220mhz Antenna Topics

By

The 220 MHz Guys Amateur Radio Club

220mhz Antenna Topics

Ground Plane	**¼ wave Ground Plane 30° to 45° elevated radiation pattern. Omnidirectional radiation pattern.**	
Slim-Jim(J-pole)	**About + 2 Dbi over ¼ wave ground plane – Horizontal radiation pattern Omnidirectional radiation pattern.**	
Beam	**About +7 to +19 Dbi (depending on number of elements) over a ¼ wave ground plane – Horizontal directional radiation pattern.**	
Coax:	**RG-213 – 3.3dB loss @ 100 Ft.**	**$.081 per foot 0.405 in. O.D.**
	RG-8X - 5.4dB loss @ 100 Ft.	**$0.59 per foot 0.242 in. O.D.**
	RG-58 – 7.3dB loss @ 100 Ft.	**$0.27 per foot 0.195 in. O.D.**
	RG-174 – 11.9dB loss @ 100 Ft.	**$0.24 per foot 0.110 in. O.D,**
Connectors:	**Types – Male, Female**	
	Adapters – One Piece, Pigtailed	

Polarization:

Horizontal – CW, Side Band

Vertical – FM

Propagation:

Ground Wave – Line of sight, Multipath

Skip – Meteor scatter, Sporadic E layer

Moon Bounce – Reflecting off the Moon

Building Antenna:

Ground Plane

Slim-Jim

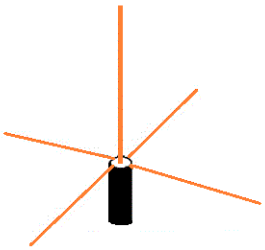
Beam

Costs approximation:

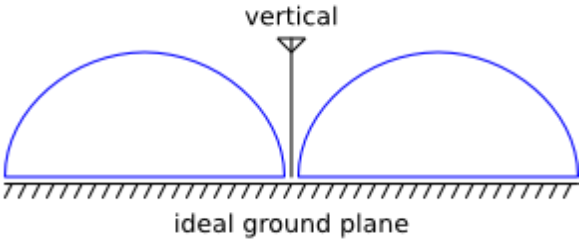
The 220 MHz Guys Amateur Radio Club

220mhz Antennas

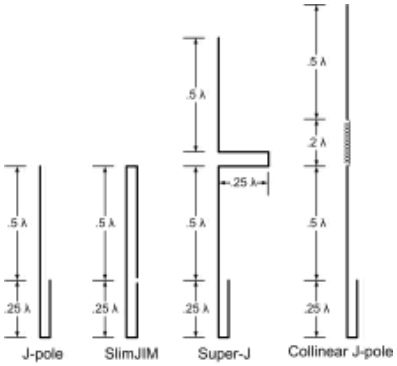
Ground Plane

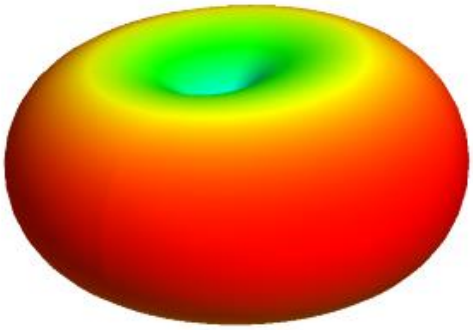


MONOPOLE WITH GROUND PLANE RADIALS

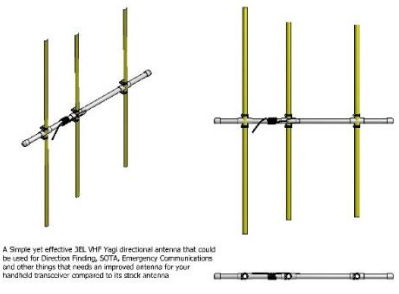


J-Pole or Slim-Jim

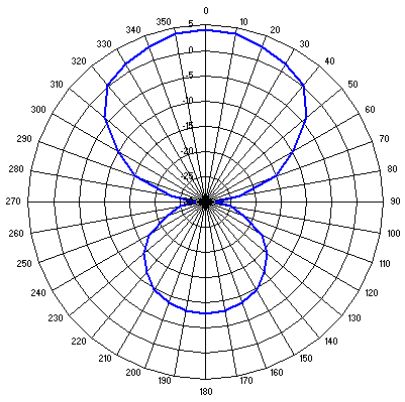




Beam



A Simple yet effective 3EL VHF Yagi directional antenna that could be used for Direction Finding, SOTA, Emergency Communications and other things that needs an improved antenna for your handheld transceiver compared to its stock antenna



https://www.wm9w.org/ 224.520 with (-) offset and PL of 110.9 Echolink: WM9W-R (Node 218858)
10/16/2017

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Ground Plane Antenna:

A ground plane antenna consists of a center vertical ¼ wave element and four horizontal ¼ wave elements. This configuration gives an omnidirectional radiation pattern. The radiation pattern is raised slightly from the perpendicular plane of the vertical element. This means that the signal is aimed slightly above the horizon. To lower the radiation pattern closer to the horizon, the horizontal elements are usually bent downward 30 to 45 degrees.

This type of antenna when used for frequencies 50 MHz and below is usually mounted on the ground, with the horizontal radiators running along the ground. In our case (220 MHz) if we mounted our ground plane on the ground, most of our signals would be absorbed, or blocked from objects close by on the ground. This would include bushes, trees, houses, cars etcetera. With our horizontal radiators and vertical radiator mounted up high, we can hear more, and be heard more.

J-Pole or Slim-Jim Antenna:

A J-Pole or Slim-Jim antenna consists of a vertical ¼-wave element and a vertical ¾-wave element. With the way these two elements are fed with your coax, no horizontal radiator elements are needed. The radiation pattern of this antenna is also omnidirectional and perpendicular to the plane of the antenna. This type of antenna is best when mounted above nearby objects.

A nice feature about this type of antenna is that it can easily be made to be portable. If the antenna is made out of 300-ohm twin lead wire, it can handle only about 35 watts.

This type of antenna should have a choke installed close to the feed point. This will improve the SWR by keeping most of the reflected RF off the feed line. *Oh, and by the way this type of antenna **cannot** be strapped to a metal or conductive pipe or pole. You can hang it from a tree, or mount it to PVC or a wooden pole.*

Beam Antenna:

A Beam antenna consists of a ½ wave driven element, a reflector element, and one or more director elements. The reflector element is longer than the driven (the one with the coax attached) element. The director element(s) are shorter than the driven element. The radiation pattern of this type of antenna is directional, with the director element pointing the main direction. The more director elements the antenna has, the tighter the beaming direction. This antenna can be either vertically or horizontally mounted.

The nice feature about this type of antenna is that you can aim it at where you want to talk or hear. These are good for Fox Hunting, and reaching station that are outside the range of an omnidirectional antenna.

This type of antenna should have a choke installed close to the feed point. This will improve the SWR by keeping most of the reflected RF off of the feed line.

The transmitting and receiving antenna should be of the same polarization for the best performance possible. Mixing the polarization could cause up to a 20db loss of received signal strength. *(And that is a lot of loss)*

Coax Loss

Attenuation (dB per 100 feet)

Coax Cable Signal Loss (Attenuation) in dB per 100ft*								
Loss*	RG-174	RG-58	RG-8X	RG-213	RG-6	RG-11	RF-9914	RF-9913
1MHz	1.9dB	0.4dB	0.5dB	0.2dB	0.2dB	0.2dB	0.3dB	0.2dB
10MHz	3.3dB	1.4dB	1.0dB	0.6dB	0.6dB	0.4dB	0.5dB	0.4dB
50MHz	6.6dB	3.3dB	2.5dB	1.6dB	1.4dB	1.0dB	1.1dB	0.9dB
100MHz	8.9dB	4.9dB	3.6dB	2.2dB	2.0dB	1.6dB	1.5dB	1.4dB
200MHz	11.9dB	7.3dB	5.4dB	3.3dB	2.8dB	2.3dB	2.0dB	1.8dB
400MHz	17.3 B	11.2dB	7.9dB	4.8dB	4.3dB	3.5dB	2.9dB	2.6dB
700MHz	26.0dB	16.9dB	11.0dB	6.6dB	5.6dB	4.7dB	3.8dB	3.6dB
900MHz	27.9 B	20.1dB	12.6dB	7.7dB	6.0dB	5.4dB	4.9dB	4.2dB
1GHz	32.0dB	21.5dB	13.5dB	8.3dB	6.1dB	5.6dB	5.3dB	4.5dB
Imped	50ohm	50ohm	50ohm	50ohm	75ohm	75ohm	50ohm	50ohm

*** Note:** Coax losses shown above are for 100 feet lengths. Loss is a length multiplier, so a 200 ft length would have twice the loss shown above and a 50 ft length would have half the loss. This multiplier factor is why you should keep cable installation lengths between radios and antennas as short as practical!

	Power Input		
Db Loss	1.5w	5w	10w
1	1.2 w	3.97w	7.94w
2	0.95w	3.15w	6.31w
3	0.75w	2.51w	5.01w
4	0.60w	1.99w	3.98w
5	0.47w	1.58w	3.16w
6	0.36w	1.26w	2.51w
7	0.30w	1.00w	2.00w
8	0.24w	0.79w	1.58w
9	0.19w	0.63w	1.26w
10	0.15w	0.50w	1.00w

Coax Loss

Often overlooked, is the loss of the RF signal in the coax cable connecting your radio to your antenna. This loss goes both ways, transmitted signal, and received signal.

Let us say your antenna is 40 feet from your transceiver, and you have a run of coax 100 feet long. What do you do with the unneeded 60 feet of coax?

A. Coil it up and make it look nice.
B. Move the antenna 60 feet further away.
C. Shorten the coax by cutting off the unneeded length.

Answer “A” is not a good idea. If you were using RG-8X coax at 220 MHz, the signal reaching the antenna would be reduced by about 70%.

Answer “B” is not that great of an idea either unless you could move the antenna 60 feet higher.

Answer “C” is probably the best way to go. If you were using RG-8X coax at 220 MHz, the signal reaching the antenna would only be reduced by about 35%.

This signal reduction from loss goes both ways. The signal you transmit, and the signal you receive, will be reduced by this percentage.

Selecting what type of coax you will be using will depend on several factors.

1. The frequency range your radio will be operating.
2. The amount of signal loss you deem acceptable.
3. The physical size of the coax.
4. The cost of the coax.

RF Connector Types

PL259

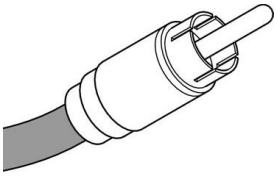
SO239

N Male

N Female

BNC Male

BNC Female



RCA Male

RCA Female

SMA Male

SMA Female

RP-SMA Male

RP-SMA Female

SMA

RF Connector Types

Pl-259/SO-239 connectors:

These connectors are used on most modern base and mobile HF, VHF, and some UHF radios.

“N” type connectors:

These connectors are can be used on UHF radios.

BNC connectors:

These connectors are sometimes used on low power radios as well as some handheld radios.

RCA connectors:

These connectors are normally used for audio but are sometimes found as RF connectors on old low power radios. Heathkit used these on some of their low powered radios.

SMA type connectors:

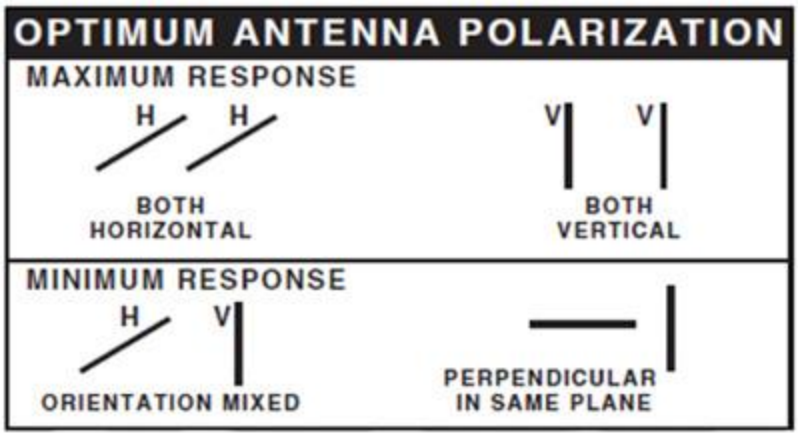
These connectors are used on most newer models of handheld VHF and UHF radios.

Pigtail jumpers:

Pigtail jumpers are used to eliminate extra stress on the handheld antenna connector. These are used to connect your handheld to a larger antenna coax wire. Since most modern handhelds use either a male, or female, SMA type connector. The pigtail, would be an SMA to SO-239 type to connect to your PL-259 connector on your coax antenna feed line.

Polarization

Vertical Vs Horizontal



Vertical Antennas: Ground-Plane, Slim-Jim, J-Pole Vertical Dipole, Vertical Beam.

Vertical antennas are used for FM and Repeaters. These antennas have an omnidirectional radiation pattern.

Horizontal Antennas: Horizontal Dipole, Horizontal Beam.

Horizontal antennas are used mainly with SSB operation. These antennas have a directional radiation pattern. The horizontal dipole antenna transmits and receives in two opposite directions, while the beam antenna transmits and receives in mostly one direction.

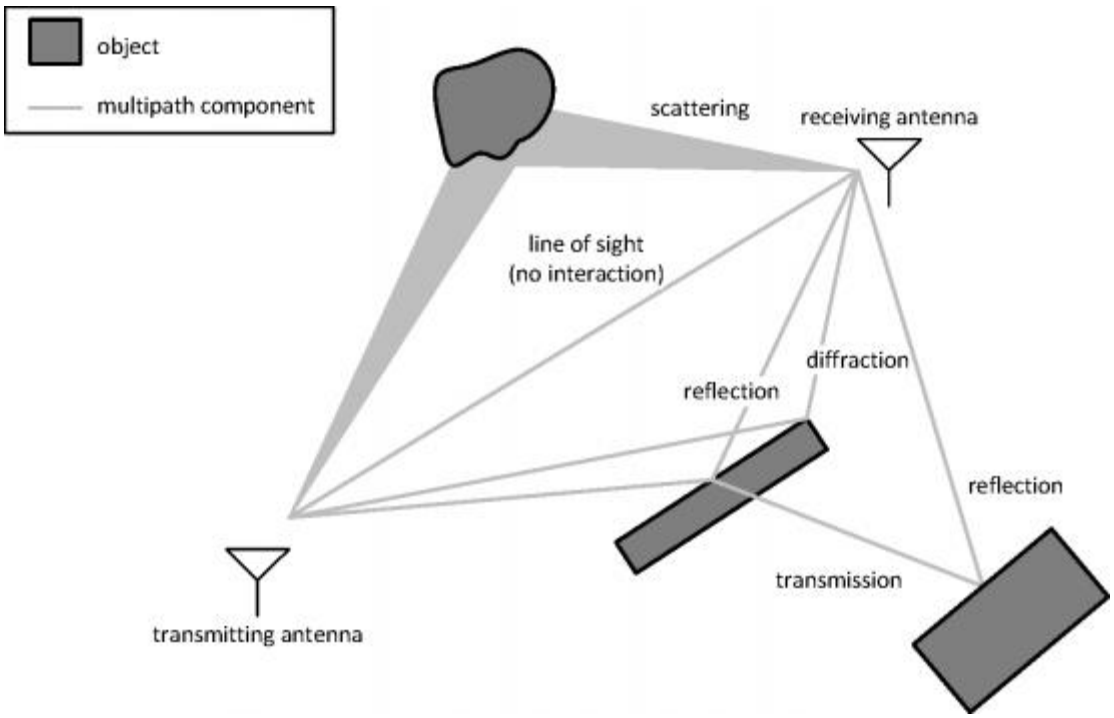
The transmitting and receiving antenna should be of the same polarization for the best performance possible. Mixing the polarization could cause up to a 20db loss of received signal strength. ***(And that is a lot of loss)***

220 Propagation

Ground Wave – Line of sight, Multipath

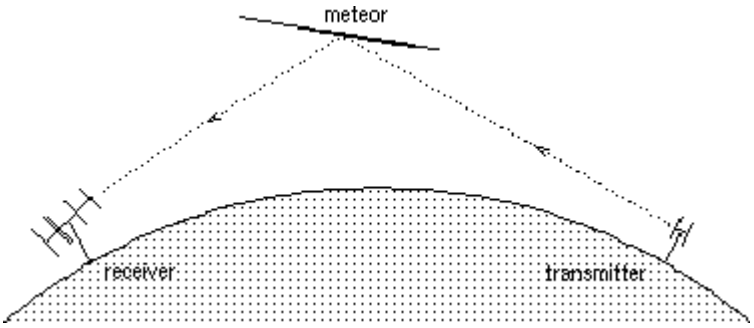
Effects of Fading/Multipath

- Multipath propagation creates small-scale fading effects. The three most important effects are:
  - Rapid changes in signal strength over a small travel distance or time interval;
  - Random frequency modulation due to varying Doppler shifts on different multipath signals; and
  - Time dispersion (echoes) caused by multipath propagation delays.
- Even when a mobile receiver is stationary, the received signal may fade due to a non-stationary nature of the channel (reflecting objects can be moving)

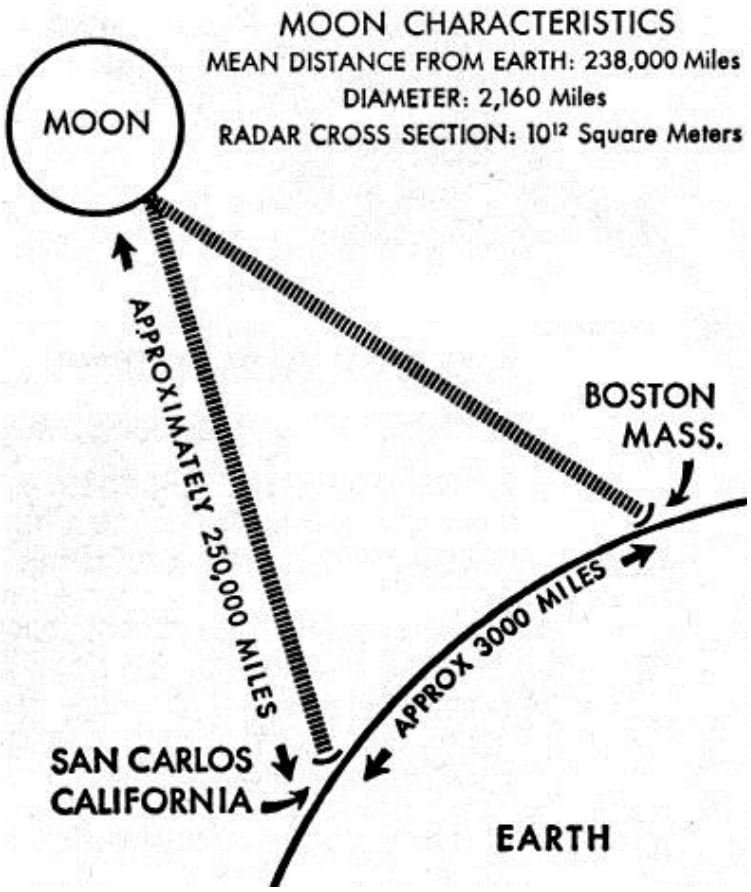


220 Propagation

Skip – Meteor scatter (rare), Sporadic E layer (rare), Tropospheric ducting (rare.)



Moon Bounce – Reflecting off the Moon. *(Requires high power, and a means to track the position of the Moon.)*



220mhz Ground Plane Antenna Build

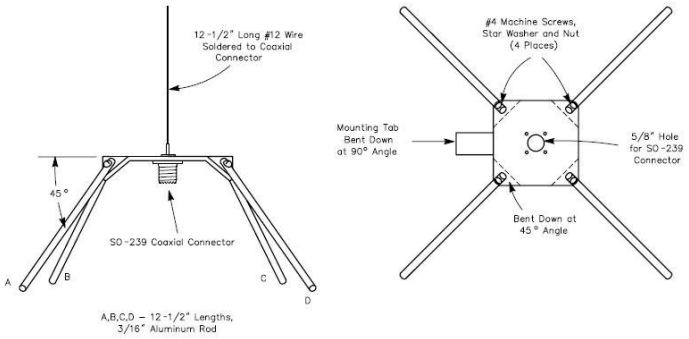


Fig 24—Dimensional information for the 222-MHz ground-plane antenna. Lengths for A, B, C and D are the total distances measured from the center of the SO-239 connector. The corners of the aluminum plate are bent down at a 45° angle rather than bending the aluminum rod as in the 144-MHz model. Either method is suitable for these antennas.

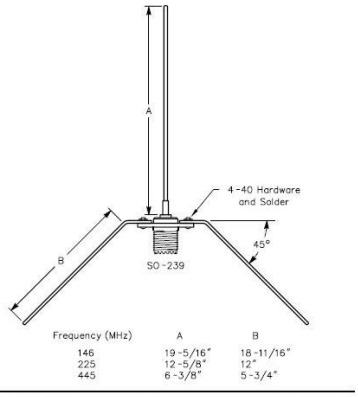


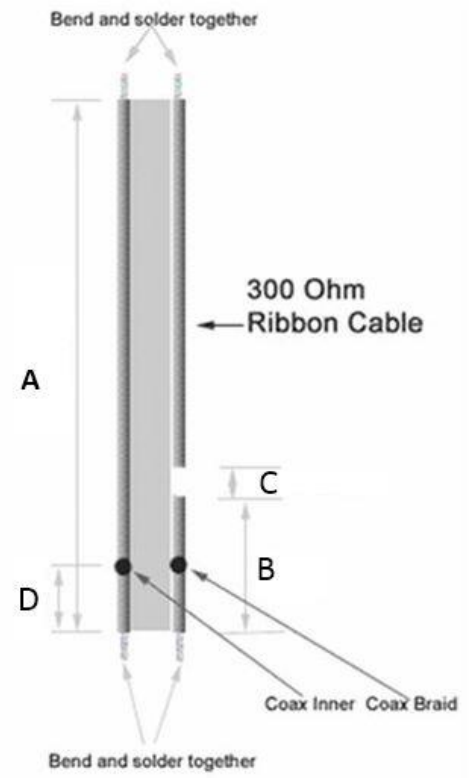
Fig 25—Simple ground-plane antenna for the 144, 222 and 440-MHz bands. The vertical element and radials are 3/32 or 1/16-inch brass welding rod. Although 3/32-inch rod is preferred for the 144-MHz antenna, #10 or #12 copper wire can also be used.

220mhz Slim-Jim Antenna Build

	300Ω	450Ω
Dimension "A" – 3/4 wave ----------	**35.5"**	**36"**
Dimension "B" – ¼ wave ----------	**11.37"***	**11.8"**
Dimension "C" – Gap ----------	**.51"****	**.51"**
Dimension "D" – Adjust for best SWR----	**1.18"**	**1.18"**

***Start with 11.8" and shorten if needed to resonate at desired frequency.**

****Will change if "B" is shortened.**

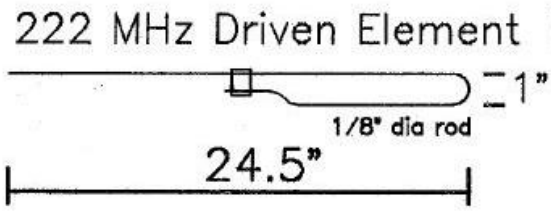


This antenna should have a choke on the feedline just below the ribbon cable. This choke can be made of 5 or 6 turns of the feedline tightly wound around a piece of wooden broom handle, or a piece of PVC.

220mhz Beam Antenna Build

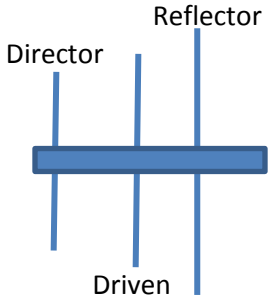
This antenna is peaked at 222.1 MHz, but performance has barely changed at 223.5 MHz.
Mine has the mounting holes drilled so I can mount it Horiz or Vert.

Driven Element for all Versions:



		Ref	DE	D1	D2	D3	D4	
3 Element	Length	26.0		23.75				All Dimensions in Inches
	Spacing	0	5.5	13.5				All Elements 3/16" dia
4 Element	Length	26.25		24.1	22.0			
	Spacing	0	5.0	11.75	23.5			
6 Element	Length	26.25		24.1	23.5	23.5	21.0	
	Spacing	0	5.0	10.75	22.0	33.75	45.5	

This antenna should have a choke on the feedline just below Driven Element. This choke can be made of 5 or 6 turns of the feedline tightly wound around the piece of wooden broom handle, or around a piece of PVC , or the wooden boom.



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220mhz Antenna Cost

Ground Plane				Cost	**Ant. Cost**
	8 Guage Wire	8 Feet	@$0.59 Ft	$4.72	
	SO239 Connector	1	@$1.00	1.00%	
					$4.73

Slim Jim					
(J-Pole)	300 Ω Twin Lead	3 Feet	@$0.49 Ft	$1.47	
	RG-8X Coax	10 Feet	@$0.38 Ft	$3.80	
	PL-259 Connector	1	@$2.50	$2.50	
					$7.77

Beam Wire Type				
8 Guage Wire	13 Feet	@$0.59 Ft	$7.67	
RG-8X Coax	10 Feet	@$0.38 Ft	$3.80	
PL-259 Connector	1	@$2.50	$2.50	
1"x1"x17" Wood Boom	1	@3.00	$3.00	
				$16.97

Beam Tape Measure Type				
Tape Measure 12 Ft	1	@$2.00	$2.00	
Hairpin wire	1 Ft	@$0.25	$0.25	
RG-8X Coax	10 Feet	@$0.38 Ft	$3.80	
PL-259 Connector	1	@$2.50	$2.50	
1"x1"x17" Wood Boom	1	@3.00	$3.00	
Black Tie Wraps 6"	10	@$0.03 Ea	$0.30	
				$11.85

Accessories	
SO239 to SMA Male 8" Pigtail	**$4.90**
20" SMA Female to SO-239 pigtail	**$7.49**

Approximate costs are from “E-Bay”, “DX Engineering”, “Quicksilver Radio”

https://www.wm9w.org/ 224.520 with (-) offset and PL of 110.9 Echolink: WM9W-R (Node 218858)
10/16/2017

SWR Power Loss

VSWR	Return Loss (dB)	Trans. Loss (dB)	Volt. Refl Coeff	Power Trans (%)	Power Refl (%)	VSWR	Return Loss (dB)	Trans. Loss (dB)	Volt. Refl Coeff	Power Trans (%)	Power Refl (%)
1.00	—	.000	.00	100.0	.0	1.64	12.3	.263	.24	94.1	5.9
1.01	46.1	.000	.00	100.0	.0	1.66	12.1	.276	.25	93.8	6.2
1.02	40.1	.000	.01	100.0	.0	1.68	11.9	.289	.25	93.6	6.4
1.03	36.6	.001	.01	100.0	.0	1.70	11.7	.302	.26	93.3	6.7
1.04	34.2	.002	.02	100.0	.0	1.72	11.5	.315	.26	93.0	7.0
1.05	32.3	.003	.02	99.9	.1	1.74	11.4	.329	.27	92.7	7.3
1.06	30.7	.004	.03	99.9	.1	1.76	11.2	.342	.28	92.4	7.6
1.07	29.4	.005	.03	99.9	.1	1.78	11.0	.356	.28	92.1	7.9
1.08	28.3	.006	.04	99.9	.1	1.80	10.9	.370	.29	91.8	8.2
1.09	27.3	.008	.04	99.8	.2	1.82	10.7	.384	.29	91.5	8.5
1.10	26.4	.010	.05	99.8	.2	1.84	10.6	.398	.30	91.3	8.7
1.11	25.7	.012	.05	99.7	.3	1.86	10.4	.412	.30	91.0	9.0
1.12	24.9	.014	.06	99.7	.3	1.88	10.3	.426	.31	90.7	9.3
1.13	24.3	.016	.06	99.6	.4	1.90	10.2	.440	.31	90.4	9.6
1.14	23.7	.019	.07	99.6	.4	1.92	10.0	.454	.32	90.1	9.9
1.15	23.1	.021	.07	99.5	.5	1.94	9.9	.468	.32	89.8	10.2
1.16	22.6	.024	.07	99.5	.5	1.96	9.8	.483	.32	89.5	10.5
1.17	22.1	.027	.08	99.4	.6	1.98	9.7	.497	.33	89.2	10.8
1.18	21.7	.030	.08	99.3	.7	2.00	9.5	.512	.33	88.9	11.1
1.19	21.2	.033	.09	99.2	.8	2.50	7.4	.881	.43	81.6	18.4
1.20	20.8	.036	.09	99.2	.8	3.00	6.0	1.249	.50	75.0	25.0
1.21	20.4	.039	.10	99.1	.9	3.50	5.1	1.603	.56	69.1	30.9
1.22	20.1	.043	.10	99.0	1.0	4.00	4.4	1.938	.60	64.0	36.0
1.23	19.7	.046	.10	98.9	1.1	4.50	3.9	2.255	.64	59.5	40.5
1.24	19.4	.050	.11	98.9	1.1	5.00	3.5	2.553	.67	55.6	44.4
1.25	19.1	.054	.11	98.8	1.2	5.50	3.2	2.834	.69	52.1	47.9
1.26	18.8	.058	.12	98.7	1.3	6.00	2.9	3.100	.71	49.0	51.0
1.27	18.5	.062	.12	98.6	1.4	6.50	2.7	3.351	.73	46.2	53.8
1.28	18.2	.066	.12	98.5	1.5	7.00	2.5	3.590	.75	43.7	56.2
1.29	17.9	.070	.13	98.4	1.6	7.50	2.3	3.817	.76	41.5	58.5
1.30	17.7	.075	.13	98.3	1.7	8.00	2.2	4.033	.78	39.5	60.5
1.32	17.2	.083	.14	98.1	1.9	8.50	2.1	4.240	.79	37.7	62.3
1.34	16.8	.093	.15	97.9	2.1	9.00	1.9	4.437	.80	36.0	64.0
1.36	16.3	.102	.15	97.7	2.3	9.50	1.8	4.626	.81	34.5	65.5
1.38	15.9	.112	.16	97.5	2.5	10.00	1.7	4.807	.82	33.1	66.9
1.40	15.8	.122	.17	97.2	2.8	11.00	1.6	5.149	.83	30.6	69.4
1.42	15.2	.133	.17	97.0	3.0	12.00	1.5	5.466	.85	28.4	71.6
1.44	14.9	.144	.18	96.7	3.3	13.00	1.3	5.762	.86	26.5	73.5
1.46	14.6	.155	.19	96.5	3.5	14.00	1.2	6.040	.87	24.9	75.1
1.48	14.3	.166	.19	96.3	3.7	15.00	1.2	6.301	.88	23.4	76.6
1.50	14.0	.177	.20	96.0	4.0	16.00	1.1	6.547	.88	22.1	77.9
1.52	13.7	.189	.21	95.7	4.3	17.00	1.0	6.780	.89	21.0	79.0
1.54	13.4	.201	.21	95.5	4.5	18.00	1.0	7.002	.89	19.9	80.1
1.56	13.2	.213	.22	95.2	4.8	19.00	.9	7.212	.90	19.0	81.0
1.58	13.0	.225	.22	94.9	5.1	20.00	.9	7.413	.90	18.1	81.9
1.60	12.7	.238	.23	94.7	5.3	25.00	.7	8.299	.92	14.8	85.2
1.62	12.5	.250	.24	94.4	5.6	30.00	.6	9.035	.94	12.5	87.5

The 220 MHz Guys Amateur Radio Club

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