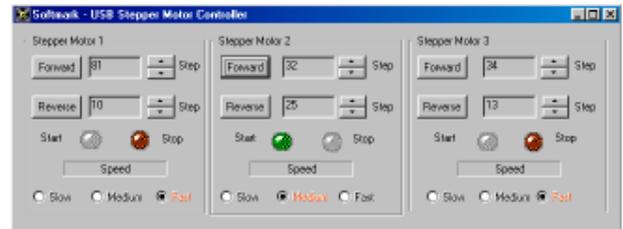


# SOFTMARK



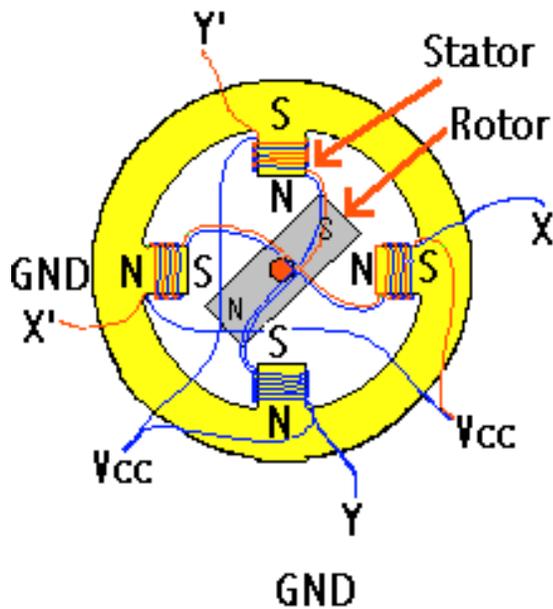
## USB Stepper Motor Controller



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The USB Stepper Motor Controller is a complete solution for intelligent motion control of three stepper motor driven products. Stepper motors are used when precise control of movement is needed. With each movement of the motor, the drive shaft steps a precise amount of distance. The degrees per pulse is set in the motor's manufacturing and is provided in the spec sheets for that motor.

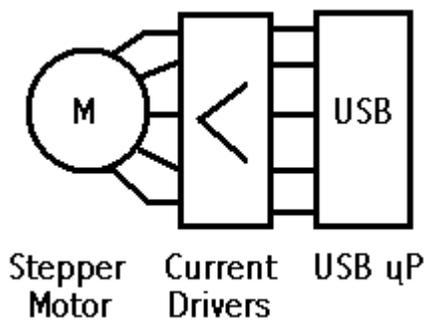
## USB Stepper Motor Controller - Introduction



**Figure 1.** A stepper motor has four coils.

Steps can range from ultra-fine movements of a fraction of a degree (i.e.  $0.10^\circ$ ) to larger steps (i.e.  $62.5^\circ$ ). In the circuit in Figure 1 above, you will notice that there are four phases labeled X, X', Y and Y'.

A stepper motor has four coils. The direction of rotation (clockwise or anti-clockwise) depends on the order in which the currents supplied to the coils are switched on. All coils are directly energized by the USB Stepper Motor Controller (see Figure 2 below).



**Figure 2.** The stepper motor is driven directly by the USB Controller.

## Mapping the coils to your motor

Stepper motors can be easily obtained from old computer equipment such as disk drives or printers. Each stepper motor connector has 5 pins. One of the pins on each connector is marked VCC and the others are A, B, C, and D (see Figure 4 below). These pins correspond to the schematic in Figure 1.

Each coil is connected to the VCC and A, B, C, and D pins. To reverse direction, you can swap the A and B connections. Use an ohmmeter to measure the resistance between pairs of wires. Each coil will exhibit a low resistance of a few tenths Ohm. You should make sure that current via the coil does not exceed 1 A (as seen in the spec for ULN2803):

$$I = 12V / R_{coil}$$

Note that all coils have the same resistance.

If your coil resistance is, for example, a hundred Ohms you will have to supply higher voltage (VCC on the PCB design) but do not exceed 50 V (as seen in the spec for ULN2803).

## How it works

A stepper motor rotates when the coils (electromagnets) are sequentially turned on and off. Rotation direction is determined by the order in which the coils are turned on and off. Once a coil is energized, the rotor steps and is held rigidly by the coil's field. This ability to stay put in a certain position distinguishes stepper motors from other electric motors.

The USB microcontroller receives commands from the PC via the USB bus. The computer instructs the microcontroller regarding which direction to rotate, how far and how fast to rotate. The microcontroller, after receiving the commands, will move the motor.

The USB microcontroller is used to control the magnetic field. ULN 2803 is only a current driver. UN5804, the popular driver which specializes in stepper motor control, is not used in this kit, the hard job is done by the software. This leads to a significant cost reduction for this project, particularly if three stepper motors are being controlled.

## Building the card

The PCB top view (element side) is shown in Figure 4 below.

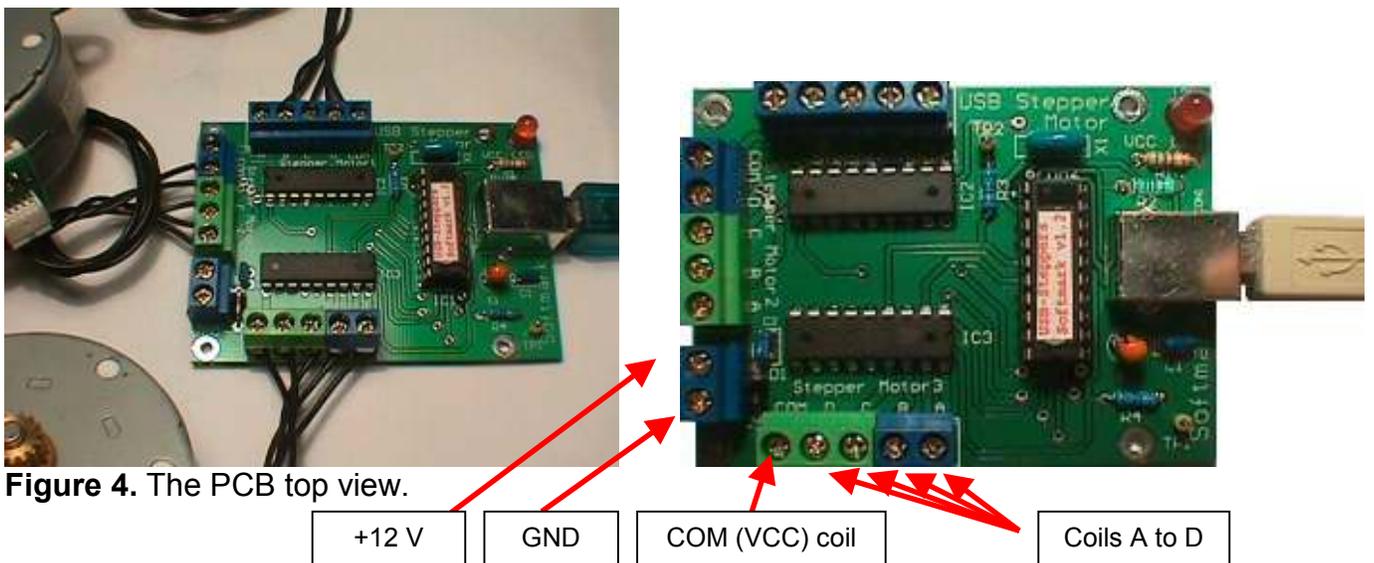
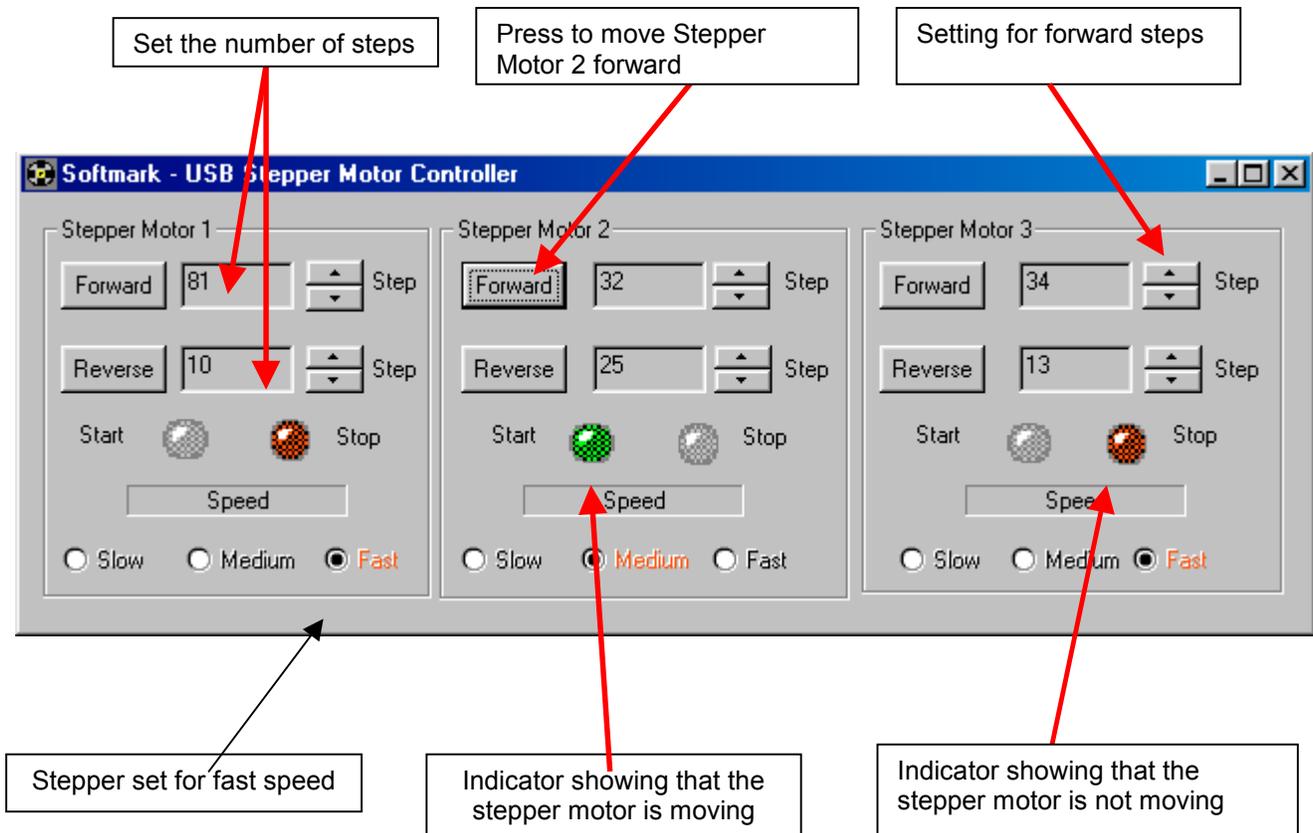


Figure 4. The PCB top view.

Firstly, fit resistors, then all LEDs, IC sockets, the USB connector and then plug the ICs into the sockets. Remember to check the soldering once you finish.

Note that the kit is also available assembled.

## Software – virtual panel



**Figure 5.** Virtual panel of the USB Stepper Motor Controller.

In Figure 5 you can see three panels for controlling three independent stepper motors.

If the “Stop” LED is red, that means that the stepper motor is not moving.

The “Start” LED is green when the stepper motor is rotating. You have to set the number of steps which you require the stepper motor to execute. Then, you have to press either the “Forward” or the “Reverse” button to set the movement direction. When the right number of steps was executed, the stepper motor will stop. The speed of movement can be chosen by the option buttons: “Slow”, “Medium” or “Fast”. All settings are saved and next time you use the Controller the settings will be restored.

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## Testing the card and installation

Connect the USB Stepper Motor Controller card to the USB port in your PC. Use a USB cable (A-B type) to do this. The red LED, LD1, should be on. This diode only shows that voltage from the USB bus is being applied to your board. If LD1 is off, check the voltage (using a voltmeter) on the USB connector's pin 1 or IC1's pin 12. LD1 could be off because of incorrect polarity or over-soldering. In this case, you should examine the polarity of the diode and PCB soldering. If the VCC line was soldered to ground then the USB controller (Host) in your PC will automatically disconnect voltage to the USB bus and to your kit. If the problem was rectified, reconnect the USB cable to your kit. If LD1 (VCC) is on, that means your board is receiving 5 V.

Next, the Windows operating system will try to find, and talk to, the USB controller (IC1). After a few seconds (usually 1-2 seconds), you will get a message on your screen that a new device was found. Following this, Windows will start installing the driver for this kit. This will only take a minute and does not have to be done again.

Note that information about installing drivers can be found on the CD ROM/disks supplied with the kit.

After the driver is installed, the next time you use the card the Windows operating system will automatically find the driver for your card. No other setup will be required.

### Important

Stepper motors are not supplied with the kit.

The USB Stepper Motor Controller only needs 12 V voltage to drive the stepper motors. The maximum current taken will be around 1 A (typically, current will be around 300 mA). Use a proper power supply with current protection. The current driver ULN2803 can only be used to a maximum of 1 A, and the maximum voltage supplied is 50 V.

Note: The USB bus powers the microcontroller (+5 V).

### Important Note:

If mains power interruption happens for both your computer and the power-supply used to power your USB Stepper Motor Controller, the computer is automatically reset but the power supply for the Controller will still be on when the mains power comes back. The Controller will not be running because the computer is off and stepper motors can get **overheated**.

If mains power interruption occurs, it is strongly recommended that you **switch the power supply (+VCC) to the Controller off**. This problem can be avoided if the power supply for the Controller is powered from the computer (additional power outlet in computer used to power monitor). But this may not apply to all computers.

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If your computer has been reset by the mains power interruption, you will not get the power coming through the computer to power the Controller.

Note also that the power supply used should have a current limitation as the maximum current for the Controller's driver is 500mA per coil.

If you develop your own software (or modify our sample software) for the Controller, you can use the TP pins from the RISC processor to switch on 12V to the Controller via an additional transistor.

If TP line is zero (due to power interruption and computer reset), the computer (your own Controller software) will not generate logic high to switch this transistor.

**Using the TP line will prevent the overheating of stepper motors where mains power interruption occurs.**

If you have any questions or are concerned about this issue, please contact [softmark@ar.com.au](mailto:softmark@ar.com.au)

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