Entwurf und Bau einer gestockten horizontal polarisierten Rundstrahlantenne

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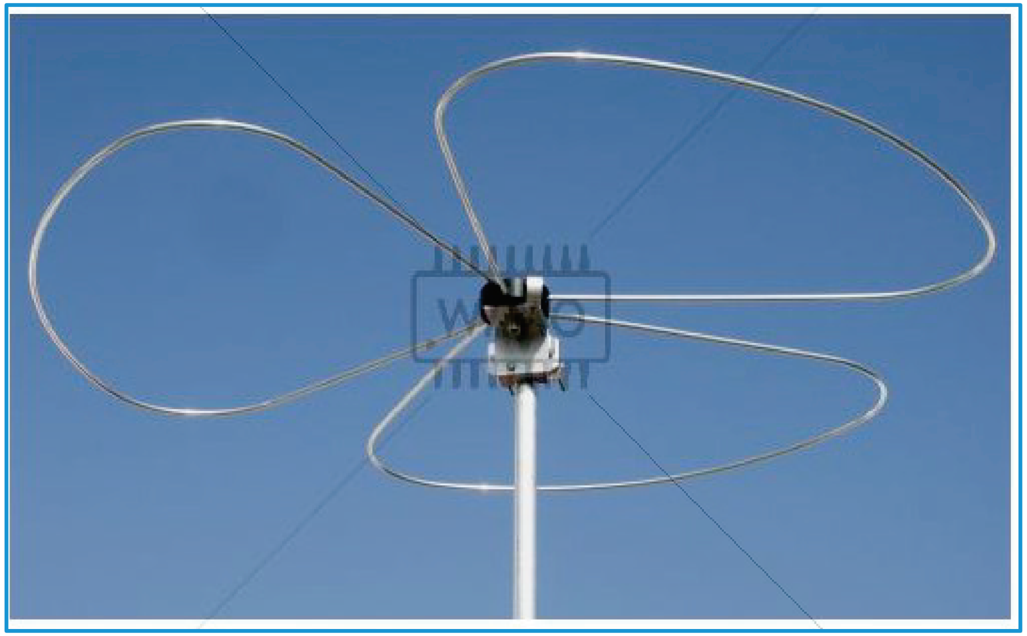
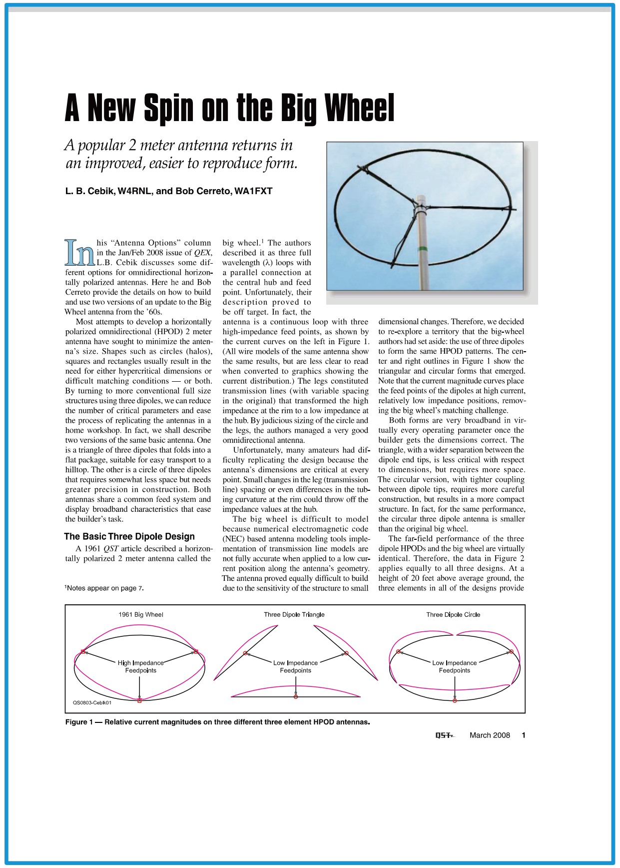
Motivation



Klassische Big Wheel Antennen

Grund für den Start des Projektes



A New Spin on the Big Wheel

A popular 2 meter antenna returns in an improved, easier to reproduce form.

L. B. Cebik, W4RNL, and Bob Cerreto, WA1FXT

In his "Antenna Options" column in the Jan/Feb 2008 issue of *QEX*, L.B. Cebik discusses some different options for omnidirectional horizontally polarized antennas. Here he and Bob Cerreto provide the details on how to build and use two versions of an update to the Big Wheel antenna from the '60s.

Most attempts to develop a horizontally polarized omnidirectional (HPOD) 2 meter antenna have sought to minimize the antenna's size. Shapes such as circles (halos), squares and rectangles usually result in the need for either hypercritical dimensions or difficult matching conditions — or both. By turning to more conventional full size structures using three dipoles, we can reduce the number of critical parameters and ease the process of replicating the antennas in a home workshop. In fact, we shall describe two versions of the same basic antenna. One is a triangle of three dipoles that folds into a flat package, suitable for easy transport to a hilltop. The other is a circle of three dipoles that requires somewhat less space but needs greater precision in construction. Both antennas share a common feed system and display broadband characteristics that ease the builder's task.

The Basic Three Dipole Design

A 1961 *QST* article described a horizontally polarized 2 meter antenna called the big wheel.[1] The authors described it as three full wavelength (λ) loops with a parallel connection at the central hub and feed point. Unfortunately, their description proved to be off target. In fact, the antenna is a continuous loop with three high-impedance feed points, as shown by the current curves on the left in Figure 1. (All wire models of the same antenna show the same results, but are less clear to read when converted to graphics showing the current distribution.) The legs constituted transmission lines (with variable spacing in the original) that transformed the high impedance at the rim to a low impedance at the hub. By judicious sizing of the circle and the legs, the authors managed a very good omnidirectional antenna.

Unfortunately, many amateurs had difficulty replicating the design because the antenna's dimensions are critical at every point. Small changes in the leg (transmission line) spacing or even differences in the tubing curvature at the rim could throw off the impedance values at the hub.

The big wheel is difficult to model because numerical electromagnetic code (NEC) based antenna modeling tools implementation of transmission line models are not fully accurate when applied to a low current position along the antenna's geometry. The antenna proved equally difficult to build due to the sensitivity of the structure to small dimensional changes. Therefore, we decided to re-explore a territory that the big-wheel authors had set aside: the use of three dipoles to form the same HPOD patterns. The center and right outlines in Figure 1 show the triangular and circular forms that emerged. Note that the current magnitude curves place the feed points of the dipoles at high current, relatively low impedance positions, removing the big wheel's matching challenge.

Both forms are very broadband in virtually every operating parameter once the builder gets the dimensions correct. The triangle, with a wider separation between the dipole end tips, is less critical with respect to dimensions, but requires more space. The circular version, with tighter coupling between dipole tips, requires more careful construction, but results in a more compact structure. In fact, for the same performance, the circular three dipole antenna is smaller than the original big wheel.

The far-field performance of the three dipole HPODs and the big wheel are virtually identical. Therefore, the data in Figure 2 applies equally to all three designs. At a height of 20 feet above average ground, the three elements in all of the designs provide

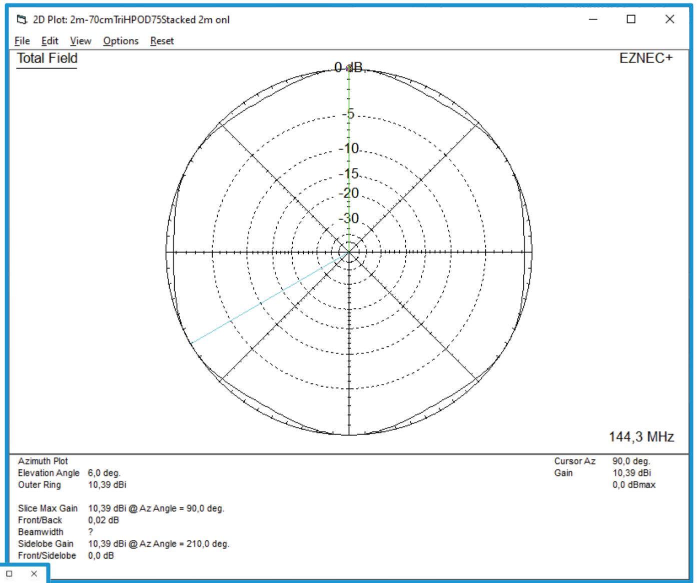
[1]Notes appear on page 7.

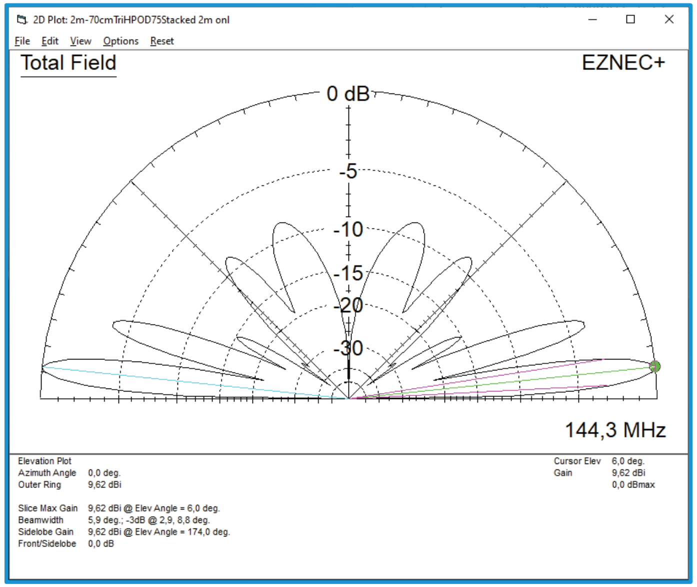
Figure 1 — Relative current magnitudes on three different three element HPOD antennas.

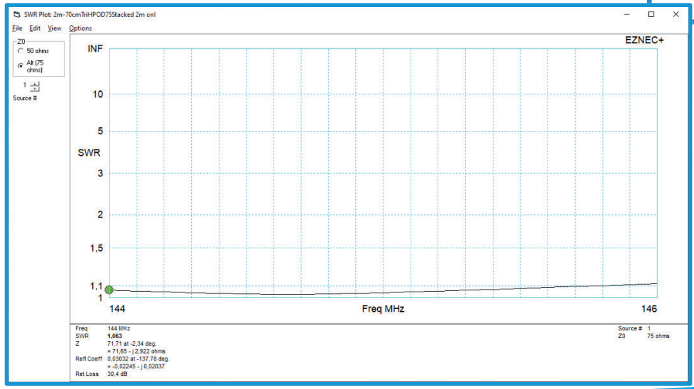
Link: https://www.pc5e.nl/downloads/antennes/2%20meter%20bigwheel%20AntenaHPOD.pdf

Vorbreitung und Planung

EzNec-Simulation 2m

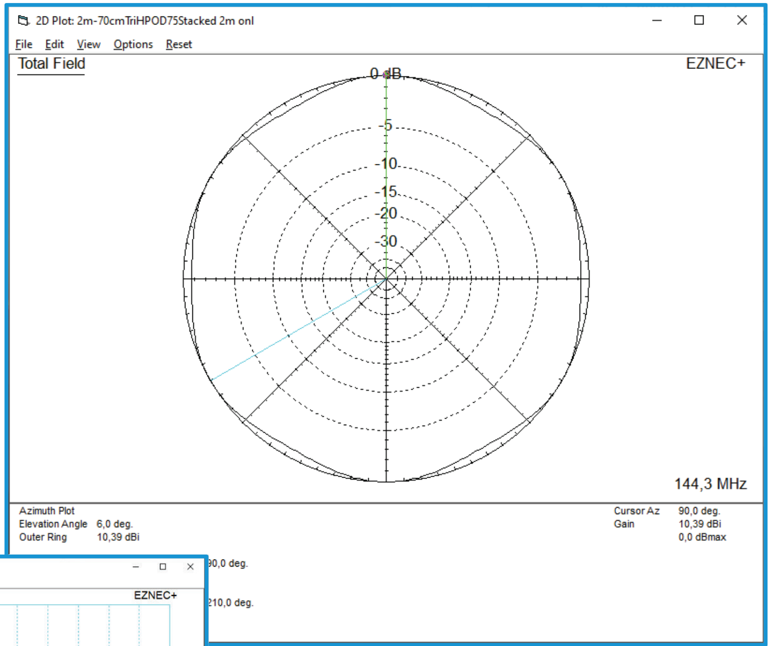


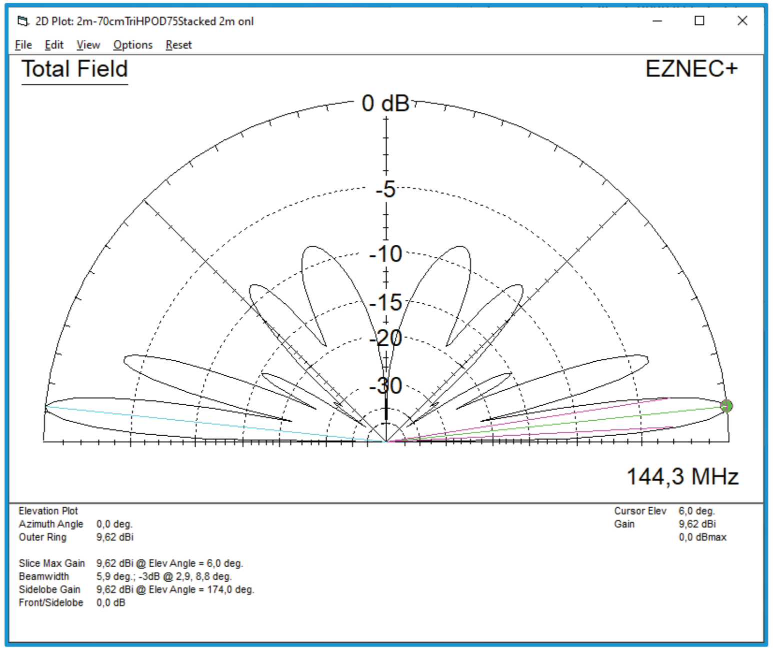


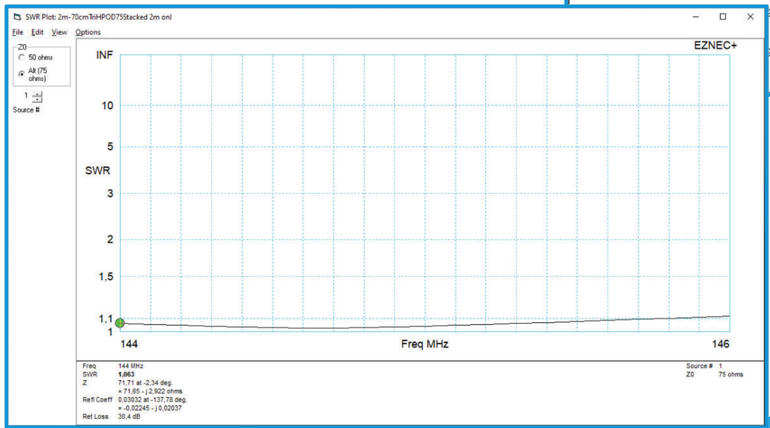


Vorbreitung und Planung

EzNec-Simulation 2m

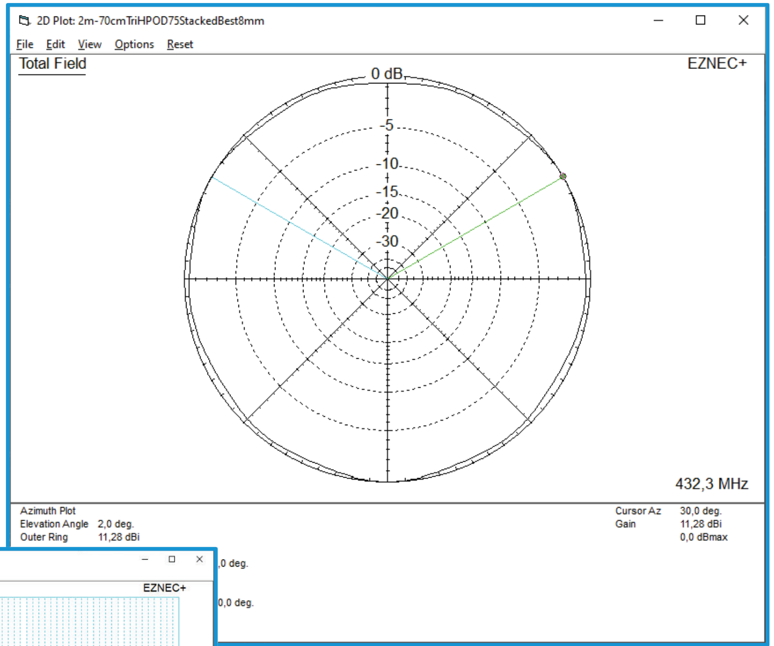


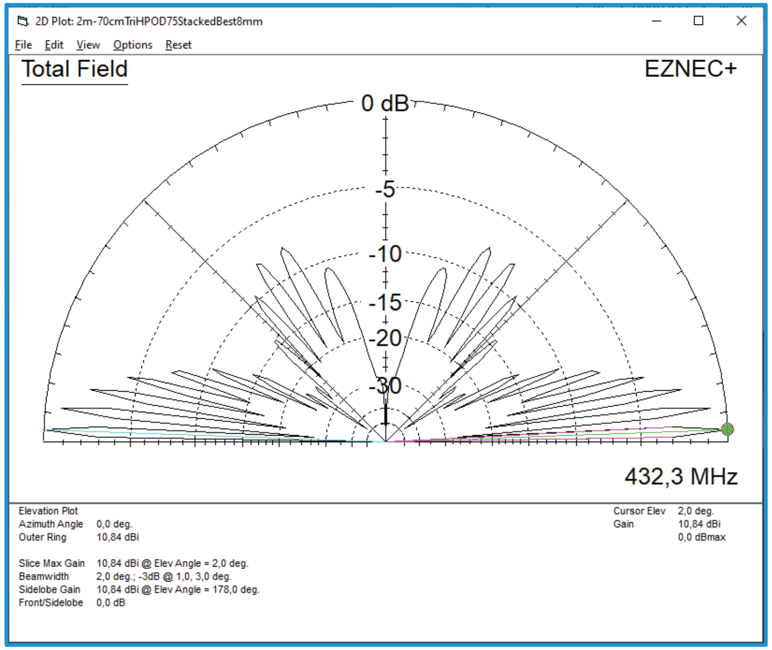


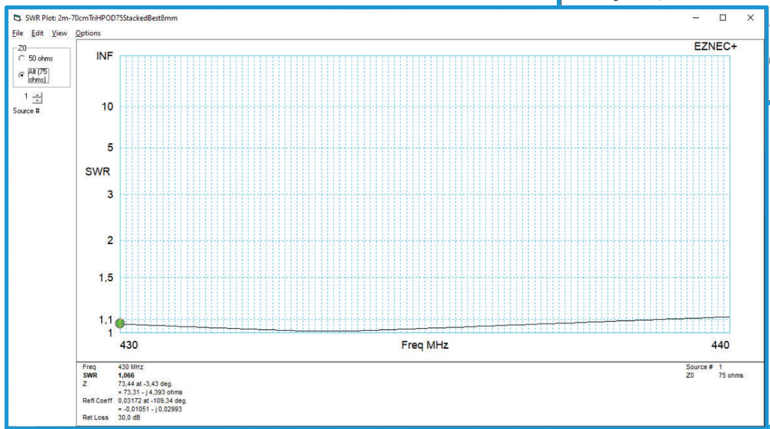


Vorbreitung und Planung

EzNec-Simulation 70cm

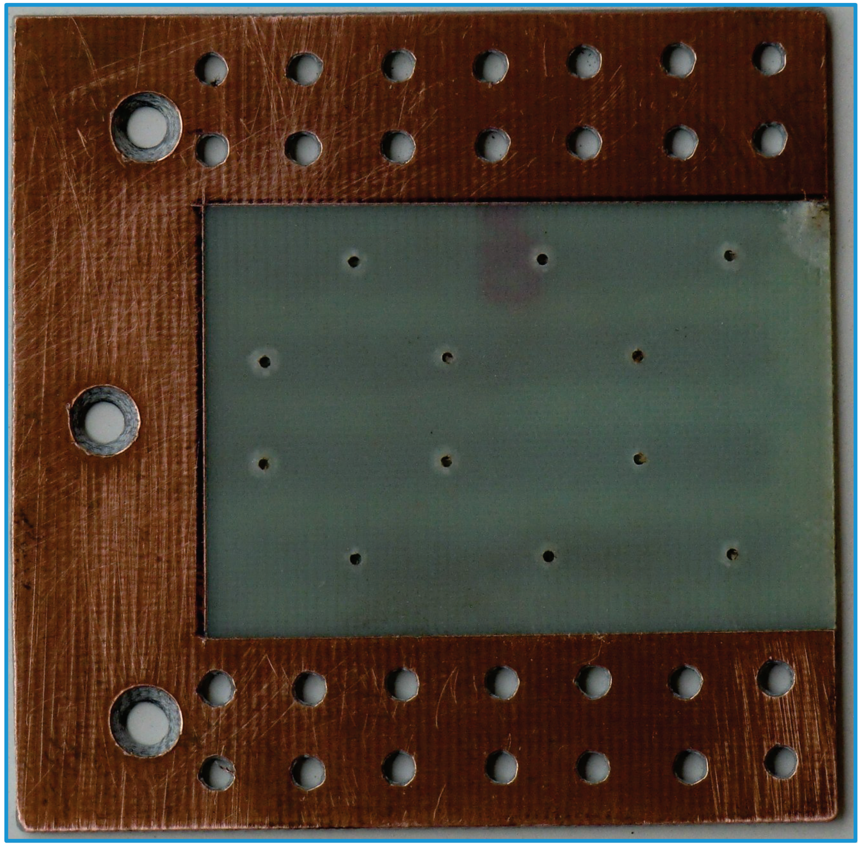


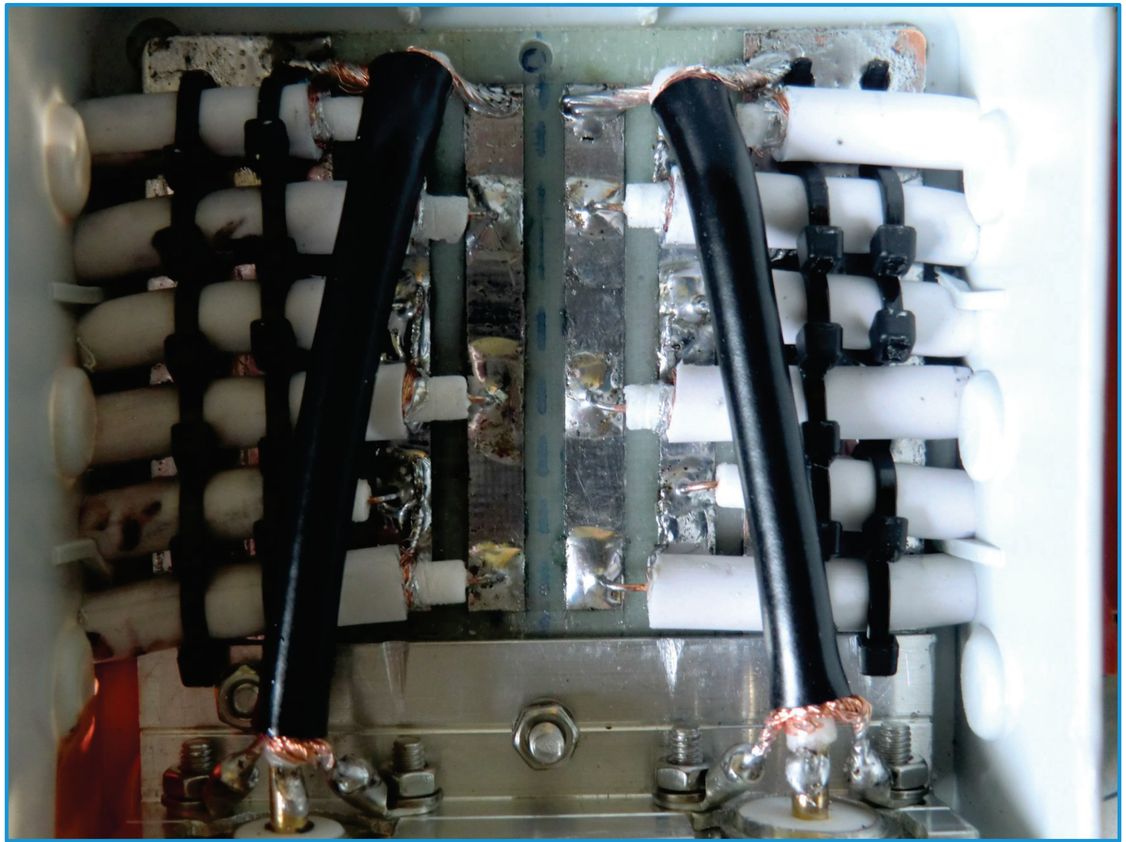




Bau – Konstruktiondetails des Prototyps

Bau – Details der Platine zum Zusammenschalten der Dipole





Tests im Garten

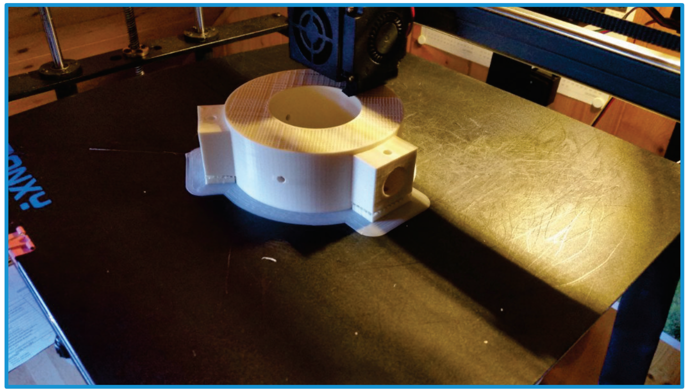
2m: Von 144-146 MHz SWR < 1 : 1,5

70cm: im SSB-Bereich 432,200-432,400 MHz zufällig SWR ~ 1 : 1,5

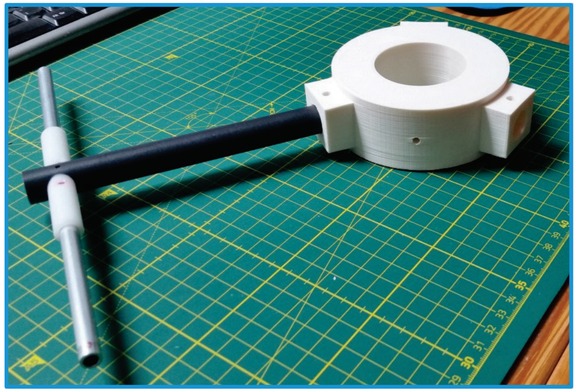
Realistischer Test im Sommerkontest Anfang August 2020

- Aufbau der Station auf 1558m asl
- SWR-Werte wie bei Gartenmessungen
- Konnte mit dem IC-9700 maximale Leistung fahren: 2m→100W, 70cm->75W
- Wegen Gewitters nur 2 Stunden Betrieb möglich (18h-20h MEZ)
- Erste Verbindung 2m: Mont Ventoux ca. 150km
- Weiteste Verbindung 2m: Nordfrankreich Ärmelkanalküste ca. 500km
- 70cm: einige wenige Verbindungen bis ca. 150 km

Schlussfolgerungen - 1

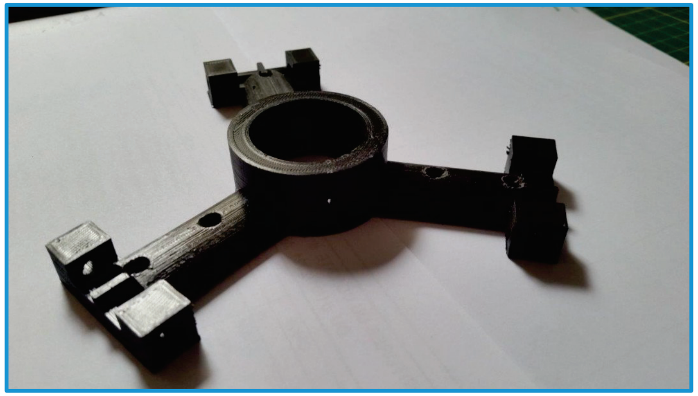


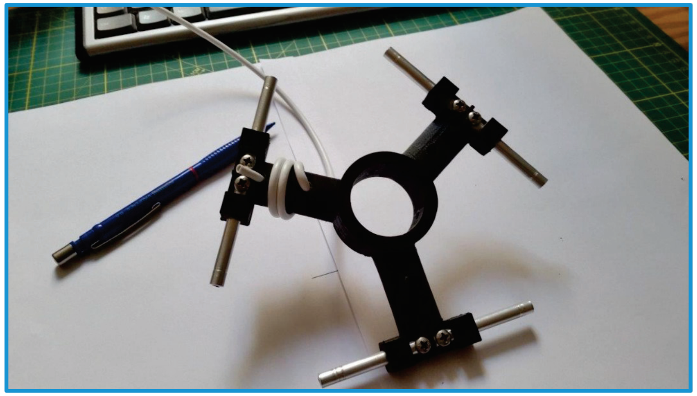
- Konzept bestätigt
- PVC-Rohr zur Aufnahme insbesondere des gestockten Systems für 2m zu labil
- => wird durch steckbarem Alu-Fahnenmast ersetzt
- Neue Halterung für Dipolebenen mittels 3D-Druck

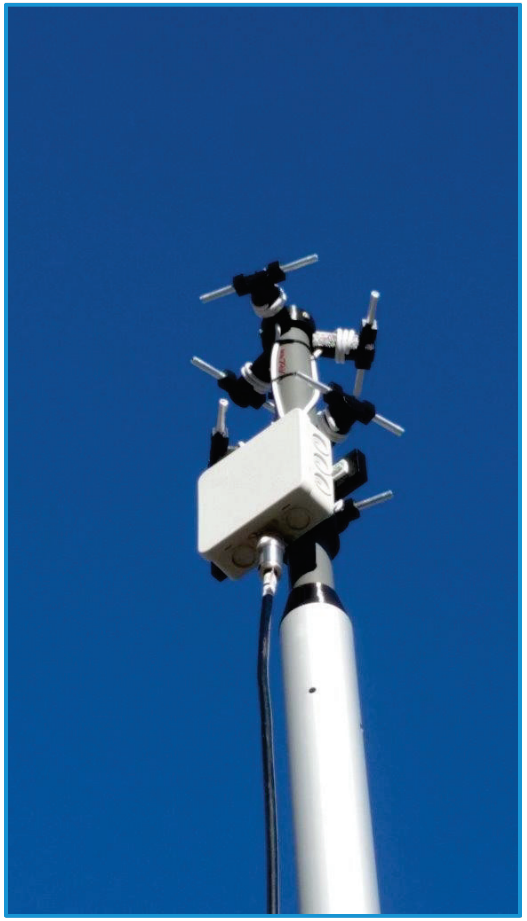


Schlussfolgerungen – 2

Versuch ein entspechendes Antennensystem für 23cm aufzubauen







- Prototyp fertiggestellt jedoch wegen sehr schlechten SWR's (bis zu 1 : 5) nicht nutzbar
- Im SSB-Bereich zufällig SWR < 1:3
- Weitere Untersuchungen notwendig