FLASHCUT CNC

CONTROL MADE SIMPLE

Titanium Series Signal Generator Hardware Guide

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Getting Started

About This Manual

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 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.**

WPI, 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. We supply this product but have no control over how it is installed or used. Always be careful!

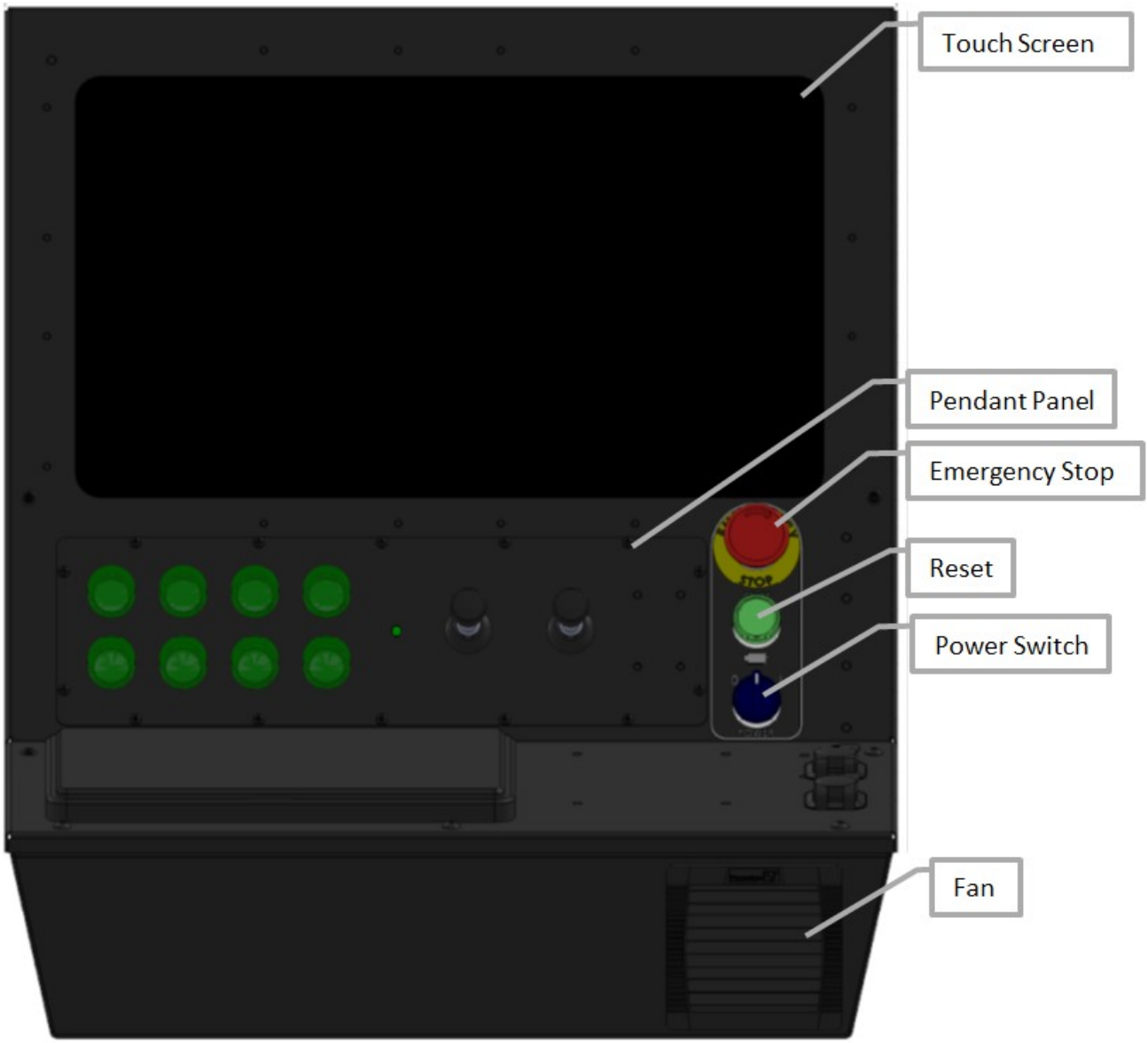
WPI, Inc. or its affiliates are not responsible for damage to any equipment or workpiece resulting from use of this product.

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

CNC Controller

Front Panel

The front panel provides a the main power switch, emergency stop button, reset button, pendant panel, keyboard, USB ports and the main cooling system input.



Touch Screen

The Titanium Series controller utilizes a 19.5” capactitive touch screen for ease of use. Thin gloves will work with this screen. The touch surface is made of glass, so precaution should be taken to avoid scratching.

Pendant Panel

The pendant panel is used to mount extra physical buttons and controls such as joysticks for jogging, cycle start and feedhold buttons that are connected to the internal USB Interface Board. The pendant panel also supplies a mounting location for physical buttons used to control external devices outside of the software. The pendant panel is shown with optional equipment and these controls are not present in the basic configuration.

Emergency Stop

The emergency stop (E-stop) is used to immediately stop the machine and the software in the case of an emergency. When the E-stop is pressed, power is disconnected from the drives and motors. Once released, the reset button must be pressed to reapply power to the drives and motors. Keep in mind, if the machine is stopped in this way, the DRO may no longer accurately reflect the machine's position until re-homed.

Reset Button

The reset button must be pressed upon initial power-up and after an E-stop event to apply power to the drives and motors. When this occurs, the button will illuminate green. If this does not happen, the E-stop may still be applied.

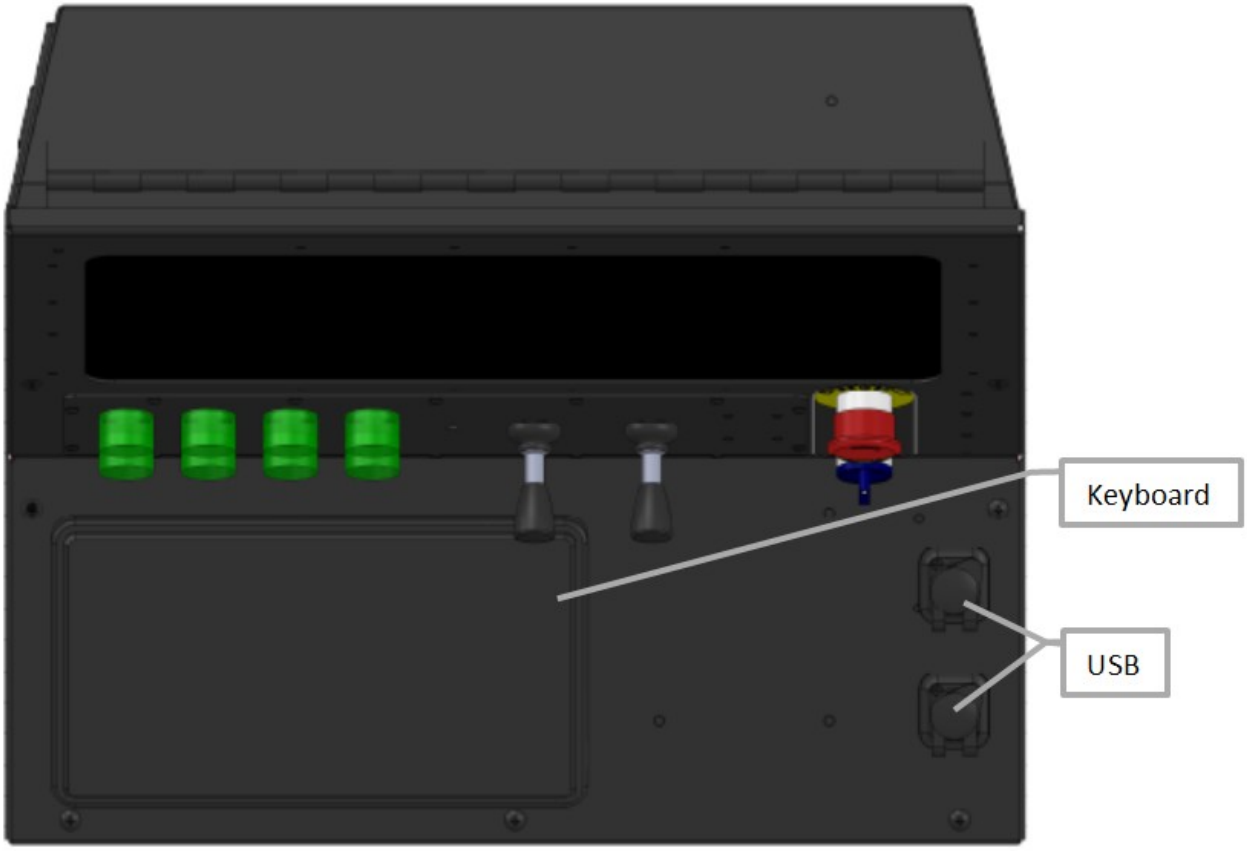
Power Switch

The power switch turns the unit on and off. If there is ever a communications error while running CNC, it may be necessary to power the system down, wait 10 seconds and turn it back on to reset the internal microprocessor. The power button is an extension to the internal computer. The computer drives a relay that switches power to the entire system.

Fan

The fan is the input of the cooling system and has a filter used to catch large, harmful debris. Do not block air flow by placing the fan in front of objects or objects in front of the fan. The filter should be cleaned or replaced based on the environment it is kept in. The exhaust for the cooling system is the vented slots and filter on the left side of the controller. Please see the Maintenance section for more information on changing the filter.

Top of Controller



Keyboard

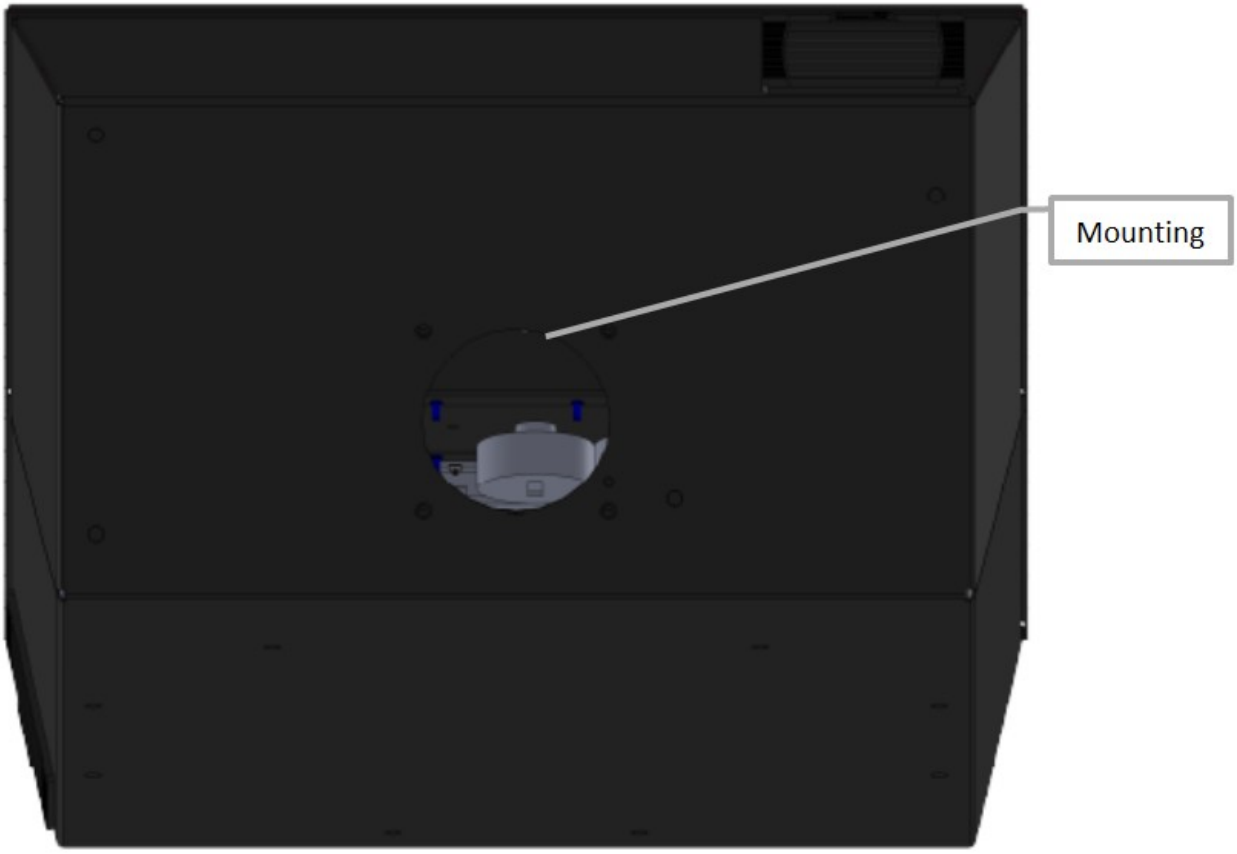
The keyboard is a sealed, ruggedized human interface device. It comes with an integrated touch mouse that may be used in addition to the touchscreen. The keyboard has variable back-light levels to aid in low-light installations.

USB

There are two external USB ports to interface other devices with the integrated computer. These devices include USB memory modules, other human interface devices, USB-to-serial adapters, etc.

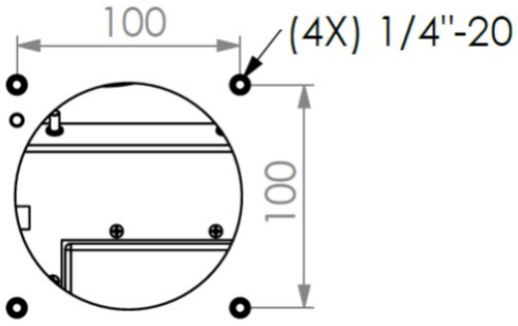
Bottom View

The bottom panel of the CNC controller provides enclosure mounting and a cabling feed-through to the CNC system.



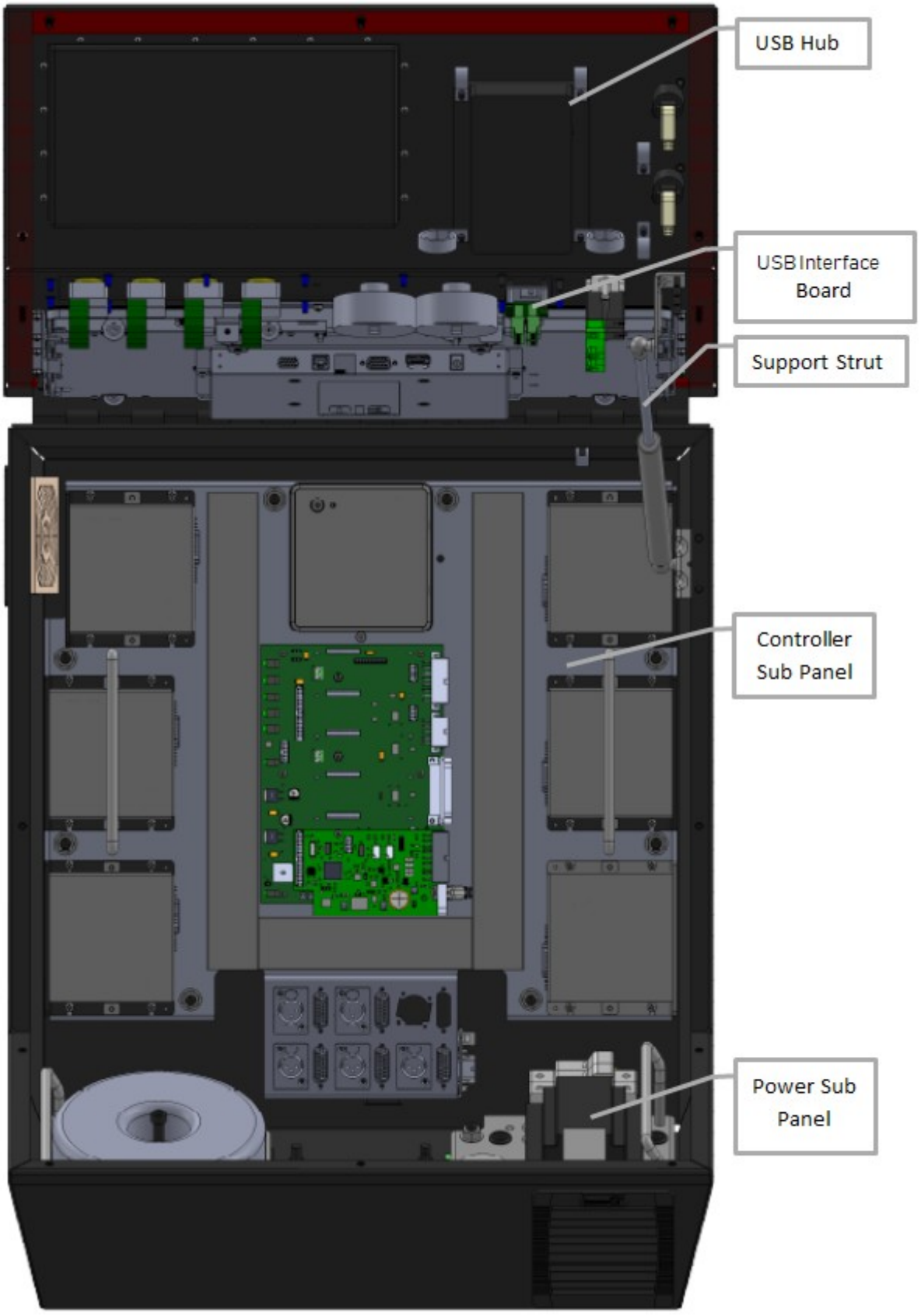
Mounting

The mounting point for the Titanium Series controller is located on the bottom of the system. A VESA-100 bolt pattern is used. Use four ¼”-20 bolts in these through-holes. Connections between the controller and machine should be made through the 4” diameter feed-through hole.



Controller Interior

The interior of the lid has several components mounted to it, as seen below.



USB Hub

The USB hub is used to connect all internal USB devices on the lid and condense the connection into a single USB cable down to the computer. The USB hub is the connection point for the two external USB ports, the keyboard, the optional USB interface board and the touch screen.

USB Interface Board

The USB interface board gives the user a means of interfacing up to 254 additional physical buttons to the CNC software to increase efficiency of the operator. This feature is optional and may not be included on basic models of the Titanium Series controller. For further information on the interface board, please refer to the USB Interface Board Hardware Guide.

Support Strut

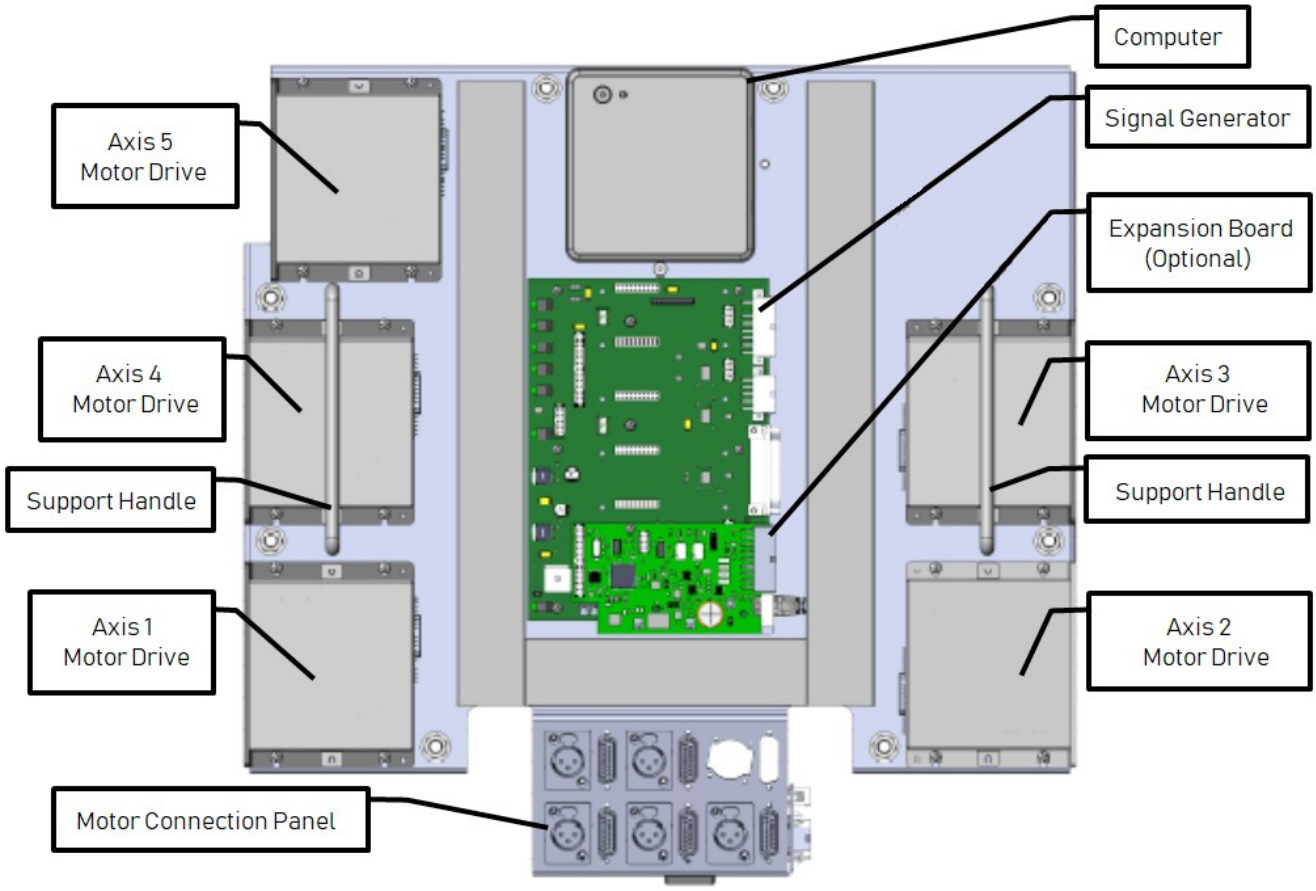
The support strut is designed to hold the load of the lid for easy-open maintenance and to dampen lid closing to reduce the potential of pinching.

Controller and Power Sub Panels

These two panels provide mounting points for control and power distribution components, respectively. The panels are not intended to be removed in-field and should only be dismounted if instructed to do so by a member of the Support Team. Please see the Controller and Power Sub Panel sections in this manual for more information.

Controller Sub Panel

The Signal Generator, internal computer, motor drives and any I/O expansions are mounted to the controller sub panel. This panel also provides connection points for the motors.



Motor Drives

The Titanium Series controller can support up to six axes of motion, with six drive mounting locations. Five of these six can move independently and in a typical 6-axis system, one drive is "slaved" to another and will move in lock-step with each other.

Computer

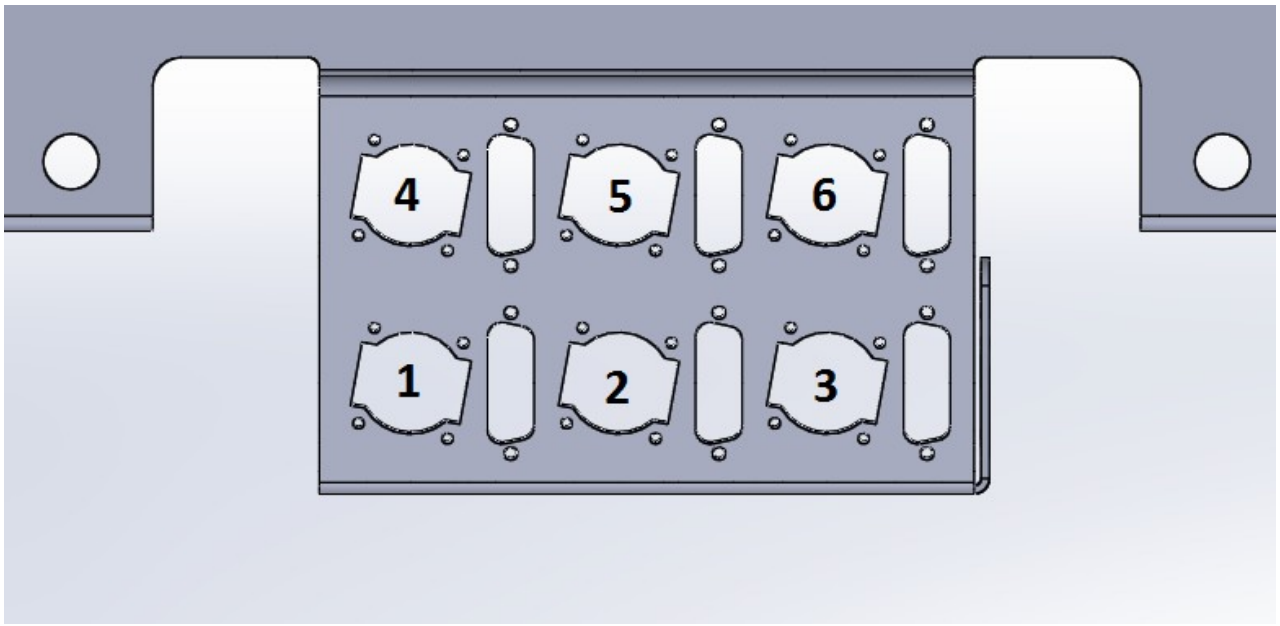
The Titanium Series controller comes integrated with a small-footprint Windows-based PC. The PC is equipped with either an i3 or i5 processor, 8GB of DDR3 RAM and a solid-state drive.

Signal Generator

The Signal Generator is the primary controller for motion. The Signal Generator sends data to and receives data from the computer using USB communication. Each of the motor drives receive position information from the Signal Generator. Any drive status lines are routed to the inputs of the Signal Generator. For further information on connections and interfaces, refer to the Signal Generator section of this manual.

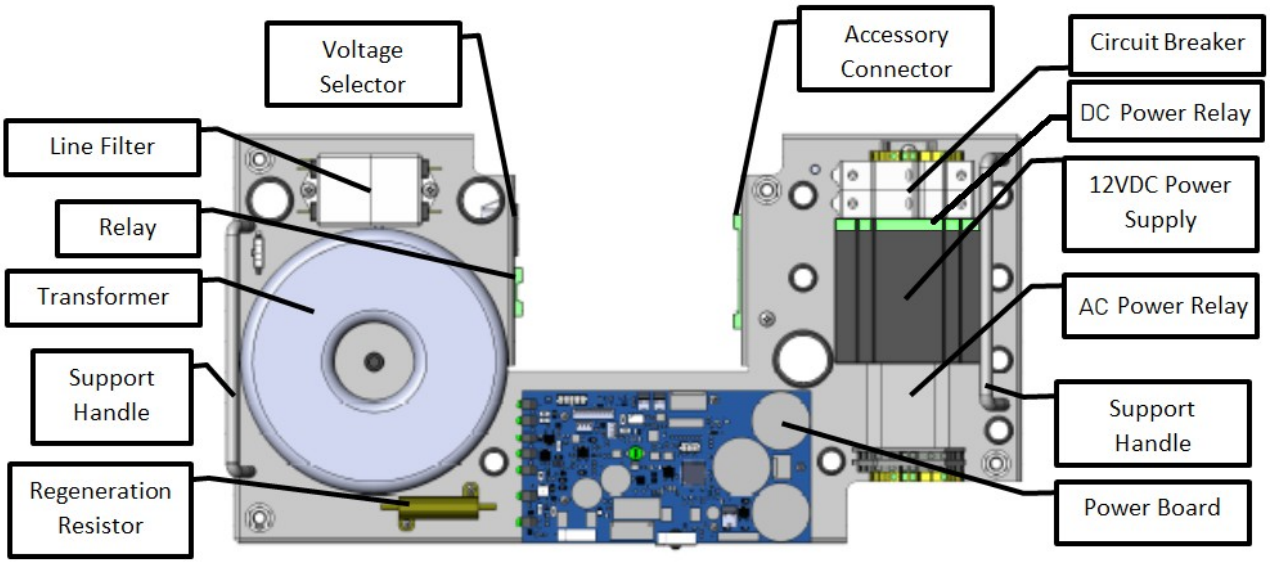
Motor Connection Panel

There are positions to mount up to six motor connectors. The axis numbers are labeled on the panel and follows the pattern shown below.



Power Sub Panel

The power sub panel is the mounting location for the transformer, circuit breaker, 12VDC power supply, line filter, voltage selector, mains relay, regeneration resistor and power board.



Circuit Breaker

The circuit breaker protects the system from over-current events and will trip at 20A. This is the connection point for AC mains to the controller. Connect the line and neutral leads to the terminals marked “L” and “N”, respectively. The protective earth ground should be connected to the ground terminal block adjacent to the breaker.

12VDC Power Supply

This power supply provides power for the monitor, computer and USB hub. The 12VDC power is always live while the circuit breaker is closed and the AC mains is connected.

AC Power Relay

This relay switches the AC mains to the transformer and any optional, AC-driven components on the controller sub panel.

DC Power Relay

This relay is driven by the power state of the computer and switches power to the touch screen and USB hub.

Power Board

The power board takes the stepped-down VAC from the transformer and rectifies it to VDC for motor and logic power. The power board handles the emergency stop circuitry to disconnect motor power in an emergency event. For further explanation of the power board, refer to the Servo Power Board section of this manual.

Line Filter

This is an AC mains line filter to suppress transients on the mains supply voltage, which can damage sensitive electronics.

Transformer

The transformer steps down the AC mains to a lower voltage, which is used as the motor power and system logic voltage on the Signal Generator. The Titanium Series controller is available with two sizes of transformer: 500W or 1000W. When the system is configured for several large motors, a 1000W transformer is likely necessary.

Regeneration Resistor

The regeneration resistor is used to absorb energy created by the motors when decelerating large inertial loads. The resistor is used to bleed down over-voltage conditions on the motor power bus and to protect against transients generated during motor power on, motor power off and emergency stop.

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

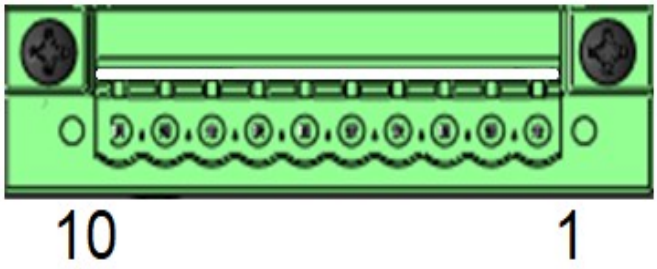
The voltage selector switch allows the controller to use an external power source of 115 or 230 VAC. If the input power is wired for 230VAC, then simply flip the switch with a flat-head screwdriver so that “230V” is clearly visible. If the input power is wired for 115 VAC, then flip the switch until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

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

Accessory Connector

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 connector's screw terminals (Molex-Waldom part number 39530-0010). 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-



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. Make sure switch 6 on the power board is enabled. 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. To use the reset input, connect a normally open switch to pins 9 & 10 and turn on switch 1 on the power board. For further information, please see the section on the power board later in this guide.

Connection Diagram

Signal Generator

LEDs

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

Power-On Sequence

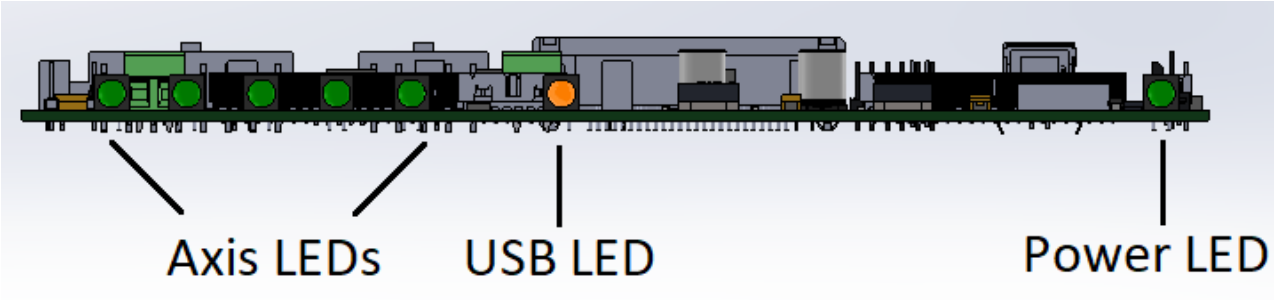
When power is first applied to the Signal Generator, the seven LED indicators go through a start-up sequence to indicate that the firmware is in a healthy state. First, all LEDs blink once. Then, each LED blinks once in order from Axis 1 to Power.

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:

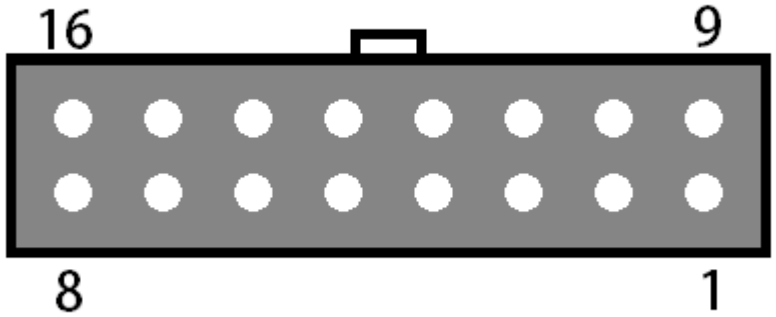
- Connect a power source to the TB-40 screw terminal.
- Connect a power source through pins 23 & 25 of the DB-25 connector.

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 the software config. Please refer to the software User's Guide under "Input Line Settings" for further information. In the 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 39-01-2160), 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 us or at 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

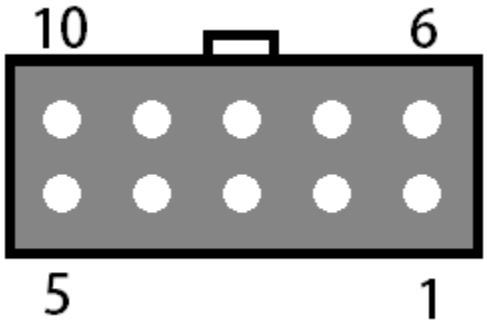
This connector is for up to eight output lines. These lines are all compatible with TTL/CMOS level outputs. The Output ports cannot drive a 24V external system unless it accepts TTL/CMOS levels. They are all driven by HCT family logic. Output logic high is normally 5V and can be as low as 3.9V at full 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 39-01-2100), 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 us or at 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

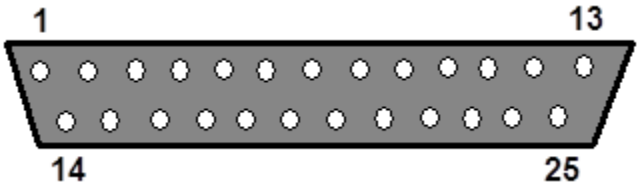
The Motor Signals connector uses a DB-25 connector to send step and direction signals from the Signal Generator to an external drive box.

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.

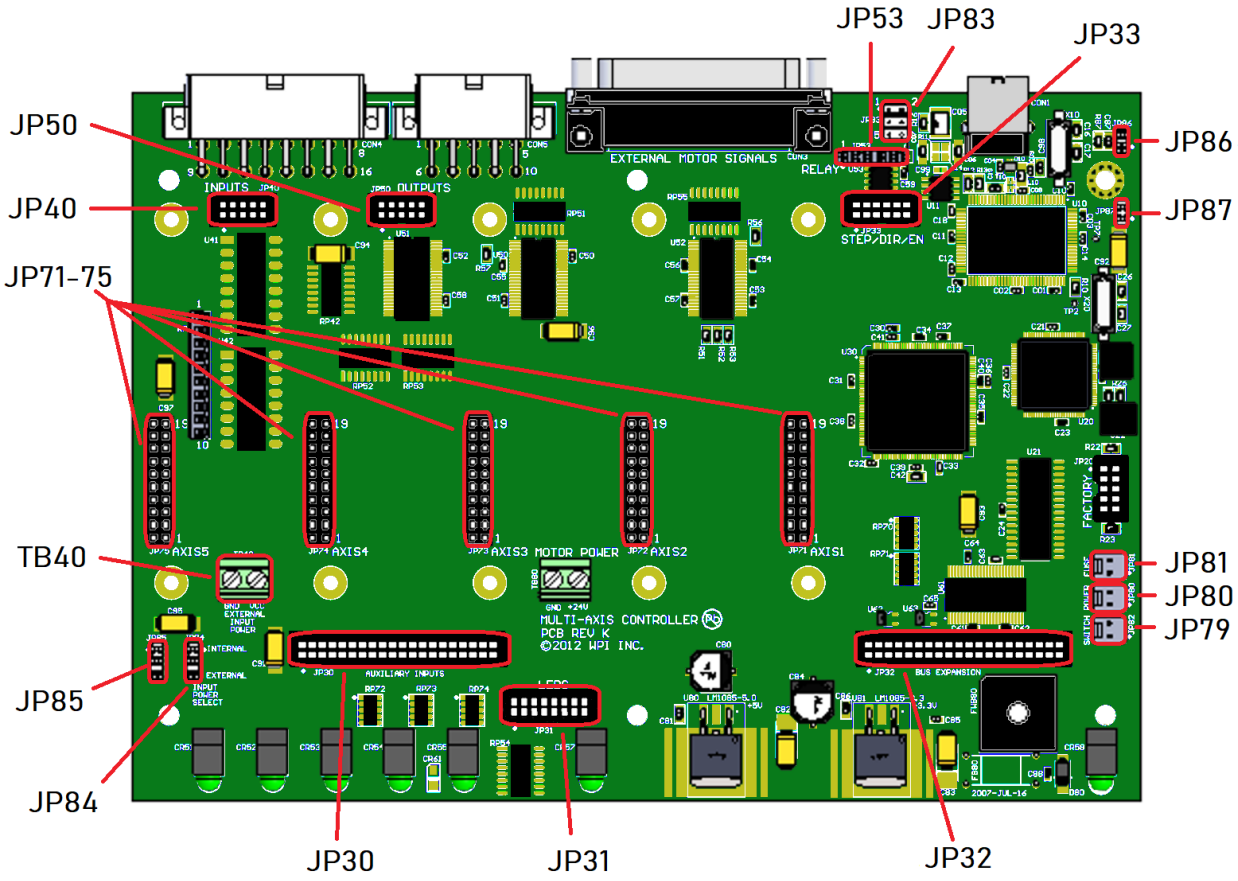
The voltage levels for each Output, Step, Direction and Enable signals are all 5V logic.

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		



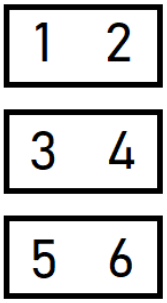
Jumper Settings

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.



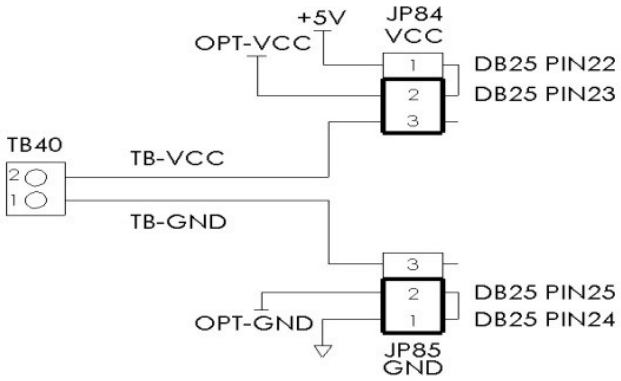
JP83 – DB to USB Ground

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

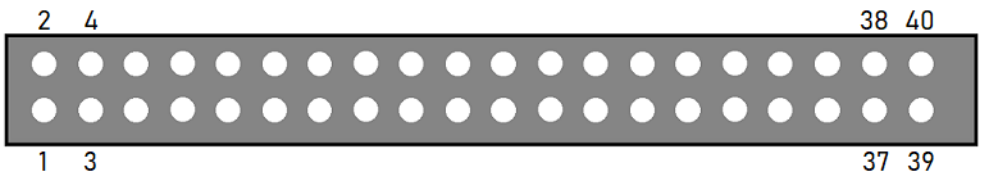
This jumper connects the internal signal ground to the chassis ground of the Signal Generator when jumped. In order to isolate the chassis ground, remove this jumper in addition to JP86 and jump pin 3 and 5, and 4 and 6 on JP83. In order to isolate the DB-25 shield, the USB shield and the chassis, remove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

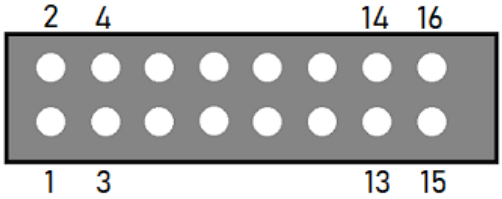
JP30 – Auxiliary Input			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	+3.3V	21	GPI-24
2	+3.3V	22	GPI-9
3	GPI-32	23	GPI-23
4	GPI-1	24	GPI-10
5	GPI-31	25	GPI-22
6	GPI-2	26	GPI-11
7	GPI-30	27	GPI-21
8	GPI-3	28	GPI-12
9	GPI-29	29	GPI-20
10	GPI-4	30	GPI-13
11	GPI-28	31	GPI-19
12	GPI-5	32	GPI-14
13	GPI-27	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.

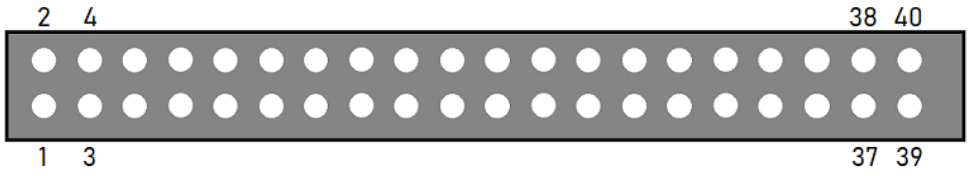
JP31 – Status LEDs			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	+5V	9	LED-DIR4
2	N/C	10	LED-STEP4
3	LED-DIR1	11	LED-DIR5
4	LED-STEP1	12	LED-STEP5
5	LED-DIR2	13	LED-AUX
6	LED-STEP2	14	LED-USB
7	LED-DIR3	15	GND
8	LED-STEP3	16	LED-PWR



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.

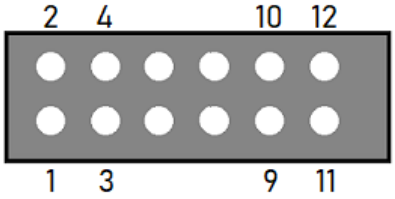
JP32 – Bus Expansion			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	+3.3V	21	DATA1
2	GND	22	DATA2
3	CS6	23	DATA3
4	STATUS6	24	DATA4
5	TXD2	25	DATA8
6	FAULT6	26	DATA7
7	RXD2	27	DATA6
8	AUX1-STB	28	DATA5
9	OUT-ENA	29	+7V
10	AUX2-STB	30	+7V
11	OUT2-STB	31	SPHOME
12	OUT1-STB	32	ENC CLK
13	OUT4-STB	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.

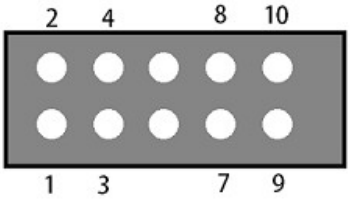
JP33 – Step and Direction			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	STEP5	7	STEP2
2	ENA	8	DIR3
3	STEP4	9	STEP1
4	DIR5	10	DIR2
5	STEP3	11	GND
6	DIR4	12	DIR1



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.

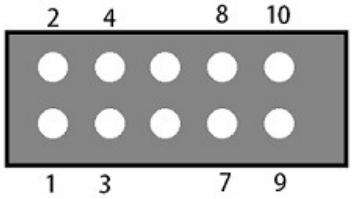
JP40 – Input Aux			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	GPI-2	6	GPI-5
2	GPI-1	7	GPI-8
3	GPI-4	8	GPI-7
4	GPI-3	9	OPT-GND
5	GPI-6	10	OPT-GND



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.

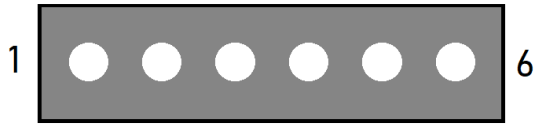
JP50 – Output Aux			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	GPO-2	6	GPO-5
2	GPO-1	7	GPO-8
3	GPO-4	8	GPO-7
4	GPO-3	9	GND
5	GPO-6	10	VCC



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.

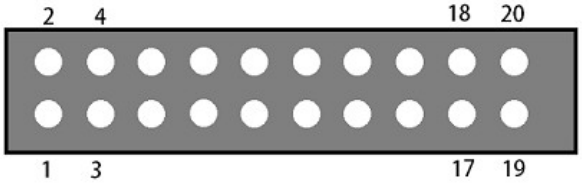
JP53 – Low-SideRelay			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	+5V	4	GPO-1 LOW
2	GPO-2 CLAMP	5	GPO-1 CLAMP
3	GPO-2 LOW	6	GND



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.

JP71-75 – Axis Plug-In Interfaces						
Pin No.	***Function***	***JP71***	***JP72***	***JP73***	***JP74***	***JP75***
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

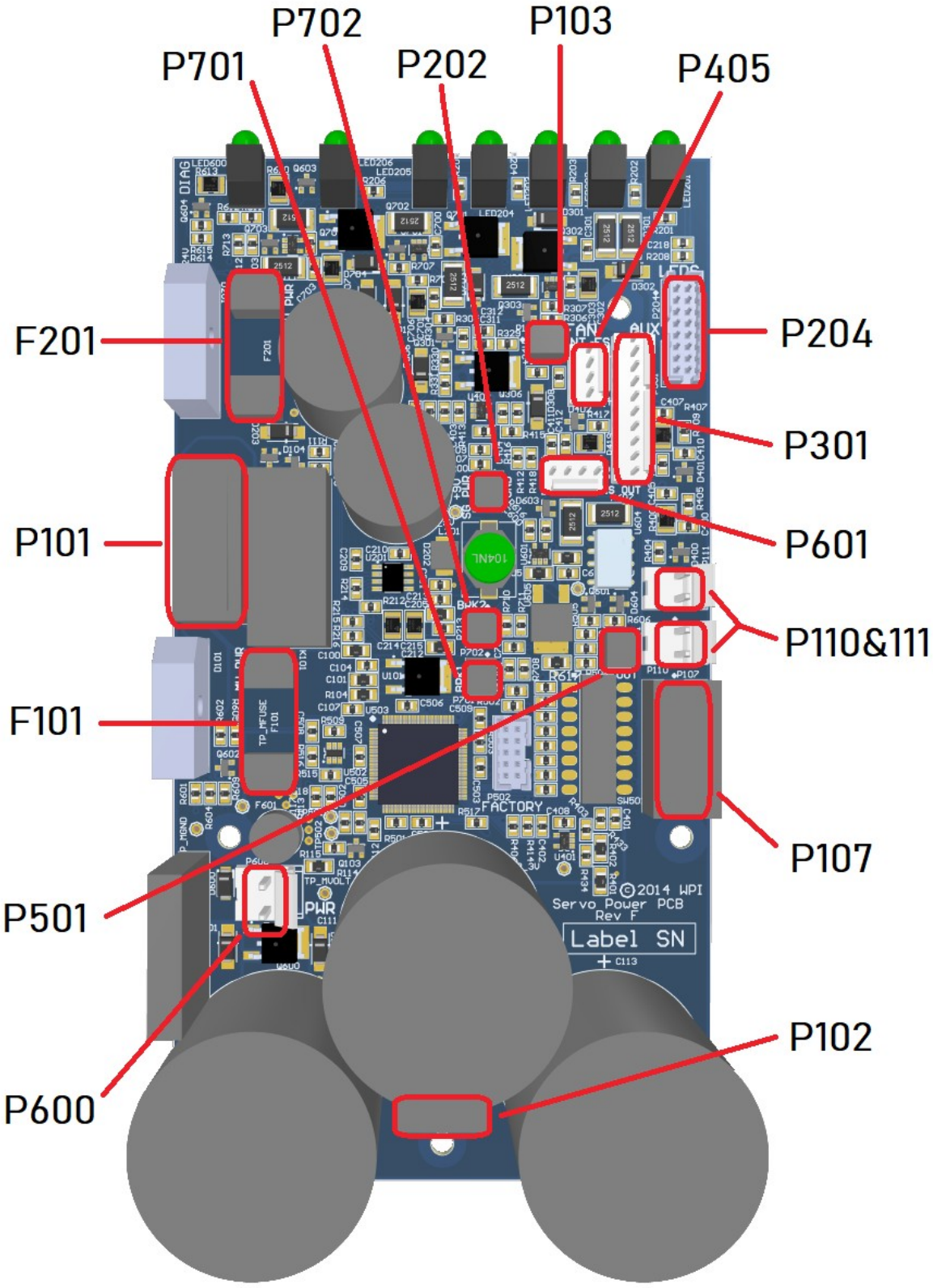
This is for an optional power fuse. The unit is shipped with a shunt instead of a fuse. If you replace the shunt with a fuse, it should be rated to 1A slow-blow or time-delay.

JP82 – Front Panel Switch

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

Advanced Power Board

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

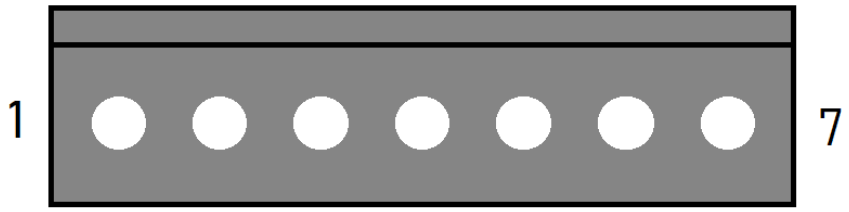


Internal Connections

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.

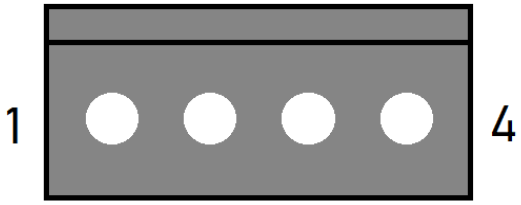
P101 – Transformer Connector			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	24VAC Line	5	MPWR AC Line
2	24VAC Neutral	6	N/C
3	N/C	7	MPWR AC Neutral
4	N/C		



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.

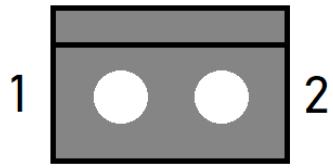
P102 – AUX Motor Power Connector			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	MPWR DC+	3	MPWR DC-
2	MPWR DC+	4	MPWR DC-



P103 – Fan Connector

This header is the power source for the system fan.

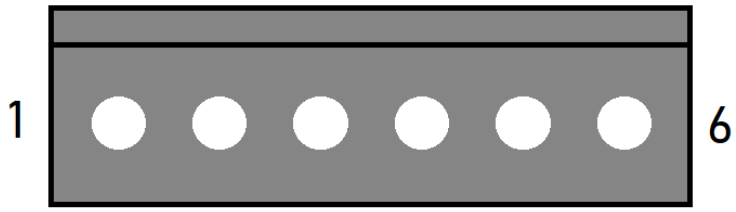
P103 – Fan Connector			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	GND	2	+24VDC



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.

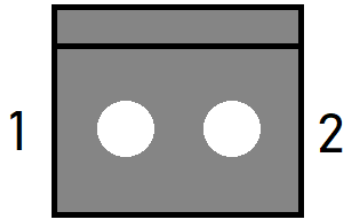
P107 – Motor Power Connector (3x)			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	MPWR DC-	4	MPWR DC+
2	MPWR DC+	5	MPWR DC-
3	MPWR DC-	6	MPWR DC+



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.

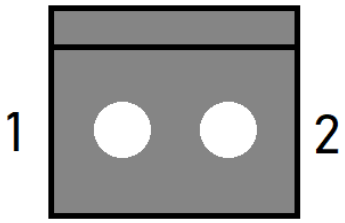
P110 & P111 – Motor Power Connectors			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	MPWR DC-	2	MPWR DC+



P202 – Signal Generator Power Connector

This header provides 9V logic power to the Signal Generator.

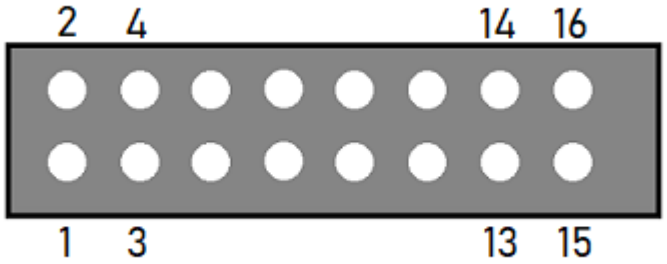
P202 – Signal Generator Power Connector			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	GND	2	+9VDC



P204 – LED Connector

This header receives system status information from the Signal Generator.

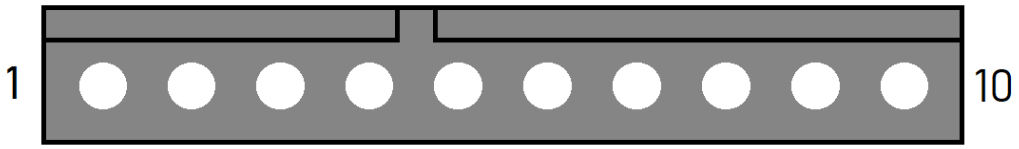
P204 – LED Connector			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	+5V	9	N/C
2	N/C	10	LED-STEP4
3	N/C	11	N/C
4	LED-STEP1	12	LED-STEP5
5	N/C	13	N/C
6	LED-STEP2	14	LED-USB
7	N/C	15	GND
8	LED-STEP3	16	N/C



P301 – Accessory Connector

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

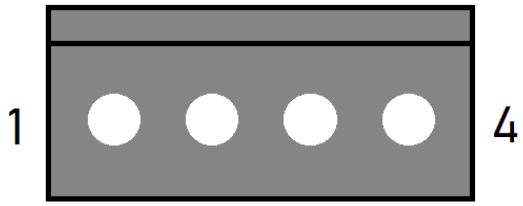
P301 – Accessory Connector			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	+24V	6	GND
2	GND	7	ESTOP_EXT+
3	BRAKE1	8	ESTOP_EXT-
4	GND	9	RESET+
5	BRAKE2	10	RESET-



P405 – Internal Emergency Stop Connector

This header contains internal emergency stop and reset control inputs.

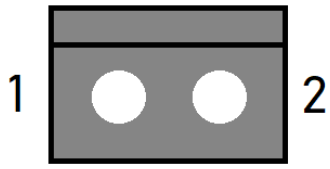
P405 – Internal Emergency Stop Connector			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	ESTOP_INT+	3	RESET_INT+
2	ESTOP_INT-	4	RESET_INT-



P501 – Relay Control Connector

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

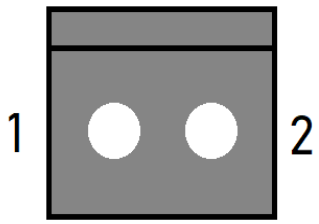
P501 – Relay Control Connector			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	GND	2	RELAY_IN



P600 – Motor Power Resistor Connector

This header connects to the regenerative clamp resistor.

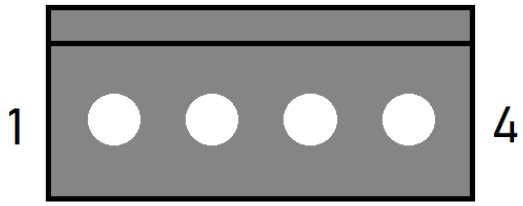
P600 – Motor Power Resistor Connector			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	REGEN_DRIVE	2	MPWR DC+ (Fused)



P601 – Emergency Stop Output Connector

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

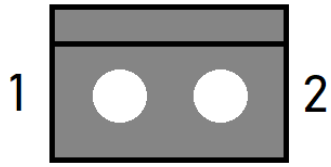
P601 – Emergency Stop Output Connector			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	RELAY+	3	ES_OUT_LOGIC+
2	RELAY-	4	GND



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.

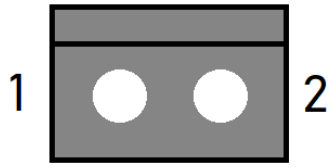
P701 – Brake 1 Input Connector			
Pin No.	***Signal***	***Pin No.***	***Signal***
1	GND	2	BRAKE1_IN



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:

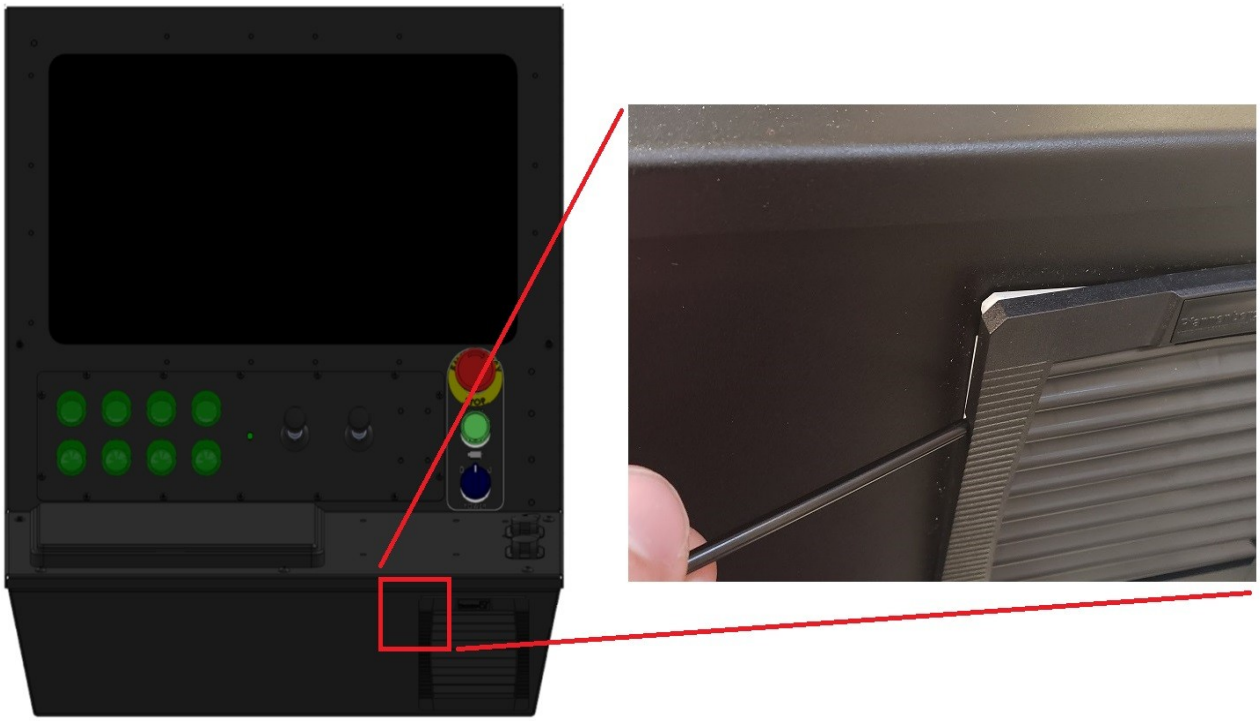
Code	Error
solid green	no error
flashing green	ESTOP closed, waiting for RESET
solid red	low motor power
2 green, 2 red	low 24V
1 green, 3 red	regen resistor locked
alternating	ESTOP open

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. The filter is Pfannenberg part number 18611600029.

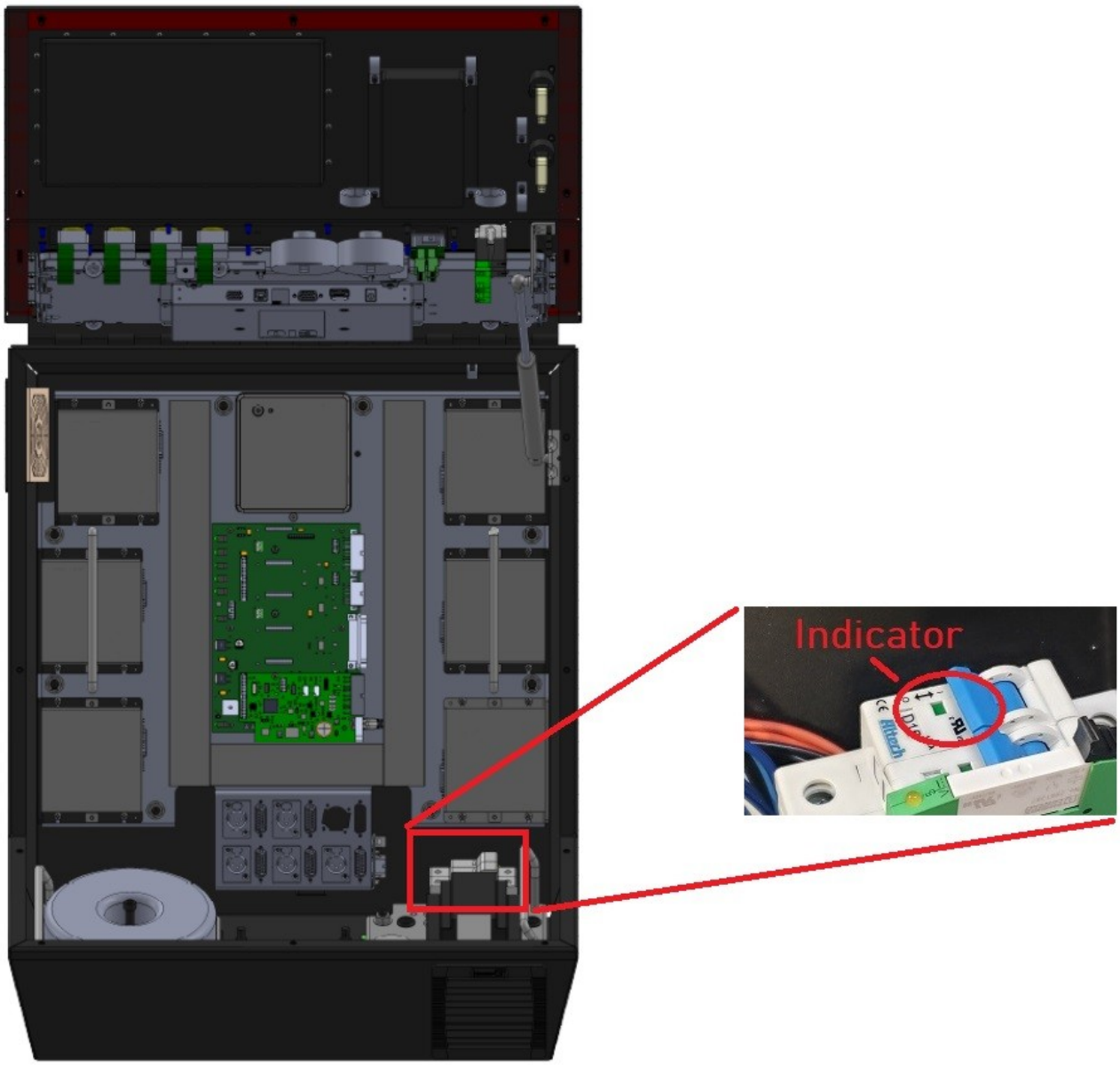
Internal Maintenance

Opening The Lid

Before installing or replacing internal components, open the lid. The lid is secured by seven 10-32 screws on the edges of the lid. Remove these using a P2 Phillips screwdriver and lift the lid off of the controls. Take care to gently guide the lid to its open position, as the support strut will provide extra opening force.

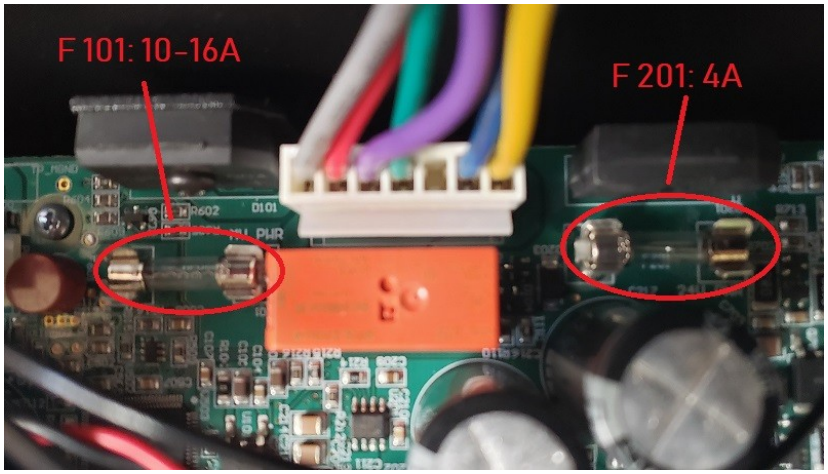
Disconnecting Power

Immediately after opening the lid, open the AC mains circuit breaker to ensure that the system is safe to work on. When power is disconnected, the breaker will show a green indicator.



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 from 10–16A and F 201 is rated to 4A.



Pin Location Index

Signal Locations

This table contains every instance of each signal in the system.

Signal Locations																		
	Signal Generator									**Mini I/O**	**Ultra I/O**							
Signal	**CON5**	**CON4**	**CON3**	**JP30**	**JP40**	**JP50**	**JP53**	**JP33**	**JP71–JP75**	**P103**	**CON 1301**	**CON 1302**	**P1301 P1302**	**JP 1301**	**JP 1302**	**JP 301**	**JP 302**	**JP 303**
Input 1		9	15	4	2													49
Input 2		10	16	6	1													48
Input 3		11	17	8	4													47
Input 4		12	18	10	3													46
Input 5		13	5	12	6													45
Input 6		14	6	14	5													44
Input 7		15	7	16	8													43
Input 8		16	8	18	7													42
Input 9				22					JP71.9							47		
Input 10				24					JP71.11							46		
Input 11				26					JP72.9							45		
Input 12				28					JP72.11							44		
Input 13				30					JP73.9							43		
Input 14				32					JP73.11							42		
Input 15				34					JP74.9							41		
Input 16				36					JP74.11							40		
Input 17				35					JP75.9									41
Input 18				33					JP75.11									40
Input 19				31						10			P1.10					39
Input 20				29						12			P1.12					38
Input 21				27									P2.10				49	
Input 22				25									P2.12				48	
Input 23				23													47	
Input 24				21													46	
Input 25				17								9		2			45	
Input 26				15								10		1			44	
Input 27				13								11		4			43	
Input 28				11								12		3			42	
Input 29				9								13		6			41	
Input 30				7								14		5			40	
Input 31				5								15		8			39	
Input 32				3								16		7			38	

Signal Locations

	Signal Generator									Mini I/O	Ultra I/O							
Signal	**CON5**	**CON4**	**CON3**	**JP30**	**JP40**	**JP50**	**JP53**	**JP33**	**JP71–JP75**	**P103**	**CON 1301**	**CON 1302**	**P1301 P1302**	**JP 1301**	**JP 1302**	**JP 301**	**JP 302**	**JP 303**
Output 1	1		1			2	4			6&15			P1.6&15					37
Output 2	6		2			1	3			7&16			P1.7&16					36
Output 3	2					4							P2.6&15					35
Output 4	7					3							P2.7&16					34
Output 5	3					6												33
Output 6	8					5												32
Output 7	4					8												31
Output 8	9					7												30
Output 9																39		
Output 10																38		
Output 11																37		
Output 12																36		
Output 13																35		
Output 14																34		
Output 15																33		
Output 16																32		
Output 17																		29
Output 18																		28
Output 19																		27
Output 20																		26
Output 21																	37	
Output 22																	36	
Output 23																	35	
Output 24																	34	
Output 25													1		2		33	
Output 26													2		1		32	
Output 27													3		4		31	
Output 28													4		3		30	
Output 29													5		6		29	
Output 30													6		5		28	
Output 31													7		8		27	
Output 32													8		7		26	
Analog Input 1										18				P1.18		30		
Analog Input 2														P2.18		29		
Analog Output 1										17				P1.17		27		
Analog Output 2														P2.17		26		
PWM Output 1										14				P1.14		1		
PWM Output 2														P2.14		7		

Signal Locations																		
	Signal Generator									**Mini I/O**	**Ultra I/O**							
Signal	**CON5**	**CON4**	**CON3**	**JP30**	**JP40**	**JP50**	**JP53**	**JP33**	**JP71–JP75**	**P103**	**CON 1301**	**CON 1302**	**P1301 P1302**	**JP 1301**	**JP 1302**	**JP 301**	**JP 302**	**JP 303**
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

+5VDC

- Signal Generator
  - CON5.5
  - CON3.22
  - JP50.9
  - JP53.1
  - JP33.11
  - JP71-75.20
- Mini I/O
  - P103.13
- Ultra I/O
  - CON1302.9
  - P1301.13
  - P1302.13
  - JP1302.10

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
- Ultra I/O
  - CON1302.10
  - P1301.4, 5
  - P1302.1, 3, 4, 5
  - JP301.1, 2, 3, 4, 5, 6

OPT-VCC

- Signal Generator
  - CON3.23
- Ultra I/O
  - JP301.24, 48
  - JP302.25, 50
  - JP303.25, 50

OPT-GND

- Signal Generator
  - CON4.1, 2, 3, 4, 5, 6, 7, 8
  - CON3.25
  - JP40.9, 10
- Ultra I/O
  - CON1301.1, 2, 3, 4, 5, 6, 7, 8
  - JP301.16, 17, 18, 19, 20, 21, 22, 23, 24
  - JP302.13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24
  - JP303.13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24
  - JP1301.9, 10

Analog GND

- Ultra I/O
  - P1301.8, 9
  - P1302.8, 9
  - JP301.25, 28, 31

5-24VDC Clamp Voltage

- Signal Generator
  - JP53.2, 5
- Ultra I/O
  - JP301.8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24
  - JP302.1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25
  - JP303.1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

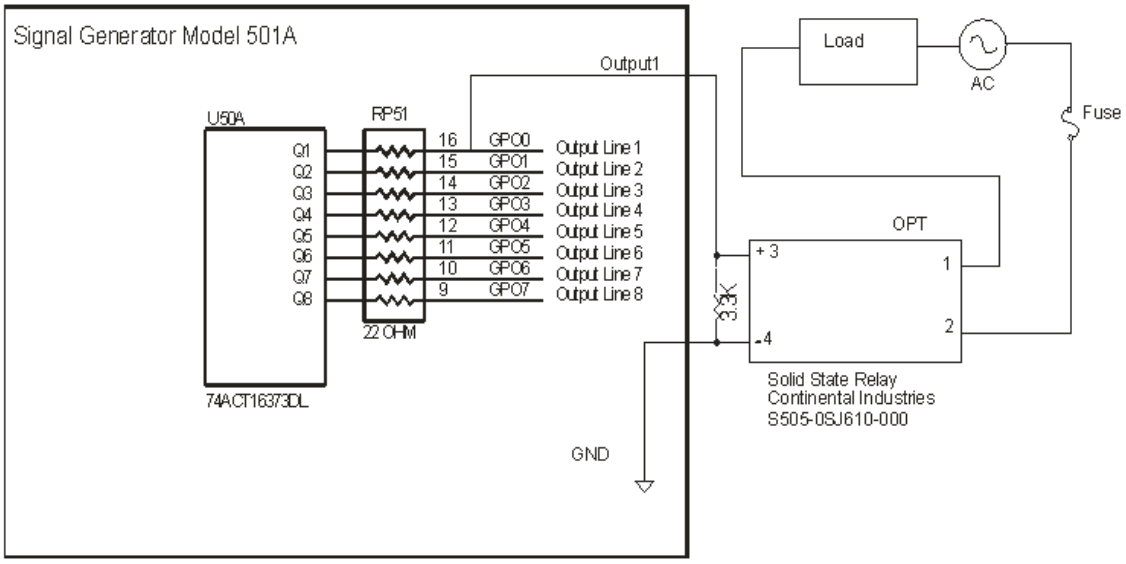
Wiring Appendix

Example Wiring

Typical Output Line Circuit

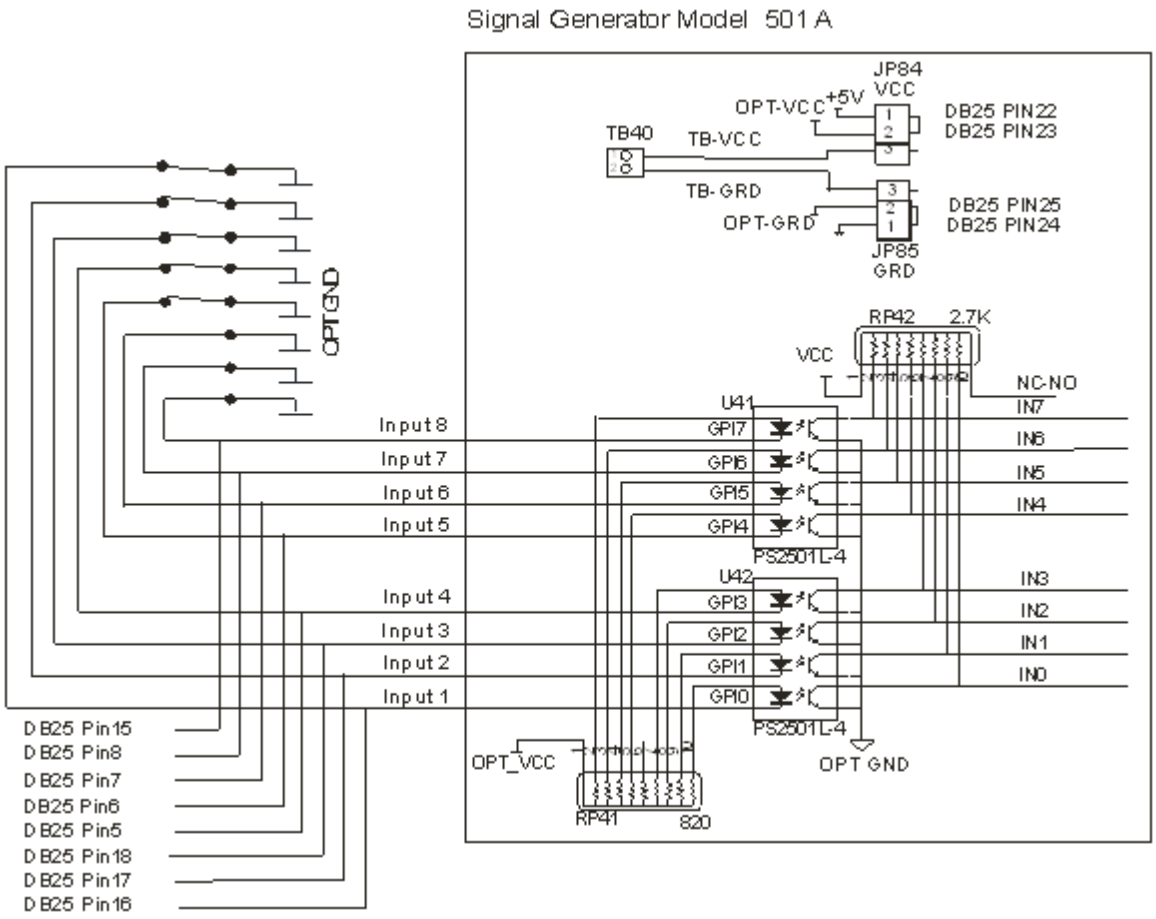
The schematic below shows a typical connection of one solid state relay controlled by output line 1 of the Signal Generator. A typical load could be a spindle, a vacuum, a laser, etc. In this example, the solid-state relay used is a Continental Industries model S505-0SJ610-000.

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. Our Spindle On/Off Relay Box is wired as shown in the below schematic.



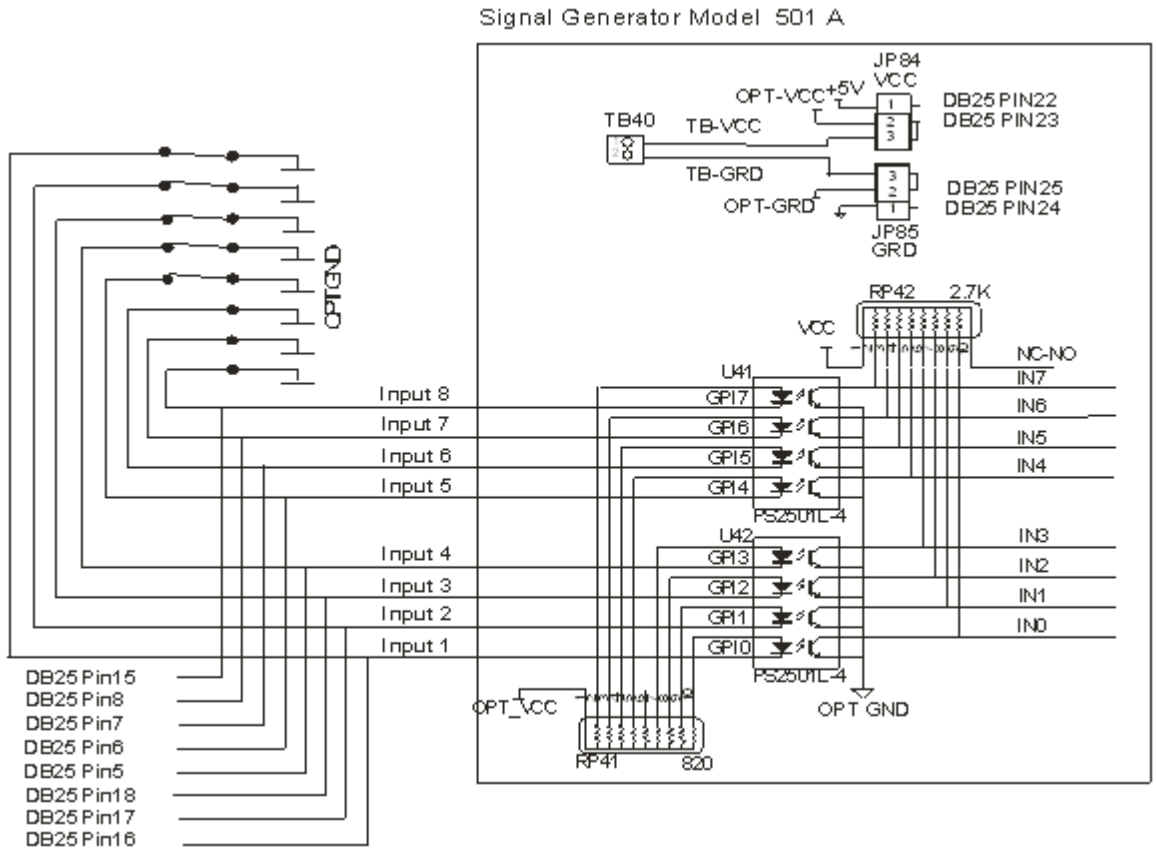
Typical Input Line Circuit – Internal Power

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.



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.

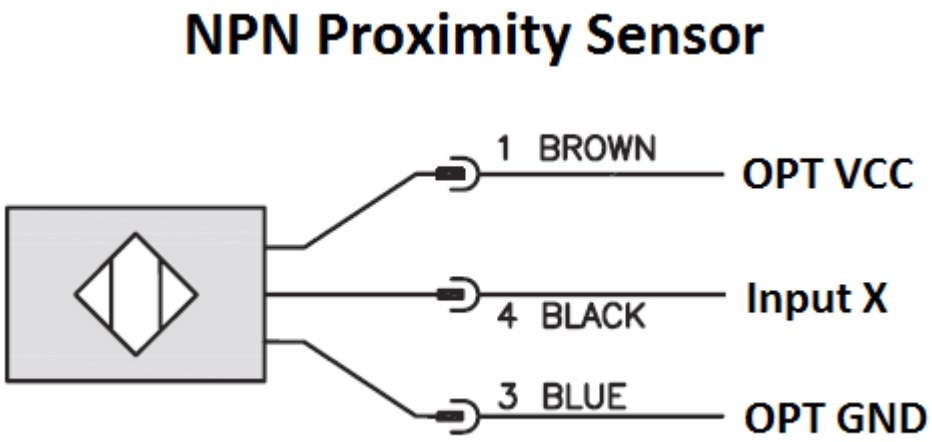


Note that the limit switch kit has the same wiring as shown in this example.

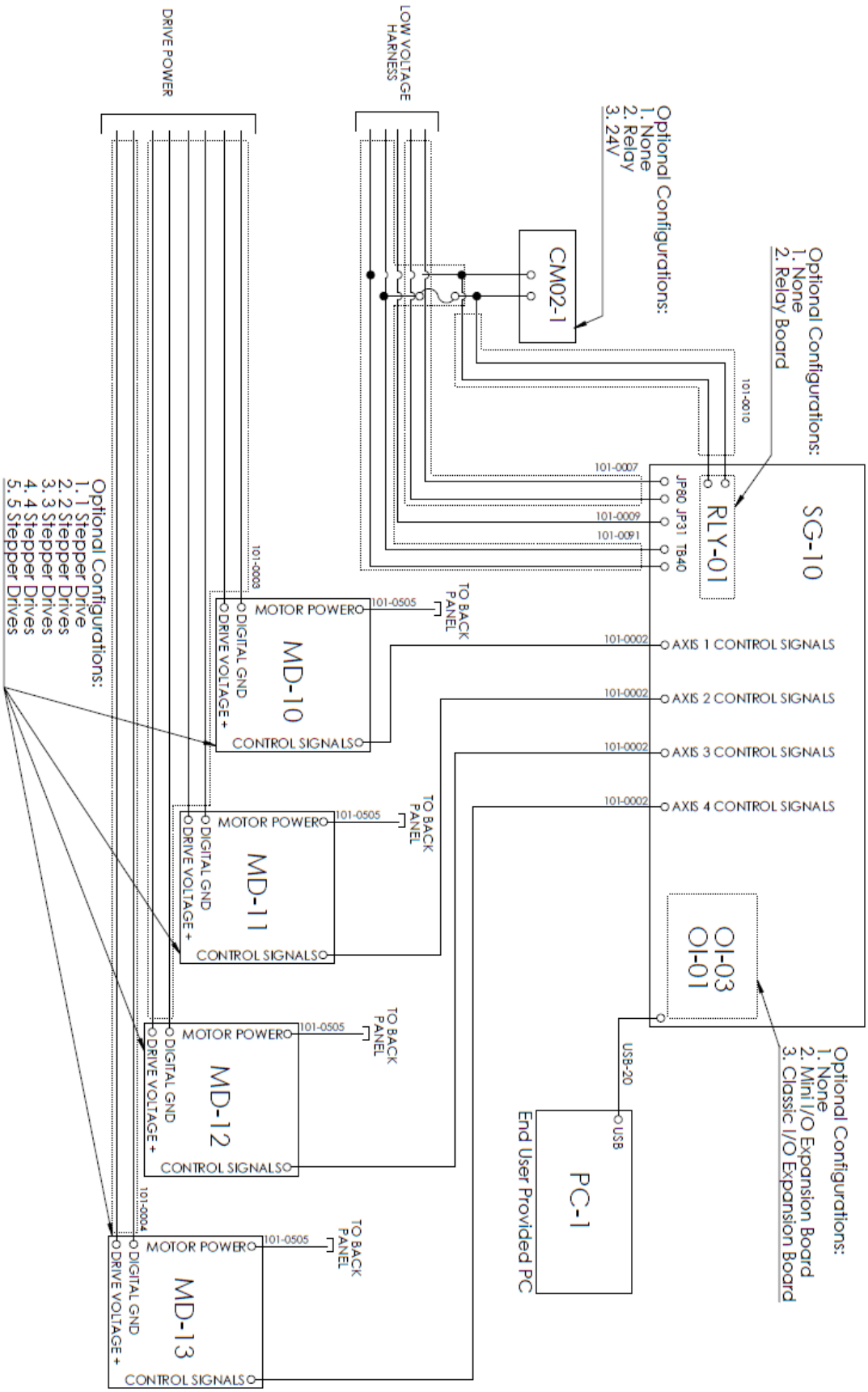
Proximity Sensors

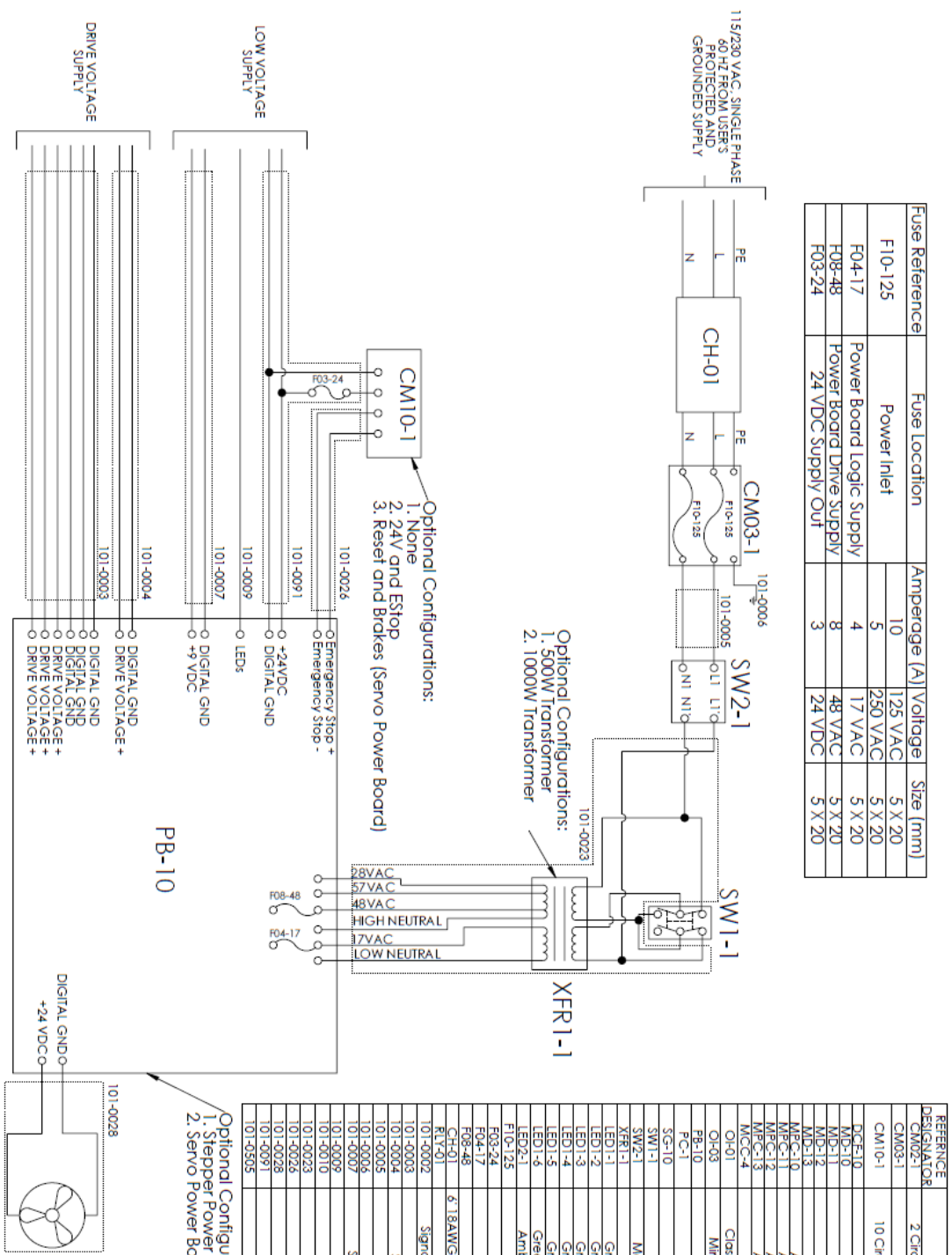
When connecting a proximity type sensor, connect to the controller using the following diagram.

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.



Internal Schematic





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

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	Toroidal 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	Green LED Controller Power Indicator
LED2-2	Amber LED USB Connection 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

Revision History

Revision B

Revision	***Date***	***Comments***
A	02/09/21	Adapted to controller with no drives
B	04/27/21	Replaced Classic I/O Expansion with Ultra