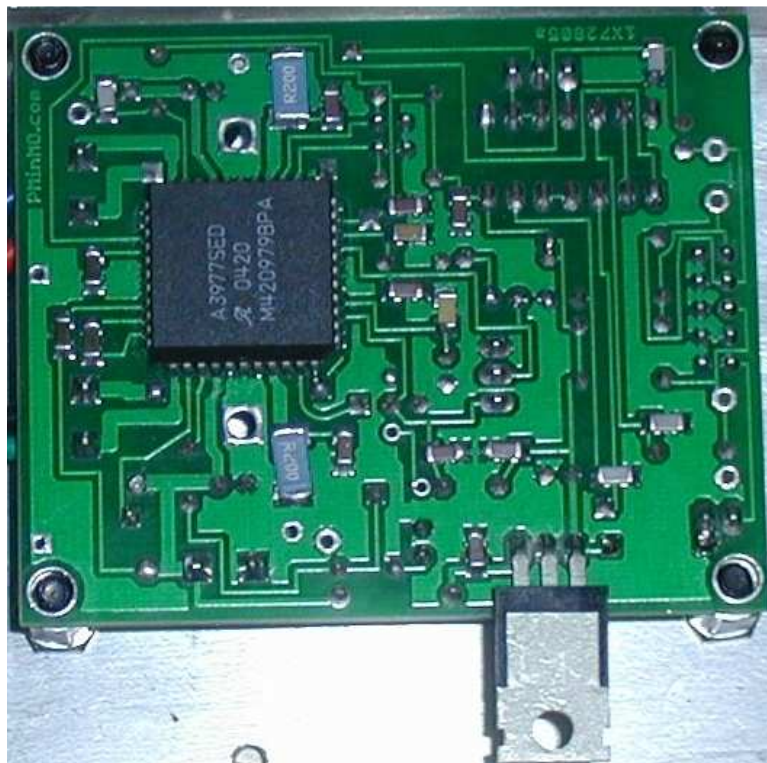
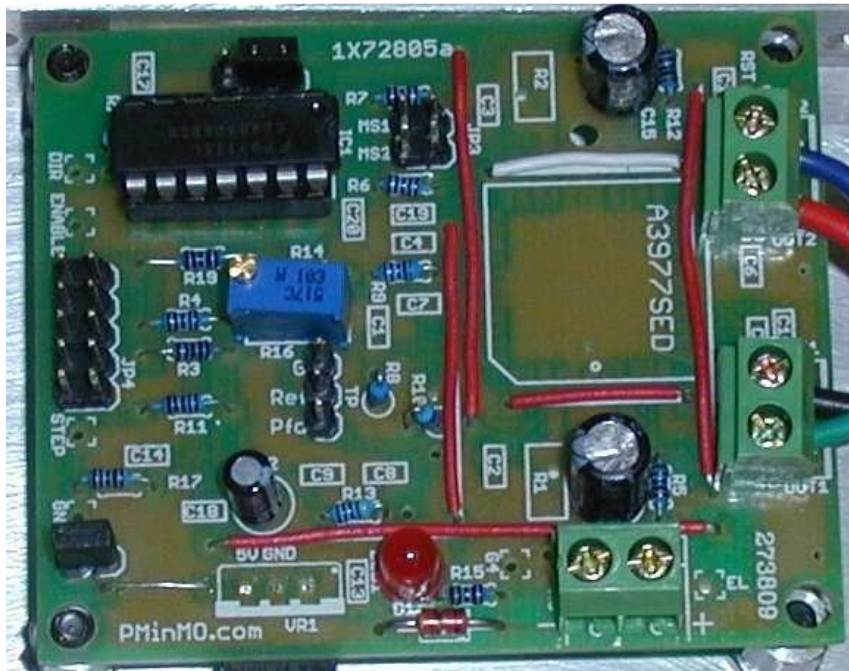


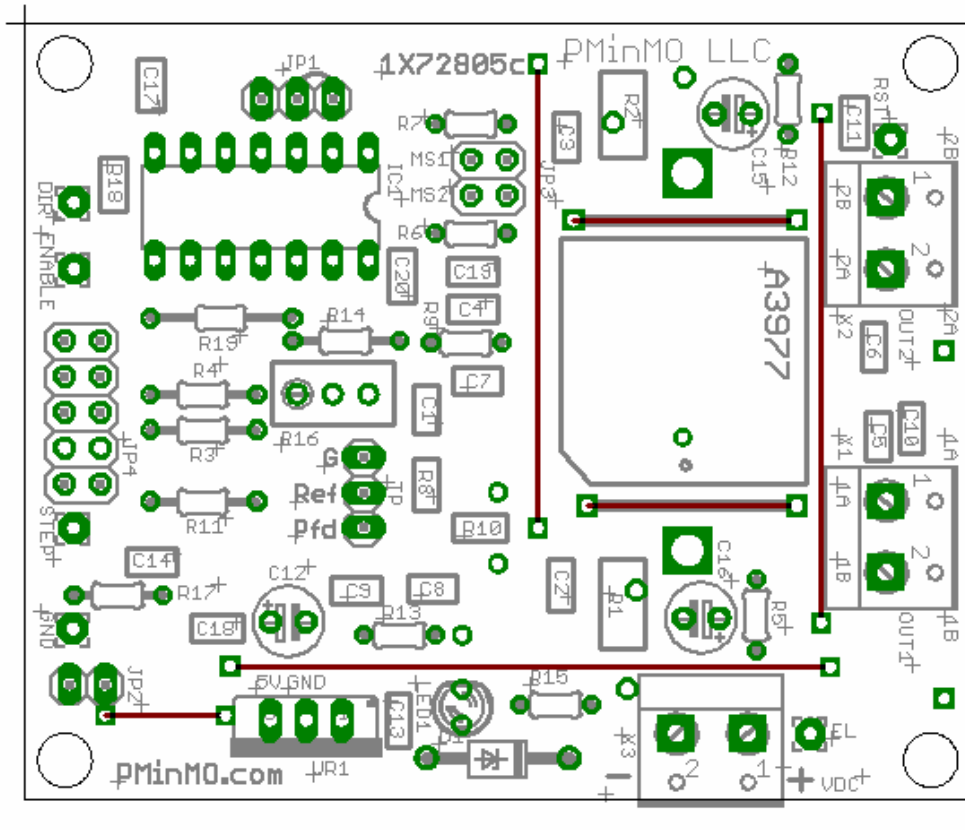


1X72805c Stepper Motor Driver



1X72805c Single Sided A3977SED Controller Board Data

8/6/07



Some Words of Caution

Never remove a connection to the stepper motor with power applied, there is a HIGH probability you will damage your 3977 IC if you do. The 3977 is rated for 35VDC max. You should limit your power supply voltage to allow for back emf generated by the stepper. Different motors will have different characteristics, safe is 24V, to extend the voltage above utilize a simple shunt regulator to protect the 3977's. Take the necessary safety precautions when utilizing any electrical and electronic circuits and motors. Be Safe!

Regarding mounting the 3977, if you can solder an electronic component to a pcb, you can do the 3977SED. **A fine point tip on your soldering iron is a must, no more than 25 watts.** Do not over heat a pin when soldering. Flux the pads with some rosin flux or a rosin flux pin helps. I have a little made up device that is basically a spring wire on a 12" square board than hold's the chip to the board. **Make sure your orientation is correct for pin one, and align them perfectly.** With fine solder in hand, place the tip of the iron at the junction of the pin and the board, so both receive the heat of the iron. Place the end of the fine solder at that junction and it should suck the solder in to fill the gap, remove the iron as soon as it does. (A second or two at the most) It doesn't take much. Solder a corner pin, then an opposite corner pin. Double check the alignment and that the part is flush to the board. Then solder the remaining pins but not the three center ground pins on each side. The ground pins take more heat and longer, especially the first one, because there is a lot of copper pulling the heat from the iron. A 12W pencil iron won't solder the ground pins in fact. **OR** If you not sure of your soldering technique, do the center ground pins on each side first. The ground pins will tolerate overheating better than signal pins. On each side of the 3977 the center 3 pins are all ground. So, if you splash solder on the center pin, if its to an adjacent ground pin, there should not be a problem.



Build Sequence

Install all jumper wires shown in red on the layout above, using insulated wire. Install D1 or jumper wire depending on power supply voltage. Install C13, C12, C9, C20, R15, LED1, VR1 and connector X3. Observe the orientation of the LED per the above layout. Apply power greater than 18VDC and no greater than 26 VDC to X3. LED1 should illuminate and you should measure 5VDC + or - .25VDC on the output of IC2 to ground. Install the remainder of the components with the exception of IC1 (74HC14N) and U1 (3977SED). Install a 14 pin DIP socket for IC1.

Troubleshooting

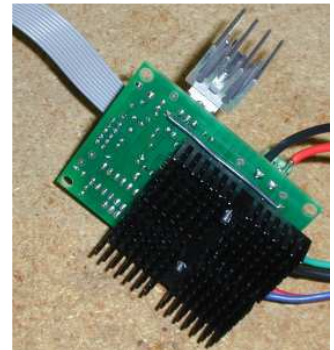
Without the 3977 soldered on and IC1 not installed:

1. Power up the board and with a DC Voltmeter with the negative lead connected to board ground, measure 5vdc at:
 - a) IC1 (74HC14) Pins 14, 13,1 and 5. U1 (3977) pin 16
2. Measure the V+ (power supply) at U1 pins 43 and 25.
3. Power down, install IC1, power back up.
4. Run the 74HC14 (IC1) through hi (Greater Than 4vdc) and low (Less Than .7vdc) states by:
 - a) IC1 pins 13, 5, and 1 should be hi, IC1 pins 2,3,6,9,12 and 11 should be low, and IC1 pins 10, 4 and 8 should be hi (GT 4vdc). Also the pads for the 3977 pins 41 and 31 should be high.
 - b). Leaving power on, jumper pad ENABLE to ground, 3977 pin 41 should now be low
 - c) Move the jumper pad Step to ground, 3977 pin 31 should go low when the step pad is grounded and should go hi when you remove the jumper.

Now you may install U1 and the 3977. (Make sure you've disconnected the board from the power source) and the orientation is correct. Remember it is on the backside of the board to the other components with exception to the two .2 ohm current sense resistors.

Heatsink

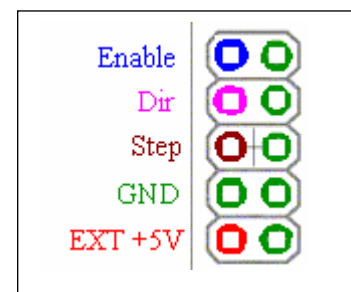
The 3977 part dissipates heat via the power ground pins which are the center 3 pins on each side. Adjacent to pins 1 and 22 of the 3977 are .090 drills which can be utilized to thermally connect to a heat sink. A heat sink is recommended for currents greater than 1 amp. The picture is using an old Intel 486 heatsink. Open air at 2.5A it gets quite warm. At higher currents, cooling fan should be used.



JP4 Inputs

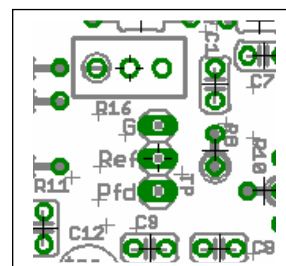
JP4 is a 10 pin IDC connector for easy hookup to the 4 axis interface board. The signal definition is below. Same orientation as the board layout above.

The outputs are enabled by a low logic signal (less than .7vdc) on the Enable pin. A second option of connection to the board is leaving JP4 off and installing a 6 pin polarized connector (.1 inch spacing). A third option is to discretely wire to the step, dir, enable and GND pads.



Jumper TP

TP is 3 test points to facilitate voltage measurements for REF and PFD. Utilize the G (GND) pin of TP when making measurements.



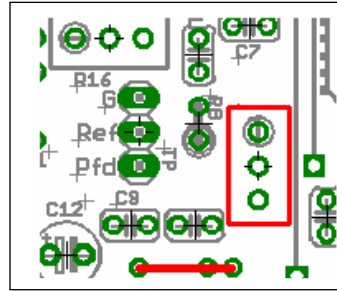
Setting Current Limit

Measuring the DC voltage between the REF Pin and GND Pin of TP. Adjust R16 as follows:

$V_{ref} = 1.6 * \text{Max motor current}$. i.e. .5A max = .8V, 1A max = 1.6V , 1.7A max =2.72V, 2.5A max = 4V.

PFD

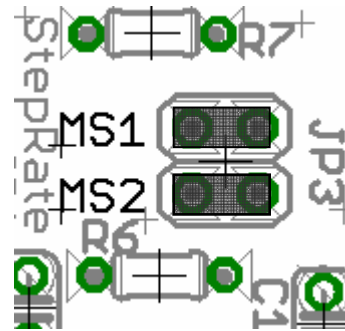
PFD is set by R10 and R13 and using the components listed in the Parts table will set it a 2.5V. It is also possible to make PFD adjustable by installing a 10K trim pot the same p/n as R16 as depicted:



Jumpers for Micro-Stepping JP3

Table 1. Microstep Resolution Truth Table

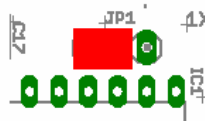
MS ₁	MS ₂	Resolution
L	L	Full step (2 phase)
H	L	Half step
L	H	Quarter step
H	H	Eighth step



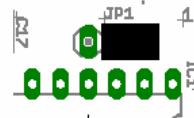
Jumper in = L, jumper out = H i.e. for full steps both MS1 and MS2 need to be installed.

Jumper JP1

JP1 is used to reverse motor direction if the software used does not have the capability to set jumper direction. JP1 must have a jumper from the center post to an adjacent post.



OR



Using the board

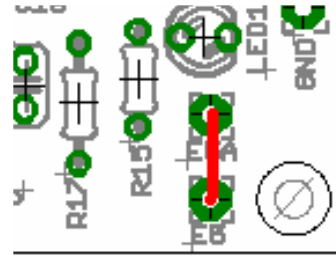
The board was designed with a high noise immunity environment in mind. Switching heavy currents and inductive loads are prone to noise. The A3977 driver chip is a chopper, in that it turns the outputs of the driving bridge on and off tens of thousands of times a second. The opportunity for electrical noise is a concern. For that very reason, IC1 is utilized to provide excellent noise rejection. There are two options for IC1. Either a 40106 or 74HC14 Schmitt Trigger Inverter can be installed. The 40106 is older slower technology is preferred for the best noise immunity, but can't be relied to be driven directly by a PC's parallel port. If driving from a PC parallel port with no active conditioning logic, a 74HC14 must be used.

Software Setup

The step signal has a simple RC filter on it, as do the direction and enable signals. **Minimum pulse width for the step pulse is 5us. Maximum step frequency is 40khz.** Most steppers torque really drop above 1khz at full step, or 8khz if your using the 1/8th step mode.

5VDC Output

Utilizing a wire jumper next to JP2 with JP2 installed will feed the driver boards 5VDC to pin 9 of JP4. This is used to power the 4 axis interface board as well as to provide 5V for to maintain true isolation for an opto isolated interface board.



Parts

1 Row 40 Pins, enough to do 5 3977 boards

2 Row 50 Pins, takes qty 2 to do 4 3977 boards and 1

Qty	Device	Value	Parts	mouser.com	Unit price	digkey.com	Unit price
1	LED3mm	n/a	LED1	696-ssl-k3044it	\$0.15	67-1069-ND	\$0.12
1	PINHD-1x3	n/a	JP1, TP	517-6211TG	\$0.81	WV6424-ND ***	\$1.16
1	PINHD-2x5	n/a	JP4	517-2350-6121TG	\$1.25	***	\$0.00
1	R-TRIMM3296VW	10K	R16	652-3296W-1-103	\$2.20	CT94W103-ND	\$1.68
8	50V 1206SMD	0.1uf	C2, C3, C7, C8, C9, C13, C19, C20	80-C1206C104K5R	\$0.08	490-1775-1-ND	\$0.17
2	2 Watt	0.2Ω	R1, R2	66-LR2512-01-R200-F	\$0.60	13FR200E-ND	\$1.55
3	50V 1206SMD	0.22uf	C5, C6, C10	80-C1206C224K5R	\$0.25	490-1776-1-ND	\$0.31
6	1/8 Watt	1kΩ	R3, R5, R6, R7, R12, R19	299-1K	\$0.08	1.0KQBK-ND	\$0.05
1	1/8 Watt	2.2kΩ	R14	299-2.2K	\$0.08	2.2KQBK-ND	\$0.05
1	1/8 Watt	4.7kΩ	R13	299-4.7K	\$0.08	4.7KQBK-ND	\$0.05
3	1/8 Watt	10kΩ	R4, R11, R17	299-10K-RC	\$0.08	10KQBK-ND	\$0.05
1	16 VDC	10uf	C12	647-UVR1V100MDA1TC	\$0.04	490-1775-1-ND	\$0.17
1	1/8 Watt	51KΩ	R9	299-51K	\$0.08	51KQBK-ND	\$0.05
1	74HC14	14 PIN DIP	IC1	512-MM74HC14N	\$0.31	MM74HC14N-ND	\$0.51
2	35 VDC	100uf	C15, C16	647-UVR1V101MEA	\$0.26	P5165-ND	\$0.02
1	1/8 Watt	390Ω	R15	299-390-RC	\$0.08	390QBK-ND	\$0.05
4	50V 1206SMD	220pf	C11, C14, C17, C18	526-SMC1206J221	\$0.14	478-1484-1-ND	\$0.52
2	50V 1206SMD	1000pf	C1, C4	80-C1206C102K5R	\$0.09	490-3348-1-ND	\$0.31
1	7805	TO220	VR1	512-LM7805CT	\$0.42	296-1974-5-ND	\$0.81
1	A3977KED	44 pin	U1	n/a		620-1144-1-ND	\$6.14
3	W237-02P	OUT1	X1, X2, X3	651-1729128	\$0.73	281-1435-ND	\$0.66
1	1N4740	Zener Diode **		512-1N4740A	\$0.09	1N4740ADO41MSCT-ND	\$0.25
1	PINHD-2x2	n/a	JP3	***		***	\$0.00
1	1206 SMD	4.7kΩ	R10*	660-RK73B2BTTD472J	\$0.05	311-4.7KERCT-ND	\$0.08
1	1206 SMD	10kΩ	R18*	290-10K-RC	\$0.05	311-10KECT-ND	\$0.08
1	1206 SMD	51KΩ	R8*	263-51K-RC	\$0.05	311-51.0KFRCT-ND	\$0.08

* R8, R10, R18 are 1206 smd resistors on the C version

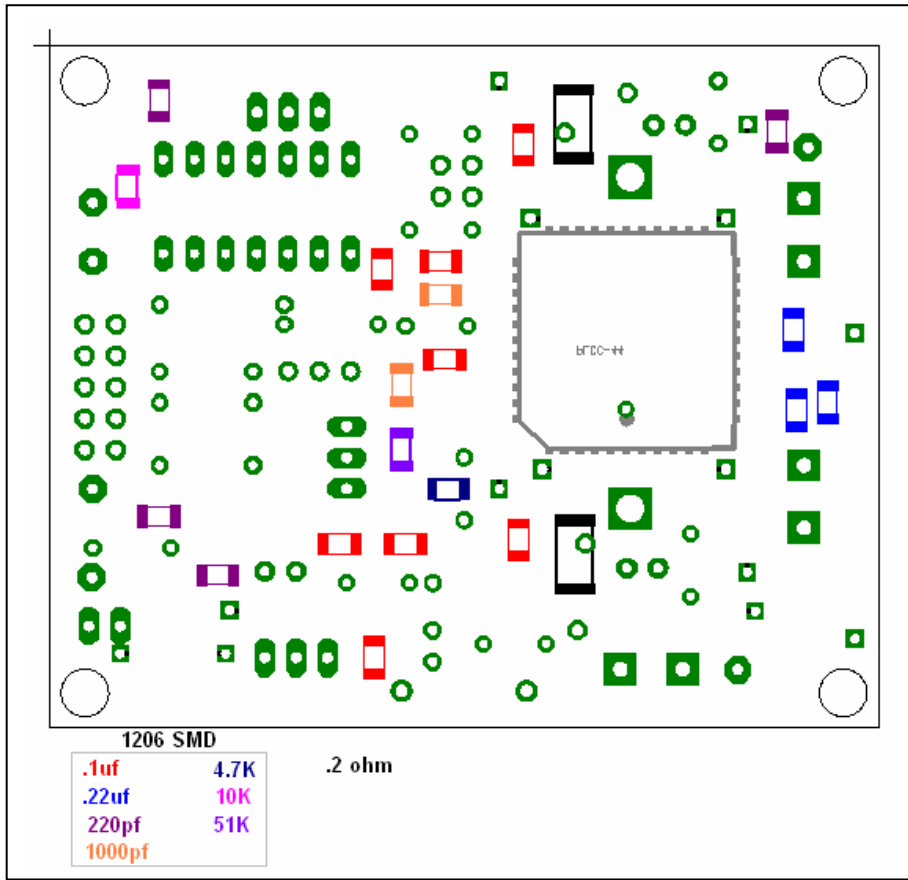
*** These strip breakoff headers, quatites reflect enough to do (4) 3977 plus one 4 axis interface

** If using a power supply of 18V or lower install a jumper wire in place of 1N4740

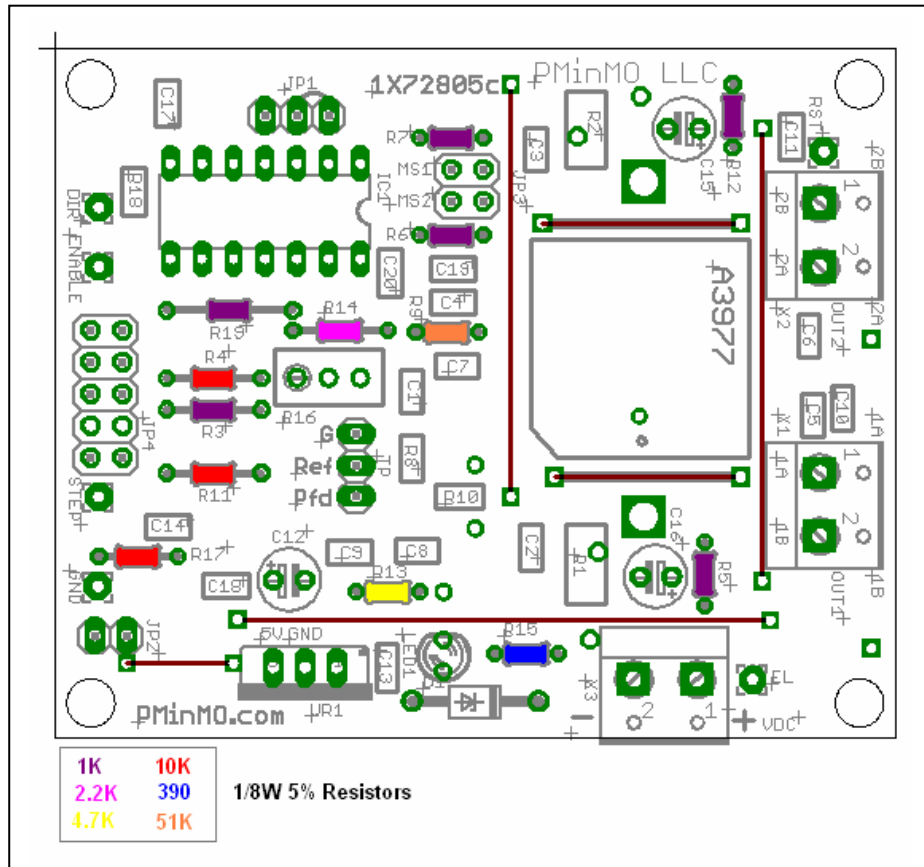
Prices as of 2006-02-18 Watch for a few parts with a minimum order qty.

Build AID

Bottom View



Top View



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