R E S T R I C T E D

BDD PUBLICATION
PWU22027
V O L U M E 1

ENIAC Mk. 1
NUMERIC INDICATOR

DESCRIPTIVE

Prepared by direction of
Bad Dog Designs

Promulgated for the information and guidance of all concerned

This Document issued with E.L. No. 10, August 2022

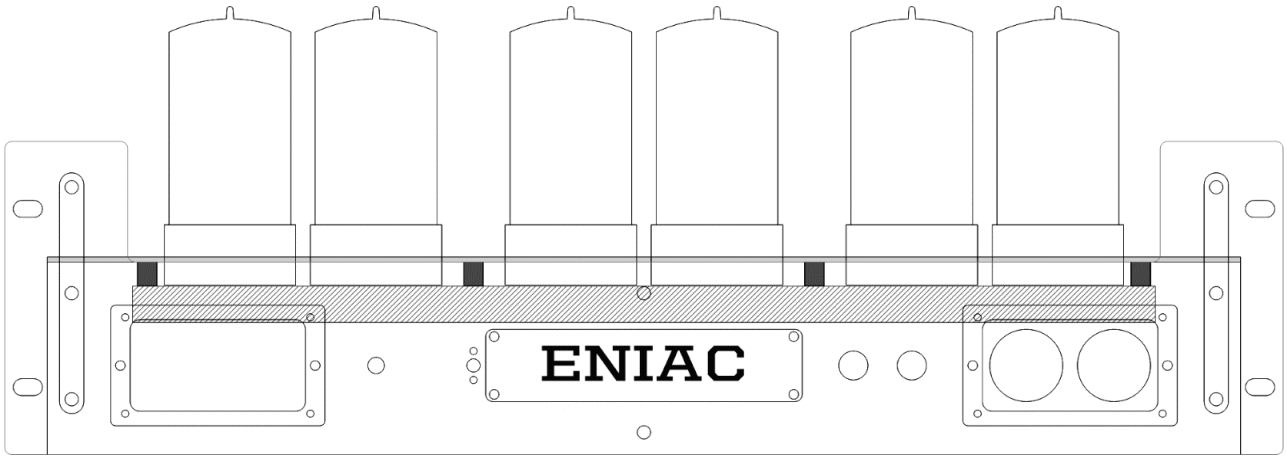


Fig 1. ENIAC General Arrangement.

INTRODUCTION

General.

1. The ENIAC is an **E**lectronic **N**umeric **I**ndicator **A**nd **C**hronometer, a development of the timekeeping and regulating component of a Primary Digital Computing Subsystem.

2. ENIAC incorporates tertiary mechanisms for acquisition of current time and subsequent timekeeping operations. Stage 1 relating to the GPS network, Stage 2 relating to an internet or ntp system and Stage 3 relating to an internal temperature compensated DS3231 IC.

3. Time is displayed on six RZ568M Nixie Tubes, with an additional programmable slave display comprising of two GN-4 (or equivalent) Nixie tubes.

4. Additional setup and configuration information displayed on a 128x64 resolution, concealed OLED display and used in conjunction with the front mounted rotary encoder.

5. ENIAC also incorporates a web server, generating HTML pages viewable in any connected web browser. This allows access to all the parameters and settings of ENIAC as well as the ability to update firmware and view diagnostic information.

6. ENIAC System status information displayed continually on three pairs of dual blinkenlight indicators situated on the top surface of the device.

7. Two front toggle switches provided for additional functionality and alteration of operating modes.

LEADING PARTICULARS

ENIAC Mk.1

General.

Type of clock …. …. …. …. …. …. …. …. …. 6 (+2) Digit Electronic Nixie Clock
ENIAC Width … …. …. …. …. …. …. …. …. …. …. …. …. 21” or 525mm
ENIAC Depth … …. …. …. …. …. …. …. …. …. …. 8” or 200mm inc handles
ENIAC Height ... …. …. …. …. …. …. …. …. …. …. 8” or 200mm to top of tubes
ENIAC Weight .. …. …. …. …. …. …. …. …. …. …. …. …. 12.5lbs or 5.6kg
Operating voltage … …. …. …. …. …. …. …. …. …. 12v DC via Mains adaptor

Nixie Display.

Main tube Type …. …. …. …. …. …. …. …. …. …. RZ568M Handmade
Main tube Drive …. …. …. …. …. Direct drive with individual digit current limiting
Main tube backlight .. …. …. …. …. …. …. Pair of WS2812 RGB leds for each tube
Slave tube Type …. …. …. …. …. …. …. …. …. …. 2 X GN-4 or equivalent
Brightness Control ... …. …. …. …. …. …. Automatic via ambient DLS light sensor
Tube Lifespan …. …. …. …. …. …. …. …. Approx 20 years under normal use

Additional Displays.

Colon Separator tubes …. …. …. …. …. …. 2 X Neon indicators, RGB illumination
Blinkenled indicators …. …. …. …. …. …. …. Three 2 X Neon status indicator pairs
Concealed OLED Screen . …. …. …. …. …. …. 128x64 resolution function display
Web page output …. …. …. …. …. …. …. HTML pages viewable in local browser

Electronic Hardware.

Core Microprocessor …. …. …. …. …. …. …. ESP32-WROOM-32U @ 240Mhz
Slave Microprocessor …. …. …. …. …. …. …. …. MEGA - AT238p @ 16Mhz
HV Generation …. …. …. …. …. …. …. …. Dual redundant MC3406 Inverters
PCB Construction .. …. …. …. …. …. …. …. 2 layer SMT Machine assembled

Configuration and setup.

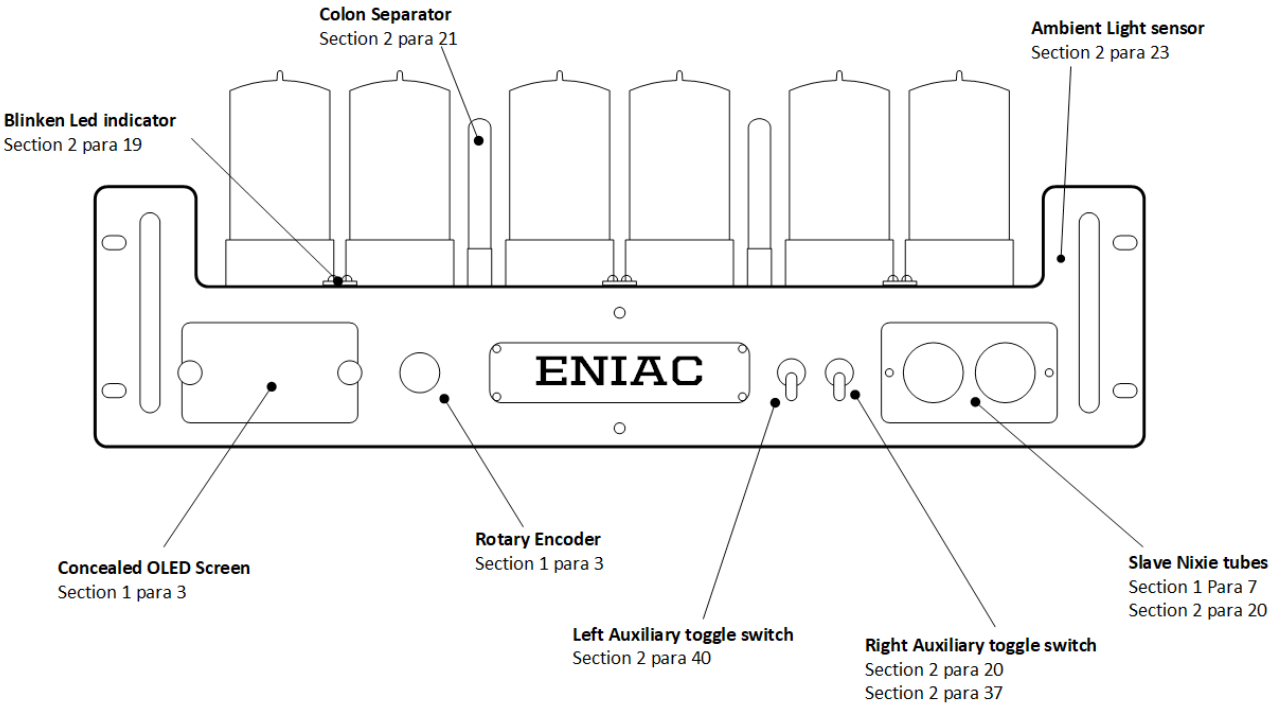
Primary Mode …. …. …. …. …. …. …. Internal Rotary encoder and OLED screen
Secondary Mode …. …. …. …. …. …. …. Via HTTP Connection to Web Browser

Time Acquisition.

Primary Mode …. …. …. …. …. …. …. …. …. Via supplied GPS antenna
Secondary Mode .. …. …. …. …. …. …. …. …. Via NTP (ntp.pool.org)
Tertiary Mode …. …. …. …. …. …. …. …. …. Via Internal DS3231 RTC Chip

SECTION 1

LOCAL OPERATION



Section 1
LOCAL OPERATION

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Initial placement and powering up.

1. Place ENIAC in its desired location, preferably not in direct sunlight and connect the GPS antenna cable to the socket on the rear connection panel of the ENIAC – locating the antenna face up, and reasonably near to a window. If not done so already, use the little thumbscrews and remove the cover on the front left of ENIAC that says ‘Remove cover for Frequency Selection and Adjustment’ and then plug the mains connector into the socket on the rear connection panel. Switch on the mains at the domestic socket the mains adaptor is plugged into.

2. Shortly you will then see all six Nixie tubes on top cycle through 0 – 9 and then settle on a time, this may not necessarily be the correct time at this point. The slave display may well also be off at this time. So far the clock has just initialised and just done some internal self checks, and you will see some messages appear on the OLED screen, and then the screen will switch off. On top you will see Blinkenlight BL3 either flashing or on constantly. This is to tell you how far the GPS has got with finding a satellite. Flashing means still looking, and constant on means locked. If after a period of more than 5 minutes still flashing, reposition the GPS antenna and try again until BL3 stays constant if possible.

OLED Screen overview and operation.

3. The screen is used in conjunction with the control knob to the right of the screen, called an encoder. The encoder can be turned clockwise or anti-clockwise and also pressed inwards to confirm a selection. There are four areas you can then select from the main menu and then view or adjust by using the encoder:

“**WiFi**” - this is primarily for connecting the clock to a local WiFi network.
“**Nixie Clock**” - this is for altering the appearance and settings of the Nixie clock.
“**System**” - this is for auxiliary functions and general maintenance of the ENIAC.
“**Manual time set**” - Used to set time manually. (This option will not appear if GPS fitted or WiFi connected)

Each area then has an end option to go back to the main menu.
The default for the screen is off, so in order to activate it you press and hold the encoder to wake it up, releasing once the screen comes on. Once the screen comes on it will display various status information, and pressing the encoder once more then comes up with the ‘Main Menu’.

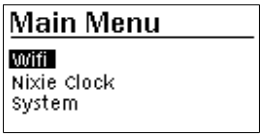

Fig 2. Main Menu Screen.

4. The active selection is inverted – in this example on the previous page it is 'Wifi' If you then rotate the encoder knob back and forth you will see each area selected in relation to the encoder movement.
Pressing the encoder will then select that area, and the screen will then show the options that are then available to you.

! Remember, the screen will timeout and switch off after about 20 seconds if there is no movement detected on the encoder, so the screen will need re-activation if it switches off!

WiFi Menu Commands and Operation.

5. It is beneficial to connect the ENIAC to a WiFi network as it will allow you to change and adjust various settings from your web browser, it will allow the clock to get a backup time reference from the internet and also allow any future updates to the clock operating software. However you can run the ENIAC without connection to the internet if not available. There are several methods for connecting the ENIAC to a WiFi network that you can select directly off the OLED screen once the 'WiFi' area has been selected off the main menu. Each one will be explained in turn, assuming the clock is not currently connected to a network. Here are the WiFi menu commands:

'Reconnect Previous' - ENIAC will remember its last WiFi connection details – the network name and password, if saved and then selecting this option will connect to the last saved network. This option only appears once ENIAC has successfully connected to a network previously.

'Connect with WPS' - WPS or WiFi Protected Setup is a feature for a quick method for connecting a device to a network. If your router has a WPS button, pressing it while this option is selected on the ENIAC will automatically connect it to the router.

'Start Smart config' - This is a developer mode, and not currently supported in this document.

'Open Access Point' - In this mode, ENIAC effectively becomes a WiFi hotspot and generates it's own WiFi network. You can then connect your phone or computer to this, and see a list of local networks that you can then select for connecting ENIAC to. See later chapter on Open Access Point Connection.

'Scan WiFi' - This will instruct the ENIAC to carry out a local scan of available networks in the background and within a few seconds will report back how many it has found.

'Select WiFi (0) ' If a scan is initiated by accessing the 'Scan WiFi' option above, here the number in brackets will show the number of suitable networks it found. Accessing this option will allow you to then choose which network to connect to.

'Enter SSID' - If you asked ENIAC to do a scan and your network did not appear, you can enter the network name (SSID) manually.

'Enter Password' - This is where you can manually enter the network password to allow connection.

Nixie Clock Menu Commands.

6. This section details the commands and options that affect the appearance of the Nixie clock that you can set via the encoder and the OLED screen. The way the information is presented is in the format of 'Function' and 'Next option' so for example, if it says "Digit Fade: OFF" this means that the digit fading of the Nixie tubes is currently *ON* so selecting this option will turn *OFF* the digit fade effect. The menu option will then refresh on the screen and you will see the function now say "Digit Fade: ON" so the function is now currently off.

! Remember, the OLED shows next available option, not what the clock is currently set to!

7. In this run down of commands the function is listed and then in brackets the possible options that are available for that function. Pressing the encoder on the selected function steps to the next option. If there are say 3 options, you will have to select the function again and press the encoder to advance to the next option.

'Tube Dimming (on / off) ' This relates to the dimming of the Nixie tubes and if it is on, the brightness of the tubes is automatically determined by the light sensor on the top of the clock. If it is off, the tubes will dim to whatever level is set in the dimming value function. This also applies to the slave Nixie tubes on the front of the clock.

'BL Dimming (on / off) ' This relates to the dimming of the back lights, the multicolour LED's that illuminate under the Nixie tubes. It works in exactly the same way as the dimming for the Nixie tubes.

'Set (12 / 24) hr mode' This determines if the clock runs in 12 or 24hr (military) time.

'Digit Fade (on / off) ' This determines the way the digits inside the Nixie tubes change from one to the next. They can either fade from one to another, or just switch instantly. This function does not apply to the slave Nixie tubes.

'Scrollback (on / off) ' A decorative effect that occurs when a digit inside the Nixie tube reaches 9. It can either just switch back to 0 for the next step, or it can rapidly count back 8,7,6,5,4,3,2,1 to get back to 0.

'Set Dimming Value (1 - 100) ' Used in conjunction with the Tube Dimming function above. Selecting this will take you to a numerical number entry screen, where rotating the encoder will increase or decrease the value. Select the required value and then press the encoder to select.

'IND Mode (chase / status) ' This is for the 6 Blinkenlights on the top of the clock. In chase mode they step in sequence once a second. In Status mode they indicate the various states of the clock, as per the legend panel on the top rear left of the clock.

'Slave Mode (Off / 100ths / Date / Secs) ' This controls the 2 slave Nixie tubes on the front of the clock. They can either be off all together, displaying 10ths and 100ths of a second, the date or the seconds count.

'ACP (Off / 1 min / 10 min / 1 hr) ' ACP is the 'Anti Cathode Poisoning' routine. This can be selected to run once a minute, once every 10 minutes, once an hour or turned off. It is used to help prolong the life of the tubes by periodically cycling through any unused digits.

'Date (Off / Wipe / Bang) ' The clock can display the date on the Nixie tubes once a minute whenever the seconds count gets to 50. This function determines if the date is displayed as a wipe, so the tubes change in sequence from time to date, or bang when all 6 digits swap at once from time to date. Alternately off will stop the date from displaying at all.

'Blank (Off / Weekend / Weekday / Always / Hours / WE or HRS / WD-Hrs / WE & Hrs / WD & Hrs)' This is for the blanking feature where you can preset ENIAC to switch off its Nixie tubes if there is nobody there to see them – for example; if you are away at the office during the day, the tubes do not need to be on. Setting up the blanking is explained later in this manual. (Section 2 Paragraph 29)

System Menu Commands.

8. This section details the System commands and functions available. As per the clock settings any options available will be in brackets after the function name.

‘Restart device’ This will reboot the ENIAC. For example if a countdown time has been set on the web interface, you will need to restart the device for it to enter countdown mode, or it is used to exit the Display Test mode.

‘Save Config’ This is an important command, if you have selected a WiFi network or changed a timezone or location, you need to save this into ENIAC’s memory so it knows to use these settings.

‘Save Stats’ This relates to the web interface / diagnostics. You can save the current clock statistics and view them on the web interface.

‘Display Test’ Used to test the Nixie tubes and RGB back lighting. Once selected all the tubes will count up 0 – 9 and the colours will change underneath. To exit the display test use the ‘Restart Device’ command.

‘WiFi at Start (On / Off) ’ This tells the ENIAC if it is to automatically log onto the Wifi network when it starts up.

‘Debug on 10m’ Developer function, turns on debugging information for 10 minutes.

‘Set Location’ If the ENIAC is not connected to a WiFi network, in order for the GPS to work correctly it needs to know your location to apply the necessary offset. Selecting this will then give you a further choice of (Americas / Asia-Pacific / Europe) and then further choices depending on your selection. Once you have selected your location you **must** use the ‘Save Config’ option and then ‘Restart device’ to see the time then change to match your location.

Open Access Point WiFi Connection.

9. This details the process to quickly get your ENIAC connected onto your WiFi network if WPS isn't available. You will need a WiFi enabled smart phone or computer and know how to turn its WiFi settings on and off.

From the ENIAC home menu screen on the OLED select the following options:

WiFi → **'Open Access Point'** → then press the encoder in, the screen will flicker briefly and timeout.

On your Smartphone or Computer, switch off the Wifi and then turn it back on to scan for a list of local access points. You will see one appear that is called **ESP32-xxxx** (where the xxxx can be various letters or numbers) This is the microprocessor inside the ENIAC, then select the option to connect to that network on your phone or computer.

Once connected, open up a web browser on your device and in the URL bar at the top enter **192.168.4.1** including the full stops and then press enter. You will then see a page that looks like (Fig 3.)

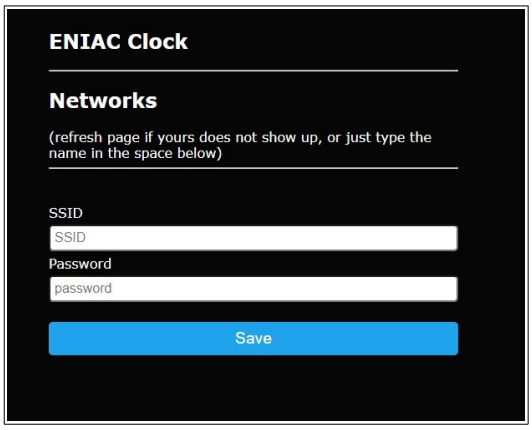

Fig 3. ENIAC Access Point Screen.

10. ENIAC will then look for all the local access points that it can find. If you then refresh the page after a short period of time you will see a list similar to (Fig 4.) Click on the name of the network that you would like to use, and it will appear in the rectangular white box at the bottom labelled 'SSID'.
You need to then enter the password for that network in the rectangular white box labelled 'Password'. Once done you need to click the blue 'Save' button. The screen will then clear and present you with a status message. With this done, you need to access the ENIAC system menu:

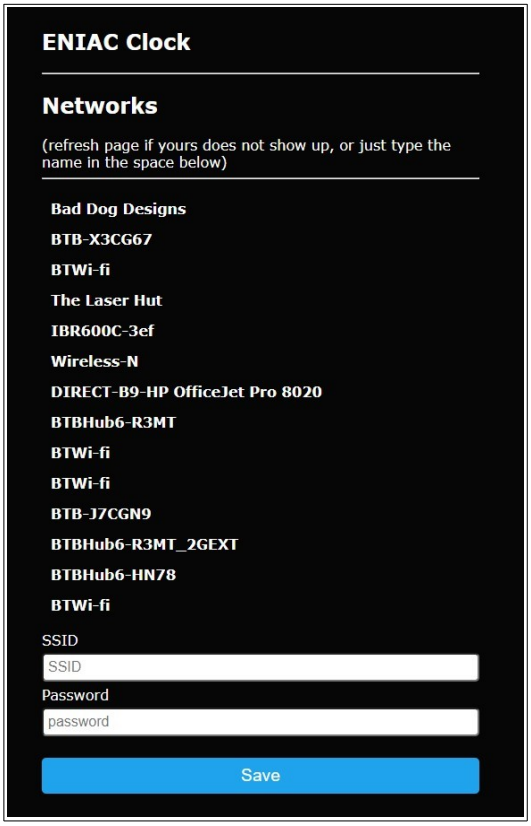

Fig 4. ENIAC Access Point Screen populated.

System → **'Save config'** and then press the encoder in to confirm.
System → **'Restart device'** and press the encoder in to confirm.

When ENIAC restarts, from the Menu go to:

WiFi → **'Reconnect Previous'** which will now have appeared in the list, and press the encoder in.

ENIAC will then connect to that network and display the network name it connected to (Fig 5.) If it didn't work then repeat process, but double check you entered the correct password.

Fig 5. ENIAC Wifi Connected Screen.

Local WiFi Scan and Connection.

11. A local scan will allow you to connect ENIAC to a WiFi network, without the need for another device or equipment, or if the Open Access Point method is unsuccessful. In order to perform the local scan you need to access the WiFi menu and select the **'Scan Wifi'** option and press the encoder in to confirm (Fig 6.) You will also note that the next option 'Select WiFi' has the number 0 in brackets afterwards.

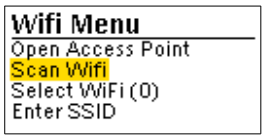

Fig 6. ENIAC Scan WiFi Command

Fig 7. ENIAC Scan Complete

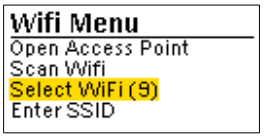

Fig 8. ENIAC Select network

12**.** After a few seconds the OLED screen will display another message saying it has done a scan (Fig 7.) and return the number of network access points it found. Press the encoder in and return back to the WiFi menu, and this time use the **'Select WiFi'** command, you will note it now has the number of valid access points in brackets after it. (Fig 8.) Once the 'Select Wifi' command has been actioned you will see a list of the networks discovered. It is then just a matter of using the rotary encoder to select the one you want, and then press it to confirm.

13. Once the desired network has been selected, you need to manually enter the password for access (Fig 9.) Select the command 'Enter password' and press the encoder to confirm. You are then presented with a data entry screen where you can put in the password (Fig 10.) Turning the encoder cycles through uppercase letters, then lowercase letters, then numbers and symbols, and finally commands 'DONE' / 'DELETE' / 'RESTART'

Fig 9. ENIAC Enter Password Command

Fig 10. ENIAC Password Entry

Fig 11. Password entry complete

14. Turn the encoder to get the correct character to match the first character of the password and press the encoder to confirm. Turn the encoder to get the second character, and so on. You will see the password being assembled at the bottom of the screen as it is entered. When you have the complete password turn the encoder past all the characters until you reach the command 'DONE' and press the encoder to confirm. (note there is also a DELETE command, should you have entered a character incorrectly) Once confirmed the Screen will revert back to the WiFi menu, but a new option at the top will have appeared **'Reconnect previous'.** Select this with the encoder, and press to confirm. If all went well, you will get a network connection message (Fig 12.) This will then be replaced with the main Status display for the ENIAC (Fig 13.)

Fig 12. WiFi Connection

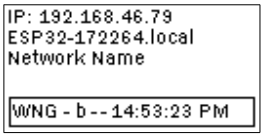

Fig 13. ENIAC Status Screen

15. Once connected we need to save the settings into ENIAC's memory in the 'System' Menu, so go to '**System**' and select the '**Save Config**' option and press the encoder to confirm.

SECTION 2

HTTP / Web OPERATION

Section 2
HTTP / Web OPERATION

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Displaying ENIAC in your web browser.

1. In order to view and modify the various settings and functions, including those accessible via the OLED screen and encoder, you can view the information in a connected web browser – provided two conditions are met.

a) You have connected the ENIAC to a local WiFi network, as per Section 1 (Open access point connection, and Local WiFi scan connection).

b) The device running the web browser is on the same network that the ENIAC has been connected to.

2. On the ENIAC, press the encoder in once to wake up the OLED screen, and then it will display the ENIAC status screen (Fig.14)

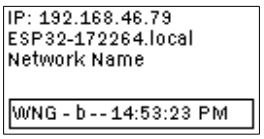


Fig 14. ENIAC Status screen

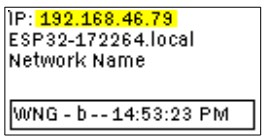
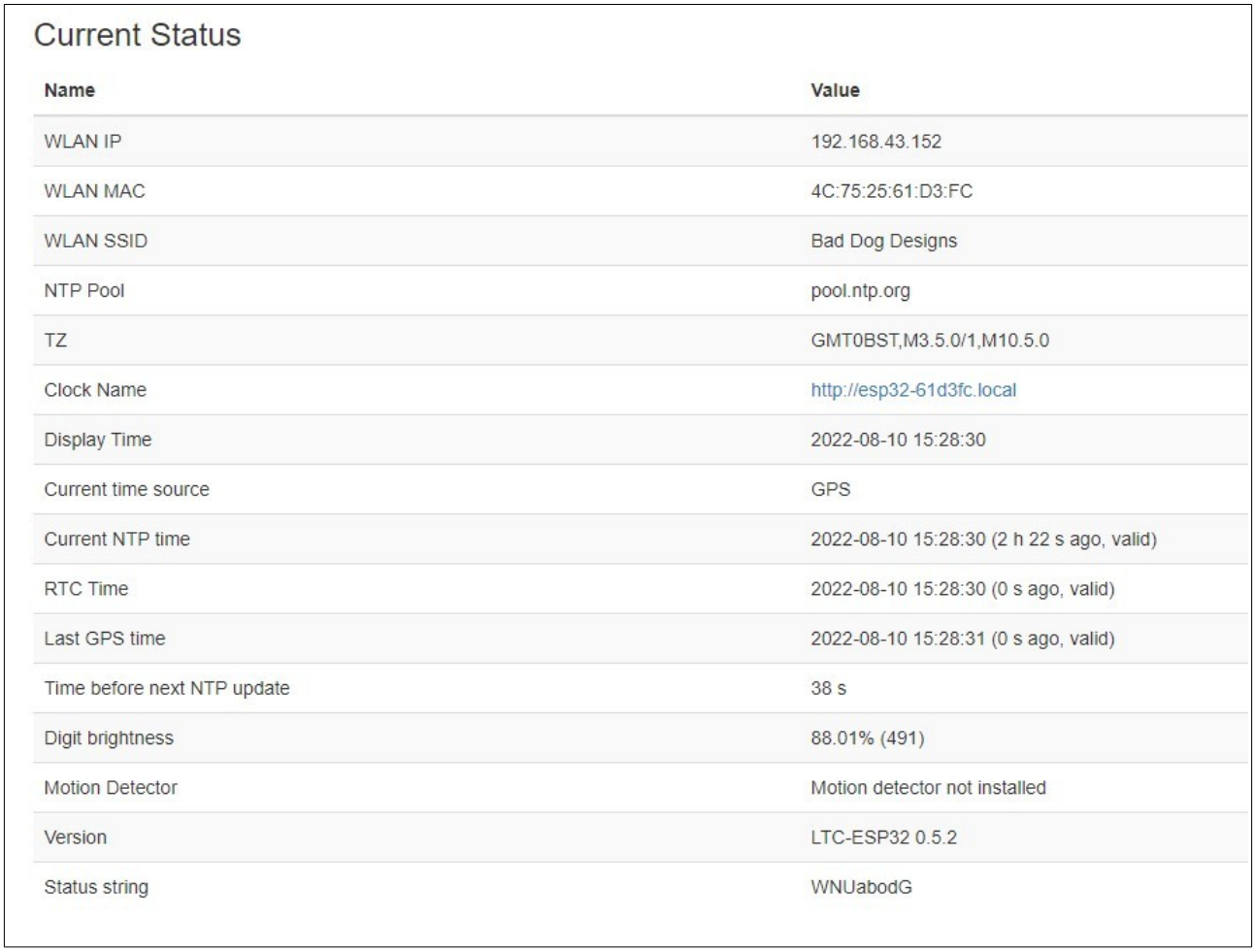


Fig 15. ENIAC I.P. Address

This status screen will display the network name it is connected to, and also the IP address it has been assigned by the local WiFi router (Fig. 15) in this example it is **192.168.46.79.** All you need to do is then open up the web browser on your device and type the IP address (complete with the full stops) into the address / URL bar at the top of the browser and then press enter.

Summary Screen.

3. As soon as the ENIAC IP address has been entered into a web browser, you will be presented with the Summary Screen that shows the current status of the ENIAC. (Fig 16.)



Current Status

Name	Value
WLAN IP	192.168.43.152
WLAN MAC	4C:75:25:61:D3:FC
WLAN SSID	Bad Dog Designs
NTP Pool	pool.ntp.org
TZ	GMT0BST,M3.5.0/1,M10.5.0
Clock Name	http://esp32-61d3fc.local
Display Time	2022-08-10 15:28:30
Current time source	GPS
Current NTP time	2022-08-10 15:28:30 (2 h 22 s ago, valid)
RTC Time	2022-08-10 15:28:30 (0 s ago, valid)
Last GPS time	2022-08-10 15:28:31 (0 s ago, valid)
Time before next NTP update	38 s
Digit brightness	88.01% (491)
Motion Detector	Motion detector not installed
Version	LTC-ESP32 0.5.2
Status string	WNUabodG

Fig.16 ENIAC Web Status screen.

4. The information is quite detailed and self explanatory. It shows what current method of time acquisition is in use, labelled '*Current time source*' for example, when the last update was done, as well as network connection information. In the top right of the web page you can see the navigation bar (Fig 17.)

Fig. 17 ENIAC Web Navigation bar

Clicking on the relevant heading will then generate the appropriate web page for you to then view or modify the current settings.

Configure Time Server Screen.

5. Once selected from the navigation bar you are presented with the 'Configure Time Server' screen (Fig 18.)

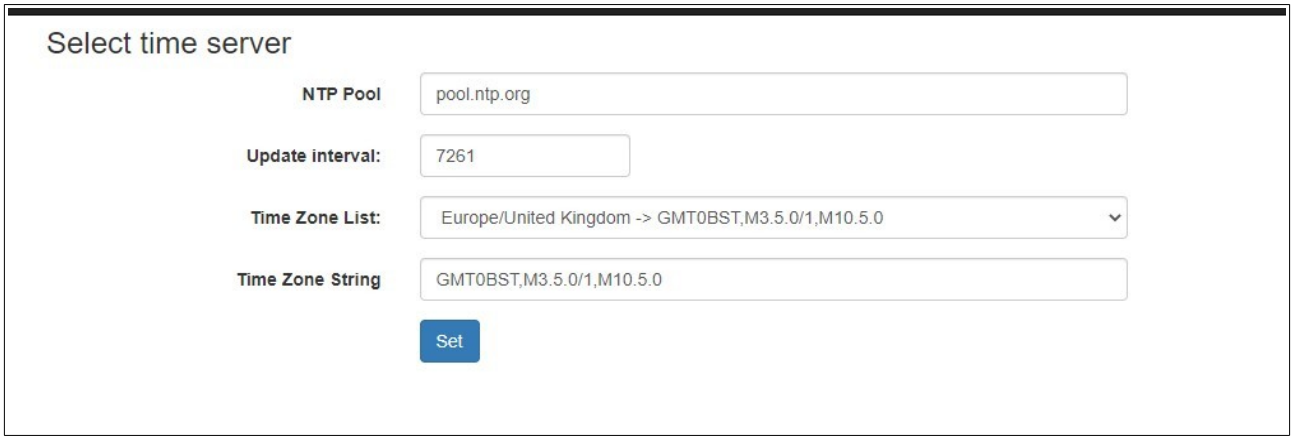


Fig.18 ENIAC Web Configure Time Server screen.

The purpose of this screen is to tell ENIAC where to get its network time information from – in this case the default source is *pool.ntp.org* although you can enter a different ntp server if you wish. Both NTP time and GPS time are in the UTC format, so in order to get the correct time for your location ENIAC needs to know what time zone you are physically located in so it can either add or subtract hours from the UTC time to get your Local time. Selecting the '**Time Zone List**' will give a selection of all the available time zones, and then you can select the relevant one for your location. This will then generate your local 'Time Zone String' which ENIAC uses to modify UTC and also implement daylight savings, if they are applicable in your time zone. This time zone selection is vital for correct operation, and the selection facility is also implemented on the OLED screen (Pg 8 – Set Location Function). Once you make any changes you must then click the blue 'Set' button to commit to the ENIAC's configuration file.

Configure Clock Settings Screen.

6. There are many settings and options to choose for ENIAC. The actual web page for this section is quite large, so it will be broken down into several sections (*General Options / Ambient Light Sensor / Digit Blanking / Countdown / Under Digit Lighting*) and each one explained accordingly. Once you have made a change or alteration to a setting you must then click the blue 'SET' button in order for ENIAC to execute it.

7. The OLED screen and Encoder on the front of ENIAC offer a limited selection of these functions. If the function is available for control by the OLED screen and Encoder you will see (**local control also**) in the description of the command in the following pages.

8. The General options section details the common options that may need to be set or adjusted to suit your own preferences. Once you select the ‘Configure clock settings’ from the navigation bar you will be presented with the general options (Fig 19.)

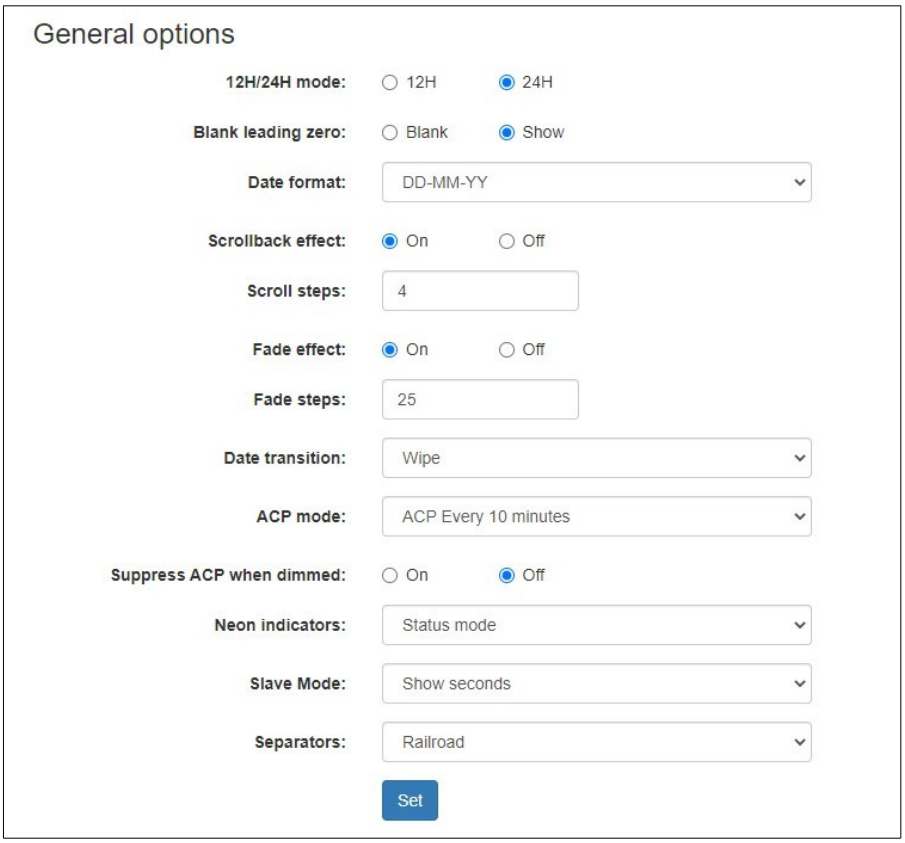


Fig. 19 ENIAC Web General Options Screen

“*12H/24Hr*” mode (**local control also**)

9. This determines whether the time is displayed in 12 Hour mode or 24Hr “Military” mode. If the clock is selected to show 12 Hour mode, you can configure the Neon Separators to indicate AM or PM if needed, or pressing the encoder will display the ENIAC status on the OLED, which will also show AM or PM.

“*Blank leading zero*”

10. This affects the first Nixie tube, and determines if the tube should show a zero, or be switched off in certain circumstances. For example if the time is 7am, the six tubes can show the leading zero so you see ‘07:00:00’ on the Nixie tubes, or the first tube can be switched off ‘**Blank**’ so you see ‘ 7:00:00’ on the nixie tubes.

“*Date format*”

11. If the date display is enabled in the ‘*Date transition*’ option, this option controls the format of the date display as it changes from country to country. Available options are (DD-MM-YY / MM-DD-YY / YY-MM-DD). On the clock the date is displayed every minute when the seconds count reaches 50, and displayed for 4 seconds.

"*Scrollback effect*" (**local control also**)

12. A decorative effect that occurs when a digit inside the Nixie tube reaches 9. It can either just switch back to 0 for the next step, or it can rapidly count back 8,7,6,5,4,3,2,1 to get back to 0. This setting allows you to turn the effect on or off.

"*Scroll steps*"

13. If the "*Scrollback effec*t" has been enabled this will allow you to change how rapidly the scrollback effect occurs. You can select (1 – 8) steps, with 1 being the quickest and 8 being the slowest.

"*Fade effect*" (**local control also**)

14. This determines the way the digits inside the Nixie tubes change from one to the next. They can either fade from one to another, or just switch instantly. This setting allows you to turn the fade effect on or off. This function does not apply to the slave Nixie tubes.

"*Fade steps*"

15. If the "*Fade effect*" has been enabled this will allow you to change how rapidly the fade from one digit to the next takes to occur. You can select (10 – 60) steps, with 10 being the quickest and 60 the slowest.

"*Date transition*" (**local control also**)

16. The clock can display the date on the Nixie tubes once a minute when the seconds count reaches 50. This function determines if the date is displayed as a "**wipe**", so the tubes change in sequence from time to date, or "**bang**" when all 6 digits swap at once from time to date. Alternately "**off** "will stop the date from displaying at all.

"*ACP Mode*" (**local control also**)

17. ACP is the 'Anti Cathode Poisoning' routine. This can be selected to run once a minute, once every 10 minutes, once an hour or turned off. It is used to help prolong the life of the tubes by periodically cycling through any unused digits.

"*Suppress ACP when dimmed*"

18. When the ACP routine is run it will automatically set the tubes at maximum brightness as this is most effective for the anti cathode poisoning to work. As the ACP makes the clock bright this may not be desirable if the clock is dimmed, i.e. at night and you don't want it then to suddenly go bright as it may disturb sleep. This will then let you stop the ACP running if the clock is dimmed.

"*Neon indicators*" (**local control also**)

19. This is for the 6 Blinkenlights on the top of the clock. In chase mode they step in sequence once a second. In Status mode they indicate the various states of the clock, as per the legend panel on the top rear left of the clock.

"*Slave mode*" (**local control also**)

20. This controls the 2 slave Nixie tubes on the front of the clock. They can either be "**off**" all together, displaying 10ths and "**100ths**" of a second, the "**date**" or the "**seconds**" count, depending on the selection chosen. Note the front axillary toggle switch will also switch on / off the slave display if ENIAC is not in countdown mode. (Para 37)

"*Separators*"

21. This setting relates to the neon separators located between the Hours and Minutes Nixie tubes and the Minutes and Seconds Nixie tubes. You can choose various flashing modes, or use them to display AM or PM indication if the clock has been set to 12hr mode. Options include (Railroad / Railroad US / Slow blink / Fast blink / Double blink / Always on / Always off / AM or PM indication)

22. After making a change, you must then click the blue 'SET' button at the bottom of the options section for the ENIAC to then execute the changes. As you continue to scroll down the "Configure clock settings" page, you will then come across the next section that details the Ambient Light Sensor and Digit blanking (fig 20.)

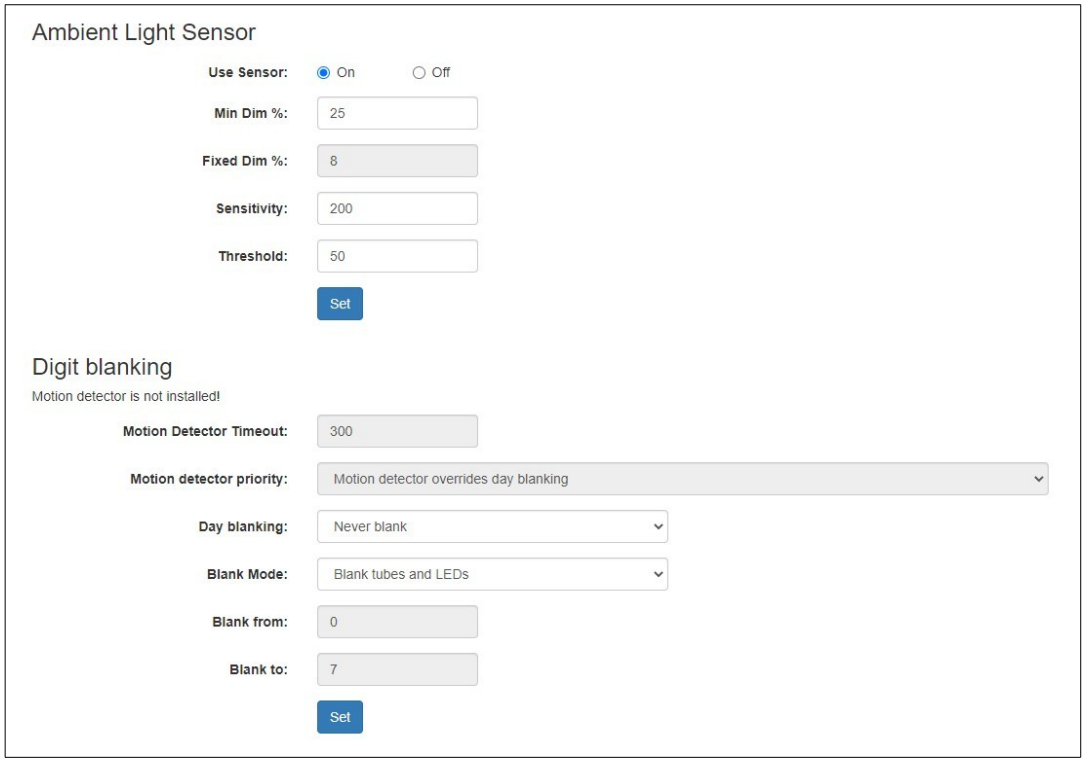


Fig.20 ENIAC Web Ambient light and blanking Screen

23. The Ambient light sensor is a small device located at the rear right hand side of the ENIAC Chassis. It measures the level of ambient light, and the information it provides allows ENIAC to automatically alter the brightness level of the Nixie tubes to suit the surroundings.

"Use Sensor"

24. This just tells ENIAC to use the sensor for automatic operation or not. If the sensor is not used then a dim level can be set manually. (para 26)

"Min Dim %"

25. This is where you can set the minimum amount of dimming that the tubes will drop down to if the sensor is used. You can enter a value from (1 – 100) Entering a value of 1 will give the dimmest setting at 1% brightness whereas if you entered a value of 90% you would hardly see any dimming effect as the minimum amount of dim is still at 90%

"Fixed Dim %"

26. If the option to 'Use Sensor' is set to on then this 'Fixed Dim %' option will be greyed out and you will be unable to enter a value. However if the sensor is set to 'off' then you can enter a value here (1 – 100) that will then determine how bright the Nixie tubes will be as a percentage of total maximum brightness.

"Sensitivity"

27. This determines how sensitive or quickly the tubes change in brightness with respect to the light level that the sensor is detecting. You can enter a value from (100 – 400). 100 is least sensitive, if for example you set to a value of 100, and then cover the sensor with a finger, it will take a while before you see the tubes dim. If though you set the value higher, then covering the sensor will give a quicker response.

"Threshold"

28. The threshold value can be set from (1 – 500) and determines when the dimming starts to occur based on the measured level from the sensor and the sensitivity value. Usually best to leave at the default value.

29. Digit Blanking refers to switching off the tubes but continuing to keep the time in the background. It is used to prolong the life of the Nixie tubes, for example if you are at work in the office during the day you can then set the ENIAC to blank the tubes while you are out. If there is no one about to see them they may as well be off. There are 2 ways to govern the blanking – either by setting up a blanking 'rule' as set in the 'Day Blanking' (Para 32) Or by the installation of an additional automatic motion detector referred to as PIR sensor. The ENIAC knows if there is a suitable PIR sensor installed and if so the relevant settings on the web page are then enabled to alter those settings.

"Motion Detector Timeout"

30. If there is a PIR sensor installed it is always looking for movement of a person in the vicinity of the clock. If it sees no movement after a certain time it assumes the person has left the area and then blanks the Nixie tubes. This setting allows you to put in a timeout period from (60 – 3600) seconds, from when the sensor last detected movement till it blanks the Nixie tubes.

"Motion detector priority"

31. If the PIR sensor is installed this setting will determine if the sensor information overrides any pre determined 'Day Blanking' rule or vice versa.

"Day Blanking" **(local control also)**

32. This allows you to set a specific rule as to when the clock blanks the tubes. There is a drop-down list and you can then select one of the following rules:

- Never Blank
- Blank all day on weekends
- Blank all day on week-days
- Blank always
- Blank during selected hours every day
- Blank during selected hours on week-days and all day on weekends
- Blank during selected hours on weekends and all day on week-days
- Blank during selected hours on weekends only
- Blank during selected hours on week-days only

The rules are self explanatory, the only thing to note is if you select a rule that uses 'Selected hours'.If one of these rule sets is chosen the 'Blank from' and 'Blank to' options will un-grey and allow you to enter the specific hours from and to that you want ENIAC to blank the Nixie tubes.

"Blank Mode"

33. This determines what ENIAC blanks once the blanking period is active. There is a drop-down list and you can then select one of the following options to blank:

- Blank tubes only(this will just blank all Nixie tubes and leave the LED lighting under the tubes)
- Blank the LEDs only (this leaves the Nixie tubes running and turns off the LED lighting)
- Blank tubes and LEDs (this turns off all Nixie tubes and LED lighting)
- Blank tubes and LEDs and Separators (this turns off all Nixie tubes, all LED lighting and the separators)

The Blinkenleds will still continue to operate even if everything is selected to blank. This is to indicate that the clock is still running and powered up.

"Blank from:" **(local control also)**

34. If one of the blanking rules has been selected (Para 32) then this option is available to then put in the start hour that you want the blanking period to commence from. The hour entry is in the 24hr format.

"Blank to:" **(local control also)**

35. If one of the blanking rules has been selected (Para 32) then this option is available to then put in the end hour that you want the blanking period to cease. The hour entry is in the 24hr format.

36. After making a change you must then click the blue 'SET' button at the bottom of the options section for the ENIAC to then execute the changes. As you continue to scroll down the "Configure clock settings" page, you will then come across the next section that details the Countdown mode and the Under Digit Lighting (fig 21.)

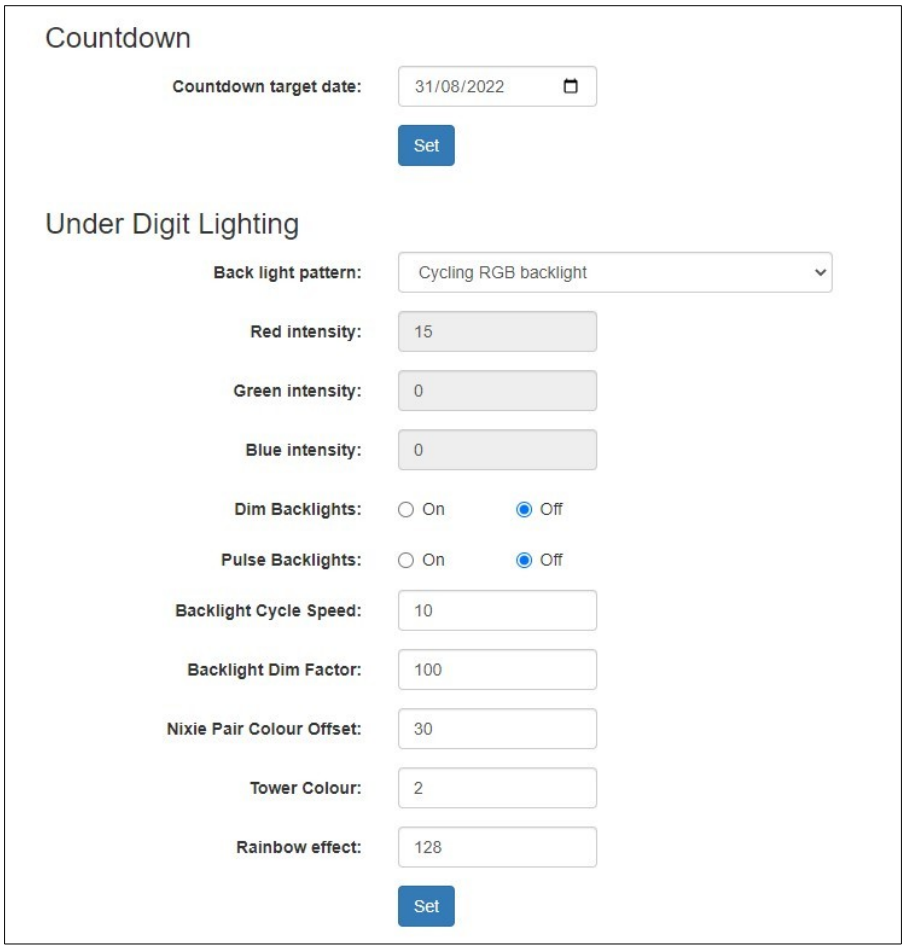


Fig.21 ENIAC Web Countdown and Under Digit Lighting Screen

37. Countdown. The countdown mode is a function where you can assign the clock to display the amount of time remaining until a specific target date has been set. It changes the primary function of ENIAC from a clock to a timer. It works by presenting a calendar display selection on the 'Clock settings page' where you can then select the future target date. There are two conditions that have to be met in order for the ENIAC to then display countdown time.

1. The target date set has to be in the future from current time and the blue 'Set' button clicked.
2. ENIAC has to be restarted via the OLED Main Menu. Go 'System' → 'Restart device' and press encoder.

Once restarted ENIAC will boot back up and the Nixie tubes will now display how long until the target date. This display is achieved, based on how far in the future the countdown has been set. The maximum time ahead is limited by the 8 available Nixie tubes so 99,999,999 hours is the largest leap forward which equates to over 11,400 years!

Depending on the time to go ENIAC will display as hours until it gets to the equivalent 999,999 minutes, and then the display will switch to show time remaining in minutes. When it then gets to the equivalent of 999,999 seconds remaining it will then show the remaining time as seconds. It therefore scales accordingly to show the best fit of remaining time on the Nixie tubes.

While the ENIAC is in countdown mode it is also possible to switch the display to regular time by using the right hand axillary front toggle switch nearest the slave display. Switching back then reverts back to the countdown display. If ENIAC is not in countdown mode, this switch will turn the slave Nixie display on or off. (Para 20)

38. Under Digit Lighting. Located below each of the 6 top mounted RZ568M Nixie tubes are a pair of RGB led lights that can be set up to display different colours for ambient lighting effects or to display further information. In addition to the top mounted Nixie tubes, the colon separators also have their own RGB led lights.
There are several settings that relate to the operation of the under digit lighting none are available from the local OLED and encoder entry, but can be adjusted manually. If the encoder is rotated anti-clockwise without pressing in the lighting colour under the tubes will change. If the encoder is rotated clockwise without pressing in the lighting colour under the colon separators will change. Alternately the under digit lighting can be turned on an off using the left hand auxiliary front toggle switch.

"Back light pattern"

39. The Back light pattern is where you can select the scheme that the RGB led lights follow. There are 4 operating schemes that you can select from:

- **'Fixed RGB backlight'** – This allows you to select any colour you wish for all 6 Nixie tubes, where you specify the amount of Red / Green / Blue to build up the required colour. (para 40)
- **'Cycling RGB backlight'** – This will automatically cycle through all the possible colours, with the later option to adjust the cycle speed.
- **'Colourtime RGB backlight'** – This offers a colourful display where each individual Nixie tube is illuminated depending on the number displayed inside it. For example if the tube is displaying the digit '0' then it will be illuminated red. If it is displaying the digit '2' it will be illuminated yellow.
- **'Day of the week RGB backlight'** – This will set all 6 Nixie tubes a different colour each day, so for example Saturday relates to blue.

"Red Intensity" / "Green Intensity" / "Blue Intensity"

40. These are normally greyed out and unable to be altered unless you have selected the 'Fixed RGB Backlight' pattern, in which case these are where you set the level of individual colour (0 – 15) to make your desired choice. Note if you set red, green and blue each to a value of 0 this will turn off the under digit lighting, which can also be achieved by using the left hand auxiliary front toggle switch.

"Dim Backlights"

41. This allows you to include or exclude the under digit lighting from the dimming regime that is in play for the Nixie tubes. (para 23)

"Pulse Backlights"

42. This is a decorative effect that will allow you to have the under digit lighting pulse on and off, or remain constantly lit.

"Backlight Cycle Speed"

43. This option is normally greyed out unless the 'Cycling RGB Backlight' patten has been selected. If selected you can choose how quickly the colours cycle through (1-10) where 1 is the slowest and 10 the quickest.

"Backlight Dim Factor"

44. If the under digit lighting has been included into the ENIAC dimming regime (para 41) this determines the maximum brightness (10 – 100) the LED's start with before any dimming occurs. The higher the value the brighter the LEDs will be.

"Nixie Pair Colour Offset"

45. Under each of the Nixie tubes is a pair of RGB led lamps. Normally they both illuminate exactly the same colour to give a uniform light under the tube. However you can offset one lamp against the other to create some interesting light effects within the base of the Nixie tube, where the glass diffuses the two colours together. It works by placing all the colours of the spectrum on a wheel (fig. 22) and then using an offset figure in degrees that you enter (0-360). For example, if a tube was set to be illuminated with a red colour, if you then enter an offset value of 180 then the main led lamp would be red but the other one would then be the polar opposite and illuminate green. Using a smaller value say 30 for example produces a crystalline effect in the base of the tube.

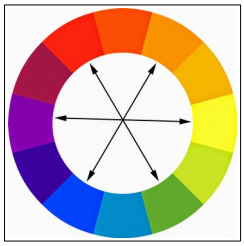


Fig 22. Colour Wheel

"Tower Colour"

46. This relates to the LED colour that is displayed under the colon separator tubes. You can enter a value from (0-360) as per the above colour wheel to change the colon separator colour. The same can be achieved by rotating the front encoder clockwise.

"Rainbow effect"

47. A decorative effect that is applied to all 6 Nixie tubes, based on the colour wheel. Normally all the tubes will display the same colour or hue (unless Colourtime backlight has been selected) but you can also alter the colour of one tube in relation to the next and so on. For example if you have selected a 'Fixed RGB Backlight' and set the colour to be red, all the tubes will be red. If you then set the 'Rainbow effect' to 360 you will then see the full spectrum of colours across all 6 tubes in the same manner a rainbow appears – hence the name. You can set a value from (0-360) so a smaller value of say 40 will show all the shades of red then changing into yellow, as yellow starts about 40 degrees around the colour wheel from red. If then combined with the 'Nixie Pair Colour Offset' setting (para 45) some very interesting colour schemes can be produced.

48. After making a change, you must then click the blue 'SET' button at the bottom of the options section for the ENIAC to then execute the changes.

Utility Screen.

49. The Utility screen (Fig 23.) is where you can see various diagnostic information, and also have the option to update the firmware inside ENIAC, should new features and updates be released by the manufacturer.

Description	Action
Reset Wifi Only (Reset WiFi, leaves clock configuration)	Reset WiFi
Reset Configuration Only (Reset clock configuration, leaves WiFi)	Reset Configuration
Reset All (Reset clock configuration, rest WiFi)	Reset All
Update firmware	Update Firmware
Force NTP update right now	Update NTP
Diagnostics	Get diagnostic information

Fig. 23 ENIAC Web Utility screen

"Reset WiFi"

50. Selecting this will remove all the WiFi settings from ENIAC's memory – so the 'Connect Previous' option will also disappear from the OLED menu system. Useful if you have had to change your Wifi router and need to connect ENIAC to a new WiFi network.

"Reset Configuration"

51. Selecting this will keep the current active WiFi settings but put all the other settings back to the factory default. Useful if you have changed something and caused ENIAC to do something unexpected.

"Reset All"

52. Selecting this is effectively a complete factory reset. It will clear all WiFi network information and user settings and configuration.

"Update Firmware"

53. If the manufacturer has an update or releases more functions or utilities it is possible to update the ENIAC firmware with this option. If you select this it will ask for a 'username' and 'password'. This will only be given by the manufacturer at the time of update, along with the necessary update files for Firmware and File system.

"Update NTP"

54. If you have set an ntp server (para 5) using this function will force ENIAC to get a time update straight away, rather than waiting for it to occur within the regular scheduling.

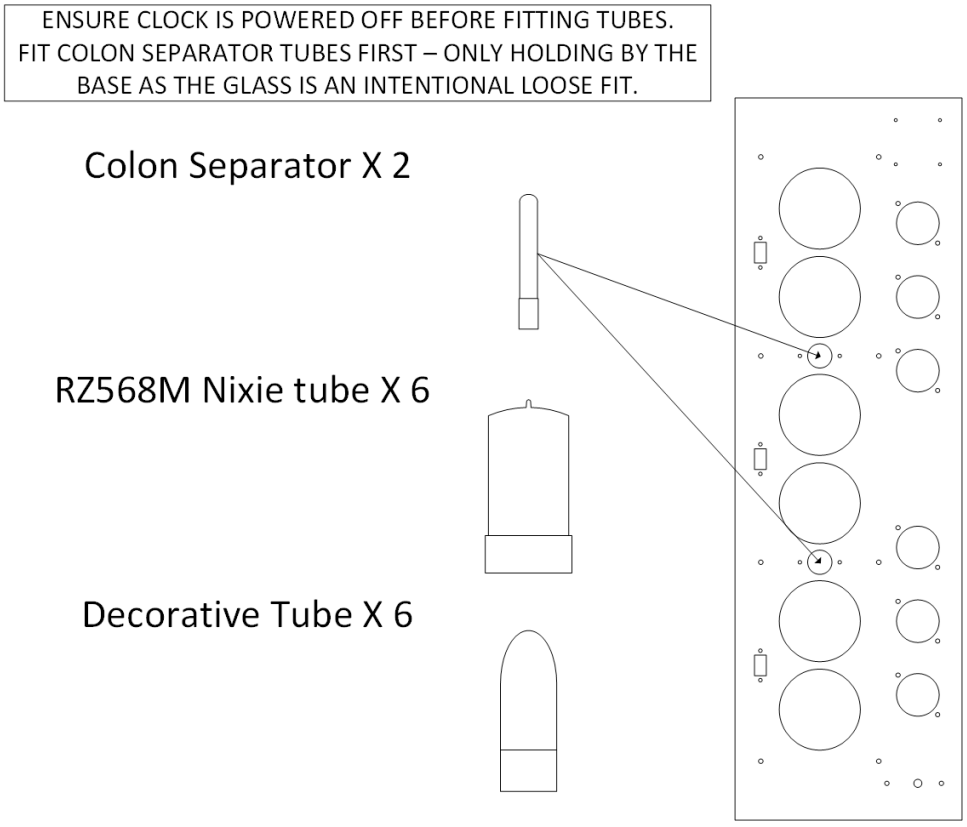
"Diagnostics"

55. Selecting this will present you with a page of technical information, if perhaps you have an issue with ENIAC the manufacturer may ask you to report back information from here, in order to assist with the issue.

Section 3
Maintenance and Commercial

ENIAC was designed to be as maintenance free as possible. There is very little the user needs to do from a maintenance point of view. The clock electronics will manage the tubes and there are various diagnostic pages and functions available within the http portal the clock produces, should any issues present themselves.

Periodically the tubes should be removed once a year to be cleaned with a microfibre cloth to remove any dust, and while the tubes are removed the opportunity should be taken to dust the ENIAC casing.



The tubes should only be removed or replaced with the ENIAC powered off. When re-fitting the tubes we recommend that you fit the colon separator tubes first. These are quite fiddly to fit and will only mate with the circuit board one way, so observe the orientation of the pins underneath before attempting to locate into the socket. Also the colon tubes are to be handled by their base as the glass cover is only a loose fit into the base.

The RZ568M Nixie tubes are the same in that they will only fit in one orientation. Obviously the front of the tube faces forward and there is no set arrangement so any tube can be put in any of the six sockets.

The decorative tubes are just that. They do not serve any functional purpose for the operation of ENIAC and again there is no set order or arrangement for their location.

ENIAC comes with a statutory 12 month warranty from purchase date as standard. The RZ568M Nixie tubes are warranted separately by www.daliborfarny.com however any issues can be dealt with by Bad Dog Designs as well.

As and when software updates are available for ENIAC you will be notified and given the information required to perform the update over the internet. Your ENIAC will need to be connected to a WiFi network in order for this to work.

Should any problems occur, in the first instance please call or email bad dog designs:

+44(0) 1543 732 734
paul@bad-dog-designs.co.uk

We can then advise accordingly.

Notes:

Bad Dog Designs Nixie Clocks Ltd
Unit 2
Pillaton Hall Farm
Pillaton
Penkridge
Staffordshire
ST19 5RZ

www.bad-dog-designs.co.uk

Section 4
Acknowledgements

The ENIAC has been a joint development over 12+ months between Paul Parry of Bad Dog Designs and Ian Sparkes of www.nixiebiz.com

Ian is based in Switzerland and responsible for the software design and PCB design, with countless updates and improvements!
Paul is based in the UK and responsible for the initial idea, mechanical design and implementation.

ENIAC came about as an idea for a fully fledged and hopefully the most feature rich Nixie clock ever made. No expense spared on the construction or the amount of prototype stages, and the amount of man hours that have gone into the software design and testing.

We sincerely hope you enjoy your ENIAC and it goes on to serve you for many many years to come!

Best wishes,

Paul Parry.