5pcb

by **vincent** on August 23, 2005

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intro: 5pcb

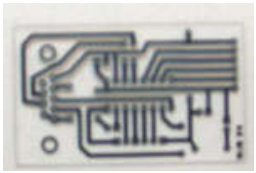
A simple 5-step process to etch your own printed circuit boards at home.

You'll need the following ingredients:

- laser printer/photocopier & transparencies (I go to a print shop to do this)
- copper board (local electronics store)
- scrubbing pads (SOS or a generic brand is perfect)
- iron
- rubber gloves (like the ones you use for washing dishes)
- Ferric Chloride or Ammonium Persulphate (local electronics store)
- drill and drill bits

step 1: Design and print

Design your PCB. I use anything from Adobe Illustrator to Cadsoft Eagle. Once you think everything is perfect, print it on a piece of paper and test it by placing your components over it. You have to 'flip horizontal' your final design so that the transfer from the transparency to the copper board 'restores' the intended design... Then print it on a transparency. It has to be a laser printer or a photocopier because we want toner on the transparency. If you can, ask the guy at the print shop to make it as dark as possible (more toner). I've noticed that I've had the best results at the worst print shops in town.

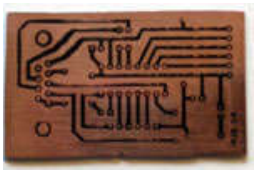


step 2: Transfer the toner

Now you want to transfer the toner (mostly made of molten plastic) onto the copper board. Set the iron to 'silk' (you'll have to experiement with the temperature...it took me quite a while to consistently get good results).

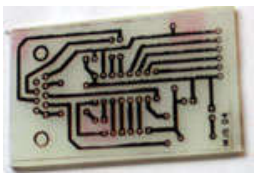
Clean and rinse the board with the scrubbing pads and soap. Dry it up. Place the transparency on the copper board, place a piece of paper on top if it all and start ironing! Depending on the size of your circuit, it takes about 2-3 minutes for the copper board to get hot enough so the toner sticks to it. When you think you're good, immerse the copper board (with the transparency stuck to it) in cold water. Then you should be able to peel off the transparency while the toner remains on the copper board.

If the toner did not transfer completely, you didn't iron long enough and/or didn't set the temperature high enough. If the toner transfered but is smudged on the copper board, the temperature was too high and/or you ironed for too long. You can use a Sharpie or any other permanent marker to fix parts of the circuit that did not transfer properly.



step 3: Etch

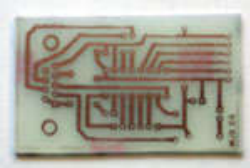
You're almost done. Put the gloves on, pour some etchant in a plastic or glass container and immerse the board. At room temperature, it can take up to half an hour. Mixing the solution as it's etching can speed up the process. Another good way to dramatically decrease the etching time is to warm up the solution. Now I strongly discourage you to get creative with the microwave or your precious pots and pans. You can however dip the container in warm water poured from the tap. When it looks good, clean the board in running water.



step 4: Clean

Use the scrubbing pads to remove the toner from the board.

You can reuse the etching solution, so just pour it back in the original container. Do not pour it down the drain! It will corrode your copper pipes... Over time, the etching process will take longer and longer. When the solution becomes unusable, contact the waste management organisation in your community to know where to dispose of the chemical.



step 5: Drill

For those of you who do not use surface mount components, you'll need to drill holes in your board. I use a Dremel (you can find generic versions for less than 40$). You'll need tiny drill bits (#66-#60). Most places you'll go to will rip you off with those tiny precise bits (10-15$ each). However, some places like Lee Valley sells them for ~$0.50 each.

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navysealltblue says: Feb 6, 2009. 9:15 PM REPLY

I guess, I don't quite understand this process. Any help with understanding it, would be greatly appreciated.

So you basically start off by transfering toner onto the board so that the traces that you want to stay don't get corroded when you "etch." That leaves you with copper traces, and the rest of the copper has changed to be non conductive. When you clean off the toner, it leaves just the copper traces, The thing that I feel like I am missing is the core of the sheet of metal. Isn't it all still conductive copper? So what keeps the current just on these traces that you see? And if you drill through the board, the same issue, isn't that patching all the connections to the raw copper on the inside?

Thanks for the help with understanding this all.

trialex says: Mar 5, 2009. 8:27 PM REPLY

No - it's NOT a sheet of conductive metal.

The initial product is a sheet of fibreglass, whith a thin layer of copper bonded on top.

You put your toner where you want the copper to remain - the rest of it gets eaten away by the etchant.

Cleaning off the toner then just exposes the remaining copper to make it easier to solder.

There is no copper "inside" the board - you drill through fibreglass.

circuitpeople says: Jul 11, 2008. 4:23 PM **REPLY**

If you need a way to print gerber files for your PCB, check out http://www.circuitpeople.com. You can upload the gerbers and download high-resolution PNG images suitable for printing, etc.

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praetorious says: Apr 22, 2008. 4:57 PM **REPLY**

If i was making a single sided board (traces on bottom), would i have to mirror the image before printing, or could i leave it as it is?

technogumbo says: Apr 23, 2008. 8:26 AM **REPLY**

Yeah, you have to mirror the image if you are using the iron on method

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praetorious says: Apr 23, 2008. 4:41 PM **REPLY**

Thanks! Are you sure though, surfing around, some people say for toner transfer with eagle on the bottom layer you don't mirror,because you are actually lookin through the board, and that you only mirror the top. Oh well, i have no idea, I will mirror the board and see if the text comes out right, if it doesn'y, i will clean and leave it as is.
Thanks!

technogumbo says: Apr 24, 2008. 1:51 PM **REPLY**

I think you do leave it as is. I'm sorry as I didn't understand your first question. I assumed you just wanted to make a single side board.

So if I now understand your question; I *dont* think you need to mirror it. Sorry for any confusion.

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praetorious says: Apr 24, 2008. 4:03 PM **REPLY**

Thanks man, i thought you didn't need to mirror it. No, no you didn't confuse me, actually it just aided in the logical thought process. Thanks, i think ill go make that board now

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dirtysanchez says: Mar 5, 2008. 7:21 PM **REPLY**

I was wondering where you get your copper clad board (the pcb board). I usually use one from MG chemicals (the postive photoresist). Your board seems to be very translucent and cool.

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vincent says: Mar 12, 2008. 6:18 PM **REPLY**

got that a looooong time ago when i lived in vancouver at some electronics surplus store. i really dont remember the name of the place... i now get my stuff from VPC http://www.vpcinc.com/ a reseller for MegaUK http://www.megauk.com/pcb_laminates.php. or have my circuits made at GoldPhoenix http://www.goldphoenixpcb.biz/special_price.php.
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joe57005 says: Mar 12, 2008. 5:03 PM **REPLY**

i'd rather use electrolysis than 'harsh' chemicals, besides, i don't think it'd be easy to dispose of ferric chloride in my area. (might copper plate some stuff at the same time too!)

jshroomy says: Feb 5, 2008. 8:04 AM **REPLY**

I've messed w/ lots of different papers, and transparencies etc... I've started exclusively using magazine pages now. Works better than anything I've used thusfar.

stasterisk says: Jan 23, 2008. 1:50 PM **REPLY**

I got HUGELY improved results by heating up the copper before setting the transparency on it. Much improved transfer.

Also, if you're panelizing, I've discovered that using a shear to break the boards apart is the best way to go - the glass part of fiberglass will dull the blade of a bandsaw in no time.

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abdulrauf says: Mar 21, 2006. 10:11 PM **REPLY**

i find your site brief and nice i just wana add one thing in the process of toner transfer that insted of using transparency to transfer your pcb ,you should use back of the sticker ...it works amazing, at least for me. it doubles the amount of toner transfered . thanks.

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funlw65 says: Sep 6, 2007. 5:31 PM **REPLY**

More info on this? Please! Thank you!

VIRON says: Jan 27, 2007. 5:12 PM **REPLY**

Although I haven't tried it, I hope you mean the paper that stickers come on (and off of), but either way it would be not funny if stickers got stuck in the machine.

Rolf says: Jul 5, 2006. 1:16 PM **REPLY**

Please explain in a little more detail what you are talking about.

lifelong-newbie says: Apr 1, 2008. 1:04 PM **REPLY**

It sounds like he means backing paper from sticker paper sheets. this kinda makes sense, it's surface type makes it sound like a good plan

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lacrosseislife24 says: Mar 27, 2007. 5:50 PM **REPLY**

This is great!
ive been trying to find a way to get circuit boards without paying 40$ for a 2x3 in chip.

VIRON says: Jan 30, 2007. 6:24 PM **REPLY**

Using transparencies this method worked so well I made 2 copies of a circuit board and both of the board copies were done and working with parts on them in just two or three hours.
Excellent!
This is the new way of making boards for me!

offlogic says: Jul 17, 2006. 9:12 PM **REPLY**

The local "Ace hardware" carries itty-bits in onsies down to #63, with a small set for a few bucks (near the welding stuff) down to #68. FYI

offlogic says: Jul 17, 2006. 9:09 PM **REPLY**

1 part HCl + 2 parts H2O2 = "PCB Cocktail"!!!!

I keep looking for the downside to it, but it doesn't stain the sink, doesn't turn your fingers brown... what's not to love?

May smell a little funky when the acid is opened, but otherwise ferri-chloride can just go play with itself.

kurthuang says: Apr 24, 2006. 5:24 AM **REPLY**

I have another way to DIY pcb at your home.
i like the use transfer paper instead photocopier & transparencies and DIY2006 machine instead the iron ,I find the solution very good .
my website is http://www.yifucosmeticbrush.com/diypcb/English/index.asp

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jaredforshey says: Apr 5, 2006. 10:56 PM **REPLY**

I second the HCl and H2O2 mention. I purchase "Muriatic Acid" from the hardware store in a gallon jug for around 8 bucks. It's used to clean masonry, and it's basically dilute HCl.

2 parts hydrogen peroxide to 1 part muriatic acid. Get this backwards and you won't get very far into your etching! You can't do this one inside; the fumes can be bad. You don't need to heat this solution like people do with other mixtures; it gets quite warm all by itself! It takes under 5 minutes to fully etch a 3 inch square piece from a 1 ounce, one-sided copper clad board.

sarain says: Mar 21, 2006. 12:06 AM **REPLY**

Laquer Thinner works very well for removing tonner from a completed board.
Just wet a paper towel with some and rub the tonner covered traces. It should come off with little effort and in my experience it doesn't smear the tonner like some solvents such as adhesive removers and acitone.

mooseo says: Mar 15, 2006. 2:33 PM **REPLY**

Nice instructable...

I've had really good luck doing this using glossy photo paper instead of transparencies... it has the advantage that it gets soggy and falls apart in water so it is pretty easy to remove from the board. I learned how to do it, including a review of the suitability of different brands of paper, from a really useful post here:

http://www.fullnet.com/u/tomg/gooteepc.htm

zohair says: Jan 31, 2006. 3:37 AM **REPLY**

I've experimented with dilute HCl and a bit of H2o2. The HCl is sold as "drain cleaner" over here and H2o2 is available as hydrogen peroxide at any chemist. Both of which can be purchased at a local general goods store. :)
