A 6el 21MHz OWA Yagi for All Locations

Justin Johnson, G0KSC

One of two G0KSC 6el 21MHZ OWAs at 9A3OS

Within this article we will look at and discuss a 6-element 21MHz OWA style Yagi. It is often the case that within articles such as this, basic wire or verticals are considered and described. Perhaps even the odd basic Yagi antenna too but this time I wanted to design an antenna that would not just give excellent 'on air' performance, but one that would be able to stand up to extreme weather conditions should it be installed within a harsh location, but also one that could be packed into a small space should the antenna be built for the purpose of field day or portable operation.

Other design considerations (in addition to the mechanical design to allow for excellent wind loading capabilities) include that of available materials within North America and the associated (escalating) costs involved in purchasing such parts. With this in mind, the elements themselves are arranged with a multi-taper configuration; 5'6'' sections to allow for the commonly available 6' tubes to be used with 6'' inserted into the next longest tube. Likewise I have made the same considerations for the boom with a boom taper for maximum wind handling and ice handling ability too.

Performance figures at 21.150MHz

Free Space Gain: 11.69dBi

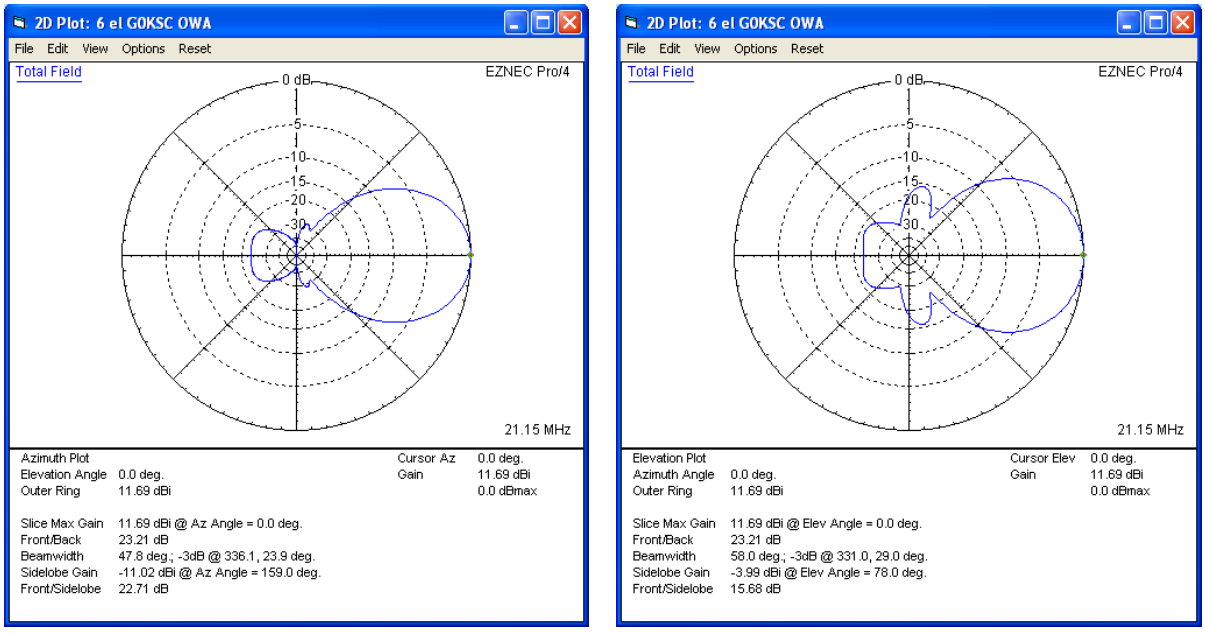
Front to Back Ratio: 23.12dB

Gain at 49' above ground: 16.63dBi

2 antennas 39' apart (stacked), 49' up: 18.78dBi

SWR: better than 1.3:1 21.0MHz-21.450MHz

As you can see from the above figures, I have modelled the antenna for a good balance of both performance and bandwidth too with maximum expected SWR being around 1.3:1 at the band edges. This should ensure no ATUs will be required when using the antenna anywhere on the 15 band. As this is also quite a 'forgiving' design, small build errors within boom position or element lengths will go pretty much unnoticed. However, this is not a sign-off to get sloppy!! Every effort should always be made to ensure an antenna is built as close to spec as possible. Let us now take a look at the plots.



The free space plots for a single antenna in both elevation and azimuth planes

The antenna has a clean pattern and good F/B ratio too and due to having a direct 50-Ohm feed point, no complex ('lossy') matching devices are needed either aiding a much simpler build. So what is going to be needed here from a parts perspective?

I would recommend fully insulated elements using Stauff Hydraulic hose clamps (or similar) which will ensure no element correction will be required; follow exactly the dimensions in the drawing below. So how will the antenna hold up to wind and what are the mechanical stats?

Safe Wind Speed:

- Elements: 110mph
- Boom: 101mph

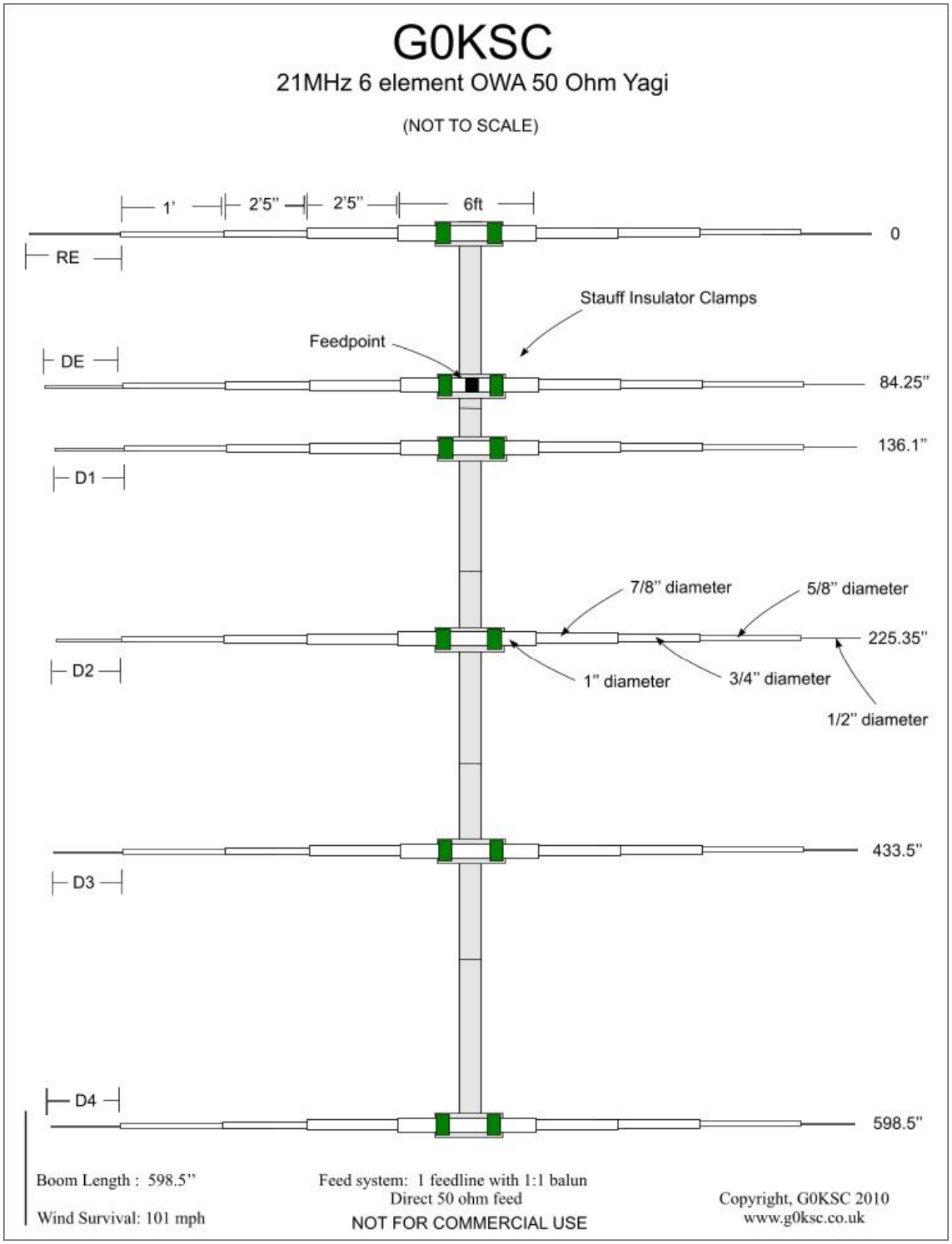
Turning Radius: 26.96 Ft

Effective Wind Area: 7.49 SqFt

Weight: 68.43 lb

A rating of at least 100mph should see most locations well catered for and provide an antenna that could stay in place for many years. Establishing such an excellent rating for wind handling on such long elements is the result of a 9 stage taper tip to tip comprising on a center section at 1 inch followed by 7/8, ¾, 5/8, ½ inch tubing, each side of the boom while the boom itself consists of a centre of 3 x 6' 3-inch diameter round tubes, followed by a 2.75 inch 6' section either side which in turn connects to another 6' section each side which this time is 2.5 inch. Finally, toward the last director, 2 x 6' sections of 2.25 inch round tube are placed and this concludes the boom.

No let us take a look at a build plan which should give us all the information to build the antenna in one view.


G0KSC
21MHz 6 element OWA 50 Ohm Yagi
(NOT TO SCALE)
1'
2'5"
2'5"
6ft
0
RE
Stauff Insulator Clamps
Feedpoint
DE
84.25"
136.1"
D1
7/8" diameter
5/8" diameter
225.35"
D2
1" diameter
3/4" diameter
1/2" diameter
433.5"
D3
D4
598.5"
Boom Length : 598.5"
Wind Survival: 101 mph
Feed system: 1 feedline with 1:1 balun
Direct 50 ohm feed
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The above diagram should give all the information you need with regards to element spacing upon the boom and also the taper schedule. The ½ inch diameter element tips will need to be adjusted to the following lengths in order to complete the antenna:

Re = 34.7''

DE = 31''

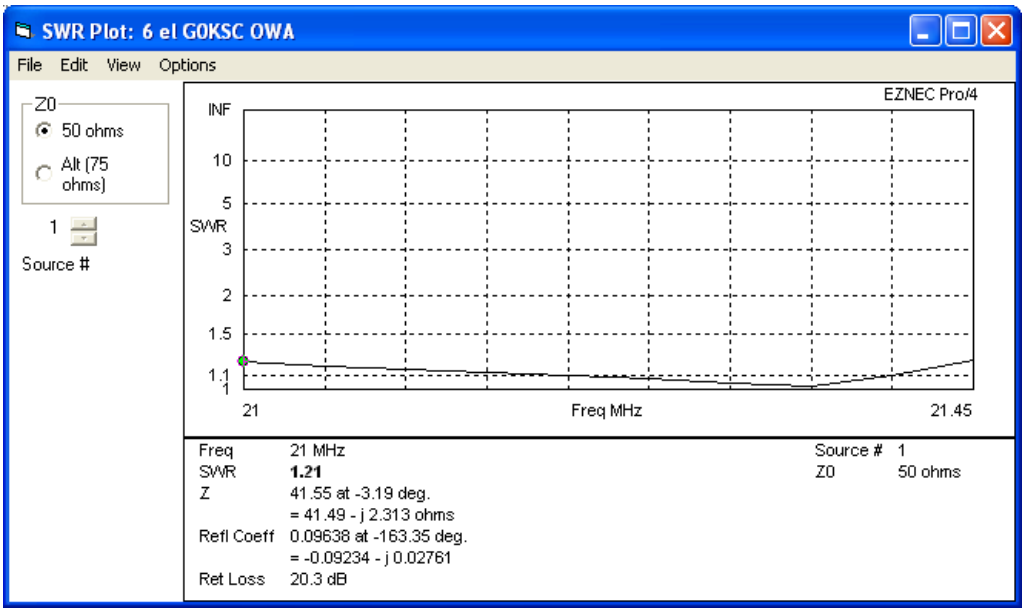
D1 = 25.25''

D2 = 22.75''

D3 = 19.7''

D4 = 14.9''

Your competed antenna will need a boom guy to ensure minimum sag. The placement of the guy anchor above the boom should be 33'' and the guy points should be 224.5'' along the boom either side of the mount point. If the boom taper schedule I have suggested is used, then the mast mount point will need to be 291.5 inch in from the reflector side of the boom.



An excellent SWR profile throughout the 21MHz band

Conclusion

This antenna while large should prove very simple to build and should provide many years of service be it as a part of a field day setup or as a permanent station antenna. As with all Yagi antennas a balun is required

to match the unbalanced coaxial feeder to the balanced feed point of the antenna. As this is a 50-Ohm, direct feed antenna, only a 1:1 balun is required. A simple choke (turns of the feeding coax at the feed point) of a ferrite type will do perfectly but do keep in mind the power rating to ensure it is in line with any amplifier you may be connecting to the antenna.

With the 6'' overlap on each element join and the fact that there are no limiting matching devices installed, the power rating of the antenna is pretty much whatever the rating is of your coax!

Enjoy the antenna and as always, if you have any questions or would like a copy of the EZNEC file, please email me. I will be happy to send back by return.

Until next time, **-30-**

Brief Biography of Author

Justin Johnson, G0KSC of the UK has been involved within security, test and measurement of the mobile/Cell phone industry for over 20 years. He is currently working from Stockholm, Sweden for a provider of the above mentioned systems at C level management. He has been a keen ham since childhood which led him into the industry in which he works today.

In more recent times, Justin has become more involved in the development of directional antennas for ham radio providing many free to build Yagi and quad designs online. However, several commercial companies now build and sell his antenna designs too. He pioneered the LFA design in late 2008. It has been patented (for commercial use only, if building for your own use, there is no issue) and now several antenna manufacturers around the World build and market my LFA Yagi designs. The LFA provides quad like performance from a Yagi Antenna. Justin provides many LFA designs on his website for Hams to build themselves for free.

Further, he designs antennas for Force12 in Texas, Vine Antennas in the UK, Eantenna in Spain, Easyagi in Italy and HSPD in Holland
More info at www.g0ksc.co.uk

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Send mail to webmaster@antennex.com with questions or comments.