CW Speaker Project

Open Tube Half Wavelength

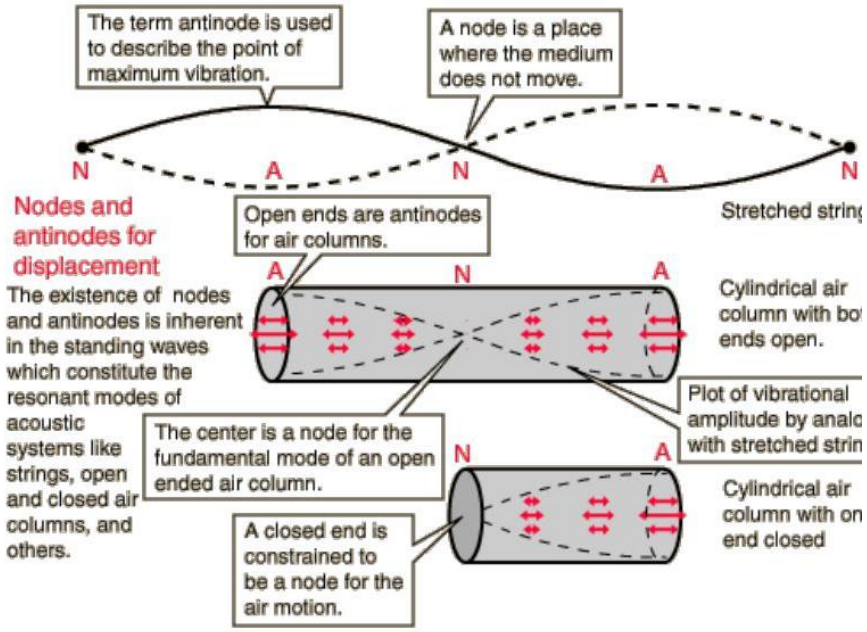
VK2WF April 2025

Introduction

After some enquiries how I still manage to hear weak 160m CW signals I decided it was time to improve may arsenal of CW speakers. This article serves both with some basic theory and construction details to allow others to replicate what I have here.

First some basic theory-

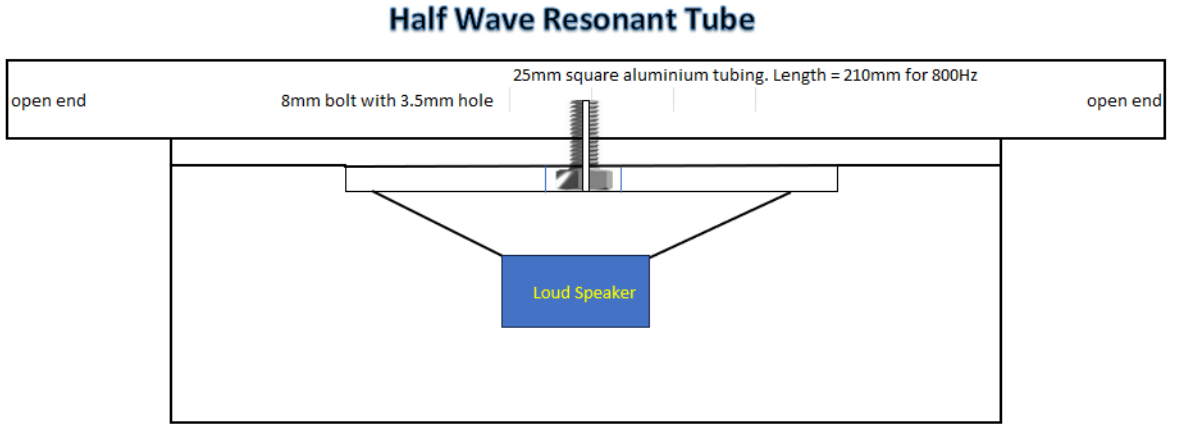
Nodes and Antinodes



Excitation!

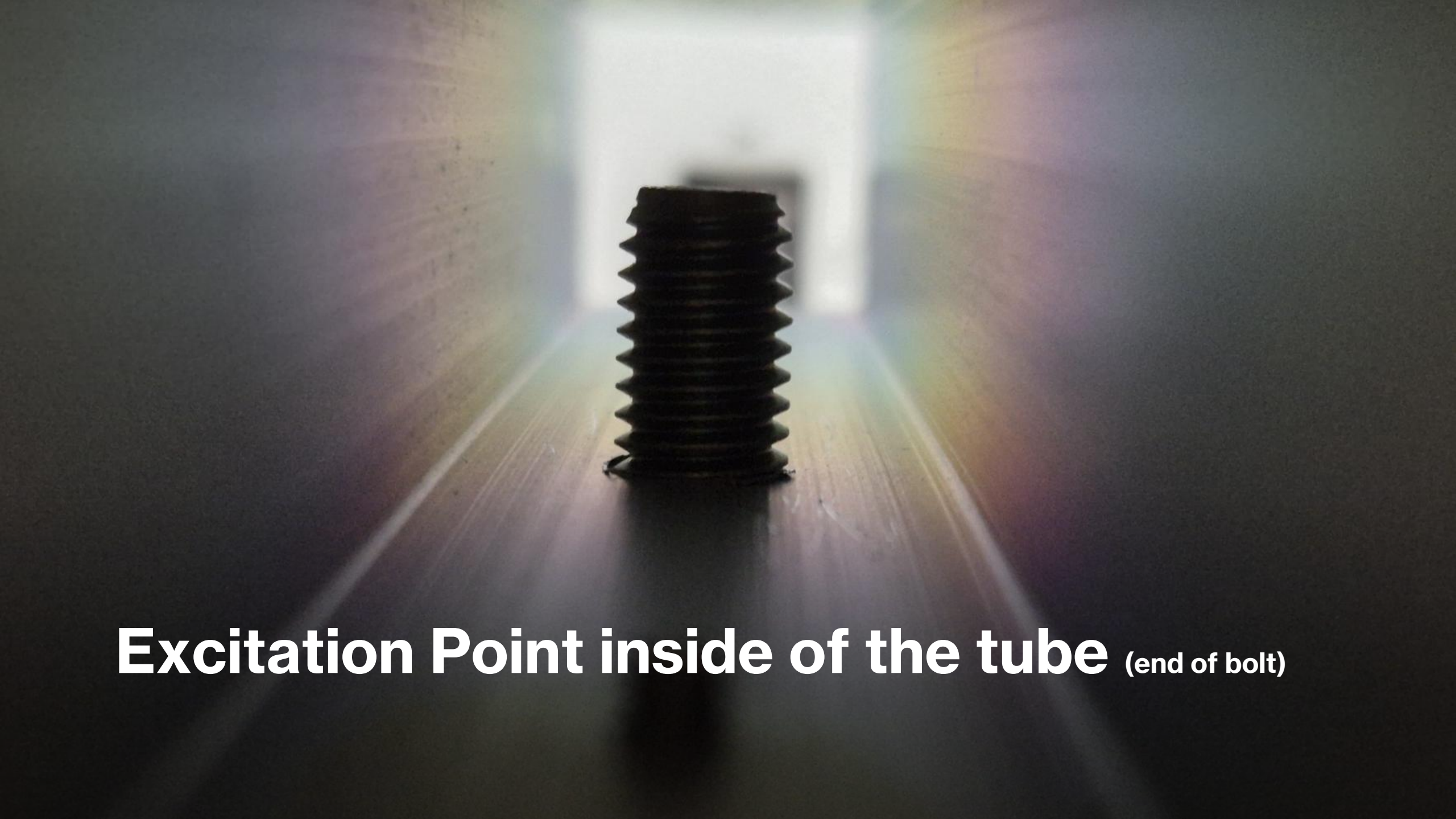
- This design utilizes a half-wavelength open ended tube. In previous versions, I didn't consider how to excite the cavity other than through a hole in the middle, leading to unclear resonance.
- In this iteration, I've aimed to focus the excitation point at the tube's internal center using another tube from the driver speaker.
- This approach isolates the speaker characteristics from the open cavity.
- When the tube is acoustically excited at its center point lengthwise but also in the center of the tube a sharp resonant tone is manifested.

Implementation



AN 8MM BOLT WITH A HOLE DRILLED THROUGH ITS CENTER IS USED TO CONSTRAIN THE NODAL POINT IN THE CENTER OF THE TUBE AT ITS MIDPOINT.

AS THE SPEED OF SOUND VARIES WITH BOTH PRESSURE AND TEMPERATURE, THE RESONANT FREQUENCY HERE FOR 800HZ IS CORRECT FOR MY QTH AT AN ALTITUDE OF 650M ASL AT 20 DEG C.


Excitation Point inside of the tube (end of bolt)

The Bolt

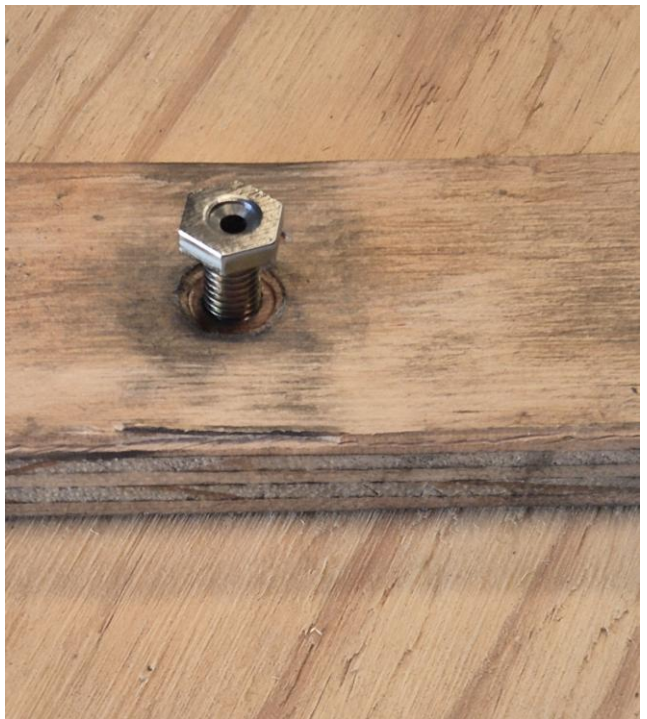
A drill press is essential. Mounting the bolt into a tapped hole in a piece of timber for drilling assists with drilling accuracy.

This is a 15mm long 8mm diameter mild steel bolt. (set screw)

I have tried various size holes through the center of the bolt from 4mm down to 2.5mm. 2.5mm seems to give the best signal to noise ratio.

The hole has been countersunk with a 12mm drill to assist with air compression through the hole.

Note: A worn drill will cause the hole to be off center at the threaded end of the bolt.



Construction

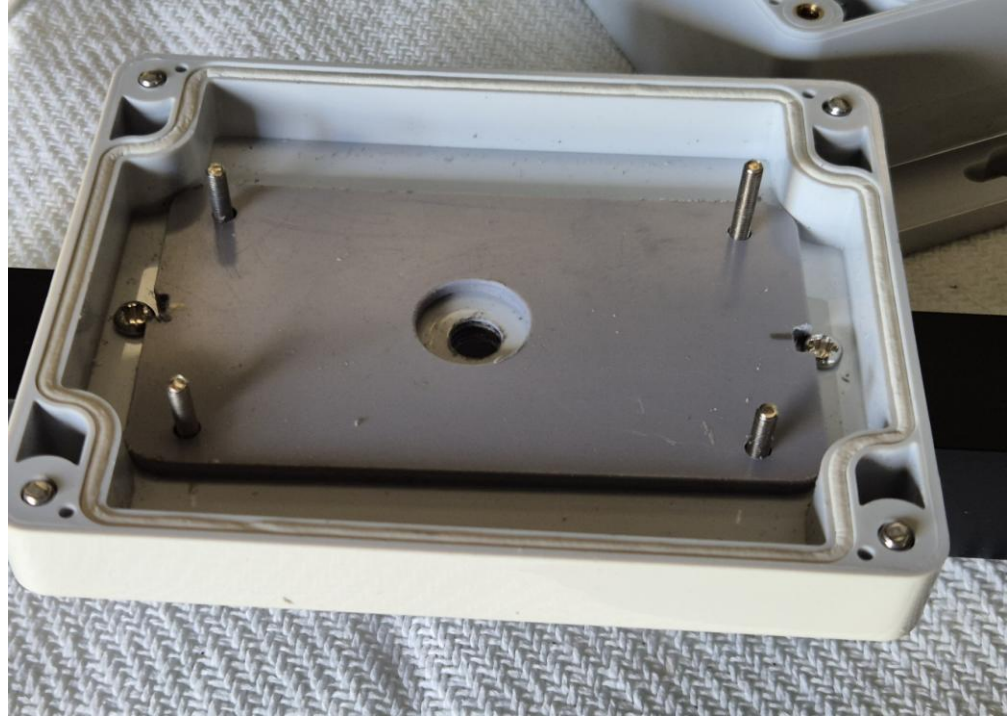
During assembly a pilot hole is used to locate accurately the center point of the tube for 8mm bolt.

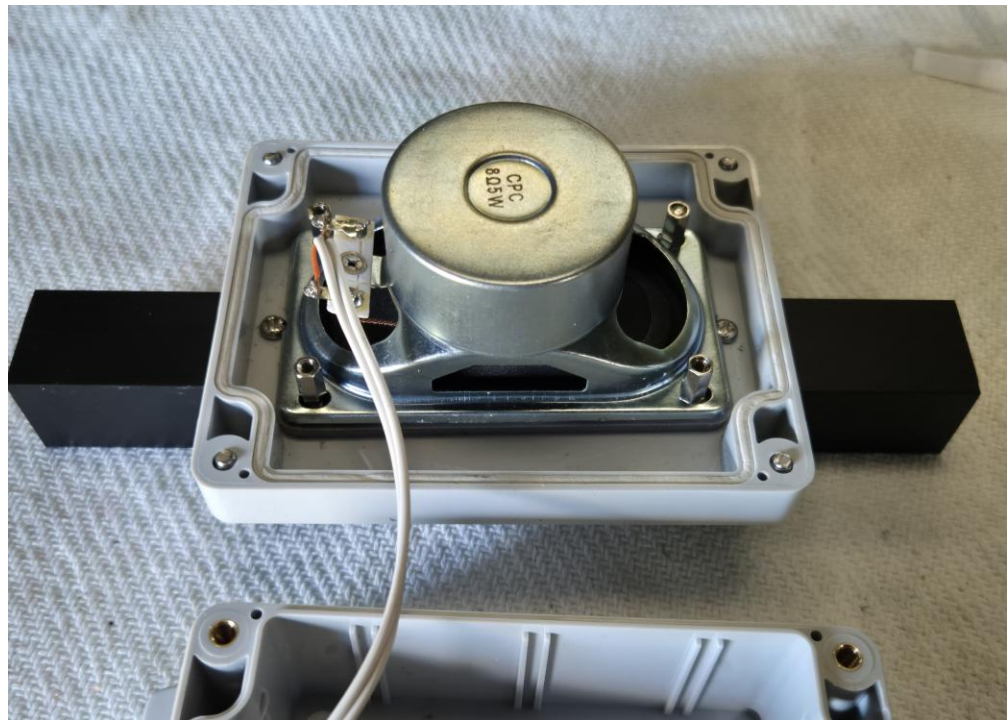
Once the tube is fixed to the lid of the box with 2 x 3mm screws, the pilot hole may be further drilled and tapped to fit the 8mm bolt.

The spacer under the speaker ensures that the bolt head does not contact the speaker cone.

Threaded spacers are used as nuts to make easy removal of the speaker from the assembly.

The 4 bolts holding the speaker are tapped into the box lid as studs.





Internal Sound Management

Effective sound management from the rear of the speaker is crucial for any useful speaker system. Here I use both Helmholtz resonators and sound absorption using foam

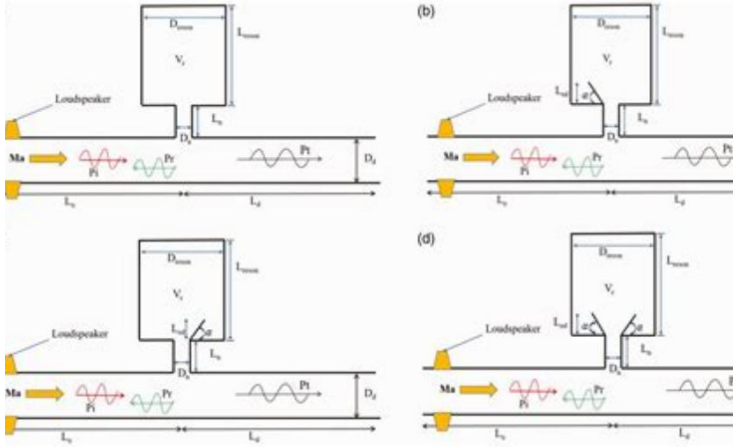
Like a bottle, resonant a frequency but all other frequencies are dissipated as heat

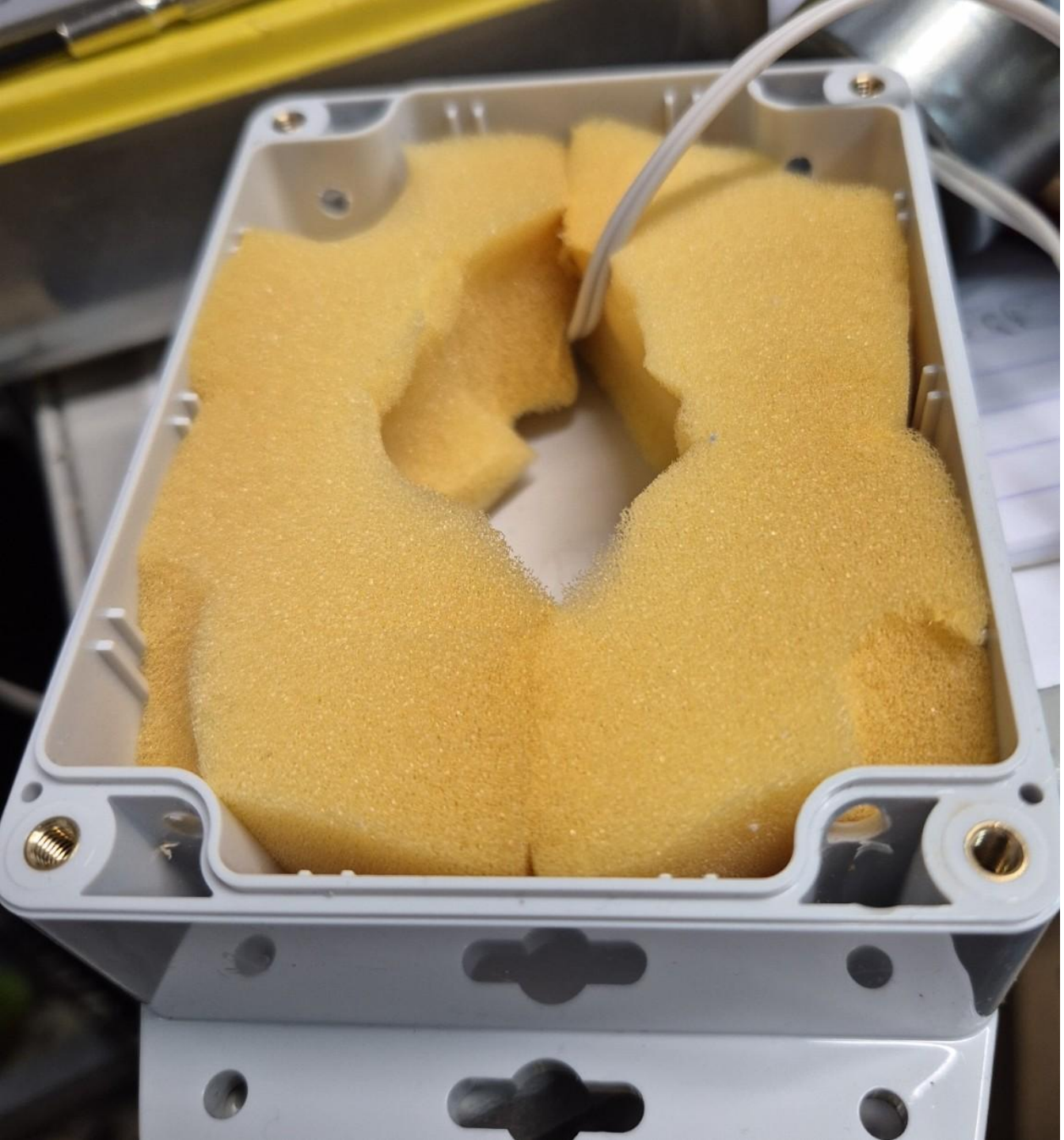
The sealed compartments located in each corner of the enclosure provide an opportunity for conversion to Helmholtz resonators

Drilling a hole as shown results in a Helmholtz resonator when the lid of the box is sealed.

Hermann von Helmholtz
ForMemRS

Born	Hermann Ludwig Ferdinand Helmholtz 31 August 1821 Potsdam, Province of Brandenburg, Kingdom of Prussia, German Confederation
Died	8 September 1894 (aged 73) Charlottenburg, Kingdom of Prussia, German Empire





Rear Sound Absorption

Further to the 4 Helmholtz chambers on the corners of the box, foam was cut to fit around the speaker to absorb the sound from the back of the speaker.

This gave the impression of a dead speaker but but the output of the tube at resonance was still quite strong.

Conclusion

This speaker is used with an ALINCO DX-R8 receiver which is set up with an 800Hz beat note in the CW mode. Hence to Speaker is also set up for 800Hz

The 160m band is considered a most challenging due to band noise.

This iteration with a 2.5mm bolt hole has now made top-band operation a pleasure.

Successful QSOs to the USA now happen under unlikely conditions.

QRN is significantly suppressed while allowing the CW tone to come out loud and clear.

Tuning the receiver just 10 Hz off resonance greatly reduces audio output.

I see this improvement as a positive result.

Adrian van der Byl VK2WF April 2025