

# **WiFi Time Provider v1**

# **for Arduino Nixie Clock**

## **Operating Instructions**

## **&**

## **Construction Manual**

## 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. There is also a forum available at:

<https://www.tubeclockdb.com/component/kunena/12-arduino-nixie-clock-kit-support-forum.html>

## Repeat order discounts

We also offer discounts for direct purchases, we save the Ebay fees, and share this with you. Contact us for information. Usually this works out as about 10%.

There are also more shipping options available.

Please go here for more information:

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

## Software

The software is available on GitHub at the address:

<https://github.com/isparkes/ArduNix6/tree/master/WifiTimeProviderESP8266>

## Troubleshooting

If everything does not work as you expect, please carefully look at the tests in the construction steps, and the troubleshooting tips.

At the end of the manual, there is a troubleshooting section, which goes through some of the common problems.

## Description

This is a WiFi time provider for the Arduino Nixie Clock. It makes sure that your clock is always right, (even when daylight savings change), and never drifts because the time is synchronised with network atomic clocks.

The module has the following features:

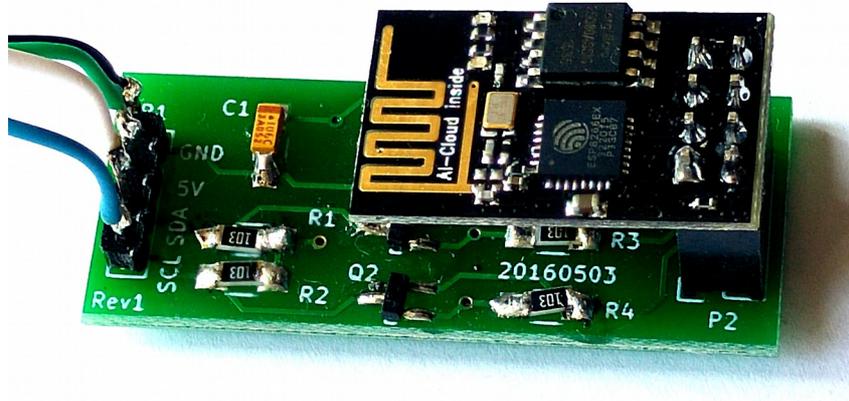
- Configure and forget. It just runs. No intervention necessary ever.
- The time never drifts – it is always right within 1 second, year after year, even after daylight savings time changes.
- Really simple configuration: You just have to enter your WiFi SSID and password, and the time zone, and the rest happens automatically.
- Logs into your WiFi network. You configure the module with the credentials, and it remembers the settings forever, or until they change.
- Based on the ESP8266 micro-controller: Easy to program with the Arduino IDE and well documented.
- Open source.
- You may modify and load the software
- Low power consumption.
- All settings are stored in non-volatile memory. Once they are set, they are remembered forever, or until you change them again.
- Configure the clock setting from the web interface. Makes setting up the clock really easy and quick.

This module works together with the Arduino 6 Digit Nixie Clock. The clock module is not provided in this package.

If you have an existing Arduino 6 Digit Nixie Clock, the clock needs to have a firmware update to work with this module.

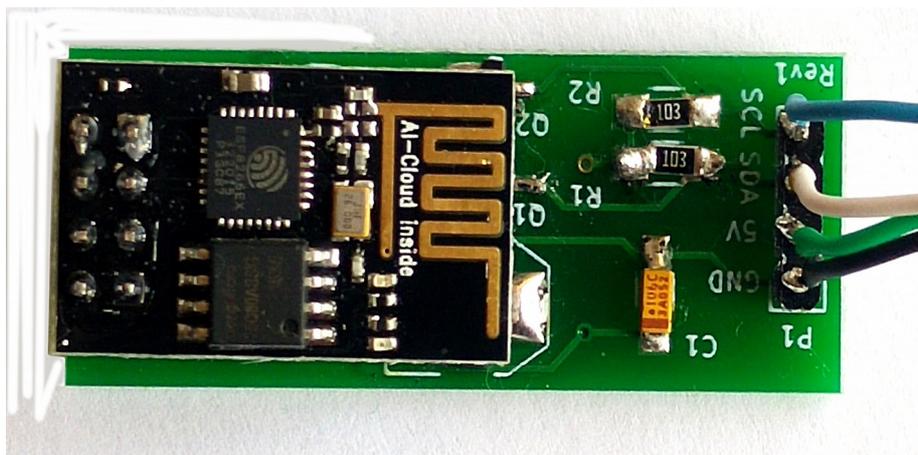
## Setting the module up for the first time

When you receive the package, it will come as two parts so that it is not damaged in during shipping. You have to assemble the two parts. The tiny black ESP8266 board goes into the 8 pins socket on the interface board so that the ESP board covers about half of the interface board:



It must **not** be placed facing outwards, because this will provide the supply voltage inverted and will surely destroy the board.

Looking from above, it should look like this:



If it does not look like this, do not proceed to power on the module.

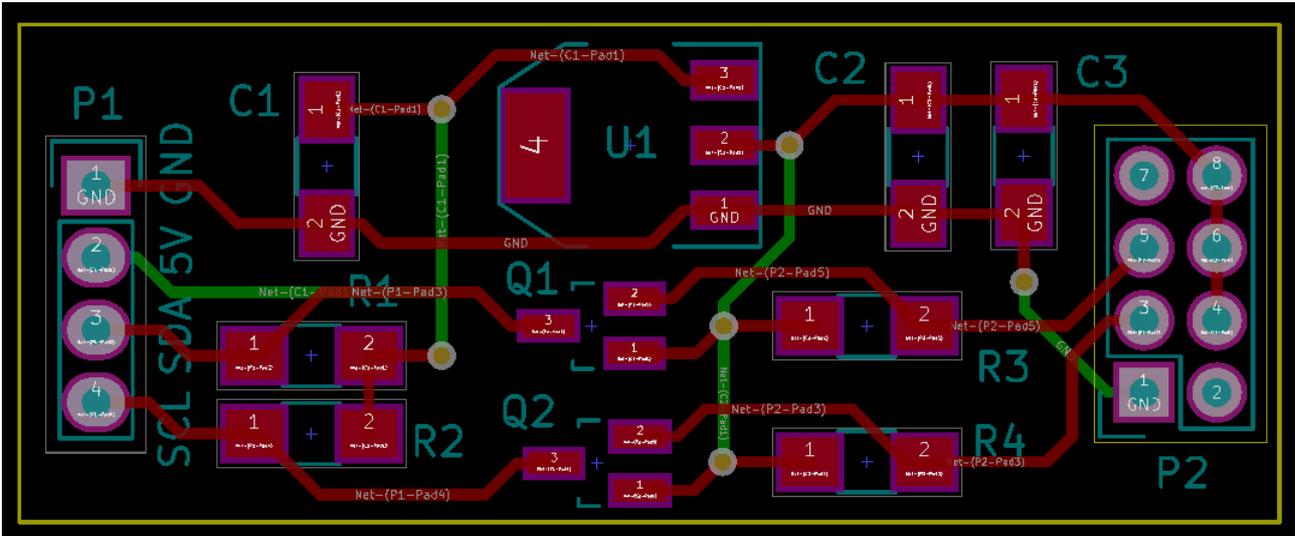
## The Blue Status LED

There is a tiny blue status LED on the Time Module. This gives you a quick check of the status of the module. The LED flashes according to the connection status of the module.

LED Status	Meaning
Flashing Quickly (about 5 flashes per second)	The module is not connected to the WiFi at all and has opened the Access Point to allow configuration. When the module is in this status, you should be able to find the "NixieTimeModule" open network available.
Flashing Medium Speed (½ second on, ½ second off)	<p>The module is connected to the WiFi, but not to the time server.</p> <p>The "NixieTimeModule" open network will not be available. (In fact it stays open until the module is restarted after initial configuration, but subsequent restarts will close it).</p> <p>You need to connect to the time module and set the time server location.</p>
Flashing Slowly (1 second on, 1 second off)	<p>The module is connected to the WiFi and connected to the Time Server. This is the normal status.</p> <p>The "NixieTimeModule" open network will not be available. (In fact it stays open until the module is restarted after initial configuration, but subsequent restarts will close it).</p>

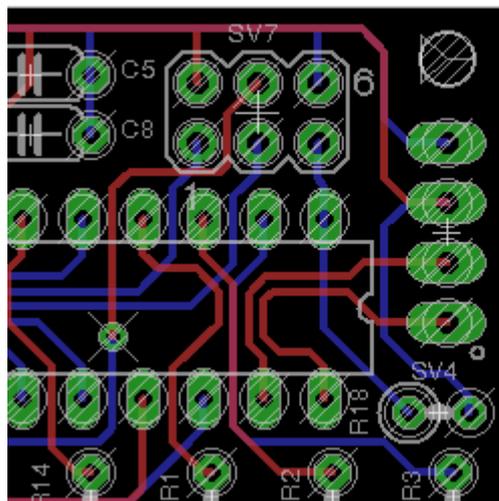
# Connecting the module to the clock

The module is a tiny circuit board which fits onto the I2C port of the clock. The layout of the board is:



You simply connect the Nixie Time Module to the existing I2C interface on the clock. The pins on P1 line up 1 to 1 with the pins on the Clock Module. You can either connect directly, or using flying leads.

The port on the clock module looks like this:



- GND
- VCC
- SDA
- SCL
- RTC

## Powering Up for the first time

Check that the ESP board is installed correctly and the I2C interface is connected.

When you power the time provider up for the first time, it does not know how to connect to your WiFi network. The tiny blue LED will flash rapidly (about 5 times per second) to tell you that the module is not connected.

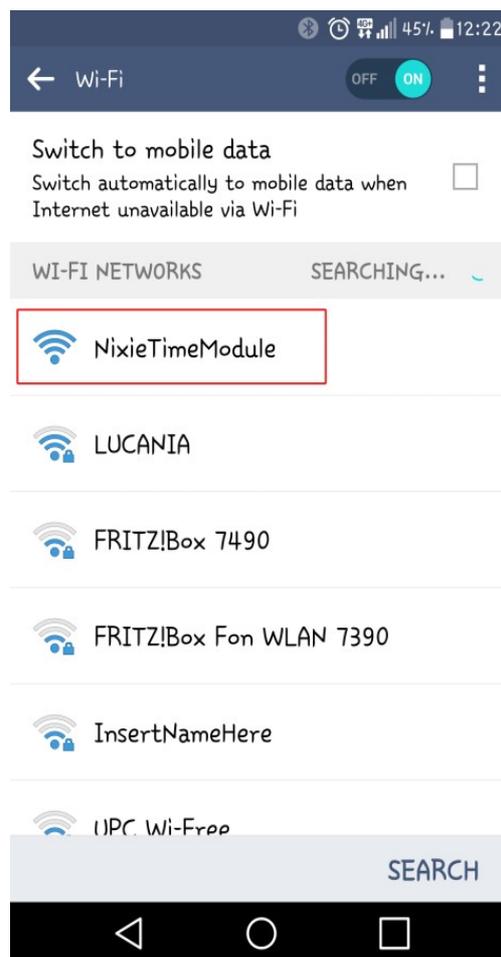
You must tell it the SSID (the WiFi network "name") and the password that goes with it. If there is no password, that's OK, just leave it blank.

To configure the module, you have to log into it using a computer, phone or tablet. It is called "NixieTimeModule", and you should be able to log into it without using a password. The "NixieTimeModule" SSID will only appear if the module finds no connection to your WLAN on startup. If it can connect to your WLAN, it will turn off the access point. This is for security.

Some computers don't always manage to log into the NixieTimeModule WiFi network, but phones and tablets almost always do. Whether you perform the first configuration using a computer, tablet, or phone, the process is the same.

### Step 1: Select the NixieTimeModule access point

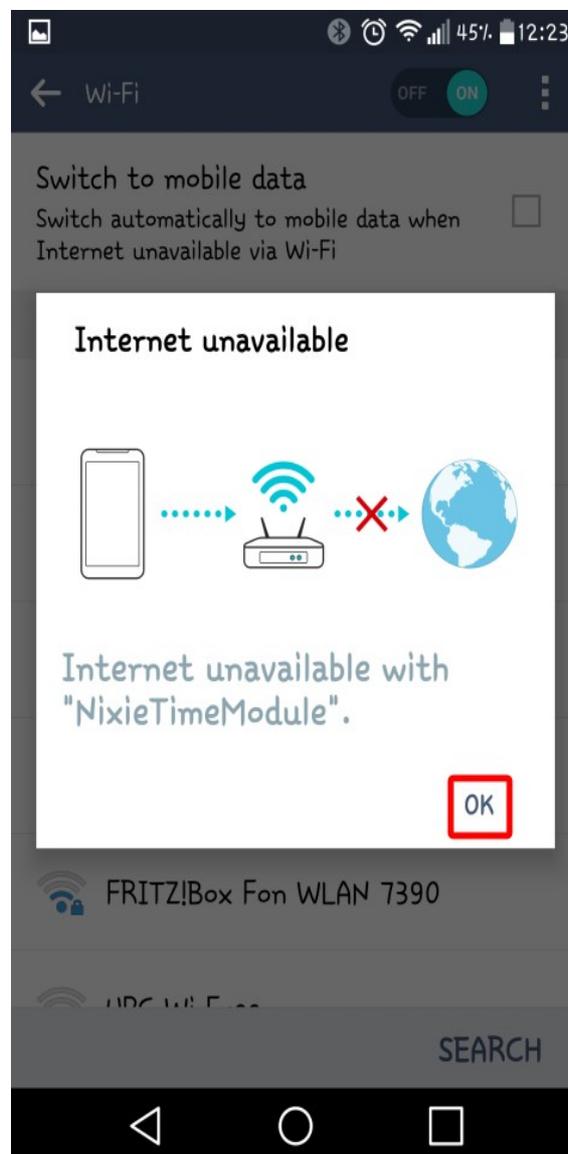
Search in the list of WiFi networks for the one called "NixieTimeModule" and connect to it. There is no password.



## Step 2: Accept the message saying that Internet is not available

When you have connected to it, you might get a message that Internet is not available. This is fine, just say "OK" to the message.

You might not get this message, depending on the device you have. It's only important that that you manage to connect to the "NixieTimeModule" network.

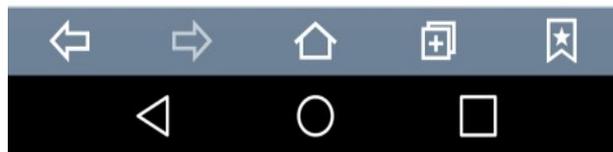
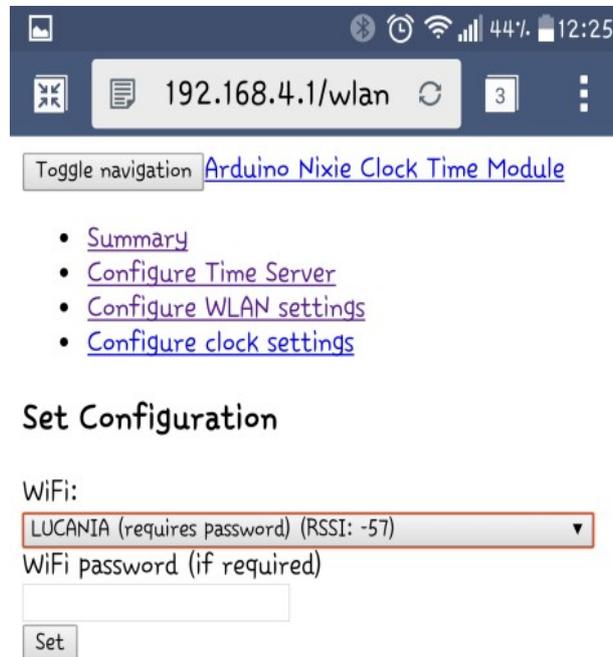


### Step 3: Configure the WLAN

Now you can log into the Module with a browser and configure it. Open a browser and enter the the URL

[http://192.168.4.1/wlan\\_config](http://192.168.4.1/wlan_config)

Don't worry if the browser looks a bit ugly at the moment, it is because we are not able to access the style sheets from the Internet (because the module doesn't have Internet access until you configure the WLAN).



Select the network you want to use from the list, and enter the password if you need one. If you don't need one, just select the network.

Press "Set" once you are ready.

For this example, I have chosen the network "LUCANIA".

## Step 4: Find the IP address of the module on the network

There are many different ways to do this, but the easiest is to go to the "Summary" page, and read the IP address of the "WLAN IP". In my case it is 196.168.1.116. Yours might be different.

Another way is to look in the configuration of your wireless router. 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 in a couple of minutes.



The screenshot shows the configuration page for an "Arduino Nixie Clock Time Module". At the top, the IP address 192.168.4.1 is displayed in a search bar. Below the navigation menu, the "Current Status" section contains a table with the following data:

Name	Value
WLAN IP	192.168.1.116
WLAN MAC	5C:CF:7F:0D:70:F7
AP IP	192.168.4.1
AP MAC	5E:CF:7F:0D:70:F7
WLAN SSID	LUCANIA
Time server URL	http://time-zone-server.scapp.io/getTime/Europe/Zuri
Time according to server	2016,5,1,12,25,46
Uptime	0 days, 2 hours, 3 mins, 8 secs
Time last update	51239
Version	1.0.0
Found I2C slave at	104

Below this, the "ESP8266 information" section contains another table:

Name	Value
Sketch size	269580
Free sketch size	167936
Free heap	32568
Boot version	5
CPU Frequency (MHz)	80
SDK version	1.5.2(7eee54f4)
Chip ID	880887
Flash Chip ID	1327328
Flash size	1018576

## Step 5: Login to the module using the WLAN you chose

Now that the module is configured on your WLAN, you should change back to your normal WLAN and log in using the address you noted in the previous step. Now things should look a bit nicer:

Arduino Nixie Clock Time Module

Summary   Configure Time Server   Configure WLAN settings   Configure clock settings

### Current Status

Name	Value
WLAN IP	192.168.1.116
WLAN MAC	5C:CF:7F:0D:F7
AP IP	192.168.4.1
AP MAC	5E:CF:7F:0D:F7
WLAN SSID	LUCANIA
Time server URL	
Time according to server	ERROR

Uptime: 0 days, 0 hours, 0 mins, 51 secs

Time last update: 47218

## Step 6: Select the time server and time zone

Now you can set the time server and time zone. We provide a time server you can use, but if you want to run your own, the source code is in GitHub at:

<https://github.com/isparkes/time-zone-server>

This is a very simple Node.js application, but the interface is described in the document. There are other ways of getting the time, but we found this to be the easiest.

Our free to use time server is at:

<http://time-zone-server.scapp.io/getTime/>

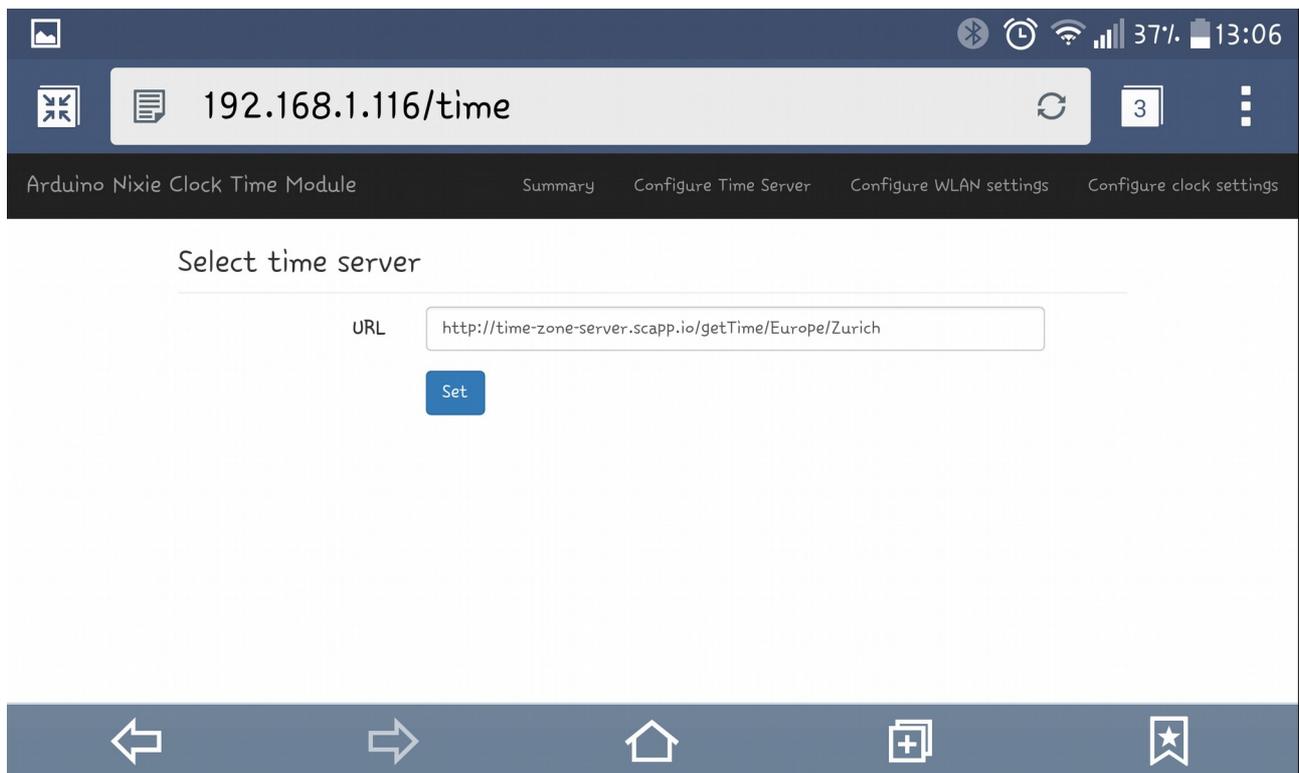
You have to know the time zone you are in. The easiest way is to select the large town nearest to you from the list on this page:

[https://en.wikipedia.org/wiki/List\\_of\\_tz\\_database\\_time\\_zones](https://en.wikipedia.org/wiki/List_of_tz_database_time_zones)

I live in Zürich, so I select "Europe/Zurich". The full URL is:

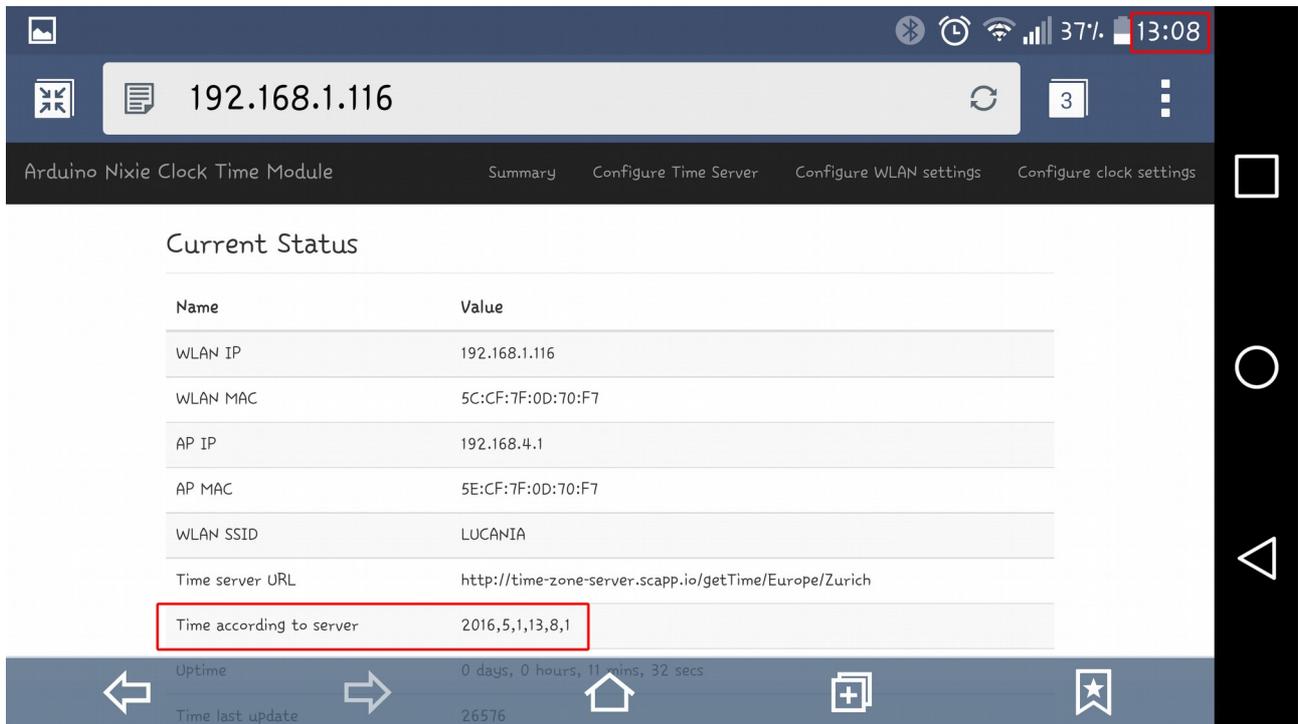
<http://time-zone-server.scapp.io/getTime/Europe/Zurich>

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



## Step 7: Check that you are getting the right time

If you have set up the time zone correctly, you should now be able to see the current time in the summary page:



The screenshot shows a mobile browser interface with the following elements:

- Address bar: 192.168.1.116
- Page title: Arduino Nixie Clock Time Module
- Navigation tabs: Summary, Configure Time Server, Configure WLAN settings, Configure clock settings
- Section: Current Status
- Table of parameters:

Name	Value
WLAN IP	192.168.1.116
WLAN MAC	5C:CF:7F:0D:70:F7
AP IP	192.168.4.1
AP MAC	5E:CF:7F:0D:70:F7
WLAN SSID	LUCANIA
Time server URL	http://time-zone-server.scapp.io/getTime/Europe/Zurich
Time according to server	2016,5,1,13,8,1

At the bottom of the page, there is a summary bar with the following information:

- Uptime: 0 days, 0 hours, 11 mins, 32 secs
- Time last update: 26576

My time shows as 2016,5,1,13,8,1, which is in the format year,month,day,hours,minutes,seconds.

My time is therefore 13:08:01 on the 1<sup>st</sup> May 2016.

That's it! From now on, the NixieTimeModule will check the time every minute and make sure that the Nixie Clock never drifts from the right time.

You should see the time on your Nixie clock change to the correct time within one minute!

## **Step 7: Restart the clock to secure the module**

If you restart the module, it will close the "NixieTimeModule" open access point. This means that no one is able to access the clock or the module from outside your WLAN network.

Turn the power off and back on, and you should see that the tiny blue LED starts to flash on and off once per second. This means that it is connected and that the open access point is closed.

Please see the section on "Security" for more information.

# Configuring the Nixie Clock

As an additional function, you can configure the Nixie clock from the WiFi module as well. This makes configuring the clock very easy and quick.

Just go to the “Configure clock settings” section of the module, and you will see the current settings. All of the possibilities of the clock are laid out here.

You can still set all of the configuration settings using the traditional way directly on the clock, if you want to.

The main configuration page looks like this:

Arduino Nixie Clock Time Module Summary   Configure Time Server   Configure WLAN settings   Configure clock settings

## Set Configuration

12H/24H mode:	<input checked="" type="radio"/> 12H	<input type="radio"/> 24H
Blank leading zero:	<input checked="" type="radio"/> Blank	<input type="radio"/> Show
Scrollback effect:	<input checked="" type="radio"/> On	<input type="radio"/> Off
Suppress ACP when dimmed:	<input checked="" type="radio"/> On	<input type="radio"/> Off
Date format:	DD-MM-YY	
Day blanking:	Blank between start and end hour during week days	
Blank from:	7	
Blank to:	17	
Fade steps:	50	
Scroll steps:	4	
Back light:	Cycling RGB backlight, dims with ambient light	
Red intensity:	15	
Green intensity:	0	
Blue intensity:	0	
Backlight Cycle Speed:	4	

[Set](#)

## Description

**12H / 24H hour time.** The hours are displayed in 12 or 24 hour mode.  
Default: 24H mode.

**Blank leading "0".** Blank out the leading "0" from single digit hours.  
Default: Don't blank.

**Scroll back.** Use the scroll back (rapid count down) effect when changing from "9" to "0".  
Default: enabled

**Suppress ACP when dimmed.** The Anti Cathode Poisoning which runs during the night lights the digits up at full brightness, and some people might find this disturbing. Using this setting, you can stop ACP happening when the display is fully dimmed (e.g. at night).  
Default: Enabled.

**Display blanking.** To preserve the tubes, you can set the display to be blanked. Note that blanking can be overridden from the clock, see the section below.

Options:

- "Never blank": the display runs all the time
- "Blank all day on week ends": the display is blanked at weekends.
- "Blank all day on week days": the display is blanked on week days.
- "Blank always": The display is always blanked unless you tell it to come on.
- "Blank during selected hours every day": Blank between the start and end hour every day, week days and weekends.
- "Blank during selected hours on week days and all day at weekends": The display is blanked during the hours you define during week days and all day at weekends.
- "Blank during selected hours on weekends and all day on week days": This blanks the clock during the selected hours on weekends and all day on week days.
- "Blank during selected hours on weekends only": This blanks between the start and end hour on weekends.
- "Blank during selected hours on week days only": This blanks between the start and end hour on week days.

Default: "Never Blank"

**Blanking From.** 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 enabled.

**Blanking To.** 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 enabled.

**Blanking Hour Start.** 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.

**Blanking Hour End.** 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.

**Fade Steps.** This sets how quickly one digit fades into the next one. You can also turn off the fade feature completely. It can be set from 20 (fast) to 200 (very slow).  
Default: 50.

**Scroll Steps.** This sets how quickly each scroll back digit is displayed when we scroll back from 9 to 0. You can also turn off the scroll feature completely. It can be set from 1 (very fast) to 40 (very slow).  
Default: 4.

**Back Light.** This sets the mode of the back light.

- "Fixed RGB backlight, no dimming". There is a constant colour on the back light, which stays bright all the time, even at night when the display is dimmed. The Red, Green and Blue intensities are set using the channel intensities below.
- "Pulsing RGB backlight, no dimming". This pulses the back light, but does not dim with the display. The Red, Green and Blue intensities are set using the channel intensities below.
- "Cycling RGB backlight, no dimming". The back light cycles through random mixes of colours, but does not dim with the display. The intensities of the channels is managed by the software.
- "Fixed RGB backlight, dims with ambient light". There is a constant colour on the back light, which dims as the display is dimmed. The Red, Green and Blue intensities are set using the channel intensities below.
- "Pulsing RGB backlight, dims with ambient light". This pulses the back light, which dims as the display is dimmed. The Red, Green and Blue intensities are set using the channel intensities below.
- "Cycling RGB backlight, dims with ambient light". The back light cycles through random mixes of colours, which dims as the display is dimmed. The intensities of the channels is managed by the software.

Default: "Fixed RGB backlight, no dimming"

**Red Channel Intensity.** Sets the maximum intensity of the red channel back light. This will be dimmed according to the display dimming. If you are in cycle mode, this setting does not do anything. The value can be set from 0 (off) to 15 (bright).

Default: 15

**Green Channel Intensity.** Sets the maximum intensity of the green channel back light. This will be dimmed according to the display dimming. If you are in cycle mode, this setting does not do anything. The value can be set from 0 (off) to 15 (bright).

Default: 15

**Blue Channel Intensity.** Sets the maximum intensity of the blue channel back light. This will be dimmed according to the display dimming. If you are in cycle mode, this setting does not do anything. The value can be set from 0 (off) to 15 (bright).

Default: 15

**Backlight Cycle Speed.** 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. The value can be set from 2 (very fast) to 64 (very slow).

Default: 10

## Understanding Security

The module is by design already quite secure. There is no known way of connecting to the open "NixieTimeModule" network and doing anything other than changing the clock settings. There is no known way of accessing through the open network to your WLAN network. However, we designed the software in the module to provide the highest security possible.

The module tries to connect to the configured Wireless LAN on start up. If it manages to connect, it will shut down the "NixieTimeModule" open access point. You can still get into the module configuration through your WLAN, using the IP address that you wrote down earlier.

If for any reason the module is not able to connect to your WLAN (say, you changed the password, or the network name), it will start to flash the tiny blue LED rapidly to show that it is not connected. It will not send any updates to the clock, but the clock will continue to work using it's internal time provider which is not highly accurate.

The "NixieTimeModule" open access point will not show up until you restart the clock! This is a security feature to make sure you are in control of when the open access point is available!

The open access point will only turn on or off on a restart of the clock.

# Troubleshooting

If not everything goes as you expect, please refer to the test steps during the construction and the associated troubleshooting tips. If that does not cover the problem you have, please see below. If you still can't find the answer, contact us!



Trouble shooting

## **I can't find the time "NixieTimeModule" open network**

First check the status of the blue LED on the module. The NixieTimeModule network is only available if the module is in "open" mode. This mode is indicated by the blue LED flashing rapidly (about 5 flashes per second).



Trouble shooting

## **I can't connect to the time "NixieTimeModule" open network**

This can depend on the device you are using to try and access the module. Not all browsers have the same capabilities, and the module does not have a perfect HTTP stack in it.

Please try connecting with a different device (for example, if you are trying with a PC, try with a tablet or phone instead).

We're always working on improving the compatibility, but experience shows that we are not in a perfect world yet.



Trouble shooting

## **I can't find the time "NixieTimeModule" open network**

First check the status of the blue LED on the module. The NixieTimeModule network is only available if the module is in "open" mode. This mode is indicated by the blue LED flashing rapidly (about 5 flashes per second).



Trouble shooting

## **The module can't seem to communicate with the clock**

First check the status of the blue LED on the module. The module needs to be in "configured" mode. This mode is indicated by the blue LED flashing slowly (1 second on, 1 second off).

If the module is fully configured and still does not communicate with the clock, look at the main configuration page for the value for "Found I2C slave at". It should say "104".

If it does say "104", please wait three minutes and see if the time is sent. (The time module sends the time every 60 seconds, and in some cases the module sends the time but it gets missed).

If it does not say "104" please check the connections between the module and the clock.



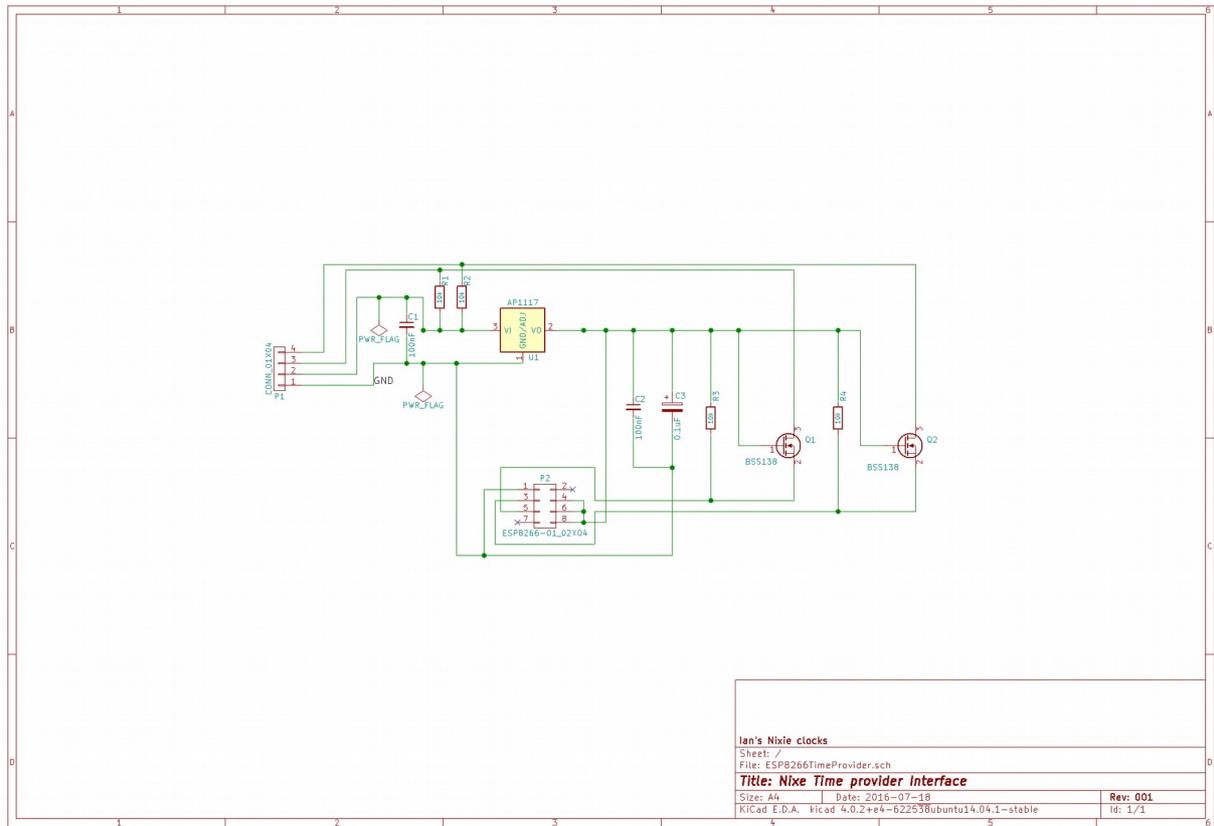
Trouble shooting

## **The module is configured, but I don't know the address of it**

In this case, you should log into the administrative area of your wireless router and look up the IP address from there. The name of the device will be "ESP\_XXXXXX", where the value of "XXXXXX" depends on your module.

# Schematic

Here is the schematic of the board:



Revisions:

V0001a: 01May2016: Initial version

V0001b: 31May2016: Added information about security

V0001c: 27Jul2016: Added Add schematic

V0002a: 16Feb2017: Added troubleshooting tips