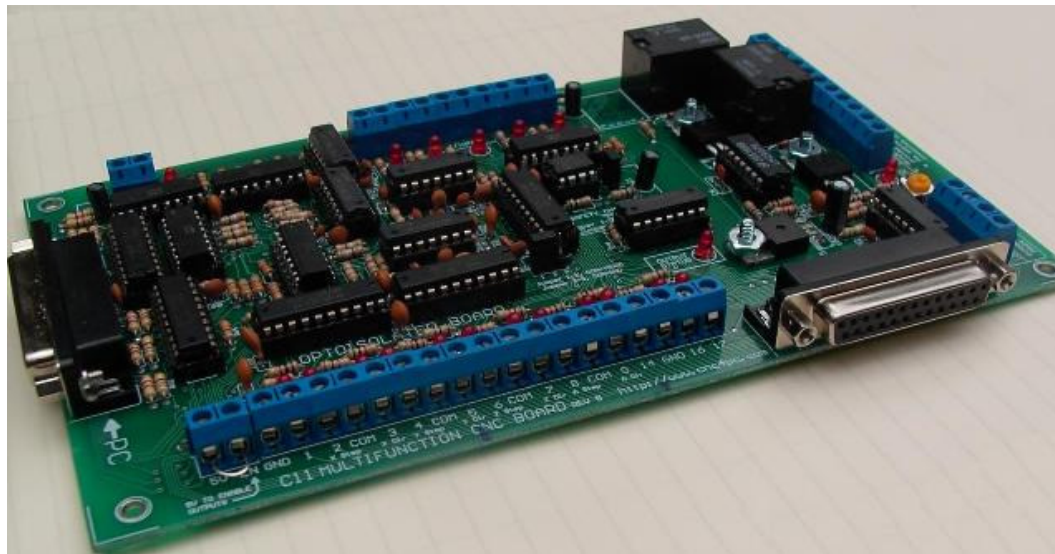# C11- MULTIFUNCTION CNC BOARD Rev. 9.3

User manual Rev. 2

1. Overview

This card has been designed to provide a flexible interface and functions to your computer projects, by using the parallel port control software. This board provides a faster way to connect devices and reduce the possibility of wiring errors.

2. Features

- **IEEE 1284 Standard compatible.**
Includes the circuitry recommended by the IEEE 1284 Level 1 standards for bidirectional parallel communications between personal computers and peripherals

- **PULL-UP or PULL-DOWN selection for inputs.**
Includes jumpers to select the best input configuration for your application.

- **Fully optosiolated**
The card isolates connections to protect your computer from short-circuit. An opto-isolator is an integrated circuit that transmits the signal through an encapsulated LED and phototransistor. When the signal is on, the LED lights up, the phototransistor captures it and relays the signal. The signals are transmitted through light and not through physical connections. In this way, a power surge has no way of reaching your

board can be adjusted to other voltages.

- **Two Built-in Electromechanical Relays with NO and NC positions.**

- **All pins can be used in a concurrent manner.**
You can use all the input or output pins in a concurrent manner. For example, if you are using output pin #1 to control the Built-in Electromechanical Relay, you can also access that signal from the output pin on the board or from the DB25 connector for output. Each connection will not affect the other current from the other connection.

- **Has an extra DB25 female connection for output.**
You can use this card to optoisolate any existing setup just by connecting this card between your computer and your current setup. That way, you can also see and access all your signals. This makes this card ideal for use with the Xylotex, HobbyCNC or other non-optoisolated boards. You only

have to add this board to a DB25 male connection to a male cable.

- **Input and output pins with close by ground connections.**
Forget about grounding problems. Easily connect your pin by using your close by ground connection. No need to be an electronics expert to ground all your stuff. The terminals next to pins 2-9 can be set to have +5VDC or GND according to your needs. There is a jumpers that allows you to select +5VDC or GND for the COM pins.

- **Works directly with popular CNC hardware and software.**
That goes for Geckdrive, DeskCNC or Rutex and parallel port control software such as mach2, Linux EMC, TurboCNC, CNCZeus and other/ (Not all have been tested).

- **Screw-On connections for all terminals.**
You only have to screw-on the wires to make all your connections.

3. Specifications.

DIGITAL INPUT SPECIFICATIONS	
Numbers of inputs	5
On-state voltage range	2 to 5V DC
Maximum off-state voltaje	0.8V
Typical signal delay	2.8uS

DIGITAL OUTPUT SPECIFICATIONS	
Number of outputs	12
Maximum output voltage	(5V power supply voltage) + 0.5V
Typical output current	24mA
Maximum off-state voltaje	0.44 V
Typical signal delay	3uS
Time of transition to high impedance state	120mS*

Time passed since a fault in the SCHP signal is detected and the outputs are disabled.

The recommended pulse width for the inputs and outputs is 2us.

4. Functional Block Diagrams

4.1 Outputs 2-9 simplified functional block diagram
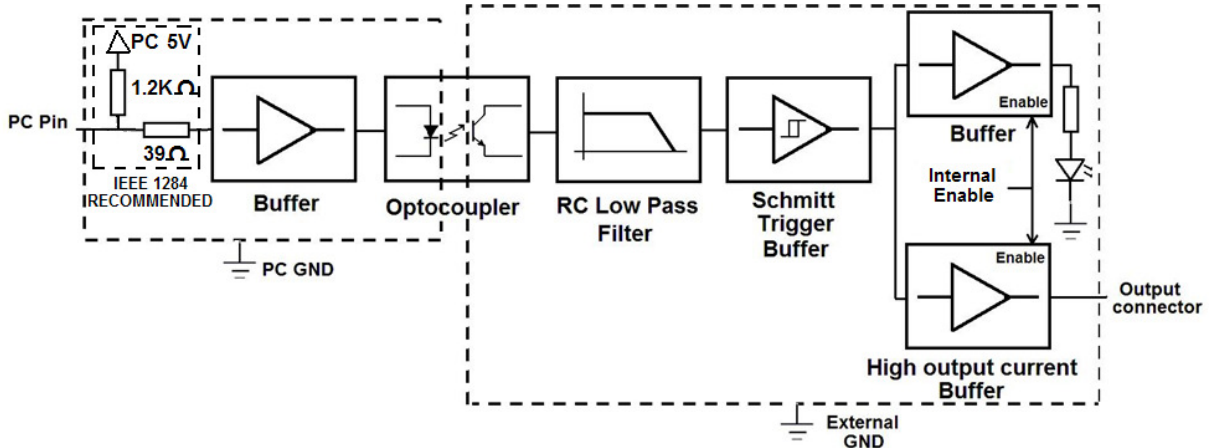
Fig. 1 Simplified functional block diagram for the outputs 2-9.

Parallel Port coupling is done following IEEE 1284 standard recommendation.

An RC Low Pass filter followed by a Schmitt Trigger gate is used to help reduce the effect of the noise from drivers or other devices. LEDs are driven by a different buffer to avoid residual currents affecting the signal.

4.2 Outputs 1, 14, 16 and 17 simplified functional block diagram
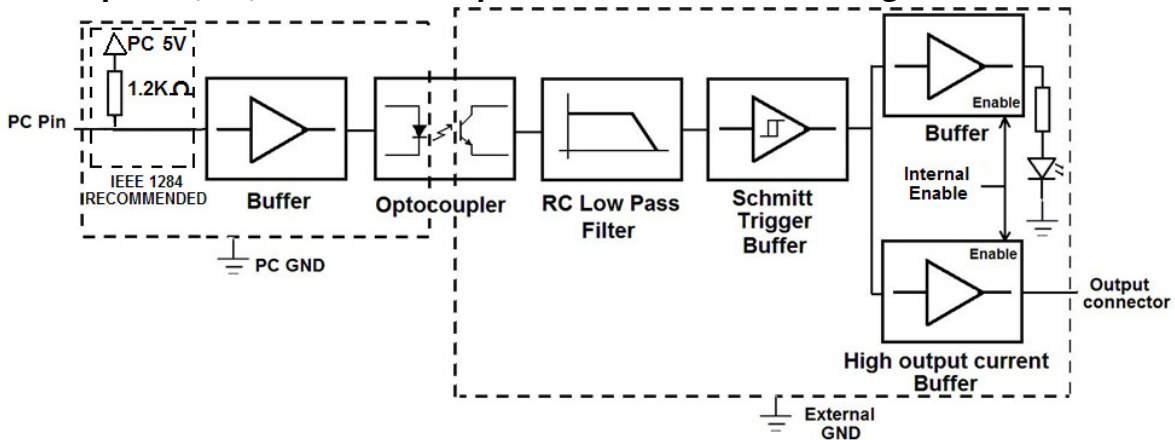
Fig. 2 Simplified functional block diagram for the outputs 1, 14, 16 and 17.

Note: *"Internal Enable"* **=** *"External Enable Pin"* **AND (** *"SCHP"* **OR** *"Bypassed SCHP"* **)**

The "Internal Enable" is the result of an AND Operation between the "External Enable Pin"and the SCHP operation mode selected by the user.

Note: The output will be deactivated if the board is not connected to the PC parallel port.

4.3 Input simplified functional block diagram
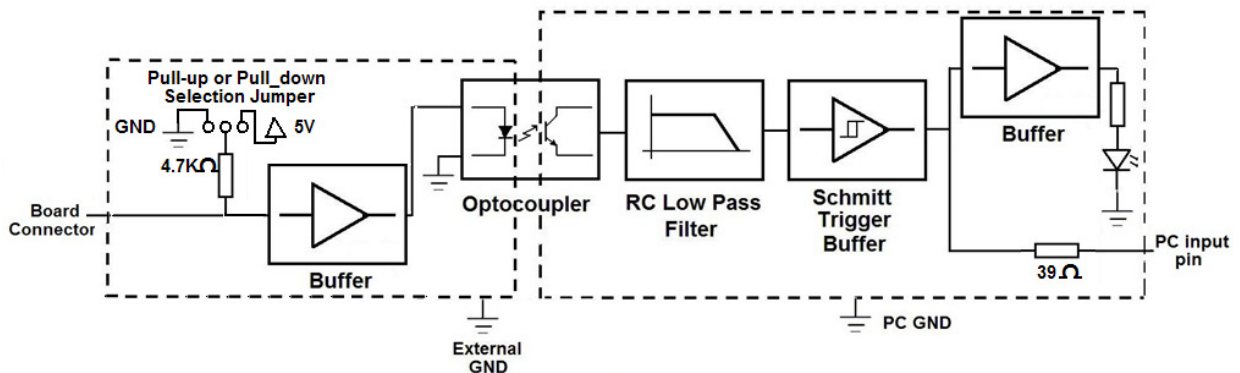
Fig. 3 Simplified functional block diagram for the inputs.

Pins 10, 11, 12, 13 and 15 can be set to pull-down or pull-up by selecting the jumper in the appropriate position.
The input pins can be set to be pulled up or down with a 4.7Kohm resistor.

1-2: PULL-UP
2-3: PULL- DOWN
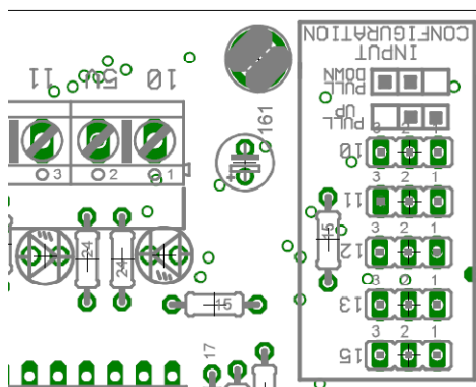
4.4 External Enable Pin.

The card must be provided with a 5VDC signal to enable operation. This feature has been added to externally control the status of the outputs. An external switch or a Safety Charge Pump can be added to provide the enabling signal. When the enable signal is not present, output signals sent high impedance state. If this function is not required, an jumper can be placed between +5vdc and the EN terminal. It has an internal 4.7kOhm pull-down resistor.
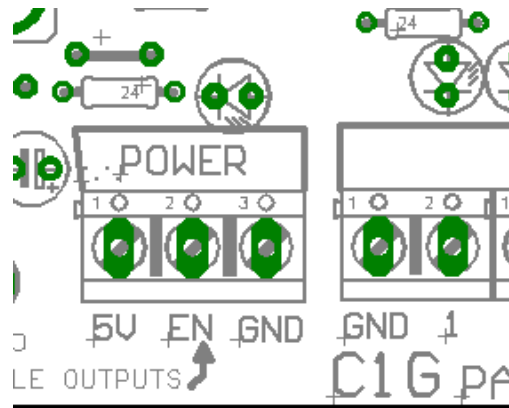
WARNING: This card must have the power supplied while it is connected to the PC. If power is removed to the card while it is connected to the PC, noise can be introduced to the output lines. This can create a dangerous situation as relays or other devices that might be connected to this card could get activated.

5. Wiring diagrams

While this board supports only TTL +5VDC signals, different kind of sensors, switches using different voltages can be connected using the diagrams that follow:

Note: The below wiring diagrams are an example, any input can be used for the connections.

Note. The bellow wiring diagrams require setting the inputs to use pull-down resistor.

5.1 Connecting Switches or push button.
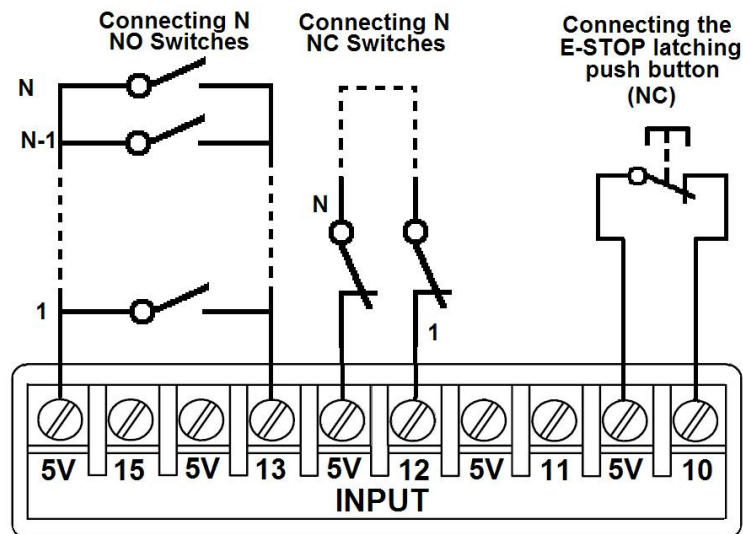
Fig. 7 Wiring diagram to connect switches.

5.2 Connecting NPN sensors.
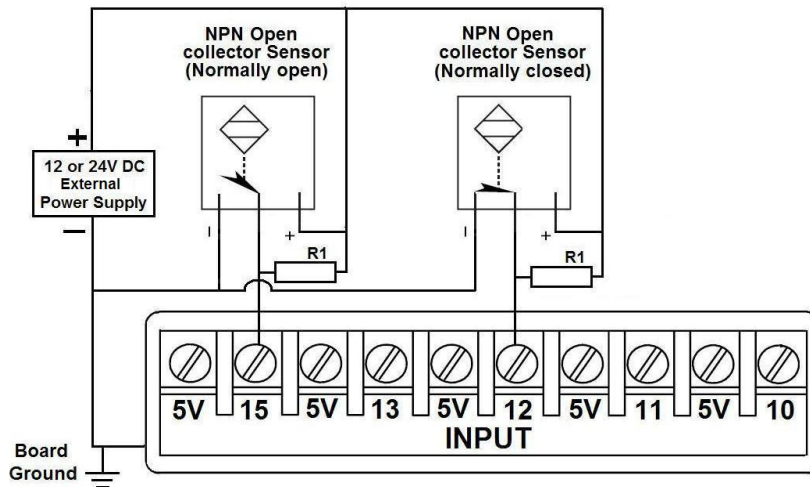
Fig. 8 Wiring diagram to connect NPN open collector proximity sensors.
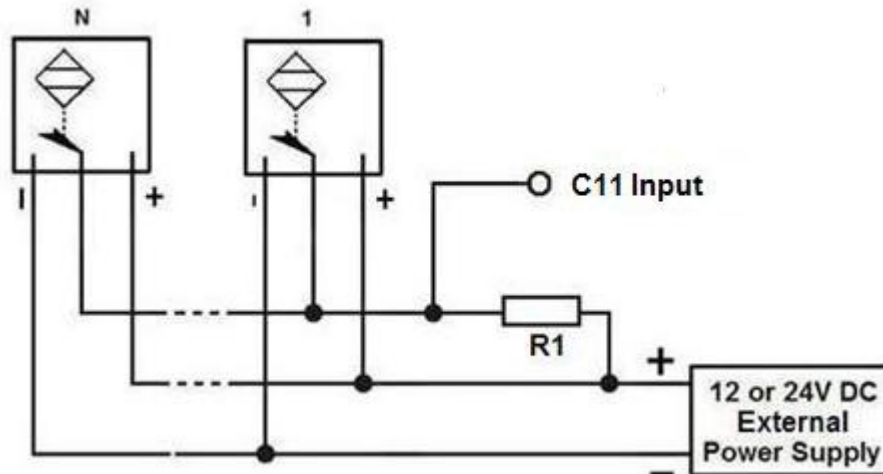
Fig. 9 Wiring diagram to connect in parallel NPN open collector proximity sensors.

Connecting NPN open collector proximity sensor with the C11	
R1 Value (12V)	R1 Value (24V)
Aprox. 10KΩ	Aprox. 25KΩ
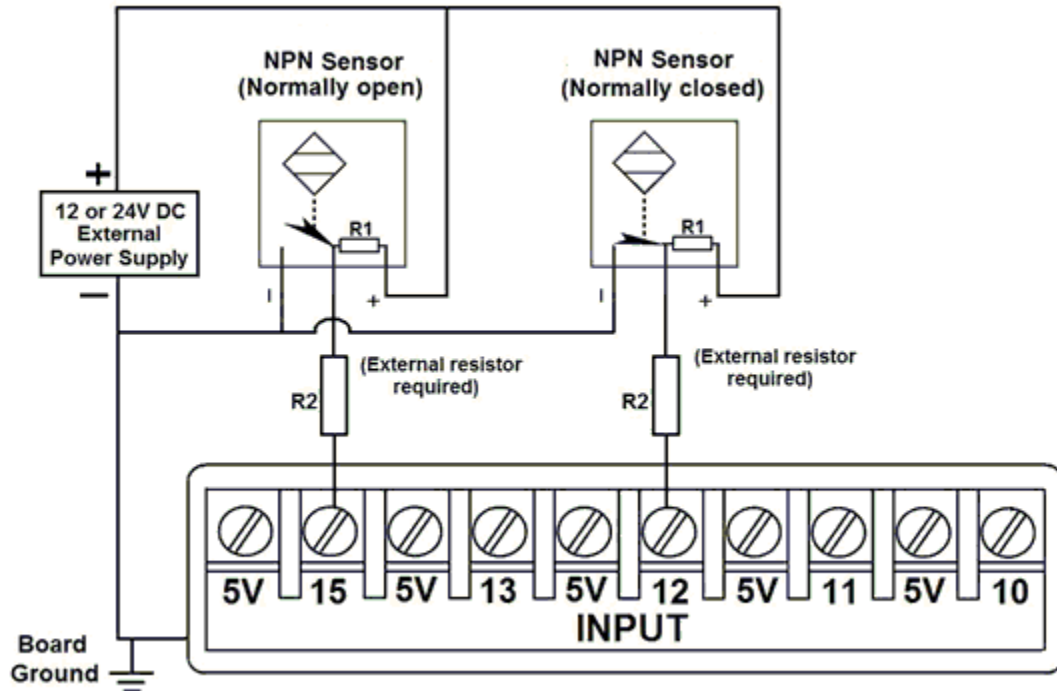
Fig. 10 Wiring diagram to connect NPN proximity sensors with internal pull up resistor.
Some NPN proximity sensor has a pull-up resistor (R1) internally. It is necessary to know its value in order to connect safely the sensor with the BOB. Follow this recommendation:

Connecting NPN open collector proximity sensor with the C11	
(R1+R2) Value (12V)	(R1+R2) Value (24V)
Aprox. 10KΩ	Aprox. 25KΩ

Calculating the R1 value.

Note: Rx is the unknown resistor value.
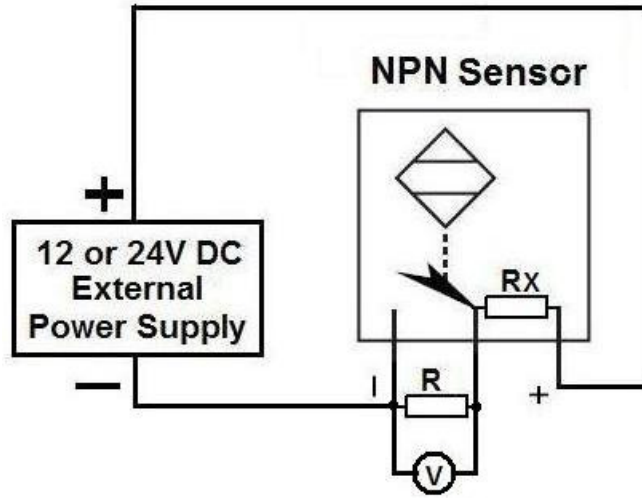
$$R_X = V_{EX} \cdot (R/V) \; - \; R \qquad (1)$$

Where:

V_{EX} is the external power supply voltage

V is the voltage across the R resistor

An external resistor and a voltmeter are required to calculate the internal resistor (Rx) value.

Note. The user should know the R value to do this operation. A 4.7KOhm @ 1/2W is recommended.

SAMPLE: if you are using a 12V power supply (V_{EX}), and using a 4.7KOhm as external resistor (R), then the voltage across R should be 6V, using the equation 1, the Rx value is 4.7KOhm.

5.3 Connecting PNP sensors.
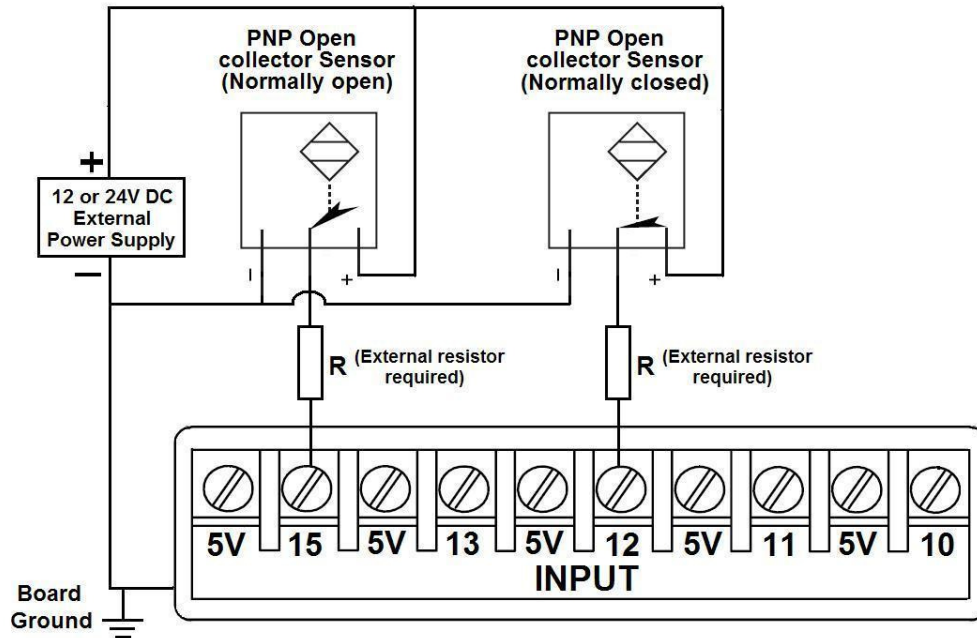
Fig. 11 Wiring diagram to connect PNP proximity sensors

Connecting PNP proximity sensor with the C11G	
R Value (12V)	R Value (24V)
Aprox. 10KΩ	Aprox. 25KΩ

5.4 Other connection.

Other connections can be implemented by setting the inputs to pull-up resistor.
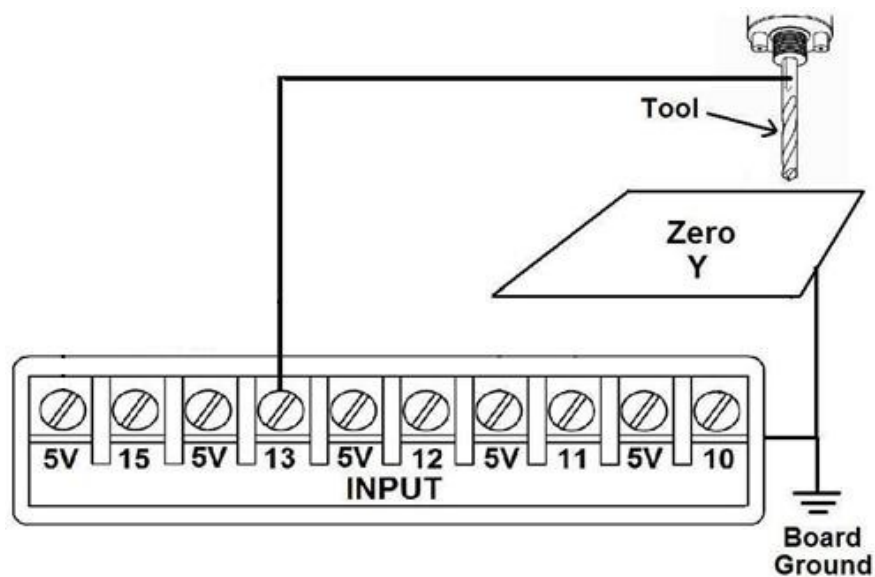
Fig. 12 Wiring diagram to do an "Auto Tool Zero"

http://cnc4pc.com/Tech_Docs/E_STOP_N_EN_Wiring.pdf
http://cnc4pc.com/Tech_Docs/E_STOP_N_SCHP.pdf

6. Special Functions

6.1 Safety Charge Pump "SCHP". (Pin 17)

This board takes advantage of Mach ability to send a specific frequency through one of the pins of the parallel port when the program is in control of the system. CNC machinery can be very dangerous, and you could have a risk of the machine doing something different that what you intend the machine to do if the program loses control of your system. Mach be can be programmed in a way, so when it is "in control", it delivers a 12.5 KHz signal through one of the pins. This card lets you use this signal to work as an On/Off switch for your system, enabling a powerful safety system for your equipment. If you ever had windows crash on you, then this card is for you. The port can also do weird things while the system is coming up, or down.

> **For Configuring the *Charge Pump* in *Mach X*:** Use the dialog *Config / Ports and pins / Output Signals*. Enable the *Charge Pump* output and configures it as is shown in the Fig. 8   Next, press the *apply* button.

Fig. 9. Charge Pump configuration

Selecting the SCHP operation mode.

The Safety Charge Pump can be activated or deactivated depending on the jumper position.

1-2: SCHP OFF
2-3: SCHP ON
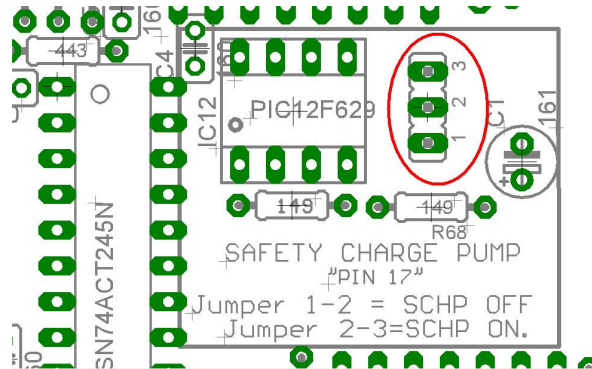
Note: When the Safety Charge Pump is activated, the EN terminal is active and a valid SCHP signal is present, pin 17 will go high. This h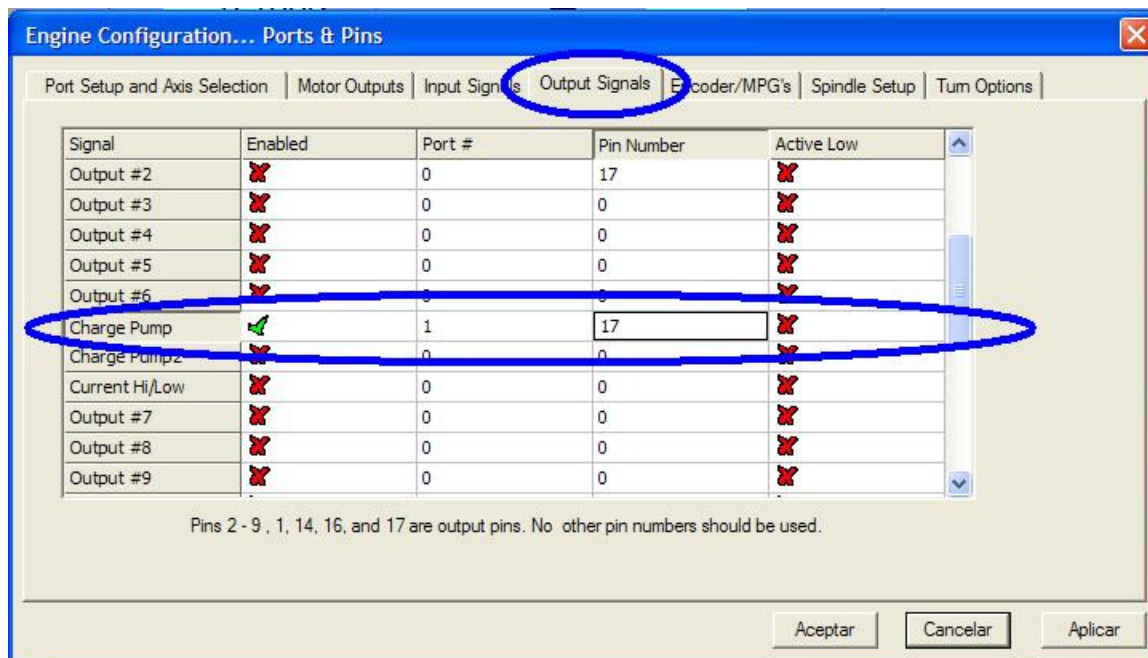igh signal can be used to enable other external devices, such as enabling other Breakout Boards, or relays that would enable servos, VFDs, contactors, etc….

6.2 Variable Speed Control. (pin 14)

This function lets you control your spindle with step and direction signals, as if it was an axis motor. It converts the step signal into an analog (0-10VDC).

A Variable Frequency Drive or Inverter works by modifying the frequency for AC motors. Most of these devices with an external analog signal (0-10VDC). That is, if there is 5VDC coming into through the control signal, the motor will run at 50% of full speed, if there was 10VDC, the motor will run at 100% of full speed. If there is no signal coming out, then the motor will stop.

This function can also be used on many DC motor controllers by replacing the potentiometer that controls the speed.

Requirements:

It requires a +12VDC@20mA power supply to operate.

⚠ WARNING: To keep the output signals optoisolated, these must not have common ground or connections to current with other circuits you are using.

You will require a voltmeter to fine tune your system.

Wiring:

Before connecting anything, please be sure to read your VFD's manual and make sure you understand all the safety issues.

Please check the wiring guide and wiring samples here:
http://cnc4pc.com/Tech_Docs/C6R5_WG.pdf and
http://cnc4pc.com/Tech_Docs/C6R5_WS.pdf

Configuring the Control Software:

It is strongly recommend you read your control software's manual. You need to configure your control software to control the spindle as if it was an angular axis. This card requires a 25 KHz input signal in the pin 14 to deliver 10VDC. So you have to set the speed of the motor (spindle) at maximum. For acceleration values adjust them to where you feel comfortable. Keep in mind the acceleration of the motor must also be set in your VFD.

For configuring Mach follow these steps:

1. Go to Config / Ports&Pins / Motor Outputs. Enable the spindle and select the port and pins you wired for step and direction.
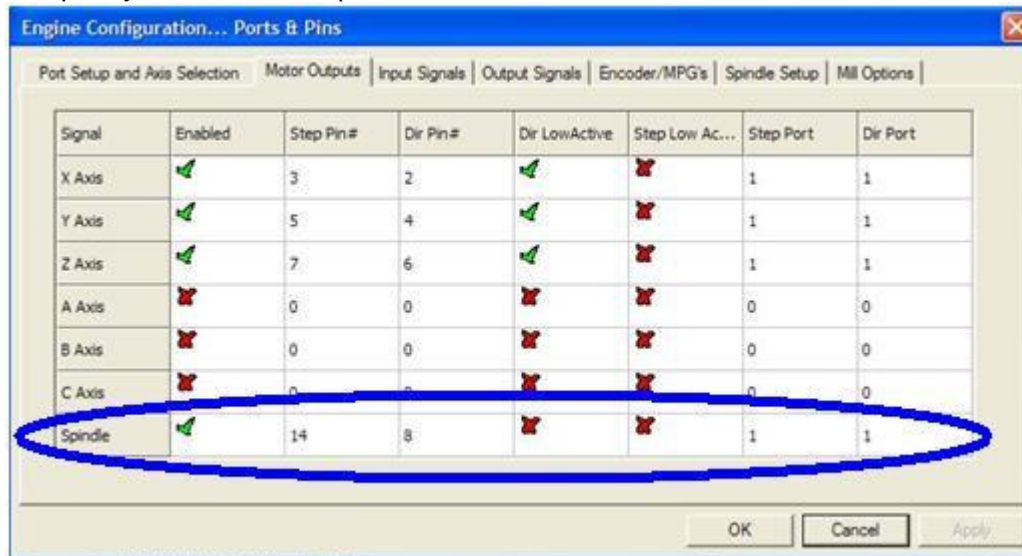
Fig. 10. *Ports&Pins* **configuration screenshot**

2. Go to Config / Ports&Pins / Spindle Setup. In the motor control box, check Use Spindle Motor Output and Step /Dir Motor. Under Pulley Ratios set the pulley ratios of the machine.
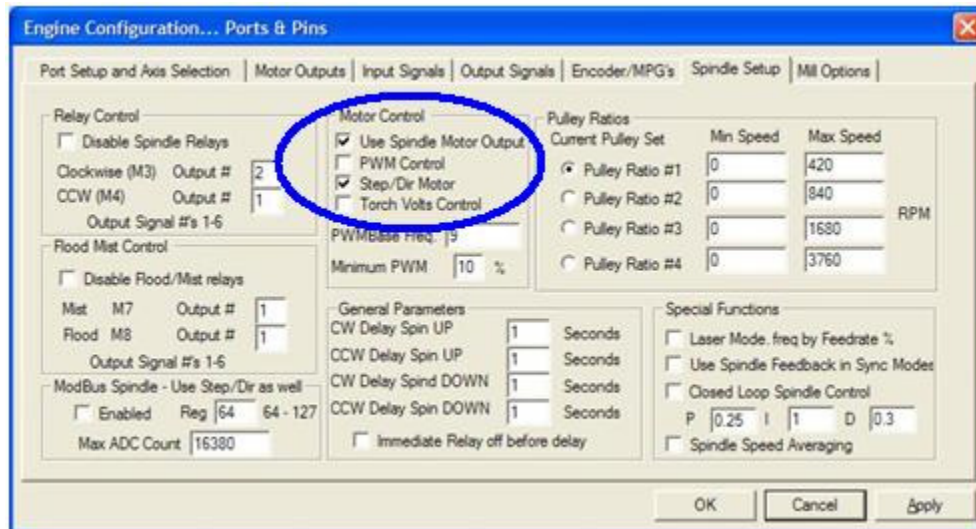
Fig. 11. *Spindle Setup* screenshot.

3. Go to Config / Motor Tuning / Spindle. On Steps per unit put 1,000, set velocity to maximum. For Acceleration, choose the acceleration that you feel comfortable with. Start slow, increase acceleration as you test your system. Under Step Pulse length, use a number from 3 to 5, but start with 3. This number is directly proportional to the final voltage you will get in the analog output. Use this number and the fine tuning pot to adjust the voltage you want to get at max speed.
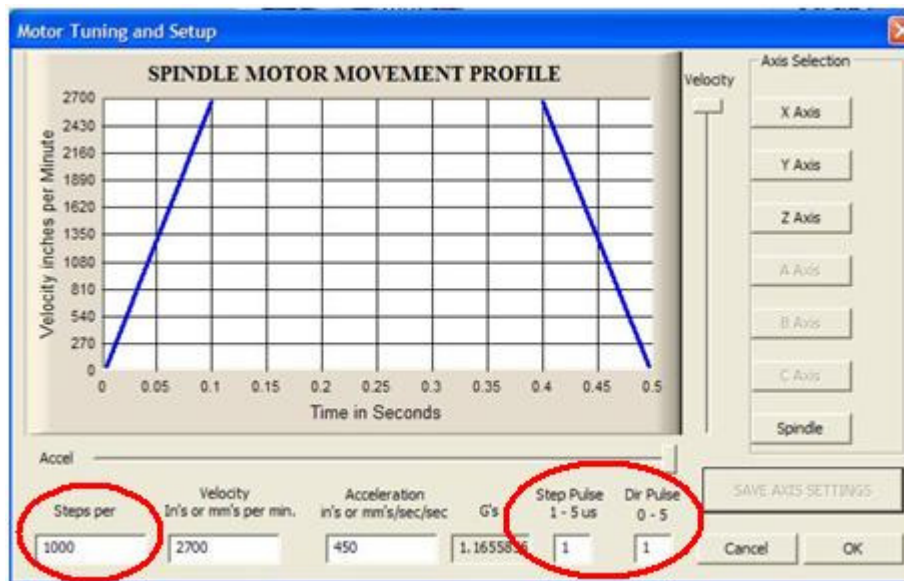
Fig. 12. *Motor Tuning and Setup* **screenshot.**

After configuring the Mach, these steps should be followed.

Step 1. Ensure that all external power sources are set to **OFF.**

Step 2. Connect the power supply to the Power Inputs Connectors (X1).

Step 3. Turn on the external supplies

Step 4. Connect a multimeter in the analog outputs connectors (X2) and make and fine tune this output:

Make sure that when you reach the max speed in the control software you get 10VDC out (X2). This voltage can vary depending on many things, including the electrical properties of parallel port or breakout board you are using, the length of the step pulse your software is delivering, and the normal hi or low status of your step pin. Play with the pot, hi/low status of the pin, and pulse length to fine tune the output voltage.
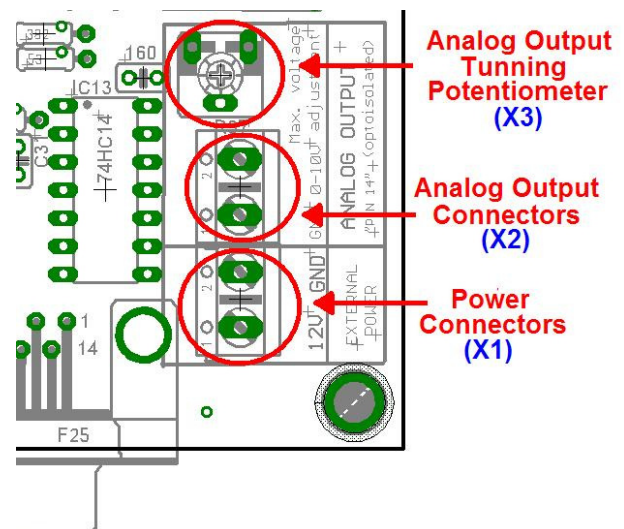
6.3 **Electromechanical relays. (pins 1 and 16)**

Mechanical relays are very flexible because they can be used for AC or DC and come with NO and NC (Normally Open and Normally Closed) positions. Relay are independents, one reacts to Pin 1 and the other one to Pin16 and that both can be used at the same time. The relay specification are showed in the below table.

ELECTROMECHANICAL RELAYS SPECIFICACTIONS	
Maximun Current (AC)	7A@240VAC; 10A@125VAC

| Maximun Current (DC)	15A@524VDC; 10A@28VDC

Table 2. Electromechanical Relays Specifications.

6.4 **Using the COM configuration jumper.**

This is for selecting the value to get at the COM terminals found next to step and direction terminals (Pin2 2-9). Some drivers expect a ground, and others

       1-2: COM= +5V
       2-3: COM= GND

expect +5vdc. There is a jumper that allows you to select +5VDC or GND for the COM pins.
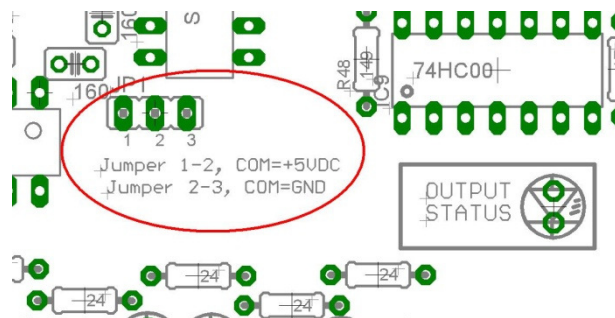
7. Troubleshooting.

SYMPTOM 1: THE BOARD DOES NOT REKAY THE SIGNAL.

POSSIBLE CAUSE	POSSIBLE SOLUTIONS
- **Pin conflict or mach3 configuration**. It is possible that the port address used for the pin is not right, or that there is a pin conflict with the. That is that you are using that same pin twice. (it could be assigned to a different function).	- Go to the device manager in windows, and check the memory address used for the parallel port you are using. Usually it will be 378 for LPT1. Check also that the port does not have a conflict. Then in mach3, go to Ports & Pins / Port Setup and Axis Selection. Check the memory address is correct. - Check that the pin you are using is not been used anywhere else in your setup. Got to motor output and output signals, and check all the entries.
- **The board does not like the waveform it is getting.** Some breakout boards could invert the signals or modify the pulse width.	- Play with the active low status of the pin used for the frequency.

Changing the active low status of the pin used also inverts the waveform.	
- **The signal or frequencies are not getting to the board.** It could be the cable or that you are passing the signal through the same breakout board that you are enabling/disabling, so the outputs could be disabled, so they will not get to the breakout board.	- Try a different cable. - Test the pins in the cable (before they reach the breakout board) with a multimeter.
- **Problems with Mach3 Pulse Generation.** Mach3 could have installation problems (you did not restart immediately after installation), or there could be something creating a conflict. Some dongle devices might cause this, other software, like QuickTime or drivers for touch screen.	- Test this in a different PC. - Follow Art's suggestions for optimizing up WinXP: http://www.machsupport.com/downloads/XP_Optimization.txt.

SYMPTOM 2: THE ANALOG OUTPUT DOES NOT REACH THE 10VDC.

POSSIBLE CAUSE	POSSIBLE SOLUTIONS
- **Insufficient pulse width.** It is possible that the signal pulse width is not enough to activate the optocouplers.	- In Mach *X*, go to Config / Motor Tuning / Spindle. Under Step Pulse length increase this value, use a number from 3 to 5, but start with 3.
- **The signal is set active low or the breakout board could be inverting the signals.**	- In Mach *X*, go to Config / Ports&Pins / Motor Outputs. Change the active low status of the pin used for step.

SYMPTOM 3: THE OUTPUTS DO NOT GET ENABLED / NO SIGNALS ARE COMING OUT.

POSSIBLE CAUSE	POSSIBLE SOLUTIONS
- **The EN terminal (Enable Outputs) is not enabled.** The board requires to be externally enabled.	- Make sure you are providing +5vdc to the EN terminal. This +5vdc can be taken from the terminal next to it.
- **The Safety Charge Pump is not configured.** The Safety Charge Pump	- Start by disabling the SCHP. Enable it and configure it once your system is

|	
can either be configured in the control software or disabled by moving the jumper to the disable position.	setup.
- **The parallel cable is not well connected to the PC parallel port.**	- Check if the parallel port is well connected to the PC.

SYMPTOM 4: THERE IS NOISE IN THE SYSTEM, OR THE MOTORS DO NOT MOVE SMOOTHLY.

POSSIBLE CAUSE	POSSIBLE SOLUTIONS
- **The board could be underpowered.**	- Make sure you are using a +5vdc 1.5amp power supply.
- **There could be a short that could be draining the power to the board.**	- Check that there are no hot spots in the board or it's connections. - Measure the board's power consumption, it should be less than 1200mA (depending on the features used).

SYMPTOM 5: A I/O PIN MIGHT NOT BE WORKING.

POSSIBLE CAUSE	POSSIBLE SOLUTIONS
- **A chip may have gone bad.** These buffers could act as fuses for the signals, and they can go bad because of noise spikes or even strong static.	- These chips are inexpensive and readily available. You can order them here: http://www.cnc4pc.com/Store/osc/index.php?cPath=38_43. - Carefully moving chips around and checking if the problem moves around could be a way of figuring out if this is the case.
- **There could be a problem with the parallel cable or parallel port.**	- Test this with a different PC or parallel port.

8. Dimensions.
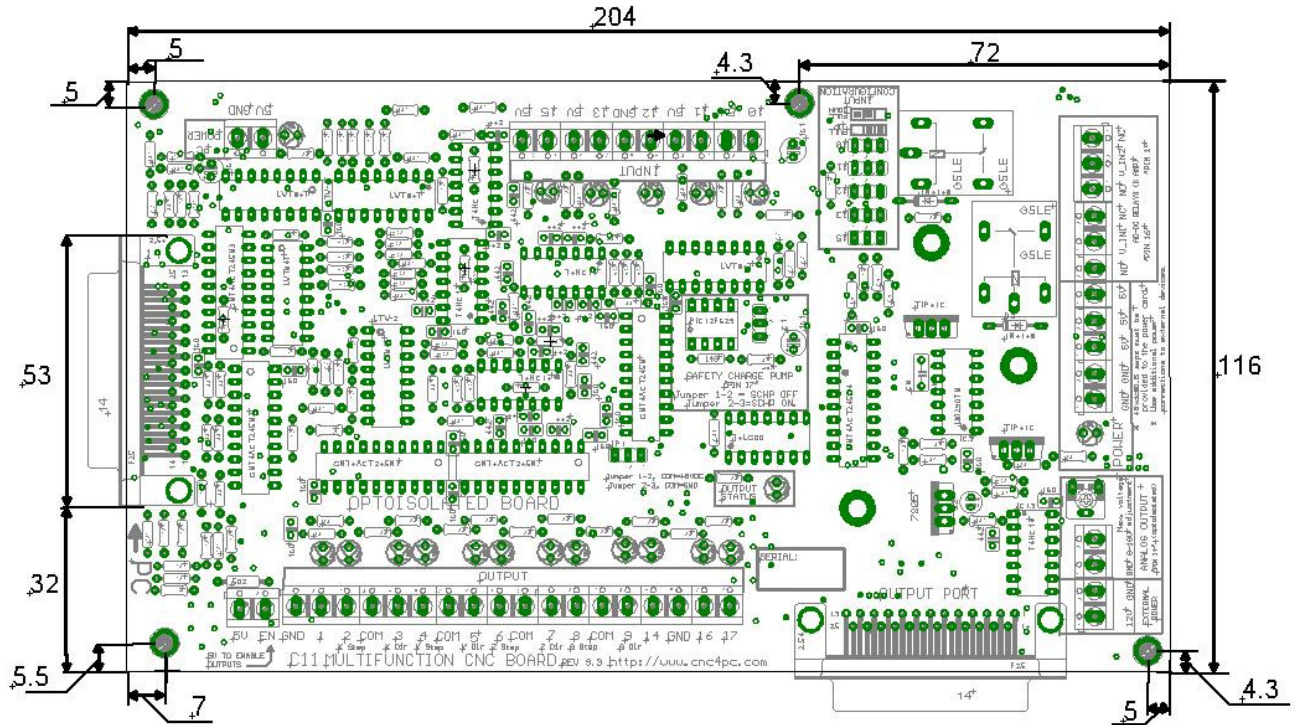
All dimensions are in Millimeters.

Disclaimer:
Use caution. CNC machines could be dangerous machines. DUNCAN USA, LLC or Arturo Duncan are not liable for any accidents resulting from the improper use of these devices. The C11 is not fail-safe device, and it should not be used in life support systems or in other devices where its failure or possible erratic operation could cause property damage, bodily injury or loss of life.