The Aerial-51 Model 807-L: A Multiband Antenna for HF and 6m

Dr. Engineer WERNER HEGEWALD – DL2RD

No, this Made in Germany Antenna is not based on Alien Technology. It comes from Spiderbeam and is a 40.5 m long Current-Summation-Antenna that works all HF bands from 3.5 to 30 MHz, as well as the 6m band. The 60m band is not covered and 30m requires an antenna tuner. This article describes how it works and present its test results.

I arrived at the appello/Spiderbeam booth at the Friedrichshafen Hamfest in 2017 just as Rick Westerman, DJ0IP, one of their technical consultants, was explaining the new 807-L multi-band antenna to a customer. All HF bands from 80m to 10m, plus 6 m, with a single 40.5m-long radiator, a Standing Wave Ratio (SWR) of under 3:1, and a 500W power rating sounded interesting. The 60m band was the only band not covered; 30m requires an ATU and should not exceed 150W. This is no problem since 150W is the maximum permissible power level in Germany from 10.1 MHz to 10.15 MHz.

Fig. 1. This handy sized bundle of a hybrid balun (above), a long wire leg including an RMU Remote Matching Unit (below), and a short wire leg (top right) fits into a large pants pocket.

Photo: Red. FA

Concept

At a first glance, the antenna looks like an Off-Center-Fed Dipole (OCFD). German Old-Timers immediately recall the well-known Windom antenna that Kurt Fritzel, DJ2XH, under the name FD4, brought to the German market in the early 1970's (still available today by hofi, *www.hofi.de*).

That is incorrect. The fundamental idea behind this new antenna is based on the *Current-Summation-Antenna*, a clever concept put forth by Karl Hille, DL1VU [1].

Let's imagine a halfwave dipole for 3.5 MHz. This can also be excited on its higher harmonic bands, for instance 7 MHz, 10.5 MHz, etc.

However, the resonant frequency of the higher bands tends to wander slightly up in frequency. Further-more, the feedpoint impedance is only low on the odd harmonics, 10.5 MHz, 17.5 MHz, 24.5 MHz. On 7 MHz, 14 MHz and 28 MHz, its impedance is high.

The trick is to find a feedpoint position away from the middle of the antenna, where the impedance is nearly the same on as many bands as possible. This is the concept behind the FD4 coax-fed Windom.

This can be found simply by plotting the Sinus current flow along the 80m half wavelength dipole, by band, onto a piece of paper. Points of intersection represent feedpoint positions where the impedance is nearly equal.

Table 1: Manufacturer's Technical Data

Amateur bands	3,5 … 28 MHz except 5 MHz 50,0 … 54,0 MHz*
SWR	≤ 3,0** except on 10,1 MHz
Length	40,5 m (12 m + 28,5 m)
Weigth	500 g total
Max. Power	500 W/150 W, CW, SSB

* German 6 m band: 50,03 … 51 MHz
** $s \le 3{,}5$ on 24,9 MHz

Unfortunately, this antenna does not function on 30m nor 15m – a band highly desirable by holders of the German E-class license.

DL1VU said that finding a feedpoint position where an SWR range of less than 3:1 on all bands is good enough.

This enables us to bring in more bands: To find this position, he added the currents together of all bands to be covered, point by point, and graphically represented the resulting sum. The peaks represent points where the sum is the highest and the impedance of the individual bands, on average, is relatively low. See Fig. 5.

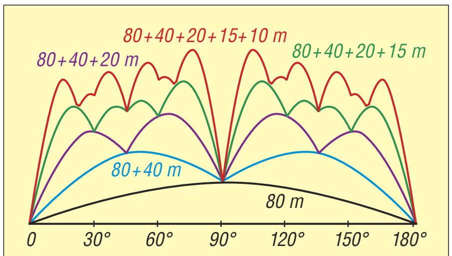

Fig. 5: The principle of the Current-Summation-Antenna; "Peaks" of the red current curve show favourable feedpoints.

This can be calculated on a PC using freeware software [2].

Rick used this principle for designing his antenna, using EZNEC modelling for the indispensable fine tuning, followed by countless field tests.

DL1VU was satisfied using balanced feedline, (i.e., Window-Line), for feeding his antenna. Using coax is much more user-friendly but requires more work in optimizing the parameters. Further, it mandated building a balun that not only matched the impedance but also was capable of im-

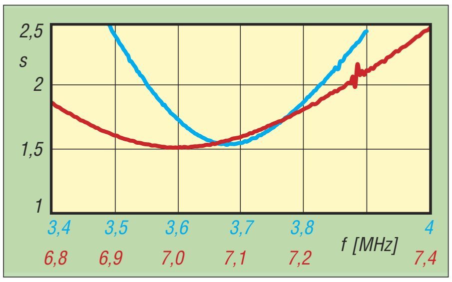

Fig. 2: SWR on 80m (blue) and 40m (red), as measured with a FA-VA II analyser.

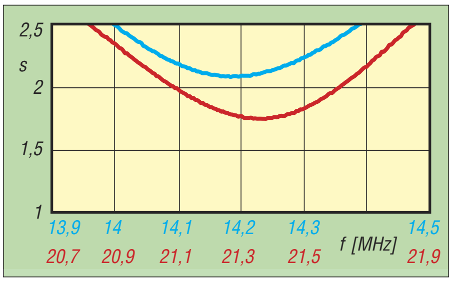

Fig. 3: SWR on 20m (blue) and 15m (red) as measured in the shack with 43m of Aircell7 Coax.

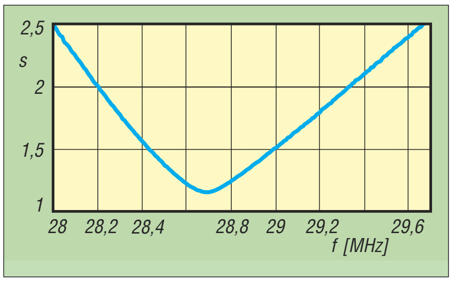

Fig. 4: SWR on 10m. This band favours the SSB mode.

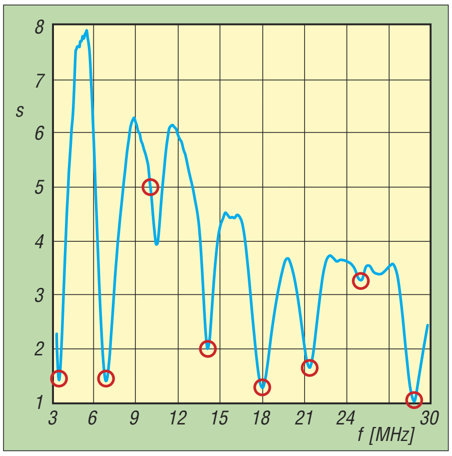

Fig. 6: Measured SWR curves from 3 MHz to 30 MHz. The amateur bands are marked.

peding the high amount of common-mode-current associated with this type of antenna.

When covering 3.5 MHz to 54 MHz, the 80m band is especially critical. The result was a Hybrid-Balun, that is, a combination of Guanella- and Ruthroff-Balun.

Praxis

The handy bundle of wire in picture #1 weighs about 500 grams, whereby the major contributor is the balun. The RMU – Remote Matching Unit – is used on the lowest band to establish resonance. It determines if the antenna is resonant in the CW or SSB portion of the band. User preference should be considered when ordering the antenna.

The recommended configuration is a slightly inclined, drooping Inverted-V, and Rick's advice, Height = Might, should be taken to heart.

Table 2: Measured SWR is in blue and Gain simulated over real earth

f [MHz]	*SWV** *s*	G_{ges} [dBi]	G_{DX} [dBi]
3,68	1,5	4,72	0,44 @ 30°
7,06	1,6	4,72	1,64 @ 22°
10,125	5,2	6,14	3,51 @ 17°
14,2	2,1	5,69	3,02 @ 11°
18,07	1,4	6,88	4,35 @ 9°
21,3	1,7	7,44	5,26 @ 8°
24,89	3,2	7,54	4,31 @ 6°
28,5	1,1	7,85	4,70 @ 5°
50,15	2,5	8,93	5,84 @ 3°

* Measured with 43 m Aircell 7 on FA-VA II

I limited my height to 12.5m at the feedpoint. I used a 15m long fiberglass telescoping pole from vdl-fiberglas.de without pulling the top segment out (See picture on page 304).

A stable 12.5m fiberglass pole with its top two segments unused supports the end of the short arm of the antenna, whereas the long arm is extended with a guy rope to an evergreen tree, such that it can sway freely in the wind.

If one follows the installation directions in the user manual and assures a relatively free placement of the antenna, (s)he can simply hang the antenna and forget about it. There is nothing to adjust. Changes to the length of this pre-optimized antenna *should not be attempted*.

SWR measurements made with a FUNKAMATEUR FA-VA II analyzer can be seen in pictures 2 to 4 and 6.

On 18 MHz the SWR was below 1.4:1 across the band, and on the 24 MHz band slightly above 3:1.

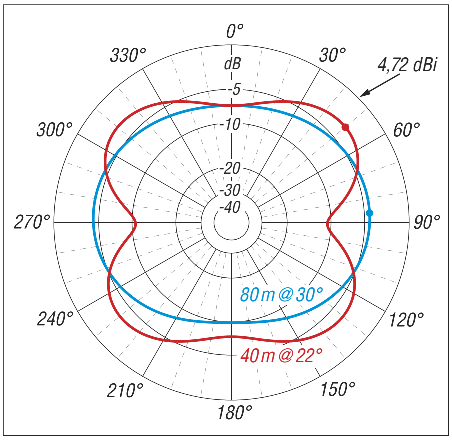

Fig. 7: Simulated horizontal radiation diagram for 80m and 40m over real ground.

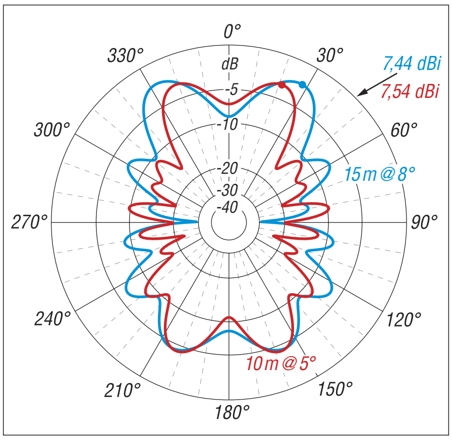

Fig. 9: Simulated horizontal radiation pattern over real ground, for 15m and 10m.

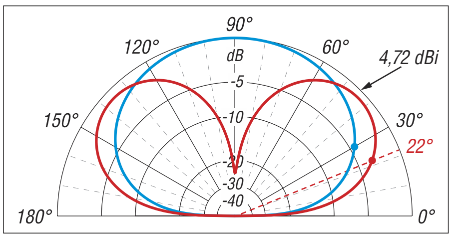

Fig. 8: Simulated vertical radiation diagram for 80m and 40m over real ground.

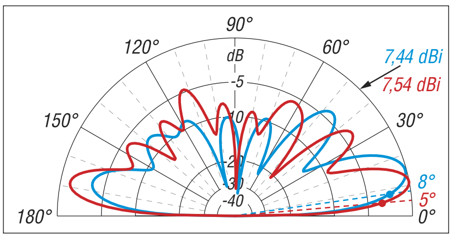

Fig. 10: Simulated horizontal radiation pattern over real ground, for 15m and 10m.

The old saying that an SWR of 3:1 is only 1.25 dB loss due to the mismatch doesn't help much because today's typical transceiver somewhere between 1.7:1 and 2:1 begins to fold back its power. If the transceiver has a built-in ATU, operations on all bands is no problem. At the same time, this enables operation on the 30m band. This proved to be very useful for me in FT8 operation, because the 807-L covers a different direction than my Loop antenna.

Simulation Results

An EZNEC simulation over real ground (i.e., $\varepsilon_r = 13$, $s = 5$ mS/m), based upon the optimum take-off angle for DX, which was determined by DL3AO [3], is very informative. Figures 9 and 10 show these results.

While the major radiation lobes of the from North to South strung 80m antenna are off its sides (i.e., East/West), on the higher harmonic bands they split into several minor lobes, with the main radiation tending to be towards the end of the long arm of the antenna (here, North).

In addition, it looks like there are deep nulls in the horizontal radiation diagram – which is typical for harmonic-excited wire antennas. The lobe splitting is also seen in the vertical radiation pattern.

For working DX with low band antennas at this low height, the higher vertical radiation angle produces slightly less than maximum gain, but the impact is acceptable.

For working DX with low band antennas at this low height, the higher vertical radiation angle produces slightly less than maximum gain, the impact is acceptable.

Summary

I was enthused by this antenna from the very beginning. It is hardly noticeable in the yard and has proven its DX-ability in countless Pile-Ups – even on 80m and 40m.

Multiband operations from 80m to 6m is trouble-free, especially in conjunction with the built-in ATU in modern TRX.

If someone only has 20.3 meters of space for an antenna, (s)he can simply remove the RMU and its trailing 20m of wire, and still have 40m through 6m coverage; I did not test this feature.

The Aerial-51 Model 807-L is a lot of antenna for just 199 Euro.

The 807-L is available from Spiderbeam GmbH: *www.Spiderbeam.com*

A sturdier, Heavy Duty version (807-HD) is also available for the same price but is slightly longer (40.7m) and about 200 grams heavier. See also the market pages in FUNKAMATEUR magazine 8/2017 and 3/2018.

Finally, a thank you to Rick, DJ0IP, for the loan of the antenna and countless productive discussions.

Literature and Sources

[1] Hille, K., DL1VU: Windom- und Stromsummenantennen. FUNKAMATEUR-Bibliothek Band 15, Theuberger, Berlin 2000, FA-Lerservice: *X-9141*

[2] Warsow, K., DG0KW: Stromsummen-Antennen-Berechnung. *www.dl0hst.de/stromsummenantennenberechnung.htm*

[3] Schick, R., DL3AO: Der verflixte flache Abstrahlwinkel. FUNKAMATEUR 58 (2009) H. 1, S. 30–34

More infos can be found in the FA-Download area: *http://www.funkamateur.de/downloads.html*

