

## MFJ-1796 Vertical Antenna

### INTRODUCTION

The basic 40 meter quarter wave vertical antenna is 33' tall and requires a reasonably good ground or counterpoise system to function properly. The usual way to eliminate the requirement for a complicated and space consuming ground system is to center feed a 1/2 wave (in this example a 66' tall) antenna.

MFJ solved these problems by combining efficient end loading with a balanced center feedpoint design. The result is a physically small vertical antenna that gives good performance and does not require any type of RF ground system.

The reduction in size is accomplished by adding separate loading coils and capacitance hats at each end of the antenna for the HF bands. The efficient end loading coils are wound on fiberglass forms. The high quality materials and construction of the HF loading system allows a maximum power rating of 1500 watts on 40, 20, 15 and 10 meters. The continuous CW power ratings are 500 watts on 40 meters, 750 watts on 20 or 10 meters and 1000 watts on 15 meters.

The six and two meter amateur bands are covered with the addition of four quarter wave decoupling stubs. The power rating of the antenna is 750 watts on six meters and 300 watts on two meters.

***WARNING: Improper installation and assembly can be hazardous! Read these instructions thoroughly before attempting to assemble, install or operate this product! High power transmitting devices produce voltages that can cause severe burns or other injuries.***

### CHOOSING A LOCATION FOR THE ANTENNA

The best performance on receiving and transmitting will be obtained by mounting the antenna in a clear location above or away from buildings, towers, feedlines, utility wires, and other antennas. While your own ingenuity and particular circumstances will determine the final mounting method, we'll pass along a few ideas for both permanent installation and portable operation.

**Never** mount this antenna in a location that will permit unsuspecting people to come in contact with the loading spokes or any other part of the antenna.

**Never** mount this antenna where a mechanical failure might allow the antenna to contact power lines or other utility wires.

**Always** ground the feedline at the point where it enters a building to a good earth ground for lightning protection.

***WARNING Always mount this antenna so that it is out of the reach of adults as well as children. The capacitance elements can cause injury and or severe RF burns.***

**Permanent Installation**

The ideal installation is a rigid pole or roof mount that puts the antenna completely in the clear. If the ideal installation is not possible, choose the best compromise. TV mast, heavy-duty rigid electrical conduit, or steel water pipe are suitable mast materials. This antenna will mount on masts between 1 and 1-1/2" OD. The use of soft or thin wall masts is not recommended

The MFJ-1796 will perform quite well even at ground level, which means the lower capacitance hat should be at least 5 ft above ground level on a short rigid mast. However, the antenna installation **MUST** be protected (with non-metallic fencing) to provide personal safety and to prevent damage to the antenna itself.

**Portable Operation**

This antenna may be disassembled to the extent necessary for transporting to a temporary location. If possible, only remove the two HF loading coil assemblies. Leave the two main elements with the 2 and 6 meter stub assemblies intact. *Some retuning may be required after moving the antenna.*

Even for temporary or portable operation, do not be casual about selecting a suitable mast. If the antenna falls it will be damaged and may cause serious injury. Whatever type of installation you choose, remember that the antenna should be installed where it can *never* be contacted by people or animals.

**TOOLS AND TIME REQUIRED FOR ASSEMBLY**

The estimated assembly time for this antenna is two hours. Antenna assembly requires the following hand tools:

- 1/4" nut driver
- 3/8" open end wrench
- 5/16" nut driver (or 1/4" blade standard screwdriver)
- 7/16" nut driver
- 7/16" open end wrench
- Large wire cutters
- #1 phillips screwdriver at least 6" long or longer
- #2 phillips screwdriver
- suitable eye protection

In addition, you will need two stable supports at least 30" tall (such as saw horses or trash cans) and a short (6-8') temporary mast (1 to 1-1/2" OD) for temporary mounting during tuning.

**MFJ-1796 PARTS LIST**

As you unpack your antenna you should find the parts in the following list.

- [ ] 2 Fiberglass Coil Assemblies
- [ ] two bundles of wire capacitance spokes 28 **short**, 12 **medium**, (and 4 spare **long** spokes)
- [ ] one bag of clamps 10 hose clamps and 2 saddle bolts
- [ ] 5' upper radiator, 6061-T6 AL tubing, 1 1/8" OD with the 6 and 2 meter stubs inside
- [ ] 5' lower radiator, 6061-T6 AL tubing, 1 1/8" OD (this tube has two holes through it)
- [ ] one bag of short 6-32 stainless screws (you will only use 40, the rest are extra)
- [ ] 4 small "L" brackets with holes one end
- [ ] 4 long "U" channel "L" brackets
- [ ] 4 flat fiberglass insulators
- [ ] 2 hollow white nylon insulators
- [ ] 1 solid rod fiberglass center insulator
- [ ] 5 split ring 1/4" washers
- [ ] 5 1/4" dia. 7/16" head bolts
- [ ] 5 1/4-20 x 7/16" nuts
- [ ] 20 6-32 x 1/2" stainless screws
- [ ] 20 6-32 x 1/4" nuts
- [ ] 8 10-32 x 3/8 nuts

For installation you will need some items not supplied with the antenna installation kit.

- [ ] A 6'-8' rigid mast or other mounting pipe between 1" and 1.5" outside diameter. (suitable materials include TV mast sections, galvanized iron pipe, or heavy duty rigid conduit.)
- [ ] Quality low-loss 50-Ohm coax with a PL-259 from antenna to transmitter.
- [ ] Either a SWR meter or Analyzer (MFJ-207 or MFJ-249)

### SAFETY PRECAUTIONS:

***WARNING! You can be killed if the antenna, feedline, or the equipment used to install the antenna accidentally contacts any utility lines. Never install an antenna near power lines!***

1. Be careful while climbing and carrying the antenna. It is heavy enough to cause you to lose your balance if it is handled too casually or if the capacitance spokes are snagged on a gutter, ladder, tree limbs and so forth.
2. Mount the antenna high enough so that it is out of reach. The ends of the capacitance spokes can cause eye injury, serious RF burns or both.
3. Make sure that the mast is sturdy enough to support the 15 pounds weight and the wind load of approximately 2 square feet.

### ASSEMBLY and INSTALLATION PROCEDURE

During assembly of this antenna refer to the figures in this manual and the picture on Page 1. The assembly instructions tell you how to first install the balun and then connect the upper and lower elements. Then the 2 and 6 meter stub elements are installed. Last the loading coil assemblies are assembled and installed on the upper and lower elements.

If you do not wish to install the 6 and 2 meter stubs operation on the other bands will not be affected. Skip steps 4, do not install the hose clamps in step 10 and skip steps 13-18.

After the antenna is assembled it is checked and adjusted for resonant frequency and SWR. It can then be mounted on a tower or rooftop and given final adjustments.

**NOTE:** Wear safety glasses whenever working near or on this antenna.

**Warning:** *Do not tighten the screws that connect the loading coil terminal lugs to the capacitance hats or you will BREAK the fiberglass form. If the terminal lugs loosen tighten the NUT down on the lug.*

### Step-By-Step Procedure

- [ ] 1. Prepare a temporary ground-level mounting mast that will permit easy initial testing and adjustment. Set up saw horses or any other stable support (plastic trash cans or folding tables, etc.) near the mast.
- [ ] 2a. Sort out the parts you have unpacked into groups of similar parts. Be sure all the parts are available.
- [ ] 3. After examining the antenna parts, gather the tools needed for basic assembly. At the minimum these consist of:
  - [ ] #1 Long Phillips screwdriver for capacitance spoke screws
  - [ ] #2 Phillips screwdriver for other 6-32 screws
  - [ ] 1/4" standard screwdriver or a 5/16" nut driver for hose clamps.
  - [ ] 3/8" wrench for 6 and 2 meter stub nuts
  - [ ] Two 7/16" open end wrenches or one wrench and one nut driver for "U" BOLTS and center insulator bolts.
  - [ ] Wire cutters for trimming capacitance spokes.
  - [ ] Safety glasses.

**IMPORTANT:** Do not use a high torque electric screwdriver to mount the capacitance spokes. The screw heads will be sheared off if too much torque is applied.

- [ ] 4. Assemble the four small "L" brackets to the 4 long fiberglass insulators with the 6-32 x 1/2" screws and the 6-32 x 5/16" nuts as shown in Figure 1.
- [ ] 5. Bolt the top balun hole loosely to the top hole in the base mounting assembly with a 1/4-20 x 7/16" nut and the 1/4" x 7/16" head bolts. Use the hollow white nylon spacers to separate the balun from the mounting bracket. Finger tighten only. See Figure 2.
- [ ] 6. Bolt the bottom balun hole to the bottom hole in the base mounting assembly as in Step 5.
- [ ] 7. Tighten the balun bolts with a 7/16" wrench.
- [ ] 8. Bolt the coax connector assembly to the base mounting assembly with four 6-32 x 5/8" screws and 6-32 nuts. See Figure 2.
- [ ] 9. Slide the bottom radiator (the one with two sets of holes) over the fiberglass rod with the holes that are 2" from the end toward the base mounting bracket. Slide a hose clamp to the bottom of the element. The radiator should butt against the insulating plastic of the base mounting bracket. Install a 1/4 x 7/16" bolt through the element and fiberglass rod and tighten with a lock washer and 1/4 x 7/16" nut.

- [ ] **10.** Slide three more hose clamps over the bottom element. Tighten the hose clamp installed in step 9 over the slit in the bottom element. This clamp will make the antenna more rigid.
- [ ] **11.** Insert the fiberglass center insulator into the bottom element and insert a 1/4" x 7/16" head bolt with a lock washer through the hole. Thread a 1/4" x 7/16" nut on the other end. Finger tighten only. See Figure 3. Slide a hose clamp over the center insulator. Tighten the hose clamp on the slit in the bottom element. Slide another hose clamp over the insulator.
- [ ] **12.** Slide the top 1" diameter element over the center insulator and install the 1/4" x 7/16" head bolt and nut as in step 10. Tighten the hose clamp over the slit in the top element until the element will not sway.
- [ ] **13.** Slide three hose clamps over the top element.
- [ ] **14.** Clamp the four long U-channel "L" brackets to the elements 1/4" above and below the center insulator bolts. See Figure 4 and Figure 6.

**NOTE:** The upper and lower stubs (U-channel "L" brackets) on each band should not be installed perfectly in line. There should be enough offset so that the threaded ends won't touch if the stubs are fully shortened. *The alignment of the stubs will not affect operation.* See Figure 5.

[ ] **15.** Mount the two short stubs by threading a 10-32 x 3/8" nut 1/2" from the end of the threads, toward the elements unthreaded end. This will leave a large area of the threads exposed at the end of the element. Add a second nut to sandwich the bracket between the two nuts. See Figure 4. The two short stubs should be mounted opposite from the balun. See Figure 5.

[ ] **16.** Mount the two long stubs by threading a 10-32 x 3/8" nut, 1/2" from the elements threaded end. This will leave only a small amount of threaded area below the nut. Add a second nut to sandwich the bracket between the two nuts. See Figure 4. The two long stubs elements should be on the same side as the balun. **See Figure 5.**

[ ] **17.** Install two long fiberglass insulators over each long stub one approximately 20" and the other 14" from the unthreaded ends of the long stubs by clamping them in place with hose clamps. See Figure 6.

[ ] **18.** Install the remaining long fiberglass insulators over the short stubs approximately 5" from the outside ends of the stubs. See Figure 6.





- [ ] 19. Install the short 6-32 screws in the ring of both loading coil assemblies away from the hose clamps and brackets. Do not thread the screws completely in. Put the **long** capacitance spokes in the six holes in these rings on both coil assemblies. Tighten the screws until the spokes are snug. At this point you should be able to turn the coil assemblies over and they should balance on the long spokes. USE THE #1 PHILLIPS SCREWDRIVER HERE.
- [ ] 20. Install the screws in the next set of rings and install six short spokes in these rings.
- [ ] 21. Install the next groups of four spokes on each loading coil assembly.
- [ ] 22. Check the bare wires running along the side of the loading coil assembly to be sure that there is at least 1" of clearance between the bare wire and the capacitance spokes. It is okay to bend the bare wire enough to clear the spokes properly. See Figure 7.
- [ ] 23. Remove the nuts on the center insulator bolts of the main element and install the *center conductor* lug of the coax *under the upper* element nut and the *shield* lug *under the bottom* element nut. Hold the nut in place and turn the bolt head to tighten these bolts so that the lug does not break off the end of the coax. Be sure to dress the coax so it loops up in a drip loop so water cannot get into the end. See **Figure 8**.
- [ ] 24. Use the three wire ties to affix the coax to the antenna as illustrated on page 1. ***Do not allow the coax to come within 1 inch of the base mounting bracket.***
- [ ] 25. Slide a hose clamp over the top element. Mount the top coil assembly to the antenna by inserting the fiberglass insulator in the top element. Tighten the bus wire from the coil assembly under the hose clamp.
- [ ] 26. Mount the coil assembly with the angle mounting bracket four inches from the bottom insulator of the antenna.
- [ ] 27. Double check the tightness of all the hardware you installed and then mount the antenna on the short temporary tuning mast.
- [ ] 28. Tune the antenna, see the next section.
- [ ] 29. Mount the antenna in it's permanent location. Slight re-tuning may be necessary.

## FREQUENCY AND SWR ADJUSTMENT

This antenna covers wider frequency ranges on the higher bands, and narrower segments on the lower frequency bands. The 40 meter band has the narrowest range of operation (approximately 40 KHz) and is the most sensitive to adjustments.

The entire antenna must be accessible during initial coarse tuning and testing. Any repair or adjustment to the antenna after it is installed on a tall support will make adjustments difficult and time consuming. It is best to install the antenna on a short temporary mast or pipe that is located in a reasonably clear location for tuning. The antenna should be mounted vertically with the base of the antenna around six feet above ground to make tests and adjustments easy.

The SWR can be measured by using a transmitter and SWR bridge or an SWR Analyzer. The best location to make SWR measurements is at the base of the antenna. If the measurements are not taken at the base of the antenna, the antenna must be fed with a reasonably short length of good quality 50 ohm coaxial cable to insure proper results. If using a transceiver and SWR meter, set the transceiver to the lowest power possible to make measurements.

**The normal resonant frequency of this antenna is at or just below the bottom of each amateur band.** This allows the user to "trim" a small amount off the *inside end* of the capacitance spokes to raise the resonant frequency. Conversely, adding a longer capacitance spoke will lower the resonant frequency of a loading assembly. Spare spokes are included in case you need to lower the resonant frequency of the antenna.

**CAUTION: Always start tuning on 40 meters and adjust each band progressively higher in frequency.** Adjustment of a lower frequency band will always have the most effect on the next higher frequency band. The tendency of the interaction is that if you move one band higher ALL the other bands move higher, but only very slightly. It is always best to "shoot for" the lowest end of the range you intend to use and "trim in" by adjusting the bottom loading assembly after the antenna is in it's final location. ALWAYS work from the bottom band up.

### Tuning the Antenna

1. Measure and record the frequency that the lowest SWR occurs on for each band. The lowest SWR should be at or below the bottom end of each HF band. The SWR should be below 2:1 at resonance on each band.

The following is a typical chart for initial measurements of a new antenna before tuning:

40 M 1.7:1 at 6.99 MHz	10 M 1.7:1 at 27.97 MHz
20 M 1.2:1 at 13.9 MHz	6 M 1.2:1 at 51 MHz
15 M 1.2:1 at 20.85 MHz	2 M 1.2:1 at 146 MHz

If the resonant frequency is lower than your equipment can detect take one spoke off to raise the resonant frequency. Measure the resonant frequency and calculate the approximate resonant frequency as if the spoke was in place using the chart on the next page.

**CAUTION: Never trim the outer (rounded) end of the spokes. The sharp end that remains can be a safety hazard and the power handling of the antenna will be greatly reduced on some bands.**

The following tips will help you obtain an even better SWR on 7 MHz than the tuning method used on other bands. On 40 meters the lowest SWR is usually not obtained with the top and bottom loading spokes adjusted to the same frequency.

**Low End of 40 Meters:** If you desire operation below 7.1 MHz the lowest SWR will be obtained by adding two extra long spokes to the bottom 40 meter loading coil assembly. It is best to add the spokes on opposite sides of the coils, closest to the horizontal as possible (perpendicular to the vertical element.) Short 40 meter spokes from both coils can then be trimmed equal amounts to resonate the antenna. This will leave the bottom loading assembly with two spokes that are longer than the top.

**High End of 40 Meters:** If you desire operation above 7.2 MHz the lowest SWR will be obtained by trimming the top spokes only until the antenna is resonant approximately 15 KHz below the operating frequency.

**Middle of 40 Meters:** For operation between 7.1 and 7.2 MHz only add **ONE** long spoke to the bottom before tuning.

Begin tuning by trimming one 40 meter spoke *from each end of the antenna* by cutting off small, equal sections from the inside end of the spoke until the antenna resonates approximately 15 KHz below the desired operating frequency. Use the chart below to *approximate* the amount of spoke to be trimmed. Trimming only one spoke from the top or bottom results in half the frequency change.

40 M: 1" trimmed off a pair of spokes equals *approximately* 25 KHz  
 20 M: 1" trimmed off a pair of spokes equals *approximately* 100 KHz  
 15 M: 1" trimmed off a pair of spokes equals *approximately* 175 KHz  
 10 M: 1" trimmed off a pair of spokes equals *approximately* 250 KHz

2. If the SWR is acceptable at the desired operating frequency the adjustment for that band may be skipped.
3. Now tune progressively higher frequency bands by trimming pairs of spokes (one top one bottom). Keep each pair of capacitance spokes equal in size. 20 meters must be the second HF band adjusted, 15 the third and 10 meters last. After adjusting 10 meters go back and check the other bands. Tighten all spoke screws.
4. The six and two meter bands are tuned by lengthening or shortening the threaded portion of the stubs. See Figure 9. This adjustment is very coarse. If the frequency is still too low with the stub element extension at a minimum, the unthreaded ends of the stubs can be trimmed. Once again the lower frequency stub (6 meters) should be adjusted first.

The six meter stub covers from 50 to 54 MHz as it is adjusted. Be careful because the third harmonic resonance of the six meter stub will show up as a low SWR on the third harmonic of it's setting, usually between 150 and 160 MHz. The range of the two meter stub allows frequencies as low as 130 MHz to be covered with the stub fully extended and 148 MHz with the stub fully contracted.

5. Final frequency adjustments can be made by trimming spokes on the bottom hat only when the antenna is permanently mounted. The minor adjustment of bottom spokes without the symmetrical trimming of the top spokes is perfectly acceptable so long as the frequency is changed less than 30 KHz on 40 meters and 60 KHz on the higher bands with the final adjustment. The result of attempting to move the resonant frequency too far with only the bottom spokes will be an increase in the SWR of the antenna at the resonant frequency.

**NOTE:** The spokes can also be bent toward another spoke *in the same mounting ring* to raise the frequency slightly without cutting.

## GROUNDING CONSIDERATIONS

Although this antenna is designed to operate efficiently without the requirement of an earth ground, SAFETY GROUNDING MUST STILL be provided to protect equipment, property and persons from the hazards of lighting strikes and other weather related electrical discharges. In addition the coaxial cable feeding the antenna should have the shield grounded to eliminate the risk of any indoor equipment failure from allowing hazardous voltages from appearing indoors and creating a shock hazard.

Adequate protection can be accomplished by grounding the shield of the coax where it enters the building to a good earth ground or directly burying the cable in the earth for several feet before it

enters the building. The coaxial cable should be totally disconnected from the station during threatening weather conditions for maximum lightning protection.

A less effective method of protecting station equipment is to install an in-line coaxial lightning arrester with a heavy duty ground wire to a suitable earth ground, or a safety switching system as part of the basic ham station equipment.

## **MAINTENANCE**

Your antenna is constructed of heavy duty non corrosive 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 and also around the center-feed connections, especially in coastal areas where salty mist is commonplace.

GE makes a pure silicone grease called "SILICONE DIALECTRIC COMPOUND" that can be applied SPARINGLY to the threaded area of the female connector. This compound, or even a clear silicone heatsink 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 still adequate sealer is the automobile seam sealer commonly sold as "coax seal". This is a semi-pliable black sealing compound.

When installing any "coax seal", NEVER completely cover the barrel of the coax connector. The sealer should ONLY be placed near the junction of the threaded part of the chassis connector and the knurled area of the male connector. This will leave the bottom of the male outer sleeve open and permit the connector to "breathe" 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 following the manual you may call MFJ toll-free at 1-800-647-TECH (8324) or FAX to 601-323-6551, or TELEX 53 4590 MFJ STKV. Outside of the continental U.S.A. 601-323-5869. You will be best served 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 to MFJ Enterprises, INC., P.O. Box 494, Mississippi State, MS 39762. Send a complete description of your problem, an explanation of exactly how you are using your unit and a complete description of your station.

## FULL 12 MONTH WARRANTY

MFJ Enterprises, Inc. warrants to the original owner of this product, if manufactured by MFJ Enterprises, Inc. and purchased from an authorized dealer or directly from MFJ Enterprises, Inc. to be free from defects in material and workmanship for a period of 12 months from date of purchase provided the following terms of this warranty are satisfied.

1. The purchaser must retain the dated proof-of-purchase (bill of sale, canceled check, credit card or money order receipt, etc.) describing the product to establish the validity of the warranty claim and submit the original or machine reproduction of such proof of purchase to MFJ Enterprises, Inc. at the time of warranty service. MFJ Enterprises, Inc. shall have the discretion to deny warranty without dated proof-of-purchase. Any evidence of alteration, erasure, or forgery shall be cause to void any and all warranty terms immediately.
2. MFJ Enterprises, Inc. agrees to repair or replace at MFJ's option without charge to the original owner any defective product provided the product is returned postage prepaid to MFJ Enterprises, Inc. with a personal check, cashiers check, or money order for **\$7.00** covering postage and handling.
3. MFJ Enterprises, Inc. will supply replacement parts free of charge for any MFJ product under warranty upon request. A dated proof of purchase and a **\$5.00** personal check, cashiers check, or money order must be provided to cover postage and handling.
4. This warranty is **NOT** void for owners who attempt to repair defective units. Technical consultation is available by calling (601) 323-5869.
5. This warranty does not apply to kits sold by or manufactured by MFJ Enterprises, Inc.
6. Wired and tested PC board products are covered by this warranty provided **only the wired and tested PC board product is returned**. Wired and tested PC boards installed in the owner's cabinet or connected to switches, jacks, or cables, etc. sent to MFJ Enterprises, Inc. will be returned at the owner's expense unrepaired.
7. Under no circumstances is MFJ Enterprises, Inc. liable for consequential damages to person or property by the use of any MFJ products.
8. **Out-of-Warranty Service:** MFJ Enterprises, Inc. will repair any out-of-warranty product provided the unit is shipped prepaid. All repaired units will be shipped COD to the owner. Repair charges will be added to the COD fee unless other arrangements are made.
9. This warranty is given in lieu of any other warranty expressed or implied.
10. MFJ Enterprises, Inc. reserves the right to make changes or improvements in design or manufacture without incurring any obligation to install such changes upon any of the products previously manufactured.
11. All MFJ products to be serviced in-warranty or out-of-warranty should be addressed to **MFJ Enterprises, Inc., 921A Louisville Road, Starkville, Mississippi 39759, USA** and must be accompanied by a letter describing the problem in detail along with a copy of your dated proof-of-purchase.
12. This warranty gives you specific rights, and you may also have other rights which vary from state to state.

