The G5RV
Multiband HF Antenna

By VK1OD

(G5RV Info Updated 06-27-2012)

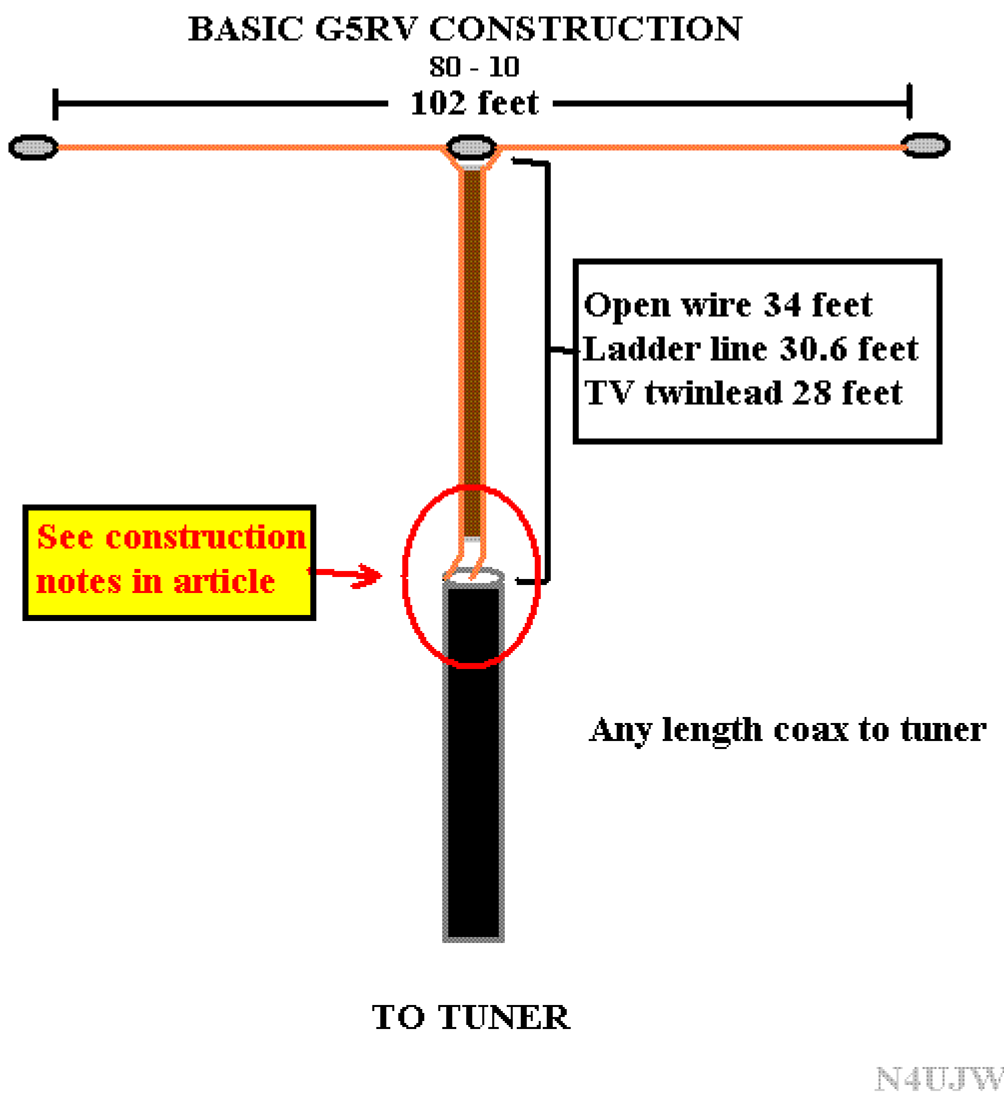
Over the last few decades, the G5RV antenna has become one of the most popular and widely used "all around" multi-band antennas in the world. Even though it is a "compromise" antenna, it has good overall performance on most hf ham bands when used with an external tuner, and allows coax as an entry feedline to the radio equipment eliminating the need and hassle of ladder line or twinlead. 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.



Note that the "any length coax to tuner" in the drawing is debateable... see *conclusion* at bottom of article!

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 / 14.15mhz = 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 "JR" 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 it's 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 it's 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 twinlead in ours.
VF of TV type twinlead is .82

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

492 x .82 = 403.44

403.44 / 14.15mhz = 28.51 feet for TV type twinlead

FULL-SIZE, DOUBLE-SIZE and HALF-SIZE (sometimes called the "JR":

Band Coverage	3.5 - 28 MHz (most popular)	1.8 - 28 MHz	7 - 28 MHz
Length of Antenna	102 ft (31.1 m)	204 ft (62.2 m)	51 ft (15.55 m)
Matching section :			
- Open wire	33.7 ft (10.28 m)	67.5 ft (20.56 m)	16.9 ft (5.14 m)
- Ladder line	31.3 ft (9.54 m)	62.6 ft (19.08 m)	15.6 ft (4.77 m)
- "TV" twin lead	28.5 ft (8.69 m)	57 ft (17.38 m)	14.3 ft (4.35 m)

Band characteristics of the G5RV:

3.5Mhz. 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.

7Mhz. 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 twinlead 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.

10Mhz. On this band the antenna functions as a two half-wave in-phase collinear array, producing a polar diagram virtually the same as on

7mhz. A reactive load is presented to the feeder at the base of the matching section but, as for 7mhz, the performance is very effective.

14Mhz. 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.

18Mhz. 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.

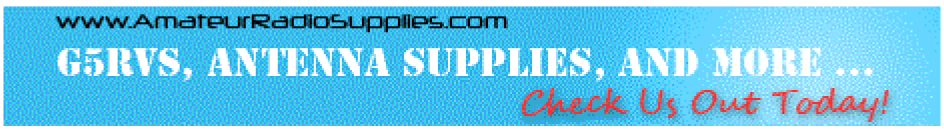
21Mhz. On this band the antenna works as a "long-wire" of five half-waves, producing a multi-lobe polar diagram with very effective low zenith angle radiation. Although a high resistive load is presented to the feeder at the base of the make-up section, the system loads very well when used in conjunction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

24Mhz. 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.

28Mhz. 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:

Editors note: If you don't have the time, patience, experience or materials to build the G5RV then we recommend that you buy a commercially made G5RV from a reputable dealer like Amateur Radio Supplies.com...click here for info on their line of very inexpensive and very high quality G5RV antennas or click the banner below to see their full line of products!



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 twinlead 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 feedline. Do not tape the matching section to a metal mast or pole.

Conclusions based on comprehensive research by VK1OD

Suggest balanced line matching section of 9.85m (32.31 feet) of Wireman 554, extended by 15.15m (49.47 feet) of RG6/U coaxial cable to a "local" tuner. (Local tuner means tuner in the shack)

(Wireman 454 is **440 ohm**, 14 AWG, 19 strand copper-clad steel)

This is the least cost "local" tuner solution; losses acceptable on 3.5, 7, 14, 21, 25 MHz bands