How to Start on Microwave EME Using Homebrew Dish and Equipment

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First JT65B EME 144MHz in 2007

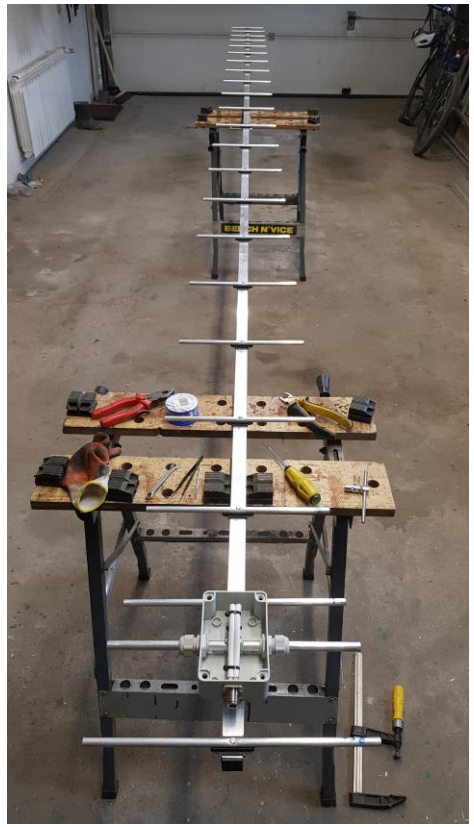
- EME communication has fascinated me from the very beginning of my amateur radio hobby
- HF never was for me, I have always looked for challange, ultimate DX and for… microwave EME
- In 2007 I was able to make first EME contact JT65B 144MHz using a set of 4 x 9 el yagi F9FT, only 50w PWR from FT-847. At the time using QRP and these yagi set temporary mounted on balcony carried out about 30 QSOs JT65B.

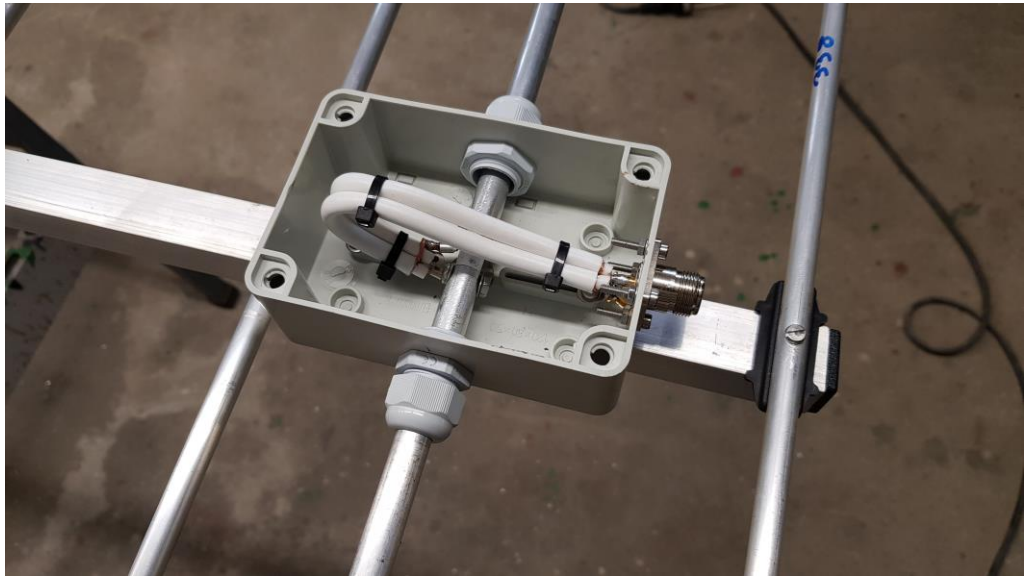
First CW EME 432MHZ

In 2019 I decided return to the EME and to build 8x23 432MHz yagi set. The single antenna was made based on the DK7ZB study with gain of approximately 17dBd at a lenght of 560cm. A set of 8 yagi should has a theoretical gain about 26dbd. Using 400W from the shack and these yagi array I was able to start in ARRL EME 2019 with results 14 QSO random CW. I was not focused on any results because it was my first start but I was bit surprised to earn 4th place in the SO 432MHz CW only category.

Homebrew 8 x 23 432MHz yagi set

- More details on DK7ZB website https://www.qsl.net/dk7zb/70cm-longyagi/23-ele.htm
- Boom lenght 560cm, aluminium square profile 25x25x2mm
- The elements have 12 mm, 10 mm diameter.
- The 2x75-Ohm-coax-cable in the box with the N-socket for the DK7ZB-match





Is microwave EME your goal? So, you should try to build the dish...

- In 2020, I have started new EME project, 6.4m (31 feet) dish with f/d 0.4
- I wondered long time how to build new EME system suitable for multiband operation from 70cm up to 9cm, using garage tools, without spend a lots of money.
- There is a lot of better way to achive the same results or even more. Im just only an amateur...
- My construction arent perfect, there are some things to do improve
- The dish work flawlessly since November 2021
- This presentation shows that anyone can to try microwave EME

Garage workshop, handy tools, enough to start new EME project

- Reflector ribs, were made using 120kg of aluminium angles 20x20x2mm as compromise between strenght and lightness of the structure.
- Oriented Strand Board, durable and covenient base for forming reflector ribs.
- Ribs conception based on Chris SP7DCS great solution. More details on Chris website https://sp7dcs.pzk.pl/details6dish.html

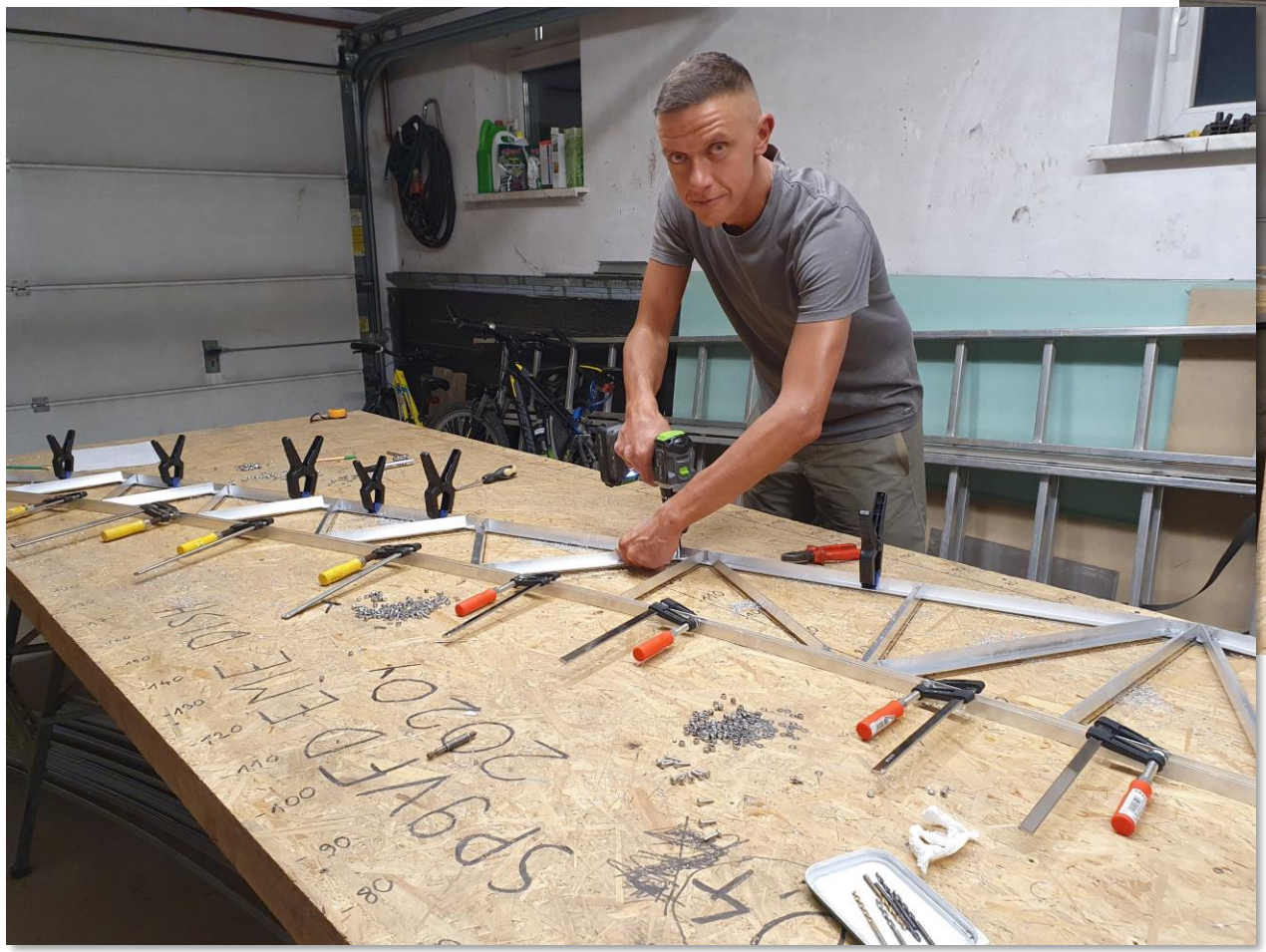
Ribs construction

Pre-bent aluminium angle, by hand...

A set of already prepared elements for the ribs. All elements of aluminium angles 20x20x2mm.

Template for the production of ribs, also made of aluminium angles 20x20x2mm.

Ribs construction



Internal ribs junctions were made by drilining through two angles and screwing using stainless screws.

Yeah... the first rib just done, a lot of fun! ☺

Ribs construction

Each of ribs had two cut areas. I welded this using TIG

The hub

The HUB, central part of the dish. Aluminium plate 6mm thickness. Front side wheel 60cm diameter, back side wheel 100cm, distance beetwen wheels 45cm.

Dish assembly

All of ribs are screwed with stainless steel screws.

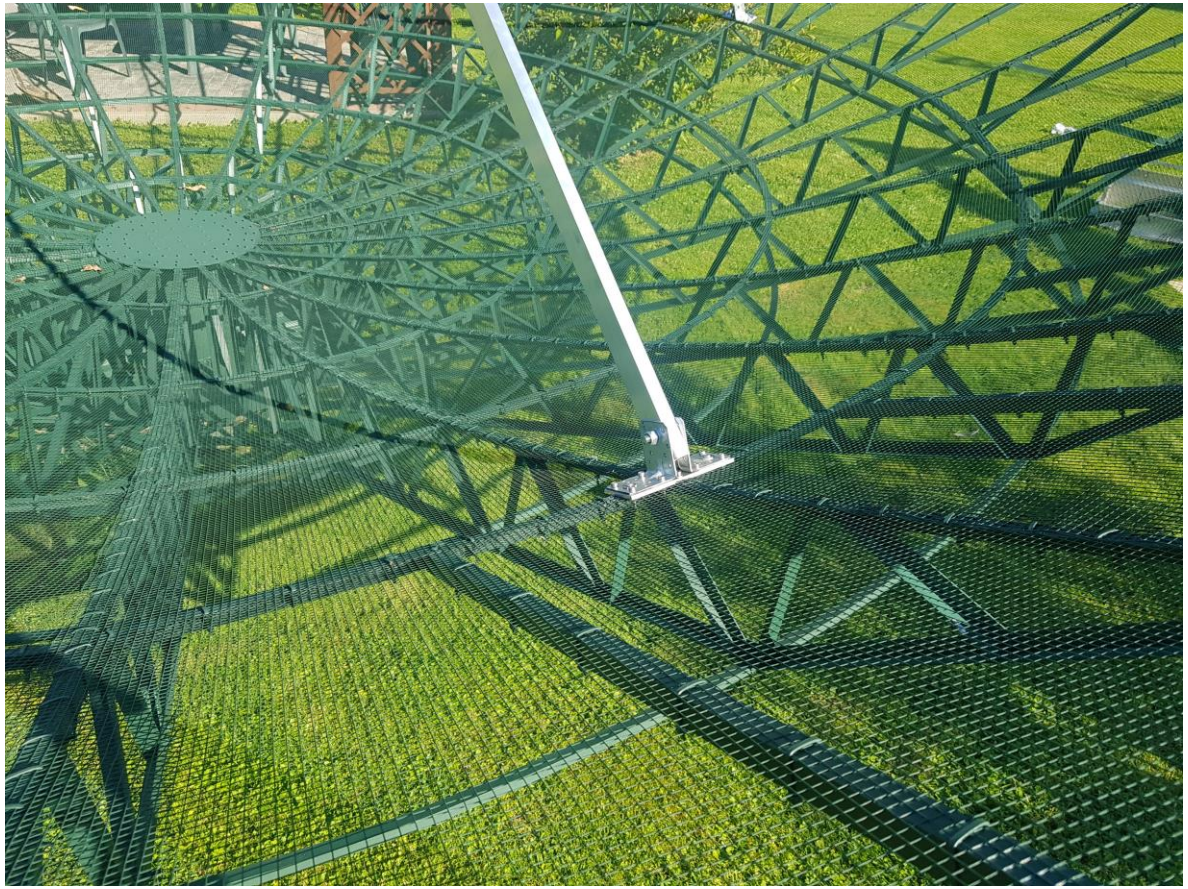
Pre-assembled 6.4m dish and set of 8 x 23 432MHz on the tower.

Covering by mesh

Fixing the mesh with cable ties. A lot of boring job but almost done... Mesh holes dimensions 8x8x0.8mm should be suitable up to 9cm.

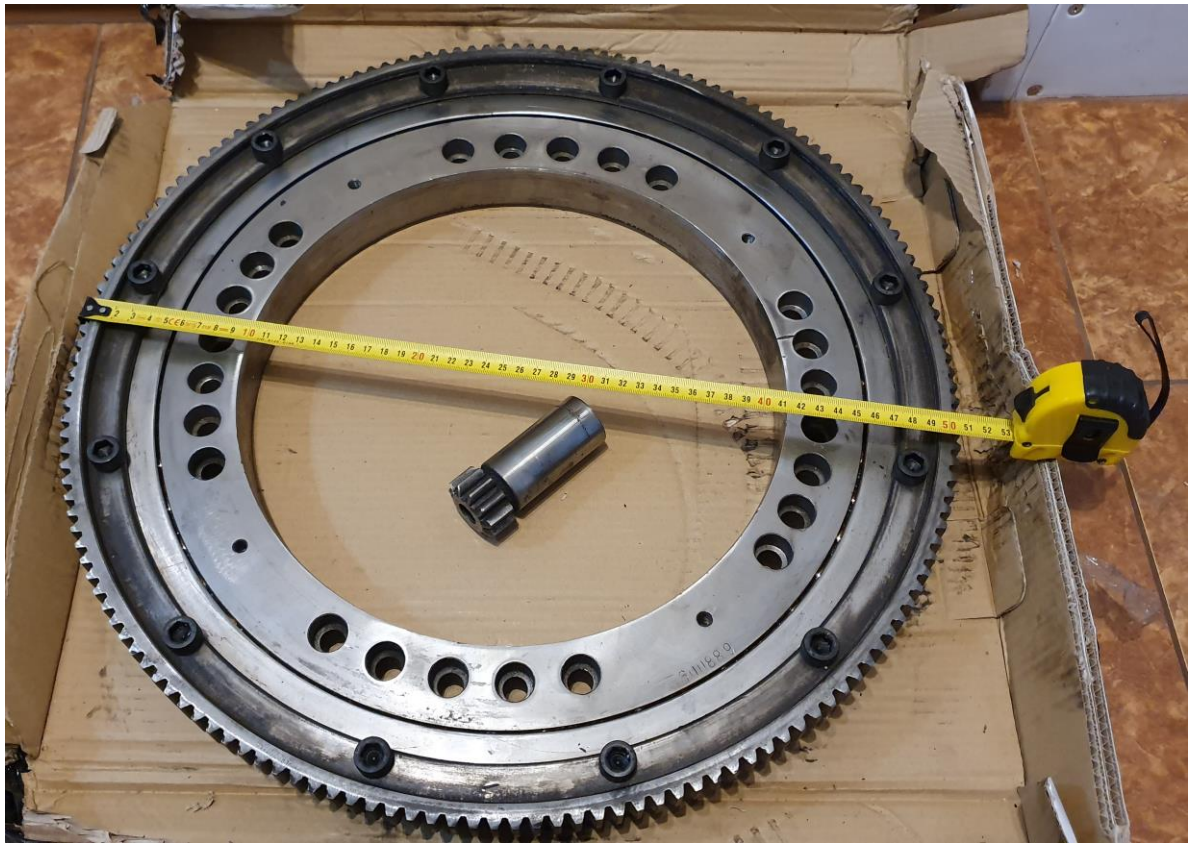
The mesh was cut into a triangle using hand scissors.

Covering by mesh



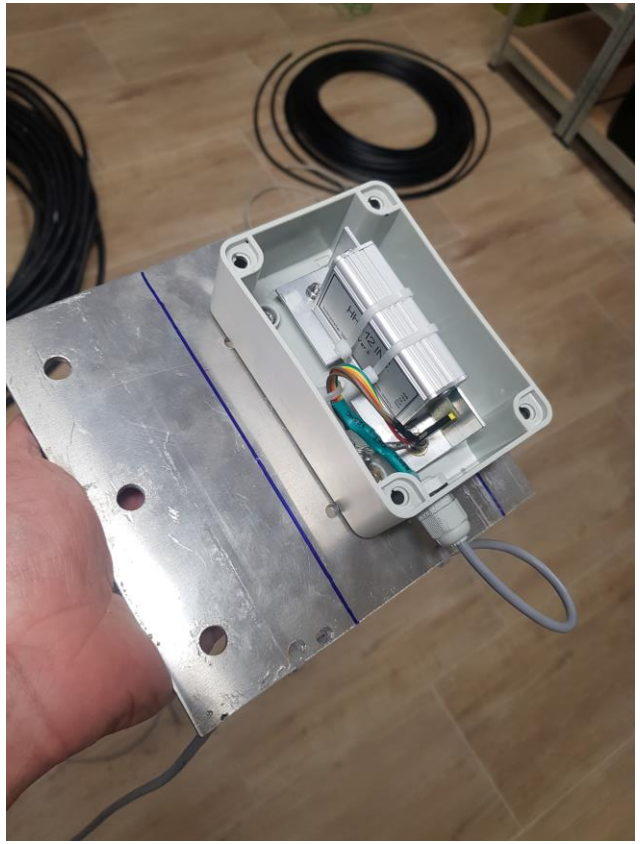
Finally, I painted the dish by green using roof paint, to be more friendly for my neighborhood.

Azimuth drive



Mini crane main bearing, surplus part obtained from internet junk shop. Bearing with a diameter of 51cm. Load capacity several ton...

EME dish control



EL reading, inclinometer
HH-12INC DF1SR

AZ reading, absolute encoder
HH-12 DF1SR

On the left AZ drive, 230V AC 180W engine with gear ratio 1:1200. On the right absolute encoder HH-12 enclosure.

EME dish control

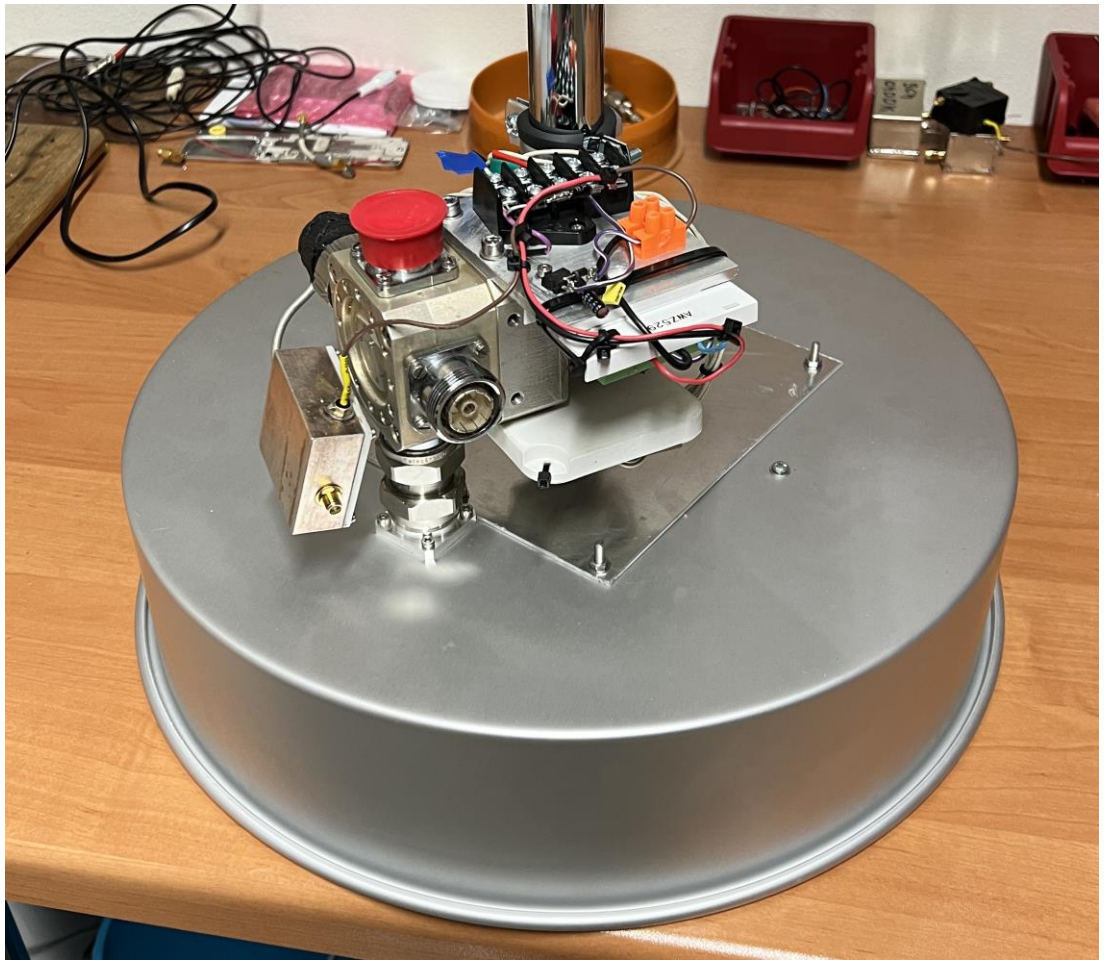
Homemade OE5JFL controller, working perfectly with 50m lenght CAT6 cable, tracking resolution 0.2 degree

EL drive, actuator GNT 3500N, 36” 230V

Rising up the dish

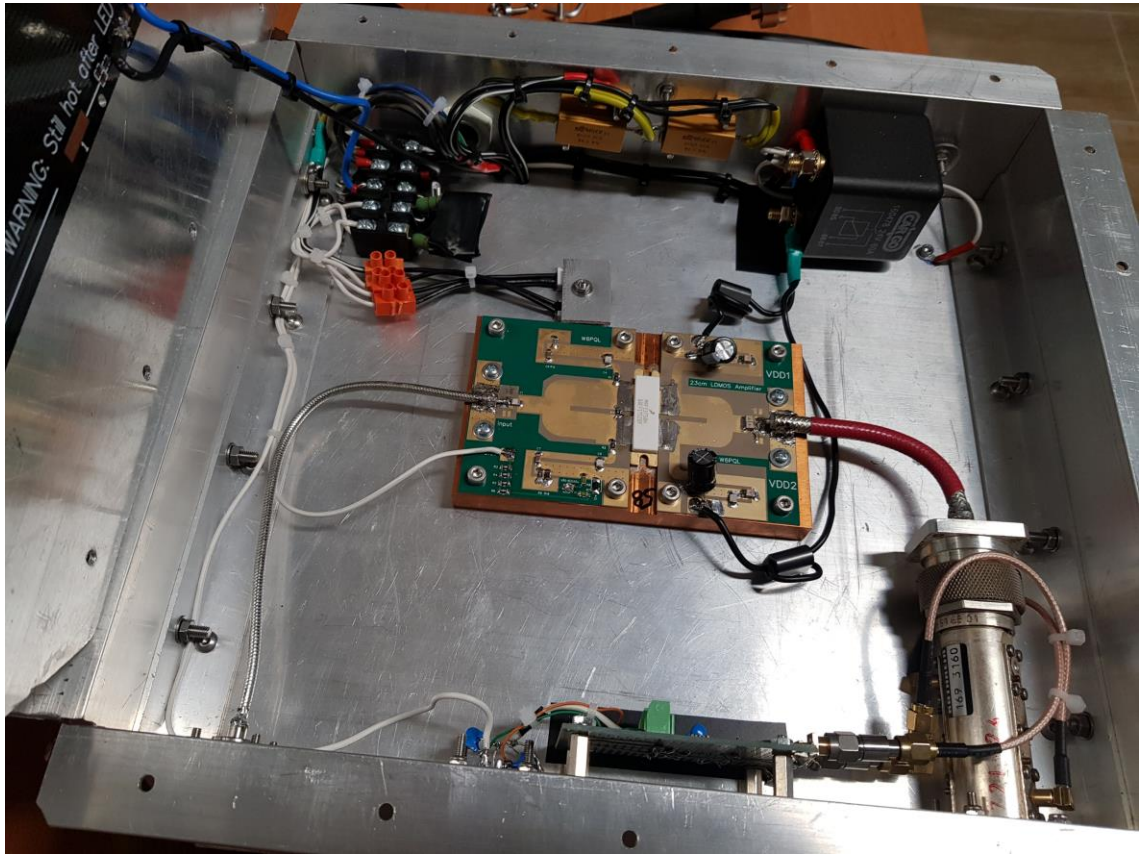
Obviously rising the dish using crane is most convenient and safety solution. There are also some other quite good solutions, the cheapest way is to build the simple ramp with manual winch.

432 MHz loop feed



Rotary „pancake” 432MHz loop feed, ATF54143 LNA (later added second stage PGA103+) 7/16 Spinner relay, Sun Y measurements showed dish advantages, 6.4m dish has much better results then set of 8 x 23 yagi.

1296MHz SSPA



Well known W6PQL 600W 23cm pallet amplifier. The 3D printer heating plate helps keep the interior of the amplifier dry on frosty and humid days, when amp is not in use.

1296MHz feed & SSPA

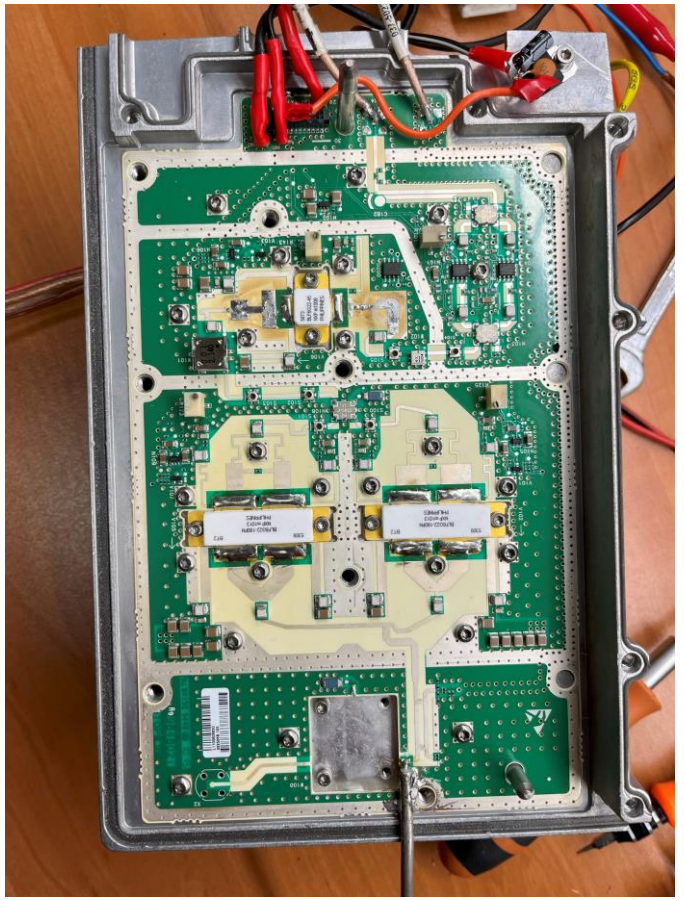
Septum feed and 600W 23cm amplifier. G4DDK homemade LNA. There is only short ½” coax jumper ended both side 7/16 plugs, betwen SSPA output connector and TX port of the feed.

13cm feed & SSPA

13 cm septum feed, relay box with LNA and 150W SSPA

13cm feed & SSPA

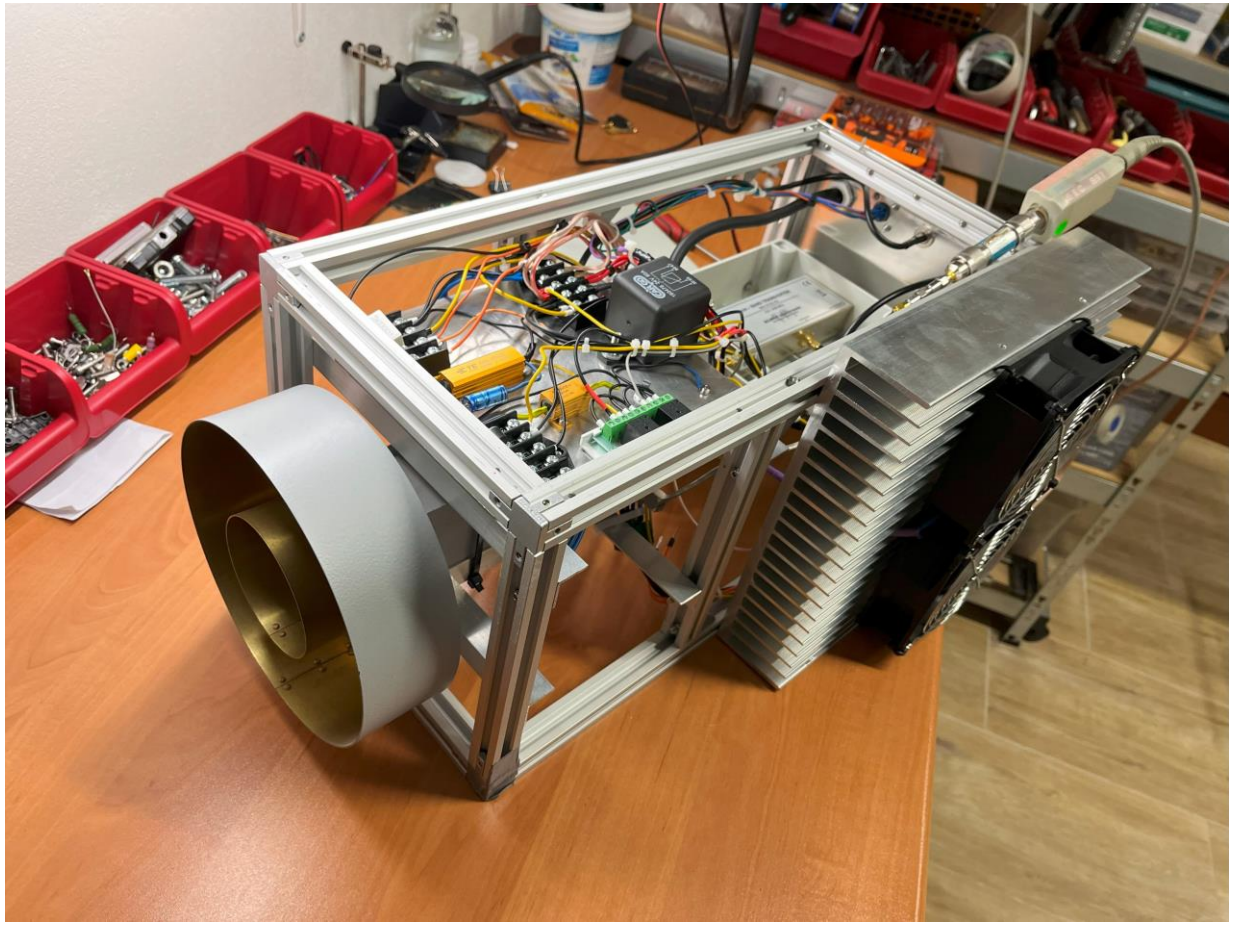
13cm WA6PY LNA 0.3dB NF 33dB gain. Aluminium enclosure with protection SMA relay.



2 x BLF6G22-180PN UMTS SSPA surplus board. Surplus part, easy adaptation to use on 13cm.

The original amp was dedicated to run with UMTS service, but after simple modification this works also pretty well on 13cm.
With only 50mW drive, output PWR as follow:
2300MHz 180W
2320MHz 150W
2400MHz 60W

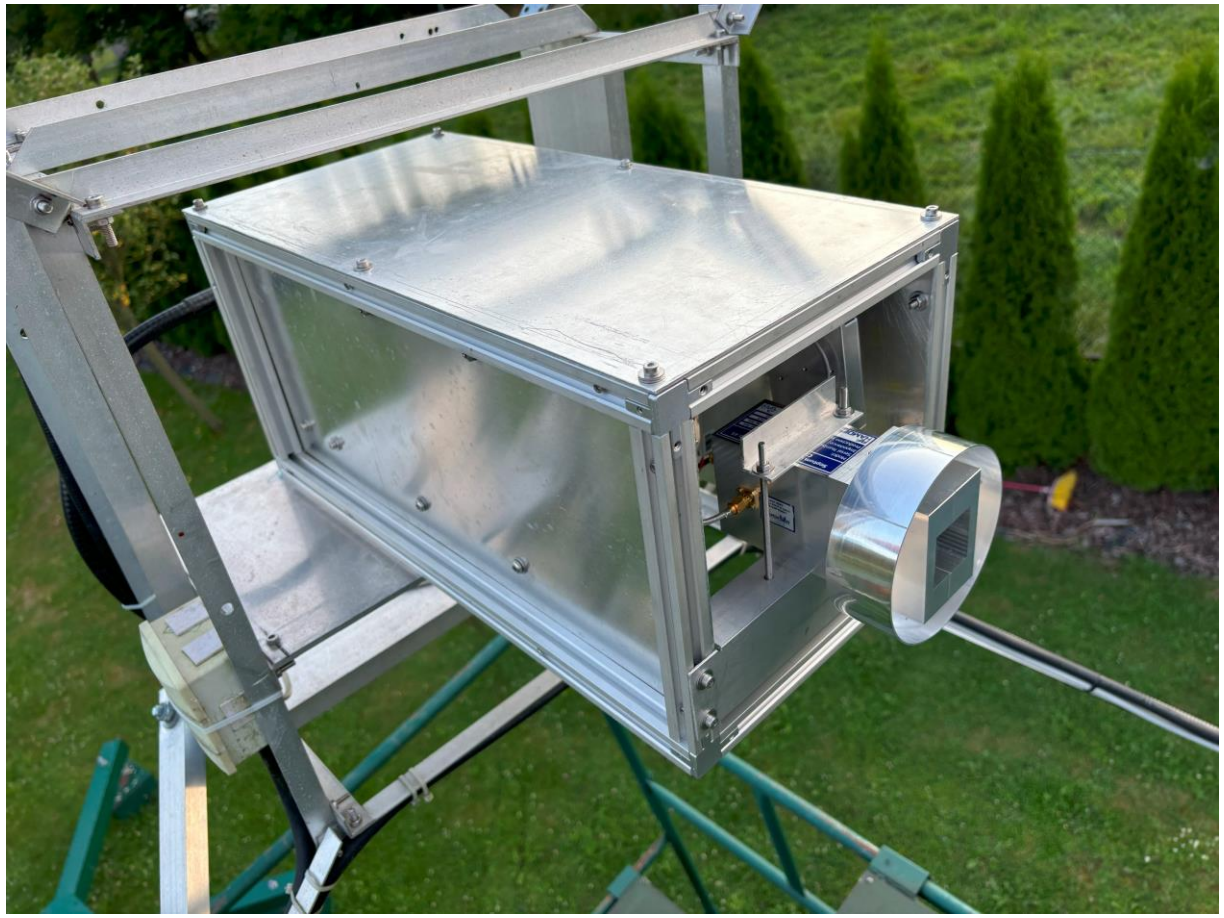
EME set for 9cm band



9 cm septum feed, DG0VE LNA 0.55dB NF 17dB gain, MKU 34 G3 432 Kuhne TRV, modified UM2683B Toshiba SSPA.

EME set for 6cm band

First 6cm CW EME QSO on July 28th 2024

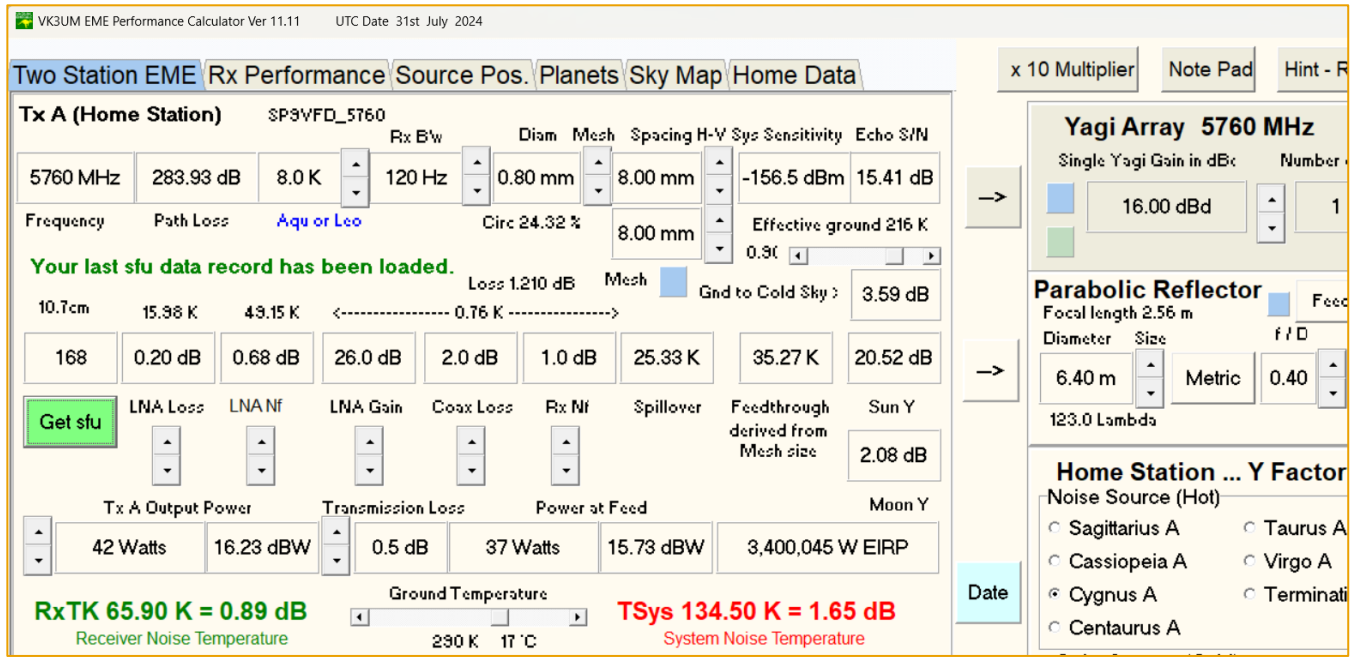


Set for 6cm band in the support of 6.4m HB dish

RFDesign septum feed, DU3T LNA 0.68dB NF 26dB gain, MKU 57 G4 Kuhne TRV, 40W PA3DZL SSPA

Set for 6cm EME

6.4m dish covered by mesh with holes diameters 8x8x0.8mm has high System Noise Temperature on 6cm. TSys 134.50K



Measured CS/GND 3.5dB, CS/SUN 13dB

In spite of overall poor system efficiency I had 6 CW EME QSOs at the end of July 2024

Next EME project on the way...

3.2m solid dish for 6cm/3cm EME operation and future 8.4GHz DSN

2021 – 2024 EME activity

From November 2021 most of my EME operation 70cm – 6cm occurred using CW mode. Some SSB and digital QSOs also went into my log.

I didn’t any initials statistic yet, but using my HB 6.4m dish I was able to make 674 QSOs since November 2021. 90% CW random style.

I love pure random CW EME operation but due to less and less activity I’ve started increase also digital operation.

To make EME QSO using Q65 mode with QRP stations gots a lot of fun!

Sometimes there are harsh winters in JN99XN…

Special thanks to:

George DF1SR
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Jac PA3DZL
Jan PA0PLY
Ingolf SM6FHZ
Marek SP3XBO
Andrzej SP6JLW
Jacek SP6OPN
Krzysztof SP7DCS
Paul WA6PY
John WA9FWD

Guys, you are awesome. I wouldn't have achieved anything without your help...

Thank you for watching

If you are interested in further details please contact me at:

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73 de Rafael SP9VFD

I prepared this presentation at the honest request of Allen K2UYH and dedicate this paper to his memory