

Using vision-integrated cobot system to detect quality issues in low-volume PCB assemblies

Case study | September 2020

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Overview

Although most PCBs are produced in large quantities, there is significant demand for multi-layer, high-density interconnected (HDI) boards that are used in certain critical subsystems and devices. Manufacturers of HDI PCBs cannot afford quality defects, yet they too often rely on manual inspections to detect errors.

One HDI PCB manufacturer asked Omron for help with developing a more efficient and reliable inspection process. Omron combined its FH Series vision system and TM Series collaborative robot to create a turnkey, fully integrated automated inspection solution that is accurate, affordable, and easy to set up in existing environments.

This solution provides the following benefits:

- Ensures accuracy by eliminating error-prone manual inspection processes
- Enables easy setup and integration with existing equipment
- Allows lines to run faster around the clock while minimizing quality issues
- Provides a full solution where one main platform handles all equipment, even from different suppliers



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Printed circuit boards (PCBs) have been around for decades. Manufacturers use them to easily connect electrical components such as capacitors, resistors, diodes, and transistors.

Most PCBs are produced in large quantities, but there is also significant demand for multi-layer, high-density interconnected (HDI) boards, which are used in a variety of critical subsystems and devices. These specialized PCBs often carry a much higher per-unit cost relative to mass-produced boards.

When HDI PCBs are manufactured in small numbers, quality control is particularly important since stocks of replacement boards are similarly limited. Problems in quality control can disrupt complex production processes, cause premature device failures, and, ultimately, undermine marketplace reputations.

“Manufacturers of low-volume HDI PCBs check units before they are shipped,” says Omron account manager Frank Wester. “But human inspectors are inconsistent and inefficient, and the manual processes they follow are not conducive to traceability.”

The need for automation in HDI PCB quality control

Producing high-density interconnected (HDI) PCBs in low volumes makes automated quality control particularly crucial, since quality issues can disrupt production processes and lead to premature device failures, and replacement stocks are usually limited.

Human inspectors are inconsistent and inefficient, so automation is ideal for this essential task. Furthermore, automated machine vision inspection is conducive to traceability in a way that manual inspection is not. A turnkey vision-plus-cobot system is an excellent way to quickly and accurately inspect dozens of data points on HDI PCBs.

Human quality inspections deliver inconsistent results

One HDI PCB manufacturer recently asked the team at Omron Automation Americas for advice on developing a more efficient and reliable inspection process.

“This company manually inspected its HDI PCBs,” Omron application engineer Ron Freeman says. “One of its customers, a medical device maker, had received a number of dead boards and was considering switching to another PCB fabricator.”

The company’s HDI PCBs had 30 critical inspection points. It was not clear if the human inspectors were missing issues or if working boards were somehow being damaged after they left the manufacturer’s facility. To gain more insight into its processes, the HDI PCB manufacturer decided to investigate installing an automated visual inspection system.



Turnkey vision plus cobot inspection system proves effective

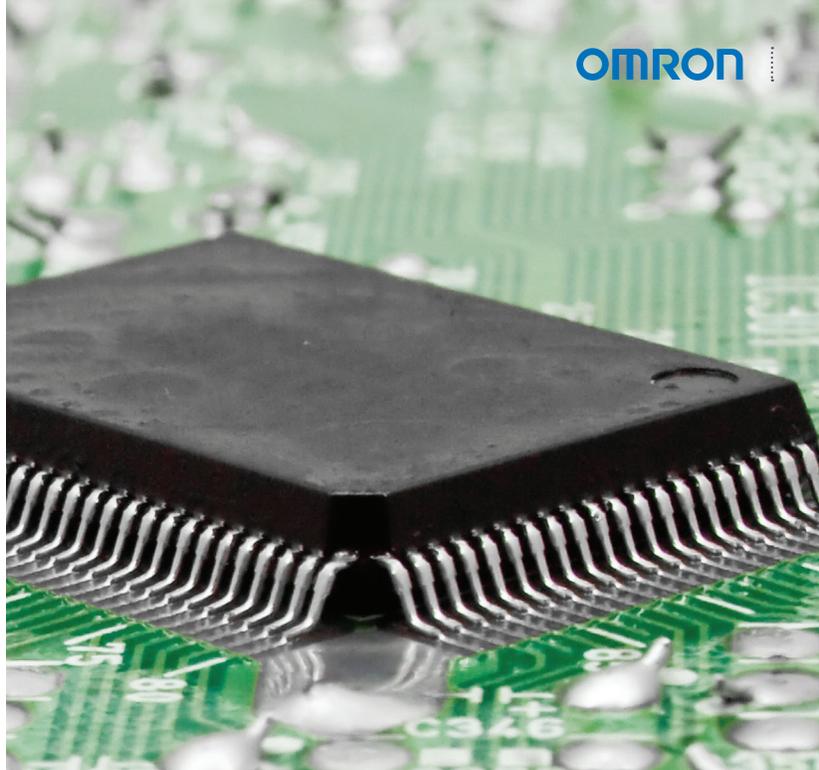
Wester, Freeman, and Omron robotics application engineer Jeff Johnson were assigned to develop the HDI PCB inspection solution. After considering several strategies, they decided to build the solution around proven components such as the Omron FH Vision System, NX-Series controller, Sysmac Studio automation software, and TM Series collaborative robot (cobot).

“We wanted a turnkey system,” says Johnson. “Everything we specified is proven, compatible, and easily supported by our field service providers.”

Johnson specified that the TM Series cobot allowed the team to place the inspection station alongside workers without having to include an expensive safety cell. Its articulating arm meant they could use a single camera to image inspection points instead of multiple statically mounted cameras.

During testing, the team discovered that the cobot’s onboard camera needed more resolution to ensure accuracy at each inspection point. To resolve this issue, Johnson sourced a new 21-megapixel color camera for this application.

The new camera leverages the Omron Shape Search III object detection algorithm that was originally developed for Apple’s facial recognition software. The algorithm enables the camera to capture accurate images even under difficult lighting conditions while avoiding false positives.



Technology spotlight: FH Series vision system

Omron’s FH Series vision system is a compact yet powerful solution for advanced defect detection that provides industry-leading sensing and processing capabilities. Designed to maximize production line performance and flexibility, the FH Series uses high-speed, high-resolution cameras, an innovative multi-dimensional multi-color (MDMC) light, and top-of-the-line image processing algorithms to capture subtle defects more sensitively than the human eye.

Automated inspection ensures accurate track and trace

By specifying the Omron FH Series vision system, the team was able to deliver a controller and database infrastructure for in-line track and trace. When linked to a visual interface, the system also provides features such as detailed diagnostics, user information, and direct database communication.

The system also includes the Omron Sysmac Studio package. Sysmac provides an integrated development environment and library of prebuilt function blocks for accelerating programming time and testing new programs before deployment.

“Sysmac makes it much easier to program the robot to inspect new PCBs,” Freeman says. “With it, operators can log into an Omron NA Series HMI to modify and insert function blocks directly into ladder programs.”

The new automated vision system has had an immediate impact on quality at the HDI PCB manufacturer, and it reports that customer satisfaction is rebounding. Tracking and tracing data is also helping the company gain insights into how it can change processes to further improve quality.



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