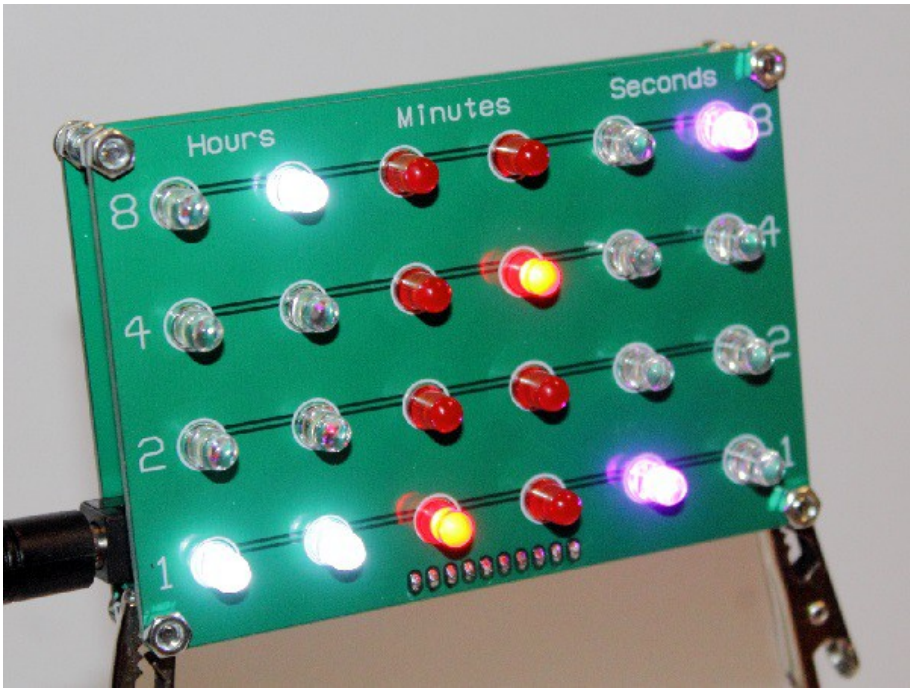


# GPS-Powered, Binary-Coded-Decimal Clock

*(with battery-backup)*



## OPERATING INSTRUCTIONS

The BCD clock can work **with** or **without** a GPS receiver.

## With a GPS receiver

GPS receivers give a nice and accurate time ... but the time they provide is always UTC.

To ensure that this clock can be useful to everyone (not just people in the UK for only half the year) it can be configured for different timezones. Use the TZ+ and TZ- buttons to cycle through to your local timezone. The following 39 timezones are supported:

-12h, -11h, -10h, -9h30, -9h, -8h, -7h, -6h, -5h, -4h, -3h30, -3h, -2h, -1h, UTC, +1h, +2h, +3h, +3h30, +4h, +4h30, +5h, +5h30, +5h45, +6h, +6h30, +7h, +8h, +8h30, +8h45, +9h, +9h30, +10h, +10h30, +11h, +12h, +12h45, +13h, +14h

(See [https://en.wikipedia.org/wiki/List\\_of\\_UTC\\_time\\_offsets](https://en.wikipedia.org/wiki/List_of_UTC_time_offsets))

Depending on signal strength where your clock is located, it may take a minute or two to get the current time. In my home office (a windowless garage full of metal and all sorts of electronic equipment) it can take about two minutes. This seems perfectly acceptable if your clock is going to be running all day!

There's sometimes a GPS "settling" period where the time will be out by a couple of seconds. This is due to the GPS receiver updating its Almanac and compensating for the "leap second", and will normally correct itself within about 10 minutes.

If you fit a CR2032 battery, then the current time will be maintained even when power has been disconnected. When next powered on, the clock will use that time as its display whilst waiting for new GPS data - so your clock will still continue to show a useful time.

## Without a GPS receiver

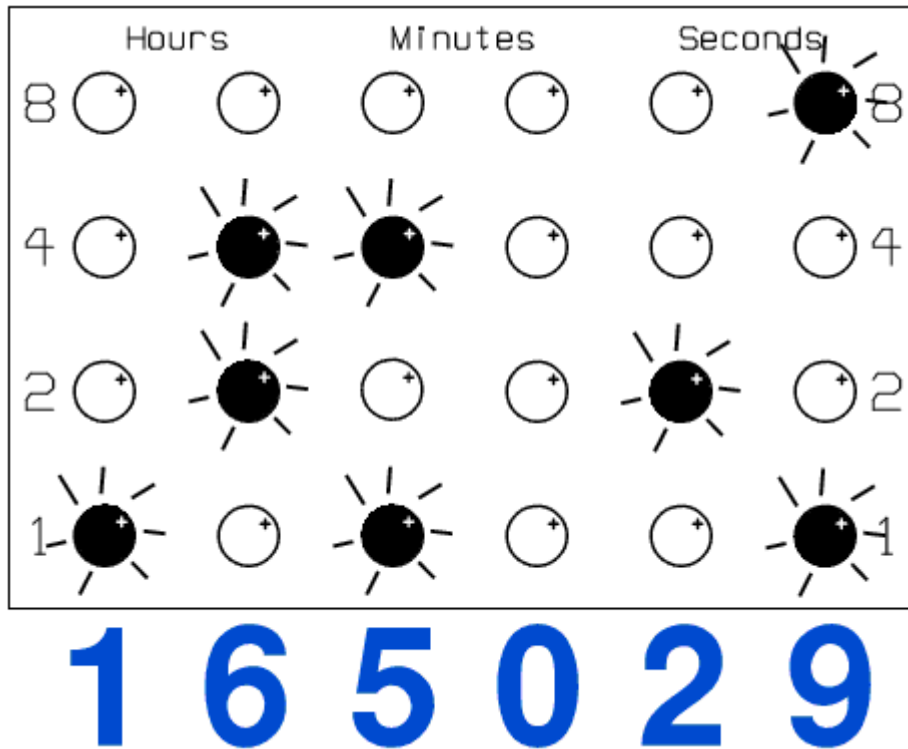
If no GPS receiver is fitted, then the clock will act in the conventional manner - counting time as best it can. In this mode, the TZ+ and TZ- buttons will instead increment hours and minutes. Without GPS to adjust its time, the clock is accurate to within about 15 seconds per month.

## Powering the clock

The kit comes with a USB-to-barrel cable. It uses the power supply from a USB port, but not any data connections. This means it will run from any spare USB port on your PC or monitor, or a mains-to-USB mobile phone charger. It consumes a maximum of about 150mA when a GPS module is fitted, or much less without.

## Reading the time

The time is shown in "Binary Coded Decimal" format - which means each of the six digits of HH:MM:SS are shown in a binary column. For example:



It becomes obvious when you see it in action - particularly the seconds columns. With a bit of practice (that's why you want it on your desk!) it becomes very easy to read - a useful and educational clock for all programmers, geeks and electronic enthusiasts ... And a good way to annoy your non-geek family!

## FAQ

***Q: Hmm ... the time can sometimes be two-seconds out for a while after power-up?***

A: This is caused by the GPS unit failing to account for the "leap second". This gets fixed when the GPS receiver updates its Almanac, which takes (if the signal is good) around 10 minutes.

***Q: Some of the LEDs will never be used, won't they?***

A: Yes, that's right! But I tried building the front panel without those LEDs, and it looked ... rather messy. It seemed simpler and more attractive to fit them all. Besides, this way it leaves the option open to do other things with the screen.

***Q: How do I change between GMT and BST?***

A: With the timezone buttons. GPS data doesn't include any information about "local" time, so it can't figure this out for itself.

***Q: What's wrong with an ordinary clock, for heaven's sake?***

A: (sigh) Mum, I've told you before ...

***Q: If I need to reprogram the processor, how do I do it?***

A: The kit behaves like an Arduino. Use a CH340 USB-to-TTL adaptor (they're cheap, and readily available on eBay and the like) and connect it to the six-pin connector on the back of the clock. Use the Arduino IDE to program it, as usual. The firmware for this project is available on my website.

[http://danceswithferrets.org/geekblog/?page\\_id=1034](http://danceswithferrets.org/geekblog/?page_id=1034)