EDGES MEMO #329

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To: EDGES group

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Subject: Antenna resistive loss estimates

The resistive loss in the antenna comes primarily from the currents in the pipes which for EDGES-2 and EDGES-3 act as a parallel conductor transmission line in parallel with the antenna port and a short across the end. At the low frequency end of the band this shorted line is less than a quarter of a wavelength and adds inductance which improves the S11 at the low end. For EDGES-2 this loss is in addition to the balun transmission line loss which is treated separately in memo 210 for lowband and memo 273 for midband. Other minor contributors to the loss are the losses in the antenna panels and the top cap in EDGES-2. Table 1 below shows that the antenna resistive loss is extremely small but there is significant fine structure which results in a significant rms in spectra going below 55 MHz for EDGES-3 and midband.

antenna	resistive loss % at 50 MHz	resistive loss % at 120 MHz	rms from 5-term fit mK 50-120 MHz	rms from 5-term fit mK 55-120 MHz	rms from 5-term fit mK 60-120 MHz
EDGES-3	0.1446	0.0268	63	17	4.7
midband	0.2213	0.0196	58	16	4.6
lowband	0.0349	0.0401	4	1	0.5

Table 1. Resistive loss in EDGES antennas from FEKO simulations

The last 3 columns in Table 1 show the rms residuals to a 5-term Linlog fit to the sky at GHA = 12hr.

A conductivity of 2e7 S/m was used for the brass pipes used for the Roberts Balun in EDGES-2 low and midband and the pipes for the fiber, DC power and air circulation in EDGES-3. A conductivity of 3.5e7 S/m was used for the aluminum parts.

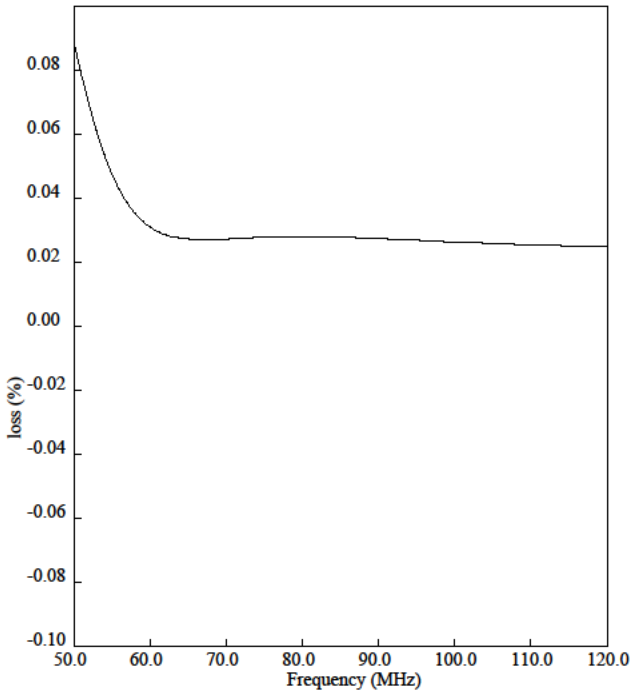

Figure 1. FEKO simulations of resistive loss of EDGES-3 antenna

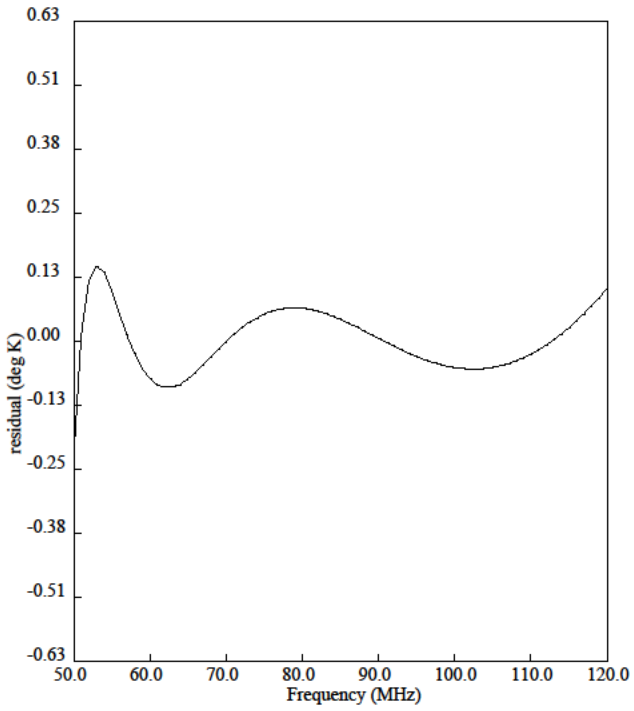

Figure 2. Simulated rms residuals of EDGES-3 antenna loss for a 5-term Linlog fit to the sky at GHA = 12hr

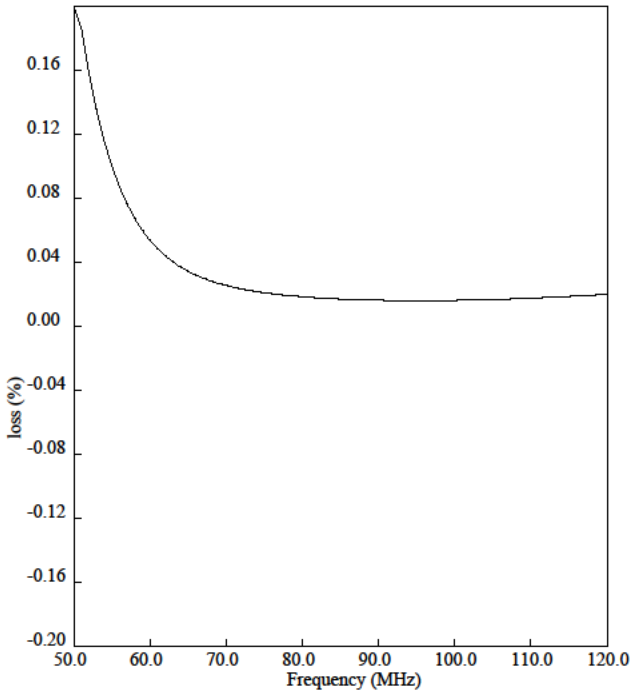

Figure 3. FEKO simulations of resistive loss of Mid Band antenna

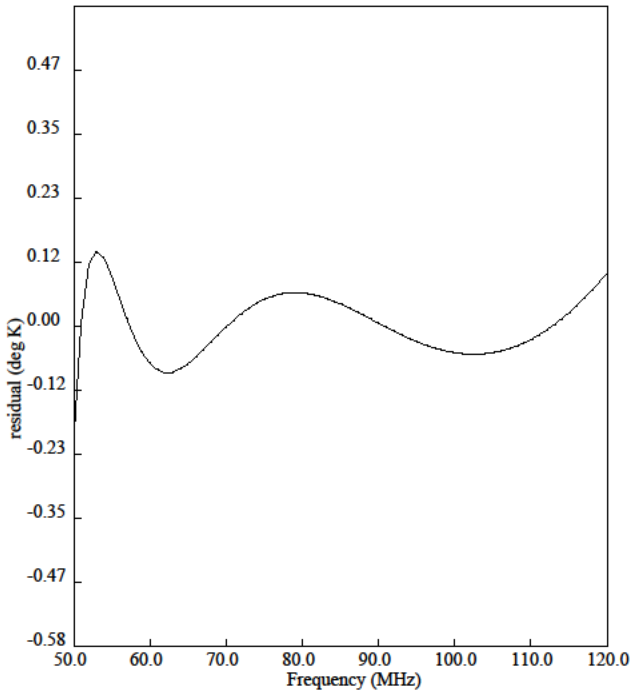

Figure 4. Simulated rms residuals of midband antenna loss for a 5-term Linlog fit to the sky at GHA = 12hr.