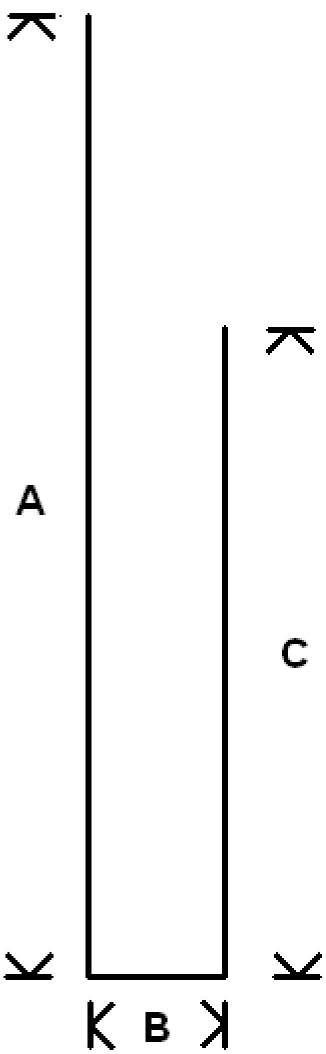
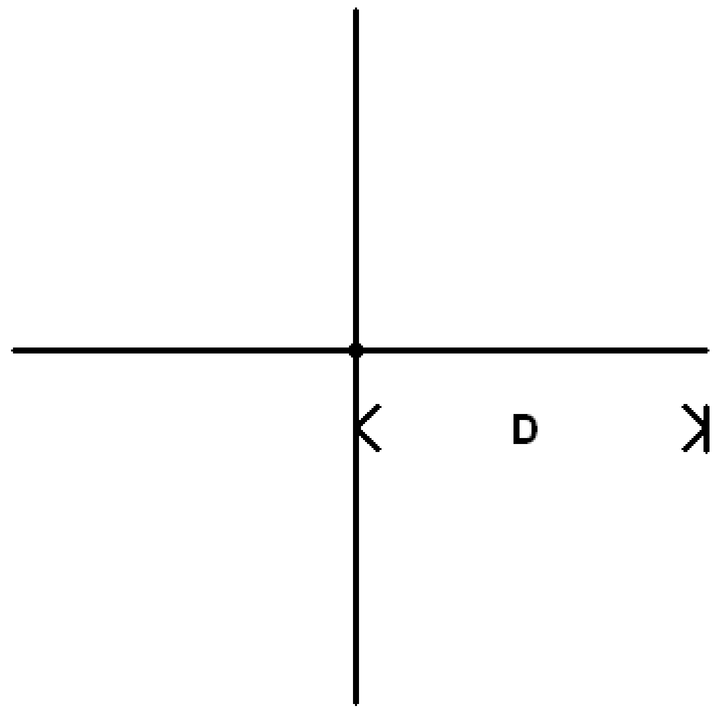
"Sputnik-II"

Economical Multi-Band Antenna

Version 2.0 – 04-01-2010





BANDS:	A	B	C	D
2m – 1.25m – 70cm	19 ½"	1"	12 ⅜"	21"
2m – 70cm	19 ½"	1"	6"	21"

Not To Scale

FLUX RESEARCH

Antenna Versions:

The antenna was originally designed to cover 2m – 1.25m – 70cm in a single ground plane style unit. The design utilizes 2 elements for the radiator, the longer of which operates as a ¼ wave at 2m and a ¾ wave at 70cm. The short element is ¼ wavelength at 1.25m which is also a ½ wave at 70cm and appears to be a short, directing the energy on 70cm to the more attractive ¾ wave element.

¾ wavelength antennas however are not very desirable for ground to ground use because of the large lobe emitted 45 degrees upwards. This trait may be desirable for stations trying to use a repeater at the base of the mountain it is located on or for knife edging DX stations in a mountainous region. The sky wave lobes have approximately 4dB additional gain above the ground wave on this band.

If 1.25m operation is not desired the antenna may be constructed as a 2m – 70cm Dual-Band antenna which has better ground wave performance, by making the shorter element a ¼ wave on 70cm. A slight gain increase is noted on the elevation plane in the direction of the shorter stub in this version; the azimuth pattern is approximately Omni-directional. Please refer to Dual-Band 2m – 70cm Elevation and SWR Charts later in this document.

Bronze welding rod is used as the elements because that was readily available at the hardware store visited during construction of the prototype antenna. Electrical performance will be increased if copper or brass rods 36" in length are obtainable.

Construction Materials:

Item	Description	Qty	Cost Each
Radiator	1/8" x 36" Bronze Welding Rod	1	$2.39
Ground Plane	3/32" x 36" Bronze Welding Rod	4	$1.29
Housing	1 ¼" PVC End Cap	1	$0.49
Mast	Random Length of 1 ¼" PVC Pipe	Per Foot	$1.19
Connector	SO-239	1	$2.39
Coaxial Cable	RG-58	Per Foot	$0.30
Connectors	PL-259	2	$2.39
Reducer	PL-259 to RG-58	2	$0.39
Epoxy	JB Weld	1	$4.49

Construction:

Bend Radiator element into "J" shape according to dimension chart for bands desired. Add an extra ½" – 1" to the dimensions of segments A and C to facilitate trimming for best SWR at target frequencies if desired.

Drill 2, ⅛" holes in PVC end cap to facilitate Radiator element. The holes should be adjacent to each other spaced ½" from top center of the end cap.

Measure 1” from the top of the end cap down the side and draw a line around the circumference of the end cap. Drill 4, 3/32” holes, 90 degrees apart from each other and 45 degrees apart from Radiator element holes.

Dry fit the radiator element into end cap. If spacing is too tight because of segment B, bend a slight “V” shape into the center of segment B with pliers or a vice.

Pre-tin center of segment B with high wattage soldering iron or solder gun. Solder center conductor of the SO-239 connector to the center point of Radiator segment B. Be careful not to melt plastic dielectric of SO-239. Solder in a way that the mounting holes of the connector are 45 degrees to segment B of the Radiator to facilitate Ground Plane connection. A coating of JB weld or equivalent epoxy may be added to protect this connection from the weather and add stability.

Insert Ground Plane rods into the side holes in end cap. Using needle nose pliers, bend the ground rods ¼ - ⅜” from the end 90 degrees. Push each rod towards center of end cap and tin with solder individually so that the PVC does not melt. Pull rods towards outer of cap after cooled.

Insert the Radiator into end cap. Pull Radiator elements 1 at a time with pliers to bring connector into PVC housing. Position the ends of the radials so that they go through the SO-239 mounting holes. Continue pulling radiators so that SO-239 sits flush with Ground Plane radials.

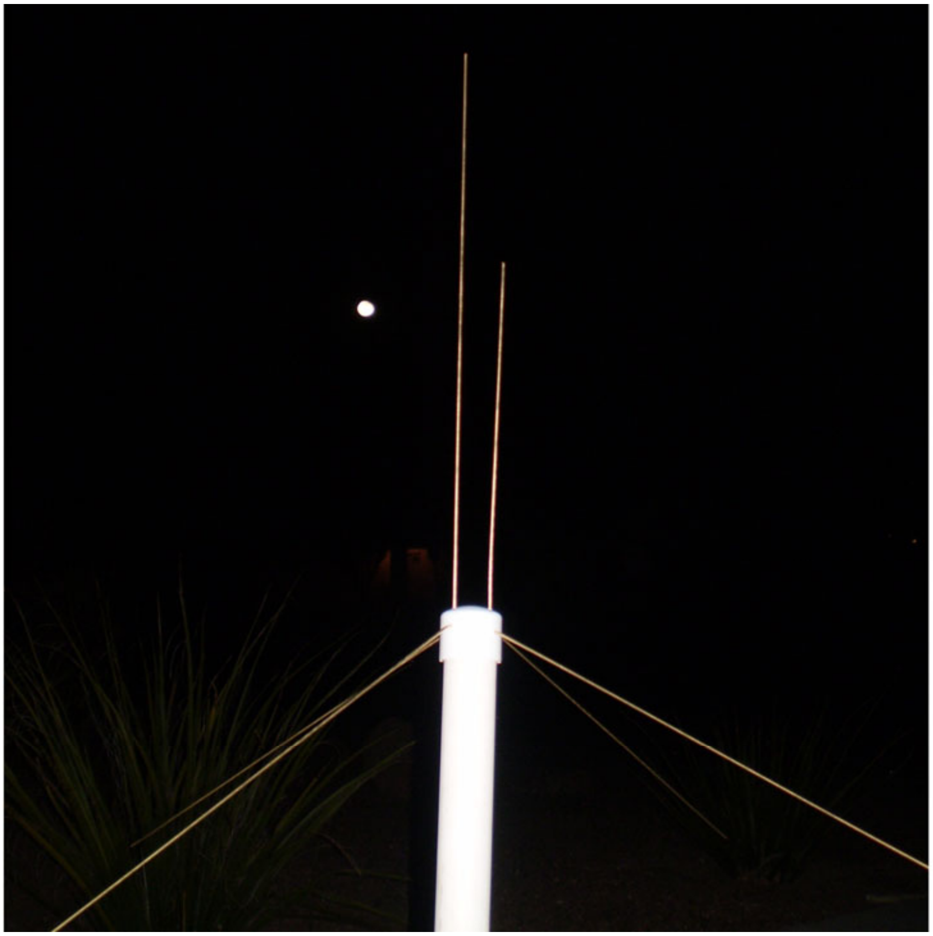
Bend the radials now coming through the holes in the SO-239 an additional 90 degrees outwards from the connector, this makes a better physical connection and it makes room for the PL-259 when attached. Solder Ground Plane radials to SO-239, take care not to melt the plastic dielectric of the connector or touch the PVC end cap.

Apply a liberal coating of JB weld to the interior of the end cap to secure Radiator and Ground Plane to housing and allow it to dry, if there is not enough room to get at the Radiator the epoxy may be added to the exterior of the end cap instead.

Construct or purchase a pre-made jumper cable from the desired coax and connector types. RG-58 is recommended for installations 25’ or less from the antenna. RG-8 type should be used for distances exceeding this. Connect cable to SO-239 and mount assembly on PVC pipe. Do not glue the end cap to pipe to allow coax maintenance if necessary.

Bend the radials approximately 45 degrees downwards and trim to length listed for segment D.

Tri-Band 2m – 1.25m – 70cm Antenna Construction Prototype:



Tri-Band 2m – 1.25m – 70cm Tuning:

Attach a watt meter between the transmitter and antenna. The long element of the Radiator is for 2m and 70cm. Set radio for 147 MHz, Trim ⅛" at a time from the end of the longer element until the SWR is lowest. A small overshoot is acceptable. Do not trim the longer element any further. As the longer element is also a ¾ wave on 70cm, check for acceptable SWR on 442.5 MHz.

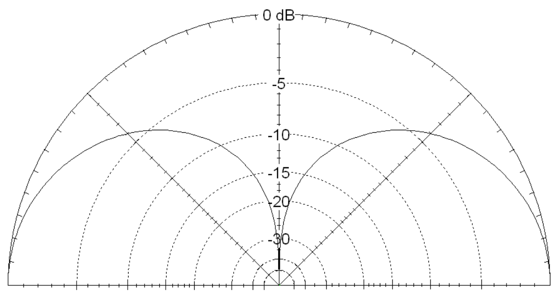
Tune the shorter element for 223 MHz by trimming ⅛" at a time from the end. Trim the shorter element only, do not trim the longer element any further when tuning the higher frequency.

Dual-Band 2m – 70cm Tuning:

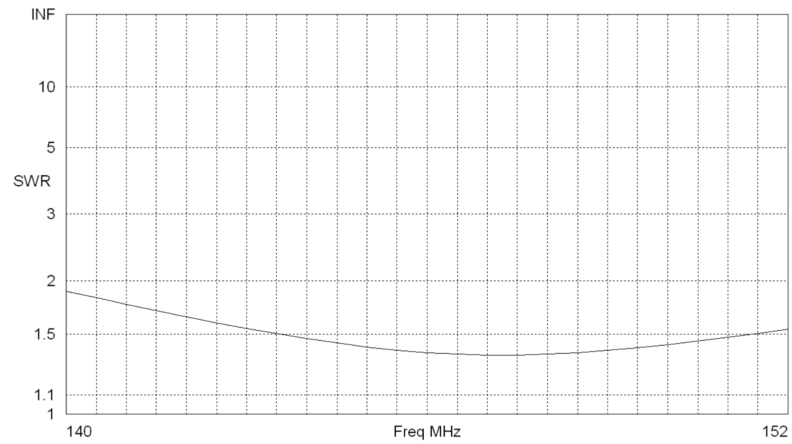
Tuning is the same as the Tri-band version for the longer element; however the shorter element on this antenna is tuned to 445 MHz instead. It should be noted that trimming the shorter element will have less visible effect than tuning the longer element did as both are resonant at 70cm.

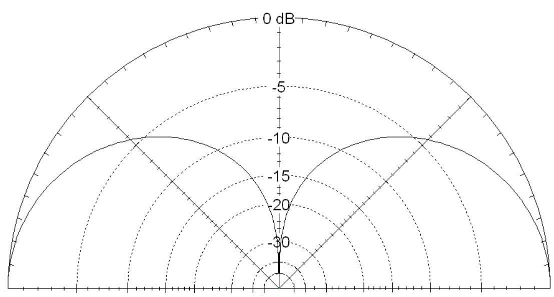
A return loss bridge may be used for tuning instead of a watt meter if one is available.

Tri-Band 2m – 1.25m – 70cm Elevation and SWR Charts:

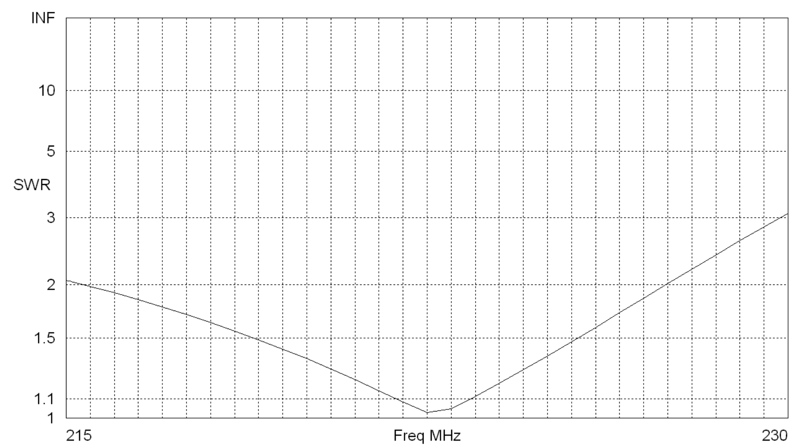


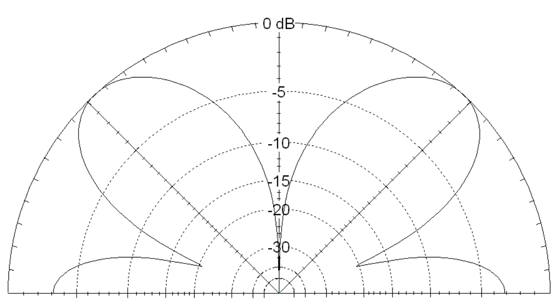
147.5 MHz



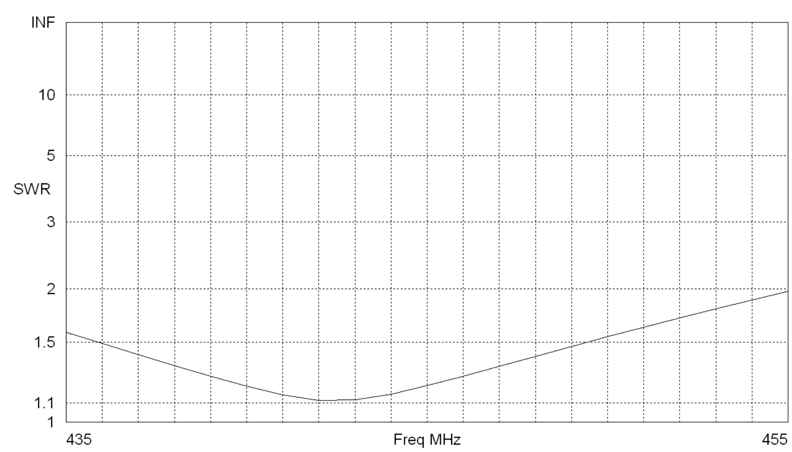


222.5 MHz





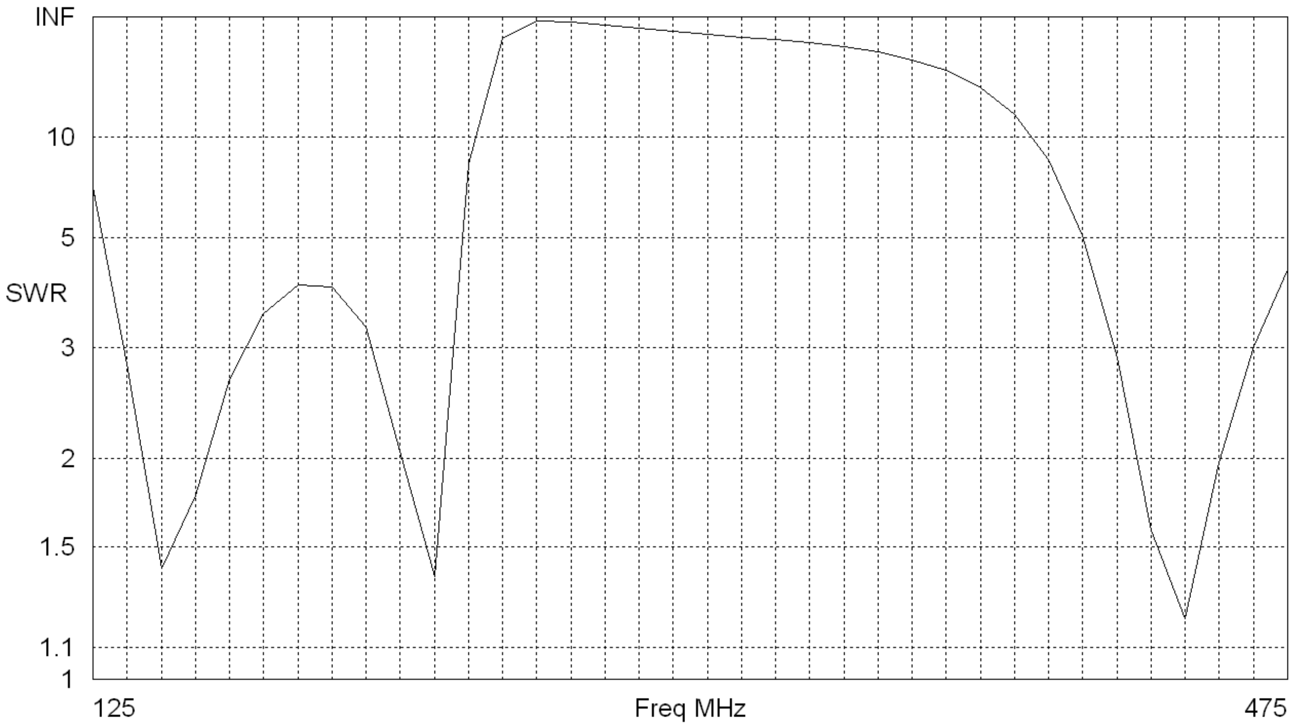
442.5 MHz



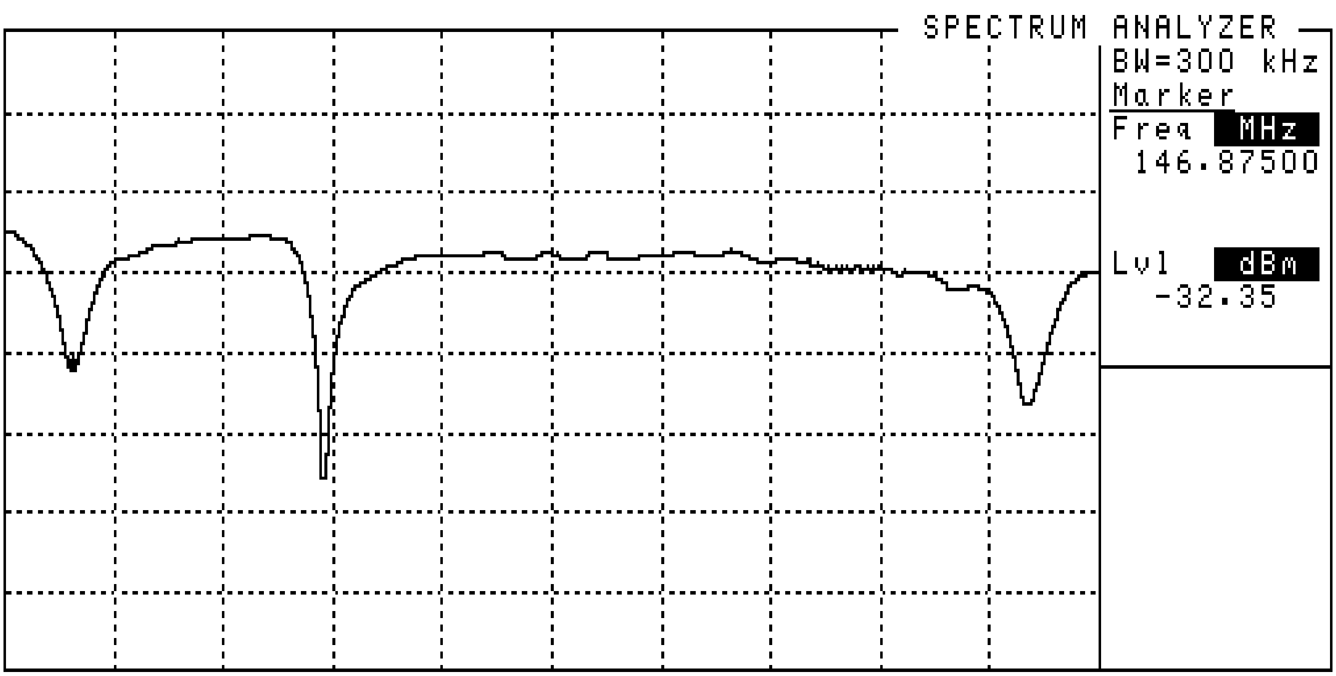
Tri-Band 2m – 1.25m – 70cm Theoretical Gain in to Radio Horizon:

2m = 5.3 dBi, 1.25m = 6.6dBi, 70cm = 2.7dBi

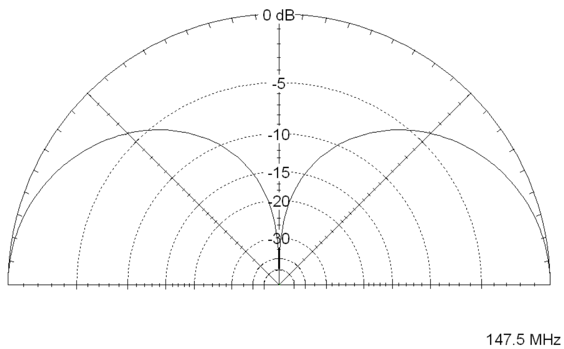
Tri-Band 2m – 1.25m – 70cm Theoretical SWR:

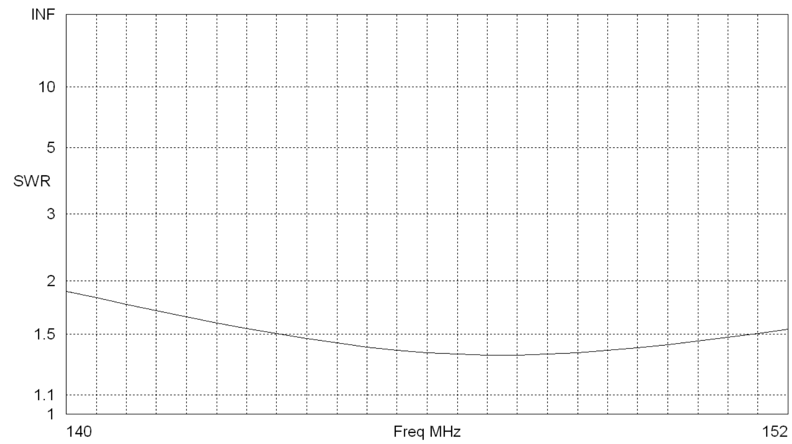


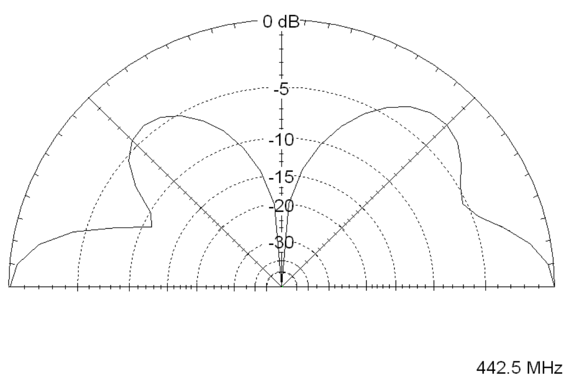
Tri-Band 2m – 1.25m – 70cm Measured Return Loss:

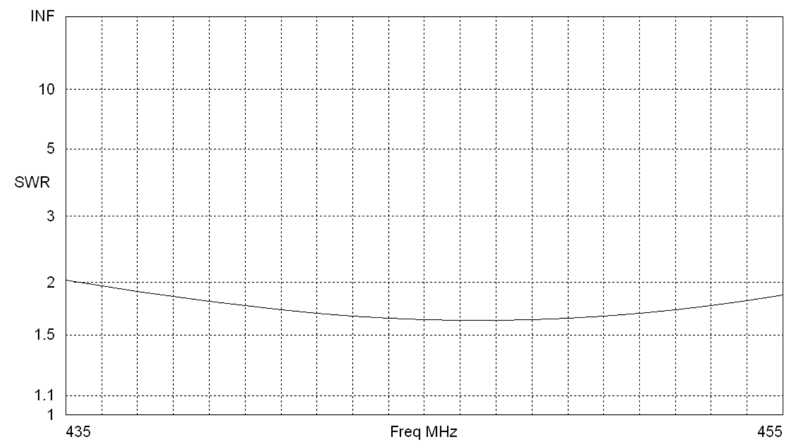


Dual-Band 2m – 70cm Elevation and SWR Charts:









Dual-Band 2m – 70cm Theoretical Gain in to Radio Horizon:

2m = 5.0dBi, 70cm = 6.4dBi

Photographs, Frequency plots and Elevation data by: Matt Krick, K3MK
Measured Return Loss Equipment by Hewlett Packard and Eagle
Theoretical Patterns Plotted with EZNEC v5.0 by Roy W. Lewallen