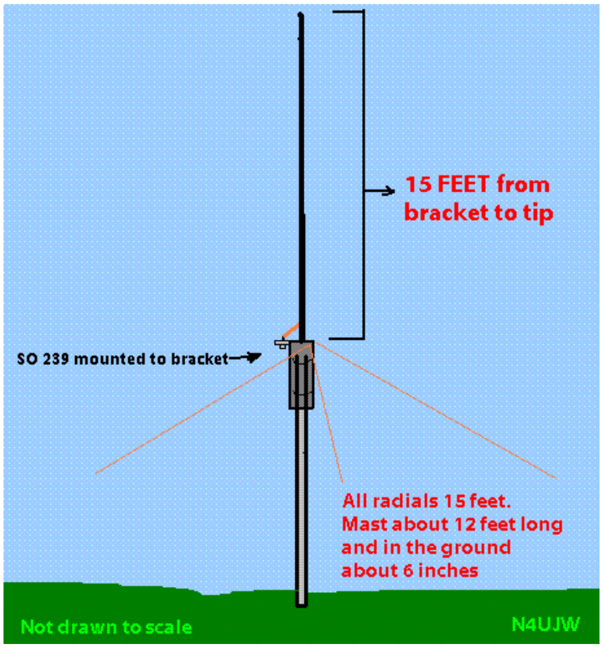
PROVEN ANTENNAS BY N4UJW and KL7JR

Simple to build HF and VHF antennas for Hams and SWLs without all the antenna geek talk!



Don Butler, N4UJW

John Reisenauer Jr, KL7JR

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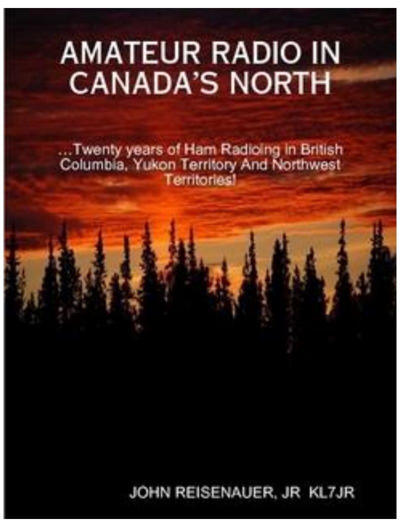
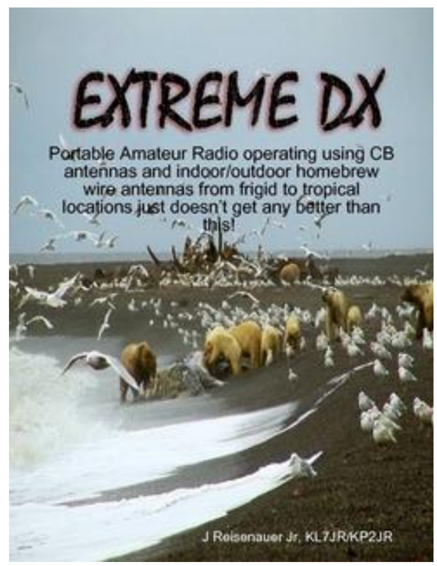
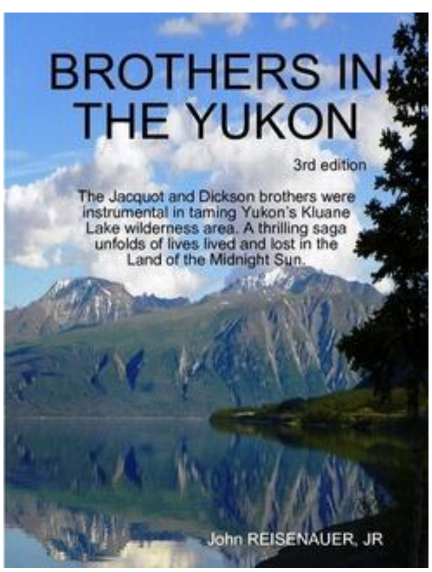
PREFACE

Hello, I'm John Reisenauer, KL7JR. I was first licensed in 1978 as KA7BKI. I have several books available at **LuLu.com** which are large print easy to read, action filled and as real as it gets on portable Amateur Radio DXpeditions or about the land I love- Alaska and the Yukon. I used many of the homebrew antenna designs in this book with very good results in the north. I hope you enjoy the read and thanks for your support! It was fun teaming up w/Don N4UJW! 73, John KL7JR

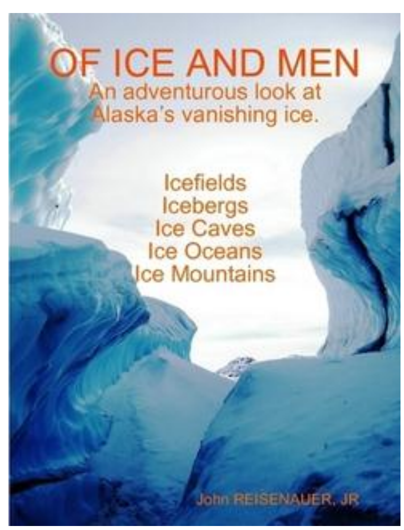
My most popular Amateur Radio books are:







My most popular "other" books:



Hello, I am Don Butler, N4UJW, publisher/owner of Hamuniverse.com. Thank you for reading this far! (It never hurts to put a little humor in!) Also, thank you for helping to support Hamuniverse.com on the web.

If you are an antenna expert, read no further! I am not! But I have always been fascinated by the “magic” of a piece of wire or other rf conductor connected to a transmitter that can send out radio signals to the far reaches of our world and even beyond. And better yet, retrieve those magical wonders to our receivers.

What you are about to read and hopefully use, is a compilation of many easy and fun ham radio and shortwave listening antenna projects that John, KL7JR, and myself have put together in this form that we believe can get you on the air and make those contacts or improve your SW listening experience. The projects are easy to follow and do not contain all those charts, computer simulations, graphs or other techno “geeko stuff" that just takes forever to pass by. You want to get on the air and not take a course in physics!

Many of the antenna projects are for restricted or limited space use and some are not, but they all take little effort and expense to get you on the air. Some are taken from many ideas and knowledge passed on to you and I from all of the many dedicated hams over the past 100 years or so that love antennas. Many are John's and my original designs that we have used and enjoyed.

Several of these antenna projects can be used away from home, camping, backpacking, DXing, field days and more. They range from HF and shortwave listening types, to VHF and beyond types-something for everyone. All of them are in simple, easy to follow instructions.

How it all came together.

John and I had hashed around the idea of putting these projects and information into actual book form but decided that would have been more expensive for you and us. So by using this information in this pdf file form, you can go to it anytime without being on the internet by simply saving it to a file on your hard drive and it would be in its original form as if you saw it on Hamuniverse.com. Your computer will open it much faster than dialup so this is one of the main reasons it is in this form.

These projects are targeted toward the experimenter in you and if you follow the instructions in them, they should work well at your ham station. I stand on the shoulders and dedicate all of my fun with building and experimenting, and using many of them, to all of you who have or do antenna experimenting. Little is left in ham radio these days to experiment with, but antennas top the list.

And last but not least, we have included some helpful hints and tips that you may not have already known. You should be able to “search” this pdf file using the pdf reader you are using. My grateful thanks goes to John, KL7JR, for putting all of this together!

Have fun with ham radio and antennas and never stop experimenting. That is the main thing!

73 from Don, N4UJW

INTRODUCTION

"Antenna experimenting can be one of the most rewarding experiences you can have if you are into ham radio and short wave listening like I am. I have always had a fascination with how a simple wire can retrieve an invisible electromagnetic wave from around us and transfer it into receivers that produce sound, pictures, data and much more useful information. It also fascinates me that the reverse of this works with transmitting the same sound, pictures, and other information over the air waves.

In my contribution to this book along with the wonderful projects and ideas you will see by John, KL7JR, you will see many ideas using simple and cheap antennas that you will enjoy building and experimenting with and at a cost of very little money compared to commercially built antennas. Most of them will work as well or better than the "store bought" antennas. I hope you enjoy them as much as I have and when you build them yourself, you can say, "I built it myself", and be proud of your accomplishment."

73 Don Butler, N4UJW

"I agree with Don, N4UJW 100%. The feeling of accomplishment on the first DX QSO of my homebrew aerials is always totally awesome! I make most of my antennas and not all are winners, but that's what experimenting is all about. How will you know if your "super-duper" antenna idea will work or not if you don't try it? I must admit that dipoles are my least favorite antenna simply because they are usually mono-band, non-gain and limited in coverage. Since I do most of my operating portable from remote areas, I need multi-band, omni-directional coverage and a little gain never hurt anyone! Simply put- I strive for “more bang for my buck”. What antennas do I use most? That would be ¼ wave or ½ wave verticals, including Inverted Ls which are nothing more than bent verticals, and vertical loops. When I only have room to put up one support, I’ll go with a G5RV in an inverted V configuration. Sometimes I’ll throw up something similar to a G5RV and make my legs about 40 feet long and the vertical radiator about 20 or 30 feet long. I’ve had great success using this modified design with a tuner of course. When I finally purchased an antenna analyzer (MFJ 259B), the world of antenna experimenting opened up to me!

73 and have fun antenna building”!

John Reisenauer Jr, KL7JR

[**FRONT COVER-** Converted CB vertical antenna for the Ham Bands sketch by N4UJW, and picture of HI3/KL7JR’s 10 and 12 meter vertical monopole (see March 2012 QST, UP FRONT). **BACK COVER-** Antenna sketch of a Delta Loop by N4UJW and picture of HI3/KL7JR’s Stealthy Vertical Loop (see September 2012 QST, UP FRONT).]

1. DIPOLES

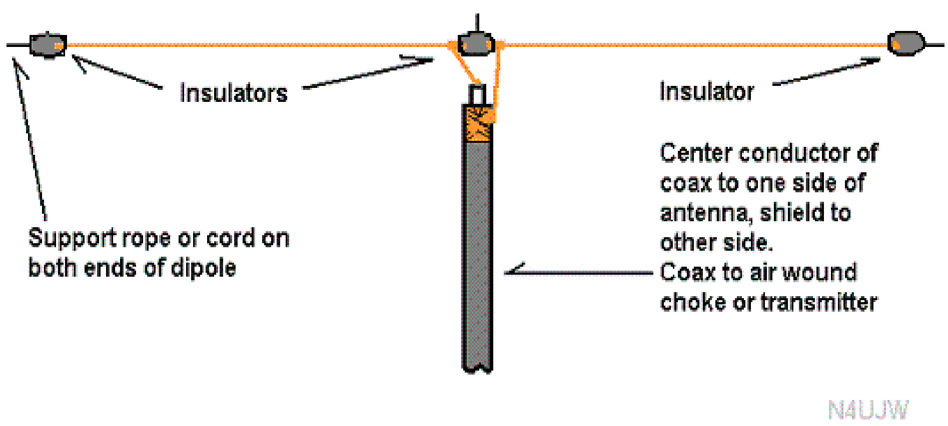
Dipoles are the most common antenna and probably the simplest to make. Beams are no more than dipoles with either a reflector or director or both parallel to the dipole part. A vertical dipole is just what it says. It will even yield some gain where as a horizontal dipole does not. You can build them as a single or multi-band aerial. Let's get started.

Build a 10 Meter Technician Class Dipole

Get on 10 Meters fast with this basic 10 Meter Dipole project!

by N4UJW

This 10 meter dipole project will enable you to start using your new HF privileges as a Technician class operator on 10 meter SSB between 28.300 MHz and 28.500 MHz. It is a half wave dipole designed for the center frequency of 28.400 MHz but should cover most of this 200 KHz spread with low SWR. This project shows the 10 meter dipole in the



horizontal configuration but may also be installed in the inverted V fashion. Since any dipole is considered a balanced antenna, it should be used with an air wound choke to help eliminate rf on the coax. See the "**Ugly Balun Project**" at Hamuniversedotcom for instructions on how to build one from coax. Building the 10 meter dipole is very easy and simple construction is used with very inexpensive materials you may already have laying around the shack. (See drawing)

It consists of 2 equal lengths of #12 or #14 wire insulated in the center and on each end and supported with rope, nylon cord, etc. from both ends and the center if needed.

The insulators can be homebrewed from any non-conductive material that will withstand the rigors of mother nature such as glass, plexiglass, painted wood, pvc, heavy plastic, commercially made insulators,etc. The center insulator actually can be used as a dual purpose device, both for support at the center and to prevent the two outer radiators from touching. It should be made heavier and a bit larger to handle the weight of the entire antenna, coax and support ropes. Remember that it contains all connections to the antenna and some method must be used to secure them from separating from each other due to wind load, etc. such as plastic wire ties to eliminate strain on the coax end.

The center support rope at the insulator may not be needed depending on how much the completed assembly droops when put up between the end supports. Don't suspend it between trees unless some method is used on the ends to prevent tension from breaking the wire if the wind blows. It is fed with standard 50 ohm coaxial cable, from the center of the dipole with the center conductor attaching to one side of the dipole and the shield of the coax to the other side. The type of coax is up to you but the larger coax like RG8 will give a bit less loss depending on feed line length. The coax should come away from the dipole at a 90 degree angle to the wire if at all possible when tuning and in the final installation. It does not matter which side is connected at the coax just as long as neither side of the antenna is shorted to the other side, hence, the insulator in the middle. Seal all connections at the coax end where it connects to the antenna including the end of the coax. This keeps water out. From the antenna, the coax should go to an air wound choke at the antenna as mentioned above using the same coax that would go to the transmitter. NOTE: Rather than have connectors at each end of the air choke, just make the feed line coax about 18 to 21 feet longer than needed to reach from the transmitter to the antenna and then wind your coil on the form and attach to the antenna. Here is the standard formula used for half wave dipoles that you should already know and it is used for the overall length of the radiating elements. NOTE! It is always better to start LONGER with each half of the dipole than the formula results below! No two antennas will perform the same in all locations with the formula! It is much easier to cut than add wire to a dipole.

468 / freq. (MHz)= total length in feet: Example:

468 / 28.400 MHz = 16.478 feet (total length end to end in feet)

Round off 16.478 feet to about 17 to 18 feet total length, end to end, for swr tuning. Don't forget to feed it in the exact center giving you 2 equal legs on each side of the center insulator. Do not attempt to tune the antenna on the ground! It must be raised to its final operating height for tuning! If you have an MFJ 259B analyzer or equal, your tuning will be much quicker and you can do it off the air!

After you have built the antenna, raise it to the final operating height, (the higher the better), tune your transmitter to 28.400 MHz, listen for unused frequency and using the AM, CW or tune mode with very little power, (just enough to get a reading on your SWR meter), transmit your call sign and say testing; (here again assuming you have a clear frequency)......immediately check SWR, say you're call sign again and "Test clear, unkey, trim short equal amounts from each end, again listen for unused frequency, and repeat on the air "Testing" with your call sign, key up, check SWR again, unkey, repeat as needed for lowest SWR on 28.400 MHz so you will be centered in the Tech portion of the band. Once you have tuned it for lowest SWR, make certain you have all supports firmly tied down and you are ready for some fun on 10 meter SSB!

Added notes of interest: If the dipole is installed in a horizontal (flat top) fashion, it will tend to be bi-directional, meaning that it will transmit and receive equally well at 90 degrees (broadside) to the antenna and very little off each end.

A more popular method of installing it is in the inverted V fashion which will yield you a more omni (all direction) pattern. You will have to compensate with the swr tuning using this method as it may be different from horizontal mounting. For an inverted V, simply have the center higher than the ends, like an upside down V. Don't bring both ends together. Use about a 45 degree angle from the center insulator. Performance: The dipole has no gain compared to a yagi (beam) antenna. The dipole is used as a reference antenna for comparison of other types of antennas and is usually referenced as 0 db gain or in technical terms 0 dbd. The "d" at the right side of 0 dbd represents the reference (dipole). It is a standard, basic antenna and the most widely used of all antenna types. A reference to a dipole is much more realistic when comparing antennas. Until the 11 year sunspot cycle starts to climb, activity on 10 meters (DX) will be very difficult and limited.

The band will be most active during the daylight hours (when it is "open"), but very good "local" contacts will be made using ground wave coverage anytime, so don't expect to set the world on fire until the 11 year cycle really starts to climb! Then the world will open up to you with stations from around the world. When the sun spot cycle is at its peak, it is very common to work around the world with 5 watts SSB using a 10 meter dipole!

More about dipoles!

A dipole antenna is a straight electrical conductor measuring 1/2 wavelength from end to end and connected at the center to a radio-frequency (RF) feed line that is connected to the transmitter/receiver. This antenna, also called a doublet, is one of the simplest and most basic types of antennas, and makes up the main RF radiating and receiving element in various sophisticated types of antennas. The dipole is inherently a balanced antenna, because it is bilaterally symmetrical or contains equal conductors on each side of the feed point.

Ideally, a dipole antenna is fed with a balanced, parallel-wire transmission line. However, this type of line is not extremely common and its impedance does not match the output of most ham transceivers. It is extremely low loss however, and due to this fact, it is often used by hams and can be matched to most 50 ohm output radios. This is usually done with a matching transformer called a balun, which is a contraction of the words "balanced" and "unbalanced". An unbalanced feed line, such as coaxial cable, can be used, but to ensure optimum RF current distribution on the antenna element and in the feed line, a balun should be inserted in the system at the point where the feed line joins the antenna.

How high should it be in the air?

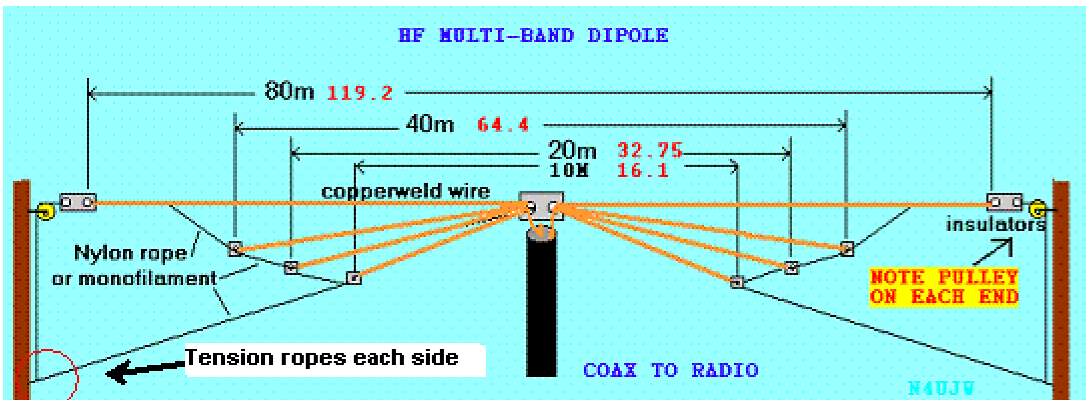
For best performance, a dipole antenna should be at least or more than 1/2 wavelength above the ground, the surface of a body of water, or other horizontal, conducting medium such as sheet metal roofing. The antenna should also be at least several wavelengths away from electrically conducting obstructions such as supporting towers, utility wires, guy wires, and other antennas. This is very difficult to do with most ham installations.

Dipole antennas can be oriented horizontally, vertically, or at a slant. The polarization of the electromagnetic field (EM) radiated by a dipole transmitting antenna corresponds to the orientation of the element. This means that if the antenna is installed with its wire horizontal to the ground, it radiates a horizontally polarized field. If it is installed in a vertical position, then it would be said to have a vertical polarized field in reference to the ground. When the antenna is used to receive RF signals, it is most sensitive to EM fields whose polarization is parallel to the orientation of the element. The RF current in a dipole is maximum at the center (the point where the feed line joins the element), and is minimum at the ends of the element. The RF voltage is maximum at the ends and is minimum at the center. The RF current portion of the antenna is where the maximum rf field is radiated. Enjoy and welcome to the world of HF.

73, Don N4UJW

MULTIBAND FAN DIPOLE

FOR ALL BAND HF ANTENNA EXCITEMENT by N4UJW



Tension rope is not tied to pully rope in picture. It is tied near location of pully rope down on supports within easy reach. It is tied last after final SWR adjustment and the antenna is in it's final position.

Suggested total lengths:
80 meters - 120 feet
40 meters - 65 to 66 feet
20 meters - 34 feet
10 meters - 17 feet
These lengths are not exact. Some tuning may be required. Use the standard formula 468 / freqmhz for total feet for each band (freq) of interest. Adjust each length longer or shorter as needed.

FIGURE 1.

CONSTRUCTION UPDATES FOR EASIER TUNING:

Based on research done by the Stanford Research Institute (SRI) to construct a three-frequency multi-band dipole that would work without any need for cut and try techniques, we pass on this information in the hope that it will help you more easily get this type of antenna on the air quicker.

What they came up with was much improved method over the old cut and prune technique. They found that the wires at the center feed point had to be separated by at least 5 1/2 inches vertically and the ends separated by 38 inches in the 2 to 18 MHz range. By this simple change they found that you could accurately cut the antenna element lengths for given frequencies and eliminate the need for pruning.

In Figure 1. drawing, the lowest frequency antenna is on top and is cut 4% short of the standard 1/2 wave length. (Length in feet= 0.96 times 468 divided by the operating frequency in MHz).

The middle frequency antenna (lower in frequency), is cut for an exact 1/2 wave length. (length in feet= 468 divided by the frequency in MHz) The highest frequency antenna is at the bottom and cut for 1% longer than the 1/2 wavelength (length in feet= 1.01 times 468 divided by the frequency in MHz)

The only construction effort necessary over a standard multi-band dipole is the fabrication of a feed block or center insulator that is about 12 inches vertically by 3 inches wide, made of a good insulating material, such as Lucite, Bakelite, fiberglass, or PVC. The end 38 inches of separation can be maintained by separate halyards on each element or a spreader bar with a common halyard. The bandwidth will be at least plus or minus 2% for a 1.5 to 1 SWR according to Stanford Research Institute.

Older cut and try method below:

CONSTRUCTING THE MULTIBAND DIPOLE: (Older cut and try method)

Here is a fairly simple and easy to build multi band horizontal fan type dipole that can be constructed for all band operation from 160 meters up thru 6 meters or even higher. In the drawing above, it is shown for just four bands, 80 thru 10. One separate dipole for each band needed. However you can build it to suit your own preferences by using the standard formula for a dipole: 468/freq (MHz) = total length for each band. Use the formula for your desired center frequency.

Each dipole length above in **RED** is in feet and tenths of a foot for the center of the General portion of each band and is derived from the above formula and should be cut longer for swr trimming. Use #12 or #14 gauge copperweld wire if possible or use what you have on hand. The top most dipole must support the entire weight of the antenna.

Start with your lowest (in frequency) band of operation as the main (top) support for the entire setup. Cut it per the formula but add a couple of feet on each end for tuning. Try to use a wire size that will support the other dipoles. This is the main support for all the other dipoles and must carry their weight. Cut a dipole for each band of operation. Cut each full length in half....example: for the 10 meter length from the formula you get 16.1 feet for the total length. Cut it in half at about 8 feet per side. Make sure you cut each length about a foot longer for swr trimming and attaching to center and end insulators! If you are building the four band dipole above, you should have 8 lengths of wire scattered all over your work area.

It is assumed that you have your end support poles, trees, center and end insulators, pulleys all ready to go before you start working on the actual dipoles. A very important part of this design is the installation of the pulleys (in yellow on drawing) on each end attached to each side support. They are added to this design due to the swr trimming process and make it very easy to pull the entire antenna up and down while making the swr adjustments. Mount a suitable size pulley on each end attached to your pole, trees, etc. for the diameter of cord or rope used to support the system.

Start your antenna trimming with the top dipole.... attach your coax to the center insulator leaving several inches of the center conductor and shield exposed. Each half of each dipole will be connected to the coax center pigtail and the shield separately. In other words, connect one side of the dipole to the center conductor and the other side to the shield. Attach the other end of each half of the longest wire to the support cord and run thru the pulley on each end and pull the dipole up into the air between the end supports. Check swr. Trim as needed with low power for lowest swr possible, lower with pulleys, attach the next highest band dipole electrically to the same point as the first dipole, raise it to operating height, check swr, lower for trimming, up and down, up and down.........due the same for all other dipoles for each higher band of operation. When you are finished with the highest band of operation, pull the entire system up with the pulleys and tie of at the bottom securely. Make certain that the coax center conductor is attached to one half of each dipole and the shield to the other half. All dipole ends at center insulator are connected together. This may not be very clear to the new antenna builder so please see the drawing below for the center insulator arrangement.

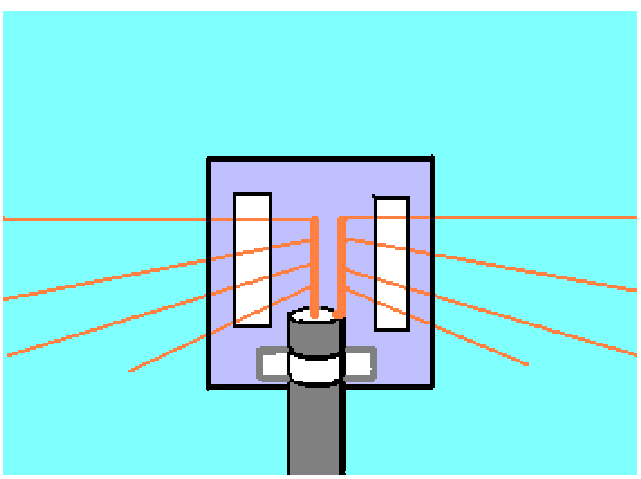


Figure 2.

(NOTE: IF USING THE NEWER CONSTRUCTION METHOD

MENTIONED ABOVE, INSURE PROPER SPACING OF ANTENNA LEGS AT THIS CENTER INSULATOR!)

The white areas in the center support drawing above are mechanical supports, clamps, wire ties or whatever your genius can come up with to support the main (top wire) and the weight of the coax. Remember, all the weight of this antenna system is supported by the top wire. The connections should be soldered and all should be sealed including coax end from water, ice, snow etc. Use a 1:1 balun like an "**Ugly Balun**" (at Hamuniversedotcom) close to the center before coax goes to your rig.

For best performance get it as high as possible and remember that since this is a dipole arrangement, it will be somewhat bi-directional towards and away from you as viewed in the drawing. (BROADSIDE) Remember that all elements will interact with each other in the tuning process and the final setup must be secured so the angle or distance between each dipole does not change when blowing in the wind, etc. The angle or distance between each dipole is not critical but the final spacing must be maintained!

It will take lots of work (trial and error) in getting each dipole to the lowest SWR. Just keep TRYING. It should also be noted that the antenna can be used in an inverted v fashion but remember the spacing should be secure in the final operating position. Tune it as in all the above instructions. You may use a tuner with this antenna un-trimmed to save a lot of work but doing it correctly for best swr without a tuner is always better!

Note:

The multiband fan dipole can be very difficult to tune for lowest swr in some installations. There are many variables that will make tuning difficult. Height above ground, sometimes the angle of each dipole relative to the other dipoles, surroundings, etc. If you can get the swr to around 2 to 1 or lower for each band....don't worry too much about it. (see the newer construction method above). You might also consider using a good antenna tuner if you are having major tuning problems. A 2:1 SWR or lower can be handled by most built in tuners in radios.

You might also consider removing HF combinations such as 40/15 meters and 80/30 meters. For these cases, cut the element for the lower frequency and let it serve double duty at the odd harmonic. In other words, cut the 40 meter element and let it serve also as the 15 meter element which eliminates the 15 meter section. Make sure that the distance between all dipole elements does not change when tuning. They must be in a fixed position always with some sort of spacer. In theory, we could fashion a four-wire antenna for the 80, 40, 30, 20, 15 and 10-meter bands.

In practice, it may be difficult to obtain a good match on all bands. Since the resonant length of a given element in the presence of the others is not the same as a dipole by itself, tuning can be a tedious and difficult procedure. Adjust elements for resonance in order from lowest frequency to the highest such as in an 80, 40, 20, 10 combo. Start with 80 first then go to next higher frequency dipole. Always cut each dipole a lot longer than required for each band to make tuning easier. Trim as needed for your operating frequency. All of these bandwidth, adjustment and matching problems are easily solved with an antenna tuner at the transmitter, feeding the antenna through 100 feet or less of RG-8 coax.

73, Don N4UJW

KL7JR's Off-Center Fed G5RV Dipole

Probably the most built dipole is the venerable G5RV. I've used many of them over the years and it's a great multi-band antenna for about $5.00 worth of wire! I've even experimented with a G5RV as an off-center fed dipole where one leg was about 30 feet long and the other 40 feet or so (I used what I had on hand), and vertical radiator was about 25 feet long. I literally worked the world (as VE8RST and VY1RST) several times from the north with this design and an ATU of course!

Many hams swear by G5RVs and some, who no doubt expect miracles from them, swear at them! They are easy to construct and very economical. My favorite is the G5RV "junior or shorty" rated 10-40m which I've found also works well on 80m especially when installed as an inverted V. You don't need a lot of space and only one major support (at apex) is required. Just tie the legs off to anything handy and keep them at least 8 feet off the ground for safety reasons.

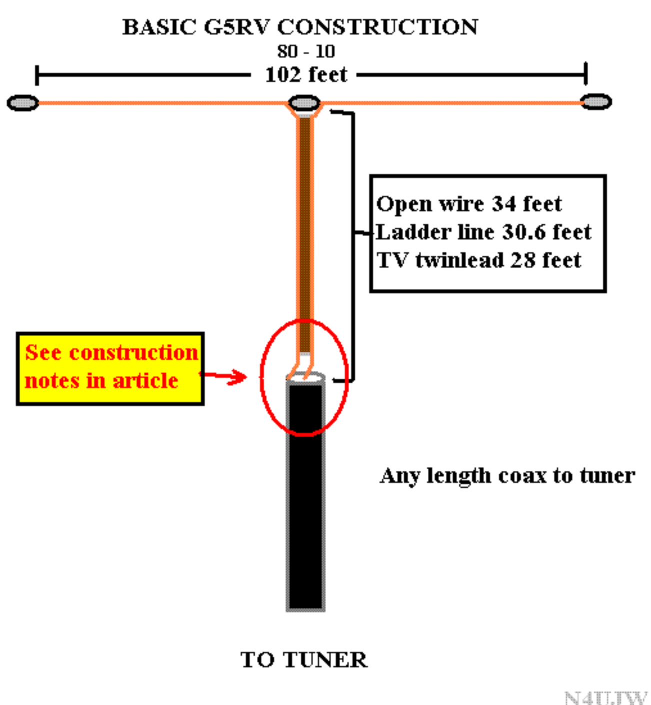
Some of the DX I worked in the first two hours of operating from Ft. Liard, Northwest Territories, Canada in June 2010 as **VE8RST using my off-center fed G5RV:** (see the next pages for Don's excellent "how to build" G5RV!)

KL7RB	UA0CW	VA7KO	SP6BOW
KL7KK	JG1SRB	VE3LDT	VE3ZZ/VY2
SM3DX	F5HRY/F5	VE5ROD	OH10X/mm
AL7TC	PA0GMW	EA1ALE	RX9FX
JA7KOJ	LY600A	+Many states	

The G5RV Multiband HF Antenna by N4UJW

Over the last few decades, the G5RV antenna has become one of the most popular and widely used "all around" multi-band antennas in the world. Even though it is a "compromise" antenna, it has good overall performance on most HF ham bands when used with an external tuner, and allows coax as an entry feed line to the radio equipment eliminating the need and hassle of ladder line or twin lead. It should be noted that some internal tuners just don't have enough range to "tune" it.

It was invented in 1946 by Louis Varney, whose call sign is **G5RV** ("SK" on June 28, 2000, age 89). Hence the name, the G5RV antenna. The basic G5RV antenna measures only 102 feet across the top for 80 thru 10 meter operation, and is fed at the center through a low loss 34 feet feed-stub. The interaction between the radiating section and the feed-stub makes the G5RV usually easy to match on all-bands from 80 through 10 meters with an ordinary low-cost antenna tuner.



In spite of small size, it provides "almost" dipole equivalent coverage on 80 and 40 meters. From 20 on it favors DX with four to six low angle lobes reaching out in all directions which makes it a very popular antenna on the higher frequency bands. Many hams swear by them and many swear AT them due to tuning difficulties that some have.

THE ANTENNA LENGTH :

The design center frequency of the full-size version (configured as a 3/2-wave dipole on 20m) is 14.150 MHz, and the dimension of 102 ft is derived from the formula for long-wire antennas which is :

TOTAL LENGTH IN FEET = 492 X (N - 0.05)) / F(MHz)

So we have: 492 x ....N - 0.05 = 3 - 0.05 = 2.95 ("N" is the number of 1/2 wave lengths)

Continuing with the formula: 492 x 2.95 = 1451.4

1451.4 / 14.15 MHz = 102.57 feet total length (51 feet per half rounded off)

In practice, since the whole system will be brought to a low swr for use by the transmitter with the use of an antenna "tuner", the antenna is cut to 102ft (31.1m). In some cases, this is still too long to fit in the required space. In this case, a half-size version, covering 7 to 28 MHz is still very usable. This is sometimes called the "Junior" version if bought commercially.

Conversely, some amateurs would like to have 1.8 MHz capability, and have the 204 ft (62.2 m) length necessary for the G5RV antenna. The antenna does not need to be put up as a flat-top (horizontal fashion), but can be installed as an inverted-V. If the antenna is raised as an inverted-V, the included angle at the apex should not be less than 120 degrees. The center of the antenna should be as high as possible, of course, and the matching section should descend at a right angle to the antenna.

THE ALL IMPORTANT MATCHING SECTION :

The matching section may be designed in several ways.

Open Wire :
This is the preferred construction using open-wire feeder for minimum loss, as this section always carries a standing wave on it. Due to the standing wave, the actual impedance is unimportant.

Ladder Line (Window-type line) :
The next most desirable matching section would be made from window-type open wire line, either 300-ohm, or 450-ohm. This is basically a ribbon line, like heavy duty TV-type twin lead, with #16 to #20 wire, and "windows" cut in the insulation every 4 to 6 inches. The advantage of the "window" line is that the conductors won't short together if the line twists in a high wind due to its construction.

"TV" Twin Lead :
The main disadvantage of the TV-type twin lead is durability. The advantage of it is that it is readily available at electronics outlets although it is getting more scarce. Do not use the "shielded" twin lead. The shield will interact in the matching section, especially on 3.5 or 7 MHz. MATCHING SECTION LENGTH : The length of the matching section is an ELECTRICAL half-wave on 14 MHz. The actual physical length is determined by the following formula:
LENGTH (in feet) = (492 x VF) / f (MHz) (VF = the velocity factor of the matching section)

The velocity factor is determined by the type of line, and the dielectric properties of its insulation.

For the three types of line discussed so far, the VF is:
Open wire = 0.97
Ladder line (Window line) = 0.90
"TV" twin lead = 0.82

Note that these velocity factors may differ between various suppliers so it is best that you check the specifications of the type that you use. Also remember that your tuner will make up for any minor differences.

By substituting the VF in the formula, and calculating for a center frequency of 14.15 MHz, you come up with the following matching section lengths :
Open wire = 33.7 ft (10.28 m)
Ladder line (Window line) = 31.3 ft (9.54 m)
"TV" twin lead = 28.5 ft (8.69 m)

Here is the math for those who need an example:

Let's use TV type twin lead in ours.
VF of TV type twin lead is .82

So.....Length in feet for matching section (total) = 492 X .82 / F MHz =

492 x .82 = 403.44

403.44 / 14.15mhz = 28.51 feet for TV type twin lead.

G5RVs are named as; FULL-SIZE, DOUBLE-SIZE and HALF-SIZE (sometimes called the "Junior or Shorty").

Band Coverage	**3.5 - 28 MHz**	**1.8 - 28 MHz**	**7 - 28 MHz**
Length of Antenna	102 ft	204 ft	51 ft
Matching section:			
- Open wire	33.7 ft	67.5 ft	16.9 ft

-Ladder line	31.3 ft	62.6 ft	15.6 ft
- "TV" twin lead	28.5 ft	57 ft	14.3 ft

Band characteristics of the G5RV:

3.5 MHz. On this band each half of the "flat-top" plus about 17ft (5.18m) of each leg on the matching-section forms a shortened or slightly folded up half-wave dipole. The rest of the matching-section acts as an unwanted but unavoidable reactance between the electrical center of the dipole and the feeder to the antenna tuner. The polar diagram is effectively that of a half wave antenna.

7 MHz. The "flat-top or horizontal section" plus 16ft (4.87m) of the matching section now functions as a partially-folded-up "two half-wave in phase" antenna producing a polar diagram with a somewhat sharper lobe pattern than a half-wave dipole due to its colinear characteristics. Again, the matching to a 75 ohm twin lead or 50/80 ohm coaxial feeder at the base of the matching section is degraded somewhat by the unwanted reactance of the lower half of the matching section but, despite this, by using a suitable antenna tuner the system loads well and radiates very effectively on this band.

10 MHz. On this band the antenna functions as a two half-wave in-phase collinear array, producing a polar diagram virtually the same as on 7 MHz. A reactive load is presented to the feeder at the base of the matching section but, as for 7 MHz, the performance is very effective.

14 MHz. At this frequency the conditions are ideal. The "flat-top" forms a three-half-wave long center-fed antenna which produces a multi-lobe polar diagram with most of its radiated energy in the vertical plane at an angle of about 14 degrees, which is very effective for dx working. Since the radiation resistance at the center of a three-half-wave long-wire antenna supported at a height of half-wave above ground of average

conductivity is about 90 ohm, and the 34ft (10.36m) matching section now functions as a 1:1 impedance transformer, a feeder of anything between 75 and 80 ohm characteristic impedance will "see" a non-reactive (ie- resistive) load of about this value at the base of the matching section, so that the vswr on the feeder will be very nearly 1:1. Even the use of 50 ohm coaxial feeder will result in a vswr of only about 1.8:1. It is here assumed that 34ft (10.36m) is a reasonable average antenna height in amateur installations.

18 MHz. The antenna functions as two full-wave antennas fed in phase; combining the broadside gain of a two-element collinear array with somewhat lower zenith angle of radiation than a half-wave dipole due to its long-wire characteristic.

21 MHz. On this band the antenna works as a "long-wire" of five half-waves, producing a multi-lobe polar diagram with very effective low zenith angle radiation. Although a high resistive load is presented to the feeder at the base of the make-up section, the system loads very well when used in conjunction with a suitable antenna tuner and radiates very effectively for dx contacts.

24 MHz. The antenna again functions effectively as a five-half-wave "long-wire" but, because of the shift in the positions of the current anti-nodes on the flat-top and the matching section, now presents a much lower resistive load condition to the feeder connected to its lower end than it does on 21mhz. The polar diagram is multi-lobed with low zenith angle radiation.

28 MHz. On this band, the antenna functions as two "long-wire" antenna, each of three half-waves, fed in-phase. The polar diagram is similar to that of a three half-wave "long-wire" but with even more gain

over a half-wave dipole due to the collinear effect obtained by feeding two three-half-wave antennas, in line and in close proximity, in phase.

Construction notes and tips:

1. The matching section is connected to the center of the antenna as with any ordinary dipole antenna, and allowed to descend vertically at least 20 ft or more, if possible. It can then be bent and tied off to a suitable post or line, and connected to the coaxial cable and run to the antenna tuner. 2. At the junction of the matching section and the coax, it is highly recommended that this junction is well sealed from rain, ice, snow, etc. Also provide a strain relief support for the entire junction section to prevent breakage here. This area will be prone to breakage by wind twisting. 3. A good center insulator support to provide strain relief for the matching section is also recommended. 4. Under certain conditions, either due to the inherent "unbalanced-to-balanced" effect caused by the direct connection of a coaxial feeder to the end of the (balanced) matching section, or other causes, a current may flow on the outside of the coaxial outer conductor. This effect may be considerably reduced, or eliminated, by winding the coaxial cable feeder into a coil of 8 to 10 turns about 6 inches in diameter immediately below the point of connection of the coaxial cable to the end of the matching section. The first and last turns should not touch and the coil should be taped securely to help prevent this. Some builders use this, some don't. 5. If you use regular TV type twin lead for the matching section, it's probably a good idea that you do not run much over 100 watts of power due to high swr on the feed line. Do not tape the matching section to a metal mast or pole.

73, Don N4UJW

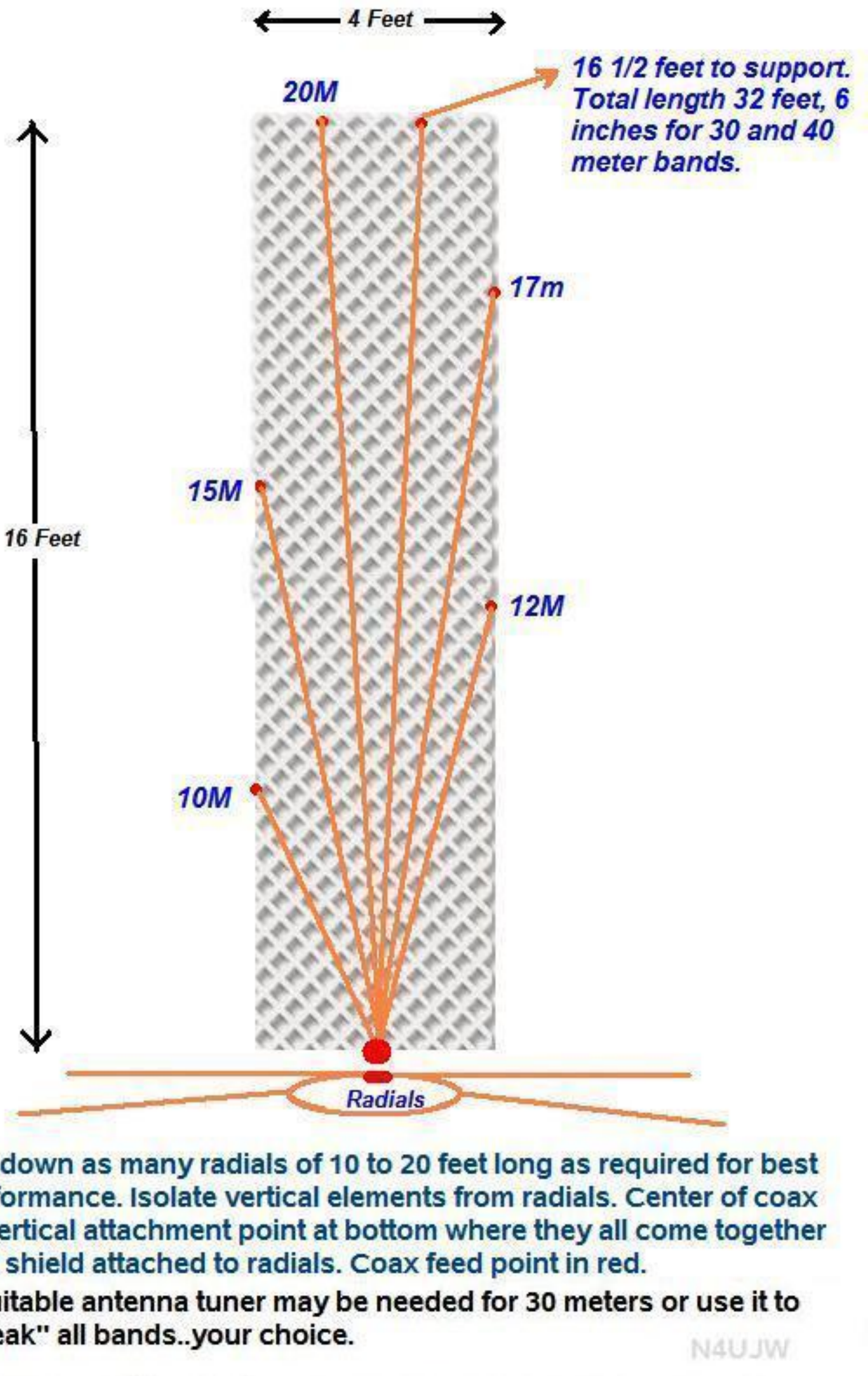
2. VERTICALS

Another easy to build antenna is the one-quarter or one-half wavelength vertical which can be made from wire, pipe or other conducting materials. I've had great success with them over the years from hundreds of portable locations. They come with the bad reputation of being noisy, and some are but most are not according to my experience. I hear hams on the air who have only built one complain about them and give up on verticals as good antennas. I just laugh because nothing good comes easy and with a little effort (keep them in the clear, make solid weatherproof connections and install a ground rod) they could have a great antenna!

Contrary to popular belief, sometimes putting down several radials is overkill as they cancel themselves out. I always use 4 as a minimum, and never more than 10 of various lengths of wire. A ground rod or tossing a radial or two in saltwater or fresh water helps cut down noise and broaden the ground plane if you are lucky enough to live close to the ocean or a river.

A Seven Band HF Stealth Vertical Using Landscaping Lattice! by HI3/KL7JR

Please your XYL, the neighbors and yourself with this stealthy 1/4 wave vertical antenna idea hidden within a lattice frame made from wood, PVC, vinyl or other non-conductive lattice work material. The 1/4 wave lengths for each band are interwoven into the pattern of the lattice design as needed to hide them from view. If you have existing lattice work that has vines already growing, then that is all the better. Use green insulated wires as the radiators and they will become almost invisible even when you are looking for them! If you don't have foliage on the lattice, then use wire the same color as the lattice material. They will be very hard to see against the same color background of the lattice.



There are many patterns, colors and sizes of lattice material available from Lowes, Home Depot and other outdoor landscaping improvement suppliers but this project uses 2 each 4 X 8 foot rectangular sections that can be put together to form the 16 foot height required by this project.

One particular style that might be of interest to you is a "fan" type design but that may look sort of odd when you stack 2 of them.

It’s your choice of course. Beauty is in the eye of the beholder! The vertical elements (radiators shown in orange in the drawing) are formed as 1/4 wave length sections using the old standby formula of 234 / your frequency = feet in length. The 30 and 40 meter band section of the antenna may require a tuner to tweak the swr or your internal tuner may do the job, but cutting the 1/4 wave lengths for the other bands should not be a problem without a tuner if you cut each one long and tune for lowest swr as needed.

Precalculated lengths as follows (use your own calculations as needed for your center frequency):

10m 8'- 3"	12m 9'- 4 1/2"	15m 11'
17m 12 '- 10 3/4"	20m 16'- 5"	40m 32'- 6"

(you may wish to use a separate 30m 1/4 wave section rather than use the 40 meter section for both bands...your choice.)

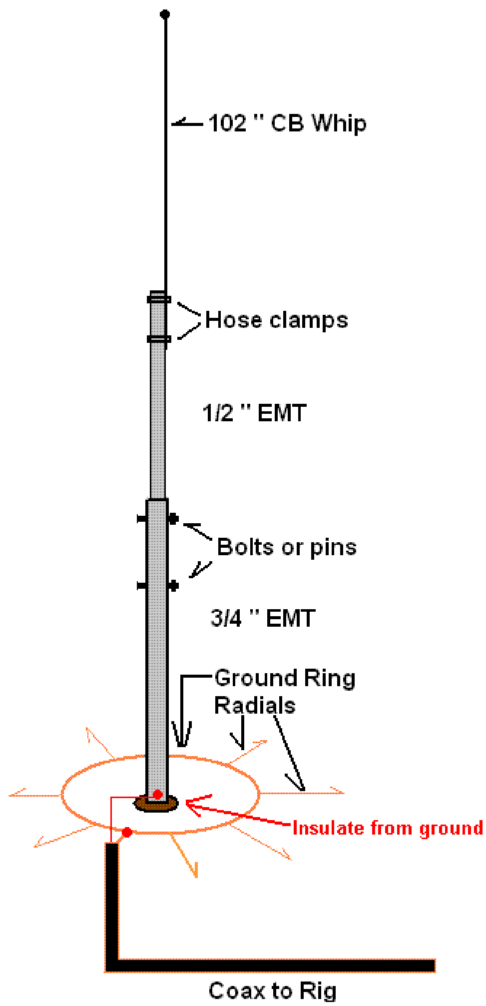
All vertical elements in the design are connected together at the bottom of the lattice, soldered of course and the center conductor of the coax feed is connected there. The 1/4 wave sections must be fanned out as far as possible from the bottom center. The shield of the coax is connected to the radial field (see the KL7JR radial ring at Hamuniversedotcom for some ideas for the radials).

Do not install the finished lattice vertical antenna against a metal wall or one that has internal wiring, duct work, metal plumbing etc. as you will not be pleased! This project is more suitable for 2 story buildings if attached to the house wall. The main idea with this project can be applied to other methods of supporting and hiding stealthy vertical antennas so use your imagination and have fun in experimenting with yours!

73, John KL7JR

5 BAND PIPE VERTICAL

by John, KL7JR



A simple, cheap and easy to build 26 feet long vertical antenna
that works DX on 20 - 10 meters including WARC BANDS. That's 20, 17, 15, 12 and 10 meters! It is designed for portability for field days, camping, or permanent installation, cost, and to achieve at least 1/2 wavelength on the WARC bands. You will not believe its performance until you try it!

Material List:

-1 each 10 foot 3/4 inch EMT conduit

-1 each 10 foot 1/2 inch EMT conduit

-1 each 102 inch CB whip

-3 each hose clamps

-Assorted bolts, nuts from junk box

-Insulating support for base of antenna

(maintain about 3 inch separation of vertical radiator to the ground) Assorted # 12 wire or plumbers tape for radial ring, 4 to 6 or more radials + - 16 feet long from wire for each radial

NOTES and BUILDING TIPS: (See drawing)

It is assumed that you will use a good tuner with this antenna and low loss coax with short runs. Cheap RG-58 types of coax is not recommended (wise up Radio Shack!). As designed, the swr will be high on the bands since this is a non-resonant antenna so an external tuner will be needed. The internal tuner on your radio may not have enough range to work properly. Slide 1/2 inch EMT pipe into 3/4 inch EMT pipe 18 inches. Drill and bolt or pin above sections together. (Assure that you have good electrical and mechanical connections between all sections). Hose clamp the CB whip on the outside surface of the 1/2 inch EMT section assuring that it overlaps 12 inches with the 1/2 EMT for a total length of all 3 sections for a total of 26 feet top to bottom. Use some form of insulator on the base to isolate the antenna from ground. Build your ground and radial ring from about 12 inches of wire and lay around the base of the antenna. Attach the radials, as many as you can get out. Attach the center conductor of your coax to the base of the antenna and the shield to the ground ring where radials are attached. Raise antenna and guy if required. Connect to tuner and rig. ENJOY!

73, John KL7JR

Home Brew HF Vertical From Copper Pipe
by John, KL7JR

Use it portable or for fixed station operation! Interchange lengths for 5 band HF fun in the Wild! In my younger days on portable island activating adventures, I used a homebrew multi-banded quarter-wave vertical antenna that was easy to assemble and disassemble and didn't take up a lot of space in my canoe. The antenna was not only lightweight, but cheap and easy to construct, (I didn't want to lose any more expensive ham gear the next time I'd tip my canoe over!).

I'm still using this antenna over a decade later, and I sure have logged a lot of DX from all over the lower 48, Alaska and Canada with it! It's great for portable use or set it up for permanent station operation.

BILL OF MATERIALS

1- 10' length 1/2" copper pipe (top section)

1- 10' length 3/4 inch copper pipe (base)

1- 3/4" male sweat fitting threaded

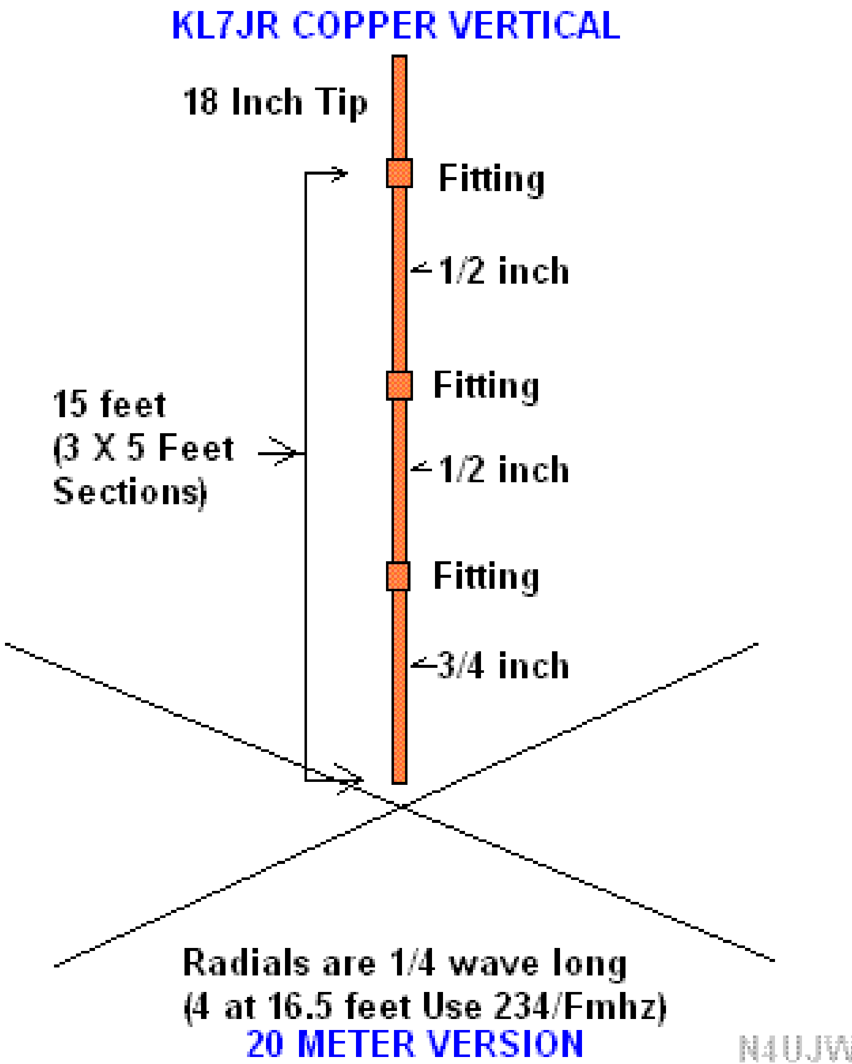
1- 3/4" female sweat fitting threaded

1- 3/4" by 1/2" reducing coupling threaded

1- 1/2" male sweat fitting threaded

1- 1/2" female sweat fitting threaded

70' #14 or #16 wire (ground radials) and various nuts, bolts and clamps from the junk box



CONSTRUCTION:

Now cut both pipe sections in half and solder the appropriate fittings on. (5 foot sections makes for easy portability)

Total cost around $25.00 and two hours to build.

If you've never soldered copper tubing before, perhaps a little help from someone who has; would be nice.

Pipe lengths plus appropriate tip = band of your choice:

PIPE LENGTHS	TIP LENGTH	BAND
3 @ 5 feet* See note	18 inches	14 MHz
2 @ 5 feet	36 inches	18 MHz
2 @ 5 feet	12 inches	21 MHz
2 @ 5 feet	none	24 MHz
2 @ 5 feet	none	28 MHz

NOTE: * 2 @ 3/4" and 1 @ 1/2". Use the two 3/4" sections of pipe for the other bands.)

The same ground radials were used on all bands.
I used 5 foot lengths only because it packed well in my truck and canoe. You may want to use shorter or longer lengths depending on your situation (ie- instead of one 5 foot length, perhaps you want to go to a more transportable length of 2 at 30 inches long).

To secure the antenna I built an "**H frame**" structure from 2" PVC pipe and used 1" PVC for the riser. The H frame breaks down to two pieces for transporting. You'll need to isolate the antenna from ground. A piece of PVC pipe stuck in the ground would work too but many islands that I want to activate back home are mostly giant rocks. I used a 3" long piece of scrap 1/2" PVC glued inside the T fitting of the riser. The antenna sits on this piece to maintain the 3" distance from ground.

Cut a 1 inch square hole in the riser and on the bottom section of the copper pipe (the one without a fitting on one end) to accept the coax connection. [For a great photo of the H frame base, see the most interesting ham website of N0LX - click in "antennas" category for "Mini Antenna Mast and PVC base" and in "Portable" category "Islands of Colorado" for a heavier duty version photo.] I used heavy duty alligator clamps for both the center coax and braid connection. Since I operate mainly on 20meters, I cut four lengths of wire at 16.5 feet long (1/4 wavelength formula 234 divided by Freq. in MHz) out of #14 insulated wire. Then bare one end and tie all four together. I used a 1/4" bolt with a couple nuts and washers as the connector. The alligator clamp on the coax braid clips easily on the 1/4" nut as does the clamp on the center conductor of the coax to the pipe.

I keep the ground radials permanently attached to the PVC H frame with ty-raps and when transporting, I simply coil the wires and stuff in each PVC leg. When I'm set up, I simply throw out the radials in each direction. I put as many in the water as I can. I'm sure it helps cut down on the "noise" verticals are known for.

Additional tips and notes:

I highly recommend using a tuner with this antenna since background and ground conditions affect SWR and will differ from set up locations and the 24 and 28 MHz lengths are a bit long "electrically speaking". You may want to cut tips of the correct lengths for 10 and 12 meters. Also, very important, do not use a wrench to tighten the pipe sections as it's easy to strip the pipe threads! (I only had to do that once!). Hand tighten the copper pipe sections only. I can honestly admit this antenna is easy to tune on many bands, is not noisy and works DX! 73 and happy hunting!

73, John KL7JR

Add 17 Meters To a Hustler (Newtronics)

4 BTV VERTICAL

Do the Conversion for Pennies!

(Try it with other brand antennas too!)
by Don Butler N4UJW

The Hustler 4 BTV is a multi-band vertical covering 40, 20, 15, and 10 meters as it comes from the factory as you probably know. I have used the 4 BTV for some time now with very good success GROUND MOUNTED AND NO RADIALS but I wanted to get on 17 meters and this antenna did not cover this fun band.

It was DEAD on 17 meters! Only VERY STRONG signals could be heard and it was useless as far as transmitting on 17 was concerned. I did consider using a tuner with it but decided against it in favor of this project! This project is nothing more than adding 1/4 wavelength of wire alongside the existing 4 BTV mast in parallel with it and extended away from the vertical portion a short distance!

This article and project will enable you to modify your Hustler 4 BTV for use on 17 meters with almost NO expense other than a bit of labor (fun) if you have about 1/4 wavelength of wire lying around gathering dust and cobwebs. You only need about 13 feet or so (I used #14 from the junk box) to make the 4 BTV work on 17 meters. This is such a simple modification, that I can't understand why I had not thought of it before!

The basic 17 meter modification to the original 4 BTV requires no holes or any other modification that requires damaging the original mechanical structure of the antenna.

All you simply do is calculate about 1/4 wave of wire at your center frequency on 17. I choose 18.130 MHz. 234/ 18.130 = 12.9 feet. I

rounded this off to 13 feet. Then it a simple matter of attaching one end of the 1/4 wavelength of wire to the feed point at the base of the 4 BTV, extending it horizontally out and away from the base mount about 6 inches and running it parallel to the main antenna to the top and hanging and insulating it from the Top Hat structure supporting it with heavy cord, string, etc.
See Pictures at bottom of article.
There is very little weight to 13 feet or so of wire so I don't think you need be concerned with the weight bending one of the Top Hat elements. (See additional mods below)

The wire can be simply attached near the feed point on the tubing above the bottom feed point with a hose clamp. This is the area just above where the coax is normally attached; and then just extends to the top of the antenna, however, this may give you swr problems with wind blowing it close to or touching the main element. I first tried it this way but noticed the swr changing with the wind- although not much. This is why I used the bottom extender or spacer to get the wire away from the main element. This also changed the tuning of the wire to get it to an acceptable swr and match for 17 meters.

I made the spacer from a short flat (about 6 inch) piece of aluminum and about 3/4 inches wide. I formed it into an L shape and drilled one small hole at the longest end so the wire could get thru it. You could also just attach the end of the wire on the end of the CONDUCTIVE spacer using nuts, bolts etc. **as long as it (the wire), is making electrical contact with the main element of the 4 BTV base**. In other words, the spacer would become part of the 17 meter antenna. Again....see pictures.

Attaching and tuning the wire was the hardest part of this project.
I removed the main portion of the antenna from the base mount and laid it on the ground. I then attached the "top" end of the wire to a nylon cord (acting as an insulator) and tied the other end of the cord to one of the Top Hat elements making certain the wire would hang straight down and parallel with the rest of the antenna and not twisted around the vertical

element. Then I re-mounted the 4 BTV back on its base mount, attached the remaining end of the wire to the connection point near the feed point. After several attempts at "tuning" the 1/4 wave section of the wire, I finally arrived at an acceptable swr and match.

2 to 1 SWR bandwidth
16.625 MHz 2:1
19.175 MHz 2:1

18.068 MHz 1.1 to 1
18.168 MHz 1.2 to 1
Match efficiency 99% (all readings above using MFJ 259b)

After final installation of the modification, swr was checked on the "normal" bands, 40, 20, 15 and 10 meters with no noticeable change from previous readings. Some builders of this project mod have experienced a slight swr problem on 15 meters, but adjusted that portion of the original antenna with no problems afterward.

It should be noted that the 4 BTV is not a very tall antenna. It is only approximately 21 feet tall from the ground and can be easily handled ON THE GROUND BY ONE PERSON.

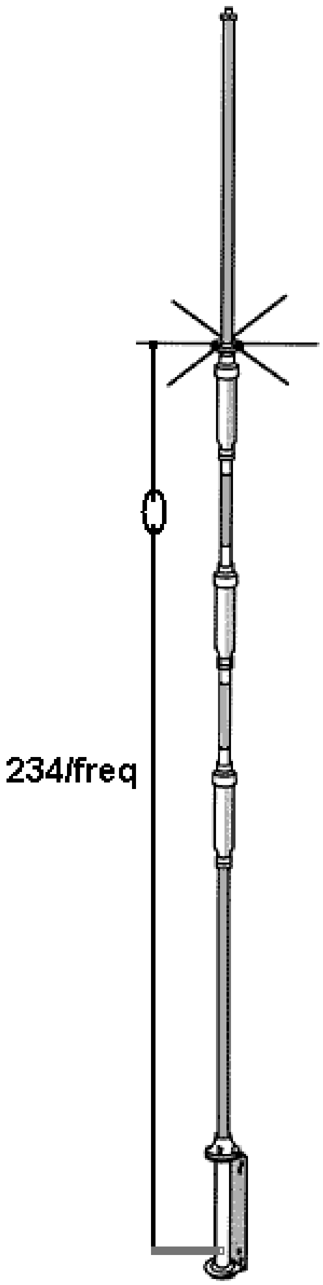
Attempting this project up on a roof or ladder by yourself could cause some very serious harm to more than the antenna! Get some help and remember to keep it away from those power lines!

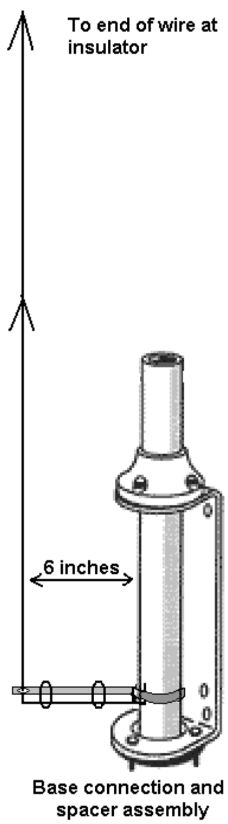
Also as an afterthought remember that your installation IS and WILL BE different from mine. I used NO ground radials and the antenna is ground mounted in poor dry Texas soil...clay and sand! Your length of wire will probably be different than mine so some fun will be had in tuning this antenna. The starting point for the wire length is 1/4 wave long or a bit longer. 234/freq MHz = length IN FEET. This should be the length from the main radiator at the bottom of the main antenna to the tip of the modification, but allow a few inches for tuning if needed. The proof is

in the pudding! On the air tests made my Yaesu FT-107 come ALIVE on 17 meters with this modification and I am still making contacts while I write this article! I had NONE on 17 meters before! Italy was 5 9 + 10 over today! California was a bit weaker! Is12m next? (**Yes-read on!)**
PICTURED BELOW (Original artwork Copyright Newtronics. Mods N4UJW)

NOTES: In the drawings below, the 2 ovals near the bottom do not represent coax shield. They represent nylon wire ties to secure the wire to the aluminum bracket.

These are the rough measurements that I used above. Your wire lengths may be different! Connection at the base feed point area (left picture above): aprox. 3 inches from bottom L plate.

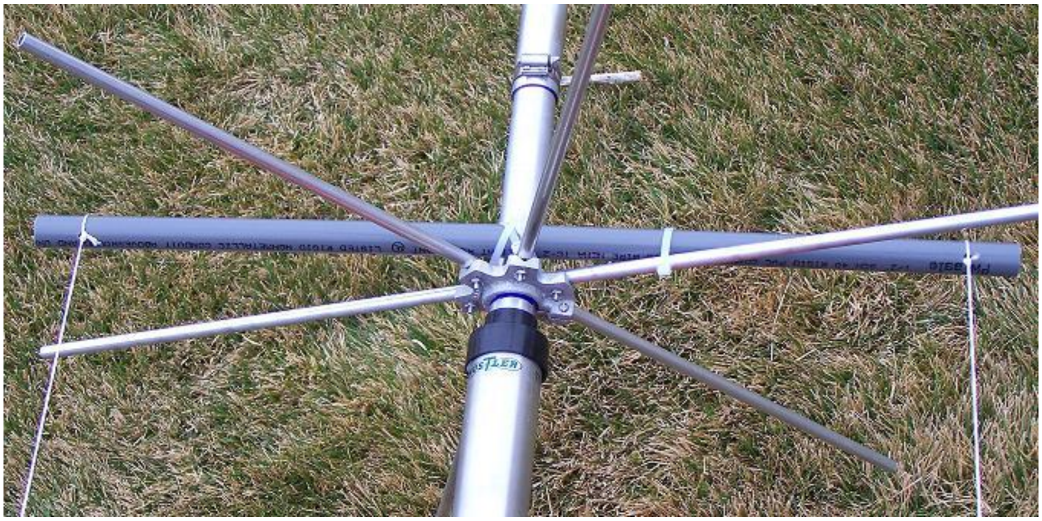




The wire can be secured to the spacer with two nylon ties as in the picture. End of wire extends out from the connection point about 6 inches and then turns 90 degrees and up to about 3 inches below the top most trap and attached to an insulator. I see no reason why you could not use aluminum tubing instead of wire for a stronger mod. Another project for me? Could be! A possible bit of tuning should get you up and running on 17 meters! Drawings are not to scale.

73, Don N4UJW

You can easily add **12 meters** to your 4 BTV or 5 BTV as in the mod by N4UJW by simply adding the 12m radiator to the opposite side of the 17m radiator. It worked a lot of DX for me! 73, John KL7JR



12 and 17m vertical radiators on Top Hat of KL7JR's 4 BTV.

Bottom temporary connections" are for portable use. Vertical radiators (one shown) are connected to 4 BTV by hose clamp and coax is connected via battery clamps. Coax shield clamped to radial ring making a fast and easy set up for my portable jaunts.

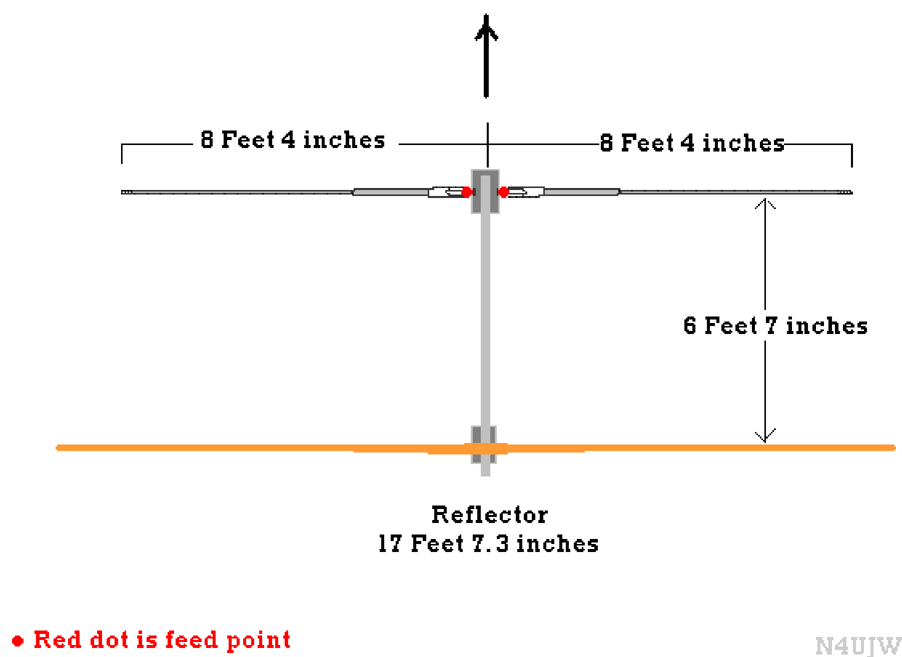
(full details available at Hamuniversedotcom, "Hustler 4 BTV 12/17 Meter Mod by KL7JR")

3. BEAMS

Here's a simple beam design that will get you on 10 and 12 meters. You can use a rotor or not! Oh, an ATU is required for 24 MHz use. A couple hams have built this design and are amazed by all the DX they are working!

Portable 28 MHz 2 Element Beam Using 102" Steel Whips by KL7JR

The old standby 102 inch steel CB whip has been around for a long time and used on the amateur bands by many hams over the years. This design will incorporate four of the steel whips and allow us to concentrate our signal to a specific area and give us 3 to 4 dBd to boot (*)! It is direct feed with 50 ohm coax. It will also be easy to assemble and fairly transportable at a cost of about $100 depending on how you connect the whips to the boom or use new or used materials. Here's a method I chose which will make it a snap to assemble and install in cold weather, Field Day, etc.

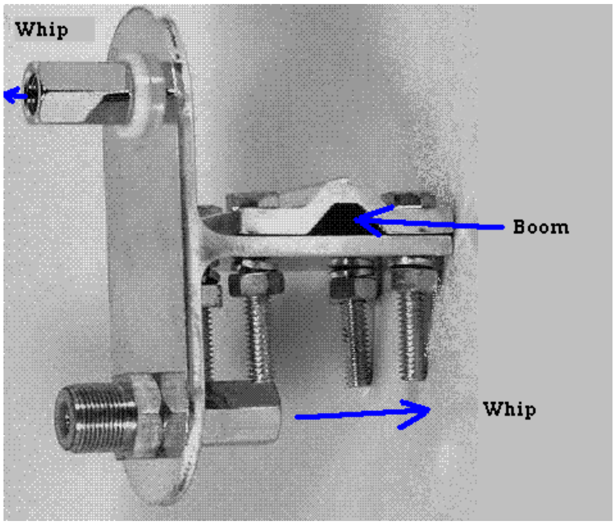


Version shown is for 28.450 MHz

A 102 inch steel whip is a quarter-wave on the CB band (27 MHz). Using the **N3DNO** antenna calculator we arrive at the following dimensions for our desired frequency of 28.450 MHz (+-): driven element is 8 ft and 4 inches long each (there's 2 for a total of 16 feet 8 inches), the reflector is 17 ft and 7.3 inches long with the spacing at 6 ft and 7 inches from the driven element. Note that the reflector is one continuous piece electrically. (Not insulated from the boom.)

Now, keeping that in mind, and trying to maintain the 8 ft and 6 inch length of the CB whips (I didn't want to cut the whips down as I may want to reuse them some day for other projects) we find these dimensions (trial and error using the above antenna calculator): for 27.8 MHz the driven element is 8 ft and 6 inches long (the actual length of each whip+-) on each side, and the reflector is 18 feet long (**) with a spacing of 6 ft and 9 inches. The difference in the desired frequency of 28.450 MHz vs. the "not to cut the whips" frequency of 27.8 MHz is only .650 MHz which should be easily handled by any antenna tuner.

To mount the whips to the boom, you can U-bolt a short piece of "L" channel (+- 6 inches long with the predrilled holes) to the boom and then mount the antennas to that using insulated connectors for the driven elements and non-insulated connectors for the reflector.



(Or if you are like me and want something a bit more attractive, you can use a pair of commercially made mounts (MFJ mini dipole mount #347 or others like in the picture above).

The 102 inch steel whips are available from various sources (mine came from Radio Shack several years ago). This design may also work well on 12 meters. The above dimensions should be good starting points, and you may choose to cut your whips down to the design dimensions above.

Keep in mind that whether or not you use the commercial mounts on the reflector, or your own mechanical design, that you will have to make certain both whips are connected together forming one continuous electrical connection. Otherwise it will not work! If you have trouble tuning for lowest swr or just don't want to bother, then use your tuner. A 1:1 balun at the feed point is also suggested.

73 de Yukon John, KL7JR

*See "2 Element Wire Beam for 28 and 24 MHz" at Hamuniversedotcom

** You can add 6 inches of wire to each of the 102 inch whips to get the 18 ft length, or not. Experiment either way.

HORIZONTAL MINI "V BEAMS"

Using MFJ Verticals by "Yukon John", KL7JR

While some hams may not agree, I'll call this design my "one-element horizontal mini V Beam" as that's what they look like! They outperformed other mobile verticals used as horizontal dipoles in comparison. Some "antenna experts" have called this nothing more than a degraded dipole! You decide what to call it and how well it works for you. I sure liked my results!

Cramped for space? Need a very portable compact antenna that works DX? If so, imagine a small "beam like" antenna with some theoretical gain, about 180 degree directivity, easy to install, direct coax connection, very portable and a price tag at under $50! It sounds too good to be true, right? You know, when I get interested in something I just have to see how far I can take it. In this case it's experimenting with MFJ HF vertical mobile antennas as horizontal mini V Beams.

I've had some very good results using CB antennas as V beams on 15 and 20 meters which laid the groundwork for this antenna design (1). Most brands of CB or ham verticals should work on some other ham bands other than the designed band using an appropriately sized whip. You just need to experiment a bit! This experiment concentrates on the MFJ brand mobile verticals. I used my MFJ 259B antenna analyzer which made testing painless. I highly recommend this economical antenna analyzer for antenna experimenters!

40 METER V BEAM

I was very pleased with the performance of the MFJ 40 meter mobile verticals (MFJ 1640T) I used as a horizontal one-element V beam on July 17, 2010 from the Yukon as VY1RST. The numbers were on previous tests indoors from my apartment: SWR 1.4, R 65 and X 12 and outdoors in the Yukon mounted on a picnic table: SWR 1.1, R 60 and X 0 for a height of about 8 feet!

Now those are great numbers, but will the antennas perform with those numbers? On 7.205 MHz W6HMB in California and N7EKD in Oregon gave me 57 and 55. They were both 59 with me at 0500Z for a good 10 minutes before the band dropped out. A half hour later I got 5x9 from an AZ station (in my excitement I forgot to log him- he was 5x9+20!) and a 5x5 off-the-side of my V beam from KL2DV in Seward, Alaska! I was pointed down the Alaska Highway.

Antennas were pruned for 7.220 MHz and worked well above and below that using my LDG Z-100 auto tuner. The next day I hoisted the V beam up 18 feet high and worked N7EKD again, K6AAX and KL3AB in North Pole, Alaska (he was 55 off- the-back and I was 44!). I was quite surprised on the "off-the-back" and "off-the-side" signal reports received and given! N7EKD said I was louder than last night. The old saying "higher is better" was evident. Wondering if the antenna would also work on 20m, I just had to try. It easily tuned and I worked K6HP with 59 signals both ways. N7EKD and

K6AAX were 59+10 and both gave me 55-57 with QSB (I'm running 50 watts). Dialing around I heard the Midwest and South coming in loud,

but before I could call, a windstorm had started up so I immediately lowered the unguyed antenna. This was not the first time Mother Nature tried to jinx me in the Yukon, storm had started up so I immediately lowered the unguyed antenna. This was not the first time Mother Nature tried to jinx me in the Yukon, hi hi! All in all, I am very pleased with how easy the MFJ verticals tuned and all the contacts I made in the horizontal position.

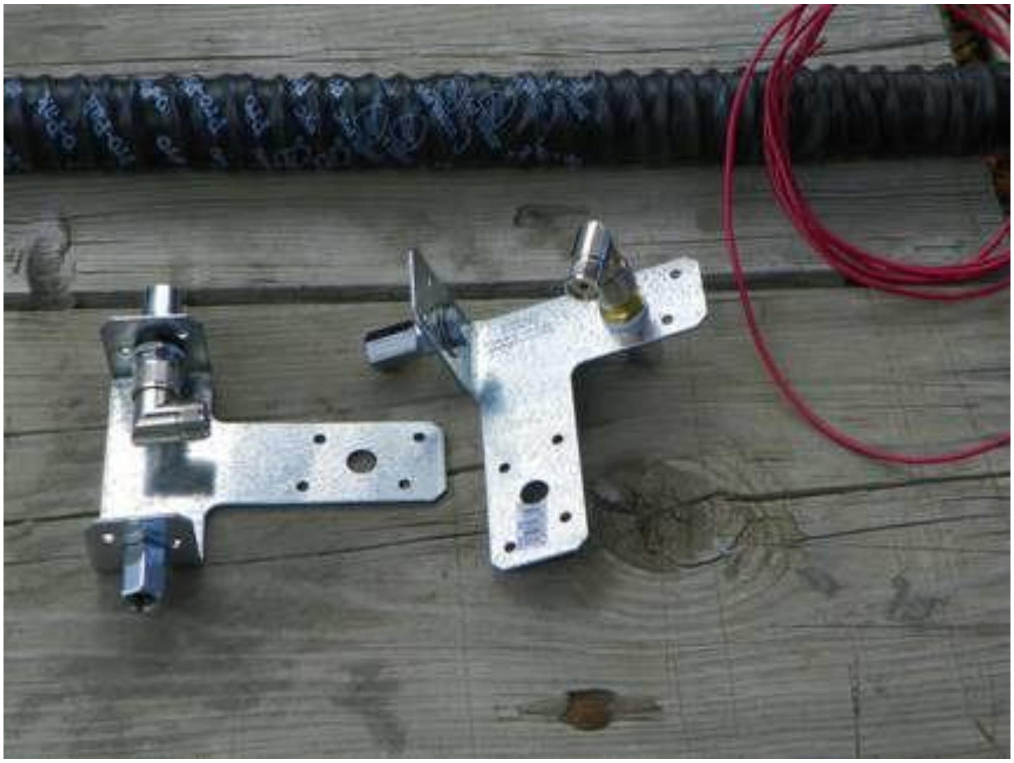
40 meter V beam mounted on top of a picnic table using MFJ 40m verticals from Kluane Lake near Destruction Bay, Yukon! Note 20m vertical dipole in lower left of photo using CB verticals and Webster Bandspanner in background.

KL7JR's 40 meter V beam at 18 feet high pointed down the Alaska Highway working N7EKD, N6AAX and KL3AB before Mother Nature stepped in!

Let's try the same idea with a pair of MFJ 20 meter mobile verticals (MFJ 1620T) and see if they are as flexible as the 40m models as used above. I mounted the 20m V beam on a ¾ inch EMT mast about 8 feet long inside the box of my truck. After a few minutes of pruning, test results were: SWR 2.3, frequency 14.200 MHz, "R" 45 and "X" 30. I ended up with a 6 1/2 inch long stinger (that's the entire supplied stinger inserted all the way in to the antenna and 6 ½ inches protruding. I'm sure once I get the antenna higher the SWR and X will come down to the levels I experienced with the 40m verticals but that won't happen from the RV park I'm staying at. I experimented with whip lengths of 6 inches to 8 inches and all had high "X" levels of 30-40. While I had everything set up, I wondered how long the antenna would be when used as a vertical. On 14.270 MHz the SWR was 1.2, with "R" at 50 and "X" at 10 for an overall antenna length of 33 inches making this a very compact antenna for 20 meters.

From another location the next day, I got the V beam up about 15 feet high in an area free of other objects to see the SWR and X down to lower levels. I fired up my TS-570 only to find S9 QRN and no audible signals. I am confident the 20 meter V beam will work DX as its 40 meter cousin!

As shown in photo, here's what I used for my antenna mounts. It doesn't get much easier than that. Hurricane "T" connectors ($4 at Lowes) bent and drilled out to accept 3/8 inch threaded connectors for horizontal or vertical dipole (left) or horizontal V Beam (right) mounting (black coil and wire is for another project). Detailed step-by-step homebrew info is available here for the dipole mount. V Beam mount is the same but one end of "T" bent 90 degrees.



In conclusion, it appears the V beams need to be installed at least 15 feet high above ground, somewhat far enough away from other objects and having a great big body of water nearby doesn't hurt any! The bottom line, MFJ HF Mobile HamTenna Whips, available for 6 through 75 meters, are economically priced ($19.95 each, 2010 price) heavy duty compact mobile antennas that perform well, especially outside their intended design! If you worked me in 2011/2012 from the Dominican Republic (HI3/KL7JR) or Hawaii (NH7DX), I used these antennas!

Aloha! Testing from Hawaii October, 2010!

20 Meter Mini V Beam on Broom handle 4 stories up!

October 27, 2010 Maui, Hawaii, "N7I" Special Events for US Islands program (ops KH7/KL7JR and KH7/WL7MY). I experimented further using MFJ 20M short verticals as horizontal and vertical dipoles and as a V Beam. V Beam won hands down! Maybe it's just because of poor propagation? Using 6 1/4 inch long stingers on the whips, [(MFJ 20 meter mobile verticals (MFJ 1620T)], I worked several stations in Washington, Arizona and Oregon on 20 meters and on 17M I snagged a pair of JA's and a Seattle station under extreme QSB and QRM.

Antenna was mounted on a broom handle lashed to the balcony of our 4th floor condo overlooking the ocean. Several different weather

patterns and high winds were experienced the first 3 days of operating. Antenna with short whips loaded all bands 10-40M!

73, John KL7JR

THE CLOUD WARMER NVIS BEAM

AIM FOR THE CLOUDS AND GET BETTER "LOCAL" SIGNALS!
AN NVIS STYLE "BEAM" ANTENNA FOR BETTER "LOCAL" AREA COVERAGE ON HF

THIS IS NOT A DX ANTENNA!

Some of you may recognize this design as nothing more than a half wave dipole, but upon closer examination, you will see that there is a reflector at the bottom of the antenna spaced at about .15 wavelengths or less from the driven, (dipole), element. This in fact, makes this antenna a 2 element wire "beam" aimed straight up at the clouds! Hence the name "Cloud Warmer Beam". NVIS style antennas work best below about 8 MHz as confirmed by the U.S. military.

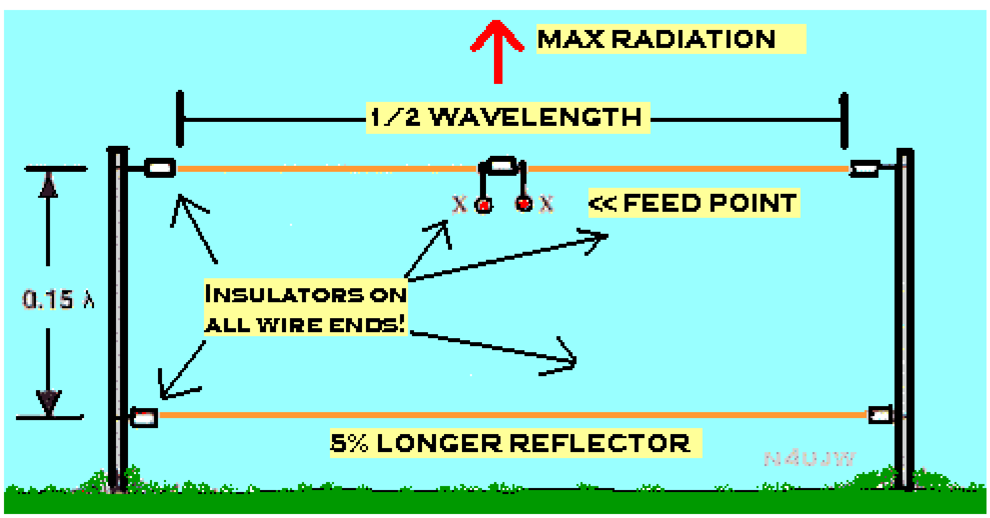
If you already have a half wave dipole up and running, then you have been using this type of antenna to some extent without knowing it, however, yours is not as effective in getting your signal to the "local" area out to a few hundred miles due to the properties of the ground underneath, your present dipole, and the nature of the dipole pattern.

This design gives you the ability to more closely match the ideal situation for your dipole to perform much better in the close in range, (a few hundred miles radius), from your station and give you a little added "gain"!!!! The military uses the NVIS configuration while operating mobile for better "local" coverage on their low bands by laying down their whips in a horizontal position on their mobile units. THERE IS NOTHING SPECIAL ABOUT THIS ANTENNA CONSTRUCTION

OTHER THAN THE ADDED REFLECTOR AT THE BASE OF THE DIRECTOR (DIPOLE)!

By adding the reflector, which is 5% longer than the driven element, and spacing it .15 wavelength or less below it, you turn your dipole into a beam type antenna projecting your signal up to that big reflector in the sky where it is bounced back down into a sort of upside down cone pattern extending out several hundred miles! **NOTE: THIS IS NOT A DX ANTENNA!**

The standard formula can be used for calculating the length of the director....468/freq. MHz
Reflector length = director length + 5% longer.
Spacing = aprox 140/freq MHz



See further experimentation concerning spacing below~

Example:
Design for middle of the General Phone Band around 3.925mhz

468 / 3.925 = 119.24 FEET FOR DIRECTOR (DIPOLE)
REFLECTOR = 5% LONGER THAN DIRECTOR = 119.24 X .05 = 5.96 FEET ADDED TO 119.24 = 125.20 FEET

SPACING = 936 / 3.925 MHz = 238.47 FEET X .15 = 35.77 FEET FOR SPACING
(See further experimentation concerning spacing below)

If your starting this project from scratch, start with the director, (the dipole), a little longer and prune to lowest swr for middle of band as with any other antenna project! If your dipole is already up with low swr, then just add the reflector at the proper spacing distance.
The distance from the reflector and the ground should not make any difference. You will note by the calculations above that the distance from the driven element and reflector would require that the director be at least 35.77 feet from the ground! If you can't get the formula spacing for installation reasons, then just do the best you can. Some experimenters state that even much lower overall dipole height above the reflector work even better. See below.

UPDATE! Spacing Experimentation
More recent experimentation by Pat Lambert, W0IPL and others conclude the distance from the antenna and the ground can be lowered considerably with much better results.

Here is a teaser comment made by him:
"While 1/8th wave works reasonably well, better coverage is obtained if the antenna is mounted at about 1/20th wavelength above ground. A second advantage of lowering the antenna to near 1/20th wavelength is a lowering of the background noise level. At a recent S.E.T. communication on 75 Meters was started with a dipole at approximately 30 feet. We found communication with some of the other participants to be difficult. A second 1//2 wave dipole was built and mounted at 8 feet off of the ground. The background noise level went from S7 to S3 and back when we switched back the antennas, plus communications with stations in the twenty-five and over mile range were greatly enhanced."

ANTENNA SUPPORTS MUST BE NON-CONCUCTIVE FOR BEST RELULTS! USE A GOOD HEAVY SIZE # 12 OR 14 WIRE. OTHER

TYPES OF ANTENNAS CAN BE USED NVIS STYLE BY JUST ADDING THE CORRECT LENGTH REFLECTOR AT THE BOTTOM OF THE ANTENNA.

About NVIS antennas
HF NVIS COMMUNICATIONS
Edited from U.S. Military training documents

NVIS propagation is simply sky wave propagation that uses antennas with high-angle radiation and low operating frequencies. Just as the proper selection of antennas can increase the reliability of a long- range circuit, short-range communications also require proper antenna selection. NVIS propagation is one more weapon in the communicator's arsenal.

To communicate over the horizon to an amphibious ship or mobile on the move, or to a station 60-190 miles away, the operators should use NVIS propagation. The ship's low take-off angle antenna is designed for medium and long-range communications. When the ship's antenna is used, a skip zone is formed. This skip zone is the area between the maximum ground wave distance and the shortest sky wave distance where no communications are possible. Depending on operating frequencies, antennas, and propagation conditions, this skip zone can start at roughly 12 to 18 miles and extend out to several hundred miles, preventing communications with the desired station.

NVIS propagation uses high take-off angle (60° to 90°) antennas to radiate the signal almost straight up. The signal is then reflected from the ionosphere and returns to Earth in a circular pattern all around the transmitter. Because of the near-vertical radiation angle, there is no skip zone. Communications are continuous out to several hundred miles from the transmitter. The nearly vertical angle of *radiation also means that lower frequencies must be used. Generally, NVIS propagation uses frequencies up to 8 MHz.*

The steep up and down propagation of the signal gives the operator the ability to communicate over nearby ridge lines, mountains, and dense vegetation. A valley location may give the operator terrain shielding from hostile intercept and also protect the circuit from ground wave and long-range sky wave interference. Antennas used for NVIS propagation need good high take-off angle radiation with very little ground wave radiation.

73, Don N4UJW

4. HAM ANTENNAS USING CB VERTICALS

Many hams use various CB verticals and beams on the ham bands with very good results….I know I'm one! The Solarcon A-99 is probably the most used CB vertical on 10, 12, 15 and 17 meters. You will work a lot of DX, and probably get in to your neighbor's TV and telephone if you are not willing to take precautions, hi hi!

Using CB Antennas on the 10 Meter Ham Band

by N4UJW

Operating on the 10 meter ham band can present many challenges to the ham radio operator but when everything, including Mother Nature, is working with you, this band can be very exciting and loaded with great fun and many local and DX contacts worldwide! When the band is "open" it does not take loads of power, multi-element arrays or lots of skill to make contacts to distant lands and fellow hams around the world. In making "DX" contacts, (contacts out of your country), you will want your signal to reach out as far as possible at a low angle to the earth's horizon and not go out at a high angle relative to the earth. The lower the angle of radiation, the further your signal will go bouncing further and further around the globe using the ionosphere as your "reflector" in space.

Having an antenna that has a low angle of radiation on 10 meters is of great importance in getting those DX stations to hear a stronger signal from you. Using low angle radiation type vertical antennas also greatly improves your chances over your "local" area also. Many operators use 10 meter mobile rigs in their vehicles with of course vertical antennas mounted on them, so in order for you to communicate with them at any distance, your antenna must be the same polarization-vertical.

So what types of antennas have a low angle of radiation that will reach those local operators AND DX stations with the same antenna you may ask? Enter the vertically polarized antenna.

There are many ways to utilize a vertical antenna on the 10 meter band from simple homebrew wire verticals hung in a tree to commercially built high dollar multi-element beam antennas designed for this purpose.

Use a CB antenna on 10 meters!

One of the simpler ways of getting a really good low angle signal out at much less expense is to use a vertical CB antenna converted to 10 meters. Yes, you read that correctly....a CB antenna. Many of the commercially made CB antennas can be easily converted to 10 meter use by just a simple tuning modification of the CB antenna length. Since they were originally designed for 11 meter use on the CB band, they are usually longer than those required for the 10 meter ham band due to the difference in frequencies.

So by using an old CB antenna OR a new one that may be very inexpensive, you can modify it by shortening it until you get the lowest swr on your favorite band, 10 meters. There are several brands and models of commercially made vertical CB antennas that have been designed to cover many of the ham bands "outside" of their original design parameters of the CB band.

So what would be a good commercial CB antenna to use on 10 meters? One commercially made CB antenna that can be easily tuned to 10 meters is the Solarcon A-99 and the Solarcon Imax 2000 verticals with great success. These particular verticals come with a tuning adjustment that will enable them to be used even down to 20 meters with a tuner. They get very highly rated reviews and are very popular among 10 meter operators and have been used for many years. They work well without a tuner when used on 10 meters due to their wide frequency range design. The adjustment to take them "up" to 10 meters is a simple matter of a shortening of the vertical element and a fine tuning of a "tuning" ring adjustment for lowest swr. The A-99 antenna is a 17 foot tall antenna (1/4 WL over 1/2WL variable- whatever that means!) as designed and the Imax 2000 (5/8 WL) is 24 feet tall when it comes from the factory. Either of these antennas can be readily used on 10 meters with just a bit of simple tuning and you will be very pleased at their performance. They get great reviews and are widely used.

The A-99 is the less expensive of the 2 models at around $60.00 (2011 prices), and the Imax 2000 is usually under $100.00. Both are fiberglass and will handle more than the legal limit of RF power. So bottom line, if you don't want to build your 10 meter antenna or convert that old CB antenna you may have laying around, then these antennas are highly recommended and highly rated for the 10 meter operator who wants to get more signal out to the horizon for those DX contacts.

73, Don N4UJW

[Feedback from John, KL7JR: Many hams use the A-99 on 12 and especially 17 meters. I have used the A-99 down as low as 40m but it is a big compromise, and somewhat on 20m but a killer on 10, 12, 15 and 17m! You wouldn't believe my log books on my portable outings with low antenna heights using the economically priced A-99. Oh, if you have a 102 inch whip lying around, substitute that with the A-99's top whip and you'll be surprised it will work better on 20m and sometimes 40m as well!]

Pictured is my 10 and 12M vertical monopole using metal clothes hangers as tuned radials (see March 2012 QST "Up Front").

The vertical radiator is an old 2 foot tall mobile CB antenna I had laying around. The radials are each 34.5 inches long which gave excellent numbers on my antenna analyzer. I worked over 60 countries on 10m and about 40 on 12m (Nov. 2011-April 2012) from my Dominican Republic QTH. Now where's that guy who says "CB antennas don't work on the ham bands"- hi hi! 73 de HI3/KL7JR

In 2000 on Cousins Island, Maine from my rental car I worked over 50 countries on 10, 12, 15 and 17 meters in one long day of operating. My A-99 was duct taped to the trunk hinge!

5. LOOPS

Another popular antenna on the ham and SWL bands is the loop. It can be square, rectangular, round, delta in shape or other shapes, and can be fed with coax or ladder line. You can install it in the horizontal or vertical plane and be amazed what it will do for you. My favorite loop is the vertically polarized loop made from #12 wire. **It's multi-banded, omni-directional and exhibits some gain- now there's more bang for my buck!**

"I LOVE MY LOOP. I Sure Did" An All Band 80 Meter Loop Project by John, KL7JR

"When I think back a few years ago I had 10 acres to use for my antenna farm. It was great to be able to put wires on the towers or off my garage or in the field anywhere I wanted. Oh well, now it's a two car garage to experiment in and then head off somewhere in the motor home to test the antennas. I'm in a deed-restricted community of Town Homes that does not allow any antennas except for the Dish satellite (and the 40m loop on my roof that has been hidden from everyone for 2 years) hi hi!"

"I LOVED MY LOOP~~I SURE DID" Now let me tell you about it!

Much has been printed in QST over the years on loop antennas. Experimenting with wire antennas is a favorite pastime for me. I recently had great results with a delta loop on 10 meters and a rectangular loop on 20 meters, (50+ countries in 3 weeks of casual operating!), then I decided to take the plunge and put up a 80 meter full-wave horizontal loop which would allow operation on all HF bands. After gleaning all the info in the articles referenced below, and adding my own twist, the antenna would either work or be a "cloud-burner".

I am happy to say this simple antenna far exceeded my expectations! What I found to be so appealing about this antenna was that it was fairly economical and easy to build and install, works on all HF bands and requires no special feed networks, only a transmatch, coax and some space!

80 METER HORIZONTAL SQUARE LOOP

Length of a full-wave 80-meter loop is about 270 feet long (1005 divided by frequency in MHz) or about 67 feet per side. I use "about" because exact numbers are not that critical according to my results. In my opinion, when constructing antennas, not only is the old saying "the higher the better" true, but also "the longer the wire the better" may also fit some loops. Since I lived on 10 acres in the country, I decided to make my horizontal loop longer to start with to better fit my backyard. So, my "longer" loop is about 1.25 wavelengths on 80 meters (2.5 on 40m, 5 on 20m and 10 on 10m) and is installed between 30 to 40 feet in the air.

Scaled-down versions, say 75% of a wavelength may also work fine if you don't have the room for a full-wave or longer antenna. According to antenna experts, a circular loop is "ideal", but impractical for most hams. I found a square or even a rectangular loop is easier on the pocketbook and muscles to put up and would provide about the same results. To support my loop made from salvaged telegraph line wire from the Yukon Territory (just think about the stories this wire has already told!), I used my 50-foot tall tower and three masts, each 35 to 40 feet long, made from 2 inch galvanized water pipe. Each support is "supported" by one ¼ inch diameter steel guy wire attached by a U-bolt in the opposite direction of the wires "pull" and a small pulley with 3/8-inch diameter rope for hoisting up the wire to the top of masts (see Figure A).

Figure A Detail of a Mast Support

The telegraph wire is #6 AWG copper-clad steel and not all that easy to work with, but the price was right. For the feed point connection I used a 1-1/2" PVC pipe T terminating the antenna wires to a ¼" eye bolt as used on some commercially made baluns.

RG 213 coax (chosen for strength, durability and because I may use an amp) terminates on the eyebolt nuts with two flat washers.
The coax is taped to a ten-inch long bottom extension of the PVC T to remove strain on the hanging coax. Silicone caulk was then applied to the connections for weatherproofing. For antenna insulators, I used porcelain electric fence insulators. Once the support masts are complete with guy wires and pulleys and installed, raising the wire becomes a one-man operation.

On my tower I installed a six-foot long 4x4 painted wood post hanging off near the top of tower for one of the four required supports (see Figure B). On the post end that is further away from the tower I used an electric service entrance insulator fastened by U-bolt to "float" (ref. ARRL Antenna Book page 5-17) the antenna wire as with the other three supports. I wasn't sure if all "floaters" would actually allow the wire to float, but they did quite easily.

The wire antenna and feed line connections were made up on the ground then hoisted up each mast one-by-one with the rope and pulley. Once the wire was in the air and about a foot or two away from the masts, I merely tied off the rope to whatever was handy (i.e.- nearby barn roof, tree etc.). I only had to take up a bit more slack from one pulley (the wire pulls through all the pulleys) for final wire sag adjustments. Since my wire was very heavy duty, I could pull it tight. Your sag will depend on the type and size of wire used. Smaller gauge wires will break if pulled too tight or used on long spans - just ask me! My loop is fed about mid-span and the coax drops 30 feet straight down into my shack.

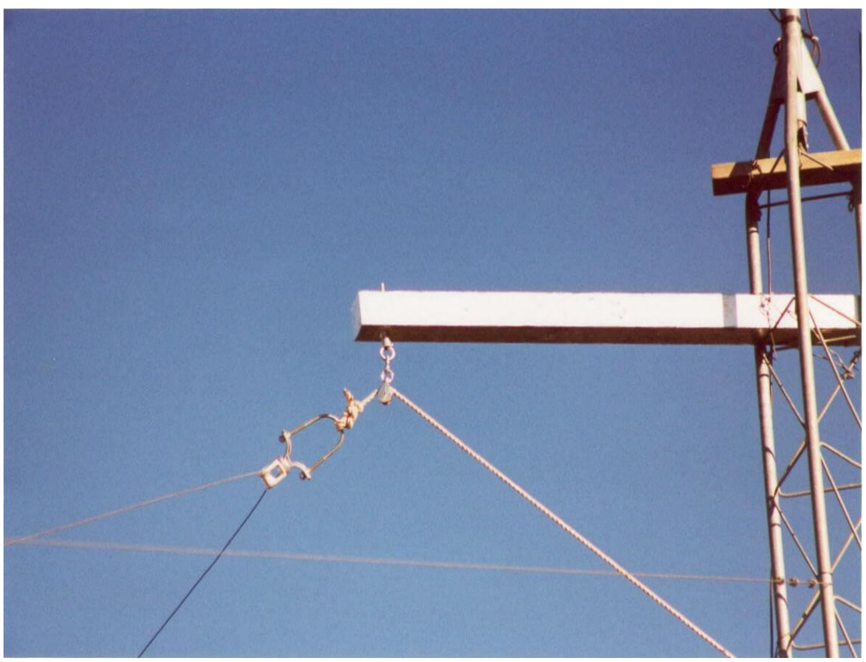


Figure B Detail of the Tower Support

HOW DOES IT WORK?

During the first 3 months of use, (October through December), 75% of my QSOs on 10 and 20 meters were either 5x7 or 5x9 reports "both ways". About 75% of them being with stations outside North America *(about 10% were 5x9 +20!), and about 20% of the total QSO's were 5x5 to 5x1 quality "both ways".
For those doing the math, call the remaining 5% split equally either 3x3 signals or simply "no contact at all" (you can't work them all!).
Also, my log indicates "sent" report was the same as "received" most of

the time. I even broke several big pileups on the first or second call.

Directivity? Well, the loop seemed to work just fine equally in all directions (I'm still scratching my head!). That's what I really like about this loop! Gain, you ask? Well, some..... depending on your choice of feed line and how high you install your antenna. L.B. Cebik W4RNL (SK) goes into a lot of detail on gain (see ref #4 below) in his article so I won't get into that here.

Although I have mostly tried this antenna on 10 and 20 meters, I was also pleased with a weekend of experimenting on 15 and 17 meters.
DX worked on 15 meters: KL7, HL5, JR1, KH0, RV9 and BD4.
DX worked on 17 meters was KL7 and OH1. Many Ws and VEs were also worked on 15 and 17 meters. Both bands produced about the same results on signals mentioned above over the two-day period of tests.
I am confident this antenna will produce good results on 40 and 80 meters as well. I know it tunes 40 and 80 meters quite fast!

To give a better perspective on this versatile antenna, on December 29, 2001, I worked Rick KL7AK back-to-back on 15, 17, 12 and 40 meters! On 15 and 17 meters we both exchanged 59 +20 reports, on 12 and 40 meters we were up to 5x5 quality. Not bad for a piece of wire, eh?

I did learn however, both 300 watt manual tuners (MFJ and Vectronics) that I used took some time to tune the loop, with a couple bands requiring a lot of patience! I did not try the auto-tuner on my TS-570D since my Tucker 1.5 kW tuner easily handled the job quite fast on all bands 80-10 meters. My tri-bander will remain stored in my garage as I work on a new loop design around 1200 feet long supported off of 60 foot tall power poles (but that's another article!) - when I tire of this antenna that is! I highly recommend this antenna. Good luck with your antenna experimenting! Any and all feedback is appreciated.

**I worked all over the USA and Canada, including: KL7, KH6, JY4, V47, KH0, WP2, WP3, HP1, FO, PA2, 8R1, DS3, G3, LU1, ON7, JA (all), DU1, I2, ES1, UA9 and UA6 to name a few!

Some final words!

Believe me when I say, it was the best all-around antenna I ever used! I liked it so much I decided not to waste my time and effort putting the tri-bander back up. Often times on 80m nets I was 20 over S9 to other WA and OR stations who were 100-200 miles away. I wasn't using an amp either. I regret only using the antenna 4 years. I even had plans for a higher and longer version in the future as mentioned in the article.

Oh well, I guess we all have had a favorite antenna at one time or another. In summary........" I LOVED MY LOOP"
73, John KL7JR

References:

1. "The Loop Skywire", by W0MHS, QST Nov. 1985, page 20 and ARRL Antenna Book 16th edition, pages 5-16.

2. "The Droopy Loop" by KJ7MZ, QST July 1996, page 57

3. "Loop Antennas", ARRL Antenna Book, 16th edition, pages 5-1

4. "HO-HO-HOHPLs" by W4RNL (SK) (www.cebik.com) Do a search

(Note: #1 is available to download from ARRL website, do "search" for "constructing loop antennas

KL7JR'S Confined Space Stealthy Loop 6 Through 20 Meters

I can't say "I love loops" enough.
It seems the more I use them the more amazed I am!

Hint. Look at the "jungle" on right side of picture above the rails. Now that's stealth! One section of the loop is also barely visible on the left side. There is also an 80 meter TAK-tenna. Can you see the antenna farm at first glance?

The simplicity of installation and cost to build are hard to beat. Benefits are multi-band capability, omni-directional coverage (if that's your fancy) and gain from some loops. This antenna project is another take off of my tried and proven vertical loop design used indoors and outdoors, but this time to fit a small space and be as "unseen" as possible from our island oasis condominium in the Dominican Republic.

(reference http://www.hamuniverse.com/kl7jrindoorloop4010.html).

Our patio space shown in the photo on the previous page, is about 16 ft long x 8 feet wide with a ceiling height of 15 feet in our newly purchased condo, occupies the top floor (3rd) of an ocean facing building. My new best friend, Mr. Saltwater, is about 120 feet in front of me!

Not many options for antennas, and using Hamstick type antennas was my last resort. I wanted a full wave vertical loop for 20m but the coils then had to be very long which exceeded the 30% rule (ie-do not make the coils longer than 30% of the wire antenna length….I read that somewhere). Yes, I tried stretching it to about 50% and it did not work out as I was merely talking to myself most of the time (It was "fair" for "close by" DX only. Learning that, I now make it a point to keep my coils at 15% maximum of the total antenna length. It works well for me).

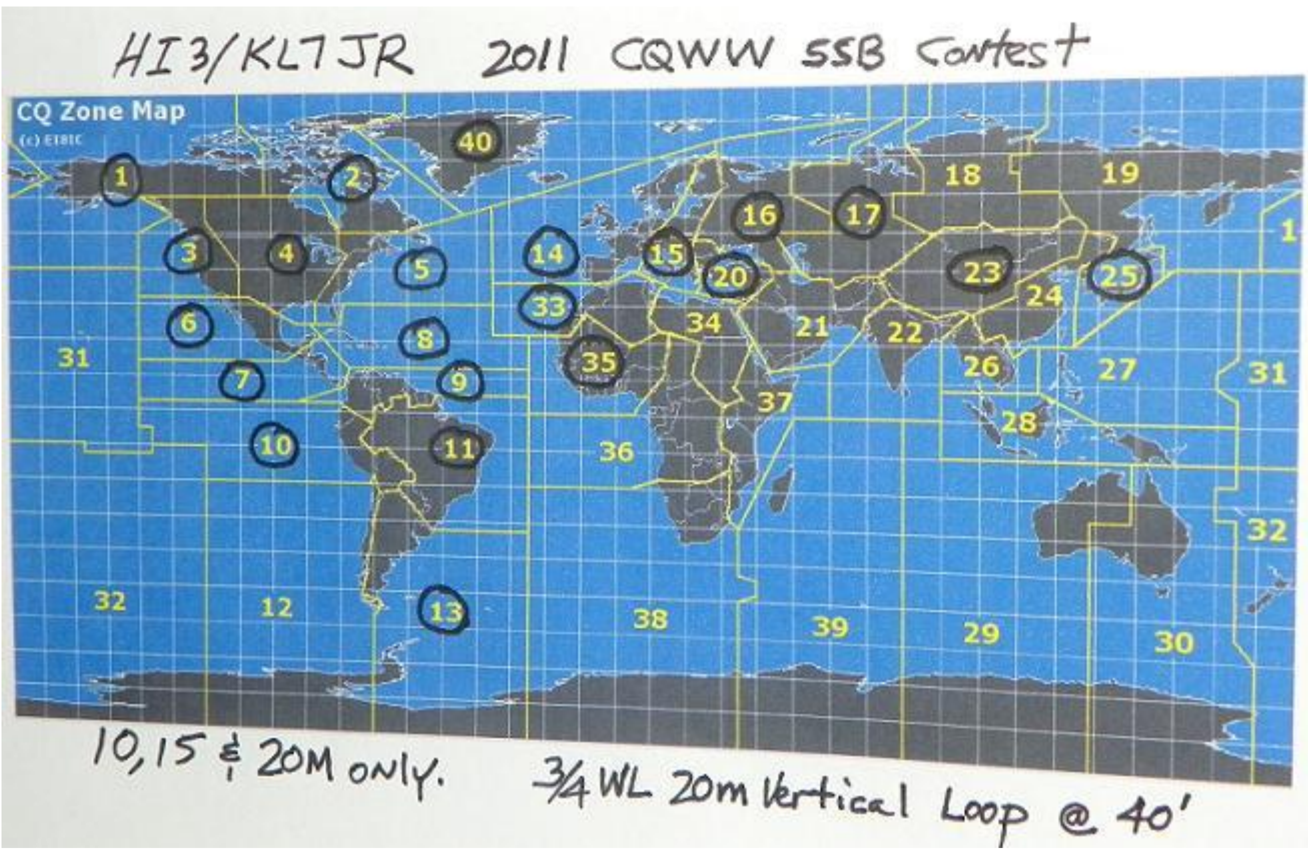
An easy fix for me was cutting out some wire (oh, I used white colored wire for the entire antenna to match the patio paint!) on the coils to arrive at 3/4 wavelength and re-stretching the antenna.

I now have a square, or almost square loop measuring 13' horizontal x 12' vertical and a 2 foot long coil #14 wire (wound on 1" scrap PVC pipe) in each of the vertical radiators. Using the formula, 1005 divided by frequency we arrive at 53 feet for a 3/4 wavelength antenna set for 14.250 MHz (1005 div. by 14.250=70.5 feet times .75=53 feet). 13' x2 plus 12'x2=50', and allow 3 feet for the 2 coils (I used 2 feet/coil). I used an air choke (6-8 wraps coax on 6 inch dia.) at the feed point to eliminate stray RFI getting in to my shack, and especially in the neighbor's TV set! It is shown in the photo below.

After a year of operating with the loop, someone from below finally noticed "something" and asked what the ropes were for. My flower trellis I quickly replied! A trip to the plant shop for some fake flower vines were in order as shown in the photo above. I'm in good

shape again until someone asks where to get flowering plants year-around, hi hi! Corner Feed Point and Choke "out of sight, out of mind". My fishing hole is also shown.

I am working DX all over the world again (10-20m, and hopefully 6m soon!) from this QTH now 1 floor higher than before. The top of the loop is right at 40 feet above ground and the ocean fishing hole is only 120 feet away helping out. Yes, I catch more DX than fish!



Come on experiment. You'll be surprised with what a little wire will do (don't be afraid to reduce the loop if you have to)! The loop continues to be a workhorse for me. **After one year of use I have worked over 100 countries with it using 100 watts!**

73, “Yukon John” HI3/KL7JR

6. SWL Antennas

I suppose there's a little short wave listener in all of us. I know I was a SWL at about age 9 before I even knew what it was called. I remember staying up late at night and logging as many AM and FM radio stations as I could. Fond memories of listening to KOMA in Oklahoma City, Oklahoma from my basement listening post which consisted of a small transistor radio are still with me today. I don't do much SWLing anymore as Amateur Radio has me captive, especially from remote island paradises. I leave all the SWLing to Don, N4UJW! Check out his simple to build receiving antennas.

BUILD A SHORTWAVE ANTENNA

"The Search For The Perfect Shortwave Antenna"

by N4UJW

Follow these simple plans to build a multiband shortwave antenna and be on your way to world band radio excitement! Hear shortwave signals live as they happen directly from around the world!

Introduction

Many years ago, my dad sparked my interest in shortwave radio, which led to me becoming a licensed Amateur Radio Operator in 1989. Lots of us "Hams", listen to the shortwave bands when we are not in the "talk" mode ON THE AIR. I have enjoyed shortwave radio since a small child! The excitement of listening to voices, music, news and other fascinating information and radio signals of all types from around the world can by yours too. You, my friend are probably just getting started in this fascinating hobby or you just want to improve your reception..... WELCOME!

Just follow these simple instructions below to build either an outdoor or indoor multiband shortwave antenna. These antenna types described below can generally be used either outdoors or indoors, but lots depends on the room you have for the wire. They have been broken down into their most common use and simple antennas. For the most part, they will outperform or at least equal commercial made shortwave antennas for a lot less money and you will have the satisfaction of saying, "I built it myself"! You don't have to know antenna theory to build these antennas, but included is one very simple formula that all Hams use in designing these types of antennas. Let's get started.

A NOTE ABOUT WIRE FOR SHORTWAVE ANTENNAS:

An antenna is composed of a conductor that carries the electrical signals to your receiver. There are many kinds and types of wire starting with single wires made of copper and stranded wire made from steal with a copper coating on the outside. Many "wires" have multiple conductors like telephone wire used for adding extra telephones or regular speaker wire with only 2 conductors side by side. Most shortwave antennas require only one conductor or wire in the "elements" of the antenna so when using "wire" for antennas, you can use the least expensive types.

The size of the wire can be an important thing if the antenna is designed to be used outdoors in the weather. Use a minimum wire size of about #20 to #18 outside. When you use sizes much smaller than these, you get into problems with breakage from ice, wind, birds, etc.
Wire sizes are numbered by their gauge; larger sizes are the smaller gauges. A #14 wire is larger in diameter than a #20 wire gauge. Most ham radio operators use # 12 to #14 wire sizes outdoors!

THE LONG WIRE SHORTWAVE ANTENNA

The simplest multiband shortwave antenna for shortwave listening is probably the long wire for most newcomers to building antennas. It is literally, a random long length of wire stretched out from the shortwave receiver antenna connection and attached with some form of an insulator on the opposite end. No bells or whistles and usually very easy to do. Your shortwave radio probably has either a short telescoping (pull-up) antenna and or a connection point for an external antenna usually on the rear. **A very simple method of drastically increasing the signal strength to your shortwave radio** is to simply add about 50 to 70 feet or more of insulated wire of small diameter, (size not critical, it must support its own weight), attached to either the telescoping antenna with an alligator clip or a suitable connector to the rear external antenna connection and stringing it out across or from the house to the appropriate support as high as possible on each end with some form of insulator along the entire length, (a non-metal device that will not pass electricity). In other words, don't run it along a water pipe, conduit, metal house siding, rain gutters, etc. It can be tacked along the ceiling or snaked up into the attic or around the roof. Just don't run it close to metal objects. Use your imagination. Make sure that you have removed the insulation when adding the connector or alligator clip.

DANGER! DO NOT STRING THIS ANTENNA OR ANY ANTENNA OVER, UNDER or NEAR ANY ELECTRIC POWER LINES OF ANY TYPE! YOUR LIFE WILL BE IN YOUR HANDS, NOT MINE and I assume no liability. Repeat....never OVER, UNDER or NEAR POWER LINES! This includes the service drop wire from the utility power pole to your electric meter! Have adequate space allowed to insure that if a power line falls, it will not fall on your shortwave antenna! Use this rule of thumb.... If it is under the power line......the power line WILL FALL! If it is over it, the antenna WILL FALL! Don't let either happen!

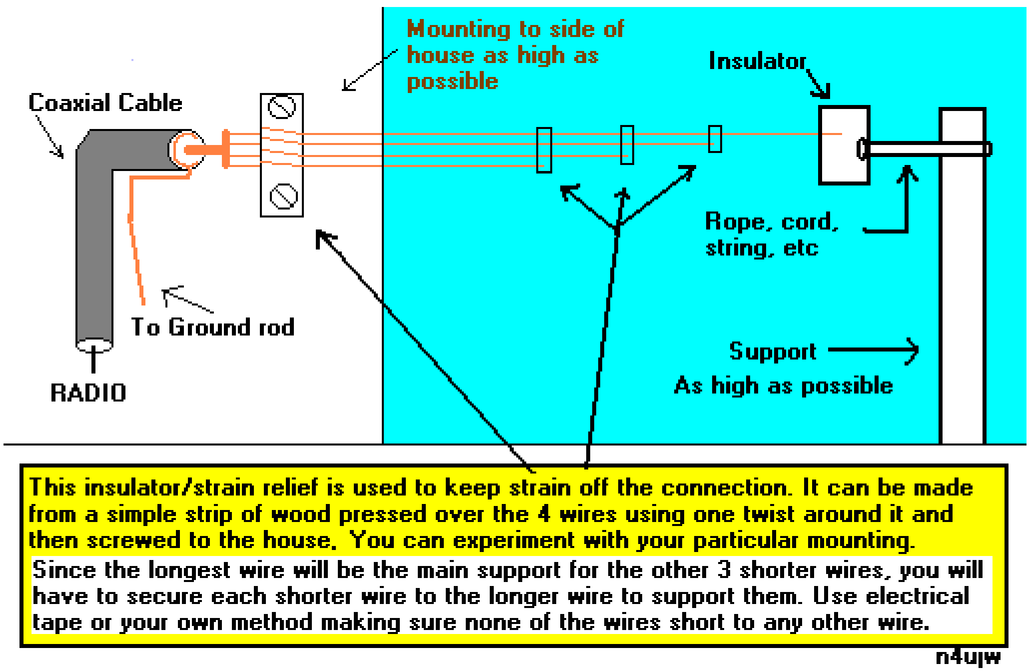
Now back to shortwave antennas.
The long wire type of antenna is a compromise as ALL antennas are. Don't expect the same reception 100% of the time from the same station. Mother Nature and man-made variables will surely destroy your expectations. This type of antenna generally "picks up" stations better in the direction of the wire, so if you live in the U.S.A., you can string it in a Northeast Southwest direction and get the European stations somewhat better. Don't worry if your layout is not perfect....just put it up and have fun listening.

THE MULTIBAND LONG WIRE SHORTWAVE ANTENNA

A Much Better But More Complicated Antenna. This antenna is end supported and designed to receive the major shortwave bands between 90 meters and 16 meters. It uses only 4 wires and a unique antenna property called harmonics to get 8 bands using only 4 wires! Again, it is a compromise but an excellent performer....the perfect antenna does not exist. We "Hams" are working on it constantly!

After construction, this shortwave antenna should be stretched out in a straight line as high as possible as in the long wire antenna above, and about 140 feet straight out from the house! Don't fret! If you can’t, you can't. Utilize your existing space. More supports may be required for a zig zag layout but performance may suffer a bit. Don't worry; it will certainly outperform that built in poor excuse for an antenna!

Note: The antenna consists of 4 separated insulated wires, (measurements below), all connected (soldered) on one end, leaving the opposite end unconnected and insulated at the support. If you do not know how to solder, then scrape all the coating from the wire down to bare copper and tie the ends together using several knots.



You really should learn to solder. This will make for a more permanent and much better electrical connection. The soldered end must be between an insulator and the radio for mechanical strength. You don't want much stress on the soldered connection other than the coax leading to the radio. The end that has all wires connected should be soldered to the center wire of a suitable length of 50 - 75 ohm coaxial cable leading to the short wave radio with a suitable connection.

A ground wire is soldered to the shield only of the coax at the same end that you soldered all the wires together and attached to a ground rod driven into the ground near the house. Seal and tape all outdoor connections from the weather. This antenna is called an end fed half wave antenna. See picture, formula and wire measurements for bands below: (The lengths are not extremely critical, but try to get them as close as possible.)

Note: In the instruction box on previous page, the last sentence refers to the long portion of the wires, not at the connection point to the coax feed line to the receiver. All wires are connected together at the connector center conductor wire! (frequencies shown below are approximate shortwave band centers):

Wire 1 (LONGEST WIRE) 3.25 MHz (90 meter band) 09.75 MHz (31 meter band 3rd harmonic)
468 divided by 3.25 = 144' 0"

Wire 2 3.95 MHz (75 meter band) 11.85 MHz (25 meter band 3rd harmonic)
468 divided byi 3.95 = 118' 6"

Wire 3 5.10 MHz (60 meter band) 15.30 MHz (19 meter band 3rd harmonic)
468 divided by 5.10 = 91' 9"

Wire 4 (SHORTEST WIRE) 5.90 MHz (49 meter band) 17.70 MHz (16 meter band 3rd harmonic)
468 divided by 5.90 = 79' 3"
The number 468 divided by the frequency above is the formula for

calculating a half wave antenna length used all the time by Amateur radio operators in building many different kinds of antennas.
You'll need about 435 feet of wire for this antenna plus appropriate length of coaxial cable. Check with Lowe's, Home Depot, Radio Shack, Wal-Mart, farm supply stores and other stores that might have wire bargains. Dual conductor speaker hookup wire can be purchased in rolls and split in half to double the length. Multi-conductor tv antenna rotor wire can be used the same way. Electric fence wire is also a good alternative.

The wires are spread 3-4 inches apart, held in place with simple non-conductive spacers. Just cut a few pairs of the acrylic, Plexiglas, plastic strips or other non-conductive material that will not be damaged by moisture long enough to attach the wires keeping the spacing about 3 to 4 inches or further if you want. Use your own ingenuity with the attachment method while keeping them separated.
To accomplish all of this, you stretch the antenna on the ground, assemble it, and then get it up to the support with your own best way.

OUTDOOR CENTER FED MULTIBAND (FAN) DIPOLE SHORT WAVE ANTENNA

NOTE: For use with the higher quality table model communications receivers that have standard antenna connectors capable of using direct coaxial cable connectors. This antenna type is used by many Ham Radio Operators worldwide and is very popular but the lengths for the Ham bands are entirely different. The entire length of the antenna is about the same as the one above and the coaxial cable is connected in the center of the span with the center conductor connected to one side of the antenna and the shield connected to the other side then at the other end, to the receiver. The formula used for this antenna is the same as the Multiband Long Wire above:

468 / by frequency in MHz = total length in feet. This resulting length is cut in half! One antenna per band stacked. It is somewhat more

complicated in construction due to the center connection and requires support in three places....each end plus the center. The preferred method for using this antenna is drawn in the picture below with the wires "fanned" apart with at least a foot of separation between the ends.

All of the wire elements can be close spaced but some interaction will occur. Insulated wire is best so the individual wires do not connect on the longer lengths of the antenna. Choose the antenna of your choice depending on your constructions skill and needs. Either way, they both will be much better than the little telescoping antenna that comes with most portable receivers.

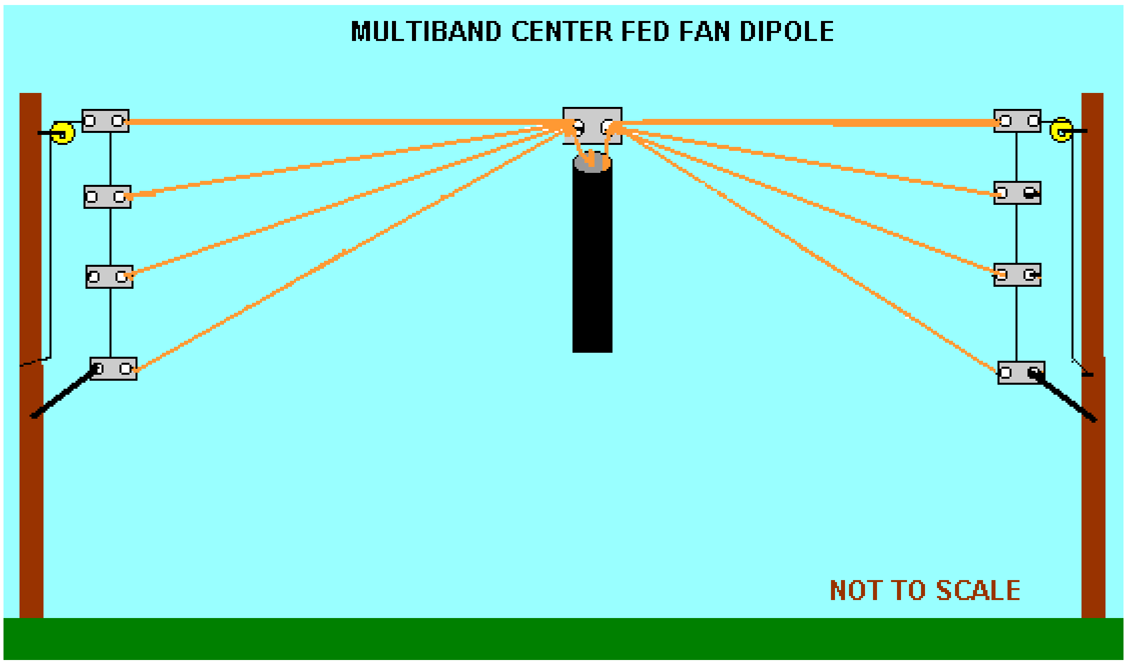
The center fed multiband dipole antenna (drawn below) consists of 2 separate sections of 4 wires on each side of the center connection at the support consisting of 4 wires connected to the center conductor of the coax and the other 4 connected to the shield.

In this arrangement, one half of the antenna is feeding the center conductor and the other half is feeding the shield. Each side must be insulated....not connected....to the other side. The other end of the coax is connected to the radio with the appropriate connector.

Use lengths in the multiband antenna as shown on the next page with total length split in half using the formula....half on one side and half on the other for each wire length per band. The coax can be anything from 50 ohm to 75 ohm.

Not critical on receive! Note in the drawing on the next page that the small gray rectangles represent insulators!

The final assembled antenna can be installed with the center section higher than the ends, making it look like an inverted V, like this /\ . Make the angle of the V about 90 degrees or more.
Or it can be horizontal to the earth or anywhere in between.
The inverted V configuration is more omni-directional, (all



Shown supported between two wooden poles. Gray rectangles are insulators.
Yellow circles are pulleys.
Orange lines are dipole elements.
Heavy black vertical line in center is coax leading to radio.
Note that one side of antenna is connected to center of coax, shield to the other side.

directions), than the horizontal method which tends to receive best, broadside to the wire. Less real estate is required for the inverted V method. Center supporting also has less tension on the antenna so smaller wire size may be used to save money.

Choose the antenna of your choice above depending on your constructions skill and needs. Either way, they both will be better than the little telescoping antenna that comes with most portable receivers. Enjoy!

INDOOR MULTBAND SHORTWAVE ANTENNAS

Attic Antennas

To begin with building and installing an attic antenna that helps your reception, you need to take stock of your attic's measurements, particularly the length of the attic at its longest distance that you have easy access and your radio's location. One of the more common house sizes is about 50 to 60 feet long and about 25 to 30 feet wide at the ground level. Your house or home may be entirely different. The accessible attic space usually is much less than this. You will have to really compromise with an attic antenna as far as the band coverage is concerned for a short wave antenna to perform adequately. Use the dimensions of your attic and compare them with the lengths of the long wire and dipole type antennas in this article above and choose the one that you can "fit" into the attic. You may not be able to use lengths for all the bands, but again, no matter what length your end result is, it will certainly outperform that little pip squeak of a poor excuse for an antenna that came with the radio! Just utilize the space that you have and don't worry about the length. Just use as much wire as you can and forget about that "perfect antenna". It still does not exist up to this point in this article! Hams are still working worldwide on it!

The best place to mount or attach the antenna is against the peak or highest part of the roof thereby keeping it away from ductwork, AC and heater systems, telephone and all the other metallic environment that exists in most attics. Once you have the location selected, then build the antenna while keeping in mind that the coax or wire will have to get to the radio. If you're working up on the roof, get a helper to assist, an adult, not children! Be careful on those ladders!

You can push most small coaxial cable under the space where the carpet and wall come together and wire should be no problem, then to the nearest closet, up the wall and into the attic. You can work from the attic down or radio up....your choice. Lots of variables here too so you will have to choose your own route and method of installation. If you have to drill into a wall to feed the wire, use caution and don't drill into electrical wires! It may be the last time you do!

IN ROOM ANTENNAS!

In those cases where you can't put an antenna outside or up in the attic, then you can install it in the same room with the radio! They won't be as effective as those up in the attic or outside but will still get more signal to your radio which is what you want. Simply use your own method to attach a random length wire, up next to the ceiling against the walls...around all sides of the room if possible. One other choice is to push a random wire between the carpet and the baseboard around the walls of the room. You will be surprised at the difference compared to that telescoping antenna that came with your radio. Just attach the antenna to the telescoping rod...don't forget to remove the insulation on the wire at the attachment point!

RANDOM WIRE SHORTWAVE ANTENNAS.

The name says it all......just use any length of wire and as long as possible. Now wasn't that one simple. Use same construction techniques as in above for supports and connections.

NOTE: NONE OF THE ABOVE ANTENNAS ARE DESIGNED FOR TRANSMITTING....USE FOR RECEIVE ONLY!
DAMAGE TO TRANSMITTER MAY RESULT.

"As I have stated above a couple of times, don't worry too much if you can't get the lengths exact or you don't have the ideal amount of real estate required for the longer antennas. Just have fun and try to learn by doing. EXPERIMENT!

These shortwave antennas may actually overload your receiver with too much signal on the less expensive short wave radios with telescoping antennas only. Just disconnect the alligator clip from the antenna and just wrap the wire several turns around it without the actual wire inside the insulation touching the antenna. This will probably improve the overload."

"This author has helped the wire industry stay in business over the years as have other Amateur Radio Operators have done and I have enjoyed every minute of if. I have used just about every kind of material for an antenna for shortwave listening that would conduct a radio frequency including window frames, bed springs, rain gutters, conduit, aluminum tubing, coffee cans soldered together, old CB antennas, TV antennas, curtain rods, copper tubing, aluminum trim from kitchen counter tops and on and on...... and the old standby............wire!
I hope this article and projects were of some small use to you in your quest for the perfect short wave antenna!" Experiment, experiment, experiment! Have fun!

73, Don N4UJW

7. HANDY HAM HELPERS

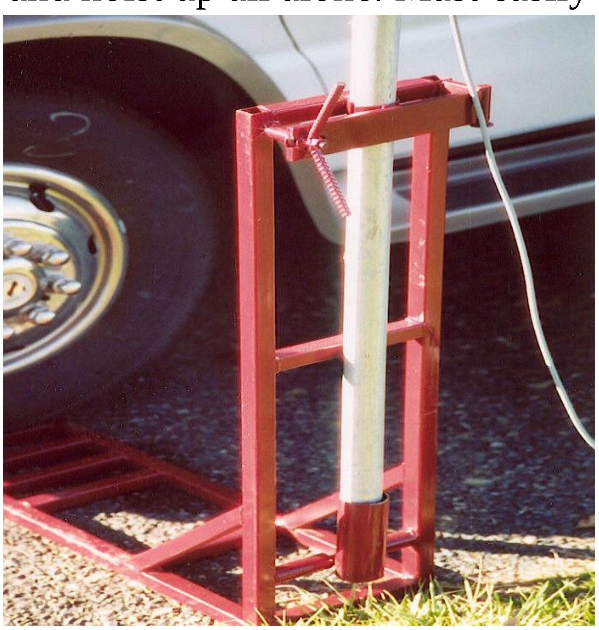
We all have our favorite homebrew item that has made hamming a lot simpler for us or perhaps added a little bit of "eye candy" to our shack. OPAR for me has allowed me to have an extra set of muscles around when I was raising my antennas especially when it is 40 below in the Yukon or Alaska!

O P A R- The One Person Antenna Raiser

by KL7JR

Do you operate portable? Do you have trouble finding help for antenna erecting at your QTH? This may just be the answer for you.

You can drive a vehicle on the base for portable operations or mount permanently at your QTH by bolting base to concrete inserts. Slip the mast in the base of OPAR (short pipe section tilts), mount your antenna and hoist up all alone. Mast easily secures in place with moveable locking bolt and large spanner nut. Guying methods should also be employed for heavier antennas. I've used OPAR to lift small beams, verticals, rigid dipoles and various wire antennas to heights of 20-30 feet with minimal effort all by myself!



OPAR shown with antenna raised and mast locked in place.

Although OPAR is designed for "one-person operation" using small to medium sized antennas, it's always good safety practice to have help on hand. OPAR as pictured is considered "medium-duty" use. Several variations (use your imagination for your own particular use!) exist (ie-length of vertical or horizontal members, etc.) depending on your specific use. A flexible design is what makes OPAR more "user friendly" compared to the commercially made models. For larger antennas or operating in the Arctic, I'd recommend adding a second vertical brace higher up on the vertical section and adding at least another 12 inches or more to the overall height (36 to 48 inches plus). If you are not an experienced welder, it's best to have a professional welder do the welding (the number of "good welds" is directly proportional to the length of time the antenna and mast stays in the air!). My OPAR cost about $340 to make locally. Raising a tri-bander alone is not easy especially for the inexperienced Ham, but it is possible if done correctly. Remember to have help on hand if at all possible. I wished I had OPAR many years ago! Good luck with your antenna projects.

OPAR shown above set up ready to accept antenna mast. Simply insert mast end in to OPAR pipe stub, install antenna and raise.

MATERIALS LIST (medium duty OPAR)

- vertical support 36 inches tall by 9 inches wide w/support braces every 6 to 8 inches.
- horizontal support (drive-on) same as above.

- 1 inch OD square tube steel used (approx. 20 feet total required) for strength vs. round stock.
- 1/2 inch x 3 inch long bolt with welded spanner nut
- mast hinge is ½" pipe by 6 inches long inside two ¾' pipe sections.
- 3/8 inch by 2" wide plate used to secure mast to top of vertical support.

Some economical mast materials used by KL7JR:

1. Light-duty use: Chain link fence "top rail" pipe or EMTconduit for smaller light weight antennas.
2. Medium to Heavy-duty use: IMC threaded conduit or galvanized threaded water pipe (1 ¼" size works great).

The tallest mast I used was 25 feet, unguyed with an A99 Solarcon vertical or Shakespeare 2010 vertical, or various wired antennas (dipoles, G5RV's etc.). Anything over 25 ft becomes unmanageable and must be guyed. I've used small beams up to 20 feet without guys. On lighter wire antennas I used light weight conduit (EMT or IMC threaded 1 1/4") or chain link fence top rail pipe 1" diameter.

OPAR, pictured with the 2010 vertical at 24 feet, withstood some strong Yukon winds, storms and -25 degree F temps in Nov. and Dec. for several days!

For verticals or beams, 1 1/4" IMC or galvanized water pipe worked great. The antennas go up fast and easy, but you must do it fast to gain momentum, or the antenna becomes very heavy midway the push up and then you'll struggle with it.

Below you'll see the lighter version of OPAR which worked great on several of my outings. Oh, I added a 2nd down brace from the top of the raiser that clips to the mast to the bottom of the raiser for heavier antennas like I used.

The photo below shows the additional **brace** I added from the top to the bottom of OPAR to accommodate heavier antennas.

I kid you not, and I highly recommend you do a couple trial "hoists" without an antenna to get the swing of things, this baby is slick! You don't have to be parallel with the vehicle either when you drive on the base. Sometimes I've had to go up at an angle less than and more than 90 degrees. Round pipe would also work. Square tubing was on hand. You can also play with the height and width of the support depending on what you want to hoist up. I based my design on heavy pipe and heavy antennas. I've been using my OPAR for about 15 years now and it's been a life saver for me hoisting up antennas by myself.

New Updated Compact LIGHTER Version!

I've been kicking this simple design above around for some time. It's smaller and lighter than my original

OPAR (one person antenna raiser) at the beginning of this article, and only cost $50 (2009 prices), for a welding shop to make for me.

Quarter-inch plate and 1/4"x4"x3" angle. Modify it to your own design as you wish! Update 11-2010- Well I just wouldn’t let it be. I just had to make a lighter version but hopefully just as sturdy.

The older and heaver designs in the earlier part of this article were Yukon tested (the purple one is the original design and the black is the lighter version and the aluminum is the 3rd design you see above.....phew! After using the lighter version on 4 setups over a 3 week period, I know I had to try to go lighter yet....(I ain't getting any younger!)

The Aluminum OPAR - Redefining a proven design!

Although the latest design of OPAR worked well for me on my 2010 VY1RST/VE8RST trip, I wanted an even lighter antenna raiser. Would

an aluminum version work in the harsh arctic or just end up a brittle mass of scrap metal when 40 below zero? This design uses 4"x 4" aluminum angle (2 at 30 inches tall) and a 1/4 inch aluminum plate (8"x 20"). The bolts are 7/16 inch and I will probably replace with eye bolts which are easier to grab with gloves on.

Construction is similar to the lighter version OPAR but the weight is now cut down to a mere 16 pounds! Four inch angle should handle large heavy antennas such as a tri bander, and 2.5 inch or 3 inch angle would easily handle smaller lighter antennas. I have $200 invested (aluminum costs more in material and welding labor than steel) in this beauty and I am confident it will work fine in the arctic. CQ DX here we come! ENJOY!

[DISCLAIMER Feel free to copy or modify this design at your own risk. Neither USI, NCDXA nor KL7JR claim any responsibility. 73 de Yukon John, KL7JR]

Portable Vertical Antenna Mount

By "Yukon John", KL7JR/VY1RST

Here's a nifty little antenna mount I take camping with me. It has a permanent place in my motor home when I want to slap up a quick antenna. When I first came across the 18 inch tall metal folding table or stool at Wal-Mart, I knew what its new use would be! It cost around $8.00 several years ago. A short metal step ladder or camera tripod will also work- use what you have!

Photo is from July 2010 mini-DXpedition using the Webster Bandspanner on 20 meters from Cottonwood RV Park on Kluane Lake near Destruction Bay, Yukon.

All I did was to drill a 1/2 inch hole in the center top and add a 3/8" threaded CB connector to it. Sometimes I add ground radials to broaden the ground plane. I drilled a couple ¼ inch holes on the table top and just add a bolt to connect the ground radials to the table, or I simply alligator clip the wires to the legs. It needs no additional support for smaller antennas, but when used with heavier antennas such as my 50 year old

Webster Bandspanner, it gets top heavy real quick so I just anchor it down with whatever is available. Smaller antennas require no extra guying.

I've worked a lot of DX over the years with it sitting on picnic tables or on the ground with various mobile vertical antennas (Outbacker, Webster Bandspanner and misc. CB verticals). During the first two hours of operating once 20m decided to open, I casually worked OH2BAD, UA3SAQ, ES5QD, HA25NAR (special event) and a few stateside stations to boot with 5x7 or 5x9 reports all around.

You can drill a couple of other holes (see bolt heads near antenna base) for ground radials which I often use with this mount.

73 John, KL7JR

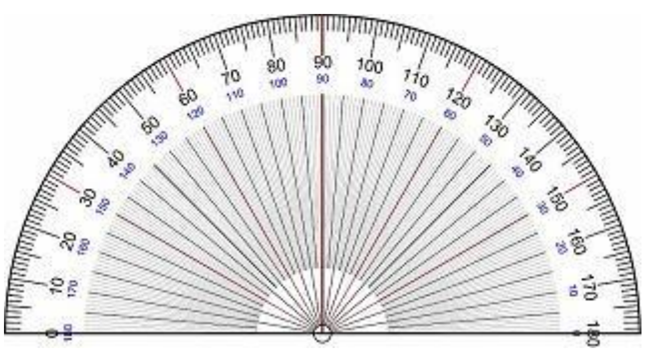
How to mark and drill holes in tubing that are 180 degrees apart without using a drill press or drill guide! by N4UJW

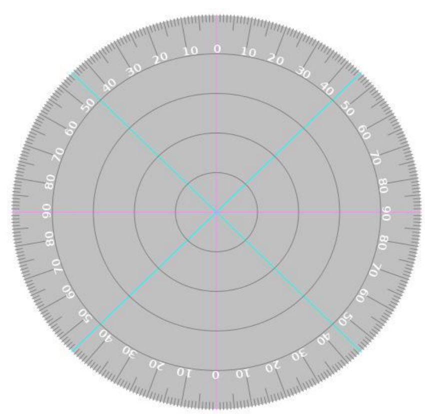
Go back to your school days!

How to use a protractor for marking and drilling holes in round tubing used for the boom of Yagi antennas or other round tubing projects. This tip came about when a fellow ham radio operator asked me how to drill holes in the round boom of antennas if you don't have a drill press so that they would be exactly 180 degrees apart. After much searching of my limited mental faculties, this is what I came up with. This should work in most cases where you want to drill holes that are exactly 180 degrees apart on the boom of a Yagi antenna you are building, or for that matter, with any project that requires holes 180 degrees apart in round tubing. If you don't have a drill press or drill guide- read on.

Enter the protractor!

In case you have forgotten, a protractor is "tool" usually made from plastic that is transparent and is used in marking and drawing various angles. You probably used one in school in geometry class many years ago but had forgotten about it. It has markings on it that are in increments of 180 degrees. They also come in 360 degree versions.

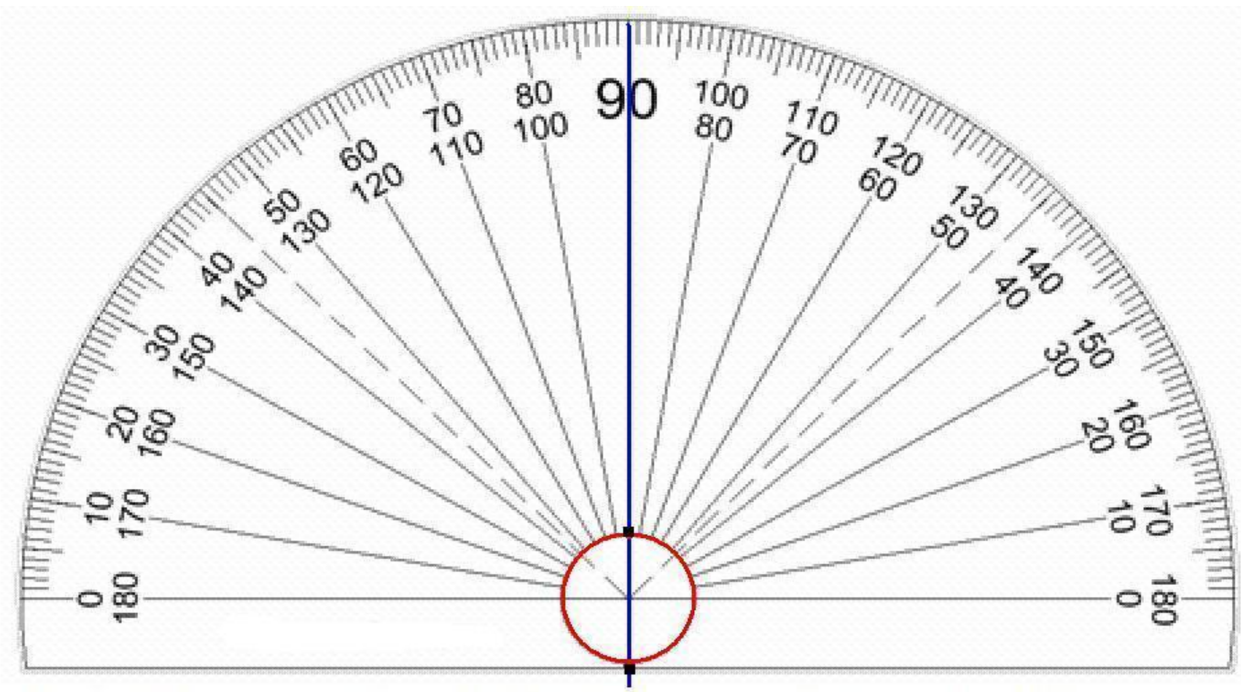




180 degree protractor on left....360 degree version on right (not to scale- see previous page). Now since tubing is usually a perfect 360 degree circle when viewed from the end, you want to be able to find a way to mark both sides of it for the Yagi antenna element holes we are using in this example that you want to drill. You know that for the antenna to perform as designed these markings must be exactly 180 degrees apart so the antenna elements will all be in the same plane with each other.

A very simple method to mark your tubing using a protractor, (either version shown above), is to simply lay the protractor on a flat surface, then set your tubing on top of it while lining up the exact outer top and bottom surface of the tubing with the line drawn from the 90 degree mark at the top of the protractor to the bottom where all of the angles intersect...this forms a 90 degree angle relative to the base of the protractor.

FIGURE 1.



Instructions: Refer to Figure 1 on previous page.
Using this method may get you extremely close for the holes. The red circle in the above graphic represents the end of the pipe, tubing, etc as seen from its end, all of which is laying on a flat surface. The dark squares on the top and bottom of the red circle represent marks on tubing, pipe, etc. The tubing or pipe to be marked should rest on the exact line from the top 90 degree mark to the center at the bottom of the protractor. The blue line represents the exact center of the tubing, etc. Now mark the ends of the pipe with a marker exactly where the blue line crossed the ends....then do the same on the other end of it. **Don't let the pipe or tubing move.** Clamp it down if needed. Now draw a line between the marks on each end to the other end. This is the center of the tubing lengthwise. Do the same on the exact opposite side. You can now mark on the line where you want the holes drilled!

Using Figure 1 above in this example, you simply use a **fine tip felt marker** and mark the outer end edge of the tubing on the top and the bottom of it. See the small black squares in Figure 1 above. You now have one end marked. Do the same for the other end.

Important Hint! Since we want to mark BOTH ends **exactly in the same plane,** you will need to have some method of **preventing the tubing from turning** from its present position after you mark the first end. This method will be left up to you but you could use a heavy weight or someone to hold it to keep it from turning while you place the protractor on the other end, etc. This is the very tricky part of marking both ends exactly in the same plane. If after you mark one end AND the tubing accidentally turns, the other marks you make will be out of plane with the other end! The tubing MUST NOT TURN when marking the second end.

The next step is to draw a line between the end markings on BOTH sides of the tubing, then measure out your drill hole lengths, center punch them exactly where the elements will go inside the boom, mark them, etc.

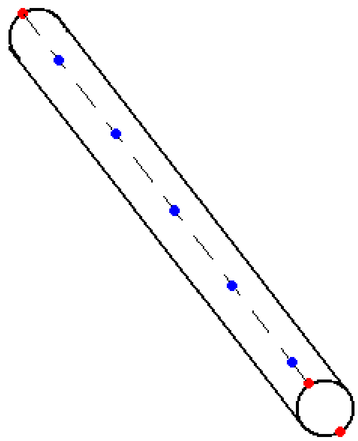


FIGURE 2.

Tubing shown with ends marked in "red dots" and a "line" drawn between them on one side. Draw the line for both sides using straight edge, carpenter chalk line, etc. Blue dots represent element holes.

You know have a line on both sides of the tubing down the center of it from end to end on the tubing that is 180 degrees apart where you can mark the holes to be drilled for the antenna elements! Use a small center punch in the center of your element position marks for starting the drill bit. Drill one side at a time and don't attempt to drill both at once. This is the key to drilling the holes without using a drill press or drill guide in tubing that yields you holes that are 180 degrees apart! This tip will save you a lot of money if you were prepared to buy a drill press or drill guide for your tubing drilling project.

73, Don N4UJW

Aids To Understanding HF Propagation Numbers and Using HF Beacon Tracking Programs

by N4UJW

This article is in 2 parts:
1. Propagation number understanding
2. HF Beacon Tracking Programs

1. HOW TO UNDERSTAND PROPAGATION NUMBERS

Understanding HF propagation can be a daunting task for the newcomer to HF radio. There is much information on the internet and when you consider all of the theory books that, when digested, can still leave you thinking, "What does it all mean to me? All I want to know is can I make some good DX contacts today on the HF ham bands that I am authorized to use?"

There are a multitude of answers to that question and they all can be confusing to you. In this article we will not present a multitude of charts and graphs that mean little to many of you so, here we hope to help you understand what those numbers mean in all of that information. Let's get started......Take a look at the propagation forecast box with real-time info below courtesy of G4ILO and WebProp. Study it carefully!

You will notice first off, it states "HF Propagation": (meaning 160 thru 10 meters)

Next the date and UTC time, then:
Solar Flux and a number beside it.
K Index and a number beside it.
Sunspots and a number beside it.
"Conditions" forecast and a word or two in the right column.
_ signs means stable or no change.
Arrows beside the numbers pointing up or down mean change in the

respective direction.

So what do those numbers mean to me?

Look again at the numbers in the box above then compare them below.

Solar Flux [HIGH is GOOD]
70 NOT GOOD
80 GOOD
90 BETTER
100+ BEST
Higher Solar Flux generally suggests better propagation on the 10, 12, 15, 17, & 20 Meter Bands; Solar Flux rarely affects the 30, 40, 60, 80, & 160 Meter Bands.
Represents the overall geomagnetic condition of the ionosphere ("Ap" if averaged from the Kp-Index) (an average of the eight 3-hour K-Indices) ('A' referring to amplitude) over a given 24 hour period, ranging (linearly) typically from 1-100 but theoretically up to 400.

A Index [LOW is GOOD]
1 to 6 is BEST
7 to 9 is OK
11 or more is BAD
A lower A-Index generally suggests better propagation on the 10, 12, 15, 17, & 20 Meter Bands; a low & steady Ap-Index generally suggest good propagation on the 30, 40, 60, 80, & 160 Meter Bands.

K index [LOW is GOOD]
0 or 1 is BEST
2 is OK
3 or more is BAD
5 is VERY VERY BAD
The overall geomagnetic condition of the ionosphere ("Kp" if averaged over the planet) over the past 3 hours, measured by 13 magnetometers between 46 & 63 degrees of latitude, and ranging quasi-logarithmically

from 0-9. Designed to detect solar particle radiation by its magnetic effect. A higher K-index generally means worse HF conditions.

A lower K-Index generally suggests better propagation on the 10, 12, 15, 17, & 20 Meter Bands; a low & steady Kp-Index generally suggest good propagation on the 30, 40, 60, 80, & 160 Meter Bands.

Next is "Conditions" with frequency ranges on the left and the "condition" of those frequencies on the right :
< 10Mhz (Means less than 10Mhz in frequency
The other two frequency ranges are self explained.

So the most important part of the propagation forecast box above is the "Conditions" section if you don't wish to refer to those "numbers".

Using them for the particular ham band/s within the frequency range you want to checkout should enable you to get a good "educated guess" at how the band/s will perform for you for those DX contacts!

But one important question remains....where in the world will those bands be open? Is South America open? Is Europe open? What about that other country you are interested in?

If the information in the forecast box still means little in answering your questions as to what part of the world is open.......then read on....

2. HF BEACON TRACKER PROGRAMS!

Beacon tracker programs can be very helpful when you are ready to try DXing on the HF bands. But do you really know in advance if the band/s are open to the area of the earth you are interested in? The propagation forecast information above will only tell you "in general" if your band may be open and won't be "specific" to any particular country or part of the world.

How the HF Beacons Work:

HF beacons operated by amateur radio operators all over the earth transmit a CW signal varying power levels in all directions. If you can hear it from its location you are usually "good to go" for that particular location! But you need to know from what part of the earth the beacons are being heard at your station. If you can't hear them from a particular part of the world, then odds are that the band is not open between your station and that part of the world!

HF Beacon Worldwide Sequence of Operation:
The 10 second beacon transmit sequence moves westward from New York across North America, Asia, Pacific to Africa, Europe, and South America. On each frequency, each beacon transmits the following for ten seconds: its call sign (in Morse code at 22 wpm) and a one-second carrier at 100 watts followed by three additional one-second carriers at 10, 1, and 0.1 watts respectively.

When each beacon completes a transmission it goes silent on that band and switches to the next higher band. One by one each beacon station will transmit it's call and output four 1 second carriers (100, 10, 1 and .1 watts) until all 18 beacons have completed the cycle. Then the sequence will start over again. Total time for all 18 beacon stations to complete a transmit cycle on a given band is 3 minutes.

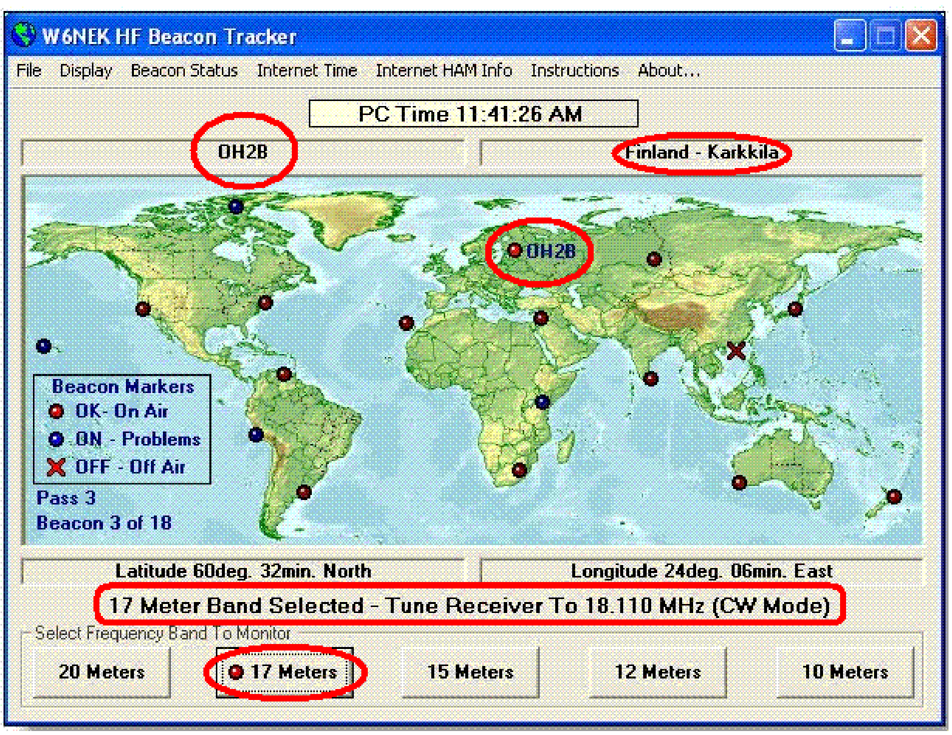
"Seeing" the Beacons On The Map!
Beacon tracker programs can let you "see" if the beacons are on the air by a "lighted" indicator in various countries. They are located all over the earth. You can "see" if they are transmitting and whether or not they can be heard with your receiver tuned to that particular beacon frequency *at your location* using the program and your receiver.
Using both your receiver and the program together helps confirm that the band is propagating signals *from* a particular area of the earth where the HF beacon is located *to your location*.

So what this means is, if you can't hear the HF beacon on your receiver, that part of the world is usually "dead" at the present time for THAT SELECTED BAND AND THAT PARTICULAR TRANSMITTING

BEACON so you must try another hf band or wait for the program to cycle thru all 18 beacons in the NCDXF/IARU network using a beacon tracker and hopefully you will "see" and hear a beacon on your chosen band. Each beacon station cycles between the 5 bands listed in a programmed sequence, so in real time, if you are listening to a beacon on say 17 meters, there is another beacon in another part of the world transmitting on another band.

There are many methods, websites, programs, etc you can download to your computer that will help you to get an idea of what bands are open to various countries or parts of the world. Some are free and some are not! One of the programs I recommend that you download and install on your computer is called The *W6NEK HF Beacon Tracker* and best of all it's FREE and very simple to use! It does a great job in telling you what beacons are transmitting in real time from their respective countries. *You do not have to be connected to the internet for it to work.* You can use it directly from your computer.

One of the better FREE HF Beacon Tracking Programs is shown below.



Screen shot above showing tracker in action on 17 Meter band.

How to use it.

It could not be simpler! The tracker is shown above set for 17 meters at 18.110 MHz

CW on your receiver. It shows OH2B in Finland active and transmitting with the red "led" indicator. The beacon in Finland will transmit for 10 seconds, then the beacon tracker will switch to the next beacon in line at another location and repeat the process. You will notice that all of the other beacon "leds" are off on the map. The beacons from various locations rotate transmitting and are synchronized with each location with very accurate time so as not to interfere with other beacons. What this means is that only one of the beacons on the map is transmitting at any given time *for one chosen band* at the bottom of the tracker program. Each beacon transmits for 10 seconds then the next one in line starts the sequence with its turn on the air in the pathway around the world. All of this happens in real time as long as your computer time is accurate!

In simple words, Turn on your transceiver then download and install the beacon tracker program on your computer...set the computer time on the internet (it MUST be very accurate to work with this program), open the tracker program, follow any instructions you see and it will start tracking worldwide HF beacons including the ones in the U.S. Choose the band with the buttons on the bottom, (refer to screen shot above), tune your CW receiver to the frequency shown where the beacon transmits CW for the band you choose on the tracker and watch the magic happen. It will "scan" the world showing the active beacons from different parts of the earth. If you can hear one or more of them, then you know, that band in that part of the world indicated by the tracker is "open" or at least is propagating that frequency to your location that you are hearing on your transceiver! It helps to know CW since the beacons are transmitted in Morse Code at 22wpm for identification! No, there is nothing to hookup to get the program to work!

You can download it here> http://www.w6nek.com/ Read all about it, download, install it and have fun!   73, Don N4UJW

How to Use an Antenna Tuner

Get maximum power to your antenna by learning how to hook up and use a tuner to properly "trick" your rig!

Yes, "TRICK" YOUR RIG!

WHAT IS AN ANTENNA TUNNER?

You have to learn how to hook them up to your transceiver properly and tune them correctly to make your radio "think" that it is feeding it's signal into a "perfect or near perfect 50 ohm load called your antenna! *An antenna tuner, (transmatch), doesn't really TUNE your antenna OR ANY PART OF IT!*

What an antenna tuner or transmatch does do, however, is transform the impedance at the antenna feed output at the radio to a value that your transceiver can handle, (typically 50 Ohms).
When thinking about antenna tuners and SWR, it's important to remember that **the tuner has no effect whatsoever on the SWR between itself and the antenna. It's the SWR between the transmitter and the tuner that is changed with the tuner controls.**

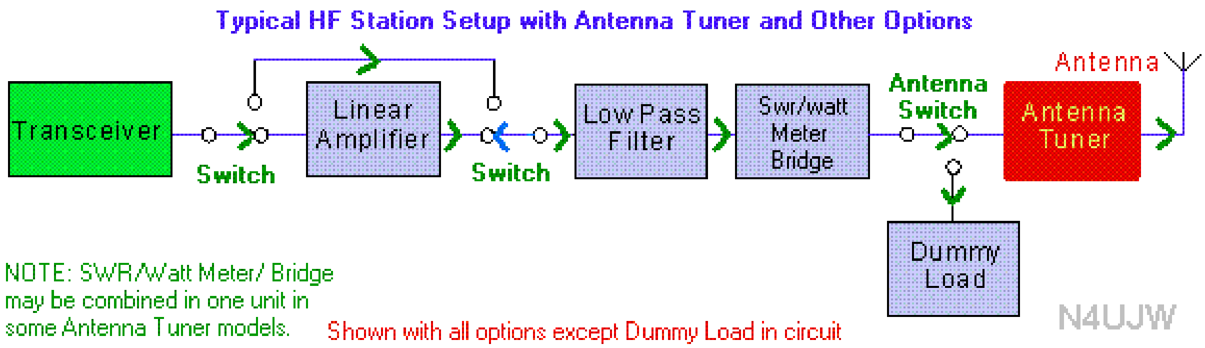
In layman's terms, all a tuner does is act as a kind of adjustable impedance transformer between the radio and the antenna. It takes whatever impedance the antenna system presents, up to the design limits of the tuner, and attempts to convert it back to 50 Ohms--or something reasonably close to that value for the transceiver. When the transceiver "sees" a 50 Ohm impedance, it is able to load or produce its maximum designed RF output into the system because it is designed to operate into a 50 ohm load.

Your rig "thinks" it's seeing a 50 ohm antenna on its output!
That power is transferred through the antenna tuner, to the feed line and, ultimately, to the antenna--minus any losses incurred along the way.
If you have high loses and a poor excuse for an antenna, you will have a poor excuse for a good signal no matter how well your tuner "tricks" your radio. Much of the power will be lost as heat in the tuner and very little will get to the other station!

These losses are the reason that the highest efficiency feed-line for each individual case is desirable and why some amateurs use ladder line on HF, which has the least loss per foot, which means maximum power at the input terminals of the antenna.

HOW TO HOOK UP AND USE
So now that you have a better understanding of what an antenna "tuner" actually does, let's hook one up in a typical HF station. In the block diagram (next page) we have typical HF station setup consisting of, from left to right:

-An HF Transceiver
-A Linear or power amp
-Low Pass Filter
-Swr/Watt Meter combo
-The Antenna Tuner
-A Dummy Load
-The MOST IMPORTANT PART......THE ANTENNA!



Take a look at the block diagram above and notice where the antenna tuner and SWR meter are in relation to the flow of the RF signal coming from the transceiver. (Note that the rf is actually flowing in both directions and not just toward the antenna).

PLEASE DISREGARD THE LINEAR AND LOW PASS FILTER FOR THE MOMENT! (Your station may not use them) You will notice that.... first, from left to right, you have the transceiver, Swr/watt meter, ANTENNA TUNER and then the antenna on the output. The rf moves from the transceiver to the SWR/WATT meter, then finally thru the "tuner" and out to the antenna. You just learned how to hook it all up! Just remember that our goal is to make the transceiver think all is well, and in order to "read" the SWR and Power out pertaining to "all is well"......at the radio's output....**the swr meter must be between the radio and the tuner**. **NOT ON THE ANTENNA SIDE!**

Now let's learn how to "tune" that "tuner"

Most antenna tuners have an inductance rotary switch and two capacitors. (refer to photo at top of page) The capacitors are often labeled ANTENNA and TRANSMITTER. In some antenna tuners the inductance switch is replaced with a continuously variable inductance, popularly known as a roller inductor.

Let's assume you're using a tuner with an inductance switch, because they are the most common.

SHOCK HAZARD! NEVER TRANSMIT WITH THE TUNER COVER OFF AS IN THE NEXT STEP!
TURN OFF THE POWER TO THE RADIO!

Place both capacitor controls at their mid-range positions. Don't trust the knob markers if this is your first experience with the tuner! If you are comfortable with the next procedure, remove the cover of the tuner and turn the knobs until the moving capacitor plates are only half meshed with the stationary plates. If the knobs are pointing to half scale with the reference markings on the knobs and front cover, consider yourself lucky. If not, loosen their Allen screws and rotate the knobs so that they point to mid-scale. Re-tighten the knobs, replace the tuner cover and you're ready to go.

Turn the radio on and tune receiver to an un-used frequency on the band you desire, listen for a few seconds, with the antenna and transmitter controls at mid-scale, move the inductance switch to each of its positions until you hear the loudest noise or signals coming into your radio. Then, rotate the antenna and transmitter controls until you get to the absolutely loudest noise or signal level on the radio. All three of these controls interact with each other so practice on several bands to get the "feel" of the procedure.

Select your final band of operation and repeat the procedure above. When noise peaks out using your ears and the S meter, your tuner settings should be very close for final operation. With your rig set to low power monitor the frequency to assure that it is not in use, send your ID then transmit a continuous carrier while you tweak the antenna and transmitter controls for the lowest reflected power reading with the highest output power as read on the Swr/Watt meter. You may find that you have to vary the position of the inductance switch a position or two either way to get your best match.

Play it safe and un-key before turning the inductor switch...un-key first....turn the switch...key up....repeat as needed until lowest SWR and maximum output. Be gentle to your radio; keep the key-down periods as short as possible. Depending on the impedance at the antenna input (and the overall design of the tuner) you may not be able to obtain a flat 1:1 SWR on all frequencies and bands. Also important to remember is that your Swr will change, go up, as you tune further away from the frequency you used to "trick" your radio! So re-check and re-tune as needed as you move around the band.

You can get an idea of your SWR bandwidth by starting with your original frequency, and using the procedures above with low power, (don't move any knobs or switches after best setting)....sweep or tune your VFO up and down the band while watching the SWR readings and note the frequency where the SWR reaches 2:1 at the highest and lowest frequency. Stop there!

Example: If you’re on 40 meters at say...7.262mhz as your starting point, and your SWR is 2:1 at 7.292mhz and the highest swr going the other way is 2:1 at 7.259mhz, then your "safe tuning range" without retuning the antenna tuner would be about 60khz. Keep in mind to use very low power and ID because your signal may be heard for a split second as you tune across the band! When that transmit key is down, someone somewhere can hear you. Even a dummy load gets out somewhere! Remember your "TRICKING" your way around a good antenna!

73, Don N4UJW

8. Various VHF/UHF Antennas

Keep in mind many of the following VHF designs can also apply to UHF or even HF applications if you have the space! You decide what is "too big" for you.

CHEAP AND EASY TO BUILD 2 METER ANTENNAS

Interested in ultra-low cost 2 meter antennas that are easy to build using cheap parts; that require no tedious matching and adjusting; that are almost invisible; that are portable, compact, quickly assembled; and that can be converted into a beam? If so read on!

These antennas are somewhat based on the "V" designs in other projects on this site. They include; the Ultra-simple Wire version in **Figure 1,** the Table Top version in **Figure 2** and the 2 Element Beam version in **Figure 3**

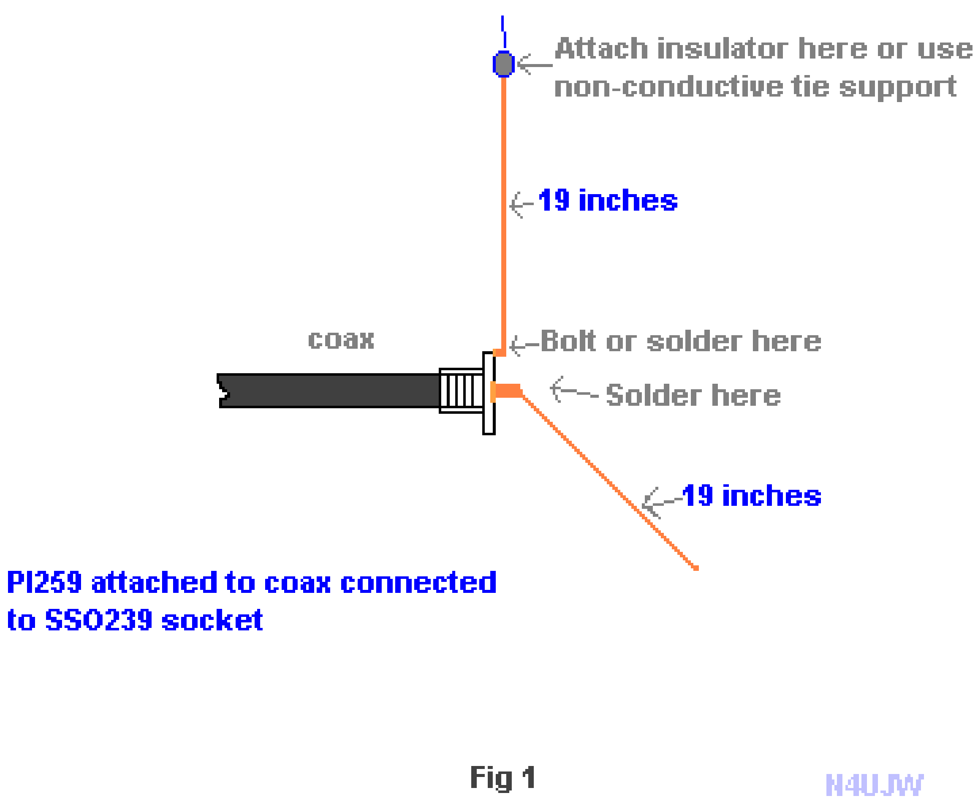


Fig. 1 Ultra-simple "wire" version above made on an SO-239 connector. Designed for hanging from any handy support and

can be hung from trees, used inside motel rooms or as a "stealth" antenna.

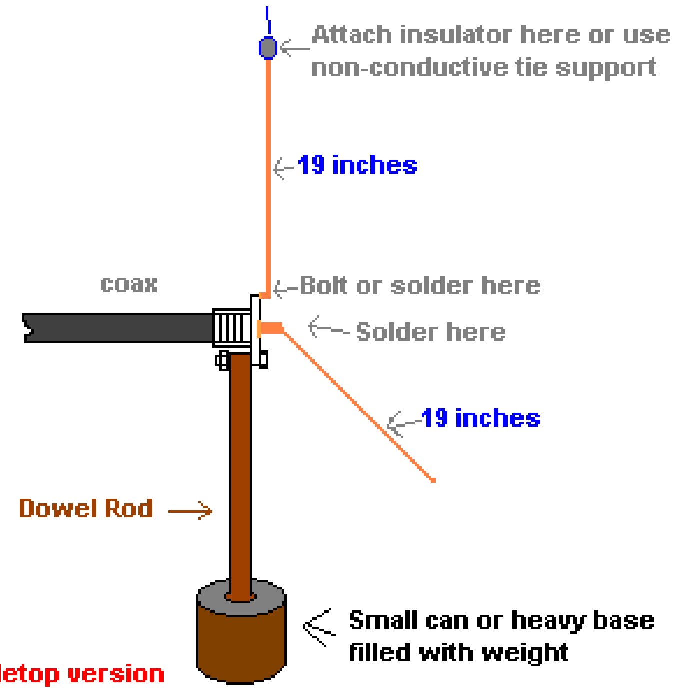


Fig 2. Tabletop version

Fig 2. Table top "wire" version above using a dowel or other simple base. Upper and lower elements must be self supporting. Use aluminum or copper tubing.

Disregard the reference to the upper insulator in figure 2.

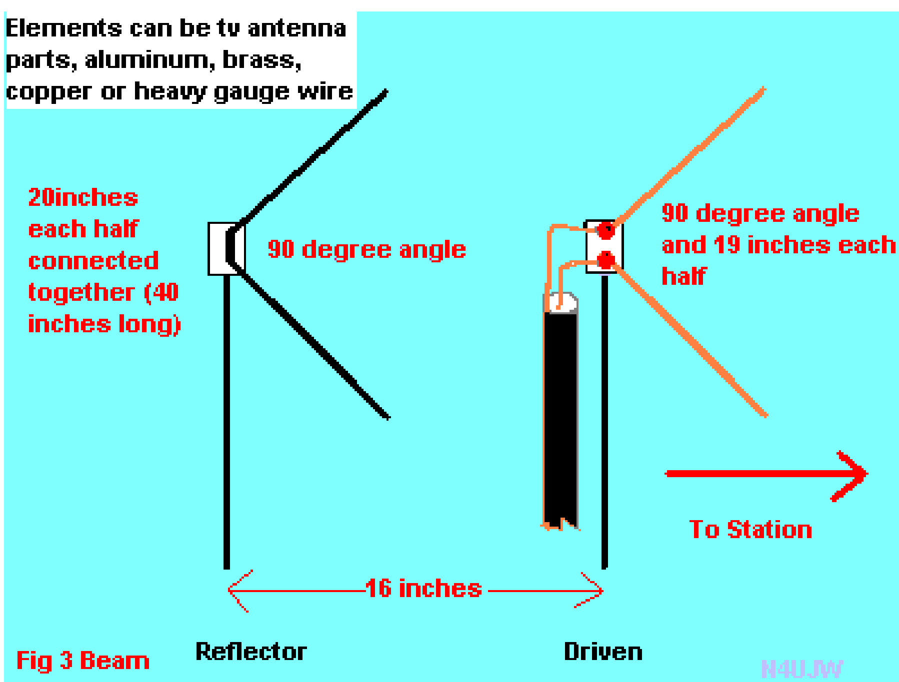


Fig 3. Yagi or Beam version on previous page.
This is a variation of the designs above. By adding the extra reflector element about 16 inches behind the driven element and increasing its length to 20 inches each side (5%), some gain can be realized! According to the article, this version had not been tested but should work with a bit of experimentation. It's no more than a standard dipole with a reflector added to come up with a 2 element yagi with all elements bent forward at a 90 degree angle.

CONSTRUCTION NOTES AND TIPS

In all of these designs, please note that the center conductor from the coax connection is connected to the element in the "down position". According to the article from which these designs were taken, this helps in adjusting swr!

Simply change the angle and or trim each half a very small amount for best swr. Remember on these antennas that the driven elements have to be insulated from each other and also their support.

The beam version can be made in a "T" shape with an insulated boom between the driven element and reflector and the "T" portion for the support mast. Small diameter PVC would be a good choice.

You will have to use your ingenuity for the mounting of the elements to the support so the antenna will maintain the approximately 90 degree configuration. Experiment.

An alternate version of each antenna can be built with all elements either vertical or horizontal instead of in the form of a sideways “V”.
These designs can be used from HF up thru 440 or above with a little experimentation. Just dig out that old formula you should have learned for a starting point for the lengths......468/freq MHz = half wave dipole (driven element) and add 5 percent to the length for the reflector. The spacing should be a little less than .25 wave lengths from driven to reflector.

(According to the article, using a director and driven element arrangement would cause problems with a poor match and the spacing would be a lot closer.)

Using an MFJ 259b or equal would help with tuning the antenna for your particular choice of frequency, but if you're not that lucky, then just use the old swr meter and very low power while testing. As always, start with longer elements and trim down. It is very difficult to add length! DON'T FORGET TO “ID WITH YOU KNOW WHAT” WHILE TESTING!

N4UJW Notes:
These plans have been edited for length and came from a copy that originated from the America Radio Club, Hialeah, Florida about 13 years ago. The club is believed to be no longer in operation.
No author or call sign was listed. We do not take credit for this article or the design, only for the "art work".
Enjoy!

73, Don N4UJW

The Vent Pipe "Lightning Rod" *Almost Invisible* Antenna for the 2/440 Meter Bands by N4UJW

Here is a simple and effective *almost invisible* method of hiding a *2* meter or 440 band 1/4 wave length ground plane antenna in an outdoor setting with stealth up on the roof and it should have a dual purpose of "doubling" as a "lightning rod" just in case the HOA police asks.

It will get your antenna much higher above ground to help you get a better signal out on 2 meters or the 440 ham band. If you use this idea for a very stealthy 1/4 wave length 2 meter ground plane only, it will only be about 19 inches tall! A single band 440 ground plane would be about 6 inches tall! Height is everything and this will help if you can get it built and installed.

The plumbing codes in the U.S. requires that the sewer drain pipes in homes and other buildings be vented to the outside air and require that there is one or more vent pipes up on the roof to vent sewer gas outside. In case you don't already know, the sewer vent pipe on the roof looks similar to the photo below.

2 vent pipes are on the roof pictured located in the left middle and right lower part of picture. The large

wind turbine in upper part of picture is for attic ventilation. Photo taken from the ground.

By using one of these vent pipes as an antenna location mounting idea for a 2/440 band ground plane antenna and making it "stealth" in the process, we offer the following as a suggestion or idea for you if you live in a HOA or antenna restricted situation and want to "hide" (go stealth), a 2 or 440 band antenna up on the roof. Even if you are not hampered by the HOA situation, this is a good method of supporting your 2/440 band antenna.

This method will work best and be safer for YOU during the installation if you live in a single story house, apartment, etc. If your residence is more than a single story, be very careful and get help if needed. Be extremely careful on severely pitched roofs!

If you look very carefully in the mockup photo above, you should see the ground plane antenna mounted on the side of the vent pipe nearest to the upper part of the roof on the "back" side of the vent pipe as viewed from the ground. The copper colored lines represent the actual antenna elements and the black line represents the coaxial cable leading down the roof surface to the transceiver inside the house.

In the next "doctored" photo below you should see what this "may" look like IF you painted the antenna elements, the mounting, and the coax to match almost exactly the background as seen from the ground. You have to look very close to see the antenna elements and the coax. Painting the "antenna system" that is visible from the ground and its mount to match the background of the roof and vent pipe color will be the most difficult part of this idea. Here is where the "stealth" may help in keeping it almost invisible from the ground.

If the roof shingle design has darker horizontal separations between the shingles as in the photos here, try to add "horizontal" paint marks on the vertical and radial elements of the antenna. This may help with blending of the roof pattern to the antenna. Use your own imagination.

This is not an actual installation shown in the photo above but it demonstrates a bit of Windows Paint "magic" in making the coax and the antenna elements become almost invisible.

So how do you build and mount 2 meter or 440 band ground planes to the vent pipe? See this article for plan ideas for a ground plane antenna and its support. Use the formulas provided in it and you will be close with some small bit of tuning required for lowest swr.

The actual mounting will depend on the size of the vent pipe diameter and how YOU want to mount it. There are many options. Use your imagination as required. Keep the mounting as simple as possible to reduce visibility from the ground and from the street if the vent pipe is located on the street side of the roof.

If the selected vent pipe location is more near the peak of the roof as viewed from the street, then it would be best to route the coax over the peak of the roof and then back down to the radio room. However, use the shortest length of coax leading to your 2 radio as possible given your circumstances. Here is one idea you may want to try for a support for the ground plane:

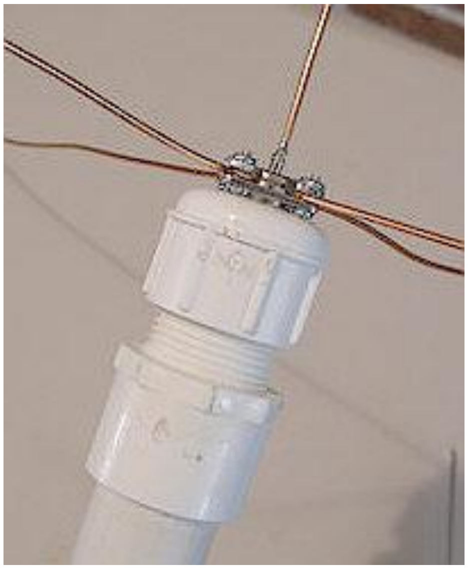


Photo shows ground plane antenna mounted to end of short length of PVC.

See this article for reference on mounting and building the ground plane antenna to a short length of PVC pipe which is then attached to the back side of the vent pipe in our article.

The whole assembly would be mounted to the back side of the vent pipe using whatever method is best for you and your skills. If the vent pipe is metal, DO NOT MOUNT the antenna below it. Tuning problems and "shielding" of your signal will result. Let the vertical radiator extend beyond the top of the pipe. If the vent pipe is PVC, then there is little concern. Stainless steel hose clamps work well to attach the support mount to the pipe or you may wish to mount the antenna on a metal "L" bracket attached with bolts or screws to the top back side of the vent pipe. Don't drop parts down the pipe and don't cover the pipe with anything! It must be open to the sewer piping below for proper venting. Don't defeat its purpose!. The method of mounting the antenna to the pipe is your choice.

Don't let the antenna mounting support stick way above the pipe end. The more that it or any part of the antenna or coax is "visible" the more it won't be "invisible" to the HOA cops from the ground and the harder it will be to paint for a stealthy look. Remember to route the coax (lowest loss and smallest size diameter) down the roof shingles following either the "vertical" or horizontal pattern of the shingle separations. This is your choice. In many cases following the horizontal pattern may be easier. Then route as needed to the transceiver but attempt to FIRST route it down to the ground to a real "ground rod" of your choice...then from there, bury it if at all possible a short distance to the entry point of the house to the radio room. Doing it this way will help to convince the "HOA police" that it is a real lightning rod that takes lightning to the earth.

The secret in this idea is in the complete hiding of the coax length from antenna to the ground rod to the radio! Route, bury and paint as needed to blend in well with the roof and wall background color. You might consider some sort of flower trellis on the wall to help hide the coax feed line. You can use the flowers of your choice including artificial.

Of course you need not go directly to a ground rod although this would be a good precaution against real lightning! In all actuality the antenna really does become a real "lightning rod" because it is up in the air but you could just route the coax from the antenna as needed to the radio in whatever manner you choose as long as it is "stealthed" with paint, flowers, etc. with the hope that mother nature does not see it when a thunderstorm comes your way and touch it with her electrified finger.

Much of this idea will depend on your situation, your roof composition, vent pipe layout, design and your skills, but where there is a will, there usually is a way! To help prevent prying eyes, installation in the nighttime hours should be highly considered but not as safe. This idea may not work for you due to many variables but never give up with attempting operating "stealth" if at all possible if you live in a restricted antenna situation. If your "antenna" is "discovered" and you are asked by the HOA "police" what that wire "thing" is doing attached to the vent pipe, just play "dumb" and act like you are thinking, then say something like, "Oh....it is a lightning rod to help prevent lightning from starting a fire and spreading to the neighbors." Hopefully that will convince them. Don't forget roof climbing safety and don't install any antenna near power lines, and get help if needed.

73, Don N4UJW

A Quick and Simple 2 Meter Ground Plane Project! by N4UJW

If you are just getting experience in building antennas or you are an old pro, here is a simple and fun project! This antenna is perfect for those hams living in the primary coverage area of the repeater for 2 meter use. This antenna is nothing more than the old standby "Droopy Ground Plane" and can be used on any band where it's physical size does not pose a problem. Remember that the vertical radiator is 1/4 wavelength long at your operating frequency.

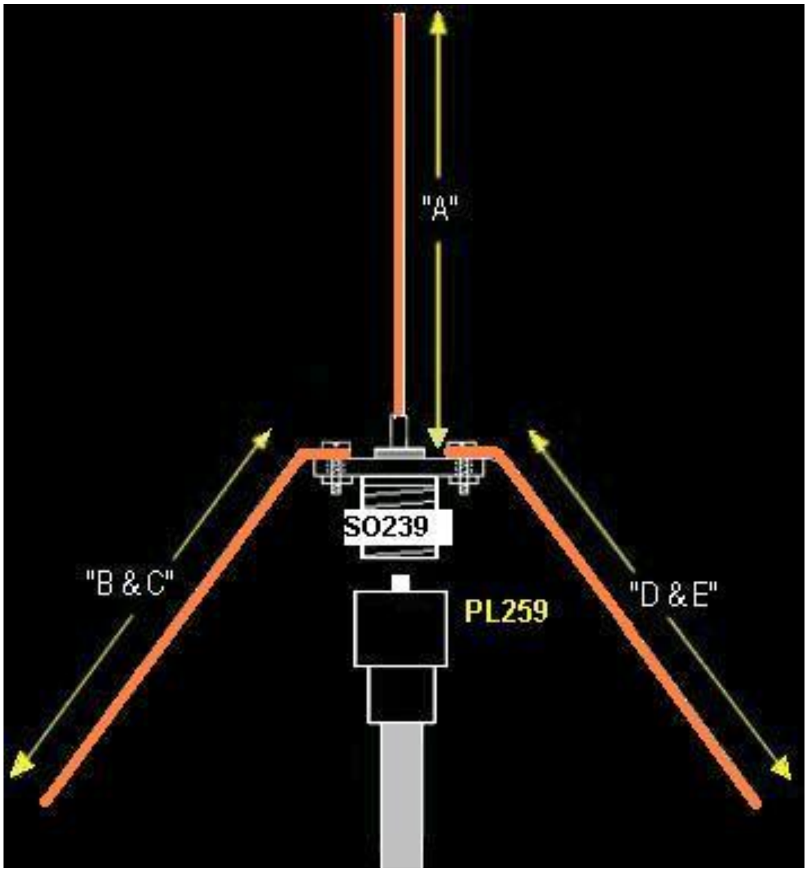
It has no gain but makes an excellent small antenna that can be mounted just about anywhere and with a little planning, can be used mobile on a short mast from the bumper!! Adding a small attachment loop at the tip of the radiator will enable it to be suspended from above for inside use.

The vertical element and radials can be made of #12 copper wire or welding rods, coat hanger, etc. The vertical radiator (A) should be soldered to the center connector of the SO239. The four base radials (B & C) and (D & E) can be soldered or bolted to the SO239 mounting holes using 4-40 hardware. The four base radials then should be bent downward to a 45 degree angle.

The antenna can be mounted by clamping the PL259 to a mast or even passing the coax through a 3/4 ID PVC pipe and compression clamping the PL259. Either way let your creativity work for you. If you plan on mounting it outside, apply RTV or sealant around the center pin and PL259, and TAPE WELL, to keep water out of the coax.

Make each radial a 1/4 wave of your desired xmit frequency. Sometimes it helps to add a little extra length to the radials and radiator. This will give you some adjusting room when you adjust the SWR.
(If adjustment is needed, clip all radials equally about 1/8 inch at a time

while checking SWR, USING LOW POWER). Center the lowest swr on your transmit operating frequency.



Example Calculation:

Freq 146 MHz

A= 19 5/16 inches (Note "A" length is to the SO-239 insulator but not critical)

B THRU E= 20 3/16 inches

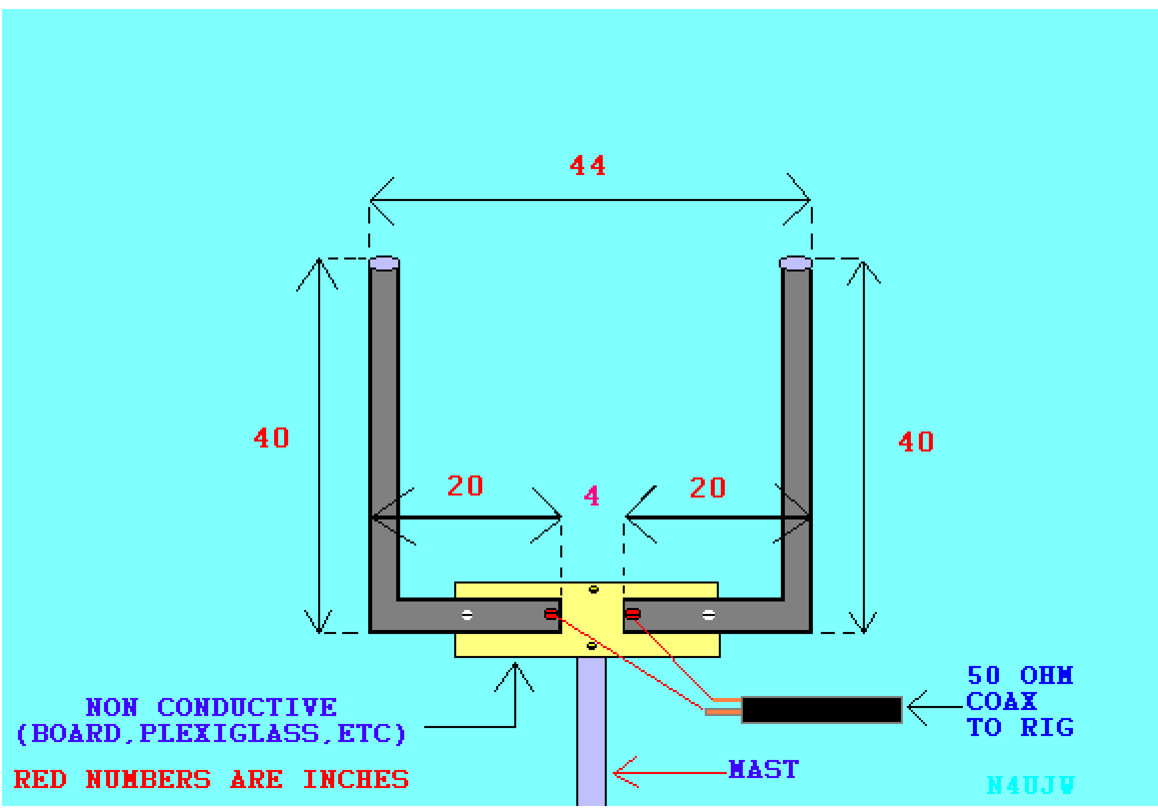
LENGTHS FROM FORMULA (234/FREQ MHZ) + 5 % LONGER FOR RADIALS

Try one on 440 or other bands using same formula and construction.
73, Don N4UJW

The "Slingshot" Antenna for 2 Meters

Re-edited by N4UJW from an original article by David Younker
KA8OGD (call no longer active)
73 Magazine April 1989

While recently going thru some of my old ham radio magazines, I ran across this inexpensive and easy to build antenna project for 2 meters. I have not seen it on the internet so here it is for you to try! I personally have not tried this antenna but it should work fine if you follow the very simple directions! It can be built as is for 2 meters, or you can try it on other bands or frequencies with the formulas provided by me below.



THE SLINGSHOT ANTENNA (NOT DRAWN TO SCALE)

Please note in drawing that elements are bent 90 degrees. Make your bends as needed depending on material used for elements. If you use copper tubing, a 90 degree elbow on each should work fine. If you are comfortable with bending, great, if not, get the hardware store to do it for you!

The completed antenna is bi-directional with a rough figure 8 pattern and is composed of 2, 3/4 wavelength sections of electrical conduit bent and cut to the lengths in the drawing and supported as shown on any type of insulating material attached to the mast with whatever arrangement of bolts, nuts, clamps, etc. You should note that the bottom (horizontal element portion) is 1/4 wavelength long and the top (vertical element section) is 1/2 wavelength long. The element mounting plate (in yellow in the drawing) can be plexiglass, painted wood or whatever you happen to have that is NON CONDUCTIVE. You can use copper or aluminum for the active 3/4 wave elements, but aluminum would be preferred due to less weight. Although electrical conduit comes in various sizes, the size was not stated in the original article but I would suggest 1/2 inch or larger in diameter. (The larger, the greater the bandwidth.)

The total length of each element is 60 inches + - and they are attached about 4 inches apart on the mounting plate with enough bolts and nuts as needed. The coax attachment points are in red on the picture, and I would suggest that you use spade lugs on the ends of the coax to attach it to the bottom end of each element (the ends nearest the bend) with bolts, nuts and lock washers all the way thru the element and plate. There must be a good electrical connection between the coax center conductor and shield braid and each element. Keep the connections lengths from the end of the coax as short as possible. They become part of the radiating element lengths.

It does not matter which conductor from the coax is attached to which element.
SEAL ALL CONNECTIONS AND THE END OF THE COAX!

When attaching the elements to the mounting plate, drill enough holes all the way thru the elements and plate for good mechanical stability and attach with bolts and nuts. The elements and coax connections must not touch the support mast at any point if the mast is made of metal of any kind! You could use a pvc pipe or length of lumber of the required length instead of metal to get the antenna up as high as possible and a half wave or more is preferred!

"This design, untrimmed, up a half wave, presented an SWR of 1.5:1 across the top 2 MHz of the band (146-148 MHz)".......KA8OGD

A note or two more about experimenting with this antenna:
MAXIMUM SIGNAL IS OFF BOTH ENDS (TO THE RIGHT AND LEFT AS DRAWN NOT BROADSIDE. Point the boom at your target!)
ANTENNA SHOULD BE ROTATED IN DIRECTION NEEDED!

The formulas for calculating the lengths for this project seem to be approximately the following. There is a more complicated formula first and then a simple version....take your choice...they both yield the same result:

11808/freq MHz = 1 wavelength in inches
11808/147.00 MHz = 80.3 inches (using 147.00 MHz)
3/4 wavelength = .75 x 80.3 = 60.2 inches

Simple version formulas:
8856 / freq MHz = 3/4 wavelength section in inches (total element length)
5904 / freq MHz = 1/2 wavelength section in inches
2952 / freq MHz = 1/4 wavelength section in inches

Lets do a calculation for 144.200 MHz ssb using the more complicated version formula:
11808/144.200 = 81.88 inches

3/4 wavelength = .75 x 81.88 = 61.4 inches total element length per side 1/4 wavelength would be = 81.88 / 4 = 20.47inches or 1/3 of 61.4 inches. (The vertical section takes 2/3rds of the total length of one side of the antenna element) .The 90 degree bend will be at the 1/4 wave point on the total length.

Footnote to construction: It is advisable to add about 5 or 6 turns of coax at the base of the antenna as an air choke to help keep rf off the feedline. Some builders do this....some don't.

According to the article, 15 meters is about as low in frequency as it can be used before it becomes very difficult to keep it up due to size and weight! (one element would be about 34.5 feet long according to my Texas Instruments model TI-7140 handheld calculator and the above formulas!) HI!

73, Don N4UJW

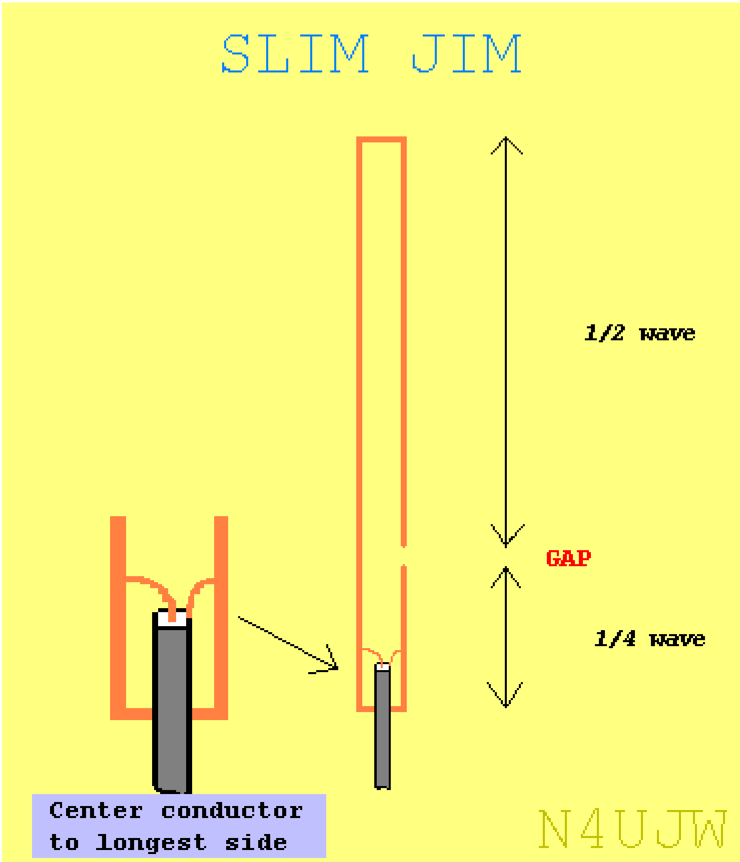
SLIM JIM ANTENNA PROJECT

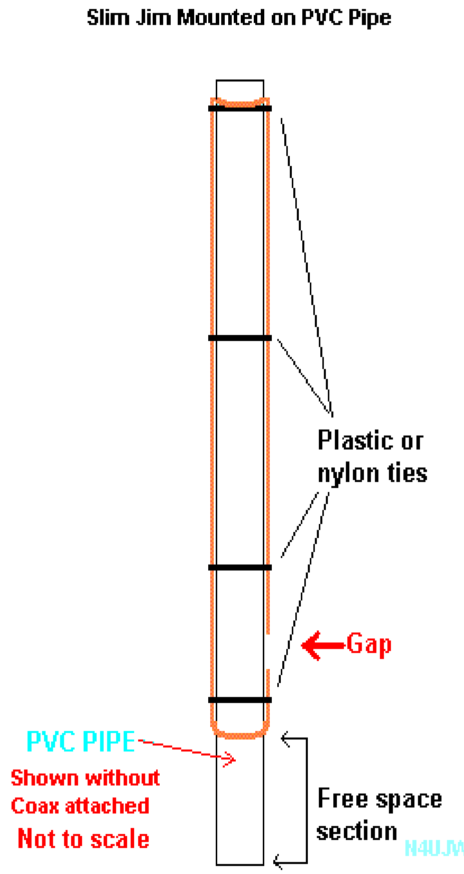
Several designs rolled into one
Edited and condensed from various designs
Page updated with new information and videos

The Slim Jim is a vertically polarized omnidirectional end-fed antenna having considerable "gain" and this is concentrated almost parallel to ground toward the horizon rather than skyward making it more efficient than a ground plane type antenna by about 50 percent better. It can be built for almost any frequency! (Below 10 meters it gets VERY tall) Due to its SLIM design, there is very little wind loading. It is fed with 50 ohm coax.

It uses a 'J ' type matching stub (J Integrated Matching = **JIM**), hence the name SLIM JIM. Credit for the original design goes to F.C. Judd, G2BCX. Since the vertical angle of radiation is so narrow, about 8 degrees toward the horizon, it usually out performs 5/8 wave or ground plane type construction due to their much higher angle of radiation. It is estimated that the Slim Jim appears to have about 6dB gain over a 5/8 wave antenna due to the extreme low angle of radiation. (Most of the radiation is directed toward the horizion making the "gain" appear much greater than other vertical type antennas it has been compared to with A/B testing) Editor's note: There are many gain figures quoted for this antenna and also various descriptions of the actual type of antenna on various websites. Some have even stated that, "In fact I found it outperformed a 1/2wave over 1/2wave over 1/2wave colinear!"
No matter what you call it, it seems to do an excellent job according to most reports. What have you got to lose?

Using heavy duty construction would make this a good omni repeater antenna. When correctly matched for lowest swr, it has wide bandwidth.





Drawing on right shown with antenna mounted on PVC pipe

Construction details:

NOTE: NO PART OF THIS ANTENNA SHOULD BE GROUNDED! It should be totally insulated from its mount, mast, tower, etc. with at least 1/4 wavelength of "free space" distance. Formulas are provided below for all the measurements including the free space distance.
The Slim Jim should be constructed from 1/2" copper pipe. Also old tv antenna elements or aluminum tubing could be used with some ingenuity and would be lighter. Experimentation with heavy gauge wire supported inside PVC tubing or attached to insulated material such as wood could also be tried and would probably be successful with some ingenuity. 300 ohm twin lead versions also work great!

Using copper pipe, bends are made with soldered 90 degree copper elbows. An adjustable slip sleeve made from copper can be added to the element on top above the gap for tuning purposes or possibly some sort of nut, bolt arrangement soldered into the upper end to adjust spacing if needed. (See the 2 meter SSB loop project on this site for better details and pictures of the nut, bolt arrangement.) Depending on the frequency or band, the average length of the gap and spacing between the elements is 3" at 72 MHz and 1" at 220 MHz. (See updates below) For 2 meter work this would be around 1 1/2 to 2 inches. Some experimenters report about 1 inch or less works well. Experiment with the adjustment for best results. The recommended mount is the use of PVC pipe and PVC pipe "T's."

Testing and tune up:

Support the antenna as high as possible from the ground and other nearby objects especially metal, and fit the coaxial cable to the antenna with some crocodile (alligator) clips. It is suggested that the center conductor be attached to the longest element, shield to the shortest. See diagram above. Attach about 2 to 4 inches up from the bottom and check the VSWR at the design frequency. USE LOW POWER!
Adjust the clips up or down to get the best match, mark where they are to be finally installed, remove the clips, and solder the coax directly or use clamps, screws, etc. Waterproof or seal all connections and the end of the coax. Use the copper sleeve or nut bolt arrangement, if added, for any necessary tuning.

FORMULAS

(For results in inches) NOTE: Air gap and element spacing may have to be determined by some experimentation for various frequencies.
See new info about gap spacing below.

(Divide results by 12 for feet)

3/4 wave (longest section = 8415 / f MHz = inches
1/2 wave section = 5610 / f MHz = inches
1/4 wave section = 2805 / f MHz = inches

* 1/4 wave free space = 2953 / f MHz = inches
* This is the distance that antenna should be from mounting boom, mast or tower.

Note: These formulas are believed to be accurate.
Some trimming or tweaking of lengths may be needed with YOUR construction!

Slim Jim Metric Formulas:

(For results in meters. Updated June, 2006 (For results in Centimeters, multiply results by 100)

213.74 / f MHz = 3/4 wave overall length
142.496 / f MHz = 1/2 wave length
71.248 / f MHz = 1/4 wave length
Feed point = About 10 to 20% of 1/4 wavelength (+ - tuning)
75 / f MHz = 1/4 wave "free space" in Meters

NOTE: These formulas are believed to be accurate. Some trimming or tweaking of lengths may be needed with YOUR construction!

Some Examples

2 Meters 146.00 MHz

3/4 wave section 8415 divided by 146 = 57.63 inches
1/2 wave section 5610 divided by 146.00 = 38.42 inches
1/4 wave section 2805 divided by 146.00 = 19.21 inches
1/4 wave free space 2953 divided by 146.00 = 20.22 inches
Feed point about 10 to 20% of 1/4 wave = 1.9 to 3.84 inches (+ - tuning). The gap would be a guestimate at about 1 1/2 to 2 inches (+ - tuning). Remember, the 1/4 wave free space is the distance from the mount as a minimum.

6 Meters 50.150 MHz

8415 / 50.150 MHz = 167.79 inches
5610 / 50.150 MHz = 111.8 inches

2805 / 50.150 = 55.93 inches
Gap spacing 10 to 20% of 1/4 wave = 8 inches (15%)
Free space mounting distance 58.8 inches

10 Meters 28.400 MHz
8415 / 28.4 MHz = 296.30 inches (24.69 feet)
5610 / 28.4 = 197.5 inches (16.45 feet)
2805 / 28.4 = 98.76 inches (8.23 feet)
Free space mounting distance 103.97 inches (8.66 feet)

17 Meters!
A 52 foot vertical including minimum distance from ground!
Hey don't laugh! It might be worth a try for about 6 db more!
Please send us your input if you have suggestions for any band using this antenna! will have to be adjusted slightly for the addition of the top and bottom connection points. See Construction and Testing tips below.

CONSTRUCTION:

The Slim Jim should be constructed from 1/2" copper pipe OR near this size of any conductive material but this is not an absolute! The bends are made with soldered 90 degree copper elbows if you're using copper tubing. A slip sleeve or other arrangement can be added to the upper or lower part of the gap made from copper, brass or aluminum for adjustment of the gap measurement for swr tuning, although the average length of the gap and spacing between the elements is 3" at 72 MHz and 1" at 220 MHz. Some experimentation may be needed for gap distance.

For 2 meters, this would be about 1 1/2 to 2 inches. Here again, this measurement is not extremely critical and the gap, element spacing and element length all interact. The total distance from the top of the gap around the entire length and back to the bottom of the gap should equal about 1.5 wavelengths or in the case of the 2 meter example above about 115.26 inches. No part of the antenna should be grounded to the tower or mast. The recommended mount is the use of PVC pipe and PVC pipe

"T's." Make sure the space between the tower or mast and the antenna is one "free space" 1/4 wavelength.

TESTING:

Stand upright (on a railing or non-conductive object, clear of metal surfaces, drain pipes, etc.) and fit the coaxial cable to the antenna with some crocodile (alligator) clips. Attach about 2 to 4 inches up from the bottom (at 2 meters). It is suggested that the center conductor be attached to the longest element, shield to the shortest and using just enough power to get an swr reading, check the VSWR. Adjust the clips up or down to get the best match, mark where they are attached, remove the clips, and solder the coax directly. Seal connections and end of coax! Use the copper sleeve, or other spacing adjustment if added, for any necessary tuning. You may not get that perfect 1:1 match! The air gap, total length and element spacing all interact.

73, Don N4UJW

The 2 Meter 146 MHz Slim Jim Antenna Using Aluminum Tubing!

By Don, N4UJW

Further Experimentation With The 2 Meter (146 MHz) Slim Jim Antenna Using Aluminum Tubing! Well, here I go again! Not wanting to be out done by myself and after having the temporary J Pole To Slim Jim Conversion project lay down on the ground due to some high winds we had, I decided to get with it on this 81 degree day in January, 2006 (yes, 81 degrees in Texas in January! It won't last long!) and rebuild the old Slim Jim antenna conversion with aluminum tubing using half inch diameter "junk" tubing that I found hiding from me.

THE PARTS LIST

The following instructions may help you if you decide to try the Slim Jim antenna with aluminum tubing. Refer to the Slim Jim Antenna Project for more details if needed. I used half inch OD "junk" aluminum tubing cut to these final lengths: NOTE: THE TOTAL LENGTH FROM TOP TO BOTTOM IS 57 1/2 INCHES. You should end up with a very, very elongated rectangle with a space (air gap) between the shortest section and the one above it of about 1 inch. (Again.....see pictures and refer to the original Slim Jim antenna project featured before this design.

Cut tubing as follows:

-one section 57 1/2 inches

-one section 37 1/4 inches

-one section 19 1/4 inches (actually a bit shorter than this) 19.2 inches was used in the original Slim Jim antenna project on the site using copper tubing from the formulas on that page, but I rounded as close as possible.

-2 sections of aluminum stock around 1/8 inch thick and about 1/2 inch wide by about 2 1/2 inches long used as top and bottom spacers "crossovers" to provide 2 inches between elements. I did not have a good method for bending the tubing for "one piece construction" so I used the "crossovers" instead.

-assorted screws, nuts, lock washers and bolts. No I did not use stainless steel....did not have!

-one non-conductive spacer from an old piece of plastic, PVC, etc. This is used for support between short section and longest section about 5 inches down from the air gap. (See pictures below....it is a shade of green/blue in the picture) This spacer and the bottom crossover of the Slim Jim antenna is used to mount the antenna to a 10 foot piece of PVC pipe at final installation by attaching self-tapping screws thru each one....see pictures.

-one section of non-conductive material between shortest section and the top half. (dark color in picture) . This came from another antenna "junk" pile. It is used only for support and an insulator, also to keep the bottom and upper sections in line.

CONSTRUCTION

I drilled holes suitable for the small bolts I had near both ends of the longest section (57 1/2 inches), and one end of the shortest section (19 1/4 inches) and one end of the section above the shortest section. (37 1/4 inches) Next I attached the "2 1/2 inch "crossover" sections used as spacers and crossovers at bottom and top of Slim Jim using the bolts, lock washers and nuts. Then I attached the air gap insulator/support between the lower and upper sections.

The construction of the Aluminum Slim Jim antenna was now finished except for mounting to the 10 foot PVC pipe, checking and adjusting swr and having some fun with it. Remember...this project was built from just scraps of this and that found lying around my pile of "junk"....(junk is defined by the XYL...it is gold to you and I)!

FINAL ADJUSTMENT WITH A SURPRISE!

I attached the Slim Jim antenna to the PVC pipe using the bottom crossover section and the green/blue spacer on the shortest section with self-tapping screws. You may want to use a different arrangement such as nylon ties along with the screws or put bolts all the way thru the PVC for extra support. The antenna ends up mounted against the upper most part of the PVC pipe with the pipe in the center of both vertical elements.

To attach the coax to the antenna feed points, I used standard adjustable hose clamps that would tighten down on the shield and center conductor of the RG 58 coax that I used. I suggest you use stainless steel clamps....again....I did not have any. The center conductor is attached to the LONGEST side of the antenna under the hose clamp.
The shield is attached to the SHORTEST section under the hose clamp. DO NOT tighten so as to crush the coax. (My feed point connections were just a temporary measure so I could easily slide them up and down for swr tuning.) They can be attached after tuning with screws, nuts, bolts, etc. I trimmed off enough of the black outer coax covering exposing the shield about one inch and the center conductor extended so they could be attached to the feed points. I did not measure. Cut coax so the shield and center conductor can be attached underneath the clamps. I connected the coax center conductor first and brought the rest at a 90 degree angle over to the shortest side for its attachment. Tighten the clamps at around 4 1/2 inches up from the bottom of the antenna. (This measurement was derived at by my experimentation during tune up). Yours may be different.

The clamps at the feed point connections may have to be adjusted up or down for the best match, hence, the reason for the hose clamps. (The first attempt I made was with the feed at about 3 inches from the bottom.... and the antenna resonant point was way out of the 2 meter band....about 138 MHz with an swr of around 3 to 1). This told me that the Slim Jim was way too long......after adjusting the feed point closer to the air gap at 4 1/2 inches from the bottom, I was in business!

These are the final swr readings with the antenna up in its final position....all of 10 feet above the ground beside the house:

144 MHz swr 1.2, 145 MHz swr 1.1 and 148 MHz swr 1.3 and all had 50-52 ohms resistance and a 98 percent match according to the MFJ 259B Antenna analyzer! All lengths of the Slim Jim may be changed slightly either way depending on your construction for better swr. You may not get that perfect 1:1 reading.

THE SURPRISE!

After I stood back and marveled at my "new" Slim Jim, it dawned on me that the bottom of the antenna was only about 8 inches from the metal roof flashing under the shingles! This was a NO NO according to all of the Slim Jim articles I had researched on the Web.
The "free space" distance should be no less than about 20 inches (1/4 wave) from ANY metal in ANY direction!

THE HORROR!

I rechecked the swr, resonant points, etc over the entire 2 meter band using the MFJ 259B, in case I had made an error, (not a mistake), but the numbers were the same as before. Now my curiosity came out showing it's ugly face, so I managed to get the 10 foot piece of PVC pipe up higher so the bottom of the antenna was at least 36 inches from ANY metal..... I re-checked the readings using the MFJ 259B and to my wonder.......NO CHANGE AT ALL! I suspect that the free space distance of 20 inches or more quoted in previous articles and research on this antenna is used so the pattern will not distort up or down from the "8 degree" angle of radiation from the ground. I have not done further research or testing on the air to confirm this but hope to in the future. If any of you out there wish to "model" this antenna using different distances from surrounding metal....I am open to your input.
An air wound choke may be used at the base of the antenna to help prevent rf on the feed line, creating difficulty with SWR readings, and help prevent distorting the low angle pattern.. For 2 meters, the air choke

coil is about 4 turns of coax at 5 inches in diameter. Some builders use it....some don't...I have not added one at this time but plan to in the future to see if there is any effect on the pattern.

One note of further information for you should you decide to build the Slim Jim. During the period of time between this version and the dismantling of the old Slim Jim, I decided to put it back up as a Slim Jim antenna....take some S meter readings of area repeaters for a reference and then re-convert the same antenna back to the old standard J Pole......take some readings of the same repeaters and compare them.

I found that the Slim Jim could bring up several of the same repeaters that the J Pole could not! No changes were made between the two comparisons except the antennas! This tells me that the Slim Jim antenna has something going for it.....try one and get something going for you.........HAVE FUN! EXPERIMENT, EXPERIMENT, EXPERIMENT...

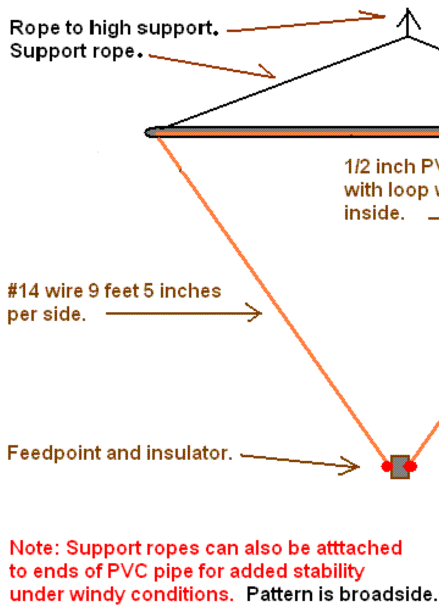
73, Don N4UJW

Don’s 2 Meter Slim Jim. I wished my antennas looked that good!

Notice the hollow insulator covering the air gap at the top of picture.

THE END

Amateur Radio and SWL antennas are easy to build!



N4UJW

Don't buy. Homebrew your antennas!

KL7JR