



Computer Numerical Control for Windows

Model 401A

Signal Generator

Hardware Guide

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Section 1. Getting Started

About this Manual

Torchmate 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 Torchmate 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.

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

Applied Robotics, 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

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 Torchmate 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 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 (using normally closed switches).

X, Y, Z, A - Turns green when the respective motor is stepping. Note that the polarity of these lights will be reversed if the Park Signal is set to Low in the Motor Signals Setup dialog box.

RXD - Turns yellow when receiving data from the host PC.

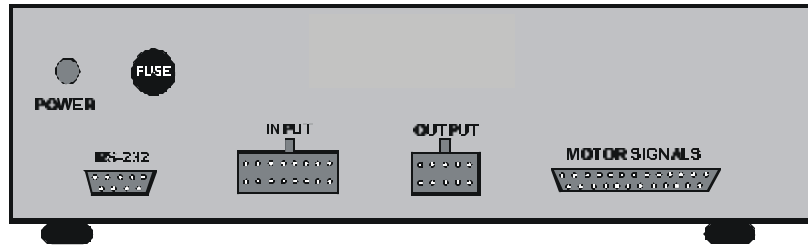
TXD - Turns yellow when transmitting data to the host PC.

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 Torchmate, 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 level 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 normally closed (NC) switches. 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. You can use normally open (NO) switches, however the red Limit light will always be on. Note that all 8 input lines must be normally open, or all 8 input lines must be normally closed. If you are not using the input lines, the Limit light will always be illuminated.

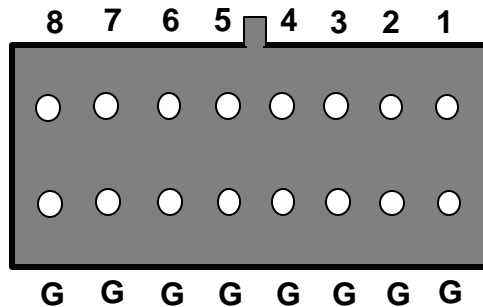
If you are using normally closed switches, make sure the Signal Generator Model 401A option is selected in the System Options Setup dialog box. If you are using normally open switches, make sure the Signal Generator Model 401 option is selected in the System Options dialog box. All input lines must be properly defined in the Input Lines Setup dialog box.

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

Limit 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 a servo position error signal, back to the Signal Generator. Note that if the signal 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). The input lines as seen from the back of the box are arranged as follows:



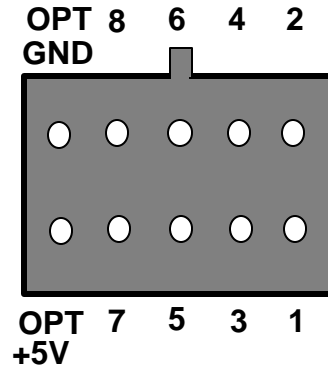
OUTPUT - The connector for up to 8 output lines. These lines are all optically isolated, TTL level outputs. Low is 0V and high is +5V.

Two input pins are provided for optical ground and optical +5V. You must connect these pins to ground and +5V from an external power supply for the output signals to operate. Note that these pins are internally connected to the optical ground and optical +5V pins on the Motor Signal connector. Therefore, if you are connecting a power supply to the optical ground and optical +5V pins on the Motor Signal connector, do not connect an external power supply here.

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. **If you are using an external supply, the output lines will go high if the Signal Generator is turned off and the external power supply is still on. THIS WILL CAUSE ANY DEVICE CONNECTED TO THE OUTPUT LINES TO TURN ON.**

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). 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 Torchmate 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.

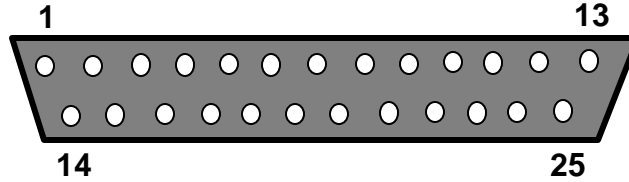
The motor signal lines are all optically isolated, TTL level outputs.

Two input pins are provided for optical ground and optical +5V. You must connect these pins to ground and +5V from an external power supply or the internal power supply for the output signals to operate. Note that these pins are internally connected to the optical ground and optical +5V pins on the 10-pin Output connector. Therefore, if you are connecting an external power supply to the optical ground and optical +5V pins on the 10-pin Output connector, do not connect an external power supply here.

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

Two pins are directly connected to ground and +5V from the internal power supply. These are provided for convenience as a source for the optical ground and optical +5V if there is no external power source available. Using the internal supply to power the optical isolators will negate most of the isolation provided by the optical isolators. To use the internal supply, directly connect Motor Signal connector pin 24 to 25 and pin 22 to 23.

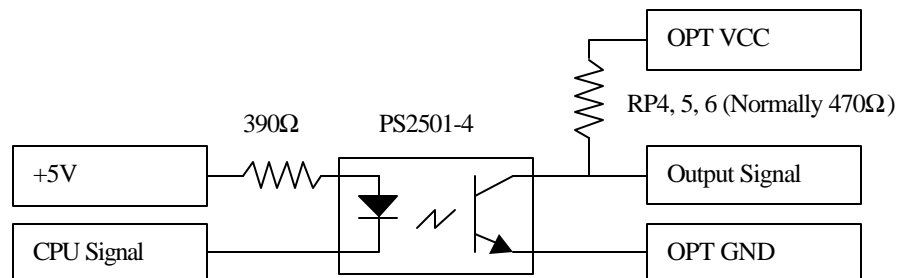
The motor signal lines as seen from the back of the box are arranged as follows:



DB25 Pin	Signal	DB25 Pin	Signal
1	NC	14	ENABLE ALL
2	NC	15	A PARK
3	NC	16	Z PARK
4	NC	17	Y PARK
5	INPUT 5	18	X PARK
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		

Output Signal Schematic

The output signals are all optically isolated using a series of PS2501-4 optical couplers. The strength of the output signal can be controlled by changing the value of resistors RP4, RP5 and RP6. These resistors come shipped as 470Ω. In some applications, it is best to remove the resistor altogether. Please consult the user's manual for your stepper motor drive or any other output device for the strength of this signal. The end of this manual contains some sample wiring diagrams for different types of drives. Below is a schematic for the typical output signal:

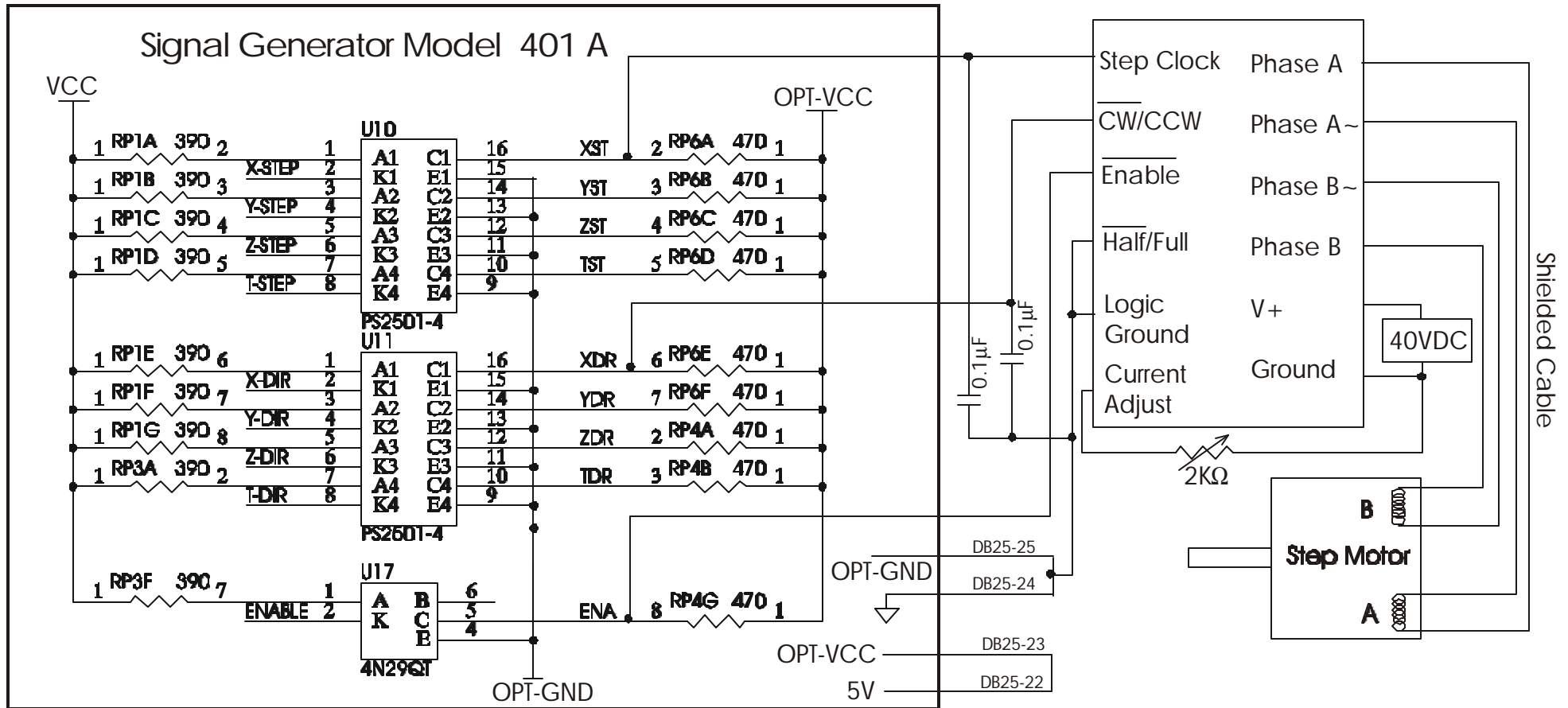


Turning off the Controller

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

Section 3. Sample Wiring Diagrams

Typical Motor Signal Circuit



The above schematic shows a typical connection of a motor driver to the motor signals of the Signal Generator.

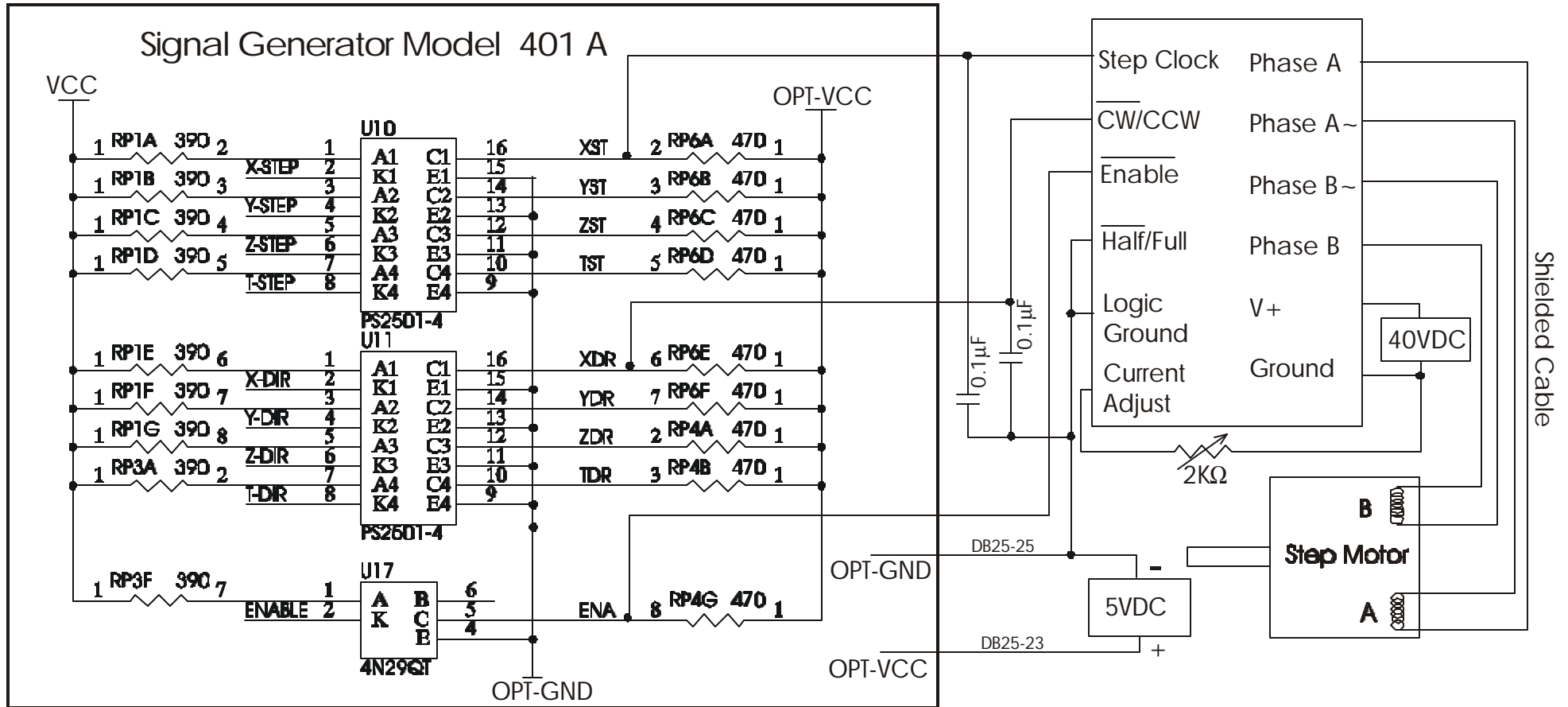
Since the Motor Signal lines are run off the optical couplers (PS2501-4) there must be an optical power source. In this example we have bridged the optical power source with the internal power source of the Signal Generator by connecting lines 22 to 23 and 24 to 25 of the DB25 Motor Signal connector.

Alternatively, we could have connected an external 5V power supply to pins 23 and 25 of the DB25 or the OPT GND and OPT +5V pins of the Output connector. Note that if an external power supply is used, the load on any output signal will get powered on if the Signal Generator is turned off while the external 5V power supply is still on.

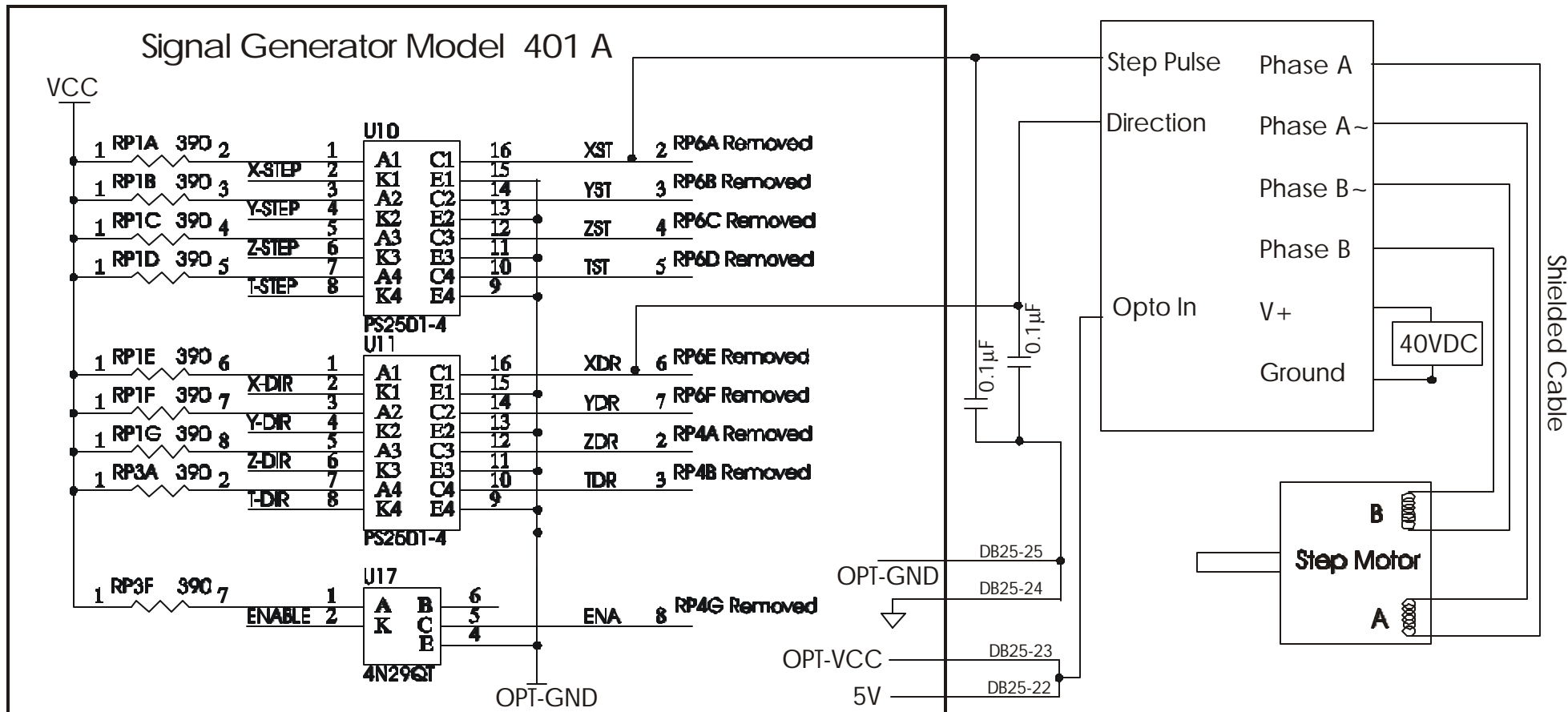
Also note that RP4 and RP6 are socketed 470 ohm pull-up resistors. These resistors can be changed or removed depending on current requirements for the input signal of the motor driver. The resistor is an 8 pin 7 resistor package. For the Torchmate Servo Drive, this resistor value should be 4.7Kohm

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's better to place these capacitors on the drive unit rather than the Signal Generator.

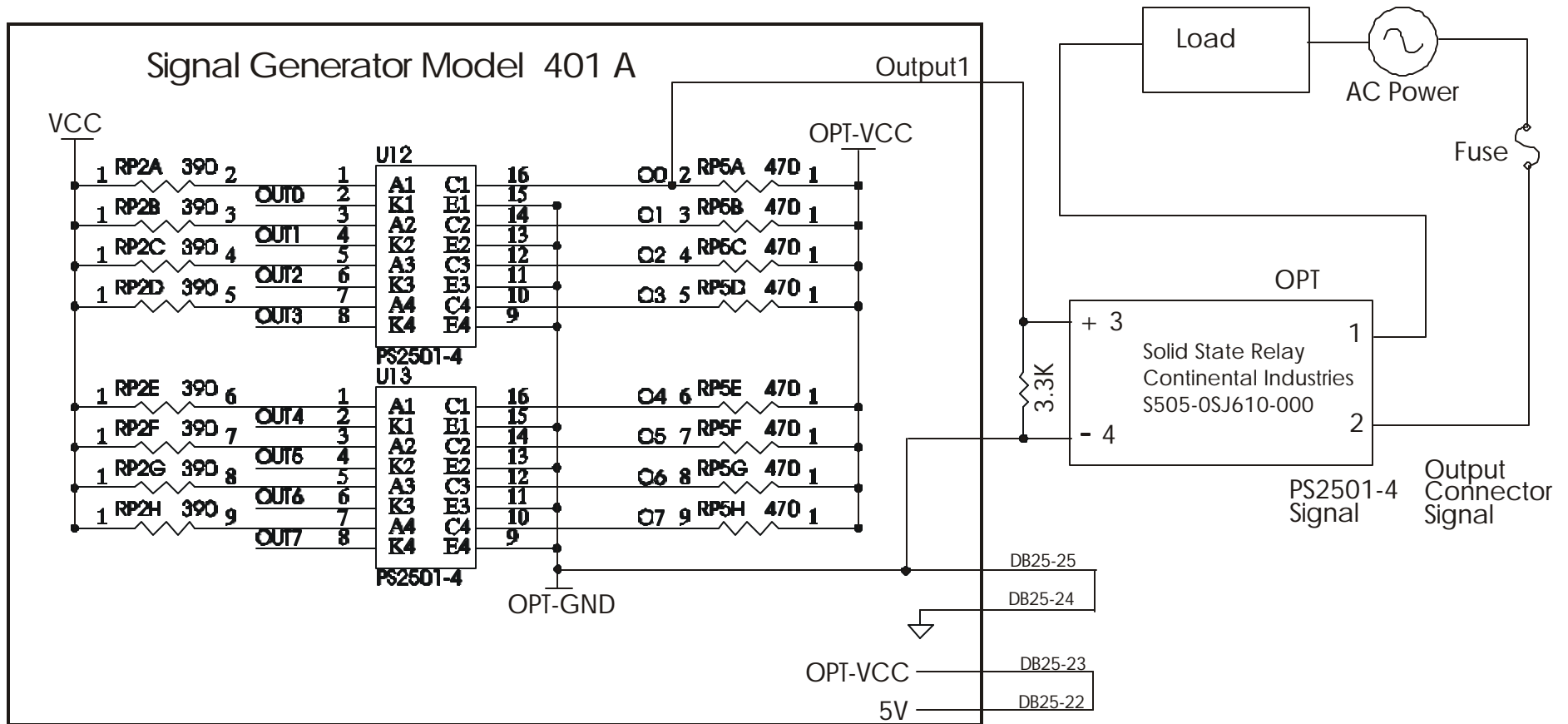
Typical Motor Signal Circuit With an External 5V Power Supply



Typical Motor Signal Circuit Without Pull-up Resistors



Typical Output Line Circuit



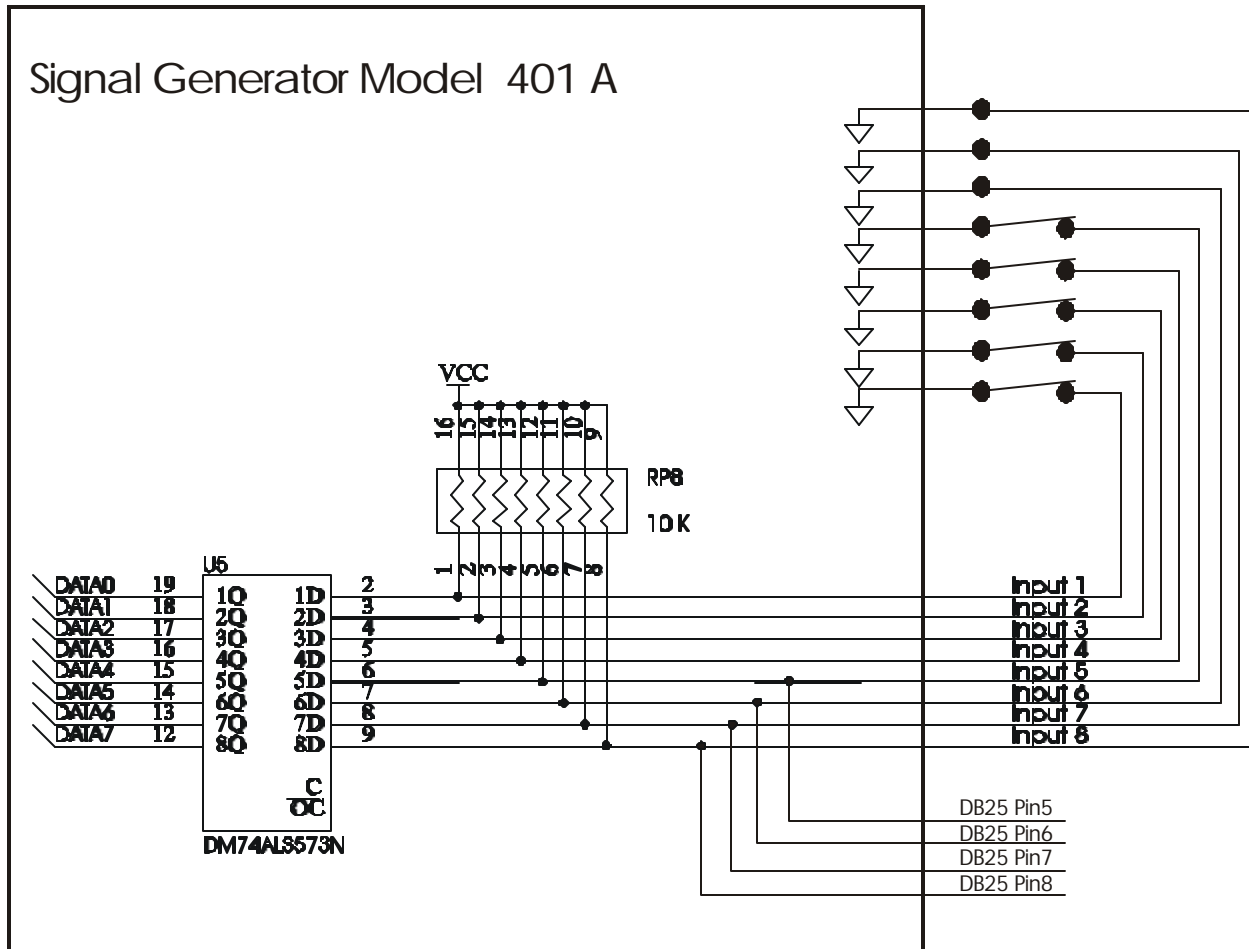
The above schematic shows a typical connection of one solid state relay controlled by output line 1 of the Signal Generator. A typical load would be a plasma torch, spindle, a vacuum, a laser, etc. In this example, the solid state relay used is a Continental Industries model S505-0SJ610-000. It takes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

Since the Output lines are run off the optical couplers (PS2501-4) there must be an optical power source. In this example we have bridged the optical power source with the internal power source of the Signal Generator by connecting lines 22 to 23 and 24 to 25 of the DB25 Motor Signal connector.

Alternatively, we could have connected an external 5V power supply to pins 23 and 25 of the DB25 or the OPT GND and OPT +5V pins of the output connector. Note that if an external power supply is used, the Load might get powered on if the Signal Generator is turned off while the external 5V power supply is still on.

Also note that RP5 is a socketed 470 ohm pull-up resistor. This resistor value can be changed or removed depending on current requirements for the input signal of the device you are switching. The resistor is an 8 pin 7 resistor package.

Typical Input Line Circuit

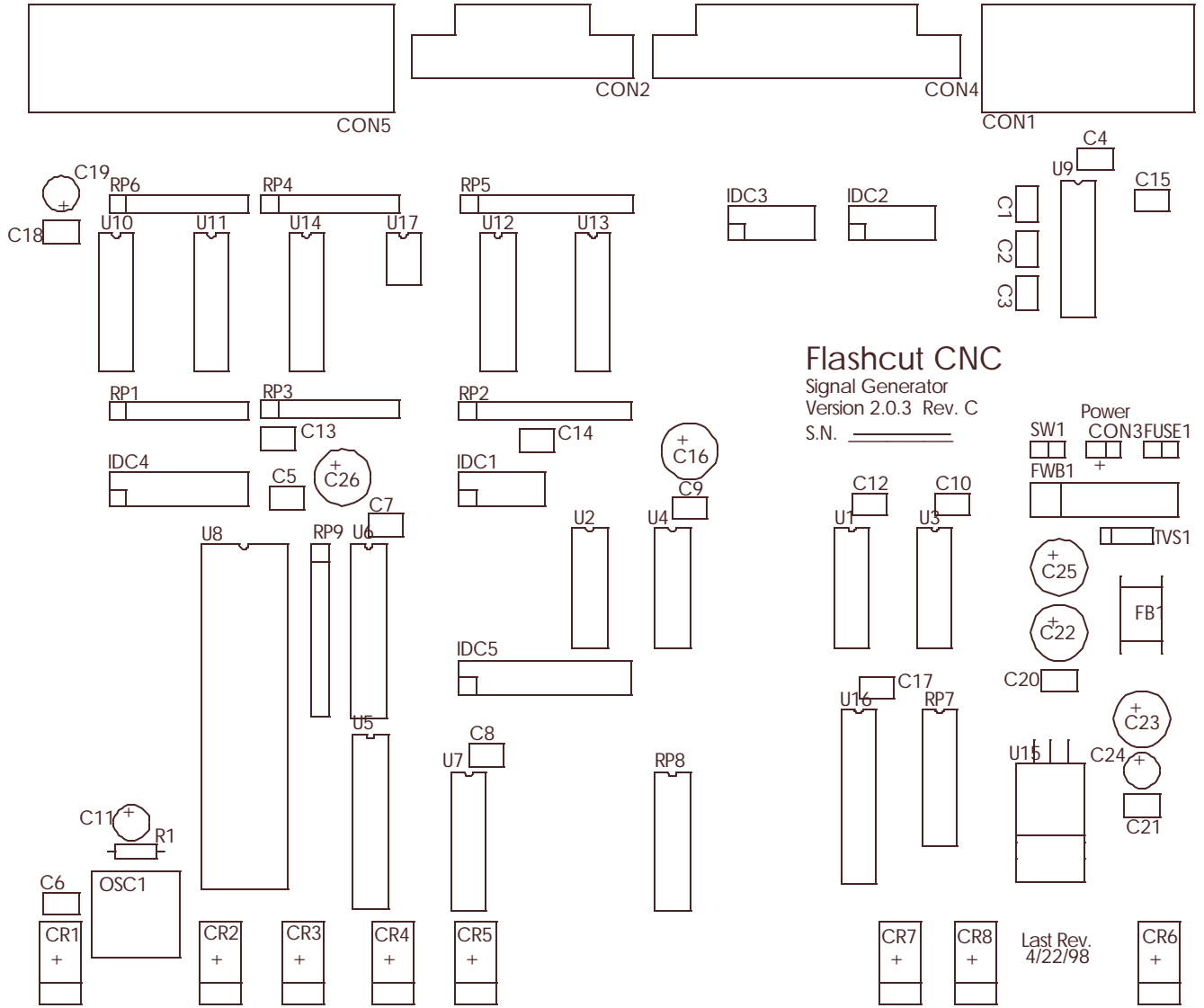


The above schematic shows a typical connection of 5 normally closed switches. These switches are connected between input lines 1-5 and ground. Lines 6-8 connected directly to ground with jumper wires. All external connections shown are made through the Input connector on the back of the Signal Generator.

Input lines 5, 6, 7 & 8 are internally connected to pins 5, 6, 7, & 8 respectively of the DB25 Motor Signal connector.

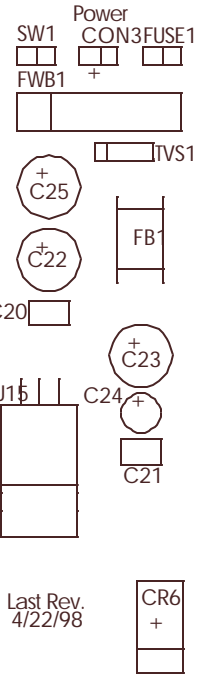
Note that this is the same connections made by the Torchmate limit switch kit.

Signal Generator Board Layout



Flashcut CNC

Signal Generator
Version 2.0.3 Rev. C
S.N. _____



Last Rev.
4/22/98

I/O Connector Schematic

