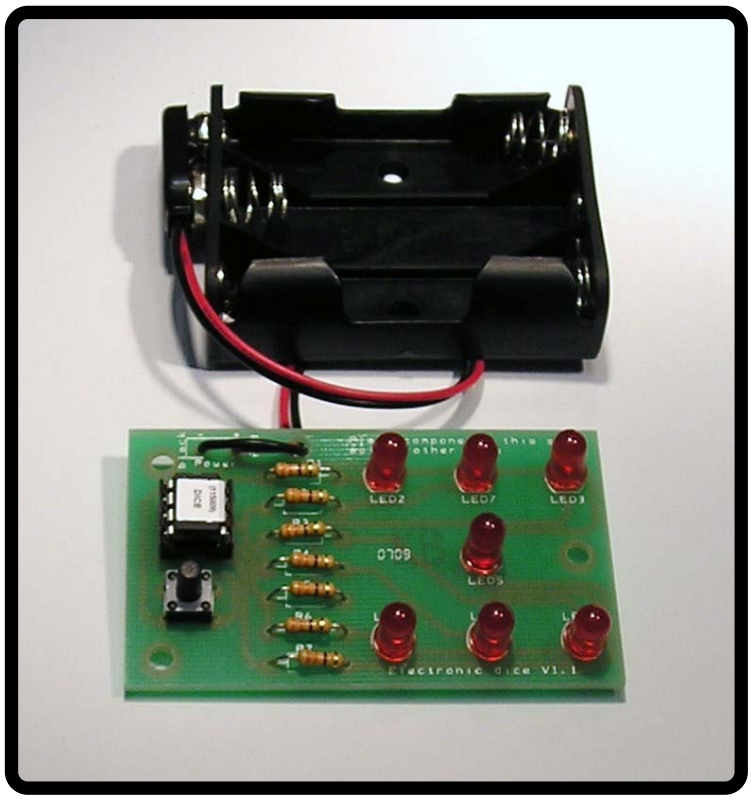
Dice Project



Build Instructions

Issue 1.4

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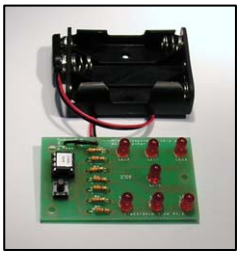
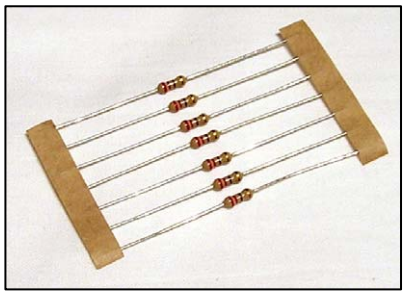


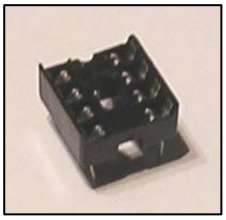
Before you put any components in the board or pick up the soldering iron, just take a look at the Printed Circuit Board (PCB). The components go in the side with the writing on and the solder goes on the side with the tracks and silver pads.

You will find it easiest to start with the small components and work up to the taller larger ones.

Step 1
Start with the seven resistors (shown right):
R1 – R7 are 330Ω (orange, orange, brown coloured bands)

The text on the PCB shows where R1, R2, etc go.





Step 2
Solder the Integrated Circuit (IC) holder (shown left) in to IC1. When putting this into the board, be sure to get it the right way around. The notch on the IC holder should line up with the notch on the lines marked on the PCB.

Step 3
Insert the switch (shown right) in to the board where it is labeled SW1. Once you have got the pins lined up with the holes they can be pushed firmly into place and soldered.

Step 4
Solder the seven Light Emitting Diodes (LEDs) as shown left in to LED1 – LED7. The LEDs won't work if they don't go in the right way around. If you look carefully one side of the LED has a flat edge, which must line up with the flat edge on the lines on the PCB.

Step 5
The battery connector (shown right) should be soldered into the 'Power' terminal. First feed the power clip through the strain relief hole next to the power connection. You should feed the wire from the solder side of the board. The red wire must go to the '+' terminal (also marked 'red') and the black wire must go to the '–' (also marked 'black') terminal.

Step 6
The IC can be put into the holder ensuring the notch on the chip lines up with the notch on the holder.

Checking Your Dice PCB

Check the following before you insert the batteries:

Check the bottom of the board to ensure that:

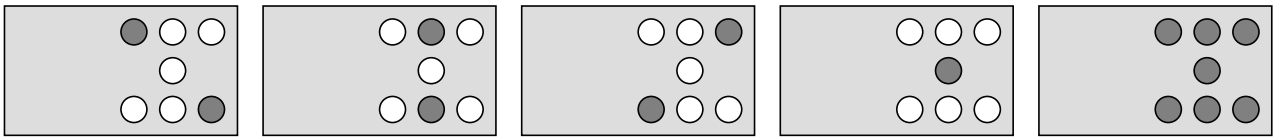
- All holes (except the 3 large 3 mm holes) are filled with the lead of a component.
- All these leads are soldered.
- Pins next to each other are not soldered together.

Check the top of the board to ensure that:

- The notch on the IC holder / IC is next to the power connection.
- The flat edge of each of the LEDs match the outline on the board.
- The red and black power leads are connected to the correct pads (see the PCB markings).

Testing the PCB

The software on the microcontroller has been specially designed to allow easy testing of the PCB. Each time the board is power up the LEDs will flash the pattern shown below before it then works as a dice.



Power up your board and check this sequence is displayed.

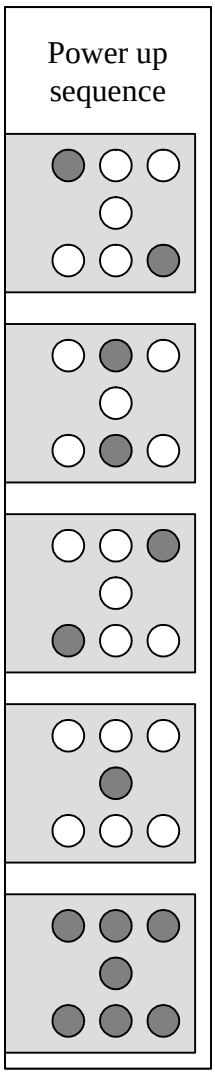
Push the switch and check the lights flash and that when the switch is release a number is shown.

If your dice doesn't work as described use the fault-finding flow charts to find out why.

Using your dice

- When the button is pressed a number is shown on the dice.
- Pressing the button again will display a new number.
- After a number has been displayed for 30 seconds the LEDs go out and the microcontroller goes to sleep. In this state is takes virtually no power so the batteries can be left connected when the dice is not in use. Next time the button is pressed the dice wakes up and functions as normal.

Fault finding flow chart - page 1



Start
Power the board up

Do any LEDs light?

No

Check
- The batteries are good and in the right way around
- Check the power clip is connected the right way around and soldered correctly.
- IC1 pin 1 & 8 for dry joints
- IC1 is in the right way (the notch is next to the power leads)

Yes

Do all LEDs light in sequence?

No

Do 3 or 4 LEDs light at the same time?

No

Go to page 2

Yes

Yes

Push and release the switch (SW1)

Do the LEDs flash, then stop on release?

No - they keep flashing upon release

There is a short between IC1 pins 3 and 4

No - nothing happens when pressed

Check
- For dry joints on SW1
- For a dry joint on IC1 pin 4

Yes

Stop

Is LED6 and LED7 on constantly?

No

There is a short on IC1 pin 6 and an adjacent pin

Yes

Pin 7 & 8 on IC1 are shorted together

Fault finding flow chart - Page 2

Start
Continued from page 1

How many LEDs don't work?

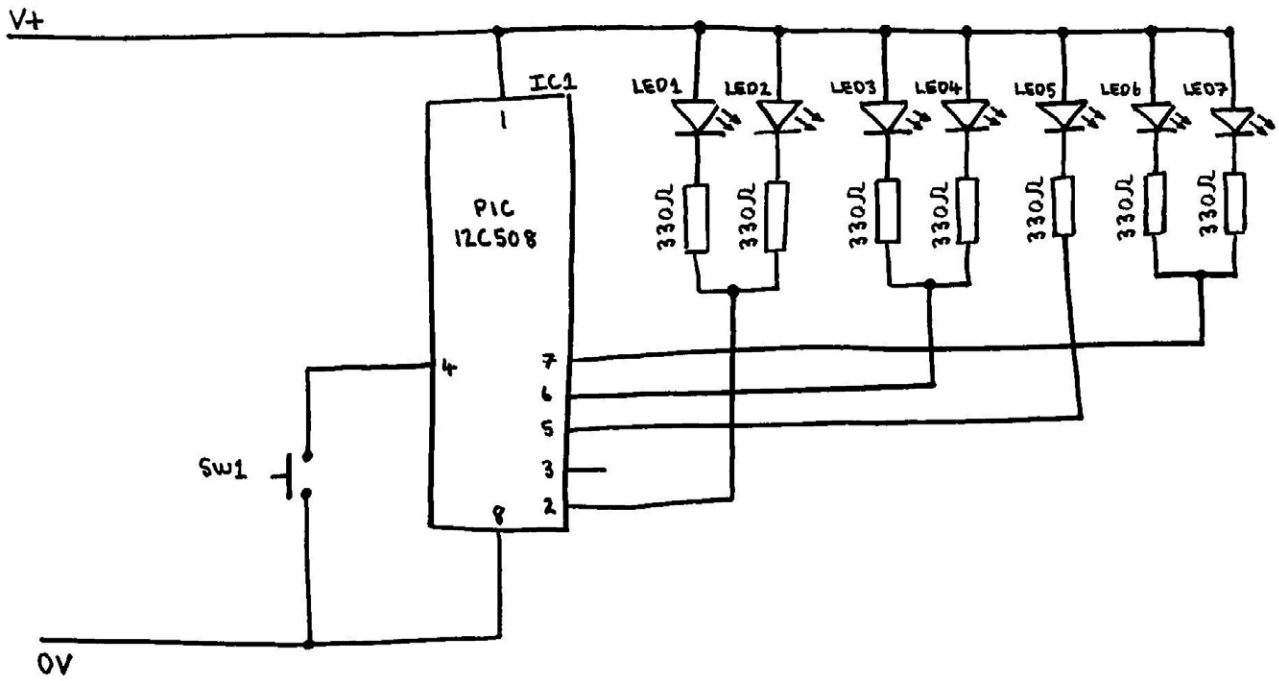
2

LED not working	**Possible cause**
LED1 & LED2	Dry joint on IC1 pin 2 Short on IC1 pins 1 & 2
LED3 & LED4	Dry joint on IC1 pin 6
LED6 & LED7	Dry joint on IC1 pin 7

1

LED not working	**Possible cause**
LED1	LED1 in backwards, shorted or dry joint Dry joint on R3
LED2	LED2 in backwards, shorted or dry joint Dry joint on R1
LED3	LED3 in backwards, shorted or dry joint Dry joint on R5
LED4	LED4 in backwards, shorted or dry joint Dry joint on R6
LED5	LED5 in backwards, shorted or dry joint Dry joint on R7 Dry joint on IC1 pin 5
LED6	LED6 in backwards, shorted or dry joint Dry joint on R4
LED7	LED7 in backwards, shorted or dry joint Dry joint on R2

How the Dice Works

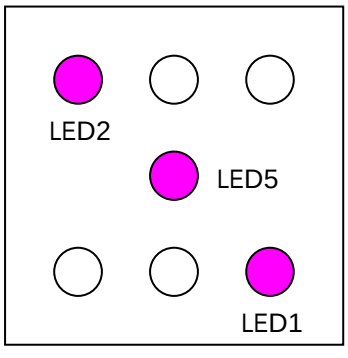


At the heart of the electronic circuit is a PIC microcontroller. A microcontroller is in effect a small computer. The circuit uses a push switch to detect when it should start generating the next number to be displayed. When the button is pressed the PIC very rapidly cycles through number 1 to 6, upon release of the button the number is displayed. The PIC then determines which of the LED's should be lit up and sets pins 2, 5, 6 and 7 as required.

The relationship between the number that is to be displayed on the dice, the LED's that need to be lit up and the PIC pins that controls them are shown in the table to the right.

Number on dice	LED's that are on	PIC pins
1	5	5
2	1+2	2
3	1+2+5	2+5
4	1+2+3+4	2+6
5	1+2+3+4+5	2+5+6
6	1+2+3+4+6+7	2+6+7

So for example, if the number 3 (shown right) was to be displayed on the dice this would require LED's 1, 2 and 5 to be lit. These are controlled by PIC pins 2 and 5 (pin 2 controls LED's 1 and 2). As the cathode of the LED's are permanently connected to V+ the LED's are turned on by taking their associated PIC pin low. This creates a voltage across the LED(s) and which turns it/them on.



The value of resistors R1-R7 is 330Ω. These resistors limit the current that can flow through the LED's. This protects the LEDs and controls their brightness.