

# Dual-Band 2m / 70cm Tape-Measure-Yagi

Matthias Bopp

DD1US

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Some weeks ago, I had a very nice QSO with Jean-Philippe F4EGM via the QO-100 satellite while he was on travel in Belgium. On his qrz.com page (<https://www.qrz.com/db/F4EGM>) I noticed, that he had built a “2+3-Element Tape Measure Yagi”. As I had been considering for quite some time to build a portable Yagi antenna for 2m and 70cm satellite operations, I decided to try his design.

## Original DK7ZB design:

The design of F4EGM is based on a design originally developed and kindly published by Martin DK7ZB ([https://www.qsl.net/dk7zb/Duoband/duoband\\_2-70\\_2-3.htm](https://www.qsl.net/dk7zb/Duoband/duoband_2-70_2-3.htm)).



Picture 1: 2+3 Element Dualband Yagi DK7ZB

The interesting part of the DK7ZB design is that only the 2 m radiator is directly connected via a coaxial cable to the transceiver. The 70 cm radiator is parasitically coupled to the 2 m radiator (picture 1). Therefore, for this dual-band antenna no diplexer is needed. He used a 50 Ohm RF choke made of 40 cm RG-188 (or similar) coaxial cable on a 16-20 mm PVC-tube to connect the unbalanced coaxial cable to the balanced dipole.

The design of Martin DK7ZB is using an aluminum boom (20 x 20 x 1.5 mm square) and he is using also solid aluminum tubes with a diameter of 6 mm for the elements.

Elements (6mm)	Length	Position
Reflector 2 m	1022 mm	0 mm
Reflector 70 cm	320 mm	230 mm
Radiator 2 m	939 mm	370 mm
Radiator (passive) 70 cm	323 mm	399 mm
Director 70 cm	297 mm	500 mm

Table 1: Dimensions of DK7ZB design

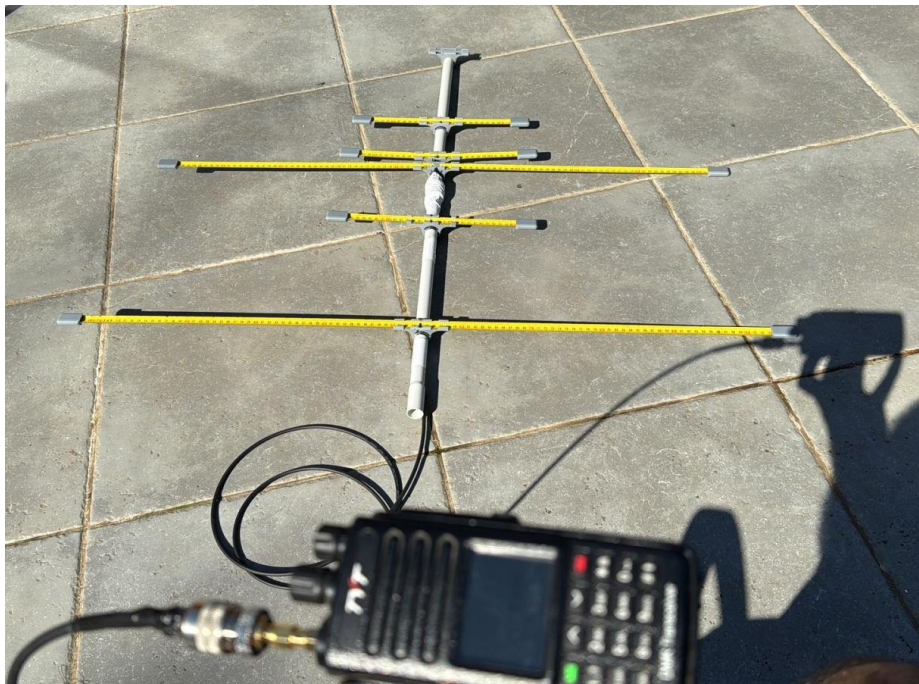
Martin DK7ZB published also electrical parameters of his antenna design.

Band	Gain	F/B	3dB-angle hor.	3dB-angle ver.
145 MHz	4,1 dBd	10 dB	70°	137°
435 MHz	6,2 dBd	12 dB	45°	108°

Table 2: Electrical parameters of the DK7ZB design

**Dual-band tape-measure yagi design F4EGM:**

In order to make this antenna more portable Jean-Philippe F4EGM not only changed the solid aluminum elements to a tape measure design but also substituted the solid aluminum boom by a plastic tube (picture 2).



Picture 2: „2+3” Element Tape-measure Dual-Band Yagi F4EGM

Jean-Philippe kindly published the dimensions of his modified design (Table 3):

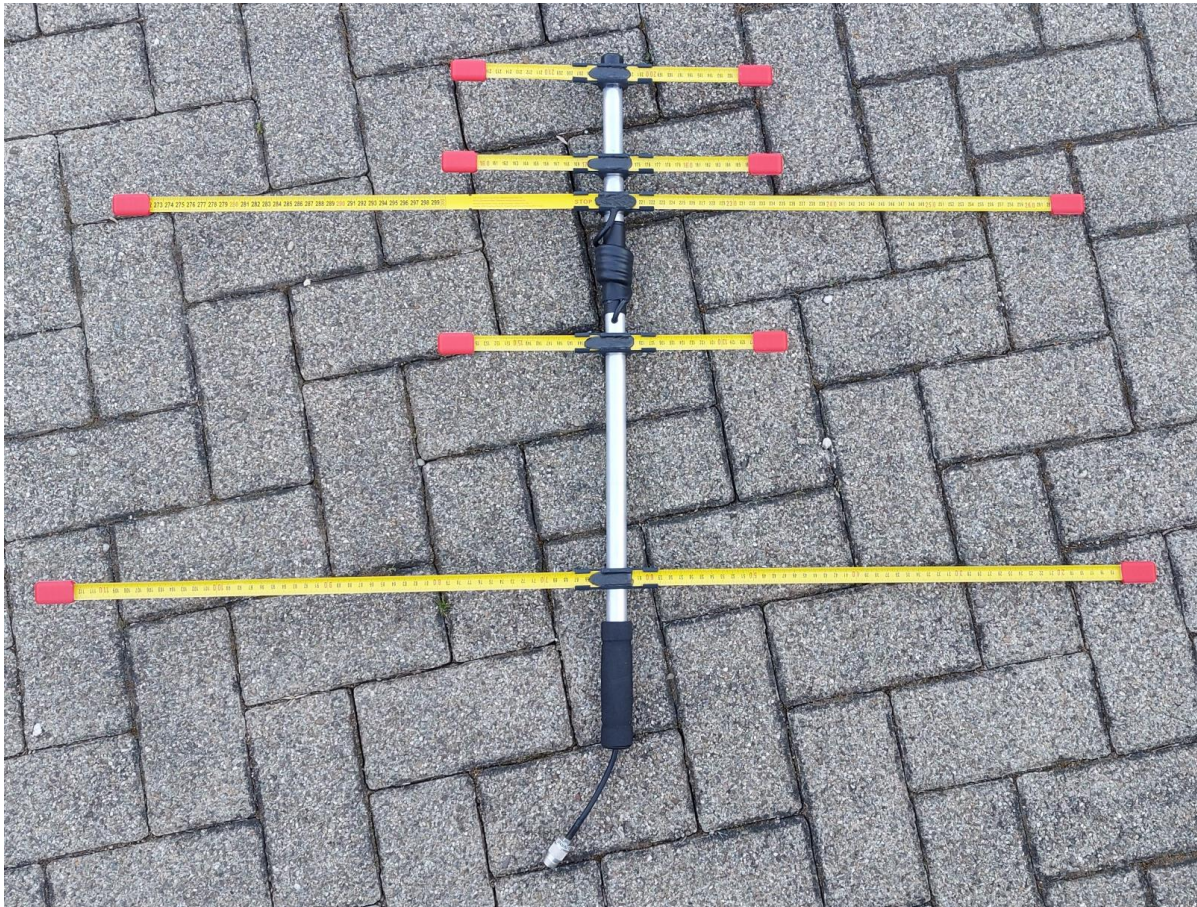
Elements (Tape meas.)	Length	Position
Reflector 2 m	1023 mm	0 mm
Reflector 70 cm	320 mm	230 mm
Radiator 2 m	946 mm (incl. 9 mm gap)	372 mm
Radiator (passive) 70 cm	322 mm	400 mm
Director 70 cm	298 mm	500 mm

Table 3: Dimensions of F4EGM design, positions measured from middle to middle of the antenna elements

For the 50 Ohm RF-Choke Jean-Phillipe made 6 turns of RG58 on the 20mm plastic boom.

### **Implementation of dual-band tape-measure yagi by DD1US:**

My design is based on the tape-measure design of Jean-Philippe but I chose to use a 20mm tubular aluminum boom as it is more rigid than the plastic tube (picture 3).



Picture 3: 2+3 Element Tape-measure Dual-Band Yagi DD1US

To mount the tape measure elements on the boom Jean-Philippe published 3D designs for the element holders (picture 4).



Picture 4-8: 3D printed element holders for radiating elements and reflectors/directors



As the tape measure is quite sharp, he also added some protective 3D printed caps which can be put over the end of the elements (picture 9).



Picture 9: Protective 3D printed end caps for the tape-measure elements

Jean-Philippe kindly agreed that you can download the design files for the 3D printed parts also on my website [www.dd1us.de](http://www.dd1us.de).

When tuning the antenna, I found that the most critical part is the distance of the parasitic 70cm radiator element from the 2m radiator element. Also, I had to change the length of the 2m radiator and 70cm radiator elements slightly (table 4).

Elements (Tape Meas.)	Length	Position
<b>Reflector 2 m</b>	1023 mm	0 mm
<b>Reflector 70 cm</b>	320 mm	230 mm
<b>Radiator 2 m</b>	946 mm (incl. 9 mm gap)	372 mm
<b>Radiator (passive) 70 cm</b>	323 mm	410 mm
<b>Director 70 cm</b>	298 mm	500 mm

Table 4: Dimensions of implementation by DD1US

I used RG223 double shielded coaxial cable for the 50 Ohm RF choke which is wound on the 20 mm aluminum tube on which I had added a 1 mm heat shrink tube before winding the coaxial cable on it. I also fixed the RF choke by adding another layer of heat shrink tube on it (picture 10). The same RG223 cable is used from the connection to the 2m radiator element via the RF choke to the N-female-connector. After the RF choke the cable is routed inside the aluminum boom and leaves it at the handle (picture 11). The solder connection of the RG232 coaxial cable to the 2m radiating element is sealed by some Spinner Plast 2000 sealant and I also fixed the other elements to the 3D printed holder with some of it.



Picture 10: Sealed RF choke



Picture 11: soft grip handle

As mentioned before the antenna needed some fine tuning, especially the distance of the 70 cm radiator from the 2 m radiator and the length of both radiators. Even an effect of the center frequency from the 3D printed endcaps can be noted.

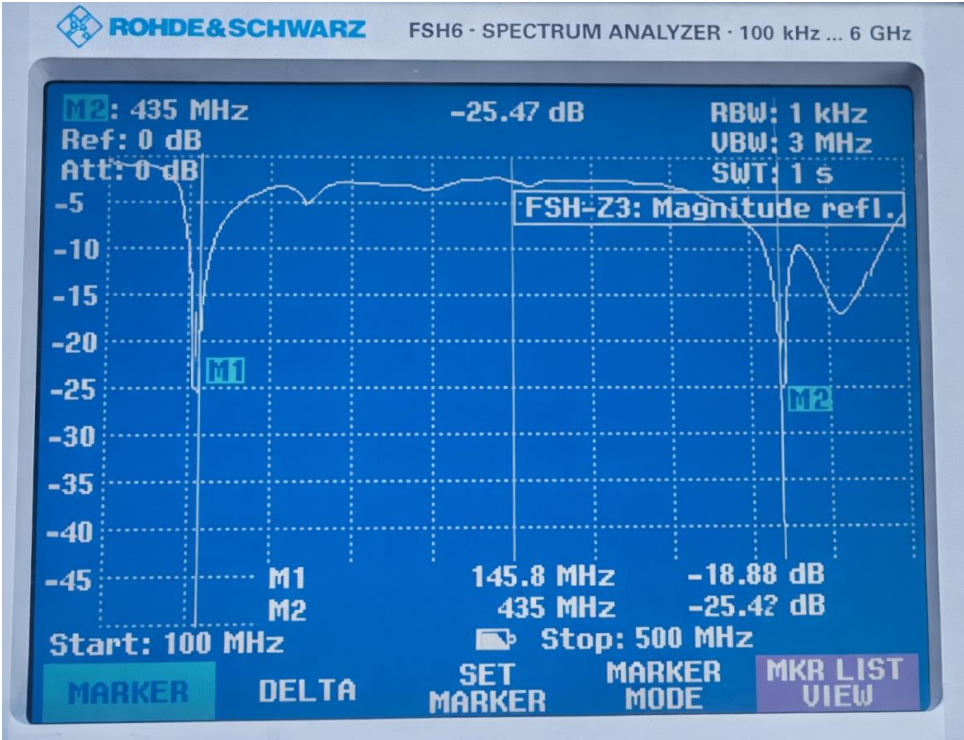
The total length of my antenna is 67 cm, its width is 105 cm (2m reflector element including end caps), its weight is 380 g.

I measured return loss and VSWR with the antenna pointed to the sky (picture 12).

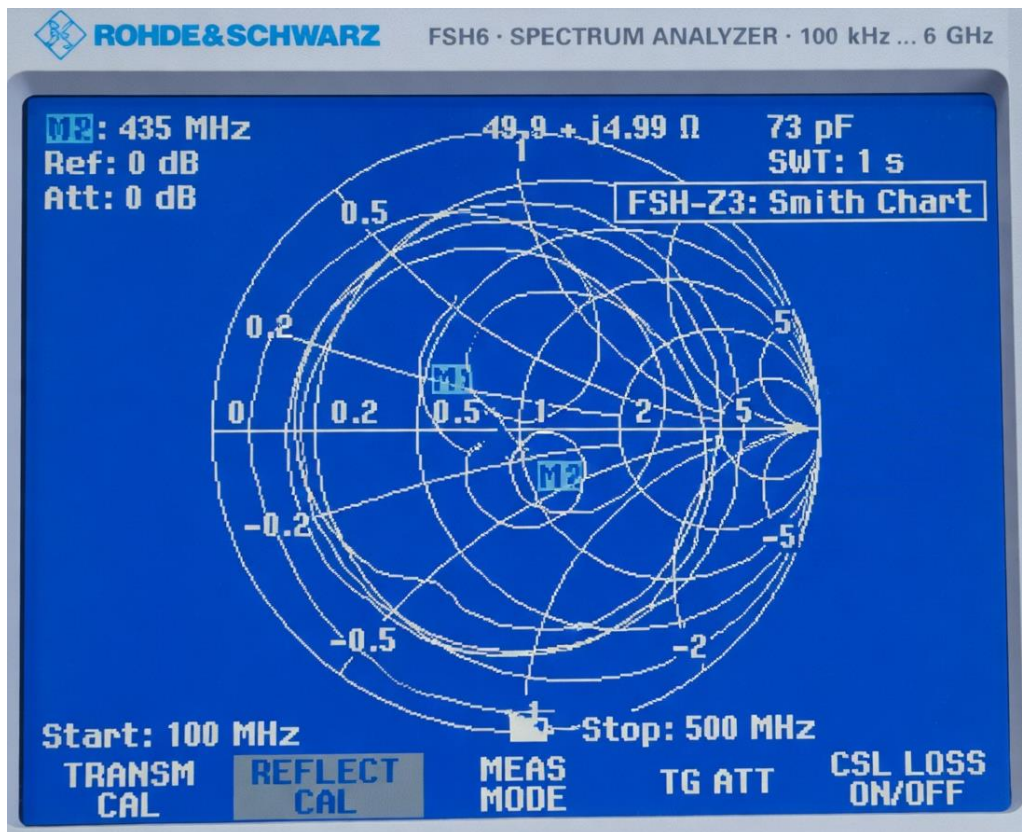


Picture 12: Antenna pointed to the sky during the measurements

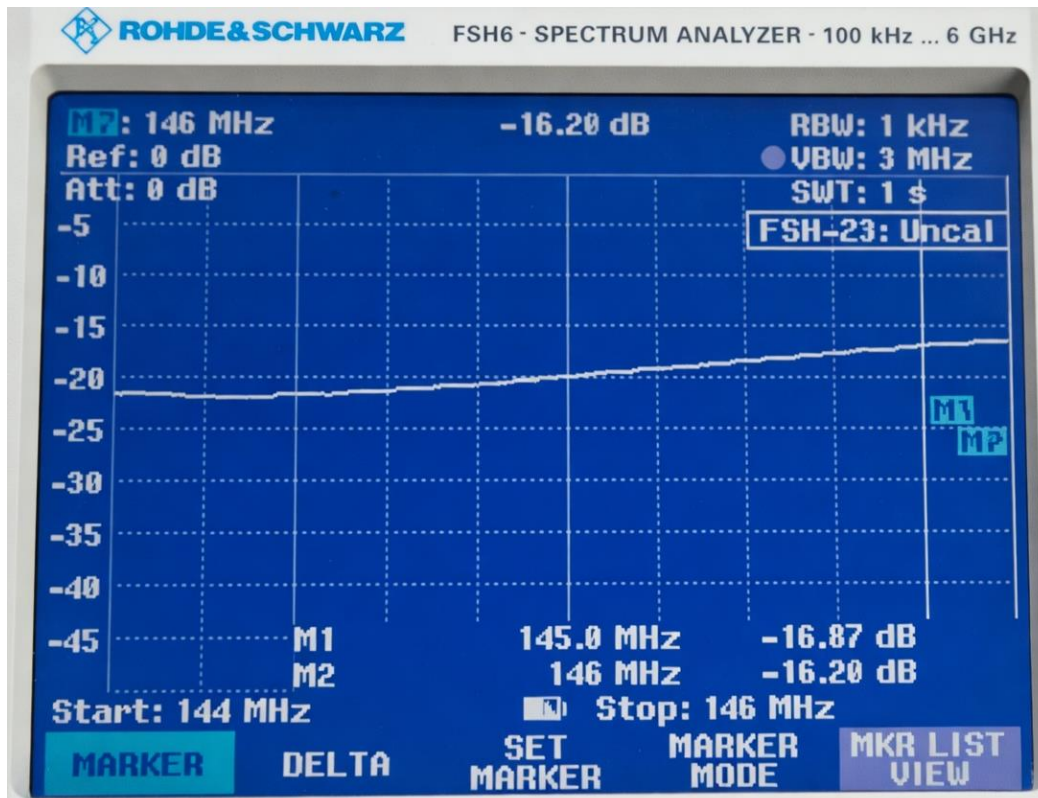
Originally the measurement screenshots were of rather poor quality because I had strong reflections of the bright sky at the network analyzer's display. However, Jean-Philippe was kind enough to clean them up using an AI software (pictures 13-18).



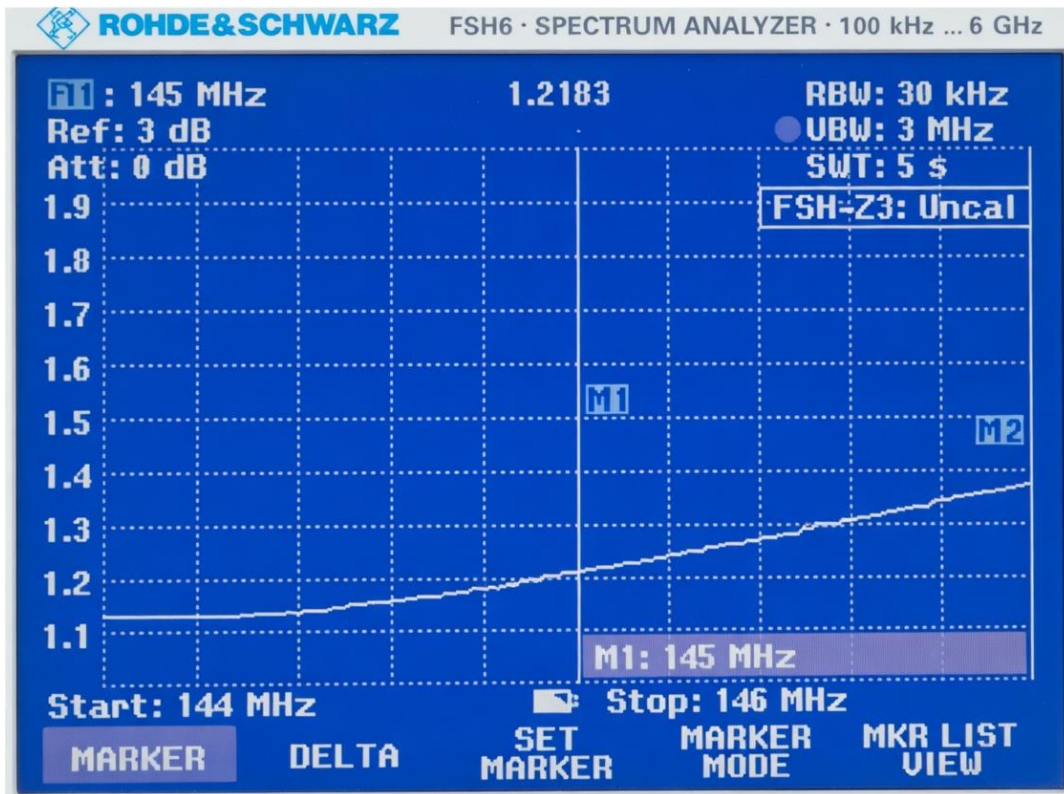
Picture 13: Wideband (100 MHz to 500 MHz) return loss measurement. Return loss at Marker 1 is -19 dB @ 145.800 MHz and at Marker 2 it is -25 dB @ 435 MHz.



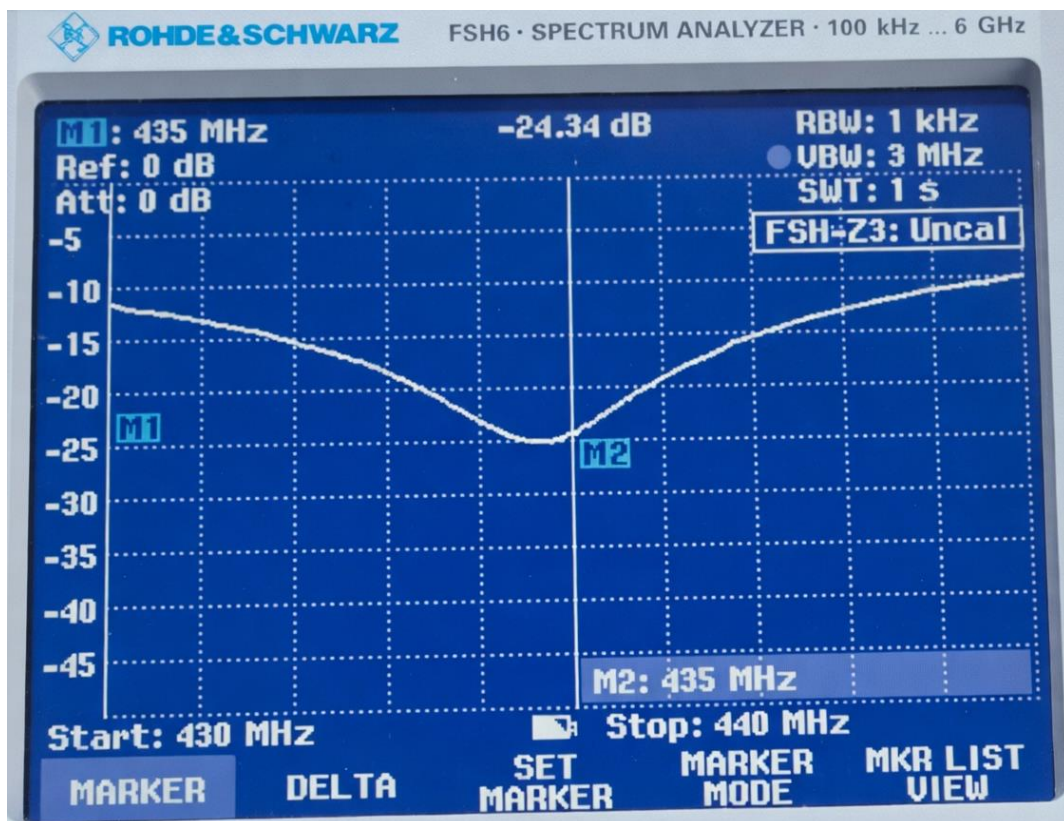
Picture 14: Smith Chart showing the impedance in the frequency range 100 MHz to 500 MHz.



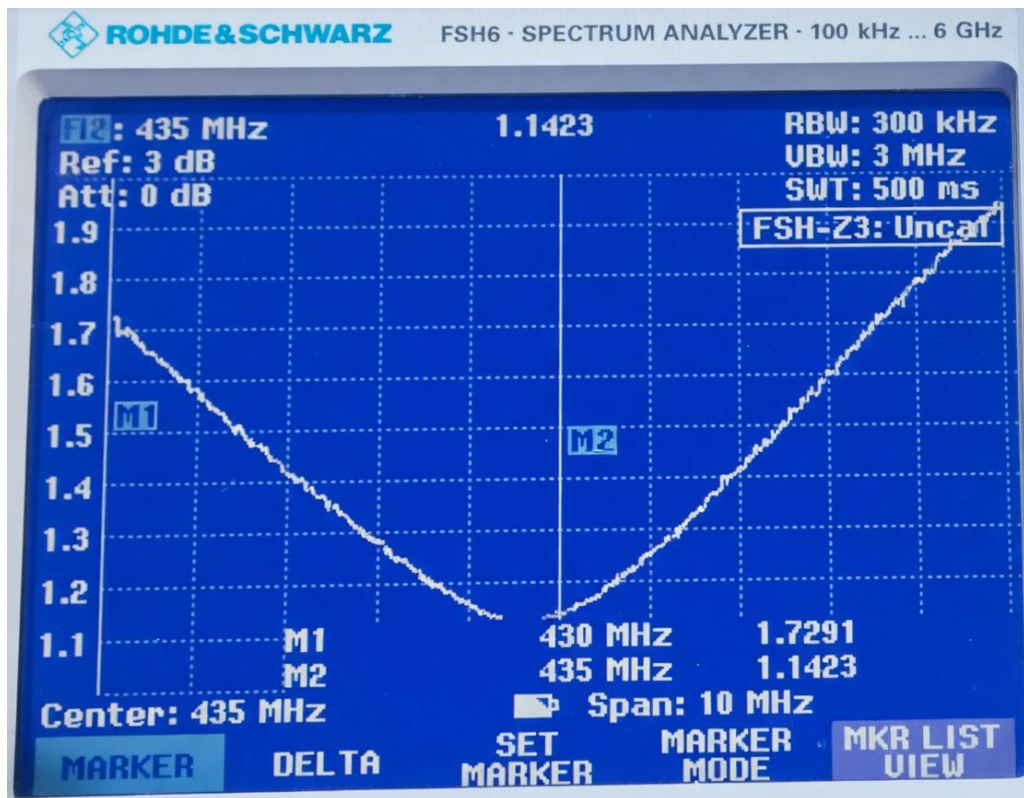
Picture 15: Minimum return loss is 16.2 dB in the 2 m band (144 to 146 MHz). I could have improved this further by slightly shortening the 2 m dipole element but I deemed it to be good enough.



Picture 16: VSWR in the 2 m band shows a VSWR in the range of 1.15 to 1.4.



Picture 17: Return loss in the 70 cm band (430 MHz to 440 MHz): -24 dB @ 435 MHz respectively -10 dB at the band edges.



Picture 18: VSWR measurement in the 70 cm band (430 MHz to 440 MHz): 1.14 in the center @435 MHz and up to 1.9 at the band edges.

When the antenna is not in use the tape measure elements can be rolled up and the antenna can be stored and transported in a rather small size without any disassembly (picture 19).



Picture 18: Antenna elements rolled up for transport and storage

Many thanks to Martin DK7ZB and Jean-Philippe F4EGM for publishing their design data as well as to Andi DL3RCG for printing the 3D parts for me.

I always appreciate feedback and will be happy to answer questions. Please send them to the Email address given below.

Best regards

Matthias

[www.dd1us.de](http://www.dd1us.de)

[matthias.bopp@dd1us.de](mailto:matthias.bopp@dd1us.de)