Emco retrofit with UCN5804B

A while ago i bought an Emco 5CNC lathe and an Emco F1 Mill,
Mechanically these machine's are great, but the control wasn't so great.

While searching for a poor-guys way to retrofit it, I've read hundreds of posts and browsed hundreds of websites. But then I found a post on the Yahoo! Emco_cnc_users group. It was posted by Gelandangan and had the following text:

> "Hi
>
> *Funny, this seems to be the first post :)*
>
> *A little background on my experiences.*
> *Okay, I own a F1 CNC mill for about four years now. The native programming for the F1 is in a word SUX. So, I look around and found the company WelSoft, its www.welsoft.co.uk and looked at their Wellmill conversion board. Simple thing methinks, but godalmighty aint they expensive!!!*
> *So, I do a little research on the way the wellmill connected to the emco. Having a circuit diagram for the F1 helps a lot :)*
>
> *Lo and behold, I came up with a design that works for the past 3 years.*
>
> *I use Allegro's UCN5804B chips for step/dir control, TurboCNC from DAK engineering for the Gcode to Step/dir translator, DeskProto for STL to GCODE translator and Solidworks for design.*
>
> *If anyone need some help...*
>
> *Gelandangan."*

That was what I was looking for!
Finally something to start with, and something to work from.
I've searched for the UCN5804B chips on ebay and I found them for roughly $2,50 each. So I ordered three of them. And opened a topic on the Yahoo! Message board where I found the message in the first place.

I could have never done the retrofit on my own, I just don't have the experience with electronics. So, if you're reading this, keep in mind that I'm not the one you should thank for this manual, thank the ones who've made it possible. "I'm just the messenger".

Okay, enough introduction, let's get into how it's done, and more important, how you can do it!

This retrofit is a bit more complicated than the Emco 5 PC retrofit which was published by the Digital Machinist in the Summer 2007 magazine.

We will need a couple more parts and tools to get this done.

Here are they:

- A blank PCB with vertical copper lines on the back
- Soldering station with tin.
- Wires, lots of thin wires
- Shielded cable, For connection the Emco stepper board and for an serial cable.
- 3 Allegro UCN5894B chips (or two for a 5 CNC Lathe)
- 12X 5.1K resistors (or 8X for 5 CNC lathe)
- 6X 10K resistors (or 4X for 5 CNC lathe)
- Some small tools, screwdriver, tweezer(?), hex keys etc.
- 25 pin male LPT connector (we connect the machine's controls straight into the pc's parallel port)

Image 1

The first thing I did was to solder the chips somewhere onto the PCB. Keep in mind that the chips must be in the opposite direction as the copper lines are. (Lines vertical, chips horizontal and vice versa)

As soon as they're soldered on, cut the copper lines between the soldering on the chip as shown in image 2. The copper connecting pins 4 to 15 and 5 to 14 can be left intact if desired. All of these are ground pins
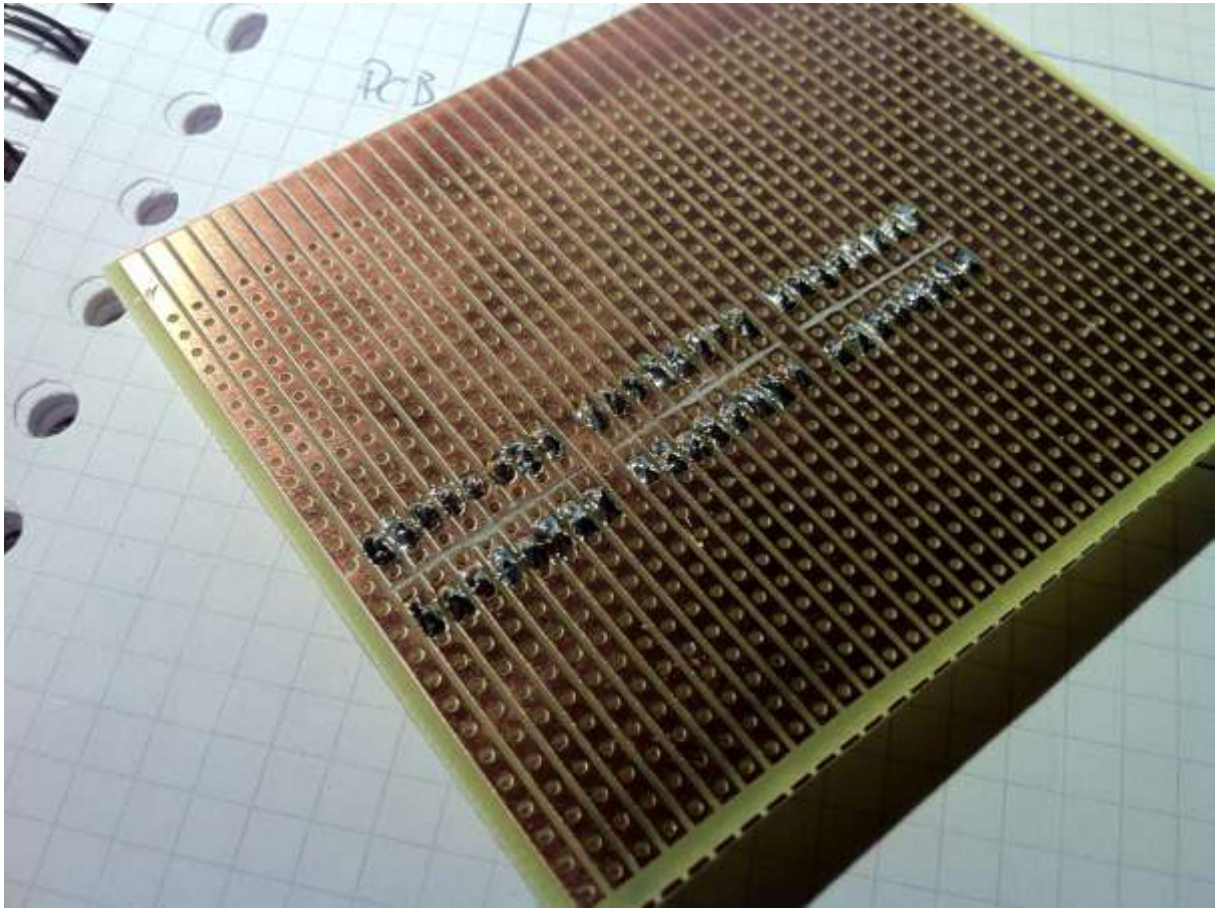

Image 2

What I did first, was to connect some wires on it as you can see in image 3. (You will see on other pictures later in this manual that the wires have been replaced for other shielded cable. Don't get confused by the different cables in the pictures)
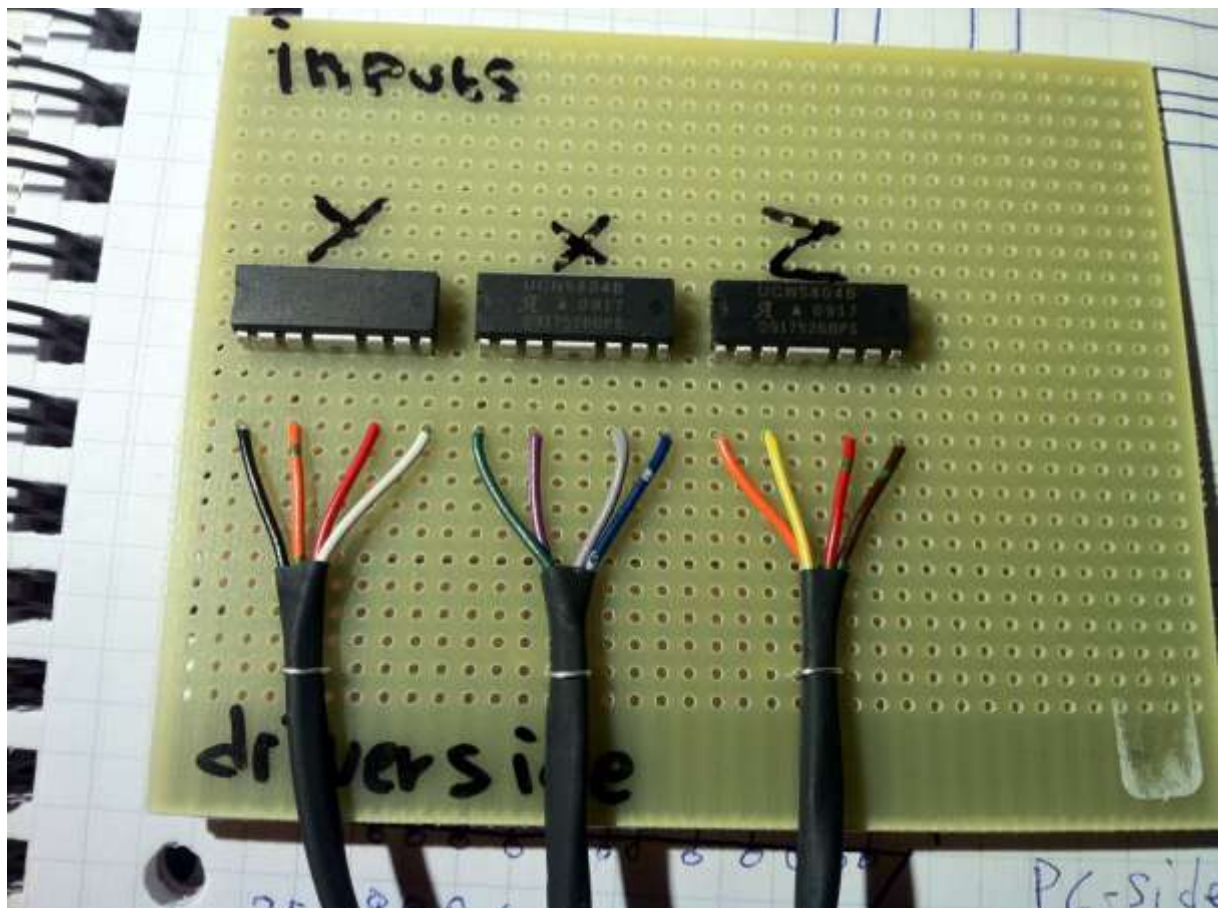
Image 3

From here we take quite a big step forward. First I'll show the original UCN5804 schematic. And then my hand drawn connections. I'll comment each step as we move forward, and later on I'll post some photo's when it's done.
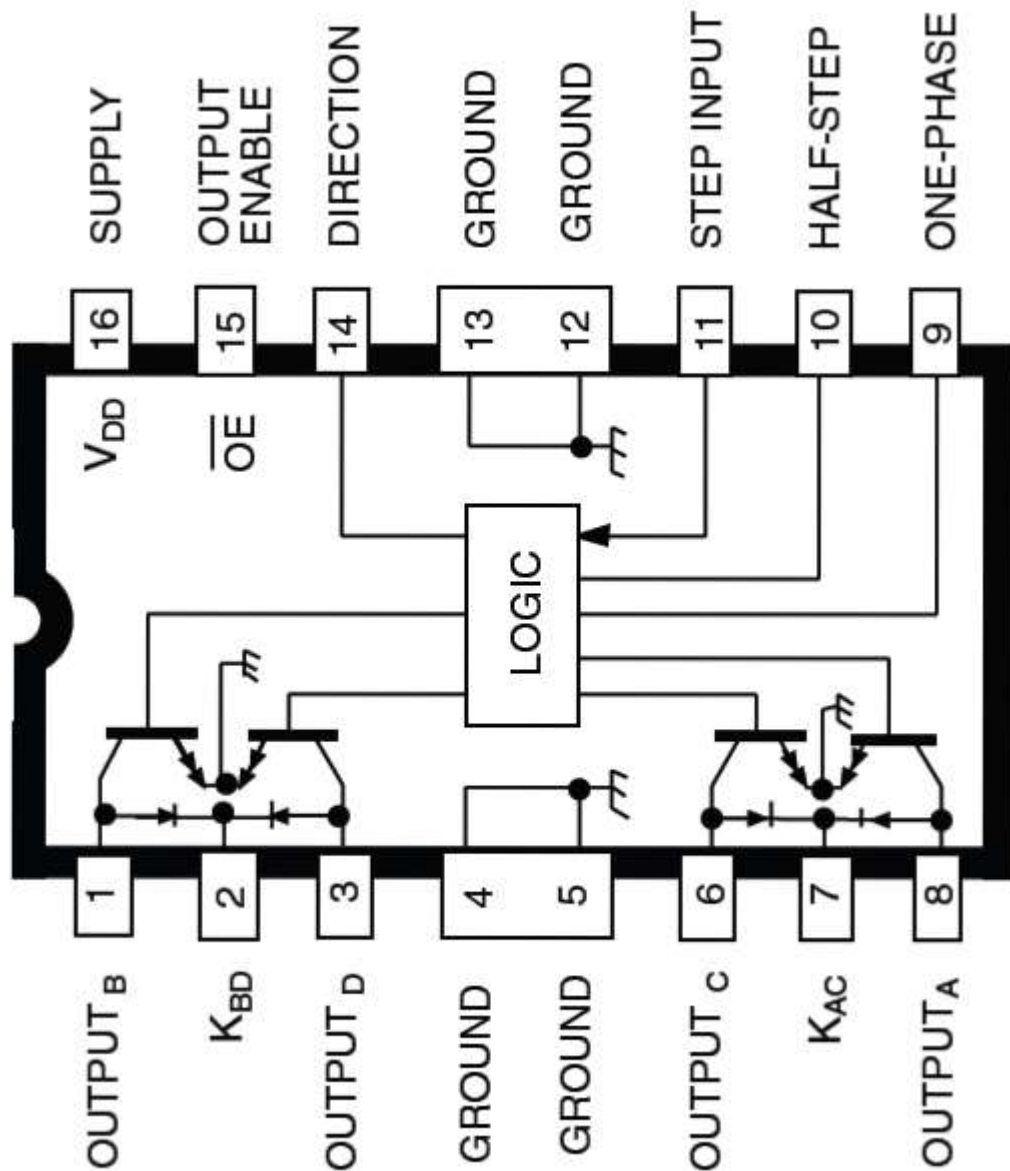
Image 4

In image 4 you see the schematics that was provided on the UCN5804B datasheet. I've pasted it here because it shows the original inputs and outputs. If you use google and search for "Allegro UCN 5804B" you will definitely find the original datasheet with information that I have not provided here. I'm not going to explain how the logic works because 1. I don't know how the logic works and 2. You probably don't need to know it either.
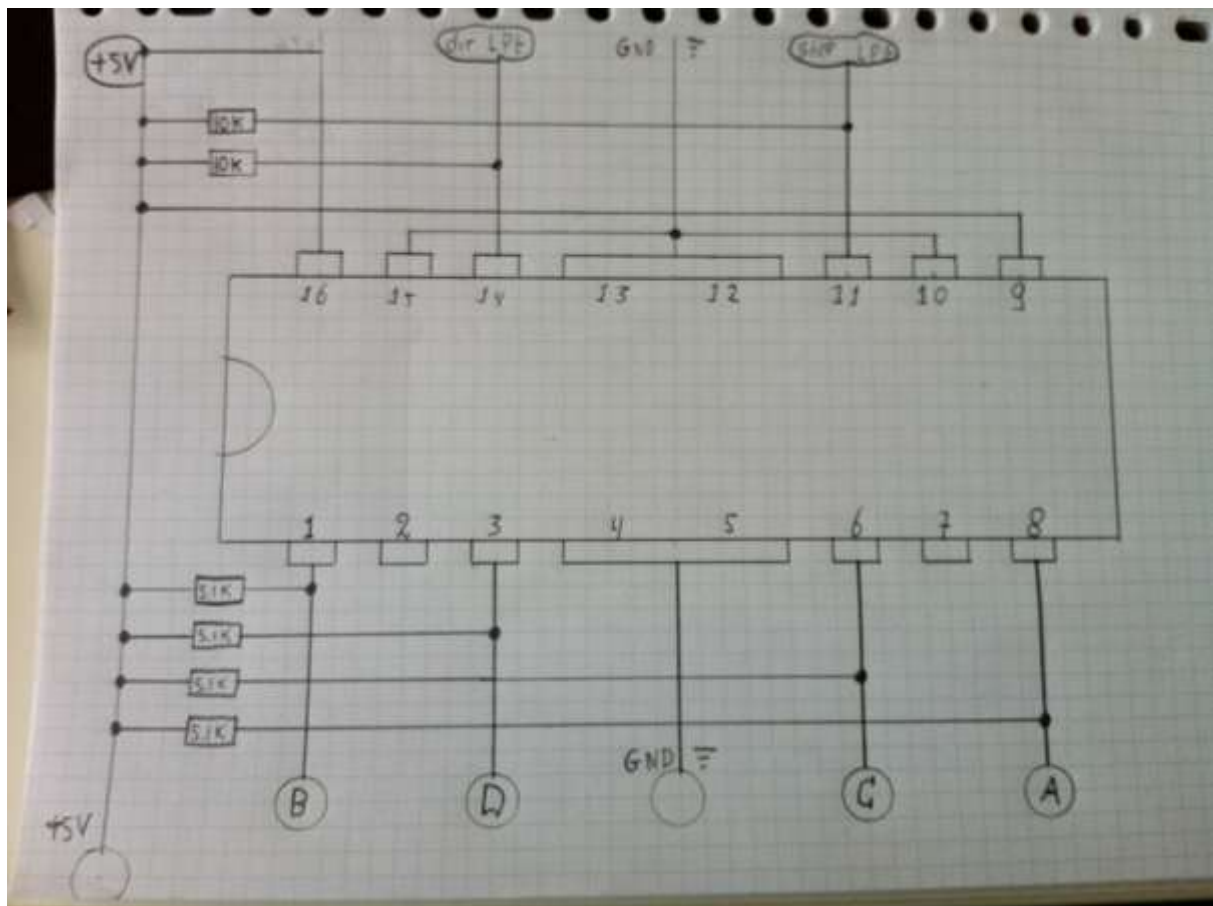
Image 5

 Above in image 5 you see my hand drawn "schematic". On the top you'll see the inputs (+5V, GND, Dir signal and Step Signal) and the two 10K pull-up resistors. And on the bottom you'll see the outputs (+5V, GND, B, D, C and A) . (According to the data sheet the schematic shows (see pins 9 and 10) the '5804 is set up for "One Phase" a.k.a. "Wave Drive" stepper operating mode. This contrasts with the normal Emco operating mode which is "Two Phase". Both of these modes are considered "Full Step" drive modes. However, operating in One Phase mode results in operating the motors with half the torque they are capable of and what the machine is designed for.)

This is how I've set it up:

I pulled a +5V and a GND source from the Emco Power Board (The powerboard is located on the right side of the cabinet. Completely on the bottom you'll see a bunch of connectors. Just remove what's in the connectors 5 and 6. And screw 2 new wires into connector 5 and 6. Pin 5=+5V and pin 6=GND)

I put the +5 volt cable on my PCB somewhere on the right side, so I had one vertical copper line powered with +5 volt. And from there I pulled the source for my chips (see image 9).

I also connected the copper line next to my chips on the left side. So I had another vertical copper line sourced with 5 volt. I used this for the pull up resistors and to connect to the stepper interface board later on.

So, at this moment we have 4 copper lines sources with 5V (if it's a mill, it'll be three lines if it's a lathe) and pin16 from the chip has been sourced with 5V. Connect pin 9 of the chip to either pin 16

or to the 5V line next to pin 16.

Now we're going to place the pull-up resistors. See also image 5 to see how I've done it.

On the input side we connect a 10K resistor between the following connections:

+5V to pin 14 of the chip.
+5V to pin 11 of the chip.

On the output side we connect a 5.1K resistor between the following connections:

+5V to pin 1 of the chip.
+5V to pin 3 of the chip.
+5V to pin 6 of the chip.
+5V to pin 8 of the chip.

Now we take the wire that is connected to pin 6 on the Emco power supply board, this will be our GND. Connect it to a free copper line somewhere next to our +5V copper line. So we have one vertical GND line. From here we connect it to pin 12 or 13 on the chip. So the chip has also GND now. Also connect pin 10 and 15 to pin 12 or 13. So pin 10 and pin 15 have been grounded as well.

Now the whole PCB is ready to use/install. All we need to do from this point is connect the PCB to the Emco stepper board and connect the inputs to our parallel port cable.

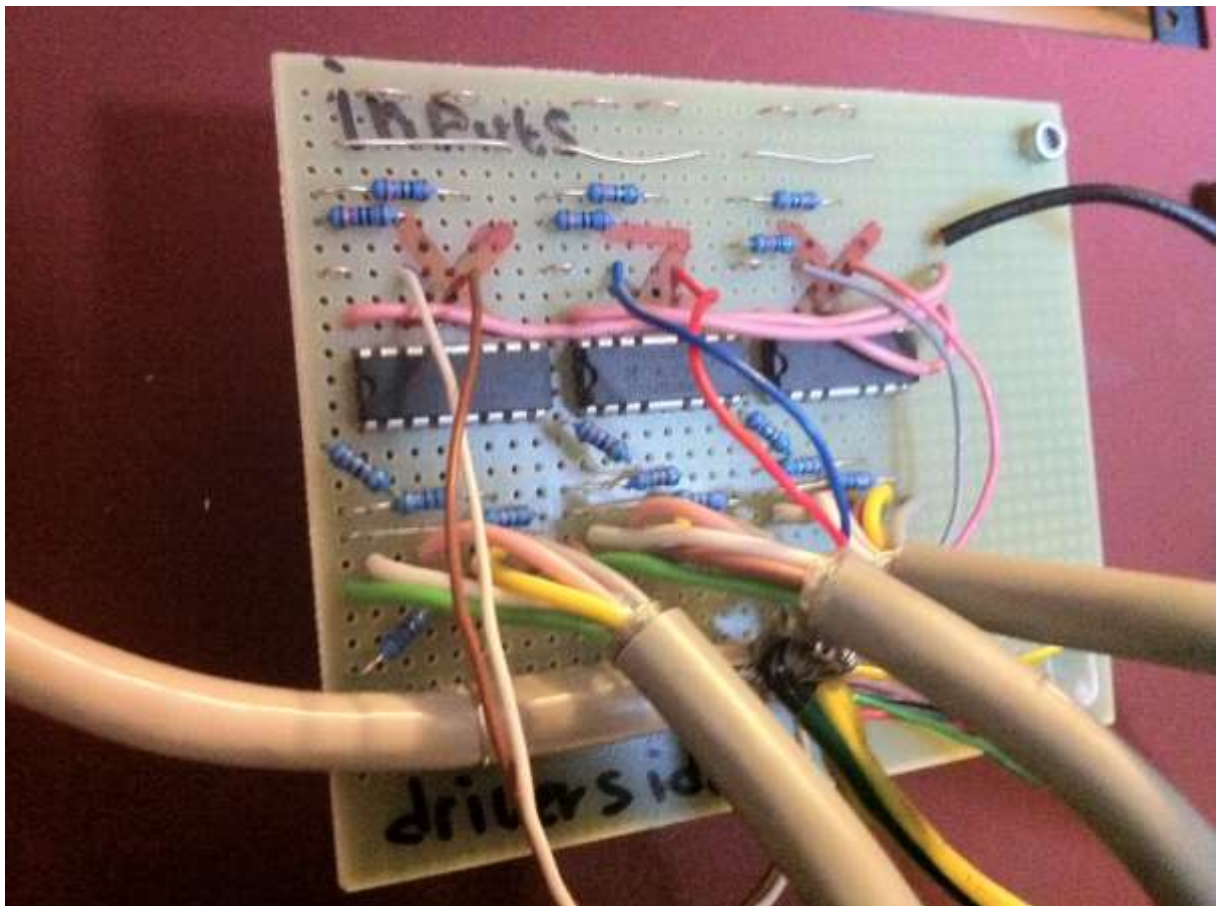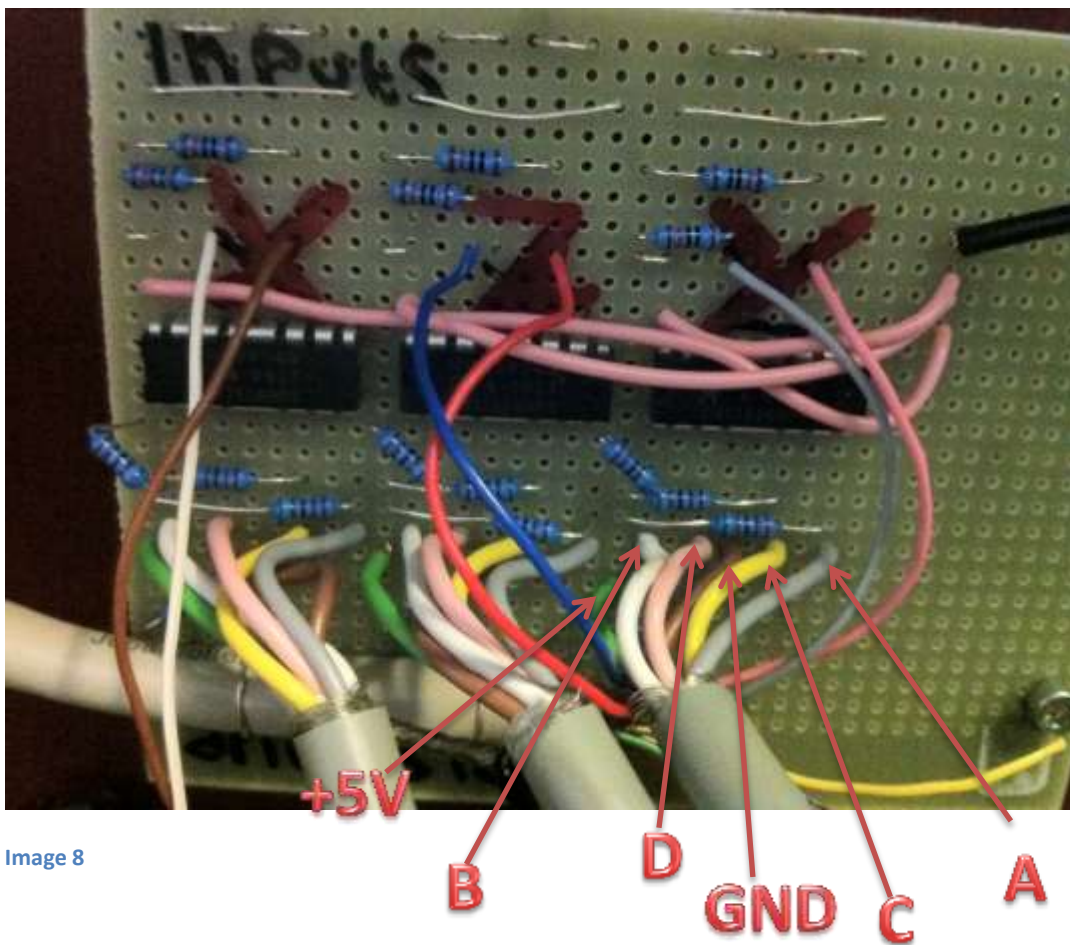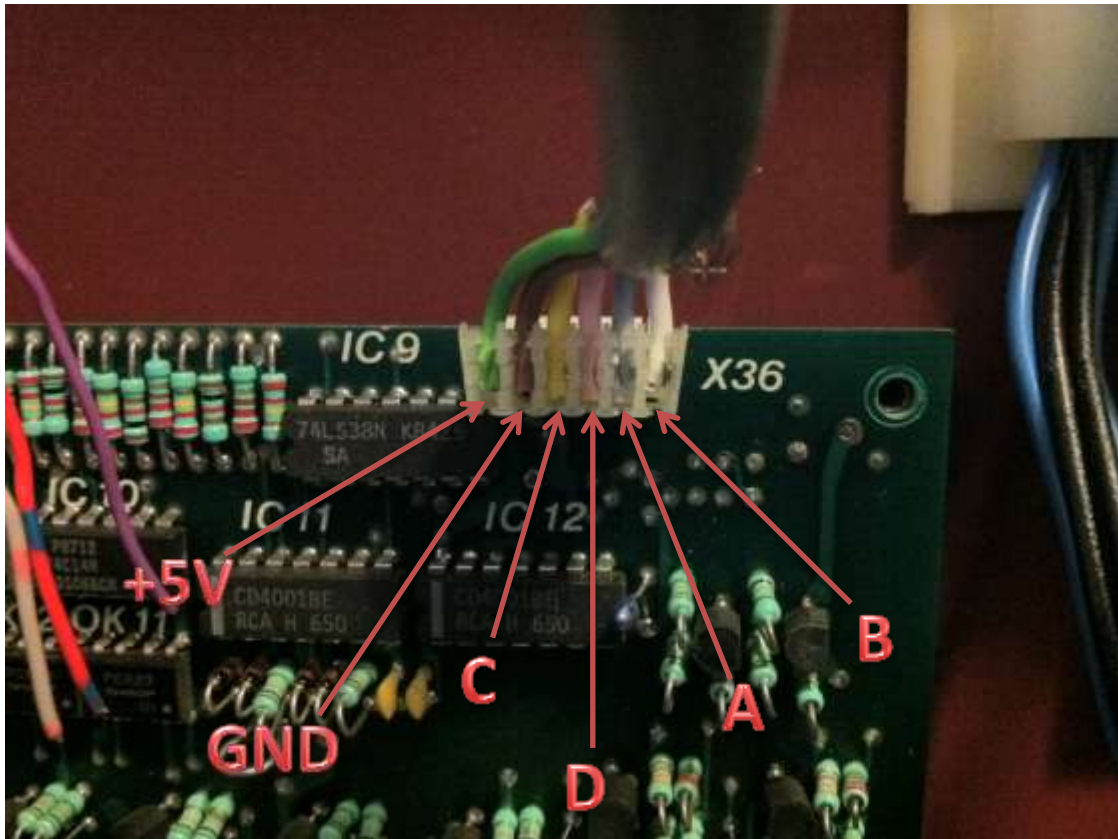But first I'll show a few pictures of my setup:

Image 6

Image 7
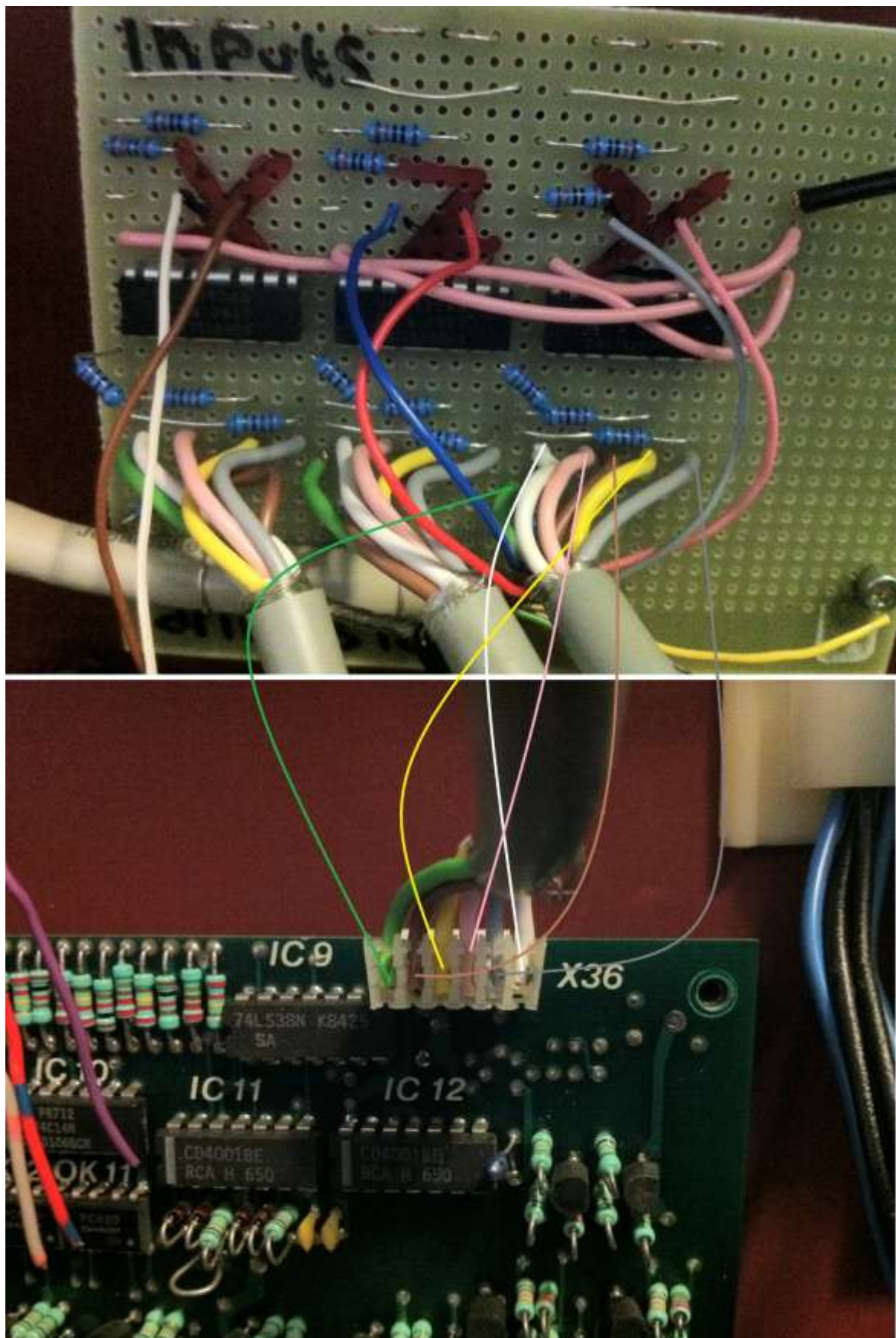

Image 8

Image 9

Image 10

On the input side we have still one thing to do, connect a shielded cable to one side of the chips and a parallel port connector to the other side.
In my case I had the following connections:

X Step 3 (Brown)   Dir 2 (White)
Y Step 5 (Pink)   Dir 4 (Blue)
Z Step 7 (Red)   Dir 6 (Grey)

These were the pin assignments for the parallel port connector. image 11 shows three shielded cables going to the Emco stepper drive pcb and one cable that goes to the PC Parallel port.
So, one side goes into the machine, and the other goes to the computer. Connect the wires to the pins on the chips as well as the parallel port connector. Ground both ends of the shielded cable. One side to the ground of the machine, the other side to the steel housing of the parallel port connector.

Hook up the machine to your PC, and configure Mach3 using the setup guide provided on the mach3 website. It's really easy. And for the stepper motor settings, I have been using the settings provided with the retrofit guide from Digital Machinist. As mentioned earlier.

If you've been watching the pictures in this document and IF you were able to understand what I I've been talking about you should be able to retrofit your own Emco machines like I did.

I know I'm not a copywriter, and I'm not trained in either electronics or writing study books. But I do hope that you can retrofit your own machine. And I wish that a lot of people are having success trying to get their machine running with a modern control for just roughly €20,00. That is all that it has cost me.

It's definitely worth the effort. And comparing the €20,00 to several hundred for new drivers and steppers it's really cheap.

By now I'd really like to thank the guys at Yahoo! Yahoo_Emco_users group:
http://finance.groups.yahoo.com/group/Emco_cnc_users/
Especially Gelandangan for making the first post/idea about using these chips and Henk (C5CNC) and Walt (cncwannabe) for helping me out when I was stuck with a malfunctioning setup and for reviewing this tutorial. You can read all about it on the forum.

Good luck with your own retrofit,

Peter.