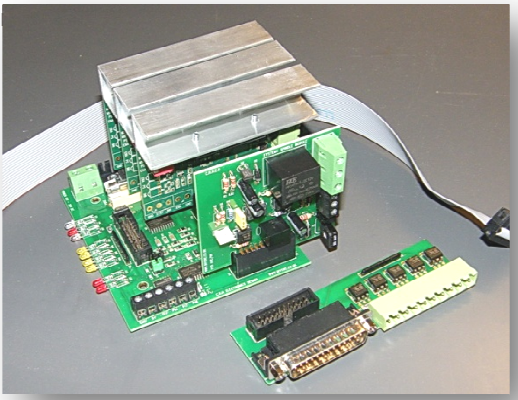
SYSTEM 4C

C R H Electronics Design



SYSTEM 4C

All in one modular 4 axis CNC drive board

By C R Harding

Specifications

Main PCB & Input PCB

- Available with up to 4 Axis X, Y, Z, & A outputs.
- Independent 25 way PC Parallel port board with plug-in input connector
- LED indicator display of Direction for each axis plus Enable, Main power, Power Save mode and relays.
- Un-pluggable stepper boards for easy replacement
- Buffered optical isolated inputs.
- Socket for Optional Spindle control/relay board
- Available populated with 2, 3 or 4 driver boards
- Power save feature to reduce current when not active.
- 3 pin 12V fan connector
- Built in charge pump circuit connected to all output drivers and relays.
- On board 5V & 12V regulators with spare output connections.
- Uses single power supply line (24V -30V DC regulated supply recommended)
- Fused power rail with over voltage protection.
- Slim design for mounting in EN1case
- Boards supplied with 40cm inter connection cable.
- Motherboard size 110 X 93mm, input board 110 X 32mm. FR4, silk screen legend, 1oz copper, RoHS compliant.

DRV30S

- Step increment and current settings for each motor.
- Two phase PWM operation.
- Drive boards have thermal shutdown, UVLO and crossover current protection.
- 1/16, 1/8, 1/2 or full Step selectable with 20%, 50%, 75% & 100% current switch selectable max stepper current.
- Maximum 30V @ 3.0A per phase motor outputs.
- FR4, silk screen legend, immersion gold, 2oz copper, RoHS compliant.
- Board is surface mount for greater reliability.

Spindlemod

- Stepper pulse to analogue voltage convertor
- 10V maximum output
- Can be voltage trimmed on board or via software.
- 10A 240V AC 2 way relay for motor reverse or on/off
- Fully isolated on board power convertor.

Extmod

- Step, Direction, Enable, 5V+, Gnd and Power signals to feed external driver boards like the DRV50 or other third party manufactures driver boards.

Manual V1.2 March 12
Hardware V1.2 March 12

Motherboard overview

Power Input

Maximum input voltage 30V, recommended regulated voltage 24-30V.
If using an unregulated power supply, check peak voltage across output before connecting the System4C board. A 25V unregulated supply can have 35V peak unloaded output. It may be necessary to place a load resistor permanently across the output to reduce the peak voltage as when the board is not enabled the power consumption is quite low.
Power is supplied to the board via a separate 20A terminal block.
A separate connector provides a 5V &12V regulated supply that can be used to power sensors etc.

Signal Inputs

The separate input board has five inputs that are optically isolated from the main board and PC via the parallel port. The inputs use internal power to provide logic switching without an external voltage. Ideal for e-stop buttons or limit switches etc.

Signal Outputs

The board has three spare output connections which are buffered and capable of driving up to 30mA drive current. These outputs are only enabled with the charge pump signal and are all located at the side of the board. These pins can also be used for driving external relay boards.
Note: Pins 16&17 are shared with the spindle control board when fitted; only pin14 is independent.

Module connectors.

The System4C main board has 5 module connectors. Four of these provide power and drive signals for stepper drive boards and the fifth is for a Spindle control board. When using external driver boards with the System4C motherboard you may run the driver boards from a different power rail than that used by the System4 main board. This would also be necessary if you needed to draw higher currents for the external driver boards as there is a limit of 3A on the current available to each socket.

Power Save

The System4C board has a power save system that sends a signal to all four Axis. If there are any signals present on any of the four axis step lines the power save mode will be disabled ie; while running a program. When the signals are absent and the program is complete the power save will re activate reducing the current through the motors and driver chips saving energy and helping to keep everything cool. This function can be disabled by removing link L4 if required.

LED display

The board has several led's. There are four yellow direction led's on the X,Y, Z, A axis, two red signal led's on pins 16&17. A green power save led a red enable line led and a blue power led.

Axis configuration

There is a pair of jumper pads between the X&Y axis connectors that may be configured so that you can have two motor drivers on the X axis, as sometimes needed on wide bed routers. See fig2.(note: Mach3 can be configured in software to do this feature but not all other software packages have this)

Power Outputs

5V+: Power output from the onboard regulator. This can be used to work other circuit boards, sensors, relays etc. **Maximum external load must not exceed 100mA.**
12V+: Power output from the onboard regulator used to drive external relays. **Maximum external load must not exceed 100mA**
12V+ 3 pin Fan connector

Charge Pump Circuit

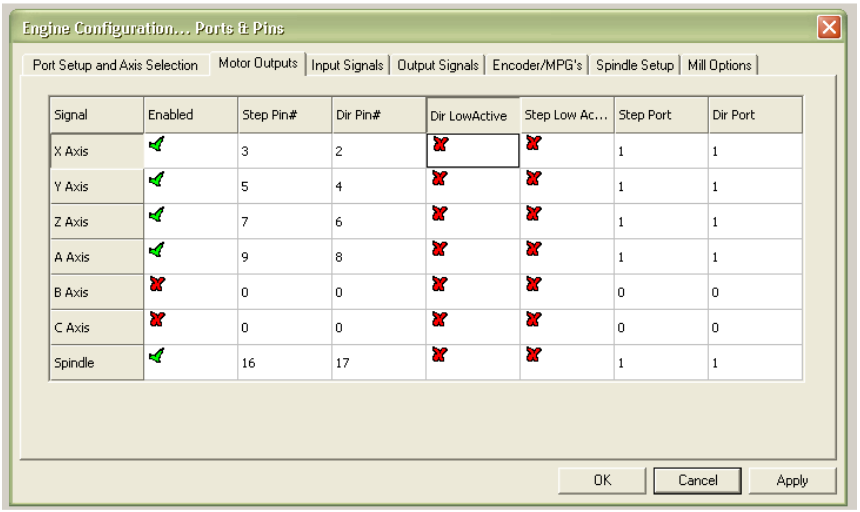
The System4C board uses a 12 KHz charge pump signal from the controlling software to operate the enable line on all four driver circuits. This signal uses pin1 from the parallel port for its input and must be setup in your software configuration. When the signal is present the red enable light will illuminate showing that the board is active. If your software does not support this function you may override this signal with the L1 jumper link making the board permanently enabled.

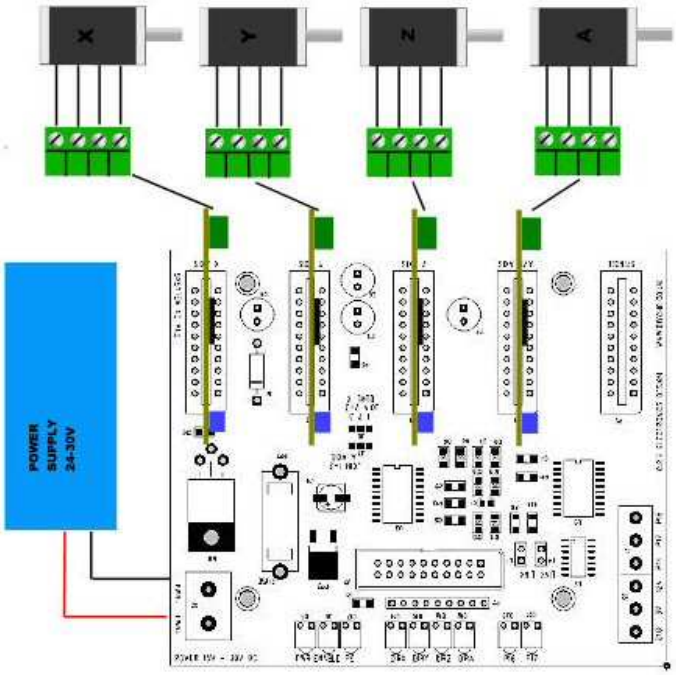
The following table shows a typical parallel software set-up

Parallel Port Pin	System 4C signal	Input / Output
1	Charge pump signal	Enable
2	X Direction	X Axis
3	X Step	X Axis
4	Y Direction	Y Axis
5	Y Step	Y Axis
6	Z Direction	Z Axis
7	Z Step	Z Axis
8	A Direction	A Axis
9	A Step	A Axis
10	Input 1	Input pin
11	Input 2	Input pin
12	Input 3	Input pin
13	Input 4	Input pin
14	Output signal	Output pin
15	Input 5	Input pin
16	Spindle pulse	Output pin
17	Relay 1	Output pin
18-25	Ground	GND

Pins 16 & 17 are used for spindle control if the spindle mod board is fitted. The step signal becomes the speed signal and the direction becomes on/off or backwards/forwards.
If you are using Mach2/3 software, set up each axis as shown above and leave the, low/step box unchecked. You can check or uncheck the direction box to reverse the stepper motor direction as required.

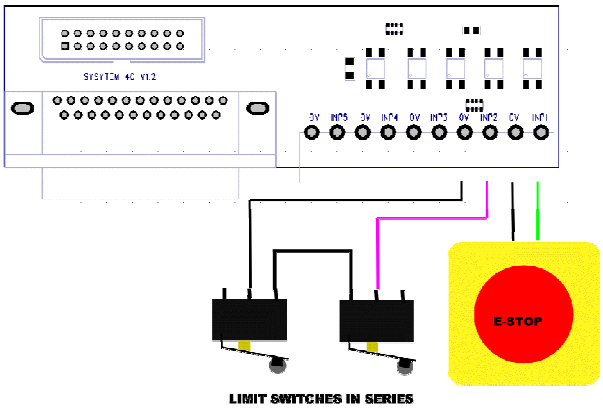
Mach3 Motor Output Configuration screen





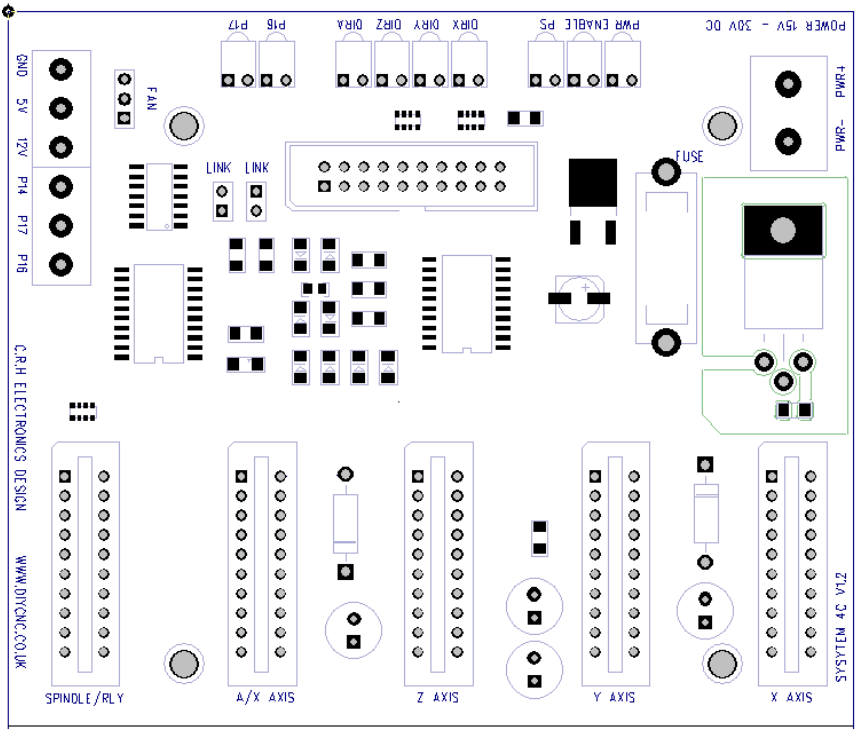
Main board

Power into the board is via J9 and is marked plus or positive and minus or ground.
J8 allows external power to be taken from the board, 5 or 12 volts for a fan etc.
The board is fused with a 10 amp fuse and D1 is a voltage limiting diode. If voltages greater than 32V are applied to the board, the diode will conduct and blow the fuse. Pin 14 is the only signal not used by the system if fully populated with modules and is available on J1.
P16 and P17 will also be free if the Spindle module is not installed. All these outputs are buffered and have charge pump enable protection. LED's are normally in black holders but an extended lead version is available for fitting the EN1 enclosure allowing the LED body to penetrate the metal front panel.

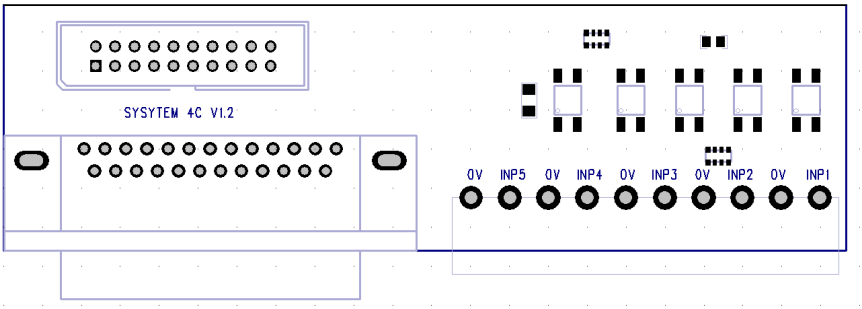


System 4C General layout

Four of the slots P1 –P4 allow for connection to external driver boards and the DRV30S boards to individual requirements. The A axis can also become a second X axis for systems large router tables that may need twin X axis motors. The fifth slot P5 is used for a optional spindle control board.



Input board



The Main board and input board are linked via a coloured 20 way IDE cable. This has a key on each connector J2 and J4 so you can only insert one way round.

DRV30S

The DRV30S is a new stepper motor drive board for the System4. The design incorporates full power save control which reduces power consumption of the board when there are no stepper signals present. As soon as a step signal is detected the board returns to normal power conditions.

Dip switch settings

MS2 & MS1 Adjust Step rate.
(MS2 off MS1 off) Full Step
(MS2 on MS1 off) 1/2 Step
(MS2 off MS1 on) 1/8thStep
(MS2 on MS1 on) 1/16th Step

C1 & C2 Control maximum stepper current
(C1 on C2 off) 50% (1.5A)
(C1 on C2 on) 100% (3.0A)
(C1 off C2 off) 20% (0.6A)
(C1 off C2 on) 75% (2.25A)

Note: the System4 version of the board DRV30S has only a four way dipswitch, power save and enable signals are handled on the main motherboard.

Stepper motor connections

The following diagrams show typical connections for a range of different motors.
It is recommended to use Parallel motor connection with our 3.1Nm motors.

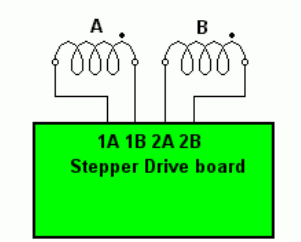
Warning

It is imperative that you do not plug the driver boards in reverse, ie with motor connector towards the LED's. This can also damage the main PCB components. Also, never unplug a board from it's slot or remove the motor connector while power is applied. This nearly always results in failure of the driver I'C. It is OK to power the driver boards without a motor connected.

4 leads - Bipolar Drive

4 Leads
The standard connection for a four lead motor.

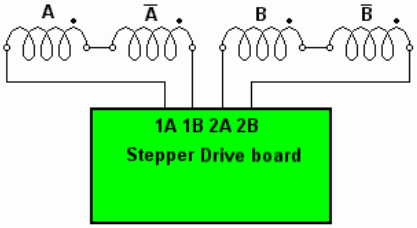
This is the standard connection for a bipolar drive. There are still four windings and, depending on motor type, they are in series or parallel. Most manufacturers makes two models with the same winding, but one time connected is series and one time in parallel.



Bipolar Drive - Serial Connection

6 Leads
The windings are connected in serial. Since most 6 lead motors are wound bifilar - link -, so the inductance will be quadruple of the single winding value.

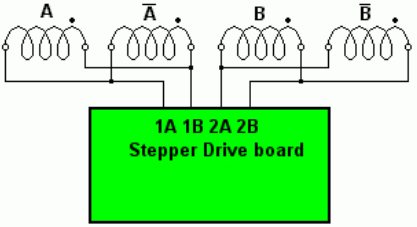
8 Leads
The windings are connected in serial. Since most 8 lead motors are wound monofilar - link -, then the inductance will be double. If the motor was wound bifilar - link -,the inductance will be quadruple .



Bipolar Drive- 8 leads - Windings Parallel

8 Leads
This is the standard high speed connection for an eight lead motor.

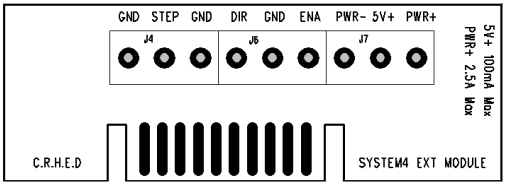
With the windings in parallel, the motor current can be higher whilt the inductance is lower. This is a typical connection for a motor that need to run at a high speed..



IMPORTANT:
Double check that connections are correct before applying power to the board, windings connected out of phase may cause damage to the board. Do not connect or disconnect wires with the power on. It is a good idea to adjust the current switch settings to the minimum setting if you are in any doubt of the connections. It should be noted that some six wire motors are three phase operation and are unsuitable for this board.

The PCB Stepper outputs on the DRV30S board are marked 1A &1B this represents one winding. Outputs 2A & 2B are the other winding.

Extmod
The small board used for connecting external stepper driver boards.
Although there is a main power rail provided on the board this is optional and a totally separate power supply may feed the external drivers which may need higher current and voltage requirements.



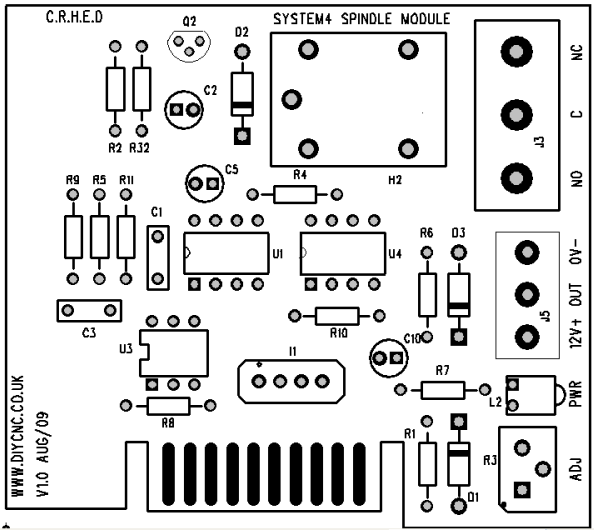
Spindlemod

The board is able to take step signals to drive a spindle motor board that normally uses a potentiometer to control spindle speed. This is achieved by converting stepper pulses on pin 16 of the parallel port into a voltage level suitable for the spindle drive board. There is also a relay with contacts rated at 2400 Watts or 240V AC at 10 Amps suitable for switching power to the motor that is controlled by the forward, backward signal on pin 17. Some motor control boards allow full reverse features, others are single direction only. The board has Opto isolation and an isolated dc/dc convertor for power to the analogue side of the board making external power unnecessary.

WARNING

It should be noted that some motor controller boards have no mains isolation and instead rely on being self contained systems. Connecting other circuits to these boards present a possibility of hazardous voltage levels which may result in electrocution or severe damage to circuit boards. We strongly recommend isolating all spindle motor power while handling this board as full mains potentials are possible between various parts of the circuit.

When using the spindle board to control an existing manual system only two connections are required between the Spindle module and the spindle drive motor board. A ground or bottom of the variable potentiometer connection to the 0V- pin and the centre pin or variable or wiper connection of the pot to the OUT connection. You must remove the existing potentiometer connections to prevent it loading the circuit.



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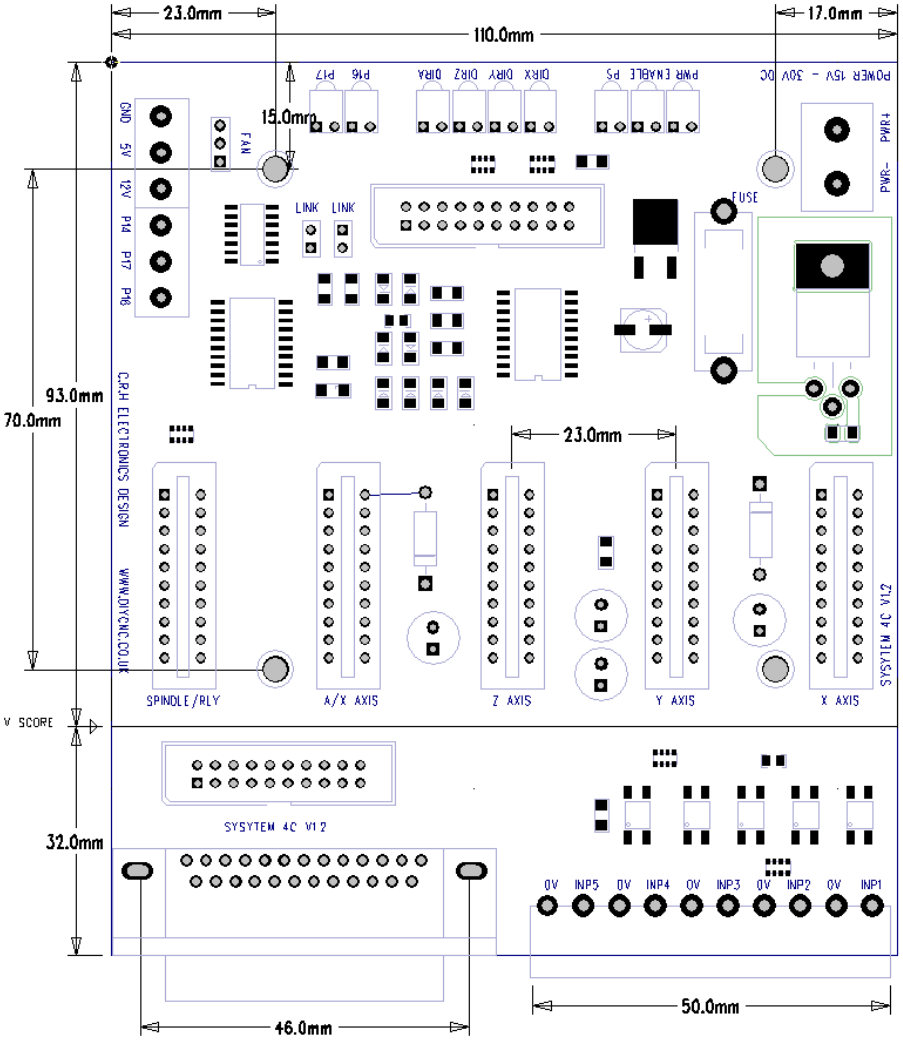

Dimensions for board and fixings. Hole diameters are 3.2mm for M3 bolts