PCB Processing Using the Talon® UV Laser

In recent years, ultraviolet (UV) wavelength lasers are proving their worth in many industries when it comes to advanced micromachining applications. The driving factor for the use of UV laser technology as a solution is its ability to cleanly and accurately ablate a wide range of materials at high speed in a cost effective way. Furthermore, the shorter wavelength allows tighter focusing which is beneficial to process small, high-precision features in a non-contact manner.

Lasers are routinely used in a variety of PCB manufacturing processes including via drilling, depaneling, profiling (cutting), laser direct imaging (LDI), repair, trimming, marking, and skiving. Laser technology, being a non-contact process, completely eliminates mechanical stress on the material. Burr formation and micro-cracking in solder resist material are also avoided. Tighly focused UV lasers can remove only a small volume of material, reducing deposits on the circuits. Precision machining enabled by lasers allows more circuits on a single panel, increasing the net usable area. Moreover, UV wavelength lasers provide a flexible solution to process materials such as copper and polyimide that are used in PCB manufacturing. For example, higher beam intensity achievable with tighter focus can remove copper while lower beam intensity by reducing laser power can cut polyimide without damaging the bottom copper layer, or continue to cut completely through material fulfilling process requirements.

LASER DEPANELING OF PCBS

Singulation of finished devices from the PCB panel—a task known as depaneling—is a growing application.

We have investigated the depaneling process on various PCB materials using Spectra-Physics' UV lasers to meet the demands of high-volume PCB manufacturing. For example, for a 0.55 mm thick PCB, a good quality cut with minimal carbonization was observed at an average cutting speed of ~12 mm/sec using a multi-scan process and the Talon® 355-12 laser.

As with many applications, there is a tradeoff between throughput and quality. If a higher throughput is desired, continuous rapid scans to cut through the links are performed in few seconds, but this yields a surface with slightly higher carbonization. On the other hand, if the best-quality cut is desired, the cutting process is slowed down by introducing cooling delays between scans, which yields lower throughput and much lower carbonization.With the Talon laser's relatively short pulse width at a higher repetition rate, a higher speed and higher quality cut can be achieved.

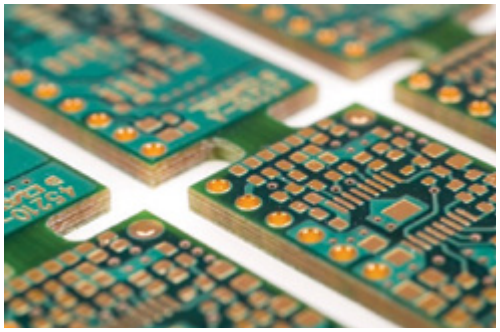

FIGURE 1.
PCB panel with individual boards linked together, ready for the laser depaneling process.

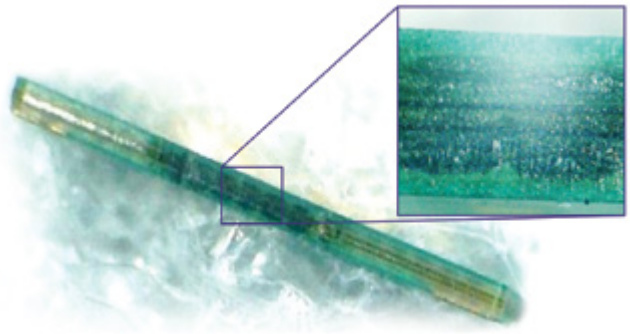

FIGURE 2.
A clean cut surface of a depaneled PCB moduled.

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COVERLAY CUT FOR FLEXIBLE PCBS

Coverlay is a mechanical protector for fragile conductors. It determines solder resist areas for component assembly on flexible and rigid-flex multilayer circuits for environmental and electrical insulation. Coverlay usually consists of ~12.5 µm to 25 µm thin polyimide films coated on one side with adhesive attached to a release paper.

Body cutting for singulating flexible circuits from their panels comprises of cutting patterns in coverlay – a polyimide and adhesive combination – without cutting through paper backing material. The cut pattern then is peeled from the sheet. As seen in Figure 3, we have demonstrated high-quality cuts in a 25 µm thick polyimide film at an effective cutting speed of 400 mm/sec using the 12 W Talon. Even higher speed of up to 500 mm/sec or greater is possible with the 15 W Talon laser.

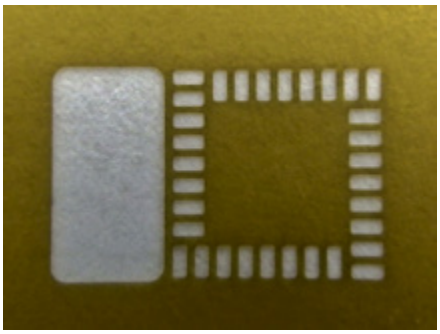

FIGURE 3.
25 µm thick polyimide film ablated with a coverlay pattern.

PRODUCTS: *TALON 355-15*

Talon is a new family of UV and green diode-pumped solid state (DPSS) Q-switched lasers that deliver an unprecedented combination of performance, reliability, and cost. Based on Spectra-Physics' *It's in the Box*™ design, with the laser and controller combined in a single, compact package, Talon 355-15 uses field-proven technology to output >15 W and >300 µJ per pulse of UV with a wide repetition rate range of 0 to 500 kHz, high pulse-to-pulse stability and excellent TEM_{00} mode quality for tens of thousands of operating hours. The Talon laser is designed specifically for micromachining applications in a 24/7 manufacturing environment where system uptime is critical.

	Talon 355-15	Talon 355-12	Talon 355-6
Wavelength	355 nm	355 nm	355 nm
Power	15 W at 50 kHz 13 W at 100 kHz 3 W at 300 kHz	12 W at 50 kHz 10 W at 100 kHz 3 W at 300 kHz	6 W at 50 kHz 4 W at 100 kHz 1 W at 300 kHz
Repetition Rate	0 to 500 kHz		
Pulse Width	<30 ns at 100 kHz		

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