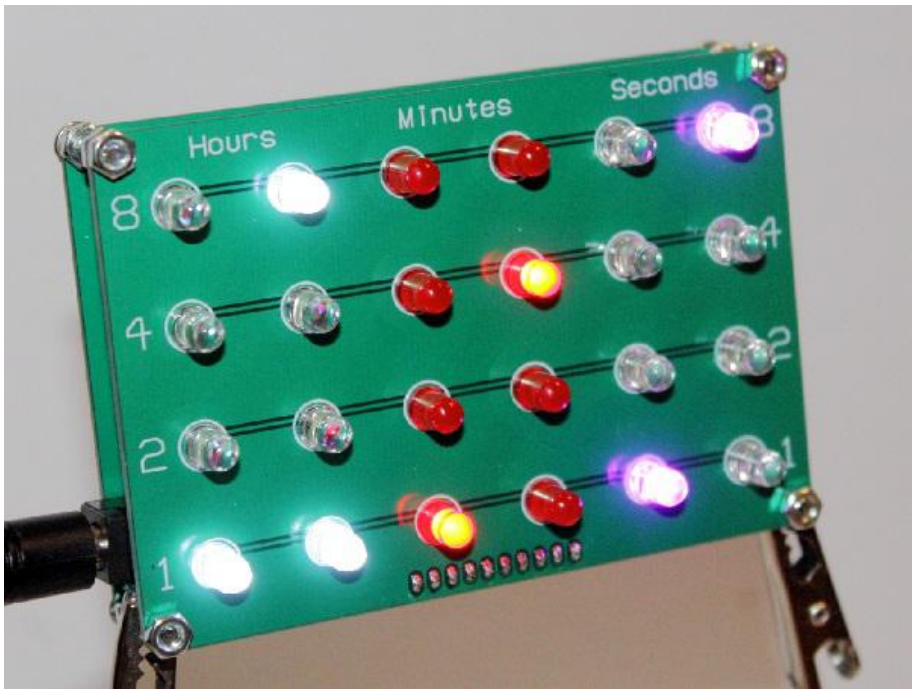
GPS-Powered, Binary-Coded-Decimal Clock

(with battery-backup)



ASSEMBLY INSTRUCTIONS

What is it?

This kit will allow you to build a binary-coded-decimal clock. That's a clock that presents the time in binary, but still in a sensible format. This is a great kit if you want to learn to read binary at speed, love unusual clocks … or just want to impress/infuriate your co-workers!

When fitted with a GPS receiver, this clock becomes self-setting and maintains a high accuracy. The push-buttons allow you to select your local timezone.

Without a GPS receiver, it works like a normal clock. The push-buttons allow you to set the time, as usual.

Assembly overview

The clock is made up of two PCBs. The front PCB is the display, with a 6x4 matrix of LEDs. The rear PCB has all the driving electronics.

The PCBs should be fitted back-to-back, connected via a ten-way connector (pins on one PCB, sockets on the other). The PCBs are held together with a brass standoff at each corner; each standoff is held in place with two M3 bolts.

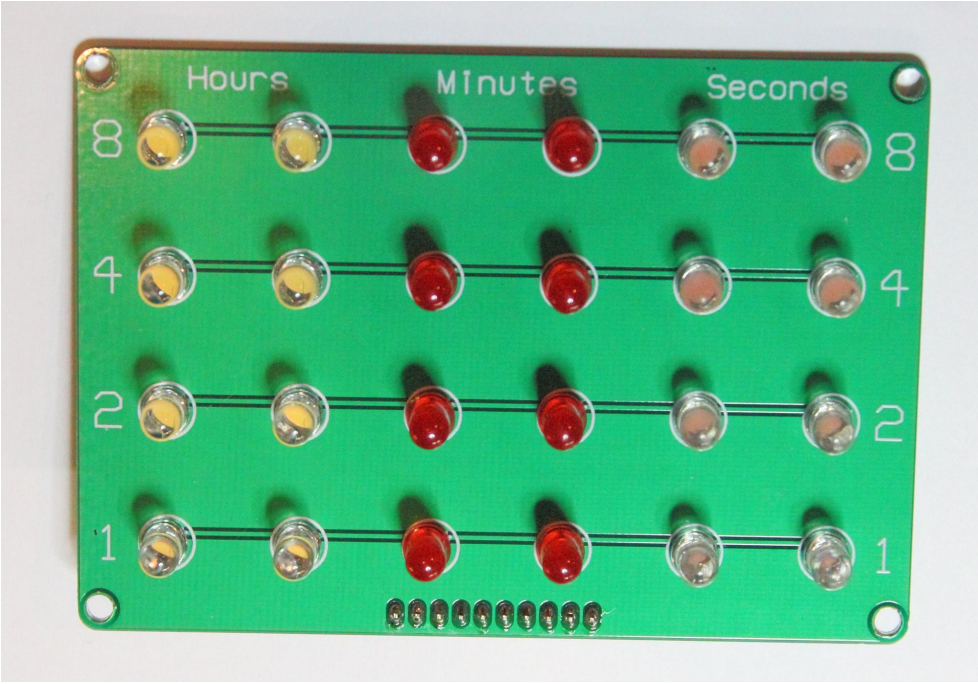
Preparation

A 40-way pin header and 40-way pin socket is provided. These need cutting with cutters or a craft knife.

1. Front PCB: A row of ten pins is required to connect to the rear PCB.
2. Rear PCB: A row of ten sockets is required to connect to the front PCB.
3. Rear PCB: A row of four pins is required for the (optional) GPS receiver.
4. Rear PCB: A row of six sockets is required for the (optional) programming connector.

Assembling the front PCB

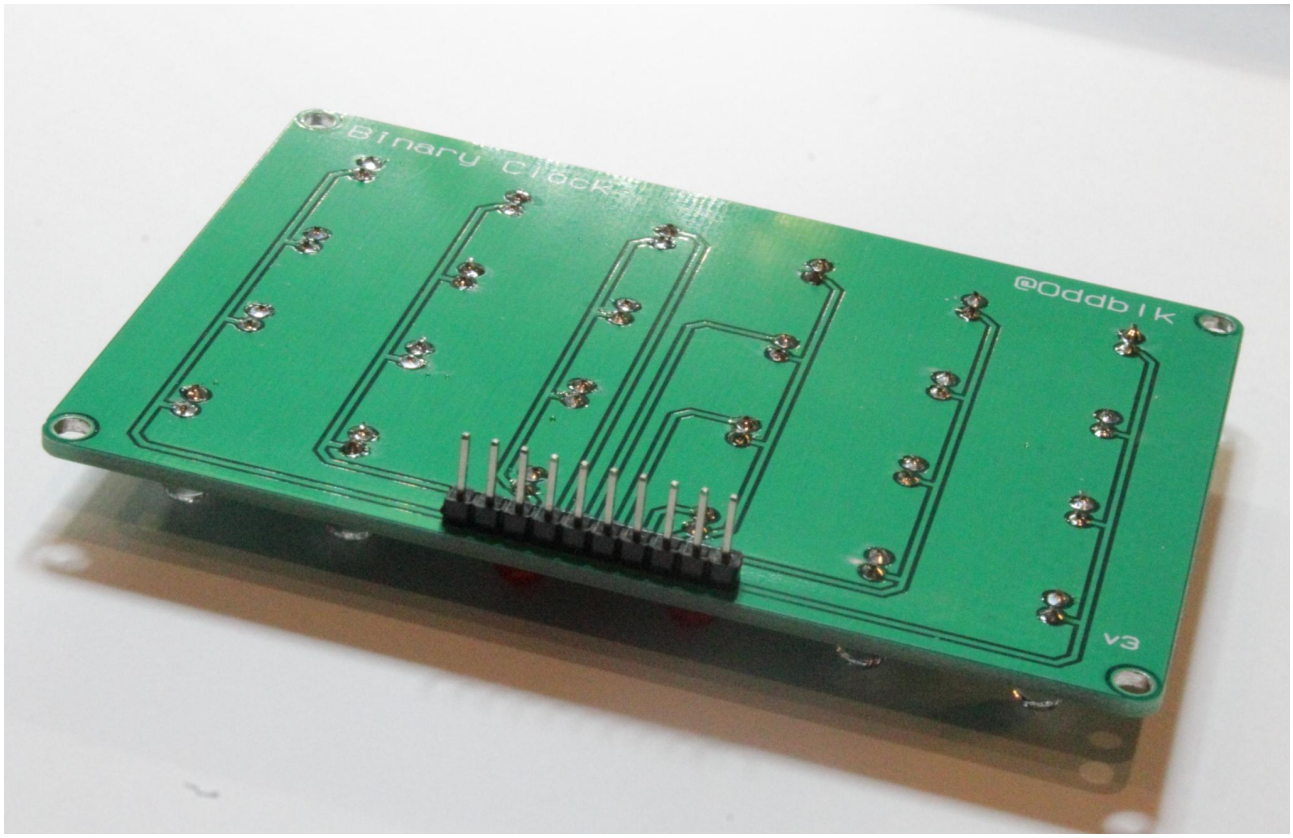
Spend a bit of time thinking about your colour-scheme. I normally choose a colour for each pair of columns: it helps "group" columns together and makes it a bit easier to speed-read. I've also found that just using a single colour works well ... but it's entirely up to you!



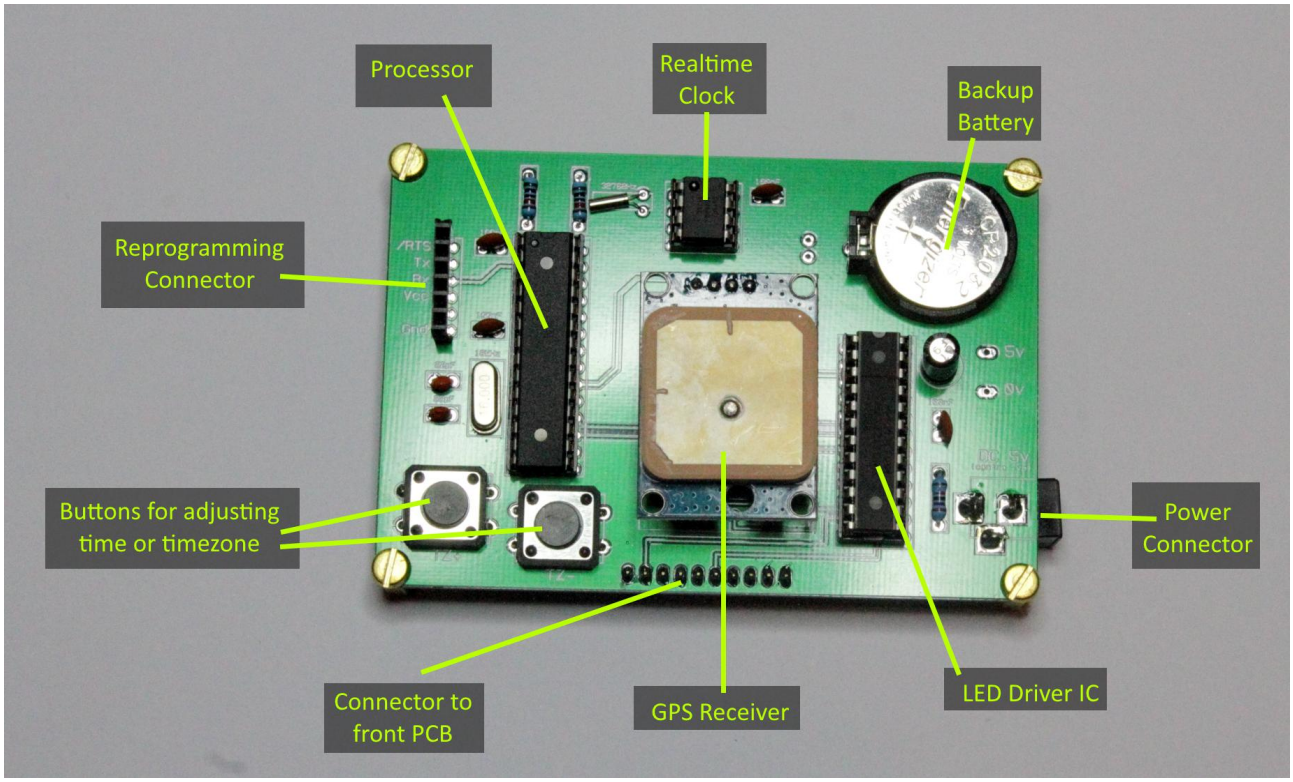
Note that LEDs must be soldered the correct way around. If you look at the silk screen (the white markings on the PCB) you'll see that each LED has the positive pad marked with a "+" symbol. The **longer** of the LEDs two legs should go in here.

Push the LEDs in from the front, solder on the back. After you've soldered each LED, trim the excess legs off with a pair of cutters.

The ten way header-pin should obviously point the opposite way to the LEDs: pushed in from the back, soldered from the front.



Assembling the rear PCB



I like to solder the smallest parts first (the parts that stand shortest on the board), moving on to the larger parts later.

Something like this:

1. The 32768Hz crystal oscillator. It's a small metal "can" (about the same size as a resistor) with two spindly legs sticking out of one end. Solder this so it lies flat on the board.

2. The resistors. The two 10K-ohm resistors go near the top-left of the board, and the 27K-ohm near the bottom-right.

3. The smaller capacitors. The 22pF ones are marked with "22", and the 100nF ones are marked with "104".

4. The 16MHz crystal, which goes just to the right of the two 22pF capacitors.

5. The three IC sockets (a 28-pin one on the left, an 8-pin one top-middle, and a 24-pin one on the right).

6. The two push-buttons.

7. The (optional) battery holder.

8. The 10uF capacitor, which is near the bottom-right of the board. It matters which way around this one is fitted - the positive leg is marked on the board (with a "+")

and the capacitor itself has a stripe down its side pointing towards the negative leg.

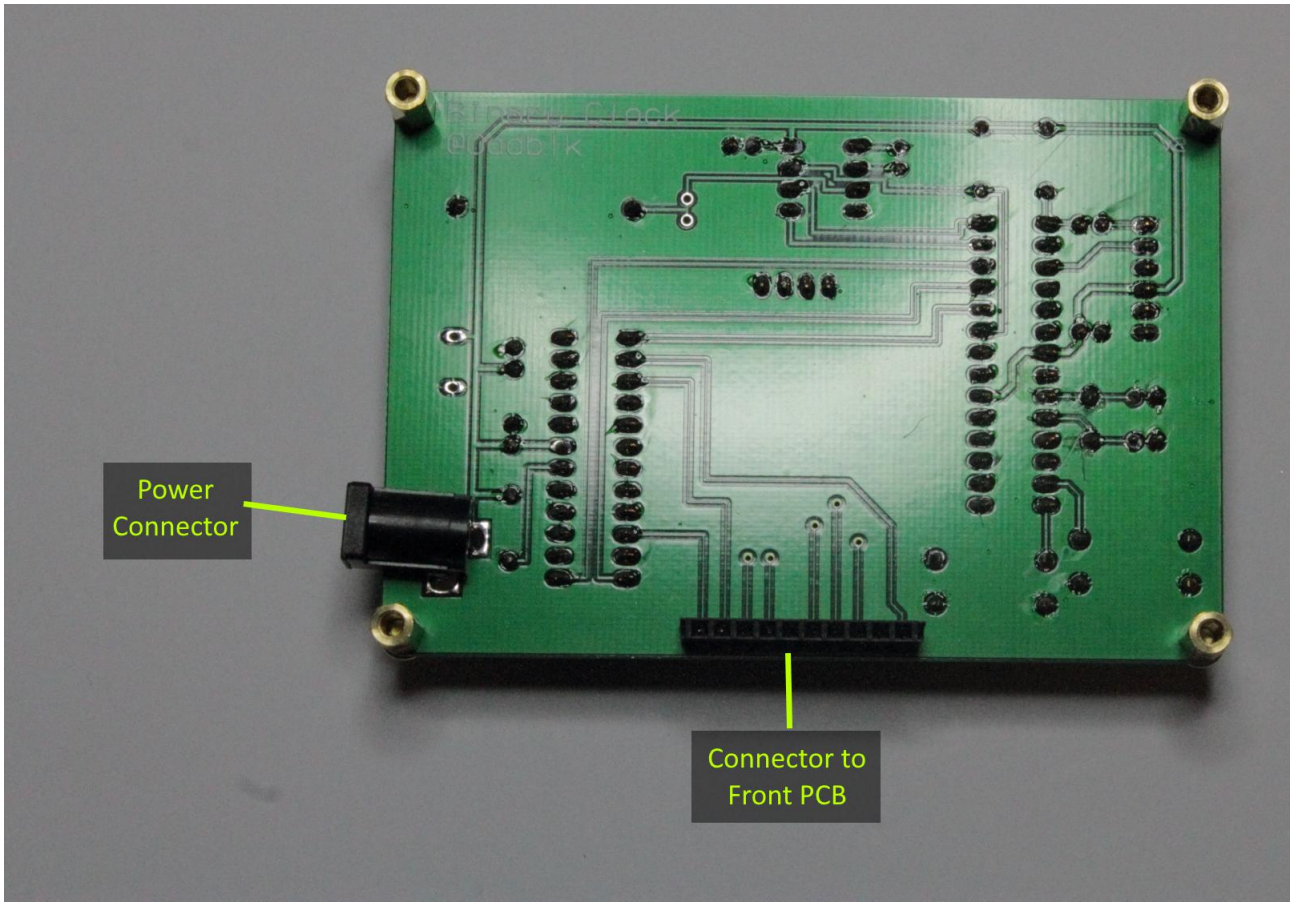
9. The (optional) row of six pin-sockets at the upper-left, in case you ever want to reprogram it.

10. The (optional) GPS receiver. Soldering a four-pin header to the PCB, then drop the GPS receiver onto it and solder that. Then trim any excess pins with a pair of cutters.

And on the other side of the rear PCB:

1. The DC barrel socket. It is placed on this side so that when assembled, it'll sit nicely between the two PCBs.

2. The row of ten pin-sockets that will connect the rear PCB to the front PCB.



Fit the three ICs

Remember: The notch on each IC should be pointing upwards, towards the top of the PCB.

Fit a CR2032 watch battery (optional)

This just gives battery-backup for that period between powering the clock up, and getting a GPS fix. For this reason, it is optional. If you find that your clock gets the time quickly after power on (or it is left on most of the time anyway) then you probably don't need to fit a battery.

Connect the PCBs together

Use a brass standoff at each corner, with M3 bolts to hold them in place.

This completes the assembly!

Plug it in!

The clock can be powered from any USB socket, consuming no more than 150mA of power (well within the specification of USB ports). Power it from any spare socket on your computer, or monitor, or one of those little USB mains adaptors that you often get free with your new mobile phone.

Mounting the screen, cases, cradles ...

That's all entirely up to you! I've bought an adjustable mobile phone cradle that clips to my desk. Or, if you're the creative sort you could make yourself a wood or acrylic case, or 3D-print a pair of comedy clown shoes to stand it upright, or hold it with one of those crocodile-clip "helping hands" - whatever works for you! Please send me pictures of whatever you make!

A PDF with the measurements of the front PCB (including LED spacing and mount points) is available from my website in case you find that helpful. Please also visit my website for schematics, information about how to read the clock, and for any firmware updates.

Have fun!

For more information …

Please visit my blog page all about it, here:

http://danceswithferrets.org/geekblog/?page_id=1034