16 5mm LED Display Board - “Newton”


You’ll find the latest versions of the instructions and example code at the address above.

Thank you for purchasing the Freeman board! I hope you have lots of fun with it!

If you have any suggestions for future boards then please let me know. I’ll send you some free boards if I like your idea!

This kit can be powered by many microprocessors and development boards. I have been using it with the Arduino and PICAXE systems.
Kit Contents

This kit was put together by a team of highly skilled octopuses; it should contain the following items:

1) The main PCB
2) 16x 5mm LEDs
3) 16x 330Ω resistors
4) 1x 1N4001 diode
5) 2x 16 pin DIP sockets
6) 2x 74HC595 shift registers
7) 2x 0.1µF capacitors
8) A 6 pin header

Important Things to Remember

This kit is designed to run from 5V. Do not exceed 5V or the ICs and LED components will be damaged. It will work fine from 4x 1.2V rechargeable batteries.

The diode, LEDs and IC sockets (and corresponding ICs) must be placed on the board in the correct orientation or Newton will not work.

The two shift register ICs are sensitive to static shocks so handle them with care and avoid touching the legs (pins).

Before soldering any components check and then double-check that they are correctly oriented.

Don’t rush, and have lots of fun!

If you need a good tutorial on soldering then SparkFun Electronics has a good one (https://www.sparkfun.com/tutorials/106) as does Adafruit Industries (http://www.ladyada.net/learn/soldering/thm.html).
Building Instructions

You will need a soldering iron, solder, an octopus (or a set of handy helper things) and wire cutters. To keep some of the large components in place while soldering you might find Blue-Tac useful to stop them moving around or falling off (avoid putting them on the leads of components or parts that will get hot).

Take your time and check the placement of every component before soldering them in place!

All of the components sit on the top of the board, solder them to the underside.

**STEP 1 – Resistors**

Solder each of the 16 resistors on to the board first. These protect the LEDs from excessive current. It doesn’t matter which way around they go (but I like to make them all face the same way!).

They are labelled on the PCB as R1 to R16.

**STEP 2 – DIP sockets**

These sockets will eventually hold the two 74HC595 shift registers. Don’t put chips in until the end.

Place them on the board so that the “notch” is on the right hand.

**STEP 3 – The diode**

The 1N4001 diode sits on the 5V line and protects the circuit from reverse polarity – that is, it will stop the sensitive components on the board from being damaged if the GND and 5v connections are connected the wrong way around.

The diode MUST be placed so that the end with the white marking is facing the “CONTROL” header (as in the picture).

**STEP 4 – Headers**

These will be used to connect power and data to the board.

Split the 5-pin header in to a 3-pin and 2-pin header. The 3-pin header goes in the space marked “Control” on the board. The 2-pin header goes above it, in the space marked “Power”. Place them so the pins are pointing outwards.

The control pins are labelled:

- **DS** Data (serial data input)
- **ST_CP** Latch (storage register clock input)
- **SH_CP** Clock (shift register clock input)

**STEP 5 – The Capacitors**

There is one capacitor for each of the shift register ICs and they go in the spaces labelled C1 and C2. They are not polarised, they can go in anyway round.
**STEP 6 – The LEDs**

These are placed in the locations marked LED1 to LED16. The long lead of the LED (the anode) goes in the hole marked in the image below, the shorter lead (the cathode) in the other hole. It is very important they go in the correct way or they will not work!

![LED polarity diagram](image)

**STEP 7 – ICs in to the sockets**

Now all of the components have been soldered to the board it’s time to place the two 74HC595 chips in to their sockets. They should be socketed so the notch on the chip is on the same side as the notch on the socket – facing to the right.

Before you try to **carefully** slot the chips in to sockets you’ll notice that the legs are spread out too much to fit. They’ll need to be bent inwards before they’ll fit. **DO NOT FORCE THEM.**

The way I like to do this is by **very carefully** pressing each side of the chip on my desk until both sets of pins are parallel. Once the legs are parallel it will take a bit of force to push the chips in to the sockets, be gentle and **patient.**

![ICs in sockets](image)

That’s all the hard work finished, you should now have something that looks like the image below. Connect the board up to your microcontroller of choice and start having fun.
## LED Colour Suggestions

<table>
<thead>
<tr>
<th>All red</th>
<th>All yellow</th>
<th>All orange</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="LEDs" /></td>
<td><img src="image2.png" alt="LEDs" /></td>
<td><img src="image3.png" alt="LEDs" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>All green</th>
<th>All blue</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image4.png" alt="LEDs" /></td>
<td><img src="image5.png" alt="LEDs" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Bi-colour</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image6.png" alt="LEDs" /></td>
<td><img src="image7.png" alt="LEDs" /></td>
</tr>
</tbody>
</table>
Output Format

To output to the 16 LEDs, send 16 bits to the shift registers:

    Set the ST_CP (latch) low
    Do this section 16 times, once for each bit:

    {
        Set the DS pin (Data) to low or high (depending on data).
        Set the CLOCK to low.
        Set the CLOCK to high.
    }
    Set the ST_CP (latch) high

Byte 1   Byte 2
87654321 87654321

Byte 2 sets LEDs 1–8, byte 1 sets LEDs 9–16. A “1” turns an LED on, a “0” turns it off.

It’s important to send the bits from LEFT to RIGHT. The MSB of byte 1 first; the LSB of byte 2 last.

Have a look at the example programs for more information on how to talk to the shift registers.
Example source code for the following platforms can be found here:


- Arduino (and compatible boards) (arduino.cc)
- Espruino (and compatible boards) (espruino.com)
- PICAXE microcontrollers (picaxe.com)
- Raspberry Pi (all models) (raspberrypi.org)

If you would like some example code for a different platform then please get in touch.

If you have any comments or suggestions for this kit then please let us know.

For more information, updates and details of new kits check out the following links:

- Website: www.MaximumOctopus.com
- Twitter: http://www.twitter.com/maximumoctopus
- Blog: http://maximumoctopus.wordpress.com
- Online store: http://store.MaximumOctopus.com
- YouTube: https://www.youtube.com/user/freshneyorg

This kit was designed and manufactured in the UK.

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Last update: March 17th 2015