

Simple Multi-Band HF Vertical Dipole

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On a Spiderbeam 12m HD Telescoping Fiberglass Pole

for: 80/40/30/20/17/15/12/10m

Total Height: 12m (40 ft.)

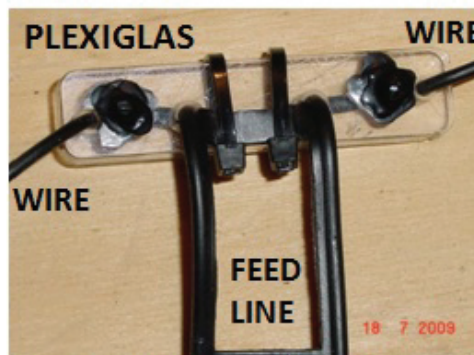
Wire: Spiderbeam CQ-532

(6m per side – total 12m long)

(20 ft. per side – total 40 ft. long)

Note: Spiral the radiator wire down the pole about one turn per meter.

Tip: tie a knot in the wire about 2cm (1 in.) before each end, then fasten the wire to the pole with electrical tape or a wire-tie. The knot prevents the wire from slipping back through the tape or wire-tie.



Simple lightweight insulator

Insulator will be about 6m (20 ft.) above ground. Fasten with wire-ties.

Guy Ropes: 2mm Kevlar



50cm (2 ft.) above ground

Guy stakes 5 to 7m away from pole. (16 to 23 ft.) spaced equal distance around the pole. Or, use tree or fence to fasten ends.

450Ω Openwire Feedline

Although the length is not critical, there are some lengths which can cause trouble. See text.

CAUTION HV!
(HIGH VOLTAGE)

Good Antenna Matchbox

MFJ-974B*

* Alternatives described in text.



Spiraling the wire down the pole distributes its weight evenly around the pole and prevents it from flopping in the wind. Since the lower half of the pole is thicker (wider) than the upper half, the wire will end about 50cm above the ground.

IT IS IMPORTANT TO KEEP THE WIRE THIS DISTANCE FROM THE GROUND!

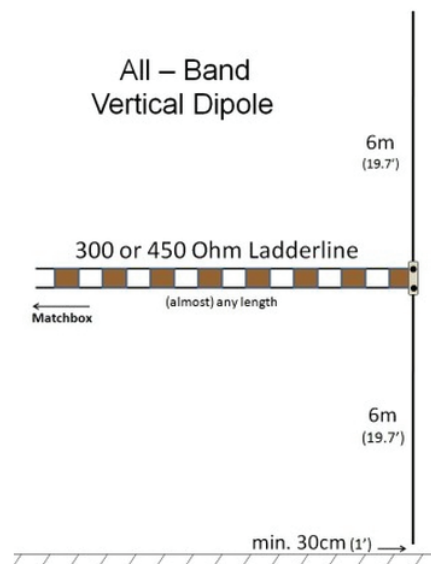
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DESCRIPTION:

This simple non-resonant vertical dipole enables users with limited space to erect an antenna capable of being used on all ham bands from 80 through 10m. It requires NO RADIALS. Yet its performance is amazing for its size and simplicity.

This antenna requires a **GOOD** antenna matchbox with much broader impedance matching capability than the ATU's built into most transceivers. The ideal matchbox will be a balanced (symmetrical) matchbox. There are very few of these currently available on the market. You may substitute an asymmetrical matchbox with external balun, but care should be taken in the choice of matchbox and balun. More Antenna Matchbox and Balun details are shown at the end of this paper.

If your matchbox has a built-in balun, you may try it but don't be surprised if you encounter problems. Most matchbox manufacturers use the wrong type of balun in their products. For more information, see: http://www.karinya.net/g3txq/tuner_balun/



PHYSICAL DESCRIPTION:

Height:	12m (40 ft.)
Wire Length:	6m (20 ft.) per side; 12m (40 ft.) total
Guy Line Distance:	5 to 8m (17 to 25 ft.) The distance from the pole to the ground stakes may be slightly shorter for the 2 guy ropes but the guy line using the feedline as a guy should be as long as possible. The angle of the feedline to ground should not be less than 45 degrees (more is better).

THEORY OF OPERATION:

This antenna proves two popular antenna myths 'wrong':

1. An antenna must be resonant to be efficient.
2. Short antennas are not very efficient.

According to L.B. Cebik, W4RNL (SK), if we can find a way to **efficiently** match an antenna to the transmitter, antennas as much as 1/8 of their standard size can be an efficient radiator.

The reality is, short antennas have very low impedances and antenna matchboxes are usually inefficient when matching low impedances. **Special attention must be paid to the matchbox.**

The use of short openwire feedlines keeps feedline loss low.

The challenge is to find the right matchbox to enable an efficient match.

ALL MATCHBOXES WERE NOT CREATED EQUAL!

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FEEDLINE:

In a perfect world, the feedline should be run at a 90 degree angle away from the antenna. In most installations, especially portable installations, this is difficult, even impossible.

And it is **NOT** necessary. Always try to keep the feedline as high as possible when routing it away from the antenna, but don't worry at all if you cannot run it at a 90 degree angle!

In most installations where we have used this antenna, we have installed it as shown in the picture on the first page, with the feedline sloping down at a 45 degree angle. The antenna will still perform very well, even with the feedline at this angle.

FEEDLINE LENGTH:

Long ago I was taught (personally) by Lew McCoy, W1ICP (SK) that the optimum length of the feedline should be:

"long enough to reach from the antenna's feedpoint to the matchbox in the shack."

Theoretically, that is all you need to know, because performance wise there really is no critical length – as long as your matchbox is capable of efficiently dealing with the resulting impedance. In practice, we will find that certain feedline lengths will transform the impedance on one or more bands to a value outside of the matching range of the matchbox. Not only will the matchbox fail to match the load, this may also cause arcing inside the matchbox during the tuning process and damage the matchbox.

TWO SOLUTIONS: 1) buy a better matchbox; 2) change the feedline length.

CAUTION: tables of recommendations for "good lengths" of openwire feedline were created assuming a **resonant dipole**. "This antenna" does not use a resonant dipole. It intentionally uses a non-resonant dipole to help avoid extremely high impedances. This makes those tables invalid. The hardest band to match is 80m where the impedance is extremely low.

So use W1ICP's formula: cut the feedline to the length you need it and extend it when necessary.

RULE OF THUMB: If you encounter arcing in the matchbox, or a band which will not match, even at low power levels, you should add 1/8 wavelength of feedline to the existing feedline. In fact I have often found that adding just 1/16 wavelength was enough to solve the problem.

THE FOLLOWING TABLES OF FEEDLINE EXTENSION LENGTHS show typical 1/8 wavelength lengths for Window Line, such as WIREMAN, and assumes the velocity factor of "0.90":

MHz	M	Ft.
3.7	9.3	30.5
7.1	4.8	15.9
10.1	3.4	11.2
14.2	2.4	8.0

MHz	M	Ft.
18.1	1.9	6.2
21.2	1.6	5.3
24.9	1.4	4.5
28.5	1.2	4.0

Simple Multi-Band HF Vertical Dipole

As stated above, you don't always need this much additional feedline. For instance, for 40m I have always used a 13 ft. long piece of feedline, and it has always worked for me. These are approximate lengths and good starting points.

CAUTION: NEVER TUNE AN ANTENNA MATCHBOX WITH FULL POWER!

Always reduce power to about 10 to 20 watts while tuning the matchbox.
After you are certain that the SWR is good, increase the power level.

CAUTION: NEVER ROTATE A MATCHBOX SWITCH UNDER POWER!

**Roller inductors are designed to be adjustable under power.
Switched inductors are not!**

Matchboxes with switched inductors:

MUST NOT BE ADJUSTED WITH POWER APPLIED TO THE MATCHBOX!

If you need to rotate the switch, un-key the transmitter to remove power, rotate the switch, then key the transmitter again.

NOTE: The matchbox recommended here (MFJ-974B) is a switched inductor matchbox!

CONSTRUCTION TIPS:

- DO NOT USE THICK WIRE when mounting this antenna to telescoping fiberglass poles. Thicker wire near the top of the pole may result in breakage of the pole. The wire recommended in the drawing (CQ-532) is AWG-18 wire.
- Make the feedpoint insulator as lightweight as possible. It does not have to support much weight and there is very little force on it.
- Insulators are NOT necessary on the ends of the wires.
- Tie a simple knot near the end of each wire to prevent it from slipping after it has been fastened to the pole. Instead you may also slip a 1 cm (½ in.) long length of heat shrink tubing (with hot glue inside) over the tip of each wire leg and shrink it with heat.
- It is **strongly recommended** to use the optional Clamp Set with the Spiderbeam fiberglass pole. This will prevent the collapse of the pole in the event of large temperature drops in the weather.

DON'T FORGET: HIGH VOLTAGE on the bottom of the antenna.

(Even with just 100w).

Keep children and animals away from the antenna.

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APPENDIX A: ANTENNA MATCHBOX SELECTION

The antenna described here has some very demanding requirements on the antenna matchbox. They exceed the capability of most “built-in” ATUs inside of our transceivers.

Despite the recent fad of switching to fully automatic tuners, nothing beats a good old fashion manual tuner. It has seamless tuning (no steps or jumps in capacitance or inductance) and its large capacitors can handle more voltage and current.

BEST PRACTICE:

Always use a symmetrical matchbox (balanced matchbox) with symmetrical antennas.

Sounds good in theory but it is not always so easy. Most people do not have a symmetrical matchbox and there are very few on the market. In addition they are more expensive than asymmetrical matchboxes because they require more components.

The following antenna matchboxes are ideal tuners for power levels of up to 100w (barefoot):

Available NEW:

- MFJ-974B
- HamWare AT-502

Available USED:

- Annecke 200w Symmetrical Koppler
- Johnson Viking 275w Matchbox
- DECCA KW EZEE Match

These are the only popular ones I am aware of that were built in large quantities.

BEWARE: there are plenty of “claimed” symmetrical matchboxes which are NOT symmetrical.

Alternative: Asymmetrical Matchbox with a ‘good’ external 1:1 Guanella (current) Balun.

There is no other device in ham radio that is as misunderstood as the balun. Most people think all baluns were created equal. They are NOT. Most people think the purpose of the balun is to balance the antenna. It is NOT!

There are many different kinds of baluns because we use them for many different purposes. The only type of balun you should use between a matchbox and a multi-band antenna fed with openwire is a 1:1 Guanella Balun. There is plenty of lab and field data explaining and supporting this. More info in the Appendix on Baluns below.

Unfortunately the antenna tuner manufacturers have failed to comprehend this point and most continue to sell their products with 4:1 Guanella (current) or even worse 4:1 Ruthroff (voltage) baluns. **If your antenna matchbox has a balun, it is probably the wrong kind.** Therefore you should use an external balun. USE A GOOD ONE. It is VERY SIMPLE to build a good balun.

FOR INFO: Very few automatic antenna tuners on the market have the broad impedance matching capability that good manual tuners have. In fact many of the auto-tuners are pretty pathetic. “Price” or “Brand” is no guarantee that your tuner will be adequate for “this” job.

Simple Multi-Band HF Vertical Dipole

APPENDIX B: EXAMPLES OF GOOD 1:1 GUANELLA (CURRENT) BALUNS

A 1:1 Guanella balun is the simplest type of balun to build. It can be as simple as wrapping 12 or 13 turns of coax around a large toroid core. The cost is about \$15 to \$20 - without an enclosure; a little more if you wish to build it into an enclosure – but you may also just lay it on the table without an enclosure.

You will need about 1.2m (4 ft.) of coax and one toroid (2 toroids if more than 500w).

For Low Power:

- 40 through 10m
 - Use RG-316 (thin Teflon coax) and an FT-140-61 toroid
 - Or, RG-58 and an FT-240-61
- 80 through 10m
 - Use RG-316 (thin Teflon coax) and an FT-140-31 or FT-140-43 toroid
 - Or, RG-58 and an FT-240-31 or FT-240-43 toroid

For up to 500w:

- 40 through 10m
 - Use RG-142 (Teflon coax) and an FT-240-61 toroid
- 80 through 10m
 - Use RG-142 (Teflon coax) and an FT-240-31 or FT-240-43 toroid

For 500 to 1000w: Use two identical cores glued or taped together and wrap coax around both as if it were one thick core. Requires about 1 ft. more of coax.

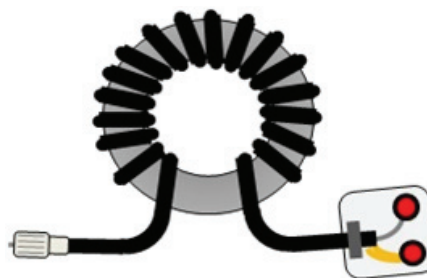
For QRP: You may also use RG-174 and the small toroid.

Simply wrap the coax around the core, securing the ends to the core with wire-ties, and leaving short stubs of 15 to 25cm (6 to 10 in.) extending beyond the toroid. Solder a PL-259 to one side and connect the openwire to the other side. **See picture on right** →

Use whatever type of connection you prefer to connect the open wire. We often use banana jacks. You may also use Andrew PowerPoles, screw terminals, whatever.

There is no magic or technical skill required.

Basically, nothing can go wrong, except for a poor solder joint to the PL-259.



Simple Multi-Band HF Vertical Dipole

TIP: For mechanical convenience it is better to wrap the coax using the “Reisert Method” which is also known as “cross-winding”.

See picture on right →

Electrically it is identical to wrapping all the turns in a single direction, but has the mechanical advantage that the two ends of the coax exit the core on opposite sides.

The core shown here is from Ferroxcube, not Amidon, and is coated with white epoxy. It is identical to the Amidon FT-140-43.

The coax here is thin RG-316.

The picture is much larger than the real Balun!

Once the coax is wound and secured to the core, simply solder a PL-259 to one side and a pair of terminals (for the open wire) to the other side. We usually use banana jacks for the antenna connection. Again, use whatever you prefer.



EXTRA: BAD BALUNS / GOOD BALUNS

There is a lot of disagreement on balun technology. Most hams cannot even define the correct job of the balun. Most believe it has to do with the antenna. NOT! A balun is a device associated with transmission lines. (Check the ARRL Handbook to confirm)

See: *Baluns: What They Do And How They Do It*, by Roy Lewallen, W7EL

<http://www.eznec.com/Amateur/Articles/Baluns.pdf>

The information on baluns presented in this paper is based upon 3 things:

1. The opinions and lab measurements of Tom Rauch, W8JI.
 - http://www.w8ji.com/tuner_baluns.htm
2. The opinion, and lab measurements of Steve Hunt, G3TXQ
 - http://www.karinya.net/g3txq/tuner_balun/
3. My own personal experience and field measurements.
 - www.dj0ip.de (see “Common Mode Current Test”)

I have two recommendations to the readers:

1. Do not place too much trust in the message of people trying to sell you something.
2. Do your own due diligence!