EDGES MEMO #181

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Subject: Model of low frequency balun compared with lab measurements of S11.

The low frequency antenna was deployed without a measurement of the balun loss so that only a model was available for the complete calibration of the low frequency data. To correct this another low band balun (see memo 166 for design) was built and S11 measurements made. In the process an error in the dimensions of the Fairview microwave SMA connector (model SC3792) given on the manufacturer's data sheet was discovered. The data sheet specified a diameter of the inner conductor of 0.086" and a diameter of the dielectric of 0.304" when the actual dimensions are 0.05" and 0.161" respectively. A measurement of the balun with the end extended with an additional piece of outer pipe was taken to check the model. In this case the balun was open at the end with an effective length of 45.5".

Figure 1 show the measured S11 and the modeled S11. The model parameters were

Part	Diameter (inches)	Material	Length (inches)	Conductivity relative to copper	dielectric
Outer tube	0.75	Brass	50	0.24	1.07
Center conductor	0.3125	Copper plated brass	45.5	0.8	
Connector outer	0.16	Stainless steel	1.0	0.024	2.05
Connector inner	0.05	Gold plated brass	1.0	0.24	

Table 1 balun model parameters

For high accuracy the VNA was calibrated assuming an offset delay for the load of 33ps and loss of 2.5 Gohms/s. The tube length used to the model to be applied for the calibration of the field data is 43.6". As a further check a measurement of the S11 with the end shorted was taken as a further check. In this case the effective length equals 43.6". This result is shown in Figure 2. It is not as reliable owing the difficulty of getting a perfect short. In the case of the open rms error in magnitude increased to 0.005 dB without the delay offset correction for the calibration load. A slight improvement in the fits at the 0.002 dB level were obtained assuming 80% conductivity for copper plate brass. Increasing the conductivity of gold plated brass degrades the fit presumably because the gold plate is too thin to be effective below 200 MHz.

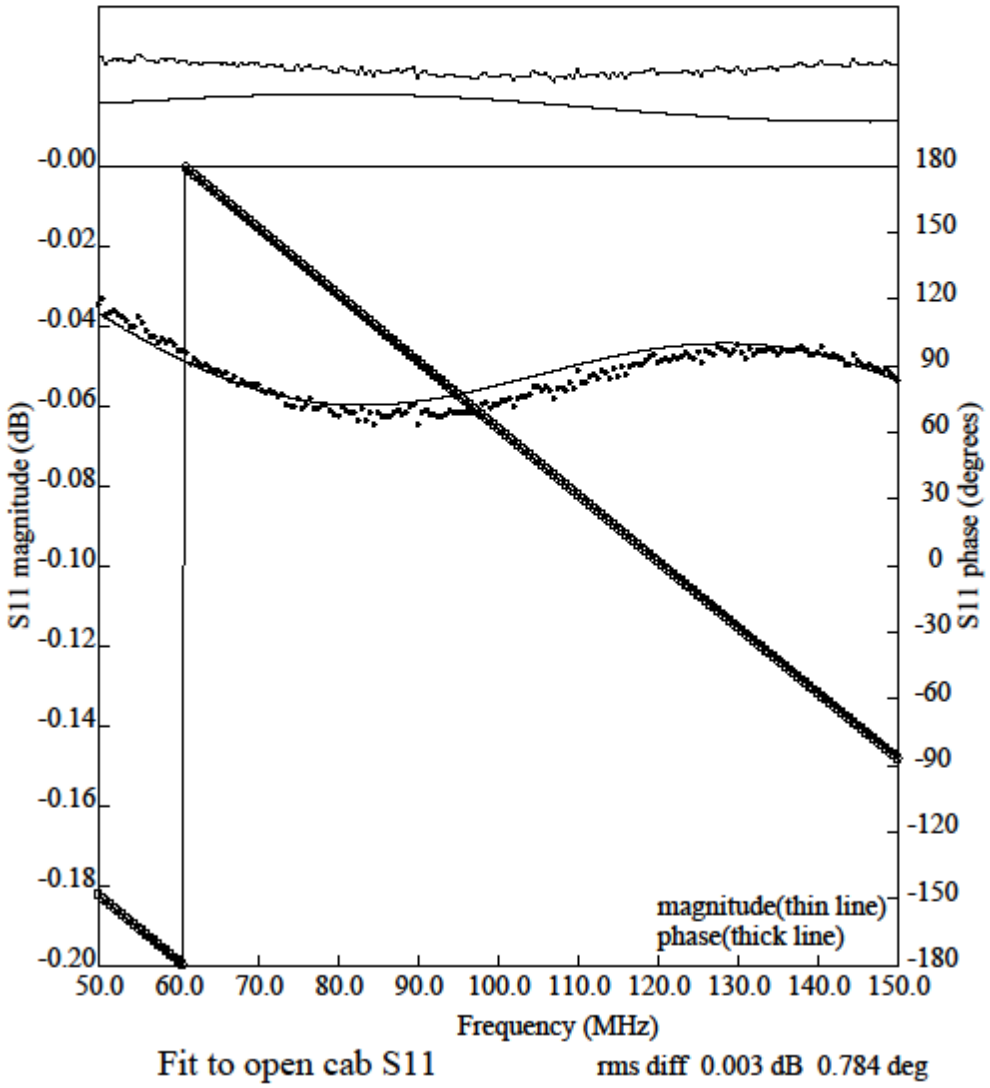

Figure 1. Comparison of S11 with model for open ended low band balun.

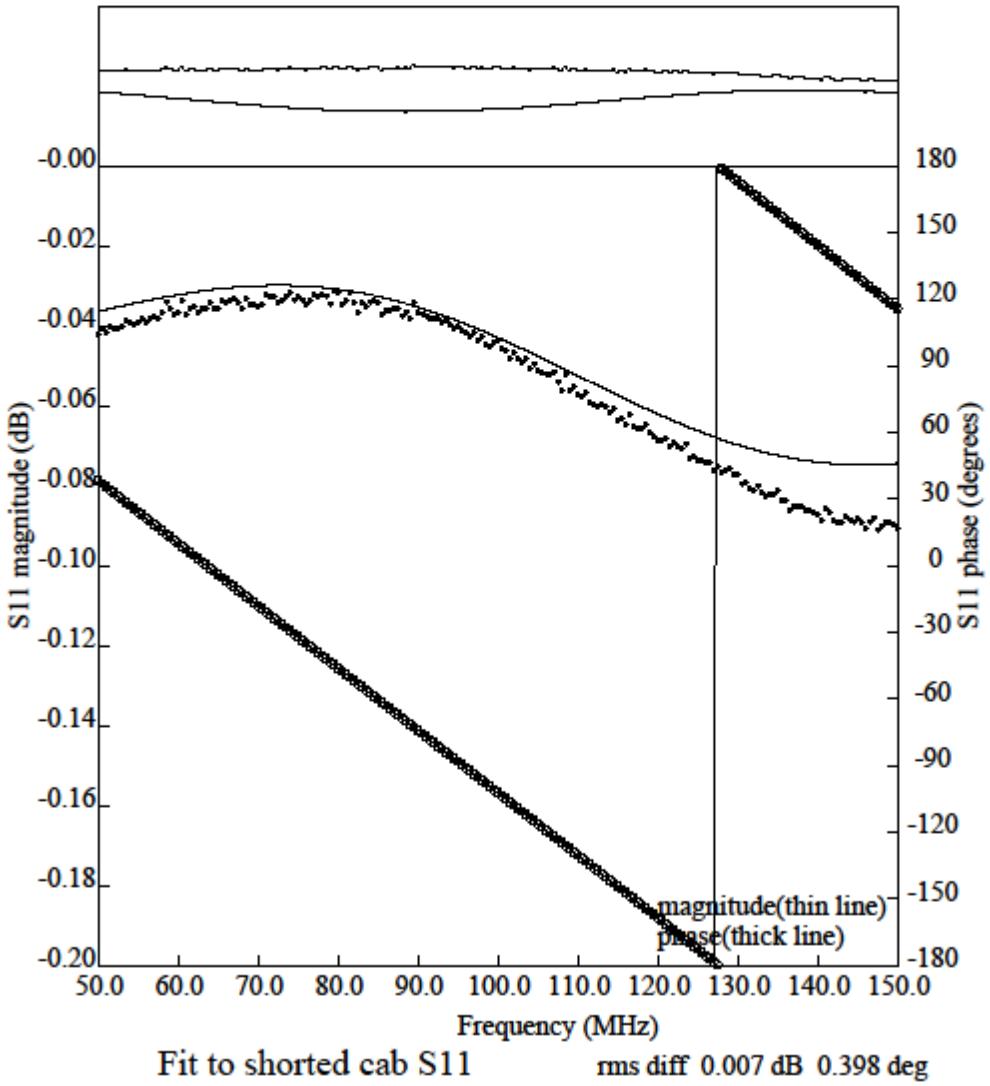

Figure 2. Comparison of S11 with model with shorted end.