BeaconBoxLite

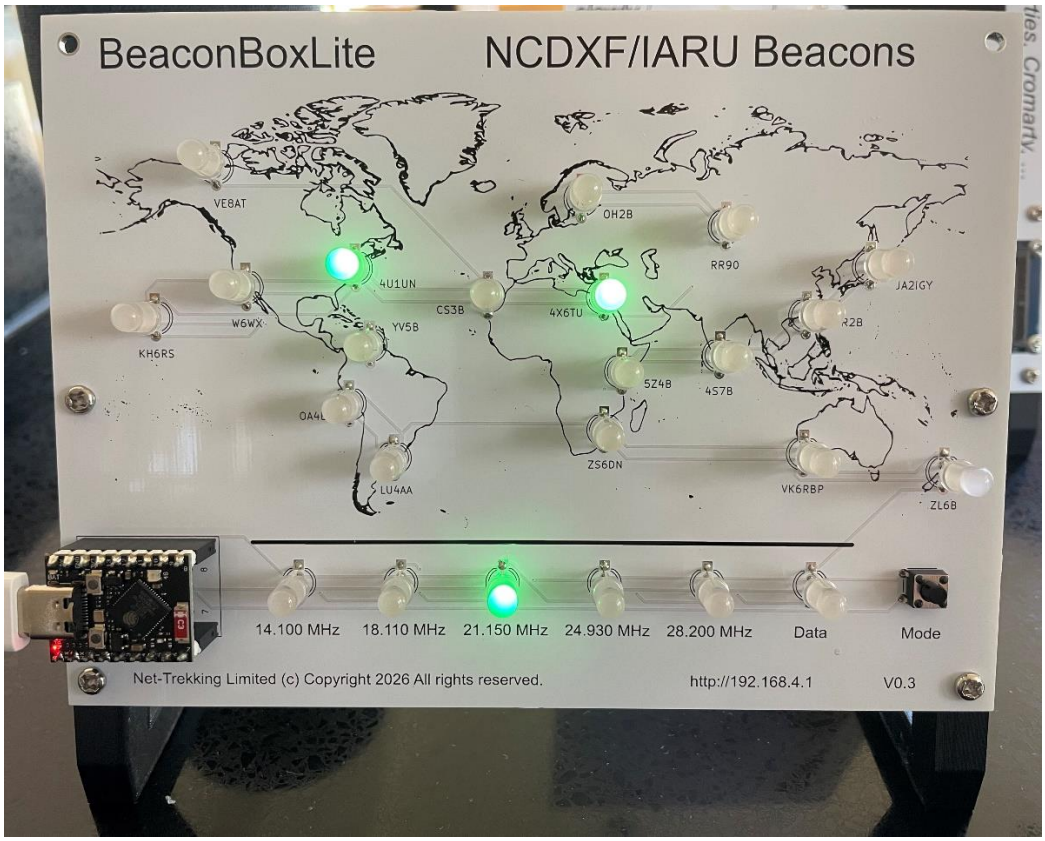
Net-Trekking Limited

Version 0.3 Rev E

http://www.Net-Trekking.co.uk

"Every Geek should have one!"

Simple, easy build kits following a brutalist style that every geek should have.



BeaconBoxLite

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1. Introduction

BeaconBox was first described in the March 2025 edition of Practical Wireless.

The NCDXF/IARU International Beacon Project has been around since 1979. It hosts 18 beacons HF beacons spread around the world from Hawaii in the west to New Zealand in the east. Each beacon transmits on each of the fixed frequencies 14.100 MHz, 18.110 MHz, 21.150 MHz, 24.930 MHz, and 28.200 MHz once every three minutes. The timing of the transmission and well documented and predictable. They are there to "to provide a mechanism for amateurs around the world to learn and understand more about radio propagation". By listening on the frequencies and noting the beacons being heard then you can quickly gain insight into the current HF propagation conditions.

BeaconBox was designed to do the listening for you and to display its findings on a map indicating which beacons you would be hearing at any given moment. The article in Practical Wireless made use of the classic YEASU RADIO AMATEUR's WORLD MAP which is rather large and consumes a great deal of wall space. BeaconBoxLite brings the technology to the desktop.

How does BeaconBoxLite listen? BeaconBoxLite has no receiver of its own. Instead, it makes use of the Reverse Beacon Network. The Reverse Beacon Network (RBN) is an innovative, volunteer-run, internet-connected network of amateur radio stations that use automated software to listen to radio bands. Each station reports, in real time, the callsigns of stations and beacons that have been heard. This data is then made freely available to anyone wishing to se it. For more information and more details about the Reverse Beacon Network see https://www.reversebeacon.net/.

BeaconBoxLite has three modes of operation: "Beacons Heard" mode, "Beacons Active" mode, and "Beacons in Daylight" mode. The small tactile button at the bottom right of the PCB can be used to cycle through these modes.

In "Beacons Heard" mode the frequency display cycles through each of the frequencies used by the NCDXF/IARU beacons. If beacons have been heard in the last 5 minutes - this duration is configurable via the Web interface - then the frequency LED and the LEDs for the beacons heard will show as green. If the frequency LED shows as red, then no beacons have been heard.

When listening for beacons BeaconBoxLite matches the data from the ReverseBeaconNetwork with callsign patterns configured in the settings. By default, these patterns match callsigns from the United Kingdom, G*, M*, 2E*, etc. So, when BeaconBoxLite illuminates a beacon, for example CS3B (Madeira), this means that someone on the UK has reported hearing that beacon in the last configured time interval.

The "Beacons Active" mode is a simple emulation of the MFJ-890 Beacon Monitor and shows you which beacons are currently transmitting on which frequency. If you browse to

https://www.ncdxf.org/beacon/index.html#Schedule you will see the LEDs lit up in sync with the changing list of beacons on the left-hand side of the page.

The “Beacons in Daylight” mode does just that, it shows which beacons are currently in daylight. This might be useful if chasing grey line propagation.

On top of these modes sits an animation mode. This provides a way to cycle the BeaconBoxLite through the modes on a time basis. Again, this is configured via the Web interface.

2. Assembly

Assembly is relatively easy and should take no more than an hour.

2.1. Required Tools

To assemble the kit, you will require the following tools:

Tool	Comment
Small soldering iron	
Solder	See safety notes above.
Wire cutters	
Small cross head screwdriver	

2.2. Parts List

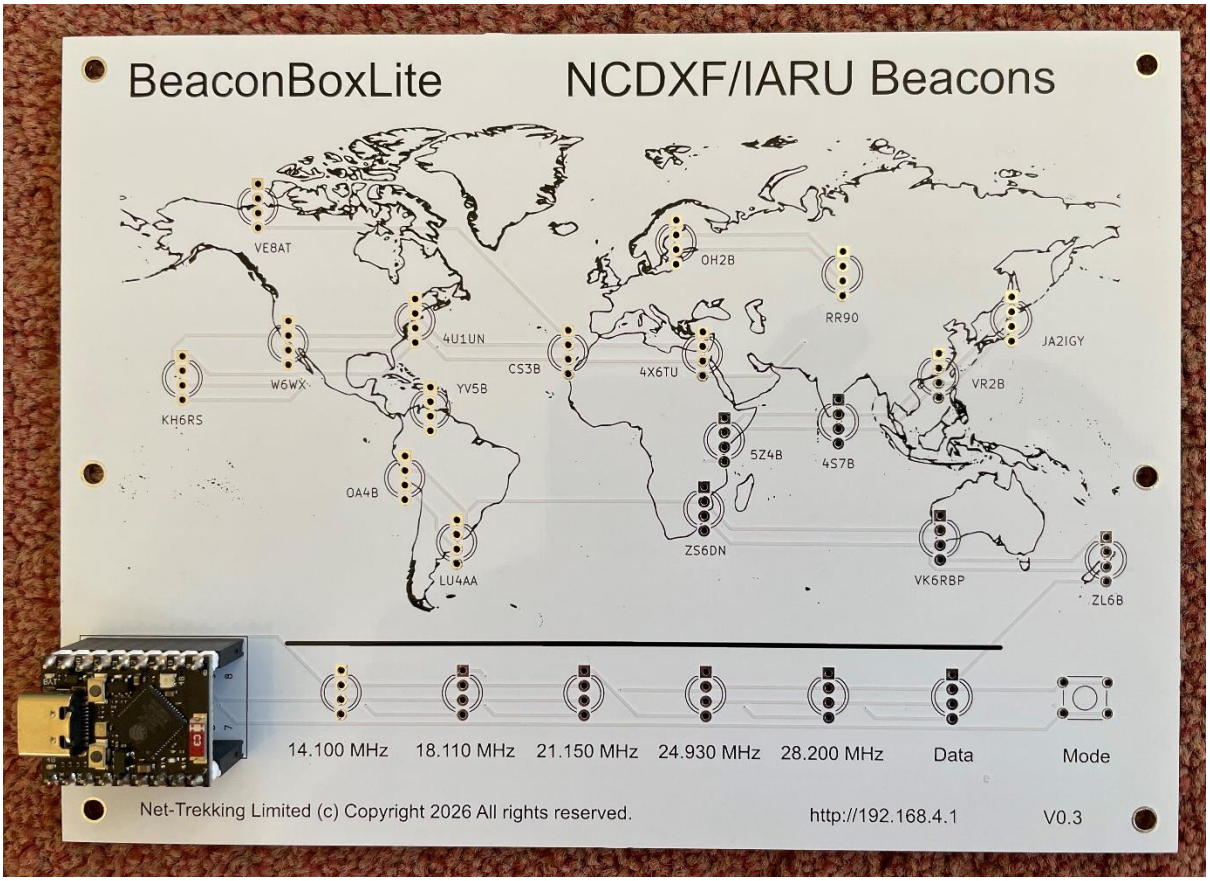
Part	Quantity	Comment
Bolt M3 12mm	4	
ESP32 S3 SuperMini	1	
LED Insertion tool	1	
LED WS2812B APA-106	24	
Nut M3	4	
PCB	1	
Stand – Left hand side	1	
Stand – Right hand side	1	
Switch - Tactile	1	
USB Cable	1	

2.3. Assembly Steps

Assembly is sometimes easier working from the lowest profile components to the highest. With that in mind the suggested order of assembly is given below.

2.3.1. ESP32 S3 Header Pins and ESP32 S3

Next insert the two rows of header pins for the ESP32 S3 and solder them home. Solder one pin of each strip and make sure the pins are flat against the PCB before completing all the soldering. The long pins go through the PCB. Place the ESP32 S3 on the pins and apply solder. Once complete the PCB will look like:



2.3.1. LED Array

There are 24 LEDs to be inserted. Care needs to be taken to ensure that all LEDs are at the same height and vertical. To assist with this the kit contains a small tool. Start by inserting an LED into the tool as shown below.

Note the flat side of the LED (and the long legs) are at the top. All LEDs need to be inserted with the flat side at the top. Next insert the LED into the holes just above 14.100 MHz on the PCB and push home as shown below.

Turn the PCB over, solder the pins, and remove the excess.

At this point power may be applied to the board and the LED should run through a test sequence changing colour from White, Red, Green, and then Blue.

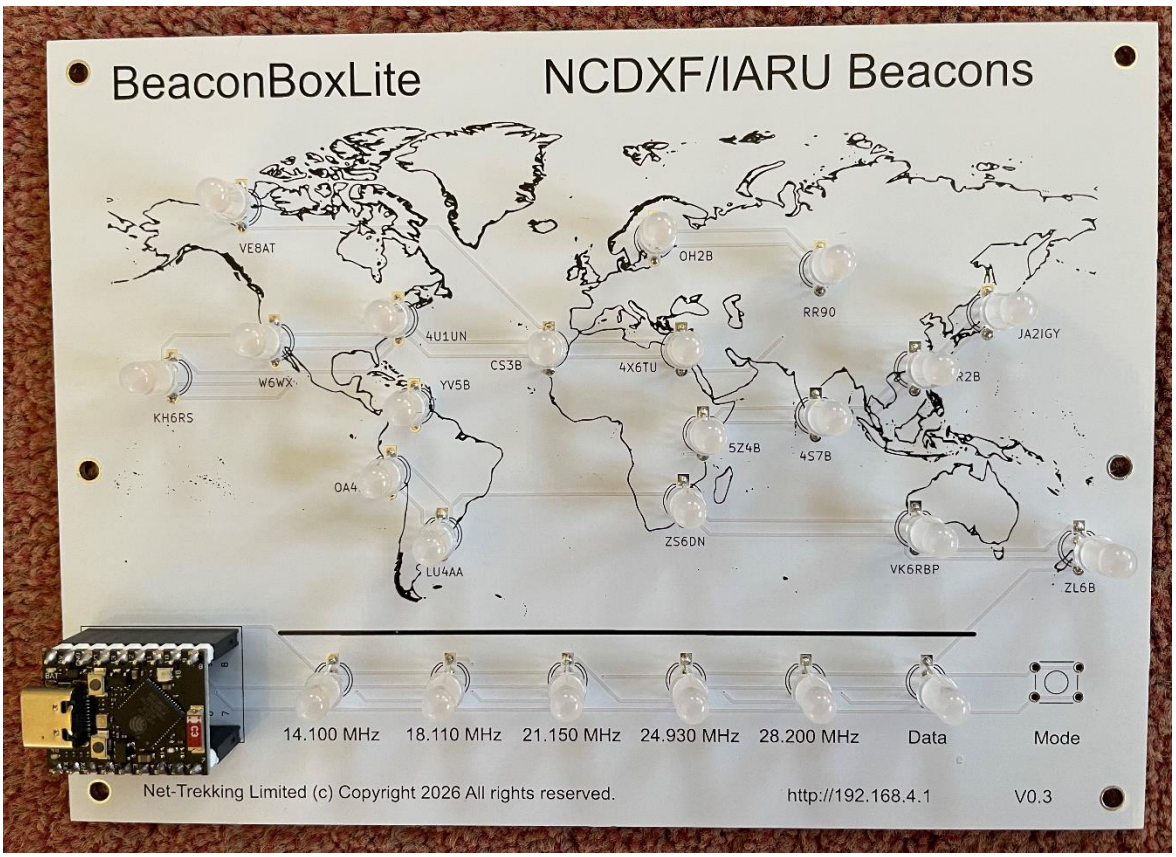
Remove the power and proceed with the remaining LEDs. It may be necessary to spin the LED on the tool where LEDs are physically close together. It is recommended to install the LEDs in the following order:

14100 MHz, 18110 MHz, 21150 MHz, 24930 MHz, 28200 MHz, DATA
ZL6B, VK6RBP, JA2IGY, VR2B, 4S7B, RR90, 4X6TU, 5Z4B, ZS6DN
OH2B, CS3B, VE8AT, W6WX, KH6RS, 4U1UN, YV5B, OA4B, LU4AA

After inserting each LED apply power to ensure that the LED follows the test sequence. If it doesn't cheque for shorts between pins. Do not proceed until any problems are resolved.

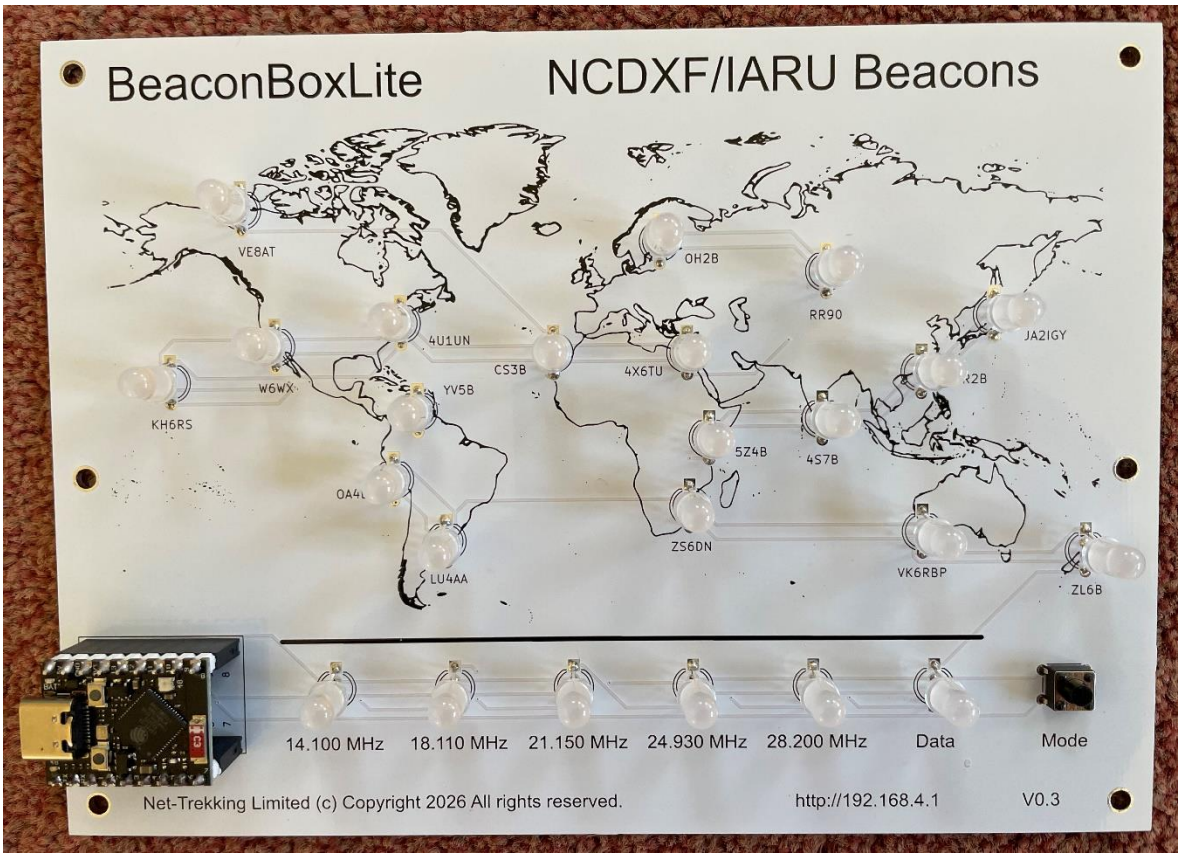
The LEDs may also be orientated by the length of the legs. Please ensure that the long legs are inserted at the top.

Once complete the PCB will look like:



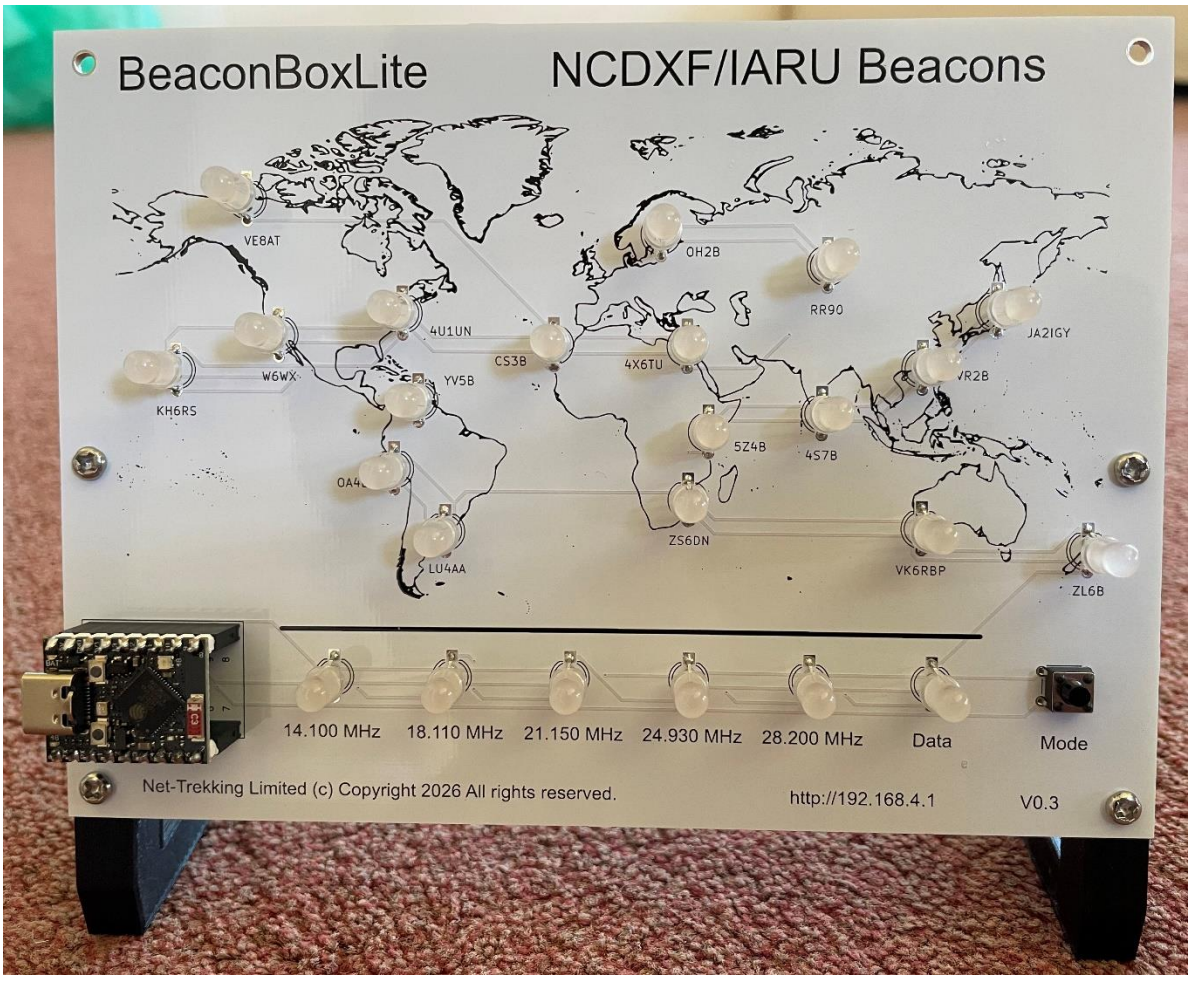
2.3.1. Tactile Switch – SW1

Next insert the tactile switch. Once complete the PCB will look like:



2.3.2. Attach the Stand

Each side of the stand is attached with two 12mm bolts. Before attaching to the PCB put each bolt in a hole, apply the nut, and tighten up. This should pull the nut into the leg so that it sits flush with the leg surface. The right-hand side has the cutout / cable restraint in the lower limb. Once complete the PCB will look like:



3. Settings

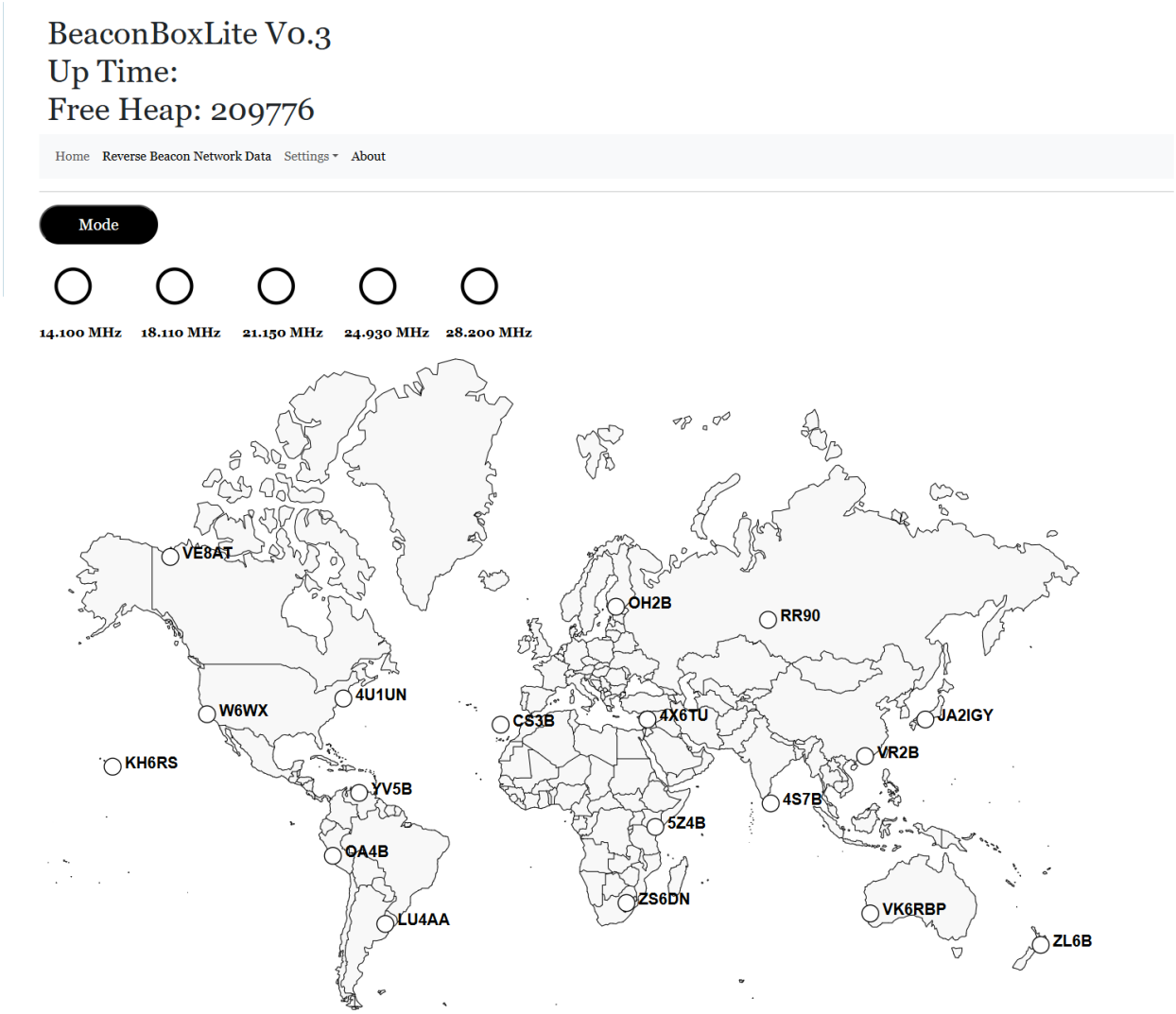
3.4. Basic Settings

Settings are changed via a simple webpage served up by the ESP32 S3. Insert the USB cable and plug the device into a power source. The LEDs will cycle through a power up sequence and then display a diagnostic pattern – see below for complete list. At this point, an access point called BeaconBoxLite should be visible to a phone or Wi-Fi enabled personal computer. Connect to the access point and browse to:

http://192.168.4.1

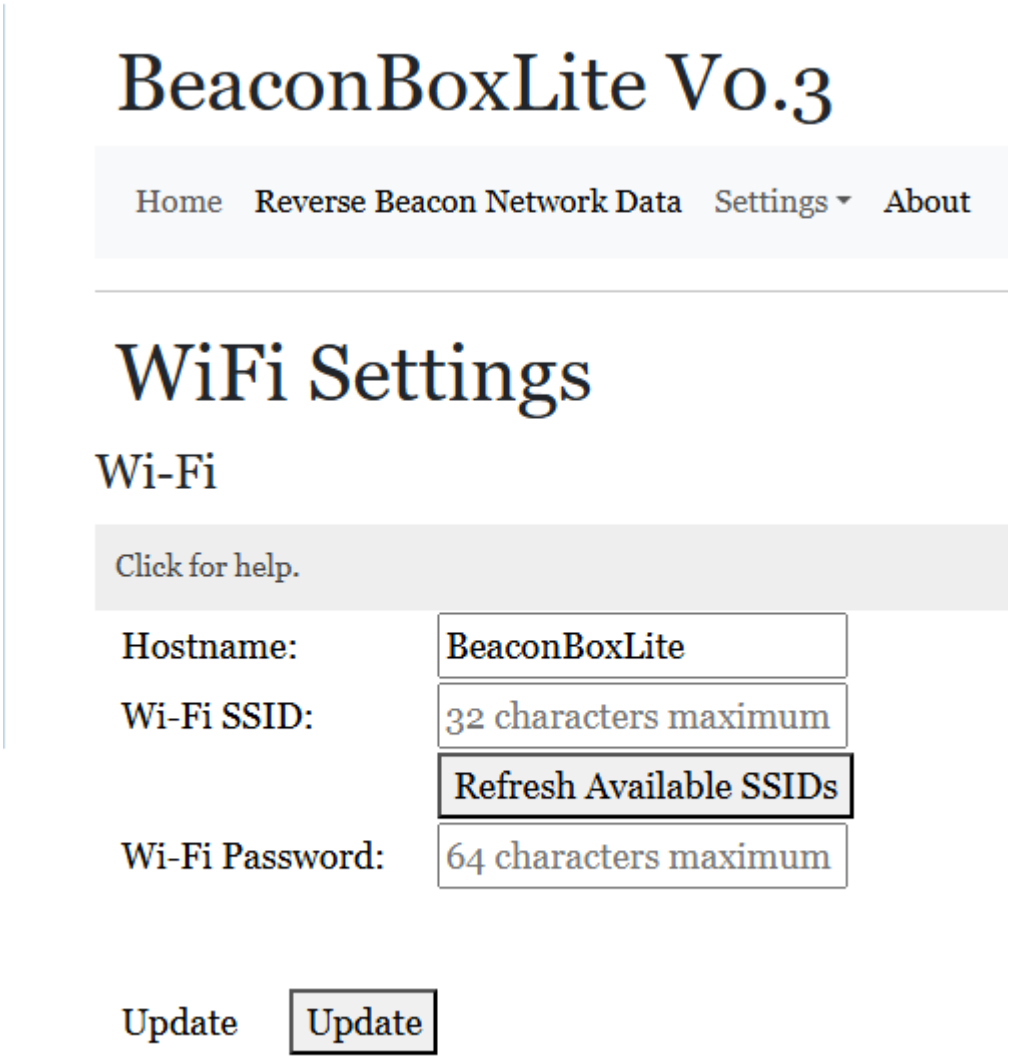
You will see the following page:

BeaconBoxLite



When configured correctly this page will reflect the active state of the LED array. Though not purposely designed as an alternate interface to BeaconBoxLite, it may be used as one.

Click on the Settings | Wi-Fi Settings menu option. You will see a page like the one below.



The main fields of interest here are the Wi-Fi SSID and Wi-Fi Passwords fields. These must be populated to allow the device to connect to a Wi-Fi connected to the Internet.

When complete, hit the update button located at the bottom of the screen.

There may be a short delay after which the device will start showing cycling through beacon information.

The board should now be on your Wi-Fi network so you should be able to simply browse to http://BeaconBoxLite without having to connect to the BeaconBoxLite access point. Your Wi-Fi router may take a few minutes to acknowledge the BeaconBoxLite device so please be patient. If router is being slow then simple reconnect to the BeaconBoxLite Access Point and carry on.

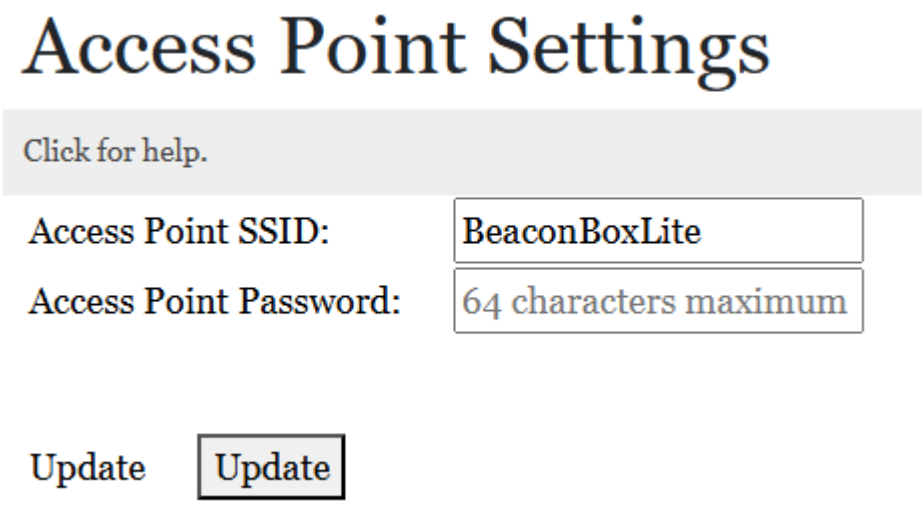
Note: you may need to reconnect to BeaconBoxLite the access point.

3.5. Advanced Settings

Further settings can be found below the Settings | Access Point menu option and Settings | Settings menu option.

3.5.1. Access Point

By default, the Access Point settings are set to:



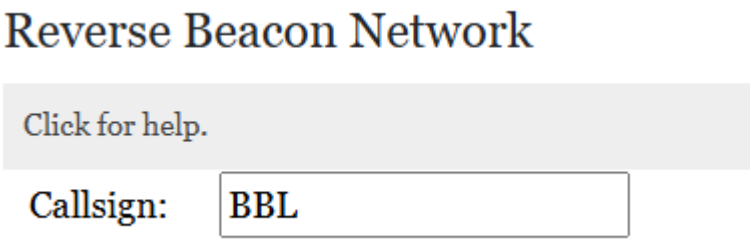
The access point related controls can be used to control the following:

- Access Point SSID - The SSID associated with this device. If multiple BeaconBoxLite devices exists on the same network, then it may be necessary to give each device a unique name.
- Access Point Password - The password associated with the device SSID. The field can be left blank if password access is not required.

Once changes have been made the Update button must be pressed.

3.5.2. Reverse Beacon Network

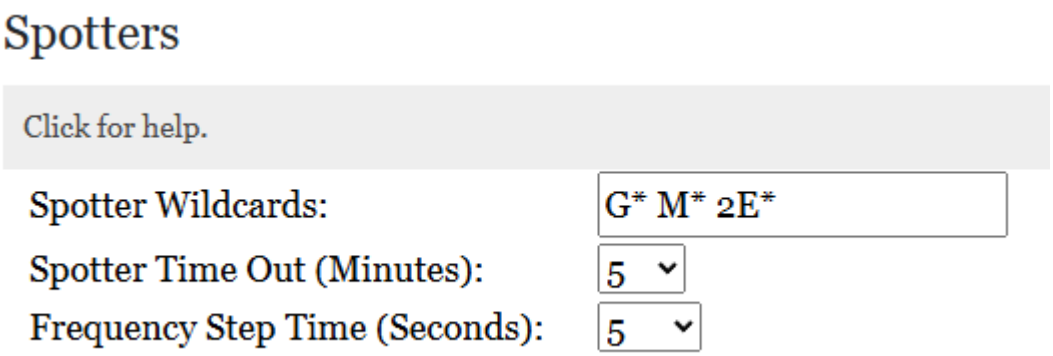
By default, the Reverse Beacon Network settings are set to:



The setting Callsign is a identify given to the Reverse Beacon Network when the connection to read the data is made. By default, it is set the BBL (BeaconBoxLite) but as a courtesy to the Reverse Beacon Network it is suggested that this be set to something more personal, perhaps an Amateur Radio callsign, or listening station number.

3.5.3. Spotters

By default, the spotter settings are set to:



The settings are:

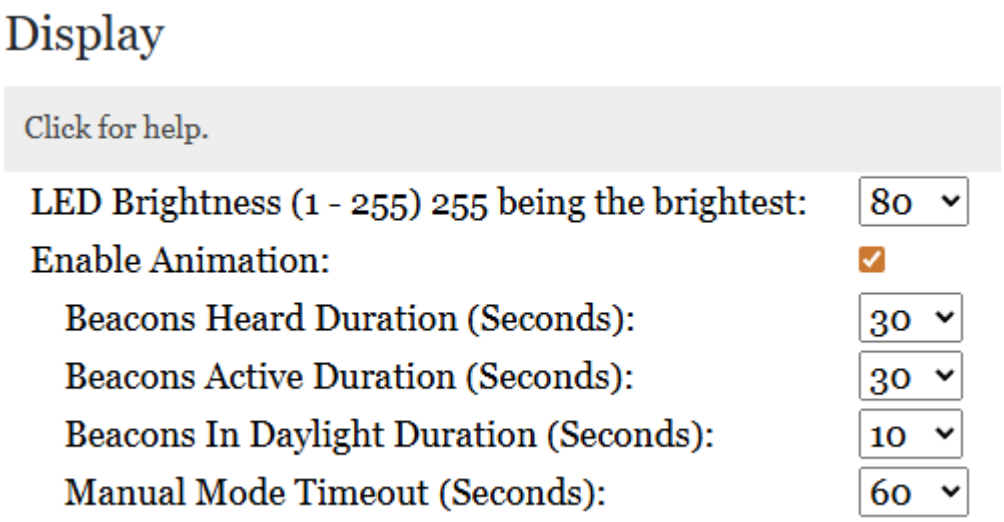
- Spotter Wildcards - This is a SPACE separated list of callsigns containing wildcards, either *, or ?, that are compared against the Reverse Beacon Network "spotter" data to determine if a beacon has been heard. The default value for this is G* M* 2E* which is any station within the United Kingdom.

- Spotter Time Out (Minutes) - Beacons spots time out. After this time the spot is ignored. The default value for this is 5 minutes.

- Frequency Step Time (Seconds) - This is the time, in seconds, that the beacons associated with the active frequency remain visible. The default value for this is 5 seconds.

3.5.4. Display

By default, the display settings are set to:



The settings are:

- LED Brightness - This controls the brightness of the LED display. This ranges from 1 to 255 with 255 being the brightest.
- Enable Animation - In animation mode BeaconBoxLite cycles through each of the three modes. The time it spends in each mode is controlled by the three settings below. If any mode is set to 0 then it is not part of the animation. For the animation to be active at least 2 durations must be greater than 0.
- Beacons Heard Duration (Seconds) - This controls the time in seconds spent in beacons heard mode. The ranges from 0 - 120 seconds.
- Beacons Active Duration (Seconds)- This controls the time in seconds spent in beacons active mode. The ranges from 0 - 120 seconds.
- Beacons In Daylight Duration (Seconds) - This controls the time in seconds spent in beacons in daylight mode. The ranges from 0 - 120 seconds.
- Manual Mode Timeout (Seconds) - If, with animation enabled, the user makes use of the Mode button then the mode change is honoured. It will remain in the chosen mode for the given number of seconds before returning to animation mode.

4. Factory Reset

If the Mode button is pressed when power is applied, then this will force a factory reset, and all setting will return to the default values.

5. Software Updates

Software updates are made available via the website https://www.Net-Trekking.co.uk

6. Diagnostic Patterns

BeaconBoxLite may display the following diagnostic patterns:

6.6. Cycling Single Red LED

This pattern indicates that BeaconBoxLite has not been configured yet. Follow the Settings | Wi-Fi Settings menu options and ensure the details are correct.

6.7. Cycling Two RED LEDs

This pattern indicates a Wi-Fi connection failure. Follow the Settings | Wi-Fi Settings menu options and ensure the details are correct.

6.8. Cycling Three RED LEDs

This pattern indicates that no Reverse Beacon Network callsign has been specified in the settings. Follow the Settings | Settings option and ensure the Callsign input box is populated.

6.9. Cycling Four RED LEDs

This pattern indicates that BeaconBoxLite has failed to connect to the Reverse Beacon Network. This is rare but may indicate that the Reverse Beacon Network is currently down.

6.10. Cycling Five RED LEDs

This pattern indicates BeaconBoxLite file system failure. This suggests a firmware issue and will require the software to be re-installed. Software is made available via the website https://www.Net-Trekking.co.uk.

6.11. Data LED showing RED

The Data LED is initially painted RED as will remain that way until data is received from the Reverse Beacon Network.