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Spiderbeam Aerial-51 Model 404-UL

A lightweight 20m long off centre fed dipole

INTRODUCTION. Portable and holiday-type HF operation seems to be gaining in popularity. This may be helped by the appearance of lightweight radios like the Yaesu FT-817 and latterly the Elecraft KX3. And if QRP isn't your scene, transceivers like the Icom IC-706 or Kenwood TS-480 can give you 100W all-band performance in a transportable package. The only problem is that you still need an antenna to use when you get to your dream island location.

Rick, DJ0IP at Germany's Spiderbeam, with its Aerial-51 brand, has come up with a possible solution with its lightweight 20m long Off Centre Fed Dipole (OFCD). I think Aerial-51 is a pun on the infamous top secret air base in the USA – think about it!

CONSTRUCTION. Weighing 400g (including balun and 12m of RG174-50 low-loss coax), the Aerial-51 Model 404-UL is an ultra-lightweight, asymmetrical dipole operating on seven or eight shortwave bands, namely 40m, 20m, 17m, 15m, 12m, 10m and 6m with an SWR of less than 4:1. It will also operate on 30m at less than 6:1. Spiderbeam says the supplied coax offers lower losses than the more common RG-174U, with a worst-case scenario on 28MHz of -1.61dB and -2.17dB on 50MHz.

You should aim to use an ATU on at least 30m, 17m and 12m, and one may also be useful on the other bands to bring the match right down to 1:1.

The OCFD is rated for a maximum 200W power, apart from 30m where power should be restricted to 50W to avoid overheating the balun.

The antenna is designed to be strung in an inverted-V style using a single support, such as a telescoping fibreglass fishing pole. Spiderbeam sells these in 12, 18 and 26m variants, although the latter two cannot really be classed as being suitable for suitcase-type operations.

All the hardware used is stainless steel and the antenna wire is made from CQ-534 insulated 1mm OD multi-strand copper-clad steel wire, which has very low wind load and weighs only 31g, yet has a breaking strength of 10kg.

The lightweight 4:1 'Guanella' current balun matching unit uses two matched toroidal transformers potted in epoxy for rigidity and weather protection. The balun also provides choking resistance to suppress common mode currents. The balun has a stainless steel eye to help with mounting.

The design is a classic off centre fed dipole with two legs – I measured this as one 8.4m long and the other leg 12.2m, making a total of 20.6m. Both dipole ends finish in small plastic toggles to which supplied heavy-duty monofilament fishing line is attached. This can easily be removed if you want to attach your own supporting cord.

The balun uses two matched toroidal transformers potted in epoxy.

ANTENNA MODELLING. An OCFD is usually fed at the one third/two thirds point where the impedance is close to 200 or 300Ω on a number of bands, depending on the antenna's height above ground.

SWR readings at end of supplied coax:

7.000MHz	2.1:1
7.100MHz	2.2:1
7.200MHz	2.4:1
10.100MHz	6.6:1
14.000MHz	2.4:1
14.175MHz	2.2:1
14.350MHz	2.0:1
18.068MHz	3.6:1
18.168MHz	3.6:1
21.000MHz	2.4:1
21.225MHz	2.3:1
21.450MHz	2.4:1
24.900MHz	4.1:1
28.000MHz	1.2:1
29.000MHz	2.0:1
29.700MHz	2.6:1
50.000MHz	2.3:1
52.000MHz	2.6:1

When fed with a 4:1 or 6:1 impedance transformation balun the match is then brought closer to 50Ω. This way, an antenna cut as a half wave dipole for 40m can usually be persuaded to work on at least 20m and 10m as well.

This dipole is fed at the 59%/41% point, rather than the more conventional one third/two thirds. The reason for this I think is simple. Modelling the antenna in *MMANA-GAL* show that when erected as an inverted V the 59%/41% feedpoint is better for giving a reasonably low impedance match on all of the bands it is designed for. If it had been fed at the 66.6%/33.3% point I doubt you would get such a good match on 17m and 15m.

My *MMANA-GAL* model shows the antenna should offer a reasonable match on 40, 20, 15 and 10m, with a poorer match on 12 and 17m, after adjusting the lengths of the modelled wires to allow for the estimated velocity factor of the PVC-coated wire.

The antenna model shows the antenna tends to be a bit of a cloud-warmer on 40m with largely Near Vertical Incidence Skywave (NVIS) radiation when mounted as an inverted V with the apex at about 8m. This is ideal for close-in contacts rather than DX. On the higher bands the pattern breaks up into a multi-lobe shape offering both high and low-angle radiation. If you want to work DX the higher you can mount the antenna and its ends the better.

This is where Spiderbeam's 12m pole comes into its own.

TESTS. Once I put the the antenna up at eight metres I did some SWR tests at the end of the supplied 12m of coax and the results are in the table. These were in line with the manufacturer's claims, although the 10MHz figure was slightly higher. No doubt mounting the antenna a little higher and/or supporting the ends a little higher too would bring this within the specification.

The wire used is so thin that it is almost invisible. If mounting this permanently I would consider using springs or bungies on the ends to remove some of the strain due to wind.

The antenna itself performed very well and was a good competitor to the half wave dipoles it was tested against. Signals were usually absolutely equal to those on a 40m centre-fed dipole, which is to be expected.

On the higher bands it was a little more of a lottery depending upon whether the station you were working was on one of the antenna's radiation lobes or not. Signals were either equal to the dipole or up or down a little, but this is due to be expected due to the more complex radiation pattern of the OCFD as it is longer than a half wave at these frequencies.

When mounted away from the house, and with a choke balun at the bottom of the feeder, it was a quiet antenna too.

The 404-UL OCFD fulfils its design objective of being a lightweight multi-band HF antenna.

CONCLUSION. Overall then, I thought the antenna was well built, lightweight with a lot of attention being paid to the quality of the materials and the balun. Feeding the antenna at a slightly different point has resulted in a better match across a lot of bands, although I would still recommend using an ATU where possible. An internal ATU would probably have no problems matching the antenna fully on its designed bands, with perhaps only 10MHz being a little more problematic on some makes of radio.

The 404-UL OCFD fulfils its design objective of being a lightweight multi-band HF antenna, suitable for taking on DXpeditions and holidays. I can't help thinking it would make a good low-profile permanent antenna too.

Our thanks to Rick, DJ0IP at Aerial-51 for the loan of the antenna, which costs €99 plus postage. The antenna is also available from UK distributors Nevada and LAM Communications. You can find out more at www.aerial-51.com.

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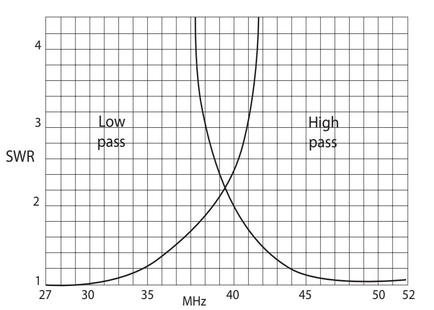

FIGURE 2: Frequency response of the diplexer high pass and low pass sections.

PHOTO 4: The completed diplexer. Input on the left, high pass output at the top of the photo and low pass at the bottom. Note the solder tags that connect the copper board to the bolts that secure the three SO-239 sockets.

PHOTO 5: The diplexer attached to the 10m and 6m quads via quarter wave stubs. The connections were liberally waterproofed with self-amalgamating tape.

TESTING. On completion, a 50Ω dummy load was attached to the low pass and high pass outputs in turn and the graph of Figure 2 was derived using my MFJ analyser, showing frequency versus SWR.

Finally, to measure power loss across the diplexer, a 50Ω dummy load was attached to the transmitter and it was adjusted to a steady 20W at 28.5MHz. Without changing the power output, the diplexer was inserted and both outputs were terminated in 50Ω. The same power meter now showed 18W at the low pass terminal. Repeating using 20W at 50.2MHz, 17W was measured at the high pass terminal. This represents a loss of less than 0.5dB at 28.5MHz and about 0.75dB at 50.2MHz.

IN USE. I waterproofed the box and its connections, then attached it to the two band quad, as shown in Photo 5. It resulted in an SWR of better than 1.3:1 at 28 – 28.5MHz and at 50 – 50.3MHz.

CONCLUSION. Clearly the diplexer could be used equally well to feed 10m and 6m Yagis designed for 50Ω feed without the need for matching sections. 10m and 4m quads would also be a possibility, but perhaps it would be sensible to move the diplexer centre frequency up a bit, maybe to 40-50MHz or so. Similar techniques could be used on other well-spaced frequencies.

WEBSEARCH

[1] How to design diplexers, N6RK.com