

Productronica 2001: An end to the puddling effect!!

Wet process specialist PILL with new etching system

The trend towards electronic terminals of ever diminishing size featuring smaller and smaller circuit boards for enhanced user convenience poses a major challenge to PCB manufacturers. Increasing miniaturization of circuit boards necessitates the use of ever thinner base materials, finer conductors and gaps, whose production calls for ingeniously engineered etching methods and sophisticated conveyor systems. These new requirements serve to further highlight the existing drawbacks inherent in the use of conveyORIZED horizontal production lines. The etching results achieved on the top side of the circuit board differ substantially from those achieved on the bottom side. The insufficient exchange of etching solution, particularly in the centre of the board, results in what has come to be known as the "puddling" effect. The etching solution drains away only slowly, forming puddles which hinder achievement of an optimum etching effect and leave behind copper residues. A totally new etching module developed by PILL eliminates the root causes of puddling, resulting in equal etching results on the top and bottom side of the PCB with only a single pass through the etching chamber.

Every PCB manufacturer making use of conveyORIZED lines in the wet chemical processing steps will have experienced the problem of puddling. Due to the nature, the etching solution is unable to drain away as quickly at the centre of the upper board side as it does at the corners or underneath. The poor drainage problem is exacerbated by complex panel guidance systems designed to convey ever thinner laminates and inner layers, which also encourage fluid build-up. The result is a minimal exchange of etchant, fresh etchant is unable to gain



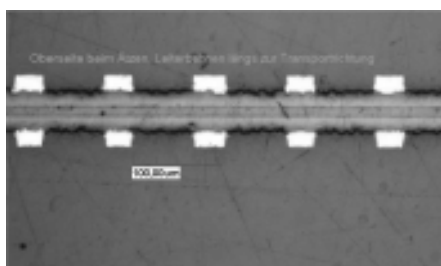
a look into the etch chamber

access to the copper surface, and the targeted etching result is not achieved. Furthermore, the conveyor wheels or guide bars of transport systems cause a shadow in the spray jet of the nozzle which additionally impedes the achievement of optimum etching results.

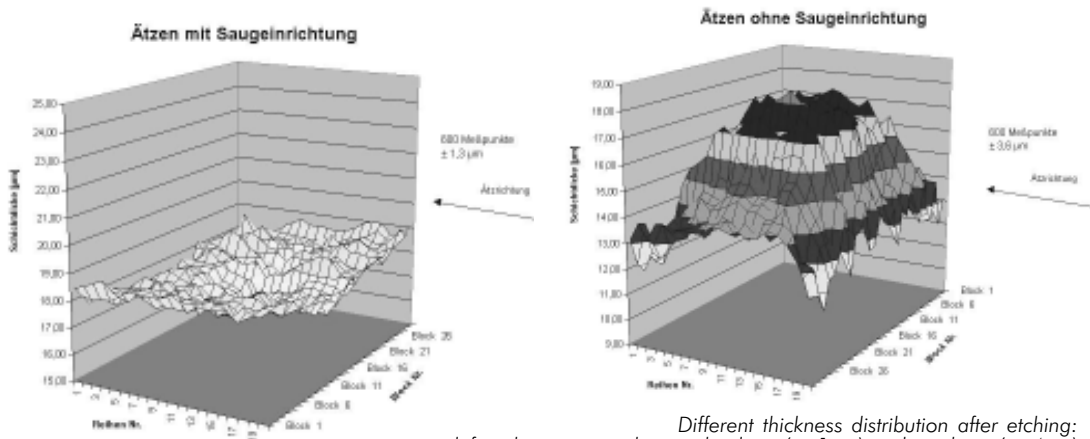
The procedure adopted to date has been to correct the problems by reworking. The poorly etched surface is detected by optoelectronic sensors. In a re-etching module, only the nozzles positioned above the problem areas which still demonstrate residues of copper are activated. The required results are then achieved by targeted correction. Although the final results achieved are good, this type of

re-touch operation involves a whole range of drawbacks: It is exacting work involving time-consuming adjustment processes, is susceptible to faults, and extends not only the length of the etching equipment but also the necessary production time.

The development engineers at PILL in Auenwald near Stuttgart in Southwest Germany have come up with a totally new method of achieving identical, uniform etching results. The technique is based on preventing the occurrence of puddling. By continuous extraction of the etching solution on the panel surface directly following the etching processes between the spray bars, space is conti-



Equal etching results on both the upper and lower surfaces (left), small undercuts and high etch factors after etching (right)



Different thickness distribution after etching: left with vacuum-etching-technology ($\pm 1\mu\text{m}$), right without ($\pm 4\mu\text{m}$)

uously created for the application of replenished solution. In this way, the conditions naturally created on the bottom side of the board due to gravity are simulated on the top side. An extraction pipe mounted between each of the spray bars extracts the etchant from the surface and feeds it back to the machine's sump. This suction effect replaces the immediate "drainage" of the etchant as it drips from the bottom side of the board. The necessary vacuum is created by venturi nozzles in the pressure pipe of a separate circuit. This system ensures that the extraction of air alongside the etchant is able to take without problems.

To prevent unwanted etching results in the spray shadow cast by conveyor wheels or guide bars, the engineers at Pill arranged the upper spray bars in staggered formation relative to the lower bars, and interrupted the guidance system in their respective spray zones. Interruption of the guidance system was made possible by the fact that the unilateral spray pressure exerted on the surface due to the staggered formation of the spray bars prevents flexible materials or inner layers straying from the set path. PILL offers the so-called Flex system, which permits reliable transport of even the thinnest films and laminates, in a number of version categories. The highest category (Flex 15) allows reliable transport of films and base materials with a thickness of only $50\ \mu\text{m}$, also using the Vacu-Etch technique.

The results, which have been confirmed by a series of exhaustive tests, are certainly impressive. The etching results on the top PCB side are identical in terms of evenness between the edge areas of the

board and the centre without the need for reworking, even when using a conveyor system designed for laminates of only $50\ \mu\text{m}$ in thickness. The difference in the etching result on the top and bottom side of the board is negligible. This technique eliminates the need for separate pressure adjustment for individual spray bars and oscillation of the entire spray manifold to achieve equivalent results.

The inventive engineering team in Auenwald also gave thought to the fact that even the latest technology requires occasional servicing. As a result, not only the spray bars and extraction pipes but also the entire conveyor insert can be completely removed without the need to use

tools, allowing them to be cleaned, dismantled or repaired and exchanged as required outside of the machine. To remove the individual spray bars, all that is needed is to open a small cross-section in the front of the module. The module's exhaust air system can remain operational while inspecting the nozzles. Because the lid of the etching chamber lifts upwards in keeping with

the customary Pill design, helping to circumvent the leakage problem frequently encountered in modules with a "front door", it does not even need to be opened for the inspection of nozzles. Vapours released when the etching chamber is opened at operating temperature are avoided, meaning that the etching process only needs to be briefly interrupted without the need to wait for the etching solution to cool down. PILL will be presenting this world innovation to the public for the first time at the Productronica in Munich.

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