"SNC46"

Arduino Interchangeable Nixie Clock Rev1

User Manual

IN-12

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What this document is about

This document is the construction manual for the "SNC46" Arduino based "Small-format" Tube Nixie Clock shown on the first page.

This is a brand new design, and gives you a great features in an easy to build, high quality Nixie Clock. This new design takes care all of the difficult steps of building a high quality, fully featured Nixie clock, and lets you concentrate on final finishing and case design.

The User Manual for everyday use is in a different document, also available from the documentation site at

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

Contact Information

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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

The clock uses the latest generation of our Nixie Clock electronics and is designed to be as simple to operate as possible, or allow you to delve into many layers of settings if you so wish.
There is a basic setting mode, and a more complex menu system. All settings are carried out with two buttons labelled on the rear of the clock 'H' for Hours and 'M' for Minutes.

First Start and self check

When you start the clock up the very first time, it will start in "Tube Test Mode". This mode is intended to let you see if all the tubes are working correctly and the backlight by cycling through the digits 00:00 to 99:99 and varying the backlight LED colours.

Exit Tube Test mode:

Once you have seen that the tubes are okay, you can exit "Tube Test Mode" by pressing the '**H'** push button when the display shows 88:88 and the clock will then do a couple of system self checks, display the software version number on the tubes and then revert to clock mode.

Basic Time Setting

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 a few 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 a few seconds until the green flashing stops, the Minutes are now set.

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.

If you have the WiFi module, you can skip this section. Time is automatically set from the network time. Instead you should follow the "Wifi Users Manual".

Clock button functions and menu system

Normally the clock is in "Clock Mode" which will show the time. If you press a button for differing lengths, different things will happen.

"Brief 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"

"Medium Press" (more than 1 second): If you press the '**H**' button it will let you set the hours, if you press the '**M**' button it will let you set the minutes for example as you've previously set.

"Long Press" (more than 2 seconds): If you press and hold the **'H'** button during the Setting Mode for example, it will save the values and exit.

"Dual Press" (Both buttons at once for more than 1 second) this will put the clock into it's parameter setting mode. In this mode, the '**H**' button advances the parameter and the '**M**' button alters the value. The options here are given in the section "Parameter Setting Mode"

"Power up" (With the clock unplugged – Press and hold the '**H**' button while you plug the clock in) This will effectively put the clock back to its factory settings and start up in "Tube Test Mode"

Temporary Display Mode

While the clock is normally in "Clock Mode" a brief press of the '**H**' button will cycle through these pieces of information relating to the clock:

Mode	Description	Values
Seconds	**Shows minutes/seconds instead of hours/minutes.** Normally the clock shows hours and minutes, but this mode shows the minutes and seconds.	Example 34:06
Date	**Date.** The current date will be shown in the date format you selected.	Example 17:06
Temp	**Temperature.** 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" are the whole degrees, "tt" are the fractional degrees, with 0.25 degrees resolution.	"TT:tt" Example: 22:25 Means "22.25 Degrees"
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	Display the software version number. The format will be "VV:vv", where major version is "VV", minor version is "vv".	Example 05:01
Mux Speed	This shows the refresh rate of the display. It varies a little based on the exact workload, but is usually about 150 impressions per second	Example: 01:50

Parameter Setting Mode

To enter setting mode, press both buttons together for more than 1 second ("dual press"). The "RGB back light" LEDs will start to flash white.

Pressing the **'H'** button advances the particular parameter, and pressing the **'M'** button changes the value of the parameter.

Each time you advance the parameter, the current parameter number will be briefly shown, until you let go of the **'H'** button. After you let go of the button, the configured value will be shown, this can either be a "on/off" setting ("0" = off, "1" = on"), a two digit setting, in which case the setting number will be shown on the "minutes" tubes, and the value shown on the "hours" tubes, or a four digit value, in which case the value is shown across all 4 tubes.

Pressing and releasing the **'H'** Button will advance the parameter number onto the next one. When you finish going through all the parameter numbers, the clock returns to normal time display mode.

To exit the setting mode before going through all the parameters, press and hold the **'H'** button for more than 2 seconds ("long press"). The "RGB back light" LEDs will return back to their normal operation.

To change a parameter value, press the **'M'** button for less than one second, and then release it ("Brief press").

Note that some options will show the option number while you have the button pressed, and then revert to the value when you let go of the button. This is because some values require all 4 digits to be displayed correctly.

Note that if you have the WiFi module installed, it does not make sense to set the time manually.

Parameter	Description	Values
	Clock 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 – When you press both 'H' and 'M' for more than 1 second, this is the first Parameter		
01	**Set Hours.** Each brief **'M'** press will advance the hour. The hours roll over back to zero after reaching 12 or 24 (depending on the 12/24 hours mode).	HH MM
02	**Set minutes.** Each brief **'M'** 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.	HH MM
03	**Reset seconds.** Each brief **'M'** press will reset the seconds to 0, without changing the hours or minutes.	MM SS
04	**Set Day.** Each brief **'M'** press will advance the day. The day roll over back to one after reaching the maximum number of days in the month. Depending on the date format you have set, this will be shown in day:month format, or month:day format.	MM DD or DD MM
05	**Set Month.** Each brief **'M'** press will advance the month. The month roll over back to zero after reaching 12. Depending on the date format you have set, this will be shown in day:month format, or month:day format.	MM DD or DD MM
06	**Set Year.** Each brief **'M'** press will advance the year. The year roll over back to 2015 after reaching 2099.	20 YY

These initial parameters are just for setting time and date, as such the parameter number is not shown on the first two tubes, just the value to be altered with the **'M'** button is highlighted. The basic time setting can also be done with just the **'H'** and **'M'** buttons as detailed in the 'Basic Time Setting' section.

The clock will not display the date by default, until a value has been set for it (parameters 04 and 05). Once a date has been set, the clock will then display the date once a minute.

The next set of parameters just continue on, once you have set the year (parameter 06) and they then relate to the functions of the clock that you can adjust and customise.

Parameter	Description	Values
Basic Settings		
07 mm "07" flashing "mm" = value	**12 or 24 hour time.** The hours are displayed in 12 or 24 hour mode.	"1" = 12 hour "0" = 24 hour default: 0
08 mm "08" flashing "mm" = value	**Blank leading "0".** Blank out the leading "0" from single digit hours.	"1" = blank "0" = don't blank default: 0
09 mm "09" flashing "mm" = value	**Scroll back.** Use the scroll back (rapid count down) effect when changing from "9" to "0".	"1" = enable "0" = disable default: 0
10 mm "10" flashing "mm" = value	**Fade.** Use cross digit fading.	"1" = enable "0" = disable default: 0
11 mm "11" flashing "mm" = value	**Date format.** Set the format that the date is displayed in.	"0" = MM.DD "1" = DD.MM default: 1
12 mm "12" flashing "mm" = value	**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 mm "13" flashing "mm" = value	**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 mm "14" flashing "mm" = value	**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 mm "15" flashing "mm" = value	**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: 1

Parameter	Description	Values
Special Effects Settings		
16 mm "16" flashing "mm" = value	**Use ambient light sensor**. If you disable the sensor, the tubes will always work at maximum brightness.	"1" = enable "0" = disable default: 1
17 mm "17" flashing "mm" = value	**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 mm "18" flashing "mm" = value	**Fade Speed Slower**. Each short press will make the fade speed between digits slower.	Default: 50 Max: 200 Min: 20
19 mm "19" flashing "mm" = value	**Fade Speed Faster**. Each short press will make the fade speed between digits faster.	Default: 50 Max: 200 Min: 20
20 mm "20" flashing "mm" = value	**Scroll-back Speed Slower.** Each short press will make the "scroll-back" speed slower.	Default: 4 Max: 40 Min: 1
21 mm "21" flashing "mm" = value	**Scroll-back Speed Faster.** Each short press will make the "scroll-back" speed faster.	Default: 4 Max: 40 Min: 1
22 mm "22" flashing "mm" = value	**Date display** You can have the date shown automatically once per minute for about 5 seconds.	"1" = enable "0" = disable default: 1
Radar sensor Settings – Only applicable if radar sensor installed		
23 "minutes" digits blanked then tt tt	**Radar Timeout Longer.** You can set the amount of time that the clock will wait before blanking the display, in seconds. This setting will be shown after you release the button. Only the setting number will be shown while you hold the button.	Default: 300 Max: 3600 Min: 60
24 "minutes" digits blanked then tt tt	**Radar Timeout Shorter.** You can set the amount of time that the clock will wait before blanking the display, in seconds. This setting will be shown after you release the button. Only the setting number will be shown while you hold the button.	

Parameter	Description	Values
Back Light Settings		
25 mm "25" flashing "mm" = value	**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. "Colourtime" mode shows a different specific colour for each value shown on the digit, loosely following the rainbow. Options "0", "1", "2" and "6", do not dim with the Nixies. Options "3", "4", "5" and "7" do.	"0" = Fixed "1" = Pulse "2" = Cycle "3" = Fixed/Dim "4" = Pulse/Dim "5" = Cycle/Dim "6" = "Colourtime" "7" = Colourtime/ Dim default: 0
26 mm "26" flashing "mm" = value	**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 mm "27" flashing "mm" = value	**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 mm "28" flashing "mm" = value	**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 mm "29" flashing "mm" = value	**Cycle Speed.** If you are in cycle mode, this controls the speed at which the colours cycle. The higher the number, the slower the colours will change. If you are **not** in cycle mode, this setting will be skipped.	Default: 10 Max: 64 Min: 4

Parameter	Description	Values
Special settings – these can adversely affect display operation, only adjust if requested.		
30 "minutes" digits blanked then mm mm	**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 "minutes" digits blanked then mm mm	**Decrease Minimum dim.** This setting allows you to decrease the minimum brightness you want to have when the clock is fully dimmed.	Default: 100 Max: 500 Min: 100
32 "minutes" digits blanked then mm mm	**Increase Anti-ghosting.** This setting reduces "ghosting" (the number on the right shows faintly on the digit on the left). This is due to transients when switching.	Default: 0 Max: 50 Min: 0
33 "minutes" digits blanked then mm mm	**Decrease Anti-ghosting.** This setting reduces "ghosting" (the number on the right shows faintly on the digit on the left). This is due to transients when switching.	Default: 0 Max: 50 Min: 0
Information Settings – only shows a value, cannot be altered		
35 "minutes" digits blanked then TT tt	**Current case temperature.** Show the current temperature inside the case RTC chip	
36 "minutes" digits blanked then VV vv	**Clock version.** Show the clock software version.	
37	**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 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.

You are also able to override the blanking. Press the **'H'** 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 **'H'** 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

Radar Motion Detector Blanking

If you have a Radar 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

Factory Reset

To reset the clock back to initial settings, hold down the **'H'** button while powering on. The LEDs will rapidly flash some 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 "Tube Test Mode".

Specifications

- Latest technology, highly reliable and accurate. Low power consumption.

- Long tube life: Anti Cathode Poisoning (ACP) and configurable blanking with optional Radar sensor 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 colour of the back lighting to practically any colour 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

- Highly accurate using separate RTC (Real time clock) 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

The Clock is based on the Arduino platform, and is a result of a collaboration between Bad Dog Designs, and Ian Sparkes from Nixieclocks.biz who made this possible!