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MFJ-1778 G5RV 160 through 10m Antenna

Introduction

The G5RV antenna is a multi-band center-fed dipole antenna capable of 1500 Watts. It was originally designed to operate as a $3/2$ wavelength center fed antenna for 14 MHz, but amateurs soon discovered it would offer reasonable performance on many other bands. The MFJ-1778 (G5RV) consists of a 102 foot flat top fed with a 32.5 foot 450 ohm matching section ending in an SO-239 coaxial connector.

The 450 ohm balanced transmission line serves as a 1:1 transmission line transformer on 14 MHz. The SWR is approximately 2:1 at 14 MHz. The same balanced line section acts like a transmission line impedance matching section on the other HF bands. This antenna generally requires the use of a suitable matching network (antenna tuner) since the SWR of the G5RV is almost certainly not 1:1 on any band. The use of a tuner will guarantee maximum performance from solid state excitors.

The G5RV is a balanced antenna that is fed by an unbalanced coaxial line. This feed system causes unwanted parallel RF currents to appear on the shield of the coaxial feedline. A choke type balun should be used with this antenna to eliminate or reduce the undesirable parallel feedline currents. Failure to use a choke balun may result in RFI, RF feedback, or other symptoms of RF "in the shack". The Balun Requirement section describes how to construct a choke balun for this antenna.

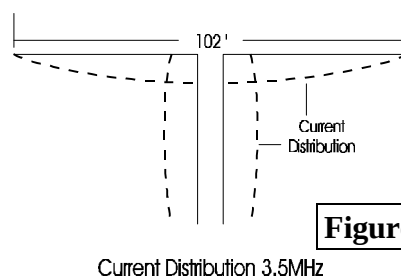
WARNING: Always mount this antenna so that it is out of the reach of adults and children. Contact with any part of this antenna can cause RF burns or other injuries.

Theory Of Operation

A description of how the G5RV functions on each band follows:

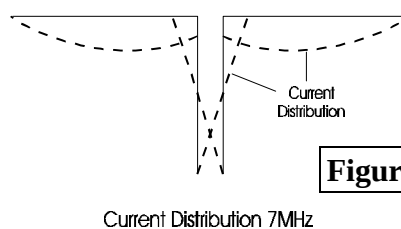
80 meter band:

On 80 meters the MFJ-1778 (G5RV) functions as a slightly short half-wave dipole. The current distribution of the antenna and matching line is shown in figure 1. The horizontal radiation pattern is the same as a half-wave dipole on this band. With horizontal polarization at heights below 100 feet the antenna is practically omni-directional and has a high takeoff angle.



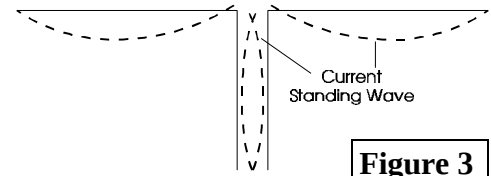
40 meter band:

On 40 meters the MFJ-1778 (G5RV) functions as "two half-waves in-phase" fed with a quarter-wave impedance matching transformer. The current distribution of the antenna and transmission line impedance matching section is shown in figure 2. The horizontal radiation pattern is somewhat narrower than the pattern of a half-wave dipole and is broadside to the radiator on this band. The G5RV has a small amount of gain and radiates at medium wave angles on 40 meters.



30 meter band:

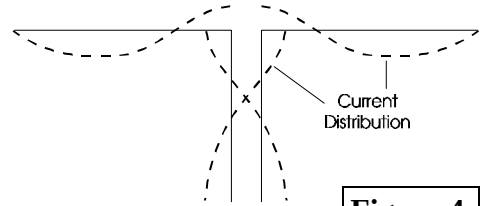
On 30 meters the MFJ-1778 (G5RV) functions as an extended double zepp. The current distribution of the antenna and matching line is shown in figure 3. The horizontal radiation pattern is similar to the pattern of the 40 meter band (broadside) but has four additional minor lobes. The antenna has a gain of around 3 dB on 30 meters.



Current Distribution 10MHz

20 meter band:

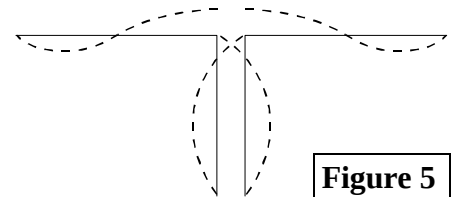
This is the true design frequency of the MFJ-1778. The antenna is a $3/2$ wave center-fed antenna and has a multi-lobe pattern on this band. On this band the G5RV is a good DX antenna at heights of 30-60 feet. The radiation angle is fairly low. The feedpoint of the antenna is approximately 100 ohms resistive, and the ladder line functions as a 1:1 ratio transformer. See figure 4 for a diagram of current distribution.



Current Distribution 14MHz

17 meter band:

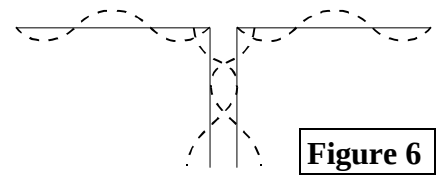
The antenna is a pair of full-wave antennas fed in-phase on this band. The radiation angle of the antenna is low with many lobes in all directions. The current distribution of the antenna and matching line is shown in figure 5.



Current Distribution 18MHz

15 meter band:

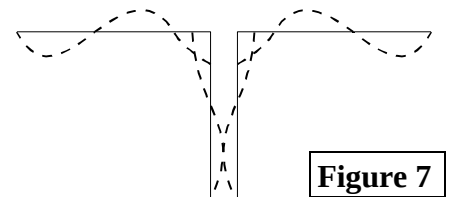
The antenna is a pair of 1.1 wavelength long wires fed in-phase on this band. This pattern is multi-lobed in the horizontal plane with a low radiation angle. The current distribution of the antenna and matching line is shown in figure 6.



Current Distribution 21MHz

12 meter band:

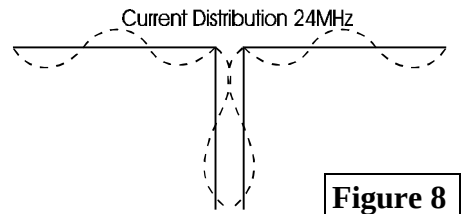
On 12 meters this antenna is a pair of 1.3 wavelength longwires fed in-phase. The feedpoint resistance is fairly low. The radiation pattern has many lobes and a low radiation angle. The current distribution of the antenna and ladder line is shown in figure 7.



Current Distribution 24MHz

10 meter band:

The MFJ-1778 functions as two $3/2$ wave longwire antennas fed in-phase on this band. The pattern has multiple lobes in all directions. The current distribution of the antenna and matching line is shown in figure 8.



Current Distribution 28MHz

MFJ-1778 G5RV Multiband Antenna

160 meter band:

The MFJ-1778 (G5RV) can function as a top loaded vertical antenna with the dipole element acting as a capacitance hat on 160 meters. Operation on this band requires a ground screen or radial ground system (see the INSTALLING and OPERATING THE ANTENNA section). The radiation pattern of the antenna is omni-directional and vertically polarized on 160 meters.

Caution: On 160 meters the feedline conductors must be tied together and fed in parallel. As an alternative, either the shield or the center conductor can be fed with the opposite terminal unconnected. DO NOT try to operate this antenna as a conventional dipole on 160 meters.

Tools And Time Requirements

This antenna requires no assembly. The time needed for installation will vary with your skill and equipment.

No special tools are required to install this antenna. Nylon ropes are needed to support the ends of the antenna from a suitable structure or tree. If a tree is used, you will need a way to get ropes over it. The most common method is to use a weighted arrow or a fishing rod and a heavy sinker to place a small line over a tree. A larger line is then pulled up and used to pull the support rope over the tree. The ARRL Antenna Handbook has detailed suggestions for installing wire antennas.

Safety Precautions:

WARNING:

- This antenna is an electrical conductor. Contact with power lines can result in death or serious injuries. Do not install this antenna where there is any possibility of contact with power cables or the service drop. The antenna should not be close to power lines during installation, operation, or removal.
- Follow the guidelines for antenna installation recommended by the US. Consumer Product Safety Commission.
- Keep this antenna out of reach of adults, children, and animals.
- Any contact with this antenna while transmitting can cause RF burns.
- Never place this antenna close to electric power lines or utility wires.
- Install the antenna away from living areas to reduce levels of electromagnetic fields
- Never operate this antenna near RF sensitive medical devices such as pacemakers
- Keep the ladder line away from buildings or metallic objects. Ladder line is a high impedance line that may develop high RF voltages with high transmitter power levels.
- Use a minimum of 50 pound working load weather resistant rope to support the tension and wind load of this antenna.

Installing The Antenna

Please read the following suggestions and examples.

The best location for this antenna is as high and far away as possible from utility wires, other antennas, and other structures. It is difficult to find a perfect location, so the best compromise usually must be accepted.

The antenna can be installed in three basic ways:

Horizontal Antenna

This method requires two tall supports separated by at least 102 feet. Suspend the antenna with at least a 50 pound working load nylon rope or another equivalent strength weather resistant non-metallic rope. Never use wire or wire core rope to support the ends of the antenna. Attach the rope to the end insulators through the empty holes.

Try to keep the antenna as horizontal as possible. The antenna must be more than 35' above ground level to give acceptable performance, and should be as high as 80 feet for the best overall performance. The ladder line should drop vertically from the horizontal section for ***at least*** 20 feet and should be kept several inches from conductive objects. If the antenna's ladder line has to be installed near conductive objects, space the line at least 6" from the object with non-conductive supports (for example: PVC pipe standoff supports 6" long). Use nylon cable ties to secure the feedline to the supports.

NOTE: An example of how to mount this antenna horizontally using two trees is shown in figure A on the inside front cover. Be sure to allow enough slack or use some type of pulley and counterweight system to prevent the antenna or rope from breaking if the trees move in the wind. It is also possible to use masts, towers, or other tall structures for supports. Try to keep the ends of the antenna at least five feet from metallic supports.

IMPORTANT: Use weather resistant rope rated at a minimum of 50 pounds working load to support this antenna.

Inverted "V" Antenna:

This method requires only one tall support and also places the least strain on the antenna. Hang the antenna from the support using a nylon rope or other non-conductive rope tied to the center hole of the center insulator. The center insulator should be the highest point of the antenna.

The antenna ends should be ***less than*** 25.5 feet below the center insulator. This avoids an ***inside angle of less than 120 degrees*** between the antenna's legs. The antenna ends should be secured with nylon or weather resistant non-metallic rope to suitable supports.

The ladder line should drop vertically from the center insulator for at least 20 feet and kept away from conductive objects. If the antenna's ladder line has to be installed near conductive objects, space the line

MFJ-1778 G5RV Multiband Antenna

at least 6" from the object with non-conductive supports (for example: PVC pipe standoff supports 6" long). Use nylon cable ties to secure the feedline to the insulated supports.

NOTE: Figure B on the inside front cover shows this antenna mounted in an "Inverted V" configuration using a tree. You can also use a pole, tower, or roof mounted mast to support this antenna.

Sloper Antenna:

This antenna can also be used as a sloping dipole. This requires one tall support and one short support. The center of the antenna must be at least 30 feet above the ground in this configuration. The antenna radiates mainly in the direction of the downward slope. The optimum angle of "slope" will vary with the desired coverage distance and the frequency of operation, but will almost always be somewhere between 45 degrees and almost vertical.

160 Meter Operation:

The MFJ-1778 (G5RV) will function on the 160 meter band as a **Marconi Antenna**. Operation on 160 requires a tuner and a good RF ground system.

Warning: Never attempt to operate this antenna as a conventional dipole on 160 meters!

To use the MFJ-1778 as a Marconi antenna, the bottom end of the feeder (ladder line) and any vertical coax should be connected together at ground level. This allows the vertical feedline to become a radiating element. The feedline should be kept as vertical and as clear of metallic objects as possible.

The preferred method of 160 meter operation is to connect the antenna's shorted feedline conductors to the center conductor of a coaxial feedline that goes into the station. The shield of the coaxial cable going to the station must be attached to a good RF ground (radial system) at the location where the vertical feedline attaches to the cable. A suitable matching network (tuner) is usually required in the station.

As an alternative, the feedline can be tied together in the shack and worked against the station ground. This is not the preferred method, however, because of potential RFI problems. This method still requires a good ground system for the best performance on 160 meters.

A good way to visualize an RF ground is to picture a large conductive "mass" that the antenna pushes against. The "mass" should have a short connection to the ground point and extend as far as possible in every direction. The ideal ground system for 160 meters would have 120 straight evenly spaced radials at least 140 feet long. A marginally acceptable ground system requires a **minimum** of four or more long (60 foot or more) straight radials. Other large metallic masses (such as fences or water lines) should also be "tied in" to the ground system.

The earth and fresh water are poor electrical "masses" because of their poor conductivity (1 to 30 milliohms/meter). Although salt water is several hundred times (5000 milliohms/meter) more conductive than dirt, copper is several hundred times (millions of milliohms/meter) better than saltwater. Copper radials obviously offer a much better ground than saltwater.

Ground rods almost never suffice for RF grounding in applications like this because they connect to the lossy dirt. This is why radials are required when feeding this antenna as a Marconi. Radials will improve your signal even if the earth is wet or saturated with salt water.

Elevated counterpoise systems are also effective, but they also require as much "electrical mass" as possible. A supplemental earth connection is always required for lightning and low frequency ac grounding.

Balun Requirement

The G5RV is a balanced antenna fed with a balanced 450 ohm line that terminates in a SO-239 connector. When feeding this antenna with an unbalanced line (such as coaxial cable), it is a good idea to use a 1:1 choke BALUN at the coax to feedpoint connection. The balun will reduce or eliminate parallel currents on the outside of the coax shield. This will prevent or reduce RFI, RF feedback, RF burns, and other effects of excessive RF in the station.

The best balun for this antenna is an **air-core choke balun**. Avoid using other types of baluns, such as ferrite sleeve or transformer type baluns. This antenna has a high reactive component at the feedpoint SWR of more than 2:1. The high SWR increases loss in ferrites and may cause excessive core heating, core saturation, or arcing in the windings.

Air Wound Balun Construction

The air wound balun required for this antenna can be constructed by winding the coaxial feedline cable in a single layer solenoid coil with at least 10 turns of 4 to 6 inch diameter. The turns can be taped or secured by nylon cable ties. The balun can be wound on PVC pipe or any other non-metallic form. Place the balun immediately at the point where the feedline leaves the air (for 160 meter operation) or at the feedpoint connection (if the antenna is only operated on 80-10 meters). The feedline shield should not be grounded on the antenna side of the balun.

Warning: The balun should be kept away from any conductive material!

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Tuning The Antenna

The G5RV requires a tuner to match it to the transmitter impedance. Operating this antenna without a tuner is not recommended. The use of a tuner like the MFJ-962C or MFJ-986 will provide proper matching on all HF bands.

Important: If you have a problem tuning this antenna on any band, try changing the length of the coax (by 3-6 feet) from the tuner to the antenna.

Grounding Considerations

This antenna requires a good earth ground connection to reduce the risk of lightning damage to the station equipment and to improve operator safety. Adequate protection can be obtained by burying the coaxial feedline **directly** in the ground for 20 feet (or more) before the feedline enters the building. The feedline's shield should be grounded to the station ground at the entrance point of the building before reaching the operating position. Failure to follow these precautions will increase the risk of lightning damage to equipment and reduce safety.

The earth ground should consist of at least one copper ground rod driven into the earth a minimum of 6 feet. Multiple ground rods and buried wires are superior to a single rod for lightning and RF protection. 160 meter operation requires special grounding considerations. These considerations are discussed in the "160 Meter Operation" section.

Never use woven flexible braiding for ground connections unless *absolutely necessary*. Braiding has high resistance to RF and lightning. Copper flashing, wide copper foil, or large gauge solid copper wires are the proper materials for use in RF and lightning grounding applications. Never ground the feedline on the antenna side of the balun.

In-line coaxial lightning arrestors offer a minimal improvement in lightning protection. The best method of protecting station equipment is to disconnect the feedline outside the building.

Maintenance

This antenna is constructed of heavy duty materials and should withstand normal climates for many years. The use of some type of coaxial connector moisture protection is recommended at the bottom coax connection. This is especially true in coastal areas where salty mist is commonplace.

GE makes a pure silicone grease called "*silicone dielectric compound*" that can be applied **sparingly** to the threaded area of the female connector. This compound, or even a clear silicone heat sink compound, will prevent moisture from entering the connector through the threads and protect the connectors from corrosion. ***This is the same type of sealer that commercial antenna installers and CATV companies use with great success.***

A less desirable but adequate sealer is the automobile seam sealer commonly marketed as "coax seal". This is a pliable black sealing compound.

When installing any coax sealer, ***never*** completely cover the barrel of the coax connector. The sealer should ***only*** be placed near the junction of the threaded part of the connector and the knurled area of the male connector. The bottom of the male connector's outer sleeve should be left open to permit the connector to "breathe". Mount the connector vertically with the unsealed barrel end down so it does NOT collect moisture!

Technical Assistance

If you have any problem with this unit first check the appropriate section of this manual. If the manual does not reference your problem or your problem is not solved by reading the manual you may call *MFJ Technical Service* at **601-323-0549** or the *MFJ Factory* at **601-323-5869**. You will be best helped if you have your unit, manual and all information on your station handy so you can answer any questions the technicians may ask.

You can also send questions by mail to MFJ Enterprises, INC., P.O. Box 494, Mississippi State, MS 39762; by FAX to **601-323-6551**; through Compuserve at 76206,1763; or by email to 76206.1763@Compuserve.com. Send a complete description of your problem, an explanation of exactly how you are using your unit, and a complete description of your station.