Arduino Nixie Clock
“MNC6”

Operating Instructions
Firmware V1

Supported Models:

MNC6

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About this document

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

- MNC6 PCBA Clock

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 skip 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.

http://www.open-rate.com/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:

https://goo.gl/dQUYWx

Which should redirect you to the much longer:

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

Description

The MNC6 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. Factory assembled for maximum reliability.
- Open source code
- Based on the Arduino micro-controller: Easy to program and well documented.
- 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.
  - Automatic blanking using a PIR (Passive InfraRed sensor) so that the tubes are turned off when no one is in the same room as the clock.
  - Time based blanking
  - Direct tube drive
- 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. The back lights can show 16 million colours.
- Random RGB back lighting provides a constantly changing, subtle back lighting effect if you configure it.
- Ambient light sensing, with automatic tube dimming, which sets the tube and LED brightness according to the light conditions. This also increases tube life.
- Silent operation. Some Nixie clocks emit an irritating “buzz” or “hiss” which is especially annoying if you keep the clock in a bedroom.
- 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
- Highly accurate when using RTC module:
  - Battery backed, temperature compensated, high accuracy clock. The accuracy is Accuracy ±2ppm from 0°C to +40°C. (Maximum 1 minute per year).
  - The battery life should be 3 years in normal use.
  - Retains the date and time even when turned off (not just for a few minutes, but for as long as the battery lasts)
  - Leap Year Compensation Valid Up to the year 2100
- Extremely accurate when using the on-board Wifi module:
  - 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, by using the ICSP port on the board.

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 assemble and used this clock, it is not intended for anyone unqualified. You are also responsible for ensuring that others are not injured by this clock, and you must enclose it is a suitable case which ensures that people cannot touch the internals. You must also provide adequate ventilation for the case.

This clock can be a fire risk. You are responsible for making sure that it does not cause a fire.

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 pushbutton.

First Start

When you start the clock up th very first time, it will start in “First Start Mode”. This mode is intended to simplify the set up of the hardware. It cycles through the digits “0” - “9” and shows the LEDs in different colours..

To **EXIT First Start Mode, press the pushbutton when the display shows “88:88:88”, and the clock will enter calibration mode!**

Once you have exited First Start Mode, it will not enter it again until you do a factory reset (See below).

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.

Every 10 minutes (at “xx:x9:15”, the clock will do “Anti-Cathode Poisoning”, which will cycle all the digits for about 15 seconds.

This is not an error! It is important to keep the tubes healthy in the long term.

Time Providers

The clocks can use either a battery backed RTC module or a WiFi module.

If you install both, the WiFi module will set the RTC module to keep it up to date. After 5 minutes when no information is received from the WiFi module, the clock will revert to using the RTC module.

WiFi Time Providers

By default, the clock is designed to use a WiFi real time provider, which logs into your home WiFi network and periodically retrieves the time from Internet time sources. These are accurate to 1 second, and auto adjust for Daylight Savings Time. You configure once, and then the module remembers the configuration forever.

Additionally, the WiFi time module gives you an easy to configure interface, which you can use to set up the clock using a tablet, phone or computer.

Real Time Clock

The clock comes with a Real Time Clock (RTC) module on the main board, which provides a battery backed time source that remembers the time even when the clock is not powered up. If you have a WiFi module installed, the RTC is automatically set according to Internet time.

Basic Time Setting (RTC Only)

To set the hours – press and hold the '**H**' button until you see the Hours illuminated with a green flashing light. Release the '**H**' button and then press it repeatedly to cycle through the hours 00 – 23. When you have the correct hour, remove finger from button and just wait for 10 seconds until the green flashing stops, the hours are now set.

To set the Minutes – press and hold the '**M**' button until you see the Minutes illuminated with a green flashing light. Release the '**M**' button and then press it repeatedly to cycle through the Minutes 00 – 59. When you have the correct minute, remove finger from button and just wait for 10 seconds until the green flashing stops, the Minutes are now set. Also note, the seconds will zero while you are setting the minutes.

That's it – you now have the time set and if that's all you wish from your clock you can disregard the rest of these instructions. It will accurately and reliably keep time for you.

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.

Mode	Description	Values
Date	**Date.** The current date will be shown in the date format you selected.	Example “17:06:18”
Temp	**Temperature / Time Provider Module status.** SS (the seconds digits) can have 4 values: “10”: The clock does not have a time provider installed, and is working off the internal time source. (Not accurate) “11”: The clock has an RTC time source installed. “12”: The clock has a WiFi time source installed. “13”: The clock has a WiFi and an RTC time source installed The digits “TT:tt” (hours and minutes) will show the temperature, to the nearest ¼ degree, where “TT” is whole degrees, and “tt” is fractional degrees. In modes “10” and “12” the temperature is shown as “00:00:10” or “00:00:12”. The temperature shown is the current temperature inside the clock case in degrees Celsius. If this goes above 40, you should consider ventilating the case, because the temperature compensation is not able to work at such high voltages, and the clock life may be reduced.	“TT:tt:SS” Example: “22:25:13” Means “22.25 Degrees WiFi and RTC installed”
LDR	**Ambient Light Reading.** This shows the current ambient light reading from the LDR (light dependent resistor). It is a normalized value, and goes between 100 (dark) to 999 (bright). This controls the dimming of the tubes.	Example “01:00:––” 100: darkest 999: brightest
Version	**Version Number.** Display the version number. The format will be :”VV vv 07”, where major version is “VV”, minor version is “vv” and the “21” is the id for the version display.	Example “03:51:––”
IP Address part 1	If you have the WiFi module connected, this will show the first two digits of the 4 digit IP address. Usually this address starts with “192.168”. **Note:** The IP address is skipped if you do not have the WiFi module connected.	Example: “19:21:68” = “192.168”
IP Address part 2	If you have the WiFi module connected, this will show the last two digits of the 4 digit IP address. Put this together with the value shown in IP Address part 1 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.	Example: “00:11:06” = “001.106”

Mode	Description	Values
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 90 impressions per second. The exact value is not significant. It does not affect the time keeping.	Example: “00:00:94”

Setting Mode

Note: If you have the WiFi module connected, almost all of these settings can be configured using a browser! Connect to the address shown in the “IP Address” in the previous section.

To enter setting mode, press the **both buttons** together for more than 1 second. The “RGB back light” LEDs will turn green and blue to help you see what you are setting.

Each press of the "**H**" button will move the setting mode onto the next. Each press of the "**M**" button will change the option.

To exit the setting mode and **save changes**, press either button (or both together again) for more than 2 seconds.

If you **don't wish to save the changes**, just leave the clock alone and after 60 seconds it will discard the changes and go back into normal time mode.

Mode	Description	Values
	Time mode. 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. 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.	
Time and Date Settings		
Note that the Time and Date settings will not be shown if the WiFi module is active! Instead you jump straight to the next section.		
	Set Hours. 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).	
	Set minutes. Each short press will advance the minute. The minutes roll over back to 0 ffter reaching 59 minutes. Each time you set the minute, the seconds is reset to 0.	
	Reset seconds. Each short press will reset the seconds to 0, without changing the hours or minutes.	
	Set Day. Each short press will advance the day. The day roll over back to one after reaching the maximum number of days in the month.	
	Set Month. Each short press will advance the month. The month roll over back to zero after reaching 12.	
	Set Year. Each short press will advance the year. The year roll over back to 2015 after reaching 2099.	

Mode	Description	Values
Basic Settings		
“--:--:07” flashing	**12 or 24 hour time.** The hours are displayed in 12 or 24 hour mode.	“1” = 12 hour “0” = 24 hour default: 0
“--:--:08” flashing	**Blank leading “0”.** Blank out the leading “0” from single digit hours.	“1” = blank “0” = don't blank default: 0
“--:--:09” flashing	**Scroll back.** Use the scroll back (rapid count down) effect when changing from “9” to “0”.	“1” = enable “0” = disable default: 0
“--:--:10” flashing	**Fade.** Use cross digit fading.	“1” = enable “0” = disable default: 0
“--:--:11” flashing	**Date format.** Set the format that the date is displayed in.	“0” = YY.MM.DD “1” = MM.DD.YY “2” = DD.MM.YY default: 2
“--:--:12” flashing	**Display blanking.** To preserve the tubes, you can set the display to be blanked. Options: • “0” = “never”: Don’t use blanking. • “1” = “Weekends”: Blank at weekends. • “2” = “Week days”: Blank on week days. • “3” = “Always”: Always use blanking. • “4” = “Hours”: Blanks between the start and end hour every day. • “5” = “Hours or weekends”: This blanks all day during the weekends and between the start and end hour every other day. • “6” = “Hours or week days”: This blanks all day during the week days and between the start and end hour every other day. • “7” = “Hours on weekends”: This blanks between the start and end hour on weekends. • “8” = “Hours on week days”: This blanks between the start and end hour on week days.	“0” = Don't blank “1” = Weekends “2” = Week days “3” = Always “4” = Hours “5” = H **or** weekends “6” = H **or** week days “7” = H **on** weekends “8” = H **on** week days default: 0
“--:--:13” flashing	**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.**	Default: 00
“--:--:14” flashing	**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.**	Default: 07
“--:--:15” flashing	**Anti Cathode Poisoning night suppression.** The ACP 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).	“1” = don't do ACP when dimmed “0” = do ACP always default: 0

Mode	Description	Values
Special Effects Settings		
"--:--:16" flashing	**Use LDR**. If you disable the LDR, the tubes will always work at maximum brightness.	"1" = enable "0" = disable default: 1
"--:--:17" flashing	**Blank Mode.** You can set the tubes, the LEDs or both the tubes and the LEDs to be blanked when in blanking mode.	"0" = tubes "1" = LEDs "2" = tubes and LEDs default: 2
"--:--:18" flashing	**Fade Speed Slower**. Each short press will make the fade speed between digits slower.	Default: 50 Max: 200 Min: 20
"--:--:19" flashing	**Fade Speed Faster**. Each short press will make the fade speed between digits faster.	
"--:--:20" flashing	**Scroll-back Speed Slower.** Each short press will make the "scroll-back" speed slower.	Default: 4 Max: 40 Min: 1
"--:--:21" flashing	**Scroll-back Speed Faster.** Each short press will make the "scroll-back" speed faster.	
"--:--:22" flashing	**Slots Mode.** You can have the date shown automatically once per minute for about 5 seconds.	"1" = enable "0" = disable default: 1
PIR Settings		
"--:--:23" flashing	**PIR Timeout Longer.** You can set the amount of time that the clock will wait before blanking the display, in seconds.	Default: 300 Max: 3600 Min: 60
"--:--:24" flashing	**PIR Timeout Shorter.** You can set the amount of time that the clock will wait before blanking the display, in seconds.	
Back Light Settings		
"--:--:25" flashing	**Back Light Mode.** This sets the mode of the back light. "Fixed" mode will show the back light color according to the Red, Green and Blue channel intensities. "Pulse" will make the intensity of the back light "pulse", brightening for a second and then darkening for a second, but always respecting the relative intensities set by the Red, Green and Blue channel intensities. "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. "Colortime" sets the colour of the back light to match the digit display value. Options "0", "1", "2" and "6", do not dim with the bulbs. Options "3", "4" and "5" do.	"0" = Fixed "1" = Pulse "2" = Cycle "3" = Fixed/Dim "4" = Pulse/Dim "5" = Cycle/Dim "6" = "Colortime" "7" = "Colortime/ Dim" default: 0

Mode	Description	Values
“--:--:26” flashing	**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 will be skipped.**	Default: 15 Max: 15 Min: 0
“--:--:27” flashing	**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 will be skipped.**	Default: 15 Max: 15 Min: 0
“--:--:28” flashing	**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 will be skipped.**	Default: 15 Max: 15 Min: 0
“--:--:29” flashing	**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. **If you are not in cycle mode, this setting will be skipped.**	Default: 10 Max: 64 Min: 4
“--:--:30” flashing	**Increase Minimum dim.** This setting allows you to increase the minimum brightness you want to have when the clock is fully dimmed.	Default: 100 Max: 500 Min: 100
“--:--:31” flashing	**Decrease Minimum dim.** This setting allows you to decrease the minimum brightness you want to have when the clock is fully dimmed.	
“--:--:32” flashing	**Use PIR pull-up.** If you want to use a 3V3 PIR module (or perhaps a 3V3 microwave module), you might have to turn off the internal pull up resistor. This setting allows you to do that.	“1” = 5V or no PIR “0” = 3V3 PIR default: 1

Mode	Description	Values
Information Settings – Not in online configuration		
“––:––:33” flashing	**Current case temperature.** Show the current temperature inside the case (used as part of the temperature compensation for the clock crystal). Note: This will show 0 if the RTC is not installed.	
“––:––:34” flashing	**Clock version.** Show the clock software version.	
	Digit Test. Will roll through all digits on all locations to check that the display is healthy.	

Display Blanking Mode

During display blanking mode the tubes will be off depending on the display blanking settings, but the LEDs will continue to work as usual, telling you that the clock is still running.

You can configure the display to blank at weekends, during weekdays, always or never (the default). You are also 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.

You are also able to override the blanking. Press the button while the clock is blanked, and the display will come on again. Pressing the button will display the time for about a minute (60 seconds, but the display is only blanked on the minute change).

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

PIR / Microwave Motion Detector Blanking

If you have a PIR or microwave motion detector installed, you can have the clock blank while there is no motion near it, and have it turn on only when someone is near the clock to see it. This saves power and greatly extends tube life, especially if the clock is in a location such as a bedroom.

If you connect a motion detector to the pin on the header (it is optional, and the clock works correctly without it), the usual blanking mode will be disabled and the PIR blanking mode will be used instead. If you want to use normal blanking mode, remove the detector and restart the clock.

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. 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 while powering on. The LEDs will rapidly flash some random colours to signal that the reset has been done.

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 between 9V DC and 12V DC.

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

WiFi Module

There is a full manual available for the optional WiFi module. Here we just cover the most important information.

Please see the document "WiFiTimeProviderInstructionManual" for full details, including trouble shooting and resetting.

Helpful Video

There is a video available that explains the status meanings shown by the onboard blue LED at

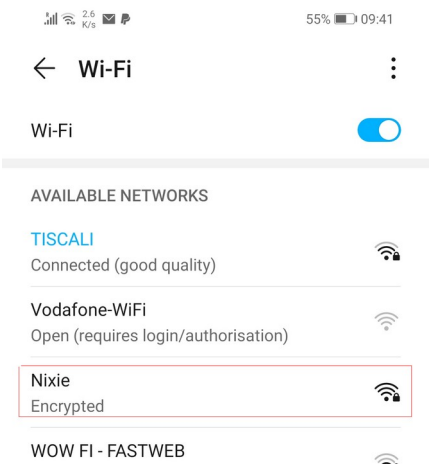
https://youtu.be/GAw4mSb_ya4

Set up

To set up the module, you will need a computer, phone or tablet with WiFi access. Any device should work.

When you power on the module for the first time, it will blink the blue LED rapidly. This means that the module is awaiting initial configuration, and is waiting for you to connect to the module. In this mode, the module will open up a WiFi access point called “Nixie”:

Computer



Android

This access point has the credentials:

Credential	Value
SSID	Nixie
Password	SetMeUp!

Note: The password is case sensitive and has an explanation mark in it!

If the access point does not show up immediately, give it a couple of minutes. Some devices take a few minutes to perform a scan for new networks.

After a few seconds, you should be taken to the captive portal of the module automatically, but if this does not happen , please see the next section which is about troubleshooting:

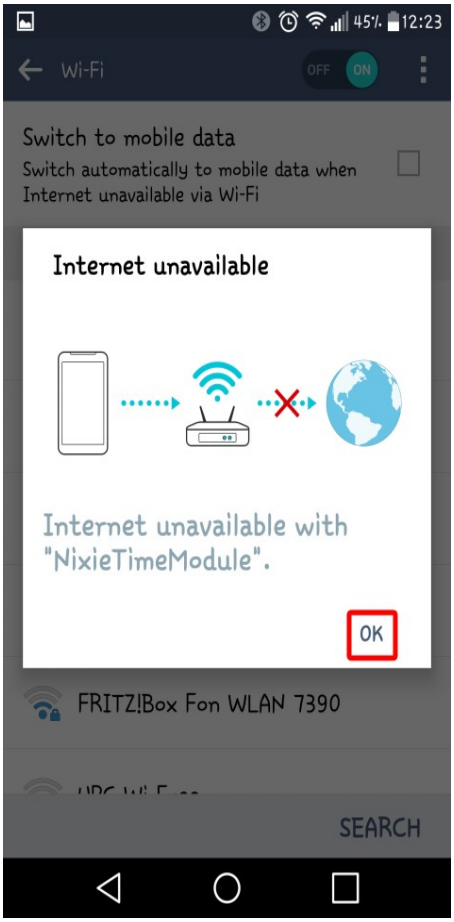
Initial Connection Troubleshooting

The captive portal does not appear

Some browsers don’t manage the redirect to “captive portals” correctly, and if the you can connect to the Module correctly, but the captive portal for the hotspot login does not appear, you can also reach it by typing the address http://192.168.4.1 into the address bar (or by clicking on the link).

Internet is not available

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.



It is normal that the Internet is not available on the WiFi module yet – we have to provide it with the credentials to reach the Internet.

Configure the WiFi

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).

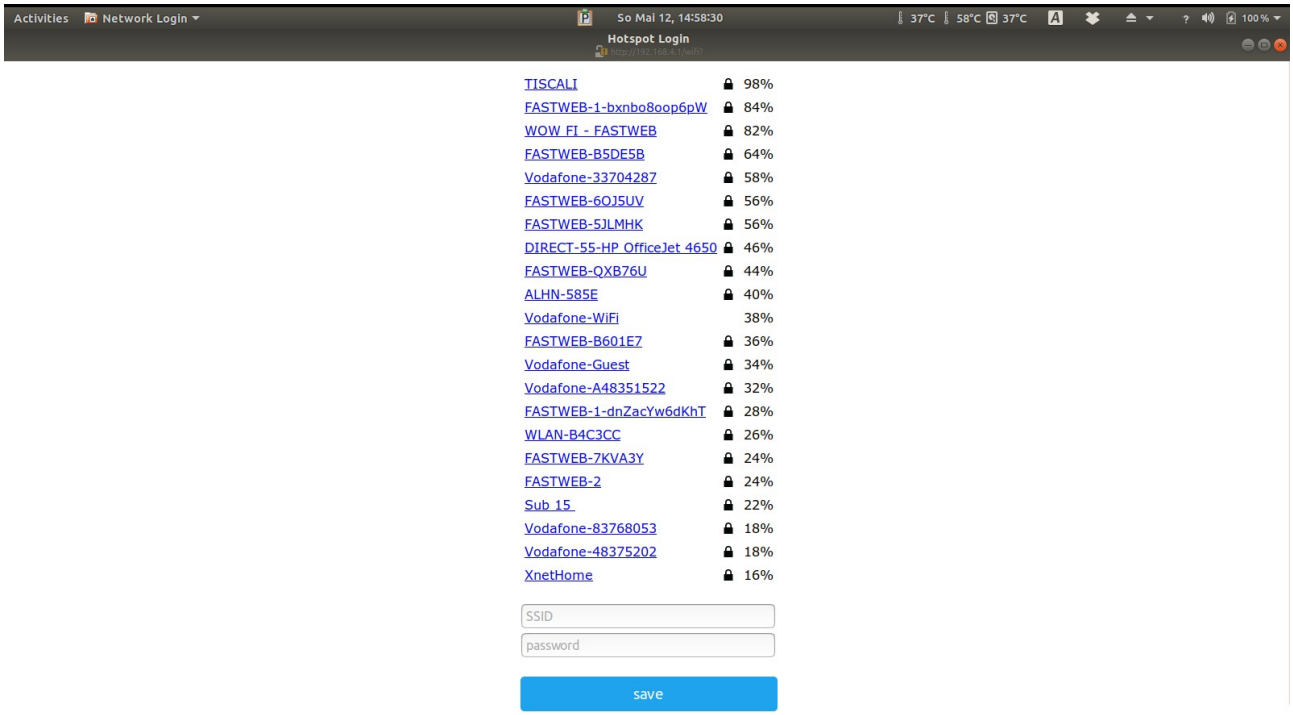
Select the network you want and enter the password for it.

Note: The network you are using and the password for it will be remembered in your module, and it will always 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. It may take up to an hour to reconnect, so please have a little patience.

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 Switzerland! Don’t worry, you can change this right away!

Revisions:

V0001: 04Feb2021: Initial version