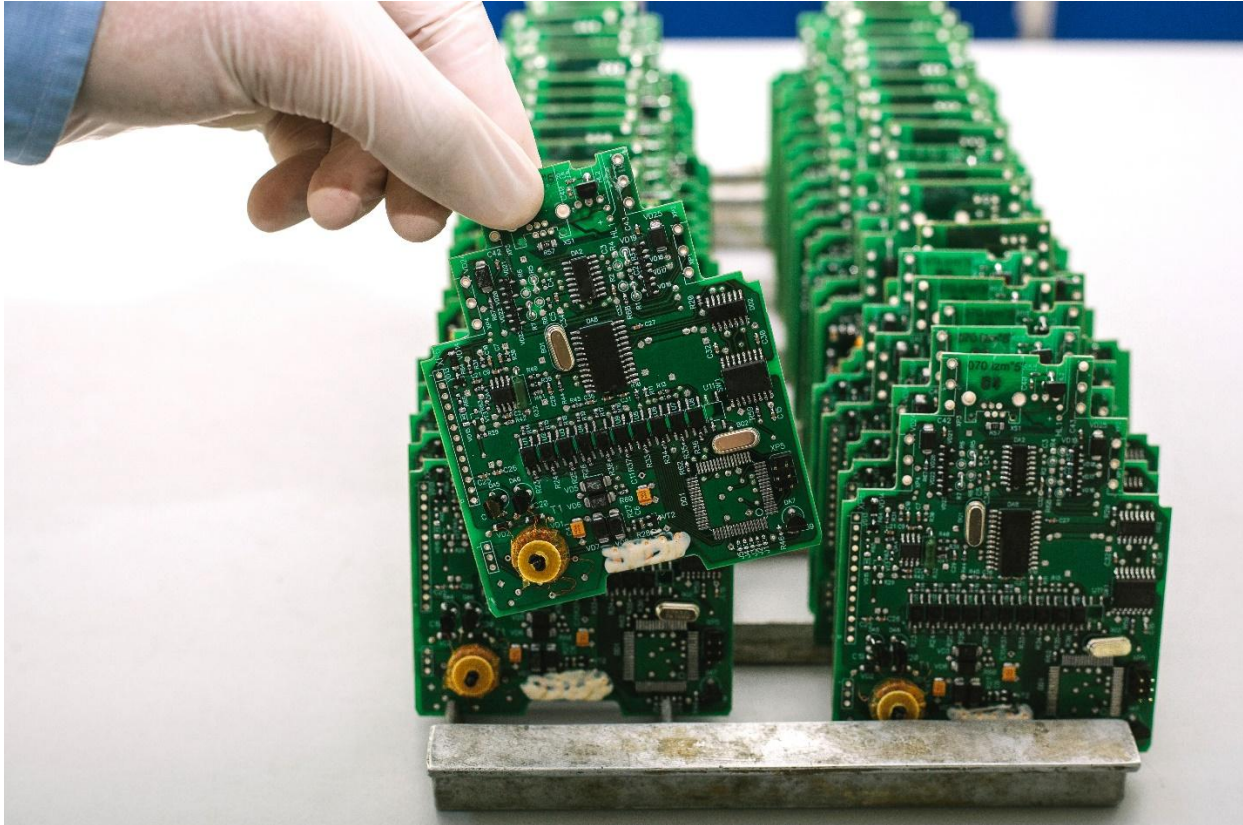


Accelerating PCB depaneling through optimized laser performance

How optimized laser performance increases process speed by up to 2.5 times



Printed circuit board assemblies: the control center of industrial machines

Printed circuit board assemblies (PCBAs) are essential parts of a machine to drive functionality. Consisting of a printed circuit board (PCB) carrying and connecting all electronic components, the PCBA controls the motion of machine parts, start and stop functions, or safety features. Separating individual PCBs from a production panel is a critical step in electronics manufacturing, directly affecting yield, component reliability, and overall process efficiency. While mechanical singulation methods, such as routing, punching, or sawing, remain widely used, laser-based depaneling has established itself as a precise, low-stress alternative, particularly for high-density and miniaturized assemblies.

Laser vs. mechanical depaneling

Although mechanical depaneling technologies are firmly established within industry, laser depaneling offers an attractive alternative for applications that require precise and stress-free processing as well as flexible cutting paths.

Contact-free processing reduces mechanical stress

Unlike mechanical tools, which apply direct force to the board during cutting, laser depaneling operates without physical contact. The absence of vibration, tensile, or shear forces significantly lowers the risk of microcracks, delamination, and solder joint fatigue. These are failure modes that are particularly critical in densely populated boards, flexible substrates, and thin laminates. Therefore, technology is especially suitable for applications with stringent reliability requirements, such as medical electronics and automotive PCBs.

Design flexibility and material utilization

Mechanical singulation is generally limited to straight-line cuts, constraining panel layout options. Laser systems, by contrast, can follow programmed straight and curved cutting paths without tool changes, enabling extremely narrow cutting lines and more efficient use of panel area. This flexibility also supports late-stage design changes without requiring new tooling.

Edge quality and process efficiency

Laser-cut edges are burr-free and typically require no secondary finishing, eliminating downstream process steps. Additionally, cutting parameters are software-defined. Therefore, changeovers between board designs occur without mechanical retooling, which is a significant advantage in high-mix, low-to-medium volume production environments.

In total, laser depaneling offers a measurable improvement over mechanical methods in terms of component protection, geometric flexibility and process efficiency, while reducing tooling-related maintenance and changeover time.



Reduced operational costs

Contact-free laser processing prevents tool wear, especially caused by fiber reinforcement



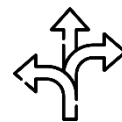
Improved manufacturing quality

No mechanical stress and thermal impact, which reduces distortion, delamination, or carbonization as well as PCB contamination



Higher process speed

Higher process speeds especially for thin PCBs when using high pulse energies



Better design flexibility

High cutting quality and speed for a variety of PCB materials, thicknesses and designs as well as improved panel packaging density



Improved operational flexibility

Fully automated process with the highest flexibility for fast changes of cutting patterns or for combining cutting and marking in one machine

Vivio 532-55-V: Engineered for higher PCB depaneling throughput

Scaling up laser power alone is not the key to faster PCB depaneling. There is more than just one laser parameter to optimize process speed and cutting-edge quality. This is our experience resulting from many years of collaboration with recognized machine integrators and through customer application testing in our Application Labs.

Based on this experience, Luxinar developed the Vivio 532-55-V for depaneling of rigid PCBs. Its optimized combination of wavelength, pulse energy, pulse duration and laser power pushes throughput while maintaining cutting quality. With Pulsecore® technology, the cutting trajectory can be optimized to reduce process time while maintaining excellent cut quality and consistent results.

To prove the performance, we tested a standard 40 W nanosecond laser against the 55 W Vivio nanosecond laser. Both lasers operated at a wavelength of 532 nm, but differed in pulse duration, pulse energy and laser power. FR4 material with a thickness of 0.9 mm was used as a representative example. The cut was made through the entire thickness of the material – without V-grooves and without ‘mouse bites’. The process parameters were optimized to achieve high-quality cutting edges avoiding delamination, carbonization and burr formation. The results are shown in figure 1.

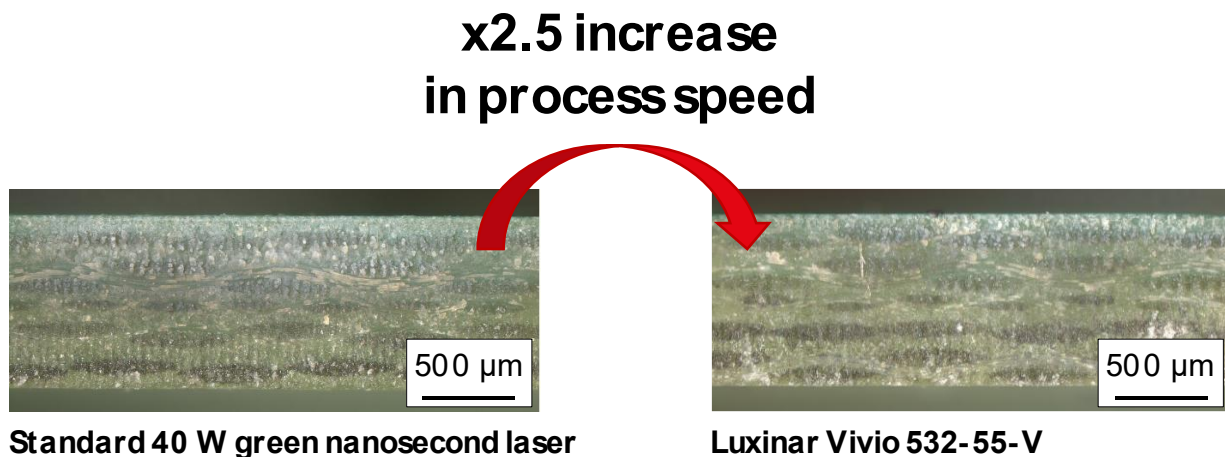


Fig. 1. Comparison of PCB depaneling using a standard green nanosecond DPSS laser (532 nm) and Luxinar's Vivio 532-55-V nanosecond DPSS laser.

The two systems produced comparable cutting quality, while the effective processing speed differed dramatically. In the tested setup, the Vivio 532-55-V reduced process time to 40 % of the reference time. This corresponds to a 2.5 times increase in effective cutting speed.

The Vivio 532-55-V laser was also compared with a standard 30 W UV nanosecond laser. Besides the 532 nm (green) wavelength, 355 nm (UV) is also a well-established wavelength for PCB depaneling. While 532 nm DPSS lasers offer high efficiency, excellent beam stability, and lower cost, 355 nm DPSS lasers provide finer, cleaner cuts with minimal heat-affected zone and delamination risk thanks to superior UV absorption in FR4/epoxy. However, 355 nm lasers typically come with lower average power, higher system cost, and shorter optics lifetime from UV-induced degradation.

The test results are shown in figure 2. In the tested setup, both systems produced clean cuts without significant carbonization of the edges. The main difference appears in the effective processing speed: Using the Vivio 532-55-V speeds up PCB depaneling by approximately 2.2 times compared with the 30 W UV reference laser.

**x2.2 increase
in process speed**

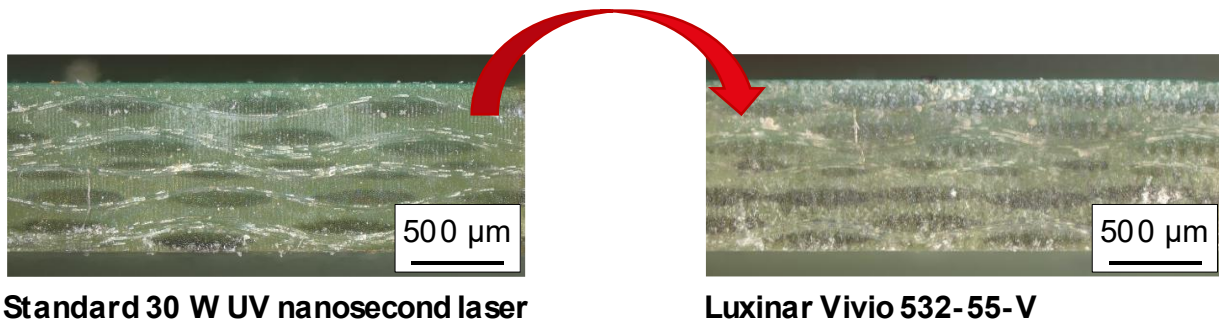


Fig. 2. Comparison of PCB depaneling using a standard 30 W UV nanosecond DPSS laser (355 nm) and Luxinar's Vivio 532-55-V nanosecond DPSS laser.

Conclusion

In both cases, the achieved process acceleration shows the high potential of the Vivio 532-55-V to increase effective PCB depaneling speed compared to UV and lower power green DPSS lasers. In industrial manufacturing, PCB manufacturers and production facilities will benefit from significantly higher depaneling throughput. This may allow manufacturers to increase output within existing equipment capacity. This lowers cost-per-part by spreading fixed costs across higher output, shortens lead times and improves delivery reliability. Reduced cycle times also decrease work-in-progress inventory and free up capacity for additional orders. In capacity-constrained facilities, this can defer investment in new machinery. Overall, it strengthens competitiveness through improved cost savings and greater production flexibility.

Luxinar - lasers for all your PCB depaneling needs

For over 10 years, Luxinar has been a trusted and reliable supplier of high-quality lasers for PCB depaneling applications. Backed by a decade of engineering expertise and close collaboration with manufacturers across the electronics industry, Luxinar has built a reputation for consistent performance, long-term reliability, and technical excellence.

Luxinar's laser portfolio supports different PCB depaneling requirements, including process speed, cut quality, material compatibility and process stability. CO₂ lasers provide cost-efficient solutions with high process speeds, making them ideal for high-throughput production environments. Nanosecond DPSS lasers offer a balance of investment costs, process speed and cut quality. For applications with the most demanding quality requirements, femtosecond lasers deliver virtually damage-free cutting results at high cutting speed.

This range of laser technologies allows Luxinar to evaluate PCB depaneling requirements and identify a suitable laser source for the material, geometry, cut quality and throughput target.

For more information, please see the following links or QR codes

[PCB Depaneling at Luxinar](#)

[Vivio laser](#)



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