



PRISM – OPEN SOURCE NIXIE CLOCK

Operating Instructions

About this document

This is the user instruction manual for PRSM Open Source Nixie Clocks

Please read this manual carefully before trying to set the clock up: It is a complicated device and you will save yourself frustration if you have a good overview of what the clock can do before you start!

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Internal time provider	Fout! Bladwijzer niet gedefinieerd.

Description

The Wemos Nixie Clock is a beautiful mix of old and new, resulting in a high accuracy, low power clock which will be a talking point in your home.

The clock has the following features:

- Latest technology, highly reliable and accurate.
- Tried and tested design
- Based on the Wemos micro-controller with inbuilt WiFi
- Low power consumption.
- Long tube life:
 - Configurable blanking and a motion detector makes sure that the tubes will stay healthy for many years with no intervention from you
- All settings are stored in non-volatile memory. Once they are set, they are remembered forever, or until you change them again.
- RGB back lighting allows you to set the color of the back lighting to practically any color you desire.
- Ambient light sensing, with automatic tube dimming, which sets the tube and LED brightness according to the light conditions. This also increases tube life.
- Absolutely silent operation. Some Nixie clocks emit an irritating “buzz” or “hiss” which is especially annoying if you keep the clock in a bedroom.
- Automatic weekday or weekend blanking, extends the life of tubes even further
- Automatic time of day blanking, can blank between a start hour and an end hour, on weekdays, weekends or every day
- Extremely accurate timekeeping using Internet based atomic time sources:
- The time never drifts, is always right to within 1 second.
- Automatically compensates for Daylight Savings Time changes, leap years and seconds.
- The controller can be programmed without removing it from the board, using “OTA” (Over the Air) updates
- Has support for a motion sensor

The clock has different modes of operation, which you select using the push button.

First Start Mode

When you start the clock up the very first time, it will start in “First Start Mode”. This mode is intended to simplify the setup of the hardware. It cycles through the digits

00:00:00	-	99:99:99
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 and cycles through colours on the NeoPixels. This allows you to check that all digits on all tubes are working correctly and that the LEDs can show all hues correctly.

The clock will stay in this mode until you exit it, no matter how many times you power up the clock. Once you have exited first start mode, it will not be used again, unless you completely reset the clock using a “Factory Reset”.

Exit First Start mode

Once you have mounted the tubes and are happy that they are working well, you can exit “First Start Mode”. To do this, you must have a push button attached to the clock, even temporarily.

To EXIT First Start Mode, press the push button when the display shows “88:88:88”, and the clock will go to normal time keeping mode!

Exit First Start mode with no tubes

When you want to exit First Start Mode, but don't have any tubes installed, you can use the separator and status LEDs to see when the exit time has arrived. They all light up simultaneously when “88:88:88” is shown.

Holding the button down for a complete cycle until all “8”s is shown will also work.

Time Keeping (“Clock”) Mode

After the first start, each time you start up the unit, the clock will go into normal clock mode and will display the time. In normal clock mode, the time will be displayed.

Factory Reset

If you want to go back to first start or calibration mode, you can perform a factory reset on the clock. To do this, hold down the button **as soon as you see the second yellow back light LED while you power on**. This will reset all settings and start up the clock in First Start Mode again.

The clock will restart after 1 second and clear the settings.

Power on diagnostics

Every time you power the clock up, it will go through a self check routine to check the most important parts of the circuitry. Behind each digit there is a LED, which tells you the status on start up. Each of the LEDs can have one of three colours, in general “Yellow” means “Checking”, “Green” means the test has passed. Red or Blue have different meanings depending on the LED.

The meanings of the different LEDs and colours are as follows:

LED	Colour	Meaning
10s Hours	Green	Clock start up correctly and LED communication is working
Hours	Yellow	Checking the local file system for configuration information
	Green	Correctly read the existing configuration information from SPIFFS
	Blue	No existing configuration information was found: reset everything back to factory status (happens on first start, or after a factory reset)
	Red	Could not mount the SPIFFS storage. This indicates that there has been an error during the flashing of the controller and that no SPIFFS space has been allocated
10s Minutes	Yellow	Trying to connect to a WiFi network
	Green	Connected to a previously entered WiFi network
	Blue	The previously configured WiFi network was not found OR there was no previously configured WiFi network. Enter Access Point mode
	Red	Could not connect to the configured network
Minutes	Yellow	Attempting to recover the time from NTP
	Green	NTP update received correctly
	Red	NTP Update was not received within a reasonable time
10s Seconds	Green	A Real Time Clock ("RTC") module was found
	Red	The RTC module was not found or is faulty
Seconds	Green	The clock is running in normal mode
	Blue	The clock is running in "debug" mode and provides diagnostic information on the serial output

seconds
flashing

"--:--:28" **Clock version.** Show the clock software version.

seconds
flashing

Digit Test. Will roll through all digits on all locations to check that the display is healthy.

Setting Up the WiFi

This step sets up the clocks access to your WiFi and lets it start up and show a display.

Start the clock and wait for the LED behind the “1 X Minutes” digit to turn blue. This means that the clock has gone into “Access Mode”. It will remain in “Access Mode” at least 60

The clock will stay in “access mode” for longer than 60 seconds if any device is connected to it.

If you want to skip over the WiFi set up, you need to make sure that no devices are connected to it.



seconds.

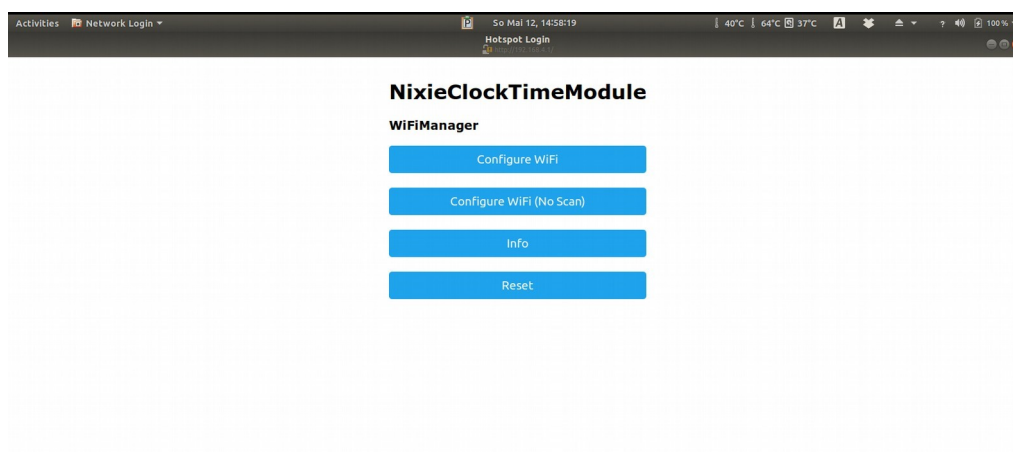
Adjustment

When the clock is in “Access Mode”, you can connect to it with any computer, tablet or phone. Search for a new WiFi network called “ESPClock”. (The Access Point name may vary) When you connect to it, you may be asked to enter the password:

If you are asked then use these credentials:

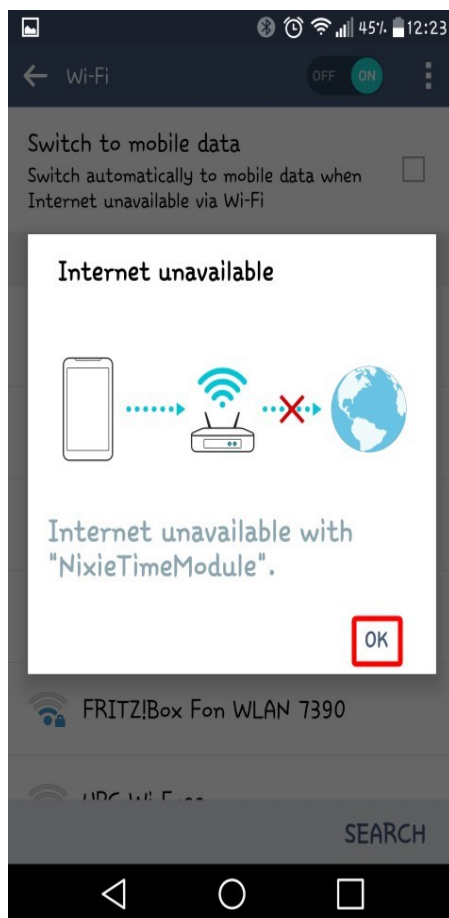
Credential	Value
SSID	ESPClock (or similar)
Password	SetMeUp!

Note: The password is case sensitive!



After a few seconds, you should be taken to the captive portal of the module:

On some phones or tablets, you may get the message that “Internet is not available”, or that you have to “Sign in to the network”. Accept these messages if they appear, at which point you should see that the landing page appears as shown above.



When you see the landing page, press the “Configure WiFi” button, and you should see a list of available WiFi networks (it might take a few seconds to come up if you have many networks in your area).

Select the network you want and enter the password for it.

Note: The network you are using and the password for it will be remembered in your module, and it will try to reconnect to the same network.

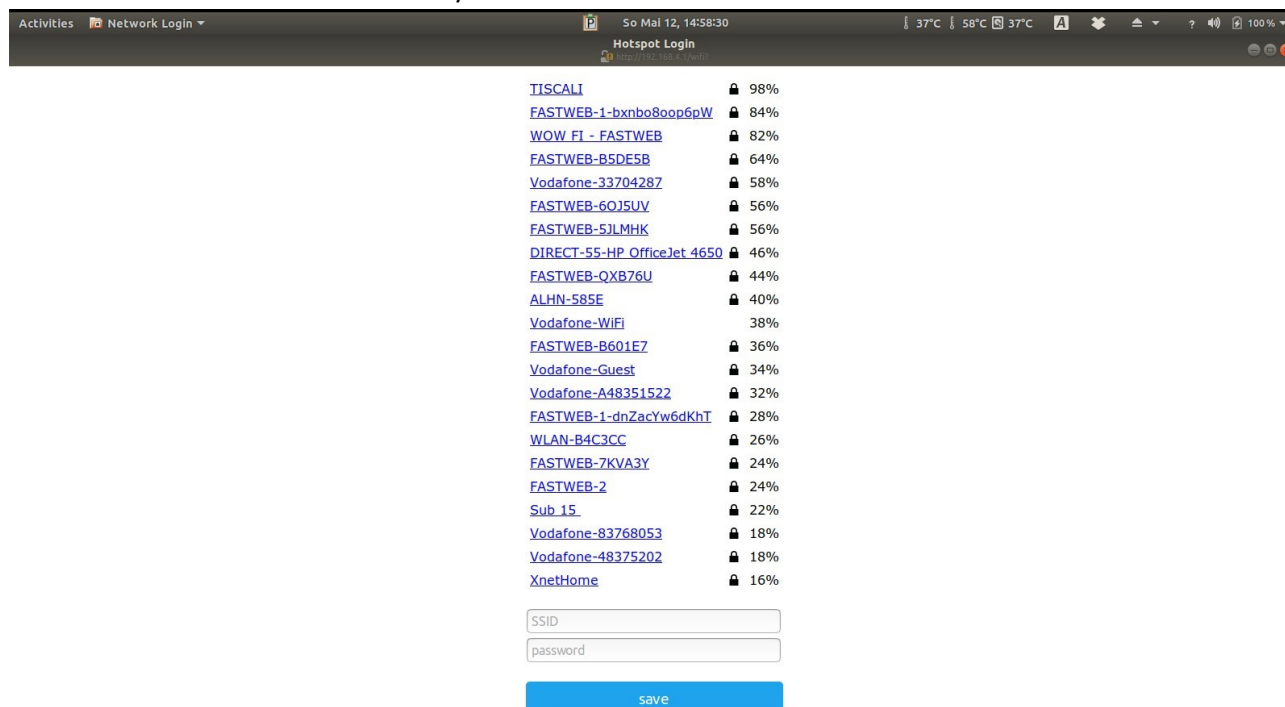
If for any reason the module can no longer find the network (for example, you have changed network or moved the clock), it will revert to set up mode when you re-power the clock.

Note: If you want to continue to use the same network, just leave the clock as it is: It will reconnect automatically when the network becomes available once more.

Note: If for any reason you are not asked to go to the captive portal, and you are sure that you are connected, you can also try going to <http://192.168.4.1> instead. Some older browsers are not able to detect the redirect.

When you have entered the information, the page should close and you will get a message saying that the information has been saved.

If you have the module connected to the clock, you should get a time update after a maximum of two minutes. The module will disconnect you from it.



Note: The time you get will be the time in Central Europe by default! Don't worry, you can change this right away!

See the section about "setting the time" for more information.

How to access the module after WiFi set up

Once the module is set up, you will need to log into it to configure the time server and set the configuration of the clock. The module has an in-built web server, and you can configure it (and your clock) using a browser.

Note: The web interface only starts to be available when the clock is running in normal time mode. **It is not available in "Test Mode"!**

Accessing the clock using mDNS

The clock registers on your network with a unique address. You can use a browser to directly access the clock if you know the address. The address of a clock never changes.

If you don't know the address of the clock, you can get it from in these ways:

- read it from the display of the clock by using the "temporary display", by pressing the button with short presses until you see the IP address (split into two parts).
- From the summary page as "Clock Name".

If you know the ESP ID you can access the clock directly using the address in your browser:

http://esp_XXXXXX.local

The “XXXXXX” is the ESP_ID and is made up of the last 6 places of the MAC address.

Reading the IP from the clock display

The clock will receive an IP address from your router, and you need to know the address in order to log into the module. The easiest way to find the IP address is to wait for the time update to the clock. When this happens, the WiFi module sends the address you need to the clock, and you can read the address from the clock display.

See your user manual for details of how to access the address and read it. The short version is that you can short press the clock button and read the address as it is shown. On 6-Digit clocks you will see something like “19:21:68”, then “00:10:47”, this means 192.168.1.47. On 4-Digit clocks you will see the same address as “1:92”, “1:68”, “0:01” and “0:47” (the address is shown as 4 parts instead of 2).

Reading the IP Address from your router

The other alternative is to look on your WiFi router to see the address the module has been given. You should find an entry in the “connected devices” list which starts with “ESP_” with some numbers and letters after it. This is the module, and the IP address assigned will be shown there.

Remember the IP address or write it down. You will need it to access the module.

Common address ranges – Cable networks

Note: If you are on a cable network, it is usual that you will get an address starting with “10” instead of “192.168” (such as “10.10.34.134”). Just follow the same steps but substitute the address you received.

When you have found the address of the WiFi module, you can log into it using any browser. In the example below, the address I saw on a 6-Digit clock was “19:21:68” then “00:10:84”.

This equates to 192.168.1.84 as shown below:

Current Status

Name	Value
WLAN IP	192.168.1.84
WLAN MAC	84:F3:EB:5A:47:DD
WLAN SSID	TISCALI
NTP Pool	pool.ntp.org
TZ	CET-1CEST,M3.5.0,M10.5.0/3
Last NTP time	2019,5,25,16,11,29
Uptime	26 s
Last time update	17 s ago
Time before next update	2 h 44 s
Version	1

Setting the time

In order to make the time as flexible as possible, you have to enter a cryptic looking string into the “Time Zone String” setting on the time configuration page. For central Europe, (the default setting) this string is:

"CET-1CEST,M3.5.0,M10.5.0/3" and it means that there is daylight savings time for this time zone, and that it changes on the the 3rd month on the last Sunday ("M3.5.0") and changes back on the 10th Month on the last Sunday ("M10.5.0/3") at 3am.

The most common codes are shown at the end of this section.

Enter this in the page "Configure Time Server", and press "Set".

4 Digit Nixie Clock

SummaryConfigure Time ServerConfigure clock settingsUtility

Select time server

NTP Pool

pool.ntp.org

Update interval:

9876

Time Zone String

CET-1CEST,M3.5.0,M10.5.0/3

Set

Some common time zone strings

Here is a short list of some common time zone strings. It is not a full list! (A full list can be found at:

https://github.com/nayarsystems/posix_tz_db/blob/master/zones.csv

Area	Value
United Kingdom	GMT0BST,M3.5.0/1,M10.5.0
Central Europe	CET-1CEST,M3.5.0,M10.5.0/3
US Mountain	MST7MDT,M3.2.0,M11.1.0
US Central	CST6CDT,M3.2.0,M11.1.0
US Eastern	EST5EDT,M3.2.0,M11.1.0
US Pacific	PST8PDT,M3.2.0,M11.1.0
Australia East	AEST-10AEDT,M10.1.0,M4.1.0/3
Australia West	AWST-8
Eastern Europe	EET-2EEST,M3.5.0/3,M10.5.0/4
Ireland	IST-1GMT0,M10.5.0,M3.5.0/1

Web Interface

Menu bar

The menu bar allows you to select the page you are interested in:

4 Digit Nixie Clock	Summary	Configure Time Server	Configure clock settings	Utility
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The options are:

Page	Description
Summary	Summary Information. This page provides information about the current status of the clock. It is not password protected.
Time Server	Time Server configuration. This page lets you set important information about the way the time is retrieved from the internet. This page is password protected.
Clock settings	Clock general settings. This page lets you set up the clock features. This page is password protected.
Utility	Utility functions. This page lets you perform additional utility functions. This page is password protected.

Clock summary page

When you log into the clock's web interface, you will usually arrive on the summary page. This shows an overview of the most important or interesting information about the clock.

Current Status

Name	Value
WLAN IP	192.168.1.84
WLAN MAC	84:F3:EB:5A:47:DD
WLAN SSID	TISCALI
NTP Pool	pool.ntp.org
TZ	CET-1CEST,M3.5.0,M10.5.0/3
Last NTP time	2019,5,25,16,11,29
Uptime	26 s
Last time update	17 s ago
Time before next update	2 h 44 s
Version	1

Option	Description
WLAN IP	This is the IP address under which the clock is available in your WiFi network.

Option	Description
WIFI MAC	This is the MAC address (unique hardware identifier) of the module in your network. You can use this if you have trouble finding the module in your router.

WLAN SSID	This is the WiFi name that you have connected to.
NTP pool	This is the NTP (Network Time Protocol) pool you are using to recover the current time from.
TZ	This is the Posix Time Zone setting you are using. This string tells the clock what time offset from Greenwich Mean Time to use and how to deal with Daylight Savings Time.
Last NTP Time	This was the time that was recovered from the NTP server the last time that it was requested. Note: This time stays fixed until the next update.
Uptime	How long the clock has been running. This will reset ever 50 days or so. (A so called “rollover”).
Last time update	How long ago the time was last recovered from the NTP server.
Time before next update	How long until the next time update is expected from the NTP server.
Version	The firmware version.

The next section deals with the information about peripherals the clock has and how these affect the current status.

Clock information

Name	Value
LDR Value	999
Digit brightness %	100.00
Motion Sensor	Not installed
Time Source	NTP
Display Time	2019:5:25 16:11:46
Real Time Clock	Not installed
Impressions/Sec	250
Total Clock On Hrs	0 s
Total Tube On Hrs	0 s

Option	Description
LDR value	The current value read by the LDR ambient light sensor. This goes between 100 (dark) and 999 (bright).
Digit	As a result of the LDR value and the configuration option “Use LDR”, this is the brightness % brightness of the display digits expressed as a percentage of full brightness.

Option	Description
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Motion	If no motion sensor is installed, this value remains “Not installed”. If a motion sensor is installed, this will show how long ago motion was last detected, and if the display is blanked.
Time source	Either “NTP”, “RTC” or “internal”. The value will show NTP is an update was received in the recent past and if we are still using the value of the NTP time update. This will stay on “NTP” all the while we are in a valid reading, and for the same time afterwards. If you set the “update interval” to 2 hours, the clock will continue to report NTP as being the time source for 2 hours after the reading has expired.
Display time	This is the time that the clock is currently showing on the display.
Real time	This will either show “Not installed” if no RTC was found, or the current internal clock time reported by the RTC. Normally this should be close (maximum a few seconds difference) to the display time.
Impressions/sec	The display update frequency. Normally this should be around 250 per second.
Total Clock	The total accumulated time the clock has been switched on. This is saved into On Hours flash memory once per day at midnight. It does not get forgotten.
Total Tube	The total accumulated time the tubes have been on. If you have configured On Hours tube blanking or have a motion sensor installed, this will be smaller (sometimes considerably smaller) than the clock “on” time.

ESP8266 information

Name	Value
Sketch size	425168
Free sketch size	2719744
Sketch hash	8278dcc0e8f63186ade39499c0219e59
Free heap	30240
Boot version	31
CPU Frequency (MHz)	160
Flash speed (MHz)	40
SDK version	2.2.1(cfd48f3)
Chip ID	5a47dd
Flash Chip ID	164068
Flash size	4194304

Option	Description
Sketch Size	The size (in bytes) of the currently loaded firmware.
Free Sketch Size	How much free space is left in the flash memory. If this is more than the “Sketch Size”, the OTA (Over the air) update option will be available.
Sketch Hash	The MD5 checksum of the firmware. This is useful when handling firmware problems, because it tells us exactly which build version you have.

Option	Description
Free Heap	The amount of volatile memory still available.
Boot Version	The boot loader version.
CPU	The speed of the CPU. This is usually 160MHz. Frequency
Flash	The speed of the communication to the flash memory. This is usually 40MHz. Frequency
SDK Version	The version of the manufacturer's software development kit.
Chip ID	Identifies the exact version of the main processor.
Flash Chip ID	Identifies the exact version/manufacturer of the flash memory.
Flash size	How big the flash memory is.

Time server options page

This page allows you to set how the time is retrieved from the internet and interpreted. This page may be protected by a password if this is configured. Please see the section on “Password Protection” for more information.

Option	Description
NTP Pool	<p>This is the “NTP Pool” you want to use for getting the time. It is recommended that you should use a pool close to you, but in practice, this does not matter very much. You can use the standard pool “pool.ntp.org” if you don’t have a preference for this.</p> <p>A NTP Pool is a group of servers which work together to handle the many requests which arrive.</p>
NTP Update Interval	<p>This is how often the time should be recovered from the NTP pool. Usually there is no real benefit to setting this value too low, because it is used only to make small corrections to the time held by the clock over a long period.</p> <p>The configuration parameter is variable from 60 seconds (once per minute) to 86400 (once per day). It is best to choose a value that is not a multiple of 60 seconds, so that the load on the NTP pool is spread out.</p>
Time Zone String	<p>This tells the clock how to interpret the UTC/GMT time from the NTP pool. It describes the usual offset from UTC, if there is Daylight Savings Time and when the DST should be applied.</p>

Note that settings are only applied when you press the “Set” button.

Clock Settings Page

The clock settings page lets you set up the clock. The options are those presented in the section “Setting Mode”. For full details of the options, please see that section.

Note that settings are only applied when you press the “Set” button.

Utilities Page

The utilities page lets you access functions which are not usually necessary for normal operation of the clock.

Care should be taken when using these options. If you are not sure what you want to do, don’t play around with these options. They can cause you to lose your settings, or potentially make the clock no longer work properly.

Option	Description
Restart WiFi Module	<p>This will cause the clock to restart. Settings are not changed.</p>
Clear WiFi and restart Module	<p>This will cause the saved WiFi settings to be cleared, and then the clock will restart to let you enter new WiFi settings. Note that after doing this, the clock will of course not connect to your network any more, and instead will go into “Access Point” mode.</p>

Option	Description
Update Firmware	This will allow you to upload new firmware for the clock. You can select the firmware file to upload and it will be loaded and installed. Please make sure you are using a firmware which is suitable for the clock, otherwise it will stop working.
Force NTP now	This will cause the clock to access the NTP pool immediately and get the Update from current time, ignoring the "NTP Update Interval".
Perform Reset	This will cause the clock to forget all settings and go into the state it was in Factory when it was first programmed.

Configuration settings

By default, the configuration options are password protected. You can change the username and password or turn off the protection if you want to.

By default, the configuration protection settings are:

Username	admin
Password	setup

OTA Update settings

The “Over The Air” update settings are:

Username	admin
Password	update

Forgotten or Lost settings

If you forget or lose the settings, you will have to factory reset the controller. Please see the section about “Factory Reset”. After a Factory Reset, the values will be the ones you see above.

Display Blanking Mode

If you have a motion detector installed

If you have a motion detector installed (either a PIR or a microwave detector), the standard display blanking will be turned off and only the detector will be used for blanking the display, using the “PIR Timeout” value to determine how long to leave the display on.

If you have a motion detector, you can skip the rest of this section.

Time based display blanking

During display blanking mode the tubes will be off depending on the display blanking settings. You can choose if you want to blank the LEDs, the tubes, or both the LEDs and the tubes.

You can configure the display to blank at weekends, during weekdays, always or never (the default). Also, you are able to define hours during which to blank. For example, I have a setting saying that the clock is blanked on weekdays between 7am and 4 pm, while I am out at work. At weekends, the display runs all the time.

Blanking override

Sometimes you will want to override the blanking, for example normally you have a clock at home that blanks during the day while you are at work, but on a holiday, you are at home. In this case it is possible to temporarily override the blanking.