

Unusual Electronics

WARNING

The LEDs used in this kit are **BRIGHT!**

Do not stare closely at them.

We recommend you build/buy a suitable case for it. Use a diffuser such as a piece of thin opaque plastic or paper in front of the LEDs or use the dimming function. (see section 6).

Contents

1. Introduction
2. Features
3. Reading the time.
4. Controls
5. Setting the Time and Date
6. Manually Dimming the display
7. Setting the alarm time.
8. When the Alarm sounds
9. Accessing the 1st Configuration option mode
10. The 1st Configuration options mode list
11. Accessing the 2nd Configuration option mode
12. The 2nd Configuration options mode list
13. Some 1st Configuration options explained
14. Reset to initial defaults or check firmware version
15. Specifications
16. Feedback request

1. Introduction

This kit is unusual because it shows the time/date using the number base-5 (Quinary) format.

If you have any questions, comments or problems please visit the website: unusualelectronics.co.uk and use the email contact form.

History

The base-5 number format was first used for a public clock in 1975. It was commissioned by the Berlin Senate to be installed on a main street called the Kurfürstendamm in Berlin and was known as the "Mengenlehreuhr"

Invented by Dieter Binninger, it used long-life light bulbs for showing the time. Eventually, high running costs resulted in it being shut-down in 1995. In 1996 it was renovated and moved to the entrance of a Berlin shopping centre where it still works today. An East-German table-top replica model using LEDs was manufactured until the late 1990s.

In Summer 1998 "Elektor" magazine published a construction project using a PIC16C54 and then in Early 2007 an article called "Berlin Clock re-make". Their 2007 design describes an SPI bus display interface and does require a separate micro-controller system to drive it.

There are even some free programs available to display a Berlin clock on your PC

The "QuinHora" design uses the same basic display format as the Berlin clock, except for an RGB LED at the base of the display for showing seconds activity etc. also the 15,30,45 minute LEDs are slightly displaced to make it easier to read the minutes.

It also has many user-configurable software features .

References

<http://www.surveyor.in-berlin.de/berlin/uhr/indexe.html>

<http://www.elektor-electronics.co.uk/>

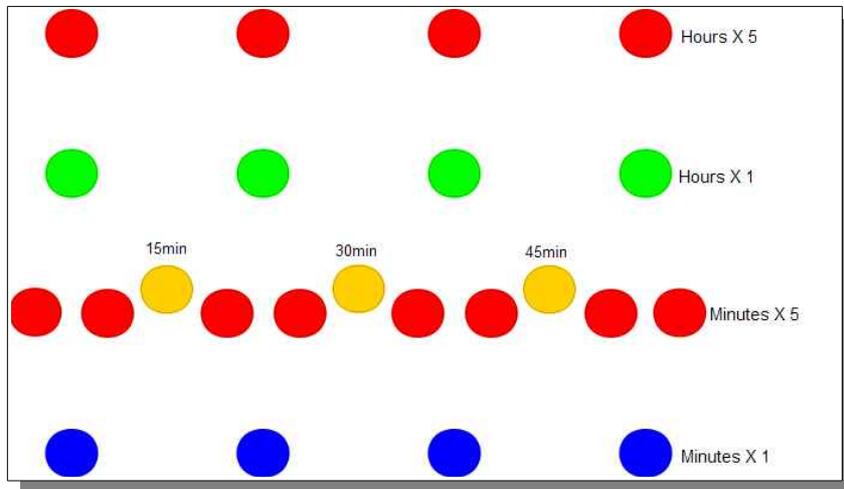
<http://widgets.opera.com/widget/4256/>

2. Features

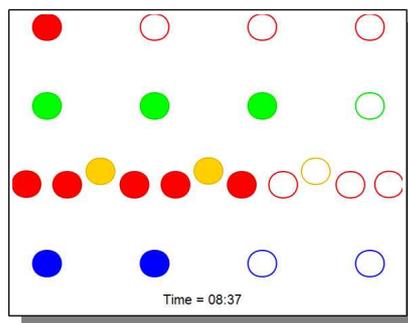
- The core of the clock is a Microchip PIC18F1330 8-bit CMOS microcontroller IC. It is programmed entirely in assembly language code for high performance.
- Timing is provided by a battery backed Dallas/Maxim DS1307 RTC “Real Time Clock” chip. Time & date is retained during power-off. The timing accuracy can be finely adjusted in the clock software.
- It incorporates an alarm clock with selectable alarm sounds/tunes with adjustable volume and snooze timer.
- All clock option settings are easily adjusted using three push-buttons and are retained in the controller EEPROM memory during power-off.
- The clock is very configurable with over 20 option settings -
- 24 or 12 hour mode time display with pm indication.
- Automatic DST “Daylight Saving Time” adjustment for UK/Europe and US zones.
- The display uses high quality “Super-bright” oval,tinted wide-angle LEDs for ease of viewing and has five brightness settings.
- Display brightness can be automatically dimmed or turn-off between set times, ideal for night time use.
- Has a pulsing RGB LED for seconds activity indication.
- The LEDs can be set to fade on/off (similar to incandescent light bulbs).
- Incorporates a date display option and automatic leap year compensation.
- There are several display special effects which can be configured to run at various intervals.
- Chimes can be enabled, including sounding the hours.
- There are two outputs that you can optionally add your own circuits to, such as auxiliary alarm indications, or flash LEDs etc.
- It is powered from 9 Volts DC so can be used worldwide (with appropriate mains adapter)
- Configuration can be easily reset back to defaults if you wish.

3. Reading the Time

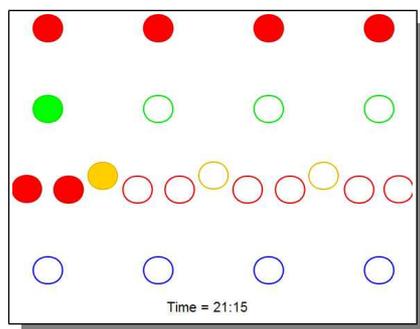
The LEDs show the time and other information using multiples of five and one:



Example 1. The time shown below is 08:37



Example 2. In the default 24Hour time, 21:15 is shown below.



(If using 12 hour mode, only two LEDs are required on the top row and the 4th LED acts as a PM indicator)

4. Controls

All settings are adjusted using three push-buttons.

The **SET** button is mainly used to access configuration options.

Depending on how long it is held pressed (see section 9 for more info)

Pressing or holding-down the **UP** button will count-up through the allowed values for each option.

The **ALARM** button can also be used to count-down the values for system settings.(not in time setting).

In addition, the **UP** button can be pressed during normal time display to dim the display.

Pressing the **ALARM** button on it's own for two seconds toggles the alarm on/off and shows the set alarm time while held pressed.

A short press (less than 2 seconds) of the **SET** button will show the date for 5 seconds.

See the following sections for a full description of the operation for each button.

5. Setting the Time

Press the **SET** button for about 2 seconds during time display and it will beep once, release the button and the hours digits begin to flash. Now pressing or holding-down the **UP** button will count-up the hours.

The next short press of the **SET** button will flash the minutes. As before, the UP button counts up the minutes.

Another short press of the **SET** button will sound a beep and the clock will resume showing the time. (If you have changed the time setting, the internal seconds count will be zeroed then).

6. Manually Dimming the display

While the clock is showing the time, each short press of the **UP** button will dim the display in five steps, and then back to full brightness again.

An automatic timed dim or display off can be configured – see the settings section.

7. Setting the Alarm time.

To set the alarm time. Press the **SET** button for two seconds (until it makes one beep). Instead of setting the normal clock time, now press the **ALARM** button and it will then show the currently configured alarm time.
Now, adjust the alarm time in the same way as setting the normal time.

To enable the alarm, while showing normal time, press the **ALARM** button for at least two seconds and it will make a high pitched beep, (and also show the configured alarm time whilst the button is held pressed).
Release the button and it will resume showing the normal time. – but the RGB LED will now have changed colour/s to show that the alarm is enabled.

To disable the alarm, repeat the above procedure and it will make a low pitched beep and when the button is released, the RGB LED will return to it's normal colour/s.

8. When the Alarm sounds..

A single, short press of the **ALARM** button will stop the alarm sound and begin the snooze countdown (this is set by default to 5 minutes but can be adjusted, see the settings section).

When the alarm resumes after a snooze, a further short press will get you another snooze period.

To stop the alarm without any snooze, press the **ALARM** button twice when the alarm sounds and it will not trigger again until the same time tomorrow.

If no button is pressed when the alarm sounds, it will cut-off after a set number of minutes (default is 5 minutes)

9. Accessing the 1st Configuration option mode

There are two configuration option modes.

Whilst showing the time, enter the 1st **configuration mode** as follows-

Press and hold-down the **SET** button for about 4 seconds, until you hear the second, higher pitched beep then release the button immediately.

The second (green) row of hours LEDs will now show “1” and the bottom two minutes rows will flash the value for that option (either 12 or 24).

To change an option value, press the **UP** button to increase it or the **ALARM** button to decrease it.

To step-on to the next option, press the **SET** button shortly. The Hours LEDs will now show this new option number and the minutes LEDs indicate it's setting value.

There are a total of 24 options in this mode, you can either step through each one sequentially as describe above or press and hold the **SET** button again for two seconds to return to the normal clock time display.

10. The 1st Configuration options mode list

Opt	Description (value in bold is the default)	Setting
1	Set 12 or 24 Hour time	12 or 24
2	Alarm sound/melody choice (0=Random)	0 - 14
3	Alarm Volume (0=Auto-increase)	0 - 6
4	Alarm duration in minutes (5 =default)	1 - 59
5	Snooze duration in minutes (5=default)	1 - 59
6	Timed dim start hour (24hour time)	0 - 23
7	Timed dim end hour (24hour time) (8=default)	0 - 23
8	Timed dim brightness (0=blank the display) (6=timed dim disabled)	0 - 6
9	Fading settings (0=no fading) (default=5)	0 - 7
10	RGB led seconds flashing colours selection (default=0,Red)	0 - 22
11	RGB led flashing colours for alarm-on indication (default=1,Green)	0 - 22
12	Change the RGB LED colour periodically (0=disabled)	0 - 6
13	Button press beeps pitch/volume (0=disabled)	0 - 10
14	Special Effect selection (0=random)	0 - 8
15	Special Effect Run intervals (0=disabled)	0 - 6
16	Special Effect Animation speed (0=random)	0 - 8
17	Special Effect run duration in seconds (default=5 seconds)	2 – 20
18	Show date every x seconds (0=disabled)	0 - 59
19	Date display duration in seconds (default=3 seconds)	1 - 15
20	Chimes interval selection (0=disabled)	0 - 7
21	Optional one second 1pps output choice (0=no change)	0 - 5
22	Optional Extra alarm output choice (0=off)	0 - 3
23	Optional Extra time pulses choice for aux output (0=off)	0 - 6
24	Optional Extra time pulses choice for 1pps output (0=off)	0 - 6

See section 13 for full descriptions of some options and their settings.

11. Accessing the 2nd Configuration option mode

The second configuration option mode contains settings that are usually less frequently needed to be adjusted.

Whilst showing the time, enter the **Second configuration mode** as follows-

Press and hold-down the **SET** button for at least **6** seconds, until you hear a total of four beeps (the last two beeps are close-together)

The second (green) row of hours LEDs will now show "1" and the bottom two minutes rows will flash the value for that option (which may be zero, (all LEDs off))

To change an option, follow the same procedure as with the first config options.

12. The 2nd Configuration options mode list

Opt	Description (value in bold is the default)	Setting
1	Clock accuracy adjustment (0=make no adjustment)	0 - 59
2	Clock accuracy, adjust plus/minus (0=minus, 1=plus)	0 - 1
3	Year	8 - 59
4	Month	1 - 12
5	Day of month	1 - max days
6	DST zone (0=disabled,1=UK/Europe,2=USA)	0 - 2

Notes

After initial configuration, the date will be stored in the RTC chip.

Clock accuracy adjustment:

Without adjustment the clock should be accurate to within about +/-1.7 seconds per day. To adjust, set the time against a very accurate clock such as a time signal.

After ten days compare the number of seconds error.

Example, if the clock was **12** seconds **slow**, set option 1 to **12** and set option 2 to **1 (plus)**. (You may subsequently need to make further small adjustments because the accuracy depends on temperature and the ageing of the timekeeping crystal)

DST (Daylight Savings Time adjustment)

If you live in UK/Europe or some states of USA, set the DST option and the clock will automatically adjust the hour transitions between Summer/Winter time.

13. Some 1st Configuration options explained

Option 1 - 12 or 24 hour time selection

The display looks great in 24 hour mode but you can choose 12 hour mode and it will then just use the first two Red Hour LEDs in the top row for showing the hours and the fourth Red LED will become a PM indicator.

(When adjusting the alarm time or timed dim options, you must always set them using the 24Hour notation)

Option 6-8 - Timed Dim Settings

These set the start and end hours for a period of dimming or blanking the display completely.

(Whilst the display is blanked or dimmed, you can restore the full brightness for one minute by a short press of the **ALARM** button)

Option 12 - Change the RGB LED colour periodically

This option changes the “ON” flash colour of the RGB periodically, which may be useful for gauging parts of a minute.

(It can work well or conflict with option 10 depending on which flash colours you have chosen in that option.)

0=off, 1=change colour every 15s (sequence=Red,Blue,Green, White), 2= change colour every 30s (Red,Green), 3=Green for last 10s, 4=Green for last 4s, 5=flash white once every 15s, 6=flash white once every 30s.

Option 15 - Special Effect Run intervals

The chosen or random special effect will run at intervals:

0= off, 1=every 15s, 2=every 30s, 3=every min, 4=every 15m, 5= every 30m, 6=every hour (Effects display takes priority over date display if they clash)

Option 20 - Chimes

A Chime “Ting” will sound every:

0=off, 1=every min, 2=every 5m, 3=every 10m, 4=every 15m, 5=every 30m, 6=every hour, 7=every hour, ping the hours (in 12hour format).

(Chimes are automatically silenced during the timed display dim period if enabled)

Options 21- 24 may be used to hack some extra functionality, connecting your own add-on devices to either of the two output connections (1pps and Aux)

These connections use two spare outputs from the ULN2003 driver chip which contains “open collector” type transistor drivers capable of driving small loads e.g. extra LEDs or an external alarm buzzer etc.

Download the ULN2003 datasheet for more info. **Ensure that if you use these outputs, you do not overload the ULN2003, the power supply or subject it to excessive voltages or “back emf” spikes etc.!!**

(We do not accept any liability if you damage anything!!)

Option 21 - Optional one second 1pps output

This option outputs either the 1pps pulse obtained from the RTC chip or continuously on during am or pm. If set to 0 it will remain in the state set by options 22 or 24
0=no change,1=1pps,2=1pps pm,3=1ps am,4=on pm 5=on am

Option 22 - Optional extra alarm indications

This option will turn-on the selected output/s when the alarm sounds.

You may want to use it to sound an external alarm or light extra LEDs perhaps.

0=all off, 1=1pps on, 2=aux on, 3=both on

Option 23 - Optional Extra time pulses choice for aux output

This will turn-on the aux output for 1 second at the set intervals:

0=off,1=every 15s,2=every 30s,3=every min,4=every15m,5=every 30m,6=every hour

Option 24 - Optional Extra time pulses choice for 1pps output

This will turn-on the 1pps output for 1 second at the set intervals:

0=off,1=every 15s,2=every 30s,3=every min,4=every15m,5=every 30m,6=every hour

Note

When setting options 21-24 you may get unexpected results if you select conflicting settings such as setting the an output to be turned-on in one option but off in another.

14. Reset to initial defaults or check firmware version

If you wish to reset all of the configuration settings back to the initially supplied defaults and erase the time and date from the RTC chip.

Turn off the power, Hold the **SET** button pressed, re-apply the power then release the **SET** button.

The display will now light all LEDS. Within 10 seconds, press the **UP** button and you will hear a short, then long, then short beep and the clock will re-start with every setting set back to defaults and the RTC chip will have lost it's time and date.

If you just want to view the firmware version, power-on with the **SET** button held as above but then press the **ALARM** button within 10 seconds instead of the **UP** button, it will show the firmware version for 10 seconds and then restart the clock.

e.g. version 1.2 would indicate 1 on the hour LEDS and 2 on the minute LEDS.

15. Specifications

Power supply adapter requirements:

A 9 Volts DC power adapter (wall-wart) (Regulated or Unregulated) rated at 250mA or better.

Power consumption:

Measured with a 9V DC regulated supply: approx 90mA (0.8 Watts) maximum with all LEDs on.

Average consumption = approx 50mA (0.45W)

Minimum consumption: 22mA (0.2W) with all LEDs off.

(Actual total power consumption when using your mains adapter (wall-wart) may be higher depending on it's efficiency and your mains supply voltage.)

Dimensions:

PCB only - 80mm X 80mm X 1.6mm (3.15" X 3.15" X 0.06") (PCB has rounded corners)

Clearance required on component side of PCB - 11mm (0.43") approx (excl. buttons)

Protrusion of LEDs – 11.5mm (0.45") approx.

Total thickness= 24mm approx (0.94) (excluding push-buttons)

Timekeeping Accuracy:

Un-adjusted crystal accuracy is within +/- 20ppm. (about +/- 1.7 seconds per 24 hours)

(Crystal frequency will drift with temperature changes and crystal ageing)

Software adjustments can be made to compensate for up to +/- 5 seconds per day in 0.1 second per day increments (i.e. Approx +/- 50ppm in 1ppm increments) while the clock is continuously powered.

Weight: (no case)

Approx 20 grams (0.044 pounds)

16. Feedback

We welcome your comments and suggestions. If there is a feature you particularly like or dislike, or you have any feature requests:

Please use the contact form on the website.