Clock Portal S3
Ambient Display
Instruction Manual

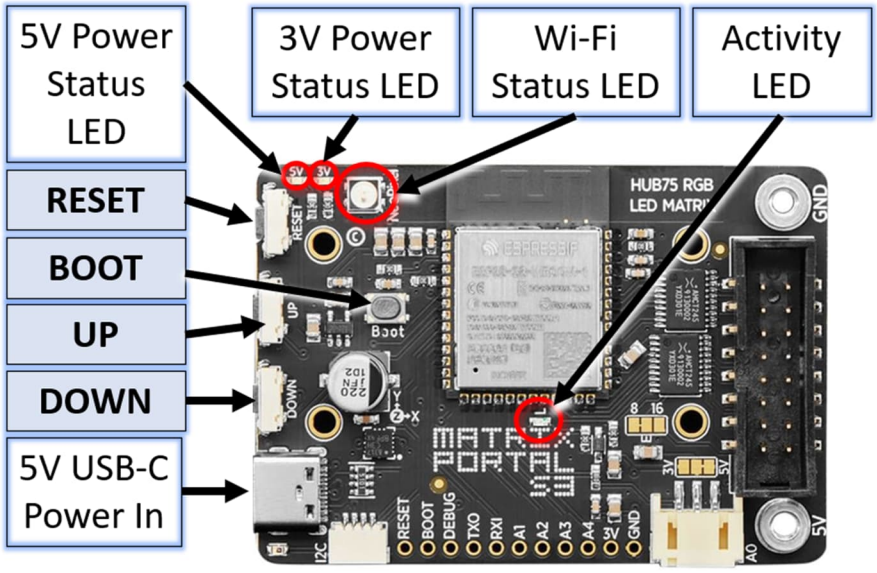
A handmade retro-themed
Clock/Calendar/Ambient Display
tgtech.dev

Clock Portal S3 Features

- 64×64 full-color RGB LED matrix for a vibrant retro-pixel display
- Customizable time, date, calendar, temperature, and color themes
- Solid hardwood frame
- Selectable seconds animations
- World Day/Night/Twilight map
- Configurable via Wi-Fi or hardware buttons
- Live temperature display
- Optional humidity and barometric pressure sensing
- Calendar mode with highlighted current day
- Relaxing Zen modes and *many* other engaging ambient visuals
- Optional timed rotation between any display modes
- 2.4 GHz Wi-Fi connectivity
- Wireless firmware updates
- Auto On/Off scheduling
- Works fully offline as a standalone clock/calendar
- Ultra-precise timekeeping (1 minute per year without Wi-Fi or a few thousandths of a second with Wi-Fi)
- Backup battery maintains time during power outages
- Automatic daylight-saving and leap-year adjustments
- Powered by a standard USB-C supply

Overview

Your Clock Portal S3 is a feature-rich, Wi-Fi-enabled display that shows time, date, calendars, animations, and much more. It includes an onboard menu, a web-based control interface, firmware update capability, and multiple visual modes. No app is required — you can use the hardware buttons or any modern browser.



Hardware

System Board

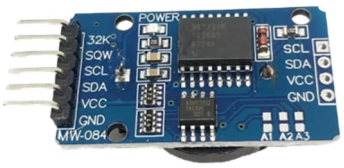
The clock uses four physical buttons for on-board control: RESET, BOOT, UP, and DOWN. Power is supplied by a 5VDC/2A USB-C adapter. The system board is accessible on the back of the LED matrix. There are two LEDs adjacent to the RESET button. One indicates 5V power is present and the other that board-generated 3.3V power is present.

There is a larger LED labeled "NeoPixel" next to the power indication LEDs; its color indicates Wi-Fi status: Green → Connected, Yellow → Connection attempt in progress, Red → Offline (Wif-Fi is not configured or there is a connection failure).

A red LED just above the "I" in the word "MATRIX" flashes each second to show the clock is running.

Real Time Clock Module

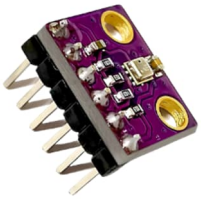
Time and date functions are performed using a high accuracy DS-3231 real time clock module (RTC). The module uses a CR-2032 battery to maintain the time if power is removed. Only use a CR-2032 battery! The positive side of the battery faces UP. Expected battery life is 5–10 years. To replace it, gently release the battery from the holder using a small screwdriver.



Optional Sensor

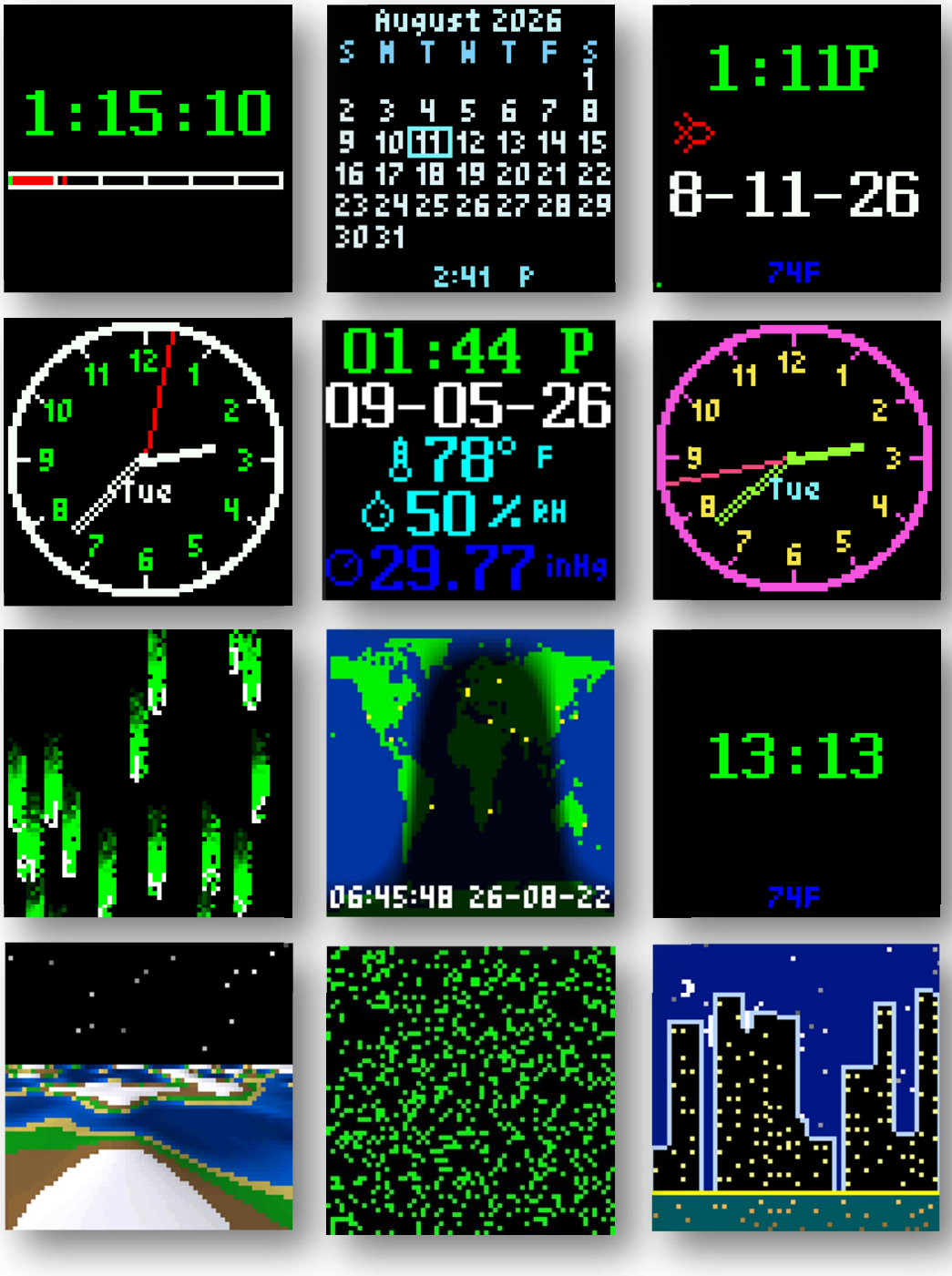
Two versions of an optional add-on sensor allow more accurate temperature readings and enable relative humidity and barometric pressure measurements:

- BME-280 – provides temperature, humidity, and pressure
- BMP-280 – provides temperature and pressure



Display Examples

Here are just a few examples of different themes and displays:



Many other themes, modes, animations, and layout options are available.

Power On

When powered on, the clock loads the last selected display mode. It takes about 10 seconds to boot.

General Menu Navigation Operation

Press BOOT from any main screen (Clock, Calendar, Ambient Display, or Display Off) to open the on-board settings menu.

Button behavior:

- UP — move highlight up / increase value
- DOWN — move highlight down / decrease value
- BOOT — select / confirm
- RESET — reboot the clock

UP/DOWN/RESET are pressed from the side; BOOT is pressed from the top.

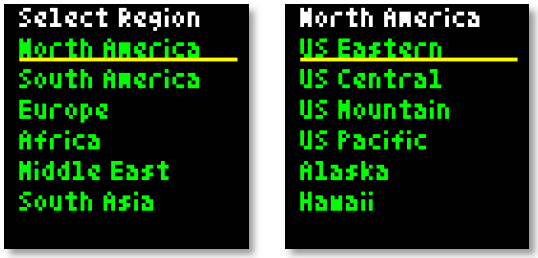
Settings persist through resets.

The web interface mirrors all on-board menu options and includes many more. The web interface also includes virtual buttons for remote control.

Always select Exit Menu and press BOOT to save settings.

Menu Item Details

1. Set Time Zone



This should be the first setting you configure. Choose your region then a specific time zone. Time zone setup uses two screens: Region Selection: Choose a region (e.g., America, Europe, Asia), and Time Zone Selection: Choose a specific time zone within that region. After setting, press BOOT to save.

2. Set Date/Time

Set the date and time manually if you are not going to connect to Wi-Fi. Use UP/DOWN to highlight fields. Press BOOT to select a field, then use the UP/DOWN buttons to adjust the value. Press BOOT again to move to the next item.

Set the date & time to the local date & time in your selected time zone.

When done adjusting, highlight Save & Exit and press BOOT. The date and time will be saved to the clock.

3. IP Mode

If connecting to Wi-Fi, you can set your IP mode to Dynamic (DHCP) which will use an IP address assigned by your network.

If you select Static IP mode, enter the IP address to assign to your clock. The IP address must be on the same network as your router for web interface to connect. You will also need to enter the Gateway and DNS server addresses. Use the same procedure to enter and change characters as with Wi-Fi setup.

4. Wi-Fi Setup

SSID Entry: The clock will scan for available networks and show their names (SSID's). Choose a 2.4GHz network and save it. The Wi-Fi will not operate on 5GHz networks.

Wi-Fi Password Entry: Enter your Wi-Fi password using the buttons. Use UP/DOWN to change characters. Hold a button down to scroll quickly. Pressing UP when "A" is shown next to Char: moves forward to "B" in the character list. Pressing DOWN moves backward. You will see Save, Cancel, or Backspace options displayed as you scroll through the list.

Pressing BOOT appends the character to the right of the Char: label and advances the vertical bar cursor. Scroll to Save, Cancel or Backspace then press BOOT to take those actions.

Confirm Wi-Fi: Shows the entered SSID and password. Press BOOT to save and connect.

The small font can be difficult to read. Refer to the order below as you cycle through characters and the Save, Cancel and Backspace choices:

```
ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789!"#$%&'()*+,-.
:;<=>?@[\]^_{}|~; <SAVE> <CANCEL> <BKSP>
```

5. Wi-Fi Info

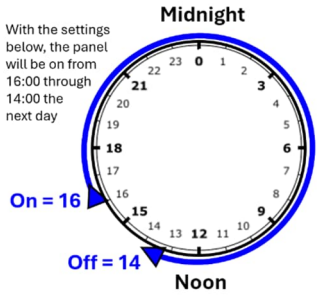
Shows network related information including the clock's network name, IP address, signal strength and hardware identification. Press BOOT to return to the menu.

6. 12/24 Hour

Select 12 or 24 hour mode. The 12 hour mode shows an A for AM and P for PM on the display if there is room for it within a particular layout. The 24 hour mode shows 00 for 12AM (midnight) through 23 (for 11PM).

7. Auto On/Off

Select an hour in 24-hour format to turn the display on and off automatically. If the “on” hour is less than the “off” hour, it is treated as a daytime window. If the “on” hour is greater than the “off” hour, it is treated as an overnight window. *Example*: On at 16 (4PM) and off at 14 (2PM) results in the panel turning on at 16:00 (4PM) and off at 14:00 (2PM) the next day. Pressing BOOT will bring up the menu if the display is off.



Set the ON and OFF times to the same hour to keep the display ON all the time.

8. Brightness

Adjust display brightness from 0–10. 0 is off, 1 is the dimmest, and 10 the brightest. Low brightness levels may make the colors take on a different hue and/or not be visible. If you select 0, the display will turn off when you exit the menu. A brightness of 0 overrides any auto on/off times, so the display will stay off indefinitely. To turn it back on, press BOOT to bring up the menu and select a different brightness level.

9. Blank Zeros [Leading Zeros]

Choose whether leading zeros are shown (08:15) or hidden (8:15). This setting is ignored in 24 hour time mode as leading zeros will always be displayed. This setting also applies to any leading zeros in the day, month and year.

10. Date Format

Choose between: MM-DD-YY, DD-MM-YY, or YY-MM-DD.

11. Panel Mode

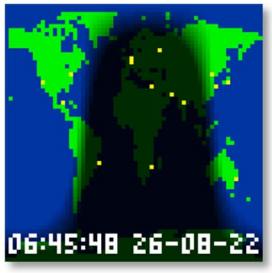
You can choose from Digital Clock, Calendar, Analog Clock, etc.

Digital Clock displays a digital clock using the settings you choose. If the Wi-Fi dot display is enabled in settings, a single LED in the lower left corner shows the state of the Wi-Fi connection. Green means Wi-Fi is connected, Yellow means it is trying to connect, and Red means not connected. A blue LED will light in the lower right corner for a short time when the clock synchronizes to NTP servers. Wi-Fi must be connected for NTP to work. Synchronization occurs once every hour.

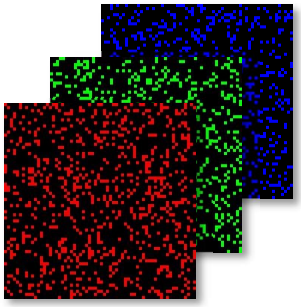
Analog Clock displays a circular analog clock. You may select whether the day of week (DOW) name (e.g. Mon) and/or the numerical day (e.g. 17) are shown on the face. The second-hand presence is controlled via the Sec Display in the main menu.

Calendar mode displays the current month in wall calendar format. Press UP or DOWN to go forward or backward a month at a time. Hold the UP or DOWN button to quickly go forward and backward. Pressing UP and DOWN at the same time returns the display to the current month. The current day is highlighted.

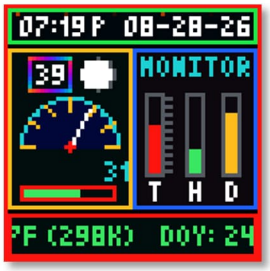
The Day/Night Map shows which portions of the earth are in daylight, twilight, or night. If you select Show Cities, yellow dots will mark New York, Los Angeles, London, Paris, Moscow, Cairo, Johannesburg, Dubai, Mumbai, Beijing, Shanghai, Tokyo, Sydney, São Paulo, and Mexico City. You may also choose to display the time and date, and the sub-solar position which is the point on earth where the sun is directly overhead. The shape of the day/night termination areas continually change with time as the Earth orbits the sun. Shape changes are due to the Earth's 23.5° tilt relative to the sun and the effect of projecting the spherical Earth as a 2D map. This is a great educational aid to show why daylight is shorter in the winter in the northern hemisphere and longer in the southern hemisphere.



Zen modes are full panel ambient "twinkling" animations. Red Zen shows random blinking red LEDs, Green Zen and Blue Zen show green and blue, and Cycle Zen switches between Red, Green, and Blue modes every 10 seconds



Mad Scientist mode shows a lively, colorful screen with the date, time and other information, including the day of the year, the week number, the moon's illumination percentage and phase, a thermometer, a hours "charge" bar, a day "charge" bar and some mysterious coded numbers! The moon appears as a circle that is shaded according to its illumination.



This mode can be used to show how a number can be presented in several different ways: seconds are shown digitally, via a needle on a meter, and with a filling bar. The vertical "T" bar is the temperature, the vertical "H" bar shows how "full" the hour is based on the number of minutes that has passed in the current hour: zero is empty and 59 is full. Similarly, the "D" bar shows how much of the day has passed based on seconds past midnight where zero is empty and 86,400 is full.

Environment mode shows the time, date, temperature, (optional) relative humidity, and (optional) barometric pressure. The temperature will be displayed using the built in temperature sensor in the DS-3231 module if no optional sensor is installed. An optional module must be installed to display the humidity and/or pressure. If the BMP-280 is installed, a more accurate temperature and barometric pressure will display. If the BME-280 is installed, a more accurate temperature, relative humidity and barometric pressure will display. See the specifications in a later portion of these instructions for the accuracy.

Game of Life mode shows patterns using Conway's Game of Life rules. Each pixel (or "cell") can be either alive or dead, and they evolve according to the following rules: Any live cell with fewer than two live neighbors dies due to underpopulation, any live cell with more than three live neighbors dies due to overpopulation, any live cell with two or three live neighbors lives, unchanged, to the next generation and any dead cell with exactly three live neighbors comes to life.

Hourglass mode shows sand dropping through an hourglass. You can select whether the hourglass shows the passage of the hour or the passage of the day.

Sorting Demo mode shows how quickly different sorting algorithms sort a list of 64 numbers. Seven different algorithms are demonstrated on a random number list: Bubble Sort, Insertion Sort, Selection Sort, Merge Sort, Quick Sort, Heap Sort, and Shell Sort. Each round of sorting uses the same list of random numbers for the selected algorithms so the time and method(s) can be directly compared. After a round is completed, a bar flows from top to bottom to erase the panel and a new round is started with a different selection of random numbers. White or Red highlights show the numbers being compared.

Text Scroller mode displays text you enter in the text box, or displays lines randomly selected from a text file you upload. Each line in the uploaded file will be randomly displayed. Each line needs to be less than 400 characters in length and end in a CR/LF (carriage return/line feed) character. For example, this can be used to scroll famous quotes across the panel.

Maze mode draws a large randomly generated maze. A solver then begins to explore possible paths until a solution is found. A fun thing to do is to capture the maze using the Matrix Snapshot function just as the initial maze is drawn and try to solve it yourself. You could also snapshot it just after the solution is displayed.

Screen Cycle will cycle through the panel modes you select and display them for the period you choose.

Flight Sim mode simulates flying over an alien landscape with turns and speed changes.

Many other panel modes may be selected. Note that the brightness setting can change how some colors appear. Dark colors can appear odd or drop out at low brightness settings due to hardware limitations of the LED panel.

12. Analog Clock Options

Select whether to show the Day of the Week, e.g. "Thu" and/or the Day Number, e.g. "24" on the Analog Clock face.

13. Theme

You may choose from several color themes. When navigating through the theme names, color swatches are shown which represent the colors used for various display elements.

14. Temperature Display

Toggles the temperature display and also selects the units (°C or °F). Temperature is shown in various panel modes.

15. Seconds Graphic

Choose an animated second indicator such as a filling bar, a juggler, a swimming fish, pong, an alien, and many others. The selected graphic glides from left to right proportional to the seconds in the minute. The seconds graphic applies to the digital clock mode only.

16. Seconds Display

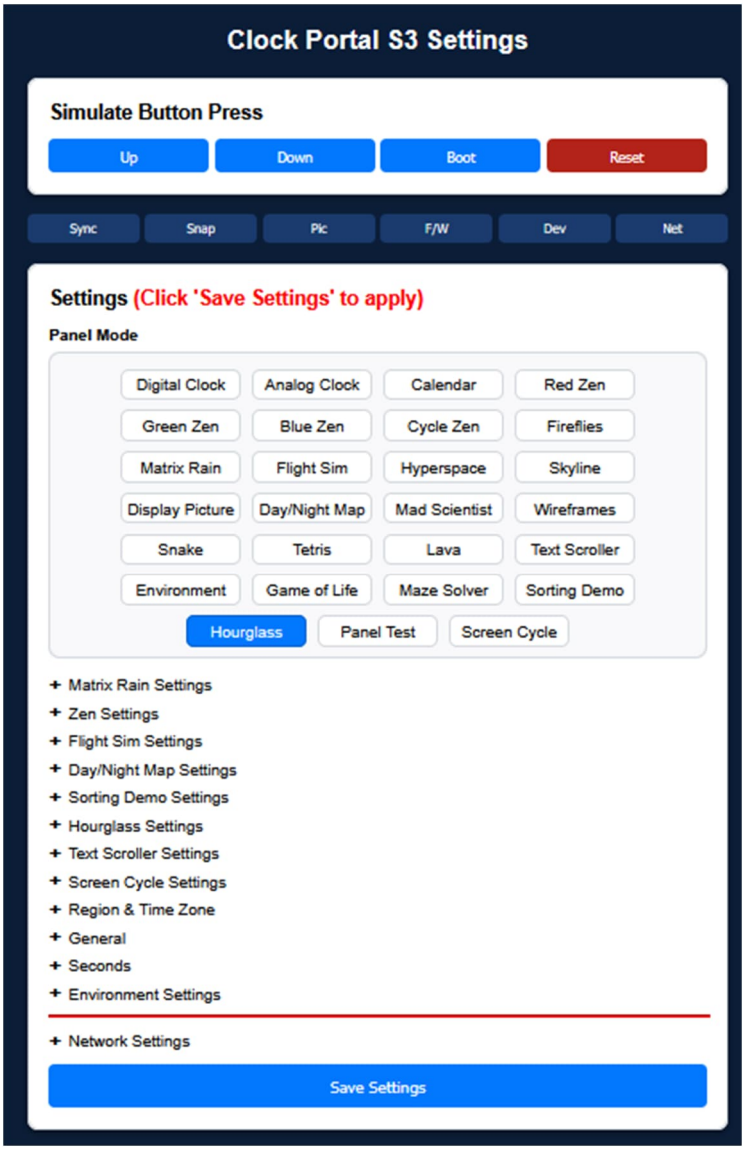
Shows or hides the seconds and the second hand in analog clock mode. This setting applies to any screen where the time is shown.

17. Exit Menu

Exits the menu. You should always select Exit Menu when returning to the display mode if you use the hardware buttons to change settings.

Clock Portal S3 Web Interface

The web interface allows you to configure clock settings from a browser instead of having to use the hardware buttons and on-screen menu. You must be on the same local network as the clock for the web interface to work.



To use the Web interface, you will need to setup Wi-Fi using the instructions provided earlier. You can see if Wi-Fi is connected by looking at the Analog Clock screen's Wi-Fi status indicator LED or the system board Wi-Fi status LED.

Find the clock's IP address by either selecting Wi-Fi Info from the on-screen menu using the hardware buttons or via the startup display.

When connected to Wi-Fi, open a browser. Go to the clock's settings screen by entering the IP address in the browsers address bar:

http://<clock-ip>

where <clock-ip> is the clock's IP address (e.g. 192.168.1.100). You may also access the clock setting via:

http://clockportalS3-<ID>.local

where <ID> is the last two characters of the MAC ID shown on the Wi-Fi Info screen. Using the <ID> addressing method can be quirky depending on your network, so it is recommended to use the <clock-ip> access method.

Some capabilities are only accessible through the web interface. One is the ability to manually sync to NTP servers by clicking the "Sync to NTP Now" button. Syncing the date and time requires a Wi-Fi connection.

Detailed clock information and status is available via the web interface.

The Upload Picture section on the Settings web page allows you to upload an image (jpg, png, or gif). Select Display Picture in the Panel Mode dropdown to show it on the panel. There are file size limits on what can be uploaded. Also note that when the image is reduced to 64x64 pixels for display on the panel, it may show artifacts. Changing the picture's brigtness, contrast, gamma etc. using an image editing program will affect how the picture is displayed. You may need to experiment a bit to get it to display the way you want it.

Updating the Firmware

To update the firmware, download it from the support section of https://tgtech.dev. The file will be named similar to *64x64LEDPanelClock.bin.*

Go to the Firmware Update section on the Settings web interface. Then click the Browse button to find and select the firmware .bin file you downloaded.

You must be connected to Wi-Fi to update the firmware.

Click Update Firmware. The panel should show a flashing "Updating" status. The clock will reboot automatically into the new firmware.

When a firmware update is in progress do not interrupt power to the clock.

Power Supply (not included)

A 5VDC/2A (minimum) power supply is needed to power the clock.

Resetting the Clock

If you need to reboot or reset the clock, press RESET. Settings are retained after a reset.

Perform a deep reset by holding BOOT, pressing RESET, then releasing both. After a moment, press RESET again to restart the clock.

Use and Care

Be careful with the LEDs on the face of the panel since they are relatively fragile. You should not touch them. Dusting the face with an air duster or a soft, gentle brush should be sufficient to clean it. The case can be cleaned using a damp cloth or duster.

Troubleshooting

No display or garbled display

- Verify sufficient power is provided via the USB-C port on the clock. A 5VDC/2A minimum power supply is needed.
- Screen may be in off mode due to Auto On/Off settings or Brightness may be set to 0. Press BOOT to show the menu and check and change brightness settings and/or Auto On/Off settings to correct it.

Clock not updating

- Press the RESET button to reboot the clock.

Wrong Time

- Check the locale and time zone settings.
- Check the Wi-Fi connection. Manually set the time if you aren't connected to Wi-Fi and confirm you entered the local time for the time zone set on the clock.
- Run a manual NTP sync from the web interface if you are connected to Wi-Fi.
- Check and/or replace the battery.

Wi-Fi won't connect

- Ensure the Wi-Fi name (SSID) and password are correct.
- Make sure you are connecting to a 2.4GHz network, not a 5GHz network.
- Make sure the clock is not out of Wi-Fi range.
- If Wi-Fi credentials are changed via the web interface, a manual reset will likely be needed.

Display too dim or too bright

- Adjust the brightness. There are limitations to brightness settings due to hardware limitations.

Clock spontaneously reboots

- Power supply not providing enough current. Ensure it can provide at least 2A of current.

Missing colors

- Brightness is set too low, increase it.

Panel Flickering

- Bit depth is set too high, decrease it.

"Last Resort" Reset

- Connect the board to a PC with a USB cable.
- Press the reset button once, wait ~0.5–1s, then press reset again.
- The board should mount as a drive (such as X:MATRIXBOOT).
- Download and copy MatrixPortal_S3_FactoryReset.uf2 to the newly mounted drive.

- The board should now show a test pattern that will have a blank bar in the middle
- Install esptool, download the firmware .bin file from tgtech.dev, then run esptool.py --chip esp32s2 --port COMx write_flash 0x10000 firmware.bin where COMX is the COM port the board is connected to and firmware.bin is the name of the downloaded firmware file.

Clock Portal S3 Quick Start Guide

1. What You Need

   - ✓ Clock Portal S3 clock with a CR-2032 battery installed.
   - ✓ A 5VDC/2A USB-C power supply.
   - ✓ Wi-Fi (2.4GHz) to enable the web interface and timing synchronization (optional).
   - ✓ BMP-280 or BME-280 environmental sensor (optional).

2. First Boot

   - ✓ Connect the power supply to the clock's USB-C power port. Check that two green LEDs light up on the system board. The clock will start after about 10 seconds.
   - ✓ Press the BOOT button to enter the menu mode.
   - ✓ Use the UP/DOWN and BOOT buttons to navigate through the menu and make selections
   - ✓ Set your time zone!
   - ✓ Select Wi-Fi Setup if you have Wi-Fi and connect to the network.
   - ✓ Set the time if you are not connected to Wi-Fi. If you are connected to Wi-Fi, the time will automatically synchronize each hour and/or when you restart the clock.
   - ✓ Highlight Exit Menu and press BOOT.

3. Customizing Settings

   - ✓ Press BOOT to enter the settings mode from any main screen. Use the buttons to select menu items, then press BOOT to select the item you want to change.
   - ✓ If you are connected to Wi-Fi, use a browser on the same network and go to http://<clock-ip> where <clock-ip> is the IP address of the clock on your local network as shown on the startup screen or the Wi-Fi info screen. Customize your settings using the web interface and click Save Settings.

4. Button Controls

   - ✓ UP/DOWN: moves selection up/down or increases/decreases values. Hold the button to repeat (repeat is not available on the web interface buttons).
   - ✓ BOOT: select/confirm.

Specifications

Item	Specification
Timekeeping Accuracy (no Wi-Fi)	± 2ppm, about 1 minute per year
Timekeeping Accuracy (Wi-Fi)	± 10 ms when synced with NTP
Temperature Accuracy	± 3°C (± 5.4°F) using the built-in DS3231 sensor ± 1°C (± 1.8°F) when using a BME-280 or BMP-280 sensor*
Humidity Accuracy	± 3% with the BME-280 sensor*
Pressure Accuracy	± 1 hPa (± 0.03 inHg) with the BME-280 or BMP-280 sensor*
Backup Battery	CR-2032 lithium button cell battery. Battery should last 5–10 years
Display	7.6" (192 mm) square display area with 4,096 RGB LEDs in a 64×64 matrix; 3 mm pixel pitch; ~8.5 DPI/PPI
Power Supply	5VDC / 2A (minimum) USB-C power adapter
Frame	Solid wood, handmade
*Optional Sensor	BME-380 provides temperature, humidity, and pressure BMP-380 provides temperature and pressure
Dimensions (Approximate)