# **Proprietory Process Provides Intensive Cleaning** of Critical Circuit Boards

Digicom Electronics' Diamond Track Cleaning Process, winner of the 2012 Global Technology Award, is a highly efficient, in-line cleaning system aimed at mitigating failures caused by contaminated PCBs.

provider of custom, high-end, printed circuit board assemblies in Oakland, Calif., Digicom Electronics, recently won the 2012 Global Technology Award in the category of Contract Services for its Diamond Track Cleaning Process<sup>™</sup>, part of the company's Diamond Track Manufacturing Process. The company's proprietary combination of chemicals, temperature, wash cycles, timing, and equipment is said to result in printed circuit boards (PCBs) that have zero levels of ion contamination and are 75% cleaner than the IPC's highest level of cleanliness. The IPC is a global trade organization and prominent source for industry standards, training, market research, and public policy advocacy.

"We are honored to receive this prestigious award," said Mo Ohady, Digicom's general manager, in a statement announcing the company's receipt of the award. "We owe it to our clients to protect their integrity and brand by mitigating failures that might occur in their products due to contaminated boards. Even with Digicom's unsurpassed level of board cleanliness, we continue to research and develop new ways to improve our cleaning, as well as all of our manufacturing processes."

Ohady later said in a phone interview that the Diamond Track Cleaning award reflects the fact that Digicom puts a lot of effort into formulating a unique way to clean its circuit boards. "We are above average in terms of the quality of the boards assembled and chances for longevity in the long run, which otherwise would not be present," he said. "Certain types of circuits are especially sensitive to the cleanliness of the boards. As a matter of need, they require extra attention. The way we clean boards delivers the cleaning that we look for in custom, high-tech applications."

The company's general manager explains that the types of circuits that are extremely sensitive to contamination are analog, high-impedance, and high-voltage circuits. A board that's not thoroughly cleaned, he says, will have ionization, mostly sodium chloride that grows on the surface of the board. This is conductive, so current leakage occurs on the surface of the board. The circuits work on very low currents, so if a surface current is allowed, it acts like a short on the circuit and the board dies.

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The Diamond Track Manufacturing Process is a system that encompasses almost everything that happens in the company on a day-to-day basis. Company officials say that it accentuates areas that include productivity, product control, quality, and integrity of the products. "It affects and complements the whole company, and it enhances the quality and durability of our products," said Ohady. "So the Diamond Track system complements everything throughout the organization to make good, accurate assemblies per specifications. With this system, we can watch and check quality in every step of the operation. If you go through all of the steps to ensure that the means of production is sound, has quality, and meets expectations, then the final step is cleaning the part."

The in-line board cleaning process is available to any company that wants to implement it, but not all board assemblers want to take on the extra measures necessary to make it work properly. "It's not anything new, but contractors avoid it because they have to go through extra steps," said Ohady. "Number one, it's expensive, and number two, the process has to be controlled and monitored. There's a cost to doing it. Many contract companies do it because the OEMs demand it. What makes it unique to us is that the kind of equipment we chose to do it with, the features we chose to put in there, and the means of the cleaning, in combination, are very unique. The machine is called an in-line cleaner."

# Cleaning Process Enlists Environmentally-friendly Technology

The Diamond Track Cleaning Process is said to be completely green technology, an area that also helped the board assembly company win the award. "We deploy a machine that's connected to our washer," said Ohady. "It has the smarts to check the content of the washes, and the amount of liquids that are there. It will supplement it, when it gets low, to expand it. It also recycles it through heavy filtration. So the amount of harmful discharge is minimized. In our case, the liquid gets recycled back into the machine, which economizes our operation and keeps the solids out of city drain systems. It's also important how we dispose of the filters, which hold on to the harmful solids. It has to be a disposal company that has EPA approvals."

"We have made it our mission to make sure that our processes produce the cleanest boards possible," Ohady said in a statement. "We have done extensive research and many experiments to come up with our cleaning process. We recently had our boards inspected by an independent lab. When we got the results back, we couldn't understand them; our score wasn't on the chart. We were told that our boards were 75% cleaner than the highest level of clean according to IPC cleanliness standards. A subsequent analysis for ions showed absolutely zero contamination of the boards, but we are still working to improve our process."

With the features Digicom uses on its in-line cleaning machine, the machine keeps every part of the process separate and modularized. Even though each board travels through the machine progressively, every step in the process is isolated from the next step. "We can impose controls on this whole process from beginning to end, and we can fine tune every single sub-process to optimize the cleaning," Ohady told *D2P*.

"The basic, simple cleaning addressed in IPC guidelines says that the range of readings are within the acceptable range and are considered a clean assembly," said Ohady. "One type of measure-

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ment is for sodium chloride. The IPC states the amount of sodium chloride in micrograms per square inch on a PCB assembly. Their range of acceptability is anywhere from 65 to 2 micrograms of sodium chloride. Our boards sample at 0.5 and, in some cases, at zero. This is why our process is unique and very effective."

The more basic electronic devices simply have a much shorter life, said Ohady, and if they're portable, they will have a battery on board that is usually calculated to have a ten year life. When shorting starts occurring, low current starts leaking across the board's surface. It can shorten the life of the battery to a few weeks. "So the cleaning becomes very critical for the life of these boards," he said. "No matter what application is used with the boards, if they are not clean enough, this migration of ionization across the board and contamination is going to render the board useless."

# Eliminating Unnecessary Cost

The origins of the Diamond Track Cleaning Process had much to do with costs to the company's high-end customers, both financial and in terms of product efficiency. First of all, Digicom had a great deal of expertise in-house that it could draw upon. Mo Ohady himself has 30 years of experience in this field while engineering and creating production techniques. Company officials also talked to experts in this field for additional advice.

"It was actually scary, some of the things we talked about, like failures and how boards fail, and the consequences to the customer," said Ohady. "It's not just about financial costs. If you are making a highly reliable product, you expect it to work. In the aerospace, medical, and military industries, you are installing boards in environments that are very hard to take out or to repair. In general, in assemblies that are encapsulated or confor-



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mally coated, where the surface of the board is buried, they are difficult to repair. Conformal coatings can be opened up and exposed, but epoxies, a lot of times, cannot be. So the assembly becomes useless, and the cost of replacing it is very expensive," he continued. "They may be mounted in very high towers or in forests, which are hard to get at. They may even be buried in the ground as sensors. So there is a much higher inherent cost for these types of devices. As far as the medical field is concerned, it can be fatal."

The Diamond Track Cleaning Process is especially imperative for Digicom's customers with critical, complex circuit boards, like in the medical, aerospace, military, and aviation fields. "The people who design circuit boards for defense and aerospace companies, medical OEMs, and other critical applications are aware of the high level of cleanliness needed for their products," Ohady said. "Simply put, board failures, in some cases, can be fatal to humans, can be environmentally harmful, or simply impose a very high cost to end users. The life of the product can be shortened to a fraction of what it was designed to perform. So our cleaning system prevents monetary damage and human damage that cannot be answered to. In some cases, the failure is unacceptable. These are very critical areas for circuit boards."

The equipment and processes the company provides are able to accurately deliver manufacturing for designs that are often challenging, according to Ohady. "We don't want to be a consumer electronics company that builds electronic circuits by the hundreds of thousands," he said. "So we have a niche to serve the low-volume, high-tech industries. It adds value to build in the United States, and still be profitable and viable. A lot of times, companies see no choice but to go overseas to find low labor costs for the commodity parts. We offer full turnkey services, like box builds. The box builds are seamless from beginning to end, in that we control the purchase of the components, assemble them, test them, and install them in an enclosure."

#### Space Science Circuit Board Assemblies

Another area that Digicom excels in is printed circuit board assemblies for three specialized systems for space science research: ROACH (reconfigurable open architecture computing hardware), IADC (integrated analog to digital convertor), and IBOB (integrated break out boards).

"These are a group of products and subassemblies that make up a system, which is born out of collaboration with a group of university campuses and scientists who do research and develop integrated systems," Ohady said. "We collaborate with the scientists, who are from U.S. research centers and from overseas centers. They are used for research at campuses, primarily in space science research. These products also have telecom applications as well."

As far as Ohady knows, Digicom is the only company in the country that provides this type of equipment. "We are privileged to be selected as the sole source for these systems," Ohady maintains. "So we feel very fortunate to be a part of this group. They selected us for this work because we were involved with them from the beginning. We help them with their prototypes and we're willing to help them with the progress of their hardware."

Research scientists and engineers and technicians from Digicom meet by phone every week when these cutting-edge projects are being engineered and manufactured at their facility. In all phases of development, everyone involved gets to discuss and



brainstorm and offer opinions about this high-tech equipment. Complete systems are then created out of these discussions. This hardware basically gathers data at very high speeds with a very wide bandwidth. It digitizes the data and then it is analyzed. When the scientists perform space science research, they are collecting information from satellites and microwave dishes, so there are a lot of signals coming in that have to be analyzed.

"We are now in the third generation of this equipment," said Ohady. "The equipment continues to get more features and higher speeds, wider bandwidth, and more capabilities in each generation. There are several groups that we work with. Imagine a series of rings. At the center are the core designers and concept generators and application writers. The second ring is the group that uses the hardware and writes additional applications for it. The outer ring are end users who do the space research."

## Medical Equipment PCBs Require Stringent Monitoring

Digicom is able to serve a high-end, critical customer base with high-quality products on a repeatable basis by accurately measuring the metrics that are in place.

"You can design a process that you think is optimal for quality delivery, but if you don't have the metrics to measure it, you are working in the dark," Ohady explained. "So you come up with metrics by which you can look at values to see where you are. If you don't have a quantitative way of looking at your processes, you're not there. You're not validating and verifying that your processes are foolproof. Therefore, validation is very important," he continued. "You have to reassure yourself that by means of readings and measuring and looking at statistics, you're on the right track. We have a very good quality control department, which is the highlight and core of our efforts. Our certifications, ISO 9001 and ISO 13485, which is for medical devices, demand that we monitor our processes and show that our objectives and goals for high quality are being met with numbers."

Ohady says that company policies at Digicom dictate that board components be supplied strictly from established, franchised sources in this country. The parts may be built overseas by semiconductor companies, but they are distributed and controlled in the U.S. The only time the company goes out of the U.S. is when a customer has already specified a part that is being sourced overseas.

"The approved vendor list only consists of established channels," said Ohady. "The component then has the quality that has been provided for years by U.S. sources. Fake and phony parts and problems in the supply chain are not allowed in this type of distribution because the channels are monitored. Parts are not sourced from unknown sources, so we can validate these parts very easily. We have to be able to trace the medical parts all the way back to the component level. We have to show our customers where we bought these parts, who we bought them from, when we bought them, and which batch they came from."

Digicom assigned its processes the name Diamond Track because it represents uniqueness and high value. "We adopted the name because we wanted our processes to have an identity, so we basically came up with this concept," Ohady summarizes. "It's representative of high quality, durability, and has a good personality for our processes. If you want to simply state the value of our processes that are in place, you can say they are of diamond quality."

