Duoband-Dipole for 2 m and 70 cm by DK7ZB

Let's first turn to a 2-m-dipole in free space. If it is the right length, it has a radiation resistance of 72 +/- j0 Ohm. If it is to be fed with a standard 50-Ohm-coaxial cable, a significant mismatch with an SWR of 1.44 results without further measures. If it is now mounted in front of a metal mast, the radiation resistance drops and at the same time it receives an inductive reactive component. The tube diameter of the mast also plays a certain role. At a distance of about 280mm, this results in an impedance of 60 + j 20 Ω. The dipole must first be shortened significantly. At –14.5mm on both sides, the radiation resistance becomes real again, and it reaches exactly the 50Ω that we are looking for.

The reflector effect of the mast results in a gain of 2.6 dBd with 5.5 dB back attenuation. The radiation diagram of the vertical dipole in this arrangement can be seen in ***Figure 1***. But what happens if we feed this dipole with three times the frequency of 435MHz? This can be seen in ***Fig. 2.*** With the 3/2-lambda resonance that is now available, the radiation diagram peaks and the two strongest lobes at +/- 52 ° have a gain of 2.6 dBd. Unfortunately you are radiating the HF in directions that are of little use to us. The reason for this are the two additional current maxima that occur with 2x 3/4-lambda dipoles (***Fig. 3***). The radiation resistance with 85 –j 100Ω and an SWR of 4.3 does not exactly correspond to our desired ideas.

A well-known rule has again proven its validity: If a half-wave dipole is excited at three times the frequency, the radiation resistance increases and it experiences a virtual shortening. Shortwave amateurs who want to use their 7MHz dipole at 21MHz know the problem. The resonance is well above the band and the SWR is not particularly good.

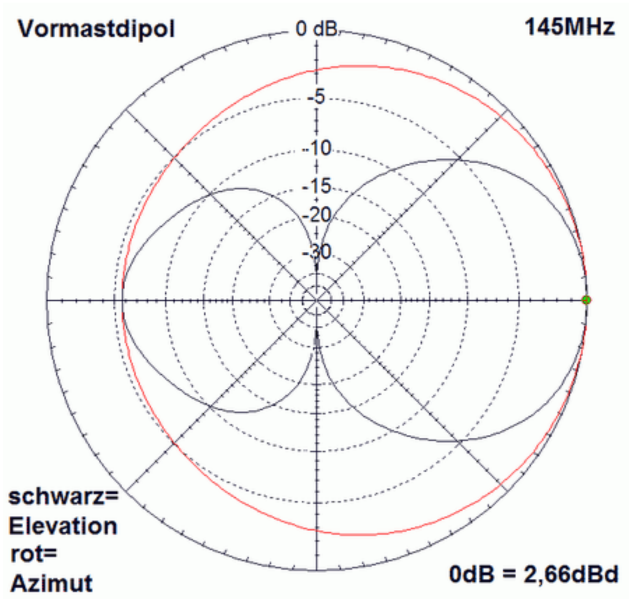


Fig. 1

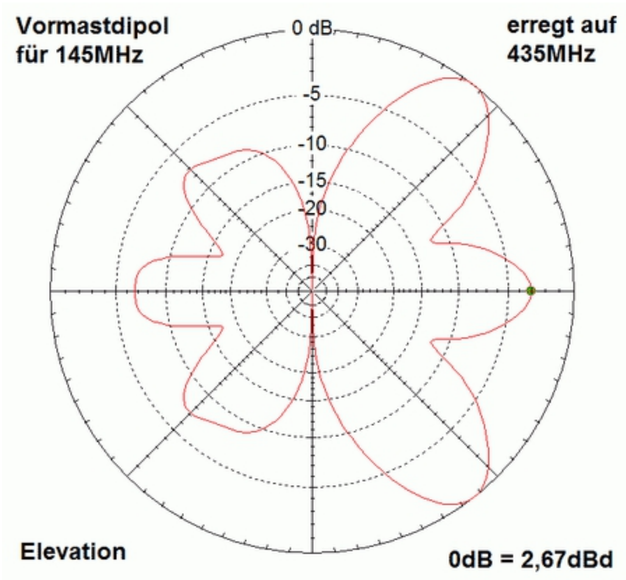


Fig. 2

But how can we solve our problem for the VHF dipole on 435MHz? Thanks to the appropriate analysis software EZNEC +6 and a PC, this can be done more quickly than experimental investigations can allow.

The trick consists in an "open-sleeve" element which is inserted passively, i.e. only radiation coupled close to the 2-m-radiator. With the correct length and correct distance to the 2m dipole, this 70cm element enables a feedpoint resistance of 50 +/- j 0 Ohm at 435 MHz. At the same time, it has the highest element current at this frequency and thus very effectively reduces the two undesired, outer lobes of the 3/2-lambda-resonance of the 2-m-dipole for the 70-cm-band (***Fig. 4***). In addition, there is a higher profit. So you have a feed point with two real 50 Ohm impedances on both bands. Element 1 is the mast, element 2 is the 2m dipole and element 3 is the additional 70cm element.

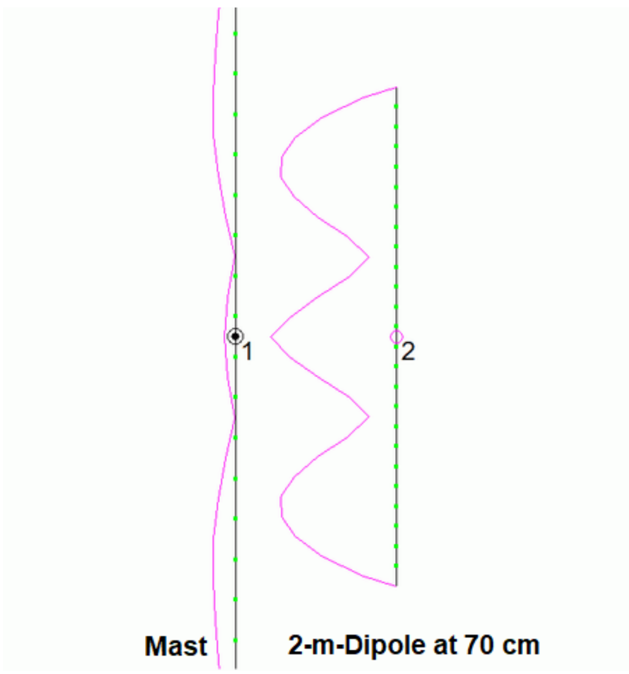


Fig. 3

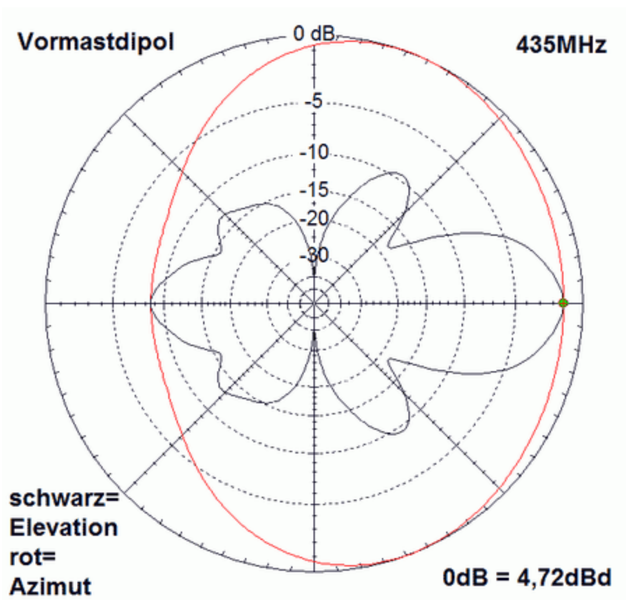


Fig. 4

The radiation diagram at 70cm is now interesting (***Fig. 5***). The red azimuth pattern represent the top view of the dipole and the black elevation pattern the side view. At 435 MHz the highest gain is 4.72 dBd at +/- 65 ° from the mast-dipole axis, in this axis it is 3.64 dBd. If you don't like this somewhat deformed diagram and if you want a little more gain, you will find a construction proposal for an extension by a 70-cm-reflector below.

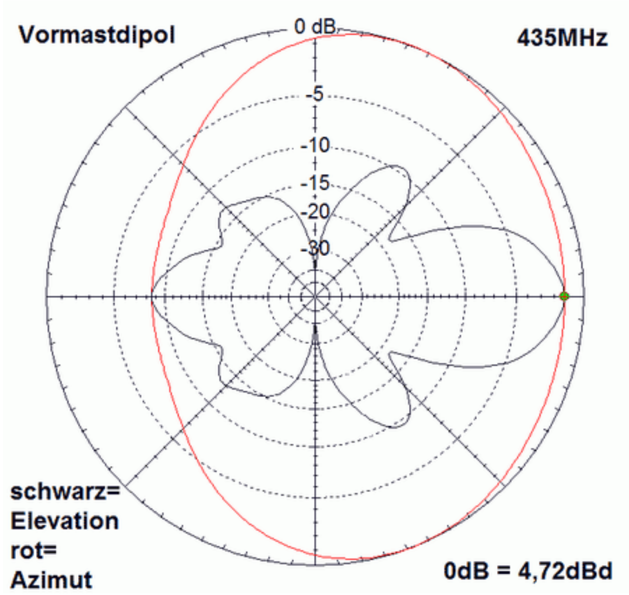


Fig. 5

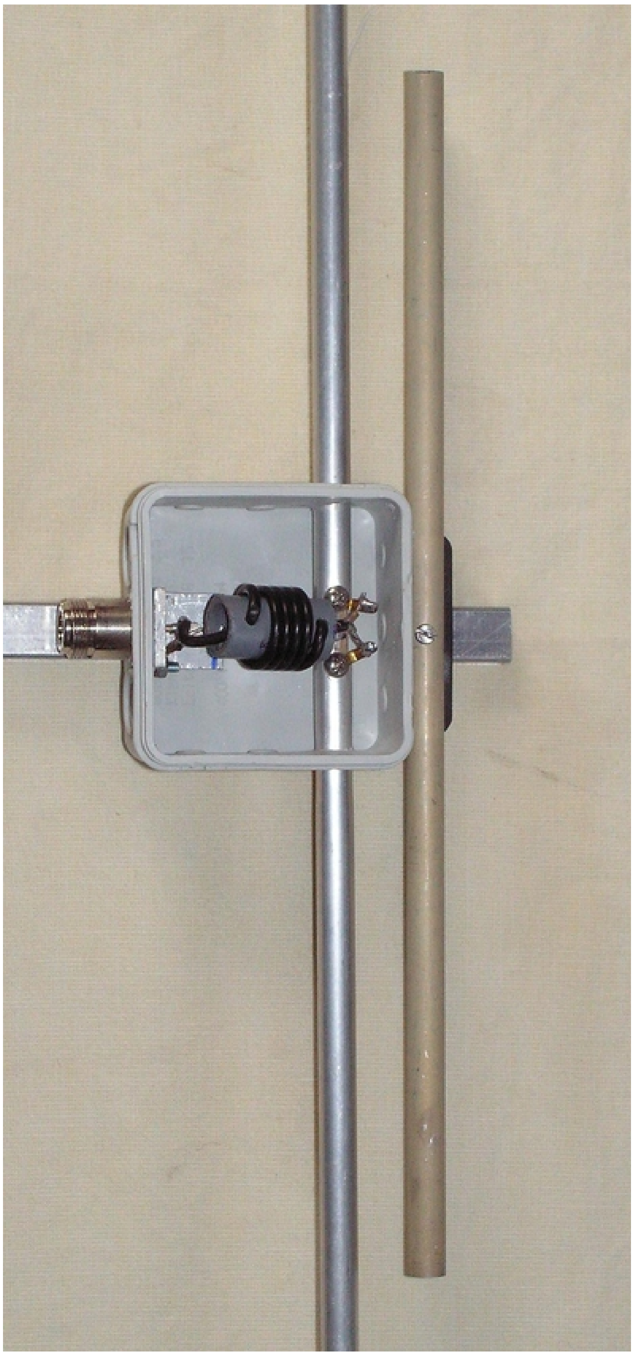


Fig. 6

The mechanical structure

No special skills and only a minimum of tools are required for this. The 2-m-dipole made of 10x1 mm aluminum tube must be interrupted in the middle. An IP 54 installation box is available for connection, in which the coaxial socket is also attached with an additional aluminum bracket. The feed choke in connection with the earthing of the socket on the boom ensure good common wave suppression (***Fig. 6***).

For the choke, 34.5 cm RG-174 cables are wound onto a 20 mm PVC pipe. This means that in FM

80 watts can be safely transferred to 2 m and 50 watts to 70 cm. If you want to use higher performance, you should use Teflon cable RG-188 (37cm). You can also use RG-58 on a 25mm tube, but it should be a good MIL version with a tight copper shield.

All elements consist of 10x1mm aluminum tube. The positions of the elements (based on their center-to-center distance from the mast) and their length are listed in Table 1.

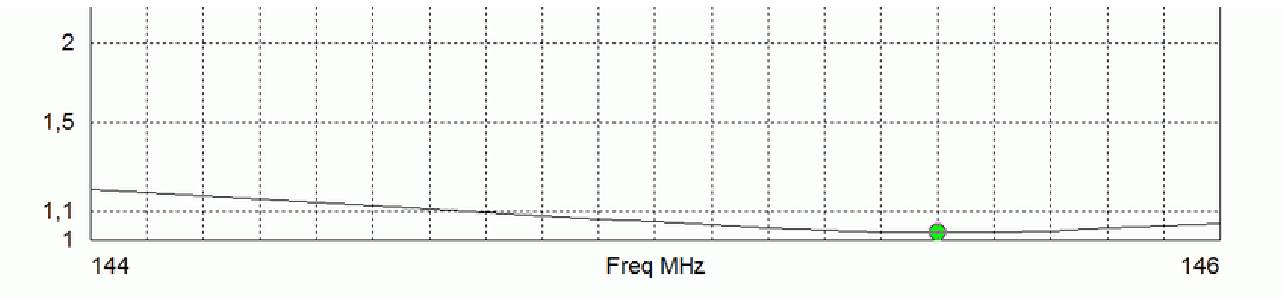
The middle section of the antenna with the mechanical details can be seen in ***Fig 6***. An aluminum square tube with a thickness of 15x15x1.5mm serves as the boom. The proportions of the fully assembled antenna can be seen in the picture on the first page.

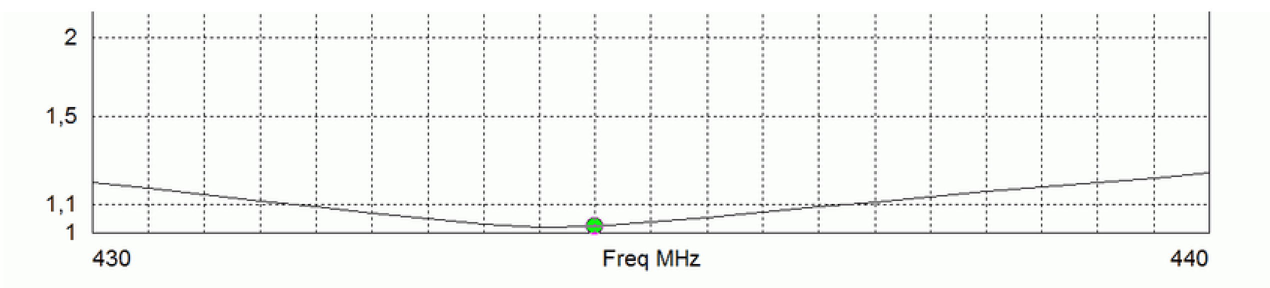
Adjustment and testing

An adjustment should be unnecessary at 2m, the sample antenna immediately had an SWR of 1.0 above 145MHz. If, contrary to expectations, the SWR is worse, changing the distance to the mast can bring an improvement.

The fastening hole for the 70cm element should not be drilled yet. The element is first provisionally attached to the polyamide holder with two strips of plastic tape. It can be easily moved and a minimum SWR can be achieved by changing the distance. Only then is the 3 mm hole drilled and the element fastened with the polyamide holder and a 3 mm stainless steel screw.

The SWR predicted by EZNEC has been fully confirmed by measurements (***Fig. 7*** and ***8***). The resonance at 2 m was placed in the upper half of the band because this is where the vertically polarized FM traffic for which the antenna is intended takes place.





Gain and directional diagram improvement

The gain can easily be increased by 2 dB. An additional 70 cm reflector is inserted for this purpose. But this has repercussions on the radiation resistance for 435MHz. For this reason, the 70 cm "open-sleeve" element has a different length and position than before. The details can be found in Table 2.

The directional diagrams for 435MHz of the antenna extended to a Yagi in ***Fig. 9*** show that a gain increase can be recorded by reducing the vertical opening angle. With this variant, too, the fine adjustment is carried out with the distance of the 70cm "open-sleeve" element. The extended antenna can be seen in Figure 12. The reflector was dimensioned so that the SWR does not change compared to the simpler antenna and also remains below 1.3 between 430 and 440MHz.

Fig. 8

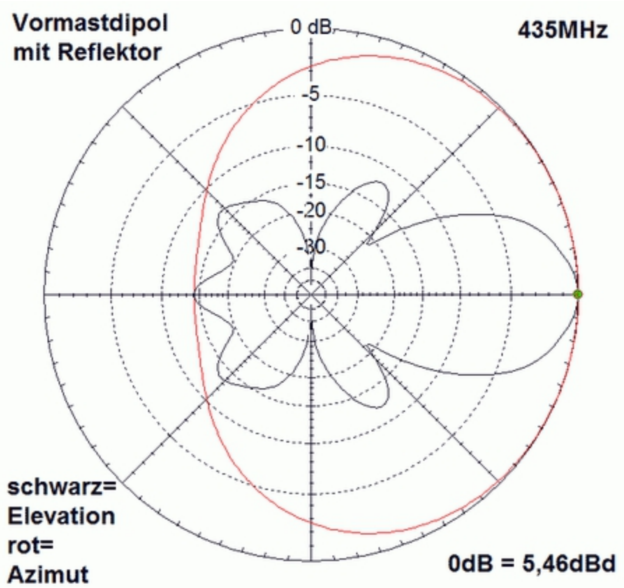


Fig. 9

For the antennas described, there is sure to be a place in the local „antenna forest“. Have fun building antennas and making QSOs!

Tabelle 1: Positions und Lengths of the 10mm-Elements (see pic. 4)

	Position	Length
2m-Dipole	280 mm	936 mm (tip to tip)
70cm-Element	307 mm	316 mm

Tabelle 2: Positions und Lengths of the 10mm-Elements with additional 70cm-Reflector

	Position	Länge
70 cm-Reflector	150 mm	324 mm
2m-Dipole	280 mm	936 mm (tip to tip)
70 cm-Element	309 mm	313 mm