In the Fast Lane:
Digitek Sets Pace for Product Quality with X-ray Test

Gentlemen, start your engines.

Digitek (Modena, Italy) lives on the speeding edge of automotive design and development, where product quality and reliability translate into safety and performance behind the wheel. Says Digitek’s Managing Director Aldo Longhi, “Speed, high performance and absolute reliability are in our DNA.” For proof, look no farther than the straightaways at Monaco or the test floor at Digitek, where high-performance automated X-ray test meets the demands of high-performance automotive engineering.
In the heart of Italy’s Modena countryside is an engineering company that shares its region’s profound passions for car racing and automotive elegance. Digitek designs and manufactures printed circuit board assemblies (PCBAs) for the automotive industry, bringing 20 years of engineering experience to customers that produce high-end production cars, motorbikes, Formula One racecars and more. It’s a demanding market with extreme quality expectations and difficult timelines. Digitek thrives in this industry with 180 employees, annual sales of up to 23 billion Euro, and an affinity for the crazy pace of automotive engineering. “No one in this company lives at a slow pace,” says Aldo Longhi, Digitek Managing Director. Good thing, because Digitek’s customers are not known for slow, methodical ways.

**Smaller, Lighter, Faster, Better**

Few electronics manufacturing sectors are as demanding as the automotive industry, as Digitek can attest. The company’s PCBAs mirror evolutions in the automobile itself: greater electronic content, higher quality expectations, ever-increasing complexity, and severe cost pressures. Add to that very high component density and shrinking geometries on PCBAs, including a wide variety of ball-grid array (BGA) and fine-pitch packages, and the challenges for Digitek become clear. “The increase in component density is a fact that can’t be avoided,” says Andrea Ghirotto, Manager of Industrial Engineering at Digitek. “In fact, it’s one of the strengths that allows our staff in R&D to create extremely sophisticated and compact devices, which can then be integrated into our clients’ final products.” Miniaturization is the watchword for the entire industry, putting the pressure on Digitek engineers to work with today’s smallest electronic components, creating denser and denser interconnects on smaller and smaller boards.

**Form Meets Function**

The shrinking geometries and ever-increasing functionality of Digitek’s PCBAs place demands on production test. Digitek found part of the answer with the Agilent 5DX X-ray Test System, which allows the company to test for quality at key points in its production process. “In order to inspect boards as complex as those we produce today,” notes Ghirotto, “it’s essential to have a machine that’s able to ‘see’ where neither the naked eye nor traditional optical inspection machines can. Only with three-dimensional X-ray analysis can we adequately test and, therefore, guarantee the reliability of the connections on BGA, micro-BGA and fine-pitch component pads.” Reliability is not an abstraction at Digitek. Most of the company’s boards end up in devices that are critical to vehicle operation, and very often are subjected to intense mechanical and thermal stress. As a result, the soldering process has to produce PCBAs that not only pass downstream electrical test, but also work flawlessly “down the road” over the life of the end product.

**Measuring Quality Objectively**

For Digitek, an essential characteristic of the Agilent 5DX is its ability to quantitatively measure solder results using a 3-D image. The Agilent 5DX makes it possible to observe in detail the results of the production process and get back precise, quantitative data on the form, position, and even quality of solder connections. The Agilent 5DX not only enables measurements that are otherwise impossible, but also automates the test so it’s feasible within the context of volume production. “An objective inspection is possible only with an automated system,” explains Ghirotto. “Evaluation of the quality of a solder joint cannot be left to the subjectivity
of a technician, even an expert one. Quality control must start from objective, repeatable data, especially when thousands of connections are involved. Otherwise, a statistical process check would not be possible.”

Thanks to X-ray test with the Agilent 5DX, Digitek has objective data to determine not just whether a solder connection is acceptable, but how close it comes to meeting internal quality guidelines. They can pinpoint problems in the production process, and identify corrective actions with an eye toward constant quality improvement. According to Ghirotto, the X-ray measurements make a tangible difference in the quality of the production process: “In many cases, after X-ray analysis, we have discovered how we can improve the screen printing and thermal profiling of the reflow oven to obtain even more reliable boards. This is significant value-added made possible by three-dimensional X-ray technology.”

**Faster Cornering with Prototypes**

Digitek turns out over eighty new products each year, and that means they produce a lot of prototypes. Ghirotto notes that here, too, X-ray test proves useful. “Designers have an objective guarantee of soldering quality from the beginning, so they’re free to concentrate on debugging to find any other errors that may arise. Even in the first prototypes, where obviously the production parameters have not yet been optimized, X-ray plays an important role by allowing us to identify soldering defects, remove them, guarantee the results of reworking, and ultimately reduce debug time.” Easy programming with the Agilent 5DX is a crucial part of the equation. Digitek engineers, even those who are new to X-ray test, are able to write programs quickly. As Ghirotto explains, “[The 5DX] is even easier to use than we could have possibly expected. In fact, we thought that fine-tuning the programs would have taken longer and been more complicated than it turned out to be in the end.”

**Eyes On The Road**

According to Directing Manager Aldo Longhi, the road ahead looks promising, especially for automotive suppliers that can build and test for quality at every stage of the production process. “Now we can only ‘see’ if our boards are good and working, but we can also precisely measure if they are strong enough to work reliably enough to survive in the most demanding environment of a typical high-performance car.” Digitek has proved its commitment to quality since its founding in 1983, and they’re not changing lanes now. The company continues to produce the industry’s most sophisticated products under ever-tightener deadlines and budgets despite ever-increasing quality expectations. “It’s a challenge,” laughs Longhi, “but we are certain we will continue our improvements. After all, the thrill of the race has always been in our company’s DNA.”

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**From Driver to Pit Crew at 270 KPH**

A data-logger for Formula One racecars, to be used by one of the biggest names in the racing industry, was developed and tested by Digitek engineers using 3-D X-ray test technology. The data-logger is part of an integrated telemetry system in the racecar’s onboard computer. This tiny PCBA, which holds a large number of circuits in BGA, micro-BGA and fine-pitch pads, collects data from the various onboard systems, stores part of the data locally on hard disk, and transmits the rest in real time to workstations in the pit. The reliability standard for such a PCBA is unprecedented: it will undergo extreme mechanical and thermal stress during high-speed operation. If it malfunctions, the stressors on the driver and pit crew would be just as extreme.

The Agilent 5DX X-ray Test System allowed Digitek to verify solder quality and process integrity for the PCBA from the earliest stages of prototyping through final production. Digitek was able to quickly confirm that the PCBA’s tiny interconnects were meeting stringent internal measurement guidelines, allowing Digitek designers to focus on board function with great confidence. They knew that the customer’s quality expectations would be met under all operating conditions. The Agilent 5DX played a key role, because for everyone involved—drivers, pit crew, racecar owner, board designers and Digitek—the PCBA had to function flawlessly. Product failure was not an option.
To learn more about the Agilent 5DX X-ray Test System, visit www.agilent.com/see/xray.

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