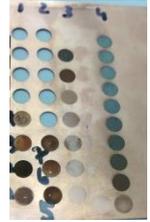


## Pico-laser Capabilities Report:

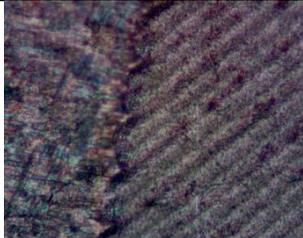
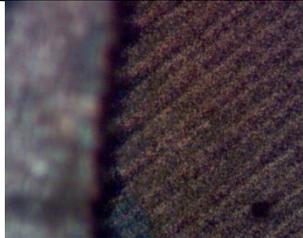
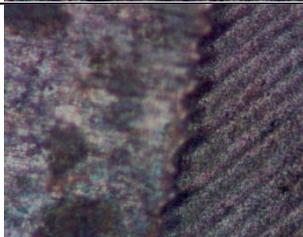
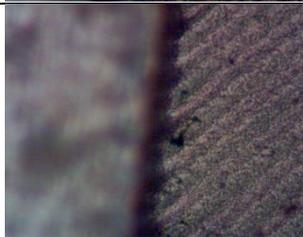
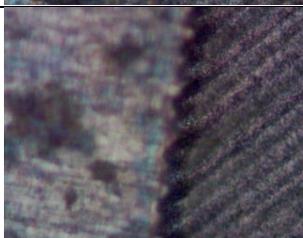
### Copper Thinning/Removal from Copper Clad Sheets

**Background:** Copper clad sheets are a widespread raw material of the PCB industry. Commonly, copper clad sheets may be purchased at standard values of copper thickness (e.g. 1 ounce=35 microns, 0.5 ounce = 17 micron). Certain application require however copper thinning to non-standard values. The aim of this report is to demonstrate Suron's new ability in thinning and in entirely stripping the copper from its dielectric substrate.

**Methods:** The basic raw material used for the experimental array was chosen to be a 0.1 mm thick copper clad, with FR4 as the dielectric substrate and 0.5 ounce (17 microns) copper. Circular patterns of approximately 5 mm diameter have been removed using a single diagonal lines approach at various laser parameters. Images were obtained under an x50 light microscope



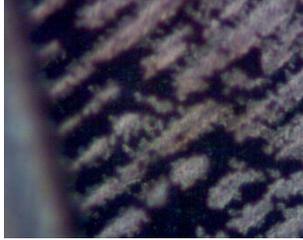
**Results:** The array of parameters used permitted for thinning of down to 2-4 microns resolution as can be appreciated from the figures below.

Thinning (microns)	Image	Thinning (microns)	Image
2		12	
5		15	
8			

*Images of the copper surface at the border line between the bare copper and the removed area. Focus was held at the thinned height, thus the bare copper area becomes blurred as thinning is increased.*

To accomplish copper removal, one must consider that FR4 is a composite material composed of woven fiberglass cloth with an epoxy resin. Hence the viewed image manifests

mainly the fiberglass backbone of the dielectric substrate. Moreover, FR4 is substantially less resilient to ablation than copper. Hence, setting the laser parameters for micron-level resolution is a tougher mission.

Result	Image	Thinning (microns)	Image
Under-removal (focus=15 micron below bare copper)		High-removal (focus=55 micron)	
Optimal-removal (focus=25 micron)		Over-removal (focus=110 micron)	

**Discussion:** Pico laser technology permits for high and repetitive XY resolution due to its small focal spot (approx. 20 microns diameter). Hence, applying the technology to the PCB manufacturing process permits achieving fine and accurate line/space values. The current report exemplifies that both total and partial conductors ablation is generally achievable upon request. Of course, the technology is only now emerging, and **results are may change under mass-production. Moreover, the results were obtained** on small samples. On larger samples, thinning resolution may be limited by mechanical system limitations (e.g. raw-material flatness, vacuum holding).

**Conclusions:** Copper thinning can be accomplished by pico-laser technology, down to 2-4 micron resolution on small samples. Copper total stripping is harder to obtain at such high resolution due to the nature of the FR4 substrate.