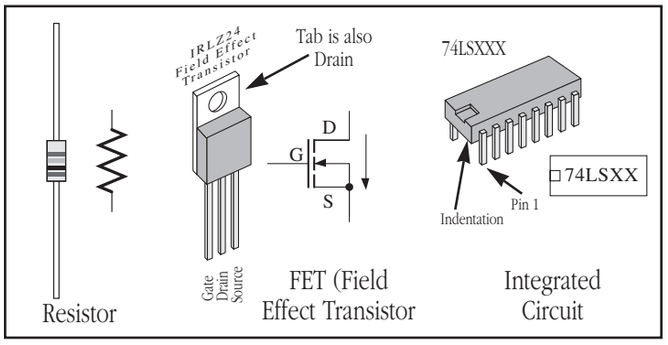
1 - Parts

As you assemble the circuit board, refer to the list below and the instructions. Each item is indicated by its part number and location code. The drawings below show the parts and their schematic symbols. Check your kit of parts with this list:

	Loc.	Qty.	Unit	Description
1)	R1	4	each	Resistor, 1 KΩ, 1/8 W (Brn, Blk, Red, Gold)
2)	R2	4	each	Resistor, 4.7 KΩ, 1/8 W (Yel, Vio, Red, Gold)
3)	C1	3	each	Capacitor, 0.1 µF, monolithic ceramic
4)	FET	4	each	Field Effect Transistor, IRLZ24
5)	-	1	each	IC, 74LS193, 4 bit up/down counter
6)	-	1	each	IC, 74LS139, Dual 1 of 4 decoder
7)	-	1	each	IC, 74LS08, Quad AND gate
8)	-	1	each	Opto Isolator, PS2501-4
9)	-	1	each	PC Board, Stepper 10A, TFX CM 4.0
10)	-	1	each	Header, 7 pin, 0.100" spacing (optional)
11)	J	1	each	Jumper (use a resistor lead or scrap wire)
12)	-	1	each	Instructions (these)

In addition, you will need a microtip soldering iron for electronics, solder, side cutter, 5 Volt power source for logic, a separate supply for motor power, and a unipolar (5 or 6 wire) stepper motor (up to 36 Volts DC). But if it is over 20V DC you will need a Zener diode as shown in Section 5, option C.

Electronics experience is helpful but not required. If you have never assembled electronics, read Section 6.

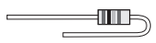


2 - Assembly

WARNING: Electrostatic Sensitive Devices.

The FETs and Optoisolator IC are sensitive to damage from static electric charges. (It's not easy to do, but don't let it happen to you.) Leave them in their protective wrap until needed, then work with them only on a metal sheet or at a grounded workstation using standard precautions.

1) Begin by bending one lead of each Resistor (either end will do), as shown.

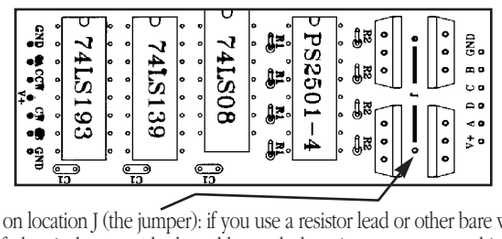


2) Insert each part, one at a time, into the marked locations on the circuit board. Observe that each part is correct for its location, and that it is oriented correctly, as shown below.

3) Double check the part's location and orientation before proceeding with the soldering. NOTE: the 74LS193 and 139 integrated circuits are easy to confuse. They must be located as shown.

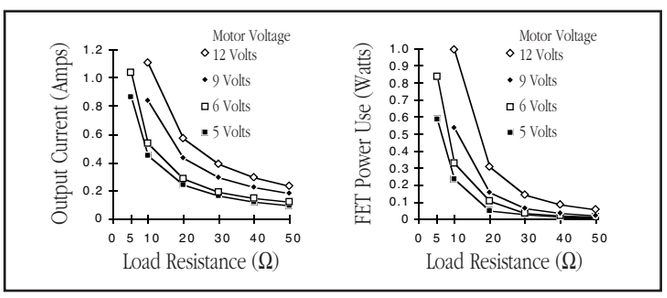
4) Carefully solder the leads of the part (if you have not assembled electronics before, see section 6 first). When the solder has cooled, clip any excess lead close to the board.

5) Repeat for all parts.



6) Note on location J (the jumper): if you use a resistor lead or other bare wire, apply a piece of electrical tape to the board beneath the wire to ensure good insulation.

About Heat Sinks - If your application requires heat sinks on the FETs, note that the tabs on the FETs must be electrically isolated from each other. Use appropriate insulators and heat conducting grease.



3 - Operation from a PC

Connect the inputs of the circuit board to a PC's parallel port, then enter this BASIC program to control the motor's speed and direction. You may use different wiring, but note that attempting to output CHR$(13) (RETURN character) gives problems on some PCs.

```
'StepDemo.BAS
'Stepper 10A Cct Demo Program 9701.27

'Setup

Plport = PEEK(1032) + (256 * PEEK(1033))
OUT Plport, 0: OUT Plport + 2, 0
OPEN "lpt1:" FOR OUTPUT AS #1
WIDTH #1, 255

Restart:
CCW = 1: CW = 1: PB = 1: PA = 1: Phase = 3: Dcnt = 10
MODE$ = "Stop": GOTO Display
Main:                   'Main motor control loop
A$ = INKEY$
IF A$ <> "" THEN GOTO Incoming
PRINT #1, CHR$(CCW + (CW * 2) + (PB * 4) + (PA * 8));
PRINT #1, CHR$(3 + (PB * 4) + (PA * 8)); : GOSUB
    DELAY
GOTO Main

Incoming:               'Set appropriate mode
IF A$ = "Q" OR A$ = "q" THEN PRINT "Done": PRINT #1,
    CHR$(15): END
IF A$ = "P" OR A$ = "p" THEN Phase = Phase + 1: IF
    Phase > 3 THEN Phase = 0
IF A$ = "J" OR A$ = "j" THEN Speed$ = "Slower": Dcnt
    = Dcnt + 1: IF Dcnt > 20 THEN Dcnt = 20
IF A$ = "L" OR A$ = "l" THEN Speed$ = "Faster": Dcnt
    = Dcnt - 1: IF Dcnt < 1 THEN Dcnt = 1
IF A$ = "I" OR A$ = "i" THEN MODE$ = "CW": CW = 0:
    CCW = 1
IF A$ = "M" OR A$ = "m" THEN MODE$ = "CCW": CW = 1:
    CCW = 0
IF A$ = "K" OR A$ = "k" THEN MODE$ = "Stop": CW = 1:
    CCW = 1
IF A$ = "R" OR A$ = "r" THEN GOTO Restart
IF Phase = 0 THEN PA = 1: PB = 1        'none
IF Phase = 1 THEN PA = 0: PB = 1        'Phase A
IF Phase = 2 THEN PA = 1: PB = 0        'Phase B
IF Phase = 3 THEN PA = 0: PB = 0        'Both A+B
GOTO Display

Display:
CLS
PRINT "Stepper Demo       Clockwise"
PRINT "                      I"
PRINT "           Slower  J  +  L  Faster"
PRINT "                      M"
PRINT "               Counterclockwise"
PRINT ""
PRINT "P for Phase   K for Stop   R for Reset   Q to
    Quit"
PRINT ""
PRINT "     PHASE:";
IF Phase = 0 THEN PRINT "none";
IF Phase = 1 THEN PRINT "A    ";
IF Phase = 2 THEN PRINT "B    ";
IF Phase = 3 THEN PRINT "A+B ";
PRINT "   MODE "; MODE$; "    DELAY"; Dcnt
GOTO Main

DELAY:
FOR I = 1 TO (Dcnt * 10)
NEXT I
RETURN                  'End of Program
```

4 - Connections & Testing

- *Are all parts installed in correct location and orientation?* If not, carefully unsolder, clean the holes, and replace properly.
- *Are all leads trimmed, with clean solder joints, no excess solder, short-circuits, or weak joints?* If not, trim, resolder or clean as needed.
- Connect the board to the required power supplies (for details see Section 5) and your computer or other drive electronics.
- Run the program and go!

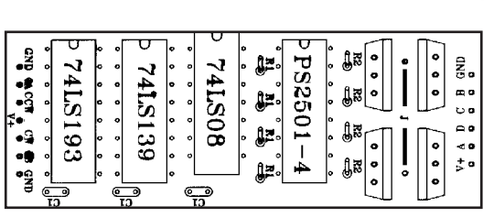
To PC parallel port or other control electronics

This connector is electrically reversible (but the control logic will change.)

Ground
Phase A
CCW
V+ (Logic)
CW
Phase B
Ground

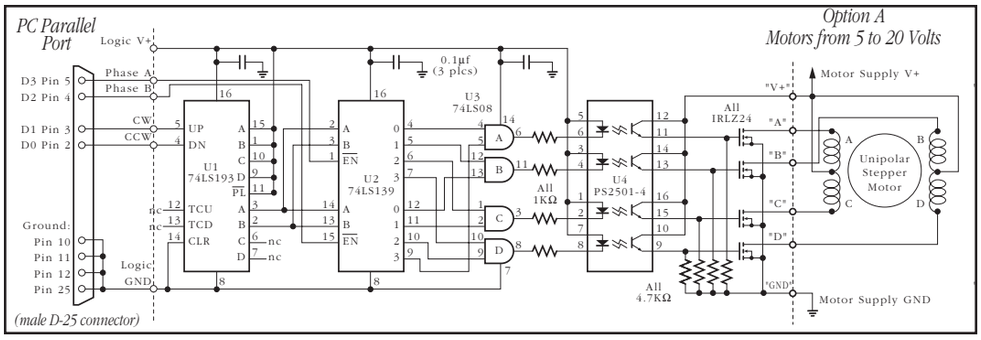
Only one "GND" need be used.

A typical parallel port cable can be up to 2 meters (6 feet) long. See Section 5 for connections.



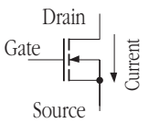
To stepper motor & motor power supply

Motor Ground
Coil B
Coil C
Coil D
Coil A
Motor Power
(see Section 5)



5 - Schematic & How It Works

For a computer to control a large stepper motor, a switch is needed that will operate from logic level (5 Volt) signals, yet that can control high currents and higher voltages. The International Rectifier HEXFET™ IRLZ24 is a magnificent power FET that turns on at low voltage (with virtually no current) and acts as a low resistance switch handling tons of current! The resistance of the FET is so low that in many applications it requires no heat sinking (especially at higher Motor voltages - go figure!).



A FET (Field Effect Transistor) has three legs called Drain, Gate and Source (see drawing). When a sufficiently high voltage is provided to the Gate (as referenced to the Source), power will begin to flow from the Drain to the Source.

The power consumed by the FET depends on the total resistance from the Drain to the Source. The lower the D/S resistance, the less total power used by the FET. A VGS (the voltage difference between Gate and Source) of 4 volts gives an RDS (resistance from Drain to Source) of 0.105 ohms. By raising the VGS to 8 Volts, the RDS will drop to 0.06 ohms! Note: VGS must not exceed 20V.

The Logic Operations

The 74LS193 is an up/down counter. Both the CW (clockwise) and CCW (counterclockwise) pins should always be held high. Clocking occurs on the rising edge of a low pulse. CW and CCW make the counter cycle back and forth from 0 to 3.

The 74LS139 is a dual 1 of 4 decoder. It sends a single line low for each count of the up/down counter, from 0 to 3. The Phase A decoder runs one step ahead of the Phase B decoder. A decoder is inactive if its Phase input is High. This permits the powering of zero, one or two coils at each step for total control of the motor.

The 74LS08 contains four dual-input AND gates. The output of each gate goes Low if either of the input signals are Low, which permits either decoder to activate it.

Each AND gate activates an LED in the optoisolator (PS2501-4) via the resistors R1. The LED shines across an insulating gap and activates the corresponding photo transistor. The transistor in turn activates a FET, which provides power to a single coil of the stepper motor.

6 - Assembling Electronics

If you have never assembled electronics you should read about the basics before you begin. The steps below outline the basic procedures for preparing, soldering and inspecting many kinds of electronic components. With a few tools and a little patience you will have no trouble assembling, testing and displaying your kit.

F6.1 - Basic tools needed: Soldering iron, small sponge, electronic solder, needle nose pliers, side cutters. Optional: Spare soldering iron tip, flux remover.

Plug in the iron, and moisten the sponge with water. When hot, "tin" the soldering iron's tip with a small amount of solder (replace the tip if old or corroded). Wipe the tip across the wet sponge from time to time to keep it clean. A clean, well-tinned tip does best.

F6.2 - Bend the component leads to fit the holes on the board.

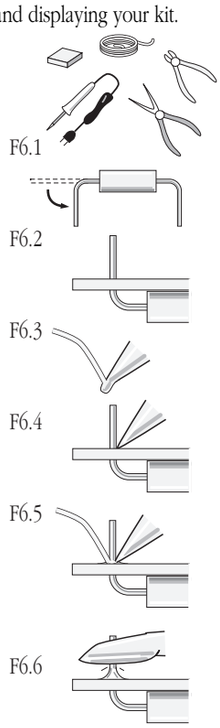
F6.3 - Insert the component, observing any special orientation it may require. Bend the leads enough to hold the part flush against the board, but do not over bend.

F6.4 - Wipe the tip clean and tin with a small amount of solder.

F6.5 - Heat the joint by placing the soldering iron's tip against both the component lead and the circuit board pad.

F6.6 - After a moment of heating, touch the solder to *the lead & pad only*. (If touched to the iron it will blob up.) When the solder flows, remove it and hold the tip in place for one second. Remove the iron without moving the part or board and let the joint cool.

F6.7 - Trim excess component lead with the side cutter. Parts with short leads do not need to be trimmed.



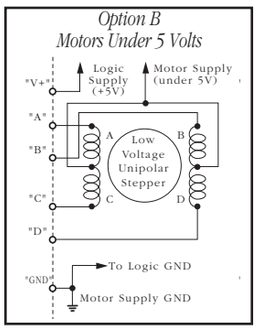
Inspect the joint. A good solder joint blends the lead and pad smoothly together, and has a smooth, bright finish. If the joint bulges or bridges to other pads, remelt it, and remove the excess solder with the soldering iron. If the joint looks fuzzy or dull it is a "cold" solder joint. Remelt it, and let it cool (without moving) to a smooth, bright finish.

Optional: After finishing all soldering, you may wish to clean the board to remove any flux residue. Use a commercial flux remover, and follow its instructions.

Option A – Motors from 5 to 20 Volts

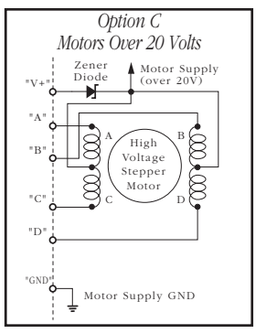
A separate Motor Supply is used to provide a VGS higher than the logic supply of 5 Volts.

Connect the circuit so the Motor Supply voltage ("V+") powers the output side of the optoisolators and FETs. This provides the FETs with maximum available VGS voltage for maximum efficiency in their operation.



Option B – Motors Under 5 Volts

Should your stepper use less than 5 Volts, note that the circuit logic still requires 5 Volts, as does the output side of the optoisolator, PS2501-4. Use the Logic Supply to provide VGS ("V+"). Connect with both supplies having a common ground, as shown at right.



Option C – Motors Over 20 Volts

If you need to power a motor with more than 20 Volts, insert an appropriate zener diode in the path from the power supply to V+ Motor Supply as shown.

Example: If Motor Supply is 30V, use at least a 10 Volt Zener to drop "+V" (VGS) below 20 V. The zener can be larger, as there is no advantage to having a "+V" (VGS) over 10 V.

Input and Output Signals

Input				Output
Phase A	Phase B	CW	CCW	Motor Power Lines A, B, C & D
H	H	H	H	No Power to Motor
L	H	H	H	Phase A Enabled
H	L	H	H	Phase B Enabled
L	L	H	H	Dual Phase (A and B)
		⊓	H	Step Clockwise
		H	⊓	Step Counterclockwise

Single Phase Operation

	Motor Coil A	B	C	D
Step 1	●			
2		●		
3			●	
4				●

Dual Phase Operation

	Motor Coil A	B	C	D
Step 1	●	●		
2		●	●	
3			●	●
4	●			●

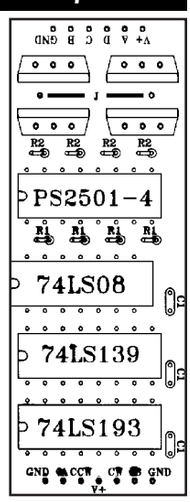
H = High voltage
L = Low voltage
⊓ = momentary Low pulse
● = Phase A or B (as enabled)

#3-303

MONDO•TRONICS

Stepper Motor Driver Kit

Easily Control Stepper Motors via Computer



This kit controls a unipolar stepper motor from logic level (5 Volt) signals. It permits full motor control: forward, reverse (single or dual phase), and stop (free turning or locked).

Ideal for electronic control of stepper motors in any application.

- *Tiny - Just 68 x 25 x 22 mm thick (2.7 x 1 x 0.8 inch)*
- *Light - Weighs under 20 grams (0.8 ounce)*
- *Efficient - Circuit uses International Rectifier HexFET™ technology for ultra-low resistance switching!*
- *Strong - Provides up to 10 Amps continuous current*
- *Easy to connect - Standard TTL level inputs (0 to 5 Volts)*
- *Optoisolated – Motor supply from 5 to 36 VDC!*
- *Interchangeable - Standardized connections with our other driver boards*

Easily assembles in under an hour. You will need: soldering iron for electronics, solder, side cutter, stepper motor of your choice (up to 36 V), power supplies (+5V DC for logic, separate supply for motor) and interface parts as required by your application. Electronics experience is helpful but not required.

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Web Mondotronics.com

We fully guarantee the quality and completness of this kit.
If you suspect something is missing, please write to us.

V1.4