Flexible PCBs: leading the charge into the second century of electronics

The first PCBs (printed circuit boards) date back to the 1920s, when they were used in wirelesses (radios) and gramophones; however, they looked very different from the highly-engineered boards with which we're now familiar. The late 1940s saw the production of the first double sided board with plated through holes, followed a decade later by the first 4-layer boards. Since then, PCBs have continued to evolve, reducing in both size and cost, while increasing in capability and complexity. As ***Zandra Forder, Production & Quality Manager at electronics manufacturer, Newbury Electronics*** *explains, we're now at the start of the next significant evolutionary step for PCBs: growing demand for, and greater understanding of, flexible PCBs.*

As the name suggests, flexible PCBs are flexible circuit boards, which can be used to join rigid PCBs together. A further development of this is the flexi-rigid PCB, which is a single item consisting of two or more rigid PCBs, joined permanently together by flexible PCBs. This has the benefit that no assembly between flex and rigid PCBs is necessary and the item will come ready tested. When designed and manufactured to optimum levels flex circuits can offer significant benefits, including greater ductility, improved reliability, low mass and space saving.

In wearable technology – whether that's a medical monitoring system, specialist clothing to help athletes to warm up their muscles, or smart clothing entertainment solutions, the unique capabilities of flexible PCBs offer obvious advantages and benefits.

The correct utilisation of a flexi circuit board may offer the optimum solutions for difficult, limited space conditions. One very simple and early application of flexi board technology, that many will be familiar with, are the PCBs in the head of a printer, where the head moves while printing, but remains connected to the micro-processor board – the brains of the printer.

As the demand for anything and everything to be connected to the IoT continues to grow, and with the collection and understanding of data seen by many as the way forward for many businesses, PCBs, both rigid and flex, are key components in many new products coming to market across a vast range of industries and sectors.

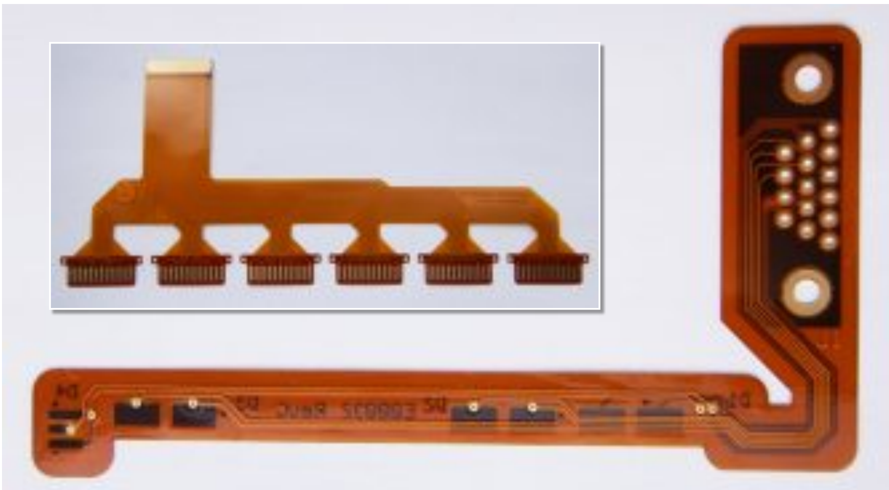
There are two areas in particular where the unique capabilities of flexi boards have an obvious benefit. The first of these is in wearable technology, be that a medical monitoring system that is being worn for 24 hours, or specialist clothing that helps athletes to warm up their muscles, to smart clothing and entertainment solutions. The key factors in any of these products are the light weight of the flex board, coupled with its ability to move in-line with the contours of the body, and to accommodate constant, but varying levels of movement without compromising its performance. These capabilities have also been recognised in the military and defence sector, where light weight, tolerance to movement and resistance to vibration, along with a high level of performance and reliability, are key requisites in the latest combat technology.

It is not easy, however, to manufacture boards of such complexity. Only manufacturers with the latest drilling and profiling technology will be able to produce a board that is typically 25 microns thick and may have holes measuring only 50 microns in diameter, rather than the 150 microns, which is typically the smallest hole that can be mechanically drilled. Obviously, work at such a small scale can no longer be inspected manually, so automatic optical inspection (AOI) is the only way to ensure the highest quality of engineering.

But, the challenge of flexi boards is not all down to manufacturing. Product designers and engineers need to educate themselves and have a better understanding of not only the capabilities, but also the restrictions of this new approach. One can't just take your product to the next level by replacing your proven rigid PCB with a similarly configured flexi board. Equally, some designers are going to the other extreme, and are either trying to make things far too complicated, or don't really understand what it is that they need. In this case, talking with a PCB manufacturer who has experience of other designs, and the manufacturing options and constraints, can be very valuable.

One significant difference between rigid and flexi boards is the use of different materials for the coverlay (the flexible equivalent of the rigid board's solder mask). In a traditional rigid PCB, an ink is used to provide the coating (solder mask), which is usually green. This, however, is not suitable for a flexible PCB, as it is liable to crack when flexed due to its brittle nature. As a result, manufacturers are using flexible polyimide with an adhesive as the coverlay, which, while less susceptible to cracking than the traditional solder mask, provides its own challenge in terms of accuracy of application. Flexible inks are also available, but are not as robust as the bonded polyimide coverlay. Manufacturers will need to develop methods to produce not only flexible PCBs, but also flex-rigid PCBs, which have rigid PCBs (with surface mount components) integrated with flexible PCBs, which offer further manufacturing challenges.

As AI, the IoT and other technological advances across all sectors take us into what many are calling the fourth industrial revolution, there is no doubt that the continued advancement and development of electronics and its key components is going to be critical to delivering the new solutions. Those earlier pioneers who set us on this path one hundred years ago may not have even imagined many of the advancements that we already take for granted. But one thing is certain: with new developments like the flexi board just on the cusp of acceptance and understanding, there is a lot more innovation and excitement to come in the second century of electronics…



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