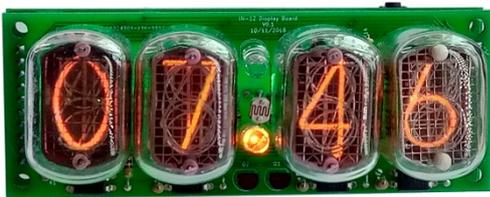


# Wemos 4-Digit Nixie Clock

## Firmware V8

### Operating Instructions Firmware V8

Supported Models:



4-Digit Wemos with IN-12



4-Digit Wemos with IN-2

## About this document

This is the user instruction manual for the Nixie Clocks shown on the first page

- 4-Digit Wemos Nixie Clock with IN-12 or IN-2 tubes

If you want to have the construction manual to guide you through the process of building the clock, please find the appropriate manual at:

<https://www.nixieclock.biz/Manuals.html>

There should have been an exact link to the clock manuals on the packing slip you received in the package.

## Contact Information

If you want to get in contact with us, please email to:

nixie@protonmail.ch

We'll usually get back to you right away. We can help you with kits or construction.

We also offer discounts for direct purchases, we save the Ebay fees, and share this with you.

<https://www.nixieclock.biz/Store.html>

There is also a forum for the clocks, where you can find many answers to questions and contact others who are also using the clocks at:

<http://bit.ly/2Ec0OvW>

Which should redirect you to the much longer:

<https://www.tubeclockdb.com/forum/wemos-nixie-clock-support-forum>

# Table of Contents

About this document.....	2
Contact Information.....	2
Description.....	4
Safety.....	5
General.....	5
Power On Self Test.....	5
First Start.....	5
Exit First Start mode.....	5
Time Keeping (“Clock”) Mode.....	5
WiFi Setup (“WiFi”) Mode.....	5
Factory Reset.....	6
Startup LED status.....	6
Using the clock button.....	8
Temporary Display Mode.....	9
Setting Mode.....	10
Setting Up the WiFi.....	15
How to access the module after WiFi set up.....	18
Accessing the clock using mDNS.....	18
Reading the IP from the clock display.....	18
Reading the IP Address from your router.....	19
Common address ranges - Cable networks.....	19
Setting the time.....	19
Some common time zone strings.....	21
Web Interface.....	22
Menu bar.....	22
Clock summary page.....	22
Time server options page.....	26
Clock Settings Page.....	26
Utilities Page.....	26
Password Protection.....	28
Configuration settings.....	28
OTA Update settings.....	28
Forgotten or Lost settings.....	28
Display Blanking Mode.....	29
If you have a motion detector installed.....	29
Time based display blanking.....	29
Blanking override.....	29
Adding a motion sensor.....	30
Motion sensor automatic detection.....	30
Tube Healing Mode.....	31
Factory Reset.....	32
External power supply.....	33

## 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, with many hundreds of clocks sold
- Based on the Wemos micro-controller with inbuilt WiFi
- Web based configuration - no fiddling with buttons and cryptic mode numbers - the clock still has a button interface, but this is kept only as a backup option
- Low power consumption
- Long tube life: Anti Cathode Poisoning (ACP) and configurable blanking makes sure that the tubes will stay healthy for many years with no intervention from you
- The multiplexed display and automatic dimming used in this design extends the life of the tubes indefinitely. Some other designs run the tubes too "hard", and this causes a rapid degradation in the useful life of the tube
- 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 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 week day 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 week days, weekends or every day
- Configurable suppression of Anti Cathode Poisoning when the clock is fully dimmed. In the middle of the night, all the digits lighting up at full brightness could be disturbing. You can choose to stop ACP when the clock is fully dimmed
- 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.
  - Has a local RTC back up chip to keep time if the Internet is not available
- The controller can be programmed without removing it from the board, using "OTA" (Over the Air) updates
- Has support for a motion sensor

## Safety

The voltages produced in the High Voltage circuit can reach peaks of 200V! Take precautions not to electrocute yourself! If you are not sure what this means, please do not use this clock and return it for a full refund.

A shock from the clock high voltage circuit is at least a nasty bite. At worst it can kill you.

We decline any responsibility in the case of injury or death. You must be qualified to use this clock, it is not intended for anyone unqualified. You must also be qualified to construct the clock. You should have a general understanding of electronics, soldering and electrical safety, both during construction and subsequent operation.

**REPEAT: If you are not sure what this means, do not use the clock!**

## General

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

### Power On Self Test

When powering up, the clock displays a “Power On Self Test” (POST) value that changes rapidly as various steps in the power up are executed. Some steps are rapid, and some take a few seconds to complete.

If your clock won't power up correctly, please report the last POST number shown and we can use this to help locate the issue.

Additionally, the back light LEDs give you an indication

### First Start

When you start the clock up the very first time, it will start in “First Start Mode”. This mode is intended to let you test the tubes during construction. It cycles through the digits **00:00** - **99:99** and repeats until you give the clock the “OK” to exit “First Start Mode”.

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

### 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. It may take a few seconds for the time to be retrieved from the Internet, and this can only happen if you have given the clock credentials to access your WiFi.

### WiFi Setup (“Access Point”) Mode

If the clock cannot access the WiFi, it will go into “Access Point” mode, and wait for you to

configure the WiFi. This might happen when the clock is brand new (i.e. there is no WiFi information stored), or if the clock is not able to connect to the WiFi you previously configured (e.g. if you changed the router SSID or password, or changed the router or the location of the clock).

When in “Access Point Mode”, the clock will halt the startup process, and show the second digit back light in blue. In this case, you can set up the clock using the instructions in the section about Setting Up the WiFi (page 15).

Eventually, the clock will continue without the Wifi, and will fall back to the RTC (“Real Time Clock”), but in this case the accuracy is reduced.

## Factory Reset

If you want to go back to the state the clock was in when it was brand new, you can perform a “factory reset”. To do this, **hold down the button as soon as you see the first yellow back light LED** while you power on. This will reset all settings and start up the clock in First Start Mode again.

## Startup LED status

Behind each digit there is a LED, which tells you the status on start up. This is less detailed than the POST values, but is a nice visual indication of the status of the clock.

Each of the LEDs can have one of four colours, in general “Yellow” means “Checking”, “Green” means the step was completed without error, “Red” means there was a problem and “Blue” means that a setup option was triggered.

The table below shows the meanings of the colours on each digit.

The meanings of the different LEDs and colours are:

LED	Colour	Meaning
Minutes	Yellow	Checking the internal SPIFFS (Non-volatile memory) for configuration information
	Green	Recovered the configuration information correctly - previously stored settings have been loaded
	Red	Failed to recover the configuration information - default settings will be used. Note that this may also indicate that the SPIFFS area of the controller has not been initialised correctly. If this state continues after the first start, please seek help from us.
	Blue	The Factory reset has been accepted if you pressed the button while the yellow state was shown.
10s Minutes	Yellow	Checking the access to the WiFi network
	Green	Joined the previously stored WiFi access point
	Blue	Failed to join the previously stored access point, or no access point stored: Gone into "Access Point Mode"
	Red	Failed to access previously stored access point, and no connection received within 60 seconds in "Access Point Mode". Enter normal clock mode using RTC.
Hours	Green	Got an NTP update
	Red	Failed to get an NTP update, using RTC until the next successful NTP update, which will be tried every few seconds until an update is successful
10s Hours	Green	Found the Real Time Clock
	Red	Did not find the Real Time Clock

## Using the clock button

Normally the clock is in “Time Display Mode”, which will show the time. If you press the button for differing lengths, different things will happen.

**“Short Press”** (less than 1 second): A temporary display will be shown for 5 seconds. This is useful if you want to know the date, for example. The options here are given in the section “Temporary Display Mode”

**“Long Press”** (more than 1 second): The clock will go into “Setting Mode” to allow you to change settings. If you are connected to a network, you can change settings using a browser which is much easier.

**Note: To exit “Setting Mode” do another “Long Press”.**

Nowadays, setting up the clock using the button is not really necessary. Please use the Web Interface for all settings of the clock.

# Temporary Display Mode

Normally, the clock will show the time. To show additional information press the button with a “short” press. Each press cycles through the following information. After 5 seconds, the display will revert to the normal time display.

Note that some of the options are not shown under all circumstances. For example, if you are not connected to a WiFi access point, the IP address will not be shown.

Mode	Description	Values
Minutes / Seconds	<b>Shows minutes/seconds instead of hours/minutes.</b> Normally the clock shows hours and minutes, but this mode shows the minutes and seconds.	Example <b>34:06</b>
Date	<b>Date.</b> The current date will be shown in the date format you selected, either MM-DD or DD-MM.	Example <b>17:06</b>
LDR	<b>Ambient Light Reading.</b> This shows the current ambient light reading from the LDR (light dependent resistor). It is a normalized value, and goes between 2 (dark) to 20 (bright). This controls the dimming of the tubes. The dark value is set by the “minimum dim” value.	Example <b>00:20</b> 0002: darkest 0020: brightest
Version	Display the <b>version number</b> . The format will be “VV:vv”, where major version is “VV”, minor version is “vv”.	Example <b>00:08</b>
IP Address part 1	If you have WiFi connected, this will show the first digit of the 4 digit IP address. Usually this address starts with “192”. If you are on a cable network, it might start with “10”.  <b>Note:</b> The IP address is skipped if you do not have a WiFi connection.	Example: <b>01:92</b>  = “192”
IP Address part 2	The second digit of the 4 digit IP address.  <b>Note:</b> The IP address is skipped if you do not have a WiFi connection.	Example: <b>01:68</b>  = “168”
IP Address part 3	The third digit of the 4 digit IP address.  <b>Note:</b> The IP address is skipped if you do not have a WiFi connection.	Example: <b>00:01</b>  = “1”
IP Address part 4	The last two digits of the 4 digit IP address. Put this together with the value shown in IP Address parts 1,2 and 3 to give the full address.  You can enter the whole value into your browser to connect to the module. You must remove any leading “0” from the value. If you receive “192.168.001.106”, you must enter this as “192.168.1.106” into your browser address bar. Do not include the leading zeros on any part of the address.	Example: <b>01:06</b>  = “106”
Mux Speed	This shows the number of impressions per second, which is the refresh rate of the display. It varies a little based on the exact workload, but is usually about 92 impressions per second. It is not very important if this number changes, it is mostly there for the purpose of satisfying curiosity.	Example: <b>00:92</b>

# Setting Mode

Usually you will want to set the clock up using the browser interface, because it is much easier to understand and quicker that way.

To enter setting mode, press the button for more than 1 second (“medium press”).

Each medium press of more than 1 second will move the setting mode onto the next. When you finish the setting modes, the clock returns to normal time display mode.

**To exit** the setting mode before going through all the options, press the button for more than 2 seconds (“long press”). Another way of exiting is to cycle through all of the setting options, after which you will return to time mode.

To change a setting, press the button for less than one second, and then release it (“short press”).

Mode	Description	Values
	<p><b>Time mode.</b> This is the normal mode and displays the time. It is the normal start up mode of the clock. If you do nothing. The clock is in this mode.</p> <p>In this mode a short press cycles through the values given in “Time Display Mode”, but always returns to the standard time display after 5 seconds.</p>	
<b>Time and Date Settings</b>		
<p><b>Note that the Time and Date settings will not be shown if WiFi is active!</b> There is no need to set the time manually in this case. If you have no active WiFi connection, you can set the time. However, as soon as WiFi is active, the time will be set according to the Internet NTP server, overwriting the manual values you have set.</p>		
<b>HH</b> <b>MM</b>	<b>Set Hours.</b> Each short press will advance the hour. The hours roll over back to zero after reaching 12 or 24 (depending on the 12/24 hours mode).	
<b>HH</b> <b>MM</b>	<b>Set minutes.</b> Each short press will advance the minute. The minutes roll over back to 0 after reaching 59 minutes. Each time you set the minute, the seconds is reset to 0.	
<b>MM</b> <b>SS</b>	<b>Reset seconds.</b> Each short press will reset the seconds to 0, without changing the hours or minutes.	
<b>MM</b> <b>DD</b> or <b>DD</b> <b>MM</b>	<p><b>Set Day.</b> Each short press will advance the day. The day roll over back to one after reaching the maximum number of days in the month.</p> <p>Depending on the date format you have set, this will be shown in day:month format, or month:day format.</p>	
<b>MM</b> <b>DD</b> or <b>DD</b> <b>MM</b>	<p><b>Set Month.</b> Each short press will advance the month. The month roll over back to zero after reaching 12.</p> <p>Depending on the date format you have set, this will be shown in day:month format, or month:day format.</p>	
<b>20</b> <b>YY</b>	<b>Set Year.</b> Each short press will advance the year. The year roll over back to 2015 after reaching 2099.	

Mode	Description	Values
<b>Basic Settings</b>		
<b>07</b> mm "07" flashing "mm" = value	<b>12 or 24 hour time.</b> The hours are displayed in 12 or 24 hour mode.	"1" = 12 hour "0" = 24 hour default: 0
<b>08</b> mm "08" flashing d"mm" = value	<b>Blank leading "0".</b> Blank out the leading "0" from single digit hours.	"1" = blank "0" = don't blank default: 0
<b>09</b> mm "09" flashing "mm" = value	<b>Scroll back.</b> Use the scroll back (rapid count down) effect when changing from "9" to "0".	"1" = enable "0" = disable default: 1
<b>10</b> mm "10" flashing "mm" = value	<b>Scroll-back Speed Slower.</b> Each short press will make the "scroll-back" speed slower.	Default: 4 Max: 40 Min: 1
<b>11</b> mm "11" flashing "mm" = value	<b>Scroll-back Speed Faster.</b> Each short press will make the "scroll-back" speed faster.	Default: 4 Max: 40 Min: 1
<b>12</b> mm "12" flashing "mm" = value	<b>Fade.</b> Use cross digit fading.	"1" = enable "0" = disable default: 1
<b>13</b> mm "13" flashing "mm" = value	<b>Fade Speed Slower.</b> Each short press will make the fade speed between digits slower.	Default: 50 Max: 200 Min: 20
<b>14</b> mm "14" flashing "mm" = value	<b>Fade Speed Faster.</b> Each short press will make the fade speed between digits faster.	Default: 50 Max: 200 Min: 20
<b>15</b> mm "15" flashing "mm" = value	<b>Date format.</b> Set the format that the date is displayed in.	"0" = MM.DD "1" = DD.MM default: 1
<b>16</b> mm "16" flashing "mm" = value	<p><b>Display blanking.</b> To preserve the tubes, you can set the display to be blanked.</p> <p>Options:</p> <ul style="list-style-type: none"> <li>"0" = "never": Don't use blanking.</li> <li>"1" = "Weekends": Blank at weekends.</li> <li>"2" = "Week days": Blank on week days.</li> <li>"3" = "Always": Always use blanking.</li> <li>"4" = "Hours": Blanks between the start and end hour every day.</li> <li>"5" = "Hours or weekends": This blanks all day during the weekends and between the start and end hour every other day.</li> <li>"6" = "Hours or week days": This blanks all day during the week days and between the start and end hour every other day.</li> <li>"7" = "Hours on weekends": This blanks between the start and end hour on weekends.</li> <li>"8" = "Hours on week days": This blanks between the start and end hour on week days.</li> </ul> <p><b>Note:</b> This setting only has a meaning when the motion detector is not connected!</p>	"0" = Don't blank "1" = Weekends "2" = Week days "3" = Always "4" = Hours "5" = H <b>or</b> weekends "6" = H <b>or</b> week days "7" = H <b>on</b> weekends "8" = H <b>on</b> week days default: 0

Mode	Description	Values
<b>17 mm</b> <small>"17" flashing "mm" = value</small>	<b>Blanking Hour Start.</b> Hour blanking will start at this hour, on the days set by the Display Blanking Mode.  If the display blanking mode does not use hours, this setting is not shown.	Default: 00
<b>18 mm</b> <small>"18" flashing "mm" = value</small>	<b>Blanking Hour End.</b> Hour blanking will end at this hour, on the days set by the Display Blanking Mode.  If the display blanking mode does not use hours, this setting is not shown.	Default: 07

Mode	Description	Values
<b>Light Dependent Resistor Settings</b>		
<b>19 mm</b> <small>"19" flashing "mm" = value</small>	<b>Use LDR.</b> If you disable the LDR, the tubes will always work at maximum brightness. If you enable it, the display brightness will vary with the ambient lighting.	"1" = enable "0" = disable default: 1
<b>20 mm</b> <small>"20" flashing "mm" = value</small>	<b>Increase Minimum dim.</b> This setting allows you to increase the minimum brightness you want to have when the clock is fully dimmed.	Default: 4 Max: 20 Min: 2
<b>21 mm</b> <small>"21" flashing "mm" = value</small>	<b>Decrease Minimum dim.</b> This setting allows you to decrease the minimum brightness you want to have when the clock is fully dimmed.	Default: 4 Max: 20 Min: 2

Mode	Description	Values
<b>Digit Blanking Settings</b>		
<b>22 mm</b> <small>"22" flashing "mm" = value</small>	<b>Blank Mode.</b> You can set the tubes, the LEDs or both the tubes and the LEDs to be blanked when in blanking mode. If you like, you can also blank the separators between the digits.	"0" = tubes "1" = LEDs "2" = tubes and LEDs "3" = tubes, LEDs and separators default: 2
<b>23 mm</b> <small>"23" flashing "mm" = value</small>	<b>Slots Mode.</b> You can have the date shown automatically once per minute for about 5 seconds.	"0" = disable "1" = enable default: 1
<b>24 mm</b> <small>"24" flashing "mm" = value</small>	<b>Separator LED Pattern.</b> Sets the flashing pattern for the separator LEDs.	"0" = "Railroad" "1" = "Slow blink" "2" = "Fast blink" "3" = "Double blink" "4" = Off "5" = On "6" = am/pm default: Railroad

Mode	Description	Values
<p><b>25</b> <input type="checkbox"/></p> <p>"25" flashing "minutes" digits blanked</p> <p>then</p> <p><b>mm</b> <b>mm</b></p>	<p><b>PIR Timeout Longer.</b> If you have a PIR or microwave motion sensor installed, this setting determines how long the clock will wait before turning the display off when there is no motion detected. The value is in seconds.</p>	<p>Default: 300 Max: 3600 Min: 60</p>
<p><b>26</b> <input type="checkbox"/></p> <p>"26" flashing "minutes" digits blanked</p> <p>then</p> <p><b>mm</b> <b>mm</b></p>	<p><b>PIR Timeout Shorter.</b> If you have a PIR or microwave motion sensor installed, this setting determines how long the clock will wait before turning the display off when there is no motion detected. The value is in seconds.</p>	<p>Default: 300 Max: 3600 Min: 60</p>
<p><b>27</b> <b>mm</b></p> <p>"27" flashing "mm" = value</p>	<p><b>PIR Pullup.</b> Use the internal pull-up resistor. Normally you will not have to change this setting, but in the case that your motion detector does not work correctly, you can set this.</p>	<p>"1" = enable "0" = disable default: 1</p>

Mode	Description	Values
<b>Back Light Settings</b>		
<b>28</b> <b>mm</b> <small>"28" flashing "mm" = value</small>	<p><b>Back Light Mode.</b> This sets the mode of the back light.</p> <p>"Fixed" mode will show the back light color according to the Red, Green and Blue channel intensities.</p> <p>"Cycle" fades the back lighting randomly, and does not use the Red, Green and Blue channel intensities. These settings will be skipped if cycle mode is selected.</p> <p>"Colourtime" sets the LED behind the digit according to the value displayed on the digit. It does not use the Red, Green and Blue channel intensities. These settings will be skipped if cycle mode is selected.</p> <p>"Day of week" sets the LED behind the digit according to the day of the week. It does not use the Red, Green and Blue channel intensities. These settings will be skipped if cycle mode is selected.</p>	<p>"0" = Fixed  "1" = Cycle  "2" = Colourtime  "3" = Day of Week  default: 0</p>
<b>29</b> <b>mm</b> <small>"29" flashing "mm" = value</small>	<p><b>Red Channel Intensity.</b> Sets the maximum intensity of the red channel back light. This will be dimmed according to the display dimming.</p> <p>If you are <b>not</b> in "fixed" mode, this setting will be skipped.</p>	<p>Default: 15  Max: 15  Min: 0</p>
<b>30</b> <b>mm</b> <small>"30" flashing "mm" = value</small>	<p><b>Green Channel Intensity.</b> Sets the maximum intensity of the green channel back light. This will be dimmed according to the display dimming.</p> <p>If you are <b>not</b> in "fixed" mode, this setting will be skipped.</p>	<p>Default: 15  Max: 15  Min: 0</p>
<b>31</b> <b>mm</b> <small>"31" flashing "mm" = value</small>	<p><b>Blue Channel Intensity.</b> Sets the maximum intensity of the blue channel back light. This will be dimmed according to the display dimming.</p> <p>If you are <b>not</b> in "fixed" mode, this setting will be skipped.</p>	<p>Default: 15  Max: 15  Min: 0</p>
<b>32</b> <b>mm</b> <small>"32" flashing "mm" = value</small>	<p><b>Cycle Speed.</b> If you are in cycle mode, this controls the speed at which the colors cycle. The higher the number, the slower the colors will change.</p> <p>If you are <b>not</b> in "cycle" mode, this setting will be skipped.</p>	<p>Default: 10  Max: 64  Min: 4</p>
<b>33</b> <b>mm</b> <small>"33" flashing "mm" = value</small>	<p><b>Backlight Pulse.</b> When this setting is set, the backlights will pulse on and off.</p>	<p>"1" = enable  "0" = disable  default: 1</p>
<b>34</b> <b>mm</b> <small>"34" flashing "mm" = value</small>	<p><b>Backlight Dim.</b> When this setting is set, the backlights will dim with the ambient light.</p>	<p>"1" = enable  "0" = disable  default: 1</p>
<b>35</b> <input type="checkbox"/> <small>"minutes" digits blanked then</small>  <b>VV</b> <b>VV</b>	<p><b>Clock version.</b> Show the current clock software version.</p>	
<p><b>Digit Test.</b> Will roll through all digits on all locations to check that the display is healthy.</p>		

# Setting Up the WiFi

This step sets up the clocks access to your WiFi and lets it start up and show a display. To complete this step you should have the display board finished and installed on the clock.

Start the clock and wait for the LED behind the “10 X Seconds” digit to turn blue. This means that the clock has gone into “Access Mode”. It will remain in “Access Mode” at least 60 seconds.



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.

When the clock is in “Access Mode”, you are able to connect to it with any computer, tablet or phone. Search for a new WiFi network called “ESP\_<ESPID>”.

**Note: You can find the full name of the Access Point by looking at the packing slip.** We write it on there for you when we prepare the clock.

When you connect to it, you will be asked to enter the password:

This access point has the credentials:

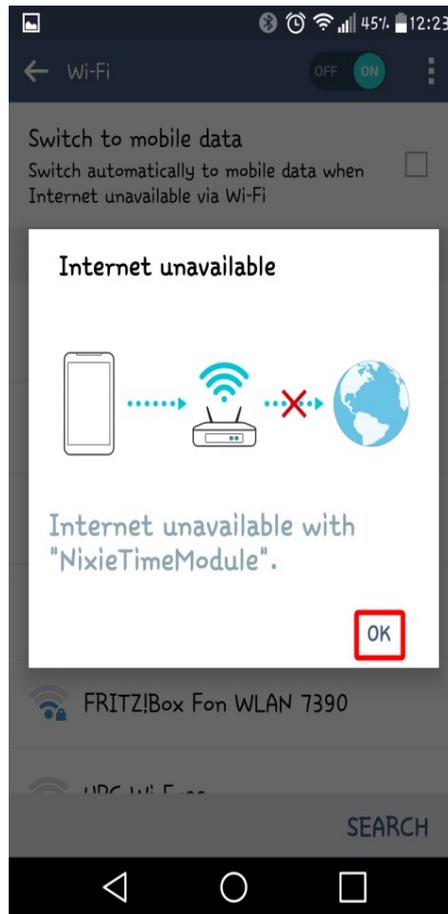
Credential	Value
SSID	ESP_<ESP_ID>
Password	SetMeUp!

**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.

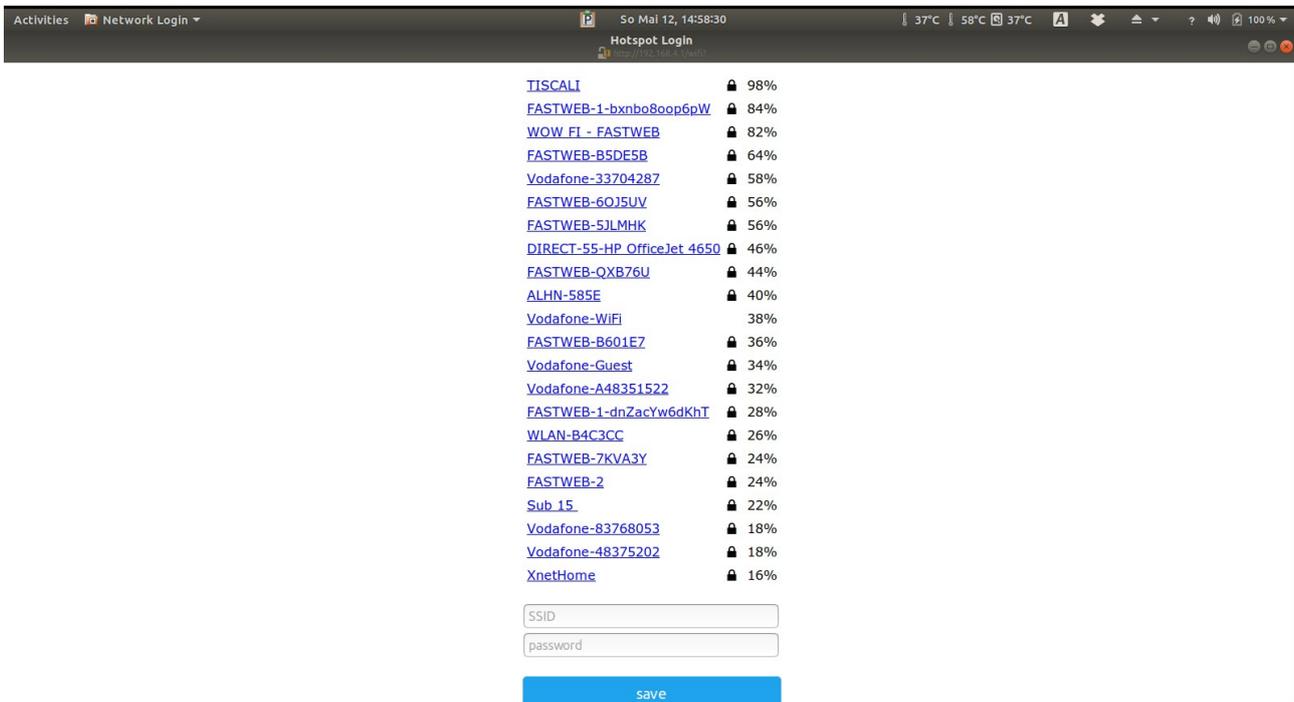
If for any reason the module can no longer find the network (for example, you have changed network or moved the clock), it will revert to set up mode when you re-power the clock.

**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 read it from the display of the clock by using the "temporary display", by pressing the button with short presses until you see the "ESPID". We also write this on your packing slip. It is also visible on the summary page.

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

`http://esp_xxxxxx.local`

### Reading the IP from the clock display

The module 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 “01:92”, “01:68”, “00:01” and “00:47” (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 3<sup>rd</sup> month on the last Sunday (“M3.5.0”) and changes back on the 10<sup>th</sup> 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”.

### Select time server

**NTP Pool**

**Update interval:**

**Time Zone String**

## 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](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	<b>Summary Information.</b> This page provides information about the current status of the clock. It is not password protected.
Time Server	<b>Time Server configuration.</b> This page lets you set important information about the way the time is retrieved from the internet. This page is password protected.
Clock settings	<b>Clock general settings.</b> This page lets you set up the clock features. This page is password protected.
Utility	<b>Utility functions.</b> 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.
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.

Option	Description
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. <b>Note:</b> 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 brightness %	As a result of the LDR value and the configuration option "Use LDR", this is the bightness of the display digits expressed as a percentage of full brightness.
Motion sensor	If no motion sensor is installed, this value remains "Not installed". If a motion sensor is installed, this will show how log ago motion was last detected, and if the display is blanked.

Option	Description
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 clock	This will either show "Not installed" if no RTC was found, or the current internal 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 On Hours	The total accumulated time the clock has been switched on. This is saved into flash memory once per day at midnight. It does not get forgotten.
Total Tube On Hours	The total accumulated time the tubes have been on. If you have configured 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.
Free Heap	The amount of volatile memory still available.
Boot Version	The boot loader version.
CPU Frequency	The speed of the CPU. This is usually 160MHz.
Flash Frequency	The speed of the communication to the flash memory. This is usually 40MHz.

<b>Option</b>	<b>Description</b>
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>
Update Firmware	<p>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.</p>

<b>Option</b>	<b>Description</b>
Force Update from NTP now	This will cause the clock to access the NTP pool immediately and get the current time, ignoring the "NTP Update Interval".
Perform Factory Reset	This will cause the clock to forget all settings and go into the state it was in when it was first programmed.

# Password Protection

## 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:

<b>Username</b>	admin
<b>Password</b>	setup

## OTA Update settings

The “Over The Air” update settings are:

<b>Username</b>	admin
<b>Password</b>	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 week days, 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.

Press the button ("short press") while the clock is blanked, and the display will come on again for a few seconds, and then return to blanking mode.

If you press the button multiple times within 5 seconds, the blanking will stay off for longer periods:

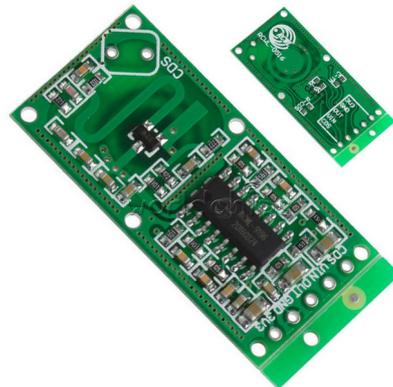
- 1 Press: 10 seconds
- 2 Presses: 1 hour
- 3 Presses: 4 hours

## Adding a motion sensor

One of the best ways for reducing power consumption and extending tube life is to use a motion sensor. This can either be a PIR (recommended: HC-SR505) or a microwave detector (recommended: RCWL-0516, shown on the right).



HC-SR505 PIR



RCWL-0516

You can also use other types of sensor, but it is important that you choose one with a 3.3V output. If you choose one with a 5V output, you could damage your controller.

### Motion sensor automatic detection

The motion sensor is automatically detected if it is installed, and the default blanking operation is disabled. From the time that the motion sensor is detected, the clock will automatically go into blanking more when the clock detects that no one is there to see the display.

This greatly increases tube life! You can see the effect of blanking by comparing the values of "Total Clock On Hours" and "Total Tube On Hours" on the summary page. For a clock in my bedroom, the on hours is less than 5% of the total on time, therefore increasing the tube life by more than 20 times.

If no motion sensor is detected, the tubes will either be never blanked, or blanked according to the time schedule you have chosen.

## Tube Healing Mode

After a long period of time, tube filaments which are not often used (e.g. the "9" on the tens of hours or minutes) can get dim, despite the ACP that is regularly done.

If you make a "long" press of the button (more than 8 seconds), the clock will enter filament healing mode. All the power will be placed through a single filament of a single digit to clean it. A short press will change the selected filament.

Another super-long press or cycling through all the filaments will return the clock to normal.

**Caution!** Don't leave a single filament in this state for an extended period of time. It is a harsh process, and may damage the tube if you leave it in this mode for too long. Normally a few seconds minutes will restore the cathode digit.

Normally you will not need to use this mode! It is only there for tubes that are already in trouble. **Don't make a habit of using this mode!**

## **Factory Reset**

To reset the clock back to initial settings, hold down the button directly after powering on, as soon as you see the first yellow LED come on. The clock will restart and the settings will have been reset.

Everything will be reset back to the factory default state, and the clock will go back to “First Start Mode”.

## **External power supply**

The perfect voltage for the external power supply is 7.5V or 9V DC. You can use 12V DC.

If you use more than 12V be aware that you might have to provide a heat sink for the power components and adjust the HV voltage generation. It is not advised to use more than 12V.

The absolute maximum permissible is 16V DC. Higher voltages than this will surely damage the clock.

Revisions:

V0001: 22May2019: Initial version

V0002: 15Sep2019: Correct startup diagnostics (was "Seconds" instead of "Minutes")

V0003: 25Oct2019: Add information about mDNS

V0004: 26Oct2019: Add information about AP naming

V0008: 01Jul2020: Rearrange button menu