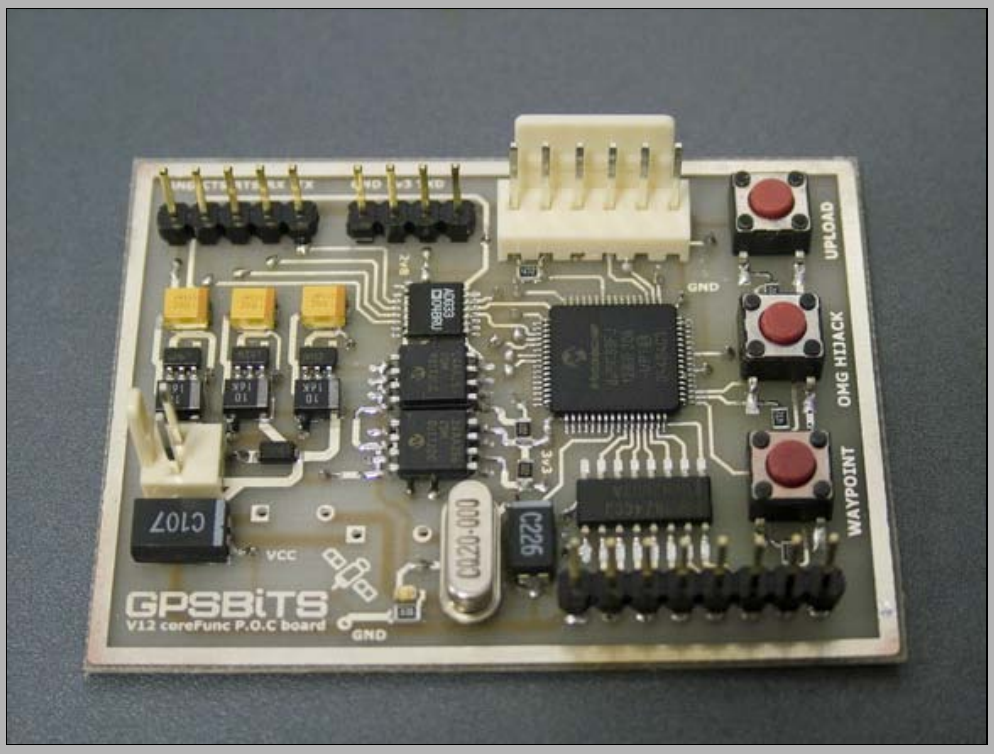
Warning: This site is under construction. Some links may cause your computer to burst into flame.

Create **High Resolution PCBs** at home!

By Ahmad Tabbouch - Thursday, July 10th 2009 @ 19:32:55 AEST

Today we'll be using our **hacked laminator** to create uber-detailed PCBs using the toner-transfer method. This article is specifically catered for use with **PulsarProFX** products (available through **US** if you're in Aussie, or **DigiKey**/**Mouser**/Etc internationally). You can, however, substitute said products for pretty much any other off-the-shelf toner transfer media such as **Press'n'Peel** (with the associated loss in quality!)



GSM/GPS processor board: A sample PCB created with this method

As always, before we begin, there are a few disclaimers we need to get out of the way (very VERY **important** information!)

- We've used this method for years and it's yielded great results, it's also **50% cheaper than Press'n'Peel**
- If you own a **BROTHER** brand printer, throw it out and buy another brand (the toner isn't re-fusable!)
- The modified laminator may pose a **FIRE HAZARD** if left unattended
- Your tie may get stuck in the laminator, leading to **death by asphyxiation** as well as **superficial burns**.
- Your printer may encounter a paper-jam, **causing a fire** if it's made in **AMERICA** (Hah! American infidels.)
- If anything else **CATCHES FIRE**, even if not listed here, we're not responsible.
- In the event there is a fire; **stop, drop and roll**

Information & pre-requisites

As I mentioned prior to the disclaimer above, this article focuses on the **toner transfer** method of etch-resisting circuitboards. That is to say, we *transfer* toner (which is laser printer "ink"), onto a blank PCB in the form of artwork, and that acts as protection against the etching chemicals (otherwise known as **etchants**). This works due to toner containing a high percentage of pulverised plastic, which we know is resistant to most corrosive and oxidising agents (the two key types of etchant)

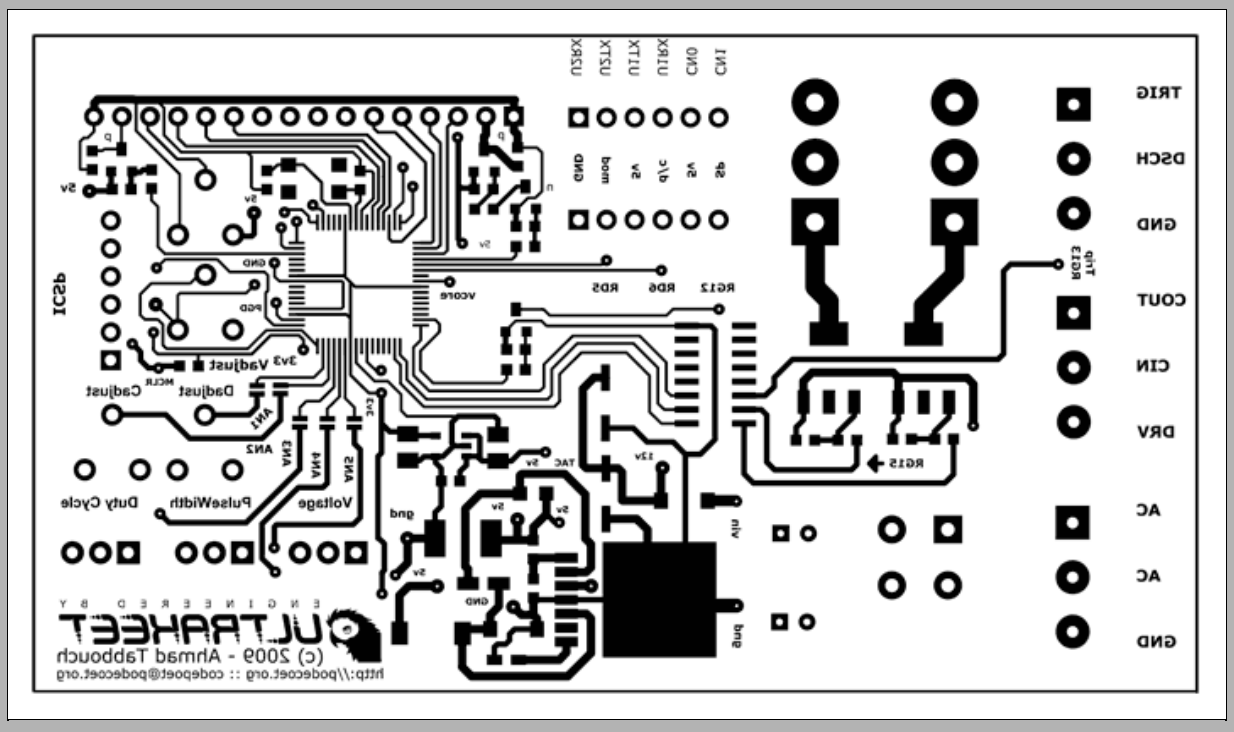
Laser printers essentially "paint" a sheet of paper with toner, which in its native state appears as a fine black dust. It then passes through a **fuser unit**, which melts the plastic content of the toner, permanently *fusing* it to the page. We'll essentially be performing the same task in reverse, using special **toner transfer paper**, designed in a way that allows the fused toner to be released from the page after printing.

You'll need the following items to get started producing HIGH QUALITY PCBs (note that substituting anything in **bold text** below will yield poorer quality results):

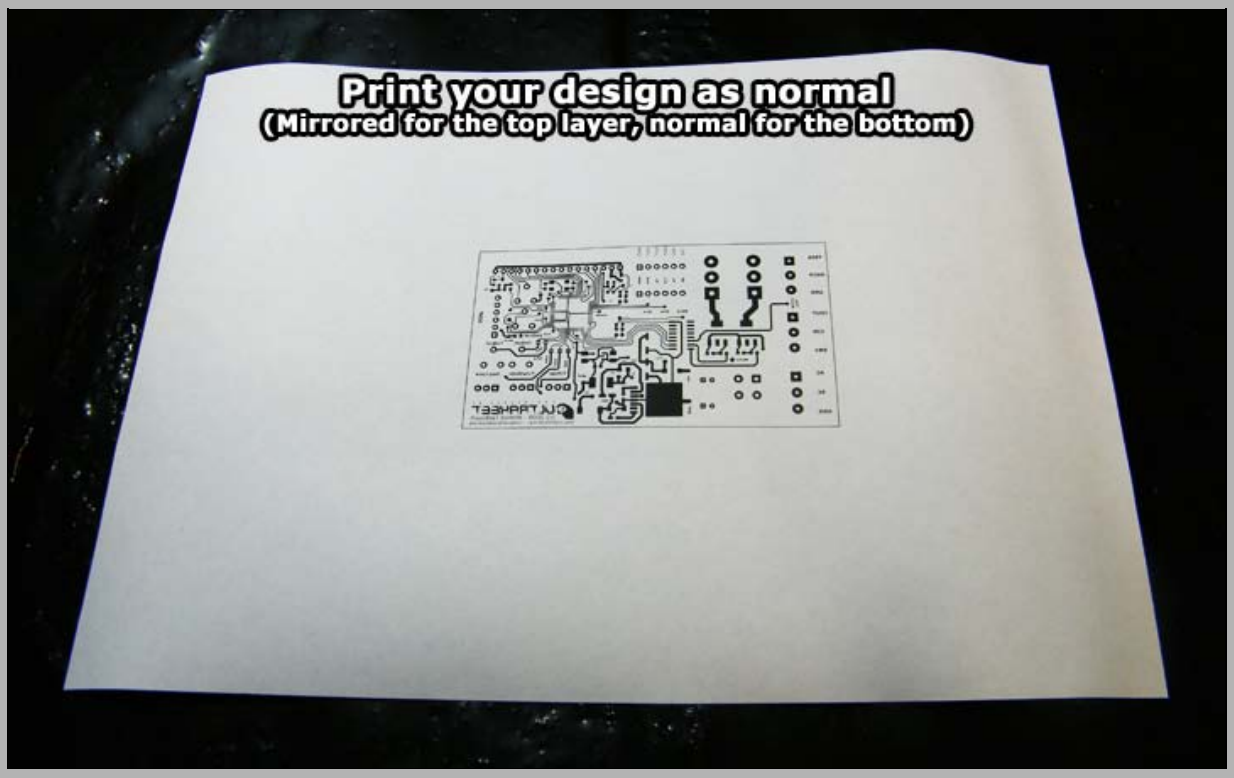
- **A laser printer** (Most brands work, except for BROTHER which uses a bad toner type)
- **A modified laminator** (Covered in the introduction, or a REALLY good clothing iron at worst)
- **Toner Transfer Paper** (Covered in the introduction)
- **Green TRF foil** (helps seal the toner image to avoid pitting)
- **0.032in blank PCB** (etches much faster than 0.064in, and fits in the cheap laminator!)
- **Ferric chloride** or **Ammonium Persulphate** etchant (your choice, we cover Ferric here)
- **A plastic container** (to fit your board, for the etchant)
- **Another plastic container** (to fit your board, for the water bath
- **Masking tape** (preferrably "Blue painters tape", doesn't damage your printer)
- **Steel wool soap pads** (or just plain steel wool)
- **A razor knife and paper shears** (the shears will be used to CUT the PCB!)
- **Some coffee!** (to keep you focussed, green tea is also good, black tea is out of the question.)

On with the article!

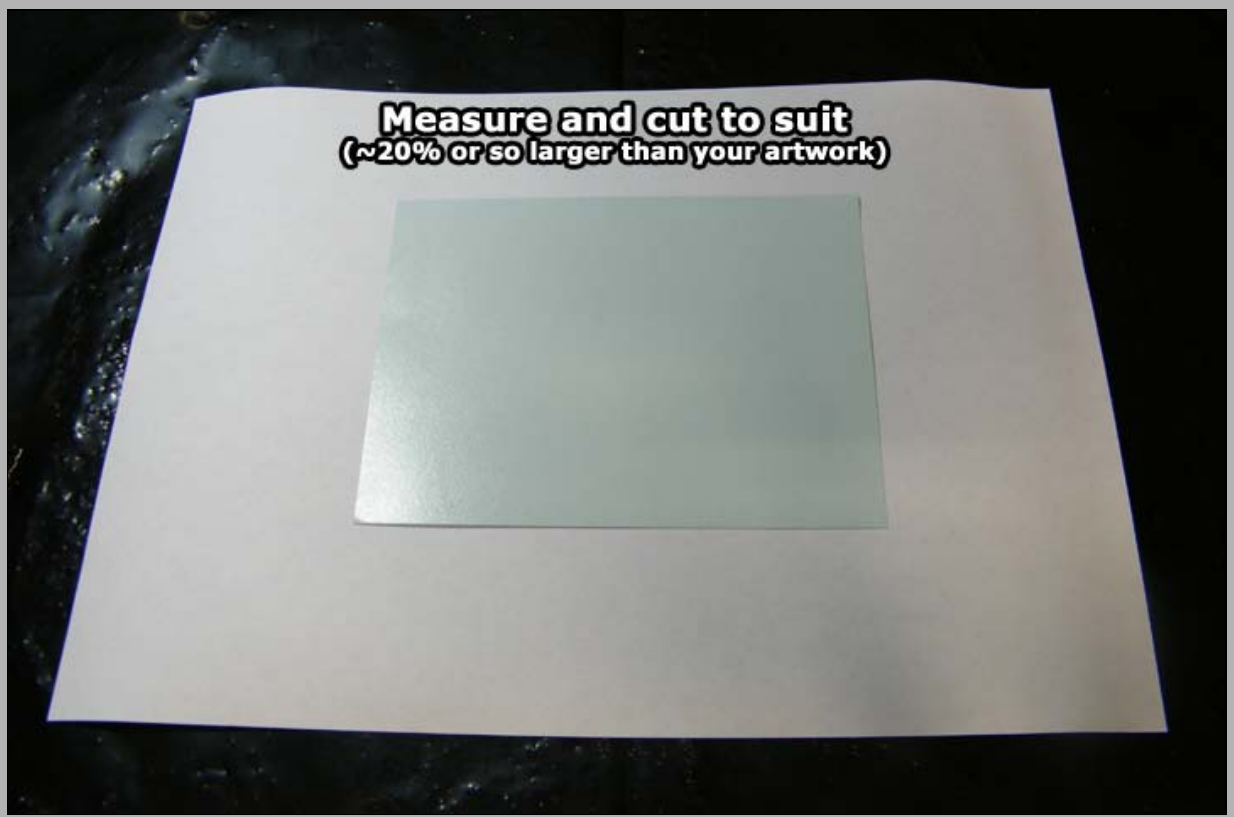
I'll be using the top layer of my **Capacitive Discharge spot-welder** project as an example throughout this page. I found it's a good balance between detail and complexity for this article --

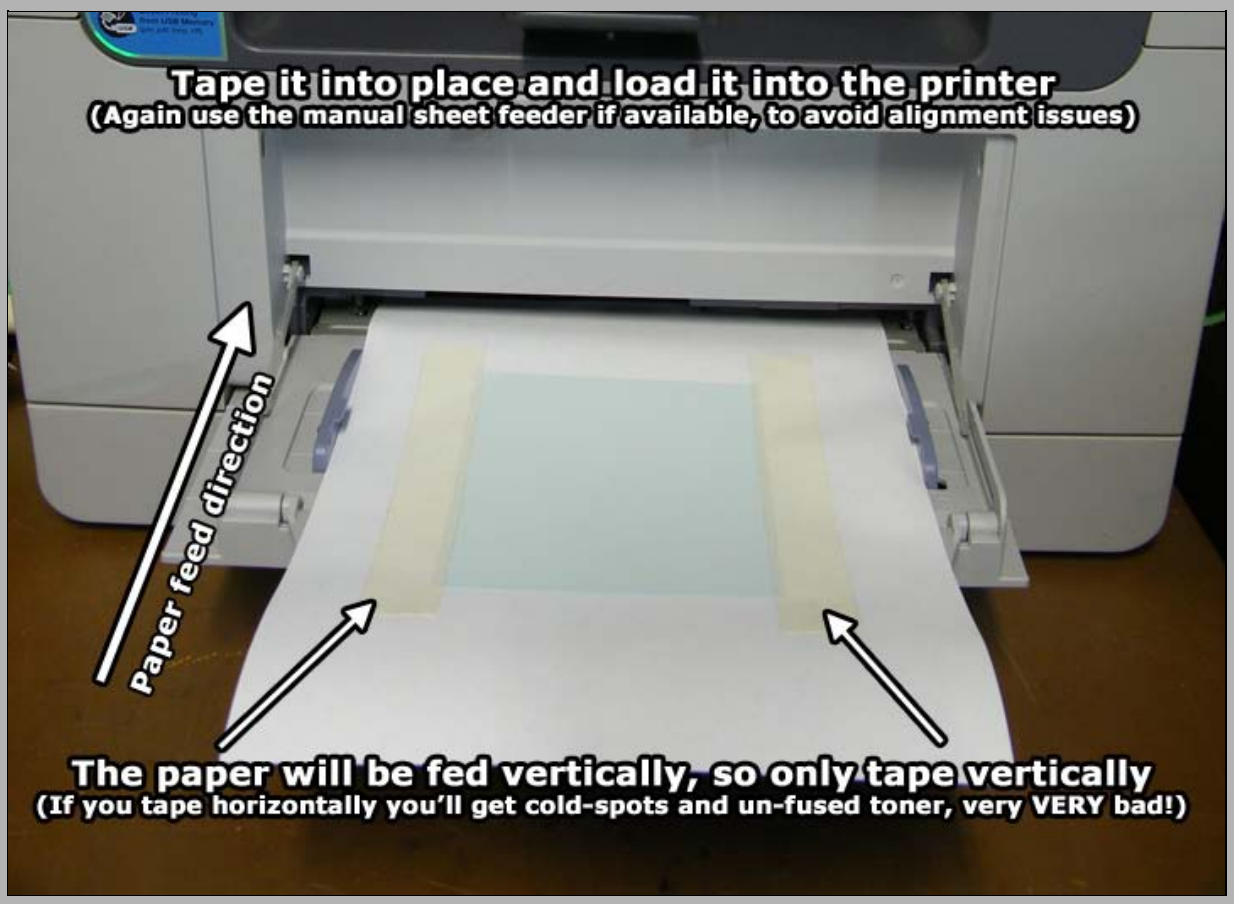


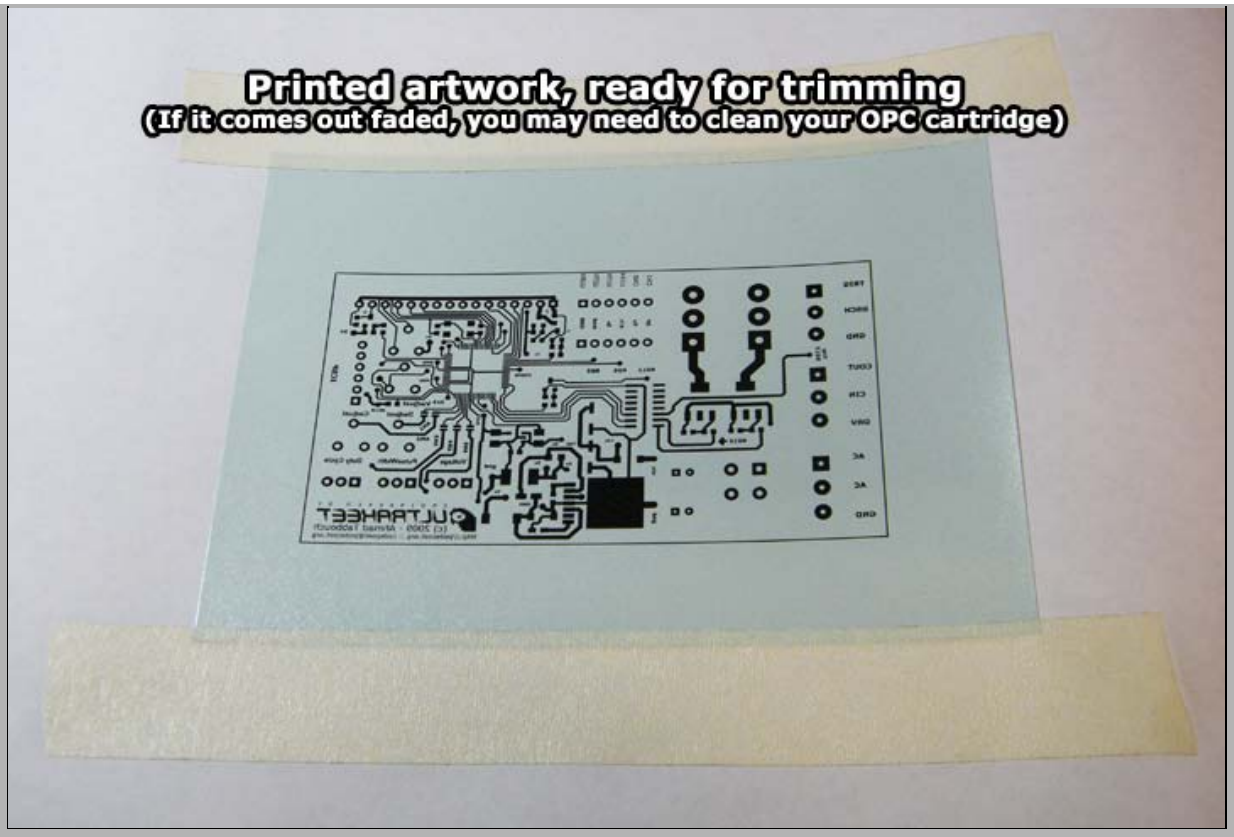
PCB artwork: Print your PCB artwork as normal (be sure to print the top layer **mirrored!**)

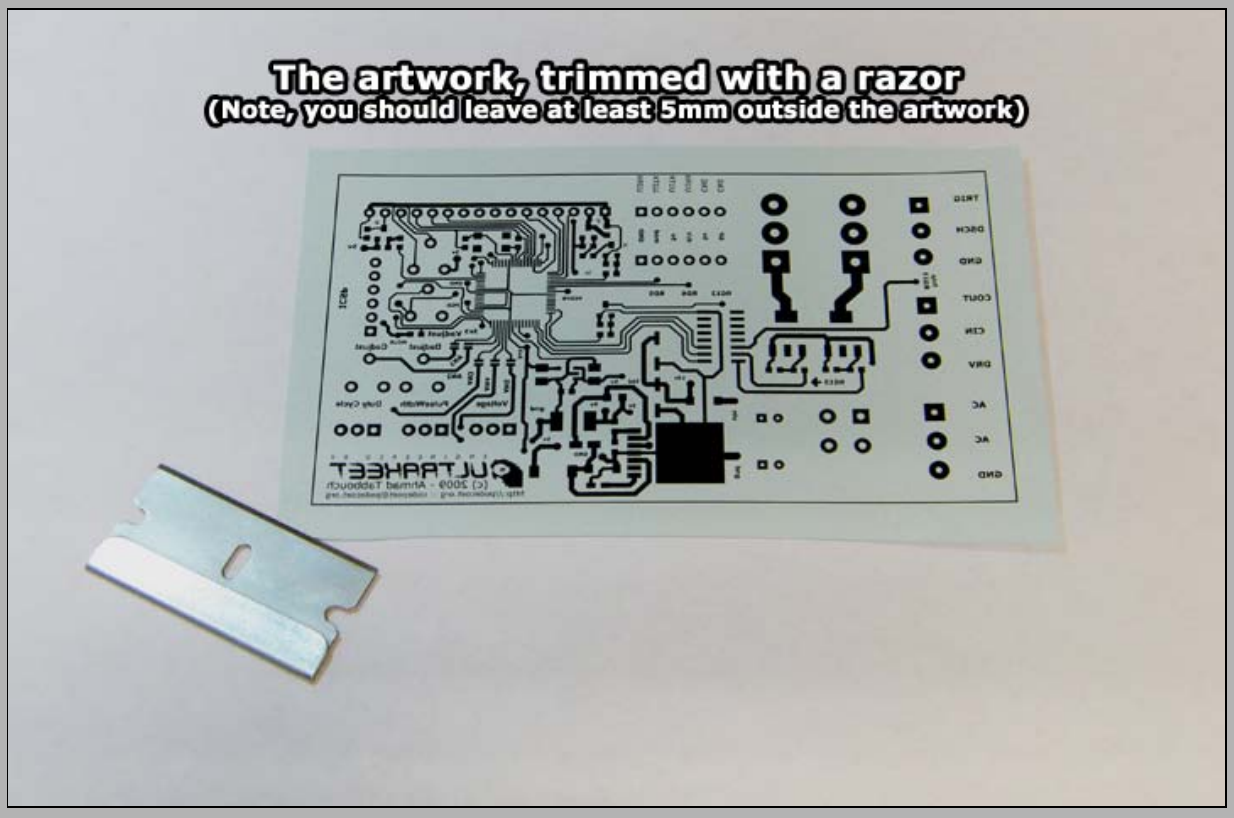

Print your design as normal
(Mirrored for the top layer, normal for the bottom)

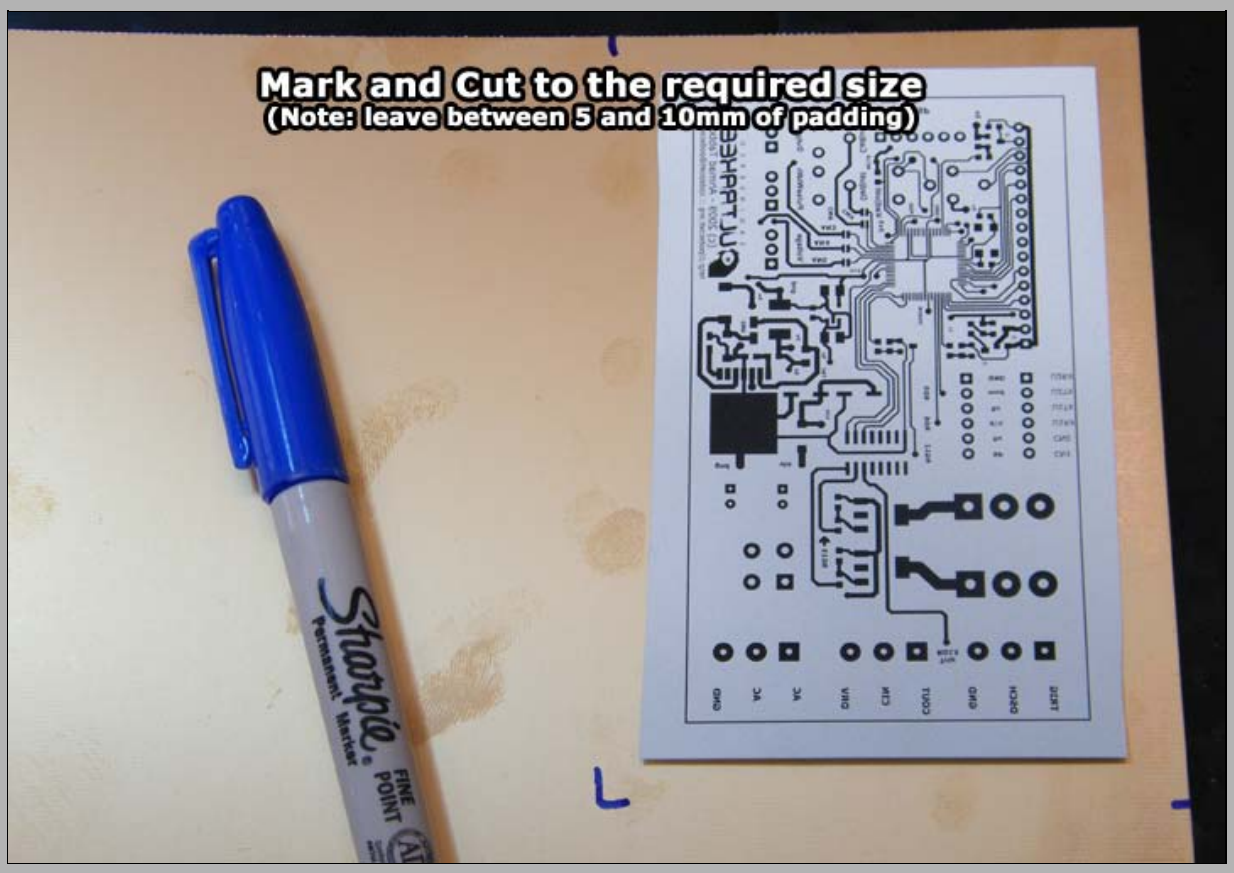

RE-SUPPLY Item for "Starter kit"
PCB FAB -IN A- BOX
TONER TRANSFER PAPER
• 10 Sheets
• 8-1/2" x 11"
• Resealable Package
Grab your pack of TTS
(and pull out a single sheet of it)

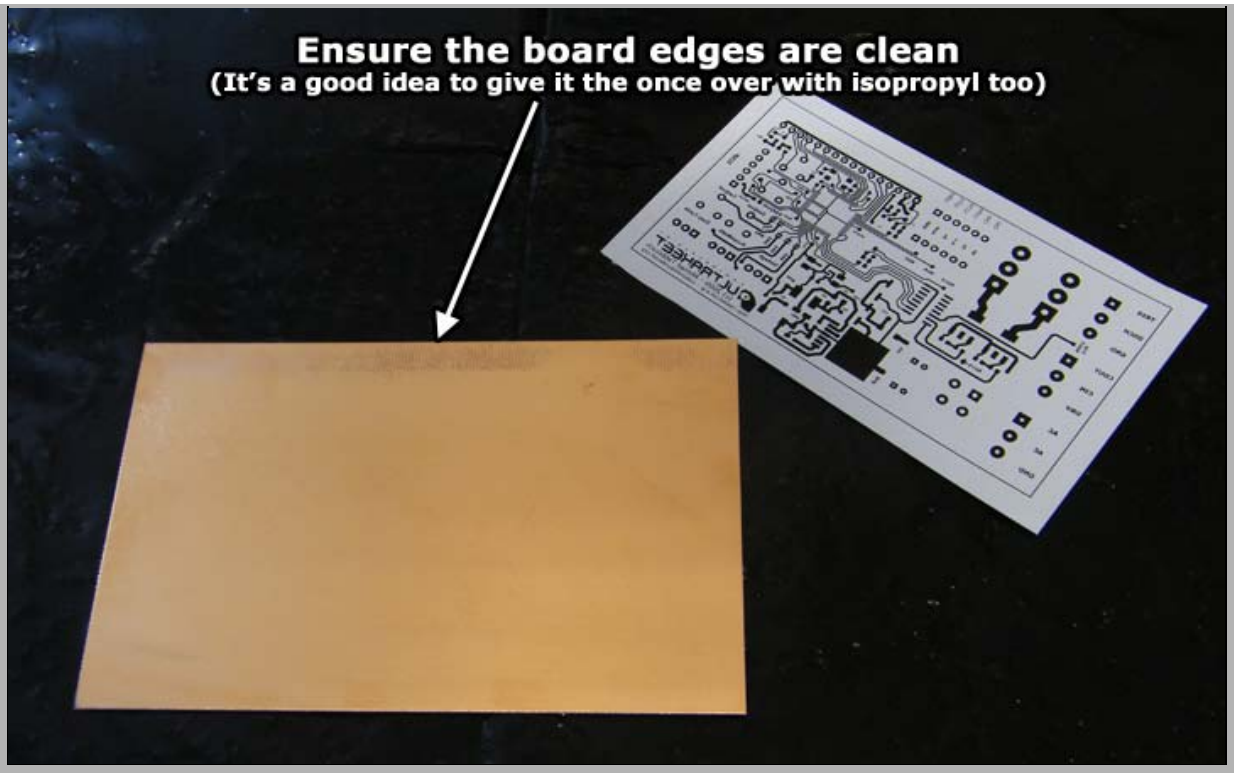

Measure and cut to suit
(~20% or so larger than your artwork)

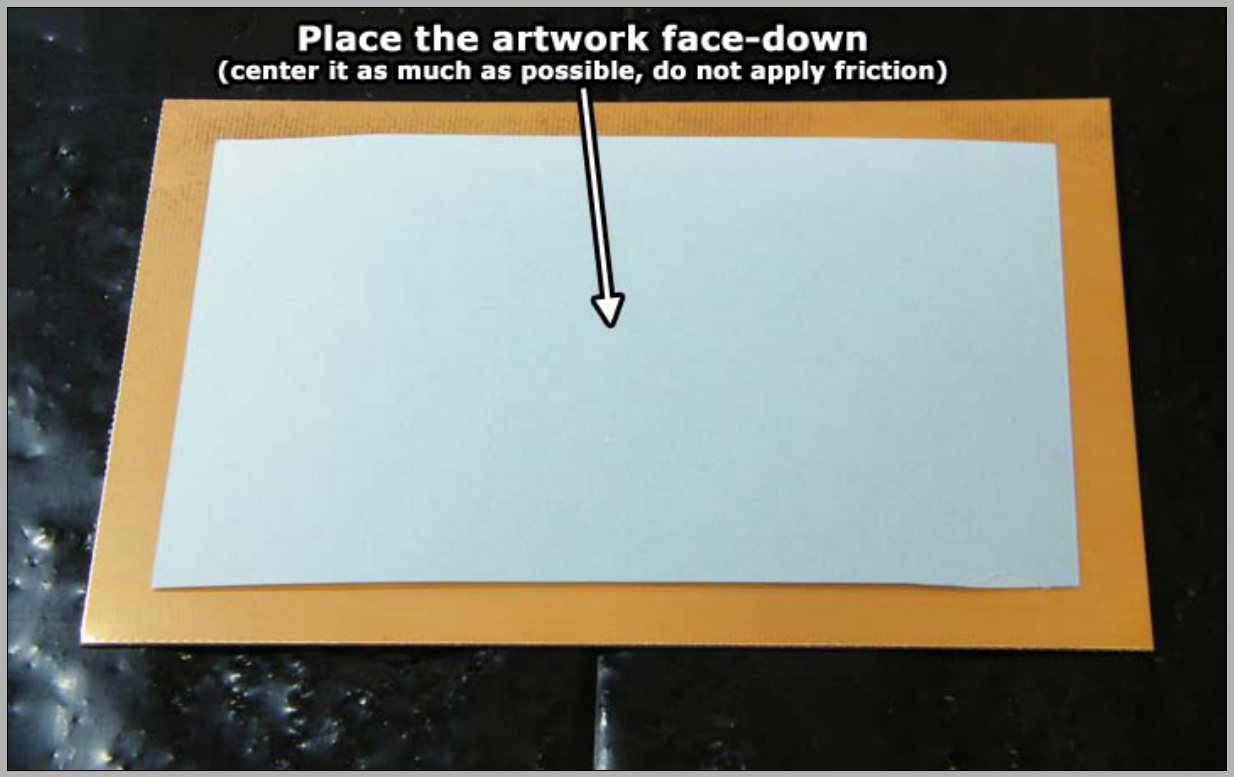

Tape it into place and load it into the printer
(Again use the manual sheet feeder if available, to avoid alignment issues)
Paper feed direction
The paper will be fed vertically, so only tape vertically
(If you tape horizontally you'll get cold-spots and un-fused toner, very VERY bad!)

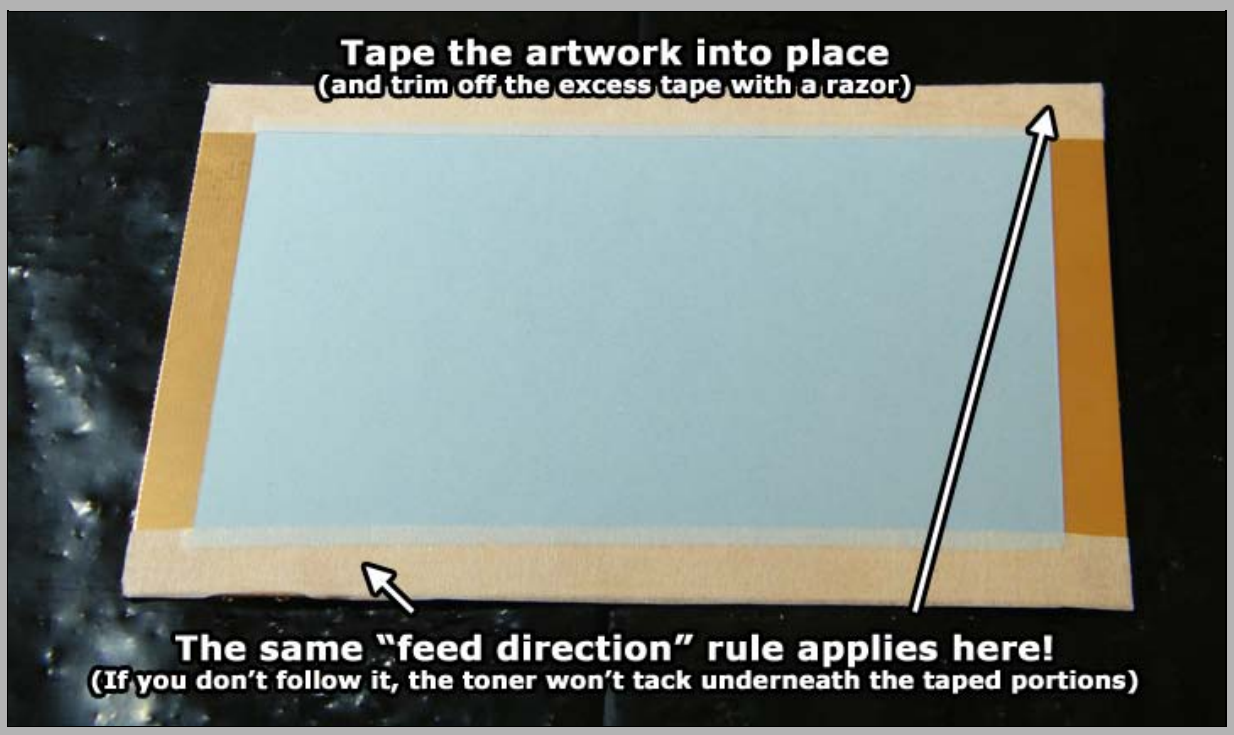

Printed artwork, ready for trimming
(If it comes out faded, you may need to clean your OPC cartridge)

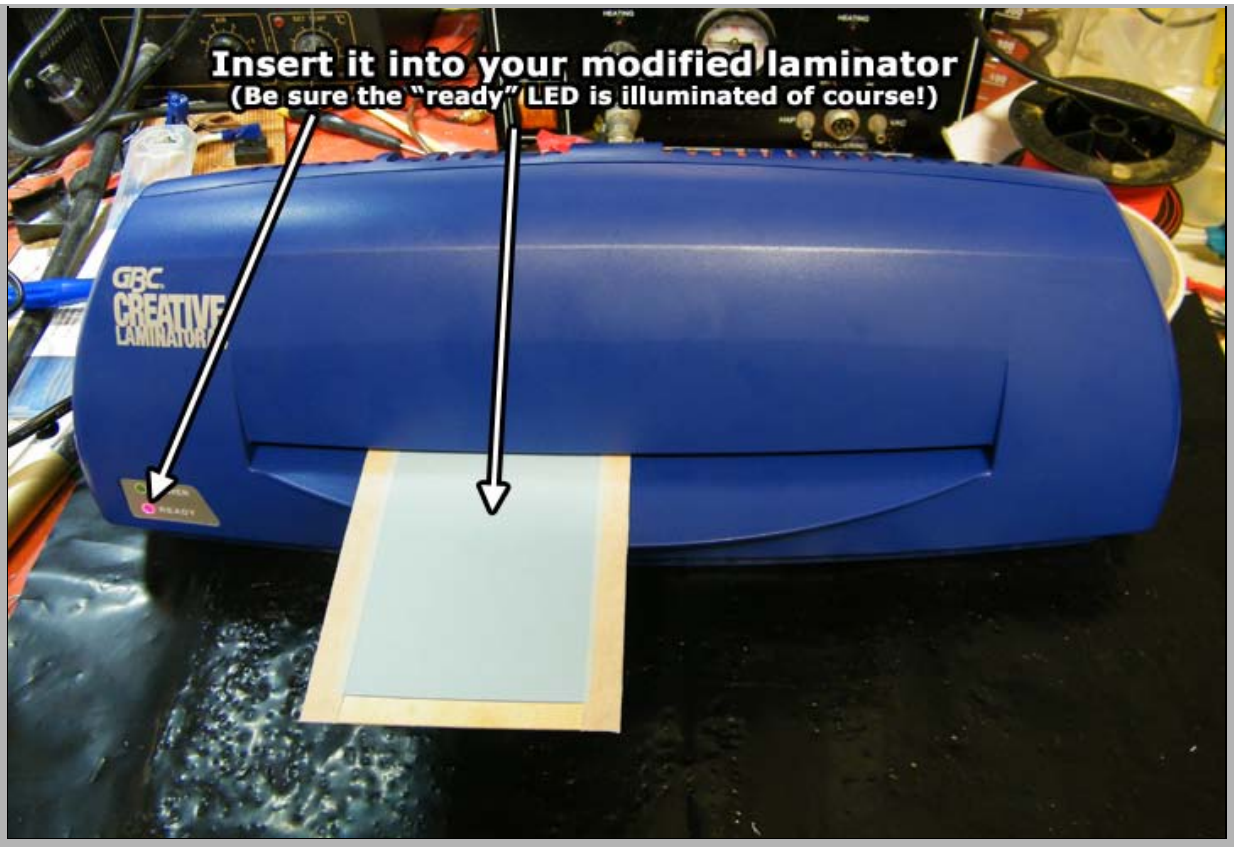

The artwork, trimmed with a razor
(Note, you should leave at least 5mm outside the artwork)

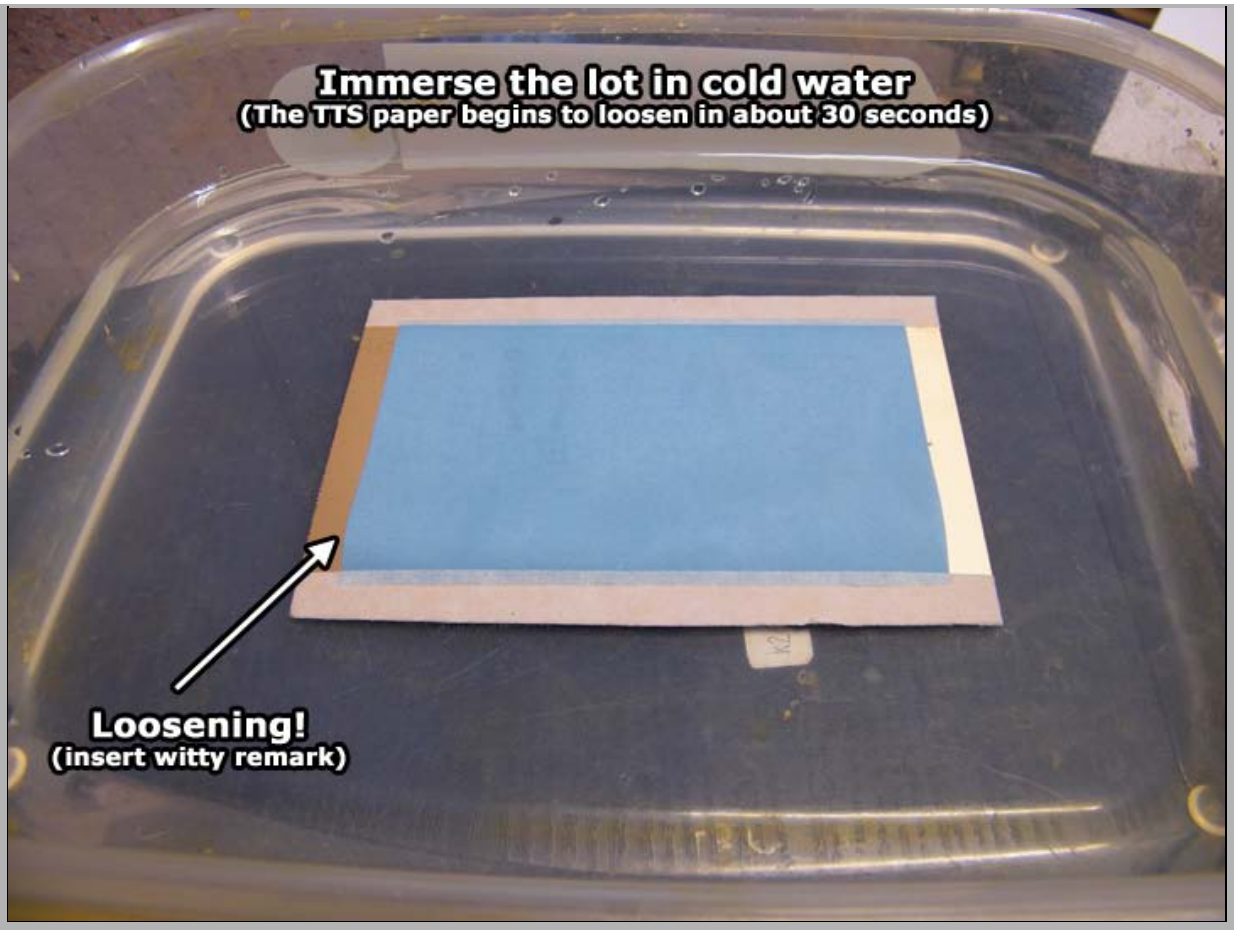

Mark and Cut to the required size
(Note: leave between 5 and 10mm of padding)
Sharpie
Permanent Marker
FINE POINT

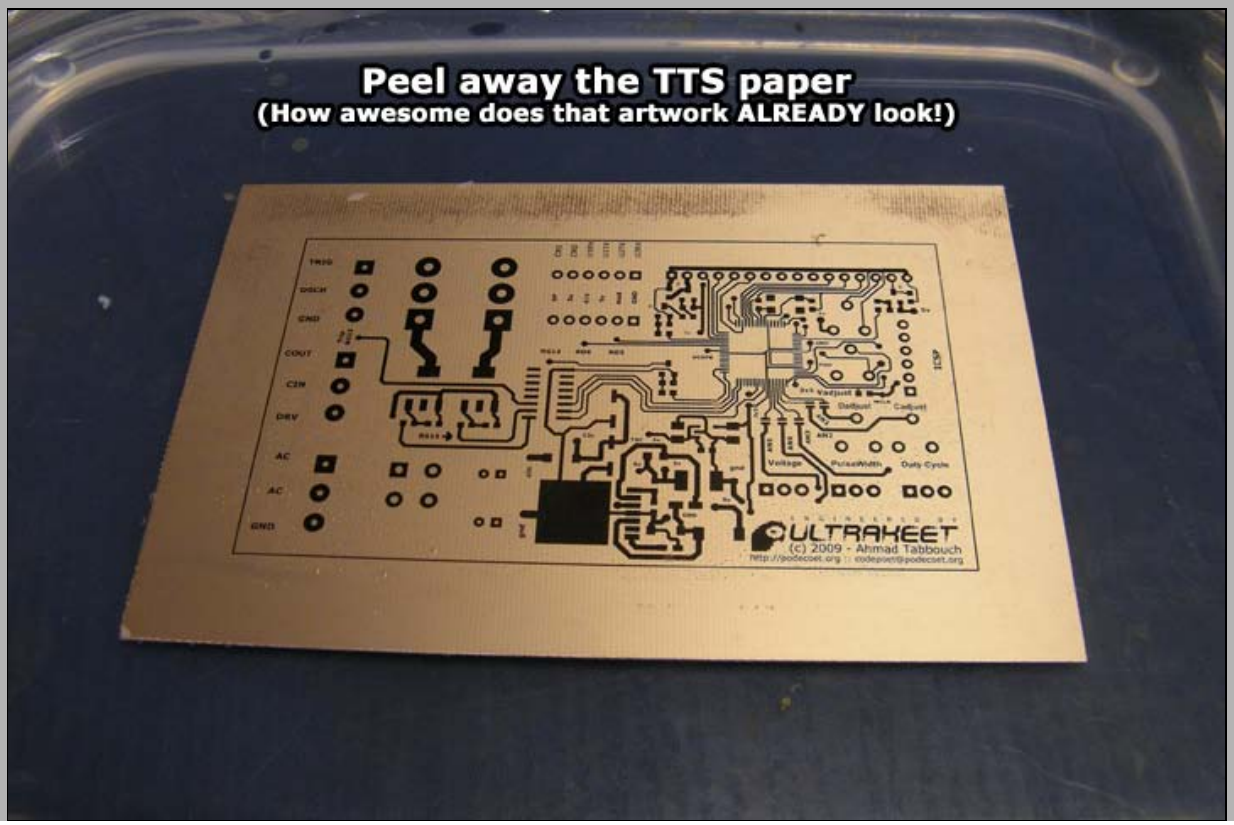

Ensure the board edges are clean
(It's a good idea to give it the once over with isopropyl too)


Place the artwork face-down
(center it as much as possible, do not apply friction)

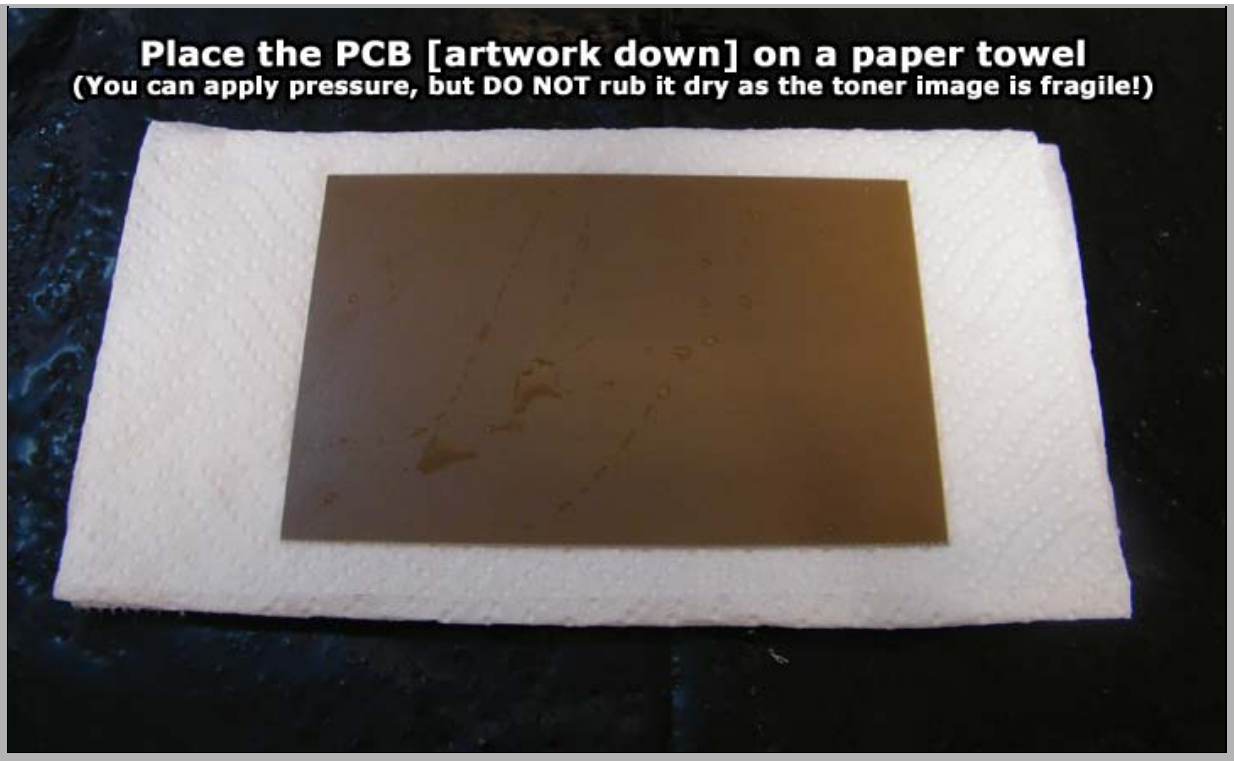

Tape the artwork into place
(and trim off the excess tape with a razor)
The same "feed direction" rule applies here!
(If you don't follow it, the toner won't tack underneath the taped portions)

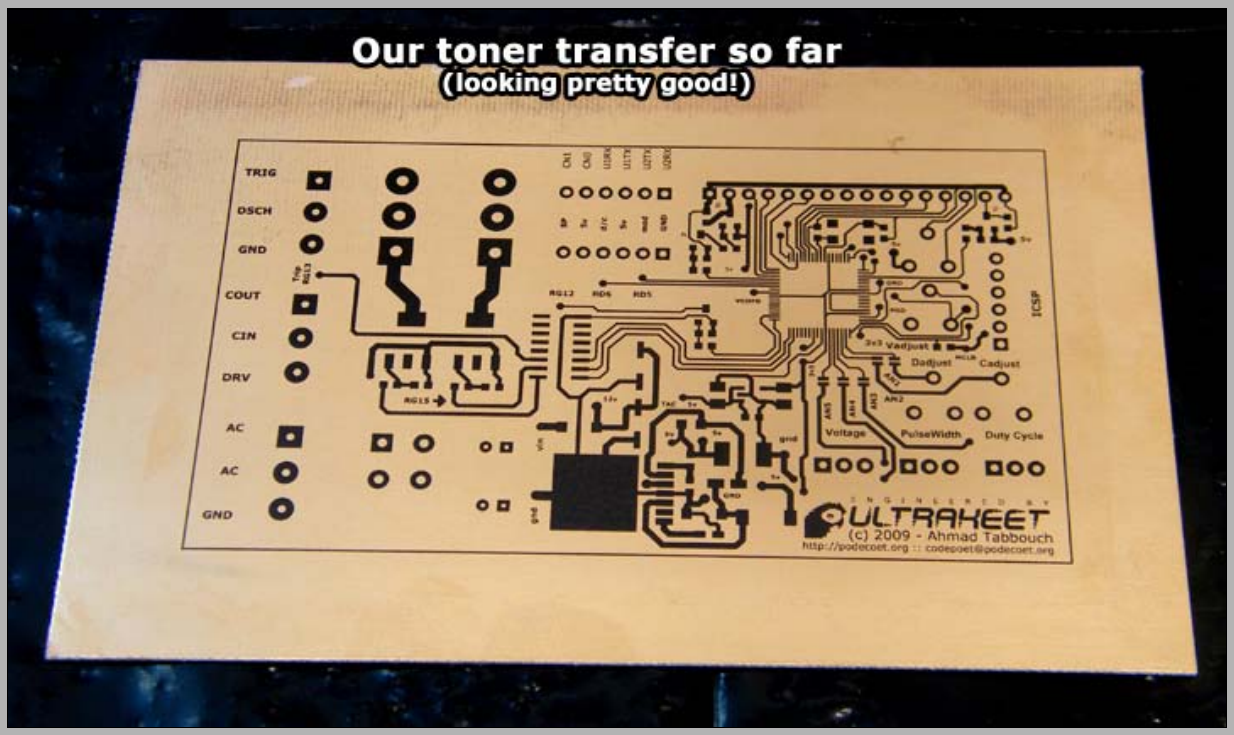

Insert it into your modified laminator
(Be sure the "ready" LED is illuminated of course!)
GBC
CREATIVE


Immerse the lot in cold water
(The TTS paper begins to loosen in about 30 seconds)
Loosening!
(insert witty remark)


Peel away the TTS paper
(How awesome does that artwork ALREADY look!)
ULTRAKEET
(c) 2009 - Ahmad Tabbouch


Rinse away any residual adhesive
(I used a squirt bottle, you could just run it under the sink)
TX3S
DSCN
GND
CDUT
CIN
DRV
AC
AC
GND
ULTRAKEET

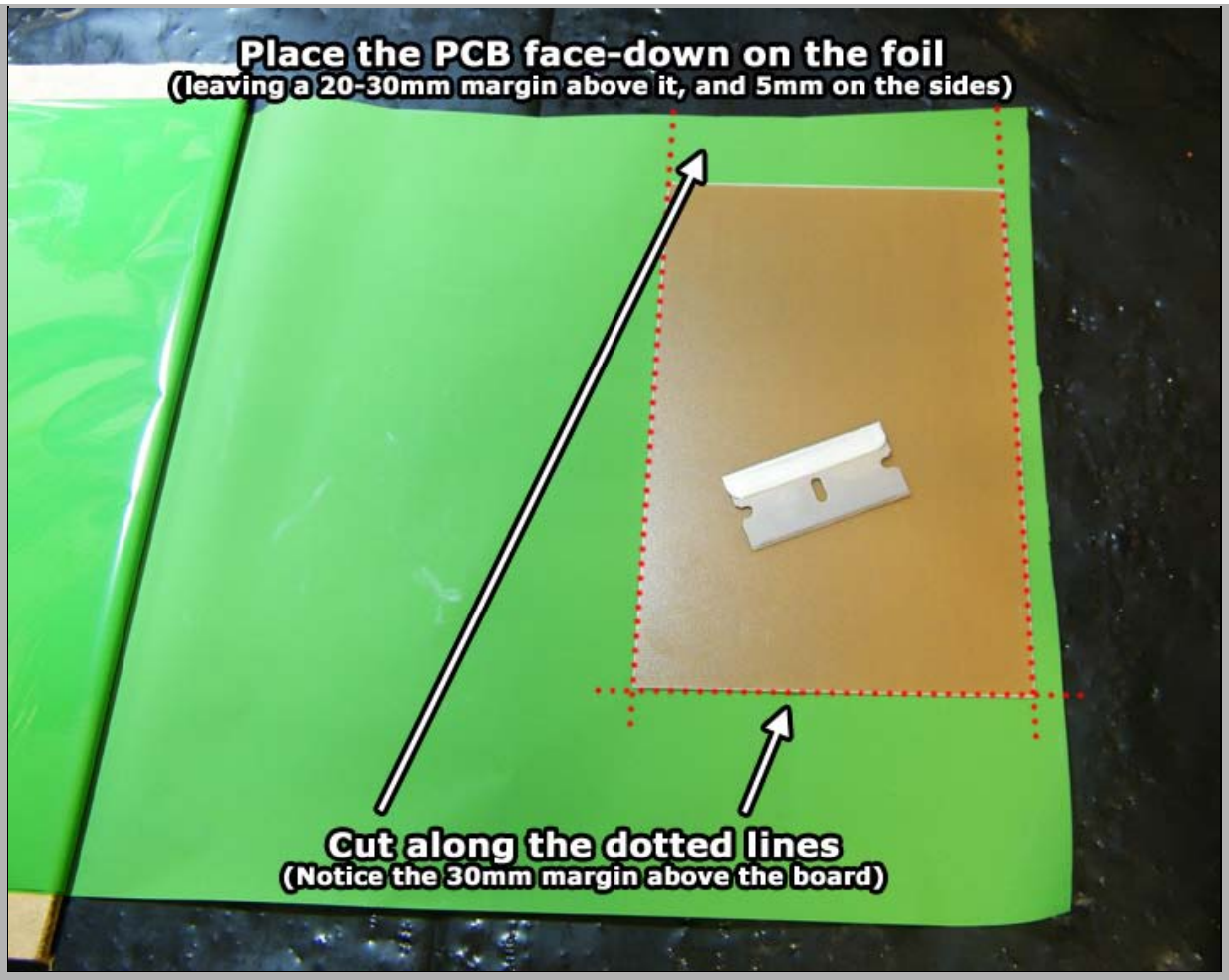




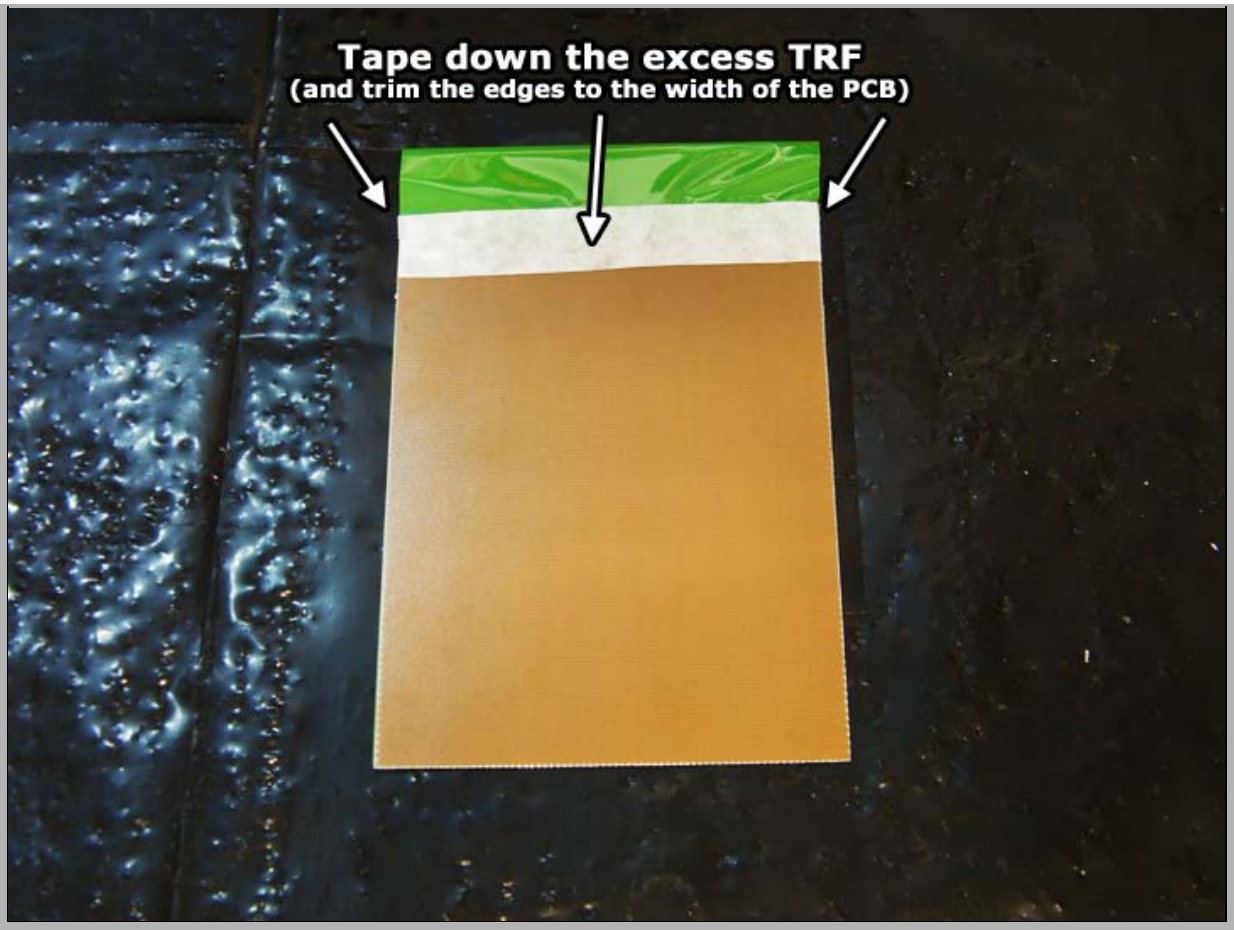
The first part of our toner transfer adventures is now complete! You may try and etch the board in its current state, however toner (in its very nature) is pourous and quite fragile. Etching at this point may result in pitted / non-contiguous tracks - Luckily for us there's something called **toner reactive foil** ("Green TRF") that's here to rescue us!

Essentially it's a special pigment-based foil that only sticks to the toner image. This in turn adds a second layer of "etch resist" to your board, allowing you to be as rough as you want during the etching process. Note that if you're using **Press'n'Peel** in place of the aforementioned products, the "blue" pigment is essentially the same as TRF and this step is not required. They both work in very similar ways, however keeping the foil separate from the "transfer paper" yields far more detailed results

On with the TRF application!


Place the PCB face-down on the foil
(leaving a 20-30mm margin above it, and 5mm on the sides)
Cut along the dotted lines
(Notice the 30mm margin above the board)

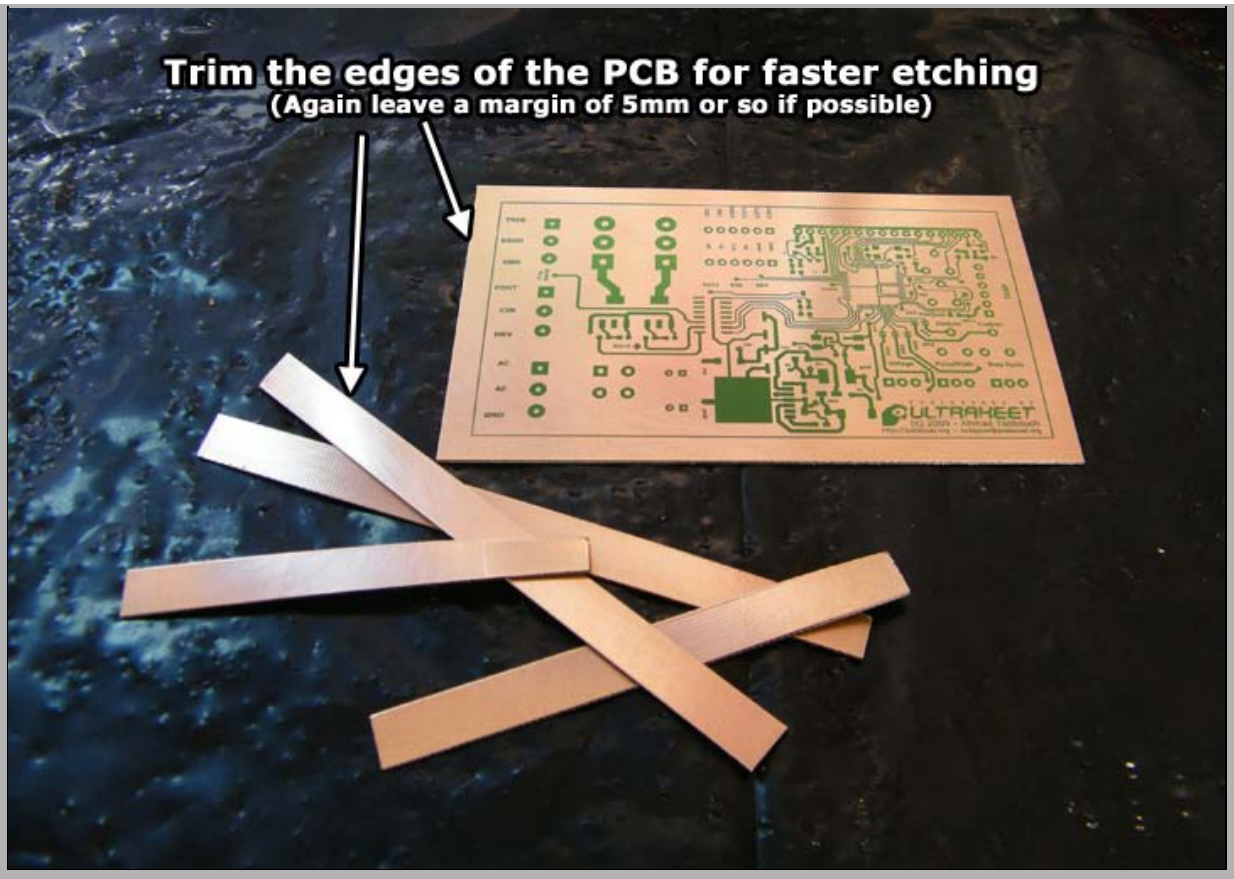

Be sure the edges are as clean as possible
(the 30mm margin, however, doesn't need to be perfectly cut)


Tape down the excess TRF
(and trim the edges to the width of the PCB)

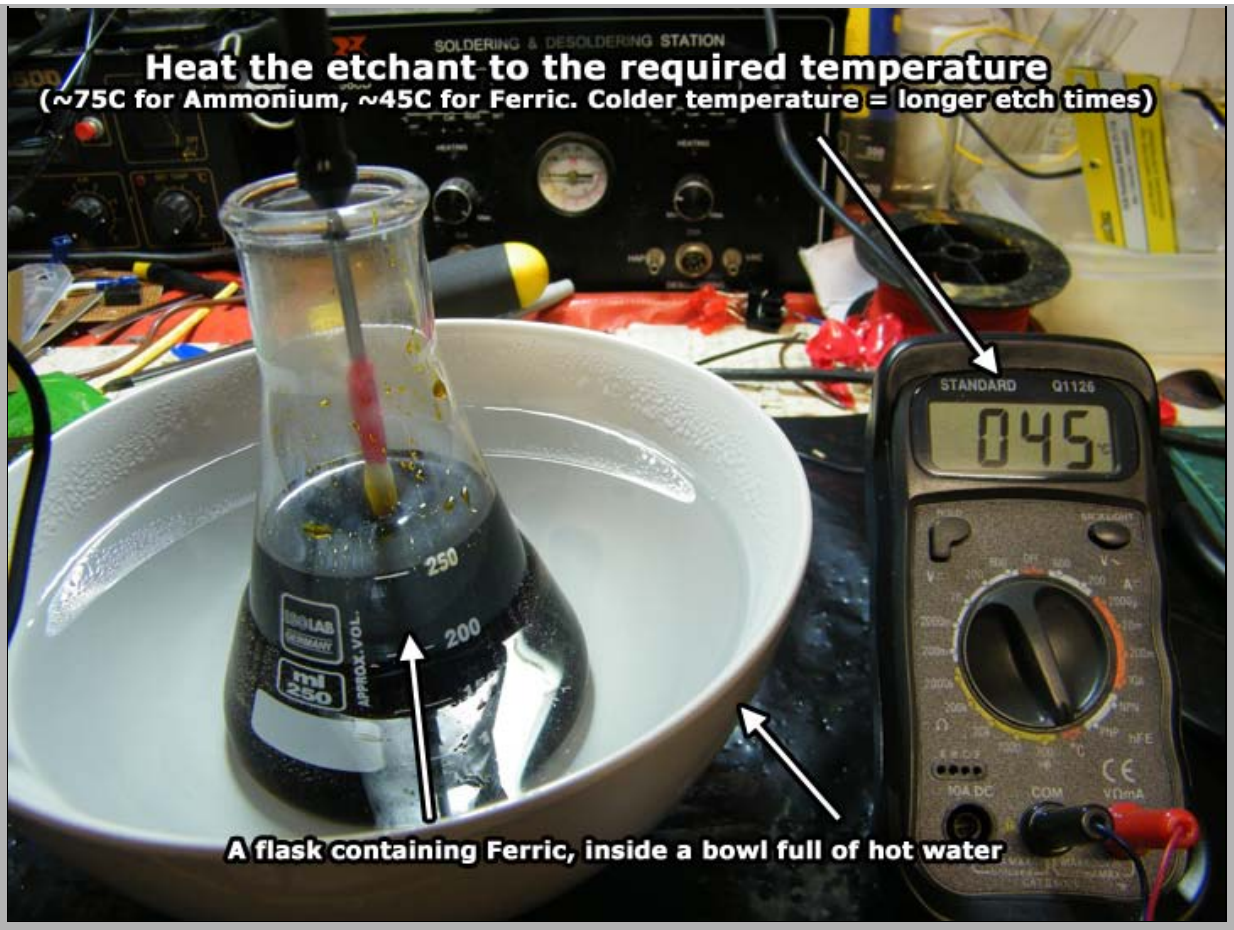

Insert the board into your superfuser
(taped side first, with the foil facing upwards)
GBC
CREATIVE
LAMINATOR
Try to keep the foil flat by applying tension


Wait for it to become cool to the touch
(or dunk it in some water if you're THAT impatient!)
Note how it appears the foil has "stuck" to the artwork itself


Peel away the Green TRF
(You can use this stuff as a UV mask for photoresist!)
Note how the artwork has turned green, this is your additional layer of etch resist!

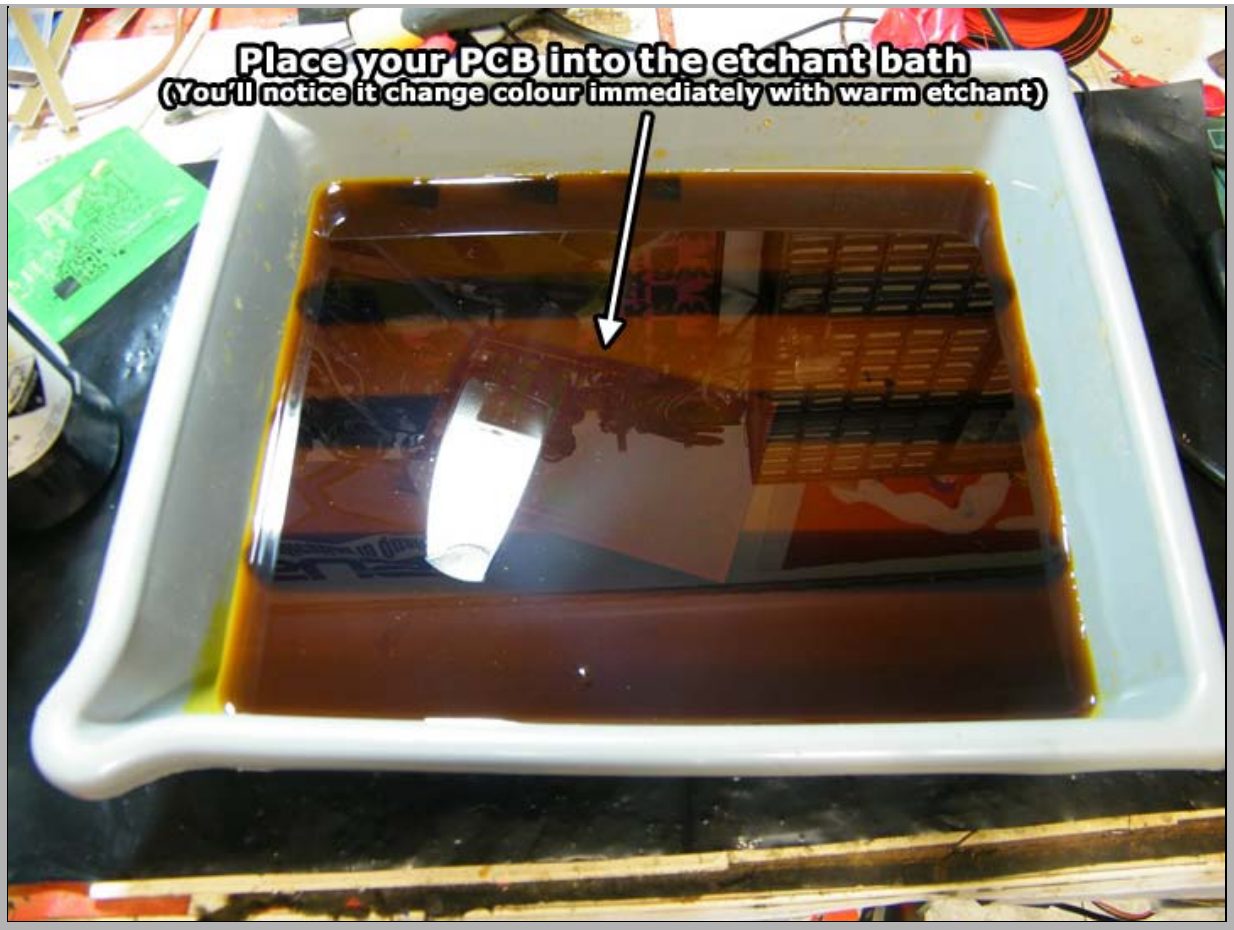

Trim the edges of the PCB for faster etching
(Again leave a margin of 5mm or so if possible)
ULTRAKEET


Prepare your preferred etchant
(Ferric Chloride is recommended but not mandatory)
DICK SMITH ELECTRONICS
UN No. 2582
CHLORIDE etchant solution
WARNING
DICK SMITH ELECTRONICS
250
200
150
100
ml 250
APPROX. VOL.


Heat the etchant to the required temperature
(~75C for Ammonium, ~45C for Ferric. Colder temperature = longer etch times)
A flask containing Ferric, inside a bowl full of hot water
STANDARD
045


Pour the heated etchant into a plastic tray
(Preferrably one you won't try and EAT OUT OF in the future!)

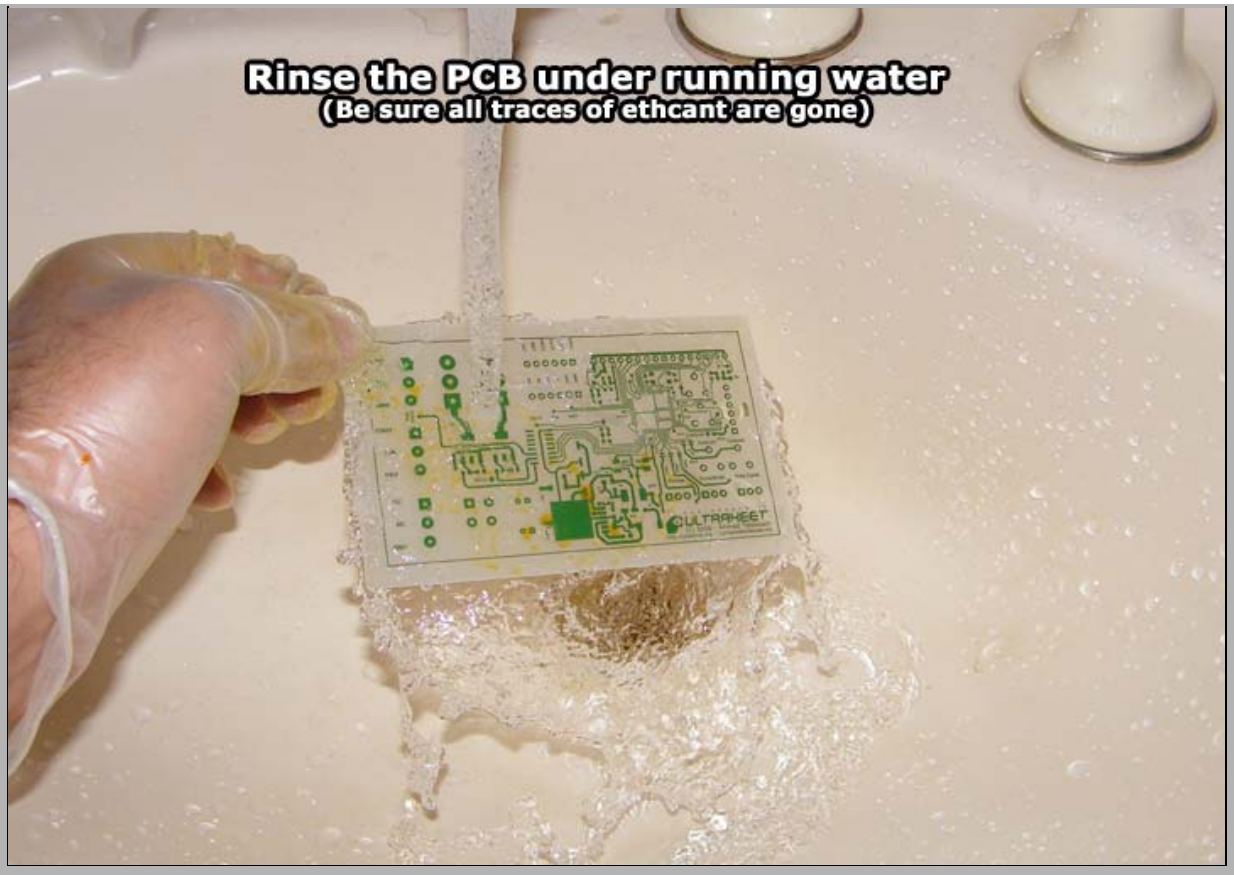

'Don your erotic latex gloves!
(or rubber gloves, if that does it for you too)

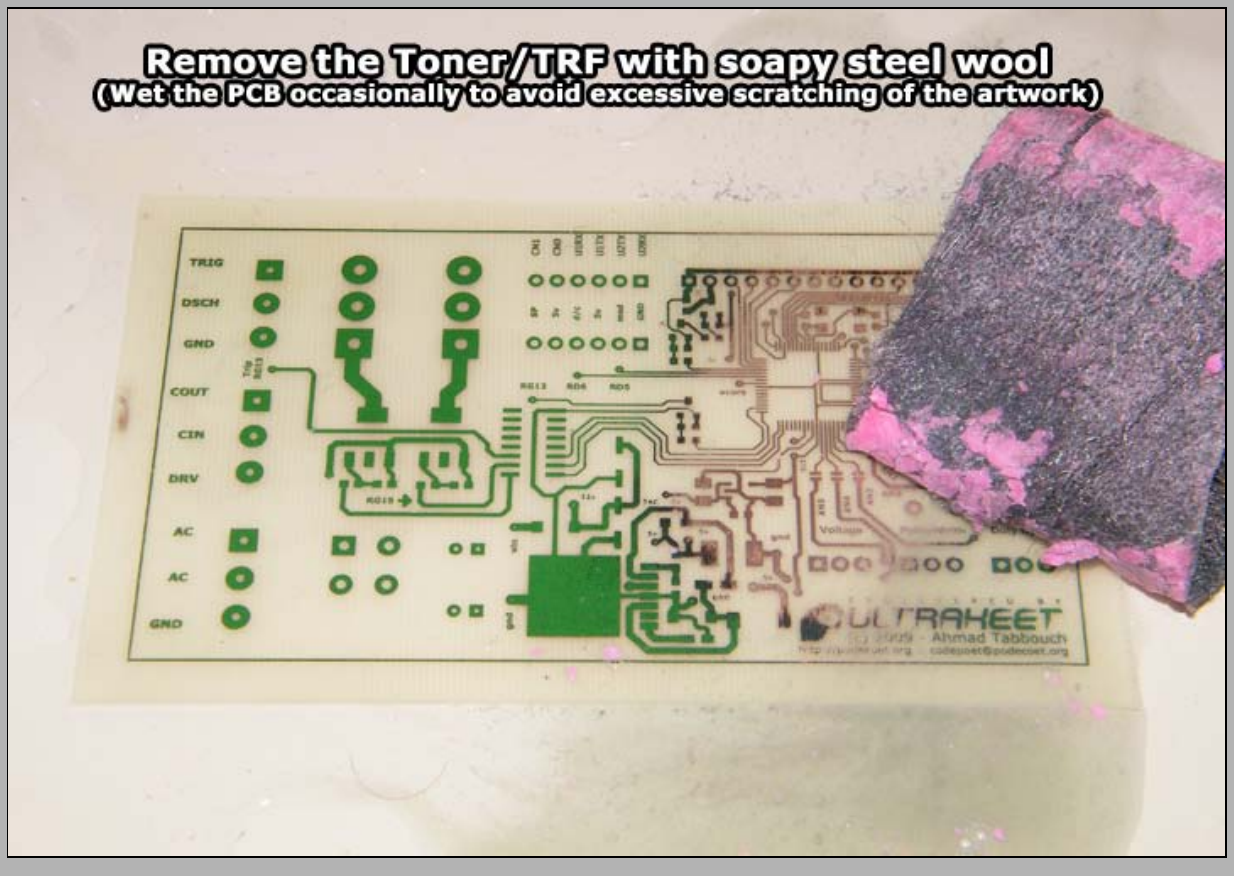

Place your PCB into the etchant bath
(You'll notice it change colour immediately with warm etchant)


Constantly wipe over the PCB with a paint brush
(This is the "direct etch" agitation technique in action!)


After 30 seconds of agitation
(Depending on the temperature it make take a little longer)


After 60 seconds of agitation, done!
(I can't think of a remark for this slide, come back later)


Rinse the PCB under running water
(Be sure all traces of ethcant are gone)


Remove the Toner/TRF with soapy steel wool
(Wet the PCB occasionally to avoid excessive scratching of the artwork)
TRIG
DSCH
GND
COUT
CIN
DRV
AC
AC
GND

Going further

You can stop here if you're not feeling too adventurous. The same products can be used to make the board even cooler looking. Please note that the following is **NOT** a normal use of TTS/TRF, and you shouldn't buy the stuff purely for the purpose illustrated below (except for the silkscreening, we know that works 100%!)

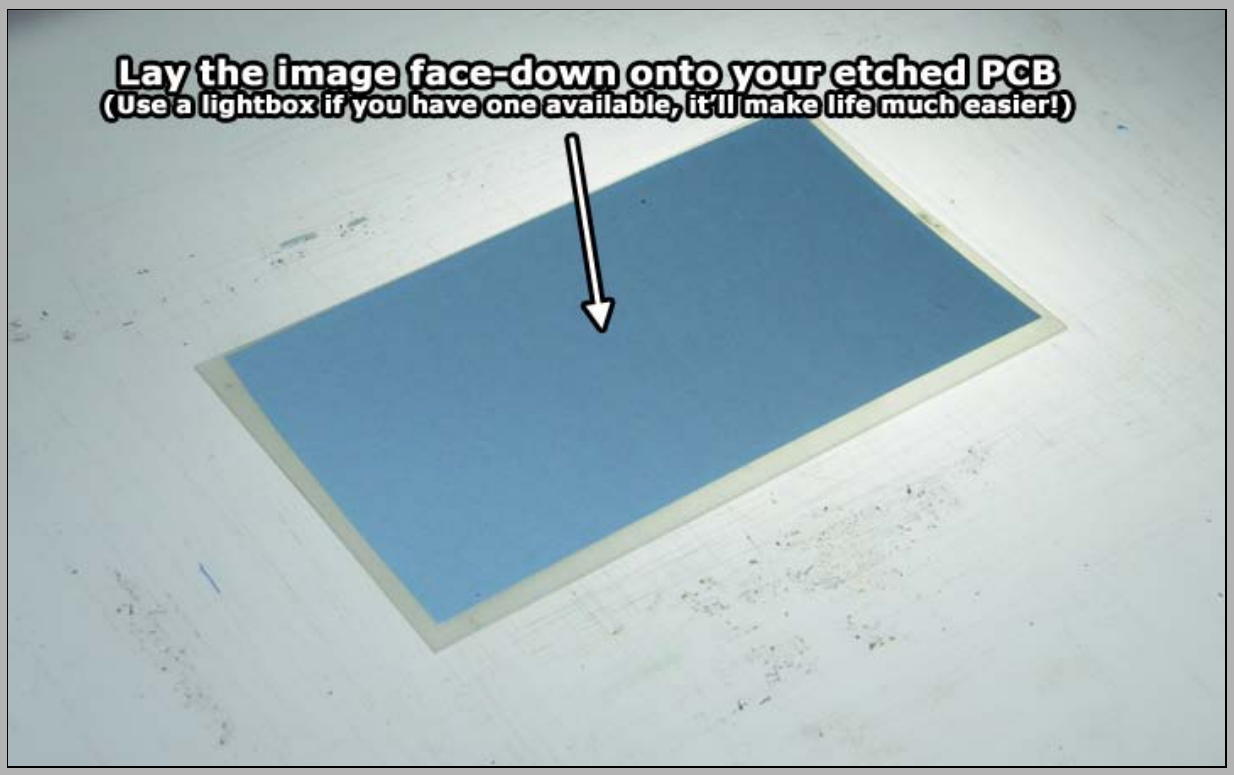
Once again, the following info about creating a **SOLDER MASK** is purely **EXPERIMENTAL** and probably shouldn't be relied upon. The same process can be used for silkscreening however, as that works flawlessly.

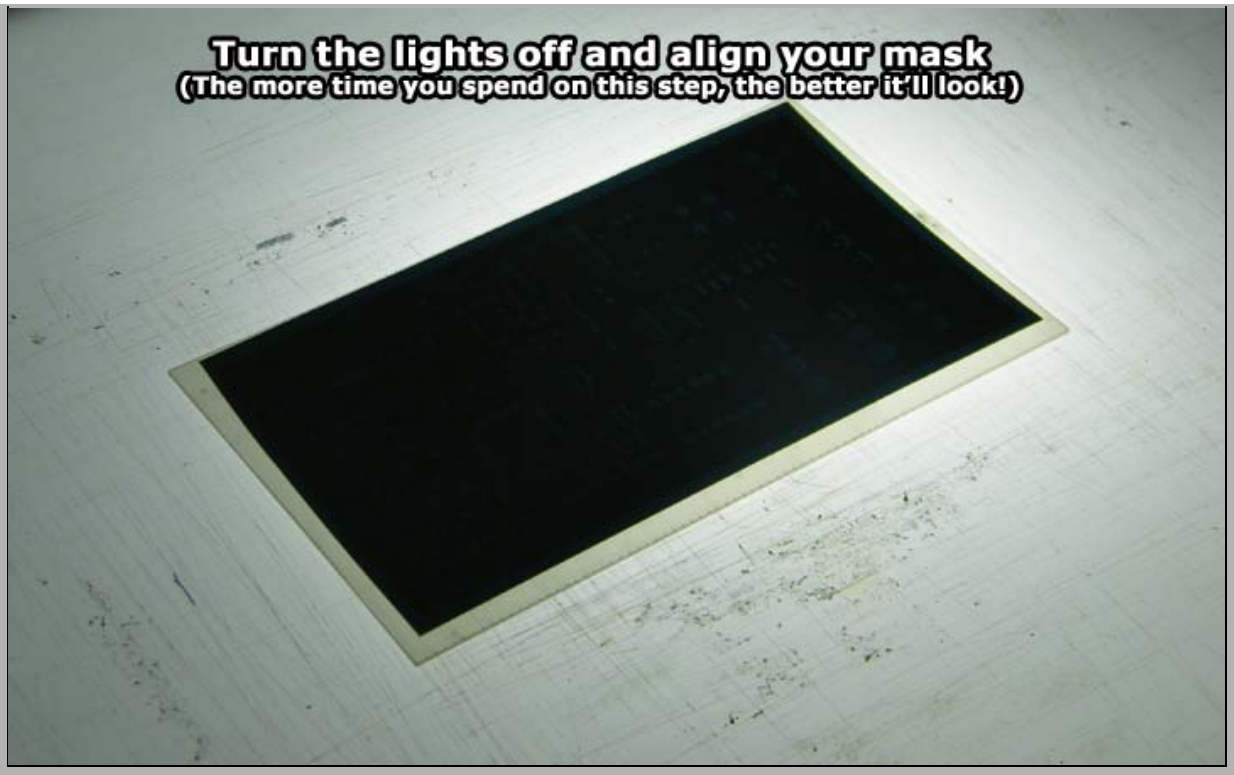
On with the show!

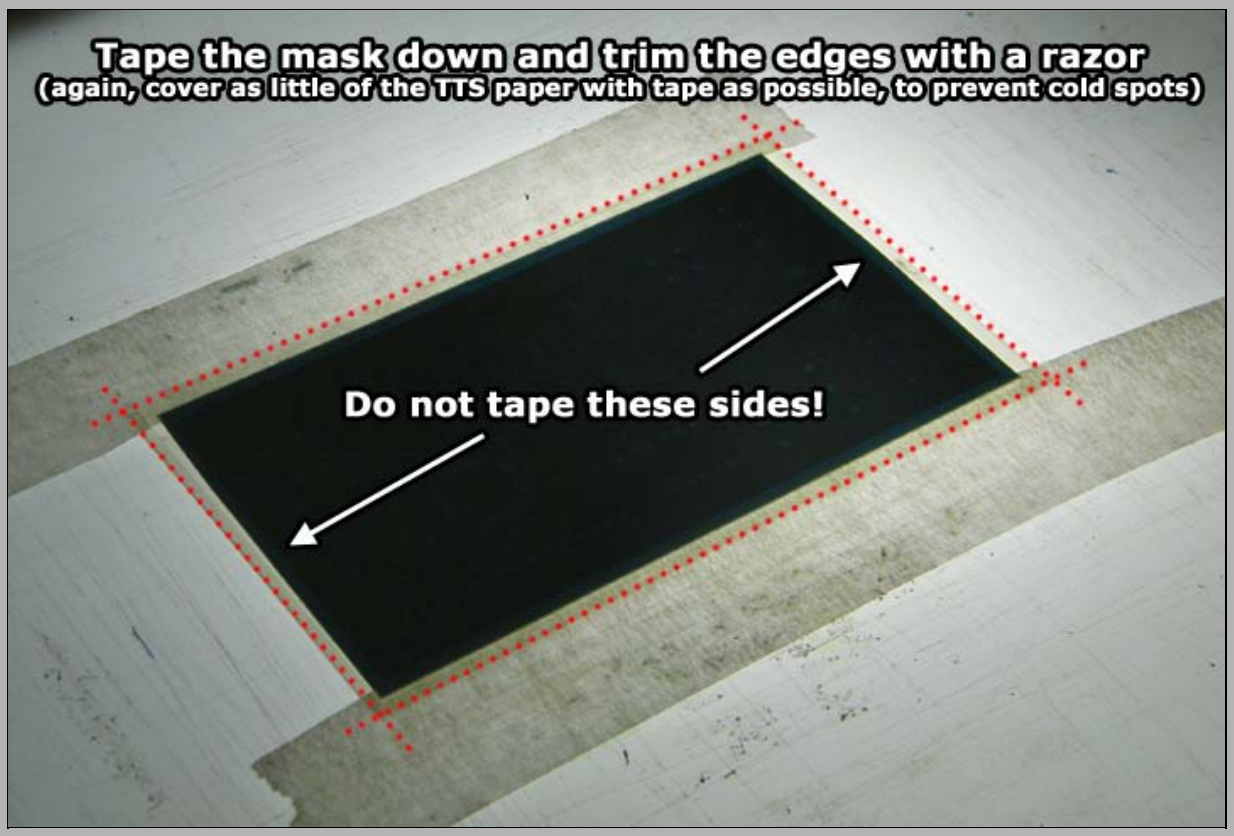
All i've done here is gone through and created a **NEGATIVE** printout of the **SOLDER MASK** layer in Altium Designer 6 (substitute with your favourite PCB Layout software). It's a little tricky to print a negative at first, but all you really do is adjust the board colour to black (which forms the background), and the soldermask / layer colours to white (which forms the "voids" in the mask itself).

At worst, you can just add a copper fill in your layout, and place it behind the layers you want to mask out, which gives the illusion of a negative image. **So let us begin!**


Print your negative mask image onto TTS paper
(Follow the exact same procedure as you did to print your PCB artwork)

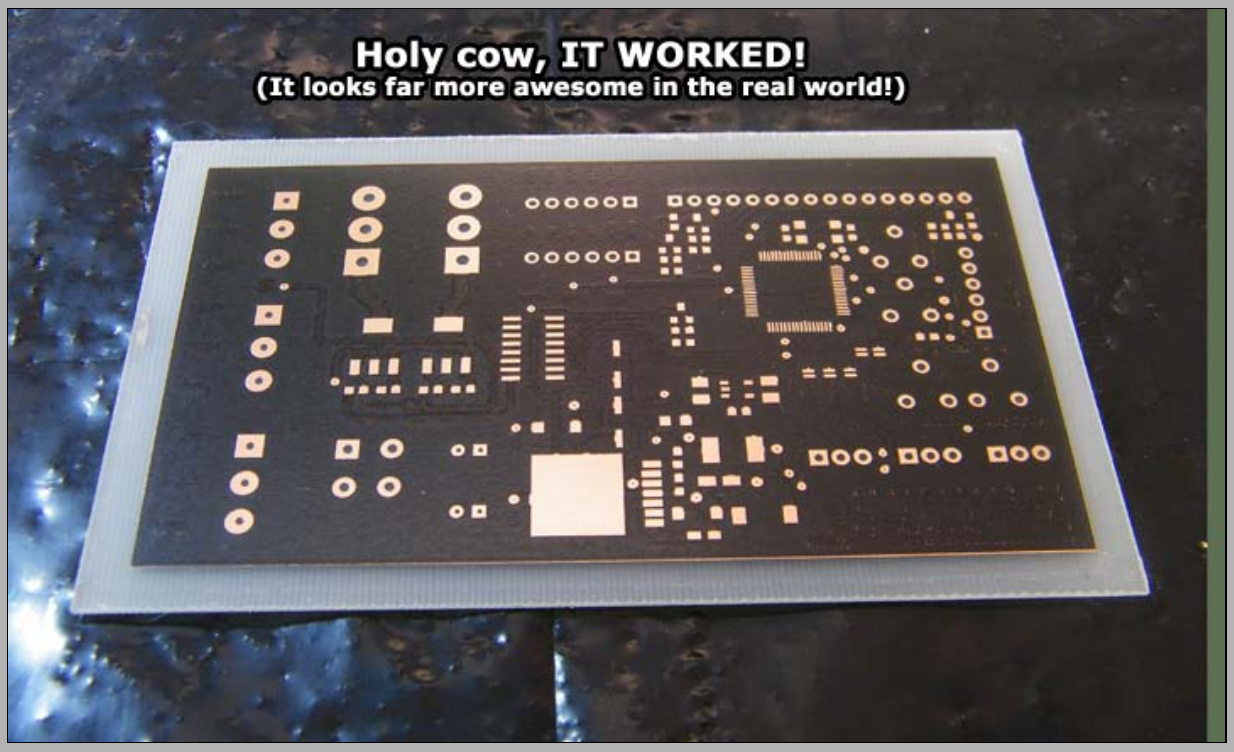

Lay the image face-down onto your etched PCB
(Use a lightbox if you have one available, it'll make life much easier!)


Turn the lights off and align your mask
(The more time you spend on this step, the better it'll look!)

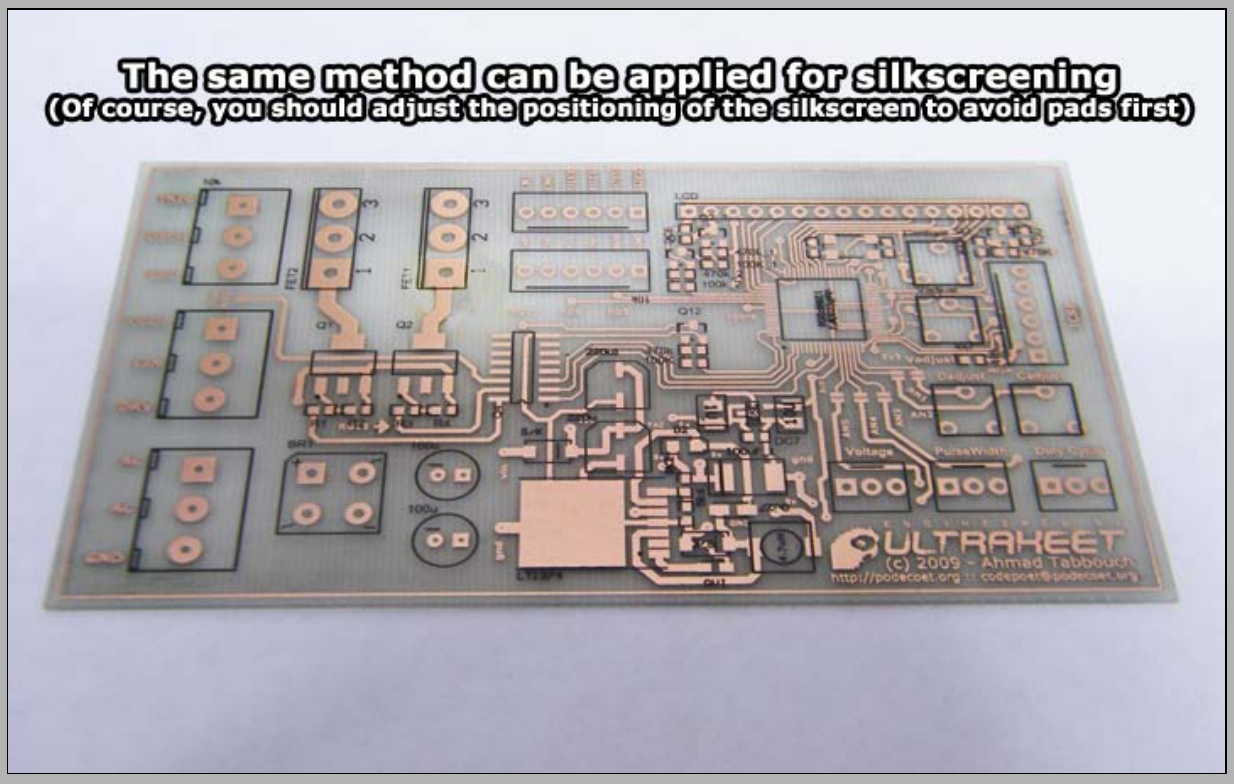

Tape the mask down and trim the edges with a razor
(again, cover as little of the TTS paper with tape as possible, to prevent cold spots)
Do not tape these sides!

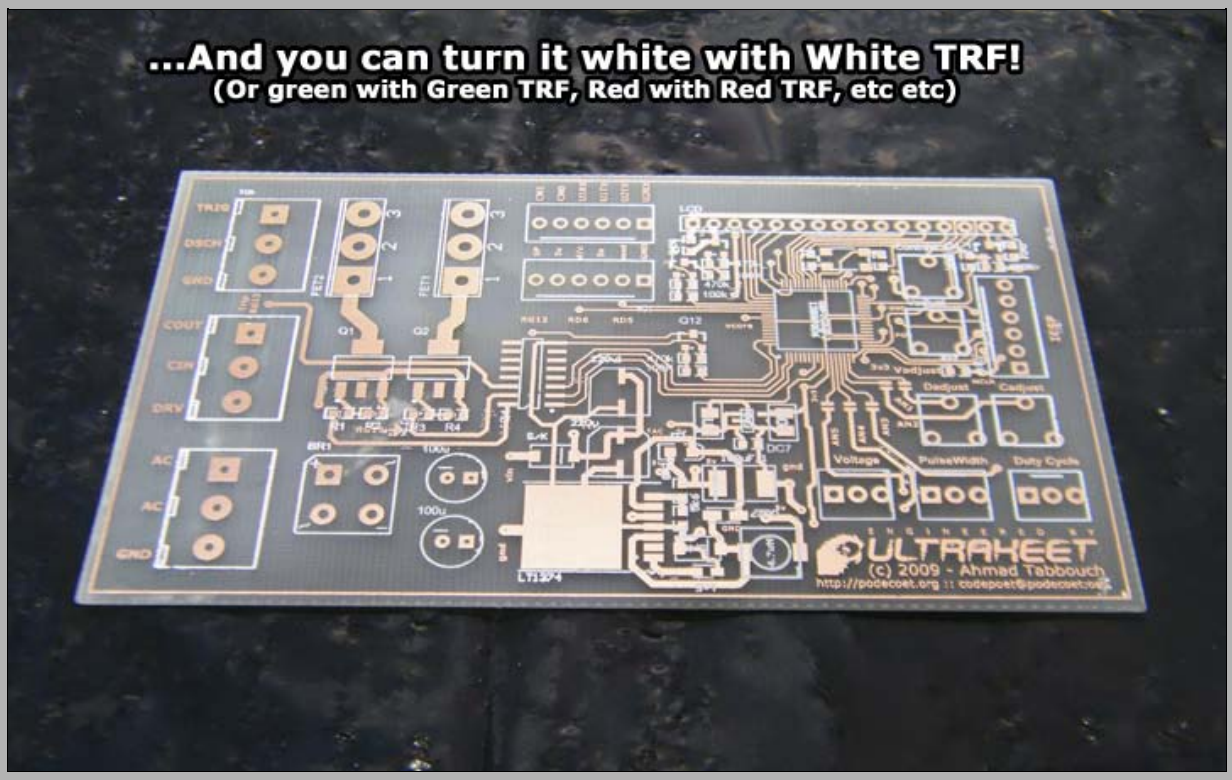

Insert it into your superfuser
(Once again, the taped side goes in first)
GBC
CREATIVE
LAMINATORA4


...Then dump it into a tray of water again
(This process can take up to 60 seconds, it's ready when the paper has loosened)


Holy cow, IT WORKED!
(It looks far more awesome in the real world!)

How is **THAT** for a homebrew PCB! As I mentioned earlier, the same method can be applied to create a silkscreen (in fact, you can apply it above the mask too!) - If you don't like the mask, you can simply strip it away with Acetone, Caustic Soda, or my favourite: Soapy steel wool. The important thing to note is, you can also apply a second layer of Green TRF if you get pitting due to dust / etc.





Done! (For real this time) - I hope you've found this tutorial useful.

Prior to becoming a distributor for PulsarProFX, I actually fell in love with their products after trying EVERY etch-resist method over the past ten years. I found they're the perfect balance between price and quality, and I've been getting many, MANY emails off my personal website (http://www.podecoet.org) inquiring about my PCB creation methods.

So if it may seem as though I'm a little biased, it's probably because I am! ;)

Enjoy!

-PodeCoet
codepoet[at]podecoet[dot]org