EDGES MEMO #013
RFI MEMO #028

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To: RFI Group
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Subject: VSWR Measurements of four-point dipole antenna for EDGES

Measurements were made on May 26, 2006, of the reflected power for the four-point dipole antenna constructed for EDGES. The spacing between dipole elements was varied from 0.25 to 0.75 inches in 0.125 inch increments. The frequencies of the –10 dB points were recorded along with the reflection coefficients at 80, 140, and 200 MHz.

An additional configuration was also measured. In this configuration, 6-inch lengths of #28 wire were added to the tips of the dipole elements. The spacing between elements was fixed at 0.5 inches. The reflection coefficients were recorded at 20 MHz intervals from 80 to 280 MHz.

The measurements were made with a network analyzer at Haystack. The antenna was approximately 10 feet from the machine building on pavement (see Figure 1).

Figure 1 – Four-point dipole antenna during testing; shown while adding the 6-inch wire extensions to the tips of the dipole elements.

The data for the five different spacings:

Spacing (inches)	Γ = -10 dB Low (MHz)	Γ = -10 dB High (MHz)	$\Gamma_{80\ MHz}$ (dB)	$\Gamma_{140\ MHz}$ (dB)	$\Gamma_{200\ MHz}$ (dB)
0.250	103.5	251	-4.2	-23.2	-16.6
0.375	101.5	260	-4.4	-25.7	-22.5
0.500	98.6	255	-4.5	-20	-23.7
0.675	96.5	253	-4.6	-17.2	-19.7
0.750	94.7	252	-4.7	-15	-16.8

The data for the comparison between the default design and the addition of 6-inch #28 wire tips to the dipole elements:

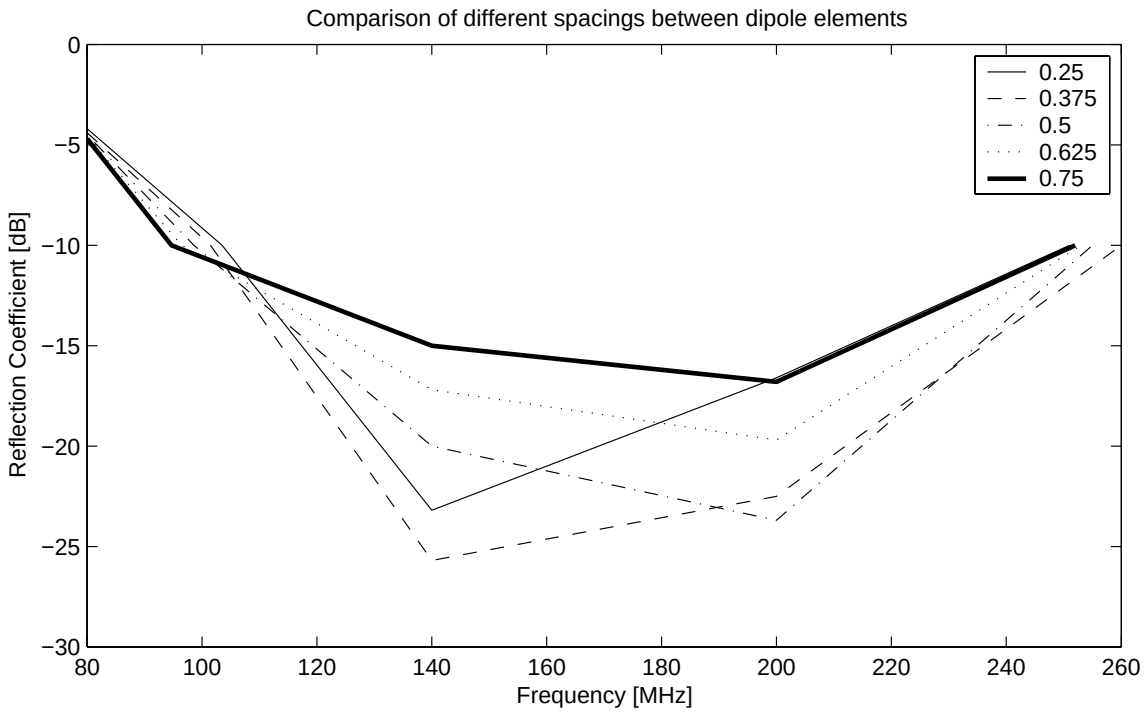
Frequency (MHz)	No wire tips Γ (dB)	6-inch #28 wire tips Γ (dB)
80	4.46	4.9
100	10.8	13.3
120	26.1	22.5
140	19.8	17.6
160	18.4	17.2
180	27.9	28.9
200	23.5	25.9
220	15.9	14.9
240	11	10.5
260	10.2	9.3
280	8.1	7.2

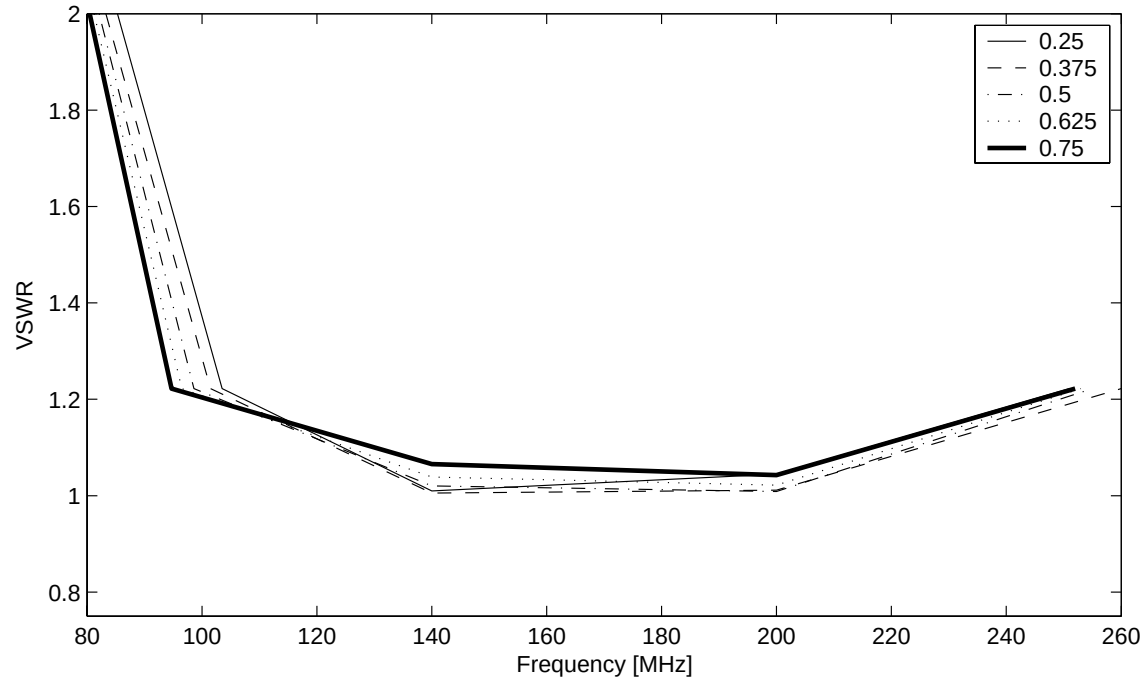
The attached plots illustrate the above data.

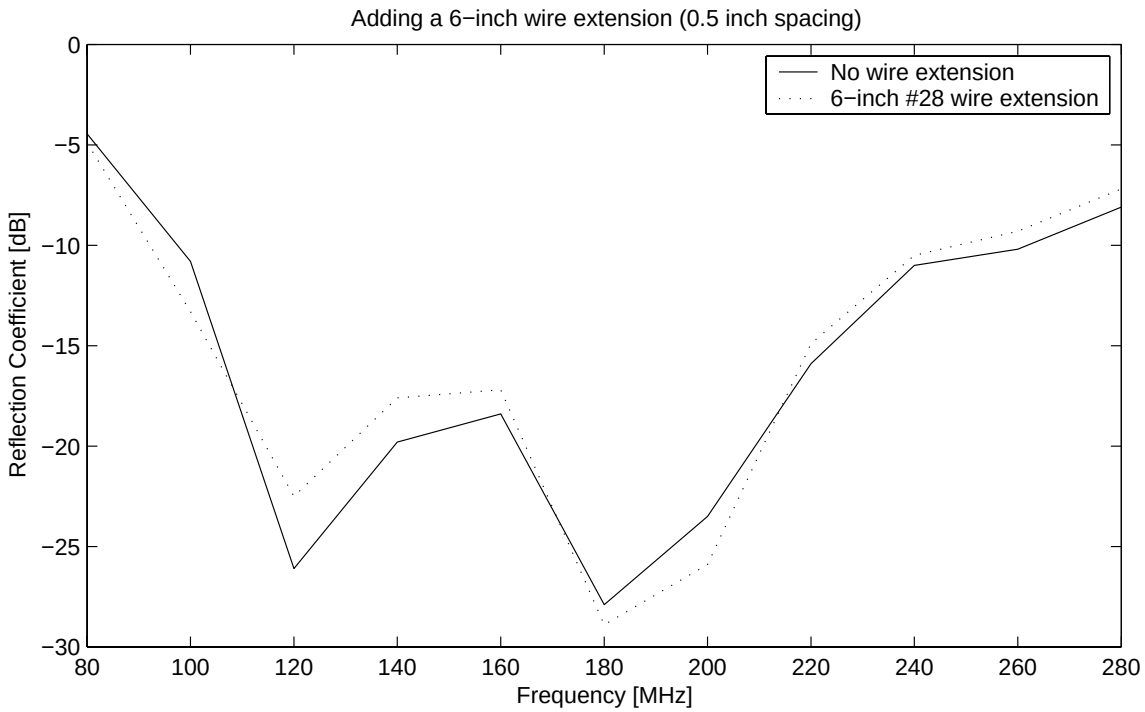
Definitions:

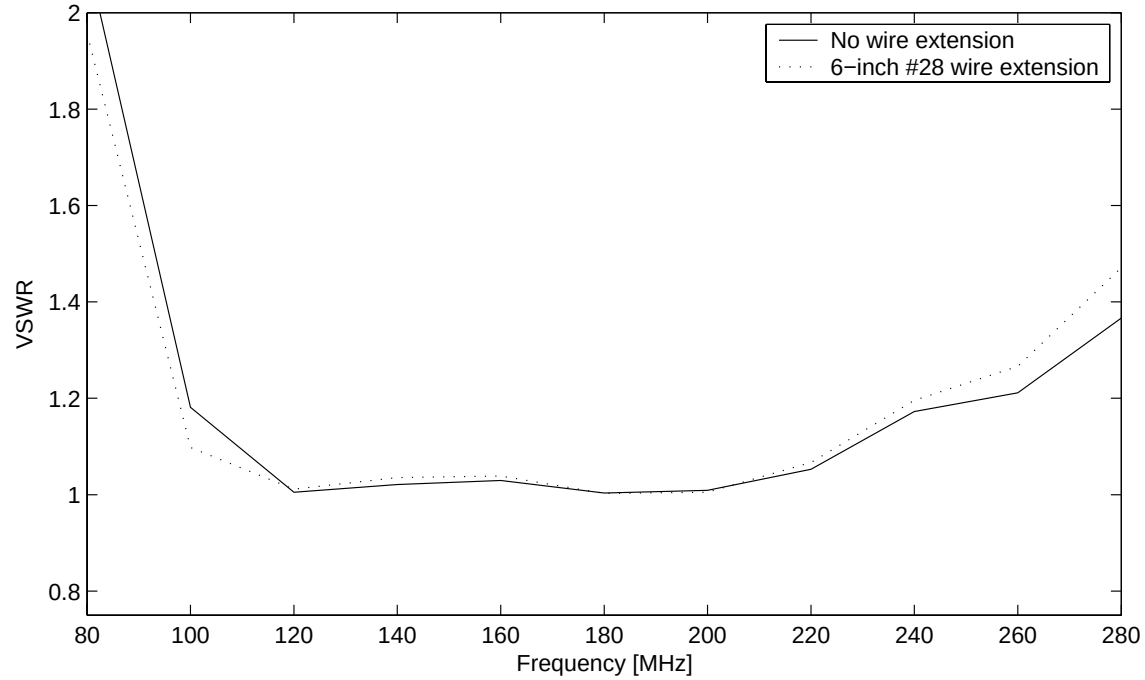
Γ = Reflection coefficient

VSWR = (1 + Γ) / (1 - Γ)


Comparison of different spacings between dipole elements
Reflection Coefficient [dB]
Frequency [MHz]
0.25
0.375
0.5
0.625
0.75
0
−5
−10
−15
−20
−25
−30
80
100
120
140
160
180
200
220
240
260


VSWR
Frequency [MHz]
0.25
0.375
0.5
0.625
0.75
2
1.8
1.6
1.4
1.2
1
0.8
80
100
120
140
160
180
200
220
240
260


Adding a 6−inch wire extension (0.5 inch spacing)
No wire extension
6−inch #28 wire extension
Reflection Coefficient [dB]
Frequency [MHz]
0
−5
−10
−15
−20
−25
−30
80
100
120
140
160
180
200
220
240
260
280


No wire extension
6−inch #28 wire extension
VSWR
Frequency [MHz]
2
1.8
1.6
1.4
1.2
1
0.8
80
100
120
140
160
180
200
220
240
260
280