A quick and easy way to make printed circuit boards

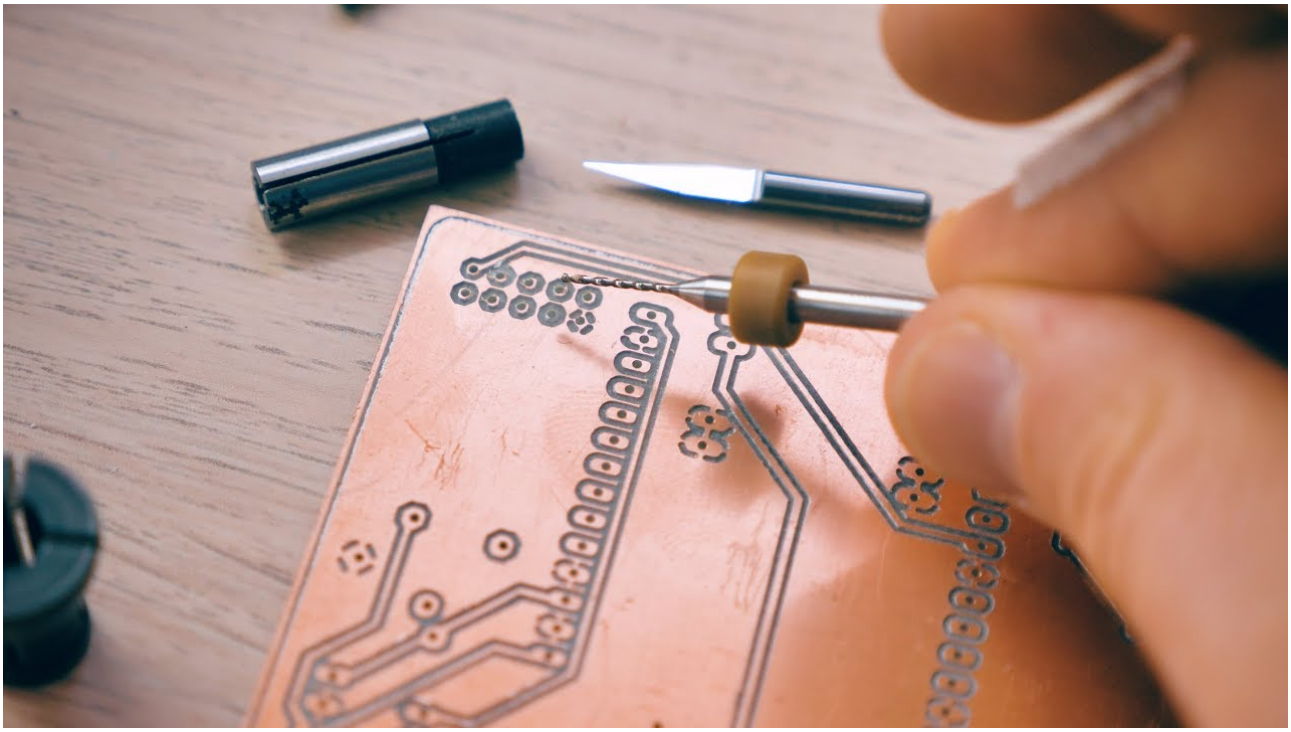
Henry Chamberlain
ZS1AAZ

I know you have probably heard this before, and it is true that there are several ways to make PC boards, and I have probably tried all of them but kept looking for a method that involved the least amount of effort and time.

The quickest method is probably doing Isolation Milling. This means that you must invest in a Computer Numerical Controlled machine, CNC for short. Many people nowadays buy lazer engraving machines, or 3D printers, and these machines all have one thing in common, they have a platform that, under computer control, can move in three dimensions, forward and backward, form side to side, and up and down.

Now you can mount three different tools on that platform, a lazer, a 3D printing head, or a high speed drill with milling bits so you can engrave on soft materials like wood or plastic. There are CNC machines available that have all three tools fitted.

The high speed drilling tool can be fitted with a wedge shaped bit with a sharp point spinning at high speed with which you can mill a groove around the tracks on a PC board, thus isolating them from surrounding tracks and components. There are many videos on Youtube on this subject, this is just one of them:



So one day I bought a CNC machine and started experimenting with it. It was the cheapest machine I had seen and Chinese made. Make no mistake, Chinese equipment can be very good quality and generally the one I bought was good quality except for the high speed motor. It tended to vibrate at certain speeds, parts of the machine would resonate with it and then errors would creep in with the positioning of the platform holding the drill.

And about a month after I bought it, it stopped working, a diode on the electronic board had blown. I contacted the agents, they said they would supply a new board which never appeared.

I am used to making PC boards so I decided to make my own, the controlling part is Arduino and I was used to working with that system. I included a speed control for the motor so I could avoid the speeds at which other parts of the machine resonated. Eventually I found that the clamp that clamps the milling bit in the motor, was the offending component. There was no way I could fix that, so eventually I bought a Dremel Stylo and fixed that to the platform. It can run at 22000 RPM and is very quiet with no vibration.

I made a few boards using the isolation milling method but did not like the end result much. It is easy to have solder bridges across the narrow gaps, and it is till a bit noisy.

Then I saw a video where someone covered a blank PC board with a plastic sheet with adhesive on one side, and used a lazer to do isolation milling. The program that I use to design PC boards is called Sprint Layout and it can do isolation milling. There are probably many others that can do the same. I had once bought some plastic that is apparently used to make logos and advertisements that are stuck on commercial vehicles. I could print on it with my lazer printer and stick them on front panels of instruments that I had made. I bought it at a company that sells all kinds of plastics.

I had to work out a method for applying it to pc board without trapping air bubbles underneath but that I sorted out. I then produced a file from my layout program that I would use to control the lazer in my CNC machine and after a little practice, I had a workable method. The end result is not as good as a board made with photographic methods, but it is very close to it.

So now the procedure is to design the board using Sprint, then produce two files with Sprint, one to drill holes in the board using the Dremel tool, and an isolation milling file to use with the laser. Both files need further processing to put them into the right format to use in the CNC machine, but it takes only a minute or two.

I cut the pcb blank to the right size, cover it with plastic and use double sided tape to stick it to the CNC table to keep it steady while all the work is being done.

First the lazer cuts the outlines of the tracks, but just through the plastic without affecting the copper underneath. I estimate that the width is about 0,3mm wide. When that is finished, the Dremel drills the holes, unfortunately just one size at a time. When that is done, I remove the board and remove the double sided tape on the back. Then I peel off all the plastic to expose all the copper that has to be removed. This takes few minutes but is an easy job. There are remnants of the adhesive of the plastic and this is dissolved away with thinners. This is done with care although the plastic can take quite a bit of handling. Practice makes perfect.

The last step is to etch the board in a mixture of hydrogen peroxide and hydrochloric acid mixed with water. 100 parts water, 30 parts each acid and peroxide. I buy the chemicals at a hardware shop, they are used for swimming pools.

Then I peel off the remaining plastic and clean the board using some more thinners. Work in a well ventilated place. Here is a picture of such a board:

I am an experimenter and I dislike using breadboards, so when I want to try something new, I quickly design a board and make it and populate it, all in a couple of hours. There are such boards scattered around my workplace!