Wiring

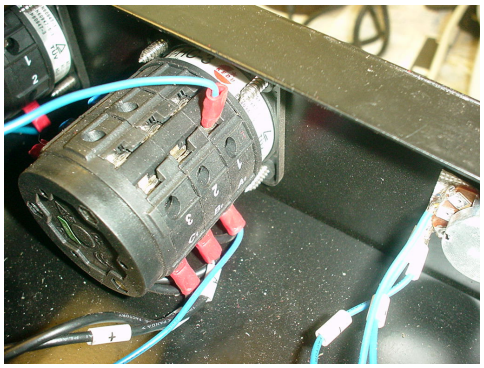
The wiring consists of five main job items :-

Wiring into existing switches and speed board.
Wiring for speed control
Wiring for the breakout board
Wiring for the E-stop

These all overlap as the wiring consists as a whole and not independent systems. It is proposed to show these as schematic, graphic and pictorial views so the builder is perfectly clear on these issues.

It must be stated at this point that mains voltages are present in this conversions and the builder MUST be conversant and familiar with working on these systems. If you are not you MUST consult someone who is. As we have no way of knowing who is going to convert one of these machines we must stress this point as it is something we have no control over.

Remove the thin blue wire from the forward reverse switch that goes to terminal 1. Cut the spade terminal off and pull out through the lower panel. Using a piece of blue light cable connect this back to terminal 1 on the forward reverse switch and leave enough to equal the original cable.
These two blue cables go to the breakout board and are for the spindle interlock and start.

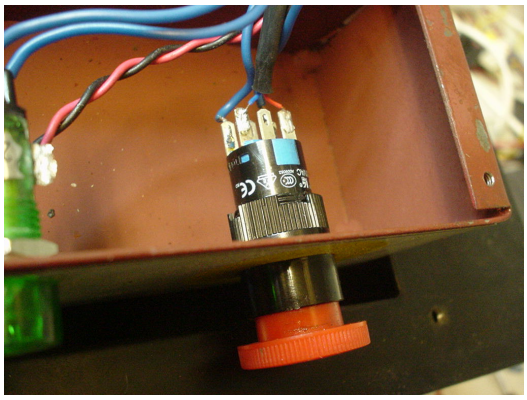


Remove the three cables from the speed control potentiometer at the speed board end marked P1, P2 and P3,
Mark and tag these and tie back into the top as they are no longer needed.
If you want, the speed pot can be removed and the hole blanked off.

Two light wires are then needed to replace these on the speed board and are connected to P1 and P2 [P3 is unused] .Again these two cables are used for the spindle speed control .
White goes to to P1 and yellow goes to P2, P3 is not used.

The last bit of the conversion wiring is to connect the E-stop into the system.

The original E-stop is a double pole, double throw switch where only one side is used so we are going to use the unused side. Below is a photo of the switch in position.



We need to use two terminals that are broken when the switch is pressed. Using the multimeter set to continuity and with one end pin as common find which of the other two pins is broken when the E-stop is pressed. The usual layout is how the other set of terminals are used but double check with a meter. Using the length of twin cable supplied solder a wire to each and thread this cable back through the conduit to exit out the lower panel access.

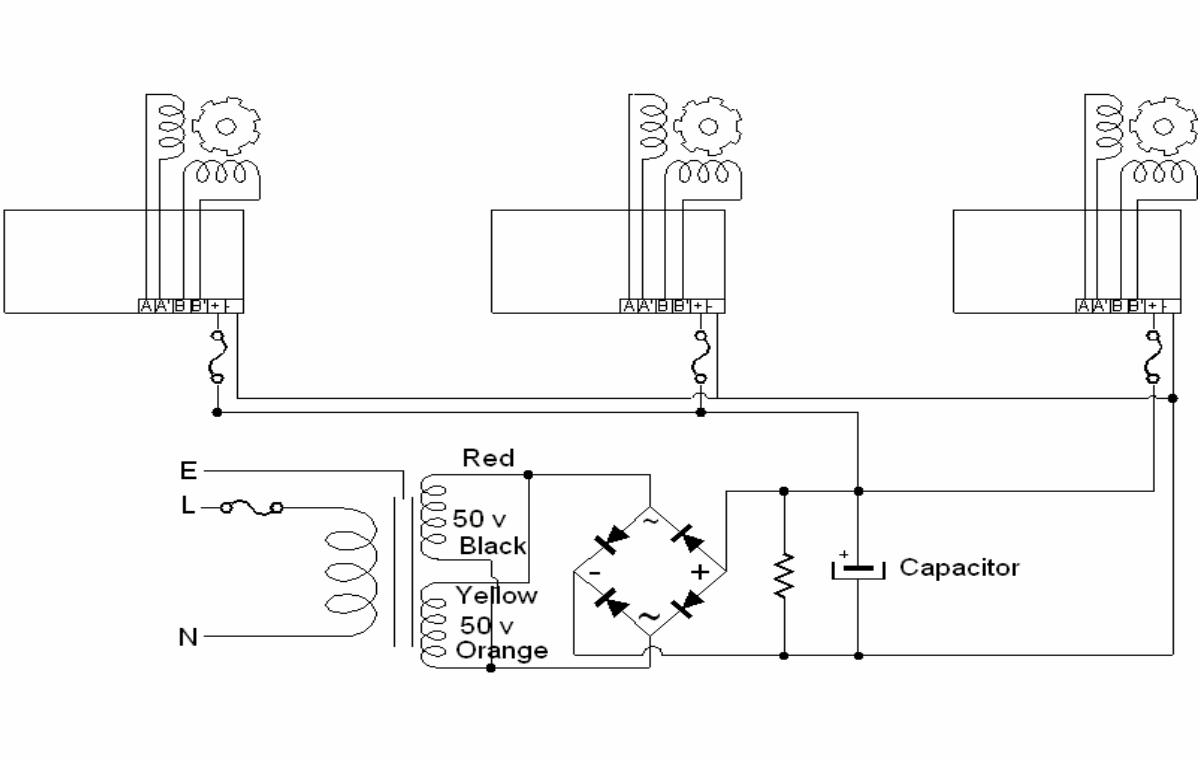
The cover can then be fitted back on top of the E-stop enclosure. And the enclosure fitted to the machine.

Above is the schematic for the stepper drive system.
The mains is taken from the mains switch where it goes through a 7amp fuse to the transformer.
The two 50 volt outputs are taken from the transformer and paralleled up for maximum power and then go to the bridge rectifier where the AC current is converted to DC.
This is then smoothed by the capacitor which increases the voltage to about 63 volts DC which is well within the safety limit of the 80 volt drives. The resistor across the capacitor is there to discharge the voltage in the capacitor when the system is off as a capacitor can hold a large charge that can damage sensitive systems.
When working on the system always allow 5 minutes for this to discharge the voltage before working on the system.

THIS VOLTAGE IS ENOUGH TO GIVE A NASTY SHOCK OR DAMAGE A DRIVE.

From the capacitor the voltage is taken through three separate 5 amp fuses to the stepper drives.

IT IS **VERY IMPORTANT** THAT THE POLARITY OF THE DRIVES IS NOTED AND KEPT TO. IF A DRIVE IS WIRED IN REVERSE IT WILL BE IRREPARABLY DAMAGED AND THE DAMAGE IS SUCH THAT IT IS OBVIOUS AND NO WARRANTY WILL BE ACCEPTED.



Below is a picture of the enclosure. The schematic diagram on the previous page shows the correct wiring but doesn't show the layout of the components.

Bolt the transformer to the base using the M8 bolt supplied with a rubber washer below and above and the shaped dish washer on the top. Secure the capacitor, bridge rectifier, mains fuse block and capacitor as shown in the photos below.

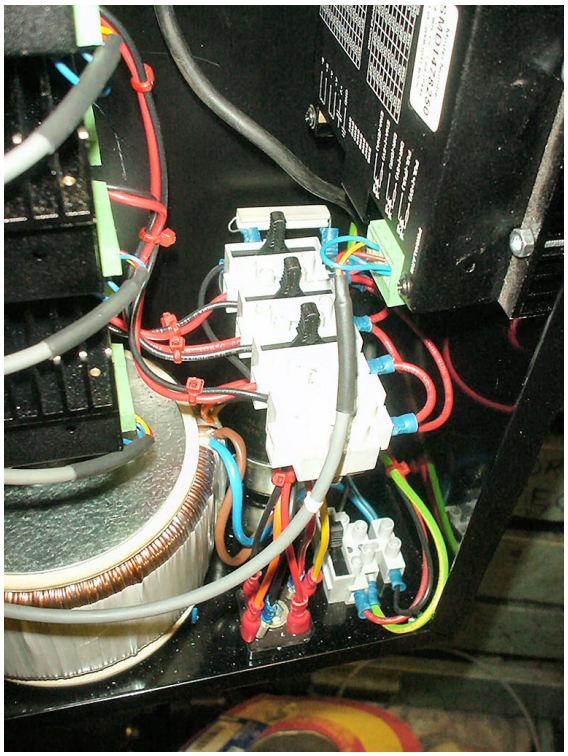
Three motor drivers are fitted on the left of the enclosure designated X, Y and Z reading from the bottom.

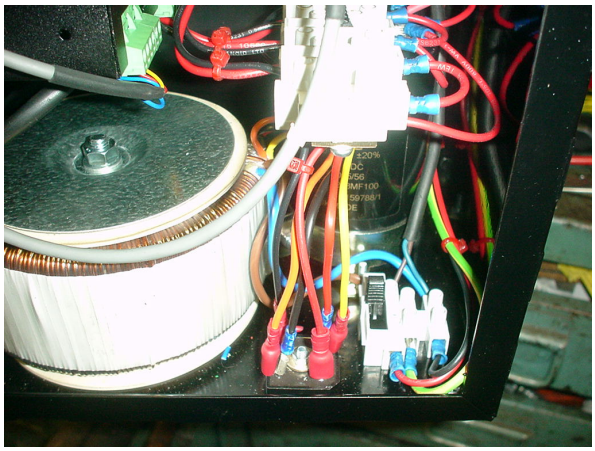
On the output side of the mains fuse holder the brown transformer cable goes to the fused side and the blue cable goes to the opposite end. The centre connection is left empty at this stage for the earth cable when the enclosure is fitted.

From the transformer red and yellow are joined and go to one of the terminals marked ~. black and orange are joined and go to the other terminal marked ~. As these are AC outputs it doesn't matter which goes to which, only that the colours named are kept to.

From the + terminal a red cable is taken to the + terminal of the capacitor and from the - terminal of the rectifier a black cable is taken to the - terminal of the capacitor.

On the - terminal the brass fuse strip is fitted with three smaller stepper fuse holders fitted. The unfused connectors are connected to the strip by the location screw and so do not need a cable to connect then to the supply. Three red cables are then taken from the + terminal to each of the fused inputs, lastly the dropper resistor is connected across the + and - terminals of the capacitor.



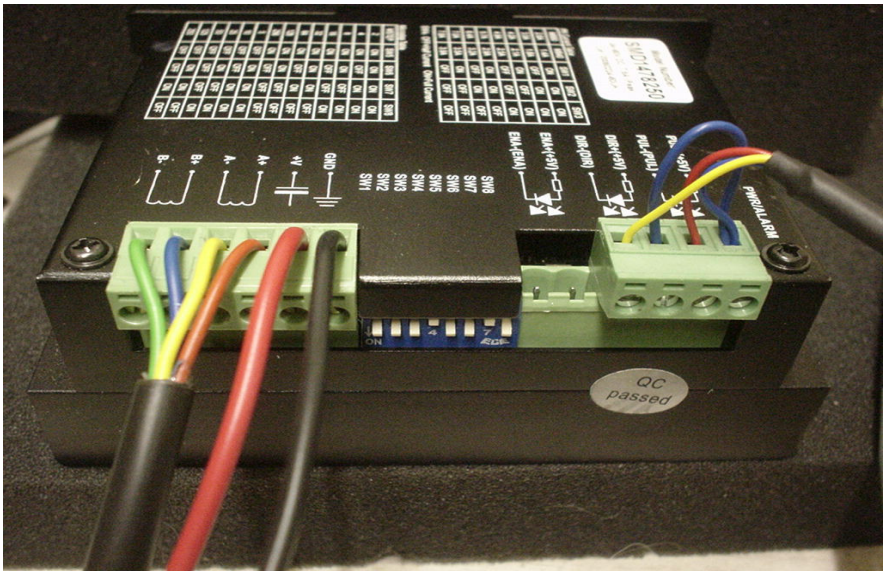


This completes the power side of the installation and if a temporary mains feed is fed to the mains fuse holder and the 7 amp mains fuse is fitted you should have about 63 to 65 volts DC across the stepper fuse holders.

Remove the mains power and allow to discharge through the dropper resistor before carrying on .

The next stage is to wire the drivers up on the power and stepper supplies. All the drivers are wired the same and all the settings are the same on each driver so we will only cover the wiring of one unit.

When the drivers are dispatched they come out of stock and the settings may not conform to what is needed for the machine. There are two settings on the drivers, output amperage and microsteps. For the X3 these need to be 2.8 amps and 8 microsteps respectively. The following picture shows the dipswitch settings, set all three drives [four if the 4th axis is being fitted] to the positions as follows :-
Switches 1,2 and 3 are set to on, 4 is set to off, 5 and 6 are set to on, 7 is off and 8 is on.
The connections on the stepper connector strip are as follows :-. + goes the the stepper fuse via a red cable. - goes to the negative connector on the strip.via the black cable.



The stepper cable from the motor then goes red to A, yellow to A1, blue to B and green to B1
This applies to all three drives. The two terminals marked Enable are not connected.
IT IS IMPERATIVE THAT THIS WIRING IS KEPT TO AND DOUBLE CHECKED.

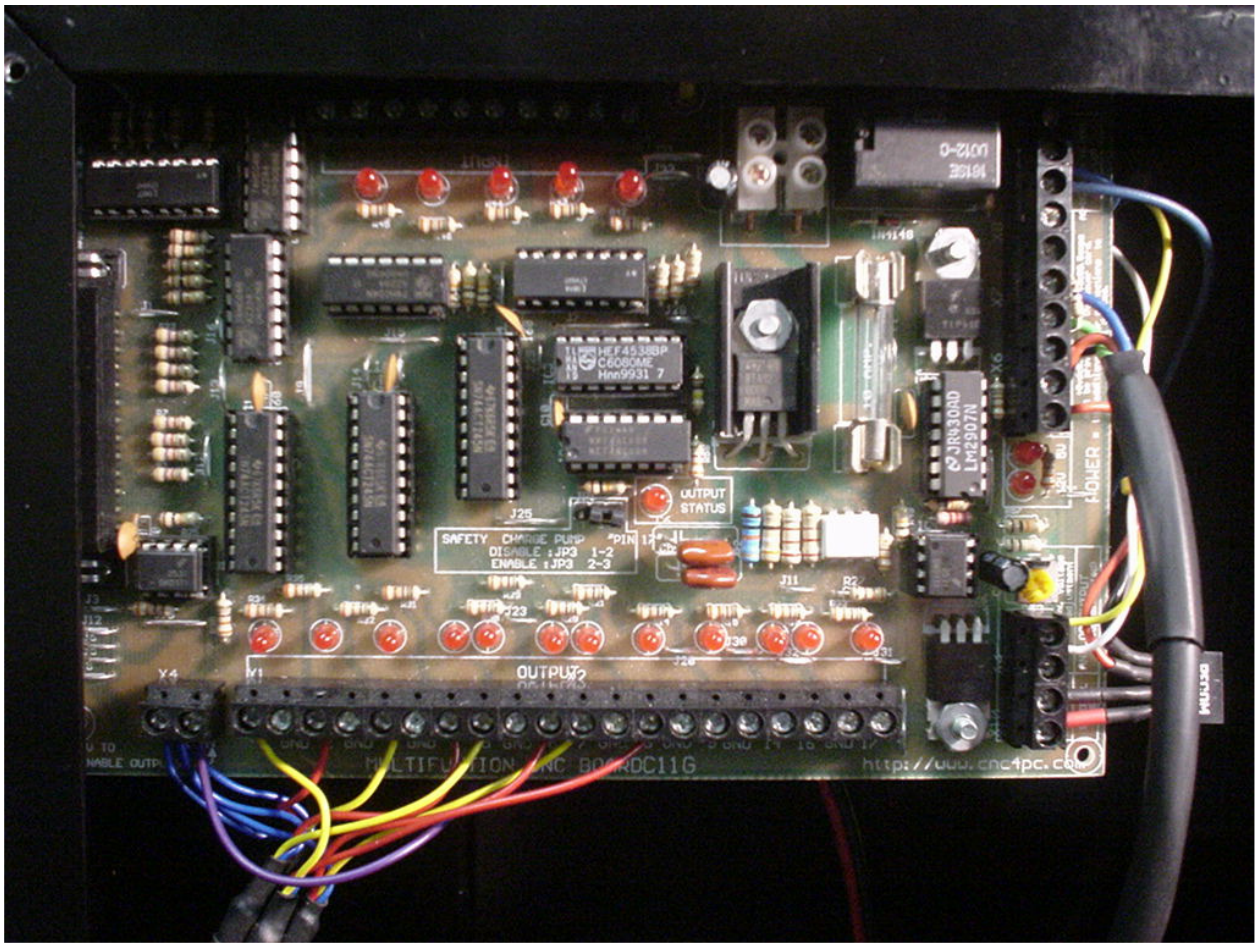
Fitting the Breakout Board

The purpose of the breakout board is to act as a buffer between the machine and the computer. Incorporated in the design of this board is a device called a Safety Charge Pump Thist isolates the machine until the controller software, Mach3 is ready or in the event of a computer crash holds the machine in a feed hold position. This board is also capable of controlling the spindle start and speed, hence the preliminary work done on the existing electrical box.

At this stage it's as well to fit the enclosure onto the original electrical box as connections will be needed to be made between the two .

The board require three separate power supplies to work, these are 12 volt for the relays and on board supply, 5 volt for the logic and a separate 12 volt supply for the isolated speed control. Due to changes made to the board for the X3 the supplied power supply only supplies two of the required voltages. It is hoped later boards will have this modified but in the meanwhile a 12 volt DC to DC chip is supplied to solve this .

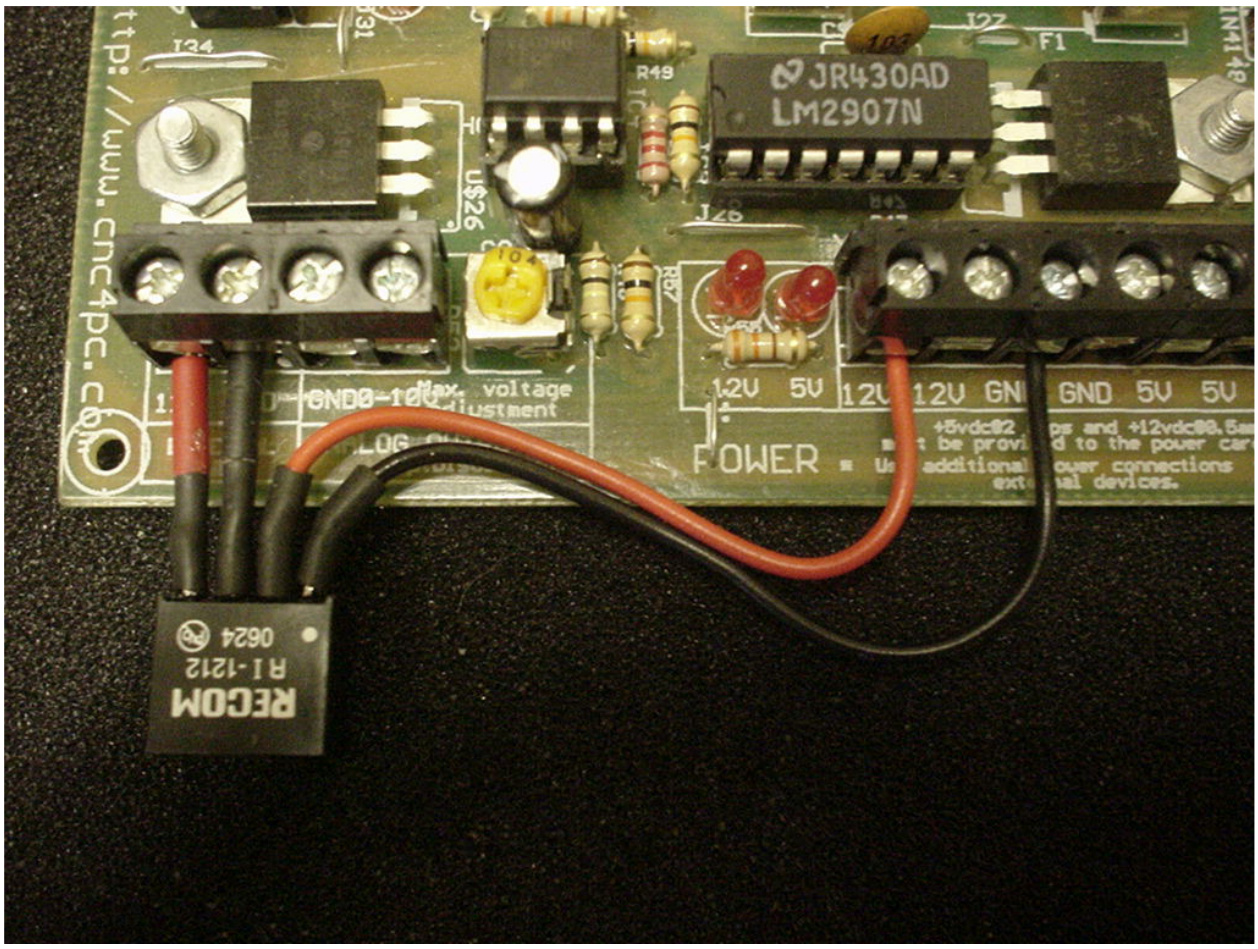
To fit the board it is necessary to remove the two screws securing the 25 D connector and use these to hold the board into the cutout in the box..



The power supply is also fitted to the top of the right hand side. A clip will have to be made for this.

The following figure shows the connection of the 12 volt DC to DC connector.

Consisting of a small chip this take the original 12 volt supply and converts it to an isolated 12 volt supply for the speed control. Using two surplus wires from the stepper motor common is connected to pin ?, 12 volts connected to pin ? And the other two pins are fitted directly into the connector strip.



On the right hand side of the board the connections are ground on the power supply to ground, 5 volts to 5 volts, 12 volts to 12 volts.

Two wires from the spare ground and 12 volts go to the DC to DC convertor and the two output wires go to ground and 12volts input to the speed control.

The two terminals on the right marked grnd and 0-10v are connected to white and yellow respectively.

The two blue wires go to common and NO on the relay at the top right.

It doesn't matter in which order for these two.

On the top of the board one wire goes from 5V to the E-stop and then returns to terminal 10 and the Enable pin, this is to ensure that when the e stop is pressed it disables both the spindle motor and the drives.

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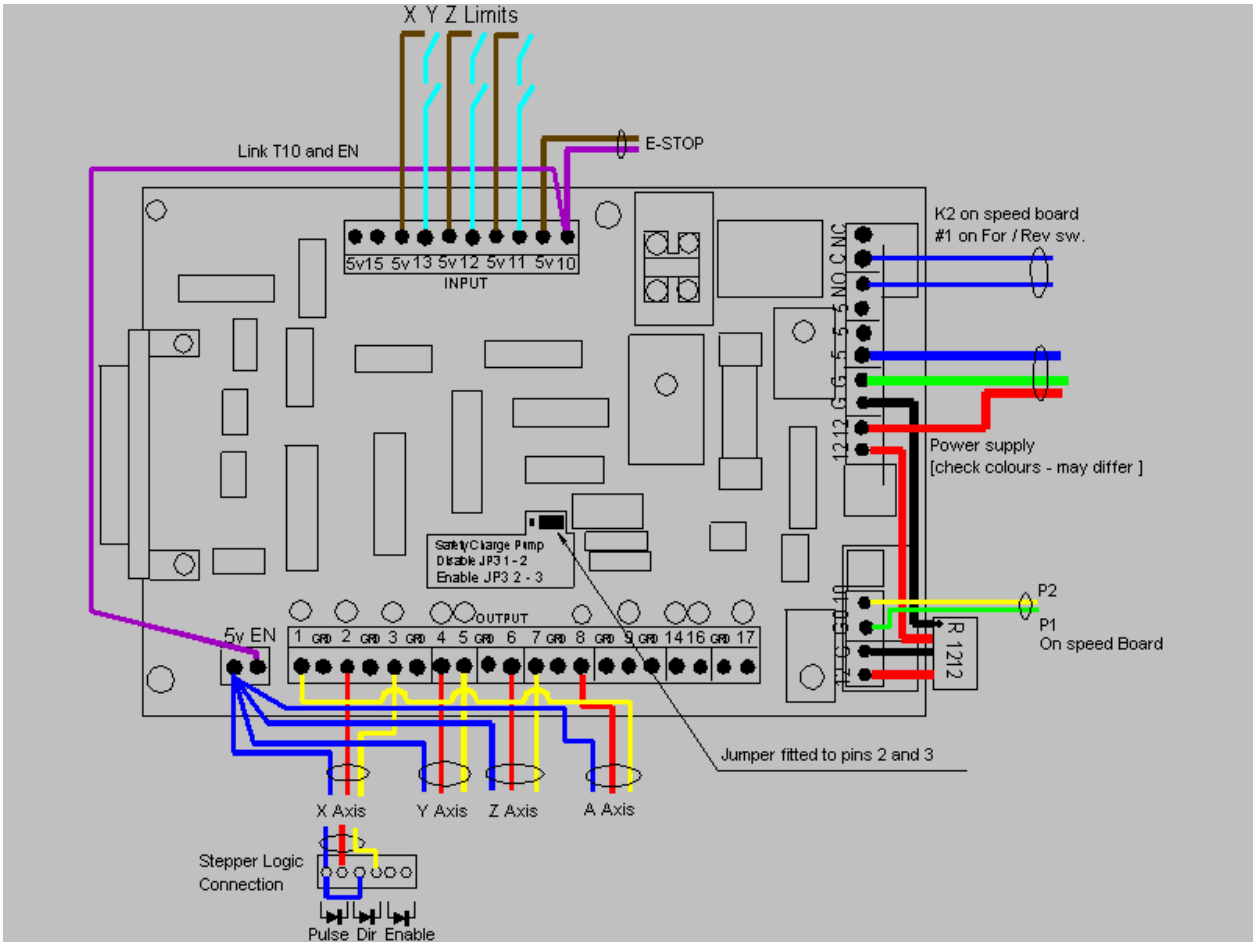
The logic wiring is below and is the complete logic wiring for the C11G board.



The logic to the stepper drives is carried by three [or four] separate light 4 core cabling. Use blue for 5v, red for step and yellow for direction, green is cut back..

Each axis needs a blue 5v cable and the 5v terminal also needs to be linked to the Enable terminal at the side.

For the X axis use red to T2, yellow to T3.

For the Y axis use red to T4, yellow to T5

For the Z axis use red to T6, yellow to T7

And for the A axis use red to T8 and yellow to T1

These terminals must be used in this order because the software outputs signals to designated pins and changing any connections will not match the software.

The logic connections for the drive are shown in the diagram above and in the picture at the bottom of page 5.

It cannot be stressed enough that all connections need to be checked and double checked before any power is applied.

Final fitting

At this stage the final wiring can be done and various tidying up details need to be done.

The mains wiring needs connecting to the mains input fuse including the earth lead.

The stepper cables to the X and Y axis also need to be secured to the base of the machine but make sure that there is enough spare when the axis are at maximum extent.

The rear cover also needs to be fitted to the enclosure by the self tapping screws supplied, take care that when drilling through you don't hit any of the internal components.

Before the cover is fitted take care to check the wiring very carefully especially as regards polarity and how the steppers are wired up as these can easily be damaged.

Setting up and Operation

Supplied with the kit is a CD containing the controller program, Mach3 plus some other files and programs.

It is advised that a stand alone PC is used as the controller for this machine. It needs to have either Windows 2000 or XP, [any version] It's best to install just a basic install with no networking or internet access

On the CD in the Mach3 folder there is a file called Setup 049.exe install this on the computer accepting all the defaults.

Once installed go into the Mach3 folder and delete the file called mill.xml copy the file off the CD called mill.xml into the Mach3 folder on the PC. This file contains all the setup information that the X3 mill requires.

This will save any motor tuning and setup by the operator needed.

If for any reason you change any settings inside Mach3 then re-save this file to a safe place as it's now the default program to run the mill.

Once the program has been installed it's important that the PC is closed down and restarted so it can find the driver.

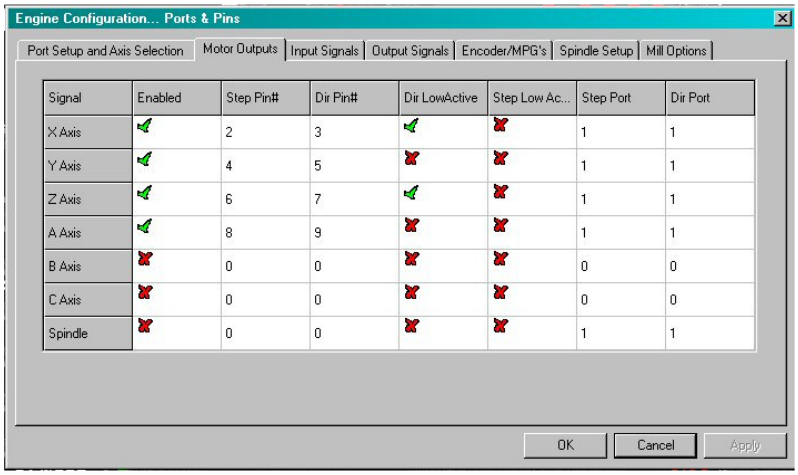
Once the program been installed then the computer can be connected to the machine and start Mach 3, then switch the machine on at the mains switch on the machine. Using the cursor keys on the keyboard you should be able to jog the axis.

The sideways keys move the X axis, the up and down keys move the Y axis and the Z is moved with page up and page down.

In the case of the Z axis page down means tool down but on the X and Y axis the keys mean the direction the TOOL IS MOVING, not the table.

If for any reason the direction is reversed which can happen if the motor has been wound differently from others then it's a simple job to change this.

On the Mach 3 screen select Setup from the top toolbar, then Configure, then Drivers and in the column marked polarity change the tick to a cross on the axis concerned. Exit the program then restart the program and check that the alteration has taken place. Once all three axis are working as prescribed the machine is ready for use.



It is not the aim of this book to explain the use of the machine or the way G and M codes work. This book is solely for fitting the kit supplied and getting it working.

On the CD are some extra programs in separate folders

Dolphin	:- This is a demo 2-1/2D CAD / CAM program for doing drawings and converting them into code. The CAD program is free and unrestricted but the CAM program needs a license.
Mach 3	:- This is the controller program.
Mach 3 Help	:- This folder contains the help files in .pdf format for users of Mach 3 Must be read before using the machine.
Mill.xml	:- Setup file for the X3 mill.
Vcarve	:-This is the demo of an engraving program for converting artwork into carvings and engravings, ideal for nameplates etc.

Assistance

Assistance is available for any problems encountered when building the kit and to get the machine running.

The kit price does cover some free support which initially need to be done by contacting John Stevenson via e-mail in the first instance at john@stevenson-engineers.co.uk

If assistance is needed as regards running the machine, writing code or use of the machine then in the first instance it's advised that the manual inside the help files on the CD is read in full. This has been compiled by actual users and very dedicated users of Mach 3.

After this there are two very well supported help groups. Both are web based, one is at http://www.machsupport.com and the other is yahoo based at http:www.yahoo/mach2mach3

The first group also has all the upgrades and bug fixes posted there which are free for licensed users.