EDGES MEMO #266

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September 7, 2017

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To: EDGES Group

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Subject: Optimization of a mid band antenna

A "midband" blade antenna has been optimized using FEKO to calculate S11 for a 3-D grid search of the width and length of the panel as well as the gap between panels. The panel height over an infinite metal ground plane is held at a fixed value of 1.04 × 75.0 / *f*center meters where fixed *f*center is the center frequency of the midband which is chosen to be 100 MHz. While the actual center frequency might be lower it is important to keep the height as low as possible to minimize the beam effects which increase with height.

At each point on the 3-D grid a search is made for the best average S11 after applying a search for the balun tube impedance, the balun transmission line impedance

Given by

$$Z = 120 \cosh^{-1}(D/d)$$

When d = diameter of balun tubes = 1"

D = distance between centers of the balun tubes and the top cap capacitance.

This involved a 3-D grid search based on the calculation of adding the capacitance and the inductance of the balun parallel pipe transmission line in parallel to the impedance at the port between panels from FEKO. This 3-D search is very fast as it involves only analytic functions. Also it is probably more accurate than using FEKO to model the balun.

Figure 1 shows an optimization from 70 to 170 MHz for which

Gap = 0.0069 m

Length = 0.670 m

Width = 1.0 m

Height = 0.71 m

Zbalun = 50 Ω

D = 2"

Topcap = 8 *pf*

Also plotted is the lowband signature with a 100 mK Gaussian centered at 100 MHz with 20 MHz FWHM added to give a perspective to the frequency coverage for extending a signature search.

Figure 2 shows an optimization from 60 to 150 MHz for which

Gap = 0.0082 m

Length = 0.719 m

Width = 1.028 m

Height = 0.78 m

D = 2”

Zbalun = 50 Ω

Topcap = 6.5 *pf*

A wideband blade dipole which was probably optimized for operation without a ground plane is shown in mathworks (www.mathworks.com/help/antenna/examples/wideband-blade-dipole-antenna-and-array.html) used a panel shape with a gap than increases towards the edge of the panel. This shape was tested but I found that it did not yield a better S11. With PEC ground plane the mathworks example had a bandwidth ratio at the S11 at – 10 dB points of about 2.5 compared with 2.3 for the results in Figures 1 and 2 but the midpoint in the mathworks example bumps up to about – 10 dB. Other potential improvements with variations on the panel shape away from the simple rectangle have yet to be explored.

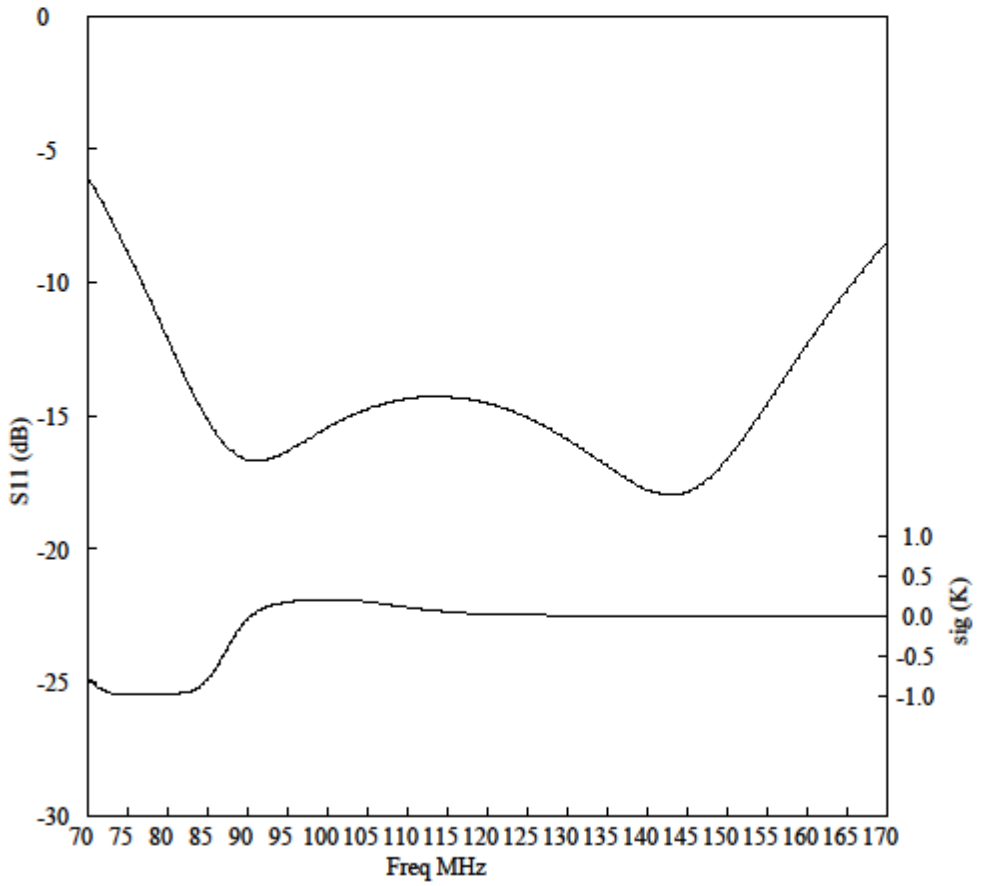

Figure 1. Midrange optimized blade covering part of the lowband signature.

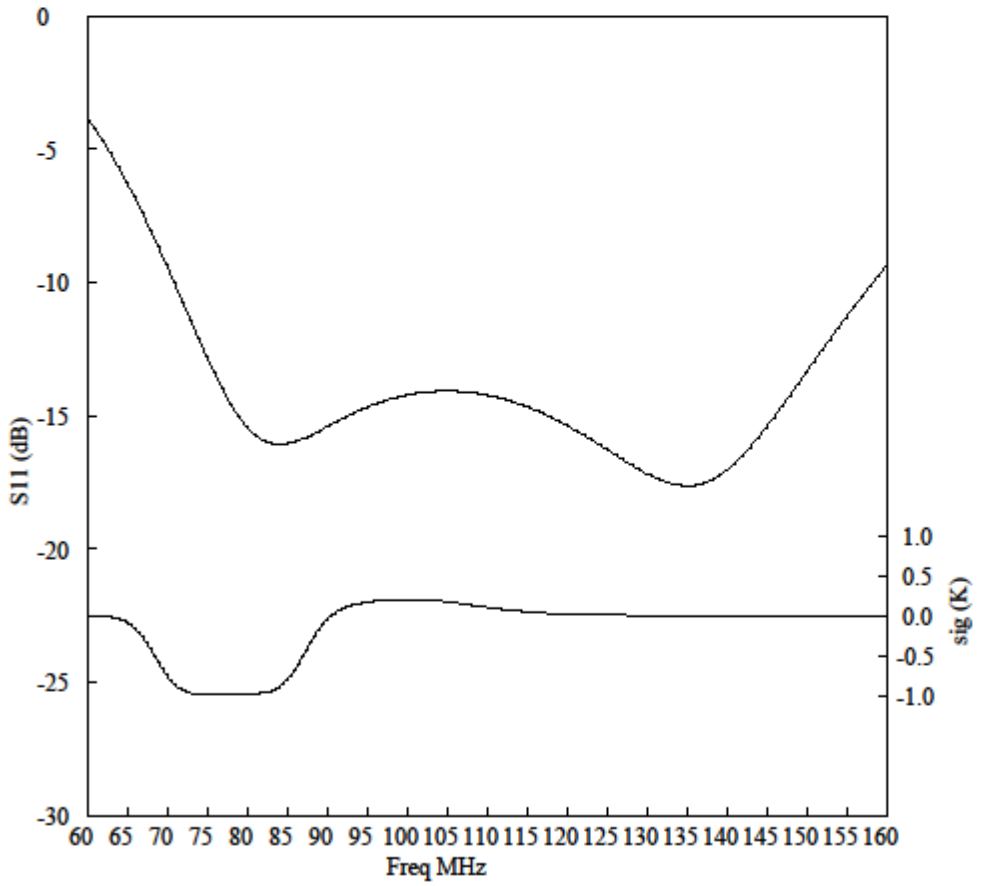

Figure 2. Midrange optimized blade covering all of lowband signature.