

# LabVIEW and IMAQ Vision Builder Provide Automated Visual Test System

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**The Challenge:** Redesigning a visual inspection system to remove the human error factor, while keeping test times within 300 ms.

**The Solution:** Implementing a LabVIEW-based vision system using National Instruments IMAQ hardware and the IMAQ Advanced Analysis Toolkit.

## Introduction

To ensure the quality of semiconductors, our customer was employing a pool of people to visually inspect thousands of components, looking for any variation, or deviations. Faulty components could display any number of defects, such as cracks, spots, discolorations, and deformities.

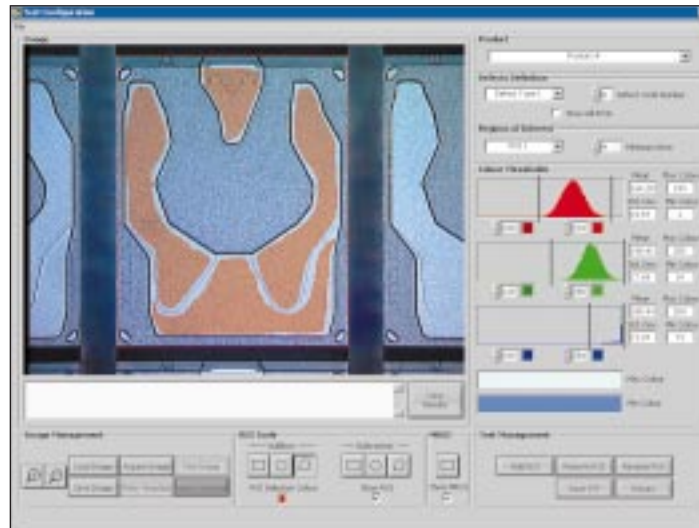
The semiconductors under test are less than 1 mm square. The operators were manually adjusting an XY table of the entire component into view and then acquiring the image using a microscope/camera combination to display it on a monitor. The operator inspected the image, adjusting intensity and tint of the monitor to best view the component.

If the operator found a defect, he logged the category of the defect, and the operation continued with the next component. Because our customer was experiencing problems with quality and consistency in this process, they decided to employ an automated technique to help resolve these issues.

## Test Methodology

After discussion with our customer, we established the following criteria for the test system:

1. We require test times less than 300 ms for good components
2. We do not count test times for failed components
3. We perform tests by comparing their components' image to a fixed "good" component image
4. We base pass/fail criteria on color variance and minimum defect size



Test Setup Screen Displaying a Reference Image with Associated Test Limits

5. Each color plane has an upper and lower color limit
6. We permit multiple regions of interests (ROI), each with their own threshold values and minimum size
7. We permit multiple defect definitions, each with a variable number of ROI
8. We make multiple test setups possible, with a variable number of defect definitions, thus facilitating multiple products

*National Instruments IMAQ Vision Builder was invaluable during the prototyping phase of development, and we were quickly able to investigate which approach to use for testing components, as well as how to implement the test setup portion of the system.*

## Test Setup

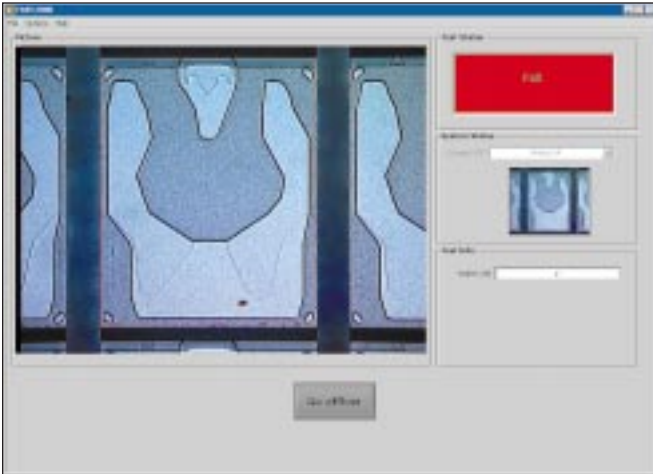
A product test plan consists of multiple defect definitions, which can contain multiple ROI. Each ROI contains its own test limit settings. This means that one test plan can contain hundreds of ROI with very precise limit settings for products. We define ROI using the ROI tools section of the user interface in the program. Using these tools, we can add to and subtract

from the ROI in square, circular, or free-hand shapes. The red section in the image displayed on the screen capture is an example of an ROI. We can achieve precise and arbitrary selection of ROIs using this method. After the operator defines the ROI, the LabVIEW program using IMAQ Vision presents a histogram of each color plane, as well as some statistical information

concerning the color distribution. Using the color threshold section of this distribution, the operator can effectively set color limits for the displayed ROI.

## Production Testing

We designed the main interface of the semiconductor test system, shown above, as a simple, easy-to-use operator interface. The operator can select which product to test from a list box (the reference image displays to give some idea of which product is under test), as well as start or stop the tester. Components tested display in real time if desired. To minimize the testing time, the program compiles all limit information for the selected product into six limit images. The program compiles these images only once the tester is brought online. The program acquires a new image and then performs a pattern match to locate the component. The program then splits the images into its three separate color planes and then completes a greater/lesser comparison with each of the limit images. Finally, we have an



Main Interface Showing a Failed Component

image that represents pixels out of limits. We then do some simple analysis to profile the areas that are out of limits and compare this information with the minimum area limit to eliminate non-defect variations.

Using this approach reduces our testing procedure to acquiring an image, matching a pattern, executing six image comparisons, and calculating and comparing areas.

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*With LabVIEW and IMAQ Vision Builder, the application has the flexibility for easy modification to meet the customer's future needs.*

## New Innovations

We can easily introduce some possible improvements into the framework of the

system that would yield more rugged test results. Using IMAQ Vision Development Modules, we can add algorithms such as edge detection, color thresholds, and object detection. Additionally, image processing and analysis routes in new features, such as color pattern matching, might result in fast throughput.

## Conclusion

National Instruments

IMAQ Vision Builder was invaluable during the prototyping phase of development, and we were quickly able to investigate which approach to use for testing components, as well as how to implement the test setup portion of the system.

The IMAQ analysis library for LabVIEW was also quick to learn and simple to use, after we defined the general test and setup procedures.

With these two elements and the quick development time of LabVIEW, we completed this solution on time and provided a system that met the

customer's requirements. With LabVIEW and IMAQ Vision Builder, the application has the flexibility for easy modification to meet the customer's future needs.

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*Throughout the development, LabVIEW greatly simplified the design of the software tools.*

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