CyberOptics Semiconductor CASE STUDY

Fab Establishes PM Schedules, Improves Die Yield by Monitoring Equipment Vibration in Real-Time

THE USER

A 300 mm European fab for one of the world's largest chipmakers.

Getting a Handle on Equipment Vibration

A 300 mm fab wanted to establish preventative maintenance (PM) schedules across its process areas, including front-end handling, vacuum chambers and vertical furnaces. They designed the PMs to detect and correct any equipment vibration that caused wafer defects and reduced die yield.

Process engineers across the fab employed multiple methods to troubleshoot possible links between wafer defects and equipment vibration in reaction to wafer scratches, breaks and particle contamination. Each method of measuring vibration was inefficient and implemented only after equipment vibration had led to wafer damage.

For instance, some techs at the fab used a stethoscope to listen to their equipment. Others placed an ear or hand on equipment to detect vibrations, according to Allyn Jackson, customer support manager at CyberOptics Semiconductor.

"The manual method was troubleshooting standby and, of course, didn't give them the insight they wanted. The information they desired would establish controls for equipment moving forward and really correct problem areas," Jackson said.

A second tool employed at the fab was an off-the-shelf accelerometer, which was configured to monitor vibration one axis at a time. The device required engineers to take apart equipment to workaround the wires, which made it impossible for them to measure vibration inside stockers, vacuum chambers and vertical furnaces.

"They would get creative and improvise to get whatever data they could along the way," Jackson said. "The wires were just too inhibiting and configuring the device was just one more hurdle for them."

Engineers also used a recording device that obtained vibration data during a process. The device required engineers to upload data into a separate reader at the end of a process. Engineers used data they culled from the device to perform trial-and-error troubleshooting to identify specific vibration sources in a process.

Jackson said that, typically, engineers found the recording device difficult to set up and characterize equipment to establish vibration standards for a piece of equipment or tool in a process.

The fab's efforts to measure equipment vibration, regardless of the method, were largely reactionary and isolated to troubleshooting, Jackson said.

Looking at Vibration in Real-Time

The European fab looked to one of its distributors for help finding a tool that would allow its process engineers to measure and trace equipment vibration. This would allow them to set equipment- and tool-specific tolerances for equipment setup and PM schedules.

The distributor introduced a wireless, wafer-like vibration sensor. CyberOptics' Jackson visited the fab to give a series of process-specific demonstrations of the device.

The fab established an internal trial to qualify the device, the WaferSense® Auto Vibration System (AVS), and its ability to set up, characterize and troubleshoot for equipment vibration.

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The device travels through process areas as a wafer does and reports real-time acceleration data in all three axes (x, y, z) for engineers to identify vibration sources. The device's companion software replays log-file acceleration data for engineers to compare different run-times, tools and triggers during wafer transfer. The software allows engineers to evaluate vibration frequency between 0 and 200 Hz and acceleration at a range of +/-2G.

The fab's process engineers were able to quickly implement the device and calibrate equipment for vibration without ancillary equipment or wires, Jackson said. Engineers used the device's real-time data and companion GUI to verify that vibration wouldn't disrupt wafer transfers on wheel carts, stockers, sorters, front ends and overhead transports.

Jackson added that process engineers at the fab used the vacuum-compatible, carbon-fiber device to access hard-to-reach and sensitive vertical furnaces to ensure the real-time integrity of wafer boats and corresponding wafer-transfer paths.

"They used it to cover every phase of a process," Jackson said. "They eliminated a lot of their guess work tracking down defects and cut down their troubleshooting time."

The European fab ultimately implemented multiple units of the 300 mm device and used it to measure vibration across process areas and set controls to ensure equipment vibration doesn't lead to the mishandling of wafers and reduced die yield.

The Bottom Line

The European fab used the wireless vibration sensor with real-time, three-axis reporting to establish yield-based vibration tolerances and PM procedures that reduced wafer damage across process areas and improved die yield.

Process engineers used the device to establish vibration and acceleration parameters for equipment and technicians, as well as identify links between vibration frequency -- such as isolated shocks versus steady humming -- and likely sources.

The fab used data collected from the device to predict robot and transfer-equipment failures and identify both wafer particle-contamination sources and inefficient movement by pass-through cassettes and FOUPs.

The fab was able to conduct regular PM for equipment vibration without taking tools down and investigate poor handoffs, wafer bumping and components wearing out. Process engineers also used the device to compress the time they spent troubleshooting wafer defects caused by events such a motors vibrating, stationary wafers walking off end effectors and slamming load-port doors.

Process engineers at the fab were essentially able to detect vibration problems before they became serious and impacted die yield, according to Jackson.

"They saw that the more they optimized acceleration and limited vibration in a process, they encountered less downtime and defected wafers," Jackson said. "And what they saw was an increase in cycle time and die yield."

Allyn Jackson, customer support manager
503-495-2237, ajackson@cyberoptics.com

13555 SW Millikan Way
Beaverton, Oregon 97005

Phone: 800.366.9131 or 503.495.2200
Fax: 503.495.2201
Email: CSsales@cyberoptics.com
Web: www.CyberopticsSemi.com