CNC USB Controller Mk1

## User manual

2014-06-12

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1 Introduction

1.1 Overview
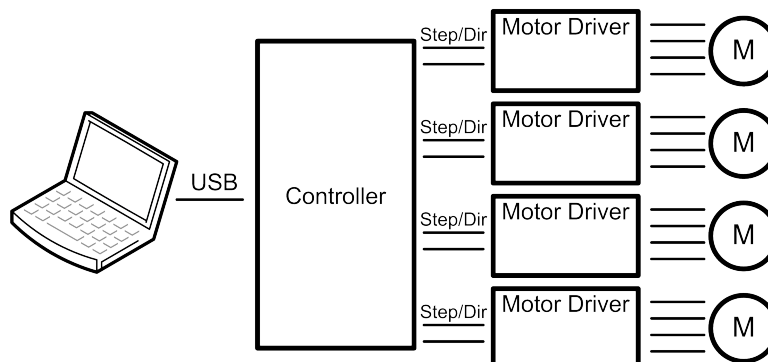
The PlanetCNC series of USB CNC motion controllers link between a personal computer and motor drivers supporting step/direction control. They are compatible with most drivers. The controllers use the USB port, available on all modern computers and laptops. They can serve as direct replacement or upgrade for many parallel port break-out boards.

PlanetCNC controllers provide a complete, fully integrated software/hardware solution. Additional machine control software is NOT required. The USB CNC Controller software is a dedicated application, designed to fully exploit the features of the purpose-built hardware. It has many advanced features to assist day-to-day CNC machine operation.

1.2 Features and specifications:

- USB (V2.x) from PC/Laptop running Windows XP, Vista, Windows 7, 8 or 8.1 (32 bit or 64bit)
- motor driver connector pin-out is compatible with 10 pin open source interface
- controller works with most step/dir stepper and servo motor drivers available on the market
- buffered IO for maximum performance
- advanced interpolation algorithms
- start, stop, pause and resume execution of program on your machine
- standard RS274/NGC G-code (EMC2 and LinuxCNC compatible)
- advanced G-codes - G40, G41, G42 (Cutter Radius Compensation) supported
- advanced G-codes - G43, G49 (Tool Length Offsets) supported
- advanced G-codes - G54, G59.3 (Coordinate System Origins) supported
- tested with SolidCAM, MasterCAM, ArtCAM, Vectric, CamBam, MeshCAM ... generated G-code
- Profili 4-axes and 3-axes G-code supported
- import toolpath from DXF files
- import toolpath from PLT/HPGL files
- import toolpath from image files
- import toolpath from NC-Drill (Excellon) files
- import toolpath from Gerber (RS-274X) files
- toolpath simulation
- automatic homing procedure
- advanced toolchange procedures
- automatic tool length measuring
- export toolpath to G-code
- export toolpath to DXF
- SDK (software developers kit) is available
- works on MacOS with virtual machine emulating Windows

Mk1 - 4 axes USB CNC controller

- 4 axes controller for stepper motors
- 25 kHz maximum step frequency
- 3 digital outputs (flood, mist, spindle)
- jog inputs for all axes
- limit inputs for all axes

1.3 System Requirements

Minimum system requirements:

- 1 GHz or faster processor
- 512MB RAM
- 500 MB available hard disk space
- Graphics with OpenGL support
- USB 2.0 port
- .NET Framework 3.5 SP1

Recommended system requirements:

- 2 GHz or faster processor
- 2GB RAM
- 500 MB available hard disk space
- Graphics with OpenGL support
- USB 2.0 port
- .NET Framework 3.5 SP1

2 Hardware

2.1 Installation

Installation of PlanetCNC CNC USB Controller requires a USB equipped PC or laptop along with motor drivers appropriate to the motors in use. The USB CNC controller is compatible with the vast majority of motor drivers that use step/direction signals.

Optional support hardware can be employed to customize installation to suit user requirement. Use of a screw terminal adapter makes connection to the type of drive in the image much easier. A DB25 adapter is available, for motor drivers requiring this form of input, with male or female DB25 connector.

For maximum flexibility in controller layout, a ribbon cable and plug kit is available. This aids the construction of longer cables and ensures plug-in connections correspond to the USB CNC Controller pin outs.
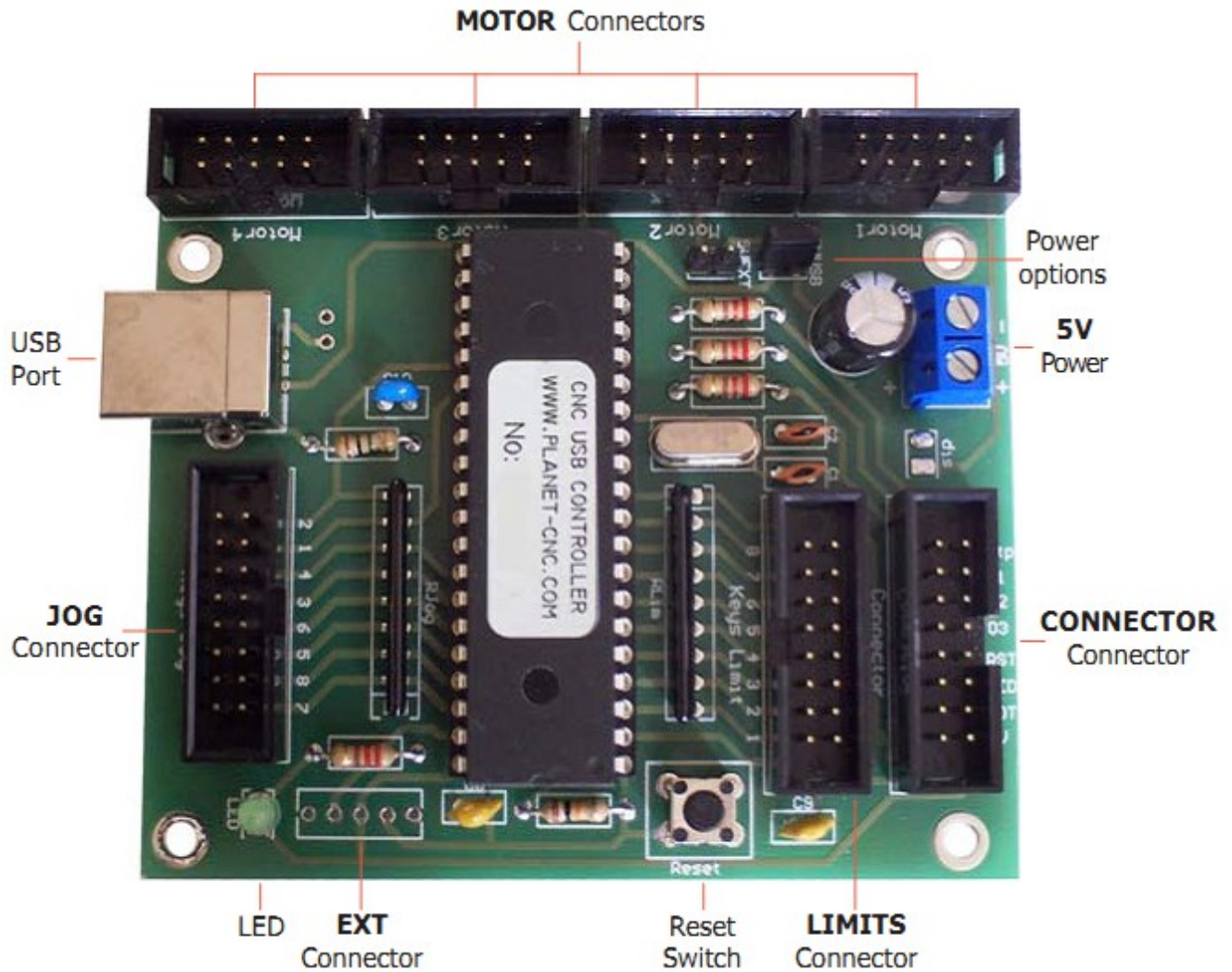

IMPORTANT:
The controller should be powered with an external power supply.
Mk1 - 4 Axis Controller hardware requires 5V DC supply.
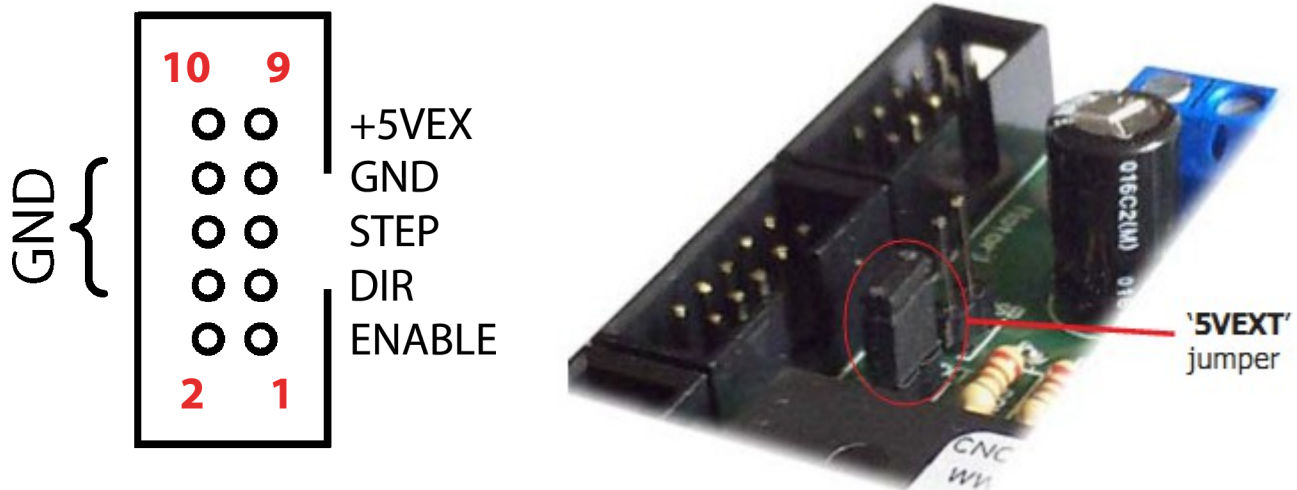Power supply should be at least 200mA.

2.2 Mk1 - 4 axis CNC USB controller description

Features:

- 25 kHz maximum step frequency
- 3 digital outputs (flood, mist, spindle)
- 12 us minimum pulse width
- manual jog input keys for all axes
- limit keys for all axes
- control external devices with I2C protocol

2.2.1 Mk1 *MOTOR* connector

```
        10    9
GND {    O O        +5VEX
         O O        GND
         O O        STEP
         O O        DIR
         O O        ENABLE
         2    1
```

Each connector controls one motor driver.

Pins 2,4, 6,7, 8 and 10 provide the 'Ground' or common side of connections.

+5VEX: Motor drivers can be powered from the USB controller. The '5VEXT' jumper, highlighted above, must be closed to enable this feature.

STEP: Provides a STEP signal of minimum 12 us pulse width to the motor driver.

DIR: Provides DIR or DIRECTION signal to the motor driver.

ENABLE: Provides ENABLE signal to the motor driver. The STOP pins on the 'Connector' connector must be connected to OUT 3 pins on the 'Connector' connector to use this feature.

The signal from 'Connector' connector OUT 3 is usually sent to a relay, to allow switching of an external device. If 'Connector' connector STOP pins are in circuit with the signal from OUT 3, the ENABLE signal on the Motor connector is also controlled by OUT 3 switching.

This can provide a useful safety feature if an E-Stop switch is included in the circuit. Operation of the E-Stop breaks all connections. Devices controlled by OUT 3 and the ENABLE signal to motor drivers would stop simultaneously on operation of the E-Stop.

GND: Ground or 'common' connections.

2.2.2 Mk1 *CONNECTOR* connector
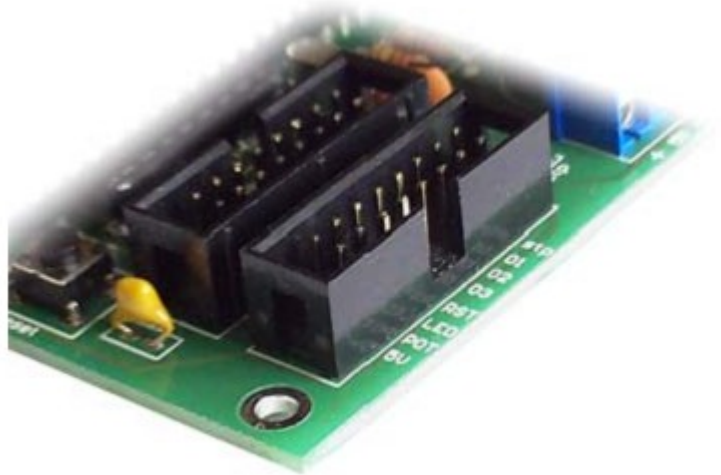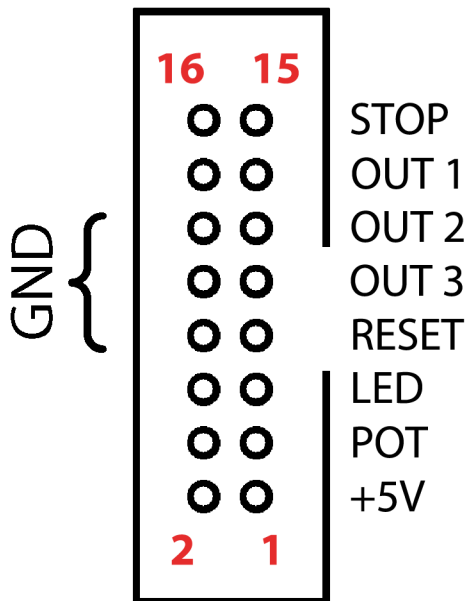
This connector provides for control of external devices and other helpful features built into controller. Pins 2,4,6,8.....16 provide the 'Ground' side of connections.

STOP: Direct connection to OUT 3 allows the ENABLE pins on the *MOTOR* connector to be controlled by OUT 3 switching.

OUT 1:   Output signal for control of external devices (i.e. coolant flood, mist, spindle, vac)

OUT 2:   Output signal for control of external devices (i.e. coolant flood, mist, spindle, vac)

OUT 3:   Output signal for control of external devices (i.e. coolant flood, mist, spindle, vac). Can be used in circuit with STOP pins to control the *MOTOR* connector ENABLE signal. Software settings allow E-stop status to be sent to this pin.

RESET: Connecting this pin to ground replicates the function of the 'Reset' switch. If the controller is enclosed, making the 'Reset' button inaccessible, a NO (Normally Open) panel mounted momentary switch can initiate the 'Reset' function.

LED: Connection for an external blinking LED. Current must be restricted to 10mA with a current limiting resistor.

POT: Connection of 5k or 10k ohm, logarithmic potentiometer provides a speed control for manual jogging.

+5V: +5V power supply for use with potentiometers.

GND: Ground or 'common' connections.

2.2.3   Mk1 *JOG* connector
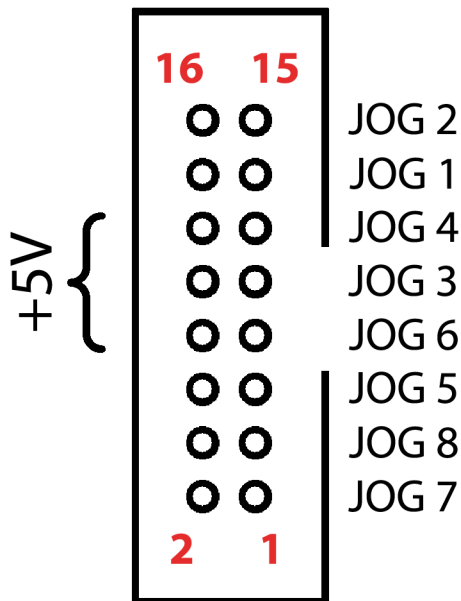
Manual jogging is controlled by switched operation of JOG 1-8. An optional plug-in 'Jogging Keyboard' can be provided. If users construct their own jogging keyboard, it's recommended that a 100nF capacitor is connected across switch terminals.
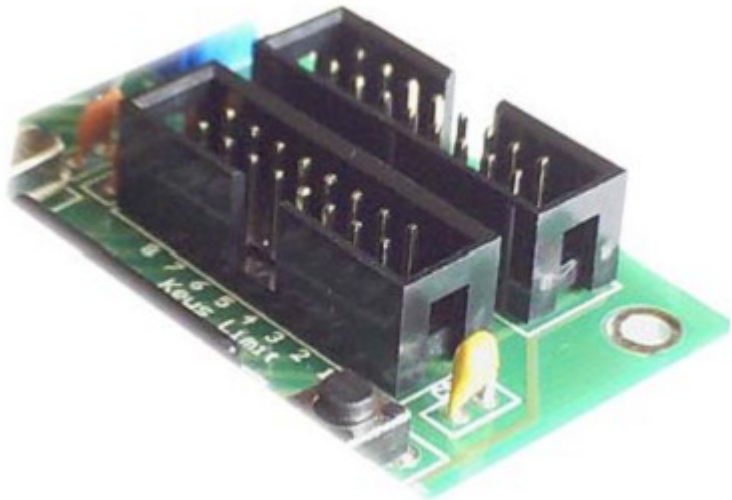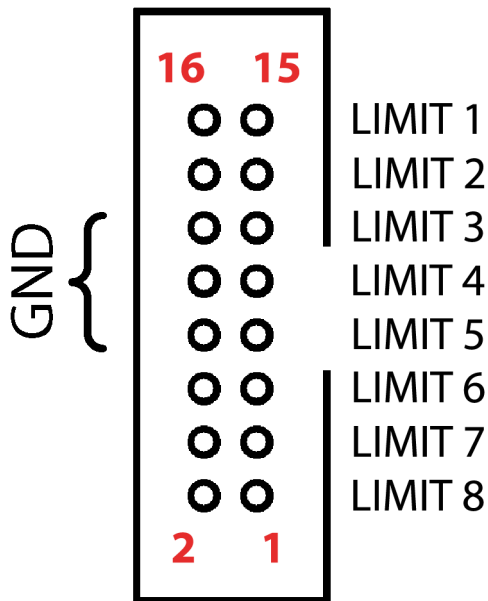
Pins 2, 4, 6, 8,10,12,14 and 16 are +5V connections.

JOG 2:	Jog X axis in positive direction.
JOG 1:	Jog X axis in negative direction.
JOG 4:	Jog Y axis in positive direction.
JOG 3:	Jog Y axis in negative direction.
JOG 6:	Jog Z axis in positive direction.
JOG 5:	Jog Z axis in negative direction.
JOG 8:	Jog A axis in positive direction.
JOG 7:	Jog A axis in negative direction.

The above is an example configuration only. Jog direction can be adjusted to suit requirement in software.

The optional jogging keyboard is pre-configured to use the Jog connector, immediately providing dedicated jog keys for all axes. Alternatively users can create their own jog controller, or use existing momentary spring-loaded switches. This provides for maximum flexibility in use.

The CNC USB controller JOG connector outputs only low-voltage and current. A safe, simple and inexpensive jog 'pendant' can be created by housing switches in a non-conductive enclosure and use of a longer cable. Users at the planet-cnc.com discussion group report use of cable lengths of up to 3 meters without problems.

2.2.4 Mk1 *LIMIT* connector

LIMIT 1-8 connects limit switches. It's recommended that a 100nF capacitor is connected directly across switch terminals.
Pins 2, 4, 6, 8,10,12,14 and 16 are 'Ground' or common connections.

LIMIT 1:   X axis negative limit.
LIMIT 2:   X axis positive limit.
LIMIT 3:   Y axis negative limit.
LIMIT 4:   Y axis positive limit.
LIMIT 5:   Z axis negative limit.
LIMIT 6:   Z axis positive limit.
LIMIT 7:   A axis negative limit.
LIMIT 8:   A axis positive limit.

Limits can use one of two possible configurations. The preferred configuration will determine limit switch connections.

NORMAL: Each switch is connected to its own pin with positive and negative limits determined by designated switches.

SINGLE INPUT: Both axis limit switches are connected to one pin. Direction of travel determines if positive or negative switch is triggered.

Enabling the 'Tool sensor' option in 'Settings' assigns LIMIT 5 (Z-) for 'tool sensor' for tool measuring procedures.
Enabling 'I2C' in 'Settings' assigns LIMIT 7 and LIMIT 8 for I2C communication. LIMIT 7 becomes I2C SDA pin, LIMIT 8 becomes I2C SCL pin.

2.2.5 Mk1 *EXT* connector
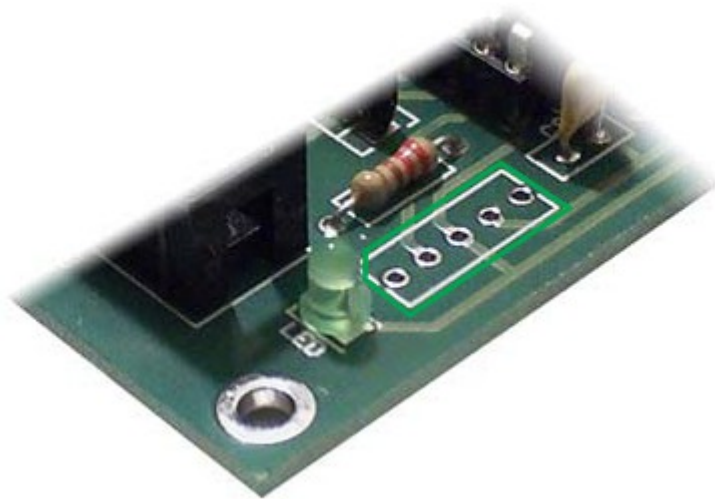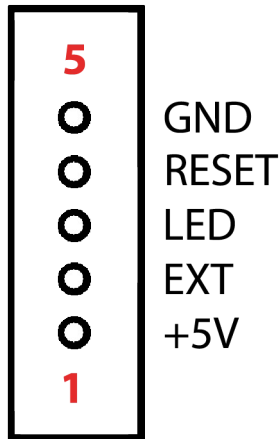
GND: Ground or 'common' connections.

RESET: A NO (normally open) momentary switch that, when closed, connects this pin to ground, duplicates the function of the built-in reset switch. This is helpful if the controller is enclosed making the dedicated button inaccessible.

LED: An LED connected to this pin duplicates the function of the onboard LED. This is a useful option if enclosure means the onboard LED is not visible.

EXT: An 'E-Stop' or 'Pause' switch can be connected to this pin. A 10k ohm pull-up or pull-down resistor is required. Use of the pin must be enabled in Settings/Misc/ExtPin. 'E-Stop' or 'Pause' function can be assigned. Invert options allow use of a normally open or normally closed switch.
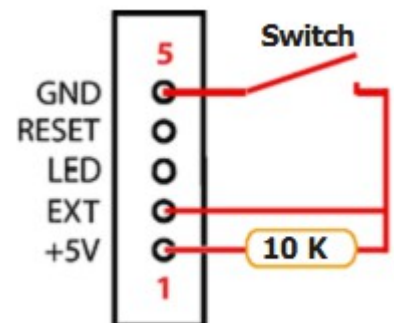

+5V: +5V power supply

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