C11 - MULTIFUNCTION CNC BOARD Rev3

Overview

This card has been designed to provide a flexible interface and functions for computer numerical control projects using parallel port control software. This board comes as a response to many users that have been asking for a faster way to connect devices and reduce the possibility of wiring errors.

Features

- ***Built-in Safety Charge Pump.***

There is an on-board safety charge pump, which is a circuit that acts a watch dog by monitoring that mach is in control of your system. Mach can be programmed in a way, so when it is "in control", it delivers a 12.5 KHz signal through one of the ports. 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 parallel port can also do wired things while the system is coming up, or down. New on revision 3 of this board is a microcontroller based system that allows for more complex and accurate algorithms for analyzing how the signal is sampled. This will also allow the user between hi and low precision settings, depending on the user's needs.

- ***Built-in Variable Speed Control.***

It has an optoisolated analog 0-10VDC output that will convert a step signal into an analog signal that can be used to command a commercial VFD. This analog can be adjusted using on-board pot, so this board can be adjusted to other voltages.

- ***Built-in 10 amp AC Solid State Relay.***

It is very useful to use a solid state relay instead of an electro-mechanical relay for starting motors or other devices that might produce arcs at contact. This will increase the life of the motors and relay. This relay is also optoisolated from the rest of the board and has a replaceable fuse.

- ***Built-in 8 amp Solid State Relay with NO and NC positions.***

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. This relay can also be used for controlling spindle rotation.

- ***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 Solid State Relay Board, 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.

- ***Fully optoisolated***

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 hi, the LED lights up, the phototransistor captures it and relays the signal. That way, your computer's electronics are completely isolated from your circuitry. The signals are transmitted through light and not through physical connections. This way, a power surge cannot reach the computer. That is the reason why this card has two power connections. One power connection powers the computer side of the circuit and the other powers the circuit that interacts with your cnc system. Extra precautions have been taken when designing this circuit, by taking into consideration the extremely high voltages that stepper drivers can achieve and lack of experience that some users could have in wiring circuits of this kind.

- ***Buffered Outputs.***

All inputs and outputs are buffered through the use of high speed and high power buffers. Each pins deliver 24 milliamps.

- ***Output pins 1,2,3,4,5,6,7,8,9,14,16,17.***

- ***Input pins 10,11,12,13,15.***

- ***Status LEDs on all inputs and output connections.***

No more guessing. You can SEE all your signals. Save valuable time and brainpower for cncing.

- ***Has an extra DB25 female connection for output.***

This card can be used to optoisolate any existing setup just by connecting this card between the computer and current control box. That way, you can also see and access all the signals. This makes the board 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 or +5vdc connections.***

Input and output pins have close by ground or +5vdc terminals to make your wiring easy.

- ***External Enable Pin (EN).***

The board has a pin that allows you to enable/disable all the outputs at once. The board requires +5vdc in the EN pin. If it is not present, it will send all the outputs to ground. You can use this to enable or disable your system manually, or you can install an external Safety Charge Pump or other external device.

- ***All TTL +5VDC or +3.3VDC Signals.***

Works with newer computers and laptops that have low voltage parallel ports.

- ***All inputs are outputs are tied to pull-down resistors.***

Pins are never in the air open to noise. If you leave a pin in the air you will get a LOW or 0. If you input a ground you will get a LOW and a +3.3 or+ 5 vdc signal will deliver a HI.

- ***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, CNCPlayer, 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.

Installation

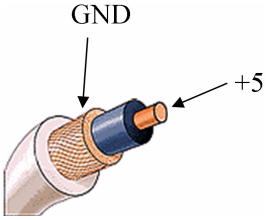
Requirements:

A power supply with 5vdc@ 2 amps and 12vdc@ 0.3 amps for operation. It also requires a connection to your PC power supply. A 6' USB cable is provided, so as to enable you to draw current directly from the PC's USB port. You can also wire it directly to your PC power supply. Cnc4pc offers an electronic switching power supply that is ideal for this board. Other commercial laptop type power supplies can also be used.

Wiring:

Follow the information on the wiring guide found in the web at http://www.cnc4pc.com/Tech_Docs/C11_Wiring_Guide.pdf, and these steps:

1. Connect the USB cable provided to the board on the PC side of the power input side.



USB Power Cable

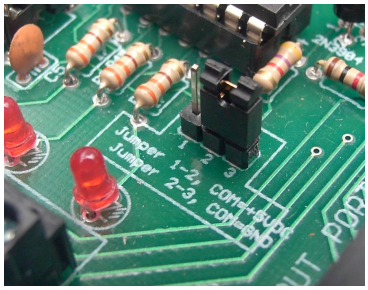
2. Connect to power the other side of the board.

3. Provide +5 to enable pin. A toggle switch is recommended, or it can be hardwired.

4. Disable the Safety Charge Pump (DIP1 = off), or configure the safety charge pump in Mach. It is recommended that you disable it until you are sure the rest of your setup is working ok.

5. Connect the parallel port cable and run your control software. You should be able to see the status of each pin. The OUTPUTS ENABLE LED on the center of the board should light, indicating the outputs are enabled.

6. Set the jumper next to outputs 2-9 to +5vdc or GND. This will determine if the terminals marked COM (next to pins 2-9) will carry +5vdc or ground.



7. Connect the relays like you would connect any other switch. Keep in mind the solid state relay is only for AC currents and does require at least a small load to work, you cannot use it with DC currents, nor can you measure continuity by using a voltmeter.

8. If an optoisolated analog output is needed, an external power supply has to be used to power this circuit. If the VFD provides a +10 or +12vdc reference, then it could be used for this purpose. If this circuit is used to replace a potentiometer, keep in mind the analog output must go to the wiper connection and the ground connection to the ground connection of the pot. The max voltage output of the analog output must be set to the reference voltage.

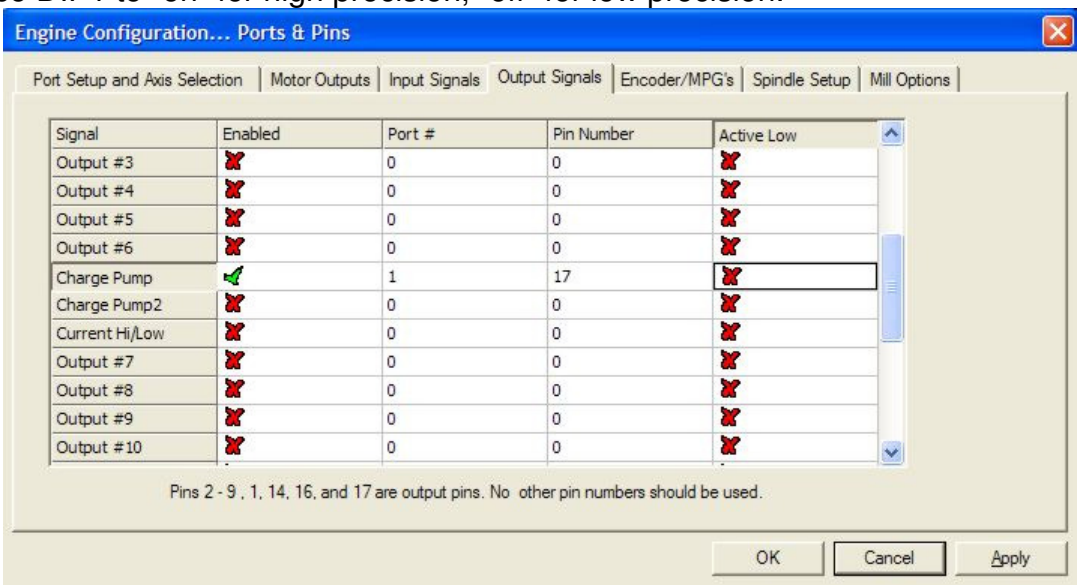
9. Set the precision that you need the safety charge pump by setting DIP2. Set the precision according to the PC you are using and your needs. If set to high precision, e-stop will be triggered if the signal is not within 10 to 15 khz in at least two samples that take place within 1/10 of a second. If set to low precision, it will require to fail 5 consecutive samples that take place in 1/5 of a second.

Configuring the Mach:

SAFETY CHARGE PUMP:

To configure mach, follow these steps:

1. Go to Config / Pins & Ports / Output Pins / Safety Charge Pump.
2. Enable the safety charge pump. Set the active low status to low.
3. Place DIP1 to “on” for high precision, “off” for low precision.

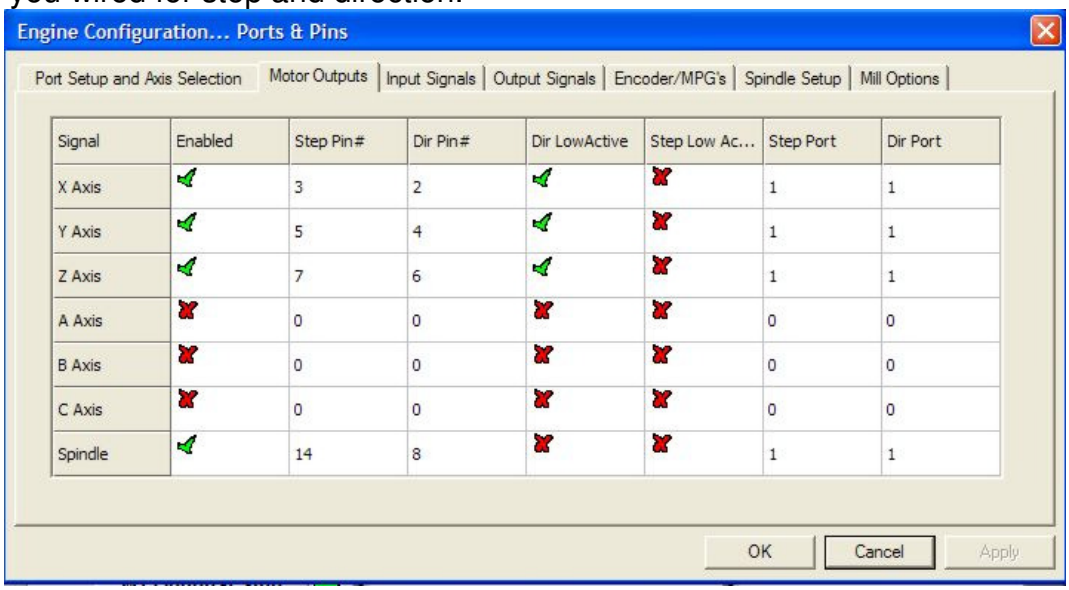


ANALOG OUTPUT:

It is strongly recommend that you read your control software 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 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.

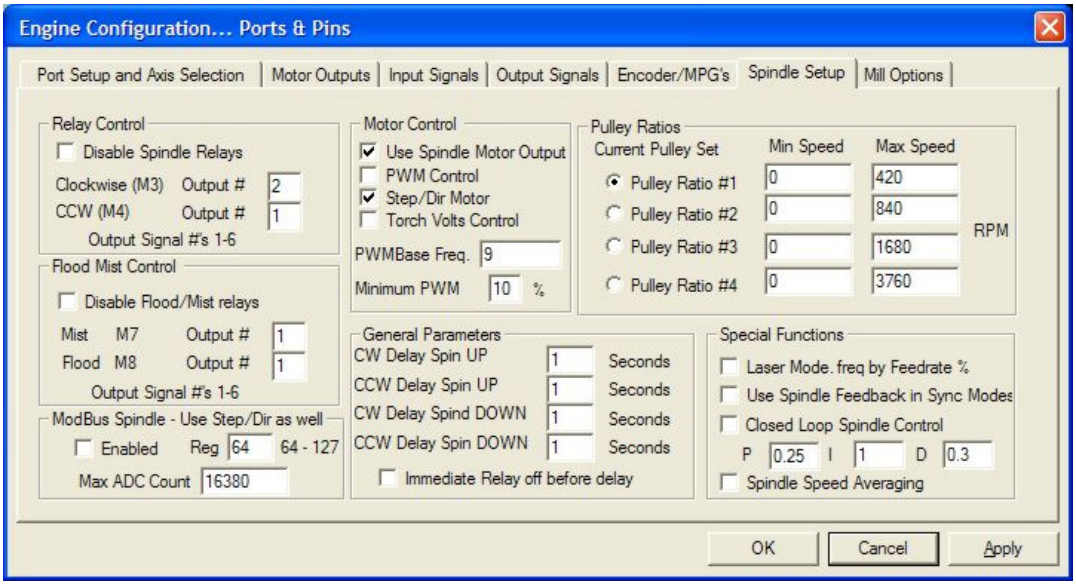
For configuring Mach follow these steps:

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



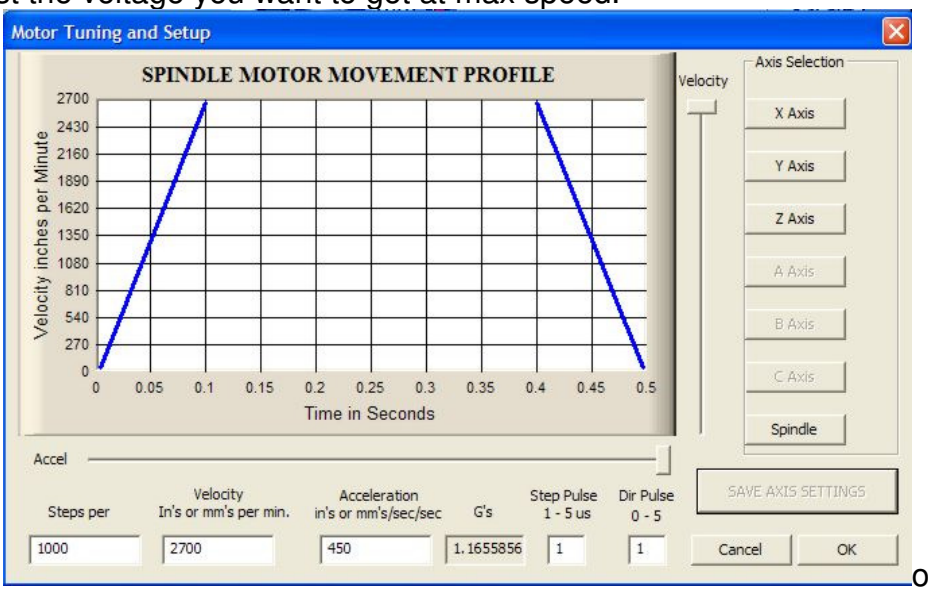
Signal	Enabled	Step Pin#	Dir Pin#	Dir LowActive	Step Low Ac...	Step Port	Dir Port
X Axis	✓	3	2	✓	✗	1	1
Y Axis	✓	5	4	✓	✗	1	1
Z Axis	✓	7	6	✓	✗	1	1
A Axis	✗	0	0	✗	✗	0	0
B Axis	✗	0	0	✗	✗	0	0
C Axis	✗	0	0	✗	✗	0	0
Spindle	✓	14	8	✗	✗	1	1

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.



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 1 to 5, but start with 1. 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.



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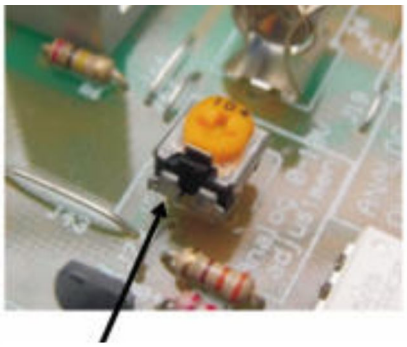
Fine Tuning:

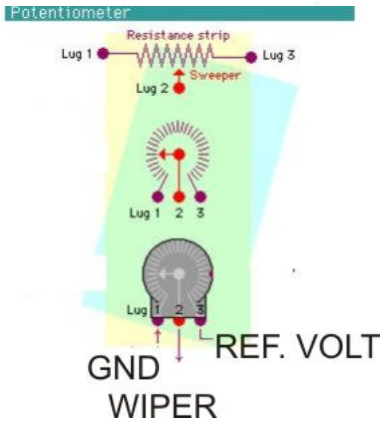
Make sure that when you reach the max speed in the control software you get 10VDC out. This voltage can vary depending on many things, including the electrical properties of parallel port or breakout board you are using, the length of the step pulse your software is delivering, and the normal hi or low status of your step pin. Play with the fine tuning pot in the card, the normally hi or low status of your pin, and the pulse width.



Pot for fine tuning the analog 0-10vdc output

Replacing a Potentiometer:

This circuit can be used to replace a potentiometer of DC motor speed control circuits. This speed controller circuits are very commonly used by SIEG, KB Electronics, and many other oriental machines. Before explaining how to do it, please first keep in mind that it can be done if the voltage that goes though the pot is +12vdc or less. This circuit cannot be used for AC currents.



In most cases the terminals that go to the potentiometer will carry these signals:

P1 = GND
P2 = WIPER
P3 = REFERENCE VOLTAGE

These are the steps for replacing a potentiometer:

1. Measure the voltage difference between P1 and P3. Make sure it measures under +12vdc.
2. Fine tune the analog output to the output voltage you got from step 1.
3. Connect the ground from the analog output to the ground of the potentiometer (P1).
4. Connect the analog output to the wiper connection of the potentiometer (P2).

If the reference voltage from pot is between +10 and 12vdc, you can use it to power the analog circuit. In this case, connect P1 to the ground of the power terminal, and P3 to the +12vdc power connector.

TROUBLE SHOOTING GUIDE:

PROBLEM	SOLUTION
1. The board is under power but there is no communication between the board and the PC.	1. Test the cable you are using. 2. Configure the memory address used by the parallel port. A.) Select My PC in you desktop. B.) Right click the mouse. C.) Select "Properties" D.) Select the "Hardware" tab. E.) Select "Device Manager" F.) Select "Ports (COM & LPT)" G.) Select the port you are using. H.) Right click the mouse and go to properties. I.) Select the "resources" tab. J.) Write down the memory address used by the parallel port you are using. K.) Go to Mach / Config / Ports&Pins. L.) Under the LPT1, record the memory address used. 3. Make sure both sides of the circuit are properly powered. Use +5vdc@100milliamps on the PC side of the circuit, and +5vdc at 1.5 amps on the other side of the circuit. Make sure there are no shorts in the board or on the things you wired to it. You can use a voltmeter to make sure that the power consumption is within the rated values, and that you do not have a voltage drop on any of the power terminals.
2. The board is under power and connected to the PC, but there are no outputs.	1. Make sure you do have communications between the PC and board. 2, Enable the outputs; make sure the LED marked "STATUS" lights up. Do the following: A.) Tie +5vdc into the EN pin. B.) Disable the safety charge pump (DIP1=off) or configure mach to output the signal through pin 17.
3. The Safety Charge Pump is not enabling the board.	1. Make sure the signals are getting to the board (Problem 1.) 2. Place the DIP1 in the "on" position and configure mach to output the safety charge pump signal to pin 17. 3. Test your system with both programs; test your system with DIP2 "on" and "off". 4. Try changing the active low status of pin 17.
4. There is no analog output in the speed control circuit.	1. Make sure that the board is connected, under power, and that outputs are enabled (Problems 1 and 2).

	2. Configure Mach, follow these steps: A.) Enable the spindle as an angular axis. Go to Config / Motor Outputs / Spindle. Enable it and set it to work on port1, pin 14. B.) Configure Mach to use step and direction spindle control. Go to Config / Spindle Setup/ Motor Control. Enable "Use Motor Control" and "Step and Direction". C.) Set the pulley ratios with max and min speeds that you are going to be using. Go to Config / Spindle Setup / Pulley Ratios. Set the min and max speeds for the pulleys you have and leave selected the pulley you are going to the tests under. D.) Tune the spindle motor. Go to Config / Motor Tuning / Spindle. Set "Steps per" = 1000, set "velocity" = maximum value, set "step pulse" =1. Save the axes. 3. Configure the maximum output voltage on the analog output. Follow these steps: A.) Determine the maximum voltage you are going to require the circuit to output. If it is not clearly labeled in the VFD or speed controller, then use a voltmeter to measure the voltage difference between ground and the reference voltage, The voltage needs to be +12vdc or less. B.) Fine tune the pot by connecting a voltmeter to the analog output while the machine is set to max speed. Make sure you turn on the spindle (M3 Sx), were x= the max speed you set in your pulley ratios (Example: M3 S1500, where 1500 is the max speed that is set in the pulley ratios for the pulley you are using). Play around with step pulse (in the motor tuning window) and the active low status (in the Motors Output). Try to set the pot as high as possible with the lowest pulse length for increased resolution. 4. Power the analog circuit and connect the analog output to the speed controller. Follow these steps: A.) Connect +10 or +12vdc to the power terminals of the circuit. High end VFDs are already optoisolated, if this is the case, you can use the +12vdc and ground connections from the connectors that are powering the board. If the reference voltage of the device you are using is between 1+10 and +12vdc, you can use it to power the board. In this case connect P1 to the ground connector of the power intake and P3 to the terminal marked +12vdc in the analog circuit. Keep in mind that this circuit consumes less than 10 milliamps. If you do not have any of the previous cases mentioned, then use a wall-mart type external +12vdc power adapter. B.) Connect the analog output and ground of the circuit to the analog input and grounds of the device you are controlling. If you are replacing a pot, connect P1 to ground and P2 to the analog output.
5. There is noise getting into output signals.	1. Make sure the board is properly powered. All those LEDs, buffers, capacitors, and optoisolators use a lot of power. Make sure you are using a 1.5amp power supply on the +5vdc signals. 2. Look for shorts. Make sure you do not have any shorts that might show in the board or on any device that you might have connected to it. See that everything is cool. Measure the voltage at the power terminals; make sure you do not have a voltage drop. Use a multimeter to measure the current consumption, if it is over one 1 amp try disconnecting things to find what is taking all the power. 3. Use ferrite beads around the output signals or use 103 or 104 capacitors between ground and the signal line. 4. Play around with the step signal length and the active low status of the pin to modify the waveform. 5. If you are sharing the ground with the analog output, try isolating this ground.

	6. Try using shielded cables. Tie the lead to earth or ground. 7. Use cables as short as possible. Try not to run them next to motors, AC currents, or other signal cables. Keep in mind that the lines that carry the signals to limit switches or other devices could act as aerial antennas.
6. There is noise getting into the input signals.	1. Check the solutions for noise in output signals (Problem 5.) 2. Try increasing the Debounce Interval value under Config / General Logic Configuration.
7. You have an issue not covered here.	1. Call Arturo Duncan at 561-2086664, or go to the yahoo group http://groups.yahoo.com/group/cnc4pc/.

FAQ

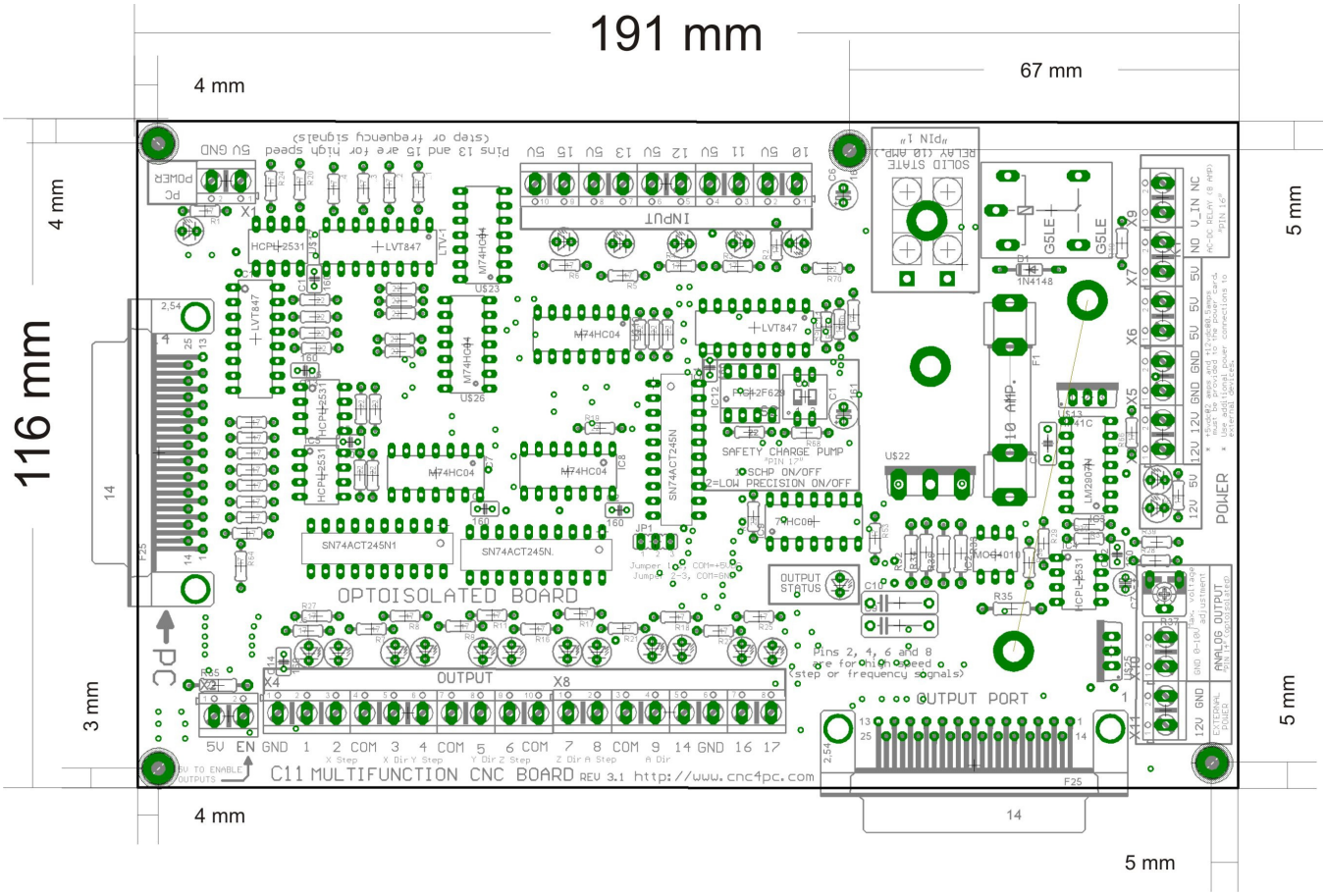
1. **Can I use the signals from the DB25 for output and the signals on the output and input pins at the same time?** Yes, but keep in mind that you have a total 24 mA per output pin, if you are using it twice and you are sharing the same current. If you have a cable connected in the DB25, but you are not using that pin, no current is drawn.

2. **Can I power both sides with the same current source (power supply)?** Yes, but you will lose optoisolation in your board. Keep in mind that this board uses up 70 milliamps on the PC side and 1 amp on the output side. You can draw a maximum of 600 milliamps from a USB port.

3. **Will this card protect my computer from a short or power surge in my drivers or wiring?** Yes, this is the best protection you can get. Your PC signals are optically isolated from your cnc system. In case of a meltdown, the card would take the damage. The most probable thing is that it could be easily repaired by replacing a couple of inexpensive ICs that are already mounted on sockets. Keep in mind that the short could not just come from the drivers, but from all the lines that are running across the system.

Power consumption of the board is 70 milliamps on the PC side of the circuit, and 1 amp on the output side of the circuit. Keep in mind you can draw a maximum of 600mA from a USB port, so do not attempt to connect this connection to a USB port.

Dimensions:



Disclaimer:

Use caution. CNC machines are dangerous machines. DUNCAN USA, LLC or Arturo Duncan are not liable for any accidents resulting from the improper use of these devices.