8 Amp Micro Stepping Pro Series CNC Controller Hardware Guide

Getting Started

About This Manual

FlashCut CNC is a unique application involving hardware and software. We recommend that you read all of these instructions before using the product.

Since automated machining is potentially dangerous, please take the time to completely read through this manual and the software User's Guide to understand the operation of the electronics, software and machine before cutting a part.

Turning Off the Controller

Always turn off the CNC Controller when it is not in use.

Safety and Usage Guidelines

When running an automated machine tool, safety is of the utmost importance. For proper and safe use of the FlashCut CNC program and your CNC machine, the following safety guidelines must be followed:

1. **Never let the machine tool run unattended.**
2. **Require any person in the same room as a running machine tool to wear safety goggles and to stay a safe distance from the machine.**
3. **Allow only trained operators to run the machine tool. Any operator must have:**
    - **Knowledge of machine tool operation.**
    - **Knowledge of personal computer operation.**
    - **Knowledge of Microsoft Windows.**
    - **Good common sense.**
4. **Place safety guards around the machine to prevent injury from flying objects. It is highly recommended that you build a safety shield around the entire tool envelope.**
5. **Never place any part of your body within the tool envelope while the machine is online, since unexpected machine movement can occur at any time.**
6. **Always keep the tool envelope tidy and free of any loose objects.**
7. **Be on alert for computer crashes at all times.**

FlashCut CNC, Inc. is not responsible for the safe installation and use of this product. You and only you are responsible for the safety of yourself and others during the operation of your CNC machine tool. FlashCut CNC supplies this product but has no control over how it is installed or used. Always be careful!

FlashCut CNC, Inc. or its affiliates are not responsible for damage to any equipment or workpiece resulting from use of this product.

If you do not understand and agree with all of the above safety guidelines, do not use this product.

Micro Stepping CNC Controller

Front Panel

The front panel provides the main power switch, input for the cooling system and diagnostic LEDs.
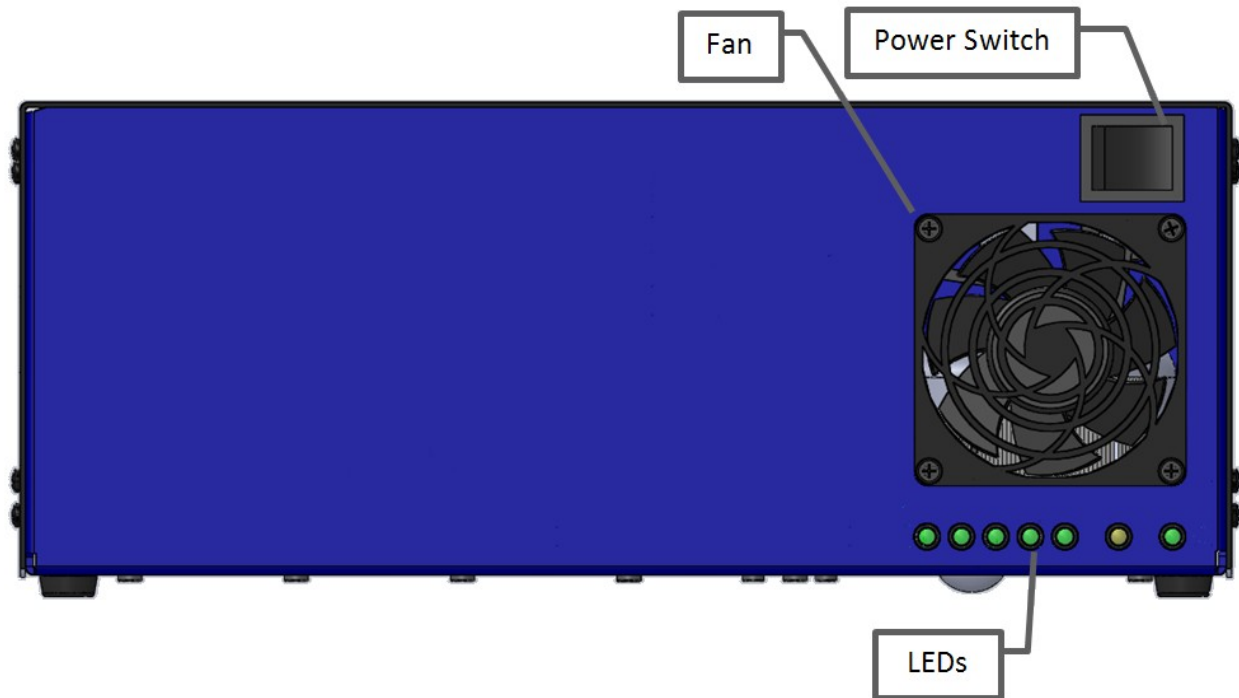
Fan

The fan is used to cool the internal components of the controller. Do not block air flow by placing the fan in front of objects or objects in front of the fan.

The fan is the input of the cooling system and has a filter used to catch large, harmful debris. The filter should be cleaned or replaced based on the environment it is kept in. The exhaust for the cooling system in the lid on the left side of the controller. Please see the Maintenance section for more information on changing the filter.

Power Switch

The power switch turns the unit on and off. If there is ever a communications error while running FlashCut CNC, it may be necessary to turn the switch off, wait 10 seconds and turn it back on to reset the internal microprocessor.

LEDs

The front panel LEDs can be used as a diagnostic tool to know the state of the system.
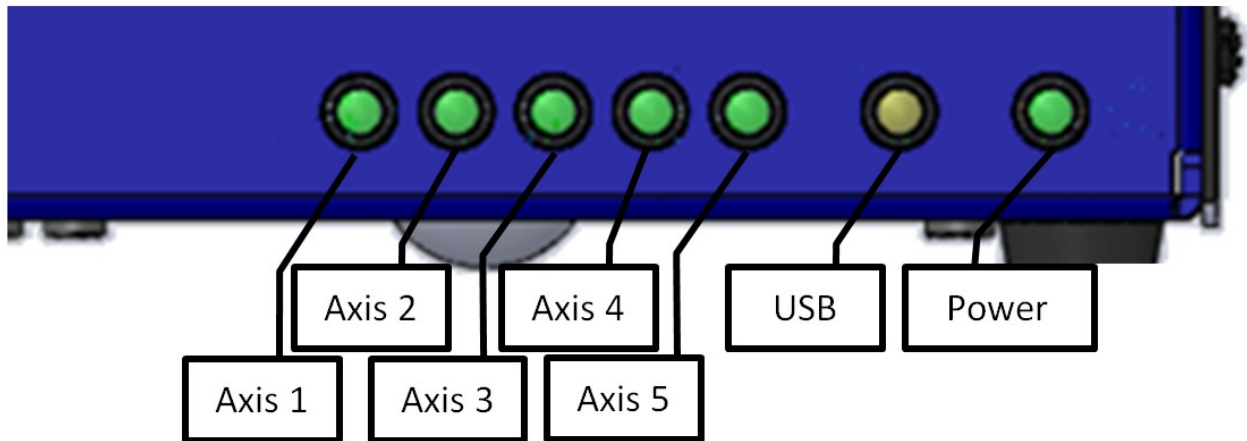
The five LEDs grouped on the left indicate the motion on axes 1-5. The brightness of the LED is based on the step rate of the axis. The faster an axis is moving, the brighter the axis LED will be. The axis LEDs are numbered 1-5 going left to right.

The amber LED indicates that the controller has a physical connection to the USB port on the PC. This is not an indication that the controller is connected through the software.

The LED to the right is the power/diagnostic LED. This LED is used to indicate that the unit is powered on.

Rear Panel

The rear panel of the CNC controller provides a connection point for main power, motor connections and all control signals used in the CNC system.
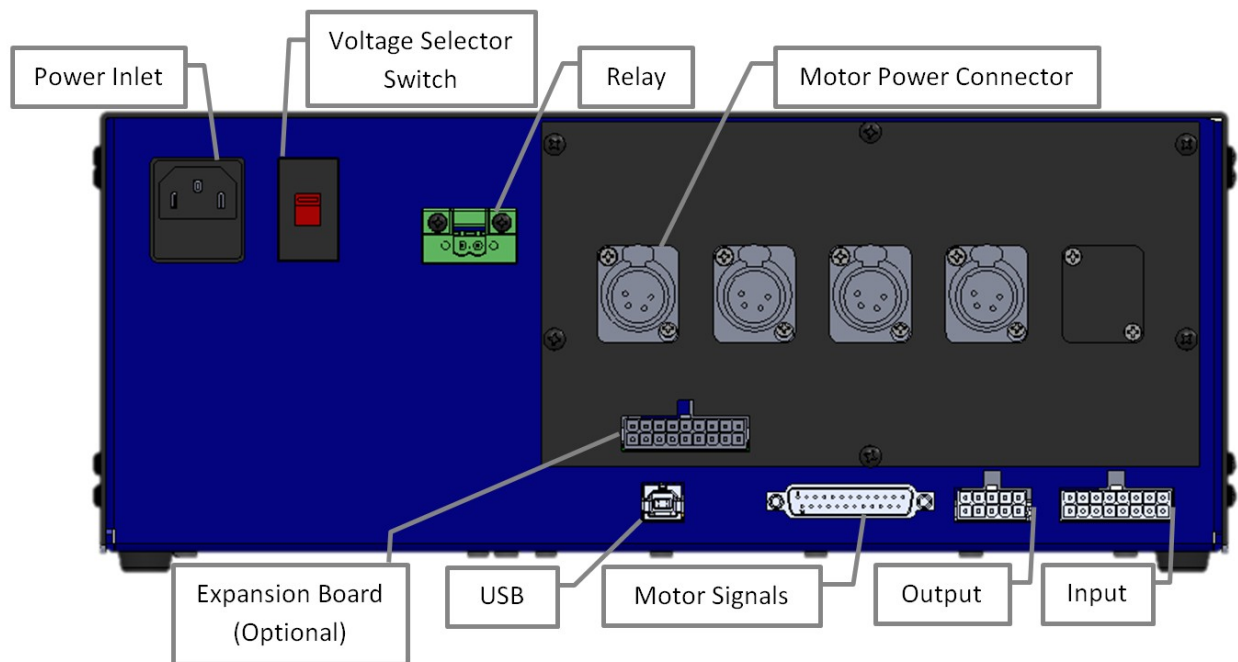
Power Inlet

The power inlet is a receptacle for supplying mains power to the controller. The unit is shipped with a standard grounded power cable for use with a 115VAC wall outlet.

The controller is designed to use 115 – 230 VAC. Make sure the voltage sector switch is in the proper position for the mains supply.

There are two fuses built into the power inlet receptacle that are rated to 10A for 115VAC installation. If the unit is going to be powered with 230VAC, the fuses need to be replaced with 5A fuses. If the power switch is in the on position and there are no lights on, then you should investigate the fuse for damage. See the Maintenance section for information on replacing the fuses.

Relay

The relay connector provides a switch closure for controlling both AC and DC devices. This connection is not polarity-sensitive and has a 0.5 Amp maximum current load. If the controller comes equipped with a Mini I/O Expansion Board, this connector is not wired as a relay because the same signal is available on the Mini I/O Expansion Board. This connector may be used for a constant 24VDC source and will be marked as such. This power source can be used for proximity sensors and other low-current devices.

Voltage Selector Switch

The voltage selector switch allows the controller to use an external power source of 115 or 230 VAC. If the input power is wired for 230VAC, then simply flip the switch with a flat-head screwdriver so that "230V" is clearly visible. If the input power is wired for 115 VAC, then flip the switch until "115V" is clearly visible.

Severe damage can occur if 115V is selected and your source is wired for 230VAC.

Motor Power Connectors

The motor power cables plug into these connectors. The numerical motor lines are correlated to any combination of the X, Y, Z, A and/or B axes in the Axes menu in the FlashCut CNC software. Each motor connector is a female XLR4 Receptacle (see the section on Motor Cabling for mating connector information). The pin assignments for the motor power connector are as follows:

XLR4 Connector for Motor Power	
Pin No.	*Signal*
1	B-
2	B+
3	A+
4	A-
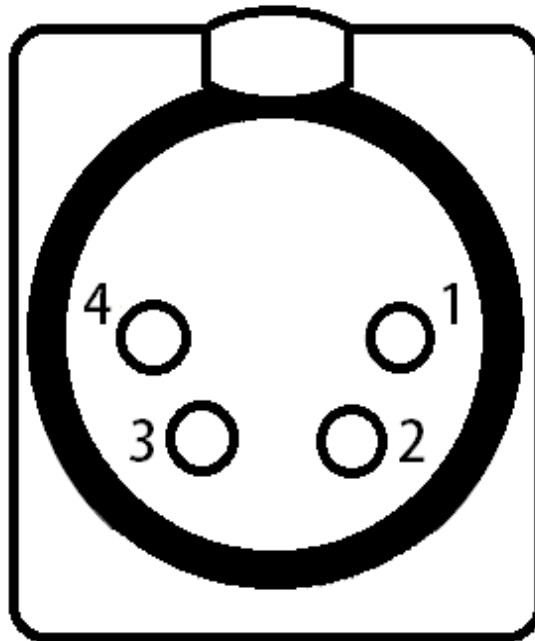
Motor Signals

The Motor Signals connector uses a DB-25 connector to send step and direction signals from the FlashCut CNC Signal Generator to an external drive box.

The Motor Signals connector also provides a connection point to inputs 1-8 and outputs 1 & 2. Inputs 1-8 are the same signals found on the Input connector. Output 1 & 2 are the same outputs found on the output connector.

The Motor Signals connector can be used to tap into the internal +5V power supply as well as provide an externally isolated power supply for the inputs. Refer to the signal generator section of this hardware guide for further information on input voltage compatibility.

The voltage levels for each Output, Step, Direction and Enable signals are all 5V logic.

DB-25 Connector for Motor Signals			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	OUTPUT 1	14	ENABLE ALL
2	OUTPUT 2	15	INPUT 1
3	STEP AXIS 5	16	INPUT 2
4	DIRECTION AXIS 5	17	INPUT 3
5	INPUT 5	18	INPUT 4
6	INPUT 6	19	DIRECTION AXIS 4
7	INPUT 7	20	DIRECTION AXIS 3
8	INPUT 8	21	DIRECTION AXIS 2
9	DIRECTION AXIS 1	22	INTERNAL VCC +5V
10	STEP AXIS 4	23	OPT. VCC (INPUT)
11	STEP AXIS 3	24	INTERNAL GND
12	STEP AXIS 2	25	OPT. GND (INPUT)
13	STEP AXIS 1		

USB

The USB connector is used for communication with the USB port on the host PC. Use a USB-A to B cable with a maximum length of 3 meters to make the connection. Plug the cable directly into PC, as opposed to a USB repeater or a hub. If the FlashCut software loses communication with the Signal Generator, electrical noise may be the cause. To reduce electrical noise problems, use a shorter USB cable or attach one or more ferrite chokes to the USB cable. Toroid-shaped chokes are more effective than snap-on cylindrical chokes. If you need more than 3m of USB cable length, use an active extension cable.

For the most robust USB connection, make sure the controller is communicating with the PC in Full-Speed mode rather than Hi-Speed mode. This setting can be found in the configuration dialog of your CNC software and will not decrease performance compared to Hi-Speed.

Outputs

This connector is for up to eight output lines. The Output ports cannot drive a 24V external system unless it accepts TTL/CMOS levels. They are all driven by HCT family logic. Output logic high is normally 5V and can be as low as 3.9V at full load. Output logic low is normally 0V and can be as high as 0.3V at full load. Each of these signals can provide up to 20mA of current. Information about the mating connector can be found in the Signal Generator section.

10-Pin Mini-Fit Jr. Connector for Outputs			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	OUTPUT 1	6	OUTPUT 2
2	OUTPUT 3	7	OUTPUT 4
3	OUTPUT 5	8	OUTPUT 6
4	OUTPUT 7	9	OUTPUT 8
5	+5V	10	GND

Inputs

The input connector provides a connection point for up to eight input lines. The most common use of the input lines is for limit or safety switches. These lines are all TTL and CMOS compatible, optically-isolated inputs. When a switch is open, its input signal is high (5VDC). When the switch is closed, the input signal is grounded low (0VDC). If you need more than eight input lines, an I/O expansion board is available.

The input circuit can be configured to be compatible with higher voltages and optical isolation. NPN type proximity sensors are compatible with the input lines, but may require a different voltage to power. For configuration and mating connector information, refer to the Signal Generator section of this manual.

16-Pin Mini-Fit Jr. Connector for Inputs			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	OPT. GND	9	INPUT 1
2	OPT. GND	10	INPUT 2
3	OPT. GND	11	INPUT 3
4	OPT. GND	12	INPUT 4
5	OPT. GND	13	INPUT 5
6	OPT. GND	14	INPUT 6
7	OPT. GND	15	INPUT 7
8	OPT. GND	16	INPUT 8

Accessory Connector (Optional)

The accessory connector is an interface to the emergency stop circuit, 24 VDC out, the reset circuit and two motor brakes. It is designed to connect external switches or circuits wired to the mating connector's screw terminals (Molex-Waldom part number 39530-0010). This connector is optional in stepper controllers and—depending on the power board used in the controller—has variable functions. The pin-out can be seen below:

10-Pin Phoenix Connector for Accessory Signals			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	ESTOP +	6*	BRAKE1-
2	ESTOP-	7*	BRAKE2+
3	+24V	8*	BRAKE2-
4	GND	9*	RESET+
5*	BRAKE1+	10*	RESET-
* Only available for systems containing an upgraded power board.			

Emergency Stop (Pins 1 & 2): The emergency stop input can be used to disconnect power to the motor drivers in the event of an emergency using a normally closed switch. For further information on the power board, please see the section on the power board later in this guide.

Switched 24V Supply (Pins 3 & 4): The switched 24VDC supply can be used to indicate when the motor drivers are powered and ready to run. The supply will not output voltage until the emergency stop and reset circuits have been cleared.

Brake Outputs* (Pins 5 & 6; 7 & 8): There are two 24VDC brake outputs to control motor brakes. When a brake output is active and supplying power, the brake rotates freely. For further information on triggering the brake output, please see the power board section of this guide.

Reset (Pins 9 & 10)*: The reset input can be used to clear an emergency stop condition. This requires the emergency stop button to be returned to a normal state. Power will then be restored to the motors when the reset input is tripped. For further information, please see the section on the power board later in this guide.

Connection Diagram

Motors

Stepper motors with XLR power connectors plug into the Axis 1-5 receptacles on the controller.

USB 2.0 cable communicates between the PC interface and controller.

Output devices to 10 pin output connector on controller

Input switches to 16 pin input connector on controller

FlashCut CNC Software on Windows PC
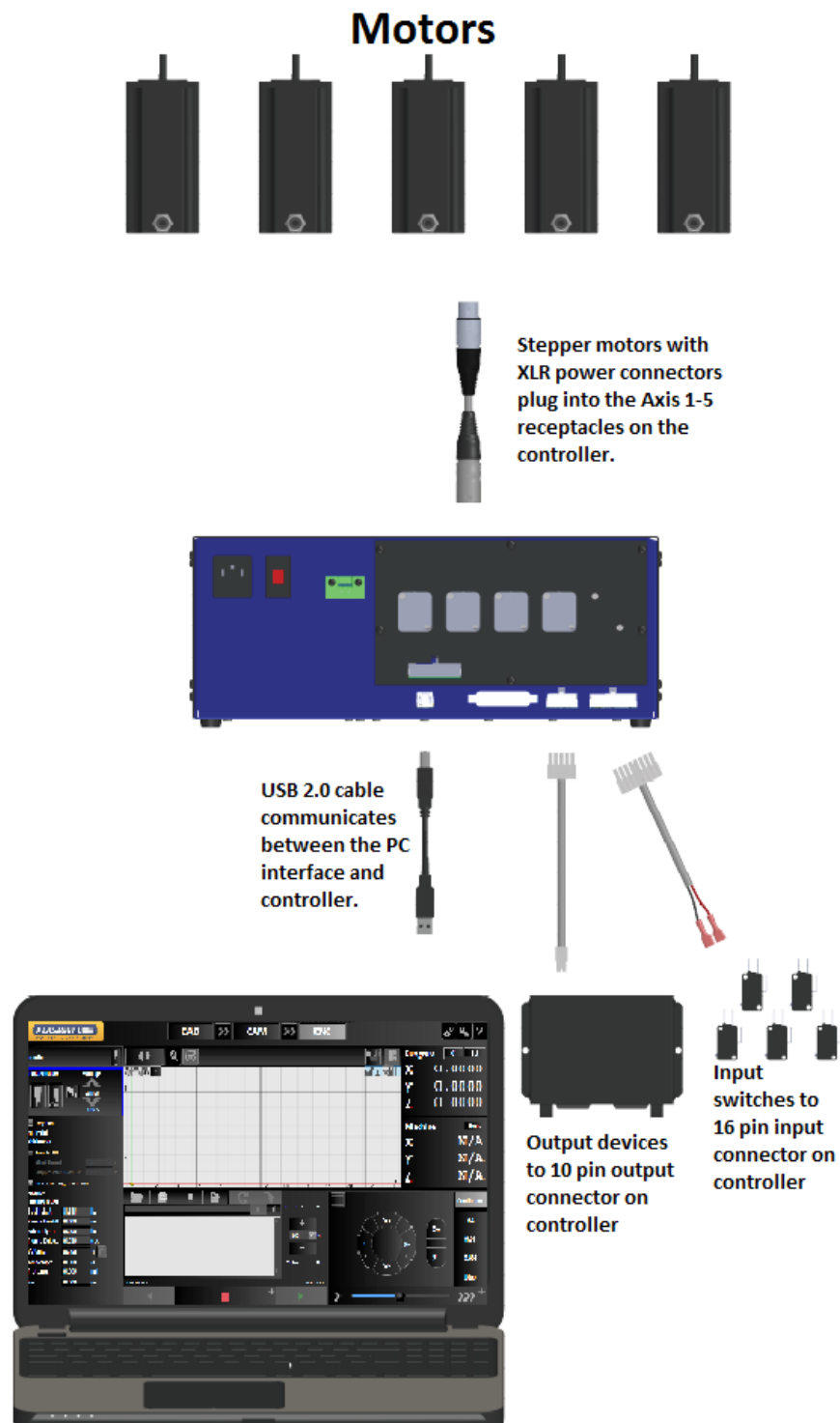
Stepper Motor Cabling

Cable and Wiring

The cable used for stepper motor wiring should be two 18 AWG twisted pairs (four conductors) with a foil shield and shield wire. Each twisted pair connects one coil in the motor to the stepper drive. An example of appropriate cable is Alpha Wire P/N 2242C. If the cable is an extension (between the controller and existing cabling), the shield wire should be terminated on both ends. If the cable is directly connected to the motor, the shield should only be terminated on the controller side. The mating connector is a male XLR4 (such as Neutrik part number NC4MX).

XLR4 Connector for Motor Power	
Pin No.	*Signal*
1	B-
2	B+
3	A+
4	A-
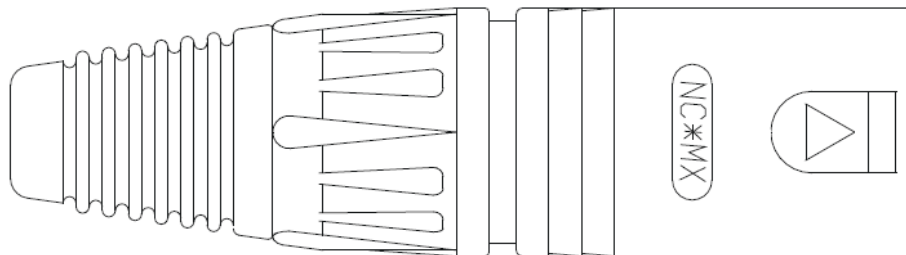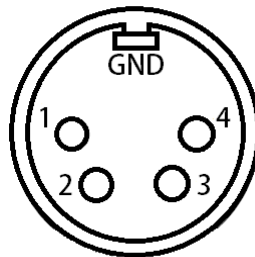
Motor Wiring for Third-Party Stepper Motors

If you have your own stepper motors, you can use the following charts for wiring. Please note that the motor colors will vary. To determine the wiring of a six- or eight-wire motor—when unknown—take resistance reading between several leads and refer to the following table.
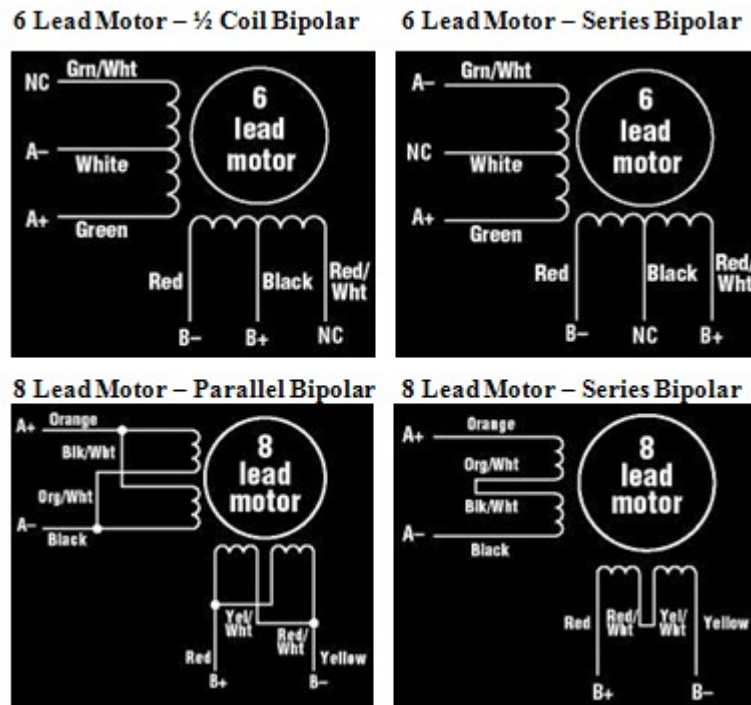
Lead Pair	Resistance
A+ & A-	1-10 Ω
B+ & B-	1-10 Ω
A+/- & B+/-	No continuity
A(center) & A+/-	½ of A+ & A-
B(center) & B+/-	½ of B+ & B-
A(center) & B+/-	No continuity
B(center) & A+/-	No continuity

If the A+ & A- , B+ & B- or A & B coils are reversed, the motor will spin in the opposite direction. This can be corrected in the software configuration on the "Machine....Axes" page. Changing the Direction for the motor in question should correct the problem.

Motor Drive Settings

Each drive module has logic connector for the Step, Direction, Fault and Enable signals coming from the Axis Plug-in connector on the Signal Generator, a motor connector for the A, B and C coils of the motor, a power connector and a group of dip switches for configuring the drive for your specific requirements. The configuration of the dip switches may vary depending on your application. The acceptable voltage input range is 24-75VDC.

DIP Switches   Rotary Switch   Indicator LEDs
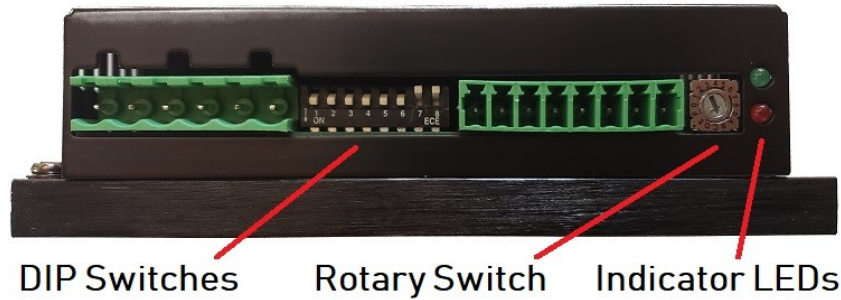
Configuring the Drives

Motor Selection

The rotary switch is used to select the motor connected to each drive for tuning and max current settings. The drives are optimized for use with FlashCut CNC stepper motors but can also drive third-party motors. Each setting matches the current and inertia of a given motor to provide the most power with minimum resonance. To select a motor, simply move the rotary switch to the letter of number that corresponds to the driven motor in the table above. Make sure the power is off before changing this setting or damage could occur to your motor, drive or cabling. If your motor is not on the list, please select a setting which matches the properties of your motor within 10%.

Rotary	Motor	Current	Rotary	Motor	Current
0	MP2301	1.4A	8	MP1702/3	2.0A
1	MP2302	1.4A	9	MP2301	2.4A
2	MP2303	3.6A	A	MP2302	2.4A
3	MP3402-P	4.3A	B	MP2303	6.0A
4	MP3402-S	2.2A	C	MP3402-P	7.2A
5	MP3403-P	4.3A	D	MP3402-S	3.6A
6	MP4201	4.7A	E	MP3403-P	7.2A
7	MP1701	1.6A	F	MP4201	7.8A

Current Factor Setting

The maximum current for the motor being driven is set automatically by the rotary switch. You may want to reduce the current to save power or lower motor temperature. This can be set using switches 1&2. This is important if the motor mounting method will not help dissipate heat or if the ambient temperature is expected to be high. Stepper motors produce torque in direct proportion to current but the heat generated is roughly proportional to the square of the current. For example, if the motor is operating at 90% of rated current, it will produce 90% of the rated torque. In this case, the motor will produce approximately 81% as much heat at maximum current. At 70% current, the torque is limited to 70% of maximum while the heat is reduced to about 50%. Switches 1 & 2 on the front of the drive set the percent of rated current that will be applied to the motor. Please set them according to the illustration below. The factory default setting is 70% (SW1 and SW2 on).

ON↓

1 2	1 2	1 2	1 2
100%	90%	80%	70%
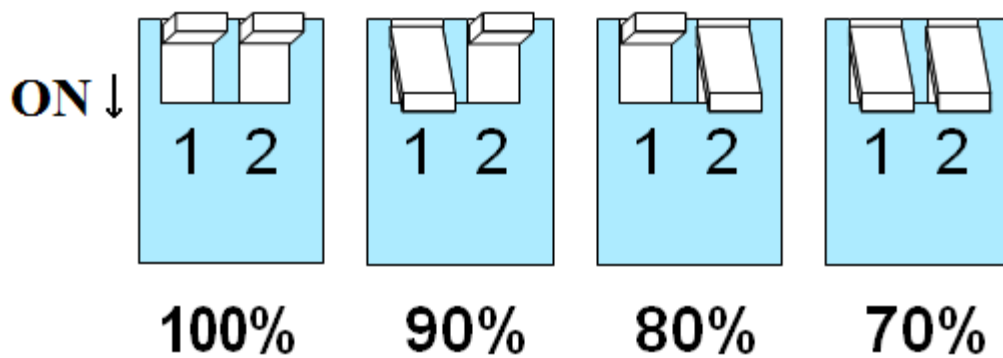
Make sure that the result of the rotary and switch current settings don't exceed the rating of your motor.

Load Inertia

The drives include anti-resonance and electronic damping features which greatly improve motor performance. For optimal results, the drive must be set to the electro-mechanical characteristics of the motor and load. Most of this is handled automatically by the rotary switch's setting but, to further enhance performance, you must set switch 3 to indicate the appropriate inertia ratio of the load and motor. The ranges are 0x to 4x and 5x to 10x. Simply divide the load inertia by the rotor inertia to determine the ratio, then set switch 3 accordingly, as shown:
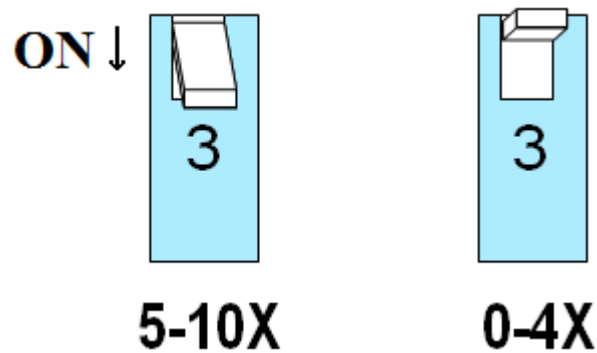
Idle Current

Motor heating and power consumption can also be reduced by lowering the motor current when it is not moving. This setting is controlled by switch 4. The drive will automatically reduce the motor current when idle to either 50% or 90% of the running current. The 50% idle current setting will lower the holding torque to 50% of the set current, which is enough to prevent the load from moving in most applications. This reduces motor heating to 25% while idle. In some applications, such as supporting a vertical load, it is necessary to provide a high holding torque. In such cases, the idle current can be set to 90% as shown below. The default idle current setting is for 50%:
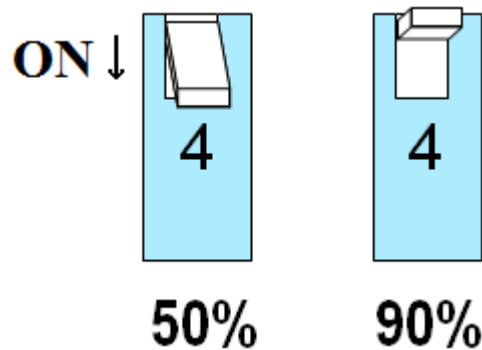
Step Mode

Smaller step sizes result in smoother motion and more precise speed but also require a higher step pulse frequency to achieve maximum speed. These step sizes are configured using switches 5-7. The smallest step size of the drives is 1/1000 of a single, discrete step and the maximum step rate of the Signal Generator is 100,000 microsteps/sec. Six settings are provided in the drive module, as shown below. Choose the one that best matches the capabilities for your system. The numbers below each setting refer to the number of microsteps in one rotation of a 200-step motor, such as those available from FlashCut.
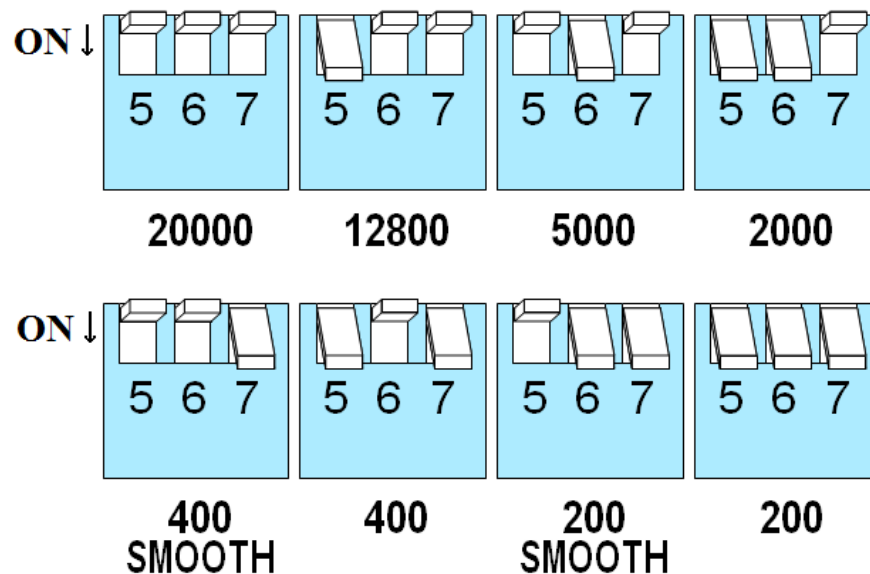
At lower step resolutions such as 200 steps/revolution (full step) and 400 steps/revolution (half step), motors may produce more audible noise than when they are microstepped (2000 steps/revolution and beyond). The drives include a feature called "Microstep Emulation" (also called "step smoothing") that can generate smooth motion from coarse command signals. If you select "200 SMOOTH or 400 SMOOTH", this feature is employed to provide the smoothest possible motion from a low-frequency signal source.

Because a command filter is used as part of the step smoothing process, there will be a slight delay in the motion. If this delay is objectionable for your application, please choose a non-filtered "200" or "400" setting. The chart on the next page shows an example of the delay. If you are using the smoothing feature, you must have all axis in the same smoothing mode. Otherwise, there will be a timing problem with multi-axis interpolation.

Motion Profile with Step Smoothing Filter
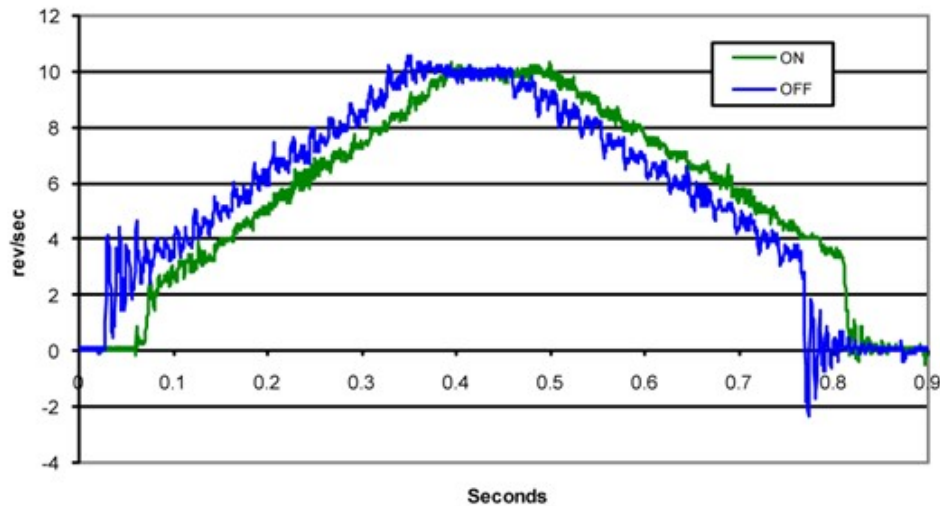
Self-Test

If you are having trouble with motor behavior, you may want to try the built-in self-test. Anytime switch 8 is moved to the ON position, the drive will automatically rotate the motor back and forth 400 steps in each direction. This feature can be used to confirm that the motor and cabling are correctly wired, configured and otherwise operational.
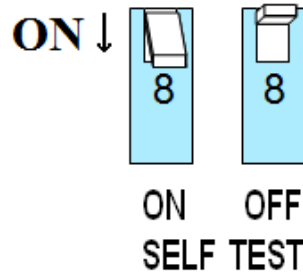
Indicator LEDs

In the event of a drive fault or alarm, the green and red LEDs will flash an alarm code corresponding to the error encountered. The pattern repeats until the alarm is cleared.

Code		Error
●	solid green	no alarm, motor disabled
●●	flashing green	no alarm, motor enabled
●●	flashing red	configuration or memory error
●●●●●	1 green, 4 red	power supply voltage too high
●●●●●●	1 green, 5 red	over current / short circuit
●●●●●●●	1 green, 6 red	open motor winding
●●●●●	2 green, 3 red	internal voltage out of range
●●●●●●	2 green, 4 red	power supply voltage too low

FlashCut CNC Software Configuration

Motor Signal Setup

In FlashCut CNC, go to "System…Controller" in the configuration and make sure the 8A Pro Series Micro Stepper Controller is selected.

Input Line Setup

If the drive encounters an electrical problem that prevents it from functioning, it will enter a fault state. If this occurs, a fault signal will be sent from the microstepper motor drive to the Signal Generator through one of the input lines.

To configure these faults to stop the software in the case of a stepper drive fault go to "I/O…Input Lines" and define Function of the lines you are using for servo faults as Safety and Wiring as N.O. This signal is automatically routed to the Signal Generator via the internal control cables.

If you are using input lines, do not occupy inputs 9, 11, 13, 15 or 17 as a conflict will occur and the input connected to these lines will malfunction and may damage the controller.

Line #	Description	Function	Wiring
9	Axis 1 Fault	Safety	N.O.
11	Axis 2 Fault	Safety	N.O.
13	Axis 3 Fault	Safety	N.O.
15	Axis 4 Fault	Safety	N.O.
17	Axis 5 Fault	Safety	N.O.

Signal Generator

LEDs

The Signal Generator has seven LED indicators on-board to show different states of the system.

Power-On Sequence

When power is first applied to the Signal Generator, the seven LED indicators go through a start-up sequence to indicate that the firmware is in a healthy state. First, all LEDs blink once. Then, each LED blinks once in order from Axis 1 to Power.

After the light sequence is complete, Axis 1-5 LEDs will remain off and the Power LED will be on. The USB LED will be on if a USB cable is connected between the controller and PC, otherwise the USB LED will be off.

If the LEDs do not sequence on power-up as described, either there is no power to the Signal Generator or the firmware on the controller has become corrupted and the controller will need to be repaired.

During Operation

Each Axis LED will pulse when its corresponding axis is commanded to move. This causes the LED to appear to increase in brightness as the commanded motion becomes faster.
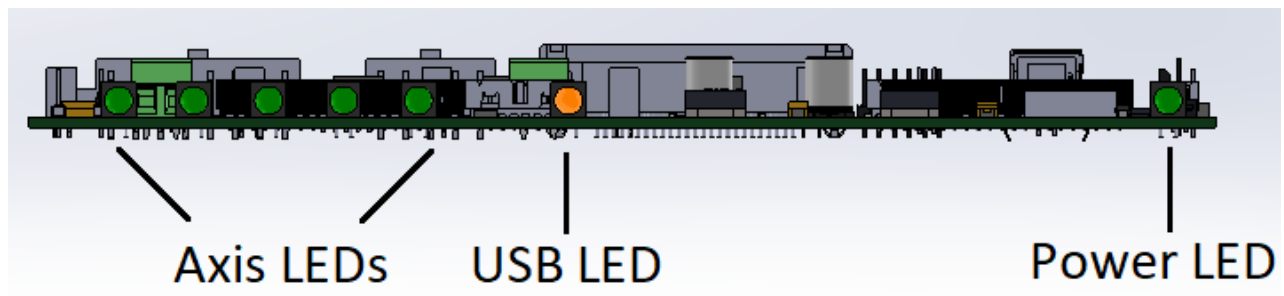
Inputs

Inputs 1-8 are all optically isolated to provide a measure of protection from overvoltage and transient voltages. The inputs' reference voltage can be supplied by the Signal Generator's internal logic power or by an external voltage wired to the Signal Generator's TB40.

Internal Power

This option works well for most applications but negates some of the signal isolation. When JP84 shorts pins 1 and 2, OPT VCC gets its power from the internal 5V power source. When JP85 shorts pins 1 and 2, OPT GND is directly connected to the internal GND.

External Isolated Power

For the best noise immunity, connect an external 5V-24V power supply using one of the following methods. This is the default configuration. Ensure that all of your input devices are compatible with the supplied voltage. When JP84 shorts pins 2 and 3, OPT VCC gets its power from the TB-VCC. When JP85 shorts pins 2 and 3, OPT GND is directly connected to the TB-GND.

Choose only one of the following methods to supply power:

- Connect a power source to the TB-40 screw terminal.

- Connect a power source through pins 23 & 25 of the DB-25 connector.

If you are providing an external voltage through pins 23 & 25 of the DB-25 Motor Signals connector or via TB-40, then you must have both JP84 & JP85 jumpers on pins 2 & 3. OTHERWISE, SEVERE DAMAGE COULD RESULT.

The input line settings can be individually changed between normally closed (N.C.) or normally open (N.O.) input lines using FlashCut CNC software.   Please refer to the FlashCut CNC User's Guide under "Input Line Settings" for further information. In the FlashCut CNC software, the Input Line Status dialog displays "OPEN" for a high-level input voltage, or open switch, and "CLOSED" for a low-level input voltage or closed switch. Each of these inputs are also accessible on the Motor Signals connector. These are the same—electrically—between this location and the Motor Signals connector.

The receptacle that plugs into this connector is a Mini-Fit Jr. Series 16 pin receptacle (Molex part number 39-01-2100), with female pins (Molex part number 39-00-0039 or 39-00-0047 for 22 gauge or thinner wires). The Molex 63819-0901 crimp tool is recommended for installing the pins. Kits containing connectors and pins are available through FlashCut CNC or an electronics distributor.

16-Pin Mini-Fit Jr. Connector for Inputs			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	OPT. GND	9	INPUT 1
2	OPT. GND	10	INPUT 2
3	OPT. GND	11	INPUT 3
4	OPT. GND	12	INPUT 4
5	OPT. GND	13	INPUT 5
6	OPT. GND	14	INPUT 6
7	OPT. GND	15	INPUT 7
8	OPT. GND	16	INPUT 8

Outputs

This connector is for up to eight output lines. These lines are all compatible with TTL/CMOS level outputs. The Output ports cannot drive a 24V external system unless it accepts TTL/CMOS levels. They are all driven by HCT family logic. Output logic high is normally 5V and can be as low as 3.9V at full load. Output logic low is normally 0V and can be as high as 0.3V at full load. Each of these signals can provide up to 20mA of current.

Two additional pins on this connector are provided for your output lines: ground and +5V. These are connected to GND and +5V and are not optically isolated. This 5V circuit can source up to 100 mA. Any larger current demand requires a larger power source.

The output lines are all initialized to low (0V) when you turn on the Signal Generator. Output lines 1 and 2 are also connected through pins 1 and 2, respectively, of the Motor Signal connector. These are the same—electrically—between this location and the Motor Signals connector.

The receptacle that plugs into this connector is a Mini-Fit Jr. Series 10 pin receptacle (Molex part number 39-01-2160), with female pins (Molex part number 39-00-0039 or 39-00-0047 for 22 gauge or thinner wires). The Molex 63819-0901 crimp tool is recommended for installing the pins. Kits containing connectors and pins are available through FlashCut CNC or an electronics distributor.

10-Pin Mini-Fit Jr. Connector for Outputs			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	OUTPUT 1	6	OUTPUT 2
2	OUTPUT 3	7	OUTPUT 4
3	OUTPUT 5	8	OUTPUT 6
4	OUTPUT 7	9	OUTPUT 8
5	+5V	10	GND

Motor Signals

The Motor Signals connector uses a DB-25 connector to send step and direction signals from the FlashCut CNC Signal Generator to an external drive box.

The Motor Signals connector also provides a connection point to inputs 1-8 and outputs 1 & 2. Inputs 1-8 are the same signals found on the Input connector. Output 1 & 2 are the same outputs found on the output connector.

The Motor Signals connector can be used to tap into the internal VCC +5V power supply on the signal generator as well as provide an externally isolated power supply for the inputs. Refer to the signal generator section of this hardware guide for further information on input voltage compatibility.

The voltage levels for each Output, Step, Direction and Enable signals are all 5V logic.

DB-25 Connector for Motor Signals			
Pin No.	**Signal**	**Pin No.**	**Signal**
1	OUTPUT 1	14	ENABLE ALL
2	OUTPUT 2	15	INPUT 1
3	STEP AXIS 5	16	INPUT 2
4	DIRECTION AXIS 5	17	INPUT 3
5	INPUT 5	18	INPUT 4
6	INPUT 6	19	DIRECTION AXIS 4
7	INPUT 7	20	DIRECTION AXIS 3
8	INPUT 8	21	DIRECTION AXIS 2
9	DIRECTION AXIS 1	22	INTERNAL VCC +5V
10	STEP AXIS 4	23	OPT. VCC (INPUT)
11	STEP AXIS 3	24	INTERNAL GND
12	STEP AXIS 2	25	OPT. GND (INPUT)
13	STEP AXIS 1		

Jumper Settings

Pin 1 of each jumper can be identified by a small, white dot printed on the PCB. A complete description of all jumpers and pin assignments can be found in the Wiring Appendix.
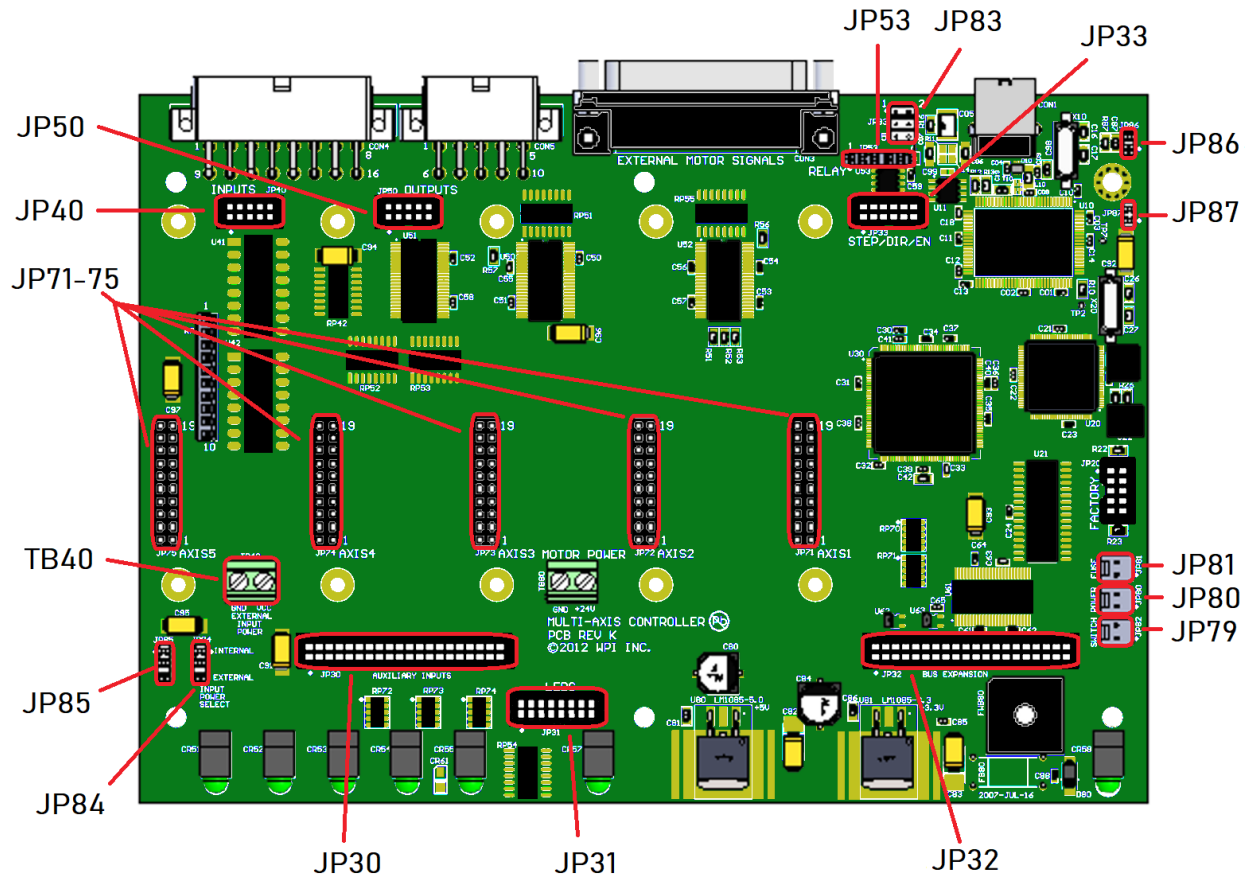
JP83 – DB to USB Ground

This connects the DB-25 ground to the USB ground. By default pins 1 & 2, 3 & 4, and 5 & 6 are jumped as pairs. In order to isolate only the USB shield, only jump pins 3 and 5 and remove JP86. To isolate only the chassis, jump pins 1 & 2, 3 & 5 and 4 & 6 and remove JP86 and JP87. For further information, please see the USB Communications Troubleshooting Guide.

JP84/JP85 – Input Power Select

These two jumpers enable you to choose between the internal power of the Signal Generator and isolated power from an external source. Both jumpers must be set on the same pair of pins (either both must be on pins 1 & 2 or both must be on pins 2 & 3). See the Input section of this guide for further details.
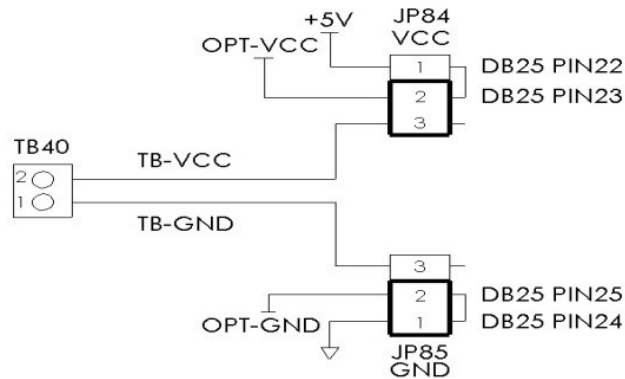
JP86 – USB to Chassis Ground

This jumper connects the USB shield to the chassis ground of the Signal Generator when jumped. In order to isolate the USB shield remove this jumper and make sure only pins 3 and 5 are jumped on JP83. In order to isolate the DB-25 the USB shields, remove this jumper. In order to isolate the DB-25 shield, the USB shield and the chassis remove this jumper as well as JP87.

JP87 – Internal Signal to Chassis Ground

This jumper connects the internal signal ground to the chassis ground of the Signal Generator when jumped. In order to isolate the chassis ground, remove this jumper in addition to JP86 and jump pin 3 and 5, and 4 and 6 on JP83. In order to isolate the DB-25 shield, the USB shield and the chassis, remove this jumper as well as JP86.

Internal Connections

JP30 – Auxiliary Input

This header contains the input signals from the Signal Generator for optional I/O Expansion. Connections should be made with approved peripherals, otherwise damage may occur.

Pin No.	Signal	Pin No.	Signal
**JP30 – Auxiliary Input**			
1	+3.3V	21	GPI-24
2	+3.3V	22	GPI-9
3	GPI-32	23	GPI-23
4	GPI-1	24	GPI-10
5	GPI-31	25	GPI-22
6	GPI-2	26	GPI-11
7	GPI-30	27	GPI-21
8	GPI-3	28	GPI-12
9	GPI-29	29	GPI-20
10	GPI-4	30	GPI-13
11	GPI-28	31	GPI-19
12	GPI-5	32	GPI-14
13	GPI-27	33	GPI-18
14	GPI-6	34	GPI-15
15	GPI-26	35	GPI-17
16	GPI-7	36	GPI-16
17	GPI-25	37	+3.3V
18	GPI-8	38	+3.3V
19	GND	39	GND
20	GND	40	GND
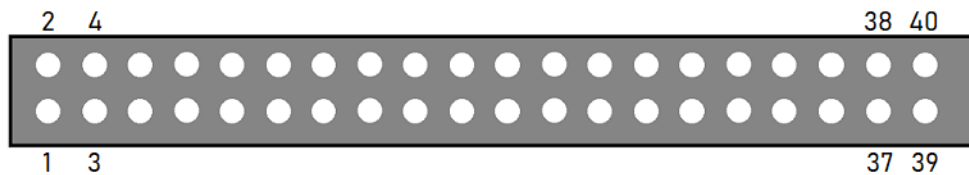
JP31 – Status LEDs

This is for connecting wired LEDs from a custom chassis to the 501A LED signals.

Pin No.	Signal	Pin No.	Signal

JP31 – Status LEDs			
Pin No.	**Signal**	**Pin No.**	**Signal**
1	+5V	9	LED-DIR4
2	N/C	10	LED-STEP4
3	LED-DIR1	11	LED-DIR5
4	LED-STEP1	12	LED-STEP5
5	LED-DIR2	13	LED-AUX
6	LED-STEP2	14	LED-USB
7	LED-DIR3	15	GND
8	LED-STEP3	16	LED-PWR
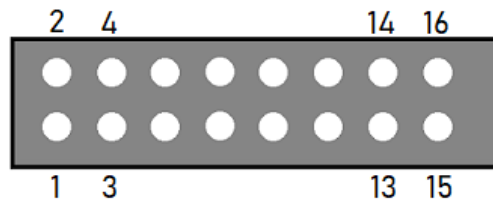
JP32 – Bus Expansion

This header contains signal and address lines for an optional I/O Expansion board. Connections should be made with approved peripherals, otherwise damage may occur.

JP32 – Bus Expansion			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	+3.3V	21	DATA1
2	GND	22	DATA2
3	CS6	23	DATA3
4	STATUS6	24	DATA4
5	TXD2	25	DATA8
6	FAULT6	26	DATA7
7	RXD2	27	DATA6
8	AUX1-STB	28	DATA5
9	OUT-ENA	29	+7V
10	AUX2-STB	30	+7V
11	OUT2-STB	31	SPHOME
12	OUT1-STB	32	ENC CLK
13	OUT4-STB	33	+3.3V
14	OUT3-STB	34	ENC DIR
15	+5V	35	AGND
16	+5V	36	AV+
17	GND	37	DAC2
18	GND	38	DAC1
19	A0	39	ADC1
20	A1	40	AGND
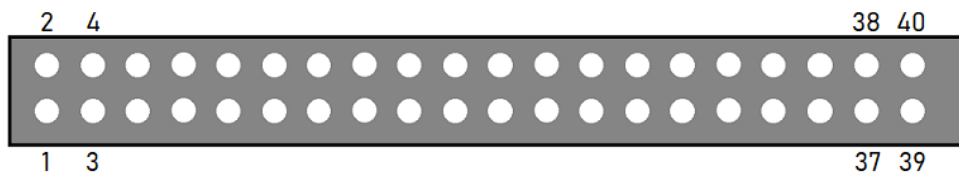
JP33 – Step and Direction

This header contains each step and direction signal for all five axes of motion as well as the global enable signal and the common ground reference.

JP33 – Step and Direction			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	STEP5	7	STEP2
2	ENA	8	DIR3
3	STEP4	9	STEP1
4	DIR5	10	DIR2
5	STEP3	11	GND
6	DIR4	12	DIR1
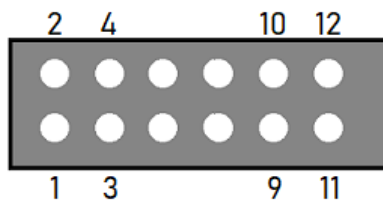
JP40 – Input Aux

This header contains the same signals as the Mini-Fit Jr. Input Connector. It is provided to use an internal input connector or an external input connector on a custom chassis.

JP40 – Input Aux			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	GPI-2	6	GPI-5
2	GPI-1	7	GPI-8
3	GPI-4	8	GPI-7
4	GPI-3	9	OPT-GND
5	GPI-6	10	OPT-GND
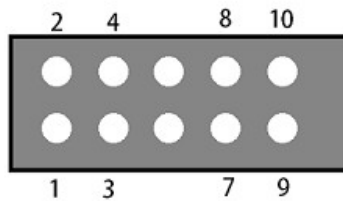
JP50 – Output Aux

This contains the same signals as the Mini-Fit Jr. Output Connector. It is provided to use an internal output connector or an external output connector on a custom chassis.

JP50 – Output Aux			
Pin No.	**Signal**	**Pin No.**	**Signal**
1	GPO-2	6	GPO-5
2	GPO-1	7	GPO-8
3	GPO-4	8	GPO-7
4	GPO-3	9	GND
5	GPO-6	10	VCC
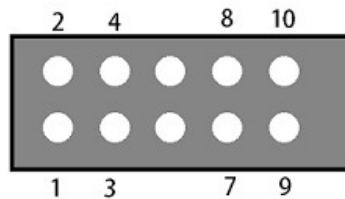
JP53 – Low-Side Relay

This header contains duplicate signals for Outputs 1&2 in order to drive an internal relay. (Either mounted here or on the power board, depending on configuration.) The clamps provide a reference voltage for use in signal isolation. The output low pins will sink current to drive devices.

JP53 – Low-SideRelay			
Pin No.	**Signal**	**Pin No.**	**Signal**
1	+5V	4	GPO-1 LOW
2	GPO-2 CLAMP	5	GPO-1 CLAMP
3	GPO-2 LOW	6	GND
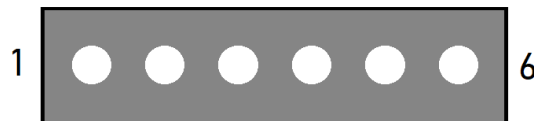
JP71-75 – Axis Plug-In Interfaces

There are five plug-in interfaces—one for each axis. They are used to add additional functions to the main signal generator board. Most typically, these provide signals to motor drives.

Pin No.	Function	JP71	JP72	JP73	JP74	JP75
			JP71-75 – Axis Plug-In Interfaces			
1	HV-PWR	HV-PWR	HV-PWR	HV-PWR	HV-PWR	HV-PWR
2	HV-PWR	HV-PWR	HV-PWR	HV-PWR	HV-PWR	HV-PWR
3	Ground	GND	GND	GND	GND	GND
4	Ground	GND	GND	GND	GND	GND
5	RxD2	RxD2	RxD2	RxD2	RxD2	RxD2
6	Status	STATUS1	STATUS2	STATUS3	STATUS4	STATUS5
7	TxD2	TxD2	TxD2	TxD2	TxD2	TxD2
8	Fault Input	FAULT1	FAULT2	FAULT3	FAULT4	FAULT5
9	Input A	IN8	IN10	IN12	IN14	IN16
10	Direction	DR1	DR2	DR3	DR4	DR5
11	Input B	IN9	IN11	IN13	IN15	IN17
12	Step	ST1	ST2	ST3	ST4	ST5
13	SM0	SM0	SM0	SM0	SM0	SM0
14	SCOM	SCOM1	SCOM2	SCOM3	SCOM4	SCOM5
15	SM1	SM1	SM1	SM1	SM1	SM1
16	CS	CS1	CS2	CS3	CS4	CS5
17	Enable (Global)	ENA	ENA	ENA	ENA	ENA
18	+5V	+5V	+5V	+5V	+5V	+5V
19	Ground	GND	GND	GND	GND	GND
20	Ground	GND	GND	GND	GND	GND
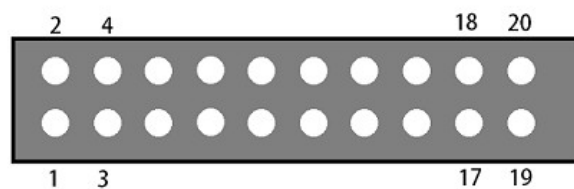
JP80 – Rear Panel Power

Connect the main power here. It can be 8.5V – 16V DC.

JP81 – Rear Panel Fuse

This is for an optional power fuse. The unit is shipped with a shunt instead of a fuse. If you replace the shunt with a fuse, it should be rated to 1A slow-blow or time-delay.

JP82 – Front Panel Switch

If the power supplied to JP80 is not switched, you can connect the main power switch here.

Power Board

The Stepper Power Board supplies logic and motor power, indicates system status and contains emergency stop (ESTOP) circuitry. If your system is equipped with the upgraded Servo Power Board, see that section instead.
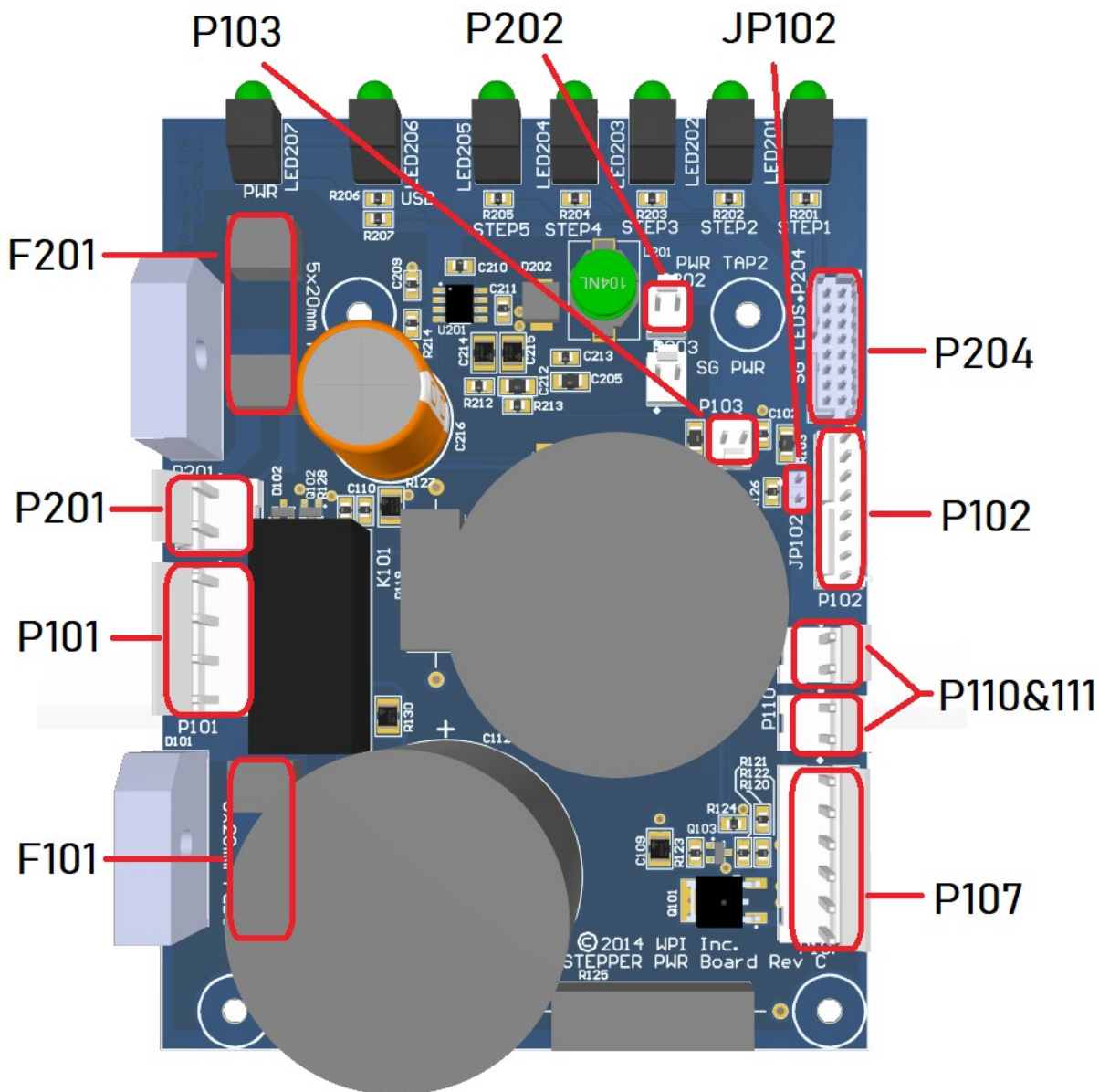
Jumper Settings

Pin 1 of each jumper can be identified by a small, white dot printed on the PCB. A complete description of all jumpers and pin assignments can be found in the Wiring Appendix.

JP102 – ESTOP Bypass

Installing a shunt across JP102 will disable external emergency stop operation.

Internal Connections

P101 – Transformer Connector A

This header is the AC power input for motor power. Pins 1 & 2 are typically wired to unused leads from the transformer but make no connection on the board.

P101 – Transformer Connector A			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	N/C	3	MPWR AC Neutral
2	N/C	4	MPWR AC Line
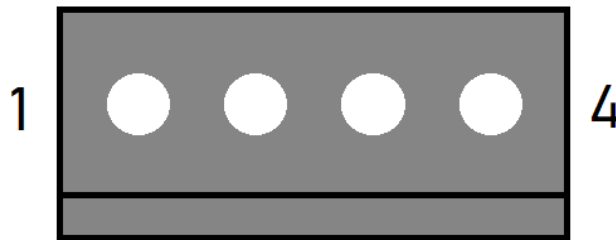
P102 – Accessory Connector

This header contains the inputs and outputs of the rear Accessory port (optional).

P102 – Accessory Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	N/C	5	+24V
2	N/C	6	+24V
3	ESTOP_EXT+	7	GND
4	ESTOP_EXT-	8	GND
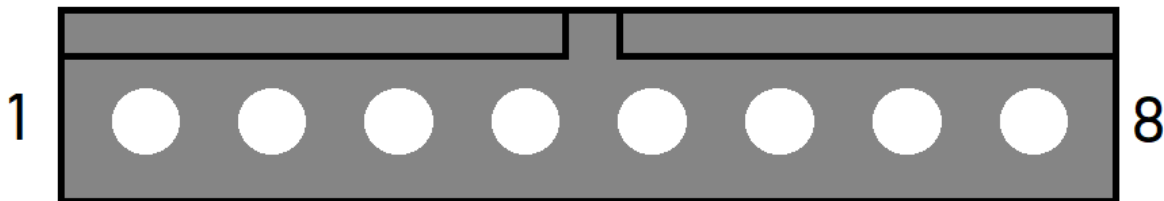
P103 – Fan Connector

This header is the power source for the system fan.

P103 – Fan Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	GND	2	+24V
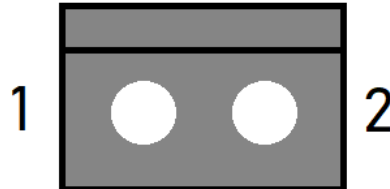
P107 – Motor Power Connector (3x)

This header provides three pairs of motor power voltage and ground.

P107 – Motor Power Connector (3x)			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	MPWR DC-	4	MPWR DC+
2	MPWR DC+	5	MPWR DC-
3	MPWR DC-	6	MPWR DC+
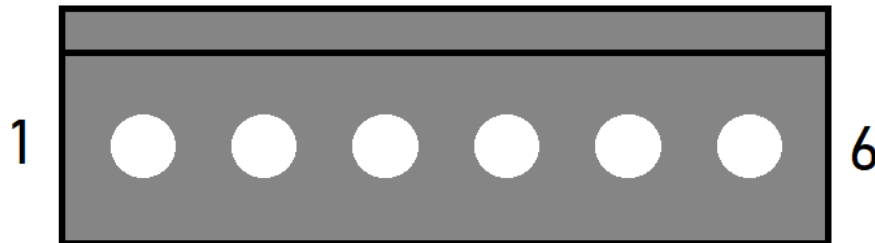
P110 & P111 – Motor Power Connectors

These headers each provide a pair of motor power voltage and ground.

P110 & P111 – Motor Power Connectors			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	MPWR DC-	2	MPWR DC+
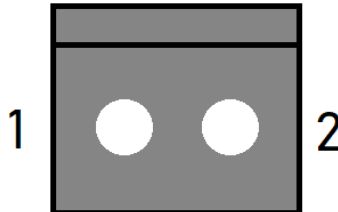
P201 – Transformer Connector B

This header is the AC power input for logic power.

P201 – Transformer Connector B			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	24VAC Line	2	24VAC Neutral
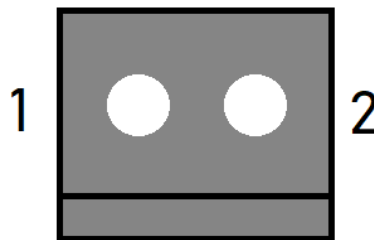
P202 – Signal Generator Power Connector

This header provides _V logic power to the Signal Generator.

P202 – Signal Generator Power Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	GND	2	+_V
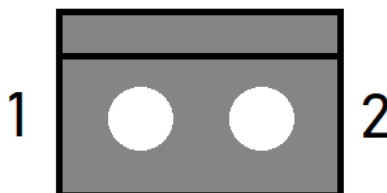
P204 – LED Connector

This header receives system status information from the Signal Generator.

P204 – LED Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	+5V	9	N/C
2	N/C	10	LED-STEP4
3	N/C	11	N/C
4	LED-STEP1	12	LED-STEP5
5	N/C	13	N/C
6	LED-STEP2	14	LED-USB
7	N/C	15	GND
8	LED-STEP3	16	N/C

Fuses

F 101 – Motor AC Fuse

This fuse protects the drive power supply circuitry. It should be replaced with a 250 VAC, 8A Time Lag (Slow Blow) 5x20mm.

F 201 – 18.8VAC Fuse

This fuse protects the circuitry that provides power to the logic of the Signal Generator and its subsystems. It should be replaced with a 250 VAC, 4A Time Lag (Slow Blow) 5x20mm fuse.

Servo Power Board

The Servo Power Board supplies logic and motor power, indicates system status and contains circuitry for emergency stop (ESTOP), motor reset and brake functionality.
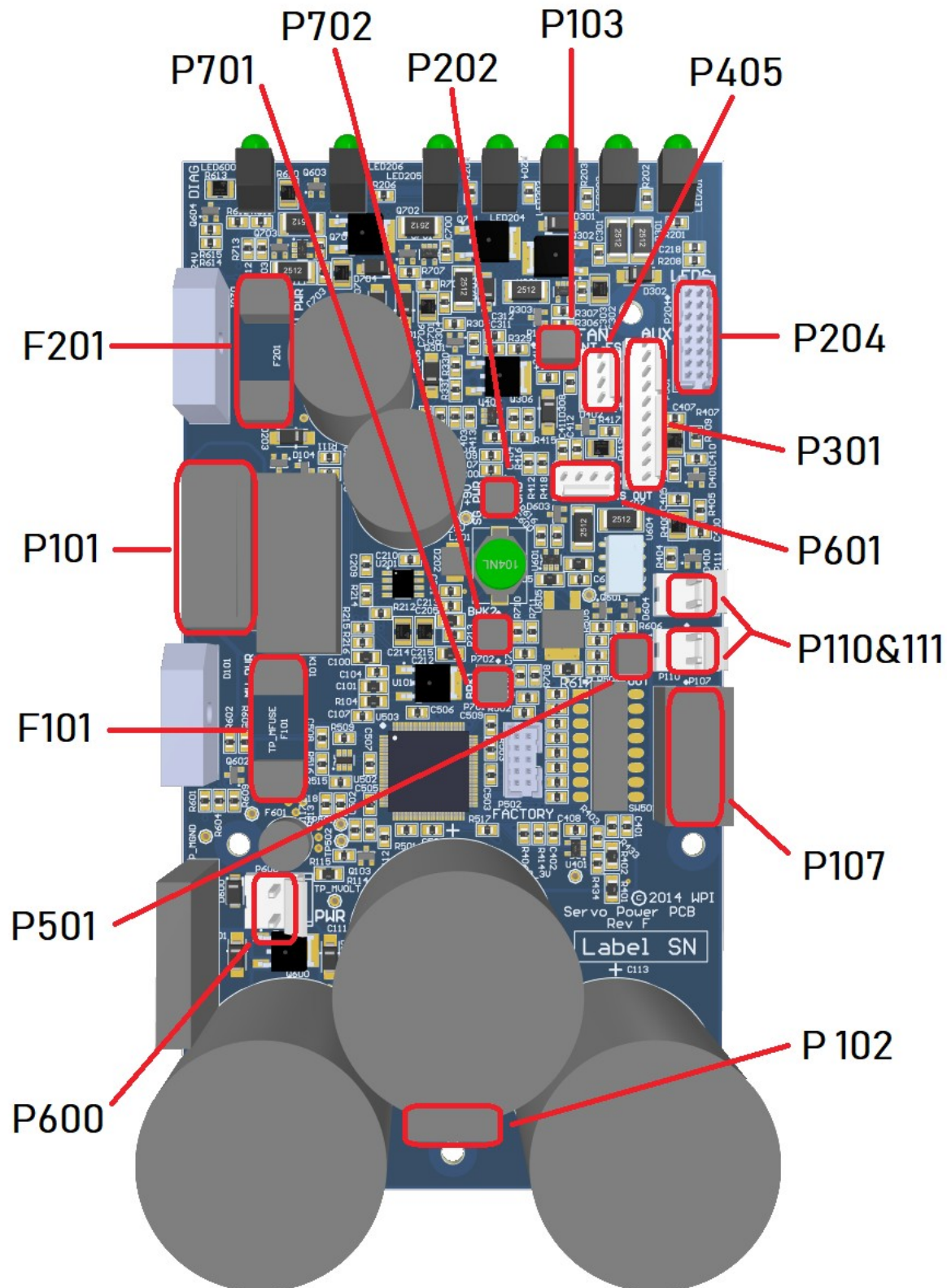
Internal Connections

P101 – Transformer Connector

This header is the AC power input for motor and logic power. Pins 4 & 6 are typically wired to unused leads from the transformer but make no connection on the board.

P101 – Transformer Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	24VAC Line	5	MPWR AC Line
2	24VAC Neutral	6	N/C
3	N/C	7	MPWR AC Neutral
4	N/C		
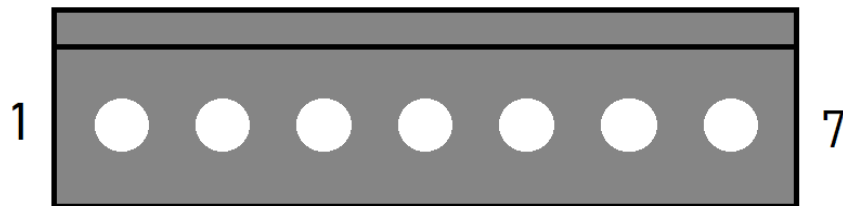
P102 – AUX Motor Power Connector

This header provides additional access to the DC motor power bus. This bus is shared between P102, P107, P110 and P111.

P102 – AUX Motor Power Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	MPWR DC+	3	MPWR DC-
2	MPWR DC+	4	MPWR DC-
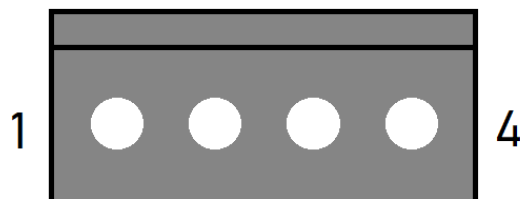
P103 – Fan Connector

This header is the power source for the system fan.

P103 – Fan Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	GND	2	+24VDC
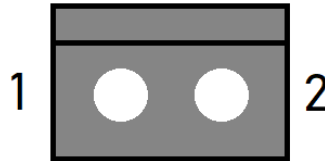
P107 - Motor Power Connector (x3)

This header provides three pairs of motor power voltage and ground. This bus is shared between P102, P107, P110 and P111.

P107 – Motor Power Connector (3x)			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	MPWR DC-	4	MPWR DC+
2	MPWR DC+	5	MPWR DC-
3	MPWR DC-	6	MPWR DC+
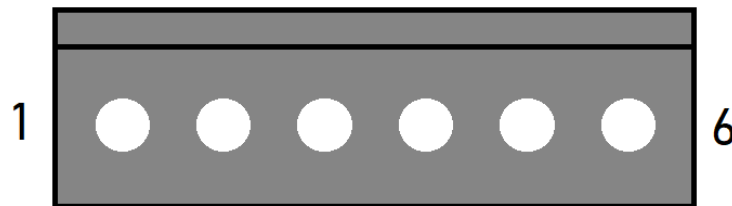
P110 & P111 – Motor Power Connectors

These headers each provide a pair of motor power voltage and ground. This bus is shared between P102, P107, P110 and P111.

P110 & P111 – Motor Power Connectors			
Pin No.	**Signal**	**Pin No.**	**Signal**
1	MPWR DC-	2	MPWR DC+
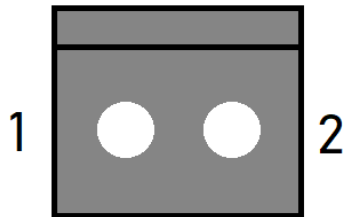
P202 – Signal Generator Power Connector

This header provides 12V logic power to the Signal Generator.

P202 – Signal Generator Power Connector			
Pin No.	**Signal**	**Pin No.**	**Signal**
1	GND	2	+12VDC

P204 – LED Connector

This header receives system status information from the Signal Generator.

P204 – LED Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	+5V	9	N/C
2	N/C	10	LED-STEP4
3	N/C	11	N/C
4	LED-STEP1	12	LED-STEP5
5	N/C	13	N/C
6	LED-STEP2	14	LED-USB
7	N/C	15	GND
8	LED-STEP3	16	N/C

P301 – Accessory Connector

This header contains the signals of the rear Accessory port. See that section for more details.

P301 – Accessory Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	+24V	6	GND
2	GND	7	ESTOP_EXT+
3	BRAKE1	8	ESTOP_EXT-
4	GND	9	RESET+
5	BRAKE2	10	RESET-
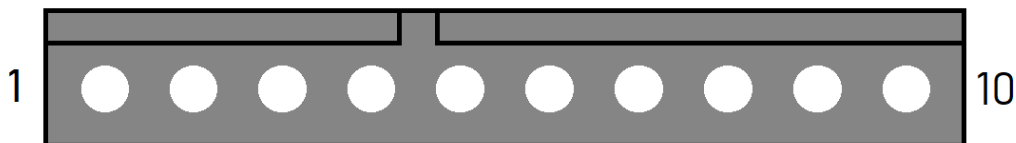
P405 – Internal Emergency Stop Connector

This header contains internal emergency stop and reset control inputs.

P405 – Internal Emergency Stop Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	ESTOP_INT+	3	RESET_INT+
2	ESTOP_INT-	4	RESET_INT-
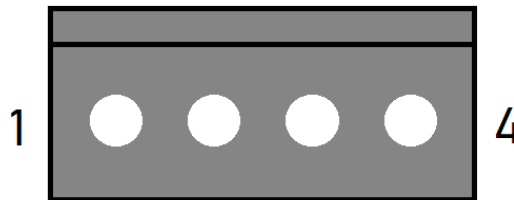
P501 – Relay Control Connector

This header controls the state of the on-board relay.

P501 – Relay Control Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	GND	2	RELAY_IN
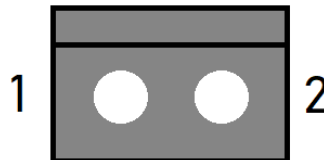
P600 – Motor Power Resistor Connector

This header connects to the regenerative clamp resistor.

P600 – Motor Power Resistor Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	REGEN_DRIVE	2	MPWR DC+ (Fused)
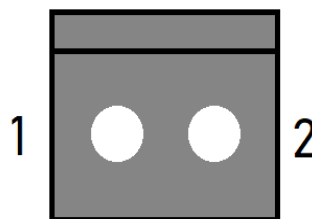
P601 – Emergency Stop Output Connector

This header outputs emergency stop state and on-board relay contacts.

P601 – Emergency Stop Output Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	RELAY+	3	ES_OUT_LOGIC+
2	RELAY-	4	GND
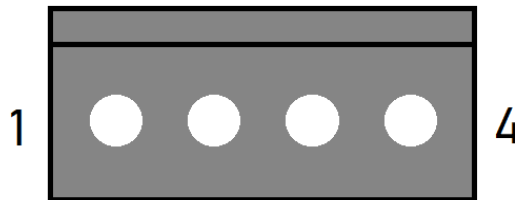
P701 – Brake 1 Input Connector

This header accepts a signal to activate or disengage brake 1. Typically, this is sourced from a motor drive's output.

P701 – Brake 1 Input Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	GND	2	BRAKE1_IN
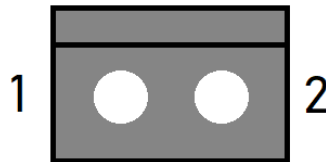
P702 – Brake 2 Input Connector

This header accepts a signal to activate or disengage brake 2. Typically, this is sourced from a motor drive's output.

P702 – Brake 2 Input Connector			
Pin No.	*Signal*	*Pin No.*	*Signal*
1	GND	2	BRAKE2_IN
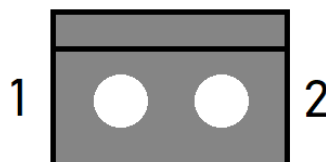
Switch Settings

SW502 – DIP Switches

This switch bank controls the settings for various on-board functions.

SW502 – DIP Switches			
SW No.	*Function*	*On State*	*Off State*
1	Reset Configuration	Reset clears ESTOP	No reset function
2	Brake Input Polarity	Active high	Active low
3	Logic Out Config	Logic uses ESTOP	False
4	Relay Out Config	Relay uses ESTOP	False
5	Internal ESTOP	Used	Not used
6	External ESTOP	Used	Not used
7	Under V Monitor	Used	Not used
8	N/A	N/A	N/A

Reset Configuration: When enabled, pins 3&4 on P405 must be jumped momentarily to activate motor power when all ESTOPs are cleared.

Brake Input Polarity: This setting determines whether a high or low signal across P701 and P702 will cause the respective brake outputs on P301 to be active.

Logic Out Config: When enabled, pin 3 on P601 will reflect the state of motor power.

Relay Out Config: When enabled, the relay output on pins 1&2 on P601 will be open if an ESTOP event is active.

Internal ESTOP: When enabled, pins 1&2 on P405 must be jumped to clear an ESTOP event.

External ESTOP: When enabled, pins 7&8 on P301 must be jumped to clear an ESTOP event.

Under V Monitor: When enabled, the power board will report under-voltage states.

Fuses

F101 – Motor AC Fuse

This fuse protects the drive power supply circuitry. It should be replaced with a 250 VAC, 8-16A Time Lag (Slow Blow) 5x20mm.

F201 – 18.8VAC Fuse

This fuse protects the circuitry that provides power to the logic of the Signal Generator and its subsystems. It should be replaced with a 250 VAC, 4A Time Lag (Slow Blow) 5x20mm fuse.

LED Indicators

The Power / Status LED provides visual indication of power board status and operation through blink codes and color codes, shown below:

	Code	Error
🟢	solid green	no error
🟢🟢	flashing green	ESTOP closed, waiting for RESET
🔴	solid red	low motor power
🟢🟢🔴🔴	2 green, 2 red	low 24V
🟢🔴🔴🔴	1 green, 3 red	regen resistor locked
🟢🔴🔴🟢	alternating	ESTOP open

Controller Maintenance

External Maintenance

Fan Filter

The intake fan filter should be cleaned periodically. The time between cleanings is dependent on the controller's environment and should be performed whenever debris buildup is noticeable. First, remove the filter cover by pulling directly away from the controller. You may need to use a small flathead screwdriver or similar tool to pry one or more of the corners away from the fan mount, as shown below.

Next, remove the foam filter and use a vacuum or compressed air to remove debris. Do not use water or cleaning products to clean the filter. Once cleaned, replace the filter in the filter cover and reattach it to the controller.

Power Inlet Fuses

The power inlet contains two 20x5mm fuses rated at 10A 250V. To replace the fuses, remove the fuse tray. See the next page for detailed instructions.

To access the fuses:

1. Remove the power plug from the inlet, then release one of the side tabs.

2. Release the other side tab.

3. Use the center tab to remove the fuse tray.

Internal Maintenance

Removing The Lid

Before installing or replacing internal components, unplug the power cable and remove the lid. The lid is secured by eight 6-32 screws on the sides of the chassis. Remove these using a P2 Phillips screwdriver and lift the lid off of the controls.

Replacing Fuses

If your system demands more power than can be safely output, you might blow a fuse on the system's power board. Fortunately, these fuses are replaceable. See the following picture for their location. They are both 20x5mm form factor. F 101 is rated to 8A and F 201 is rated to 4A.
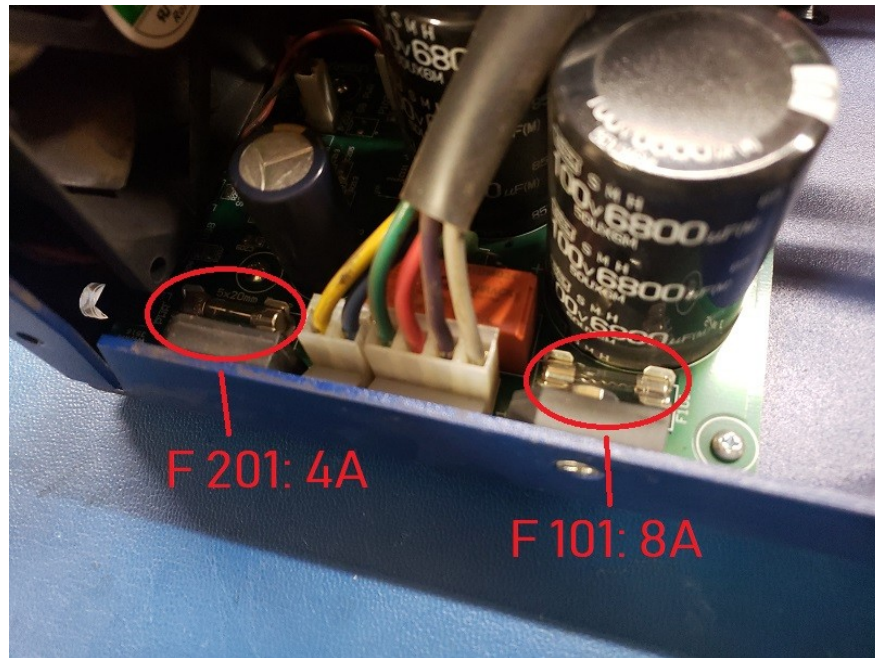
Adding/Replacing a Drive

To upgrade your CNC controller—such as adding a 4th or 5th axis—you should install the new drive module(s) using the following instructions.

Improper wiring can cause damage to your driver box or motors. Please take care in following these instructions properly. Please refer to the pictures below for the correct connectors.

1. Set the dip switches and rotary switch of the new drive to the appropriate settings for your application. See the Motor Drive Settings section of this manual for more information.

2. If replacing a drive, remove the two mounting screws and unplug all connectors.
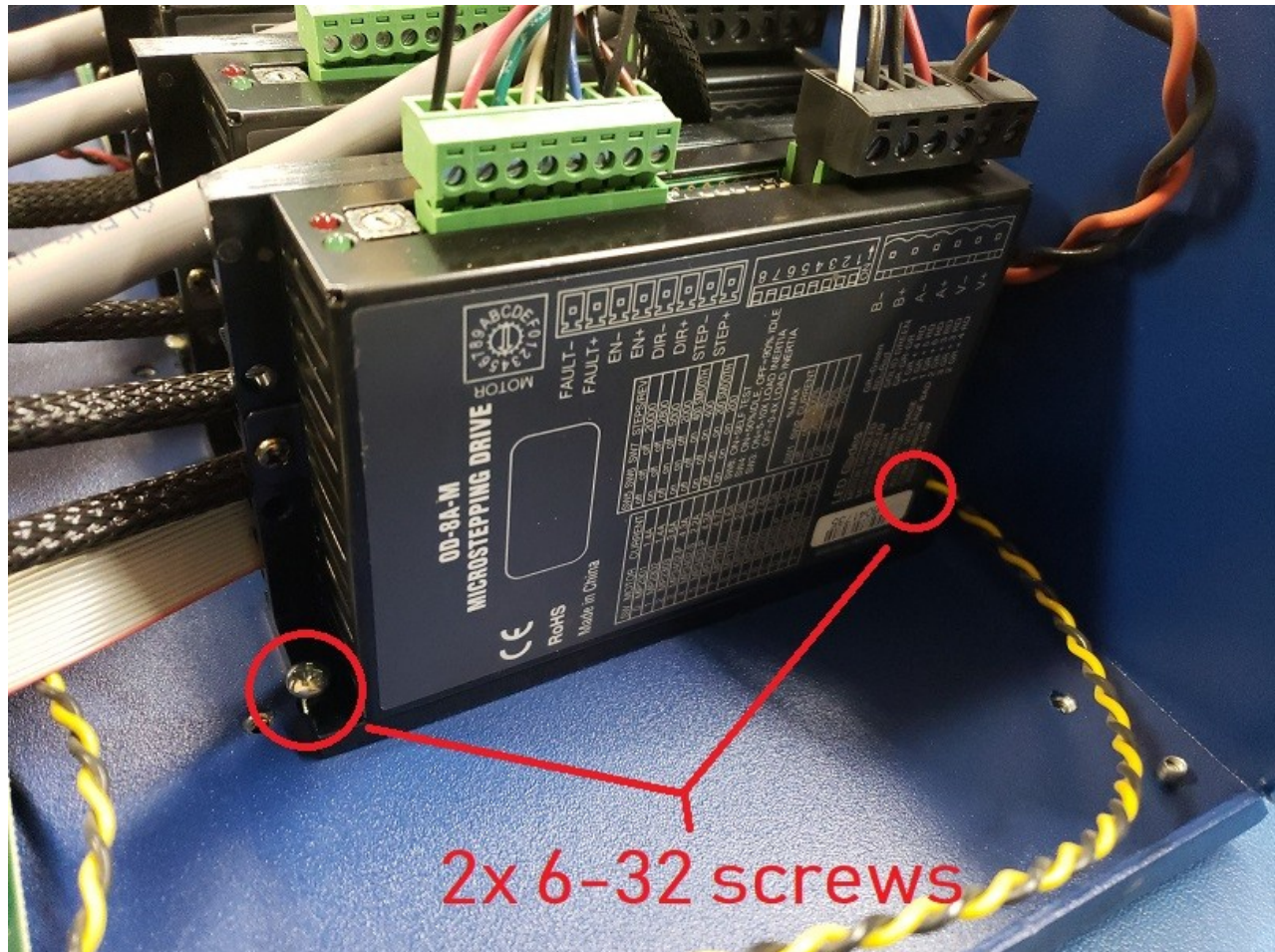
3. Add or replace the drive and mount to the bottom of the chassis using two 6-32 screws. Do not use plastic hardware.

4. Connect the Input Motor Power cable from the power board to V+ & V- on the drive.

5. Connect the Output Motor Power cable from the rear of the chassis to the drive's B-, B+, A- & A+ output.

6. Connect the motion signals of the drive to an axis interface connector on the Signal Generator with a Step/Direction cable

Pin Location Index

Signal Locations

The following table contains every instance of each signal in the system. Note that not all systems are equipped with the Mini or Classic I/O Expansion boards but these can be installed in-field. Also please note that Compact Series controllers do not support the Classic I/O Expansion board.

Signal Locations																		
	Signal Generator									Mini I/O	Classic I/O							
Signal	CON5	CON4	CON3	JP30	JP40	JP50	JP53	JP33	JP71-75	P103	CON4	CON5	CON6	JP40	JP50	JP20	JP21	JP22
Input 1		9	15	4	2												47	
Input 2		10	16	6	1												45	
Input 3		11	17	8	4												43	
Input 4		12	18	10	3												41	
Input 5		13	5	12	6												39	
Input 6		14	6	14	5												37	
Input 7		15	7	16	8												35	
Input 8		16	8	18	7												33	
Input 9				22					JP71.9		9			1		47		
Input 10				24					JP71.11		10			3		45		
Input 11				26					JP72.9		11			5		43		
Input 12				28					JP72.11		12			7		41		
Input 13				30					JP73.9		13			9		39		
Input 14				32					JP73.11		14			11		37		
Input 15				34					JP74.9		15			13		35		
Input 16				36					JP74.11		16			15		33		
Input 17				35					JP75.9								31	
Input 18				33					JP75.11								29	
Input 19				31						10							27	
Input 20				29						12							25	
Input 21				27													23	
Input 22				25													21	
Input 23				23													19	
Input 24				21													17	
Input 25				17													15	
Input 26				15													13	
Input 27				13													11	
Input 28				11													9	
Input 29				9													7	
Input 30				7													5	

	Signal Generator									Mini I/O	Classic I/O							
Signal	CON5	CON4	CON3	JP30	JP40	JP50	JP53	JP33	JP71-75	P103	CON4	CON5	CON6	JP40	JP50	JP20	JP21	JP22
Input 31				5													3	
Input 32				3													1	
Output 1	1		1			2	4			6&15								47
Output 2	6		2			1	3			7&16								45
Output 3	2					4												43
Output 4	7					3												41
Output 5	3					6												39
Output 6	8					5												37
Output 7	4					8												35
Output 8	9					7												33
Output 9												1	2		2	17		
Output 10												6	4		1	19		
Output 11												2			4	21		
Output 12												7			3	23		
Output 13												3			6	25		
Output 14												8			5	27		
Output 15												4			8	29		
Output 16												9			7	31		
Output 17																		31
Output 18																		29
Output 19																		27
Output 20																		25
Output 21																		23
Output 22																		21
Output 23																		19
Output 24																		17
Output 25																		15
Output 26																		13
Output 27																		11
Output 28																		9
Output 29																		7
Output 30																		5
Output 31																		3
Output 32																		1
Analog Input 1										18								
Analog Output 1										17			6					
Analog Output 2													8					
PWM Output										14								

			Signal Generator						Mini I/O	Classic I/O							
Signal Locations																	
Signal	**CON5**	**CON4**	**CON3**	**JP30**	**JP40**	**JP50**	**JP53**	**JP33**	**JP71-75**	**P103**	**CON4**	**CON5**	**CON6**	**JP40**	**JP50**	**JP20**	**JP21**	**JP22**
Step Axis 1			13					9	JP71.12									
Step Axis 2			12					7	JP72.12									
Step Axis 3			11					5	JP73.12									
Step Axis 4			10					3	JP74.12									
Step Axis 5			3					1	JP75.12									
Direction Axis 1			9					12	JP71.10									
Direction Axis 2			21					10	JP72.10									
Direction Axis 3			20					8	JP73.10									
Direction Axis 4			19					6	JP74.10									
Direction Axis 5			4					4	JP75.10									
Enable			14					2	17									

Voltage/GND Locations

The following sections list the locations of different voltages and ground.

+5VDC

- Signal Generator
  - CON5.5
  - CON3.22
  - JP50.9
  - JP53.6
  - JP33.11
  - JP71-75.20
- Mini I/O
  - P103.13

GND

- Signal Generator
  - CON5.10
  - CON3.24
  - JP30.19, 20, 39, 40
  - JP50.9
  - JP53.6
  - JP33.11
  - JP71-75.20
- Mini I/O
  - P103.4, 5, 8, 9
- Classic I/O
  - CON5.10
  - CON6.3, 7
  - JP20.2, 3, 4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20, 22, 24, 26, 28, 30
  - JP22.2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50

OPT-VCC

- Signal Generator
  - CON3.23

OPT-GND

- Signal Generator
  - CON4.1, 2, 3, 4, 5, 6, 7, 8
  - CON3.25
  - JP40.9, 10
- Classic I/O
  - JP40.2, 4, 6, 8, 10, 12, 14, 16
  - JP50.9
  - JP20.34, 36, 38, 40, 42, 44, 46, 48, 50
  - JP21.2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50

+12VDC

- Classic I/O
  - CON6.1

Wiring Appendix

Example Wiring

Typical Output Line Circuit

The schematic below shows a typical connection of one solid state relay controlled by output line 1 of the Signal Generator. A typical load could be a spindle, a vacuum, a laser, etc. In this example, the solid-state relay used is a Continental Industries model S505-0SJ610-000.

Each of the output signals has a 22-ohm resistor in series with their outputs. This is to reduce any "ringing" at the transient switching points. Ground and 5V are provided on this connector for your convenience. The FlashCut Spindle On/Off Relay Box is wired as shown in the below schematic.
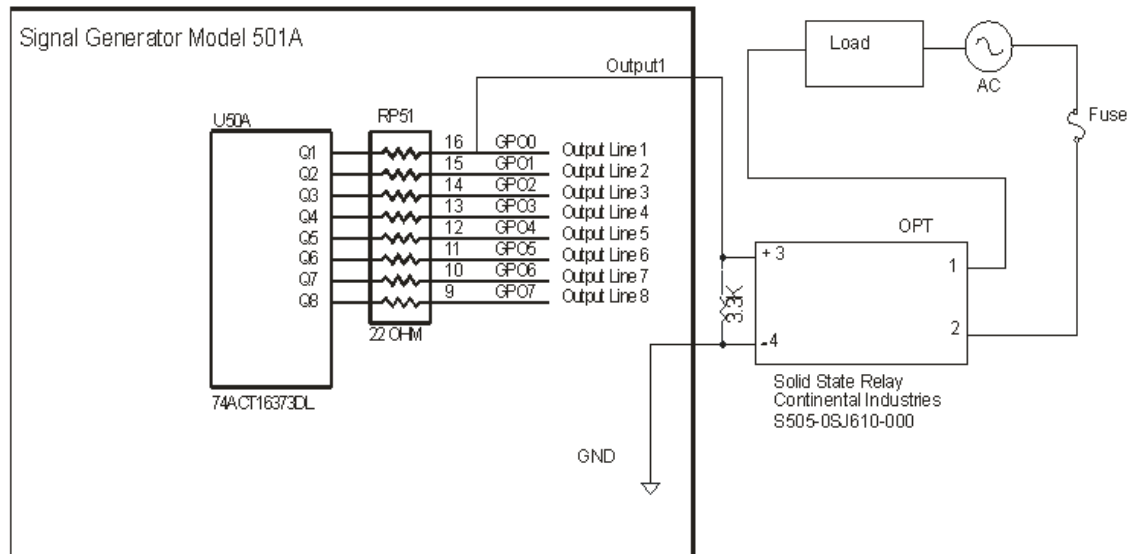
Typical Input Line Circuit – Internal Power

The following schematics show a typical connection of five normally closed switches. These switches are connected between input lines 1-5 and ground. Lines 6-8 are connected directly to ground with jumper wires. All external connections shown are made through the Input connector on the back of the Signal Generator. This resistor pack (RP 41) is socketed so that you can change the value if needed for your application.

Signal Generator Model 501 A
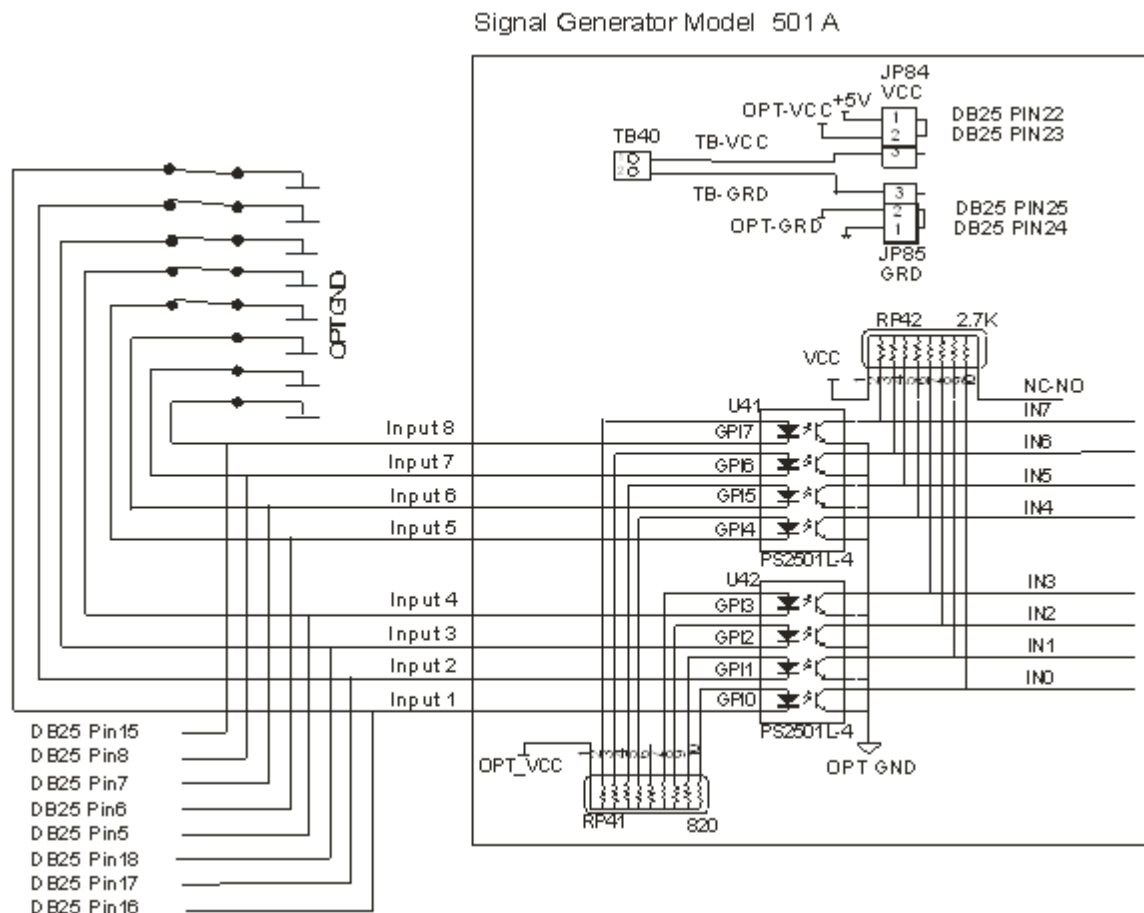
Typical Input Line Circuit – External Power

The input lines are all optically isolated. In this example, JP84 and JP85 are shorted using the internal power to source the external side of the optical couplers. However, for the best isolation, JP84 and JP85 should be open, and power should be provided through pins 23 and 25 of the DB25 Motor Signal connector. Input lines 1-4 and 5- 8 are internally connected to pins 15-18 and 5-8 respectively of the DB25 Motor Signal connector.
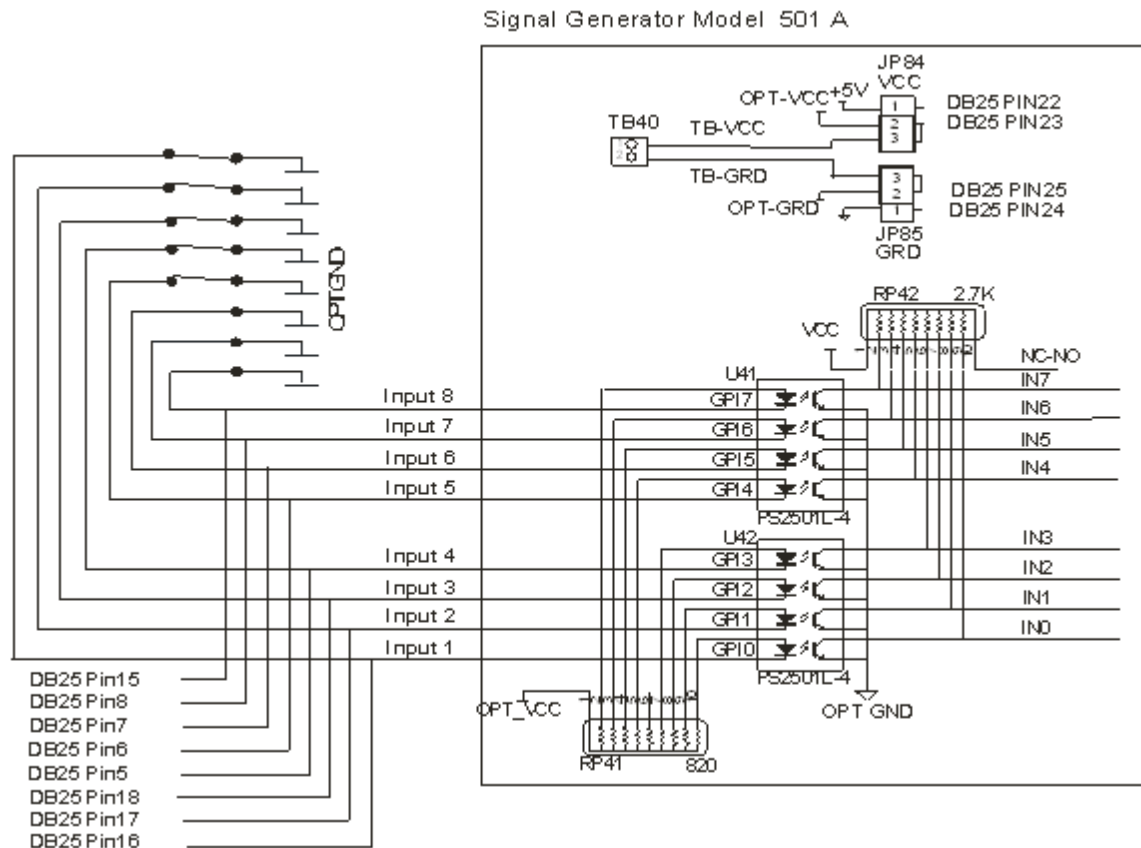
Note that the FlashCut CNC limit switch kit has the same wiring as shown in this example.

Proximity Sensors

When connecting a proximity type sensor, connect to the controller using the following diagram.

Please note only NPN type proximity sensors are compatible with the controller. Most sensors require the use of a higher, external voltage supply than the standard 5V to operate. Please see the information on Inputs in the Signal Generator section for more information on wiring OPT VCC.

NPN Proximity Sensor

1 BROWN	OPT VCC
4 BLACK	Input X
3 BLUE	OPT GND

Internal Schematic

Fuse Reference	Fuse Location	Amperage (A)	Voltage	Size (mm)
F10-125	Power Inlet	10	125 VAC	5 X 20
F04-17	Power Board Logic Supply	5	250 VAC	5 X 20
F08-48	Power Board Drive Supply	4	17 VAC	5 X 20
F03-24	24 VDC Supply Out	8	48 VAC	5 X 20
		3	24 VDC	5 X 20

115/230 VAC SINGLE PHASE 60 HZ FROM USER'S PROTECTED AND GROUNDED SUPPLY

DRIVE VOLTAGE SUPPLY

LOW VOLTAGE SUPPLY

CH-01

CM03-1

SW2-1

CM10-1

F03-24

Optional Configurations:
1. None
2. 24V and EStop
3. Reset and Brakes (Servo Power Board)

Optional Configurations:
1. 500W Transformer
2. 1000W Transformer

XFR1-1

SW1-1

PB-10

28VAC
57VAC
48VAC
HIGH NEUTRAL
17VAC
LOW NEUTRAL

F08-48
F04-17

101-0003
101-0004
101-0007
101-0009
101-0091
101-0026
101-0023
101-0005
101-0006
101-0028

DIGITAL GND
DRIVE VOLTAGE +
DIGITAL GND
DIGITAL GND
DIGITAL GND
DRIVE VOLTAGE +
DRIVE VOLTAGE +
DRIVE VOLTAGE +
DRIVE VOLTAGE +
+24VDC
DIGITAL GND
LEDs
DIGITAL GND
+9 VDC
Emergency Stop +
Emergency Stop -

DIGITAL GND
+24 VDC

DCF-10

Optional Configurations:
1. Stepper Power Board
2. Servo Power Board

REFERENCE DESIGNATOR	DESCRIPTION
CM02-1	2 Circuit Male Pluggable Terminal Block
CM03-1	IEC 320 Fused Power Inlet
CM10-1	10 Circuit Male Pluggable Terminal Block
DCF-10	24VDC Fan
MD-10	Axis 1 Motor Drive
MD-11	Axis 2 Motor Drive
MD-12	Axis 3 Motor Drive
MD-13	Axis 4 Motor Drive
MPC-10	Axis 1 Motor Power Connector
MPC-11	Axis 2 Motor Power Connector
MPC-12	Axis 3 Motor Power Connector
MPC-13	Axis 4 Motor Power Connector
MCC-4	Motor Connector Cover
OI-01	Classic I/O Expansion Daughter Board
OI-03	Mini I/O Expansion Daughter Board
PB-10	Power Board
PC-1	End User Supplied PC
SG-10	Signal Generator Board
SW1-1	Voltage Selector Switch
SW2-1	Maintained On-Off Toggle Switch
XFR1-1	Toroidinal Transformer
LED1-1	Green LED Axis 1 Motion Indicator
LED1-2	Green LED Axis 2 Motion Indicator
LED1-3	Green LED Axis 3 Motion Indicator
LED1-4	Green LED Axis 4 Motion Indicator
LED1-5	Green LED Axis 5 Motion Indicator
LED2-1	Amber LED USB Connection Indicator
LED2-2	Green LED Controller Power Indicator
F10-125	5X20mm Fuse 10A, 250VAC
F03-24	5X20mm Fuse 3A, 250VAC
F04-17	5X20mm Fuse 4A, 250VAC
F08-48	5X20mm Fuse 8A, 250VAC
CH-01	6' 18AWG NEMA 5-15 to IEC 320 C13 Power Cord
RLY-01	Relay Daughter Board
101-0002	Signal Generator to Drive Signal Cable
101-0003	3 Axis Drive Power Cable
101-0004	Single Axis Drive Power Cable
101-0005	Mains Power In to Switch
101-0006	Protective Earth Cable
101-0007	Signal Generator Power Cable
101-0009	LED Cable
101-0010	Relay Cable
101-0023	Transformer Harness
101-0026	Servo Relay Cable
101-0028	Fan Harness
101-0091	24 VDC Power Supply Cable
101-0505	Stepper Motor Power Cable