6 Digit nixie tube clock board for RFT Z568M, RJZ-568M, ZIN-70 nixie tubes

Version 1.3

Manufactured in Republic of Georgia

Introduction

Ziniko'70 is a 6-tube nixie clock board, compatible with RFT Z568M, RJZ-568M, ZIN-70 nixie tubes. It is physically compatible with Millclock's nixie tube clock cabinets, so can be directly used as drop-in replacement for Millclock's PCB to get additional features, better controls and automatic tube healing.

Features

This clock has the following features:

- Built in GPS receiver and Wi-Fi module* For time synchronization
- Built-in automatic and manual tube healer options
- Flexible options for brightness adjustment and tube saving features
- Temperature measurement options**
- Built-in LCD screen for menu setup and adjustments
- Alarm clock function, hourly chimes
- Advanced backlight controls, including user editable color sets
- 12/24-hour modes, C/F temperature display, all user selectable
- Wireless remote control*** for quick access to clock major functions
- PIR sensor*** for enabling the clock display only when motion is detected

** User has to provide his own NTP server and Wi-Fi configuration settings and has to flash firmware to ESP-01 module by himself – no support provided in that area.*

*** To display C/F sign, special model of ZIN-70 tube had to be used, made by Millclock. Temperature measurement will work with other tubes as well, just there will be no C/F sign shown.*

**** Optional, can be installed by user afterwards, if needed.*

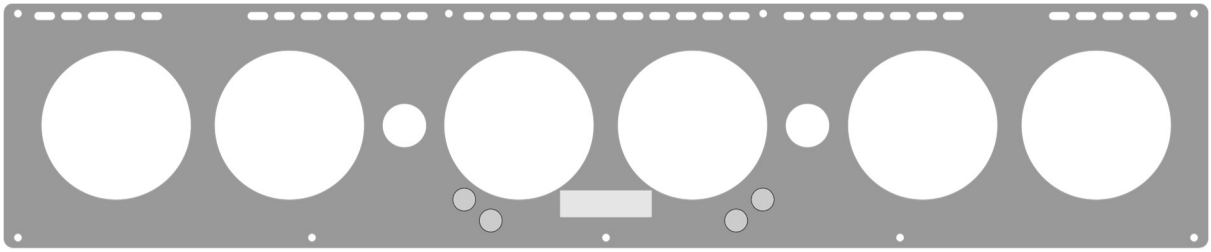
Specs

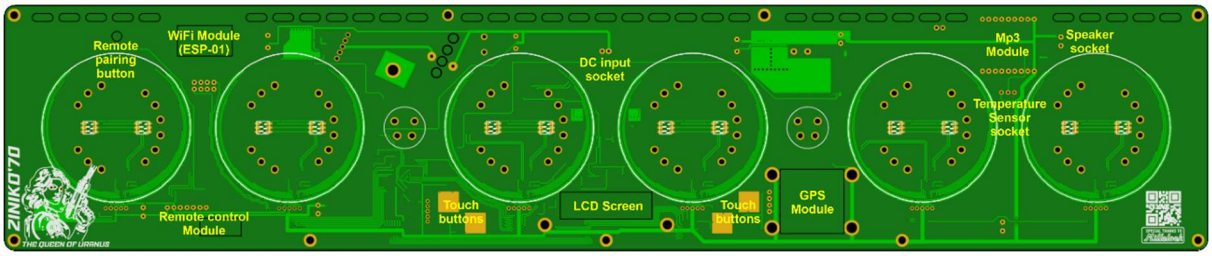
Physical dimensions:	472x96x20 mm approx. (Exact mechanical drawings for CAD/CAM are available for download separately)
Weight:	<200 grams
Power supply:	DC12-24V, <20W
Tubes supported:	Model 1: RFT Z568M, RJZ-568M, Model 2: ZIN-70
Speaker output:	Up to 3W, 4-8 ohm load

Getting familiar with your clock

This is a high-tech product, which uses high voltage, which can be lethal if improperly handled. So please read this manual completely before plugging in your clock or making any modifications to it.

This clock kit consists of two components, one is PCB with the electronic parts on it and 2nd is the translucent acrylic cover (optional), which is placed over the PCB for sleek look and safety measure to prevent accidental high voltage shock. **Please note:** To protect from scratches, acrylic cover comes with protective sheet on it from both sides. Remove it only prior to final installation. Pay attention to top and bottom sides of the sheet – they are marked with appropriate stickers.





PCB is installed with components facing down, and once installed, you put acrylic sheet over it, plug in tubes and you're done. The diagram above shows location of controls and connectors on the PCB. While there are a lot of them, end user needs only the following:

DC power input – located at the center of PCB, it is used to provide clock with 12-24V DC power. Please mind polarity, because if you accidentally reverse it, clock will be permanently damaged.

Speaker connection port – located at the top right side of the PCB. Connect either included speaker, or if you want louder sound, provide your own, with power at least 3W and impedance in 4–8-ohm range. You can also leave it unconnected, if you do not want alarm functionality.

Temperature sensor connector – this is used to connect DS18B20 temperature sensor. Pinout is written on PCB. Similarly, this sensor also can be left unconnected, it is not necessary for proper clock operation.

Besides these, there are some more connectors available on the PCB. Depending on your order, they can be occupied with modules, or left blank, so you can install your own if needed. These modules are:

ESP-01 module. It is connected to the matching socket at the top left side of PCB and can be flashed with "IceTube Clock NTP" firmware, which provides ability to

receive time sync over the NTP. The status of NTP signal later can be checked from the setup menu. Firmware for ESP-01 can be downloaded from the following URL: https://github.com/BaltasarParreira/Icetube_Clock_NTP

RF Remote module. This clock supports optional, 4 button RF remote control modules. The module connects to main PCB at bottom left side. If you ordered clock PCB without this module, you can later install one by yourself – these are sold on ebay/aliexpress and reference photo of the module of correct type is given at the end of this manual.

New RF remote pairing button. If you somehow manage to lose original RF remote, or it no longer works or you just want to replace it for whatever reason, then you have to press this button with some sharp object (like pen tip, paper clip end, etc.) and with delay of 2-3 seconds, press buttons 1-2-3-4 on your new remote, so clock will "learn" it and it can be used freely.

MP3 module. This module is used to play hourly chimes, alarm tones, keypress sounds. It has some pre-loaded content on it, but in case you need to have your own mp3 files as ringtones or hourly chimes, the module is equipped with own MicroUSB connector, so you can use it to connect to computer/phone to download new sounds. Please note, clock firmware enumerates files by their date of copying – so when you will go to playback menu, #1 file will be the first one which was copied to the memory, and so on. The total memory of MP3 module is 4MB and any number of MP3 files can be written (but clock firmware will play first 20 only). **Please note – do not delete pre-loaded content from the MP3 module** – doing so will mess up keypress sounds/hourly chimes. If you accidentally deleted them, you can restore them by downloading them from our website.

Powering on, first run & reset to default

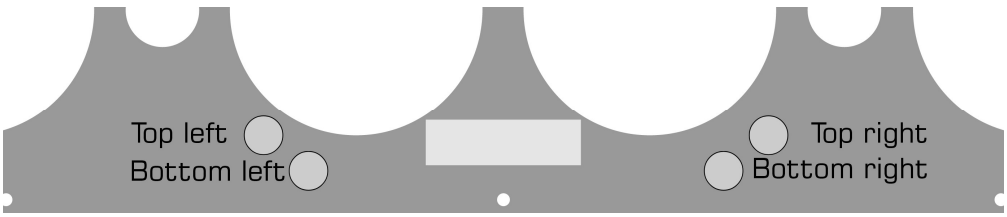
When you power up clock for the first time, "First run, reset to default value" will appear on the screen and there will be small delay before loading.

Under the normal operation, when powered up, several self-tests are conducted and "welcome" is shown on the LCD screen. After that, clock enters normal operation and LCD screen is being turned off.

If you have messed up with the settings and want to reset clock to defaults, unplug the clock, press both right buttons, power it on, and wait until you see the "First run, reset to default value" on the screen.

Clock setup is done via the multi-level, easy to navigate menu, by using on board LCD screen and touch/physical buttons around it.

There are 4 touch or physical buttons around the LCD screen. Two on the left and two on the right, as show on the drawing below:



To enter the setup, when clock is in normal mode, touch (or press) top left button and clock will enter setup.

In setup menu:

Top left button: Scroll up

Bottom left button: Scroll down

Top right button: Enter selected sub-menu

Bottom right button: Exit setup/back

There are 4 sub-menus in the main setup menu. You can select one of them with left buttons and enter by pressing top right button, or exit by pressing bottom right button.

These menu items are:

- Time/Region set
- Alarm settings
- Appearance set
- Maintenance

When you enter the sub-menu, button function changes to the following:

Top left button: Move to previous menu item/parameter

Bottom left button: Move to next menu item/parameter

Top right button: Increase selected parameter

Bottom right button: decrease selected parameter

To exit any sub-menu and return to upper menu level, scroll with the left keys to the "Return to main" item in menu, and press any button on the right.

Time/Region set sub-menu is used to set up time, date, region format.

From there you set the region – either 12-hour mode with temperature being displayed in Fahrenheit scale, or 24-hour mode, with temperature being displayed in Celsius scale. Other menu items are self-explanatory, so no need for detailed description, except the date and month. If you set illegal date, such as February 31th, clock will still work, but alarm functions might be affected. Also, in this sub-menu you can set up your UTC time zone. Please note, it is used only for initial GPS/NTP setup and is not mandatory, if you going to enter the time manually. Also, from this sub-menu you can enable/disable GPS/NTP sync if desired. Once enabled, sync is performed daily at midnight. If you want to manually force sync at current moment, go to Maintenance/GPS & NTP status sub menu. Once you enter that menu, sync will be automatically performed.

Alarm setting sub-menu has the following options to set:

Alarm mode – select whenever you want it to be disabled, enabled all week or enabled on work days only.

Alarm sound – select desired sound from the preset sounds, or write your own mp3 files into clock memory. Please note, for proper operation, with custom alarm tones, files should have names consisting of 5 digits, like 00001.mp3, 00002.mp3 and so on.

Alarm volume – you can adjust alarm volume from this menu. When you select this sub-item, previously selected alarm sound will start playing and you can use keys at right to adjust the volume.

Alarm duration – you can set how long alarm will be ringing. Settings are 30 seconds, 1 minute, 2 minute, 3 minutes. (Actual durations will vary depending on duration of alarm tone selected)

Alarm flash – it is possible to flash tube backlight while alarm is ringing, so there are 3 options for that – disabled, when backlight stays calm, "all together" – when all tube backlight colors change together and "random" – when tube backlight colors change individually.

Appearance set sub-menu is used to adjust tube brightness, enable super saver mode, adjust backlight options. It consists from the following items:

Tube brightness – there are 8 preset brightness levels and auto mode. If you select later, tube and backlight brightness will gradually decrease in the evening and increase in the morning and stay at high brightness during the day.

Night saver – enabling this option will completely turn off the clock digits and backlight at night. functions, including alarm, will operate as usual, and pressing any key on the remote control will "wake up" clock display for 3 seconds. In case of need, default time period can be customized in the "maintenance" menu.

Day saver – same as above, but for daytime use. Time period for day saver can also be customized in the "maintenance" menu.

Digit animation – it is possible to select different digit display options. Selecting "Off" means that digit will just go out and next one introduced – as on any usual clock. When "Dissolve" is selected, the digit gradually fades out, and next digit fades in. When "Crossfade" is selected, the current digit brightness will start decreasing and brightness of the next digit will be slowly increasing. With "Blur" option, whole tube will be blurred and when cleared, next digit will appear. When you scroll thru the options in this menu, digit animation will be played on all tubes, so you can have idea how it looks. Please note – when you change this setting, keys will be irresponsive for a moment, because clock is showing on all digits how selected animation looks.

Divider style – This clock allows to have some cool animation with digit dividers too: "Fixed on/off "dots will just come on and off – without brightness change. "Smooth on/off" – dots will fade in and then fade out, "Smooth climb" – first, lower dots smoothly come on, followed by top dots and action is then reversed. "Fixed climb" – same action as in previous mode, just without smooth transfer.

Main display – here you select what is displayed on the nixie tubes – only time, temperature or calendar too. There are several choices, which are quite self-

explanatory. Temperature and calendar are displayed for 10 seconds and then clock returns to normal mode.

Change content – how often clock automatically goes to calendar/temperature display. This can be set to 1, 3, 5, 10 minutes.

Leading zero – based on your decision, you can suppress the leading zero, so instead of displaying say 07:25:39, clock will display 7:25:39. This setting is for 12-hour display mode only.

Hourly chimes – If user enables this option, clock will play hourly chimes. There are several different chimes sounds to select from. Please note, you can adjust chimes start and end times in Maintenance menu

Keypress sound* – you can either enable or disable sound feedback when you press any of the keys. Please note, if you have super saver option enabled, it will silence the keys during the night automatically.

Color editor – in this sub-menu, you can create new colors for tube backlight LEDs and create new user backlight gradients ("efex"). In total, you can create 6 new colors and 6 new "efex". This sub menu has the choices for editing/deleting new colors and new efex. The following sub-items are available in this menu:

Edit color – create new color from the scratch

Edit efex – create new gradient from the scratch

Clear color – delete user created color

Clear efex – delete user created color

When you select "edit color" you will be asked for the custom color number, 1-6, which you can select with the left keys and confirm selection with top right key. If color already exists, existing values will be loaded and shown on tube backlight. After that, you will be able to navigate thru color components (red-green-blue) with the left side keys, and adjust its value with right side keys. The changes to color will be immediately show on all tubes. Once you like the result, using left side keys, navigate to "exit" menu item and press enter/confirm key.

When you select "clear color", just select color to be deleted with the left keys (tube backlight will change to that specified color) and press enter/confirm key on the right. Similar action is for deleting the "efex".

In the Efex editing menu, first you select the number of efex you want to edit, and after you confirm it, left side keys will be used to select the tube number (1 to 6, from left to right) and right-side keys will be used to assign that tube either one of predefined, or user created color. After you're done with editing, scroll with left keys to "exit" item and press enter/confirm to save results and exit from this sub-menu.

Motion sensor* – Clock can be equipped with motion sensor, which will turn off clock digits and backlight, if there's no motion for a certain period of time. In this sub-menu, you can either disable this sensor completely, or enable it and set the time in seconds, how long digits will stay on after the sensor detects the motion.

(* Feature available only in 2+ boards, has no effect on earlier models)

Maintenance – in this sub menu, you will find information about clock status, tube calibration, healing and color editing options. Use buttons at left to scroll thru menu options, use top right button to enter the sub menu and bottom right button – to return to previous menu level.

Clock status – when you enter this sub menu, you will see the clock uptime (time since last power on) time since tube calibration, internal voltages, firmware version and other technical info.

GPS & NTP status – when you select this option, you will see the status for GPS and NTP – whenever time sync is received from any of these sources. Please note, GPS has priority over NTP, so if GPS signal is available, clock will use it and won't use NTP, if not, it will fall back to NTP. In general, clock uses quite stable RTC chip, so you will hardly need GPS or NTP sync at all.

Tube Calibration, Tube healing – These are important options for the proper operation of the clock, so please read below for their detailed description.

Tube saver – in this sub menu, you can customize night/day saver options, such as start and end times and activity on weekends.

User profiles – you can save all your user data, including tube calibration settings to non-volatile memory, so you can quickly restore them after software update or if anything goes wrong. (***Feature not available yet***)

Tube Calibration sub-menu

Please note – it is advised to temporarily set digit animation to "off", if you have already enabled it, to prevent interference with tube calibration process. Once tubes are calibrated, you can re-enable animation, if desired.

Nixie tubes generally are quite tolerant to supply voltage and current changes, however, as we scale things up (make tubes bigger), tolerance actually gets reduced, so we need more precise control over tubes to extend their lifespan to maximum. For that purpose, this clock has a special calibration mode, which you will need to run only once (or if you have replaced some tubes). The process is quite easy to do and requires no special tools or knowledge.

Once you have entered this sub-menu, select the desired tube number, 1-6, starting from left to right, with the left side keys. Press "enter/confirm" again and screen will look like image below:

The digit "0" of tube will light up, or won't light up at all, or will be just partially lit. Don't worry, press the "up" button to increase the "power" value. (If you have

previously calibrated this tube, the "power" value will show the current reading). Watch as brightness of "0" segment increases. Repeat this until you see the segment connecting wires start to glow. Note the value of "power" setting and press "down" button to reduce that value, by 2-3 steps, to the amount when segment connecting wires no longer glow. Please note, when you press the "down" button, tube will go off for a second and then back, this is normal and required to prevent residual wire glow. Do not reduce this value too much, because it will affect tube brightness and might cause cathode poisoning. After you're done with the current segment, you can use left side keys to select another digit, or scroll down to the "exit" option and press any key on the right. Repeat the steps above to calibrate other digits and/or tubes. If you get bored at this stage, just go to "exit" – calibration data is automatically saved. There is ability to select 12 "segments" per tube, while actual tube only has 10. There's no error – this feature has double purpose – the 10^{th} segment is the "C/F" sign in millclock tubes, and 11^{th} segment is separator dots – you can adjust their brightness as well (To adjust separator dot brightness, select 11^{th} digit for 2^{nd} tube for left separator and 11^{th} digit for 4^{th} tube for right separators)

Tube healing sub-menu

(Special note to 2 and 2+ board users – instead of using separate tube healing, you can just set the current of badly lit segment to a value, where it will be lit up properly, and leave it in that way for week or so.)

Tube healing is a process when segments are fed with higher than normal, current, to "burn" off the residue on cathodes. This process should be done with caution, since applying too much current can cause irreversible tube damage. However, in case with this clock, you have no need to do it by yourself – the clock handles it all by itself – it randomly increases current thru the random digits while in normal operation mode, so they all will get proper treatment. However, if your tubes are already had been used and there's some cathode poisoning, you can force healing of these specific segments only in this sub-menu, for faster recovery. Please note, you can heal maximum 1 segment per tube at the same time.

This sub-menu has two entries: "Set tube/digit" where you select the tube(s) to be healed and digits in it and "Start healing" – to start the healing. To perform the healing, in this sub-menu, select the tube(s) first you want to heal, and then select segment of that tube to be healed. If no tube/segment is selected, error message will be displayed. During the healing, segments will come on for 10 minutes at full brightness, then 1 minute cool down (off) and 1 minute at normal brightness. Whole process takes approximately 3 hours. During the healing, you can visually check the condition of the segments while they're in "normal" mode. If they already achieved normal brightness and there are no dark spots, you can terminate healing by pressing any of the buttons and return to the normal clock operation. The current state of the healing will be shown on the display – "Healing"," Cooling"," Normal". If one pass of the healing is not enough, you can re-launch the process as many times, as needed.

Tube saving – in this sub-menu, tube life extension options are provided. As noted above, you can turn off tubes during the day and (or) night, to extend their life time. Here you can customize these settings, which are as follows:

Night saver start – hours when night saver mode starts working

Night saver end – hours when night saver mode ends

Day saver start – hours when day saver mode starts working

Day saver end – hours when day saver mode ends

Remote control operation

Your clock comes with (optional) RF remote control. The remote has 4 buttons which are used for the following:

Button "A" – Currently reserved, no function.

Button "B" – turn clock digits and backlight on and off, clock continues to function normally, including alarm and hourly chimes, just displays nothing.

Button "C" – changes clock display to temperature. Display will return to normal mode after 10 seconds or by pressing that button again.

Button "D" – changes clock display to calendar. Display will return to normal mode after 10 seconds or by pressing that button again.

Remote control module selection

These modules are available in variety of shapes and pinouts. Picture of one type is provided for reference. Please note, this clock ONLY supports modules with the following pinout:

VSS	1
VDD	2
D0	3
D1	4
D2	5
D3	6
BUTTON	7

Manual & firmware revision history

1.0 – Initial release

1.1 – Added new features: Motion sensor interaction, touch or physical buttons for menu editing

1.2 – Added new feature: UTC time zone selection for GPS, updated some routines to make clock start up or apply settings faster.

1.3 – Added the following new features: Ability to turn on/off GPS/NTP sync, reset to default option, manual updated with additional details and structure optimized.