Toner Transfer PCB Fabrication with Press-n-Peel Blue

Contributed by Evan
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This tutorial is intended to cover the creation of a single-sided PCB based on an existing layout. For information about creating a layout, you should seek tutorials elsewhere. I regularly use this method and have great success, easily handling traces 10 mils wide, surface-mount parts, etc.

Etching

Print the pattern on the full side of the Press-N-Peel. To make the sheet last as long as possible, I print on a piece of plain paper, then cut out a piece of PnP to the right size and tape it onto the printout, dull side up, using scotch (clear) tape. Then I print again, this time the pattern is printed onto the piece of PnP. Setting your laser printer to its darkest setting will get more toner on there, which can help if you have adhesion problems, but in general with PnP I find it's not all that necessary. It is important to trim the edges of the PnP quite close to the edges of the pattern - during ironing, the free edges of the pattern will tend to warp and can cause adhesion problems with traces near the ege.
A pattern printed onto a piece of Press-n-Peel, taped onto the original printout
(this picture is an older one, not the same board as in the rest of this tutorial)

1) Cut the board to size. I use a mini table saw with a 4" carbide-toothed saw blade that cuts PCB like butter.
http://www.harborfreight.com/cpi/ctaf/displayitem.taf?Itemnumber=93211

2) File the edges. Cutting tends to leave raised copper on the edges, and that keeps your iron from sitting perfectly flat on the surface, which often results in areas that don't transfer well. A quick pass with a fine-toothed metal file (or even a piece of sandpaper) will take care of it.
Properly filed edges

3) Clean and polish the board. Copper likes to oxidize, and gets especially nasty looking when you get fingerprints on it, and it's important to have a nice, clean, even copper surface for toner transfer. Using a scotch-brite pad is the easiest and most effective way I've found to do it - it does a great job cleaning up the copper, without making the surface uneven. Spend a couple minutes on it, so it's evenly scoured.
Polished board

4) Clean off the dust from scouring. This is an important step that's easily overlooked; when the board is scoured, it looks pretty clean and shiny, so it's easy to assume that it's clean enough. Take a paper towel, pour some rubbing alcohol on it, and wipe it over the board; you get a bunch of dark dust off of it. Keep exposing clean sections of paper towel and wiping until the paper towel is clean after wiping.
Cleaning the board

5) Heat up the iron; the Press-n-Peel site says 275-325 degrees F, I tend to agree. On my iron that's about 3/4 of the way up (around the "wool" or "cotton" settings; I used a small IR thermometer to double check, just to find a good setting to use. If you don't have one, just try a similar setting. It's tempting to turn the heat all the way up, but if it's too high it sometimes makes the toner smear, affecting the quality of your pattern. It can also have adverse effects on the plastic backing of the PnP.

6) Start ironing the pattern. I tend to lay the pattern face-up on a piece of paper and carefully place the board face-down on top of it, and then put the iron on it for 30 seconds or so to get it adhered.

7) Flip the board over, and do the real ironing. This is one quite interesting part of the process -the idea came from the Pulsar website. Rather than ironing the board against a flat surface, place the board face-up on a wooden dowel, or something similar - here I'm using a large drill bit, of all things. Place a piece of plain paper over the board, just to protect the film in case the iron slides around a bit. Then, just place the iron on top and roll back and forth, making sure to cover every part of the board. The benefit of this method is that rather than a relatively low force across the whole board, you get a concentrated pressure point at the 'roller', somewhat like using a laminator. It results in very even and high-quality transfers, in my experience.
Before and after ironing. A bit hard to see in the picture, but the thickness of the toner will make the traces appear raised on the back of the pattern, an indication of how much pressure was applied8) Cool the board. The easiest way is with cold water, either dunk it in a container or run it under the tap. 9) Peel the pattern off. Start at a corner, go slowly, and be gentle. As long as you do a good job in the rest of the process, the pattern nearly always comes off very easily without lifting any traces. If you start to peel it and see some lifted traces, lay it back down and try ironing again. If you see areas

where the blue backing stuck to the board where it shouldn't have, you can take a piece of tape, stick it down, and peel it back, to pull it off, or just carefully scrape it with a knife, being careful not to damage any traces. Another nice thing about PnP is that by looking at the peeled-off backing you can very easily see any spots that didn't transfer perfectly - easier than looking at the board itself. You can touch up any remaining lifted or broken traces with a fine-tip Sharpie marker.
Transferred pattern, and peeled-off backing
10) Etch the board. There are plenty of ways to go about this, I may go into more detail later, but use whatever etchant/method works best for you. I use a homemade etching tank , with heater and bubbler, with sodium persulphate etching solution, which etches in just a few minutes. Be careful not to let the board stay in the etchant once it's done etching, to minimize undesired etching under the edges of the pattern - this is especially important when using narrow traces.
Board during etching

11) Remove the etch resist pattern. Some people do this by scrubbing it off with sandpaper/steel wool/etc, but I prefer to just use a solvent. Lacquer thinner strips the toner off instantly with a quick wipe, the downside being that the fumes are very strong.
Lacquer thinnerSo, now you've got a fully etched PCB. If it uses through-hole components, it's time to move on to drilling.

Never mind the copper strips by the two left holes, that's just from the thread I used to hang the board in the etching tank...Drilling The drilling process is pretty straightforward, you just need the right tools. I use a Dremel drill press attachment with carbide PCB drill bits. Dremel has produced a number of different versions of their drill press attachments over the years, and some are VERY bad for PCB drilling due to slop in the mechanism. If you choose to buy one, select carefully and be sure to buy from a place that lets you return it if it turns out to be junk. To be safe, I would highly recommend the PZ541 Vertical Drill Stand from minicrafttools.com which is solid metal, uses a quality rack-and-pinion mechanism, holds standard Dremel tools (and similar), and does a great job for PCB drilling.Some people use small steel wire drill bits which dull extremely quickly in the fiberglass of PCBs. I HIGHLY recommend the use of solid carbide PCB drill bits - they pretty much never get dull (at least on the time scale of hobbyist use), are easier to work with, and do a very good job drilling. The downsides being that they are brittle, so you need to be careful and use a drill press without too much slop - and they can be somewhat expensive. However, you can always find used, resharpened carbide PCB drill bits at surplus stores or on ebay, for very reasonable prices, often cheaper than wire drill bits. I probably have $40 invested in my bits, but I have a large collection with every size I could need, and enough to last me for many years.It's very important to run PCB drill bits at high speed. The speed at which the cutting edges move along the circumference of the bit is of course proportional to the diameter of the bit, and the speed - thus the smaller the bit, the higher you should be spinning it. Commercial PCB drills often spin the bits in excess of 100,000 RPM's. In comparison, a standard household drill press can usually only achieve a speed of a few thousand RPM's. Dremels are great for this purpose because they can reach speeds of 30,000 RPM or more - it's still not as fast as the bits should be run, but it's still a big improvement. Because Dremels are loud, you probably won't want to run it at full speed, but at least try to run it as fast as you can stand - I generally go with about 1/2 to 2/3 speed.
Drilling setup, with a small focused light I use made out of three high-brightness white LEDs... No, they're not that blindingly bright in person
Once you're done drilling, triple-check to make sure you didn't miss any holes - it's not so easy to fix once there are components on the board. My preferred method is to simply hold the board up to a bright light, this tends to make missed holes quite obvious.And there you have it, a finished single-sided printed circuit board!