

$$V_{REF} = 2.05V \quad (4.1 \text{ Amps})$$

5A CHOPPER DRIVER

ASSEMBLY INSTRUCTION MANUAL

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SPECIFICATIONS:

LOGIC VOLTAGE +5VDC MAX

MOTOR SUPPLY +36VDC MAX

BIPOLAR OUTPUT

CHOPPER Frequency ~20 KHZ

HALF STEP /FULL STEP MODES

AUTO CURRENT REDUCTION

ALL WINDING OFF

1 -5AMP OUTPUT PER PHASE WITH TWO PHASE ON

BOARD SIZE 3.4X4

INDEPENDENT or MULTI AXIS

Congratulations on the purchase of a great low cost, high performance driver. Camtronics INC has decided to make these boards/kits available due to the very high costs of commercial stepper motor drivers. We have Alan Rosenbush to thank for working with us to bring this driver to the average home shop machinist.

At Camtronics we have built several versions of these drivers. All have worked very well. This should be a great stepper motor driver for most mill/drills, three in one machines and smaller full size milling machines and lathes. It should run any 4,6, or 8 wire stepper motor with a current rating of 6 amps or less beautifully. The performance you achieve may vary due to the stepper motors that you use. Select low voltage motors for best performance. Remember that the higher the voltage rating of the motor the slower it runs. You also want to use a power supply that will provide 18VDC-36VDC at 15 amps. We are running ours on 36VDC.

DISCLAIMER

The purchaser agrees that this product is provided without any warranty. The instruction have been reviewed and checked for accuracy but errors may exist. The builder agrees to assume all risks with the assembly, testing and use of this product. Resellers should thoroughly test this product before making commitments. Camtronics Inc does not warrant the design for any specific application. Resellers agree to accept this condition of sale.

Computer Controlled equipment can cause serious injury.

Inadvertent or uncontrolled operation may take place at any time. **USE THIS PRODUCT AT YOUR OWN RISK** and pass this instruction onto subsequent users.

General Information.

Read the entire assembly instructions before proceeding with assembly.

Note the following changes.

An error was made when C9 was added. There is a short circuit between the pad that goes from Vm to GND. All boards should have been modified by removing the top part of the pad next to the letter "C" in C9. Verify that your board was modified.

Note that extra holes have been provided for the following components; R23, R37, C2 to accommodate different size components.

ALL COMPONENTS ARE MOUNTED ON THE TOP OF THE BOARD and soldered on the bottom.

The CID marking for C-2 has been lost. C-2 is installed and soldered to pins 4 and 5 of U1 (note an extra hole was provided for different size parts.

Diodes D1-D8 are NOT USED. Solder the pads to fill the holes.

Use a good 25-35 watt soldering iron and 60/40 solder

All 1/4 watt resistors should be bent to .4 lead spacing using a component bending guide.

The term CID means component Identification that is silk screened onto the board.

Mosfets are very static sensitive. Do not touch the leads while installing. Use proper anti static precautions when handling. Notice the parts layout is fairly symmetrical. The thinnest components are installed first followed by increasing thickness components.

- ✓ 1. Install C1, (4700pf)(marked 472), C4(1000pf) and C5 (1000pf)(marked 102) axial capacitors at the locations shown . Solder in place avoiding excessive heat.
- ✓ 2. Bend the leads of 8 resistors (R11, R12, R15, R16, R25, R26, R29, R30) with the value 470 ohms (yellow, violet, brown) for a lead spacing of .4 inches. Install them at the locations shown on the illustration CID layer. Solder all connections and trim leads.
- ✓ 3. Bend the leads of 8 resistors with the value 390 ohms (orange, white ,brown) (R13, R14, R17, R18, R27, R28, R31, R32) for a lead spacing of .4 inches. Install them at the locations shown on the illustration CID layer. Solder all connections and trim leads.
- ✓ 4. Bend the leads of 2 resistors with the value 10K ohms (brown, black, orange) (for a lead spacing of .4 inches. Install them at the locations R3, R6 shown on the illustration/CID layer. Solder all connections and trim leads.
- ✓ 5. Bend the leads of resistors with the value 3.9K (orange, white, ~~orange~~ ^{Red})(R2, R5) ohms for a lead spacing of .4 inches. Install them at the locations shown on the illustration/CID layer. Solder all connections and trim leads.
- ✓ 6. Bend the leads of 2 resistors with the value 1K (brown, black, red) (R21, R35) ohms for a lead spacing .4 inches. Install them at the locations shown on the illustration/CID layer. Solder all connections and trim leads.

- ✓ 7. Bend the leads of 2 resistors with the value .05 ohms (R23, R37) for a lead spacing of .7 inches. Install them at the locations shown on the illustration/CID layer. Solder all connections and trim leads.
- ✓ 8. Bend the leads of 1 resistor with the value 12K(brown, red, orange) ohms for a lead spacing of .4 inches. Install at location R10 shown on the illustration/CID layer. Solder all connections and trim leads.
- ✓ 9. Insert and solder the sockets for U1 (18 pins) and U4 (24 pins).
- ✓ 10. Insert and solder the ceramic resonator (X1) (Note there is no polarity to this part).
- ✓ 11. Insert and solder R1 (1K) resistor networked (bussed) making sure the dot/line is placed over the square pad.
- ✓ 12. Insert and solder J1 and J2 noting that the ramp on J2 is by the heavy line on the CID
- ✓ 13. Install and solder C2 (1 UF .1 or .2 spacing). See note above about missing label. ~~Make sure the +go the tantalum cap goes to pin 4 of U1~~
- ✓ 14. Install and solder C9 (.1 UF.2 spacing) making sure the pad was modified. After soldering verify with a VOM that there is an open circuit across C9.
- ✓ 15. Install and solder C8 (.1uf)
- ✓ 16. Install and solder Q10 and Q11 orienting the flats on the case with the flat side of the outline on the CID layer.
- ✓ 17. Install and solder C7 making sure the - on the side of the case aligns with the ground trace.
- ✓ 18. Install and solder J6 with the holes for the wires facing outward.
- ✓ 19. Install and solder the two trim pots R38 and R39.
- 20. Install and solder Q1, Q2, Q5, Q6 IRF9Z34 .It will be necessary to spread the leads to line up with the offset pads.
- 21. Install and solder Q3, Q4, Q7, Q8 IRFZ34. It will be necessary to spread the leads to line up with the offset pads.
- 22. Install and solder J4 and J5. Note the orientation of the ramp on J4
- 23. Install and solder C3 and C6 making sure the - is lined up with the ground trace.
- 24. Inspect with a 10 X magnifying lenses upon completion of soldering all components. Verify that all connections are soldered and there are no bridges.
- 25. The heat sinks (not included in kit) will be added after the preliminary testing is completed.

Testing.

Overview

We will check to make sure there are no short circuits between the +5 lines and ground. Similarly, we check the lines on the Vmotor (18-36VDC) to ground for shorts. Next we will adjust the reference voltage to set the preliminary current of the drivers. Then we'll check to make sure that each axis is switching the voltage on each phase line from a full +VDC to a full minus -VDC or what ever the power supply output is then back again. For example if you are using a 28VDC power supply the swing will be from ~ +27.9VDC to ~-27.9VDC. Last we'll adjust for full current.

Do not connect the stepper motors or the driver to a PC at this time.

Inspect each joint one last time.

- ✓ Place a shorting jumper on J1 for the full step mode.
- ✓ Insert the IC's into their appropriate sockets observing the proper orientation. You will have to bend the leads slightly to align with the sockets.
- ✓ Using a good VOM check between the +5 VDC terminal and ground reads open. If you read continuity check for solder bridges or incorrect component.
- ✓ Using a VOM check +Vmotor to ground. Ensure an open circuit.

Do not apply any power until these check are made and are satisfactory.

Connect a +5 source to the +5 terminal on J6. Connect the 5V GND to the other terminal.

Turn on the +5 power supply. Measure the voltage at J2 . There should be +5 +/- .2 VDC at each pin as marked on the PC board except for the ground pin. Correct the problem if the specified voltage isn't observed.

Connect the VOM with the black lead to ground and the red lead to the Vref test point. These are located by Q9 and Q10. They are the large pad with the heavy white outline. Set the Vref for the current that you require. The formula is $\text{Current} = \text{Vref} \times .1/\text{Rsense}$. Since the value of Rsense is .05 ohms . The current will be $\text{Vref} \times .1/.05$. So if you place black lead of your VOM on one of the mounting holes and the + Red lead on the test pad and adjust R38 and R39 to the value that you want. Thus a Vref of 2.5V on the two test point will yield a output current of $2.5 \times .1/.05$ for 5.amps.

Next with the 5 Volt still connected and the VOM connected as above temporarily apply a shorting jumper from the GND to the enable pin on J2. After a few seconds the Vref voltage will drop thus proving that the reduced current mode is working.

Connect the +Vmotor lead to a good UNREGULATED power supply with rating of 18-36VDC with a current rating of 5A per axis. DO NOT TURN ON

Remember a 24V AC transformer will output 1.4 X the stated voltage thus a 24V transformer will put out about 36 VDC when rectified. The power supply should be rated for at least 15 amps and should have a 10000 UF computer Grade Capacitor. It should have a 5 amp fuse in series with each Vmotor lead.

WARNING. DO NOT TOUCH THE TABS OF THE MOSFETS. They may be electrically and physically hot. You may receive a serious shock if you touch the heatsinks with power on.

Connect the VOM to the phase A-a lines for the X-axis. It doesn't matter which lead goes to the + and which goes to the ground of the VOM. Set the voltage scale to the next higher reading than the output of the power supply. Turn on the power. Initially the meter will read zero. If everything is working correctly the voltage will rise to that of the power supply as soon as a step signal is present on the step line of the axis. You may have to pulse the step pin of J2 by using a test lead connected to the ground pin and tapping it against the step pin. Note that the enable pin must be pulled low by a test clip during this test.

Full/Half
0.0V

Disconnecting the test clip on the enable line ^{will} with shutoff the outputs to the stepper motor leads.. You will notice that the voltmeter will go from +V_{motor} to 0 to -V_{motor} VDC. IT IS ESSENTIAL THAT THIS BE OBSERVED ON EACH AXIS AND ON EACH PHASE A-a AND B-b STEPPER MOTOR CONNECTOR. Accomplish this task on each axis. If phase A-a check out but B-b does not- then trace out the circuit for that side of the stepper motor connector and correct the problem. Again the number one problem will be a bad solder joint and the second is a bad mosfet.

Shut of the power supply to the driver.

Install the heat sinks (not included in the kit) using the heat sink isolators provided with the kit. Use heat sink compound. Verify that the metal tabs are electrically isolated from the heat sinks.

Spare no amount of time to ensure the tabs are isolated. Failure to do so will cause the Mosfets to instantly burn out.

Connect the stepper motors to the stepper motor leads. Ensure correct wiring of the motors to the drivers. See the motor schematic for details.

WARNING

Remember the power supply has a big capacitor that has a lot of stored current. This can give a nasty shock if the power leads are touched.

Install the heat sinks (not included in the kit) using the heat sink isolators provided with the kit. Use heat sink compound. Verify that the metal tabs are electrically isolated from the heat sinks.

Spare no amount of time to ensure the tabs are isolated. Failure to do so will cause the Mosfets to instantly burn out.

Reconnect the power supply and turn on. Note that none of the motors will have any magnetic locks and are free to turn. As soon as a pulse is received on the step line of J2 the motor should spring to life and rotate when steps are applied to the step pin with the enable line grounded. Use a test lead between ground and the step pin to manually move the motor.

The Mosfets will start getting hot but should not show signs of overheating. Each motor should run smoothly. Correct any deficiencies. Look for bad solder joints and reflow the solder for the sense resistors (.05 ohm 2-watt) and the Mosfets if an axis seems erratic.

Accomplish this on each axis.

Final assembly.

Install good high quality heat sinks (not included in kit) on each axis. Ensure that insulator are used between the mosfet and the heat sink. Use heat sink compound on each mosfet and heat sink.

EACH MOSFET MUST BE ELECTRICALLY ISOLATED FROM THE HEAT SINK. SPARE NO AMOUNT OF TIME TO ENSURE THAT AN OPEN CIRCUIT EXISTS BETWEEN EACH MOSFET TAB AND THE HEAT SINK. FAILURE TO DO SO WILL INSTANTLY BURN OUT THE MOSFETS WHEN POWER IS APPLIED.

Install the completed unit in the enclosure on metal standoffs. Use a fan to exhaust the warm air around the Mosfets. Provide good ventilation for the Mosfets. Provide an emergency shut down power switch. Provide guards to keep chips out.

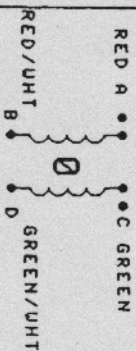
A:STEPPER7.PCB 10:27 10-2-2000 Bill of Material Detail Page : 1

DESIGNATOR	COMMENT	PATTERN
C1	4N7	AXIAL0.4
✓ C2	1UF	AXIAL0.1/.2
✓ C3,C6	220UF 50V LESR	RB.2/.4
C4,C5	1000P	AXIAL0.2
missing 2 C7, C9	47UF 25V	RB.2/.4
C8, C9	.1UF	RAD0.2
D1-D8	NOT USED	MBR10100
miss one J1	CON2	SIP2
miss all J2	CON6	SIP6
J4	CON3	AMP156-3
J5	CON4	AMP156-4
J6	CON2_BIG	
Q1,Q2,Q5,Q6	IRF9Z34	TO220-GDS-V
Q3,Q4,Q7,Q8	IRFZ34	TO220-GDS-V
Q9,Q10	2N3904	TO92-EBC
R1	1K RESISTOR NETWORK BUSSED	SIP6
R2,R5	3.9K	AXIAL0.4
R3,R6	10K	AXIAL0.4
R10	12K	AXIAL0.4
R11,12,15,16,25,26,29,30	470R	AXIAL0.4
R13,14,17,18,27,28,31,32	390R	AXIAL0.4
R21,R35	1K0	AXIAL0.4
R23,R37	.05 2 WATTS	AXIAL0.5
missing all R38 R39	1K	VR5
U1	PIC16F84 PROGRAMMED BY CAMTRONICS	DIP18
U4	PBL3776	SDIP24
X1	CERAMIC RESONATOR 4MHZ	CON3
S1	IC SOCKET	18 PIN DIP
S2	IC SOCKET	24 PIN DIP
IS	HEATSINK ISOLATOR	TO220

Comments and questions may be emailed to me at dmauch@seanet.com

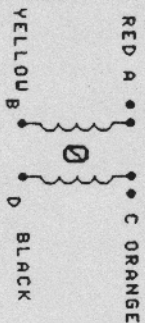
COMMON STEPPER MOTOR

ASTROSYN



BIPOLAR STEPPER

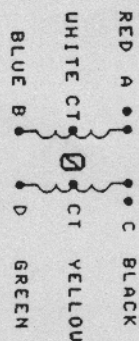
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SIGMA



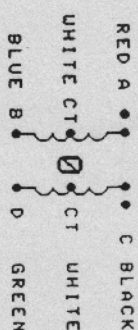
SUPERIOR ELECTRIC
APPLIED MOTION PROD
EASTERN AIR DEVICES



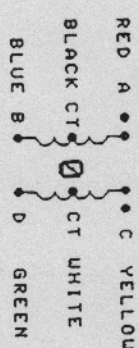
VEXTA



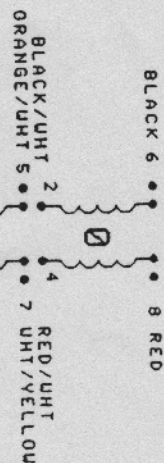
STEP-SYN



ORIENTAL MOTORS
APPLIED MOTION PROD



PACIFIC SCIENCE



ORANGE

1 3 YELLOW

ORANGE

3 2 RED

BODINE



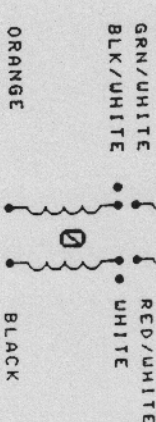
BROWN

1 4 YELLOW

GREEN

1 4 YELLOW

SUPERIOR ELEC 8 WIRE



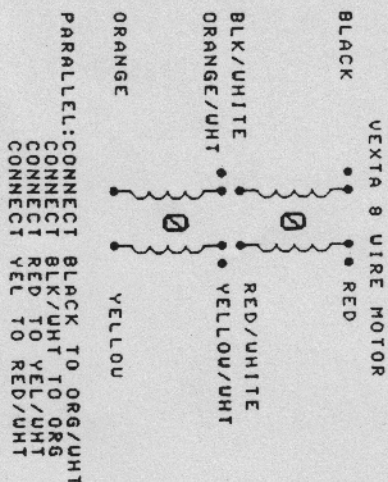
BODINE
SERIES 1 UNIPOLAR
UHT/BLK & UHT/ORG
UHT/RED & UHT/YEL

PARALLEL
BROWN AND UHT/ORG
ORANGE AND UHT/BROWN
YELLOW AND RED/WHITE
RED AND UHT/YELLOW

PACIFIC SCIENCE
PARALLEL CONNECTIONS
BLK & UHT/ORG
ORG & UHT/BLACK
RED UHT/YEL
YEL UHT/RED

CLIFTON PRECISION
PARALLEL CONNECTIONS
1 BLACK AND RED/WHITE
3 RED AND WHITE
4 GREEN AND BLK/WHITE
6 ORANGE AND GRN/WHITE

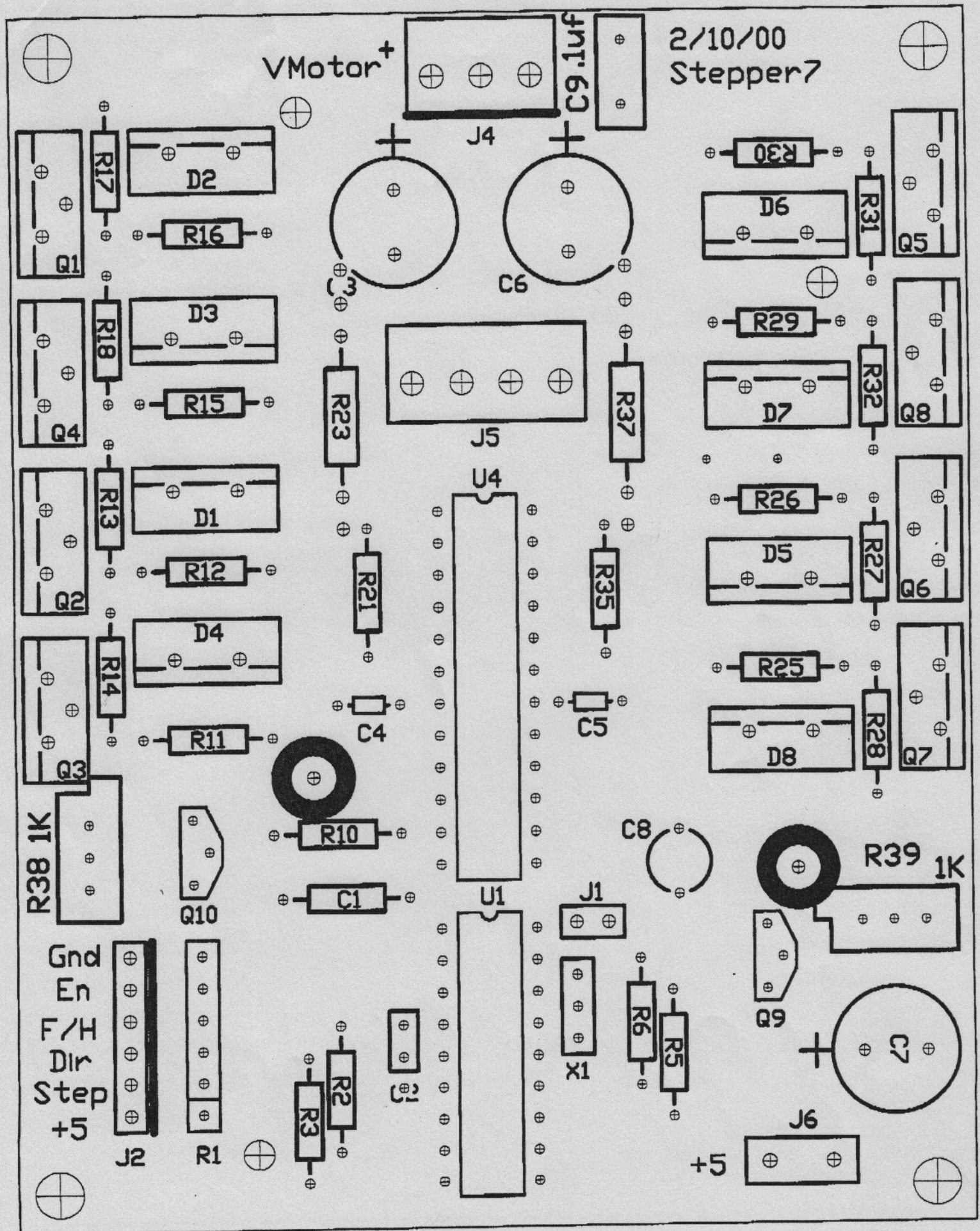
MODEL HE61FD
SPR ELCT PARALLEL
1 RED & WHITE
3 BLACK AND RED/WHITE
4 GREEN AND BLK/WHITE
6 ORANGE & GRN/WHITE

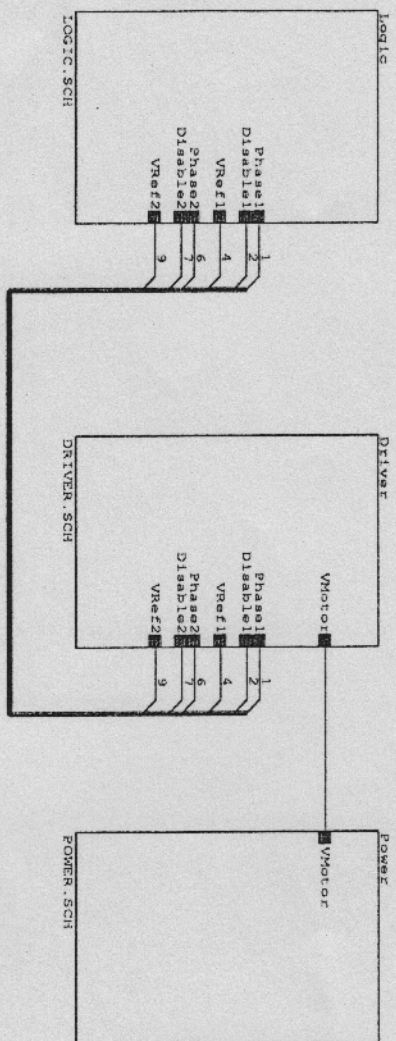


PARALLEL: CONNECT BLACK TO ORG/WHITE
CONNECT BLK/WHITE TO ORG
CONNECT RED TO YEL/WHITE
CONNECT YEL TO RED/WHITE

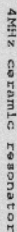
NOTE: Manufacturers have a variety of wiring color codes. Check before using.

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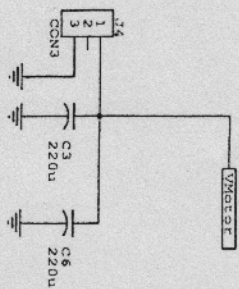




ase ELECTRONICS			
Title			
Interconnects			
Size Document Number			
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Date:	January 11, 2000	Sheet	1 of 4

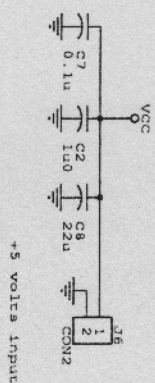


Date: January 13, 2000 Sheet 2 of 4



Motor Input Voltage

Capacitors should be low ESR type, for use in switching power supplies



+5 volts input

are ELECTRONICS

FILE

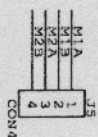
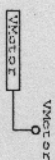
Power

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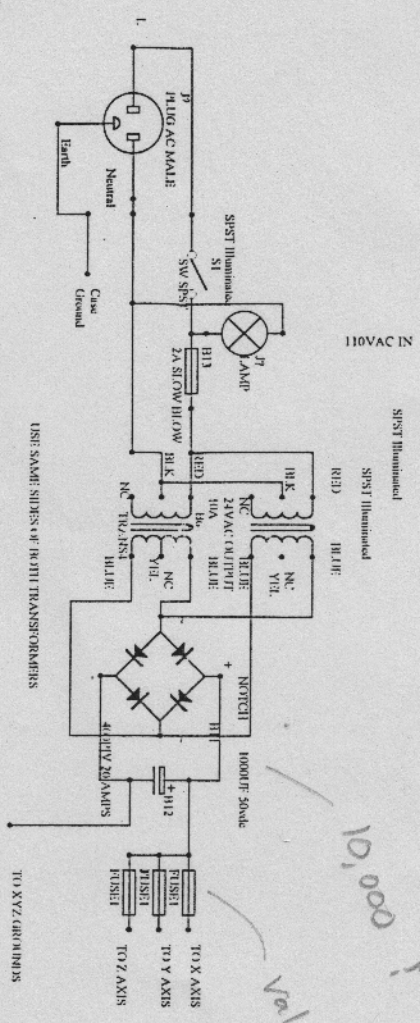
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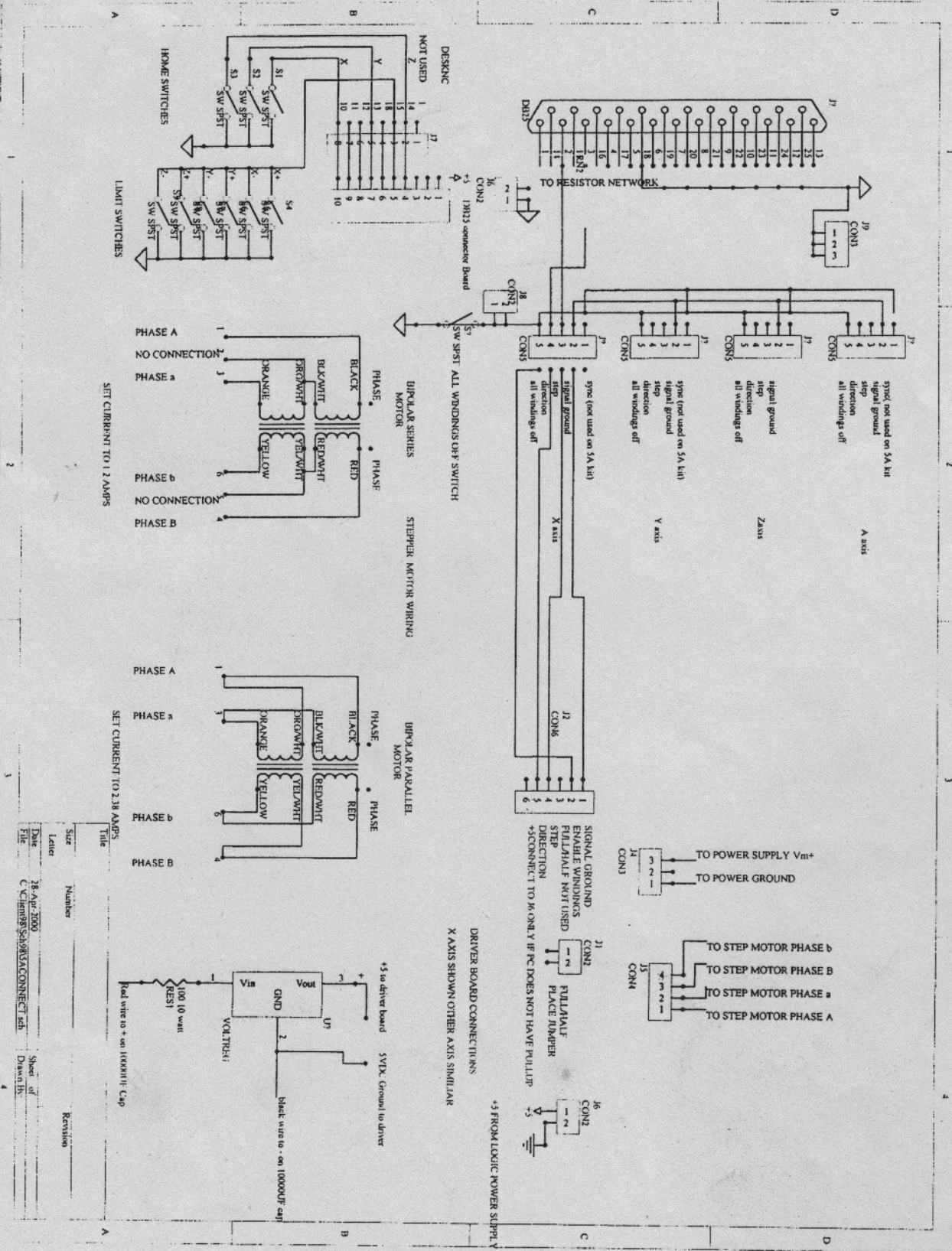
REV 2



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Date		January 11, 2000		Sheet 4 of 4	



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File	C:\Chen\98\5\Apower4.sch	Drawn By



Size	Number	Revision
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