EDGES MEMO #038

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To: EDGES Group
From: Alan E.E. Rogers
Subject: Comparison of the MWA bowtie, shortwide and shortwide with stubs.

1] Introduction

The MWA bowtie or "batwing" elements has been simulated and an improved design is to be tested. The improved design moves the 200 MHz resonance up to 240 MHz and greatly reduces the magnitude of the resonance. This new design is called the "shortwide." This memo primarily considers the possibility of adding "stubs" to the shortwide to improve the noise performance at the low frequency end of the 80-300 MHz range.

2] Isolated element

Figure 1 shows the element designs considered and table 1 summarizes the performance of an isolated element on an infinite ground plane.

	Batwing	Shortwide	Shortwide + stubs	Units
VSWR at 100 MHz	11	16	11	50 ohm ref.
200	6	7	7	"
300	5	6	5	"
Impedance at 100 MHz	6-j32	5-j42	6-j32	Ohms
200	205+j135	210+j180	260-j177	"
300	190-j121	201-j125	171-j121	"
Zenith gain 100	8.3	8.6	8.6	dBi
200	6.6	8.0	8.0	dBi
300	2.5	6.2	6.6	"
Horizon gain 100	-20	-28	-29	"
200	-0.3	-13	-14	"
300	-7	-9	-10	"
T_{rec} 100	124	165	124	K
200	34	41	44	"
300	50	52	50	"

3] Array Characteristics

Figure 2, 3 and 4 show the zenith gain of an array of elements in the “plusses” configuration with 1.1 m spacing for the “batwings”, shortwide” and shortwide with stubs respectively.

4] “Embedded” patterns

The element patterns become more complex when an element is located in an array. This is due to the coupling between the elements. Simulations have been run using EXN EC-M v. 3.0.57 in which one of the 4 “central” elements in the 4x4 array is connected to a source and the remaining 15 elements are connected to a 100 ohm load. The 100 ohm load approximates the LNA load. (In future work an accurate model of the LNA load will be used). Figure 5 shows the embedded element pattern for the “batwing” at the resonance frequency of 200 MHz. The coupling between the vertical elements along a line in the array produces the strong horizon response seen at 0 and 180 degrees. Figure 6 shows the embedded element response for the “shortwide” at the 240 MHz resonance. The effects of the parasitic coupling are much reduced because the spacing between elements no longer enhances the effects of the resonance in the isolated element. Figure 7 shows the embedded response of the “shortwide” at 200 MHz. The response is smooth with no hint of any complex structure. Figures 8 and 9 show the embedded element patters at 240 MHz with and without the stubs run with a single polarizations set of elements to reduce the computing time.

5] Conclusion

Adding stubs to the “shortwide” improves the match below 150 MHz and has very little effect on the antenna patterns over the 80-300 MHz frequency range.

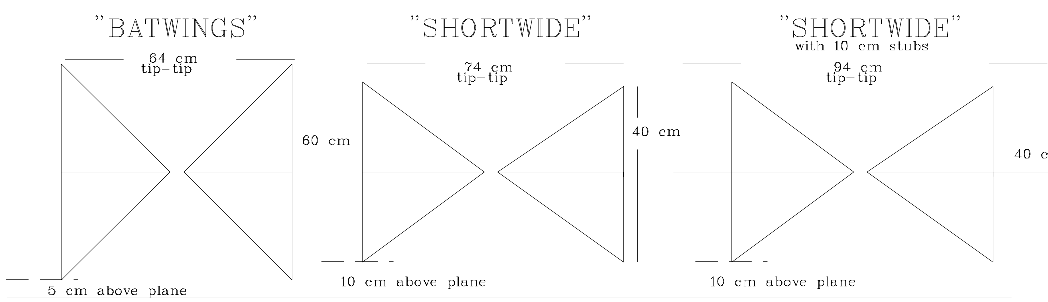


Figure 1. antenna elements

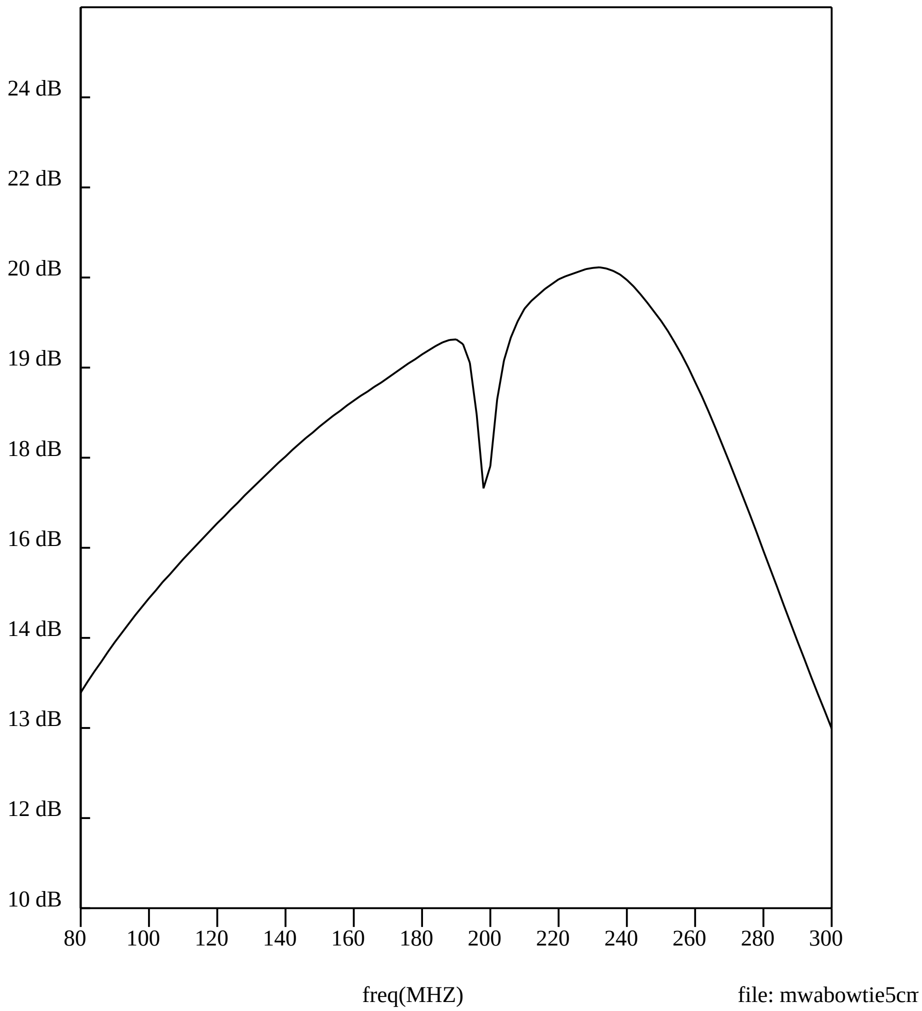


Figure 2. Zenith gain of original “batwing”

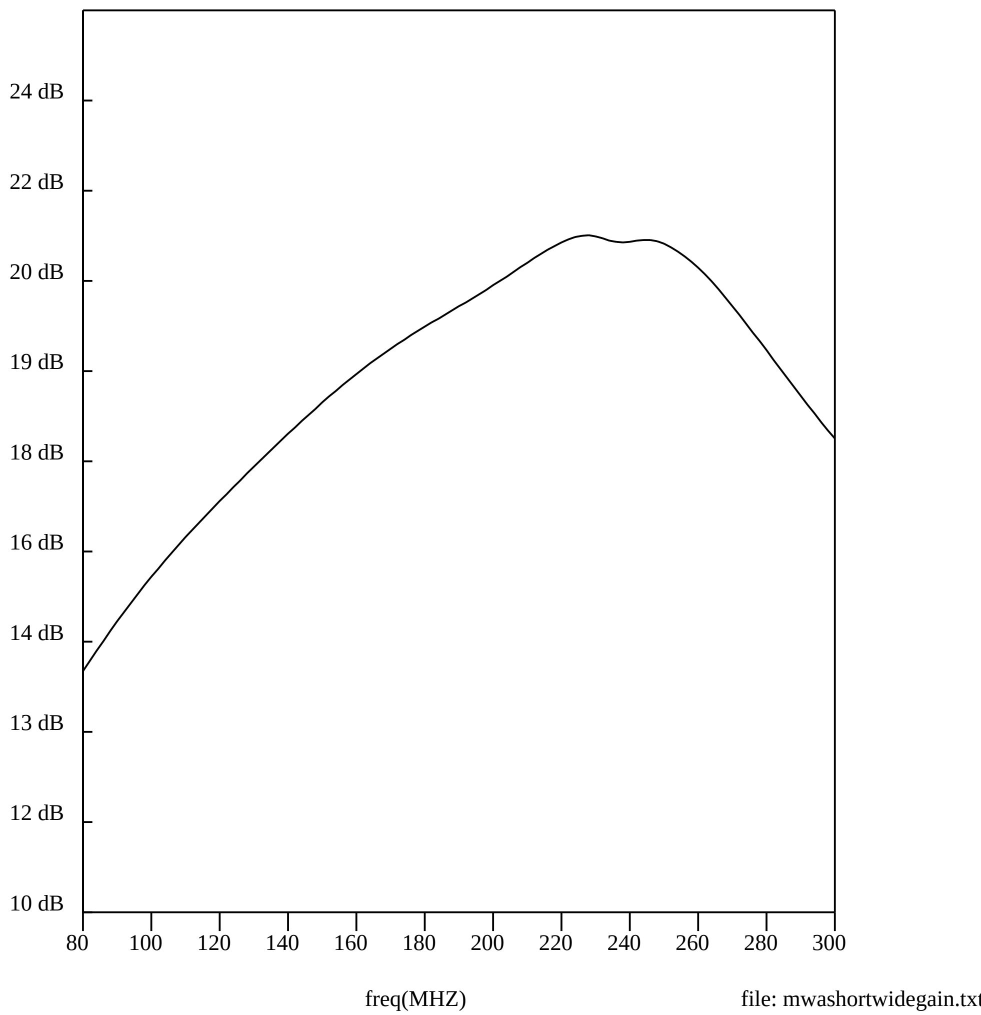


Figure 3. Zenith gain of “shortwide”

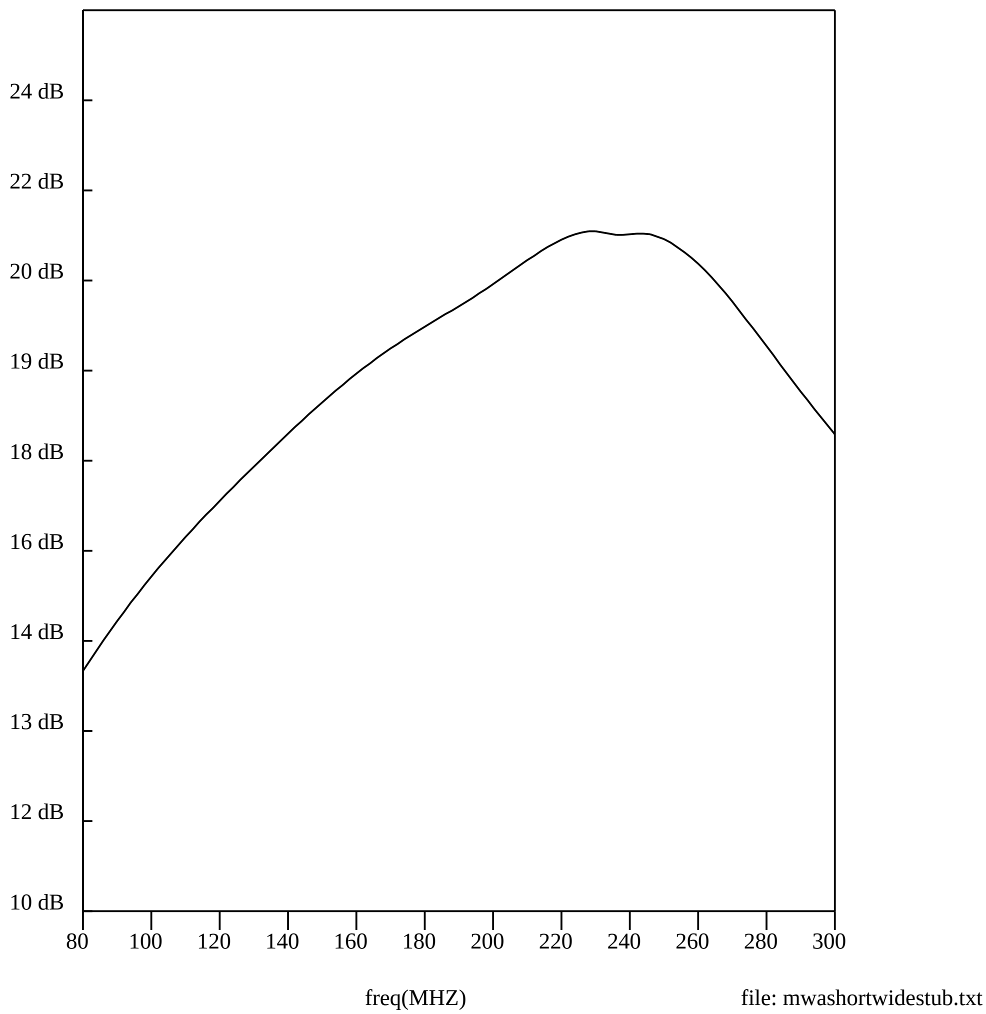


Figure 4. Zenith gain of “shortwide” with stubs

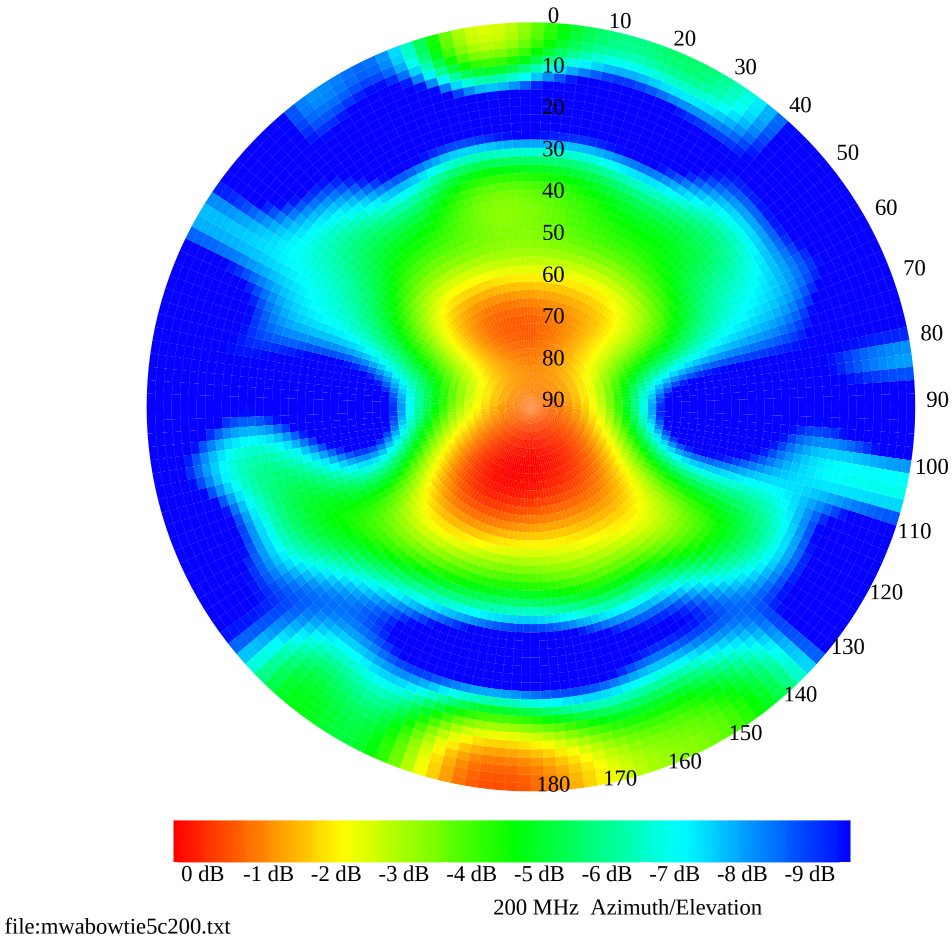


Figure 5. “Embedded” element response of “batwing” at resonance.

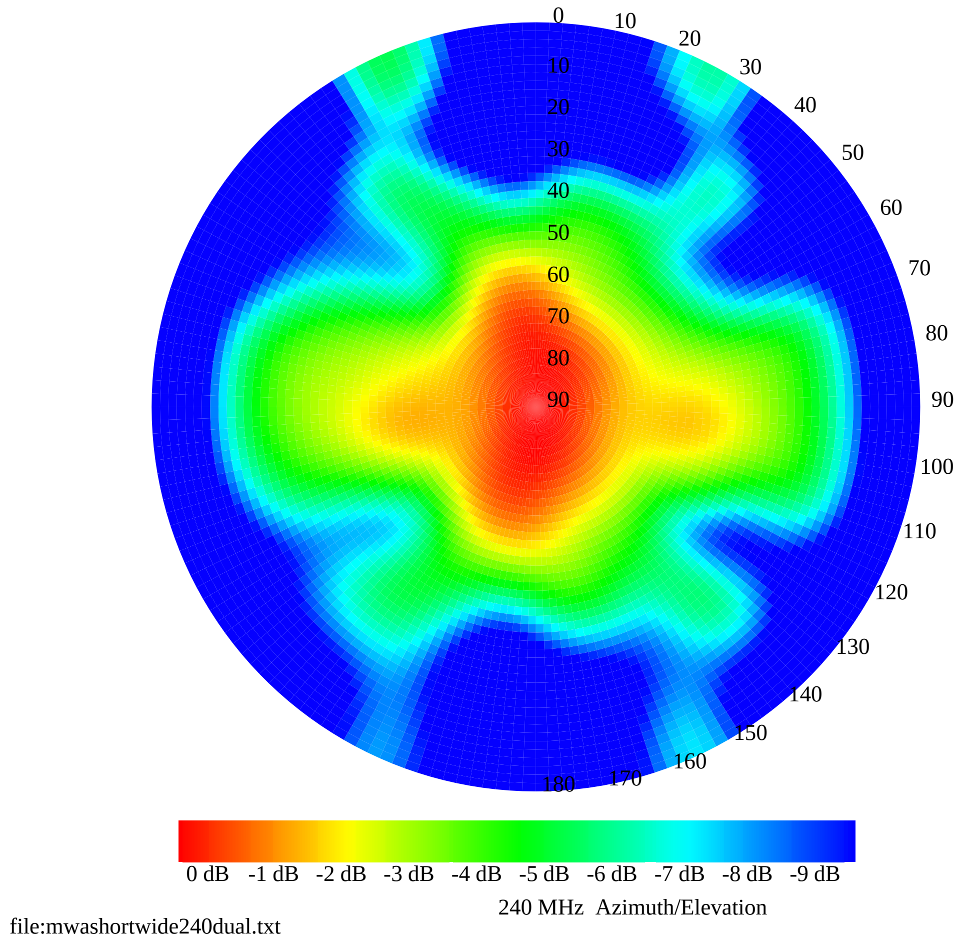


Figure 6. “Embedded” element response of “shortwide” at resonance.

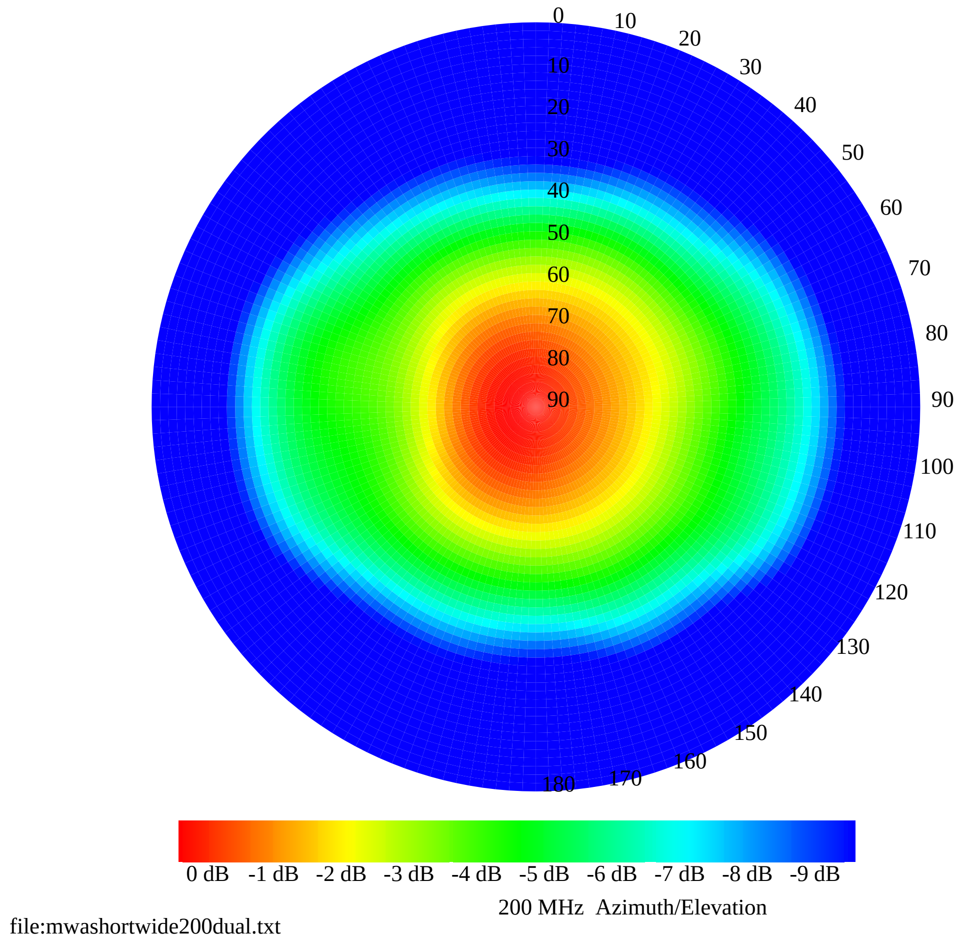
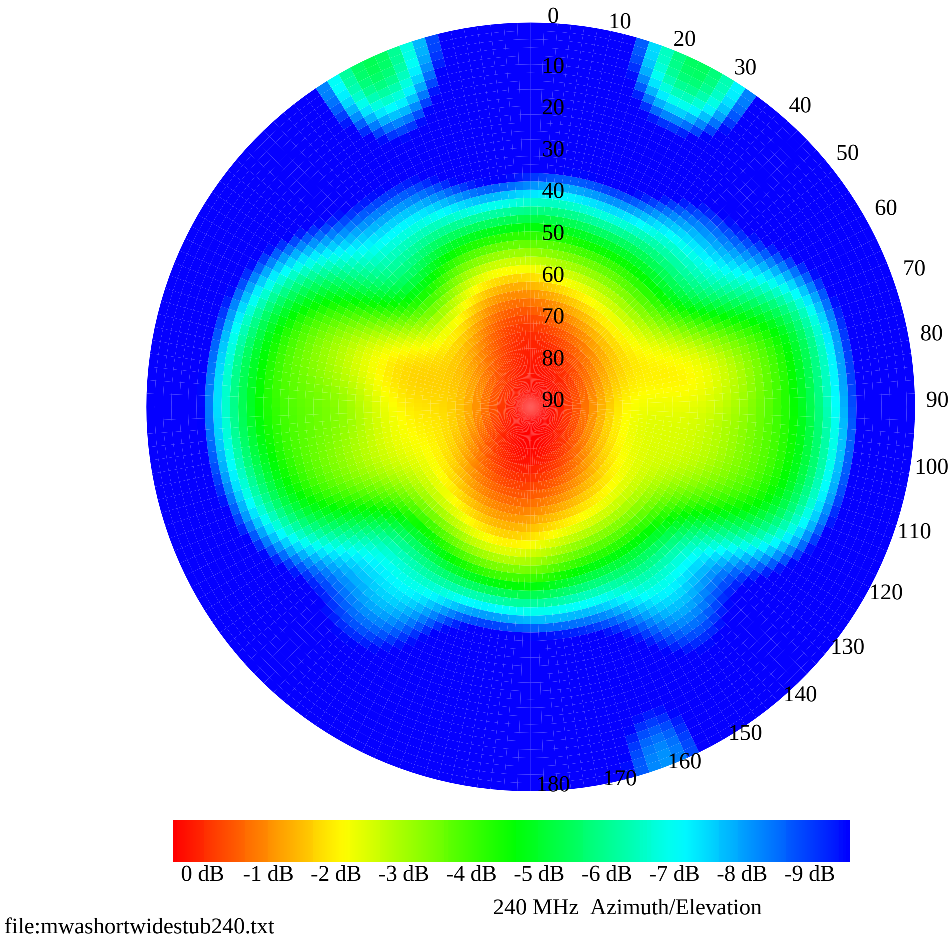


Figure 7. “Embedded” response of “shortwide” at 200 MHz.


0
10
20
30
40
50
60
70
80
90
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110
120
130
140
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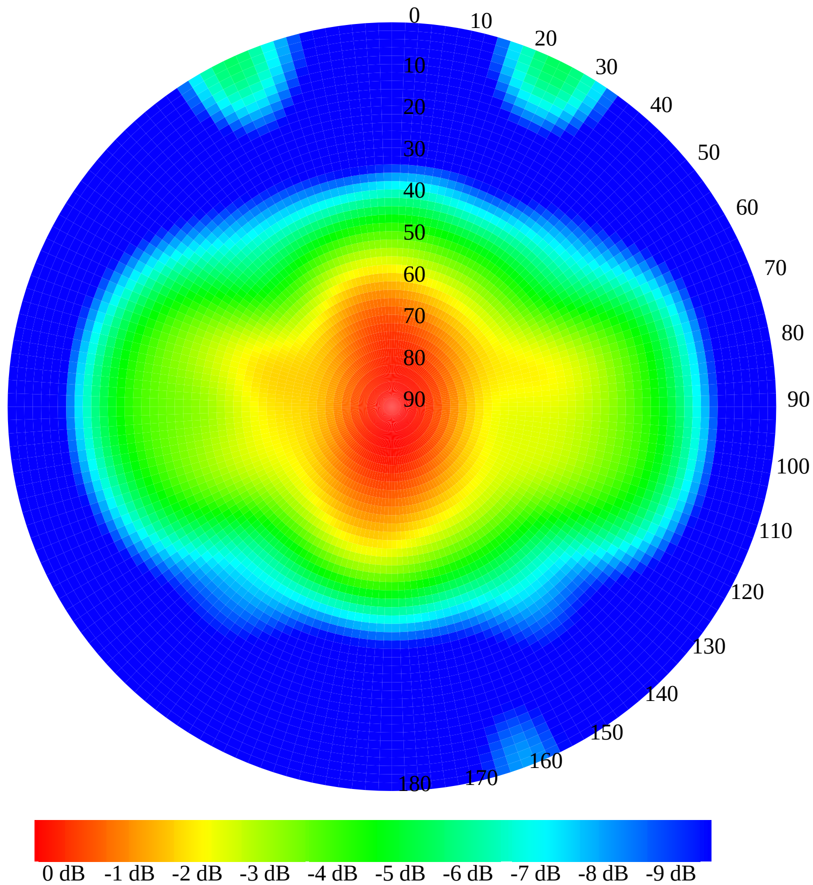
160
170
180
10
20
30
40
50
60
70
80
90
0 dB -1 dB -2 dB -3 dB -4 dB -5 dB -6 dB -7 dB -8 dB -9 dB
240 MHz Azimuth/Elevation
file:mwashortwidestub240.txt

Figure 8.



240 MHz Azimuth/Elevation

file:mwashortwide240.txt

Figure 9.