last detected edge along the center line.

**Min peak height** - sets a minimum distance, in pixels, for measuring or rejecting tips.

**Center axis** - position of the "center axis" relative to "side A" and "side B" (in percent). The spring Length is measured on the Center axis. A value of 0 places the Center axis very close to the Tip line of side B. A value of 100 places the Center axis very close to the Tip line of side A.

**Smooth along length** - a higher setting should remove small noise against a larger coil but could eliminate coil peaks in a smaller or tightly wound coil. A lower setting removes less.

g. Click the Scale button  in the Spring Properties box, to set new units (Scale) on this one measurement, or on the whole coordinate system used for this camera view.



**NOTE:** If you enter new units, and select **Coordinate System**, clicking the "Accept" button in the Scale Properties immediately applies the changes to the whole coordinate system; the "Cancel" button in the Spring Properties does not undo the change to the coordinate system. Click the Undo button  to undo scale changes and revert to Pixel Coordinates for the whole coordinate system. This removes Alignment Calibration for this camera view.

h. Click the Accept button  to accept changes and close the Scale Properties. Click the Cancel button  to close without changes. Click the Undo button  to undo scale and calibration.

i. Click the Preprocess button  to add image filtering, or feature enhancement. Preprocessing is optional. Adding preprocessing may increase inspection time. Add preprocessing before adjusting or locking the other parameters. Please refer to page [23](#) for information on the preprocessors available.

j. In the Spring Properties box, click the padlock button beside "Perfect"  to lock the value, to keep it from changing if you move or adjust your measurement. Click the padlock button to the right of the tolerance fields   to lock the tolerance values.

k. Click the Accept button  to accept changes and close the Spring Properties box. Click the Cancel button  to close without changes. Click the Apply button  to apply changes without closing the Properties box.

## 5. Set Up Communication and Outputs

1. Click the "Control" button in the main panel.

In this panel, you can define a PLC, and use Variable Assignment Equations to communicate with a PLC or other devices. Enable or Disable saving images and data in the BOA memory (History Log) or images to the hard drive (Image Log to file) on the client PC.

The screenshot shows the 'Setup Control' panel for a TELEDYNE DALSA device. The panel is titled 'ID\_00' and 'Not Configured'. It contains several sections:

- PLC Connections:** A dropdown menu currently showing 'TCP/IP Stream'. Below it is a button labeled 'Add TCP/IP Stream...'. A callout points to the dropdown with the text: 'Pull down to select the PLC type.' Another callout points to the 'Add TCP/IP Stream...' button with the text: 'Click to configure communication with the PLC.' Below the button is a list of instructions: '- Click above button to add PLC destination.', '- Add variables attached to PLC registers with specified offset.', and '- Add "Variable Assignment Equation" to read or write to PLC registers via attached variables.'
- Setup I/O Connections:** Two buttons labeled 'Inputs' and 'Outputs'. A callout points to the 'Inputs' button with the text: 'Click to configure inputs.' Another callout points to the 'Outputs' button with the text: 'Click to configure outputs.'
- Scripting:** A button labeled 'Add / Del...'. A callout points to this button with the text: 'Click to open the script editor or "variable manager". Add an equation or an expression for communicating with a defined PLC or external logic device.'
- Setup History Logging:** A button labeled 'History'. A callout points to this button with the text: 'Click to enable or disable saving images and data to the BOA's memory. Enable or disable saving images to the Client PC's hard drive or a network device.'
- Bottom Panel:** Two buttons: 'Help' (with a question mark icon) and 'Ok' (with a green checkmark icon). A callout points to the 'Ok' button with the text: 'Click "Ok" to exit this panel and go back to the main panel.'

### PLC Connections

Use the drop list to select a pre-defined PLC type, TCP/IP device, or RS232 (serial port) settings. Click the "Add (*type*)" to configure the Addressing or protocol options. At the time of this printing, the pre-defined PLC types are: Control Logix, Ethernet-IP, Profinet, GE Fanuc SNP, GE Fanuc SRTP Ethernet, Melsec, Modbus, Motoman MRC, and Omron. Each of these has its own setup panel. Please refer to the online Help for details on configuring PLCs and other communication streams.

### Set Up I/O Connections

"Setup I/O Connections" configures the Input and Output pins on the BOA vision system I/O Connector. The Configuration and Status panel changes when you click the Input or Output buttons.

## Setup Inputs

The number of inputs and features changes with the hardware platform (BOA, Vision System, PC) you are using. You can configure the polarity (Active High or Active Low) enter a debounce period. There is a trigger divider (Triggers per image) which only applies to a trigger input. This panel also shows the current status of all inputs (1 or 0; for high and low) in the "Value" column but usually does not show the real-time Trigger input state.

Input	Polarity	Debounce (us)	Triggers Per Image	Value
Trigger	Active High	200	1	1
GPI0				1

**BOA & PL-100 Inputs Configuration**

**NOTE:** In the Scripting editor, the **BOA's** Trigger input is GPI[0] and IN0 is GPI[1] when using the PL-100 module. When using the PL-200 module, IN0 is GPI[0], IN7 is GPI[7] and the trigger input is GPI[8].

With a BOA and **PL-200** this panel allows you to assign Solution ID bits and a change strobe, for the BOA only.

Input	Polarity	Debounce (us)	Triggers Per Image	Value
GPI3				0
GPI4				0
GPI5				0
GPI6				0
GPI7				0
Trigger	Active High	200	1	0

Solution Switch  
 ID First Input:  Num Inputs:  ID Accept:

**BOA & PL-200 Solution Switching Configuration**

With VICORE the inputs are associated with specific cameras. "Use Alt. Trigger" changes between Input0 and Input1 at the camera. VICORE can also support Solution Switching using inputs 0 and 1. Please refer to the VICORE Installation Manual for details.

Input	Polarity	Debounce (us)	Value
Trigger 1	Active High	200	0
IN1			0
IN2			0
IN3			0
Trigger 2	Active High	200	0
IN5			0
IN6			0
IN7			0
GPOIN0	Input to VICORE of Camera1 output		0
GPOIN1	Input to VICORE of Camera2 output		0

Use Alt. Trigger

**VICORE Inputs**

## Setup Outputs

The number of inputs and features changes with the hardware platform (BOA, Vision System, PC) you are using. You can select the Driver source and Polarity, and change the Offset, Duration, and Initial value. The fields shown in darker gray are not active or changeable. The strobe output's offset and duration is controlled in the Setup Sensor panel. The Script Setting outputs are controlled in script statements.

With a BOA or the PL-100, the panel exposes the 3 available outputs.

Output	Driver	Polarity	Pulse Offset (ms)	Pulse Duration (ms)	Initial Value
GPO0	Pass Soft Pulse	Active High	0	40	0
GPO1	Fail Soft Pulse	Active High	0	40	0
Strobe		Active High			0

**BOA & PL-100 Outputs Configuration**

With a BOA and the PL-200, the panel exposes all 11 available outputs.

Output	Driver	Polarity	Pulse Offset (ms)	Pulse Duration (ms)	Initial Value
GPO5	Script Setting	Active High	60	5	0
GPO6	Script Setting	Active High	60	5	0
GPO7	Script Setting	Active High	60	5	0
GPO8	Pass Pulse	Active High	60	5	0
GPO9	Fail Pulse	Active High	60	5	0
Strobe		Active Low			0

**BOA & PL-200 Outputs Configuration**

With VICORE the panel exposes the 8 outputs plus 3 controllable LEDs. The 8 inputs are associated with the two cameras for decision outputs and strobe signal from each. "Script setting" is not camera specific.

Output	Driver	Polarity	Pulse Offset (ms/clocks)	Pulse Duration (ms/clocks)	Initial Value	
OUT0	Camera1	Pass Pulse	Active High	30	1	0
OUT1	Script Setting	Active High	30	1	0	
OUT2	Script Setting	Active High	30	1	0	
OUT3	Strobe Pulse	Active High	60	1	0	
OUT4	Camera2	Pass Pulse	Active High	30	1	0
OUT5	Script Setting	Active High	30	1	0	
OUT6	Script Setting	Active High	30	1	0	
OUT7	Strobe Pulse	Active High	60	1	0	
LED0	Script Setting				0	
LED1	Script Setting				0	
LED2	Script Setting				0	

Use Encoder Pulse Input (GPI1)

**VICORE Outputs**

## Output Settings

**Driver** a drop-list selects what controls the output:

**Script Setting** the output is controlled by equations or statements in the Scripting language. This value disables the other fields in the row.

**Pass Pulse** an active pulse is output when the inspection result is Pass.

**Recycle Pulse** an active pulse is output when the inspection result is Recycle.

**Fail Pulse** an active pulse is output when the inspection result is Fail. Skipped parts are included as failed.

**NOTE:** The Pass Pulse, Recycle Pulse and Fail Pulse are hardware-controlled pulses. The offset and timing start from the image acquisition trigger. This is “deterministic” timing. If a decision result is not available when the pulse offset time is reached, a Fail pulse is output by default.

**Minimum Pulse Offset = Exposure Time + Acquisition Time + Inspection Time**

Runtime overhead (such as displaying or saving images) can also affect the minimum pulse offset requirement. You should examine or calibrate this time based on your typical use of the system and other equipment on the same network.

**Strobe Pulse** a pulse is output after a trigger input. The pulse uses the settings in this panel (not the light output settings in the Sensor Setup panel). (on **BOA** or PL-100 GPO1 only, on PL-200 GPO9 only)

**Pass Soft Pulse** an active (Polarity value) pulse occurs when the Solution result is “Pass”. This is a software-controlled output. The offset and timing start from the decision result availability. This is “non-deterministic” timing. *Not supported on all hardware platforms.*

**Fail Soft Pulse** an active (Polarity value) pulse occurs when the Solution result is “Fail”. This is a software-controlled output. The offset and timing start from the decision result availability. This is “non-deterministic” timing. **Note:** Skipped parts are also included as failed. *Not supported on all hardware platforms.*

**Polarity** a drop-list selects active high or active low for the output pulse.

**Pulse Offset** enter a value for delaying the output pulse, to synchronize to external equipment.

**Pulse Duration** enter a value for the output pulse width.

**Initial Value** enter a value for the state or value of the output when the solution is loaded.

**Use Encoder Input (GPI1)** – synchronize the decision outputs to a clock or pulse on the GPI[1] input instead of the trigger.

## Scripting

The iInspect script language provides a flexible scripting editor, for extending the functionality of iInspect. You can define variables, expressions or equations. These can be calculations based upon measured results, or these can be variables read from or written to a PLC or other external devices. The scripting editor has also been called the "equation editor" or "variable manager".

- Click on the **Add/Del** button under "Scripting" on the Setup Control panel. Both the Control and Navigation panel, and the Status and Configuration panel change.
- Select a Function and begin defining your assignment equations.

Defined variables.  
Click on a variable name, then drag to a field in the "Assignment Equation". Or, click in a field, then double-click on a variable name.

Select a predefined Function to contain your equation. Functions determine when equations are executed.

Note: A deleted variable takes a zero value if referenced in an equation.

Click "New" to create one of the other predefined Functions.

Your "IF" condition appears in the first field.

Your "THEN" equation appears in the next two fields.

Click to clear the "IF" condition.

Click "Evaluate" to display the current value of the equation or assignment. 1 = True, 0 = False.

Click to clear the Right Side of the equation or "THEN" statement.

Click to add the equation to the Configuration panel.

Click to create a new variable name in the left field of the assignment statement.

Click "Ok" to exit this panel and return to the Setup Control panel.

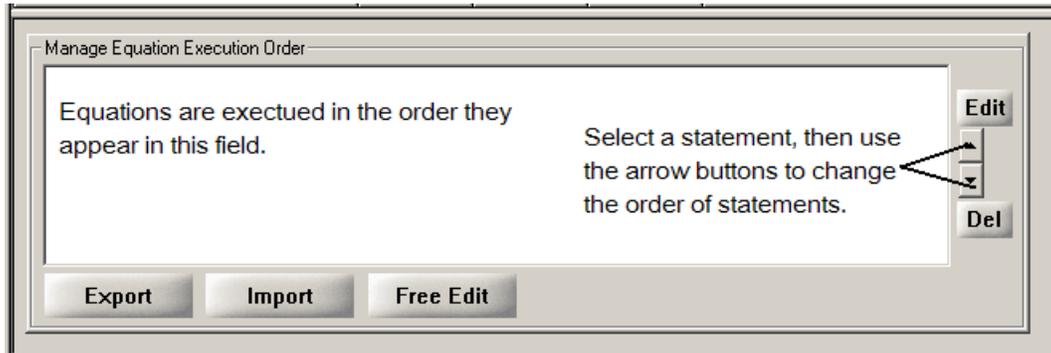
You can also right-click in the assignment equation fields to get a pop-up menu for inserting variables, etc.

Equations allow you to communicate with PLC devices. You define a PLC device, then assign variables names to the register locations. You use Equations to read and write to the variable names and manipulate values. Variables created here can be used for other data or communication outputs.

The Equations or Assignment Equations are grouped under “Functions”. The Function determines when the equations are executed. Only the first 3 functions are displayed in the drop list by default. Use the “New” button to add the other pre-defined functions.

- Pre Image Process - called after the image is acquired, before the image is processed.
- Post Image Process - called after each acquired image is processed.
- Solution Initialize - called once when a new solution is loaded.
- Periodic - called periodically with the specified interval between calls.
- User - a user function can be called from the other function types or other statements. You can define the number of parameters passed: 1, 2 or none. You cannot rename the parameters. Every User function must include the return function.
- Delayed Event - called at a defined time after (a) image acquired or (b) end of processing.
- PLC Variable Change of State - called when a PLC variable or register changes value or state. This applies only to Ethernet/IP and Modbus Slave PLCs (not a Modbus Master).
- Input State Change - called when a specified input (GPIx) changes state.

The Configuration and Status window shows the equations contained in the selected Function.



There are many pre-defined variables with special meaning for your use. You can also create your own variables. Referencing a variable automatically creates or instantiates that variable. A separate step for creating or declaring, is not necessary.

**Statements** are formed in a plain algebraic format, for example:  $a = b + c$

**Functions** are called simply in the form:  $z = aFunctionName(param1, param2)$

All your expressions, equations, and variables are saved in the Solution file, and persist when the Solution file is reloaded.

User added variables belong to the current Solution. Loading a different Solution will cause your user variable set to be replaced with the set belonging to that new Solution.

There is a special definition for Persistent Variables that retain their value for passing on to another Solution file. This Persistent variable tree has a root variable of “Prog”.

You can also use Equations to calculate additional values from Application Variables (measured results). You can override the composite decision result, by adding variables “PASS”, “RECYCLE”, “FAIL”, (must be all capitals) and setting their values to 1 (for TRUE) or 0 (for FALSE). Refer to the equation examples at the end of this manual, starting on page [146](#).

**NOTE:** In formation of (creating or composing) the final Result, FAIL supersedes RECYCLE, and RECYCLE supersedes PASS. Some illustrative examples are in the online help.

You can delete Application Variables or assign new values to the same names. Once you delete an Application Variable (Result, L1, etc.) you cannot un-delete it. This affects the output signals, output data, and the Monitor panel. If you delete a variable that is referenced in any equations, it assumes the value 0.

A group of predefined mathematical functions and string functions are available for you to insert into your equations. Right-click in one of the three equation statement fields to open a pop-up menu of functions, variables, operators and program flow elements. Complete lists of the available functions, operators, predefined variables and program flow elements are available in the on-line help.

**Inputs and Outputs** Expand the list if available, or insert a GPI or GPO, then change the index number to the input or output you desire: for example, change GPO[0] to GPO[1]. ***Under scripting control, the GPO are not pulsed unless the pulse() function is used in your statement. They are driven high or low, and held until the next decision result is available*** unless you call the pulse() function.

**Example:** If { } Then GPO[1] = [Result] !=1 drives GPO1 low when the inspection Passes, and high when the inspection Recycles or Fails. Note: "If" is blank, "GPO[1]" is in the left field.

**NOTE:** In the Scripting editor, the **BOA's** Trigger input is GPI[0] and IN0 is GPI[1] when using the PL-100 module. When using the PL-200 module, IN0 is GPI[0], IN7 is GPI[7] and the Trigger input is GPI[8].

### Defined Variables

A complete list of pre-defined variables is available in the on-line Help. Here are just a few of the defined variables. Refer to the on-line help for more information.

**Result.0** (read only) - the value of Result, before it is output. This allows equations to evaluate Result, before sending it to the output mechanisms. **Result.0** returns 3 values: 1=Pass, 2=Recycle, 3=Reject.

**Result** (read only) - the result of all measurements (the "composite decision"). This result is sent to the decision I/O and other communications. **Result** returns 3 values: 1=Pass, 2=Recycle, 3=Reject.

**Global.GPI[#]** – a general purpose input. iNspect Express treats and evaluates all inputs as steady state logic inputs.

**Global.GPO[#]** – a general purpose output. Normally the outputs are held high or low, until the next result is available. The Pass/Recycle/Fail decision outputs are pulsed. You can use the pulse function or use the Delayed Event Function to create a pulse output.

**Global.RunMode** - the current run-state or running mode. 0=running, 1=stopped.

**RelearnIndex** - assign to a General-Purpose Input as a Relearn or retrain input. For example, RelearnIndex = 1 for GPI[1] or RelearnIndex = 5 for GPI[5]. The Barcode, 2D Codes, OCR, Match and Locator tools can be retrained, by creating a new **Relearn** variable. For Example, if Relearn.Barcode1=1, the Barcode1 tool will be retrained when the assigned RelearnIndex input is asserted.

**Prog** - Persistent Variables - "Prog" is the root for variables that are to persist through Solution switching. Use "Prog." to create variables ("children") that will retain their current value and not be deleted when a Solution switching occurs (Prog.name). NOTE: The list of persistent variables can grow if subsequent Solutions add to the list. Persistent variables are only deleted when the BOA is turned off or rebooted, or when the iNspect application is closed on a PC or Vision Appliance.

## Create New Function

In the drop-list under **Manage Execution Order**, there are predefined functions:

- Solution Initialize - executes only once, right after a Solution loads.
- Pre Image Process - executes after an image acquire, and before processing.
- Post Image Process - executes after inspection but before a decision output.

You can also create different types of new functions. Click the “New” button beside the Function drop-list under Manage Execution Order, to open the New Function window.

- Periodic - executes at fixed time interval.
- User Defined - executes when called by another function or statement. Allows you to pass 1, 2 or 3 parameters. You cannot rename the parameters.
- COM Tcp/IP Command Handler Function - called when a specific command is received on a specific Com port or TCP/IP connection. (an Example is in the Help file)
- Delayed Event - executes a fixed interval after: (a) image is acquired or (b) end of processing.
- PLC Variable Change of State - executes when a selected PLC variable (or register) changes state. This option is available only with a Modbus *Slave* PLC, or Ethernet-IP PLC (because the BOA Vision System stores the variables for these two configurations).
- Input State Change - executes when a GPI changes.

**NOTE:** If the “Make Added Function Global” is checked when you create (Add) a function, it becomes common to or available to all new Solutions created after. Edits become common to all Solutions. You can only delete this Global function in the Solution in which it was originally created, and it will be deleted from all Solutions. The “Make Added Function Global” is not retroactive to pre-existing functions or to pre-existing Solutions.

When you are finished defining a function, click **Add** to add your function to the drop-list. The “Del” button beside “New” (in the Create/Edit Equations panel) will delete your function and all the statements it contains.

**NOTE:** If you are using Genie cameras with breakout or “flying leads” cables, the inputs will not appear in the “Input State Change Function” because the software does not have access to these camera inputs for this function.

## Free Edit

The “Free Edit” button under Manage Execution Order loads the highlighted statement or equation into the 3 statement fields (condition, name assignment, equation) for editing. Click the “Free Edit” button (or double-click on a statement) to open a text edit window. All statements under the current function appear in this window.

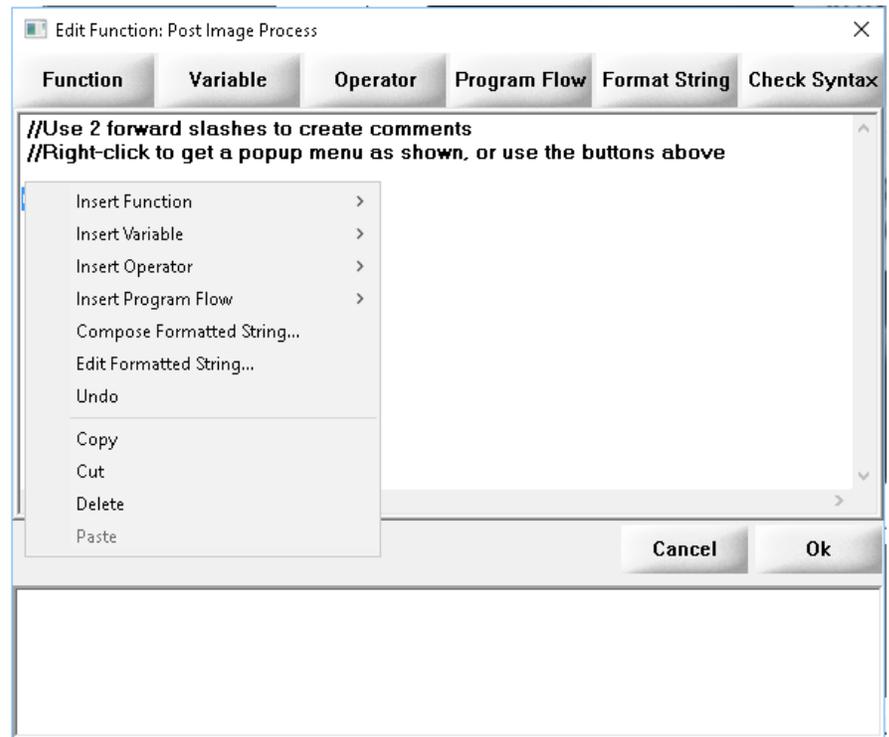
Right-click in the window to get cut, copy, paste, and insert (functions, variables, operators, flow). New Functions or User Functions will appear at the bottom of the list. New variables appear in the expanding lists.

You can use two forward slashes ( // ) to add comments to your code.

Click “Cancel” to discard any changes you made in this window.

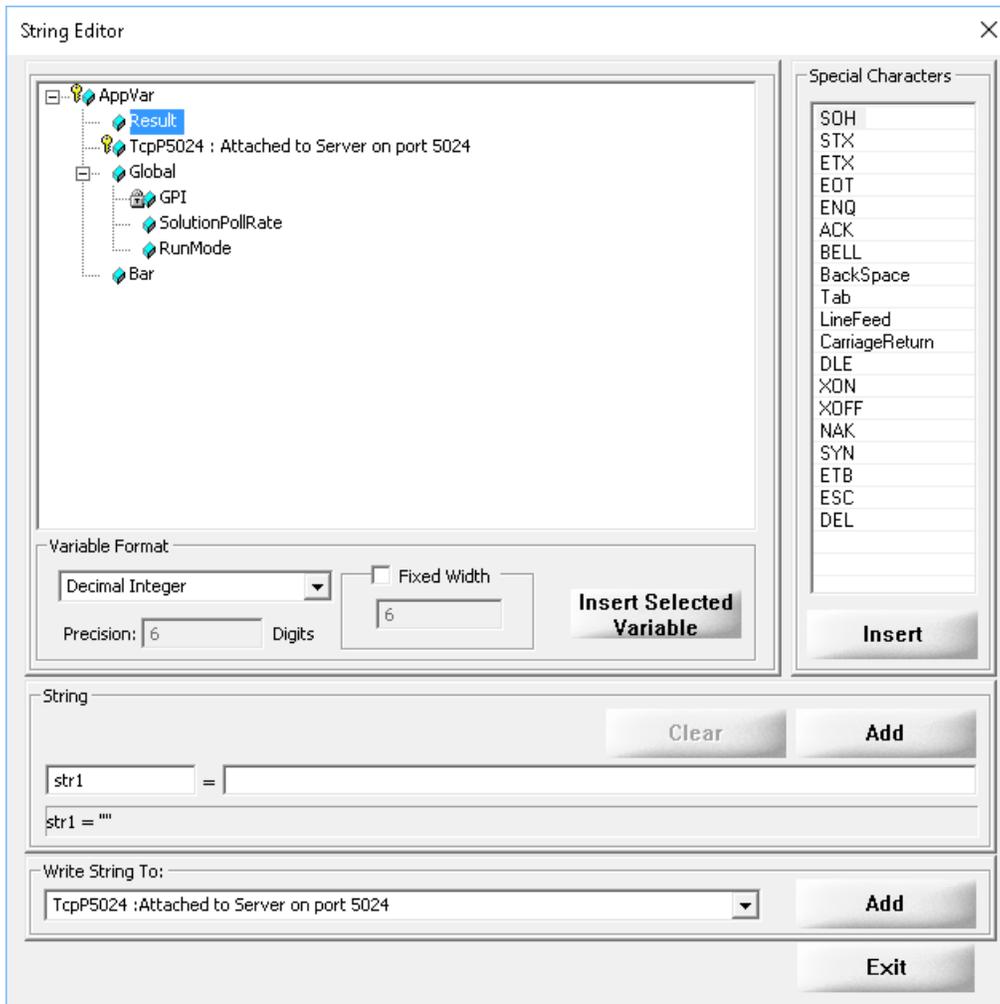
**Format String** opens the formatting window on the following page.

**Check Syntax** checks the “programmatic grammar” of the individual strings but cannot parse the statements for runtime context errors that may occur outside this window. **NOTE:** The bottom pane may show error messages. You can click on a message to highlight the related line of code in the upper pane.



## Formatting Strings

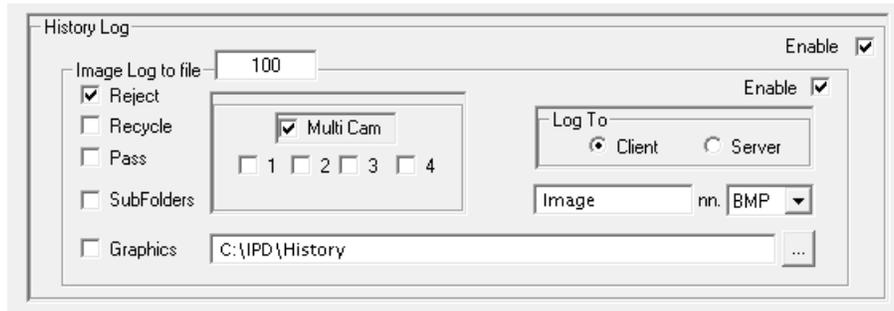
You can write your own strings or use the Format String button to open the String Editor window to help you compose strings.



## Set Up History and Image Logging

a. Click the “History” button in the Setup Control panel.

The Status and Configuration panel changes to provide options for saving data to the BOA (history log) or saving images to the client PC (image log).



Enabling the History Log saves images and data for Pass, Recycle and Reject; to the BOA memory. You can look at these from the Monitor panel, when the inspection is running.

**Image Log to file** - saves camera images (also called “image logging”) to the Client PC, BOA “server” memory, or any mapped drive, while the Solution is running.

The number field is the maximum number of images. Images are saved to file names with sequential numbers (Image0.bmp, Image1.bmp). The counter wraps at this number minus 1 and continues to overwrite older images until you disable image logging.

1. Check the Enable box.
2. Enter a maximum number of images to save (in each category or folder).
3. Select a category (Pass/Recycle/Reject).
4. If you select more than one category, select “SubFolders” to create sub-directories for Pass, Recycle and Reject.
5. Check the Graphics box if you want measurement graphics saved. If the box is clear, only the camera image is saved.
6. Check the Multi Cam box and select cameras for multiple camera Solutions.
7. Select Client (PC) or Server (Vision System). This is where the images are saved.
8. Change the file name if desired (default is “Image”).
9. Select the image format (BMP or JPG).
10. Set the destination directory (or browse to any mapped location). A directory is created if it does not exist.

The BOA Vision System is running as a Server. A PC connected through a network or Ethernet cable is a Client. Logging to the Client will stop if you close the Client application.

Saving images may impact the inspection time and cause skipped images for complex or fast inspections.

To stop saving images, you must return to this panel, clear the checkbox beside “Enable”, and exit this panel. Logging stops when you exit this panel, not when you clear the checkbox.

## 6. Run the Inspection and Monitor Results

a. Click on the **Run** button in the main panel, to see the results of inspecting.

The counters at the top of the Monitor panel should be changing. The Process Time is displayed in the upper right corner of the panel.

The screenshot shows the iInspect Express Monitor panel. At the top, a green status bar indicates the system is 'Running'. Below this, the 'Monitor' section displays inspection results: 5 parts inspected, 0 parts skipped, 5 passes (100%), 0 rejects (0%), and 0 recycles (0%). It also shows a time stamp of 3/28/2013 at 11:18:18:000, an inspect time of 30.334 ms, and a trigger rate of 2.947 Hz. A tree view shows the inspection setup, including 'AppVar', 'TcpP5024', 'Result = Passed', 'MS = 98', 'N = 1', 'L = 507.7', and 'EIPint'. A 'Runtime Setup' section contains buttons for 'Select Solution', 'Edit Tolerances', 'Setup Display', 'History Recall', 'Reset Inspection', 'Reset Statistics', 'Manual Trigger', and 'Stop'. At the bottom are 'Help' and 'Ok' buttons. Callouts provide detailed explanations for these elements.

- This "Status bar" changes to Green.
- An Exclamation Point may appear if there is a problem. Click on it, to display a message.
- A pull-down may appear for selecting a camera. Not visible with the BOA, or if only one camera has measurements defined.
- The "Inspect Time".  
Inspect Time + network/client overhead = Total Inspection Time.
- Current measured values.
- Click to load and run a different Solution file.
- Click to edit measurement Tolerances (Pass, Recycle, Reject). Also to Plot measured values.
- Set up Display options for the Configuration & Status panel.
- View history records for inspected parts. This button is not active if History Log was disabled in the Setup Control panel.
- Halt all inspecting, processing, decisions and all outputs.
- Run inspection once, or manually trigger.
- Reset the counters on this page.
- Pause inspecting to clear a halted product line.
- Click "Ok" to exit this panel and go back to the Main panel.

You can reset the counts at any time. You may not see the counts go to zero, but you will see them go to a smaller number. There is a small delay between clicking on the "Reset Statistics" button and the change in numbers.

In some cases, updating the display with images may affect the total inspection time. The Vision System may run much faster if you disable the Image update by selecting "Data Only" or "Nothing" using the "Setup Display" button in this panel.

**NOTE:** When you click the Reset Inspection button on the Monitor panel, you must tell the BOA vision system how many parts there are between the Inspection Trigger and the Rejection mechanism. These parts are "Passed" by the iInspect software.

If you are not using the output delay (BOA Outputs) then your PLC should have a similar system for dealing with parts in the pipeline.

The Pass/Recycle/Reject light is latched after a decision and stays latched until the next decision is available.

## Edit Tolerances

Click on “Edit Tolerances” in the Control and Navigation panel. The Configuration and Status panel changes to a scrollable table. You can change tolerance values or “pivot points” in this table. Changes here also affect the values in the tool properties windows. You can also move or resize the Tool outline or ROI in the Image Area when “Edit Tolerances” is open.

**NOTE:** There is no undo button. Changes take effect as soon as you enter a number and click outside the number field.

Save your Solution before making changes. You can reload the Solution to undo Tolerance changes.

If you save your Solution after making changes, the changes become permanent.

If you do NOT save the Solution after making changes, the original values are restored the next time you load the Solution.

	Value	Min Recycle	Min Pass	Perfect	Max Pass	Max Recycle	Min Value	Max Value	Mean Value	Std Devia...	Format	Decimal Places	Plot	Trend
C1.M5	98	90	95	100	100	100	98	98	98	0	Number		<input type="checkbox"/>	<input type="checkbox"/>
C1.N	1	1	1	1	1	1	1	1	1	0	Number		<input type="checkbox"/>	<input type="checkbox"/>
C1.L	507.7	501.2	502.2	506.2	510.2	511.2	507.7	507.7	507.7	0	Number		<input type="checkbox"/>	<input type="checkbox"/>

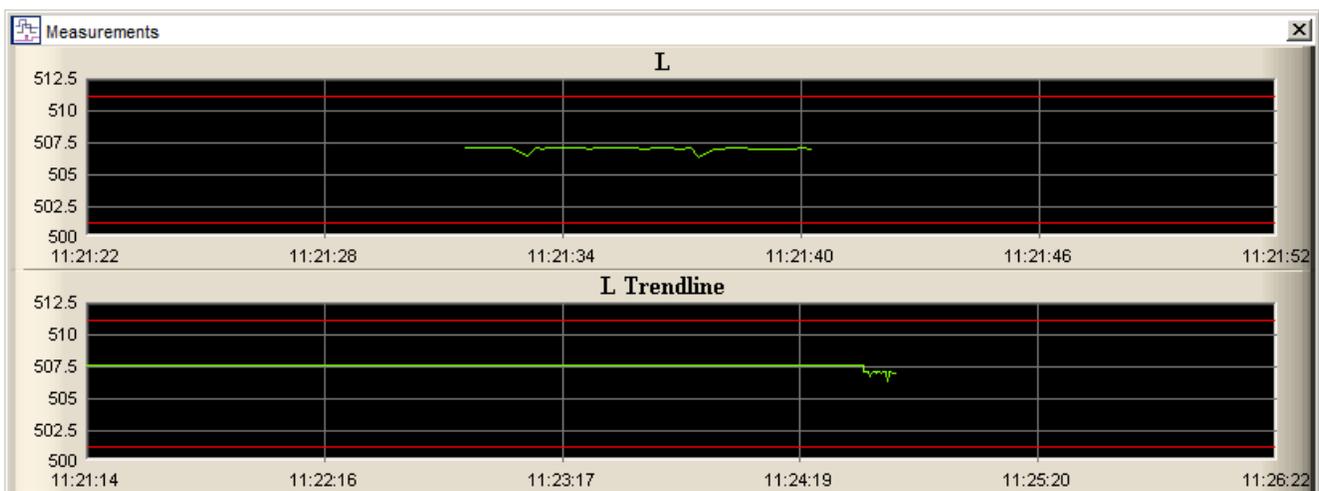
## Graphing Measurements

You can click on the check boxes at the right side of the Edit Tolerances window, to display a graph or plot of a measurement values over time. You can display more than one plot.

Right-click inside a plot window to zoom, or pan/scroll in the plot.

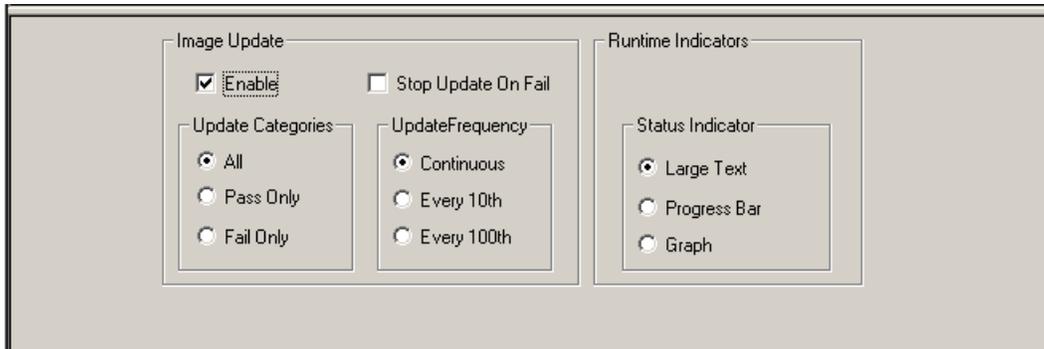
**Plot** - plot in standard time. Older measurements scroll off the left side of the plot window. This is the “Plot” option in Edit Tolerances.

**Trend** - Older measurements do not scroll off the window. The time axis is compressed over longer time, so the trend of the entire run time is displayed. The display shows less resolution over time, but trends are easier to see.



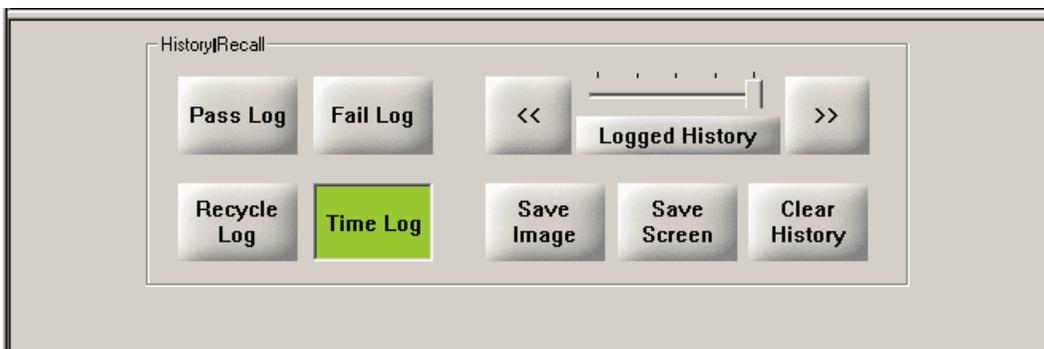
### Setup Display

Click the “Setup Display” button and the Configuration and Status panel changes. This panel controls how often the BOA updates the display on the client PC when the inspection is running. In some cases, updating the client PC may display affect the total inspection time. Another option is to use Continuous display when setting up your inspection and use every 10th or every 100th during inspection run time.



### History Recall

- Click on the “History Recall” button if it is active. This button is not active if the History Log was disabled in the Setup Control panel. We recommend disabling the history log during actual inspection. The History Recall displays (in the Monitor panel) the measured values or data. The Work Area displays the image for each part that was recorded.
- Click on “Back to Monitor” and note the “Inspect Time”.
- Click on “Ok” to return to the first panel.



**NOTE:** When you are viewing the History records, the Outputs and History Log are locked. No new images or data are added to the History Log and the Communication Outputs. Processing does continue and the Pass/Recycle/Reject outputs are still available (unless driven by equations). Communication Output will repeat the last values before the History was locked.

## 7. Save your Solution

If you are in the Monitor panel, click “Ok” to return to the main panel.

- a. Click on the “Save/Export Solution” button in the main panel. The Configuration and Status panel changes to support saving, exporting and deleting solutions.
- b. Enter a Solution ID number and enter a short description.
- c. Click on the “Save Solution” button.

The Solution ID number range is 0-1023. Up to **150** Solutions can be stored in BOA memory, depending on image size and Solution complexity of the image, measurements and scripts. More Solutions can be saved on a PC or vision system.

You should save your Solution before you try optimizing the inspection time settings.

If you are using the internal timer, you may want to return to the Setup Sensor panel to adjust the Internal Timer.

You can Export (save) your Solution to your Client PC or to a network device. Exporting a Solution allows you to distribute it across multiple target devices. “Current Solution” matches the Solution ID number displayed under the Teledyne logo.

**Note:** A saved Solution cannot be changed from a single camera to a multiple cameras (PCs or vision systems). You must at the least, capture a template image with each camera before you save the Solution, even if you do not create tools in all camera views.

## 8. Close the Application Window

If you are satisfied with your Solution and have saved it, you can return to the main panel and Click on the “Close” button to exit the iInspect Express application window, on the Client PC.

The **BOA** continues inspecting when you close the application window.

The Vision Appliance or PC stops inspecting when you close the application window.

## Monitoring from the Network

Procedures and requirements are different for iNspect software running on a BOA versus a PC or Vision System.

### For BOA Vision System

The **Monitor** application allows you to view a single BOA. Using the remote monitor requires a separate PC for monitoring. The Monitor is available in the Nexus application. You can download the Nexus application from the BOA home page using any browser.

The **iDisplay** application allows you to view multiple BOAs in a tiled display. iDisplay is available in the Nexus application and in the BOA Emulator start menu.

Only one person or PC can access the BOA at a time, whether the session is Monitor or full access. The Monitor Window is not password protected. Viewing History and resetting the production line are not available from the monitor window.

### For a PC or Vision System

Using the remote monitor requires a separate PC for monitoring, with the iNspect Express software installed. The Vision System or PC running the inspection must be running the Remote Server connection software.

Close the Monitor Window

**TELEDYNE DALSA** Running Monitor

ID\_00 Loc & Tools

Inspection Results:

Parts Inspected: 51	Time Stamp: 3/25/2011 14:46:31:000
Parts Skipped: 0	Inspect Time: 371.613 ms
Pass: 50 (99%)	Trigger Rate: 2.364 Hz
Reject: 1 (1%)	
Recycle: 0 (0%)	

AppVar

- Result = Passed
- TopP5024: Attached to Server on port 5024
- PatLoc = 99
- OCR = MERY
- Bar = 072000003664
- BarGrade = 0
- B2d = ABC12345
- PatLocAngle = 0

Runtime Setup

Select Solution Edit Tolerances Setup Display History Recall

Reset Inspection Reset Statistics Manual Trigger Stop

Help

System Configuration

Device IP Address	10.5.1.81
Device Name	SQABOA
User Connected	
Solution Running	ID 0
Description	Loc & Tools
Display Update	Continuous (All)

Inspection Status

**PASS**

## Performance Tips

Your BOA Vision System is optimized for performance for very high-speed applications it may be necessary to minimize inspection overheads, to prevent “part skipping”. This can happen if the inspection queue is full when a new part to inspect is detected. In most cases, this would not be a problem given that the BOA Vision System can capture new images as it processes and renders a result on a previous image.

### **General guidelines for performance optimization**

1. Fixture parts and orientation whenever possible.
2. Keep the Locator search pattern and movement area as small as possible. Remember to select a unique pattern in the image and position the rotation feature window diagonally away from the primary feature and search window.
3. If the application permits, use the default accuracy parameters for a given tool.
4. Reduce the amount of information to be processed. Complex objects may require more processing time. If possible, use the Application Setup page (page [132](#)) to reduce the size of a large image.
5. Turn off history recording when your inspection criteria are well defined.
6. Turn off image data to the display if it is not needed (Monitor panel, Display options). In many applications it is a good idea to display failed images only. Displaying and saving images adds to the inspection “network overhead” time.
7. If the internal timer setting, or the time between parts on the line, is less than the total inspection time, images may be dropped (resulting in missed inspections).

The **Total Inspection Time** is: Inspect Time; plus client or network overhead. The **Inspect Time** is displayed on the Monitor panel.

See Also the *BOA Troubleshooting Guide* or the *iNspect ExpressVA Troubleshooting Guide*. Both of these are provided in the BOA software download, iNspect Express software download, and on the GEVA Vision System hard drive.

**NOTE:** Skipped parts generate a fail pulse. With no decision available, they are classified with the failures.

## Solution Summary Report

A utility creates an HTML document that gives details of cameras, tools and tolerances, functions, and variables defined in a Solution. This report may be useful in documenting your tests and software. This report is not intended to recreate a Solution file.

This utility reads the currently loaded Solution file.

1. Click the “Select Solution” button in the main panel or in the Run/Monitor panel.
2. Use the menu to define where to save the report file and Template image. You can also change the file name.
3. Click the “Generate Report” button. You will be warned before overwriting an existing file. You will be prompted to view the resulting report file.

If you copy the report file to another location, you must copy the template image to the same directory location. The HTML file points to the JPEG image file.

**NOTE:** This report includes an image (without graphics) of the Template image you used to draw or train tools. This report **does not** contain an image of the tools drawn on the image. Therefore, tool placement is not documented. You can use image logging to save images with graphics.

## System Administration and Password Protection

To prevent others from changing your Solution, you can enter a password for your Vision System. Without the password, others can only access the Monitor screen, to view the Run screen only. The password limit is 6 to 15 characters.

- Click the "User Admin" button, in the main panel. Log in as the Administrator to make changes. You should change the default Administrator password.
- Click the "Enable" checkbox if you wish to enable user accounts and require a password each time Internet Explorer tries to access the Vision System. Clear the checkbox if you do not want to require logins. Anyone can view the Monitor panel without logging in.
- Check the "Enable Event Logging" button to set up collecting system events.

Enter the Administrator password and click "Log In". The button changes to "Log Off".

Automatically log off the Administrator if idle for this long.

Click this checkbox if you wish to enable user accounts and logging in. Clear the checkbox to disable.

Create a new User Account.

Delete the selected User Account.

Change a user account password.

Import User Accounts information.

Export User Accounts information.

Select or clear options for the selected user account.

Collect a log of system and user events.

Click "Ok" to exit this panel and go back to the Main panel. This Does Not Log you out!

User name is limited to 31 characters maximum. Full Name is limited to 63 characters maximum. Passwords are limited to 6 characters minimum and 15 characters maximum.

If the network connection is lost between the Event Logging Host and Vision System, the log will be stored locally until the connection is reestablished. The Vision System will synchronize the local log with the host when the connection is reestablished.

## Viewing Data Output

If you enabled output, there are several ways to view data output. This section will only describe using HyperTerminal and using the History Log page.

### History Log

There are two very similar utilities you can use:

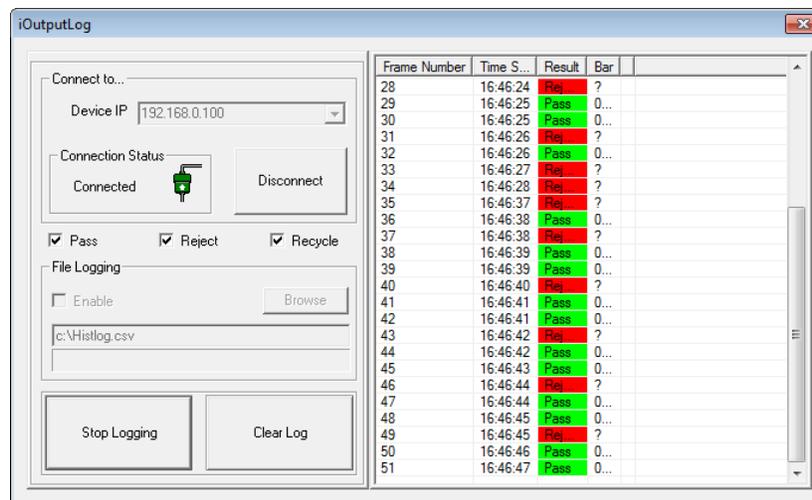
the History Log button in the Nexus for BOA application.

the iOutputLog application in the Start menu for the BOA Emulator

the iOutputLog application in the Start menu on a PC or Vision System.

- a. Open the History Log application.
- b. On the History Log window (below) use the Device IP pull-down to select a BOA or enter an IP.
- c. Click the "Connect" button, then click the "Start Logging" button.

**Note:** Before you close or leave this page, click the "Stop Logging" button, then click the "Disconnect" button.



## Network Commands

You can issue commands to the BOA Vision System over the TCP/IP network, to select or change the running Solution, or temporarily change the trigger mode. A Solution must be running.

- Open a new Terminal session, enter your area code, and click "OK".
- In "Connection Description" enter a name for the session, for example, "BOAport5021".
- In "Connect To" enter the IP Address of the BOA Vision System in the "Host Address" and enter the port number 5021. Select "TCP/IP(Winsock)" for the "Connect using".
- Type "help" (followed by Enter or Return) to display a list of the available commands. The list below may not be complete.

### Supported Commands

**Format** [ON|OFF] enable or disable pre-formatted output on port 5022 (the History Log or iOutputLog). A Solution must be running.

**eval** "statement" evaluate a statement once. This can change values of arguments defined in the Equation Assignments panel or create new arguments. For example, **eval x** would return the current value of x (in the running Solution). **eval x=5** changes the value of x to 5 (in the running Solution).

**ss ##** change the running Solution ID. The new solution must already be stored on the BOA. The running Solution will not change if the new ID is not a valid Solution. The displayed ID number changes in the Monitor panel, and other panels, but does not change on the Monitor Window (opened from the Vision System home page) until you close and reopen the Monitor Window.

**ns** get the number of solutions in Vision System memory or Index.

**sl** get a list of the solution ID numbers in use (separated by commas).

**sdl** get a list of descriptions for Solutions (separated by commas).

**sd ##** get a description for the Solution ID number given.

**tm #** changes the trigger mode. This is a manual or temporary change. The saved Solution setting is not changed, and if you navigate to the Sensor page, the trigger setting will revert to the original Solution's setting. **tm 2** = Internal Timer, **tm 3** = External Sensor Trigger, **tm 4** = Software Trigger **Note:** In Software trigger mode, the BOA responds to both the external trigger and software trigger. If you do not have an external trigger, the acquisition will wait for your software trigger. If there is an external trigger present, the acquisition will respond to the trigger, and not wait for your software trigger.

**gen** generate a software trigger. This is used after setting the temporary trigger mode to **tm 4**.

**start** start or restart the inspection.

**setcam #** *Not applicable to the BOA system.* set the current camera. **setcam 0** for camera 0.

**stop** stop or halt inspecting.

**reset #** reset the production line with a specific number of parts between the two sensors.

**rs** reset the counters for Pass/Recycle/Reject.

**saves ## Desc** saves the current Solution, using the ID number and string description given.

**gtol** get tolerances for all measurements.

**stol measName camID minRecycle minPass Perfect MaxPass MaxRecycle** set tolerances for the specified measurement.

**autosave** [On|OFF] turn on/off saving the edited solution file when exiting iNspect Express. .

**export FullPathFileName ##** export the Solution at ID ## to the specified path and name.

**import FullPathFileName ##** import the specified Solution file and store at Solution ID ##.

**reboot** – reboots a BOA. This command has not effect on a vision system.

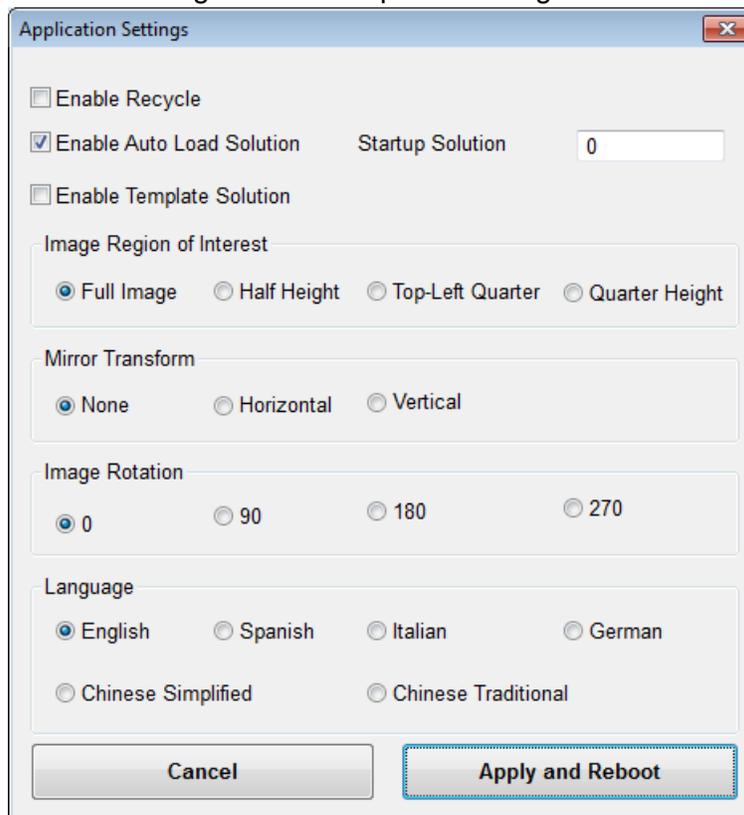
When you launch the

## Configuration Changes

There are different configuration methods and options available for the BOA Vision System, or a PC.

### BOA Vision System

In the Nexus application, click the “Settings” button to open a Settings menu.



**Enable Recycle** If you do not have Recycle tolerances and Failure tolerances, you can clear this checkbox to hide the Recycle tolerances in the tool properties.

**Enable Auto Load Solution** Clear the checkbox to disable loading a Solution when power is applied to the BOA. Or, you can enter a Solution number to load when power is applied.

**Enable Template Solution:** select this option to load your saved “Template” solution when “Start New Solution” is clicked.

**Image Region of Interest** reduces the image size (Crop) and the amount of image data acquired and processed. This also reduces the data sent to the Monitor. Top-left quarter and 1024 is not supported on all cameras. The actual image sizes may not be exactly half or fourth of the number of vertical lines.

**Mirror Transform** flip the image horizontally or vertically before processing occurs.

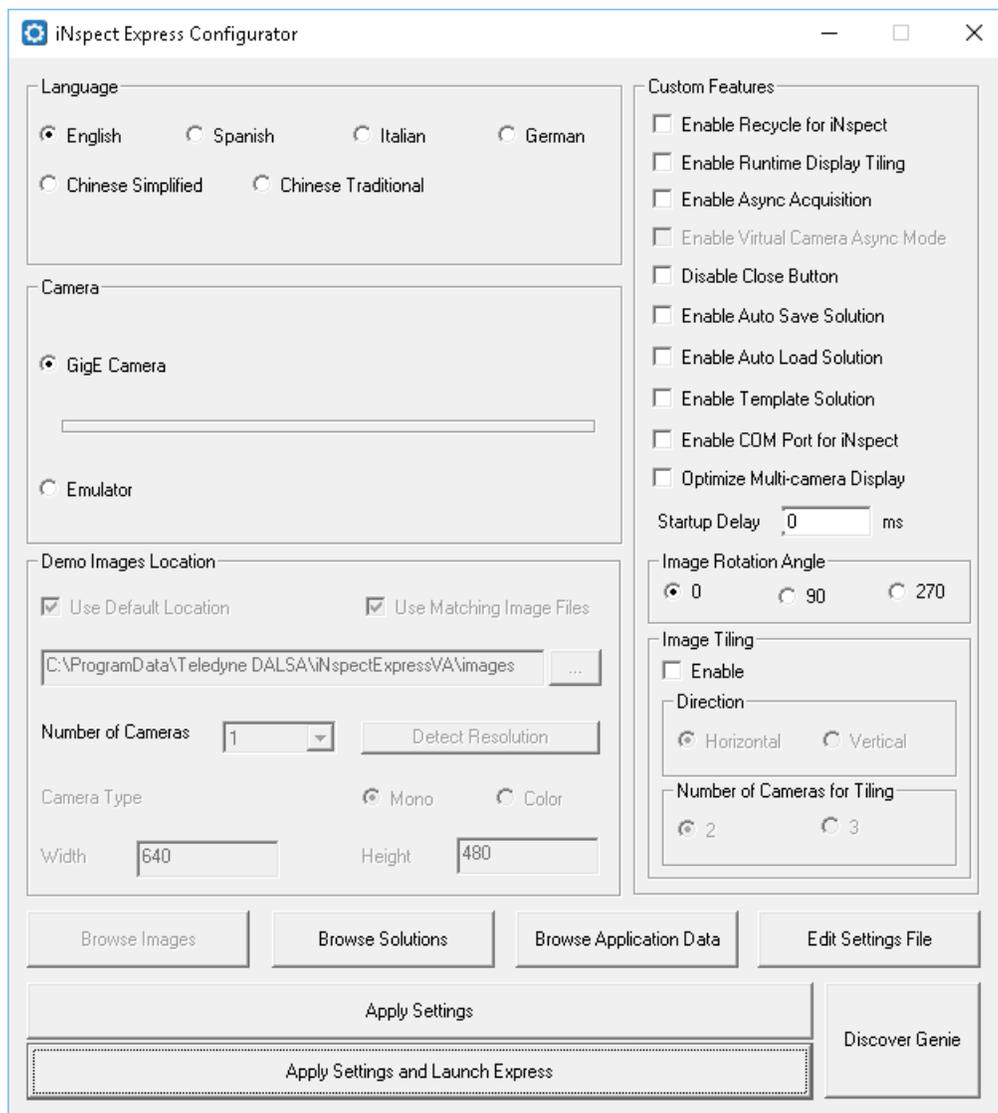
**Image Rotation** rotate the camera’s image, before acquiring into iNspect Express for processing.

**Language** Select a language for the user interface in the iNspect Express application window.

**NOTE:** The BOA vision system will perform a soft reboot when you click the “Apply and Reboot” button to accept your changes. Click the “Cancel” button if you have not made changes.

## Vision System or PC

Start→Programs→Teledyne DALSA→iNspect Express for VA→iNspect Express Configurator



**Language** Select a language for the user interface in the iNspect Express application window.

**Camera** Select a camera type: **Note:** Camera acquisition requires a valid license. The BOA is already licensed.

**GigE Camera** for VA61, GEVA Series, or PC using Genie GigE cameras.

**Emulator** uses a sequence of image files. Enables the options under Demo Images Location. **Note:** No license required for Demo mode.

### Demo Images Location

**Use Default Location** Clear this button and use the Browse button to the left to navigate to your own image files. Check this box to use the standard location \Images under User Data directory:

- \Images – Camera 1 images, \Images\Calib – Camera 1 calibration image,
- \Images\Cam2 – Camera 2 images, \Images\Cam2\Calib – Camera 2 calibration image,
- \Images\Cam3 – Camera 3 images, \Images\Cam3\Calib – Camera 3 calibration image.

**Use Matching Image files** loads only images that are the same size as the first image, or that match the size entered below.

**Number of cameras** enter the number of cameras to display in emulator mode. This value is also used by the Report Generator menu shortcut.

**Detect Resolution** uses the resolution of the first image loaded in the defined image directory location. This is useful if images provided do not match the standard camera sizes.

**Camera Type** select mono or color mode for the emulator.

**Width, Height** allows you to enter your desired image size.

### Custom Features

**Enable Recycle for iInspect** If you do not have Recycle tolerances and Failure tolerances, you can clear this checkbox to hide the Recycle tolerances in the tool properties. Only Perfect and Fail will be displayed.

#### **Enable Runtime Display Tiling**

**Enable Async Acquisition** For Genie GigE Cameras only! ASYNC mode allows independent triggers for each camera. Each camera acts independently. The solution runs when any one camera receives a trigger and runs/executes the tools/measurements for that camera only.

**Disable Close Button** removes the Close button on the Main menu (Welcome).

**Enable Auto Save Solution** Your solution file will be periodically saved as you continue to edit. The current solution file is overwritten.

**Enable Auto Load Solution** Solution 0 will automatically load when you start the iInspect Express application. Clear the checkbox to disable loading a Solution when you start the iInspect Express application.

**Enable Template Solution** Select this option to load your saved "Template" solution when "Start New Solution" is clicked. The "Save as Template" option is in the Save Solution panel.

**Enable COM Port for iInspect** Check the box to reserve the Serial port for iInspect Express solutions. If a Solution file accesses the COM port, other programs may have difficulty using the COM port once iInspect Express has reserved it. Either uncheck this box or start the other application before starting iInspect.

#### **Optimize Multi-camera Display**

##### **Startup Delay**

**Image Rotation Angle** allows you to rotate the camera image before it appears in the iInspect Express window.

**Image Tiling** for Genie GigE cameras only! Allows multiple camera images in the Image Display panel. Select the Tile direction and number of camera images.

**Browse Images** opens Windows Explorer to the Demo Images directory.

**Browse Solutions** opens Windows Explorer to the User Solutions directory. Defaults to "My Documents" if you have not saved any solutions.

**Browse Application Data** opens Windows Explorer to the User Data directory.

**Browse Settings** opens the initialization file created by this iInspect Express Configurator.

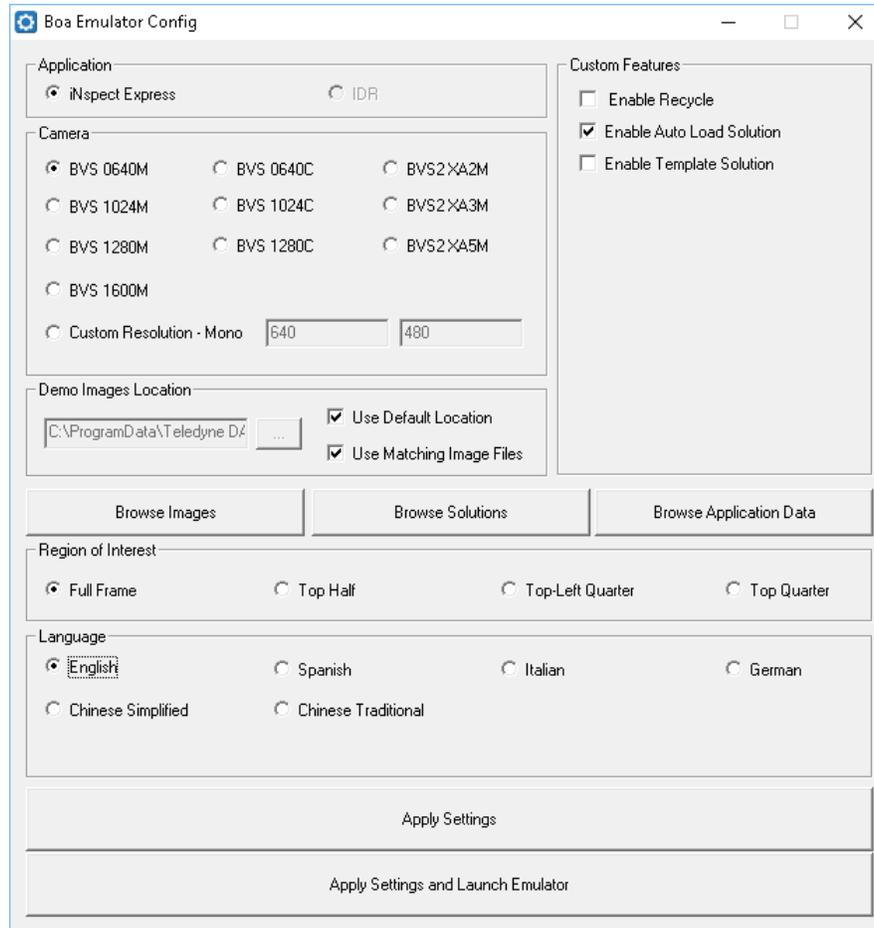
**Discover Genie Cameras** launches a separate utility for finding and configuring Genie GigE cameras accessible to this PC or Vision System.

**Apply Settings** saves your changes to an initialization or configuration file.

**Apply Settings and Launch Express** saves all your changes and launches the iInspect Express application.

## BOA Emulator Configuration

Start→Programs→Teledyne DALSA→iNspect Express Emulator for BOA→Boa Emulator Config



**Application** select which application to Emulate: iNspect Express. (IDR is no longer supported).

**Camera** select which camera resolution to Emulate.

**Demo Images Location** defines where images are located. Use the browse button to navigate to where you have stored your images.

**Use default location** uses the images distributed with the software.

**Use matching images** uses only the images that match the camera resolution you have selected.

### Custom Features

**Enable Recycle** If you do not have Recycle tolerances and Failure tolerances, you can clear this checkbox to hide the Recycle tolerances in the tool properties.

**Enable Auto Load Solution** Solution 0 will automatically load when you start iNspect Express. Clear the checkbox to disable loading a Solution when you start iNspect Express.

**Enable Template Solution** Select this option to load your saved “Template” solution when “Start New Solution” is clicked. The “Save as Template” option is in the Save Solution panel.

**Region of interest** change the size of the image. Top-Left Quarter is not supported on all resolutions.

**Language** Select a language for the user interface in the iNspect application window.

## Locator Examples

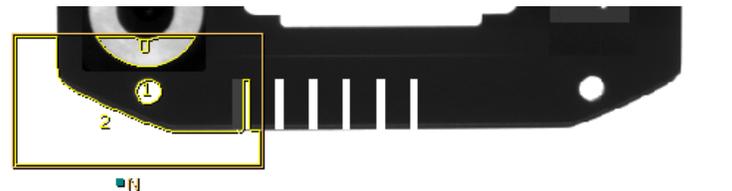
Creating a Locator requires one or two tools that create active points. While there are several tools that can create active points, some do not make good choices for the Locator anchors.

### Count Tool

The Count tool is a popular choice, because it executes quickly. You can enable the Center Point of a “blob” and use it as a Locator anchor point. Usually you create two Count Tools, on two separate features, for the position and rotation anchors. The best results are achieved when the two features are far apart. You need an area with one “blob” object that does not touch the edges of the Count tool ROI shape.

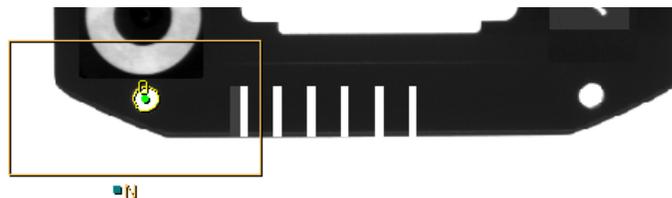
1. Click on the Count tool button, select a shape, and draw a Count tool in the image around the feature you have chosen.

2. Adjust the size of the tool to compensate for the largest expected movement of the feature and the part.



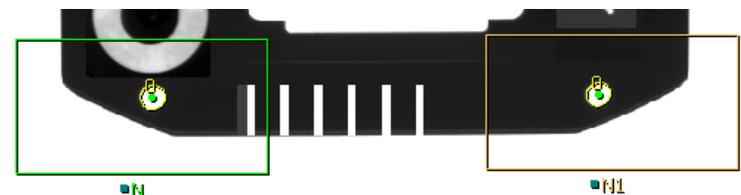
3. Right-click to open the Count tool Properties menu.

4. Click “Center” and click “Reject touch” (change “Bright” to “Dark” if needed for your image). Close the Properties menu.



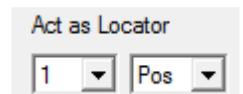
5. Draw a second Count tool in the image around a second feature. Adjust the size and shape of the tool to compensate for movement. Tip: You could copy the first Count tool and move it to the second feature.

6. Right-click to open the Count tool Properties menu. Click “Center” and click “Reject touch” (change “Bright” to “Dark” if needed for your image). Close the Properties menu.



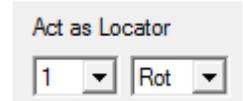
7. Hover your cursor over the center point of the feature in the first Count tool. When the point turns red, right-click to open the Point tool Properties.

8. In the “Act as Locator” section use the first drop-list to select 1. Use the second drop-list to select “Pos” to make this point the Position Anchor. Close the Point Properties. A cross hair appears on the point.



9. Hover over the center point in the second Count tool. When the Point turns red, right-click to open the Point Properties.

10. In the “Act as Locator” section use the first drop-list to select 1. Use the second drop-list to select “Rot” to make this point the Rotation Anchor. A flag icon appears on the point.



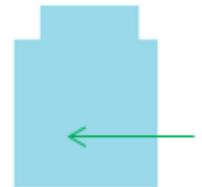
11. Go to the Run panel and see if your two anchor points are remaining inside the Count tool ROIs. If they are not, return to the Tools Setup and increase the size of the Tool ROI.

With two anchors, the Locator can track movement and rotation.

### Edge Count Tool - Line

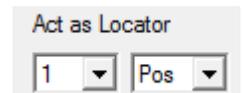
The Edge Count Tool with a Line region is used to find the leading edge of an object. We have seen this used with objects that are larger than the camera view. This method does not compensate for rotation or vertical movement of the object.

1. Select the Edge Count tool and select a Line region.
2. Draw a line that crosses the leading edge of the part.

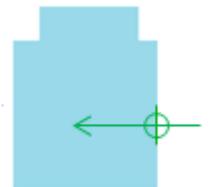


3. Open the Edge Count Properties. Enable “Activate edge points”. Make any other adjustments needed (such as Direction).
4. Select the Point Tool. Hover over the Active Point created by the Edge Count tool. When the Point turns red, right-click to open the Point Properties.

5. In the “Act as Locator” section use the first drop-list to select 1. Use the second drop-list to select “Pos” to make this point the Position Anchor



6. Close the Point Properties. A cross hair appears on the point, with the label “Loc1”.

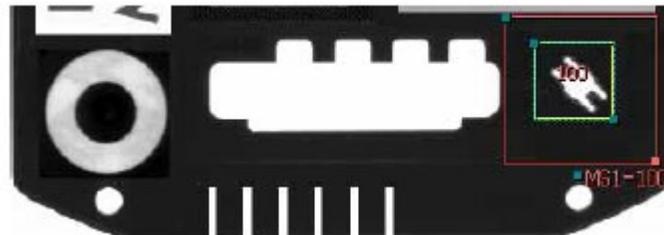


A single anchor can only track X or Y position (not both). It cannot track rotation. You can add a second anchor on another feature of the part.

## Match Tool

The Match tool is a popular choice, because it has a search box. You can adjust the search area to compensate for movement of the part. You can change the Match tool properties to look for edges only or all pixel intensities. You can also change the rotation limits of the Match tool. The Match Tool does take more time to execute than other tools. The Count and Edge Count execute much faster than the Match Tool.

1. Click on the Match tool and draw a rectangle around a feature in the image.
2. Adjust the search area to compensate for the largest expected movement of the part.



**First Match Tool**

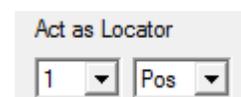
3. Hover over the Match Tool, and right-click to open the Match Tool Properties. Beside "Show points" select "center" if not already selected.
4. Create a second Match Tool in the image area. Adjust the search area for the largest expected movement of the part.
5. Hover over the second Match Tool, and right-click to open the Match Tool Properties. Beside "Show points" select "center" if not already selected.



**Second Match Tool**

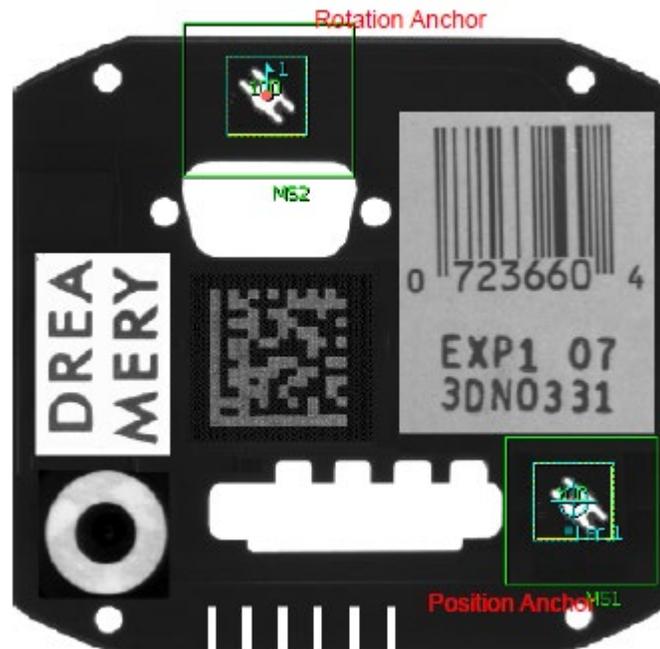
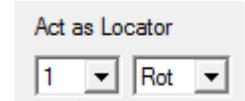
6. Hover your cursor over the center point in the first Match Tool. When the Point turns red, right-click to open the Point Properties.

7. In the "Act as Locator" section use the first drop-list to select 1. Use the second drop-list to select "Pos" to make this point the Position Anchor. Close the Point Properties. A cross hair appears on the point.



The Position anchor alone can track or follow horizontal and vertical movement, but not rotation. If your part is mechanically restricted to not rotate, for example a square or rectangle part sliding between two closely fitting rails, the position anchor alone may be enough. If your part does rotate, you need a Rotation anchor too.

8. Hover your cursor over the center point in the second Match Tool. When the point turns red, right-click to open the Point Properties.
9. In the "Act as Locator" section use the first drop-list to select 1. Use the second drop-list to select "Rot" to make this point the Rotation Anchor. Close the Point Properties. A flag icon appears on the point.



**Locator Anchors On 2 Match Tools**

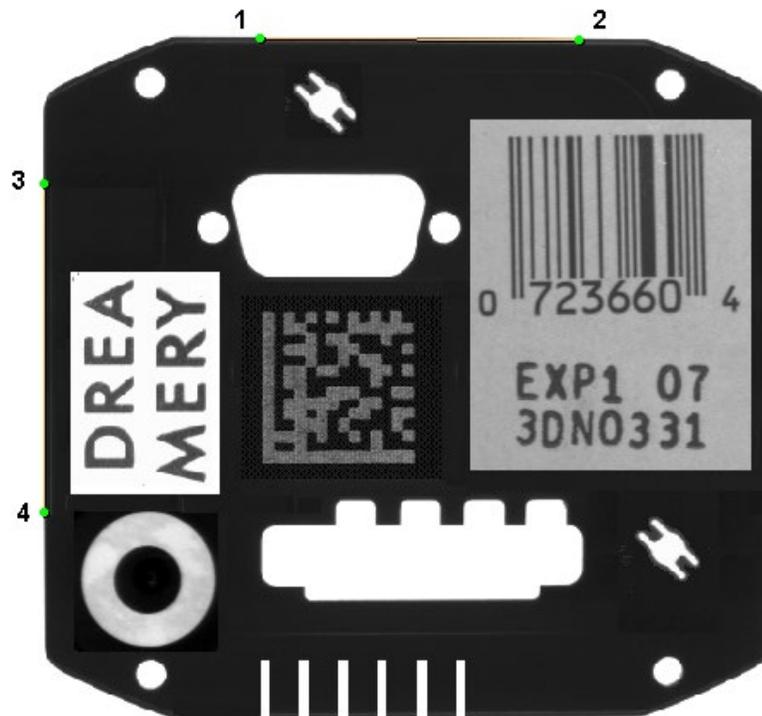
With two anchors, the Locator can track or follow movement and rotation.

The default settings of the Match Tool compensates for small rotation. The match score may drop, and Match Tool may flag a recycle or fail, if the part rotates too much. You can adjust the rotation limits in the Match Tool Properties box.

## Pencil Line Intersection

Some parts may not have features that are good for the Match tool. If the part has straight sides, the Pencil line may be a good choice.

1. Click the Pencil tool. In the image area, create a pencil line on the edge or side of the part.
2. Create a second pencil line on another edge. The illustration shows the 2 lines, and the four click points.



**Two Pencil Lines**

3. Hover your cursor over the first line. Drag the square handle at the end of the line, to extend the first pencil line past the end of the part.



**Extending the Pencil Line**

4. Hover your cursor over the second line. Drag the square handle at the end of the line, to extend the second pencil line past the end of the part, to intersect with the first pencil line. An active point is automatically created where the two lines meet (intersect).



**Both Lines Extended to Create an Intersection Point**

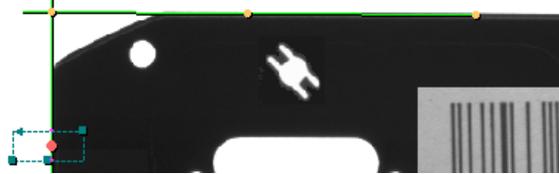
5. Hover over the first click point and extend the size of the search area to compensate for the largest expected movement of the part. Repeat for the second click point on this line.



### Increasing the Search Area

**NOTE** The Point search area only compensates for movement perpendicular to the line. In this illustration, the Pencil line is horizontal, and the search area compensates for vertical movement of the part, not horizontal movement.

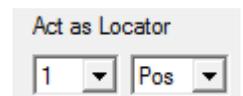
6. Hover over the third click point (second line) and extend the size of the search area to compensate for movement of the part. Repeat for the second click point on this line.



### Increasing the Search Area

7. Hover your cursor over the point where the two lines intersect. When the point turns red, right-click to open the Point Properties.

8. In the "Act as Locator" section use the first drop-list to select 1. Use the second drop-list to select "Pos" to make this point the Position Anchor. Close the Point Properties. A cross hair appears on the point.



**Position Anchor at Pencil Line Intersection**

**NOTE:** The Position anchor alone can track or follow horizontal and vertical movement, but not rotation. If your part is mechanically restricted to not rotate, for example a square or rectangle part sliding between two closely fitting rails, the Position anchor alone may be enough. If the part does rotate, you need a rotation anchor too.

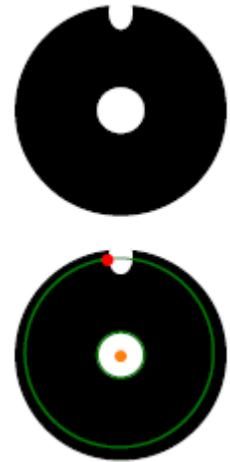
## Edge Count Tool - Circle

In some cases, the Edge Count tool used with a Rectangle or Circle ROI may be a good locator for parts that rotate by large amounts. The Match tool does have settings for rotation, but also takes more time for accurate tracking of large rotation.

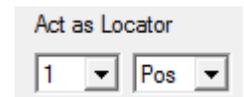
For this example, the notched disk in the following figure is always placed on a (non-moving) shaft in the camera view. The only movement is rotation. You still need two anchors to track rotation.

1. Select the Circle tool and click on the edges of the center circle.
2. Right-click on the Circle Tool to open the Circle Properties. Check the box beside "Show center point".
3. Select the Edge Count tool and select a Circle Region.
4. Draw a circle on the disk, near the outer edge and passing through the notch. Move and resize the circle as needed.

The default Direction is Dark-light. A pink cross should appear at the left side of the notch (shown as a red dot in the image to the right). You can adjust the "Direction" parameter for your needs.



5. Right-click on the Edge Count tool, to open the Properties. Check the box beside "Activate edge points". Close the Properties box.
6. Hover your cursor over the center point of the Circle Tool. When the Point turns red, right-click to open the Point Properties.
7. In the "Act as Locator" section use the first drop-list to select 1. Use the second drop-list to select "Pos" to make this point the Position Anchor. A crosshair icon appears on the point.
8. Hover your cursor over the point on the edge of the notch. When the Point turns red, right-click to open the Point Properties.
9. In the "Act as Locator" section use the first drop-list to select 1. Use the second drop-list to select "Rot" to make this point the Rotation Anchor. A flag icon appears on the point.

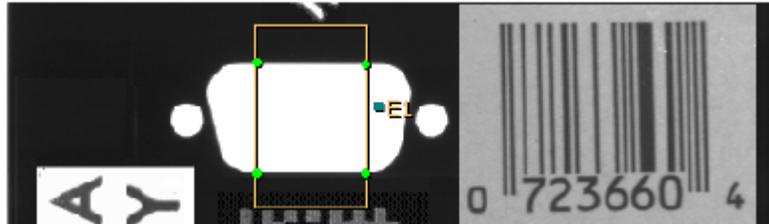


We need two anchors to find the rotation. The circle tool works only because the center of the disk is always in a fixed position in the image area. If you expand the outer search area of the Circle Tool, it will compensate for small movement, as long as the Circle center point remains inside the Circle Tool search area.

## Edge Count Tool - Rectangle

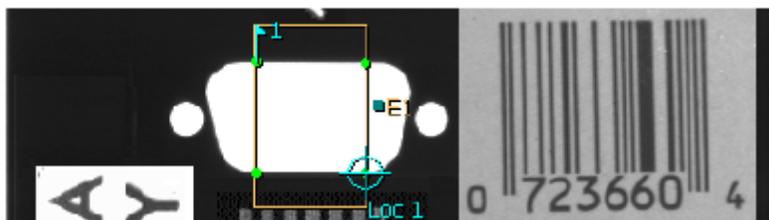
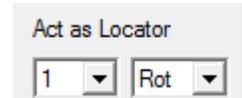
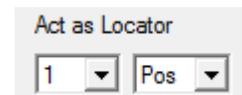
The Edge Count with a Rectangle ROI also can make a good locator for parts that rotate by more than a few degrees. The Match tool does have settings for rotation, but also takes more time for accurate tracking of large rotation.

1. Select the Edge Count tool and select a Rectangle Region.
2. Draw a rectangle crossing edges of the part.
3. Right-click on the Edge Count tool, to open the Properties. Check the box beside "Activate edge points". Change the "Direction" to "Either". Close the Properties box.



**Edge Count Tool and Active Points**

4. Hover your cursor over one of the points on the rectangle. When the Point turns red, right-click to open the Point Properties.
5. In the "Act as Locator" section use the first drop-list to select 1. Use the second drop-list to select "Pos" to make this point the Position Anchor. Close the Point Properties. A cross hair appears on the point.
6. Hover your cursor over a different point on the rectangle. When the Point turns red, right-click to open the Point Properties. For best results, the two points should be as far apart as possible.
7. In the "Act as Locator" section use the first drop-list to select 1. Use the second drop-list to select "Rot" to make this point the Rotation Anchor. Close the Point Properties. A flag icon appears on the point.

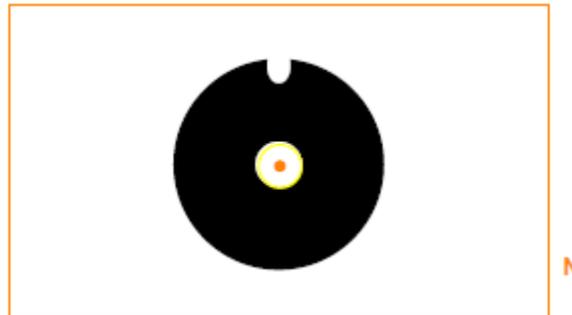


**Edge Count and Locator Anchors**

## Cascading Locators

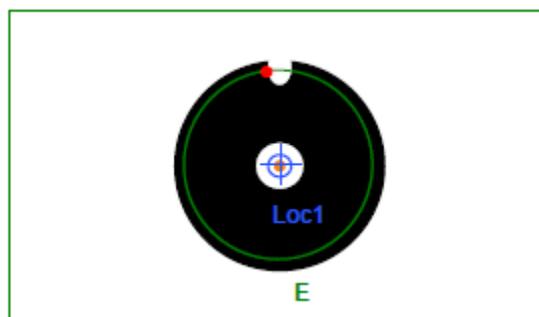
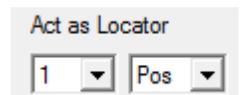
If the notched disk in the “Edge Count Tool - Circle” example was not mounted on a shaft, and could move around in the image area, the Edge Count tools would have a very difficult time finding the notch. We can use one locator to accurately place a tool for another locator.

1. Create a Count tool on the white circle in the center of the disk. Expand the ROI to compensate for movement of the disk (the whole disk) in the image.
2. Right-click on the Count Tool to open the Properties. The Object type should be “Bright” to find the bright center of the dark disk.
3. Select “Reject touch” and “Show center point”. Selecting “Reject touch” eliminates the bright background around the disk.



**Notched Disk with Count Tool**

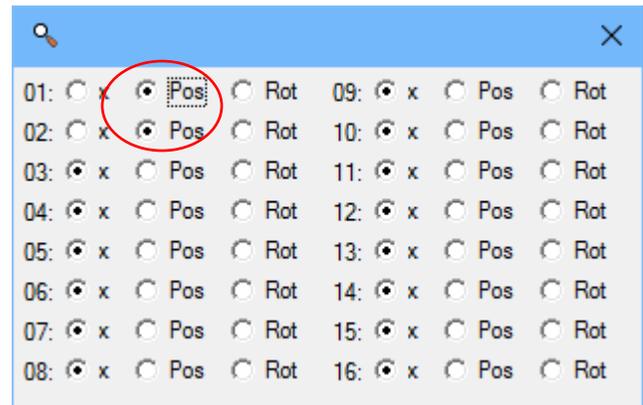
4. Hover your cursor over the center point of the Count Tool. When the Point turns red, right-click to open the Point Properties.
5. In the “Act as Locator” section use the first drop-list to select 1. Use the second drop-list to select “Pos” to make this point the Position Anchor. Click the Accept button to close the Point Properties. A cross hair appears on the point.
6. Select the Edge Count tool and select a Circle Region.
7. Draw a circle on the disk, near the outer edge and passing through the notch. Move and resize the circle as needed.



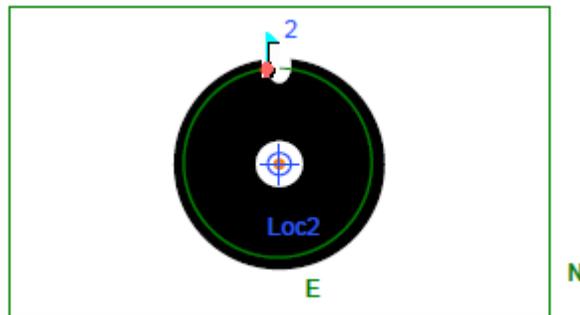
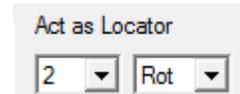
**Locator 1 and Edge Count Tool**

8. Right-click on the Edge Count tool, to open the Properties. Check the box beside “Activate edge points”. Verify that Locator 1 is selected for this tool. Click the Accept button to close the Properties box.
9. Hover your cursor over the center point of the Count Tool. When the Point turns red, right-click to open the Point Properties.

10. In the “Act as Locator” section click the Advanced button to open the advanced selection menu.
11. In the second row (beside “2”.) click on the radio button beside “Pos” to make this point the Position Anchor. This point is now selected as the Position anchor for both Locator 1 and Locator 2. Close the Point Properties.



12. Hover your cursor over the Point on the Edge Count tool. When the Point turns red, right-click to open the Point Properties.
13. In the “Act as Locator” section use the first drop-list to select 2. Use the second drop-list to select “Rot” to make this point the Rotation Anchor. Click the Accept button to close the Point Properties. A flag icon appears on the point.



**Locator 2 Anchors - Count Tool and Edge Count Tool**

In this example, we need Locator 1 to find the center circle first, to accurately place the edge count tool before Locator 2 tries to track the rotation. Locator 2 needs two anchor points to track rotation. You can use Locator 2 for all other tools added to this inspection.

## Equation Examples

### Override Examples

Here are examples for setting override variables in the "Post Image Process" function. The composite result is formed after all statements have been evaluated.

**NOTE** *The variable FAIL supersedes RECYCLE and RECYCLE supersedes PASS.*

The variable Result (the Composite Result) returns 3 values: 1, 2, 3 where 1=Pass, 2=Recycle, 3=Reject. Result and Result.0 are read-only.

#### Example 1

FAIL = 1

RECYCLE = 1

PASS = 1

The Composite Result = 3 which is the value for Reject. Because FAIL is TRUE, the value of PASS and RECYCLE are ignored.

#### Example 2

FAIL = 0

RECYCLE = 1

PASS = 1

The Composite Result = 2, which is the value for Recycle. Because RECYCLE is TRUE, the value of PASS is ignored.

#### Example 3

FAIL = 0

RECYCLE = 0

PASS = 1

The Composite Result = 1, which is the value for Pass.

### Output Examples

#### Indicate a Pass or Fail

You can make the outputs indicate the inspection passed or failed. This very similar to selecting "Pass Pulse" or "Fail Pulse" in the "Setup I/O Connections - Outputs". You can specify your own pulse width using scripting. This example is a shows a long pulse width.

**If (Result.0 = 1) Global.GPO[0] = pulse(1,3,400)**

**If (Result.0 = 3) Global.GPO[1] = pulse(1,3,400)**

The first statement outputs a 400 ms active high pulse (3 ms delay) on GPO[0] if the inspection passes. The second statement outputs a 400 ms active high pulse (3 ms delay) on GPO[1] if the inspection fails. If both outputs are low, the inspection recycled (if enabled).

Result.0 is the overall inspection result (before it gets output to the I/O).

**NOTE:** Skipped parts are classified as failing parts. To capture skipped parts you need to monitor the variable Global.Missed and flag a change in the value.

## Indicate a Specific Measurement Failed

Similar equation statements can be used to indicate a specific measurement caused a failure. There are different ways to formulate the statement. You can use the first field as part of the statement, enter a 1 (always true) or leave it blank.

### If (MS1.Result = 3) Global.GPO[1] = pulse(1,0,400)

Output a 400 ms active high pulse on GPO[1] (no delay), if the MS1 match tool fails (Result = 3).

The screenshot shows a software interface with two panels. The top panel, titled "Select Function to Edit", has a dropdown menu set to "Post Image Process" and buttons for "New" and "Del". The bottom panel, titled "Assignment Equation", has an "If (" field containing "MS1.Result =3", a "Clear" button, and an equation field containing "Global.GPO[1] = pulse(1,0,400)".

### If () Global.GPO[1] = (MS1.Result != 1)

Set GPO[1] to logic 1 if MS1 match does not pass; set GPO[1] to logic 0 if MS1 match passes.

The screenshot shows a software interface with two panels. The top panel, titled "Select Function to Edit", has a dropdown menu set to "Post Image Process" and buttons for "New" and "Del". The bottom panel, titled "Assignment Equation", has an "If (" field which is empty, a "Clear" button, and an equation field containing "Global.GPO[1] = (MS1.Result != 1)".

"If ()" is the first of 3 fields in the statement. It gets dropped off in the Manage Equation Execution Order panel, and the statement becomes:

### Global.GPO[1] = (MS1.Result !=1)

MS1.Result is the Pass/Recycle/Fail result of the Match tool. MS1 is the measured value of the match. You can use the measured value in statements, in place of the result of a measurement.

### If (MS1 < 90) Global.GPO[1] = pulse(1,5,50)

Output a 50 ms active high pulse on GPO[1] (5 ms delay) if the MS1 match score is less than 90.

### If (L1 < 400) Global.GPO[1] = pulse(1,5,50)

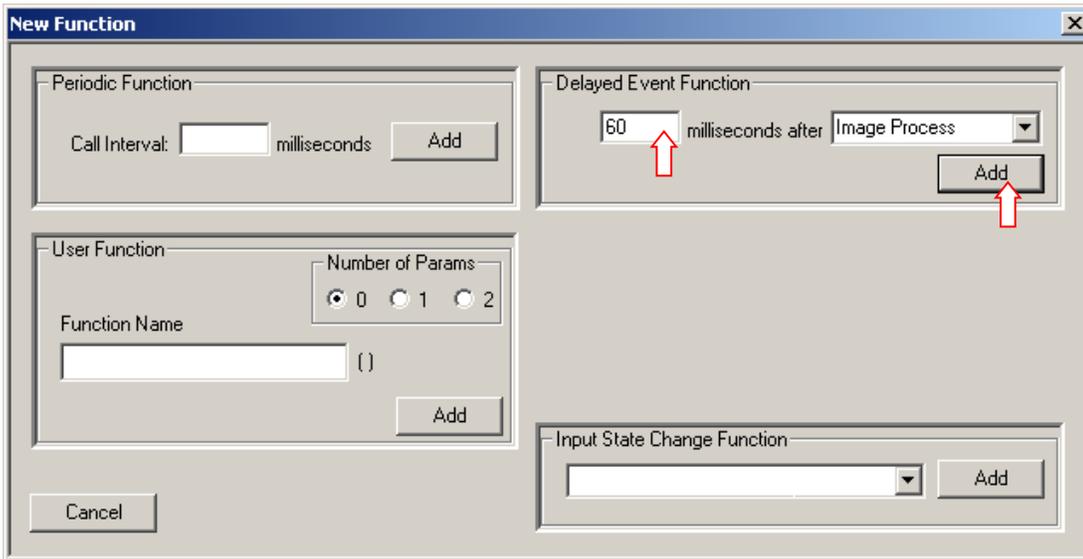
If distance measurement L1 is less than 400, output a 50 ms pulse on GPO[1] (5 ms delay).

You can substitute a PLC register or a TCP/IP stream (destination) for Global.GPO[1].

## Delayed Event Function

In one of the examples the output was set to a logic high. You can use the Delayed Event Function, to clear the outputs you set high in the Post Process Function.

Use the "New" button (Create Equations panel) to create a *Delayed Event* function, with 60 ms delay after Image Process.



In the Delayed Event Function, set the outputs low.

Delayed Event - 60 ms after Image Process:

If () **Global.GPO[1] = 0**

If() **Global.GPO[0] = 0**

The Delayed Event Function can also be used to clear or reset PLC registers or other external devices.

## Related Functions

You can use the “Solution Initialize” Function to clear or set outputs and PLC registers when you load a solution.

You can use the “Pre Image Process” Function to set or clear outputs and PLC registers after the image is acquired, and before the image is processed.

## Input Examples

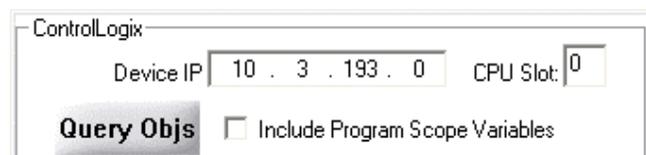
### Using a Control Logix Tag for a Trigger

Vision Systems can use a Control Logix Tag for an inspection trigger. Because the Vision System is interfacing with external equipment, there are several steps to prepare or verify the setup before the assignment equations.

1. Set the Sensor Trigger to Inspection Trigger, in the **Setup Sensor** panel.
2. Add the Control Logix PLC to the Solution file. Open the **Setup Control** panel, and select “Control Logix PLC” from the PLC Connections section. Then click on the “Add Control Logix PLC” button.



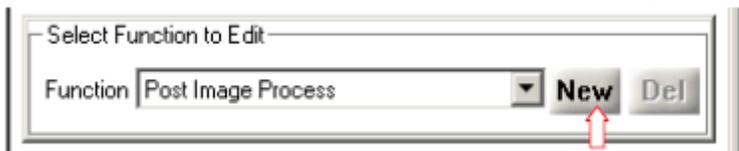
3. Set the PLC IP address to match your ControlLogix PLC, and then press the “Query Objs” button to get the PLC tags. Select (click) the tags your Solution will read from or write to, then click the “Add Variable” button.



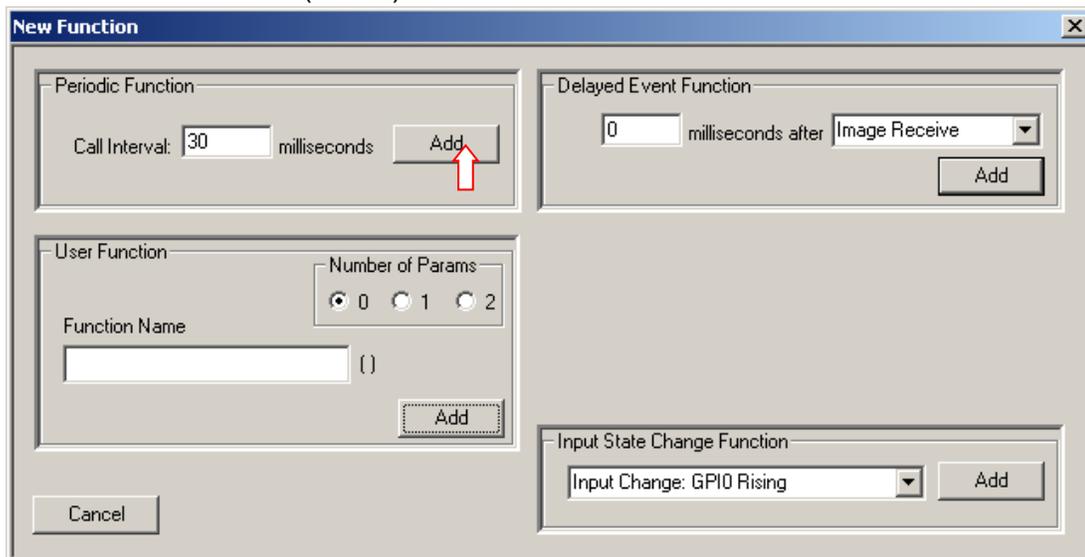
The selected tags appear in the Application Variable tree. The tags can be dragged into Assignment Equations.

**NOTE** In this example the programmer reassigned the Control Logix tags to new variable names: *CtrlLogixTriggerTag*, *TrgRecvTag*, *ResultTag1*, *ResultTag2*.

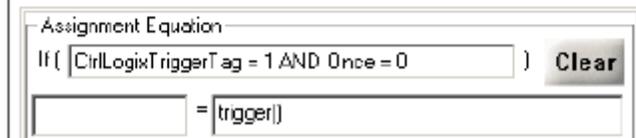
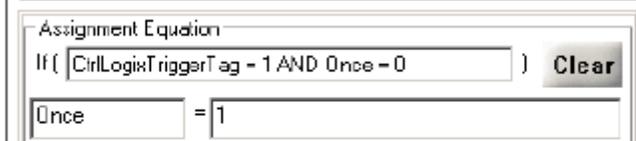
4. The Vision System will need to check the status of the tag being used as a trigger. Click the New button to create a Periodic Function that will check the tag.

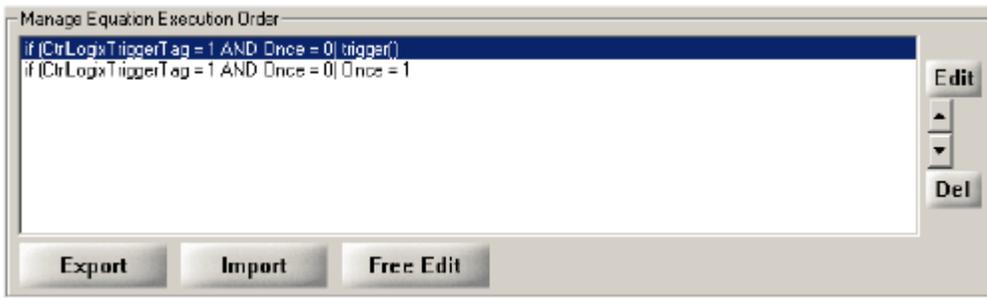


5. Set the time interval (30 ms) for the Periodic function and then click the "Add" button.

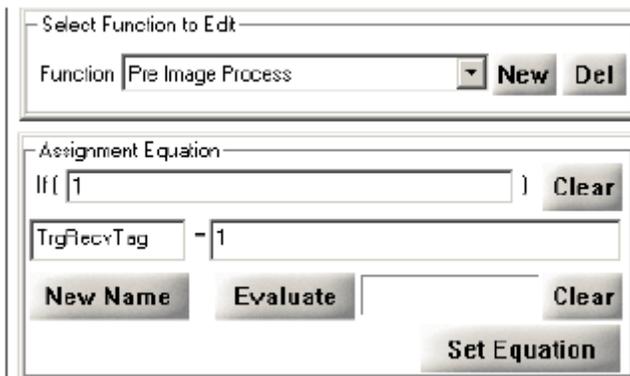


The Periodic Function now appears in the Function list. The Periodic Function will occur at the interval entered (30 ms). To prevent multiple inspections per trigger a variable called "Once", in this example, is set after one trigger is generated and will be reset after the image is processed.

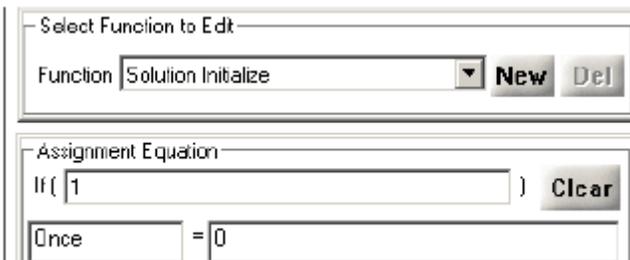




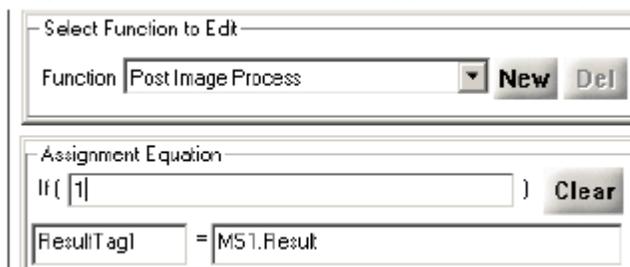
A tag that indicates that a trigger has been received is written to in the “Pre Image Process” function. This function is executed one time prior to the image processing of the image just acquired. After the PLC receives this indication, the PLC should change the state of the trigger tag to avoid processing the same part after image processing is complete.

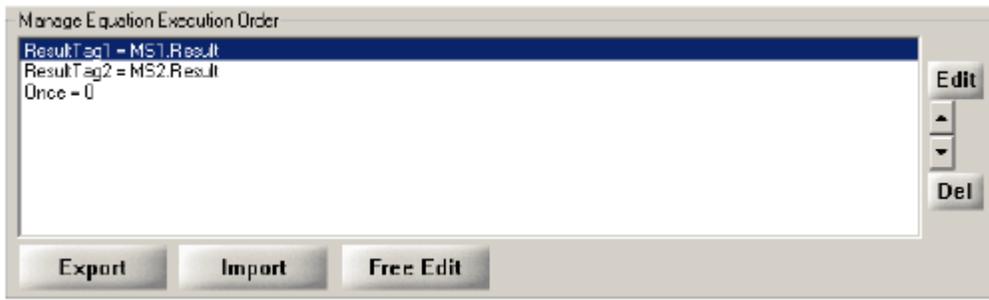


The Solution Initialize function under the Manage Equation Execution Order list is used to set I/O and Variables to an initial state when the solution file loads. The “Once” variable created earlier is set to “0”.



After the inspection is processed, the “Post Image Process” function is executed one time. This function should output the inspection results to the appropriate Control Logix tag(s). The variable, “Once” in this example, that keeps the Periodic Function trigger from happening multiple times should be reset.





The arrows to the right, between the Edit and Del buttons, are used to put the statements in the correct order. The statements are evaluated in the order they appear in this panel, from top to bottom.

The measurements used here were MS1 and MS2 (Match Tool). You could alert the PLC that a different tool failed; for example the Distance Tool, by substituting **(L1.Result !=1)** for MS1.Result in this example. This expression (L1.Result !=1) is True if the L1 Result does not equal Pass.

**NOTE:** We have observed that the Control Logix PLC takes 15 ms for each tag read during operation. Functions that read more than one tag must allow sufficient time for each tag to be read. For example, if a periodic function reads 5 tags, you must allow a minimum of 75 ms to read all 5 tags.

## Glossary

In the iInspect software, we have tried to use non-technical terms. The terms may not always seem precise to those with more experience using previous-generation image processing tools and formulas.

**Accuracy** - For most measurement tools, increasing the “accuracy” means increasing the number of sample points. Refer to the detailed description of each measurement tool.

**Aperture** - lens opening or “iris”.

**Binarization** - turning a gray-scale image into a “binary image” with all pixels replaced with values 1 and 0.

**Camera** - The camera contains a sensor that converts the pattern of light from the part into electrical signals in a 2D (two dimensional) grid. The signals are digitized into an array of values called pixels.

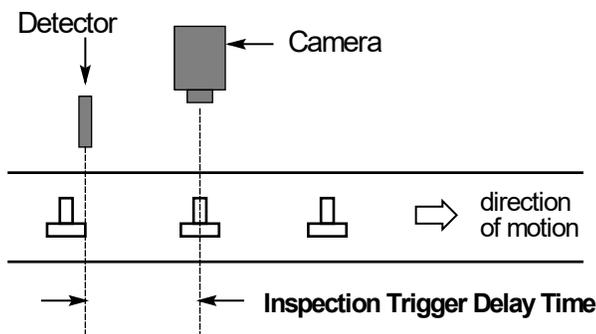
**Correlation** - comparison of gray-scale values in a trained pattern or area.

**Current Solution** - The saved solution that matches the Solution ID displayed under the iInspect logo in the Control panel.

**Edge Candidate** - a valid edge for the tool selected. A valid place to attach a measurement.

**Field of View** - The area that is seen by the camera.

**Inspection Trigger Delay** - the time between when an object is in front of the presence detector, or part-in-place sensor, and when the object is in front of the camera.



**LED** - A “Light Emitting Diode” lights up when current passes through it. LEDs are often used as indicator lights (power on, etc.) or as a light source for inspection.

**Lens** - The lens gathers the light from the part being inspected and forms an image on the camera’s sensor. The proper lens allows you to see the field-of-view you want and to place the camera at a convenient working distance from the part.

**Lighting** - In most cases you will need special lighting that ‘amplifies’ the elements of the part that you want to inspect and ‘attenuates’ elements that you don’t want to inspect. Proper lighting makes inspection faster and more accurate. Poor or inappropriate lighting is a major cause of failure in machine vision inspection systems.

**Light Ring** - a ring or circle of Light Emitting Diodes or other light sources in a circle. A light ring is usually placed around the camera lens, to light up the camera’s field of view.

**Photo-electric Sensor** - A light-sensitive device that responds to a change in light, usually reflected light but sometimes direct light. These can be visible light or infrared light.

**Pixel** - abbreviation for “picture element”, a single “point” in a digitized image.

**Progressive Scan** - a non-interlaced or single field camera that usually has an image size similar to the RS170 and CCIR standard. Lines are scanned sequentially, instead of the interlaced lines in the even/odd field method of broadcast standard RS170 and CCIR cameras. The BOA and the Genie cameras are Progressive Scan cameras.

**Rejection Delay** - The time between when an object is in front of the presence detector, or part-in-place sensor, and when the object is in front of the rejector or “kicker”. Also called Decision Delay.

**ROI** - "Region-Of-Interest" or a smaller area inside the image area.

**Score** - a measure of the similarity between the entire trained area and the entire test area. Score is calculated by subtracting the trained area from the test area and calculating the variance. A score of 100% means a perfect match.

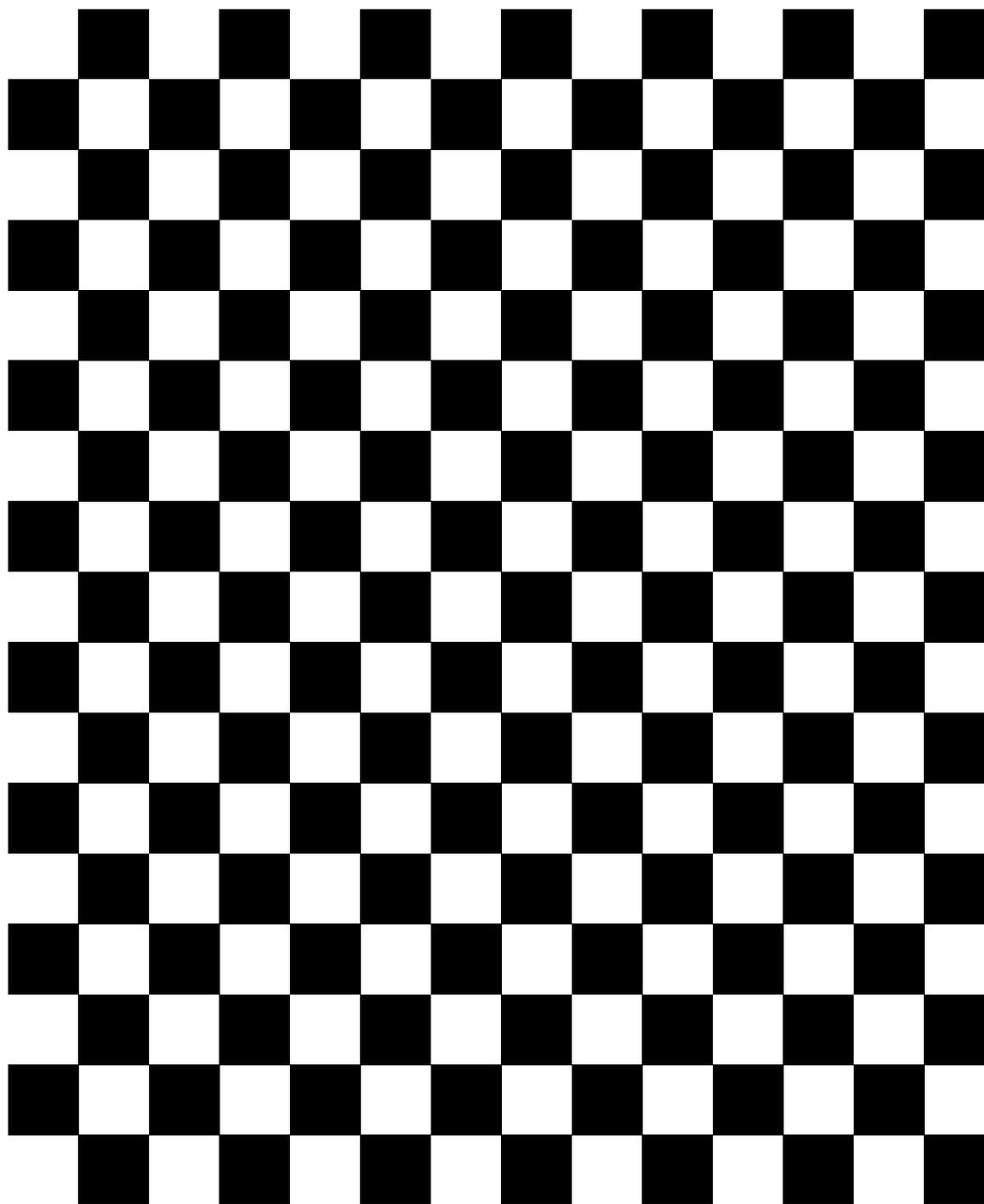
**Sensitivity** - Usually means a tool is "more sensitive" and finds more defects. Sensitivity may also refer to pixel intensity.

**Staging** - Staging holds the part to be inspected at a precise location in front of the Appliance's camera so it can 'see' the part. Putting the part in a set and known location allows the Appliance to quickly find and inspect the part. You may need a Part-in-Place sensor that tells the Appliance when the part is in its place in front of the camera.

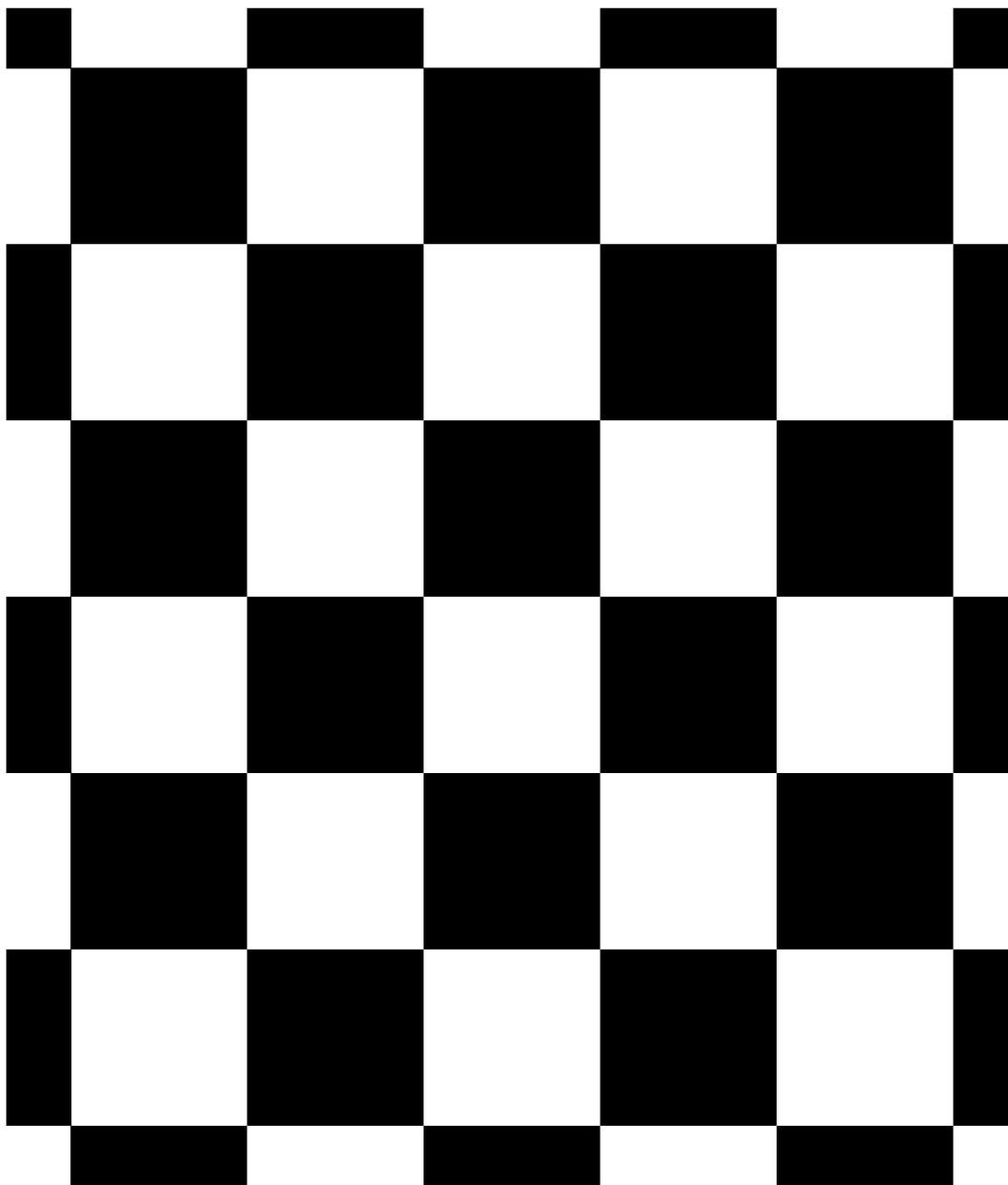
**Strobe** - A light that gives an extremely short extremely bright flash. Strobe Lights were first developed to freeze fast moving objects for still photography on film.

**Threshold** - "threshold" is a more generic term in image processing, because many qualities or measurements have a pass/fail threshold, accept/reject threshold, intensity threshold, or other limiting number referred to as a "threshold".

## Target Checkerboards



**Calibration Checkerboard - 1 cm or 10 mm or 0.40 inch Squares**



**Calibration Checkerboard - 1 inch Squares**