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The Future of Electronics Manufacturing

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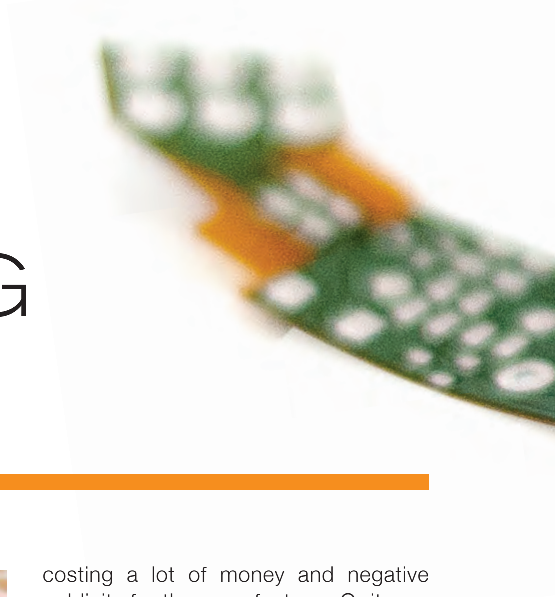


THE SOLUTION TO FPCBs DEPANELING

BY GIULIANO GALLIZIO, SALES MANAGER, OSAI AUTOMATION SYSTEMS

A study by UCLA in 2013, relating to the USA market, reports that:

"The global flexible electronics market is expected to grow at a projected CAGR of 39% to reach $17.6B in 2018 from $1.76B in 2011. The flex circuit market is primarily driven by the demand for smaller and lighter products, especially in the consumer electronics segment with the projected introduction of flexible tablets in 2014-2015. In North America, key applications for flex circuits are consumer electronics, military, healthcare and energy."

There are many factors that are critical to the production of FPCBs, one of which is the mechanical separation (depaneling) of the assembled boards from the frame at the end of the assembly line. This operation is always needed and there are different ways to achieve it - manually by an operator, mechanically using a mold or punch or by laser.

Manual separation is used when the number of the boards is very low and there is no need for high accuracy. The operator has to take care of the quality of the boards and with all the related problems that can occur.

Mechanical separation is probably the most common way to separate FPCBs but there are many risks linked to this way of depanelisation including accuracy of the cut, cracks, component damage, dust and contamination.

The mechanical depaneling of flex circuits is normally made by punching, using presses and dedicated molds. This technology cannot compensate for the dimensional tolerances always present in FPCBs, due to the material manufacturing tolerances, resulting in poor cutting accuracy and potential rejects. Another problem related to punching is the possibility to cause cracks in the components near to the edge of the board; these cracks may not be so evident as to be detected in the final tests but they can create functional problems during the lifetime of the device. If this problem often occurs, a replacement of product in the field can be requested by the customer, costing a lot of money and negative publicity for the manufacturer. Or it may be said that this is a design-related issue and should be laid at the door of the Design Authority. Depaneling can also cause delamination of the FPCB, creating weak points in the board. This is unacceptable for markets such as medical, aerospace and defense, where quality is an absolute priority.

The global market trend, related to this kind of product, is to have high mix/low volumes; mechanical punching can be extremely expensive because of the cost of production and the maintenance of the molds. So it does not fit well with this changing market. Also the time needed from project conception of a FPCB to its realization can also be adversely affected using punching because of the need for complicated molds, normally outsourced by the FPCBs producers. A "just in time" delivery is required more and more as to wait weeks before receiving a prototype is no longer practical or affordable in today's industry, as fast tracking these parts is very expensive, if it is possible.

The UCLA study goes on to state:

"Traditional depaneling methods introduce stress onto the board, which can damage both the board as well as the surface mounted components, such as semiconducting chips. See Figure 3 below for a photo of a cracked chip from stresses on a board. Interviews with industry experts discovered that laser depaneling is ideal for PCBs less than ~1-1.6mm thick, especially flexible PCBs, due to the stress from mechanical depaneling methods."

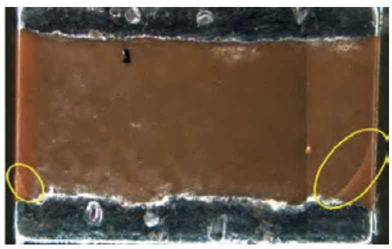
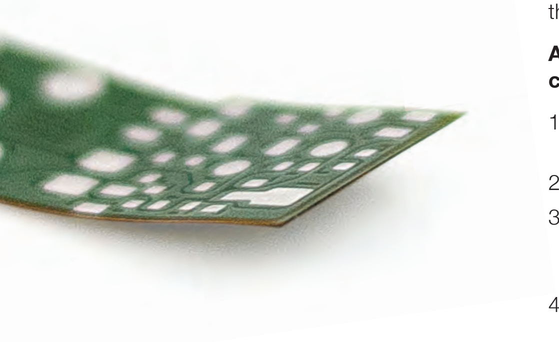


Fig 3



It's becoming more common to use laser depaneling, thanks to the benefits that this technology can offer in terms of cycle time, quality of the cut edges, dimensional accuracy of the cutting and the high flexibility that a laser cut can offer.

"TRADITIONAL DEPANELING METHODS INTRODUCE STRESS ONTO THE BOARD, WHICH CAN DAMAGE BOTH THE BOARD AS WELL AS THE SURFACE MOUNTED COMPONENTS, SUCH AS SEMICONDUCTING CHIPS

The final considerations of UCLA study reports that:

"Miniaturization refers to the growing trend to produce smaller, more compact electronics. Consider the difference in design of a board made to fit into a server main frame versus the board made to fit into an iPod Mini. This focus on making items smaller has resulted in the growth of flexible circuit boards to adjust to tight spaces, hinges, or the need for curves in product configurations. It has also resulted in tighter tolerances and smaller spacing to cut the board after component placement.

The resulting increase in flexible circuit boards and requirement for tighter tolerances thus presents an opportunity for greater demand in laser depaneling machines, which are capable of handling these delicate boards and making very precise cuts."

The best laser source for FPCBs depaneling is the UV (355nm wavelength), in combination with a processing head equipped with galvanometric mirrors (galvo head). The combination of this laser and this head permits cuts using multiple passes, without moving either the parts or the laser.

A good laser router with this source can offer the following benefits:

1. Clean process avoiding powders, burs and contamination
2. High cutting accuracy
3. 30 to 70 µm of cutting width, permitting safe component placement close to the edge of the board
4. Few microns of HAZ (Heat Affected Zone)
5. Zero mechanical stress (contactless depaneling)
6. Zero carbonization
7. Zero delamination
8. The recipes can be easily created starting from a dxf file, or directly on the machine using a camera
9. The time needed to create a new recipe is less than half an hour
10. The laser parameters can be automatically adjusted to always have the best cutting quality and speed
11. The interface with the testing machine can allow cutting of only good parts, avoiding processing panels that would ultimately be scrapped
12. The machine can recognize bad PCBs (red label) and skip them avoiding the issue above
13. ID matrix reader should be included in the base machine, for traceability
14. Depending on the laser power, it's possible to cut even FR4, with a thickness up to 1mm, opening up the rigid market to this technology

A CO_2 laser is sometimes used for cutting FPCBs, due to the lower cost of this technology compared to a UV laser.

In this case the processing head is not a galvo but a cutting one; the parts (or the laser) have to be moved and the cut is performed in a single pass. This technique generates more heat on the parts producing high carbonization, dust, powders and a large HAZ (Heat Affected Zone).

"A CO_2 LASER IS SOMETIMES USED FOR CUTTING FPCBS, DUE TO THE LOWER COST OF THIS TECHNOLOGY COMPARED TO A UV LASER

The conclusion is that UV Laser depaneling will become more and more common in FPCBs industry, due to all the benefits that this technology can offer compared to the alternatives. ■