Application Note
AN-67

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Comparison Tests of Various 70 & 23 cm, Antennas for ATV

Appendix 3 - Return Loss Measurements

Jim Andrews, KH6HTV

I measured the **Return Loss** of each of the antennas which we also tested for gain. I used a Rigol DSA-815 spectrum analyzer with it's built-in tracking generator and an external 20dB directional coupler. For the 70cm tests, I used a Merrimac model CRM-20-500 (10MHz-1GHz) coupler. For the 23cm tests, I used a MAC Technology C2023-20 (0.5-2GHz) coupler. To improve the Z match at the source I inserted an SMA, 6dB attenuator between the tracking generator output and the directional coupler. An SMA short circuit was used as the 0dB return loss standard and placed at the far end of the test cable. This was right at the location where the antenna under test would be connected. I used the Rigol "Normalization" routine then to provide the 0dB reference line on the SA

display. The sole exception was for testing the NMO base antennas. It was not possible to provide either a really accurate short nor open circuit at the NMO connector on the mag. mount. For the NMO tests, the calibration short was placed on the output of the directional coupler. The NMO results are thus the return loss from the test antenna, but only after they have passed through the NMO mag. mount's interconnecting coax cable with it's inherent loss (-1.7dB 70cm & -3.4dB 23cm).

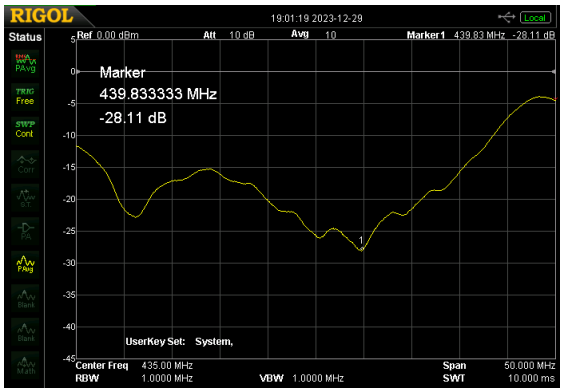
These tests were all performed at my QTH. For the yagi and base station antennas, they were mounted on a roof top antenna tripod and 5 ft. antenna mast as shown in the above photo. For the HT whip antennas, they were mounted on the camcorder / antenna bracket on a camera tripod. For the mobile antennas, they were mounted on an N connector mag. mount (Diamond DPK-4NM-N) sat in the center of a Volvo SUV's steel roof. Some HT whips were also tested on this mag. mount. For NMO antennas, a separate NMO mag. mount was used.

The results are summarized in Tables 2 & 4 in AN-66. This appendix shows spectrum analyzer screen grabs with the actual return loss vs. frequency measurements. All of the plots were taken with the following settings.

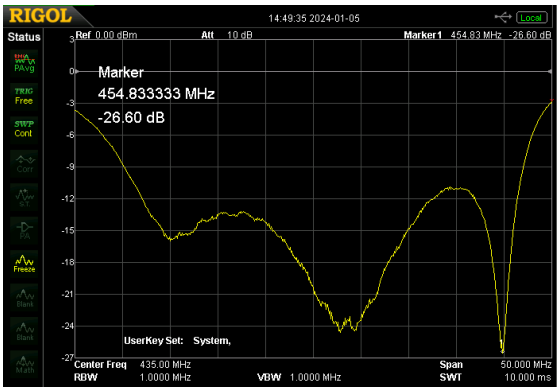
70cm Band: center frequency = 435 MHz, span = 50 MHz, 3 or 5 dB/div & 5 MHz/div
23cm Band:center frequency= 1270 MHz, span = 100 MHz, 3 or 5 dB/div & 10 MHz/div
2 m Band: center frequency = 155 MHz, span = 30 MHz, 3 or 5 dB/div & 3 MHz/div

TABLE of CONTENTS:

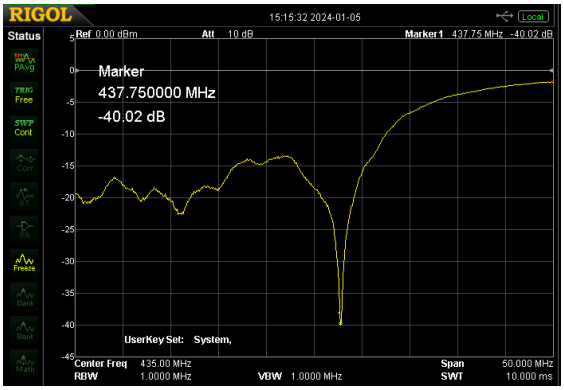
70 cm YAGI ANTENNAS:



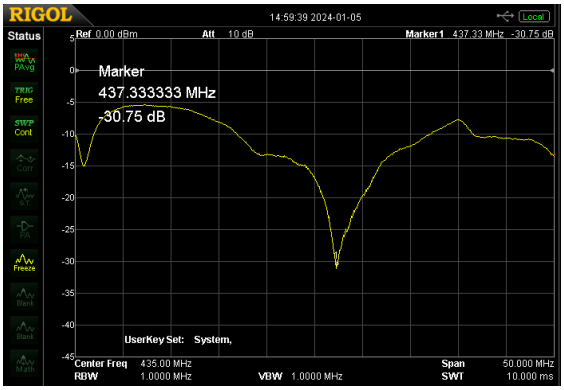
M-Squared 440-6SS Yagi
>14dB (412-451), >10dB (416-457)



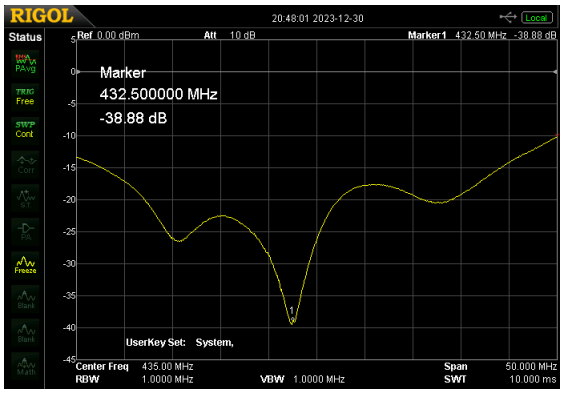
M-Squared 420-40-11 Yagi
>14dB (418-446), >10dB (416-457)



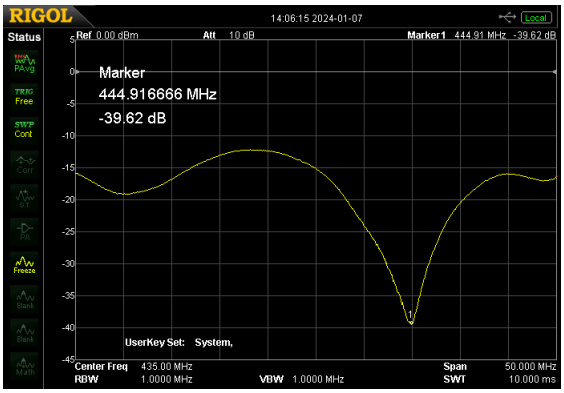
Diamond A430S10 Yagi
>14dB (433-441), >10dB (<410-442)



Cushcraft A449-11 Yagi
>14dB (433-442), >10dB (427-447)

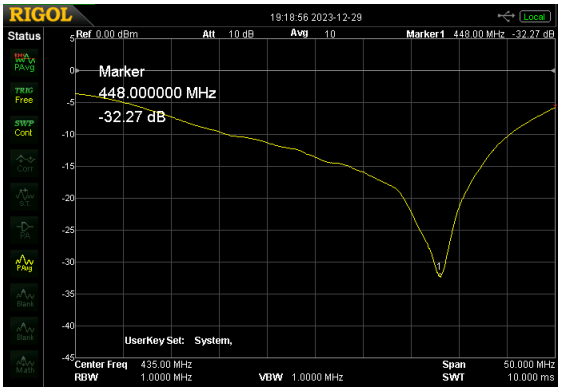


Antennas-Amplifiers 70cm2311WB Yagi
>14dB (417-437), >10dB (411-455)

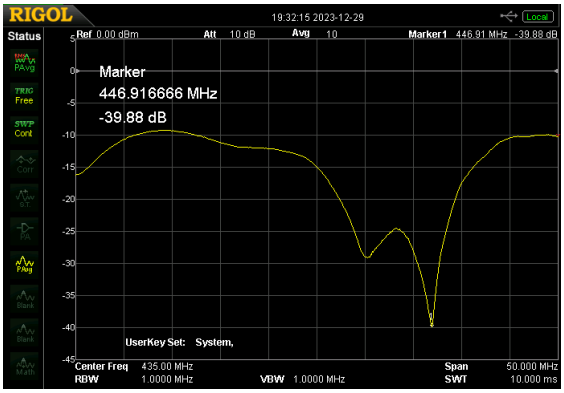


KLM, 6 element (obsolete)
>14dB (434->460), >10dB (<410->460)

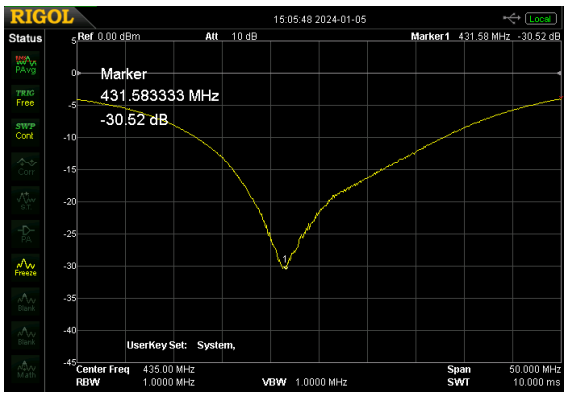
70 cm BASE STATION OMNI-DIRECTIONAL ANTENNAS:



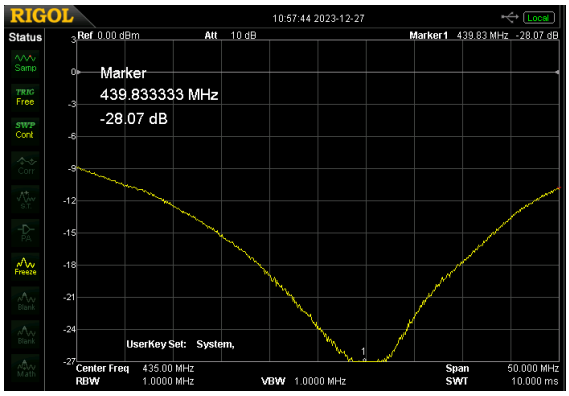
Diamond X50NA, Base Station Omni
>14dB (436-453), >10dB (426-455)



Diamond X6000A, Base Station Omni
>14dB (434-452), >10dB (423-455)

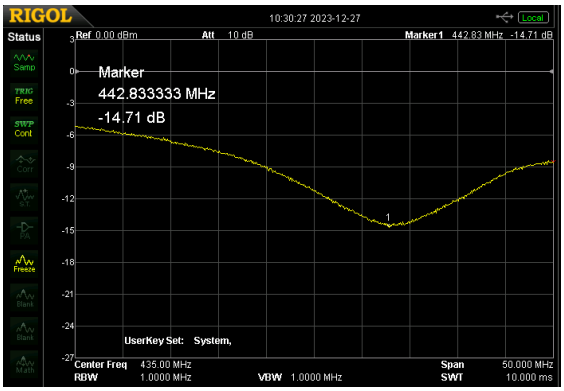


Cushcraft ELR270 Base Station Omni
>14dB (433-442), >10dB (423-448)

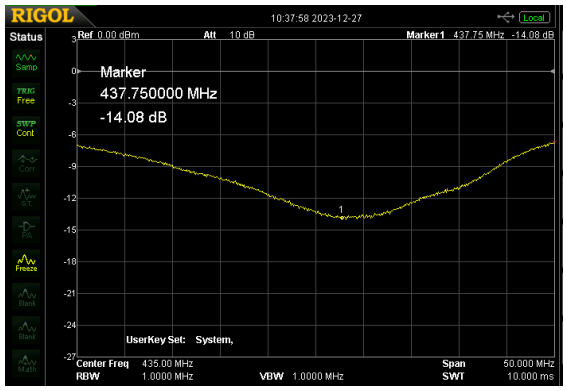


70cm Reference 1/4 Wave Ground Plane
>14dB (423-454), >10dB (413->460)

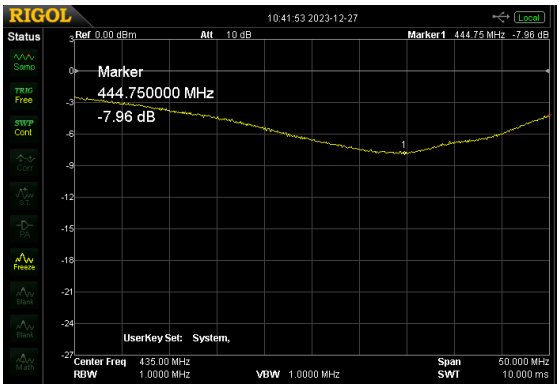
70 cm HT WHIP ANTENNAS:



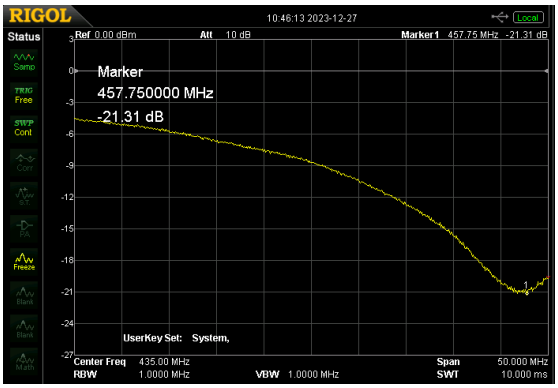
Diamond SRH999 HT whip
>14dB (438-449), >10dB (432-455)



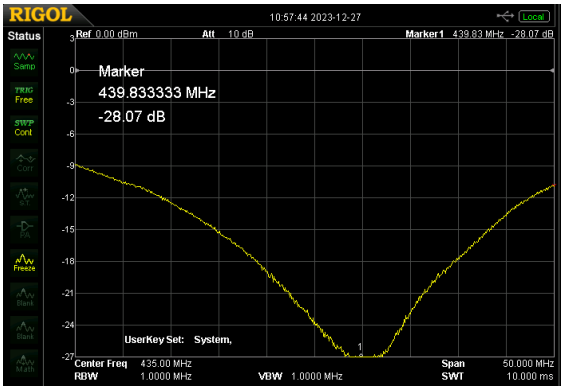
Bingfu BFN00606 HT whip
>14dB (NA), >10dB (425-452)



Nagoya/TID NA771 HT whip
>14dB (NA), >10dB (NA)

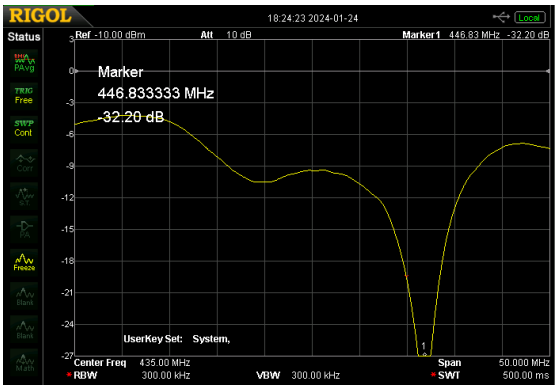


Baofeng std. 2m/70cm HT whip
>14dB (448-460), >10dB (439->460)

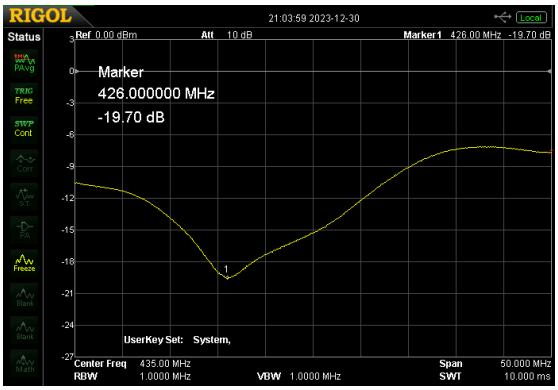


70cm Reference 1/4 Wave Ground Plane
>14dB (423-454), >10dB (413->460)

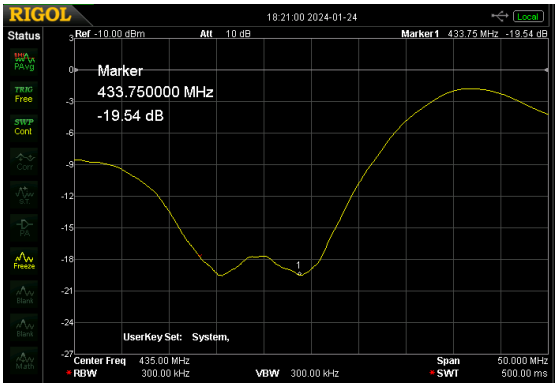
70 cm MOBILE ANTENNAS:



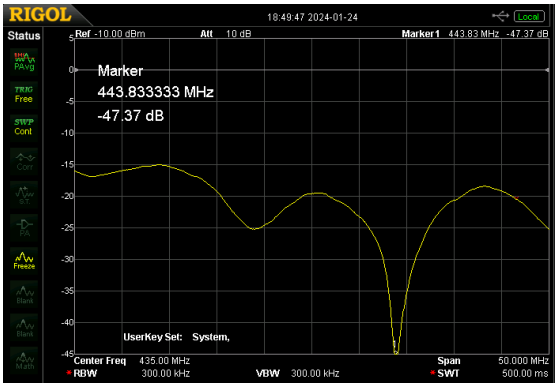
Diamond NR2000NA Mobile
>14dB (443-450), >10dB (439-452)



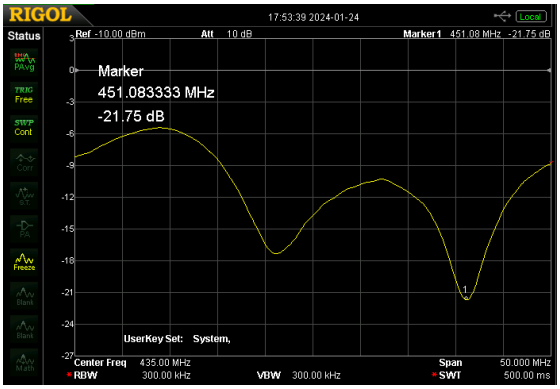
Diamond MR77 Mobile
>14dB (420-437), >10dB (410-443)



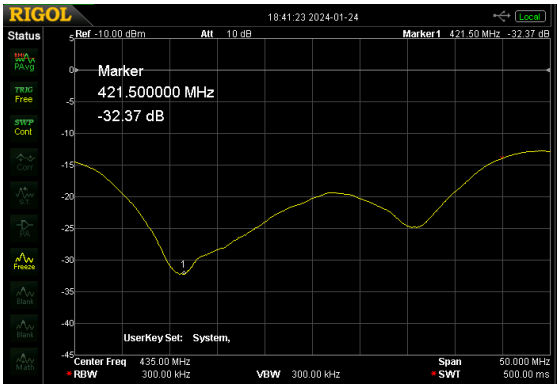
Vmuksan 770R Mobile
>14dB (420-438), >10dB (416-441)



Browning BR-1713-B-S, NMO Mobile
>20dB (425-451)

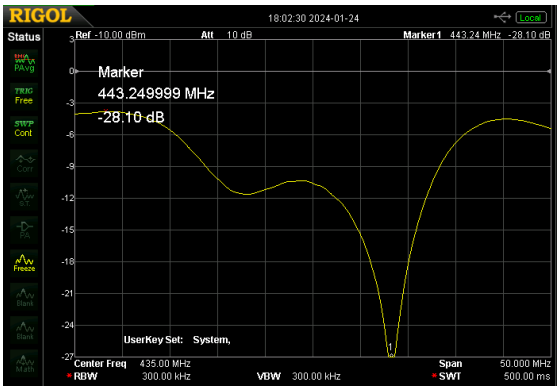


70cm Reference 1/4 Wave Ground Plane
>14dB (429-455), >10dB (426-458)

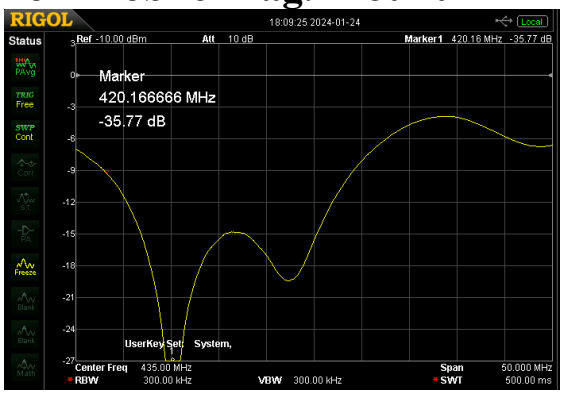


NMO 1/4 Wave Mobile Whip
>14dB (< 410 - 455)

70cm HT WHIP ANTENNAS on Mobile Mag. Mount

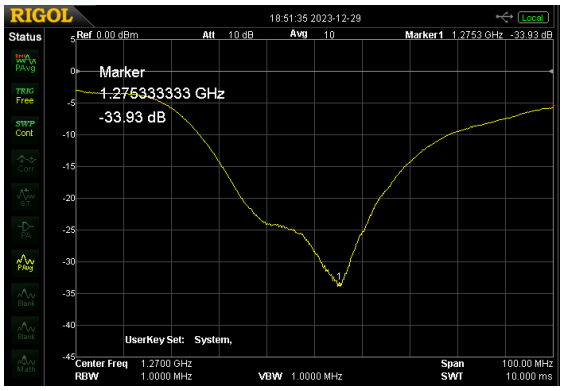


Diamond SRH999 Whip on mag. mount
>14dB (439-446), >10dB (425-448)

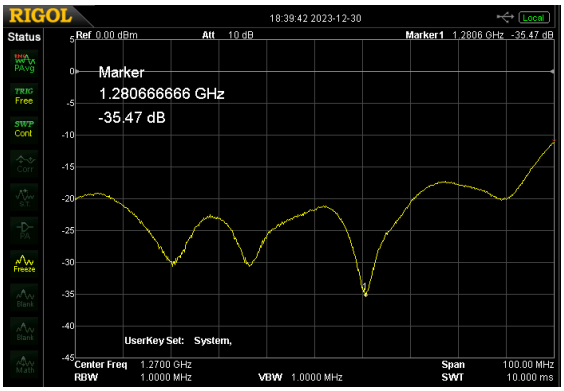


Bingfu BFN00606 Whip on mag. mount
>14dB (416-436), >10dB (414-438)

23 cm YAGI ANTENNAS:

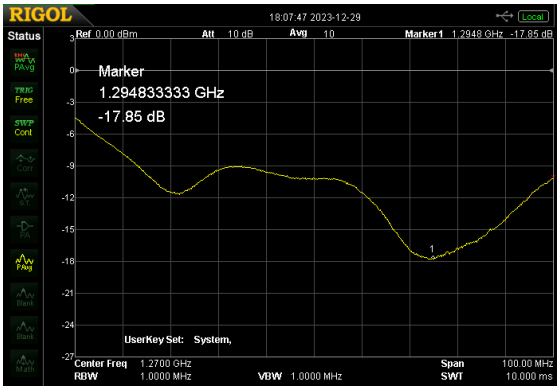


Directive Systems DSE2424LYRMK Yagi
>14dB (1250-1290), >10dB (1246-1298)

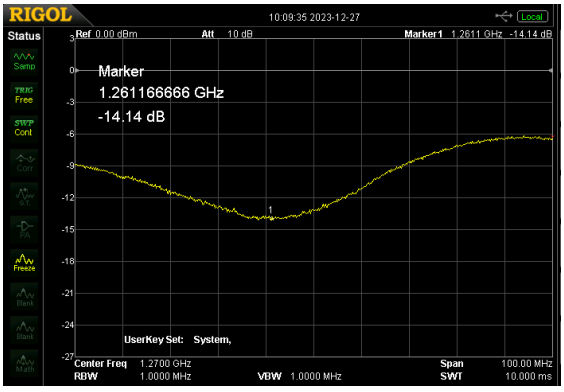


Antennas-Amplifiers 70cm2311WB Yagi
>14dB (1220-1317), >10dB (<1220->1320)

23 cm BASE STATION ANTENNAS:

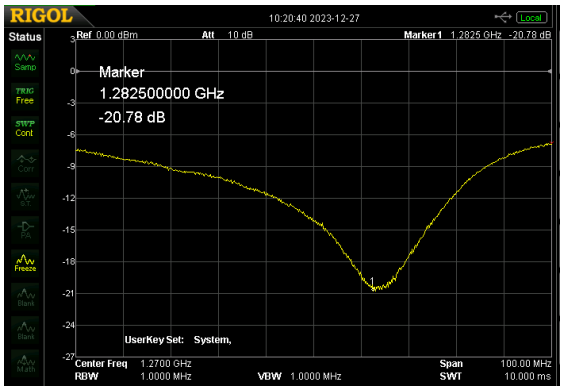


Diamond X-6000
>14dB (1290-1298), >10dB (1253-1300)

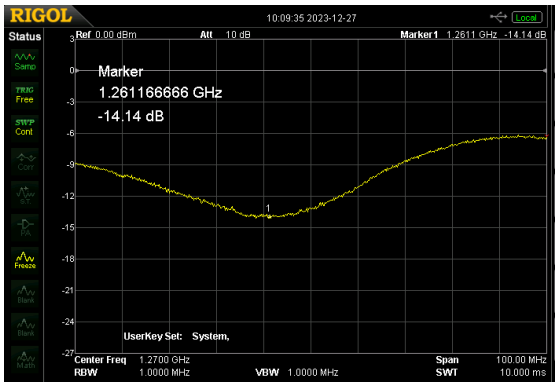


23cm Reference 1/4 Wave Ground Plane
>14dB (NA), >10dB (1231-1284)

23 cm HT WHIP ANTENNAS:

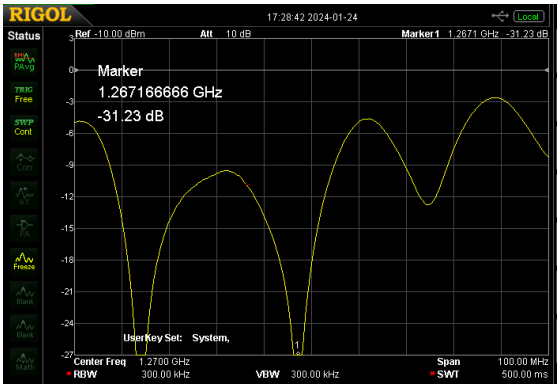


Diamond SRH999 HT Whip
>14dB (1266-1295), >10dB (1239-1303)

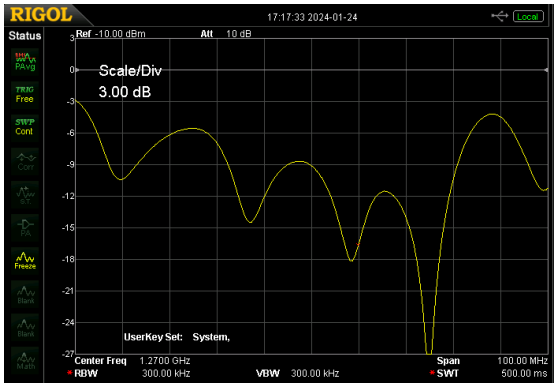


23cm Reference 1/4 Wave Ground Plane
>14dB (NA), >10dB (1231-1284)

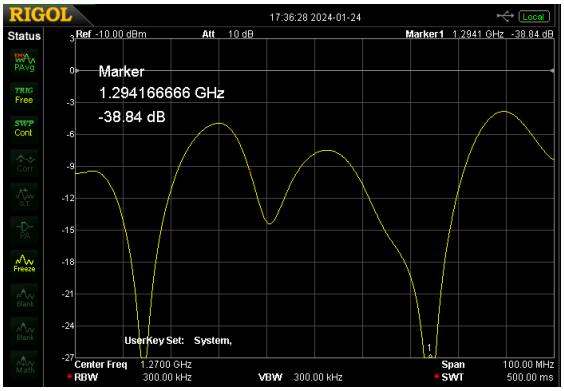
23 cm MOBILE ANTENNAS:



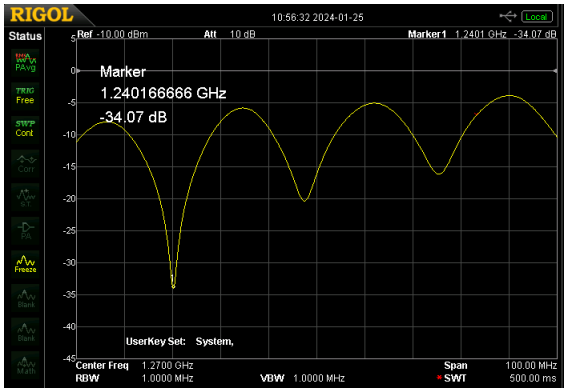
Diamond NR124 Mobile
>14dB (1260-1272), >10dB (1255-1274)



Diamond NR2000N Mobile
>14dB (1290-1298), >10dB (1253-1300)

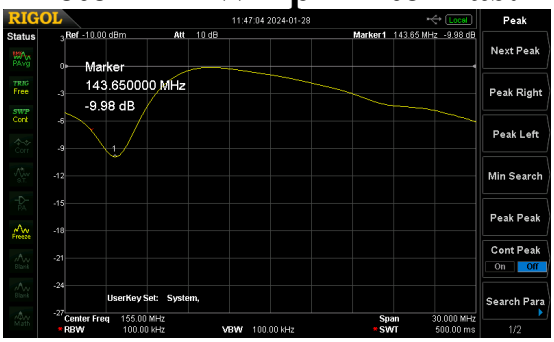


Diamond SRH999 HT Whip on mag. mount
>14dB (1283-1299), >10dB (1279-1301)

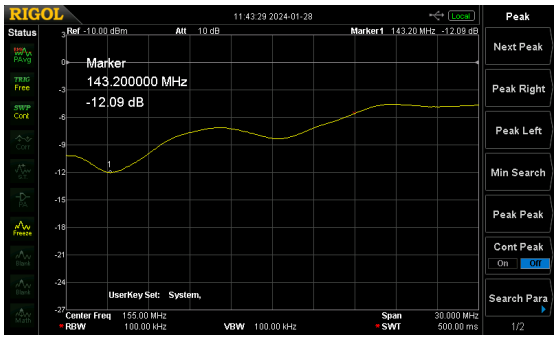


23cm Reference 1/4 Wave Ground Plane
>14dB (1230-1244), >10dB (1228-1249)

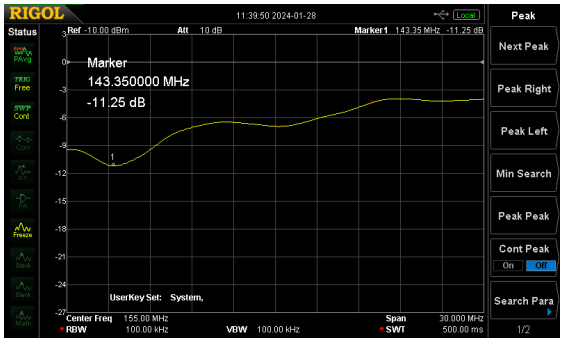
2 meter HT Whip Antennas:



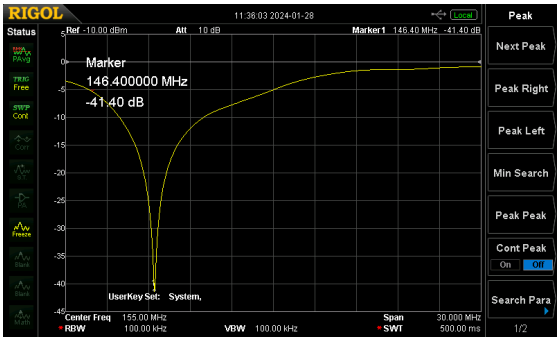
Diamond SRH999 HT Whip Antenna
>10dB (143.6-145.8)



Bingfu BFN00607 HT Whip Antenna
>10dB (140-160)

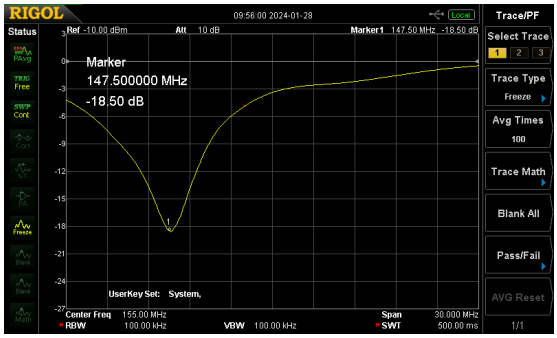


Nagoya/TID NA771 HT Whip Antenna
>10dB (< 140-158)

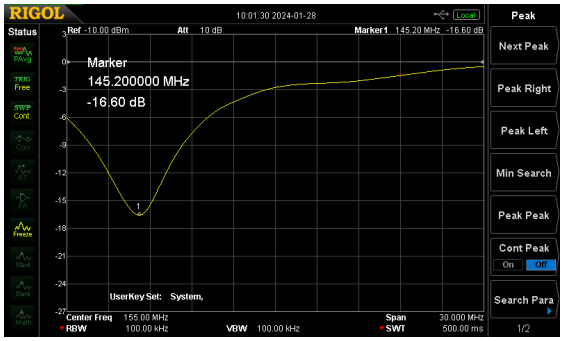


Baofeng 7" 2m/70cm HT Whip Antenna
>6dB (144.3-148.8)

2 meter Mobile Antennas:



Diamond NR2000NA
>14dB (146-149), >10dB (144.5-150)



Vmuksan 770R
>14dB (143.8-146.5), >10dB (142.2-147.9)

All above 2 meter RL plots at: 155 MHz center frequency, 30 MHz span from 140 to 170 MHz. either 3 or 5dB/div vertical and 3 MHz/div horizontal