NDT Instruments Assure High Quality For California PCB Manufacturer

Non-destructive testing (NDT) instruments are essential for maintaining a high standard of quality in manufacturing multilayer printed circuit boards (PCBs). One California-based fabricator with a reputation for high quality, short cycle times, and innovative engineering relies heavily on the performance of these instruments.

E lectro-Etch Circuits, Inc., Inglewood, CA, makes hightech multilayer PCBs that are used in computers, telecommunications, instrumentation and medical electronics. Boards for telecommunications are made in compliance with strict Bellcore (Bell communications) specifications.

Founded in 1967 by Paul Mayer, Electro-Etch is now managed by the founder's sons—John and Peter Mayer. John serves as president, while Peter is the quality assurance manager. Known for high layer-count controlled impedance backplanes, fine pitch surface mount boards and quick turnaround on all products, the company also services the timecritical market for prototype boards and original equipment manufacturing (OEM) markets requiring large production runs.

The company achieved ISO-9002 certification in 1994. The multilayer printed circuit boards manufactured there incorporate fine line circuitry, fine pitch surface-mount technology, layer counts up to 26 layers and controlled impedance, according to Peter Mayer. The NDT instruments use X-ray fluorescence, eddy-current and microresistance principles to help assure the company of maintaining its high standards.

Accuracy is a Must

"Electro-Etch uses plating thickness measuring instruments on the production lines, as well as in quality audit



Quality assurance manager Peter Mayer inspects a printed circuit board while another board is having solder thickness measurements read on a solder-leveled surface-mount pad using an NDT X-ray fluorescence system.

areas," says Mayer. "When copper plating, we need a quick and accurate method of measuring the thickness of copper that has been plated inside the hole. The testing gage* allows us to quickly determine copper thickness in the plated through-hole (PTH) before and after etch."

Using the gages saves the time required to etch a panel for microresistance-based copper thickness reading, and the time required to prepare a microsection. The hand-held gages have allowed the company to increase through-put pattern plate, while reducing first article cycle times. A plate-first article now takes only 30 seconds.

"We manufacture back planes up to .250 in. thick," Mayer said. "These products contain extremely highaspect ratio holes. The gages allow production personnel to audit the plating process on an ongoing basis."

The gages operate on the eddycurrent principle. They work on double-sided and multilayer printed circuit boards, even through tin and tin-lead resist. The eddy-current principle is used primarily to measure both non-magnetic and metallic coating over steel (copper, zinc, cadmium), and nonconductive coatings, such as anodize or paint, over non-ferrous metals, such as aluminum.

When a conductive material such as copper is subjected to an AC magnetic field from the gage's probe, eddy-currents occur in the material in proportion to the frequency and resistivity. The induced eddy-currents generate an opposing magnetic field that alters the circuit reactance and output voltage of the instrument's probe. The change in output voltage is used to calculate the coating or plating thickness.

Electro-Etch also uses a coating thickness instrument** to measure plated copper thickness for audit prior

^{*}PTX gage, CMI International, Elk Grove Village, IL **MRX instrument, CMI International, Elk Grove, Village, IL



Quality auditor Ramona Lopez measures through-hole copper thickness on an etched printed circuit panel that will be used for computer, telecommunications or medical electronics applications.

to shipping, and to verify the correct foil weight before raw material release. This bench-type system can also measure copper thickness of plated through-hole copper of the printed circuit board prior to, and after, etch. The instrument uses microresistance and eddy-current principles for measuring plating or coating thickness, depending upon the material. The plated through-hole micro-resistance principle requires precise measurement of the copper cylinder that forms the plated through-hole. Once the parameter is known, it is combined with data on the board and hole aspect ratio to calculate the average copper plating thickness. Calculations are done automatically by the instrument's software.

Requirements Vary

Electro-Etch has a diverse customer base with varying requirements for solder coating thickness on surfacemount features. Accordingly, it requires the ability to measure solder thickness on an in-process basis. "Using fluorescence plating thickness measuring system allows us to use the same piece of equipment to rapidly map solder thickness of fine pitch surface-mount pads, monitor plated gold on nickel thickness, plus monitor tin-lead alloy composition and thickness," Mayer said. Two hightech X-ray fluorescence*** systems are used.

X-ray fluorescence is considered the most precise principle for inspecting printed circuit boards. It is created when a material is subjected to Xrays. Some of the material's electrons gain energy and leave the atom, creating a void in the shell. This void is filled by an electron from a higher energy shell, releasing a photon of X-ray energy known as X-ray fluorescence.

The energy level (wavelength) and quantity of fluorescent X-rays are proportional to the element's atomic number. It is characteristic for a particular material and can be used to determine the material's thickness.

Electro-Etch has multiple production and quality control employees trained to use the plating thickness measuring instruments on all shifts. "The instruments are simple to use," Mayer pointed out. "Operators are prompted through the various setup steps," he added. "Training on the Xray fluorescence thickness measuring instrument system takes about 45 minutes per operator, including setup and calibration."

All high-tech instruments are connected to printers. The inspection results are printed and become a permanent part of the job work.

NDT thickness measuring instruments are also used for:

- Plated copper thickness audit prior to shipping (eddy-current/micro-resistance)
- Plated copper thickness before and after etch (eddy-current)
- Solder thickness and distribution on surface-mount pads (X-ray fluores-cence)
- Plated gold and nickel thickness (X-ray fluorescence)
- Plated solder thickness and alloy composition (X-ray fluorescence)
- Verification of correct foil weight prior to raw material release (microresistance)

Mayer is very satisfied with the performance of the instruments. "Fast

^{***}XRX machine, CMI International



Senior quality auditor Younos Tootla measures plated copper thickness with a meter.



Electro-Etch employee Jose Perez is shown plating circuit panel boards.

service and loaner equipment are available. It keeps us comfortable because backup equipment isn't needed and we've never been down more than a few hours with this service." Production Has Improved "Given the cost and complexity of today's high-technology printed circuit boards and backplanes, any of the instruments quite probably paid for themselves with the very first job," said Mayer. The instruments save Electro-Etch money and manhours. They have significantly improved the PCB manufacturer's throughput through copper plate. It also allows more accurate plating by showing exactly how much copper is being plated in both high- and lowcurrent-density areas.

As for the savings the instruments provide, it is mostly in reduced scrap and rework. In the past, Electro-Etch made a cross section to verify that minimum PTH copper requirements had been met. Now, on all but the thickest panels, the meter is used. It saves the company 15 minutes of lab time, 10–12 times a day.

Mayer believes high-tech NDT instruments are the most valuable quality control tools a printed circuit board fabricator can own. "There is no substitute for knowing exactly how various types of panels are plating in real time," he says. *P&SF*