A Duo-Band 6m-2m Antenna

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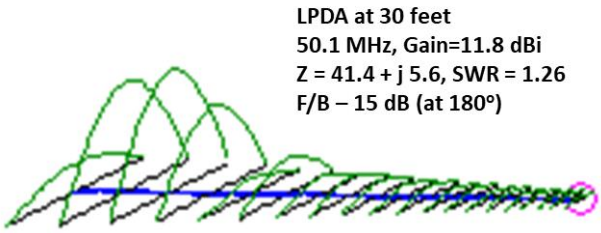
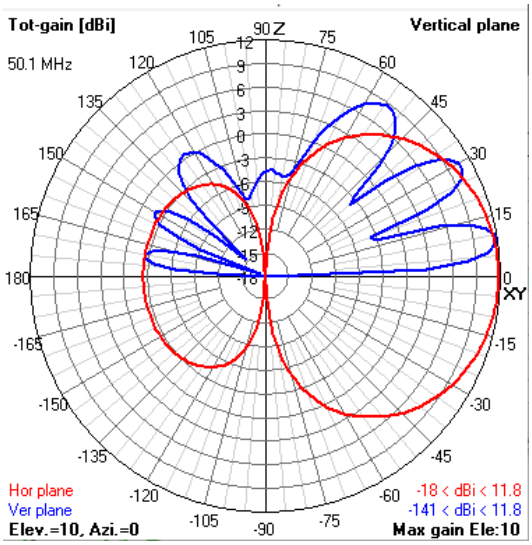
This month's column is another one about antennas. They are important, as they are the interface between our rig and the ionosphere. Hopefully this column will give others ideas on how to address a duo-band antenna for 6m and 2m.

It all started with a discussion with a local ham here in Ft. Wayne. He wanted to expand his VHF capabilities with gain antennas for 6m and 2m. One restriction he put on the design was to have only one coax to feed a duo-band design.

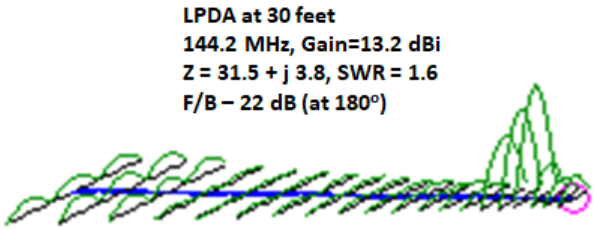
LPDA Design

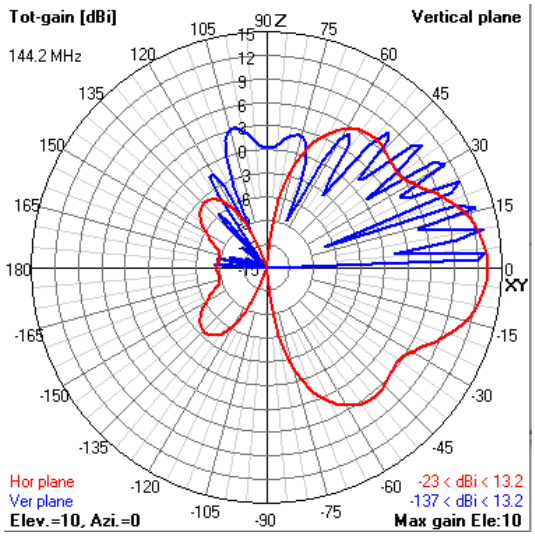
The first design we looked at was a log periodic dipole array (LPDA for short) that covered 50 MHz through 150 MHz [note 1]. The design used 20 elements on a 7-foot boom. Here are the magnitudes of the currents on each of the twenty elements, and the azimuth (red) and elevation (blue) patterns at 50.1 MHz when the antenna is mounted at 30 feet over average ground (σ = .005 S/m, $\mathcal{E}r$ = 13).





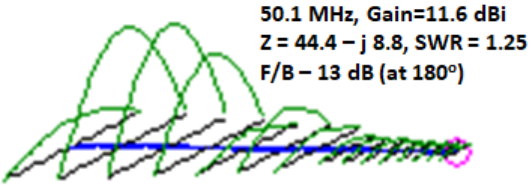
The gain on 6m is 11.8 dBi, which translates to about 5 dB over a 6m dipole at the same height. Note that the active region of this LPDA at 50.1 MHz (based on the currents) is for all intents and purposes element 1 (the longest element) through element 7. Now let's look at this design at 144.2 MHz.

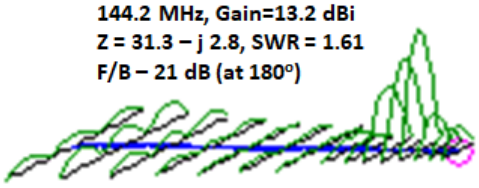


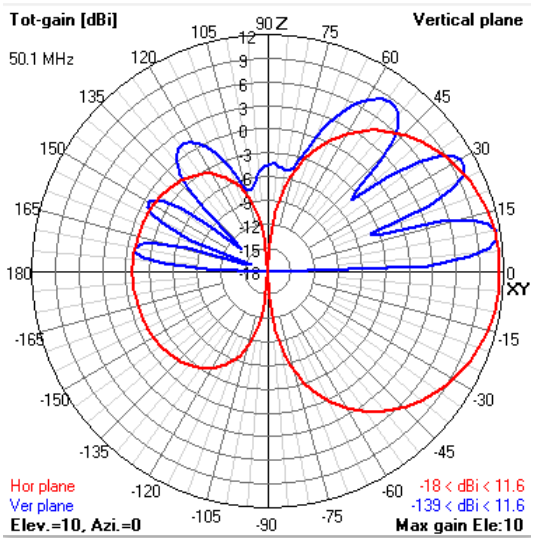


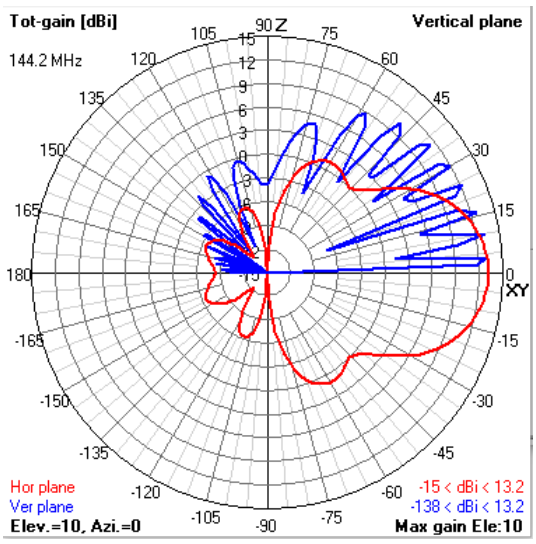
The gain on 2m is 13.2 dBi, which translates to about 6 dB over a 6m dipole at the same height. Note that the active region of this LPDA at 144.2 MHz (based on the currents) is for all intents and purposes element 13 through element 20 (the shortest element).

The two active regions tell us that the middle elements (8 through 12) are not doing anything for 6m and 2m operation – they're just taking up space on the boom. So why not get rid of them and shorten the boom? Here are the magnitudes of the currents on the new shorter-boom LPDA (the boom is now 5.3 feet) on 6m and 2m, and the azimuth and elevation patterns on 6m and 2m.









Here's a tabular summary of performance of the original LPDA design compared to the shortened-boom LPDA design.

config	freq MHz	gain dBi	Z ohms	SWR	F/B dB
original LPDA	50.1	11.8	41.4 + j 5.62	1.25	15
shortened-boom LPDA	50.1	11.6	44.4 - j 8.8	1.25	13
original LPDA	144.2	13.2	31.5 + j 3.8	1.6	22
shortened-boom LPDA	144.2	13.2	31.3 + j 2.8	1.61	21

Although there are details to work out, this cursory investigation suggests that the shortened-boom LPDA is a feasible solution for a duo-band 6m and 2m antenna with one coax feed.

Coupled-Resonator Design

We next looked at a coupled-resonator design. In this design, a 6m dipole is fed, and a 2m dipole is placed very close to the 6m dipole (but not connected to the feed coax) so that two resonances occur – one in the 6m band and one in the 2m band [note 2].

Using 4nec2 (from Arie Voors), the driven element for 6m is 110.544 inches long (split in the middle to feed it) using a 0.125 inch radius tube. The element for 2m is 39.79584 inches long (not split in the middle) using a 0.125 inch radius tube. The spacing between the two elements is 0.6 inches center-to-center.

The SWR at 50.1 MHz is 1.45:1 when these two elements are 30 feet above average ground. The SWR at 144.2 MHz is 1.68:1.

The next step would be to add a parasitic reflector and parasitic directors for each band. To maintain impedances on 6m and 2m near 50 ohms, the design of each Yagi needs to result in a feed impedance of 50 ohms – and not the usual lower impedances typical of many Yagis.

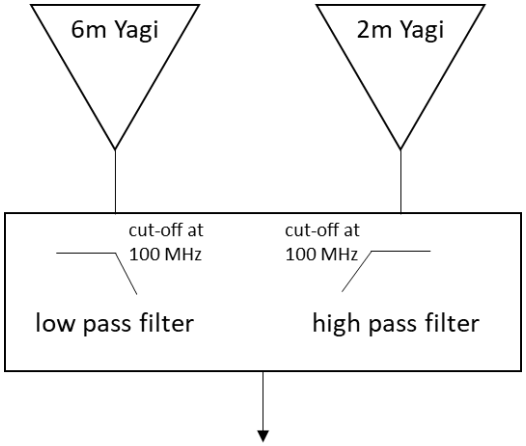
This is as far as we carried this approach. It appears to be a feasible solution for a duo-band 6m and 2m antenna with one coax feed.

Two Yagis on the Same Boom

It would be simple to implement a Yagi for 6m and a Yagi for 2m on the same boom. The issue is how do you just use one coax to feed both antennas?

One way would be to use a remote switch at the antenna to select the band.

Another way would be to use properly-designed filters per the following sketch.



In addition to the basic low-pass and high-pass functions, each filter must present a high impedance to the other frequency [note 3].

So here is yet another feasible solution for a duo-band 6m and 2m antenna with one coax feed.

Interlaced Quad

Knowing that tri-band quads (20m, 15m and 10m) can be fed with one coax, can this be done with a 2m quad inside a 6m quad? It's something we didn't look at in detail, but experience at HF says it seems to work if the two feed points can be located close to each other (by bringing the feed point of the lower horizontal wires of the lower-frequency quad up to the feed point of the lower horizontal wires of the higher-frequency quad).

An analysis of a 17m and 12m quad and how to feed it with one coax is discussed in the article "A 2 Element Quad for 17 and 12 Meters Using a Combined Feed" by Cebik W4RNL (SK) and Cerreto WA1FXT in **The ARRL Antenna Compendium Volume 8**. Techniques used in this article may be applicable to a 6m/2m quad.

Of course a remote antenna switch or filters would work here, too.

Summary

I've covered four ways to make a duo-band 6m/2m antenna with one coax feed. There are probably more ways to do this. I'd love to hear about them – you can e-mail me at k9la@arrl.net.

Notes

1) The design uses a single boom, with crossed transmission lines between each element. The other way to feed an LPDA is to use two booms and alternate the element halves on the two booms. This latter method is how my Tennadyne T6 LPDA (14-30 MHz) is fed.

2) This technique is used in several commercial antenna designs.

3) See "SO2R With A Single Tri-Bander" by Luetzelschwab, K9LA, in the September/October 2009 issue of **NCJ** (the National Contest Journal).