Welcome to MultiSight™ Vision Sensor Hands-On Lab

About This Hands-On Lab

Welcome to the MultiSight™ Vision Sensor Hands-On Lab! This session provides you with an opportunity to explore the functionality of the Allen-Bradley vision sensor. You will learn the basics of how to set up and utilize the exciting technology of this advanced sensor. The following sections explain what you'll be doing in this lab session, and what you will need to do to complete the hands-on exercises.

What You Will Accomplish In This Lab

As you complete the exercises in this hands-on session, you will:

- Learn how to set up the MultiSight™ Vision Sensor
- Learn about specific applications of the sensor

Who Should Complete This Lab

This hands-on lab is intended for individuals who:

- Apply sensors
- Are responsible for the quality and / or inspection of products

Lab Materials

For this Hands-On lab, we have provided you with the following materials that will allow you to complete the labs in this workbook.

Hardware

This hands-on lab uses the following hardware:

- MultiSight™ Vision Sensor Demo Kit including MultiSight part number 48MS-SE1PF2-M2
- Windows based PC

Accessories and Targets

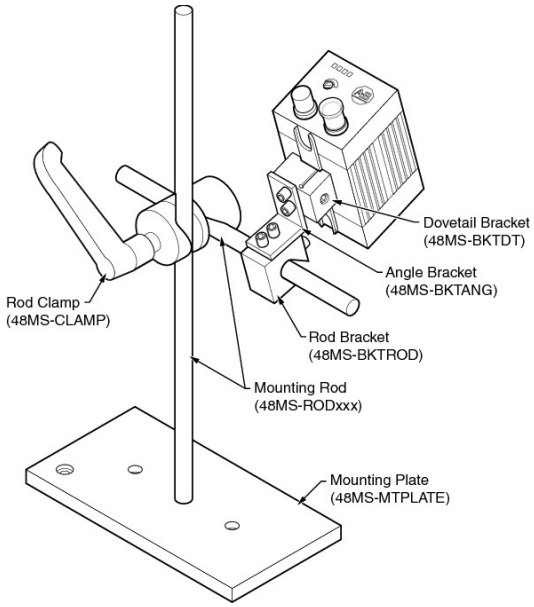
This hands-on lab uses the following accessories and targets:

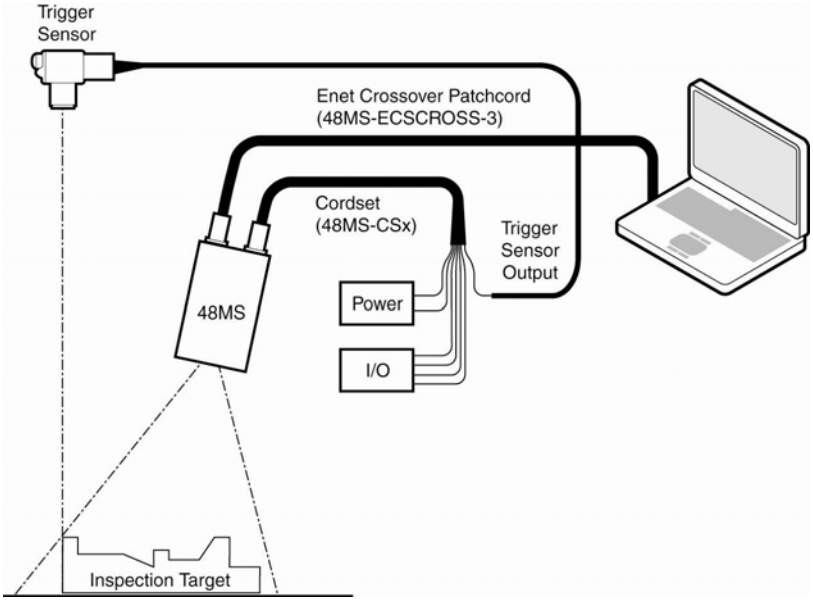
- 24VDC Power Supply (included in demo kit)
- Terminal block – application target

MultiSight™ Vision Sensor Setup – Pattern Matching Detector

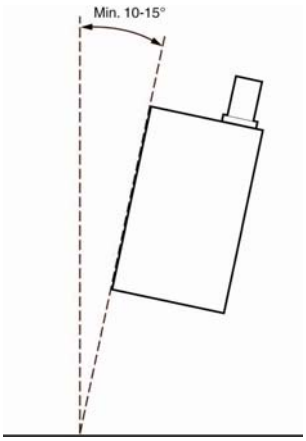
In this section of the lab, you will set up the MultiSight™ for a simple pattern matching application. The pattern matching detector type inspects the part for a specific pattern. It is the most commonly used detector type. We will set up a pattern matching detector to detect the presence of a screw in a terminal block

1. Set up the mounting hardware and connection cables according to the illustrations (we will not have a trigger sensor for this lab). Your lab station may have already been setup for you.





2. Position the sensor roughly 3 inches above the table at an angle of about 15 degrees from perpendicular.



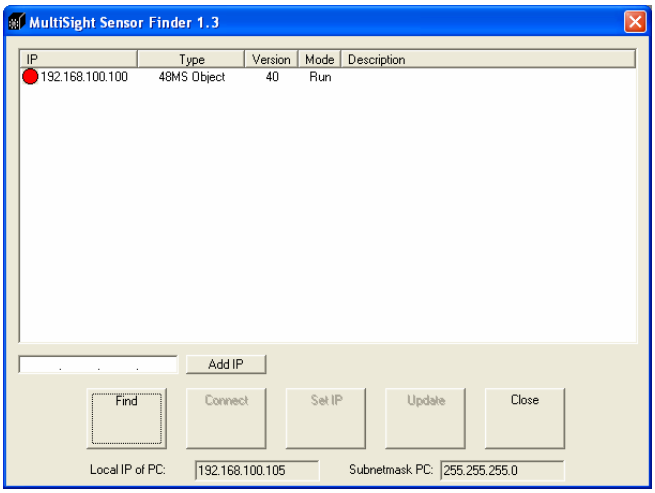
3. Connect the Power and I/O cable to the 48MS-TESTBOX (a small breakout box used to show the outputs and manually trigger the MultiSight). Plug the 24V power supply into the 48MS-TESTBOX and the other end to AC power.

4. Turn ON the power using the switch on the 48MS-TESTBOX. The MultiSight image illumination LEDs around the lens will begin flashing after a few seconds.

5. Setting up the Ethernet connection – at this point go to the network connection appendix and configure your PC network settings IF it has not already been done for you.

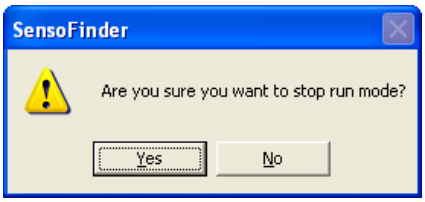
6. On your PC, double click the MultiSight software (abbreviated SW throughout this lab) icon to launch to Sensor Finder SW.

7. The following window will open.

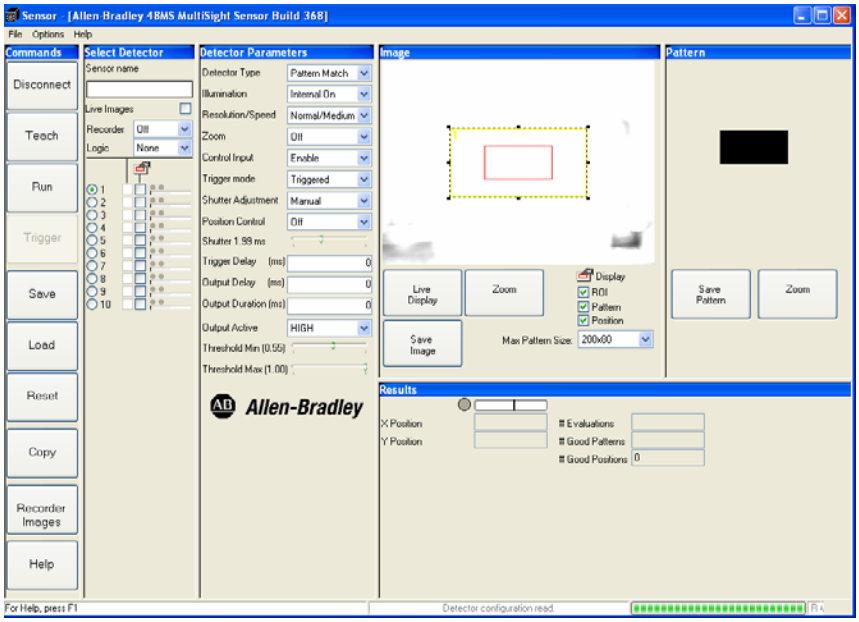


8. The Sensor Finder SW will show ALL MultiSight sensors on the local Ethernet network. In this lab, we are connected point-to-point with a crossover patchcord, so only one MultiSight will be shown. If no sensors are shown hit the Find button and wait while the SW pings the local network. The IP address and subnet mask of the main local area network connection are shown at the bottom of the window.

9. Select the MultiSight you wish to connect to by clicking on it. Establish the connection by clicking find. A warning will pop up asking if you want to stop run mode. Click Yes.

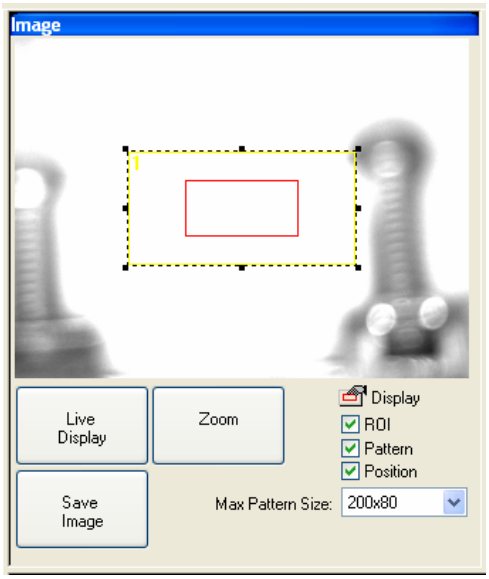


10. The configuration SW will now open.



11. Click the Reset button in the Commands section (first column). Select All Detector Configurations. This will reset all of the parameters to factory defaults. The buttons will all go gray while the system is busy updating the sensor parameters – <u>wait until they turn dark again before proceeding</u>.

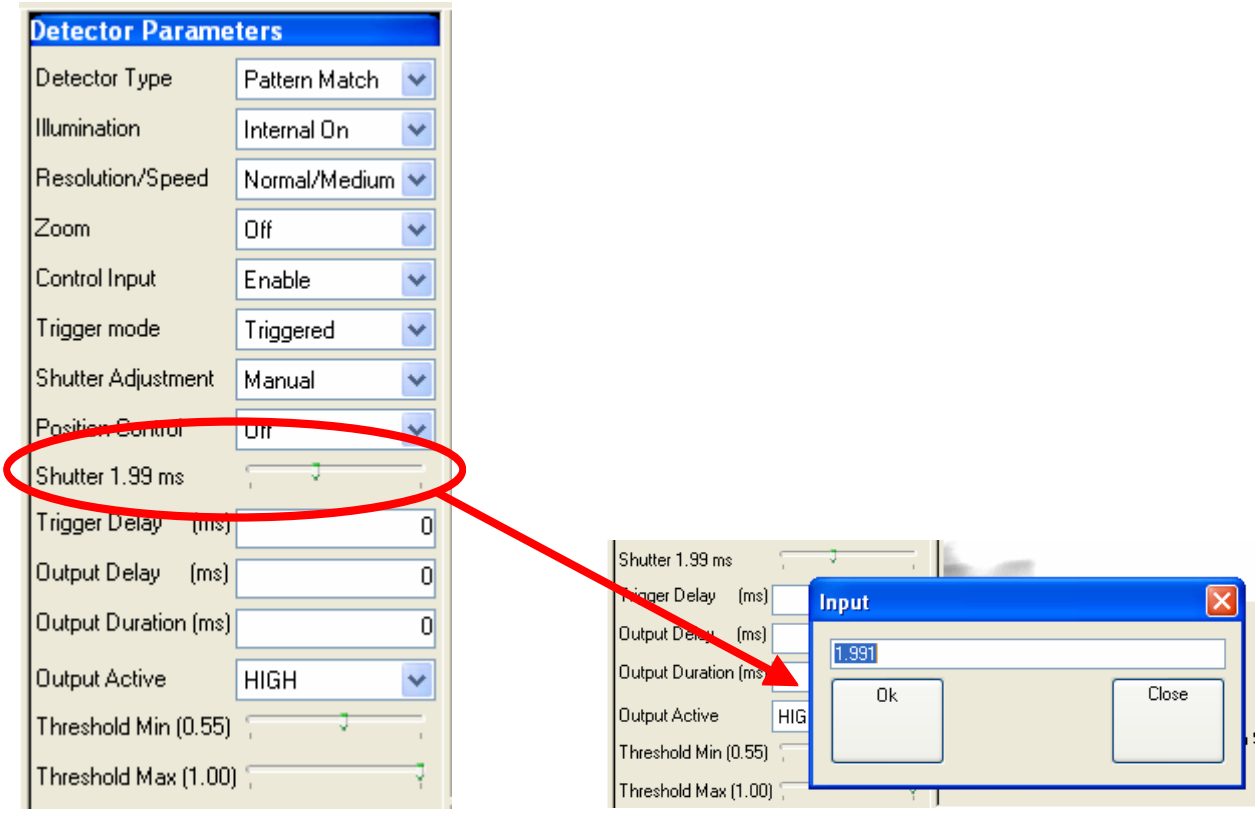
12. Click the Live Display button under the Image. The MultiSight illumination LEDs will begin flashing and you will get updated images.



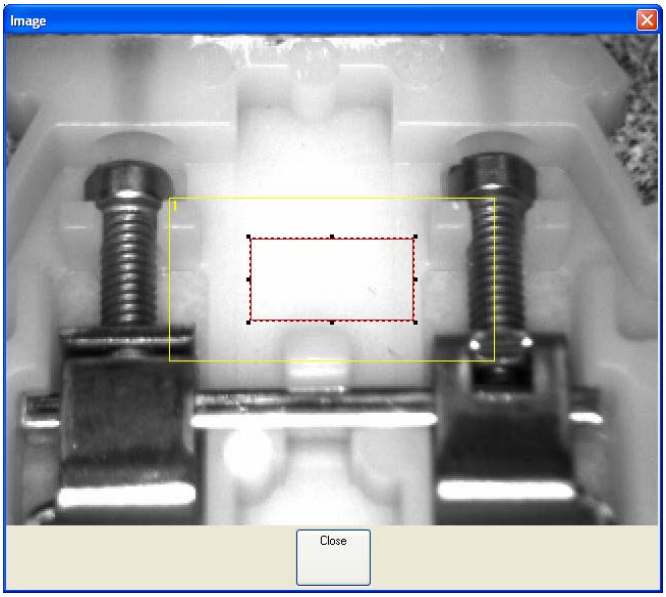
13. Place the target (terminal block or other item for inspection) in the field of view of the sensor. (The field of view is the area that the sensor “sees”. Look at the Image displayed on the SW to determine the field of view.)

14. Notice that the Image is overexposed and out of focus. The first step in a new application is to perfect the image. Two factors affect the image: shutter speed and the manual focus. The shutter parameter is in the Detector Parameters section (third column) about half way down the list. Adjust the shutter speed by clicking on the current shutter speed and typing in a new speed

or dragging the slider bar. Start with about 1 ms. You will notice that the image is now darker. We will adjust the shutter more after adjusting the focus.

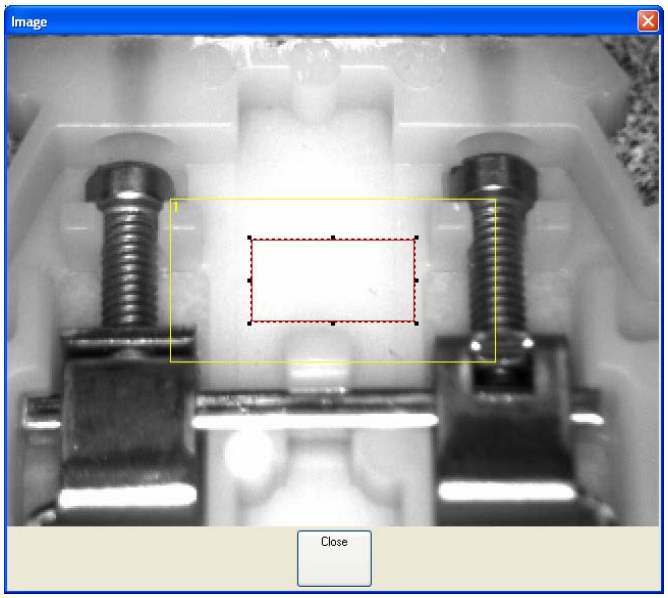


15. Slowly adjust the manual focus on the back of the MultiSight using the small screw driver until the image comes into focus. You may need to adjust the shutter speed more to get the best image. The ideal is to have a high level of contrast and a sharp focus. Click the Zoom button in the Image section if you want a larger image to work with. Observe the focus and contrast of the “perfected” image below.

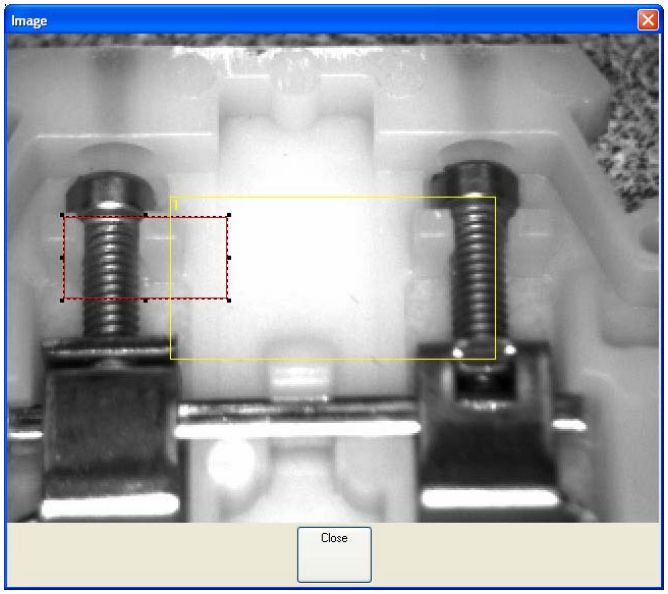


16. The next step is to position the Region of Interest (ROI) and Pattern frames. The yellow ROI frame defines WHERE the sensor will look for a pattern; the red Pattern frame will define WHAT the sensor will look for.

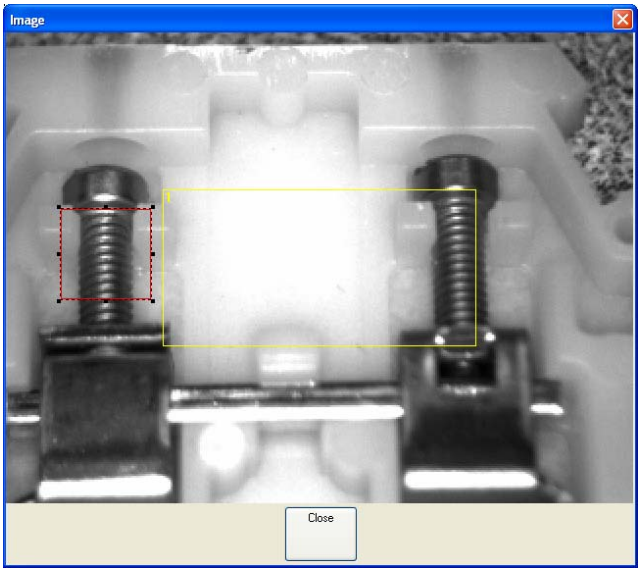
17. By default, the yellow ROI frame is be selected – you will see a dot at each corner and along each side. We want to adjust the red pattern frame first. Double click the red frame to select it.



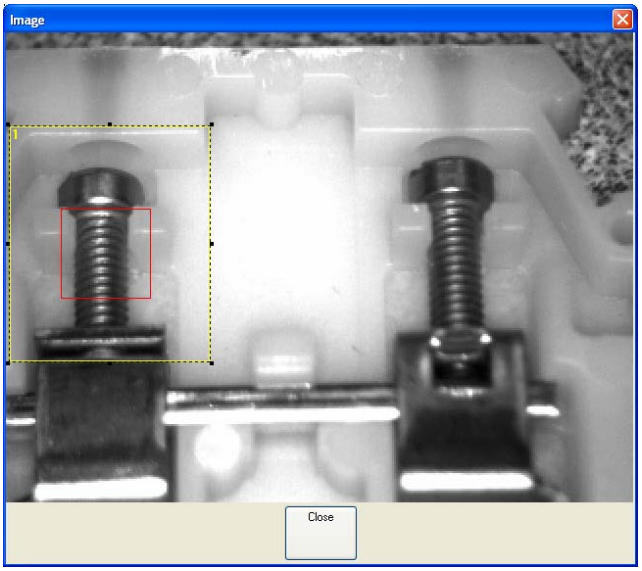
18. Put the red pattern frame around the unique feature to be inspected (the pattern that will always be there on a good part and never for a bad part). In this case we will inspect the screw. Click and drag the red frame until the upper left corner is in the appropriate position (we will adjust the size next).



19. You can adjust the frames the same way you move and resize software windows. Position the cursor over the corner or side dots. When the cursor is in the correct position, the cursor icon will change to the common Windows size adjustment cursor. Position the cursor over the lower right hand corner of the red frame and then click and drag the corner until the frame is the correct size.



20. Next we will adjust the yellow Region of Interest (ROI) frame. This frame defines WHERE the sensor will look for the pattern we defined with the red box. This means it must always be bigger than and completely containing the red frame. Double click the yellow frame to select it. Move and resize the frame in the same manner as above.



21. Notice that the target used for writing this lab has two very similar screws. We want to be sure that the ROI selected for the screw on the left will never “see” the screw on the right, so we have adjusted the frame (by clicking and dragging the corners) such that it only inspects on the left hand side of the part. Also, the larger the ROI frame, the slower the inspection.

22. If you were using the Zoom image, click the Close button so that you can adjust other parameters.

23. In the Detector Parameters section (third column), change the Trigger Mode setting to Continuous (from Triggered). While in run mode, this will cause a new inspection to start as soon as the last one finishes. This makes the initial setup easier. For most applications you will change the mode back to triggered once you have completed the initial setup. When in

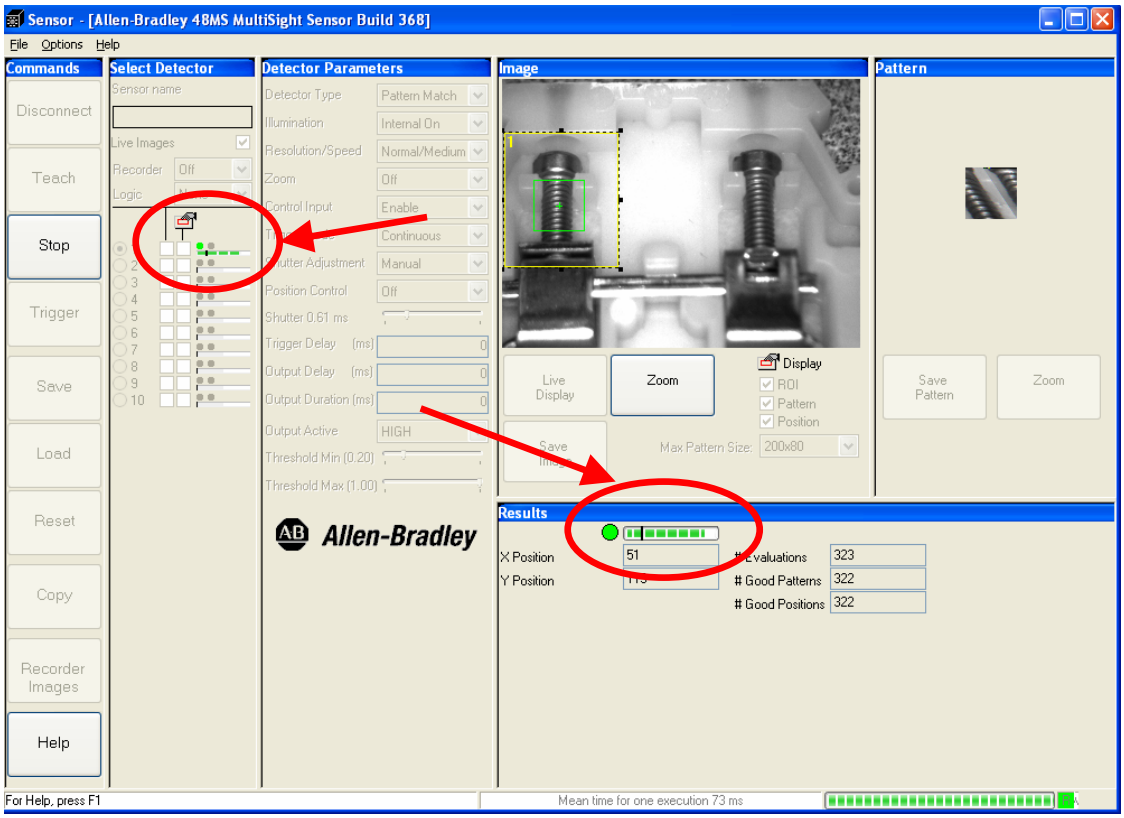
triggered mode, a trigger sensor is used to tell the MultiSight that a part is in position for inspection.

24. In the Select Detector section (second column), click the Live Images checkbox so that images will be displayed in the SW while the sensor is connected. (This also costs processing time, so if we wanted to speed up the application we would turn this feature off.)

25. Click the Stop button in the image section to stop the Live Images currently being displayed in the configuration SW.

26. Next we need to teach the sensor. Click the Teach button in the Commands section. You will see the MultiSight illumination LEDs begin to flash. After a few seconds click Stop. The pattern is now taught. It appears in the Pattern section on the right hand side of the SW screen.

27. Click the Run button in the Commands section. The sensor will go into run mode and begin flashing. Note the bar graph in both the Select Detector section and the Results section indicating the level of conformity with the taught pattern (should be 100% unless the part has moved). Try physically moving the target part. Notice that as long as the pattern is within the ROI (yellow frame), it will be detected, but as soon as it is moved outside that frame it is not detected, even if it is still within the MultiSight's field of view (on the displayed image). Notice that the level of conformity goes up and down as we move the part.



28. Based on the results of several good and bad parts, you may need to adjust the threshold settings. Click the Stop button in the Commands section.

29. At the bottom of the Detector Parameters section, adjust the slider for the Threshold Min DOWN (to the left). Put the sensor into run mode by clicking the Run button in the Commands section. Notice how the image does not have to match the taught pattern quite as closely, but even with the lower threshold the part must be fairly close to the original pattern or it will not be detected.

30. Place the “bad” part with the missing screw in the sensor’s field of view. (Remove the screw from the terminal block if you only have one part.) Notice that the sensor output does not turn on and there is no pattern match on any of the bar graphs.

31. Place the good part into the field of view until the sensor output turns on (or the results indicators in the SW turn green). Try turning the part. Notice that the Pattern Matching detector type can only tolerate about 5 degrees of rotation and still match the part.

32. You have completed the first section of this lab. You now know how to set up a single pattern matching detector with the MultiSight vision sensor.

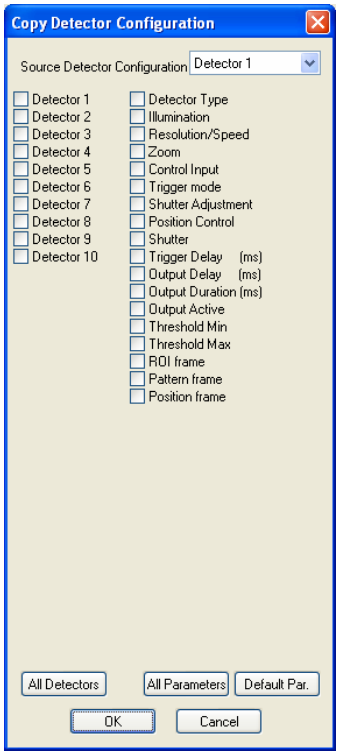
Setting Up Multiple Detectors

In this section of the lab, you will learn how to set up multiple detectors on the MultiSight and logically link them together into a single output. We are going to continue from the previous section.

1. Confirm that the MultiSight is in Run mode and is currently detecting the part. Put the part as close to the original position as possible by physically moving the part until the green frame (where the pattern is currently found) lines up with the original red frame.

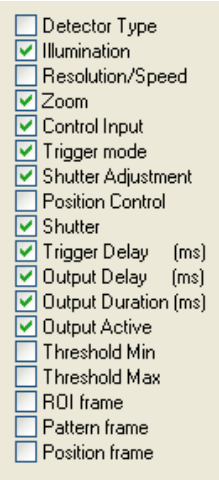
2. Click the Stop button in the Commands section.

3. We will use the detector we have already set up along with a newly configured detector. When using multiple detectors to generate a single output, it is very important that certain parameters have the same settings (see Logic in the Parameters section on page 21 of the user manual for more details). We will use the copy function to simplify this process. Click the Copy button in the Commands section. The following window will appear.

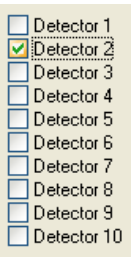


4. We will use the detector we set up in the first section as our Source Detector – probably Detector 1 (if not, change the Source Detector Configuration parameter at the top of the Copy window to the detector you used in the first section of the lab).

5. Click the Default Par. button at the bottom of the window to automatically select the parameters which are required to be the same.

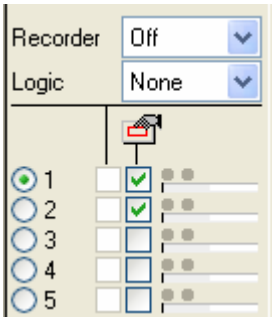


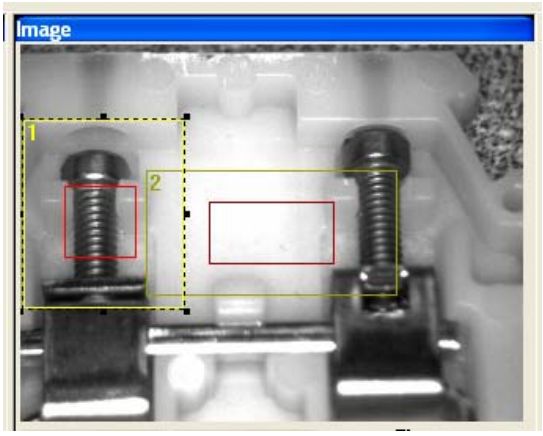
6. In the left hand column, select the check box for every Detector 1 setting you want to copy . In this case, we want to copy the settings from Detector 1 into Detector 2 only.



7. Click the OK button at the bottom of the window. The SW will copy the selected settings from the source detector in the other selected detectors. The buttons will gray-out until this process is complete.

8. We want to see the ROI and Pattern frames for both Detectors 1 and 2 on the image. Select the display check box for each detector in the Select Detector section. It is the second checkbox to the right of the radio button. Note that the ROI and pattern frames for Detector 2 appear on the image.

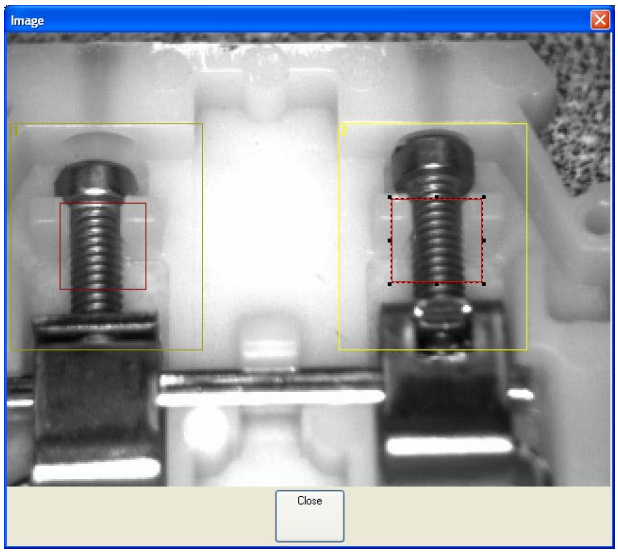




9. Select Detector 2 by clicking the radio button in the Select Detector section.

10. Note that the parameters have been updated to match Detector 1.

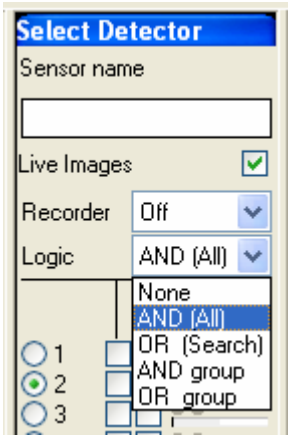
11. Move the Pattern and ROI frames around the second target (in this case, the other screw). Reference steps 17-20 in the first section of this lab for help in positioning and sizing the frames.



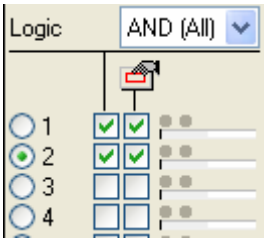
12. Once the pattern and ROI frames are in the correct places, click the Teach button to teach the pattern to Detector 2. After a few seconds click Stop. The pattern will appear in the Pattern section on the right hand side of the SW screen.

13. Click the Run button and confirm that Detector 2 is finding the taught pattern. Click the Stop button. If necessary, adjust the Threshold Min to a lower value and test again.

14. Next we will configure the logic. In this case, we want both parts to be present for the output to turn on, so we will use AND logic. In the Select Detector section, click the Logic drop down menu. Select AND (All).



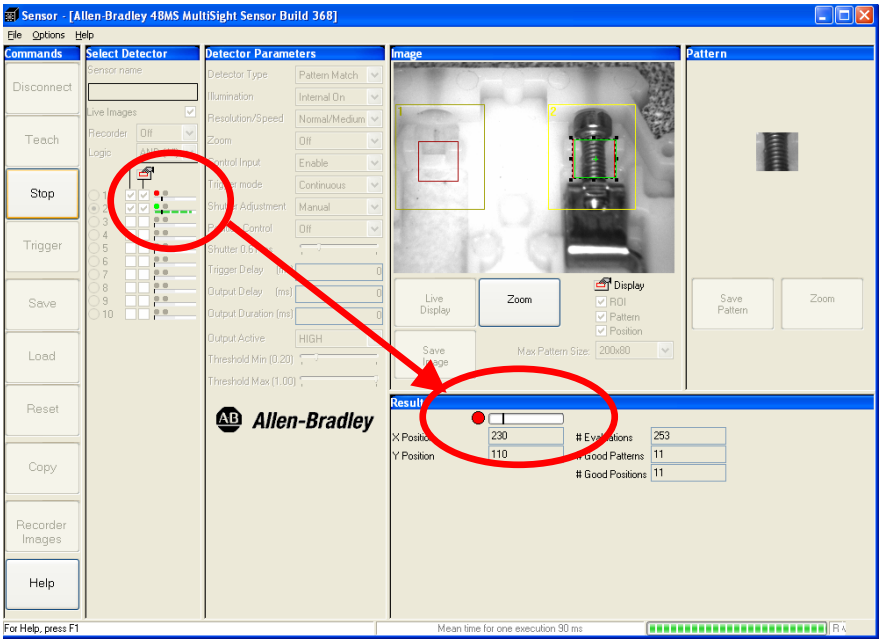
15. To include a detector in the inspection, select the Logic checkbox for that detector. The Logic checkbox is the first box next to the radio button in the Select Detector section. Click the Logic checkbox for detectors 1 and 2.



16. Click the Run button to put the MultiSight in run mode. If you receive a “Group parameters check failed” warning it means that one of the parameters that must be the same is not. Repeat steps 3-7 to correct the settings.

17. With the sensor in run mode, notice that there are now bar graphs for both detectors. If either detector fails, the overall output turns off.

18. Put the “bad” part with the missing screw into the sensor’s field of view (or remove one of the screws). Notice that one detector passes but the other fails, so the overall output fails.

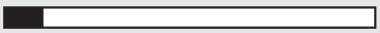


19. You have completed this section of the lab.

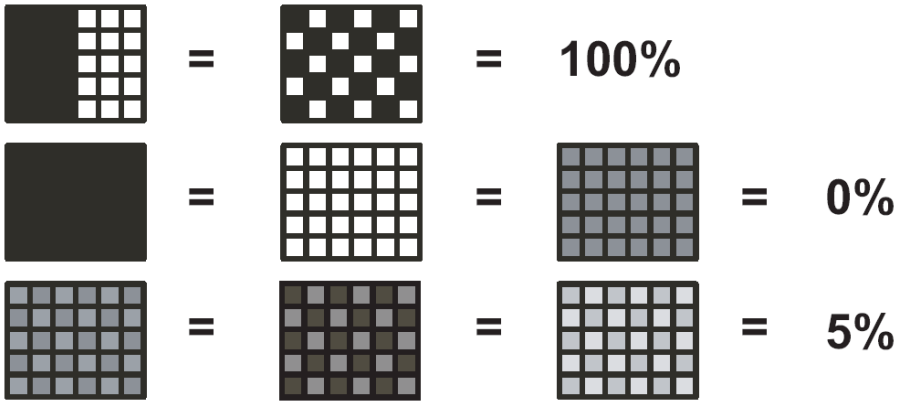
Label Detection - Setting Up a Contrast Detector Type

The MultiSight is an excellent product to use for the confirmation of label and date code placement. For certain applications it would be possible to use a pattern match detector type to detect the printing, but in many applications the label or date code changes so pattern matching will not work. For these applications the contrast or brightness detector type are the best options.

The contrast and brightness detector types analyze the pixels within the yellow Region of Interest (ROI) frame. In the case of brightness, the detector is simply counting the number of bright pixels (pixels whose gray scale value is brighter than 128 on a scale of 0-255). If the result falls within the set threshold values, the detector passes its inspection. The contrast detector analyzes the level of contrast – if the ROI is 50% pure white and 50% pure black, the contrast is 100%. (In real life applications the contrast levels almost never approach 100%.) The following chart provides a useful summary of brightness and contrast sensors.

Detector Type / ROI Image	Brightness bar graph	Contrast bar graph
	100% 	<10% 
	50% 	>90% 
	0% 	<10% 

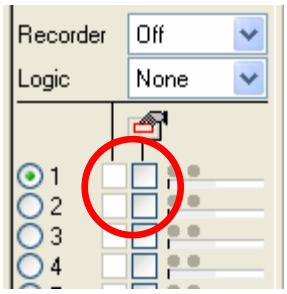
The following chart provides additional clarification of the results when using the contrast detector type.



In this section, we will set up a contrast detector to confirm that a label has been placed on the target. Confirmation that a date code has been printed would be set up in a very similar fashion. We will continue from where we left off in the previous section.

1. Click the Stop button to take the MultiSight out of run mode.

2. Unselect the logic and display checkboxes for detectors 1 and 2 in the Select Detector section (the boxes between the radio button and the individual detector results bar graphs).



3. Click the Logic drop down menu and select None.

4. Select the radio button for Detector 3 – we will use this for our contrast detector. (It is important to not use Detector 1 or 2, as we want to maintain those settings for a later portion of the lab.)

5. Notice that the image is now overexposed. This is because the Shutter Speed is back to the default 2ms. We could either start from scratch or use the settings we have already adjusted in Detector 1. The latter is typically easier. Click the Copy button in the Commands section on the left.

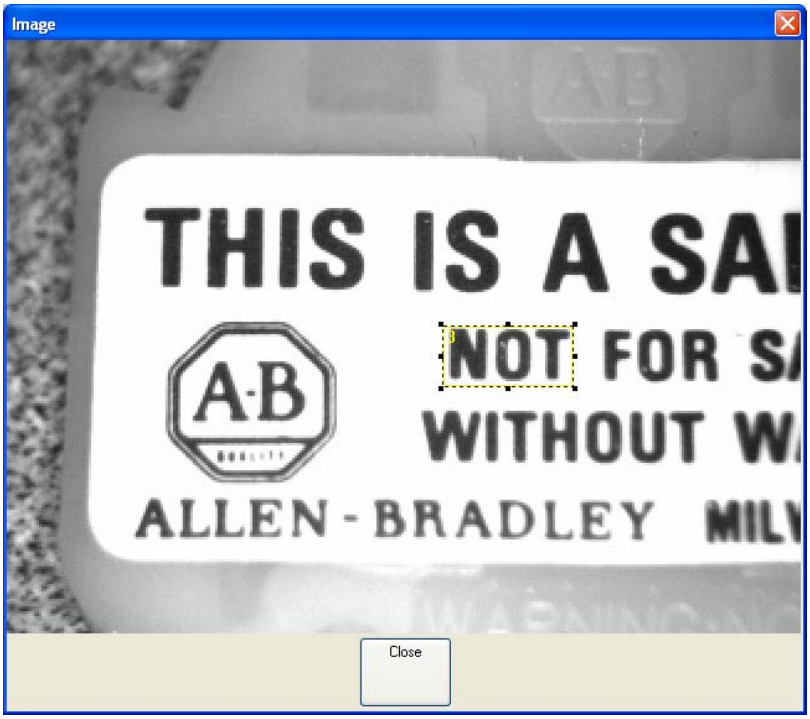
6. The Copy window with menu selection will open. Leave Detector 1 as the Source, and select the checkbox for Detector 3 as the target. Click the Default Par. button at the bottom of the window, then click the OK button. Wait as the parameters from Detector 1 are copied to Detector 3.

7. In the Detector Parameters section, click on the dropdown menu for Detector Type – select Contrast. Notice that the red pattern frame on the image disappears.

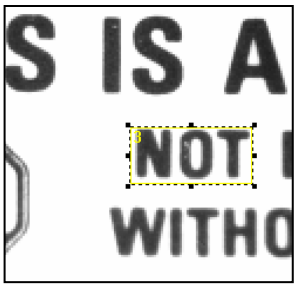
8. Click the Live Display button under the image. The MultiSight will begin flashing and you will get updated pictures in the Image section of the SW.

9. Now we will position the yellow ROI frame. If there is text on the label, this will typically give a high contrast. It is important to note that the background must have a relatively consistent color – a multi color background would result in high contrast when no label is present.

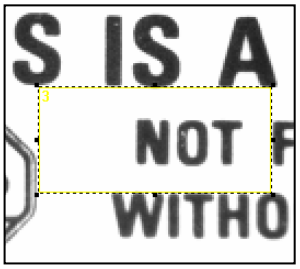
10. To maximize the contrast within the ROI, we want to make the ROI just big enough to surround the text without a lot of border. In the top image on the right, the text completely fills the ROI frame. This maximizes the level of contrast when that text is present. In the bottom image, the ROI has a large amount of white space. This decreases the contrast level, causing "text" and "no text" to look much more similar to the MultiSight and thus more difficult to differentiate.



GOOD – minimal white space



BAD – too much white space



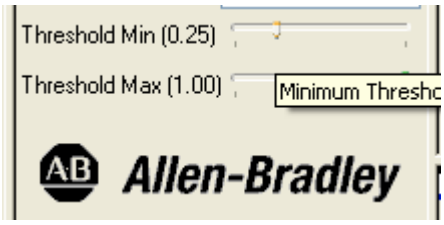
11. Move and resize the yellow ROI frame according to the above guidelines.

12. Click the Stop button in the Image section.

13. Click the Run button. The MultiSight will start flashing and you will see results in the Select Detector section and the Results section.

14. Is the inspection passing? Chances are, Detector 3 is either failing or barely above the threshold. The Contrast detector type typically requires a lower threshold value for applications. Click the Stop button.

15. Adjust the Threshold Min. parameter down (to the left). A value of 0.25 is good setting to try.



16. Put the sensor in run mode. Notice that the threshold (small black line on the bar graph) is lower). Replace the good part with the bad part (no label / no date code). Does the part fail the inspection? Depending on the level of contrast in the ROI, you may need to adjust the thresholds or even select a different area to inspect.

17. If the detector does not consistently pass good parts and fail bad parts, experiment with adjusting the threshold, the size of the ROI, and position of the ROI. (To adjust these settings, you will need to click the Stop button, make the adjustments, then click the Run button and observe the new performance. See steps 10-16)

18. You have completed this section of the lab

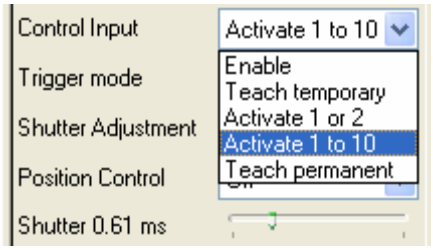
Grouping Detectors for Product Change-over

Many production lines run different parts at different times. One of the nice features of the MultiSight is that it can store settings for multiple groups of detectors and switch between groups, all without having to reconnect the PC and configuration software. The standard MultiSight can store up to 10 detectors in any combination. For example, Group A would consist of detectors 1-4, Group B detectors 5-8, and Group C detectors 9 and 10. The control input is used to switch between groups of detectors. In this section of the lab, we will use the detectors that we have already set up to demonstrate the grouping functionality.

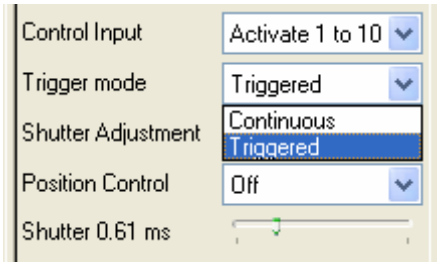
1. If the MultiSight is in run mode, click the Stop button to put it in edit mode.

2. Select Detector 1 using the radio button in the Select Detector section.

3. In the Detector Parameters window, click the Control Input dropdown menu and select Activate 1 to 10. (This is the setting that allows the control input to be used for xwitching between detectors.)

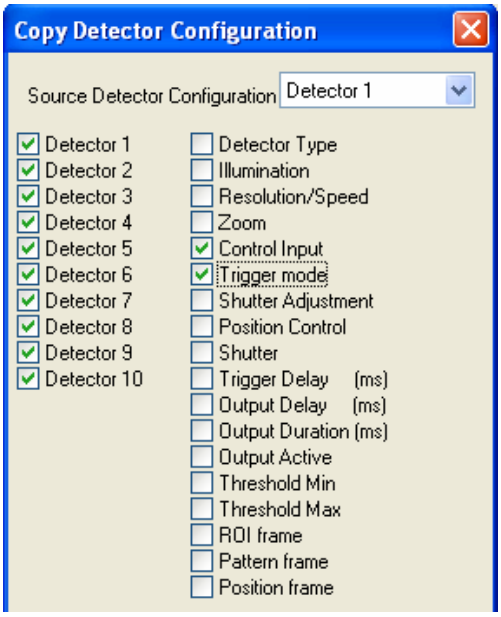


4. We will turn the control input on and off between inspections in order to change between groups. In continuous trigger mode, there is no time between inspections, so we must use triggered mode for this application. Click the Trigger Mode dropdown menu and select Triggered.



5. Next we want to copy these two parameter settings into all the other detectors. Click the Copy button in the Commands section.

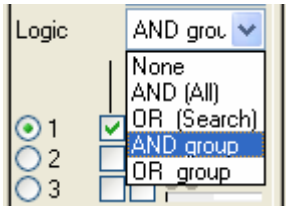
6. Leave Detector 1 as the Source Detector. Click the All Detectors button at the bottom of the window to select all detectors. Click the Control Input and Trigger Mode checkboxes in the right hand column.



7. Click OK at the bottom of the Copy window and wait for the MultiSight to write the settings to all detectors.

NOTE: Why did we change the settings on all detectors instead of just the ones we are using? If, while in run mode and not connected to the PC SW, we accidentally selected a detector that did not have the above settings, we would not be able to change away from it without reconnecting the configuration SW! <u>It is very important to make sure that ALL detectors have these two settings!</u>

8. In the Select Detector section, click the Logic dropdown menu and select AND group.



9. The Logic checkboxes work differently for Grouping. A Group is defined as starting with the Active Detector (selected by the radio button or via the control input) and including all

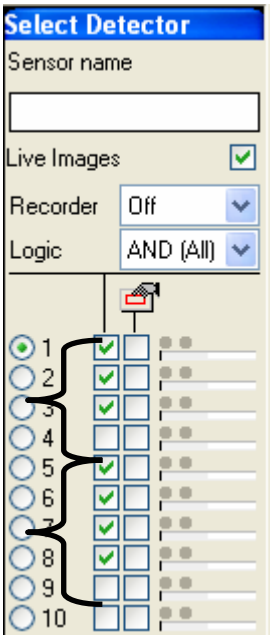
consecutive checked detectors up to and including the first unselected detector.

For example, in the below image, Group A is detectors 1-4 (1-3 checked, 4 unchecked) and Group B is detectors 5-9 (5-8 checked, 9 in unchecked)

EXAMPLE ONLY

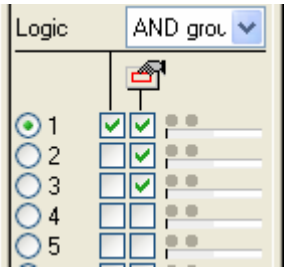
DO NOT USE

THESE SETTINGS



10. In our application we will set up Group A as detectors 1-2 and “Group B” as detector 3. Select the Logic checkbox for detector 1. Leave the Logic checkboxes for 2 and 3 unchecked. When detector 1 is active, the MultiSight will inspect detectors 1 and 2. Detector 2 is unchecked so it will not check an other detectors. When detector 3 is active, the MultiSight will inspect it. It is not checked, so the MultiSight will not inspect any other detectors.

    This is also a good time to select the display checkbox for all three detectors (second column of checkboxes). Note that all 3 detectors will appear on the image.



11. Put the original part (from lab section 1 and 2) back into the field of view. We will begin by inspecting this part.

12. Put the sensor into Run mode. The Trigger Mode is Triggered, so we will have to manually trigger the device. Click the Trigger button in the SW or push the manual trigger button on the 48MS-TESTBOX to perform each inspection. Note that the MultiSight is inspecting detectors 1 and 2.

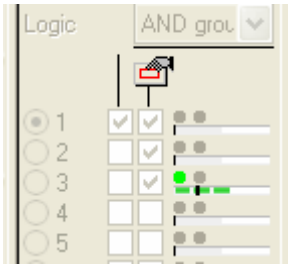
13. Now we want to switch between the groups. Trigger the sensor.

14. When that inspection is complete, the READY output of the sensor will turn on. This should take less than 100ms, so you won't see it, but if you were programming a PLC it would be important to wait for that output before proceeding.

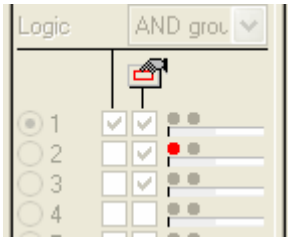
15. Push the IN2 button on the 48MS-TESTBOX three times. This IN2 button is connected to the sensor's control input. This will make detector 3 the active detector. (When programming a PLC, the input must turn on for at least 5ms each time and must be off for at least 5ms.)

16. Replace the first target part with the second part (from the Contrast detector section).

17. Trigger the sensor. Note that the MultiSight inspects detector 3. You may need to move the part around while repeatedly triggering the sensor to get it into the right position.



18. Press the IN2 button on the 48MS-TESTBOX two times. Trigger the sensor. What happens? Only detector 2 is inspected. Detector 2 was made active by sending two pulses to the control input. When we triggered the sensor, the MultiSight inspected Detector 2. Since it was not checked, the MultiSight did not inspect any additional detectors and set the output based on that one result.



19. You have completed this section of the lab.

MultiSight Lab Images

Date Code Application

Good Part

BEST IF USED BY

SEP2808US

Bad Part

BEST IF USED BY

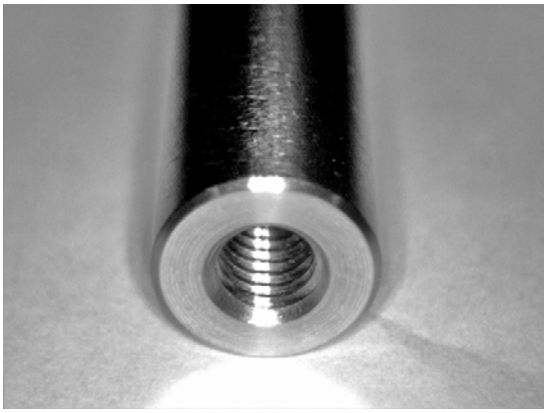
Terminal Block Application

Good Part

Bad Part

Threaded Hole Application

Good Part



Bad Part