

FLASHCUT CNC

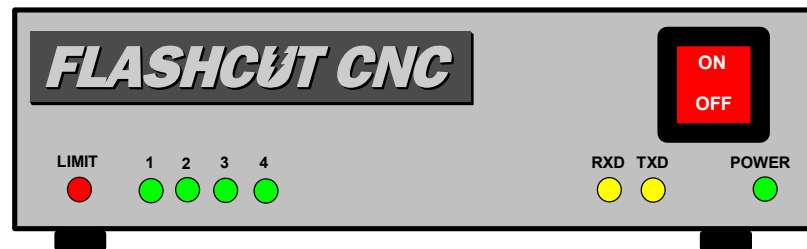
TM

Control Made Simple

Model 401A

Signal Generator

Hardware Guide



West Coast Office

1263 El Camino Real
Menlo Park, CA 94025

Phone (650) 853-1444 ♦ Fax (650) 853-1405
www.flashcutcnc.com

Midwest Office

444 Lake Cook Road, Suite 17
Deerfield, IL 60015

Phone (847) 940-9305 ♦ Fax (847) 940-9315
www.flashcutcnc.com

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Section 1. Getting Started

About this Manual

FlashCut CNC is a unique application involving hardware and software, so you'll need some instruction to get started.

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.

Safety and Usage Guidelines

When running an automated machine tool, safety is of 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.

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. WPI supplies this product but has no control over how it is installed or used. Always be careful!

WPI, Inc. is 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.

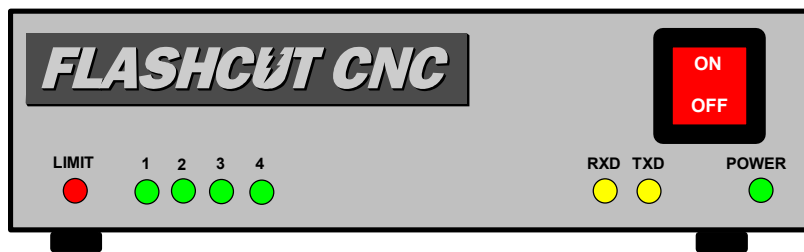
Section 2. Hardware Guide

Overview of the Signal Generator

The Signal Generator provides a flexible interface that controls up to 4 stepper or digital servo motor drivers, 8 output lines and 8 input lines. It works in conjunction with the FlashCut CNC software. Please note that there are several software and hardware settings that affect the use of the Signal Generator. These settings are described in this manual and in the software User's Guide.

Front Panel

The front panel of the signal generator has the power on/off switch and 8 LED's with the following functions:



Limit – Turns red when any limit/input switch is open when using normally closed (NC) switches, or when any limit/input switch is closed when using normally open (NO) switches. For proper operation of this LED, JP3 must be shorted for NO switches and open for NC switches.

1, 2, 3, 4 (or X, Y, Z, A) – Turns green when the respective motor is stepping. Note that the polarity of these lights will be reversed depending on the Step Signal setting in the Motor Signals Setup dialog box. Also note that these lights appear brighter or dimmer depending on the Step Pulse Width setting. A small pulse width will make them very hard to see in a well lit room.

RXD – Turns yellow when receiving data from the host PC serial port.

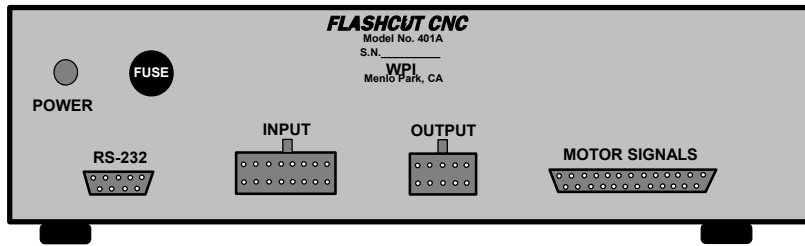
TXD – Turns yellow when transmitting data to the host PC serial port.

Power – Turns green when the power switch is turned on.

On/Off Switch – Turns the unit on and off. If there is ever a communications error while running FlashCut CNC, turn the switch off and on to reset the internal microprocessor.

Rear Panel

The rear panel has connectors for input and output signals as described below.



DC IN – Receptacle for the power supply. The unit is shipped with a 9V DC, 800-1000mA wall transformer power supply.

Fuse – Cartridge for the fuse. If the fuse blows, replace it with a 3AG, 1.5A slow-blow fuse.

RS-232 – Serial port connector for communication with the host PC (9 pin female). Most PC's have 9 pin male or 25 pin male. Use either a 9 Pin Male - 9 Pin Female or a 9 Pin Male - 25 Pin Female cable depending on the serial port on your PC.

INPUT – The connector for up to 8 input lines. The most common use of the input lines is for limit or safety switches. These lines are all TTL- and CMOS-compatible inputs. When a switch is open, its input signal is high (+5V). When the switch is closed, its input signal is grounded low (0V).

The 401A is wired for all normally closed (NC) or all normally open (NO) switches. When in NC mode, each line that is not connected to a switch must be wired directly to its ground. When any of the input lines are open, the red Limit light will illuminate and a signal will be sent to the host PC to indicate which input line(s) went high. When in NO mode, each line that is not connected should remain open. The red limit light will illuminate when any of the switches close. To change between NO mode and NC mode, set jumper JP3. When JP3 is shorted, it is in NO mode, when JP3 is open, it is in NC mode. If you are not using any limit switches, you should set JP3 to NO mode.

If you are using version 1.61 or earlier, and you are using normally closed switches, make sure the Signal Generator Model 401A option is selected in the System Options Setup dialog box. If you are using normally open switches, make sure the Signal Generator Model 401 option is selected in the System Options dialog box. All input lines must be properly defined in the Input Lines Setup dialog box. If you are using Version 2 and higher, go to the Configuration...Input Lines menu and make sure the NC or NO option is chosen properly for the wiring you are using.

The input lines are also TTL/CMOS-compatible. The FlashCut CNC display reflects a logic "1" or "OPEN" for a high-level input voltage, or open switch and a logic "0" or "CLOSED" for a low-level input voltage or closed switch. Short jumper JP3 if your switches are normally open or your normal input status is logic high. Leave JP3 open if your switches are normally closed or your normal input status is logic low. Note that all switches and input lines should have the same normal state.

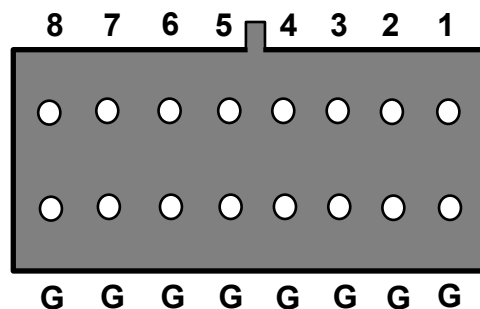
The input lines are all optically isolated. This means that a 5V power source must be provided to power the external end of the optical couplers. There are two ways to do this listed below. **Note that you must use only one of the two options below. If you use more than one, you can cause severe damage.**

1. Use the internal power source on the signal generator by shorting JP1 and JP2 on the circuit board. This is the most convenient option and works well for most applications, but negates some of the signal isolation. **OR**
2. For the best noise immunity, connect an external 5V power supply through pins 23 (OPT 5V) and pin 25 (OPT GND) of the Motor Signal Connector (CON5).

BE VERY CAREFUL WHEN DOING ANY WIRING. IMPROPER WIRING WILL DAMAGE THE SIGNAL GENERATOR.

Input lines 1, 2, 3 & 4 are also connected through pins 15, 16, 17 & 18 respectively of the Motor Signal connector, and input lines 5, 6, 7 & 8 are also connected through pins 5, 6, 7 & 8 respectively of the Motor Signal connector. This makes it convenient to send any signals from your motor driver box, such as limit lines or servo position error signal, back to the Signal Generator through the DB25 cable without the need of a separate input cable. Note that if an input line is being used through the Motor Signal connector, that line must remain open in the Input connector. Also, if the Input connector is wired as normally closed, then the signal coming in through the Motor Signal connector must be normally LOW. Alternatively, if the Input connector is wired as normally open, then the signal coming in through the Motor Signal connector must be normally HIGH. If you are not using input signals through the Motor Signal connector, then don't connect them to anything.

The receptacle that plugs into this connector is a Molex-Waldom Mini-Fit Jr. Series 16 pin receptacle (part number 39-01-2160), with female pins (part number 39-00-0039 or 39-00-0047 for 22 gauge or thinner wires). The input lines as seen from the back of the box are arranged as follows (all of the ground connections denoted by "G" are optically isolated ground.):



OUTPUT – The connector for up to 8 output lines. These lines are all compatible with TTL/CMOS level outputs. They are all driven by HCT family logic. Output logic high is normally 5V and can go down to 3.9V

at full load. Output logic low is normally 0V and can go up to 0.3V at full load. Each of these signals can provide up to 20mA of current.

Two additional pins are provided for your output lines: ground and +5V.

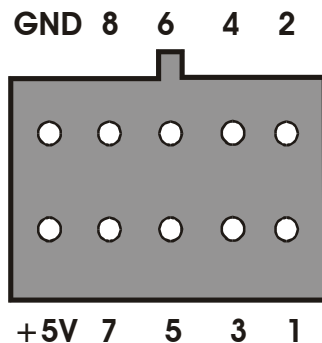
If the signal generator has a serial number of 102300 (Rev J) or below, these are connected to OPT GND and OPT +5V. To make these lines operational, jumpers JP1 and JP2 must be shorted, or external power can be provided directly to them. If these lines are shorted, you cannot provide external power through the OPT GND and OPT 5V pins on the DB25 Motor Signal Connector.

If the signal generator has a serial number of 102301 (Rev K) or higher, these are connected to GND and +5V and are not optically isolated.

BE VERY CAREFUL WHEN DOING ANY WIRING. IMPROPER WIRING WILL DAMAGE THE SIGNAL GENERATOR.

The output lines are all initialized to low (0V) when you turn on the Signal Generator. Output lines 1, 2, 3 & 4 are also connected through pins 1, 2, 3 & 4 respectively of the Motor Signal connector. This makes it convenient to connect up to 4 output signals to your motor driver box to drive devices such as solid-state relays that might be in your motor driver box.

The receptacle that plugs into this connector is a Molex-Waldom Mini-Fit Jr. Series 10 pin receptacle (part number 39-01-2100), with female pins (part number 39-00-0039 or 39-00-0047 for 22 gauge or thinner wires). The output lines as seen from the back of the box are arranged as follows:



MOTOR SIGNALS – The DB-25 male connector for all signals going out to the stepper or digital servo motor driver(s). If you are using one of the FlashCut CNC motor drivers, connect this to the DB-25 female connector on the motor driver using a DB25 M-F interface cable.

The cable used must be a DB-25 Interface Cable with all 25-pins wired straight through.

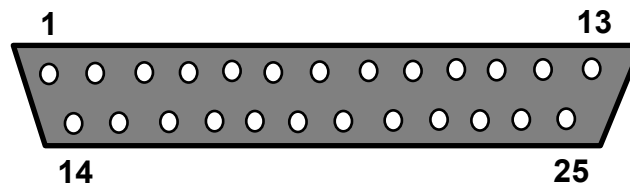
The main use of this connector is to provide step and direction signals to the motor drivers. Each of these signals can provide up to 20mA of current.

Two input pins are provided for optical ground (pin 25) and optical VCC (pin 23) to power the optical couplers on the input lines (see above). You can place a 5 VDC power source across these two pins. **If you are powering input lines internally using JP1 and JP2, do not connect these input pins.**

BE VERY CAREFUL WHEN DOING ANY WIRING. IMPROPER WIRING WILL DAMAGE THE MOTOR SIGNAL GENERATOR.

Two pins are directly connected to ground (pin 24) and +5V (pin 22) from the internal power supply. These are provided to power simple, external, 5V electronics associated with your motor driver. They can source up to 50mA.

The motor signal lines as seen from the back of the box are arranged as follows:



DB25 Pin	Signal	DB25 Pin	Signal
1	OUTPUT 1	14	ENABLE ALL
2	OUTPUT 2	15	INPUT 1
3	OUTPUT 3	16	INPUT 2
4	OUTPUT 4	17	INPUT 3
5	INPUT 5	18	INPUT 4
6	INPUT 6	19	A DIRECTION
7	INPUT 7	20	Z DIRECTION
8	INPUT 8	21	Y DIRECTION
9	X DIRECTION	22	Internal VCC +5V
10	A STEP	23	OPT VCC (INPUT)
11	Z STEP	24	Internal GND
12	Y STEP	25	OPT GND (INPUT)
13	X STEP		

Jumper Settings

JP1 and JP2

These two jumpers enable you to use the internal power of the Signal Generator to provide power to the external side of the optically isolated input lines. When JP1 is shorted, OPT VCC gets its power from the Internal VCC. When JP2 is shorted, OPT GND is directly connected to the Internal GND. **If you are providing an external 5V through pins 23 and 25 of the DB25 Motor Signal connector, then you must leave JP1 and JP2 open.**

JP3

This jumper configures the Signal Generator for all normally closed (NC) or all normally open (NO) switches. When in NC mode, JP3 should be open. When any of the input lines are open the red Limit light will illuminate. When in NO mode, JP3 should be shorted. Each line that is not connected should remain open. The red limit light will illuminate when any of the switches close. If you are not using any limit switches, you should set JP3 to NO mode (shorted). If you are using the FlashCut CNC Limit Switch Kit, you should set JP3 to NC mode (open).

JP4, JP5 & JP6

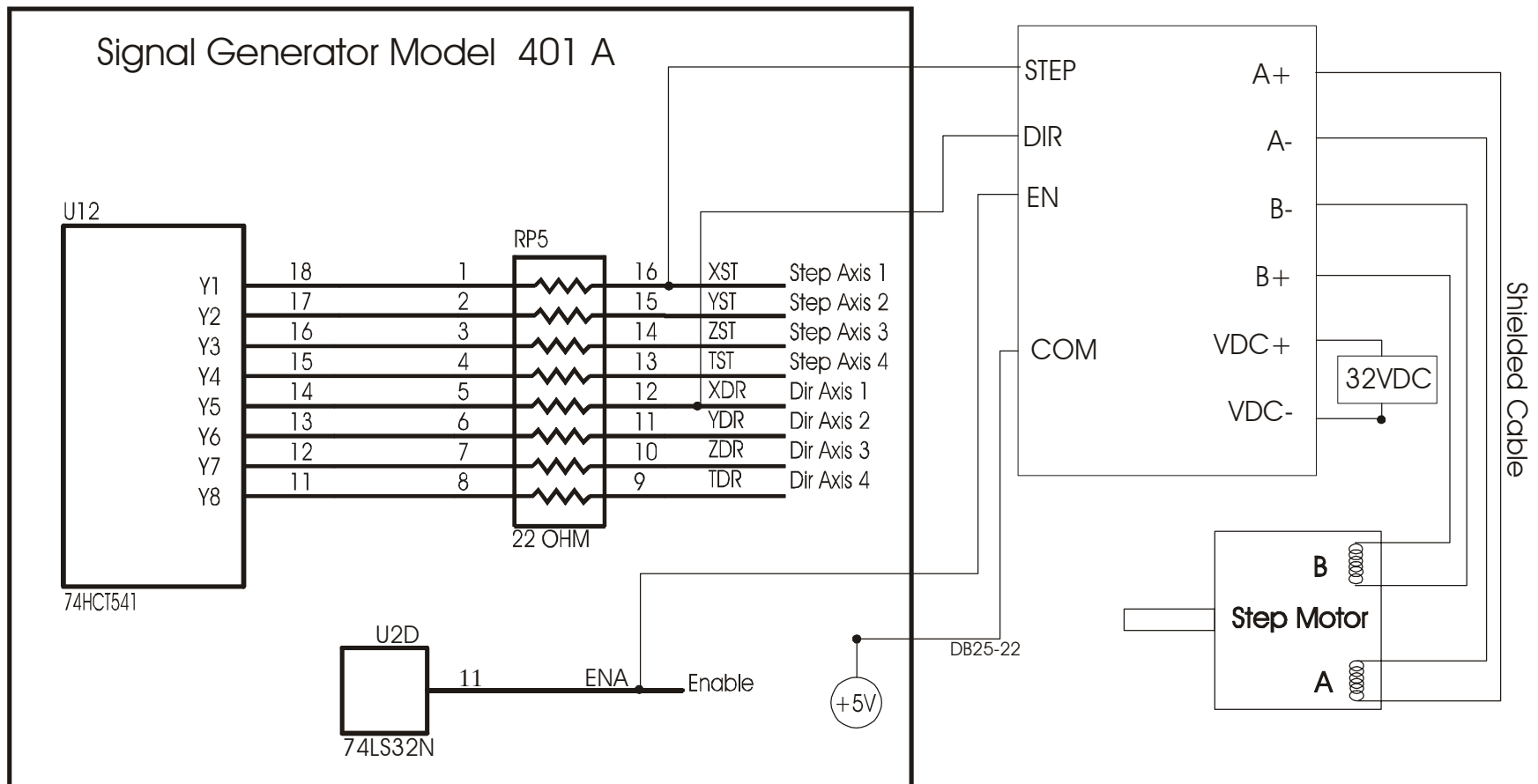
These switches are for FlashCut CNC Personnel use only and should always be open.

Turning off the Controller

Always turn off the Signal Generator when it is not in use.

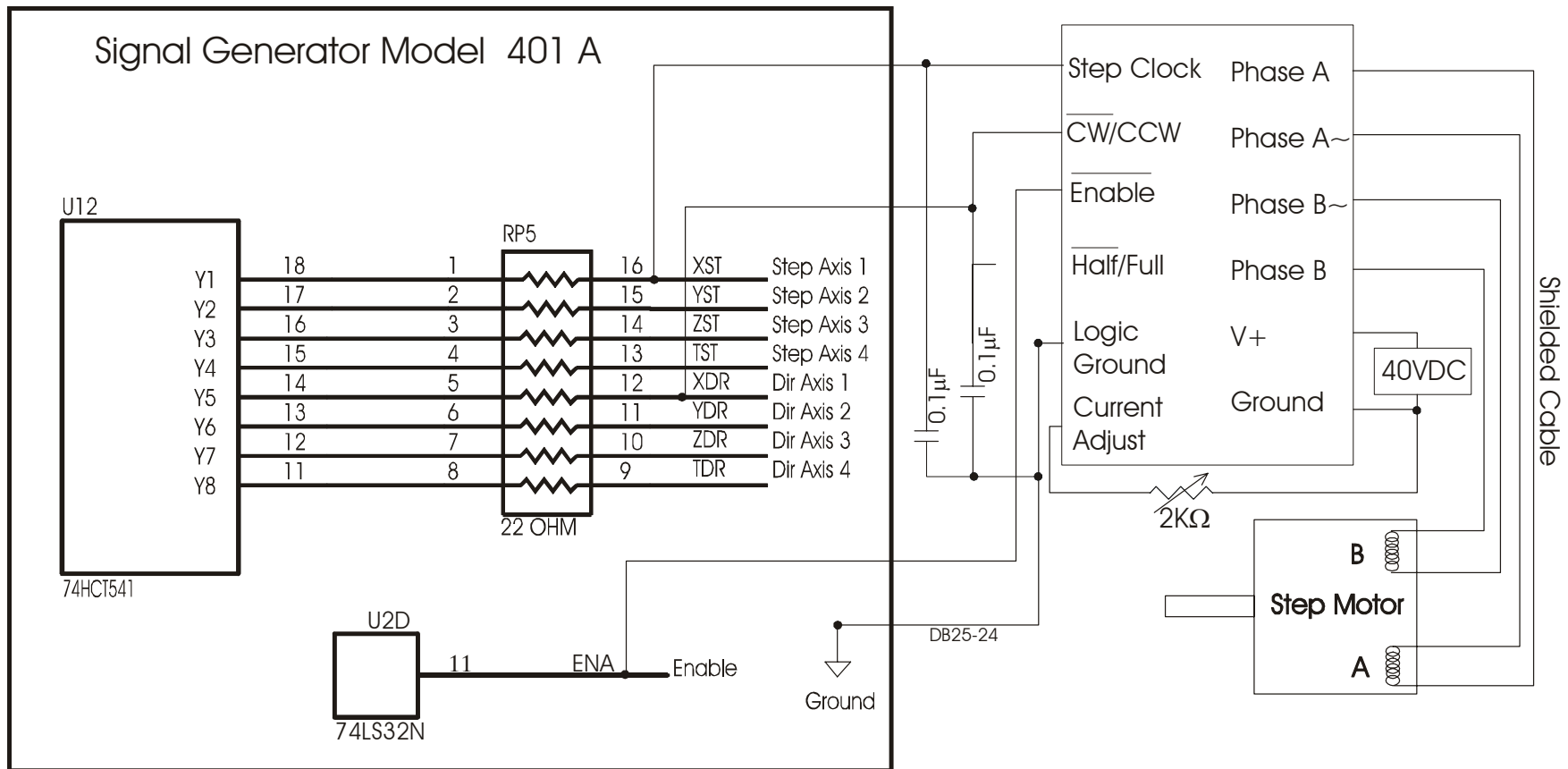
Section 3. Sample Wiring Diagrams

Typical Motor Signal Circuit For Half-Stepping and Microstepping Drives



The above schematic shows a typical connection of a single axis motor driver to the motor signals of the Signal Generator. Each of the step and direction signals have a 22 ohm resistor in series with their outputs. This is to reduce any “ringing” at the transient switching points. This resistor pack (RP5) is socketed so that you can change the value if needed for your application.

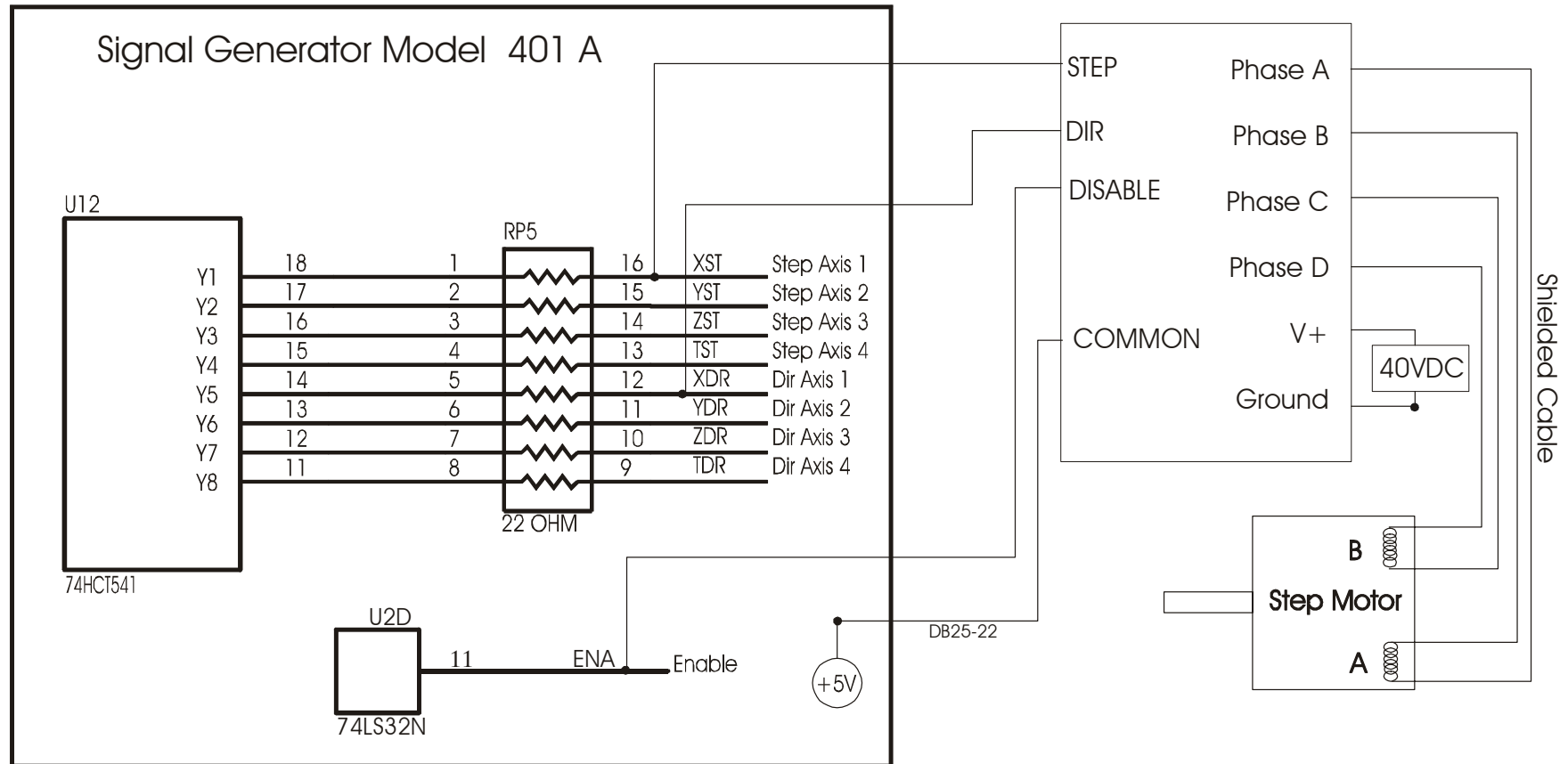
Typical Motor Signal Circuit II



The above schematic shows a typical connection of a single axis motor driver to the motor signals of the Signal Generator. Each of the step and direction signals have a 22 ohm resistor in series with their outputs. This is to reduce any “ringing” at the transient switching points. This resistor pack (RP5) is socketed so that you can change the value if needed for your application.

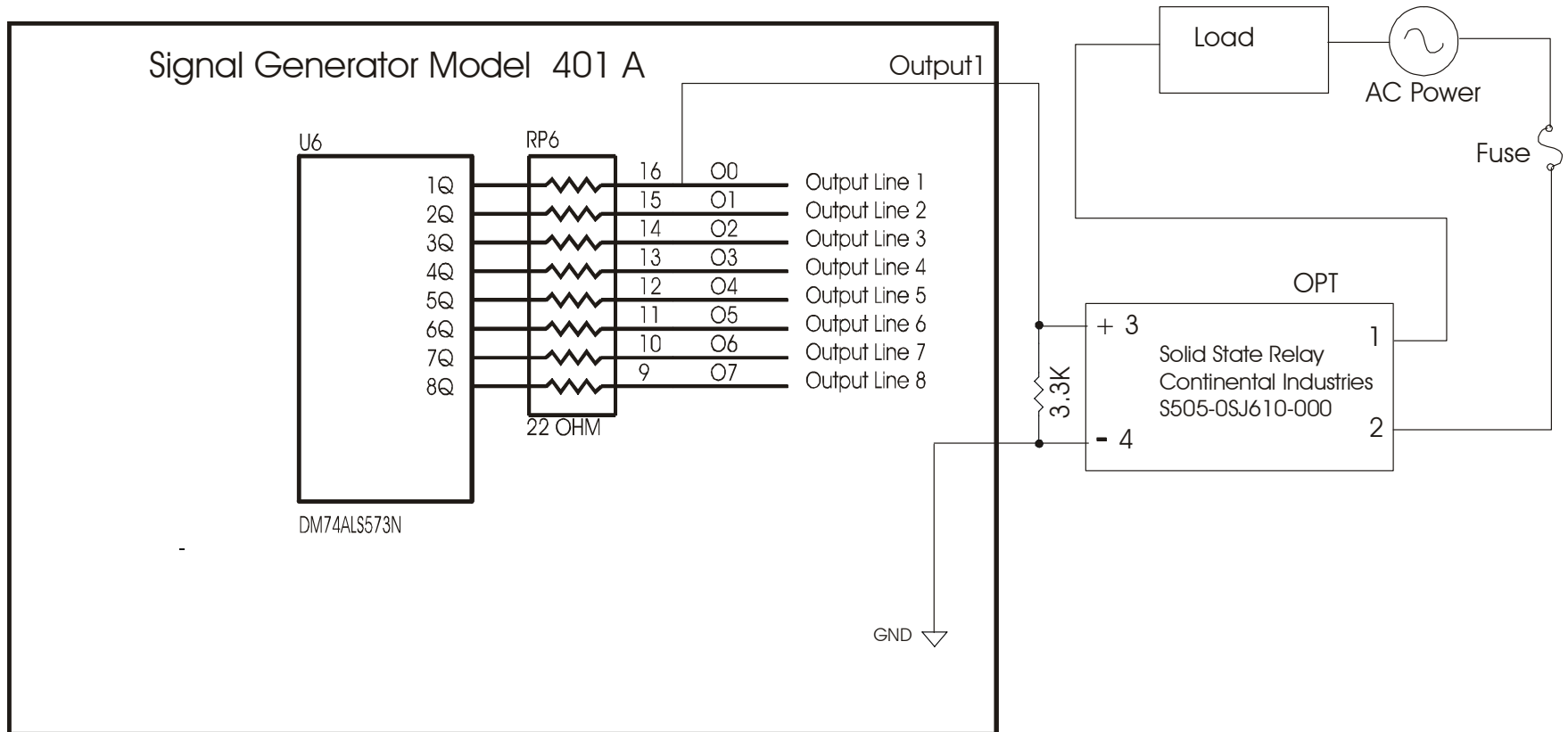
In this example a 0.1uF capacitor was placed between the step signal and ground and between the direction signal and ground. This filters out any transient noise in the signals. It is better to place these capacitors on the drive unit rather than the Signal Generator.

Motor Signal Circuit For Gecko Drives



The above schematic shows a typical connection of a single axis motor driver to the motor signals of the Signal Generator. Each of the step and direction signals have a 22-ohm resistor in series with their outputs. This is to reduce any “ringing” at the transient switching points. This resistor pack (RP5) is socketed so that you can change the value if needed for your application.

Typical Output Line Circuit



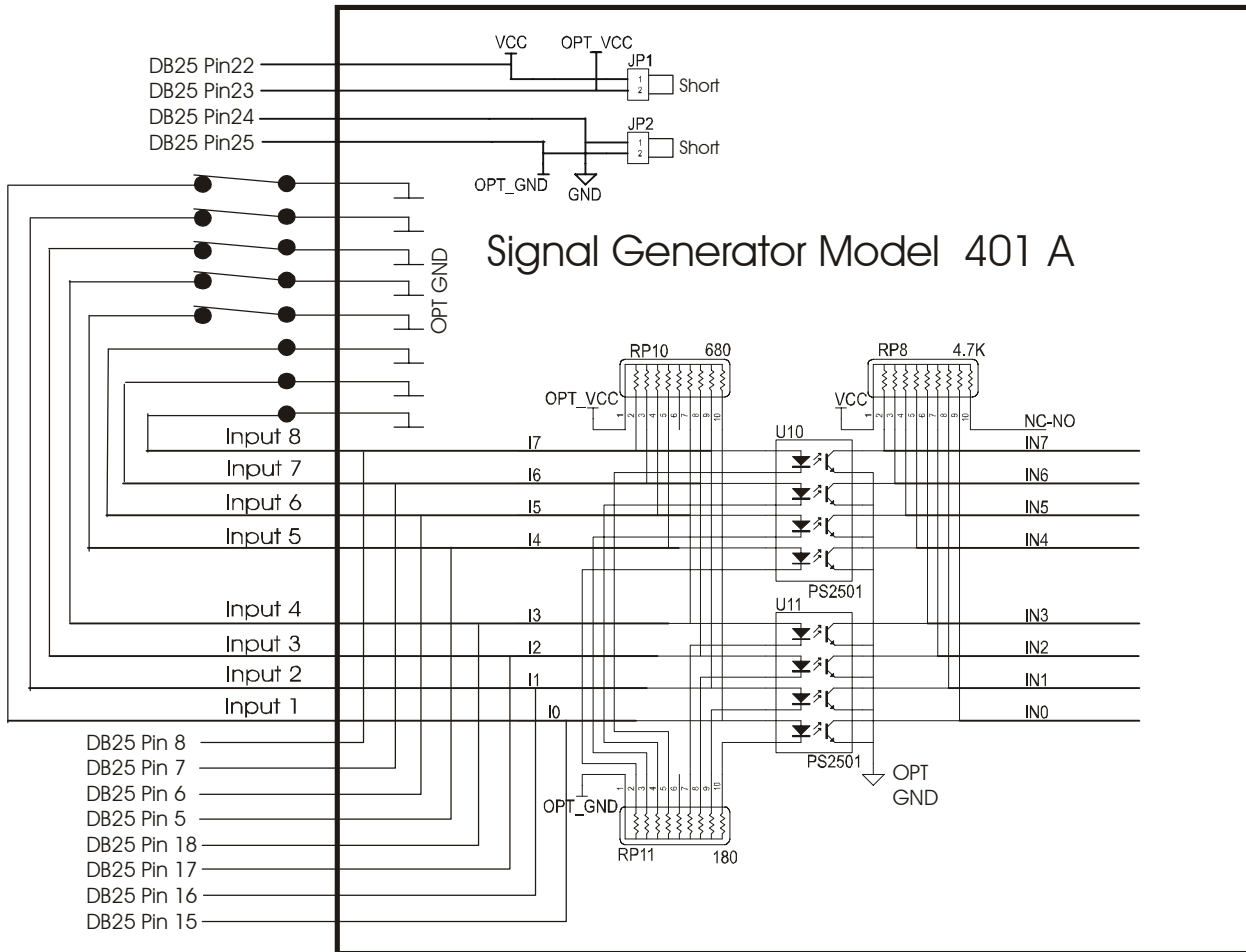
The above schematic shows a typical connection of one solid state relay controlled by output line 1 of the Signal Generator. A typical load would be a spindle, a vacuum, a laser, etc. In this example, the solid-state relay used is a Continental Industries model S505-0SJ610-000. It takes a 3 to 32VDC input and has an output of 24-330VAC.

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. This resistor pack (RP6) is socketed so that you can change the value if needed for your application.

Ground and 5V are provided on this connector for your convenience.

The FlashCut Spindle On/Off Relay Box is wired as shown in the above schematic.

Typical Input Line Circuit

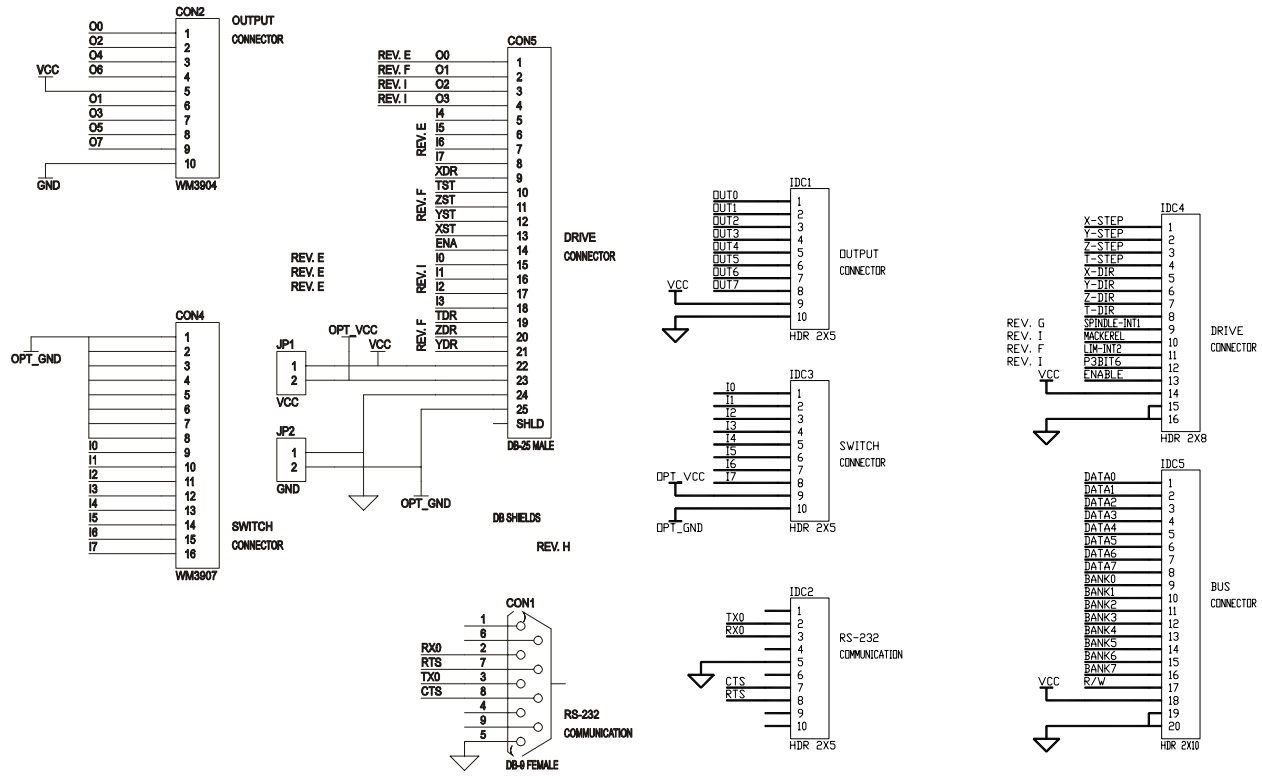


The above schematic shows a typical connection of 5 normally closed switches. These switches are connected between input lines 1-5 and ground. Lines 6-8 are connected directly to ground with jumper wires. All external connections shown are made through the Input connector on the back of the Signal Generator. Since these switches are normally closed, JP3 should be open.

The input lines are all optically isolated. In this example, JP1 and JP2 are shorted using the internal power to source the external side of the optical couplers. However, for the best isolation, JP1 and JP2 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.

I/O Connector and Header Schematic



Signal Generator Board Layout

