

RFzero Beacons

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The RFzero is a \$100 built board designed by OZ2M

It can be anything from a Beacon driver, to a Signal Generator, to a GPSDO, or Frequency Counter.

It includes: GPS Receiver, Arduino, Synthesizer, display drivers.

<https://rfzero.net/>



History of Beacons

- In the 1970's there were no beacons. Propagation was gauged by trying to key up distant repeaters.
- Then came propagation nets: K4ROM 6m, K4CAW 2m, W4ATC 432
- In mid 80's VHF and Microwave beacons started to show up with support from groups like FourLanders, Southeastern VHF Society, North Texas Microwave Society, Packrats, and others.
- Beacons were often collocated with repeaters for a control link. It meant the beacon had to be very clean to not glitch the repeater with key clicks or spurious. Mountaintops are tough locations antenna VSWR and damage wise, plus power glitches and temperature swings.

Beacon's Provide

- 24x7x365 Propagation Check and equipment test signal
- Frequency standard (GPSDO if possible)
- Antenna Pattern Tests, though repeaters are good for this too giving a continuous signal you can rotate the antenna thru to see pattern changes.
- If all of a sudden all the beacons are weak even close ones, its time to check and make sure you don't have antenna problems like water in a connector or coax.

Next Generation Beacons

- GPSDO locked frequency stability
- WSJT modes + CW + carrier
- This allows below the noise reception, ID, and real time dB measurement of signal strength changes
- PI4 Mode is used on >50% of the beacons in Europe. It's a virtual unknown here in the US. There is a good tutorial on it via the Rfzero website. <https://rudius.net/oz2m/ngnb/pi4.htm>

Things Not To Do

- Weak distant Beacons are better than strong beacons. Put them well away from population centers.
- Spread Out in frequency. Clustering against the bottom of a beacon band is a mess.. making it impossible to hear and use more distant beacons by ear.
- Keep the phase noise good and key clicks non-existent
- Never key multiple stages of multipliers, that can lead to spurious. A good test is to smoothly reduce drive and watch what happens. The effects can be a sign of what will later happen when temperature or VSWR changes occur. Nobody wants to fix a beacon in an ice storm.

ID Formats

- Don't waste time on "de" and "QST" or multiple "CQ" or "K".. Get to the point: Callsign and Grid several times. Assume the path will be weak and fading in and out of the noise.
- Don't make the carriers solid for too long. Use a small break now and then to help distinguish your beacon from spurious. If I listen longer than thirty seconds and don't hear an ID, I assume its some spur and move on tuning around. Likewise minimize the dead air. Its too easy to miss the beacon entirely tuning around if there's too many long breaks before it repeats its ID cycle.

Home Beacons

- The idea is to be able to beacon to a friend using your home station. It frees you and the station needing the signal from the time pressure of a short signal test. And gives the advantage of antenna gain.
- But your station has to be able to transmit continuously for hours without overheating. It's also a good test of future beacon hardware.
- The Icom IC-905s have been making good use of this capability. Also gives you a signal you can hear while out remote listening from the car or overlooks to test locations for clear paths. Dex W4DEX and others have even used waveguide omnis mobile to listen for their home beacon while driving to find surprise good

Reverse Beacons

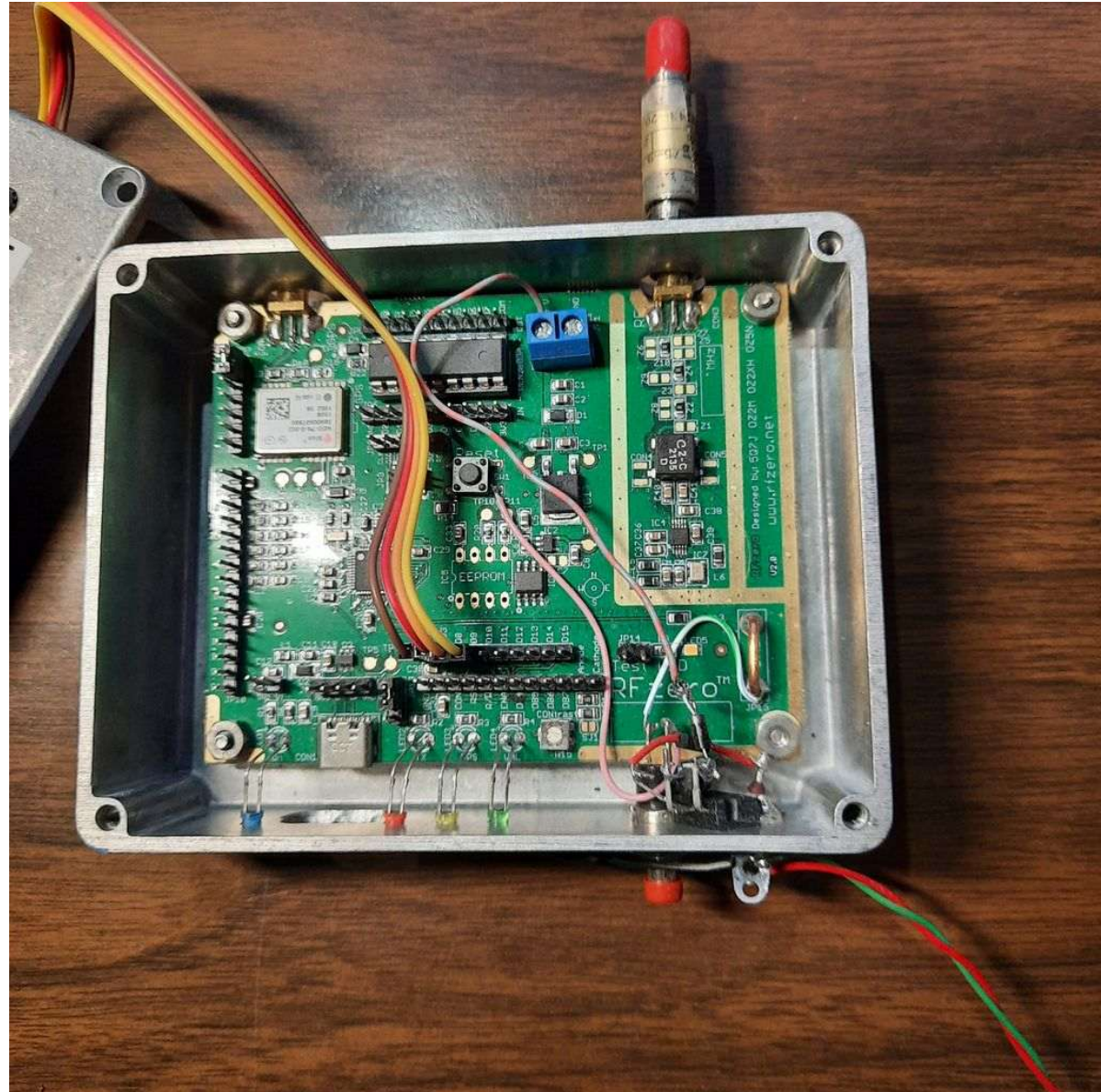
- This is also a concept Dex W4DEX has done a lot. It involves setting up a spectrogram page to monitor a specific frequency for signals. The page can be uploaded to a website every few minutes. The accumulated signals thus become a new way to test a path at unusual times or while fixing some piece of equipment and you want to see if its stable and on the right frequency. <http://www.w4dex.com/monitor.jpg>
- It also helps you find beam headings and transient rain scatter paths or odd good propagation times on 10 GHz. Have an alternate way to contact the station on other end that the path is open, and to get on the air.
- It does mean you have to be careful about getting on the air on another band that might blast the reverse beacon receiver and displayed signal. Operating on 2m while reverse beaconing on 432 for instance is tricky.

BeaconSpot

- I've been pushing this for over ten years but like a lot of things we are way behind Europe on all this. BeaconSpot.uk is a website which allows posting of beacon reception reports directly by the users. It becomes sort of a competition to see who can hear a beacon from the most distant location and with good frequency accuracy in the posted frequency. If you are wrong, others' posts will make that obvious. The way your radio tunes USB vs CW vs displayed frequency is crucial to know so others can go from your post and listen also.
- It also helps verify if a beacon is on the air or not by recording who heard it and when. If nobody has posted seeing it in years its probably off the air. Existing US beacon lists tend to be created from other lists. Long dead beacons get resurrected this way and the lists become useless. Beacons spot stops that by showing the provenance of the info.

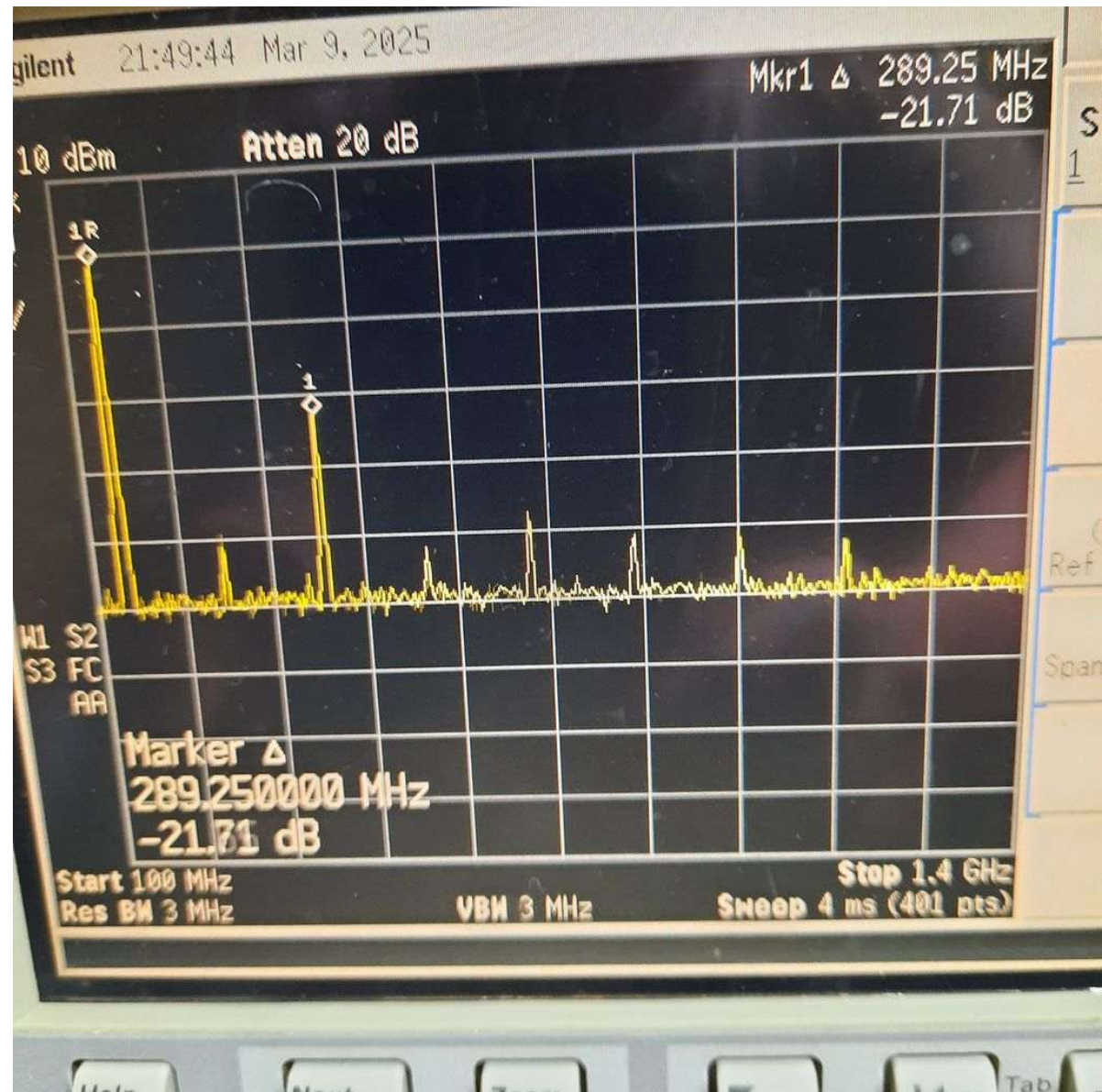
RFzero

- Rfzero is an open source software design that runs on a board containing: a GPS receiver, Arduino, display interface, and synthesizer.
- There is even software to narrow the FT8 signal so it is spaced correctly after multiplication spreading. Lots of options.



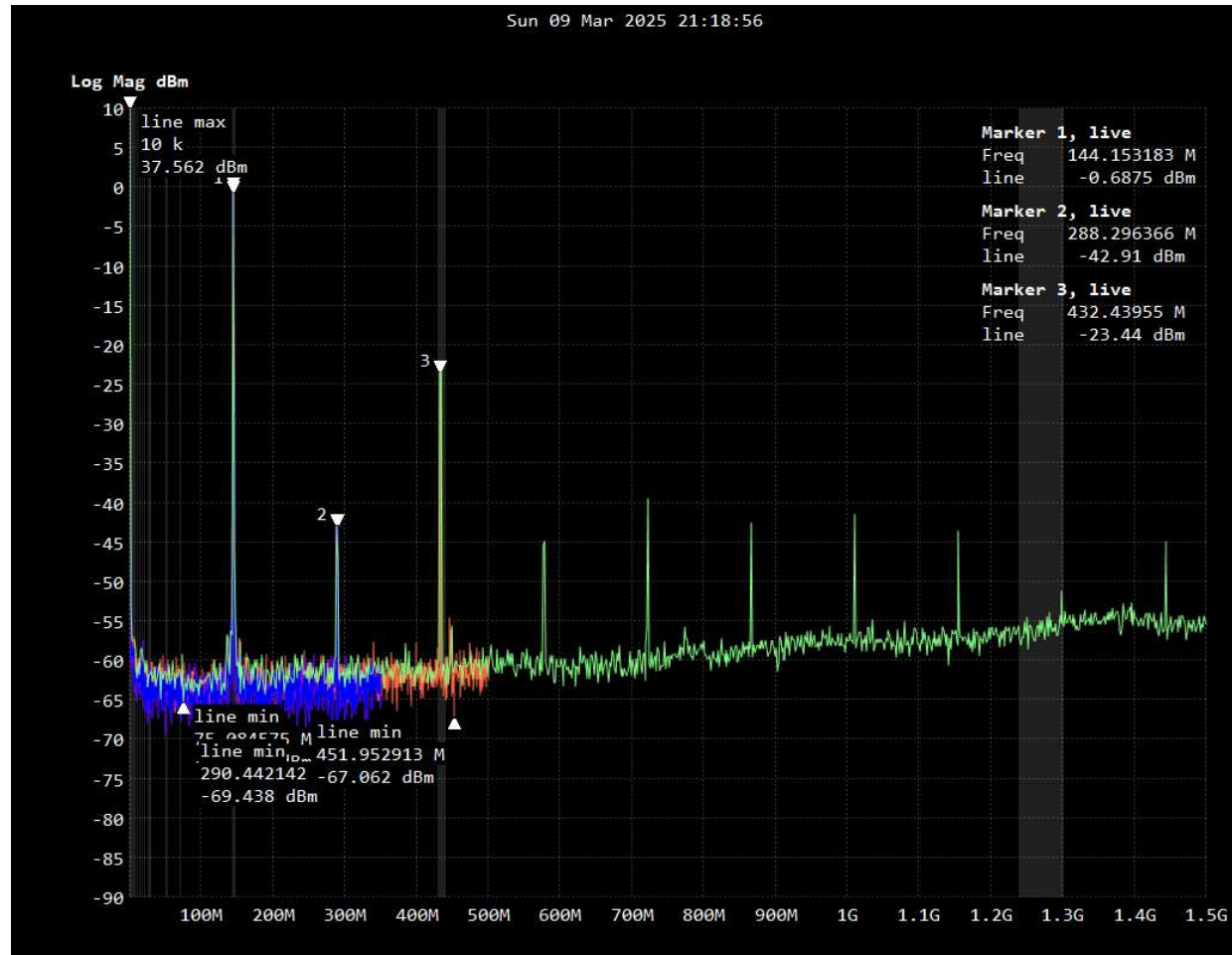
Harmonics

- The synthesizers are rich in harmonics. Expect to use a low pass or bandpass filter to clean it up as much as possible. There are places on the circuit board for a chip style LPF. This is what it looks like without filtering on a 144.245 MHz fundamental. 3rd harmonic -21.7 dBc.



TinySA picture

- Here's a similar harmonic view taken with the TinySAUltra. Be careful as these are easily overloaded and will generate harmonics in the spectrum analyzer making things look worse than they are if not careful. If you add a 10 dB attenuator and the harmonics fall more than 10 dB that's what's going on, you're overloading SA.



Test Equipment

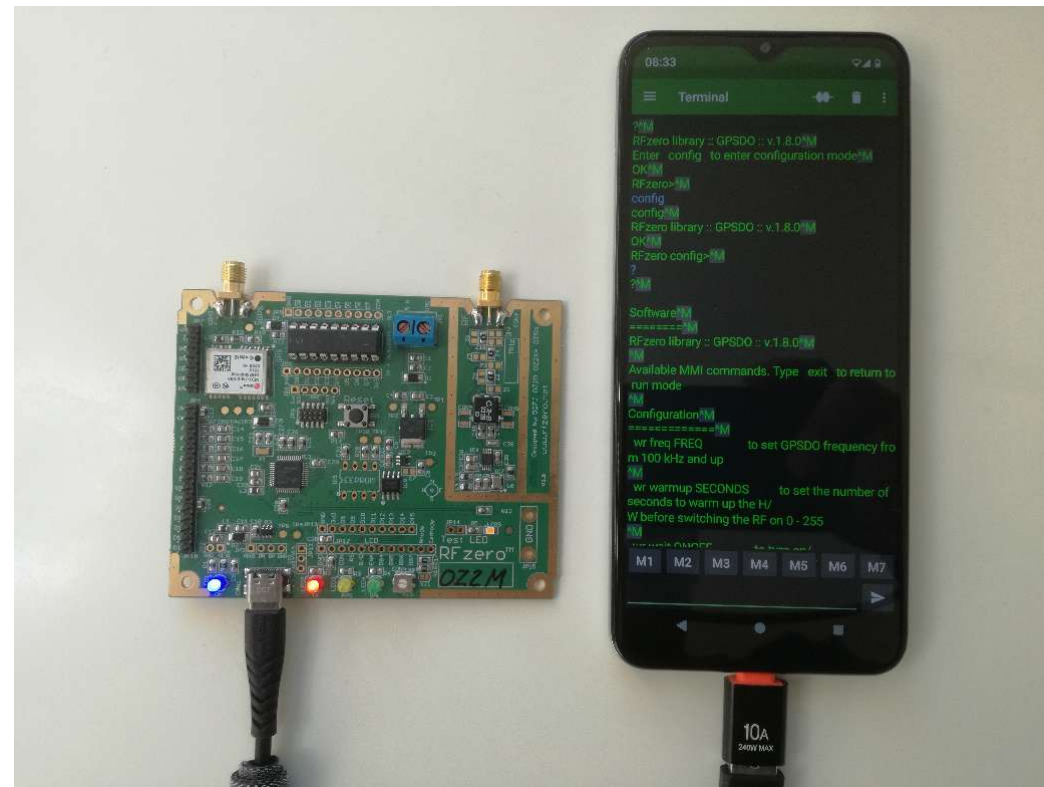
- That also means the synthesizer can be used as a signal generator and will be heard many orders above the fundamental if you just need a test signal. I haven't tried to see if I can hear it on 10 GHz. But probably.

The RFzero signal generator with an ILI9341 2,8" display and keypad. Picture courtesy Hans, OZ2XH.



Rfzero Website

- <https://rfzero.net>
- <https://groups.io/g/RFzero>
- The website has a wide variety of tutorials and sample program “sketches” which can be uploaded several ways into the Arduino.
- Way beyond me... but it can even be controlled from a cellphone with the right interface cable and terminal program (see picture to right).



Questions?